Consulting Rosarian Manual

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This manual is dedicated to
Louise Coleman and her committee
who were the pioneers of its creation.

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Introduction

In the early days of the transition of the American Rose Society from an organization of nurserymen to a society serving the general public, Dr. Robert Huey conceived the idea of providing a bureau of information for rose growers. In 1920, this group was formalized as 32 past presidents of ARS, hybridizers, nurserymen, scholars and other noteworthy rosarians were designated "Consulting Rosarians," and the CR program was born. In 1949, the ARS Board of Directors greatly broadened the scope of the service by deciding that Consulting Rosarians would be appointed by each district, following guidelines approved by the board. This made the knowledge of CRs available nationwide. To ensure further that Consulting Rosarians were well qualified, in 1996 a system of CR schools and exams, run by the districts, was established.

The American Rose Society is primarily an educational institution, and the Consulting Rosarian program is an important element in helping the Society carry out its educational mission. Hence, it is essential that every CR be qualified to give advice on rose culture. It is also important that every CR take an active part in the American Rose Society, in its districts, and in local rose societies. Consulting Rosarians are expected to inspire love and appreciation of roses. They should help recruit new members for both the ARS and local societies. Above all, they should be knowledgeable in all aspects of rose culture and should share this knowledge willingly and cheerfully.

The Consulting Rosarian Manual is intended as a tool to help Consulting Rosarians fulfill their duties. The first edition, published in 1995, was a "work in progress." The second edition was produced after five years of use in the field. The third edition has been compiled by the ARS Consulting Rosarian Committee, (made up of all District CR Chairmen), under the leadership of Mary Peterson, National CR Chairman, and from the comments and recommendations of those who knew the manual best - the many Consulting Rosarians from across the country. We hope that suggestions and recommended additions will continue to be received, as the science of rose culture and the needs of our members evolve. This manual will also be a "work in progress," as ARS strives to provide the most current information to our Consulting Rosarians and members.

The American Rose Society is not responsible
for any recommendation made by a Consulting Rosarian
that is contrary to this manual.

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Notes

Chapter 1 – The Consulting Rosarian

The Consulting Rosarian Program is an integration of rose experts who serve the American Rose Society in a variety of capacities. There are several levels within the program, all of which are very important for a smoothly running operation.

We have the CRs themselves, Cyber CRs (CCRs), the National CR Chairman and Committee, District CR chairs and Local Society Coordinators. Each level has to meld with the others and members of their local societies.

The CRs themselves are the ambassadors and representatives of the ARS. They represent the ARS in direct interactions with the public. Each District has a CR Chair who is automatically on the National CR Committee. They represent the District for all proposals and changes to the CR program.

Since 1999 some 300 CRs in 48 states have volunteered to serve as Cyber Consulting Rosarians (CCRs) and agreed to have their E-mail addresses made available through the ARS web page (www.ars.org). In this capacity they answer rose care questions received electronically via the internet, from the public as well as from ARS members.

Qualifications of Consulting Rosarians

Any member of the American Rose Society may qualify as a Consulting Rosarian by the following:

1. Must be at least 18 years of age.
2. Must be a regular or associate member of the American Rose Society for three consecutive years.
3. Must be an active member of a local rose society.
4. Must have grown roses of various types for at least five years and should be knowledgeable about equipment and materials related to rose culture.
5. Must send a completed CR Candidate Form and three letters of recommendation to the candidate's District Consulting Rosarian Chairman at least thirty days before the CR School. The letters of recommendation must be on the CR Candidate Letter of Recommendation Form and must be signed by three active Consulting Rosarians.
6. Must attend an approved ARS school/workshop for Consulting Rosarians and complete and pass an open book written review based on the material contained in the Consulting Rosarian Manual with a score not less than 75%.
7. Must be in attendance at all programs presented at the school.
8. Must know and be willing to live up to the Consulting Rosarian Code.
9. Must be willing to attend no less than one Consulting Rosarian School/Seminar every four years or accrue four credits in four years by attending approved Seminars.
10. Must exhibit a continuing willingness to share knowledge and an enthusiasm for the rose and the American Rose Society ideals.
11. Filing a Roses In Review report yearly is expected.
12. A completed individual activity report form (if required by the District) must be submitted to the District Chairman of Consulting Rosarians by the date designated by the District Chairman.

After passing the open book written review the CR then receives a date for the completion of their next 4-point audit. CRs are required to accrue 4 credits in 4 years by either attending approved seminars for CR credits or by auditing an approved CR school before the end of December of their audit year.

A Consulting Rosarian ribbon badge is available from ARS Headquarters for those who have met the school and test requirements. School receipt certificates are required to obtain the badge.

Maintaining CR Certification

A Consulting Rosarian's audit date will automatically move forward four years anytime they accrue the required four credits (three plus chemical safety) not to exceed more than once a year, i.e. if they obtain four credits in 2014 then their recertification date becomes 2018. If they obtained four more credits in 2015 then their recertification date becomes 2019, and so forth. The credits may be obtained by attending either a CR School or four approved CR seminars before December of their audit year.

CR credits are kept track of by the District CR Chair and the individual CRs. The District CR Chair will notify the ARS when a CR has completed their audit.

In order to maintain active status, a Consulting Rosarian:

1. Must be an active member of the ARS.
2. Must attend a CR school or obtain four approved continuing education credits (to include chemical safety) every four years.
3. Must remain a member of a local society.
4. Must not refuse to have their name and method of contact listed in any rose related reference.

Consulting Rosarian Code

Every Consulting Rosarian, on accepting the appointment, should be fully cognizant of the Consulting Rosarian Code and should wholeheartedly be willing to live up to the code:

"I, _____, accept the honor of the official appointment as a Consulting Rosarian of the American Rose Society for the _____ District. I pledge my earnest efforts toward the increase and stimulation of membership in the American Rose Society, in cooperation with the District Director. I shall uphold the highest standards of our American Rose Society in inspiring a love and appreciation of roses their culture and exhibition. The aims and purposes of the American Rose Society shall be foremost in my mind in promoting and forming new rose societies, securing new members and serving present members and anyone interested in roses. I recognize and accept the responsibilities of this post, as well as the privilege of service."

The Consulting Rosarian Guide

It is incumbent upon all Consulting Rosarians to exercise every effort to further a greater interest in the rose. They should SHARE their knowledge with anyone requesting information on the care of roses. The Consulting Rosarian should not wait to be asked but should share knowledge voluntarily and willingly help others. They should be available to help friends, neighbors and rose society members in any way possible.

Being an active Consulting Rosarian is more than an obligation to share technical knowledge concerning roses; it is a call to service. It involves participation in every aspect of the rose society, to which they belong, be it helping set up a rose show, present educational programs on the various aspects of rose culture, writing articles for news media or publications or serving on any of the society's committees. The object is to HELP others and to stimulate greater interest in growing roses and further the extent of this growth and scope of the rose society to which they belong. On the broader level, Consulting Rosarians should be active in furthering the cause and interests of the American Rose Society in whatever way they can. Here are some of the things Consulting Rosarians should do:

In Their Own Garden

The most obvious obligation is to grow good roses; to grow a variety of roses including hybrid teas, floribundas, grandifloras, climbers, miniatures, minifloras, shrubs, polyanthas and old garden roses if possible. There is no need to have acres of each, but there should be a few of each. The roses in the garden should include the most popular of the new introductions so as to be informed and

better able to answer questions concerning them.

Consulting Rosarians should be acquainted with what is NEW in rose culture; be it a new type of sprayer, a new insecticide or fungicide. They should be familiar with state and federal laws and regulations pertaining to use of chemicals in the garden as it pertains to their District. They should know the proper application of garden chemicals and how they should be used, safety precautions to follow, and the safe storage and proper disposal of containers.

The rose garden of any Consulting Rosarian should be open for all to enjoy and admire, and the roses should be of the quality to inspire and encourage others to grow roses.

The Consulting Rosarian should be familiar with chemical and nontoxic approaches to rose growing. Regardless of the approach a Consulting Rosarian takes in their own gardens it should involve a decision-making Integrated Pest Management process to take the appropriate action, whether it be with synthetic chemicals, natural chemicals, or no chemicals. It is essential to be knowledgeable and supportive about any and all methods when dealing with other rosarians.

In the Local Rose Society:

Consulting Rosarians should not have to be asked to help. They should meet with other Consulting Rosarians to share knowledge and information. They should volunteer to help wherever and whenever needed. They should be willing to hold an office, serve on the board of directors, head a committee or perform any other task which will further the interests of the society.

Consulting Rosarians should be willing to support all the activities of the American Rose Society.

In the American Rose Society

1. Assist members and non-members with cultural problems.
2. Obtain new members for the American Rose Society.
3. Work together in organizing and assisting new rose societies.
4. Encourage each organized rose group to sponsor at least one rose show per year.
5. Attend the Consulting Rosarian meeting each year at the district meeting when a meeting is scheduled.
6. Be a member of the district Public Rose Garden Committee where one exists.
7. Complete and submit the annual Roses in Review survey each year, and the Quinquennial Survey every five years.
8. Be in attendance at local rose shows, answering questions they are asked.
9. Ensure American Rose Society membership information is available at the show.
10. Have a willingness to share knowledge and an enthusiasm for the joys of growing roses.

Active Consulting Rosarians must be willing to give of themselves and have time to help others – members and non-members alike by sharing rose growing advice.

Finally, an active Consulting Rosarian must convey to others that growing roses is a hobby with a tremendous potential for enjoyment and satisfaction that is greatly increased by sharing knowledge and love of the rose with all.

Honorariums and Fees

It is against the principles of the Consulting Rosarian Program to charge a fee for rose advice. The only exception is when a CR is also a professional nurseryman or landscape designer and derives his/her livelihood from such pursuits.

An Honorarium may be graciously accepted for mileage and travel expenses when offered by the host or redirected to the ARS, their District or local society for any program presented by a Consulting Rosarian.

Notes

Updates

3/9/13 Completing RIR is expected, not mandatory (1-1)
3/23/13 Recommendations for CR status should be from three active CRs (1-1)
4/8/13 CR qualifications include attending a school or accruing 4 approved seminar credits every 4 years (1-1)
8/9/13 Heading Change: Maintaining CR Certification (1-1)
10/15/13 CR qualifications include sending a completed CR Candidate Form (1-1)
5/9/14 CR Age requirement: minimum age requirement of 18 years of age (1-1)
5/9/14 CR recertification date: audit date advancement (1-2)

Chapter 2 – The Consulting Rosarian Program

The National Consulting Rosarian Committee and Chairman

The National CR Chair is appointed by the President of the American Rose Society and serves at the pleasure of the President for a concurrent term of that President. The National CR Chair appoints a select committee to help carry out the mission of the CR Program. The District Consulting Rosarian Chairs are automatically members of this committee.

The District Chair of Consulting Rosarians

Each District Director shall appoint a District Chair of Consulting Rosarians to coordinate the activities of Consulting Rosarians in their district and whose term of office shall be concurrent with that of the District director. It is suggested that the individual appointed for the office must have served at least six years as a Consulting Rosarian and have been active in District affairs for that period of time. The District Chair must also have held membership in the American Rose Society for a period of six consecutive years. Exceptions may be allowed by permission of the National Chair.

Duties of the District Consulting Rosarian Chair

1. At the beginning of their term, they shall obtain from the former District CR Chair the names and status of active CR members of each local society who have met the qualifications set forth herein. The District Chair shall be responsible for exploring any question related to all required qualifications, including the required membership in ARS. ARS headquarters shall provide membership verification.
2. Coordinate and assist, as requested, local society Consulting Rosarian coordinators in obtaining and disseminating information pertaining to the District's activity at the local level.
3. The District CR Chair shall coordinate the submission of any reports and surveys requested by ARS National Committees and all other programs of the American Rose Society which may benefit from Consulting Rosarian participation.
4. The District CR Chair, in cooperation with the District Director, shall organize and conduct a Consulting Rosarian School or Seminar. An approved seminar held during a workshop, district or local society meeting for CR credit should also be considered.

Consulting Rosarian Schools & Seminars

Objective

The objective of the school is twofold: to gain new Consulting Rosarians who have prepared for the CR test and agree with the objectives of the CR Program and to provide education to existing Consulting Rosarians in the basics of rose culture, the management of fertilizers, pesticides, soil amendments, nutrients, insects and diseases of roses. The CR School helps reinforce the public relations focus of the program.

District Chair's Responsibility

All Consulting Rosarian schools must be conducted under the direction of the District's CR Chair. Schools should be scheduled periodically in different areas of the district to make them accessible to the greatest number of CRs.

The District Chair should notify ARS headquarters of the date and location of the school at least 60 days prior to the date of the school. Upon notification ARS will send out the school packet to the District CR Chair. This will include one copy of the necessary forms and the test. The Chair is responsible for making a sufficient number of copies for the school.

The District Chair will appoint qualified instructors for the school and advise the National CR Chair of the school, the agenda and the qualified instructors 60 days before the school. Instructors must be approved by the District and the National Chair before the school is officially announced.

Qualified instructors might be:

- Instructors from universities, colleges, specialized horticulture schools (i.e. nurserymen, professors, Master Gardeners, Master CRs, professionals in the field which they will be teaching).

The District Chair will provide the letters of recommendation for new CR candidates 45 days prior to the school (candidates attending a school out of the District should send letters to their home District CR Chair).

The District Chair will verify the ARS membership requirement (three years) of all candidates with ARS upon receipt of letter(s) of recommendation. The District chair will acknowledge receipt of the letter(s) of recommendation and membership verification (with ARS) to the candidate. If the candidate is attending a school out of the District, a candidate should present this notification to the Chair of the school.

The District Chair shall provide attendance sheets for the school -- both for the candidates and for CRs who are auditing the school. After grading the tests, the District Chair will notify the Chair of the School, the candidates, and ARS of the candidates who passed the test and have been accepted as new CRs. The Chair will also notify ARS of those who completed the school for requalification and for completion of their CR audit. This information should also be sent to the Chairman of the home District of any students that completed the school and test, and any out of District CRs who audited the school. The District Chair will send a report of the school to the National CR chair using the appropriate form.

CR School Procedures – Requirements & Suggestions

- The school should be open to everyone who wishes to attend; therefore a venue of sufficient size should be selected.
- Minimum duration is four hours. It is suggested that 6 to 8 hours is better with a break for lunch. Each CORE topic covered should be one hour (45 minutes presentation and 15 minutes Q&A).

Pesti**C**ides
S**O**il & Water
Fe**R**tilizers
Ins**E**cts & Disease

- The agendas should be structured to follow the subjects in the text portion of the CR manual.
- The CR Mission section should be stressed. The principles of being helpful but keeping it simple is important.
- The Pesticides section should stress safety.
- The students should be advised that the review questions will only include information in the text portion of the manual.
- Students may use their manuals to answer the review questions. (Only existing CRs and new CR candidates that have provided documentation are allowed to take the test. Visitors should be politely asked to leave).
- Candidates taking the test must score 75% for passing grade. The District chair should make sure the candidate knows which questions they missed so they can review the material.
- The official school receipt will be given to each candidate completing the school and test. The receipts may be mailed if necessary.
- At the option of the school chairman, existing CRs can be given the opportunity to take the review questions without using the manual, then the questions are reviewed with the whole group as they correct their own tests. This is an excellent learning tool. If this is implemented, the new CR candidates should take their tests in another room.
- If time permits, or a two- day school is held, a discussion of local culture can be covered and encouraged but it should be stressed that it will not be included in the review questions.

School Agenda

- Consulting Rosarian Program (including ethics)
- Consulting Rosarian Mission (including responsibilities)

- Soil and Water
- BREAK
- Fertilizers
- LUNCH
- Pesticides and Garden Safety
- Insects and Diseases
- Review Questions

Seminars/Workshops/Programs

Seminars/Workshop/programs for existing CRs should also be promoted and considered at the National, District and Local level to encourage existing CRs to renew their CR credits in a timely fashion.

Alternate topics, other than the CORE topics covered in a School, that are directly related to roses and rose growing can be considered and presented by a knowledgeable and experienced faculty. In order for four CR credits to be made available at such a Seminar/Workshop, a program on Chemicals and Garden Safety must be presented.

Topics to be covered should be one hour in duration allowing for 15 minutes of Q&A. Such a proposed program must be reviewed and approved by the National CR Chair before additional materials are sent from ARS Headquarters.

Hybridizing Rose Photography Earth Kind Roses Raised Beds & Terracing
Propagation Sustainable Rose Gardens Constructing a Watering System Getting Roses Ready for the Show Composting/Going GreenFertilizers New Rose Introductions
History & Historical Roses OGR & Heirloom Roses Miniatures and Miniflora Roses
Mulches & Ground Covers Roses of the Middle Ages Shrubs in the Landscape Design
Structures and Supports for Climbing Roses Trellises, Arbors, Arches, Pergolas, Gazebos & Privacy Hedges
Pretty Polyanthas Species Roses and Their Influence on Modern Roses Fabulous Floribundas
Is there a Future for Fortuniana Containerized Roses Climbers, Scramblers, Ramblers, Ground Covers & Hanging Baskets Landscaping with Roses Companion Planting With Roses
Predatory Abatement Anatomy of the Rose Winter Protection
The Wonderful World of Hybrid Rugosas Own-Root, Dr. Huey, *R. multiflora* & Fortuniana as Understock
Fragrant Roses Is There a Shrub Rose for Your Garden OGRs & Shrub Roses for Small Gardens
Tender Roses for Tough Climates Hardy Roses from the Explorer & Parkland Series
Arranging With Roses Hardy Roses of Buck, Sub-Zero, & Brownell Planting & Transplanting Roses
Pruning Roses Advanced information on soils, fertilizers, insects & diseases not covered by the CR Manual

Once approval has been granted, information regarding the Seminar/Workshop can be promoted via the ARS website and in the American Rose magazine (if 90 days' notice is given).

ARS Headquarters Responsibilities

At least 60 days before a scheduled school, one school packet is sent to the District Chair of Consulting Rosarians.

- ARS will verify that the three-year membership requirement is met for new candidates upon request and a reply sent to the requesting CR chair immediately.
- ARS will send CR certificates for the new CRs to the District Chair within 30 days of notification. (Membership will already be verified).
- Periodically during the year, ARS will send the National CR Chair and District Chairs a report of requalified CRs and the new CRs. A final report will be made at the end of the year.

Auditing a School for CR Recertification

- Attendance at an accredited CR School as an auditor.

- Must be in attendance at all programs presented at the school.
- Must sign the attendance sheet.

After attending the classes, the CR then receives a date from their District Chair for the completion of their next 4-point audit. Refer to *page 1-2* for more information on maintaining CR certification.

A Consulting Rosarian ribbon badge and certificate are available from ARS Headquarters for those who have met the school and test requirements. For all new schools, the certificate will be part of the fee for taking the exam.

The Typical CR Seminar

The CR seminar is a good way of presenting educational information for the public and for local area CRs who can attend and gain a CR credit. These seminars take the place of auditing a CR school, if all four necessary credits can be gained within the audit requirement. One of the credits MUST be from a lecture on Chemical Safety (pesticides).

A local society may ask a qualified individual to present one of the core CR topics as a program at one of their local society meetings. These topics are:

- Chemical Safety (pesticides)
- Soils and Water
- Fertilizer and Nutrients
- Insects
- Diseases of Roses

The local society meeting should be advertised so the public, other CRs, other horticulture society members and interested public can attend.

The lecture/seminar must be at least one hour (45 minutes lecture/15 minutes + Q&A). Attendance must be taken so auditing CRs may receive a credit for attendance.

Just as with a CR school, the District Chair receives the attendance sheet and records the credit received for each auditing CR. If the CR reaches their four points, the District Chair notifies ARS that the CR has completed their audit. Refer to *page 1-2* for more information on maintaining CR certification.

CR Records

The District CR Chair will keep the records of the CRs in the District, recording their contact information, their credits as they are earned, notifying ARS and the National Chair when a CR has completed their audit, sending the appropriate certificates to each CR as needed, recording the completion of Roses In Review each year, and also the Annual CR report (if required by the District).These records will be passed on to the incoming District CR chair at the end of each term.

If a Consulting Rosarians fails to accrue their 4 CR credits at the conclusion of their audit year, they should be considered lapsed in their accreditation. In such matters, the District CR Chair along with the National CR Chair will discuss methods and actions to reinstate such CRs.

The District CR Chair shall consider, with the concurrence of the District Director, the removal of any Consulting Rosarian who is no longer a member of a local society or who refuses to have their name and method of contact listed in rose reference materials. Special circumstances will be considered.

The District CR Chair shall exchange useful information and program materials with the Chair of the National Committee of Consulting Rosarians for possible publication in the National CR monthly newsletter.

The District CR Chairman shall provide each Consulting Rosarian in the district, through the local coordinator, with all guideline materials relating to their duties. Each District has the option of developing their own Annual report form, using the national standard as a guide.

Outstanding Consulting Rosarian Award

It is recommended that the District CR Chair participate in the Outstanding Consulting Rosarian Award selection with the District Director and the District member of the Prizes and

Awards Committee.

The Outstanding CR Award is the highest District award for CR work awarded by the ARS. All nominees should have been an active CR for at least ten years. This includes, but is not limited to:

- All nominees must be ARS members in good standing.
- All nominees must be a member of the District or, if the person has moved away, he/she must have lived within the District for at least 6 months of the previous year.)
- The award can be given posthumously, provided he/she lived within the District for at least 6 months of the previous year.
- Participation in local society activities (such as rose clinics, speaking at meetings, writing articles for newsletter, etc.)
- Demonstration of competency in all knowledge area of local rose culture.
- Service as a faculty member of a CR school or audit, or rose culture workshop.
- Demonstration of a willingness to share knowledge with people who exhibit interest in growing roses.
- Wholehearted support of the ARS.
- The OCR should be considered a lifetime achievement and only awarded to an individual once.
- Call for nominations go out to the P&A committee members in March. They consult with their local Board of Directors and/or local CRs for suggested nominations.
- Nominations are received back, compiled and sent to the CR chair(s) for approval of eligibility.
- A separate committee selects the recipient. Committee members are: the District Director, District Chair of Consulting Rosarians, District Chair of Prizes and Awards.
- P&A committee members and appointed District Board members are eligible for the award.
- The Outstanding CR Award is presented to the recipient at the District Convention.

Deviation from the guidelines due to operational and/or geographic problems may be permitted in individual Districts with the approval of the District CR Chair and the Chair of the National Consulting Rosarian Committee.

The Local Society Consulting Rosarian Coordinator

The local society CR Coordinators are the bridge between the local CRs' activities and the District CR Chair. Each local society should have a CR coordinator and it is suggested that this person should, if possible, be a knowledgeable rosarian who has had at least three years' experience as a CR.

The President of the local society shall appoint a Local Coordinator. Generally the local CR Coordinator's term runs concurrent with the term of office of the Local Society President.

The District Consulting Rosarian Chair shall be notified of this appointment. The Local CR Coordinator shall organize the activities of Consulting Rosarians within their local society.

Duties of the Local Coordinator

The duties of the Local CR Coordinator are rather simple, but very important. The local CR Coordinator should:

1. Organize the CR activities of all the CRs within their local society.
2. Ensure that local Consulting Rosarians submit all necessary paperwork and annual reports (if required) and that they are submitted to the District CR Chair and the annual RIR report to the District RIR coordinator in a timely manner.
3. Consider assigning CRs to new local society members (not just ARS members) to 'mentor'

such a member who would then feel free to call to ask questions or seek assistance. The Local Coordinator could divide newer members in their society into small groups and assign one of the Consulting Rosarians to each group to answer questions and offer advice.

4. Assist in setting up a CR information table at meetings, rose shows, fundraisers, etc.
5. Display an "Ask the Rose Expert" sign to encourage "newbies" to ask questions.
6. If possible institute a Consulting Rosarian led program "What Rosarians should be doing in the Garden This Month" segment at each meeting. This short informational presentation would address members' problems and encourage interaction with new members.
7. Chair meetings of Local Consulting Rosarians and encourage their participation in all local, district and national events when possible.
8. Introduce the Consulting Rosarian program to the general public. The Coordinator should organize events at local nurseries, garden clubs, public garden etc. where the Consulting Rosarians can meet and be of assistance to the general public. Consulting Rosarians should be identified and present at the local rose show. No opportunity should be missed that will introduce Consulting Rosarians to the public.
9. Seek new ARS members by describing all the benefits of membership, and encouraging qualified rosarians to also become CRs.

Please remember that Consulting Rosarians are the representatives of the ARS, and they need to be available, recognizable and eager to help further the goals of the local society, the District and the ARS as well.

Local society officers are encouraged to support their local CR Coordinator and all CRs. We hope that they will lend their assistance to promote and sustain this very important work.

Consulting Rosarian Emeritus

The designation of Consulting Rosarian Emeritus was approved by the ARS Board of Directors in June 1994. The honor is reserved for those who have served as a Consulting Rosarian for at least 10 years and no longer wish to be an active Consulting Rosarian.

A Consulting Rosarian who qualifies may request Emeritus status through the District Consulting Rosarian Chair. The District CR chair may suggest this status to a member in declining health if the member qualifies.

Upon approval of the request by the National Consulting Rosarian Chair and the District CR Chair, the designation will be made.

A Consulting Rosarian Emeritus certificate will be presented in appreciation of past service. It is suggested that this presentation take place at a District meeting or some other suitable occasion. Cost of the certificate will be paid for by the District making the request. Consulting Rosarian Emeritus' name will not be on the active Consulting Rosarian list.

Master Rosarian Designation

Consulting Rosarians are among the most knowledgeable and active people in the American Rose Society. The ARS needs a well-motivated and educated group of CRs if the ARS is to continue to succeed in its mission. The Master Rosarian designation was created to recognize those CRs who have made outstanding contributions as CRs over a significant period of time.

The Master Rosarian (MR) is a Consulting Rosarian (CR) who:

1. Exemplifies knowledge of roses and their culture.
2. Shows a strong and demonstrated willingness to share this knowledge with other rosarians and the general public.
3. Is a model of the ethical behavior exemplified in the CR program. The achievement of the Master rosarian designation by a CR is intended to recognize their outstanding contribution.

Basic Requirements

1. A minimum of 10 years **consecutive service** as an active CR.
2. Outstanding performance (documented in the nomination form).
3. Be an active accredited CR at the time of the nomination.

4. A willingness to continue to serve as a CR.

Nomination, Selection, and Communication Process

1. Announcements should be published in local society and district newsletters. The District Director and the local society presidents are responsible to make their memberships aware of the nomination and selection process. There are no limits to the number of yearly selections of MRs within a District. If there are questions about a nominee, the committee may request additional information from the author of the nomination or from the nominee themselves.
2. A request for nominations will be announced by the ARS in the spring and complete rules and procedures will be sent to each District Chair for publication on their website and in the District and local newsletters.
3. Nominations must be submitted on the official nomination form available from ARS HQ and on the ARS website. CRs may nominate themselves; be nominated by other ARS members; or by a committee of their local rose society or of the District. The form must be completed in its entirety. Special consideration should be made as to whether or not the RIR and District Annual (if required) report was filed.
4. The completed nomination form should be sent to the CR Chair in each District. A committee consisting of the District CR Chair, the District Director, and at least one other person, will review the nominations and approve or not approve. The District CR Chair should serve as the chair of the committee and facilitate the process. Selections should be based on information provided in the nomination form and from personal knowledge of a candidate's credentials.
5. All nominations **approved or not approved at the district level**, will be forwarded to ARS HQ.
6. The National CR Chair will review the decisions of the committee and announce the final selection. Disagreements regarding selections will be resolved by the National CR committee.
7. Districts should acknowledge the new MRs at an appropriate district meeting in the fall or winter following selection. All MRs will be given the MR certificate available from ARS HQ. An optional MR pin is available for purchase. If there is no appropriate District meeting, the announcements can be made at the local society level.
8. Local societies and Districts are encouraged to publicize the names of those who have achieved the Master Rosarian designation.
9. The nomination form should be filled out as completely as possible. It is understood that every question may not be relevant to each nominee, but a Master Rosarian should excel in at least several areas. Additional documentation is needed only if requested. If you are uncertain about the credentials of any nominee, ask the nominee themselves or someone who can help you. An incomplete nomination form weakens the overall nomination. A 'yes' response is not sufficient for those questions requiring an explanation.

Notes

Updates
5/9/14 CR recertification date: audit date advancement (2-4)

Chapter 3 – The Consulting Rosarian Mission

The Right Attitude

Consulting Rosarians are respected members of local, district and national rose societies. As such, it is important to maintain the right attitude. Earning the title is not the end but the beginning. Keep in mind that you are a representative of the American Rose Society and obligated to further its goal "... to educate the public about roses in order to foster and promote the growing and the love of roses." Consulting Rosarians should be visible in the local rose society and the community by their willingness to help. Consulting Rosarians are usually more knowledgeable than those who seek their help, but this knowledge should be shared in a friendly, non-offensive way. Remember the common bond is the love of roses.

When a fellow rosarian asks for advice it should be given with a helpful attitude, trying to solve the problem rather than showing off. A willingness to give time and information to help another successfully grow roses is a Consulting Rosarians duty. This is how we can encourage others.

- Consulting Rosarians should keep abreast of new varieties, new chemicals and problems and solutions common in their area.
- They should know which varieties perform best in their area and recommend them.
- They should be willing to write articles for their local bulletin that are helpful to others.

No one can know everything, thus Consulting Rosarians should attend workshops and seminars, and not be embarrassed to ask another Consulting Rosarian for advice. There are so many aspects to growing roses that learning should be an ongoing process.

Remember, K.I.S.S. (keep it super simple) when talking to a new rose grower. Don't turn a simple question into a complicated explanation. This is discouraging and makes rose growing seem too difficult. Most new growers need to know the basics. As their gardens improve they will seek more knowledge. Stress the pleasure and fun of the hobby rather than the problems they may encounter. Offer to be there if new problems arise.

Above all, be positive about roses, their culture and the American Rose Society.

Dealing with the Public

It doesn't make sense to be a Consulting Rosarian if there is no one to consult with or advise. Meeting with the public to make them aware that there are those ready, willing and able to help them grow better roses is very important. Here are a few suggestions for the Consulting Rosarian:

- Be involved in every public activity of your local society. Be sure provisions are made for a Consulting Rosarian table where people can ask questions and get information, especially at the rose show. The Consulting Rosarians who serve at this table have the opportunity to answer questions and help the public.
- If your local society's only public activity is the rose show, organize other activities, such as pruning demonstrations, garden tours, programs at local public gardens, etc.
- Contact garden clubs, beautification committees and other organizations and offer to put on a rose program. Outline the basics of good growing practices and keep it simple. Follow the program with a question and answer period. Pass out information on your local society and the American Rose Society, including your name, address and phone number. Let them know you are available if any of them need your help with their roses. Consulting Rosarians are not expected to speak at a group where they have personal philosophical differences, and they should never get involved with the club's internal policies or politics. If you accept, just talk roses and their culture.
- Visit your local nursery and let them know you are willing to help them with their roses. You can advise them on the best varieties to order and help if they have a problem. Ask them to post information for their customers on your local rose society plus a list of available Consulting Rosarians. Offer to do a rose day (with a few other Consulting Rosarians). This gives you the opportunity to meet and advise people buying roses.
- When contacting the public, let them know you are a volunteer, representing the local rose society and the American Rose Society, and not the nursery, sales company, etc.

- As a fundraiser and an opportunity to meet the public, consider selling miniature roses at a local fair or flea market. Provide information on growing miniatures, the local rose society, the American Rose Society and the local Consulting Rosarians.
- Offer to write articles for the local newspaper or do a program on local public TV. These reach many people and may result in the public contacting you for advice.
- If possible, grow some roses in your front yard. This attracts attention and affords an opportunity to talk to passersby about roses. In any case, you will become known as a rose grower in the local community and people will seek you out for advice.

Helping New Rose Growers

Membership is the key to our future, both in the local rose society and the American Rose Society. Dealing with new rose growers who seek help is especially important. This may be a potential new member and should be handled delicately and with sensitivity.

Take the time to visit their garden but never criticize it. Instead, make helpful suggestions for proper cultural practices. Follow the K.I.S.S. system and "Keep It Super Simple." Don't overwhelm them with so much information they get discouraged and NEVER be an "Insulting Rosarian." Make up a list of roses that grow well in your area to have on hand for new growers. Also have a list of nurseries that provide quality stock. Many new growers get discouraged because they have limited success when they choose the wrong roses, plant inferior stock, or plant them incorrectly for their area. Offer to show them how to prune, plant, etc. Invite them to a rose meeting and introduce them to other members. Keep in touch to see how their roses are doing.

Don't always wait to be asked; if you see a few roses, ring the bell and introduce yourself as a fellow rose lover. If you are shy, write a note to introduce yourself and invite them to the next society meeting.

It may be possible to become the community's gardening expert by writing a regular column about roses for your local paper. Your expertise as to the specific cultural needs of roses in your area can easily lead to many opportunities to meet local rose growers.

A newsletter circulated to the local nurseries that they can copy and make available to their customers may be another way to meet and help the rose public. If a newsletter is beyond your abilities, individual information sheets that also advertise your local society can be used very effectively. The nurseries may welcome this effort on your part.

The Last Word

Keep your enthusiasm; share your knowledge with others; be involved in your local society; participate in rose activities and use this reference manual to help others and promote the love of the rose.

Remember to Keep it Super Simple and Positive
When Advising Others

Notes

Notes

Chapter 4 – Basic Rose Culture

This chapter covers basic information and culture for review and reference by Consulting Rosarians. The information is not regional but rather covers most of the elements that are the foundation of growing good roses anywhere. A well-informed and knowledgeable Consulting Rosarian can better help others to successfully grow good roses thus promoting the love of the rose!

Types of Roses

Hybrid Teas

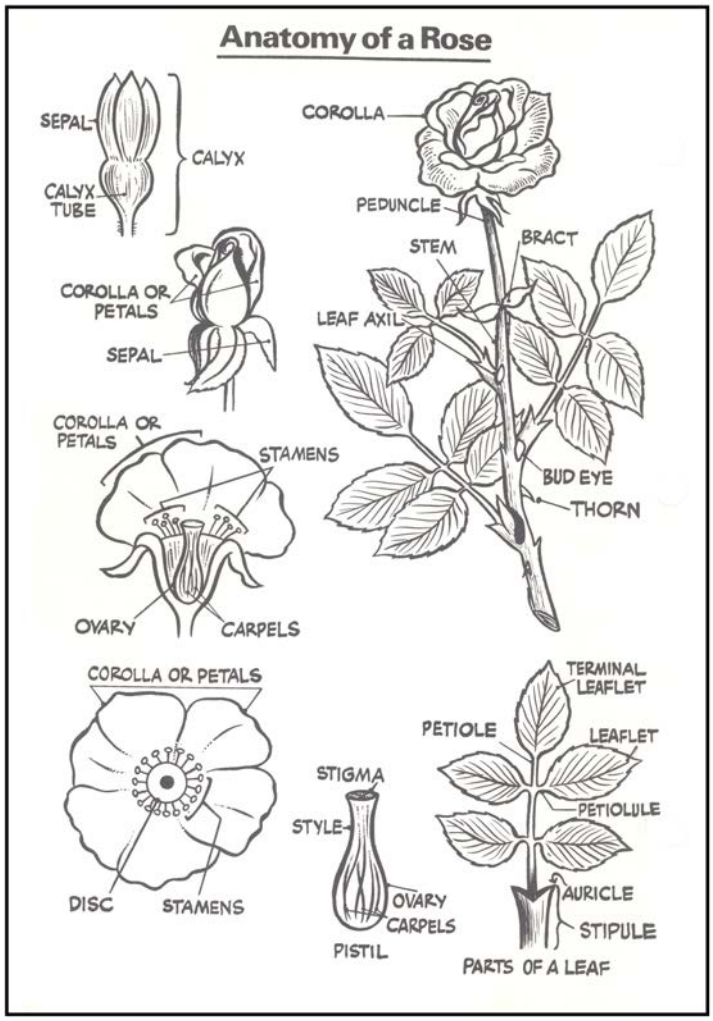
Roses can be divided into several types. The most popular, readily available, and widely grown are the hybrid teas. They are usually fair sized bushes with mostly long, one-bloom per cane topped with well-formed blooms in every color except blue and black.

Floribundas

The floribundas are most often smaller sized bushes than hybrid teas, with smaller size blooms that come singularly or in clusters, and are also available in most colors. These make ideal landscape roses, and their popularity is increasing.

Grandifloras

The grandifloras are thought to be a combination of hybrid teas and floribundas with some one-bloom canes and some cluster blooms. The grandiflora term was coined by nurserymen for the rose 'Queen Elizabeth' which was introduced in 1954. The term grandiflora still remains, although most of the newer members closely resemble either hybrid teas or floribundas.



Credit: ***Guidelines and Rules for Judging Roses***, American Rose Society, 2012

Climbing Roses

Climbing roses consist of three general types. Large flowered climbers (LCl) most often have tall stiff canes and blooms in both single and cluster flowered canes, and generally repeat bloom. Next are the rambler type climbers, which have flexible canes that require support and most often flowers with small blooms in clusters which usually do not repeat. Then there are sports (mutations) of hybrid teas, floribundas and others, which resemble their bush counterpart except for their climbing growth habit. These usually have an outstanding spring bloom, then only scattered bloom with more blooms in the fall. It seems the mutation which caused the vigorous growth habit, also affected the repeat bloom genes. We understand that roses do not really "climb" in the sense that other plants do; they do not twine, or have tendrils; they can sometimes hang onto something because of their prickles (thorns). Climbing roses are just roses that have a very vigorous growth habit. This class should include Hybrid Gigantea and Hybrid Wichurana.

Miniatures and Minifloras

Miniature roses are roses that are smaller in bush, foliage and bloom size. They range from the "micros" with blooms as small as 1/4 inch in diameter to larger minis.

Miniature roses are true roses, bred to stay small in size. Most mini roses also have smaller flowers than standard rose bushes, but they come in a variety of types and colors. Despite their small size, miniature roses are extremely hardy. In fact they are more winter hardy than most tea roses. Miniatures also tend to be profuse repeat bloomers.

First bred and released in 1973, miniflora roses resulted from crossing true miniature-type roses with standard rose shrubs. Originally, the name was written as "mini-flora" and trademarked by the inventor, J. Benjamin Williams. In 1999, the American Rose Society officially gave these plants a classification and with Williams donating the trademark name to the society, the name was simplified to miniflora.

Old Garden Roses

Old Garden Roses consist of the older rose classes existing prior to 1867, the date of the alleged first hybrid tea, 'La France'. The classes include the species (wild) roses, albas, bourbons, centifolias, damasks, eglantines, gallicas, mosses, noisettes, portlands, teas, etc. They come in numerous growth and bloom patterns and colors. Old Garden Roses are available through mail order sources and some local nurseries.

Shrubs

Shrub roses are generally roses which are hybrids of species, or roses not in any other class, such as David Austin "English" roses and Dr. Griffith Buck's roses. They are extremely varied botanically, and most are available through mail order and from local nurseries.

Earth-Kind® Roses for a Sustainable Rose Garden

The Earth-Kind® Rose Research Program was started in early 1988's under the sponsorship of the Texas Nursery and Landscape Association and Texas A&M to find roses suitable as low maintenance landscape plants for Southern gardens. One hundred roses were selected for the first round of tests and of those varieties; fifteen cultivars were eminently qualified for trials in Southern gardens.

In the next round of trials, roses were selected for Northern gardens. Roses selected would be varieties that would thrive under the added condition of cold winter climates accompanied by below freezing temperatures and drying winter winds.

Field trials were conducted by amateur rose growers who volunteered to do advanced field testing and have been divided into two groups referred to as Earth-Kind® Rose Brigades. The Southern Rose Brigade and the National Earth-Kind® Brigade which is the largest rose research study ever conducted.

The Southern Rose Brigade started with 100 cultivars and of those 15 varieties proved to be worthy of the Earth-Kind® designation.

National Earth-Kind® Brigade participants were given over 500 cultivars for their field trials from hybridizers who specialized in roses for cold climates such as the Dr. Griffith Buck's roses. Of those varieties 30 cultivars have gone on for further trials in Northern gardens.

The identification of disease tolerant, low maintenance own-root roses that would create a handsome shrub, even without blooms, and provide the extra benefit of flushes of fragrant blooms is of primary importance with little or no pruning necessary other than to shape the bush.

Roses considered for this designation should be carefree, need little or no extra moisture, need no excessive amounts of commercial fertilizers or pesticides and are drought and heat tolerant.

For a rose to be designated as Earth-Kind®, a variety would not need any excessive soil amendments after the initial bed preparation using plant derived compost; would not need excessive amounts of commercial fertilizers; would not need applications of chemicals such as pesticides, fungicides or miticides; would not need to be deadheaded and would not need supplemental watering after the first year except in extreme situations and then a drip irrigation system would be encouraged.

The use of a 3" layer of natural mulch is recommended to conserve moisture in the soil and to keep the soil cool and discourage weeds. This mulch can be renewed each spring as the mulch is turned into humus.

Once established, these highly recommended roses have tremendous heat and drought tolerance (even in temperatures of 105 F) They also do very well in almost any soil type, from well-drained acid sands to poorly aerated, highly alkaline clays. In most loam or clay soils, these roses do not even need commercial synthetic or organic fertilizers as long as one follows our Earth-Kind® compost and mulch only approach to soil management.

To educate the public regarding these unique roses, Consulting Rosarians and Master Gardeners are encouraged to take special classes so that they can better bring these remarkable roses to the rose growing public through programs given at rose society meetings, home & garden shows, retail garden centers, garden clubs, Rotary and Lions clubs, Elementary schools, Community Recreation Centers and Environmental groups.

An Earth-Kind® PowerPoint presentation can be downloaded from the web site at www.earthkindroses.tamu.edu. This presentation is available without charge and may be used without seeking the permission of TCE.

Polyanthas

Polyanthas, the "petite" roses of yesteryear, are almost the forgotten class of roses. Of the 500 or so polyanthas introduced since 1875, there are only some 50 still available, usually through mail order. These are low-growing bushes with small flowers in clusters. Common examples are 'Cecile Brunner' (The Sweetheart Rose), 'China Doll', 'Margo Koster', 'Perle d'Or' and 'The Fairy'. With the increase of landscape-type plants, polyanthas are making a comeback.

Some Things You Should Know about Tetanus

All gardeners should be aware of some basic facts about tetanus - and make certain their tetanus immunizations are current. The natural habitat of the bacterium responsible for infection (*Clostridium tetani* - a cousin of the botulism organism) is the soil. However, it and/or the spores it produces are widely distributed, both in soil and elsewhere. When growing, it produces a toxin 50 times as poisonous as cobra venom. It is this toxin which is responsible for the disease. A wound no larger or more painful than a pin prick (thorn prick?) can harbor enough bacteria to produce sufficient toxin to kill an unvaccinated human.

The bacterium is an anaerobe, meaning it grows only in the absence of oxygen - a frequent condition in puncture wounds. Buried rusty nails are common dwelling places, and anyone stepping on one can inoculate himself in a serious manner. Tetanus immunization should be viewed as a necessity for anyone who may have skin breaks and frequent contact with soil - such as gardeners, children, etc. Animal feces, including that from horses, frequently harbor the microbe (remember manure).

The following points have been extracted from a background paper published by the National Institutes of Health:

- This ancient and dreaded disease develops as the result of an infected wound, usually a puncture or laceration. However, even a superficial scratch is susceptible to infection by tetanus bacteria. When tetanus infection does occur, it is highly lethal . . . an amount of purified tetanus toxin weighing no more than the ink in the period at the end of this sentence would be enough to kill 30 grown men.
- And yet, though these bacteria produce one of the most deadly poisons known to man, a tetanus immunization injection given every 10 years will prevent its lethal effects.
- The organism is an ever-present bacillus found in soil, dust, manure, clothing, and in the digestive tracts of man and many animals. A paper cut can sometimes be as lethal as a knife wound.
- If a wounded person has not been immunized for tetanus, and the infection develops, the prognosis is grim. Fatality rates run from 45 to 55 percent, even with the best hospital care.
- Being an anaerobe, the bacterium is not normally apt to cause trouble unless introduced into a wound where it is cut off from oxygen. Although it usually begins to multiply, and produce toxin, immediately upon finding the right airless environment, the spores are very hardy and can remain dormant for a long time - tens or possibly hundreds of years.

It's Easy to Protect Yourself:

Get the Initial Tetanus Immunization - Get a Booster Shot Every 10 Years

(Some doctors suggest that people who are very active in the garden should have boosters sooner, every five years. Contact your local health provider for more information.)

Rose Thorn Disease (*Sporotrichosis*)

Sporotrichosis is an infection caused by a fungus called *Sporothrix schenckii* which is found in vegetation. It usually infects the skin of people handling thorny plants, sphagnum moss or baled hay (or a combination of these). Outbreaks have been found occurring among nursery workers handling sphagnum moss, rose gardeners, children playing on baled hay and greenhouse workers handling bayberry thorns contaminated by the fungus or mulch-rich soil.

The fungus enters the skin through small cuts or punctures from thorns, barbs, pine needles, splinters or wires from contaminated sphagnum moss, moldy hay, other plant materials or soil.

The infection manifests itself as small painless lumps or bumps resembling an insect bite 1-12 weeks after exposure. Usually the first appearance is within 3 weeks after initial infection. The lumps become open sores. The ulcers fail to heal and the microorganisms which caused them enter the lymphatics and can move along the lymphatic system eventually infecting lungs, joints or the central nervous system.

Diagnosis is made when a doctor obtains a swab or biopsy of a freshly opened bump and it is sent to the laboratory for fungus culture. It is important that the infection is properly diagnosed so that treatment can be started as soon as possible.

It is important for the rosarian to be vigilant when working with soil amendments that can carry the disease. Use gloves and long sleeves when handling wires, rose bushes, hay bales, pine seedlings or any other materials that might cause even minor skin breaks. It is also advisable to avoid skin contact with sphagnum moss. Moss has been implicated as a source of the fungus in a number of cases.

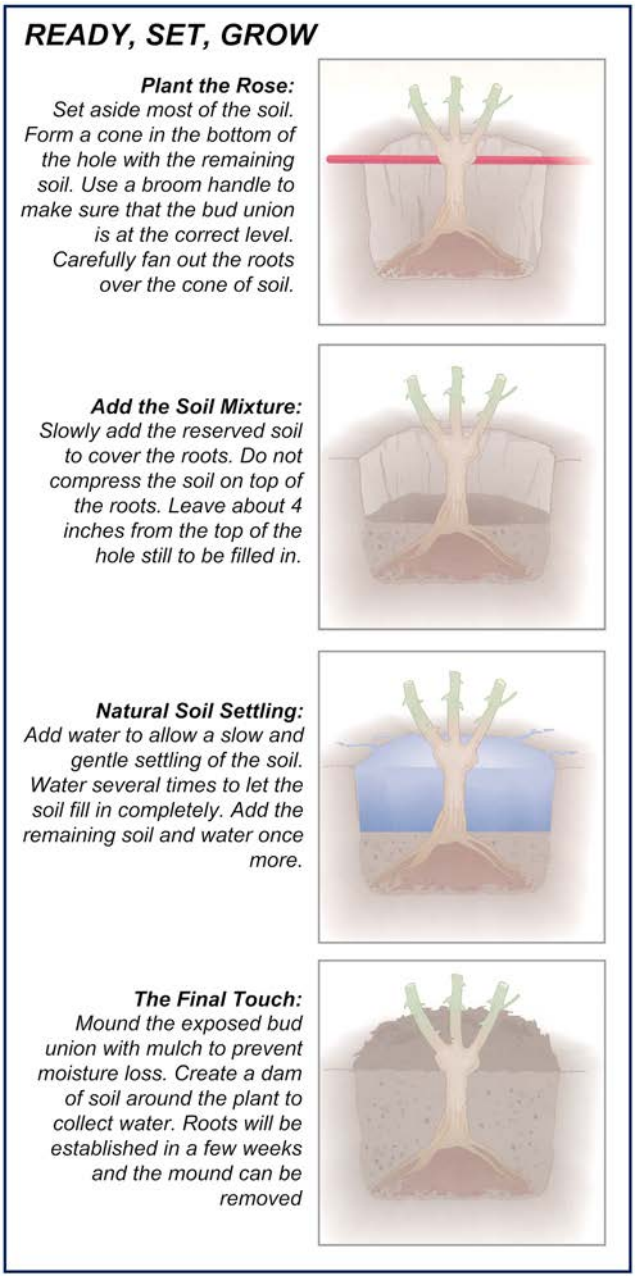
Rose Culture

Building a New Rosebed

Roses will do quite well in beds at ground level if the site has excellent drainage and will not become waterlogged from heavy rains. For many growers, raised beds, built 4 to 12 inches above the surrounding ground is best. Winter protection in severe climates is more difficult with this type bed, but soil moisture control is much simpler. In areas of heavy rainfall and hard soil, raised beds help to provide better drainage and success with roses.

A raised bed must have something to hold the soil in place. A wide variety of materials are available for this purpose: concrete blocks, bricks, and treated timbers. If drainage is a problem, the edging material must be joined so as not to interfere with drainage. For instance, bricks if laid with mortar must have drain spaces at frequent intervals.

Landscape timbers provide considerable flexibility in the design of the bed, limited only by the imagination. However, the most common construction is a rectangular bed, 4 to 5 feet wide



Credit: ***All About Roses***, Dr. Tommy Cairns, Meredith, 1999

by about 20 feet, placing the timbers two or three high. A bed this size will provide room for a double row of 14 to 15 hybrid teas in areas with a longer growing season, where the plants become larger. In short season areas, the roses can be planted much closer together.

One caution: Do not use creosote cross-ties or old railroad ties that are less than several years old. The creosote will kill roses.

Planting Roses

In most of the United States, early spring when the soil becomes workable and mild temperature make working outside easier is the best time to plant roses. Late autumn is also a good time to plant roses in some areas and is favored by many rosarians. Remember, this advice and any advice you give on any aspect of growing roses, must take into account your geographical location.

Roses also need a location that is well drained. While they require a great deal of water, a wet, water-logged soil will retard their growth, if not outright kill them. Digging deep planting holes usually provides adequate drainage. Sometimes installing raised beds helps in low-lying areas. Sometimes it may be necessary for the very serious rosarian to install some sort of tile drainage system in the yard, which, if the drainage is that bad, probably should have been done long ago anyway. But for the most part, a well-prepared hole, deeply dug, will provide an adequately drained environment for the roots.

It is very important that bare root roses be moist and not be allowed to dry out. Therefore, as soon as a shipment of bareroot roses is received from the nursery, the package should be opened and the bushes soaked in water for several hours prior to planting. The plants are dormant; they are not actively growing and, as a result, do not have to be handled as carefully as an actively growing bush. Being dormant, soaking will not harm them. On the contrary, it will assure that they are well hydrated for planting.

For bareroot or potted roses, planting starts out the same. Locate a spot that has good drainage and receives 6 to 8 hours of sunlight or the amount recommended by successful rosarians in your area. It is very convenient to have prepared the soil and dug the holes sometime during the previous fall. It makes spring planting much easier, but it is not absolutely necessary.

Dig a hole about 18 inches in diameter and at least 20 inches deep. The depth is to assure loose soil below the root growth area for good drainage. The chances are the soil from the bottom of the hole will be heavy clay. Rose roots thrive and do their best in a light and airy clay that has been modified by the addition of a lot of organic matter, such as peat moss, cow manure or compost.

PLANTING CONTAINER-GROWN ROSES

Remove the Bottom:
Lay the container on its side. Cut off the base of the compressed fiber pot with a small saw. Try not to damage any of the roots.

Place in Hole:
Place the root ball in the hole that has been dug out to about 2 feet wide and 2 feet deep. Make sure the bud union is at the proper level.

Remove the Container:
Remove the rest of the compressed fiber pot as if you were peeling an orange. Don't worry if some roots show on the surface of the root ball.

Fill in with Soil:
Fill the remaining space with a good potting soil or amended soil. Water, allow to settle, and finish off with more potting soil.

Credit: ***All About Roses***, Dr. Tommy Cairns, Ortho Meredith, 1999

Toss away the clay material that came from the bottom third of the hole and mix the remainder with a comparable volume of any of these organics. If the soil is almost all a very heavy clay, add five or six handfuls of gypsum. Gypsum mixed in a clay soil helps break it up, keep it porous, and lets the organics do their job. This won't happen overnight, but if applied over a three year period of time, you should see an improvement in your soil.

To plant a bare root rose, the roots should be trimmed. With pruning shears remove any broken roots and trim the roots to a length that will conveniently, with ample room on all sides, fit into the hole. Roots 8 to 10 inches long are sufficient. Do not try to stuff 2 feet of roots into the hole by wrapping them in a spiral. Properly pruned roots will soon sprout plenty of new rootlets as the bush becomes established.

Start refilling the hole with the soil mixture. Hold the rosebush in the hole so that the bud union (the swelling from which the canes project upward and from which the roots grow downward) is at or just an inch or two above the ground level.

In colder climates the bud union should be planted 3-4 inches below the ground level. Continue to fill the hole with the soil mixture in and around the roots. At this point it is a good idea to toss a handful of superphosphate fertilizer or bone meal into the hole and mix it with the soil that will immediately surround the roots.

This is the only fertilizer that need be added during the planting process. Any other fertilization should wait until the bushes are established as evidenced by sprouting leaves and new canes. The shot of phosphorus given at planting time stimulates root growth, a newly planted rosebush's most immediate task, plus phosphorus moves slowly through the soil.

Continue to add soil mixture, keeping the bud union at a level consistent with the hardiness zone in which you live. Sometimes it may be at ground level, well above ground in warmer climates, or well below the surface in colder climates. Use the fingers of your gloved hands to poke the soil in and around the roots. When the hole is about ¾ filled, water in well with a root-stimulator solution. Replace the soil and water it well with a couple gallons of water. This will not only moisten the roots but will help seat the soil particles around them. The water will no doubt cause the soil in the hole to settle a bit after it has drained away. When the water is gone, complete the hole-filling job with the rest of the soil. Do not compress the soil by stamping on the fill dirt.

Because of all of the organic matter that was added there should be enough left over to mound up over the canes to a height of at least 6 inches. The soil mound, which should be gradually removed after two to three weeks, will protect the newly planted bush while it begins to establish a new root system and will do the all-important task of keeping the bush from drying out.

Composting

Composting is the decomposition of plant remains in other once-living materials that makes an earthy, dark, crumbly substance that is excellent for adding to houseplants or enriching garden soil. It is a way to recycle your yard and garden waste, and is a critical step in reducing the volume of garbage needlessly sent to landfills for disposal.

Composting is not a new idea. In the natural world, composting is what happens as leaves pile up on the forest floor and begin to decay. Eventually, the rotting leaves are returned to the soil, where living roots can finish the recycling process by reclaiming the nutrients from the decomposed leaves.

Composting may be at the root of agriculture as well. Some scientists have speculated that as early peoples dumped food wastes in piles near their camps, the waste rotted and were a terrific habitat for the seeds of any food plants that sprouted there. Perhaps people began to recognize that dump heaps were really good places for food crops to grow, and began to put seeds there intentionally.

The use of composting to turn organic wastes into a valuable resource is expanding rapidly in the United States and in other countries, as landfill space becomes scarce and expensive, and as people become more aware of the impacts they have on the environment. In 10 years, composting will probably be as commonplace as recycling aluminum cans is today, both in the backyard and on an industrial scale. Many states in the USA have stated goals or legislative mandates to drastically reduce the volume of waste being sent to landfills. Utilizing yard and kitchen wastes is a big part of the plan to minimize waste overall.

Composting Fundamentals

Good composting is a matter of providing the proper environmental conditions for microbial life. Compost is made by billions of microbes (fungi, bacteria, etc.) that digest the yard and kitchen food wastes you provide for them. If the pile is cool enough, worms, insects, and their relatives will help out the microbes. All of these will slowly make compost out of your yard and kitchen wastes under any conditions. However, like people, these living things need air, water, and food. If you maintain your pile to provide for their needs, they'll happily turn your yard and kitchen waste into compost much more quickly.

There are a tremendous number of options for containing your compost. Some people choose to go bin-less, simply building a compost pile in a convenient spot on the ground. Others build bins from materials such as recycled pallets, or two-by-fours and plywood. Wire fencing, looped into a circle 3- 4 feet in diameter is an easy-to-construct bin that won't decay in time like wooden bins and, of course, there are many commercial bins on the market. Keep in mind the following basic ideas when building your compost pile:

Air

Composting microbes are aerobic -- they can't do their work well unless they are provided with air. Without air the anaerobic (non-air needing) microbes take over the pile. They do cause slow decomposition, but tend to smell like putrefying garbage! For this reason, it's important to make sure that there are plenty of air passageways into your compost pile. Some compost ingredients, such as green grass clippings or wet leaves, mat down very easily into slimy layers that air cannot get through. Other ingredients, such as straw, don't mat down easily and are very helpful in allowing air into the center of the pile. To make sure that you have adequate air ratio for your pile and its microbes, thoroughly break up or mix in any ingredients that might mat down and exclude air. You can also turn the pile to get air into it, which means completely breaking it apart with a speed or garden fork and then piling it back together a more 'fluffed up' condition.

Water

Ideally, your pile should be as moist as a wrung-out sponge to fit the needs of compost microbes. At this moisture level, there is a thin film of water coating every particle in the pile, making it very easy for microbes to live and disperse themselves throughout the pile. If your pile is drier than this, it won't be a very good microbial habitat, and composting will be slowed significantly. If your pile is a great deal wetter, the sodden ingredients will be so heavy that they will tend to mat down and exclude air from the pile, again slowing the composting process (and perhaps creating the anaerobic odor problems). If you are using dry ingredients, such as autumn leaves or straw, you will need to moisten them as you add them to the pile. Kitchen fruit and vegetable wastes generally have plenty of moisture, as do fresh green grass clippings and garden pruning. Watch out for far-too-soggy piles in wet climates (a tarp may help to keep rain off during wet weather).

Food

In broad terms, there are two major kinds of food that composting microbes need.

- 'Browns' are dry and dead plant material such as straw, dry brown weeds, autumn leaves, and wood chips or shredded wood products. These materials are mostly made of chemicals that are just long chains of sugar molecules linked together. As such, these items are a source of energy for the compost microbes. Because they tend to be dry, browns often need to be moistened before they are put into a compost system.
- 'Greens' are fresh (and often green) plant materials such as green weeds from the garden, kitchen fruit and vegetable scraps, green leaves, coffee grounds and teabags, fresh horse manure, etc. Compared to browns, greens have more nitrogen in them. Nitrogen is a critical element in amino acids and proteins, and can be thought of as a protein source for the billions of multiplying microbes.

A good mix of browns and greens is the best nutritional balance for all the microbes. This mix also helps out with the aeration and amount of water in the pile. Browns, for instance, tend to be bulky and promote good aeration. Greens, on the other hand, are typically high in moisture, and balance out the dry nature of the browns.

Other Things to Consider

If you live in a cold climate, your compost pile will probably go dormant in the winter. No problem -- it'll start back up again when the springtime thaw comes.

A common misunderstanding about compost piles is that they must be hot to be successful. This just isn't true. If you have good aeration and moisture, and the proper ingredient mix, your pile will decompose just fine at temperatures of 50°F or above. Hotter piles will decompose a bit faster, however. One way to understand why this is so is to realize that the heat in a hot pile is the result of the collective body heat of billions of microbes that are busy digesting the ingredients in the pile. Generally speaking, a hotter pile means more microbes or conditions that allow the microbes to have faster metabolisms, and therefore a faster composting process.

For a pile to get hot and stay hot for a long period of time, the typical minimum size for the pile is one cubic meter (a cube is one meter, or about 3 feet, on a side). A pile of this size has plenty of mass in which those billions of heat-generating microbes can live, yet it is also large enough that the center of the pile is well-insulated by the material surrounding it. Smaller piles just cannot insulate themselves well enough to remain hot for long, if at all. You can also provide additional insulation to a pile by stacking bales of hay or straw, or bags of dry autumn leaves, around your bin. A bin like this will itself compost over time.

When Is Compost Finished?

Finished compost is dark in color and has an earthy smell (like the smell of soil). Usually, it's difficult to recognize any of the original ingredients, although bits of hard-to-decompose materials (such as straw) sometimes can be seen.

There is no single point at which compost is finished -- it's a bit more subjective than that. For many outdoor garden applications, for instance, it can be fine to use compost that still has a few recognizable bits of leaves or straw- it will finish rotting in the soil. If you plan to use compost in seed-starting mixes, though, it is best to have a well-finished compost, because seedling roots may be attacked by decomposer microbes if the roots contact unfinished compost.

Compost as Soil Amendment: Many people put compost into their garden soil by digging it in prior to spring planting. Compost can also be used as a 'top dressing' on the soil during the growing season -- in this case it is added in and around the bases of plants, where irrigation and organisms will slowly incorporated it into the soil.

Compost as Mulch: Compost can be left on the surface as mulch around landscape and garden plants. This is essentially the same as a 'top dressing' application, described above, but mulches are typically meant to cover all the soil around the plants. Mulches protect the soil from erosion. They also save water by shielding the soil from the drying effects of the wind and sun. As they decompose, mulches add nutrients to the soil, and if composed of small enough particles, worms may slowly eat the mulch and incorporate it into the soil.

Compost as Tea: Compost tea is made by combining equal parts of compost and water and letting it sit for a while. The liquid can help to provide a 'quick boost' to dealing houseplants or young seedlings and transplants. The same compost can be used to make several batches of tea. When you're finished making compost tea, use the murky dregs as mulch in the garden or landscape.

Compost benefits the soil by adding organic matter, which improves the way water interacts with the soil. In sandy soils, compost acts as a sponge to help retain water in the soil that would otherwise drain down below the reach of plant roots (in this way, it protects plants against drought). In clay soils, compost helps to add porosity (tiny holes and passageways) to the soil, making it drain more quickly so that it doesn't stay waterlogged and doesn't dry out into a brick like substance. Compost also inoculates the soil with vast numbers of beneficial microbes (bacteria, fungi, etc.) and the habitat that the microbes need to live. These microbes are able to extract nutrients from the mineral part of the soil and eventually pass the nutrients onto the plants. A great variety of things can be composted at home saving them from a one-way trip to the landfill, and turning them into valuable soil amendments for home use.

What *Not* to Compost

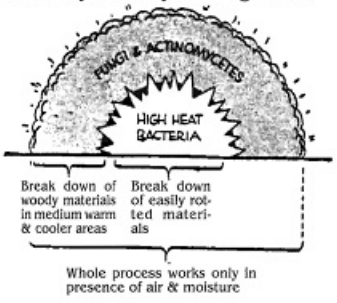
Whether because of toxins, plant or human diseases, or weeds, there are some things that shouldn't be put into compost piles.

- Chemically-treated Wood Products
- Diseased Plants
- Human Wastes
- Meat, Bones, and Fatty Food Wastes
- Pernicious Weeds and Weed Seeds
- Pet Wastes

INSTRUCTIONS TO MAKE COMPOST

COMPOSTING...

Compost can be a tremendous asset to any garden, if-and we repeat, *if*-it is developed carefully and diligently. A poorly maintained compost pile breeds enormous quantities of flies and other pests, and has an odor that can be obnoxious to both you and your neighbors.



Turn compost pile *often to keep moisture, air, and microbe action in balance.*

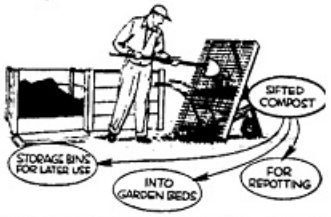
Before you build a compost bin, ask yourself these questions:
1. Do I have a good, out-of-the-way location for a bin on my property?
2. Is the time and effort involved in proper upkeep really worth it to me, when it would cost only a few dollars a year for manure or other humus-building material?

If you can honestly answer "yes" on both questions, read on. If your answer is "no" to either of them, you are better off to forget the whole idea.

Composting in its simplest form consists of piling up grass clippings, leaves, and other garden refuse, plus certain kitchen material such as coffee grounds — then allowing it to decompose. Later (usually 3 to 6 months) you spade it back into the garden, thus adding nutrients and humus to the soil.

There are innumerable improvements on this procedure, of course. The first improvement is putting the debris in an enclosed bin where you can work with it easier. All a bin amounts to is a way of enclosing raw material while microbes work on it. The compost heap should be turned every week (or oftener) with a spading fork or pitchfork, to put air into the center and to relocate material in the various phases of decomposition. The whole compost-making process can be carried out successfully only if there is a balance of moisture, air, and microbe action. At the bottom of the pile, near the center, high heat bacteria go to work on soft, easily rotted material. Fungi and actinomycetes bacteria are at work in the rest of the pile.

Sift out finished compost before you add raw materials —



To sift and load *compost in one operation, lean the screen against a wheelbarrow.*

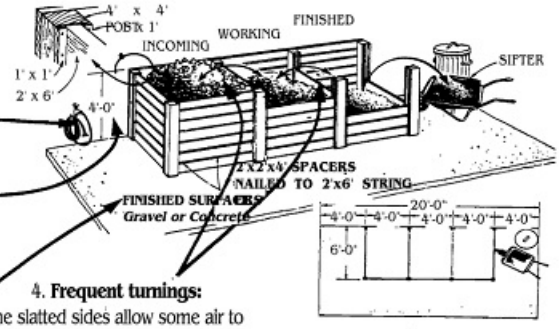
When compost becomes crumbly and ready to use, sift it through a 1-inch wire screen or sieve for general garden use. A ½-inch screen is preferable if you want finer textured compost for potting or as a lawn dressing.

Sheet composting *is popular with some gardeners as a means of putting surplus undecayed matter to good use.*

SIMPLE COMPOST BIN

This compost receptacle illustrates physical features that help make fast compost without aid of soil or manure. Many bins and boxes now in existence can be worked by this method.

1. **Water always handy:** Hose and sprinkler supply water that keeps fast-working compost damp as a squeezed sponge.
2. **Optimum height 4 to 6 feet:** If a pile is too low, heat is lost rapidly and composting action slows. If too high, the weight will compress the material, cut off vital air and make too much heat.
3. **Place to handle raw material:** Material should be walnut-size chunks or smaller. Space allows for temporary stacking to await any necessary grinding, chopping.



4. **Frequent turnings:** The slatted sides allow some air to circulate, but the significant aeration comes with frequent turnings (every 2 or 3 days for best results). This set of bins is designed for easy access with spading fork.

PLAN VIEW

Outer surface is 4 feet wide to give gardener plenty of working room.

Credit: Basic Gardening Illustrated

Mulching

Roses will grow better if the beds are covered with a thick porous mulch. It is true that roses can be grown in cool moist climates without mulches, but there are many advantages of mulches.

A good mulch helps conserve moisture in the rose bed. In most areas, roses do not get enough water for their best growth. Great extremes of rainfall and over-watering can shut off the air to the roots and cause temporary starvation, but this is rare. Constant adequate moisture in the soil keeps the plants well fed and growing. Well-mulched beds require less frequent watering and stay more uniformly moist.

Organic mulches, as they break down, supply a continuing source of essential nutrients. This includes some of the trace elements so necessary for good growth. Add spring mulch when the pruning is completed; add a summer mulch in June; then add a fall/winter mulch when the fall cut-back is done (about Labor Day in northern climates).

CALCULATING CUBIC YARDS OF COMPOST/MULCH

Multiply the width by the length of the rosebed in feet.

Width times Length = X square feet

Divide the number of inches wanted by 12 inches = Y

Multiply X by Y = Z (number of cubic feet)

Divide Z by 27 = C (cubic yards)

Example: The rose bed is 10 feet by 10 feet.

You want 3 inches of mulch over this bed

10 times 10 = 100.

Divide 3 by 12 = 0.25.

100 times 0.25 = 25 cubic feet.

Divide 25 by 27 = **0.9 cubic yards**

Credit: Steve Jones, Valencia, California

A good mulch, if chosen wisely, will help with weed control. Some manures can contain weed seeds and add to the problem. If the mulch is from a weed-free source, it is an excellent material to smother weeds. Weed-free mulches such as cotton seed hulls, pine needles, leaves, straw, bark and aged wood chips, etc., can go a long way towards relieving part of the onerous chore of weeding.

Mulches can interfere with sanitation for those who try to keep their beds free of fallen black spotted leaves, but on the other hand, it will minimize the splattering of rain-borne black spot spores. All things considered, it appears that mulches hinder rather than promote disease spread.

Good mulches keep the ground cooler in the summer, sometimes as much as 10 to 15 degrees in the heat of the day. Mulch thickness should be 2-4 inches. This makes a big difference in having good summertime roses. Mulch may also prevent root damage from an unexpected early freeze in the fall. Still air is one of the best insulators available. Air trapped in the space between mulch particles creates an excellent insulation blanket.

If manures are used as mulches, there are some precautions to be observed. Some, if too fresh, can burn and should be kept off the bud union until they have aged. Rabbit manure is safest, and fresh chicken manure is most likely to cause burns (but only if used fresh and too close to the bud union). All manures are valuable fertilizers as well as being good mulches.

Grass clippings are a good short-lived mulch but should be spread thinly after each mowing. They tend to mat and sometimes need to be stirred to allow water to penetrate. One precaution; never use clippings if any herbicide or weed and feed fertilizer has been used on the lawn: they can kill your roses. (Do not use weed and feed fertilizers anywhere near rosebeds.)

Leaves make fine mulches if precautions are taken to avoid packing. Oak leaves are good; maple leaves tend to pack unless shredded. Leaves mixed with chips or straw are good, providing a mixture of fine and coarse particles. Most leaves give an acid reaction as they decay and in many areas, will profit from the addition of ground limestone. This is not a problem in areas where the soil is naturally alkaline.

Bark, from whatever source, provides a good mulch and can often be decorative. Pine needle mulch is a very good material, if enough is used. It is the mulch used at the American Rose Center at Shreveport, which, being in the middle of a pine forest, has ample quantities. Whatever material is used, most people will grow better roses more easily if they use a good, thick mulch on their beds.

A mulch should be applied rather early in the growing season to obtain its maximum benefits, such as on about the time of the first flush of bloom, after most of the spring basal canes have made their appearance from the base of the bushes. At least a 2 - to 4- inch layer should do the job, maybe a little less around the minis. More can be added as necessary throughout the season.

List of Mulches and Compost Materials

From reports and observations in the Pacific Southwest District by District Consulting Rosarians	*From "The Rambler", Bulletin of the South Pennsylvania Rose Society*		
ORGANIC MATERIAL: Comments on the material	**ORGANIC MATERIAL**	**ORGANIC SOIL CONDITIONERS Good & Bad Qualities**	**NUTRIENTS AND HUMUS**
WOOD PRODUCTS: Bark comes in many sizes and forms, large, medium and small also shredded and ground. It can be found in many species, fir, redwood and others. Some cities will sell the materials collected by city tree-trimmers which has been chipped. This material would have to be composted before use. Needles from pine and fir trees, leaves from most trees and shrubs can be used for compost, but will work better and break down faster if shredded. By shredding the material the water will penetrate and carry the food elements into the root zone faster. This would include sawdust, wood ashes and leafmold.	**BARK**	Long-lasting, but ties up nitrogen as it decomposes. Add 1 lb. Actual nitrogen per 10 cubic feet of bark. Low salinity, can be used in containers. Good for orchids.	Valuable for humus. Nutrients variable.
	SAWDUST	Ties up nitrogen while de-composing, so add ½ lb. Nitrogen per 10 cubic feet or a pint of mixed fertilizer to a bushel of sawdust.	Valuable for humus.
	WOOD ASHES	Good source of potash (the usable form of potassium).	High in Potassium.
	LEAFMOLD	Somewhat more nutritive than newly fallen leaves.	Value humus.
	LEAVES FALLEN	A tree withdraws most of the nutrients from its leaves before they fall, but their fiber content is excellent for soil texture.	Value humus.
HOME COMPOST PILE: This the catch all pile in which all manner of refuse will go into. This compost pile has to be handled with care, the heat in the pile should be high enough to kill all weed and grass seed. Also high enough to kill insect eggs and fungi spores. In this pile the lawn clippings, kitchen refuse, leaves, rose pruning, spent blooms, weeds and wood ashes will go. There are some weeds and grasses which should not be put into the compost. ONE IS NUT GRASS.	**COMPOST**	Requires careful handling to generate sufficient heat to kill disease organisms and kill weed seeds. Should be enriched with organic or inorganic fertilizers (Nitrogen) to make a complete soil conditioner.	Value humus.
NUT SHELLS: Walnut, almond, pecan and peanut shells, etc. if found in your area can be used for a mulch if composted. It will work well under the bushes.	**CORNCOBS ground**	Higher in sugar than most mulches. So add extra nitrogen to use up the excess sugar.	Value humus.
COTTON GIN WASTE: This material is available in some areas but it could contain weed seed and cotton fibers which would not decompose well or take a long time to break down.	**COTTON SEED MEAL**	Part of its nutrients are readily available, the rest will be released slowly.	High in nitrogen (6-2-2)
STRAW, HAY GRAIN AND FRUIT BY-PRODUCTS: All of these or parts thereof can be used as a compost material or mulch. Rice hulls are reported to work well, refuse from the grape after crushing and the removal of the juice in wine making can be used, and should decompose quite fast. Straw will make very good mulch after being ground and composted. Alfalfa hay is very good and should have a great food value, but should be composted to kill any weed seed. Sometimes you can find hay that has been baled wet, or green and has started to decompose. (If it has not started to burn). Wet or green hay or alfalfa should not be stored in or near buildings because of the fire danger from internal combustion. Grass clippings would come under this precaution also. Corncobs which have been ground work well as a mulch. All of these materials should be composted before using and when composting these materials nitrogen should be added.	**LAWN CLIPPINGS**	Decays rapidly, must be replaced often. Avoid clippings treated with herbicides.	Some nutrients. Good humus.

Credit: Taken from *The Rambler*, Bulletin of the South Pennsylvania Rose Society

List of Mulches and Compost Materials

ORGANIC MATERIAL: Comments on the material	**ORGANIC MATERIAL**	**ORGANIC SOIL CONDITIONERS Good & Bad Qualities**	**NUTRIENTS AND HUMUS**
MANURES: Cattle, sheep, horse, chicken and other bird and animal refuse, when well composted has some nutrient value. It should be used as a soil conditioner or used with other composted materials for best performance. Bad qualities about most manures are it contains a high degree of salt, and its odor when fresh.	**MANURES: Cattle**	Often free for the hauling. Can be highly saline, so do not use in containers. Must be thoroughly decomposed or it will burn the plants. Requires large quantities if used as a fertilizer, but is excellent for adding humus.	Some nutrients (.5 - .3-.5) valuable for humus. (.9 - .5 - .8)
	Chicken	Generally the same as cattle manure.	(.6 - .3 - .5)
	Horse	Generally the same as cattle manure.	(.9 - .5 - .8)
	Sheep	Generally the same as cattle manure. Less odorous.	
MUSHROOM COMPOST: This material is the humus material left after growing mushrooms in it for some time. The nutrients have been used up, so a complete fertilizer should be added If used. Water will not penetrate it when allowed to dry out..			
PEAT, SPHAGNUM MOSS: This is an expensive mulch for use in the garden. It is best used in containers	**PEAT, SPHAGNUM**	The most widely available source of humus. Hard to wet, but retains water well once it's wet. Must be kept damp.	Valuable for humus.
ANIMAL PARTS: This is not a home process so has to be obtained from commercial sources	**FISH SCRAPS**	Excellent fertilizer, sometimes available free. Should be buried to avoid the odor and to prevent cats from stealing them.	High in nitrogen (9-7-0)
	HOOF/BONE MEAL	A good supplement for bark or sawdust.	High in nitrogen (14 - 0 - 0)
	BLOOD MEAL	Probably the best organic fertilizer available but like most others, it requires bacterial action before the nutrients can be released.	High in nitrogen (13 - 1.5 - 0)
	BONE MEAL Raw	Freshly ground bones containing marrow, meat scraps and blood are best.	High in phosphorus
SEWER SLUDGE: This not a good mulch but should be used as a soil conditioner. It is high in fertilizer content and trace minerals. The bad quality is it could contain some heavy metals. The sludge has been composted and processed before selling.			

Credit: Taken from *The Rambler*, Bulletin of the South Pennsylvania Rose Society

Winterizing

Winterizing is needed for most rosarians in the northern climates. Winter hardiness of roses is subject to many variables, mostly the microclimate of the garden, the condition of the rose, the weather and the varieties. Some varieties can withstand the winter better than others. There is no one way of stopping fluctuating temperatures and icy winds, but we can do many things to protect roses from them. How much protection roses need depends on their microclimate.

Bushes planted near the house are already protected to some degree. Spots in the garden that are sheltered from icy winds by shrubs or walls also may require little protection. However, bushes in the open and especially those in low ground, may require the full treatment.

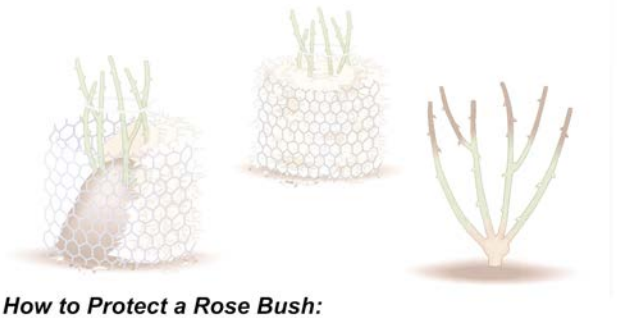
Winter survival of roses depends as much on the condition of the bush in autumn as on any type of winter covering. Sickly bushes may not make it through the winter no matter what treatments are used. Bushes heavily infected with blackspot and/or mildew and those without sufficient water will be at greater risk of serious damage than healthy bushes.

Winter damage is caused by the water that makes up the plant cell freezing and expanding. This expansion ruptures the cells, damaging and even killing them. In cold climates, pruning roses in the fall makes them more subject to winter damage as it encourages the sap to rise to form new tender growth. The sap freezes and the plant is damaged.

Cold temperatures alone are not harmful as the bushes become dormant. The trick to successful plant protection is to keep them dormant. Apply winter protection before the ground is really cold and it will delay dormancy by keeping the soil warm. Therefore, it is important to wait for the right time. Some varieties have the ability to convert water to a form that doesn't freeze. This is an inherited characteristic that makes the variety hardy.

Another cause of damage is due to drying out of canes exposed to cold winds at low humidity. Dormant roots cannot supply moisture to the canes and damage results. Often the bushes would survive better in a more protected situation. There are many easy ways to create this protection: a snow fence, burlap screen or any protective covering will do the job. Spraying with WiltPruf may aid in cutting down on moisture loss. Some growers are successful just using evergreen branches and discarded Christmas trees to cover the roses.

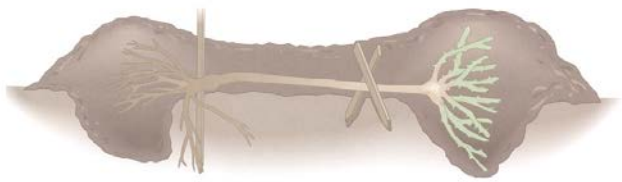
MULCHING FOR WINTER PROTECTION



How to Protect a Rose Bush:
Using a collar of chicken wire, mound the rose bush with soil and mulch. Next, fill in the space between the canes with leaves, straw, and mulch. Any canes protruding from the chicken wire collar may die back and can be removed during pruning. Remember, this is not necessary for areas in southern zone 8 and higher.

How to Protect a Climber:
Trim, defoliate, and tie canes up into a neat vertical bundle Wrap the bundle with burlap, canvas, or a similar fabric (never plastic) and tie down for security. Mound up the base of the plant with a mixture of mulch and soil.

How to Protect Standard Tree Roses:
Trim and defoliate the bush and partially uncover the root system to allow the tree to lay on its side. Hold the entire plant in place with crossed stakes, and cover it with a mixture of soil and mulch.



Credit: ***All About Roses***, Dr. Tommy Cairns, Ortho Meredith, 1999

The other side of the coin is too much moisture. A heavy, soggy mulch can wreak havoc. Consider using mulch with materials that will not hold so much water, such as oak leaves, pine needles, straw, etc. piled high on the bushes, these materials will also protect the canes from wind damage. Before using any winter protection method, it is important to clean the surface of the rose beds to prevent overwintering of diseases. If possible, one last spray for fungus is advisable.

There are many ways to winter protect roses. Protection can be as simple as heaping leaves in the rose bed or as elaborate as constructing Styrofoam® boxes.

Methods

Let's start with the simplest to winterize - the minis. Once they are completely dormant, just cover with several inches of leaves. Winter protection in cold climates should not be applied until after a hard freeze to discourage rodents from taking up residence in your rose bed.

Hybrid teas, grandifloras and floribundas are a bit more work. Winterizing may be needed for most roses in northern climates. Trim tall dormant bushes to about 5 feet to prevent them from rocking in the wind. Some bushes may need to be tied and staked. Secure climbers by tying and staking as trimming now will reduce spring bloom.

Hilling

The oldest method of protecting roses is hilling 10 to 12 inches with soil. Never scoop the soil from around the bushes as this exposes roots. Instead use some material that can be spread as a mulch in the spring. Compost is a good choice but be sure the ground is lightly frozen before applying any hilling. Gutter screening, commercial collars or good old newspapers (several layers folded in halo), or wire mesh can be used to hold the hilling material in place.

If you have bushes that deserve or need special attention, or your winters are severe, there are more elaborate methods. For instance, after hilling, cut the bush down to fit under a bushel basket or large plastic garbage pail. Some exhibitors and die-hard growers who insist on growing very tender varieties use Styrofoam® rose cones.

Styrofoam® Rose Cones

Styrofoam® cones are 22-inches high and the bushes must be cut and tied to fit underneath. They can be found at plant nurseries and box stores but shouldn't be put on until it is very cold.

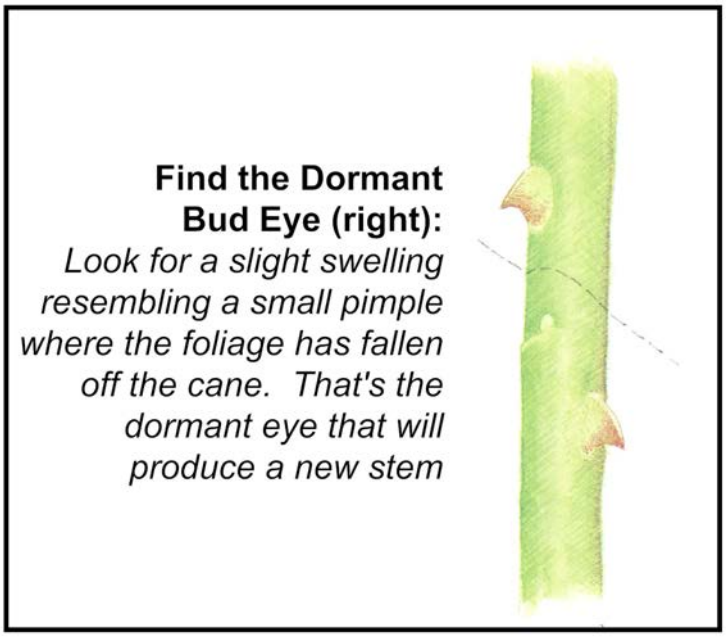
All the foliage must be removed from the plants before covering to prevent fungus growth. If it is very windy, they could go flying around. However, in a garden that refuses to stay dormant, the cones keep the ground frozen and the plants dormant during a winter thaw. Be sure to put holes for ventilation as moisture can build up on sunny days and needs to escape. An apple corer does a fine job of making the right size hole near the top of the cone. If cones are impossible to find, fashion your own version out of common materials such as fiberglass.

In lieu of cones, construct foam boxes to protect your plants, large boxes for several bushes, smaller or individual boxes for a few very tender bushes.

To make the large box, use foam sheets 2 by 8 feet by 2 inches thick. The box is constructed on site with 2 x 2 x 36-inch stakes facing each other two inches apart. Place one set a foot from the end. Next, two sets 3 feet apart down the line and the last - a foot from the end.

Slide the foam between the stakes to form the side of the box. Place one or two sets of stakes for each end, butting as close as possible. A sheet is used for the top and bricks are placed on the corners to hold it in place. If the box must be wider than 2 feet, glue pieces together to form the top. It helps to tie a rope around the box to keep it firmly in place. The sides should be put up before the ground freezes to be able to set stakes. Note: If the sides are put up too early, it will keep the ground warm and prevent it from freezing, delaying dormancy. The stakes should be set before the ground freezes, but not the sides. Remove all foliage from the plants and clean the surface of the ground of any debris. The box provides more flexibility as the plants do not have to be tied and the sides are put in place before a hard frost, leaving the top off until the ground is frozen. This allows for a quick cover-up in the event of a sudden frost and most of the work can be done more comfortably for the rosarian.

The materials are easy to store and last for years. In the spring, the top can be opened or re-moved and replaced as weather dictates. This protects from late spring frosts. Don't forget to throw some moth balls in the box to keep the rodents out.

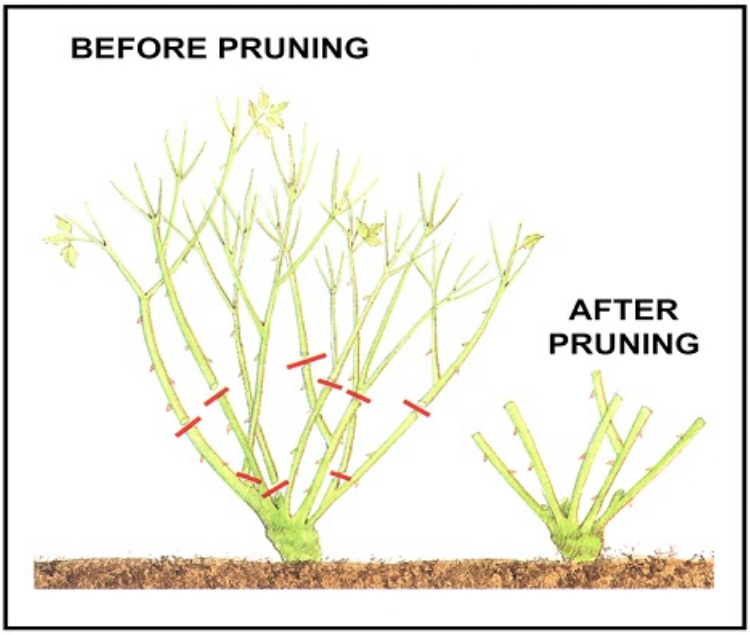


Pruning

Pruning is not a universal subject due to the diverse climates in the United States. The following covers the dormant pruning practices used in different parts of the country.

Florida (especially Southern Florida) and Hawaii are least concerned with winter pruning as they basically do not have winters. Pruning is usually done throughout the year by deadheading the roses (cut just above a five-leaflet leaf, where the bud eye is located, at a 45 degree angle away from bud eye).

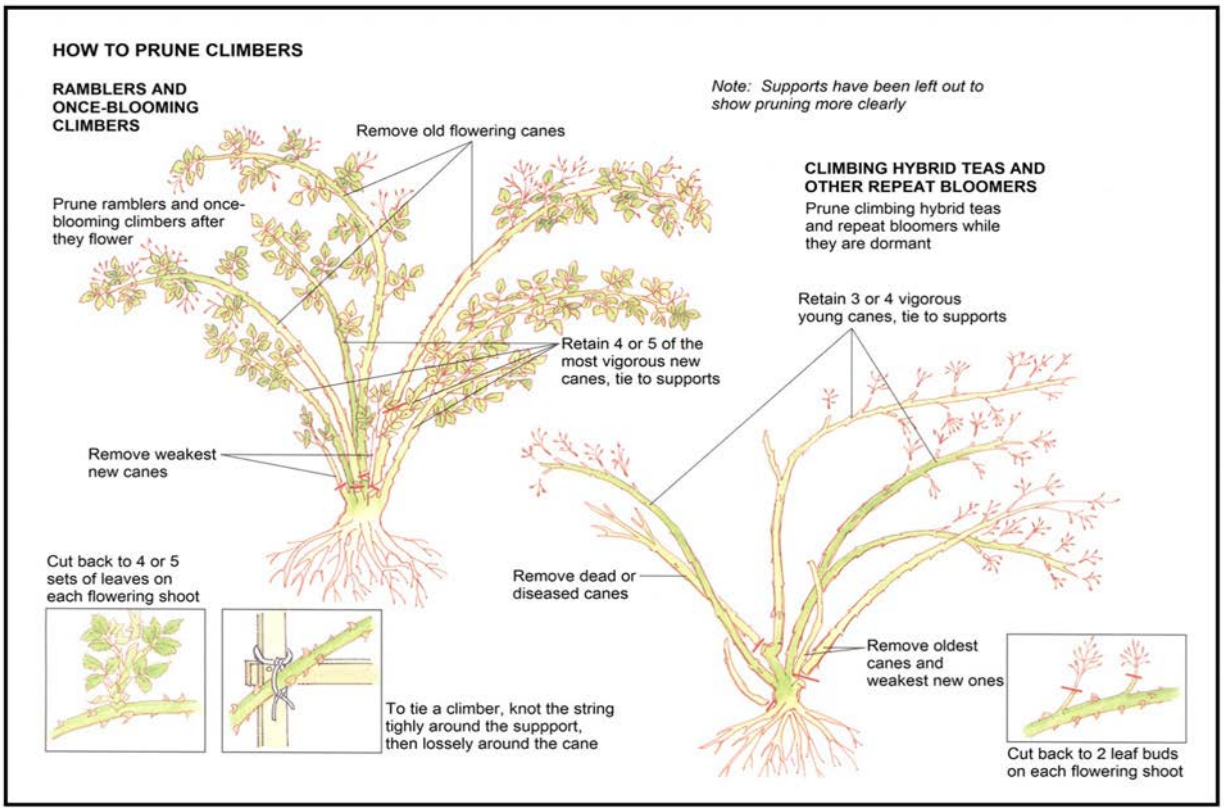
Most rosarians in the southern and western United States prune during the winter months. This allows the bushes to go dormant so they will provide a good crop of blooms in the spring. Winter pruning can be done any time between December and April. Winter protection may be necessary in the colder regions. The pruning date is delayed the further you move up north or to higher elevations.



Credit: ***All About Roses***, Dr. Tommy Cairns, Ortho Meredith, 1999

The colder regions of Northern, Central, Midwest, and Eastern United States (and Canada), have a two-step pruning process since they need to winterize. Starting generally around October or November when the plants have had hard frosts and are becoming dormant, winterizing can begin. Many hardy varieties may have their canes tied to prevent whipping, and dirt may be placed around the bud union. Do not use dirt from the area around the rose, but bring in dirt from an outside source. If you use rose cones or other protectors for tender varieties, prune the tops so the bush will fit under the cone. Generally, roses are pruned down to a few feet tall to allow rose cones or other winterizing techniques to be used to protect the rose crown. During the cold, wind, thaws and freezes, most of the uncovered rose canes will die back. ***"When the forsythia blooms"*** in your area is considered to be the right time to prune, usually from March to June. Roses are uncovered and the pruning of dead wood begins so the roses can start with all new growth for the spring.

In all areas of the United States, the basic winter pruning techniques involve the removal of all dead, diseased, and crossed canes, removing all old wood to allow new canes to form, and to remove small, growth less than the size of a pencil. A good rule of thumb for general pruning is to cut canes down to waist to knee-high for most modern roses, and cut back repeat blooming old garden roses and shrubs



Credit: ***All About Roses***, Dr. Tommy Cairns, Ortho Meredith, 1999

one-third. All once bloomers should be pruned right after blooming in the spring. Many of the once-blooming ramblers, such as 'Newport Fairy', require one-year-old wood in order to bloom the next spring or summer. If you prune these roses late in the year, they may not bloom the next year. Keep four to seven good canes (less if you want to exhibit), and prune with the plant's growth habit in mind. If the plant grows upright, prune to an outward facing bud eye. If the plant is low growing or spreading, then prune to an inside facing bud eye. This is also the rule of thumb for deadheading during the growing season. New growth will generate from the bud eye in the direction that it is pointing. When you remove a cane, make sure you take it off completely at the crown. Use a small saw if necessary.

Cleaning the bark off the crown will help generate new basal (cane) growth. This can be accomplished by using a wire brush. Remember there is little you can do wrong when pruning a rose, with the exception of removing the crown or improper winterizing. If you live in an area with cane borers, seal the cane ends with white Elmer's glue. Avoid using black sealing compound as it is not attractive and stains badly and can cause a burn to the cane when heated by the sun.

Hybridization

A common question asked of rosarians is how do they create new roses. In the past, roses were allowed to self-fertilize or to let insects do the work for them. This was not very scientific, but it worked. When roses are pollinated, they form rose hips, which contain the rose seeds. Each seed has the potential to produce a new rose plant. Without getting into genetics, there are millions of possible combinations of genes, so self- or natural-seeding could result in as many combinations as intentional

breeding. The mechanics of intentional breeding came into play about the time Empress Josephine lived at Malmaison. She invited all the top hybridizers to Malmaison to use her roses to create new varieties with this "new" method.

Despite the possibilities of self-pollination, the odds are still better that the new rose will pick up some of the characteristics from its parents, so almost all hybridizing today is done intentionally. Hybridizers select plants with desirable qualities (such as disease resistance, good bloom form or color, vigor, etc.) and that transmit some of these qualities to their offspring. Sometimes this works, other times not. The trick to hybridizing is to find good seed and pollen parents that will "donate" their characteristics. Not all roses make good seed or pollen parents, and they may be good for one and not the other. Some varieties will only give you replicas of themselves. Hybridizers keep testing different roses until they find that magic combination that will produce good, viable seeds and produce good and hopefully, unique plants. Fragrance is one trait that is difficult to breed for. Harry Wheatcroft discussed in his book, *In Praise Of Roses*, that he found fragrance in only 10 percent of rose seedlings, independent of if the parents were fragrant or not.

Most hybridizers have a special goal and are looking for a specific type of rose or characteristics. Joe Winchell bred good exhibition roses. Sam McGredy is known for his "handpainted" roses and those with excellent disease resistance. Griffith Buck bred for winter hardiness.

There are some instances where the rose ended up with all of the bad characteristics of the parent as well as some of the good. 'Soleil d'Or' gave the world yellow, bi-color, salmon, and orange colors in roses, but also added blackspot susceptibility and cane dieback from *'Rosa foetida persiana*'. So with the good can come some of the bad.

Hybridizing in a nutshell: the petals are removed from a rose just after it starts to open. The pollen is carefully removed. When the pistil becomes sticky, it is ready for pollination. The desired parent pollen is applied to the pistil. From there, the pollen migrates down the carpel until it reaches the ovule in the ovary and forms a rose seed. The hip swells with the new seeds. The seeds are harvested when the hip turns color, usually orange. The seeds are stored in a cold area like a refrigerator for 4-6 weeks, and then they are planted. Once they are growing, weak or diseased plants are removed early.

There is an association for hybridizers called the Rose Hybridizers Association (RHA). They produce a quarterly bulletin. Contact Larry Peterson, 21 S. Wheaton Rd., Horseheads, NY, 14845 for more information (lpeterso@stny.rr.com). They also have two excellent booklets called *Rose Hybridizing For Beginners* and *The Next Step* along with a CD of all past newsletter dating back to 1969. A forum is maintained at: www.rosebreeders.org.

A Brief Guide to Old Garden Roses

Definition of Old Garden Roses

Old Garden Roses are defined by the American Rose Society as all varieties in all classes which were in existence prior to 1867 (the date of the introduction of the first hybrid tea rose, 'La France'). The introduction date of a variety is not the determining factor. Refer to the ARS classification list in the *Handbook for Selecting Roses*. All roses in classes with (OGR) after the rose class name are Old Garden Roses. Some of the classes of Old Garden Roses are: species, gallicas, damasks, albas, centifolias, mosses, chinas, noisettes, bourbons, portlands, hybrid foetidas, spinosissimas, teas and hybrid perpetuals.

There are basically three broad groups of Old Garden Roses: the old European, the chinas and teas, and hybrids between these two groups. The old European garden roses are once-bloomers (with few exceptions) and winter hardy. The chinas and teas are ever-blooming and not winter hardy. These differences in blooming habit and winter hardiness make their cultural requirements different.

Many old European garden roses generally do need a dormant period, some of them do well in the South. Consulting Rosarians should be encouraged to grow roses from each class to determine what does well in their particular area. Hybrid rugosas are the most carefree and even resent being sprayed and even pruned. If in doubt, seek advice from a Consulting Rosarian who has experience with old garden roses in your area.

Definition of Shrub Roses (Classic & Modern)

Shrubs are easily characterized by their sprawling habit. There are five popular subdivisions within the class: hybrid kordesii, hybrid moyesii, hybrid musk, hybrid rugosa and modern shrubs. They can grow from 5 to 15 feet or more in every direction given the correct climate and growing conditions. Noted for their hardiness, they are usually vigorous and produce large quantities of cluster flowers.

The unique group of roses hybridized by David Austin (often called English Roses) belongs to this class. They resemble old garden roses in shape and form but are recurrent bloomers and often have fragrance.

OGR Pruning

- Old roses have lived for hundreds of years without much attention, which is one of their attractions. However, the removal of old dead canes is recommended. Then prune only lightly to shape the bushes.
- Cutting back canes of shrubs one-third after the June bloom will force laterals to break and produce heavy bloom. Prune also to shape the bush.
- Hybrid perpetuals bloom profusely in the spring and should be pruned right after blooming to the second or third lateral bud for fall bloom.
- Repeat blooming varieties are pruned similar to modern roses.

Disease & Insects

- Insects attack old garden roses and shrubs with equal vigor as they do modern roses. Therefore, use the same spray program, except for the rugosas, which dislike sprays.
- Gallicas and centifolias are susceptible to mildew; use the same chemicals as for modern roses for this problem.
- Centifolias and species are also susceptible to blackspot.
- Spinosissimas and albas are quite disease free.

Most of the information in this chapter was prepared by Pete Haring, Dick Barse and from *American Rose* magazine Beginners' Column articles written by Louise Coleman, Dr. John Dickman, Scott Hansen, Steve Jones and A. J. "Pop" Warner.

ACKNOWLEDGMENTS

Diagrams reprinted with permission from:
Guidelines & Rules for Judging Roses, American Rose Society, 2012
All About Roses, Dr. Tommy Cairns, Ortho Meredith, 1999
Steve Jones, Valencia, California
The Rambler, South Pennsylvania Rose Society
Basic Gardening Illustrated, Sunset Magazine, 1990

Notes

Notes

Chapter 5 – Soil & Water

Soil Basics

The soil is the home for all plants, and they depend upon soil for water, nutrients and to hold them in place. The soil is also critical to the health of the plants. Soil is very complex. It is a combination of inorganic and organic chemistry along with very complex biological systems. Despite its enormous complexity, a few fundamental principles are all that are needed to grow roses successfully.

Soil Structure

- A good soil is made up of four major components:
- Inorganic materials comprise about 45% (by volume)
- Organic materials comprise about 5%
- Air comprises about 25%
- Water comprises about 25%

Soil Texture

Inorganic Material

The inorganic part of soil that determines its texture is made up of sand, silt and clay.

- Sand is a very large particle (1/20 mm to 2 mm in diameter per USDA classification. 25 mm = 1 inch). Large sand particles form large pores in the soil that allows for good drainage and space for roots to grow. The drainage of water allows air (oxygen) to penetrate the soil.
- Silt is a medium-sized particle (1/500 mm to 1/20 mm in diameter) formed as sand being broken down into clay. Silt is the most important source of available water in the soil. Sand allows the water to drain away too easily and clay holds the water too tightly for plants to use.
- Clay is a very small particle (less than 1/500 mm in diameter) that is in a crystalline lattice form. This lattice causes clay particles to have a net negative charge. This charge plays a very important role in the soil's ability to hold nutrients.

There are six to nine major groups of clays depending upon which classification is being used. While all rocks eventually weather down into clays, which clay gets formed and how it changes depends upon many factors including starting material, temperature, amount of leaching water, pH, humus and availability of other minerals. However, for the purposes of this manual, clay will be treated as a single item.

The proportions of sand, silt and clay can be plotted on a graph referred to as a soil triangle. Each area on the soil triangle has a specific name. When the proportions of sand, silt and clay all contribute to the soil's properties, it is called loam. Ideally the soil texture that roses (and most plants) prefer is loam. This is a sand/silt/clay ratio of about 40%/40%20%. Adding sand to your garden soil is possible in areas of the country where sand is readily available and it is not derived from limestone. It is recommended that you incorporate copious amounts of finished compost to loosen your soils especially if you have clay based soil. Always consult with your local Consulting Rosarian or local extension agent for their recommendation as to how to loosen or correct your soil.

The texture of the soil determines many of the properties of the soil. For example, sandy soils require more frequent watering and fertilizing. This is because the water flows through so quickly and the nutrients are quickly leached from the soil. Clay soils tend to have extremely poor drainage, but require less fertilizing and watering. Loam soils have the best properties with both good water retention and drainage, while also retaining nutrients.

Mycorrhizal – Soil Organics

Many rosarians are finding that adding these fungi as a soil amendment in the rose garden has shown some positive effects on their rose plants by improving the overall planting medium especially when dealing with less than perfect soils. The fungi are able to free up phosphorus and zinc or phosphorus and nitrogen bound in organic matter and make it readily available from clay particles to their host plants. For over 400 million years these tiny organisms have been working their special magic while hidden beneath the soil.

We now are becoming more aware that some chemicals applied to the soil can have devastating effects on our ground water supplies and in some cases impact the soil by causing a noticeable degradation of the soil.

Research in the past 40 years has shown that Mycorrhizal fungi inoculants have shown some very promising results by their symbiotic relationship with plants as they are nourished by root exudates and in return deliver increased amounts of soil nutrients and moisture to their host plants. The fungi attach themselves to the outer layer of the host's roots and then they grow their filaments or hyphae into surrounding soil from a few centimeters to a meter or more. The hyphae absorb nutrients and water and brings them to the roots of their host plant.

Despite being microscopic, they encourage and keep in balance the roots of plants, other fungi, bacteria, earthworms and other tiny life forms. A plant treated with mycorrhizal fungi in the surrounding soil can take in 100 times more nutrients that those left untreated while producing better plant roots and healthier plants.

In some areas where heavy clay soils are present, Mycorrhizal amendments may not work well. It is recommended for sandy soil however.

Caution should be used in applying fungicides to any soil that has been amended with Mycorrhizal fungi as this will most likely kill them.

Organic Material

The organic part of soil is made up of living and dead portions. The organic parts of the soil play an important role in complex processes in the soil referred to as the carbon cycle, nitrogen cycle and sulfur cycle. These cycles describe how carbon, nitrogen and sulfur transition among compounds in the atmosphere, soil and plants.

The dead organic portion of the soil includes the decomposing organic matter and the resulting humus. Humic acid plays several important roles in the soil:

- Humic acid aids in breaking down inorganic materials into nutrients available to the plant. Laboratory tests have shown this decomposition is about 20 times faster in the presence of humic acids. This is the natural replenishment cycle for minerals (nutrients) in the soil.
- Humic acid and clay particles create the Cation Exchange Capacity (CEC) of the soil. The CEC of the soil is a measure of how well it can hold positive ions (cations). This is critical because many of the nutrients that the plant requires are positive ions; thus the CEC of a soil is a measure of how well the soil holds nutrients.
- Humic acid plays an important role in several of the soil aggregate formation processes. The formation of these aggregates (called peds) is critical to the formation of good soil structure.
- Humus and organic material, in general, increase the soil's ability to hold water. The available water is higher in soils with high levels of organic material.

The living portion of the soil includes a wide variation of life ranging from microscopic size to animals. The major groups are:

- Bacteria – about 100 million per teaspoon of soil.
- Actinomycetes (look like fungi, but are bacteria) - about 12 million per teaspoon of soil.
- Fungi - about 450,000 per teaspoon of soil.
- Algae - about 250,000 per teaspoon of soil.
- Nematodes - about 200 per teaspoon of soil.
- Arthropods (mites, millipedes, centipedes, pillbugs and insects).
- Earthworms - about 200-1000 pounds per acre.
- Mammals - mostly rodents such as gophers.

Although some living parts of the soil are destructive (such as gophers and some nematodes), most contribute to a healthy soil. Some of the positive effects of the living components of the soil:

- They till the soil creating air spaces, bringing organic material into lower soil levels and mixing the soil components to create a true loam soil.
- They break down organic matter into nutrients the plants can use (mineralization).
- They help create soil aggregates (peds) which improve the overall soil structure.

Air

Most of the air that plants need for growth they get via the leaves, not from the soil. However, roses cannot grow in a water-saturated soil because oxygen is extremely important to support both the living organisms in the soil and the plant roots. Soil organisms break down foods into nutrients the plants can use; thus oxygen in the soil is extremely important in keeping the soil healthy for plants.

Water

Plants obviously need water, which they get through their roots. Plants consist of 50% to 90% water, so sufficient water is critical. The major uses of water by the plant are:

- Water is a major component in photosynthesis, the process in which plants make food.
- Water is used for transpiration to cool the leaves.
- Water is used to transport nutrients and carbohydrates throughout the plant.
- Water makes the cells stiff (turgid). This is why watering plants before a rose show is so important for strong stems.

Water in the soil is affected by how close it is to the soil particles. Water molecules next to a soil particle bind very tightly to the soil particle. Water molecules are like small bar magnets and so additional water molecules attach to the first molecules and so on as the water film around the soil particle increases in thickness. The strength of the bond decreases as the distance from the soil particle increases.

The water molecules closest to the soil particle are held so tightly that plant roots cannot remove the water. This water is totally unavailable to a plant. At some distance from the soil particle (wilting point) the strength of the bond weakens enough that roots can absorb the water. Further from the soil particle is another point (field capacity) at which gravity will overcome the bond and drain the water away.

If soil is completely saturated with water and then allowed to drain (usually 24-48 hours), the resulting amount of water would be the field capacity. When evaporation and plant roots have removed all the water they can get, the soil is at the wilting point. The difference between these two points is called available water.

Smaller particles have larger surface areas per volume. If the particles in a sample of soil were all broken into particles of half the diameter, the total weight of the soil sample would remain the same but the total surface area would double. Thus clay soils have a much higher surface area than sand. Accordingly, clay soils can hold much more water because there is more space close to the particles. However, because the plant cannot absorb water molecules that are very close to a soil particle, more of that water is not available to the plant roots. Silty loam soils have the highest available water. Organic matter also significantly increases the amount of available water in the soil.

Light sandy soils allow water to pass quickly past the rose roots. Heavy clay soils, which hold too much water (reducing pore space), drastically reduce the exchange of gases such as carbon dioxide and oxygen.

Structure

The balance between air and water is important for healthy soil and healthy plants. The best soil structure has the air spaces created by the larger particles of sand and peds (soil structure) in uncompacted soil, the available water holding capacity of silt and organic matter, along with the nutrient holding capability of clay and organic matter. Soils that have all the characteristics of sand, silt and clay are called loam. Thus the ideal soil is a sandy loam with plenty of organic matter - a rich sandy loam.

Water and Roses

Too much water in the soil can be harmful. The saying that roses don't like wet feet is true. Good drainage is important so the water can percolate through the soil with the deep watering roses need. Raised beds or drainage tiles may be the answer to a drainage problem. Many rosarians report better plant growth in raised beds.

Water to Penetrate Roots;
Roses have large root systems and efficient watering must provide a relatively quick and even distribution of water throughout all the roots. A watering wand is a good way to get water to the roots.

Credit: ***All About Roses***, Dr. Tommy Cairns, Ortho Meredith, 1999

While drainage is extremely important, so is water retention. A balanced soil structure is one that allows water to pass through the soil at a rate slow enough to permit nutrients to be taken up by the plant's roots.

Fertilizer burn is generally caused by too great a concentration of fertilizer in the soil solution surrounding the roots. If the soil solution is more concentrated than the solution inside the root cells, water actually leaves the roots in an effort, through osmosis, to equalize the concentrations inside and outside the cells. The best remedy is prevention by thoroughly watering the soil before and after applying fertilizer.

Overhead watering can be beneficial if done properly. It is best to shut off the water early enough in the day to allow the foliage to dry completely. This is a good way to cool the garden during very hot weather. However, it may not provide enough water to penetrate deeply into the soil and additional water may be necessary. Overhead watering should not be used in areas of high humidity and where black spot is a major problem.

There are two simple tests that will approximate the drainage of the soil. The results will vary some depending if your soil is naturally dry or wet. However, this would be considered its natural state.

Test #1 for Water Retention

To measure the water retention capability of the soil, fill a clay pot with garden soil leaving enough room to add one quart of water. Place the pot over a quart jar and pour 1 quart of water into the pot. Mark the amount of water that falls into the jar after 15 min. - 30 min. and one hour. The percentage of water retained in the soil after an hour is measured by subtracting the percentage of water in the jar from 100%. Water retention should be around 50 percent. If the soil retains too much water, add sand (noting the proportion to the soil) and retest. If not enough water is retained, add a water-retaining material and retest until the desired results are attained.

Test #2 for Drainage

To measure the drainage rate of the soil in the rose beds, cut the ends off a metal container of at least one-quart to one-gallon size and push down into moderately moist soil about an inch. Fill the container with water. If it takes more than an hour for the water to disappear, steps should be taken to improve drainage. If the water disappears too quickly, a water retention material, such as peat moss or a planter's mix, should be added to the soil. Use Test #1 to find the right combination for the desired results.

While drainage is extremely important, so is water retention. A balanced soil structure is one that allows water to pass through the soil at a rate slow enough to permit nutrients to be taken up by the plant's roots, but it is also important that the water continues to pass down into the soil bringing with it the oxygen important to plant life.

A soil with poor drainage and/or too much water retention fills the small spaces in the soil with water forcing out the oxygen and compacting the soil. A soil with poor water retention causes nutrients to pass through the soil so rapidly that roots have little or no opportunity to access them and a great deal of fertilizer must be used.

A well-balanced soil is the answer to this and many other soil problems. It is important to understand soil and the nutrients involved in growing as imbalances can result in poor growth of rosebushes. Soils and climates differ widely across the country and may require very specific recommendations; however, the basics are the same everywhere.

Diagnosing Soil Problems

No CR should recommend a soil change without first recommending a soil test. Soil chemistry is very complex, and thus it is very easy to come to an improper diagnosis of the problem. The proposed solution based on an improper diagnosis may well amplify the problem or create other problems rather than fix it.

Soil Chemistry

The previous discussions have only touched on some of the more superficial aspects of soil chemistry. In general this is all that is needed to understand the soil, but the complexity should also not be underestimated. Besides the very complex biological interactions, the soil has very complex organic and inorganic chemistry.

One of the reasons soil testing is so important is the inter-relationship of the inorganic chemistry of the soil. Many symptoms may be caused by completely different causes. Some examples:

- Phosphorus deficiency symptoms are usually related to a soil pH problem rather than an actually deficiency of phosphorus in the soil. Phosphorus becomes unavailable in both high and low pH soils due to chemical reactions with either iron or calcium.
- Iron deficiency symptoms could be caused by low iron levels but more likely by many other problems such as high soluble salts or excesses of manganese, zinc or phosphorus. Excessive use of lime (calcium carbonate) can cause iron deficiency symptoms, as can other problems such as nematodes. True deficiencies of iron are very rare; although adding iron may still help. Too high or low of a pH will also bind iron.
- Calcium and boron must be in balance with each other. Increasing the level of calcium in the soil can control the toxicity effects of excessive boron.
- Many ions can replace each other in the exchange sites either via higher charge or by mass action. Soils high in sodium tend to have poor structure (lack of peds) and thus drainage problems. This can be corrected via mass action by adding large quantities of calcium - typically gypsum (calcium sulfate). The calcium in gypsum replaces the sodium in the exchange sites and thus makes it possible to leach the sodium (as sodium sulfate) from the soil with large applications of water.
- A more complex action can achieve the same effect. If the soil has lime (calcium carbonate), then sulfur can be added to the soil. The sulfur is converted by soil biological action to sulfuric acid (which could also be added directly) which then reacts with the lime to produce calcium sulfate (gypsum). The reaction described above can then be used to remove the excess sodium.

Soil Testing

There are many choices for testing the soil. First, one needs to decide how broad of a test is required and how accurate the results need to be. Some choices are:

- Professional soil testing laboratories or agricultural extension services. This is by far the most accurate and complete way to test the soil. The professional service will be the most expensive. Such tests can measure pH, major and minor nutrients.
- Home test kits can be used to measure just pH or pH and major nutrients. These can be fairly accurate and relatively easy to use. However, results can vary based on technique used and the age of the test reagents. A good calibration is to occasionally take a larger soil sample and send part to a agricultural extension lab and keep part to test using a home test kit. By comparing results, the accuracy of the test kit can be estimated.
- A meter or test strips can be used to measure soil pH. Low cost pH meters (under $50 that do not use calibration solutions) are very inaccurate. Such meters depend upon conductivity effects of the soil to measure the acidity and are easily fooled by many soil conditions such as moisture level. It is very easy to get a highly acidic reading from an alkaline soil and thus aggravate the problem.

- There is a very simple, fairly accurate and inexpensive method for testing soil pH. Take a soil sample and add at least the same amount of relatively neutral (pH 7.0) distilled water. Mix well and allow to settle. Carefully remove the liquid and test it with a swimming pool pH test kit.

Changing Soil Structure

Changing soil structure is one of the slowest and most misunderstood processes. Just throwing together the proper mixture of materials is not the same as a rich sandy loam.

If the existing soil were 50% clay and 50% silt, it would be called silty clay. Adding three parts sand with two parts of this soil would produce a mixture that would be 20% clay, 20% silt and 60% sand. Technically this would be called sandy loam, but would it be ideal for growing roses? There are several issues to overcome:

- A loam soil developed over many years differs from a mixture of the same raw materials. The ideal properties of loam come from the way in which the sand, silt and clay particles interact. Even mixing the materials together with a rototiller will not produce the complete distribution of an aged loam soil. (Rototilling wet soil will actually destroy soil structure by compaction).
- The mixed soil will not have the aggregates of an aged loam soil. Much of this aggregation comes from the interaction of the life in the soil; such as earthworms digesting the soil.
- Placing the new mixture back in the ground surrounded by the old soil will create soil stratification problems. Water (and root growth) does not move easily across soil boundaries. The improvements to the existing soil should be gradually transitioned from old to new. For example, putting potting soil in a hole dug in heavy clay soil will create conditions similar to using a sealed clay pot. The top of the pot will tend to dry out (thus killing the roots) and the bottom of the pot will be standing in water (thus killing the roots).
- The hole should be dug larger, thus slowing transitioned from old to new. Start with a mixture of 25% potting soil and 75% native on the outside portion of the hole, then a 50/50 mixture, then a mixture of 75% potting soil and 25% native soil. The same would be true if sand was being added.

Changing Soil Acidity

Soil pH is defined as the acidity or alkalinity of the soil. pH is the inverse log of one over the hydrogen ion concentration. Numbers 0-6.9 are acid, 7 is neutral, and 7.1-14 are alkaline (basic). Soil pH is often determined by the amount of leaching rainfall and by the original material from which the soil was created. For example, in places where rainfall is much higher than the evaporation rate, such as in the eastern part of the United States, the excess water leaches alkaline materials from the soil and thus the resulting soil is acidic. Where rainfall is closer to the evaporation rate, such as in a desert area, then the alkaline materials do not get leached from the soil and the resulting soil is more alkaline.

Nutrient availability is highly affected by soil pH. pH is a measurement of the relative acid or alkaline content of fluids or soil in a range of 1-14. With pH lower than 6.0 or higher than 7.0 primary nutrients in soil become unavailable to roses and in addition systemic chemicals may not be properly absorbed by the roses.

P is mathematical shorthand for the inverse log (or negative log) "H" is the chemical symbol for hydrogen. pH of 7.0 is considered neutral because the concentration of hydrogen ions(acidic) exactly equals concentration of hydroxide ions(alkaline). 1.0 pH is very strong acid (think concentrated sulfuric acid) and pH of 14.0 is highly alkaline (think caustic lye).

LIMESTONE REQUIRED TO RAISE pH

Soil Type Texture Class	Limestone Required from pH 5.5 to pH 6.5 (ozs. Per rose bush)
Warm Temperature & Tropical Climates	
Sandy and Loamy Sand	2.6
Sandy Loam	4.6
Loam	6.6
Silt loam	9.2
Clay loam	13.2
Muck	25. 1
Cool-Temperature & Temperate Climates	
Sandy and Loamy Sand	3.9
Sandy loam	8.5
Loam	11.2
Silt loam	13.2
Clay loam	15.2
Muck	28.4

Credit: ***American Rose*** magazine

The "p" mathematic shorthand comes into play with comparison of units of pH. Water or soil with a pH of 6.0 has 10 times the concentration of hydrogen ions as water or soil with a pH of 7.0. Water or soil with a pH of 5.0 has 100 times the acidity of water or soil with a pH of 7.0. A reduction of two pH units doesn't make water or soil twice as acidic. It makes is 100 times more acidic. This is why pH testing is so important.

Changing the soil pH is a slow and usually continuous process. In alkaline conditions, the pH can be lowered by adding sulfur to the soil. In acidic conditions, the pH can be raised by adding limestone. Which type of limestone to add depends upon the level of magnesium in the soil. If the soil is low in magnesium, dolomitic limestone should be used. If magnesium levels are sufficient, then calcitic limestone should be used.

Most organic amendments will slightly lower the pH, but will also increase the tolerance of the soil for the lower pH. Thus pH correction may not be required when using organic fertilizers or mulches. Most chemical fertilizers will lower the pH, some significantly. Highly acidifying fertilizers such as ammonium sulfate should be avoided for very acidic soils. Calcium nitrate would be a better choice on acidic soils since it raises pH. The recommendation for alkaline soils is obviously exactly opposite.

ORGANIC MATERIALS FOR IMPROVING SOIL STRUCTURE

Organic Material	Material per 100 square feet	Nitrogen to be added per 100 pounds of material
Corncobs	50 lb. (2 bushels)	1 to 1 ½ lb.
Sawdust	50 lb. (2 bushels)	1 1/4 to 1 ½ lb
Woodchips	50 lb. (2 bushels)	1 1/4 to 1 ½ lb
Leaves	75 lb (3 to 4 bushels)	½ to 1 lb.
Straw	60 lb. (1 bale)	½ to 1 lb.
Hay	60 lb. (1 bale)	None (legume hay) 1/4 to ½ lb (grass hay)
Peat moss	6 to10 cu. ft.	None
Compost	10 to 20 cu. ft.	None
Lawn clippings	4 bushels	None

Credit: **American Rose** magazine

TYPICAL ANALYSES FOR ORGANIC SOIL AMENDMENTS

Organic Amendments	Moisture Retention (% total vol.)	pH	Organic Matter %	Ash %
Sphagum peat moss	60 - 70	3.2- 4.5	95 - 99	1 - 5
Hypnum peat moss	55 -6 5	4.4 - 6.7	70 - 85	15 - 30
Reed and sedge peat	50 - 60	4.5 - 7.0	85 - 95	5 - 15
Woody peat	30 - 40	3.6 - 5.5	75 - 90	10 - 25
Sawdust	30 - 40	3.8 - 8.0	95 - 99	1 - 5
Ground bark	30 - 40	4.0 - 8.0	90 - 95	5 - 10
Compost	20 - 30	4.0 - 8.0	80 - 85	15 - 20
Leaf mold	20 - 30	4.0 - 7.0	50 - 75	25- 50

Credit: ***Western Fertilizer Handbook***, California Fertilizer Association, 1990

Acknowledgements

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American Rose magazine, American Rose Society
Western Fertilizer Handbook, California Fertilizer Association, 9th edition, 1990
All About Roses, Dr. Tommy Cairns, Ortho Meredith, 1999

Notes

Chapter 6 – Fertilizers

This chapter discusses fertilizers, their methods of availability to plants, and problems associated with fertilizer deficiencies and excesses.

Plant Metabolism

The simplest description of a plant is that it is a live growing thing that takes carbon dioxide from the air, water from the ground and, in the presence of sunlight (energy), makes sugars. These building blocks of plants are technically known as carbohydrates, which mean carbon with water. The plant does not need the oxygen left over from the carbon dioxide and so the plant releases oxygen back to the atmosphere.

Carbon dioxide + Water + Energy → Sugar + Oxygen

This reaction is known as photosynthesis. The parts of the plant not exposed to the energy source of sunlight (the roots or upper parts at night) and the living parts of the soil, obtain energy by using the same reaction in reverse. Sugars can be reacted with oxygen to produce carbon dioxide, water and energy. This reaction (the opposite of photosynthesis) is called respiration. This is why air space is so important in the soil. Without oxygen, the living parts of the soil cannot break down organic matter into nutrients for the plant and the plant roots do not have the energy needed to pick up the nutrients and transport them throughout the plant.

Elemental Composition of a Typical Plant

Element	% Amount in Whole Plant
Oxygen	45
Carbon	44
Hydrogen	6
Nitrogen	2
Phosphorus	0.5
Potassium	1.0
Calcium	0.6
Sulfur	0.4
Magnesium	0.3
Boron	0.005
Chlorine	0.015
Copper	0.001
Iron	0.020
Manganese	0.050
Molybdenum	0.0001
Zinc	0.010
TOTAL:	99.9011

Plant Elements

Plants, like most living things, are predominantly water. Most of the solid parts of plants (typically 95%) are sugars, starches or derivatives. Thus, as much as 99% of a plant is made of carbon, hydrogen and oxygen. These nutrients are obtained from the air and water.

All of the remaining nutrients are obtained from the soil. The next six most commonly used nutrients are referred to as macronutrients. They are used by the plant in the following decreasing order:

- Nitrogen (N)
- Potassium (K)
- Calcium (Ca)
- Magnesium (Mg)
- Phosphorus (P)
- Sulfur (S)

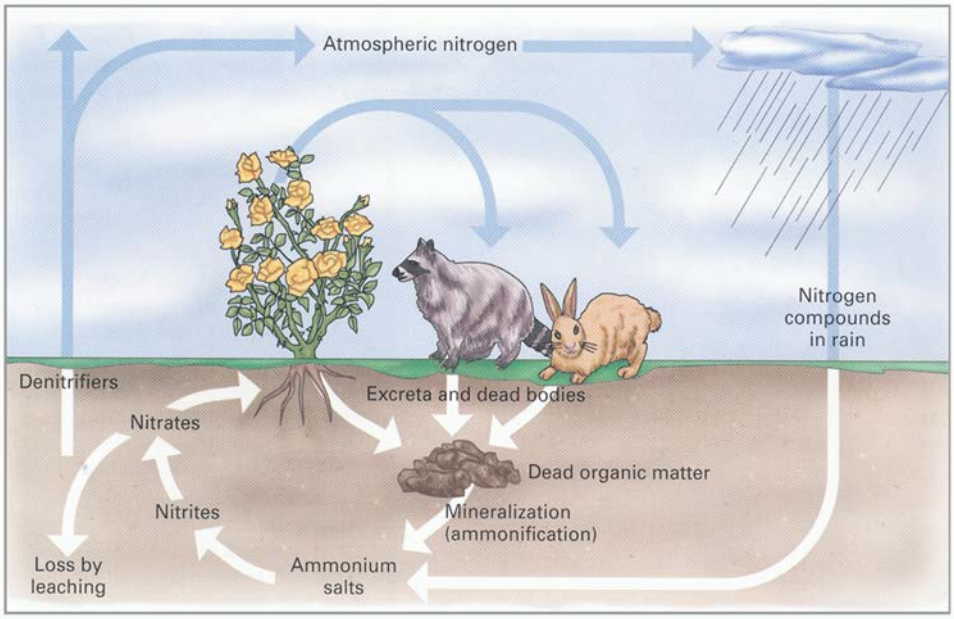
The elements needed by plants in lesser amounts, and rarely absent in most soils, are called micronutrients.

The Main Macronutrient Elements

Nitrogen

Nitrogen is the most abundant element in the earth's atmosphere comprising 78% of the total volume. Its normal state is a colorless, odorless gas, composed of two nitrogen atoms bound together. Although plants only contain about 2% nitrogen by weight, it is critical for a plant's growth and survival. Nitrogen in its gaseous state is inert, so it must undergo transformation to be available to the plant, largely through the soil. Combustion by-products also add nitrogen containing compounds to the air which can be entrapped in rain, which forms acid rain, a common problem in some parts of the United States.

Nitrogen is the element that stimulates growth. Tall, strong canes, good blooms and rich dark green foliage are evident when nitrogen is in balance in the soil. A lightening of the green color and even yellowing of leaves in extreme cases indicate a lack of nitrogen. Excesses of nitrogen can be even more harmful, resulting in weak, soft canes, small blooms and decreased plant resistance to disease. Nitrogen is converted to amino acids, which make up the genetic materials DNA and RNA, and enzymes, which control the plant's functions, such as photosynthesis, metabolism and respiration.



Credit: ***All About Roses***, Dr. Tommy Cairns, Ortho Meredith, 1999

Nitrogen generally exists in four forms for the gardener:

- ***Nitrate Nitrogen*** ($N0_3^-$) is available to the rose without going through any change in the soil. This is the most available form of nitrogen.
- ***Ammonia Nitrogen*** (NH_3 and NH_4^+) is slightly available to the plant, as most is changed in the soil *to nitrate nitrogen for plant uptake.*
- ***Urea Nitrogen*** ($H_2N\text{-}CO\text{-}NH_2$) is the slowest available nitrogen form, as it must undergo biologically induced chemical transformation to be available to the plant.
- ***Nitrite nitrogen*** ($N0_2^-$) is rarely used in fertilizers as it is very expensive.

Nitrogen is generally transformed from one form to another through biological activity. For example, when nitrogen is added to the soil, it is transformed by fungi and bacteria to ammonia, then to nitrite, then to the plant absorbing form, nitrate. These transformations are influenced by soil temperature, moisture and acidity. Soil temperature also has an important effect on the transformation of nitrogen to ammonia or nitrate (readily avail-able).Roughly speaking, the rate of transformation doubles for each 20-degree increase in the soil temperature. With a soil temperature of 40 or 50 degrees Fahrenheit, transformation is very slow, but as the temperature increases, so does the availability of nitrogen.

Adequate drainage, which permits the soil to warm up more quickly, is highly desirable in increasing the availability of nitrogen for the plant. Some nitrogen compounds from liquid fertilizers are very soluble in water, so they pass through the soil quickly if drainage is too fast.

Transformation of nitrogen to ammonia, nitrite, or nitrate form is decreased greatly as soil pH drops below 5.5, or the pH is very high. Restricted aeration in the soil may cause a process known as denitrification, changing nitrate to free nitrogen, which will be lost from the soil, thereby decreasing the nitrogen content. This explains the importance and benefit of a loose friable soil structure. Nitrogen is kept from leaching by the electrochemical reaction with other soil minerals.

Phosphorus

Phosphorus is a naturally occurring element in the soil, and makes up only 0.5% of the plant's weight. It is the one element that is greatly affected by environmental factors, which could limit uptake by the plant. It is taken up by the plant largely as the dihydrogenphosphate ion $H_2P0_4^-$.

Phosphorus stimulates root growth to produce quality plants and big blooms. It may also hasten plant maturity, adding to winter hardiness. It is a critical element in the production of ATP, which regulates energy transfer in the plant. Phosphorus is available in three categories: readily available, moderately available, and slightly available. The most important factor controlling the availability of phosphorus is soil acidity. The most favorable pH is 6.5 with a range of 6.3 to 6.8. At a pH of 6.5, the amount of iron and aluminum in solution decreases and the phosphorus remains in a form available for the plant. At a pH higher than 6.5, the availability of phosphorous is only slightly decreased. Phosphorus moves very slowly through the soil, so many rosarians will add phosphorus (usually superphosphate) to the soil as they plant a rose so it will be in close contact to the feeder roots.

The northwest, west and northern areas of the United States generally have high levels of phosphorus in the soil. The southern United States typically has low concentrations, and with heavy clay soils, it may not be available to the plants.

Potassium (Potash)

Potassium is a naturally occurring element in the soil and makes up about 2.4% of the earth's crust. Most of it is in an unusable form for plants and requires transformation. Potassium makes up about 1% of the plant's total weight, and is absorbed by the plant as the elemental ion, K^+.

Potassium promotes root growth, vigor and bloom color, and, like phosphorus, it counteracts the harmful effect of excessive nitrogen like undue ripening and exerts a balancing effect on both nitrogen and phosphorus. It is essential for starch formation and the development of chlorophyll by encouraging photosynthesis. Potassium readily leaches out of the soil and the level should not be allowed to drop too low. Low potassium and high magnesium may lead to magnesium toxicity.

Excessive amount of potassium interfere with the intake of magnesium and calcium, causing serious problems for the plant. A deficiency causes leaf margins to brown, weak stems and many blind shoots. Many things affect potassium in the soil, and the type of clay mineral in the soil has a marked influence on potassium availability. These minerals may be added in the form of fertilizer or may already be present in the soil. Certain types of clay expand, and upon drying, they contract. This entraps potassium and makes it less available to the plants. Soil acidity has little influence on potassium. However, most of the potassium available to plants can be replaced by hydrogen (the H in pH) in acid soils. An acid condition could indicate the possibility of a potassium deficiency, which causes the acidity, rather than the other way around.

Sulfur

Sulfur is used by the plant in the development of essential organic compounds of proteins, vitamins, etc. Sulfur has been removed from the air, many fertilizers, and spray formulas, to the point that it is becoming the most deficient element in our soils. Sulfur is present in organic material and is converted by bacteria to sulfates, which are very soluble and can be leached quickly from the soil. A soil test is recommended to determine the sulfur content of the rose bed.

Calcium and Magnesium

Like potassium, these two elements are present mainly in the plant's leaves. One of the important functions of these minerals is to neutralize certain toxic acids, which form as a by-product of metabolism. Deficiencies of magnesium are common in sandy soils of the southern United States and are aggravated by too much calcium in the soil. In acid soils below 6.0, most of the available calcium and magnesium is found attached to electrically charged clay and organic matter, a form readily available to plants. Magnesium is the center molecule for chlorophyll, the green in all plants; therefore a deficiency will show the lack of a green color.

Minor Micronutrient Elements

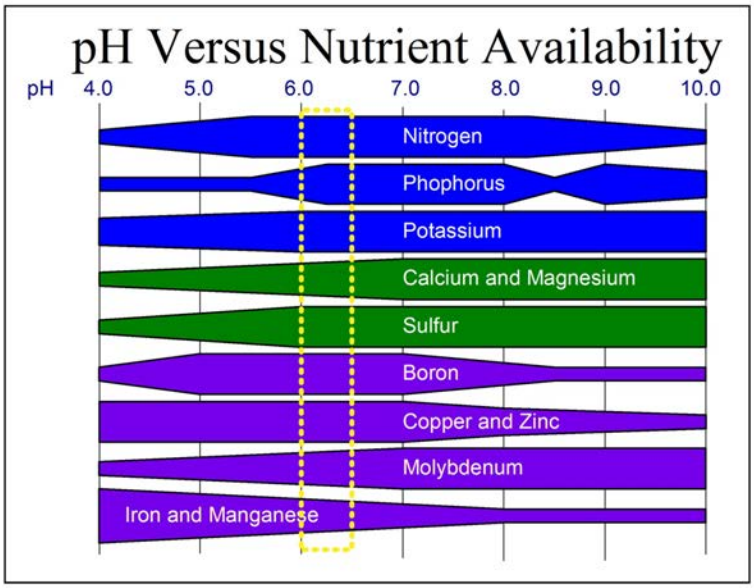
Iron, manganese, boron, zinc, copper, molybdenum and chlorine are usually sufficient in a well-prepared fertile soil. In a soil with a high pH, boron deficiency may occur because of unfavorable calcium content. Acid soils may be low in molybdenum. Iron will be unavailable in an alkaline soil until the pH is raised or lowered to just below 7.0. Only small amounts of trace elements are needed in a rose's diet, but a lack of one or more may cause a serious decrease in the availability of major elements.

Element (Nutrient) Summary

- NITROGEN - Stimulates growth of tall, strong canes, good blooms and rich dark foliage.
- PHOSPHORUS - Stimulates root growth, producing quality plants and big blooms. Also hastens plant maturity adding to winter hardiness.
- POTASSIUM (Potash) - Promotes root growth and bloom color.
- CALCIUM - Holds cell walls together and promotes stability and early growth; sturdier plant
- MAGNESIUM - Promotes chlorophyll formation and interacts to produce greener foliage and healthy, disease-resistant plants.
- SULFUR - Raw material for amino acids and proteins needed for plant health. Also lowers pH.
- ZINC - Stimulates stem growth and flower bud formation.
- IRON - Aids chlorophyll formation and sugar burning enzymes, which activates nitrogen fixation.
- MANGANESE - Aids chlorophyll formation and activates other enzymes, helps in photosynthesis, respiration and nitrogen metabolism.
- COPPER - Enzyme activator for vitamin A-forming enzymes; stimulates stem development and pigment.
- BORON - Helps move sugars from cell to cell, controls starch formation, stimulates cell division, flower formation and pollination.
- MOLYBDENUM - Needed for nitrogen fixation and nitrogen use in the plant. Specifically it is needed to make amino acids to stimulate plant growth and vigor.
- CARBON, HYDROGEN, and OXYGEN - Necessary for any plant life; roses obtain them from the atmosphere. A loose, friable soil allows these essential elements to flow through the soil.

Availability of Nutrients

Nutrient availability is highly affected by soil acidity. The acidity of the soil is measured by the pH on a logarithmic scale running from 0 to 14. A pH of 0 is very highly acidic (think battery acid) and a pH of 14 (think lye) is very highly alkaline (basic). A pH of 7.0 is considered neutral. (Logarithmic scale: For every change of 1 pH unit up or down the concentration of H+- decreases or increases by ten times.)



Credit: Steve Steps

A soil may have sufficient levels of nutrients, but if the soil pH is very far from the ideal pH for roses (6.0 - 6.5), the nutrients may not be available to the plant. This is because in certain pH ranges, nutrients will react with each other and form insoluble compounds. This is frequently referred to as the nutrients being "locked up." In some cases, this can be overcome by increasing the amount of the nutrient added to the soil. However, adjusting the soil pH is typically more effective.

The width of bars in the above graph indicates the availability of the nutrient to plants. Note that phosphorus is available between a pH of 6.0-7.0. Below 6.0, phosphorus reacts with iron to form an insoluble iron phosphate. Above a pH of 7.0, phosphorus reacts with calcium to form insoluble calcium phosphates.

Iron and manganese both decline in availability about 100 times for each 1.0 increase in pH. They become seriously deficient in alkaline (high pH) soils. Aluminum is not needed by plants, but can cause serious toxicity problems if the pH gets below 5.5. When the pH gets below 5.5, aluminum leaves the crystal structure of silicate clays and interferes with root growth. Soils that are high in organic matter are less affected by lower pH.

Storage and Movement of Nutrients

Many nutrients exist in the soil as positive ions known as cations. Clay lattice and humus in the soil are negatively charged, and, because opposites attract, the nutrients stick to the soil. How well the soil can hold these nutrients is referred to as the cation exchange capability (CEC) of the soil. The type of clay lattice and the amount of humus in the soil affects the CEC of the soil. The higher the CEC, the better the soil can retain nutrients.

Nutrients exist in the soil in several possible forms:

- As organic matter. Typically 97-99% of the nitrogen, 25-90% of the phosphorus and 70-90% of the sulfur in the soil are in organic matter.
- Adsorbed onto clay or humus as cations (CEC).
- Free in the soil as a negative ion. Because the clay or humus does not adsorb them, these ions are subject to leaching from the soil.
- In a complex organic molecule called chelate. This is the form for most trace nutrients.

Fixed in insoluble compounds. Changes in the soil pH may be required to make these nutrients available.

The issues surrounding the form of the nutrient are well illustrated by phosphorus and nitrogen. Typically less than 0.5% of the phosphorus in the soil is in an immediately available form. The majority of phosphorus (25-90%) is contained in organic matter and the rest is fixed in soluble compounds. As a result, soils are rarely deficient in total phosphorus, but frequently deficient in available phosphorus. Phosphorus moves extremely slowly through the soil; thus adding phosphorus to the hole during planting is very important.

The most available form of nitrogen for plants is the nitrate ion, which has a negative charge. Because a negative ion is repulsed by the negatively charged soil (like charges repel), nitrates move very easily through the soil. This is good when nitrogen is needed because added nitrate can get to the roots very quickly. However, this lack of sticking to the soil by nitrates allows them to leach readily from the soil. This is why nitrogen is the most frequently required nutrient in the soil. Ammonium nitrogen will be adsorbed by the soil, but must be changed to the nitrate form to be available to the plant. The organic form of nitrogen is very stable in the soil, but requires the action of soil bacteria to change it into the nitrate form required by plants.

Leaching of elements from the soil can be good for the soil. All elements can become toxic to the plant if levels are allowed to build up. This build up might come from nutrients that are being added faster than the plant needs them (such as fertilizers with excessive amounts of some nutrient) or from elements left over from the evaporation of irrigation water. This is especially a problem with roses grown in pots with either no drainage or a saucer underneath. Sodium build up is very common. Occasional heavy watering will leach out these excessive elements.

Note that soils low in organic matter, which reduces the bacteria that convert nutrients into a usable form, and low in CEC (which organic matter contributes towards), will tend to require frequent applications of nutrients. This is because CEC and organic matter contribute to most of the soil's ability to store nutrients. This problem will be aggravated if the soil pH is incorrect thus fixing many of the remaining nutrients. Soils low in organic matter and with incorrect pH will almost always exhibit nutrient deficiency problems.

Fertilizers

Primary nutrients that are added to the soil are referred to as fertilizers. They can be synthetically produced or they can come from natural sources (organic fertilizers).

Plants use nutrients in their ionic forms, so it does not matter from what source the nutrient originated. Almost all fertilizers (both synthetic and organic) tend to make the soil more acidic. However, the overall effect on the soil and its life can be very different.

FERTILIZER CHARACTERISTICS

Soluble Inorganic	Natural Organic	Urea-Form
Immediately Available	Readily Available	Slowly Available
Lasts 3-4 weeks	Lasts 4-6 weeks	Lasts 20-24 weeks
Burns Foliage	Does not burn	Does not burn
Leaches from soil	Leaches from soil	Does not leach
No carry-over	Little carry-over	Significant carry-over to next season
No Odor	Odor might be offensive	No odor
High nutrient content	Low nutrient content	High nutrient content
High efficiency	Low efficiency	High efficiency
Concentrated	Bulky	Concentrated

Credit: American Rose Society

As with the use of any chemical, safety should always be practiced. Read the label for required safety equipment. Quite often, dust masks should be worn to avoid breathing the dusts. Synthetic as well as natural fertilizers may contain harmful materials, such as heavy metals or diseases, so care needs to be taken to avoid contact.

Synthetic or Manufactured Fertilizers

Commercial fertilizers are listed by their percentage of nitrogen, phosphorus and potassium. Most commercial fertilizers contain the three main nutrients needed for good growth, nitrogen (N), phosphorus (P) and potassium (K). These big three elements are listed in the order N:P:K on the label, such as 8-10-8. Nitrogen is expressed as the percent of the single element (N), phosphorus as the percent of phosphoric acid (P_2O_5), and potassium as the percent of potash (K_2O).

In general, all synthetic fertilizers are salts. All salts interfere with the ability of the plant to obtain water. Heavy applications of synthetic fertilizers will cause a burn on the leaves similar to not watering a plant during hot weather. The strength of this effect is referred to as the salt index of the fertilizer.

Roses should always be heavily watered before and after an application of synthetic fertilizers. The existing salt level in the soil can also contribute to the burning effect of adding synthetic fertilizers. Humus in the soil can reduce the burning effect. NEVER APPLY FERTILIZER TO DRY SOIL.

In early spring, when the soil is too cool for soil bacteria to become active, synthetic fertilizers provide food for the plants in an easily available form. It is better to use small amounts often rather than large amounts of fertilizers all at one time. As the soil warms up, the addition of organics is beneficial.

As mentioned earlier, the most available type of nitrogen to plants is the nitrate ion. This ion has a negative charge and thus is not held by the negatively charged clay and humus in the soil. As a result, this form of nitrogen can move quickly through the soil. Fertilizing with a nitrate form of fertilizer can have an almost immediate effect on plants. Nitrates can also continue to move beyond the roots (leach), so this is not a long-term form of fertilization.

The ammonium form of nitrogen has a positive charge, so it is held by the negatively charged soil and thus does not leach as quickly. Soil biological action can very quickly change ammonium nitrogen into nitrate. Either frequent applications of nitrogen fertilizer are required or a slow release form of fertilizer could be used.

Phosphorus is almost the exact opposite of nitrogen. It moves so slowly through the soil that the most effective way of applying phosphorus is at time of planting.

The initials W.I.N. on a fertilizer label stands for water insoluble nitrogen. These are usually organic forms of nitrogen and urea which must be broken down before they can be used by the plant. W.I.N. fertilizers are referred to as slow release nitrogen sources. Water soluble nitrogen (W.S.N.) fertilizers dissolve readily and are composed of a simple form of nitrogen.

Average Composition of Fertilizer Materials

Fertilizer Material	Chemical Formula	Total Nitrogen % N	Phosphoric Acid % P_2O_5	Soluble Potash % K_2O	Combined Calcium % Ca	Sulfur % S	Equivalent Acidity or Basicity (in lbs. $CaCO_3$)[1] Acid	Base
NITROGEN MATERIALS								
Ammonium nitrate	NH_4NO_3	34					62	
Ammonium nitrate-sulfate	$NH_4NO_3.(NH_4)_2SO_4$	30				6.5	68	
Monoammonium phosphate	$NH_4H_2PO_4$	11	48				58	
Ammonium phosphate-sulfate	$NH_4H_2PO_4.(NH_4)_2SO_4$	16	20			15	88	
Ammonium polysulfide	$(NH_4)_2S_3$	20				50		
Ammonium thiosulfate	$(NH_4)_2S_2O_3$	12				26		
Diammonium phosphate	$(NH_4)_2HPO_4$	17	48				70	
Ammonium sulfate	$(NH_4)_2SO_4$		21			24	110	
Anhydrous ammonia	NH_3	82					148	
Aqueous ammonia	NH_4OH	20					36	
Calcium ammonium nitrate solution	$Ca(NO_3)_2.NH_4NO_3$	17			8		9	
Calcium nitrate[2]	$Ca(NO_3)_2$	15			19			20
Calcium cyanamide	$Ca(CN)_2$	21			37			63
Sodium nitrate	$NaNO_3$	16						29
Urea	$CO(NH_2)_2$	45					71	
Urea ammonium nitrate solution	$NH_4NO_3.CO(NH_2)_2$	32					57	
PHOSPHATE MATERIALS								
Single superphosphate	$Ca(H_2PO_4)_2$		20		20	12	neutral	
Triple superphosphate	$Ca(H_2PO_4)_2$		45		14	1	neutral	
Phosphoric acid	H_3PO_4		52				110	
Superphosphoric acid	---[3]		76					160
POTASH MATERIALS								
Potassium chloride	KCl			60			neutral	
Potassium nitrate	KNO_3	14		46				26
Potassium sulfate	K_2SO_4			50		18	neutral	
Sulfate of potash-magnesia	$K_2SO_4.2MgSO_4$			22	0.1	22	neutral	

[1] Equivalent per 100 lbs. of each material

[2] Fertilizer grade Calcium Nitrate contains some ammonium-N

[3] H_2PO_4, $H_4P_2O_7$, $H_5P_3O_{10}$, $H_6P_4O_{13}$ and other higher phosphate forms.

Credit: ***Western Fertilizer Handbook***, California Fertilizer Association

Slow Release Fertilizers

There are three types of slow release fertilizers. The first are materials that dissolve very slowly, such as sulfur. The second type of slow release fertilizer is one that requires action by soil microorganisms to release the fertilizer in usable form. Urea is a common form of nitrogen that is slowly converted to nitrate form by the soil microorganisms. Coating a fertilizer with a long lasting substance creates the third type of slow release fertilizer. Most once- or twice-a-year type fertilizers have fertilizer pellets coated with varying thicknesses of sulfur or resins.

Inorganic Sources of Micronutrients

MATERIAL	ELEMENTS (%)	WATER SOLUBILITY (g/100 g H_2O)	°F
Sources of Boron			
Granular borax - $Na_2B_4O_7 \cdot 10H_2O$	11.3	2.5	
Sodium tetraborate anhydrous – $Na_2B_4O_7$	21.5	1.3	32
Solubor® – $Na_2B_8O_{13} \cdot 4H_2O$	20.5	22	86
Ammonium pentaborate - $NH_4B_5O_8 \cdot 4H_2O$	19.9	7	64
Sources of Copper			
Copper sulfate - $CuSO_4 \cdot 5\ H_2O$	25.0	24	32
Cuprous oxide – Cu_2O	88.8	1[1]	
Cupric oxide – CuO	79.8	1[1]	
Cuprous chloride – Cu_2Cl_2	64.2	1.5	77
Cupric chloride - $CuCl_2$	47.2	71	32
Sources of Iron			
Ferrous sulfate - $FeSO_4 \cdot H_2O$	31.4	80	60
Ferrous sulfate - $FeSO_4 \cdot 7H_2O$	20.1	33	32
Ferric sulfate - $Fe_2(SO_{4)3} \cdot 9H_2O$	19.9	440	68
Iron oxalate - $Fe_2(C_2O_4)_3$	30.0	very soluble	
Ferrous ammonium sulfate – $Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$	14.2	18	32
Ferric chloride - $FeCl_3$	34.4	74	32
Sources of Manganese			
Manganese sulfate - $MnSO_4 \cdot 4H_2O$	24.6	105	32
Manganese carbonate – $MnCO_3$	47.8	0.0065	77
Manganese oxide – MnO_4	72.0	1[1]	
Manganese chloride – $MnCl_2$	43.7	63	32
Manganese oxide – MnO	77.4		
Sources of Molybdenum			
Sodium molybdate - $Na_2MoO_4 \cdot H_2O$	39.7	56	32
Ammonium molybdate – $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$	54.3	44	77
Molybdic oxide – MoO_3	66.0	0.11	64
Sources of Zinc			
Zinc sulfate - $ZnSO_4 \cdot H_20$	36.4	89	212
Zinc oxide – ZnO	80.3	1[1]	
Zinc carbonate – $ZnCO_3$	52.1	0.001	60
Zinc chloride - $ZnCl_2$	48.0	432	77
Zinc oxysulfate – $ZnO \cdot ZnSO_4$	53.8	---	---
Zinc ammonium sulfate – $ZnSO_4 \cdot (NH_4) \cdot SO_4 \cdot 6H_2O$	16.3	9.6	32
Zinc nitrate – $Zn(NSO_4) \cdot 6H_2O$	22.0	324	68

[1] = insoluble

Composition of Manures and Waste Materials[1]

Source	Percent Moisture	N		P_2O_2		K_20	
		%	Lbs/Ton	%	Lbs/Ton	%	Lbs/Ton
Beef feedlot	68	0.71	14.2	0.64	12.8	0.89	17.8
Dairy	79	0.56	11.2	0.23	4.6	0.60	12.0
Liquid dairy	91	0.24	4.8	0.05	0.1	0.23	4.6
Swine	75	0.50	10.0	0.32	6.4	0.46	9.2
Liquid swine	97	0.09	0.2	0.06	0.1	0.08	0.2
Horse	70	0.69	13.8	0.23	4.6	0.72	14.4
Sheep	65	1.40	28.0	.48	9.6	1.20	24.0
Poultry (no litter)	54	1.56	31.2	0.92	18.4	0.42	8.4
Liquid poultry	92	0.16	3.2	0.04	0.8	0.29	5.8

[1]**Adapted from:** L. S. Murphy in *Fertilizer Solutions Magazine*, March- April 1972.
Credit Both: Western Fertilizer Handbook ---CFA

When fertilizers coated with multiple layers of resin come into contact with water, the layers swell and increase the pore size in the resin and the dissolved fertilizer can then move into the soil. The release rate depends on the coating thickness, temperature and water content of the soil. There is often a large release of fertilizer during the first two or three days after application. Release time can range from immediate to six or nine months depending on the coating.

Another major advantage of slow release fertilizers is that they reduce the chances of fertilizer burn. This is because the plant is not subjected to a sudden increase in the salt index. If the rate at which the fertilizer becomes available in iconic form (salt) is similar to the rate at which the plant uses it, then there is no net increase in the salt level in the soil.

Caution should be used in timing the application of slow release fertilizers as they may keep the plant growth going late into the fall. This growth will not harden off completely and excessive winter damage may occur. Also, excessive watering will release the nutrients faster and they will not last as long.

Water Soluble Fertilizers

As indicated by the name, these are fertilizers in a form that will dissolve in solution. Mixed with water, the solution can be sprayed on the foliage (foliar feeding) or used as a soil drench.

Different formulations are available, some with comparable levels of N:P:K (20-20-20) some with one of the major elements in higher concentration such as 15-30-15 or 18-18-30.

The usual recommendation for roses is 20-20-20. Care should be taken to have a soil sample test before using formulations with a single nutrient with a higher level. Some formulations also contain microelements, which add to the benefit.

FERTILIZATION

Comparison of Slow-Release Fertilizers and Conventional Fertilizers

SLOW RELEASE FERTILIZER

Advantages	Disadvantages
1. Fewer applications	1. Unit cost is high
2. Low burn potential	2. Availability limited
3. Release rates vary depending on fertilizer characteristics	3. Release rate governed by factors other than plant needs
4. Comparatively slow release rate	

CONVENTIONAL FERTILIZER

Advantages	Disadvantages
1. Fast acting	1. Greater burn potential
2. Some are acid-forming	2. Solidifies in the bag when wet
3. Low cost	3. Leaches readily

MANURES OR SEWER SLUDGE

Advantages	Disadvantages
1. Low burn potential	1. Salt could be a problem
2. Relatively slow release	2. Bulky, difficult to handle
3. Contains micronutrients	3. Odor
4. Conditions soil	4. Expensive per pound of actual nutrient
	5. Weed seeds a problem
	6. Heavy metals may be present in sewage sludge; (more frequent in sludge from large cities)

NUTRIENTS REQUIRED AND DEFICIENCIES

The chart below shows parts per million needed for good growth of each nutrient, excess tolerated, reserve levels, and the deficiency indications. Note the higher needs of roses in relation to lawns.

Substance	Lawn & General Soil	Rose & Garden Soil	Plant Tolerance Levels	Reserve Levels	Deficiency Signs
	Figures represent amounts as parts per million (ppm)				
Nitrate	10	40	125		Yellow green leaves with drying & slow growth
Phosphorus	2	5	50	15	Purple leaves, slow growth, poor roots
Potassium	10	20	50	50	Spotting & Streaking w/ curling leaves & dead parts falling out
Calcium	100	150	200		Young leaves not maturing or unfolding
Magnesium	10	10	50		General loss of green color but veins stay green
Sulfate	20	20	450		Young leaves light w/veins lighter
Iron		5	50	25	Chlorotic plants
Manganese		2	25	2	Stunted growth
Aluminum			1		Test for toxic levels
Nitrite			2		
Ammonium	5	7	50		
Chloride			100		Test for toxic levels

Credit: ***Roses Inc.***

A water-soluble fertilizer can be used as an addition to a complete fertilizing program. It makes a good tonic for a quick pick-me-up for the plants and as a supplemental feeding during a rainy spell. Water-soluble fertilizers may be more suitable for container grown plants than a granular fertilizer.

For easy application a "proportioner" or an inexpensive hose-on siphon can be used to deliver the fertilizer while watering. Many rosarians advocate small amounts with every watering as a way to deliver a constant supply of nutrients. As always, do not over fertilize - follow the directions on the label.

Organic Fertilizers

Organic fertilizers are those which come from once-living organisms. They can range from animal wastes (manure) to ground up organisms (fish emulsion) to former plant materials (compost). All organic fertilizers have several characteristics in common:

- They tend to be very low in nutrient content. Even a very strong organic fertilizer, chicken manure, only has about 4.5% nitrogen. Composts are even lower yet; typically in the 1-2% range of nitrogen.
- The nutrients tend to be in slow release form, requiring biological action from the soil to re-lease the nutrients. This feeds the soil life keeping the soil healthy.
- They tend not to release nutrients unless the soil is warm because the required biological action requires the warmth.
- All organic fertilizers tend to have high levels of carbon. If the ratio of carbon to nitrogen is above 25:1, the increased biological action in the soil will require more nitrogen than what is available in the organic fertilizer. This nitrogen starvation will slow the biological action (decomposition) and available nitrogen will be reduced in the soil. Supplemental nitrogen will be required.

AVERAGE NUTRIENT ANALYSIS OF SOME ORGANIC MATERIALS

	N	P_2O_5	K_2O
		%	
Fresh manure with normal quality of Bedding or litter			
Duck	1.1	1.45	0.50
Goose	1.1	0.55	0.50
Turkey	1.3	0.70	0.50
Rabbit	2.0	1.33	1.20
Bulky organic materials			
Alfalfa hay	2.5	0.50	2.10
Bean straw	1.2	0.25	1.25
Grain straw	0.6	0.20	1.10
Cotton gin trash	0.7	0.18	1.19
Seaweed (kelp)	0.2	0.10	0.60
Winery pomace (dried)	1.5	1.50	0.75
Organic concentrates			
Dried blood	12.0	1.5	-
Fish meal	10.4	5.9	-
Digested sewage sludge	2.0	3.0	-
Activated sewage sludge	6.5	3.4	0.3
Tankage	7.0	8.6	1.5
Cottonseed meal	6.5	3.0	1.5
Bat guano	13.0	5.0	2.0
Bone meal [1]	<1.0	12	-

[1] *Bone meal values vary widely because of moisture content and processing. Available P_2O_5 12-14%; insoluble P_2O_5 14-16%; total P_2O_5 26-28%*

Credit: ***Western Fertilizer Handbook***, California Fertilizer Association

- Organic fertilizers (or mulches) slowly add to the level of humus in the soil. As mentioned earlier, humus adds to the soil's ability to store nutrients (CEC), the soil's ability to break down rocks into nutrients, helps build proper soil structure and increases the soil's available water capacity.

A major difference between synthetic fertilizers and organic fertilizers is the long-term effect on the condition of the soil. Constant use of synthetic fertilizers without adding organic material to the soil either as fertilizer or as mulch will deteriorate the soil structure and overall health of the soil. Thus even if synthetic fertilizers are being used as the primary source of added nutrition, organic material also needs to be added by means such as a top dressing of mulch.

Commonly Used Organic Materials

- ***Cottonseed Meal*** as a fertilizer is somewhat acidic in reaction. Formulas vary slightly, but generally contain 7% nitrogen, 3% phosphorus and 2% potassium. In warm soil, the nutrients are more readily available to plants, but there is little danger of burning. Cottonseed meal is excellent to use in a low pH soil as its acidic action will tend to the pH while providing nutrients to the plants.
- ***Blood Meal*** is dried, powdered blood collected from cattle slaughterhouses. It is a rich source of nitrogen, so rich that it may do harm if used in excess. The rosarian must be careful not to exceed the recommended amount suggested on the label. In addition to nitrogen, blood meal supplies some essential trace elements, including iron.
- ***Alfalfa Meal*** is not only a good organic soil additive, but also contains hormones that stimulate growth. The meal can be incorporated in the soil or used as a tea. Too much alfalfa can have a detrimental effect on growth.
- ***Fish Emulsion*** is a well-rounded fertilizer. It is a partially decomposed blend of finely pulverized fish. Fish emulsion is a good source of nitrogen and several trace elements. In the late spring, when the rose

plants have sprouted, an application of fish emulsion followed by a deep watering will boost the plant's early growth spurt. Contrary to popular belief, too strong a solution of fish emulsion CAN burn plants, particularly in containers.

- ***Manure*** is a complete fertilizer, but low in the amounts of nutrients it can supply. Manures vary in some nutrient content according to the animal source and what the animal ate. A fertilizer ratio of 1-1-1 is common. Manures are best used as soil conditioners instead of nutrient suppliers. The highest concentration of nutrients is found when manures are fresh. As it ages, leaches or is composted, nutrient content is reduced. Fresh manure should not be used where it will be in contact with tender plant roots as it will burn. Be aware that fresh manure may also harbor bacteria harmful to humans and should be handled with care. Typical rates of manure applications range from 70 pounds to 100 pounds per 1,000 square feet. Steer manure from feeding stations can contain high levels of salt, so care must be taken not to use too much.
- ***Sewer Sludge*** is the recycled product of municipal sewage treatment plants. Two forms are available, activated and composted. Activated sludge has higher concentrations of nutrients (6-3-0) than composted sludge and is usually sold in a dry, granular form. It is a general purpose, long lasting, non-burning fertilizer. There is some question about the long-term effect of using sewage sludge products. Heavy metals are sometimes present and may build up in the body if inhaled by the applicator. Heavy metals can also be toxic to the soil and will remain for years.

MANURE NUTRIENT COMPOSITION

	Average Compositions (% Wt.)				
Elements	**Cattle**	**Horse**	**Sheep**	**Swine**	**Chicken**
Nitrogen	0.53	0.55	0.89	0.53	0.89
Phosphoric	0.29	0.27	0.48	0.46	0.48
Potash	0.48	0.57	0.83	0.41	0.83
Calcium	0.29	0.27	0.21	0.19	0.38
Magnesium	0.11	0.11	0.13	0.03	0.13
	Copper - Trace amounts Manganese - Trace amounts Zinc - Trace amounts Chlorine - Trace amounts Sulfur - Trace amounts Boron - Trace amounts				
Organic	16.74	27.06	30.7	15.5	30.7
Water	81.33	68.85	64.82	77.56	64.82
Ash	2.06	6.7	4.72	6.02	4.72

Credit: ***American Rose*** magazine

Standard Fertilizer Application Rates

MATERIAL	% NUTRIENT ANALYSIS Nitrogen (N)	Phosphorus (P_2O_5)	Potash (K_2O)	STANDARD RATES Bench Crops pounds per 100 sq ft	pounds per 1,000 gal.	Relative Availability
NITROGEN (ACID REACTION)						
Ammonium Sulphate	20.0	0	0	1*	20	Rapid
Ammonium Nitrate	33.5	0	0	⅔*	10	Rapid
Urea or Nu Green	42-46	0	0	½*	10	Rapid
Activated Sludge (or)	4-6	2-4	0	4	10	Medium
Dried Blood (or)	9-14	0	0	2		Med. Rapid
Animal Tankage (or)	5-10	2-5	0	3		Medium
Urea Formaldehyde (or)	38	0	0	5		Slow
NITROGEN (BASIC REACTION)						
Sodium Nitrate (Nitrate of Soda)	16	0	0	1*	20	Rapid
Calcium Nitrate	17	0	0	1*	20	Rapid
Potassium Nitrate	14	0	44-46	½*	10	Rapid
PHOSPHORUS						
20 percent superphosphate	0	18-20	0	3-5		Slow
Trebel Superphosphate	0	45.0	0	1½-2½		Slow
Moncalcium Phosphate	0	55.0	0	1*		Rapid
Monoammonium Phosphate	11	48.0	0	1½*		Rapid
Diammonium Phosphate	21	54.0	0	1*		Rapid
Steamed Bonemeal (or)	2	25.0	0	3		Slow Medium
POTASSIUM						
Potassium Chloride (Muriate of Potash)	0	0	50-60	½*	10	Rapid
Potassium Sulphur	0	0	48		10	Rapid
Potassium Nitrate	14	0	41-46	½*	10	Rapid
Potassium Frits	0	0	36	5		Slow
COMPLETE FERTILIZERS (for dry application)						
5-10-5 or 5-10-10	5	10	5	2½		
10-10-10 (for liquid application)	10		10	10	1¼	Rapid
13-13-13	13	13	13	¼-1*	30-40	Rapid
15-30-15 (or 14-28-14)	15	30	15	¼-1*	30-40	Rapid
20-20-20	20	20	20	½-¾*	20-30	Rapid
20-5-30	20	5	30	½-¾*	20-30	Rapid
SECONDARY ELEMENTS						
Magnesium Sulphate ($MgSO_4$-$7H_2O$ (Epsom Salts)		10 Mg		2-10	5-10	Medium
Calcium Sulphate ($CaSO_4 2H_2O$ (Gypsum)		29 Ca 20 S		2-10	Insoluble	Slow
Hydrated Lime ($Ca(OH)_2$)		60-80 Ca		1-2	Rel. insol.	Medium
Dolomitic Limestone ($MgCO_3CaCO_3$		20 Mg 30 Ca		2-10	Insoluble	Slow
Pulverized Limestone ($CaCO_3$)		32 Ca		2-10	Insoluble	Slow
Sulphur (powdered) S		95 S		2-5	Insoluble	Slow

	Nutrient Analysis %	Ounces per 100 sq. ft.	Ounces per 1,000 gal.	Relative Availability
MINOR ELEMENTS ***				
Borax (Sodium Tetra Borate) $Na_2B_4O_7$-10 H_2O	11 B	¼-½	1	Medium
Chelated Iron NaFe	12 Fe	1-4	10-40	Slow
Iron Sulphate $FeSO_4$-$7H_2O$	20 Fe	16	10-100	Slow
Manganese Sulphate	24-65 Mn	¼-½	1	Slow
Copper Sulphate $CuSO_4$	25 Cu	¼-½	1	Slow
Zinc Sulphate $ZnSO_4$	22-35 Zn	¼-½	1	Slow
Molybdenum (Sodium Molybdate) Na_2MoO_4-2 H_2O	22 Mo	.025 -.05	•	Slow
Minor element mixtures ***		Rate depends on whether soluble or fritted		

* Satisfactory for liquid fertilizer; (or) organic fertilizer
** To be applied as liquid
*** Applied once or twice annually
• Refer to Cornell Recommendations for Commercial Floricultural Crops for details on liquid molybdenum application methods and rates

Miscellaneous Fertilizer Information

½ lb Potassium Nitrate + ½ lb Ammonium Nitrate = 1 lb 23-0-23
1 lb Potassium Nitrate = 1 lb Potassium Chloride + 1/4 lb Ammonium Sulfate
1 lb Ammo-Phos (mono-ammonium phosphate) = 2 ½ lb Superphosphate + ½ lb Ammonium Sulfate
1 lb Ammo-Phos = 1 lb Superphosphate + 5/6 lb Ammonium Sulfate

Credit: Roses, Inc.

Nutrient Imbalances

A rose that has either too much or too little of any nutrient will suffer. Most of these nutrient imbalances can be diagnosed by using color photographs *(See color chart of nutrient deficiencies at end of chapter.)* There are 16 nutrients that roses need and thus there are 32 possible imbalances of nutrients, plus some other toxicity effects such as too much sodium.

Fortunately, there are only four of these imbalances that are frequently observed, and it is important that the Consulting Rosarian is aware of them. These are:

- ***Nitrogen deficiency.*** Because nitrogen can leach from the soil (as nitrate), volatilize (as ammonia) or denitrificate (by bacteria), nitrogen needs to be constantly added to the soil. In roses lacking nitrogen, the leaves will show an overall pale yellow-green color, the plant will be stunted and stem size will be smaller than normal. This can be caused by a too high or too low a pH.
- ***Oxygen deficiency***. This is a lack of air to the roots typically caused by over watering or poor drainage. The veins of the leaf will show chlorosis (yellowing) followed by interveinal chlorosis.
- ***Iron deficiency***. The appearance of leaves on a plant suffering from iron deficiency has the opposite look of oxygen deficiency - the interveinal areas show chlorosis while the veins remain green. It is rare that iron is actually deficient in the soil, but rather it is likely that something is making the iron unavailable. Possible causes are high pH, poor aeration of the soil, high soluble salts or excessively high concentrations of manganese, zinc or phosphorus. Foliar sprays can give temporary relief if they contain iron. This may also be caused by too high or low of a pH.
- ***Leaf burn***. The edges of the leaves turn brown and crispy. The fundamental cause of this is a lack of water getting to the edges of the leaves. This can be caused by anything that either makes water unavailable to the plant or excessively increases the water loss from the plant. Typical causes include over fertilizing with synthetic fertilizers, high salt level in the soil, lack of water, heat stress, spray burn or a combination of the above.

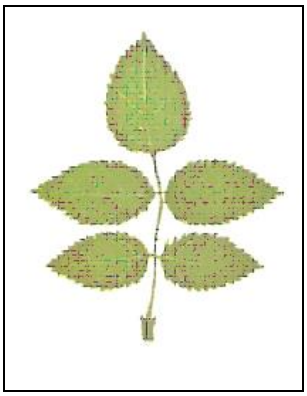
Symptoms of Rose Nutrient Deficiency

It is important to note that many symptoms of a nutrient deficiency are problems with availability rather than supply. The nutrients may be present in the soil but are unavailable because of a pH that is too high or too low. There may also be a nutrient imbalance that prevents absorption of one nutrient thus causing symptoms of deficiency. Many symptoms are similar. Generally, micronutrient deficiencies are rarely seen. The most common deficiencies are nitrogen, iron, oxygen, plus heat stress. *See the Color Plate of Common Rose Deficiencies at the end of this chapter.*

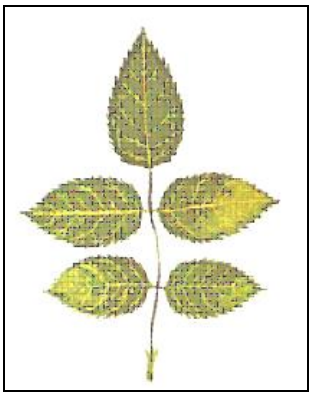
1. Mature Leaves Affected First

- Older leaves turn chlorotic, pale light green to completely yellow on the entire leaf but remains on the plant. Reduced growth with reduced leaf size. Stems weak and spindly, small flowers, lighter in color. - ***Nitrogen Deficiency***
- Do not mistake oxygen deficiency with a nitrogen deficiency. Though the symptoms look alike, no amount of nitrogen will correct the symptoms.
- The first symptom is a reduction of leaf size. Entire leaf is chlorotic with yellow between veins. Plants are stunted with large, necrotic white areas symmetrically distributed on both sides of the leaflet between larger lateral veins of the older leaves. Leaf edges of older leaves cup down. Some varieties may develop dark brown or purplish blotches scattered randomly across the leaflet. - ***Magnesium Deficiency***
- Older foliage drops without turning yellow. Leaves are dull gray-green in color. Buds slow to develop, leaf edges of older leaves may cup down. - ***Phosphorus Deficiency***
- Margins of leaf are affected first. Margins become yellow then turn brown, leaves sometimes become purple. Young shoots become hardened and stunted. Flower buds may be distorted. - ***Potassium Deficiency***

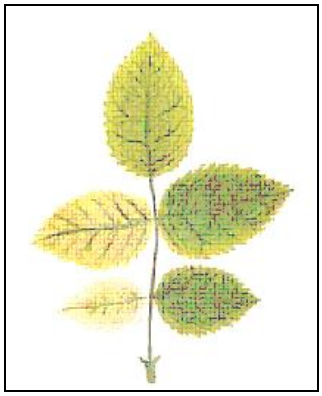
Common Rose Deficiencies



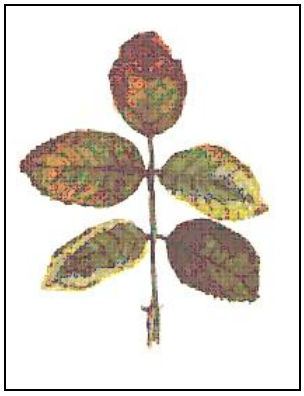
Nitrogen Deficiency



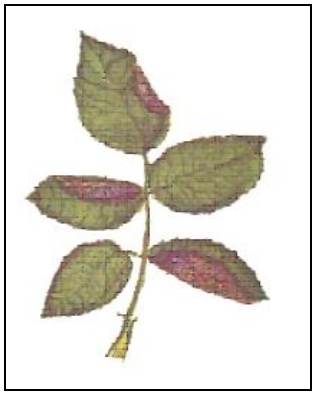
Oxygen Deficiency



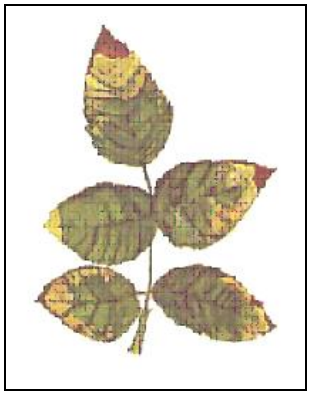
Iron Deficiency



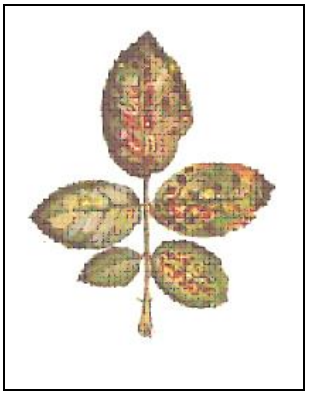
Calcium Deficiency



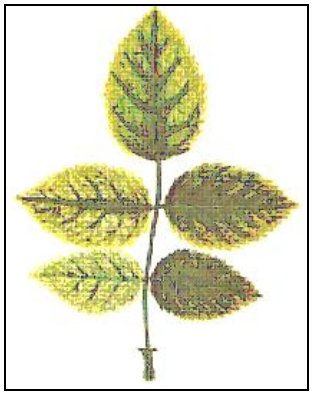
Phosphorus Deficiency



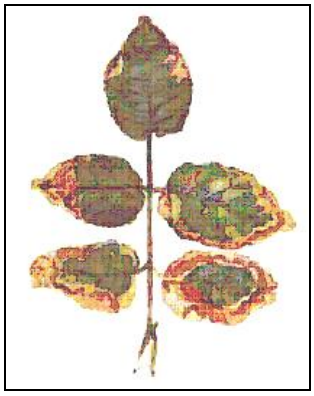
Potassium Deficiency



Magnesium Deficiency



Manganese Deficiency



Heat Stress or Salt

Credit: Baldo Villegas, Orangevale, California

2. Younger Plant Parts Affected First

- Chlorosis of young leaves. A general lightening of the green of the leaves. Interveinal areas yellow. - ***Iron Deficiency***
- Interveinal areas yellow but smallest veins remain green, more of a netted appearance. - ***Manganese Deficiency***
- Shoots often die or are hard. New growth ceases or withers. Leaves do not develop or are distorted. • Flower petals become shortened and bullheaded flowers may be numerous with petals rolled inward. - ***Boron Deficiency***
- Young leaves develop light edges, apical stem dies resulting in development of many small side branches. Possible to confuse with magnesium deficiency. - ***Copper Deficiency***
- New growth dies without development. In severe cases, plants become defoliated. Many dead roots. • Older leaf edges may cup down. - ***Calcium Deficiency***

NOTE: There is a close relation between calcium and boron. Calcium deficiency symptoms may be only a reflection of a calcium-boron imbalance. There must be ample quantities of both, but they must be present in proper balance. Often low pH, high phosphorus and high nitrogen levels, high soluble salts and heat stress create conditions which limit calcium uptake.

- New shoot growth aborted, distorted leaves. Older leaves do not cup down. – ***Zinc Deficiency***
- Symptoms are similar to moisture stress with youngest growth displaying some wilting. Weak flower stems and leaves drying from the tips and edges are also noticed. - ***Molybdenum Deficiency***

Symptoms of Nutrient Toxicity

1. Mature Foliage Affected First

- Older leaves drop rapidly with necrotic leaf margins. - ***Spray Injury***
- Older leaves do not drop at first, main vein remains green as the leaf first turns yellow then brown, then leaves drop after drooping. Young shoots become stunted, buds may be distorted. - ***Zinc Toxicity***
- Browning of mature leaves at the leaf edge, separated from the green tissue with a distinctive pink margin, brown, irregular spots, then eventual leaf drop. - ***Boron Toxicity***
- Small black spots on older leaves. May also cause iron deficiency symptoms to appear. - ***Manganese Excess***
- Similar to high salt concentrations, followed by rapid falling off of older leaves. – ***Sulfur Toxicity***

2. Younger Plant Parts Affected First

- Younger plant parts are affected first with chlorosis of terminal growth. Buds fail to develop after cutting. Too much urea may cause plant hardening. Often the foliage is increased in size and blooms smaller than normal. -***Nitrogen Excess***
- Symptoms of copper, iron and zinc deficiencies will occur with excessive use of phosphorus as it makes these elements unavailable to the plant. This is especially true with a low pH. - ***Phosphorus Toxicity***
- Chlorosis, root loss and wilting of young shoots. - ***Potassium Toxicity***

Heat and Moisture Stress

Although not technically a deficiency, heat stress symptoms are similar to nutrient deficiencies and will be covered in this section. Visual symptoms will vary depending on the severity and longevity of the stress. Soil salts can become a problem in dry soil and cause root injury, which in turn causes wilting of shoots and leaf scorch. Sometimes scorch of the leaf margins may develop on immature or nearly mature leaves; especially those exposed to direct sunlight.

Heat stress is often noticed after a period of cloudy, rainy weather promoting succulent top growth, followed by hot, dry, sunny days. The lack of oxygen in the soil caused by excessive rainfall (and possible poor drainage) puts the plant under stress to withstand the quick respiration of hot weather. Wilting of young growth may occur at this time.

Bull nosed bloom formation of roses is essentially a temperature stress problem. Red flowers are more likely to develop bull noses than light colors. The darker pigments apparently absorb more heat during the sunlight hours and re-radiate more heat at night establishing a greater temperature fluctuation within the bud.

Petal edge burn is more noticeable in red flowers and is associated with the buildup of heat in the petals. This is more evident after extended periods of cloudy weather followed by hot, sunny days.

RELATIVE SALT INDEX OF FERTILIZERS

Fertilizer	N-P-K	Salt Index Per 100 lb.	Salt Index Based per Unit of Respective Plant Food		
			N	P_2O_5	K_2O
Nitrate of Soda	16-0-0	100	1.25	-	-
Muriate of Potash	0-0-62	115	-	-	37
Ammonium nitrate	33-0-0	105	63	-	-
Urea	46-0-0	75	33	-	-
Potassium nitrate	13-0-44	74	114	-	34
Sulfate of ammonia	21-0-0	69	66	-	-
Calcium nitrate	15-0-0	68	88	-	-
Sulfate of potash	0-0-50	48	-	-	19
Magnesium sulfate (Epsom Salts)			44	-	-
Di-ammonium phosphate	21-54-0	34	32	-	-
Mono-ammonium phosphate	12-61-6	30	49	12	-
20% Superphosphate	0	8	-	-	-
Calcium sulfate (Gypsum)	0-20-0	8	-	-	-

Credit: American Rose Society

When air temperature is high, relative humidity low and air is moving across the leaf surface, the demand for water is greatest. Under these conditions, it is essential to provide water to the soil to reduce the total stress on the plant. During the hottest part of the day, it may be beneficial to water overhead. This will reduce the air temperature while providing moisture for the plant.

Effects of Soil Salts

Since roses are usually heavily fertilized, an accumulation of soluble salts is not uncommon. This could result in foliage injury and retarded growth. The effect of such salt accumulation is interference with water availability in the root zone. The higher the salt contents of the soil, the greater the stress on the plant to obtain moisture from that soil. Thus roses growing in soils having high salt concentrations tend to induce a physiological drought in the plants. This effect is intensified as the moisture content of the soil decreases.

All soluble salts do not have the same effect on the soil. Some present a more potent risk of injury by inducing physiological drought. Many of the high analysis fertilizer materials commonly used on roses are capable of producing a high salt index. However, when applied in suitable amounts for fertilizer response, the salt effect is usually not a problem.

A given concentration of soluble salts may not be injurious if the soil is kept moist and evaporation rates are low. But given the opposite conditions, the same salt concentration can cause root injury, which in turn cause wilting of shoots. All waters, except distilled, most rain or melted snow, contain some dissolved salts. Common components (ions) of salts contained in water supplies are calcium, magnesium, bicarbonate, chloride, fluoride and sulfate. Calcium, magnesium and potassium are plant nutrients, but can cause reduction in plant growth when present in excess of requirements.

Chlorides are especially injurious causing reduced plant growth and leaf drop. As the soil becomes drier, the soil solution becomes more concentrated. A concentration of dissolved salts, which is safe when the soil is moist, may become toxic when the soil becomes dry. It only takes one drying cycle under these conditions to cause the loss of roots, causing the plant to lose leaves.

The term salt index is used by scientists to indicate the relative physiological drought inducing effect produced by an equal weight of any fertilizer. Nitrate of soda, muriate of potash and ammonium nitrate are capable of inducing high salt effects when applied in any but moderate amounts. Other materials, notably the phosphates, ammoniated or otherwise, have a relatively low salt index.

It is important for the rose grower to appreciate the importance of water in the use of fertilizer material capable of inducing high salt effects. Small applications of water tend to dissolve the fertilizers and to develop the highest soluble salt concentration possible in the root area. Applications of water which cause some, but not too much, leaching tend to affect a loss of such materials as sulfates and chlorides, with little loss of ammonium or potassium, thus minimizing an increase of salts. Moreover, such watering gives good distribution of applied fertilizers. This is why one should never feed roses if the soil is dry and adequate watering should be done after fertilizing.

Where water is used conservatively, i.e. sub-irrigation, the salt concentration of the water supply is of the utmost importance. Because this method of watering is highly conducive to salt accumulation, sub-irrigation is not suitable for use with water supplies having more than low to medium amounts of soluble salts. If drip irrigation is used, the water supply should be tested for soluble salts. If the analysis is high, a watering system that delivers a greater quantity of water at one time should be considered.

All soluble salts are not equal in the effects on rose plant growth when they are present in excessive amounts. Plants will tolerate relatively large amount of sulfates as salts of calcium and magnesium and even of potassium. Nevertheless, the treatment for the correction of high salt accumulations is the same - remove them with water. If drainage is not satisfactory, it may be advisable to add gypsum before leaching. Gypsum tends to improve soil aggregation and consequently the drainage of water. It is also very effective in displacing or facilitating the leaching of other salts from the soil. The liberal supply of calcium in gypsum exchanges places with other metal ions held in the soil and can be tolerated by plants to an unusual degree.

Growth retardation of roses from the effects of an excessive accumulation of soluble salts in the soil is indicated by electrical conductance tests on soil samples. A high salt index may not be as harmful in winter as in summer. Injury is most likely to result during hot, dry days of summer.

Spray Burn

A common symptom that is mis diagnosed is damage from spray burn. Some pesticides will cause damage naturally or if not used properly. Rubigan (Recommended for use as a foliar spray. Do not apply through any type of irrigation system). Daconil (Cannot be shipped to some states. If you don't see it on the shelf at your local garden supply store, it most likely is banned in your area. It is listed as Danger/Poison**)** is known to cause spray damage.

Before looking into plant diseases and deficiencies, see what the individual is using for pest control.

ACKNOWLEDGMENTS
***Diagrams Reprinted With Permission From*:**
American Rose magazine, American Rose Society
Western Fertilizer Handbook, California Fertilizer Association, 9th edition, 1990
All About Roses, Dr. Tommy Cairns, Ortho Meredith, 1999
Roses, Roses, Inc. 1987
Steve Steps, Saratoga, CA

Commonly Used Materials in Rose Fertilizers

Dolomite
Carbonates of magnesium and calcium in equal proportions ($MgCO_3$-$CaCO_3$) can be thought of as a limestone useful for neutralizing acid soils in the same manner limestone is used. About one million tons are used annually as an ingredient in mixed fertilizers to supply available magnesium as well as render the fertilizer non-acid forming.
Potential basicity: 100B
Salt Index: 0.8

Gypsum
Calcium sulfate with combined water ($CaSO_4$-$2H_2O$) is incapable of neutralizing soil acidity. Reacts with sodium or potassium carbonate to form corresponding sulfates and insoluble calcium carbonate increasing soil permeability.
Potential basicity/acidity: 0
Salt Index: 8.1

Limestone
Generic term for a wide range of agricultural liming materials defined as having a calcium and magnesium content which is in forms that are capable of reducing soil acidity. Are essentially calcium carbonate or a mixture of that with magnesium carbonate (see dolomite). Also provides large quantities of the secondary nutrients, calcium and magnesium.
Potential basicity: 90B
Salt Index: 4.7

Magnesium Sulfate
Very soluble magnesium salt of sulfuric acid. More commonly known as Epsom salt ($MgSO_4$-$7H_2O$) Mixed with most of the ordinary fertilizer to provide ample content of the secondary nutrient, magnesium. Often used to reduce acidity of the soil through replacement of hydrogen ions.
Solubility: 85
Salt Index: 44

Potassium Phosphates
Three compounds, mono-(KH_2PO_4), di-(K_2HPO_4), and tri-(K_2HPO_4), all have excellent prospect as liquid fertilizers. However, high production costs have precluded their entrance into the market place. Wide range of N:P:K formulations is theoretically possible.
Potential basicity/acidity: 0
Salt Index: 8.4

Potassium Chloride
Commercially available as muriate of potash (KCl), it is a salt containing 48 to 62% potash (K_20), chiefly as chloride.
Potential basicity/acidity: 0
Solubility: 28
Salt Index: 1.16

Potassium Nitrate
Also known as saltpeter or nitrate of potash (KNO_3). Has several advantages; low salt concentration, nitrate nitrogen, favorable N/K_2O ratio, negligible chlorine content, and alkaline residual reaction in the soil. By AAPFCO definition, the commercial product shall contain not less than 12% of nitrogen and 44% of potash (K_2O).
Potential basicity: 26B
Solubility: 13
Salt Index: 73

Potassium Sulfate
Known as sulfate of potash (K_2SO_4), the fertilizer grade contains not les than 48% of potash (K_2O)
Potential basicity/acidity: 0
Solubility: 8
Salt Index: 46

Sodium Nitrate
Before the development of synthetic approaches, large quantities wer imported from natural deposits in Chile, hence the common name Chil saltpeter ($NaNO_3$). Commercially available as nitrate of soda containin not less than 16.48% nitrogen.
Potential basicity: 29B
Solubility: 73
Salt Index: 100

Sulfate of Potash Magnesia
Term used to describe two possible double sulfate salts of potassiur and magnesium (K_2SO_4-2MgS04 or $MgSO_4$-K_2SO_4-$6H_2O$) – should contai not less than 25% potash (K_2O) nor less than 25% of sulfate of magnesi
Potential basicity/acidity: 0
Salt Index: 43

Superphosphates
Best described as the product obtained when rock phosphate is treate with either sulfuric acid or phosphoric acid or a mixture of these acid Three grades available; normal with about 20% P_2O_5, enriched with a content of 27% P_2O_5, and concentrated containing 45-46% P_2O_5.
Potential basicity/acidity: 0
Salt Index: 10

Surfactants
These compounds have the ability to lower the surface tension of liquic when dissolved in them, thereby increasing the penetration in the so when applied. Most commonly used are the anionic alkyl aryl sulfonate - can be likened to a soap or detergent action.

Urea
Commercial synthetic acid amide of carbonic acid ($CO(NH_2)_2$), it contain about 42% nitrogen. Widely used in both solid and liquid fertilizers Readily absorbed through the leaves and hence efficiently used as plant food.
Potential acidity: 84A
Solubility: 67
Salt Index: 75

Credit: Dr. Tommy Cairns

WATER SOLUBLE FERTILIZERS

MIRACLE-GRO® for ROSES

Manufacturer: Scotts Miracle-Gro Company, Marysville, OH 43041
N-P-K: 18-24-16
Guaranteed Analysis:

TOTAL NITROGEN (N)..... 18%
6.3% Ammonical Nitrogen
5.0% Nitrate Nitrogen
6.7% Urea Nitrogen
AVAILABLE PHOSPHORIC ACID (P_2O_5).....24%
SOLUBLE POTASH (K_2O).....16%
Copper.....0.05%
Iron (Fe).....0.10%
0.10% Chelated Iron
Manganese (Mn).....0.05%
Zinc (Zn).....0.05%

Nitrogen from ammonium phosphate, potassium nitrate, and urea; phosphoric acid from ammonium phosphate; potash from potassium nitrate; copper from copper sulphate; chelated iron from iron EDTA; manganese from manganese sulphate; zinc from zinc sulphate.

Potential acidity equivalent to 700 lbs. calcium carbonate per ton.

Label Description: "Contains special forms of plant nutrients that are speedily absorbed through leaves and roots. So easy - just sprinkle solution over entire plant, wetting most of the foliage. The feel roots by soaking soil around the plant as far out as the branches reach."

Recommended Use: One level tablespoon per gallon of water per bush every two weeks with double dose for larger bushes.

PETERS® Professional Soluble Plant Food

Manufacturer: Peters® Fertilizer Products, W.R. Grace & Co., Fogelsville, PA 18051
N-P-K: 20-20-20
Guaranteed Analysis:

TOTAL NITROGEN (N).....20%
3.89% Ammonical Nitrogen
6.11% Nitrate Nitrogen
10% Urea Nitrogen
AVAILABLE PHOSPHORIC ACID (P_2O_5) 20%
SOLUBLE POTASH (K_2O).....20%
*Water soluble micronutrients
Primary plant nutrient sources: Urea, ammonium Phosphate, potassium nitrate.
Magnesium*..... 0.5%
Boron*..... 0.068%
Copper*..... 0.036%
Iron (Fe).....0.10%
Manganese (Mn)*..... 0.25%
Zinc (Zn)..... 0.025%
Molybdenum.....0.09%

Potential acidity 597 lbs. calcium carbonate equivalent per ton.

Label Description: "A completely soluble plant food for general purpose use for all outdoor and indoor plants."

Recommended Use: For roses, one tablespoon per gallon per bush every two to three weeks.

RA-PID-GRO® Concentrate plant food

Manufacturer: RaPidGro Corp., Dansville, NY 14437
N-P-K: 23-19-17
Guaranteed Analysis:

TOTAL NITROGEN (N).....23%
4% Ammonical Nitrogen
5% Nitrate Nitrogen
14% Urea Nitrogen
AVAILABLE PHOSPHORIC ACID (P_2O_5).....19%
SOLUBLE POTASH (K_2O)..... 17%

Sources: Urea, ammonium phosphate, potassium phosphate, potassium nitrate.

Potential acidity equivalent to 800 lbs. calcium carbonate equivalent per ton.

Label Description: "RA-PID GRO® Plant Food is a soluble plant food which should be mixed with water before use. Do not apply in dry form. Because it is in a liquid form when applied it is readily available to the plant, not only to the roots but also the leaves, stems, and buds of many plants."

Recommended Use: Foliar application at dose level of one tablespoon per gallon per bush every two weeks during blooming season.

Credit: American Rose Society

Notes

Updates

6/9/15 Color Plate of Common Rose Deficiencies corrected (6-14)

Chapter 7 – Pest Control Basics

Integrated Pest Management

Basic Concepts

Whether a rosarian is growing roses strictly for enjoyment in the garden or for winning trophies at a rose show, the basic concepts of pest control are the same. Whether a rosarian is an "organic" grower or immediately resorts to using every chemical pesticide available, the fundamental decision process is the same. It is only the decision thresholds and selection of choices that are different among rosarians. This decision process is known as Integrated Pest Management (IPM). This term is usually associated with organic growers, but it really describes the process used by all rosarians - organic or chemical.

IPM Definition

IPM is a decision making process that utilizes regular monitoring to determine if and when treatments are needed. Many factors enter into this decision such as ecological, economic, medical, and sociological consequences. When the decision to treat is made, a program is put together that integrates a number of techniques such as biological control, physical control, habitat modification, and least toxic chemical control. Treatments are chosen on the basis of how disruptive they are to natural controls, how hazardous to human health and to non-target organisms, how likely they are to effect a long-term reduction in habitat necessary to sustain the pest, and how cost effective they are in the long and short terms. [From *"Common Sense Pest Control XI(3)", Summer 1995, Bio-Integral Resource Center*.]

IPM Basics

IPM can be reduced to four elements:

- Decision whether to treat.
- Decision when to treat.
- Decision how to treat.
- Evaluation and review of the decisions.

These IPM elements form a spectrum of choices. At one extreme, a rose exhibitor who has no tolerance for any pests on their roses, will go through all four elements very quickly. For example, they may decide to treat anything that is not part of the rose with no regard as to whether it is a good or bad or somewhere in between. Treatment will be immediate and in some cases preventative. For example, they may spray for fungus diseases whether or not the fungus has been observed or even whether conditions are favorable for fungus growth. The treatment method which provides the most immediate effect will be selected and the evaluation is simply whether or not any remaining pests are observed.

A person on the other extreme of the spectrum may be very interested in reducing the use of synthetic chemicals. They may spend a large amount of time going through each of the IPM elements - including a great deal of time evaluating the results of each of the decisions. For example, this rosarian may spend time determining what it is they are seeing on their roses. Is it damaging their roses, having no effect on their roses or is it helping control other damaging pests? If it is a pest, what is its life cycle? How many of the pest will it take to reach a damaging level? This rosarian may be keeping records on the increasing and decreasing levels of the pest. What is keeping the pest from a major outbreak? What are the natural predators of the pest? What can be done to tip the balance in favor of the natural predators? Can simple cultural changes ensure future outbreaks of the pest are controlled more quickly? For any action taken, this rosarian may be keeping records so that in the future he or she will know what actions provides the best long-term control of the pest.

Both rosarians are practicing IPM. What differs is how quick, cost effective and long lasting will be their results.

Decision Whether to Treat
Identification of Pest

Before any decision can be made about treating a pest, one needs to correctly identify the problem. Stories abound of rosarians repeatedly spraying mummified aphids with pesticides or spraying the beneficial syrphid fly larvae ("kill those worms"). It is just as ineffective to be spraying fungicides on a bush suffering from a lack of water - it will only decrease the health and appearance of the bush.

Correct identification of insects should include whether the insect is damaging, helpful or neutral. Information on the insect's life cycle is very important for making decisions as to when to treat and how to treat. Even the decision as to whether or not to treat has many other factors beyond whether it is a good bug or bad bug. Every decision carries consequences.

Consequences of Treatments

The first four of these consequences are referred to as "3 R's and an S."

Pesticide Residue. Very little of the pesticide actually reaches the target pest. What happens to the rest of the pesticide? Will other household members or pets come in contact with the residue? How long does the pesticide remain active? Will it get into the ground water? If it is windy, where will the pesticides drift? Will it impact other plants or other people's yards?

Pest Resistance to Pesticides. The first known pesticide resistance buildup was to sulfur in 1914. However, the increased reliance on chemical pesticides after World War II has led to resistance buildup in almost every pest. Frequent sprayings with dilute solutions will increase the rate of pesticide resistance buildup.

Pest Resurgence following pesticide use. Most pesticides kill the predators as well as the pests. Because pests can usually rebuild populations faster than the predators, it is very common to see increases in pest levels (resurgence) a few weeks after applications of pesticides. Even use of non-specific beneficials can decrease overall predator levels and thus allow a resurgence in pest levels.

Secondary Pest Outbreaks. Treatment of one pest may result in an increase of another pest by accidentally killing the beneficials, which had the secondary pest under control. Spider mites are rarely a problem in yards where pesticides are not used. Spider mites were generally only a problem for greenhouse-grown roses until the widespread use of DDT and more modern pesticides reduced the spider mite predators. High infestations of spider mites are also seen in gardens where broad spectrum insecticides are used on a regular basis.

Health hazards. Will people and especially children come in contact with your roses while the pesticides are still active? The National Research Council in their 1993 study called "Pesticides in the Diets of Infants and Children" warned that because of their size and diet, infants and children are at greater risk for pesticide residues. The study warns: "Depending upon the dose, some pesticides can cause a range of adverse effects on human health including cancer, damage to the nervous system, lung damage and reproductive dysfunction."

Social factors. Is your neighborhood and town supportive or intolerant of pesticide use? Will frequent spraying of your roses cause others to avoid growing roses?

Cost factor. What is the economic cost of a spraying or beneficial release? What benefit will it provide versus waiting for natural checks and balances to control the pest?

Appearance problems. Treating rosebushes with imported beneficial insects will still leave the roses with insects. The blooms may be unusable in a rose show without extensive cleanup. Likewise spray residue (whether "synthetic chemicals" or non-toxic antitranspirants) can be both unsightly and can lead to disqualifications at a rose show as a "foreign substance."

Decision When to Treat Pest

Pest Monitoring & Threshold levels for action: "No pest is an island, alone to itself." Rather, all pests are part of a complex system, which is why pest levels tend to fluctuate. Certain conditions (such as hot or wet weather) allow for rapid increases in pest levels while other conditions (such as humidity or predator levels) cause rapid decreases in pest levels.

Based on economic or other reasons (for example, rose shows) a "damaging" threshold can be established for each pest. Then a level can be chosen below that as an "action threshold." When a pest level exceeds the action threshold, then treatment action is taken to avoid allowing the pest to exceed the damaging threshold.

The best method for determining when to treat for pests is through careful monitoring and recordkeeping of pest levels, beneficial levels and other environmental conditions. For example, past records might indicate that even if aphid levels are quite high, no treatment is required as long as there appear to be syphid fly eggs present in most aphid colonies. Only if little to no beneficials are observed will action be necessary.

Likewise, records may show that rust is only a problem during extended periods of rain when the weather is relatively cool. If so, preventative spraying during dry spells may not be required at all. Only if the forecast calls for a period of cool and rain should fungicides for rust be applied.

Decision How to Treat Pest

Disease Triangle (Host, pathogen (pest) and environment): Once the decision has been made to treat the pest, there are many choices in how to treat the pest. A useful concept for deciding how to treat the pest is usually applied to fungus diseases, but can also be applied to insects and other pests.

Pest outbreaks occur because all parts of the triangle were favorable. Of course the pest has to be present, along with an appropriate host and a favorable environment. This directly leads to possible controls for the pest: attack one or more parts of the triangle. For example: one could avoid light-colored roses (host) to reduce thrips problems; one might use mulches (environment) to interfere in the thrips' lifecycle; or one could spray a pesticide directly onto the thrips. Overall, these lead to the following set of choices in pest control.

Pest Control Choices

- ***Cultural controls***
  - Crop rotation -- not very useful for perennials like roses.
  - Cover crops -- protects the soil, adds nutrients to soil and may host beneficials.
  - Soil solarization - kills weed seeds and fungi.
  - Cultivation - useful for controlling weeds and some pupating pests.
  - Plant selection - avoid varieties very subject to common fungi.
  - Crop residue destruction - for control of overwintering insects and fungus.
- ***Physical and mechanical controls***
  - Barriers - copper barriers (for snail control); screens, or nets.
  - Traps - pheromone, bait, sticky or light traps; temperature and/or humidity manipulation normally used in greenhouse situations.
  - Electric current - electric fence for deer or copper strips for snails.
  - Mechanical action - machinery such as vacuums used for pest control.
  - Manual removal - hand picking of pests.
- ***Biotic control agents***
  - Predators - beneficial insects which hunt down and eat pests.
  - Parasitoids - beneficial insects which lay eggs in pests.
  - Pathogens - virus, fungi, bacterial microbes, and protozoa, e.g., milky spore bacteria for control of Japanese beetles.
- ***Biological Control Methods***
  - Importation - non native natural enemies released to control a pest.
  - Conservation - avoiding use of pesticides for control of other pests which might reduce beneficial insect levels.
  - Inoculation - releases of non overwintering beneficial insects to start natural process.
  - Augmentation - releases of already existing beneficial insects to increase their levels.

- ***Least toxic chemical & microbial control***
  - BT (*Bacillus thuringiensis*) - protein crystals that act as stomach poisons.
  - Pheromones (confusants) - used to disrupt insect mating.
  - Pheromone attractants - used to trap insects.
  - Insect growth regulators - chemicals that disrupt insect metamorphosis process.
  - Botanical pesticides - plant derived pesticides (e.g., Neem).
  - Insecticidal soaps - soaps that break down insects' outer covering.
  - Chemical control- Selective pesticide - a pesticide that only effects a limited population of pests and is less likely to also damage beneficial insects.
  - Broad range pesticide - A pesticide that kills everything - good or bad.

Evaluation & Review

The results of each decision (what, when and how to treat a pest) should be evaluated to deter-mine how effective the decision was and what were the consequences. For example, one may have decided not to treat an outbreak of aphids prior to a rose show and the result was damage to the roses. What went wrong? Were there not enough predator eggs present or did some other factor (for example, spraying a fungicide with oil) cause the eggs not to hatch?

Is there a correlation between various actions? For example, do you always have spider mite outbreaks after spraying your roses with Orthene for control of thrips? Could you change your spraying program to just mist the blooms instead of spraying the whole plant? Does this control the thrips while not allowing a spider mite outbreak?

Summary

IPM may seem to be a very complicated process, but it does not have to be overwhelming. The key concept to keep in mind is that all pests live in an environment of checks and balances. Every action (or inaction) you take will affect the checks and balances. It is just a matter of observing these causes and effects and using them to one's advantage.

Notes

Notes

Chapter 8 – Pesticides & Garden Safety

The approach to using pesticides is changing - rose lovers interested in protecting our precious resources and being good environmental stewar/ds are shifting from routine, preemptive use of potent pesticides, to a selective, integrated pest management approach using pesticides when needed as an aid to growing their favorite flower.

Pesticides can be useful tools when used appropriately, but incorrect or careless use can result in undesirable effects; elimination of beneficial insects and pollinators, toxic exposure to humans and pets, and accumulation/contamination of local environments being the most common.

Before using any pesticide product, be prepared – become knowledgeable about the pesticide you choose to use, how to use it correctly and what to do in the event of accidental poisoning, exposure or a spill. By following the basic guidelines listed below, you can be confident in using garden pesticides safely and effectively.

Safety First

Most chemical accidents result from carelessness or ignorance. To safeguard human and animal health and the environment from pesticide injury, learn safe procedures. Practice them, and as a Consulting Rosarian, teach them to others.

The U.S. Environmental Protection Agency (EPA) and individual states register or license pesticides for use in the United States under the authority of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). States are authorized under both FIFRA and state pesticide laws and may place more restrictive requirements on pesticides than the EPA.

Before using any pesticide it's important to read the product label. Federal law strictly defines what information manufacturers must put on pesticide labels. The label is a legal document required for every pesticide registered in the United States and is the main source of information on how to use the product correctly, safely, and legally.

Exposure

Pesticides are designed to kill living organisms that are considered "pests." Because they are toxic by design, many pesticides can pose health dangers to people and pets. Pesticides can enter the body in various ways:

- **Oral**: taken in while eating or smoking during mixing or during and after spraying.
- **Dermal**: absorbed through the skin through clothing wet with chemicals or direct contact with the skin while mixing, especially in concentrated form.
- **Inhalation**: dusts, spray mist or fumes can be drawn into the lungs.

The dermal (skin) and inhalation routes of entry of pesticides into the body are generally more dangerous than the oral route. The most common cause of pesticide poisoning by users is through skin contact, with pesticide concentrates being especially dangerous. Most chemicals spilled on the skin are absorbed in the first few minutes. If this should occur, wash it off immediately.

Personal Protection

Before using any pesticide, plan ahead, and wear the appropriate protective gear described on the product label. That protection should be used from the time you begin handling the pesticide container, to your final clean-up. Refer to guidelines below on specific recommendations for personal protection.

Environmental Protection

Any pesticides used on your roses or garden can contaminate groundwater or travel through storm drains and contaminate creeks, lakes, and rivers. Keep pesticide use in your garden; avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

Do not place containers containing pesticide in the trash or pour pesticides down sink, toilet, or outside drains. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways. Follow directions on the label for appropriate method of disposal. See section below on pesticide disposal for more information.

First Aid

Before You Begin, read the product label for instructions on what to do if the product is swallowed, inhaled or contacts your eyes or your skin. Look at the emergency and first aid measures to take if someone has been exposed. ALWAYS call a physician or a poison control center for further treatment advice. Remember to have the pesticide container with you.

If someone has swallowed or inhaled a pesticide or gotten it in the eye or on the skin:

- Call 911 if the person is unconscious, having trouble breathing, or having convulsions.
- Check the label for directions on how to give first aid.
- Call the Poison Control Center at 1-800-222-1222 for help with first aid information.
- Contact the National Pesticide Information Center (NPIC) (1-800-858-7378) for information about pesticide products and their toxicity.

About Pesticides

Caution Should Always Be Used When Handling Pesticides
Never Make Recommendations for Use of Pesticides Other than Those Listed on the Label
Never Recommend the Use of Restricted Chemicals!

Definitions

The term pesticide was coined in 1939 from the English word pest and -cide, from the Latin cidium "a killing," and caedere, "to cut down, kill." Many people associate pesticides with chemicals, but a pesticide is any material used to control, prevent, kill, suppress or repel pests.

Types of Pesticides

There are many different types of pesticides, each focused on the group of pests they are designed to control. Some of the most common include:

- **Biocide**: kills microorganisms.
- **Fungicide**: kills fungi that may infect and cause diseases in plants, animals, and people.
- **Herbicide**: kills weeds and other plants that grow where they are not wanted.
- **Insecticide**: kills insects and other "bugs."
- **Miticide**: also called acaricides, kills mites that feed on plants and animals.
- **Molluscicide**: kills snails and slugs.
- **Nematicide**: kills nematodes (microscopic, wormlike organisms that feed on plant roots).
- **Ovicide**: kills eggs of insects and mites.

Mode of Action - How Pesticides Work

Every pesticide will have a specific "mode of action"- how the pesticide works on the targeted pest.

- **Selective:** products kill only a few closely related organisms.
- **Broad spectrum (non-selective**): kills a range of pests and also non-target organisms.
- **Contact**: kills when it touches the external surface of the target organism.
- **Systemic**: carried through the internal system of treated animals or tissues of treated plants.
- **Residual**: remains toxic to pests long after application.
- **Fumigant**: volatile enough to be inhaled by the pest in lethal doses.
- **Repellent**: distasteful to pests making them avoid treated areas.

Additional Terms Applicable to Fungicides

Some additional terms applicable to fungicides include:

- **Protectant:** applied before infection.
- **Eradicant**: applied after infections appear and kills on contact.
- **Multi-site, broad-spectrum surface protectants**: do not enter the leaf; the active ingredient remains on the leaf surface.
- **Single-site, mostly locally systemic**: do enter the leaf; the active ingredient penetrates to the interior of the leaf (upon entering the leaf, the fungicide is carried by the xylem stream out to the ends of the leaf, it is not translocated upward to subsequent new growth).

Origins – Where Pesticides Come From

The origin of a pesticide may be natural or man-made, and produced from organic (carbon containing) materials or inorganic (do not contain carbon) materials like arsenic, copper or sulfur. Natural and organic do not automatically mean that the material is safe; some are as toxic, or even more toxic, than synthetic chemical pesticides.

Pesticide Formulations

Pesticides are available in many different forms. They are generally mixtures of one or more active ingredients (the component in the product that kills or otherwise controls the target pest) and other inert materials; the inert components may make the pesticide more convenient to use or enhance its effectiveness.

The amount of an active ingredient is listed on the label as a percentage by weight. It can be listed either by the chemical or the common name. Inert ingredients do not need to be specifically identified, but the label must state their percentage of the total contents.

Inert does not mean that the ingredient is harmless; it may be more hazardous than the active (pesticide) ingredient itself. Information on hazardous ingredients in a pesticide formulation can be found in the Material Safety Data Sheet (MSDS) for the product. Go to the www.greenbook.net website for more information on labels and MSDS's.

The formulation determines how the product will be applied or mixed before application. Some of the more common formulations are:

- **Solution (S):** liquids in a ready to use or concentrated form.
- **Emulsifiable concentrates (EC or E):** an active ingredient mixed with an oil base that is diluted with water before application; it must be continually agitated to keep it in solution.
- **Aerosols (A):** low concentration solutions that are applied as a fine spray.
- **Soluble powders (SP):** powders dissolved in water before application.
- **Wettable powders (WP or W):** an active ingredient combined with a fine powder that is mixed with water before application.
- **Baits (B):** an active ingredient mixed with an edible or attractive substance.
- **Granules (G): a**n active ingredient mixed with coarse particles of inert material that are applied directly.
- **Dusts (D):** an active ingredient added to a fine inert clay or talc that is applied directly.

Pesticide Toxicity

Commercially available pesticides all have some level of toxicity as defined by the EPA. Toxicity is a measure of how poisonous a material is. The commonly used measure of oral and dermal toxicity is LD_{50} (the lethal dose to kill 50% of the study population). The lower the LD_{50} the more poisonous the chemical is. LD_{50} is usually expressed in milligrams (mg) of material per kilogram (kg) weight of target.

In order to provide a rapid identification of the dangers of a chemical, there are warnings on all product labels - a numeric category and a signal word used to describe the toxicity level. The category and signal word for all pesticides is listed below along with a general indication of the probable oral lethal dose of a pesticide for a 150-pound (approximately 68 kg) person:

I	**Danger Poison:** highly toxic, taste to 1 teaspoonful.
I	**Danger:** highly hazardous; pesticide specific (see label).
II	**Warning:** moderately toxic or hazardous; a teaspoon to an ounce.
III	**Caution:** low toxicity; more than an ounce, less than a pint.
IV	**Caution:** low toxicity; over a pint.

A skull and crossbones on the label indicates a highly toxic pesticide. DANGER without a skull and crossbones symbol shows the pesticide is a potent skin or eye irritant.

Product Identification

Before you purchase or use a pesticide, learn all you can about the pest you want to control and make sure the pesticide is registered for use on the particular type of plant or site you plan to treat as pesticides can seriously damage some plants.

Pesticides carry three different names: their product, trade or brand name - the name on the container you purchase; the common or active ingredient name and the proper chemical name. *Round-up* is the brand name for glyphosate (the common name of the active ingredient); its proper chemical name is N-(phosphonomethyl) glycine. Common names are generally easier to identify than chemical names. Several companies may sell the same pesticides using different brand names, but the labels will have the same common or chemical name.

Pesticide Labels – Read Before Use!

All pesticides legally marketed in the U.S. must have a label approved by the EPA. It is a legal document that is required for registering a pesticide. Pesticide product labels provide information on the safe handling and use pesticide products. The directions on the label help you achieve maximum benefits from the product with minimum risk.

Information contained on a pesticide label includes:

- Trade name or brand name
- Active ingredients and their percentage by weight
- Types of plants or sites where pesticide may be used
- Pests targeted
- How much to use
- How and when to apply
- Required protective clothing and equipment
- Signal words
- Precautionary statements defining hazards to people, domestic animals, or the environment
- Emergency and first aid measures to take if someone has been exposed
- Proper storage and disposal of the pesticide and empty containers

Read the label before buying the pesticide. You may have forgotten part of the label instructions or they may have changed since the last time you purchased the product. Use of any pesticide in any way that does not comply with label directions and precautions is illegal. It may also be ineffective on the pests and, even worse, pose risks to users or the environment.

Using Pesticides Safely

What to Use

Before using a product, check the label to make sure it has an EPA registration number. Due to their toxicity and potential environmental danger, some pesticides are restricted for use only by licensed and trained professionals. Homeowners should never use these chemicals!

- Identify the problem you wish to control and use the proper chemicals.
- Select the least-toxic pesticide; read the label and MSDS sheets and choose products with the signal word Caution if possible.
- Choose an effective product that is labeled for use against the pest you want to control. Never make recommendations for use of pesticides other than those listed on the product label.
- Select the best formulation; carefully consider risks of human exposure, environmental impact and effectiveness when determining which formulations (liquid, granular, dust, etc.) to use.
- Buy only the amount of pesticide for the current season and always store it in the original container in a dry, dark place.
- Don't use restricted pesticides unless you have a Certified Pesticide Applicator's license. It's not only against the law, it is dangerous.
- Don't use additives to spray materials unless recommended by the manufacturer; vinegar, buffers and other additives may interact with the chemical and cause plant damage.
- Use a spreader sticker only according to label information to prevent plant damage; many liquid chemicals already contain a spreader sticker.
- Don't move or split a pesticide and store part of it in an unmarked container. This is not legal and dangerous since the pertinent label information is no longer with the pesticide.

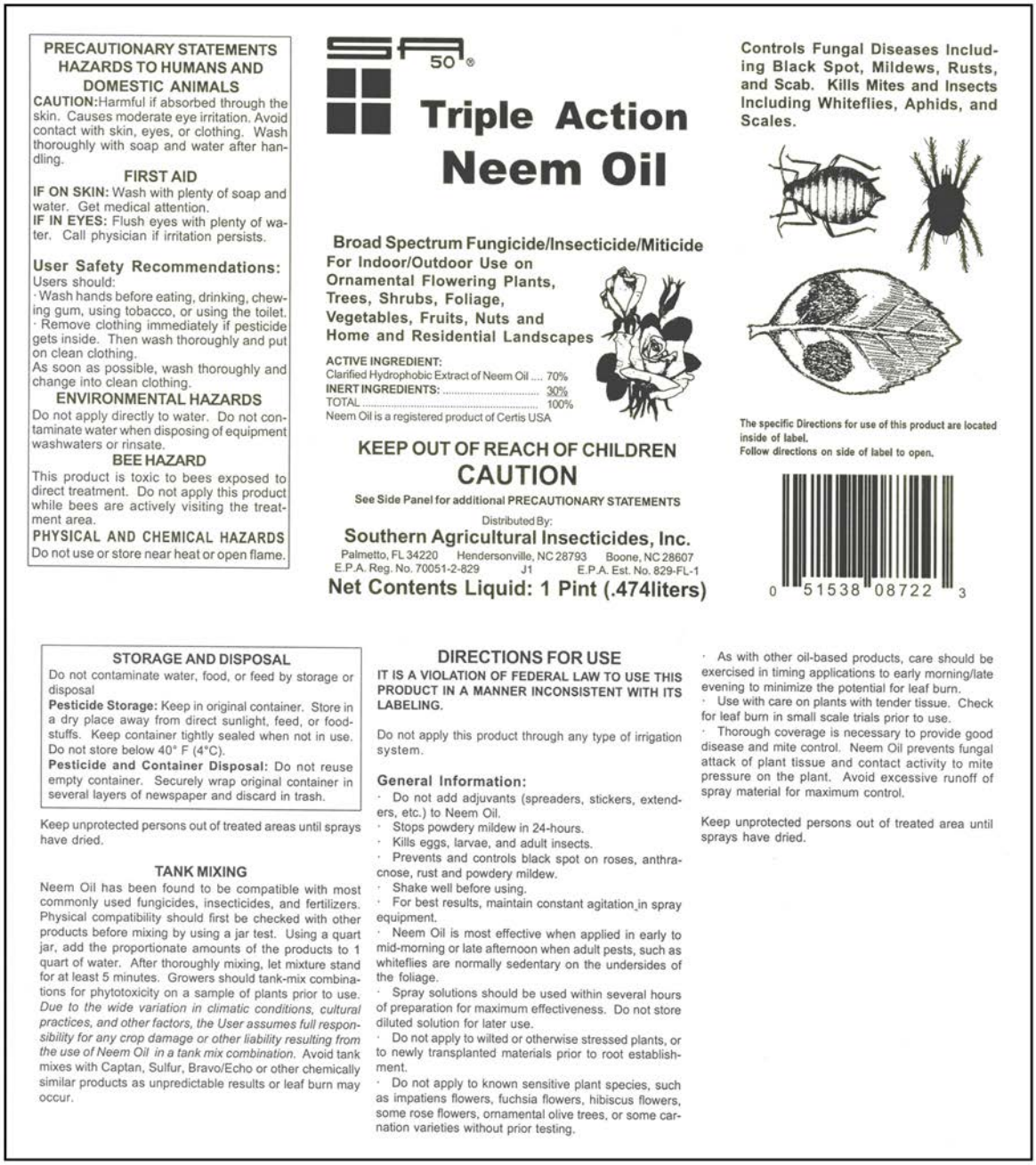
The application method for pesticides varies with the type of pesticide, its physical form, and the location in which it is used. Common application methods include:

- Sprayers (aerosol, trigger, compressed air, trombone, hand, or garden hose)
- Pumps (hand, compressed air, bucket, or garden hose)
- Dusters and foggers
- Rotary and drop spreaders

Homeowners can use any of these application methods. Introducing pesticides through an irrigation system is generally prohibited – ***read the pesticide label*** for specific guidance.

Never use equipment to apply a pesticide if it has used for the application of an herbicide as any residual herbicide in the equipment may result in injury to plants.

Example of a Pesticide Label



PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Harmful if absorbed through the skin. Causes moderate eye irritation. Avoid contact with skin, eyes, or clothing. Wash thoroughly with soap and water after handling.

FIRST AID

IF ON SKIN: Wash with plenty of soap and water. Get medical attention.
IF IN EYES: Flush eyes with plenty of water. Call physician if irritation persists.

User Safety Recommendations:
Users should:
· Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
· Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

Do not apply directly to water. Do not contaminate water when disposing of equipment washwaters or rinsate.

BEE HAZARD

This product is toxic to bees exposed to direct treatment. Do not apply this product while bees are actively visiting the treatment area.

PHYSICAL AND CHEMICAL HAZARDS

Do not use or store near heat or open flame.

SEA 50®

Triple Action Neem Oil

Broad Spectrum Fungicide/Insecticide/Miticide
For Indoor/Outdoor Use on Ornamental Flowering Plants, Trees, Shrubs, Foliage, Vegetables, Fruits, Nuts and Home and Residential Landscapes

ACTIVE INGREDIENT:
Clarified Hydrophobic Extract of Neem Oil 70%
INERT INGREDIENTS: 30%
TOTAL 100%
Neem Oil is a registered product of Certis USA

KEEP OUT OF REACH OF CHILDREN
CAUTION
See Side Panel for additional PRECAUTIONARY STATEMENTS

Distributed By:
Southern Agricultural Insecticides, Inc.
Palmetto, FL 34220 Hendersonville, NC 28793 Boone, NC 28607
E.P.A. Reg. No. 70051-2-829 J1 E.P.A. Est. No. 829-FL-1

Net Contents Liquid: 1 Pint (.474liters)

Controls Fungal Diseases Including Black Spot, Mildews, Rusts, and Scab. Kills Mites and Insects Including Whiteflies, Aphids, and Scales.

The specific Directions for use of this product are located inside of label.
Follow directions on side of label to open.

0 51538 08722 3

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal
Pesticide Storage: Keep in original container. Store in a dry place away from direct sunlight, feed, or foodstuffs. Keep container tightly sealed when not in use. Do not store below 40° F (4°C).
Pesticide and Container Disposal: Do not reuse empty container. Securely wrap original container in several layers of newspaper and discard in trash.

Keep unprotected persons out of treated areas until sprays have dried.

TANK MIXING

Neem Oil has been found to be compatible with most commonly used fungicides, insecticides, and fertilizers. Physical compatibility should first be checked with other products before mixing by using a jar test. Using a quart jar, add the proportionate amounts of the products to 1 quart of water. After thoroughly mixing, let mixture stand for at least 5 minutes. Growers should tank-mix combinations for phytotoxicity on a sample of plants prior to use. *Due to the wide variation in climatic conditions, cultural practices, and other factors, the User assumes full responsibility for any crop damage or other liability resulting from the use of Neem Oil in a tank mix combination.* Avoid tank mixes with Captan, Sulfur, Bravo/Echo or other chemically similar products as unpredictable results or leaf burn may occur.

DIRECTIONS FOR USE

IT IS A VIOLATION OF FEDERAL LAW TO USE THIS PRODUCT IN A MANNER INCONSISTENT WITH ITS LABELING.

Do not apply this product through any type of irrigation system.

General Information:
· Do not add adjuvants (spreaders, stickers, extenders, etc.) to Neem Oil.
· Stops powdery mildew in 24-hours.
· Kills eggs, larvae, and adult insects.
· Prevents and controls black spot on roses, anthracnose, rust and powdery mildew.
· Shake well before using.
· For best results, maintain constant agitation in spray equipment.
· Neem Oil is most effective when applied in early to mid-morning or late afternoon when adult pests, such as whiteflies are normally sedentary on the undersides of the foliage.
· Spray solutions should be used within several hours of preparation for maximum effectiveness. Do not store diluted solution for later use.
· Do not apply to wilted or otherwise stressed plants, or to newly transplanted materials prior to root establishment.
· Do not apply to known sensitive plant species, such as impatiens flowers, fuchsia flowers, hibiscus flowers, some rose flowers, ornamental olive trees, or some carnation varieties without prior testing.
· As with other oil-based products, care should be exercised in timing applications to early morning/late evening to minimize the potential for leaf burn.
· Use with care on plants with tender tissue. Check for leaf burn in small scale trials prior to use.
· Thorough coverage is necessary to provide good disease and mite control. Neem Oil prevents fungal attack of plant tissue and contact activity to mite pressure on the plant. Avoid excessive runoff of spray material for maximum control.

Keep unprotected persons out of treated area until sprays have dried.

Credit: Southern Agricultural Insecticides, Inc.

Pesticide Resistance

Pesticide resistance is the ability of a life form to develop a tolerance to a pesticide. It develops when pesticides are used too often and when the same pesticide or similar pesticides are used over and over again. Pests that become resistant to a pesticide will not be affected by the pesticide, and are more difficult to control. Using an integrated pest management approach can help guard against pesticide resistance. Also consider:

- Using selective pesticides that break down quickly.
- Using pesticides that have different sites of action.
- Alternating different pesticide groups, if there is more than one generation of pest.

Pesticide Incompatibility

Applying mixtures of different pesticides, or pesticides in combination with various spreader / stickers or fertilizers might be a time-saving approach, but it can also be a recipe for disaster. Mixing of two or more chemicals that do not physically or chemically suit each other can result in incompatibility. Physically incompatible pesticides may become unstable forming crystals, flakes, or sludge while chemically incompatible products may have their composition altered through chemical reactions. The results of this incompatibility can result in:

- Reduced effectiveness of one or both products.
- Precipitate in the tank, clogging screens and nozzles in the sprayer.
- Plant phytotoxicity or stunting.
- Excessive residues.

BEFORE MIXING ANY CHEMICALS, ***read the product label*** and identify the specific recommendations for each product's compatibility.

When to Use

Timing is everything; before using any pesticide, confirm you are applying it at the right time (time of year, time of day, growth of plant, growth stage of pest, etc.). Also,

- Make sure roses are well watered before spraying as damage may result.
- Never spray in the strong sun or when temperatures are above 80°F; plant damage may result.
- Don't apply pesticides just prior to rainfall or on a windy day.

Where to Use

Pesticides should be applied uniformly no more than 3 to 4 feet to the side of the person doing the application and pattern should be directed so that the person applying the pesticide does not walk through it. Application should be continuous and uninterrupted, giving uniform coverage with a minimum of overlap (overlapping can cause an excess of pesticide in certain areas).

- Check pesticide labels for warnings regarding use near bodies of water such as streams, rivers, and lakes.
- Avoid applying pesticides to hard surfaces such as sidewalks or driveways, where they can easily be washed off.
- Use caution when spraying around contained sources of water – ponds, swimming pools, fountains and birdbaths, to prevent inadvertent contamination.

How to Use

Follow label use instructions precisely, including mixing and dilution directions. Take the time to work out the conversion arithmetic if your application equipment is a different size from the example on the label.

Before Use

- ***Read the pesticide label BEFORE using a pesticide.***
- Confirm product compatibility before mixing more than one pesticide or related product.
- Put on the proper gear before opening the pesticide container.
- Cover up pet dishes, sandboxes, plastic pools, etc. before spraying.
- Bring children and pets indoors when applying pesticides.
- Warn neighbors that live close by before spraying so they will have the opportunity to close windows and bring in children and pets.

Personal protection

- Follow label requirements for protective clothing.
- Wear clean clothing that provides full skin coverage (long pants, a long-sleeved shirt, socks, closed shoes and gloves).
- Don't wear leather shoes, boots, or gloves while handling pesticides as they cannot be decontaminated easily.
- Don't wear shoes made of canvas or other porous materials.
- Cover the head to prevent pesticide being absorbed through the scalp.
- Remove rings and watches because spray material may concentrate there.
- Wear waterproof gloves with long, tight-fitting wrists.
- Use a respirator when using air blast sprayers to protect from spray drift.

Equipment

- Equipment should fit the job; keep it in good working order.
- Consider using separate, dedicated pesticide equipment to prevent residual contamination.
- Use the type of nozzle that gives the largest but still effective droplet size.
- Check the sprayer before beginning application to be sure there are no leaks in sprayer or hose connections.
- Clean the respirator after each use.

Mixing

- Re-read the label before using or re-using a pesticide, don't rely on your memory.
- Open, mix and dilute the pesticide outdoors or in a well-ventilated area.
- Use care when opening containers; don't use the same knife or scissors to open the bags that you use with food.
- Avoid creating dusts or splashes when opening a container or pouring liquids.
- Use measuring cups and containers that are dedicated for pesticide use; don't use for other purposes.
- Mix the pesticide at the recommended rate and amounts; don't "guess" with the measurements.
- Mix only what you need.
- Fill tank with water until about one-half full.
- Add concentrate gradually while water is swirling; don't add water to concentrate.
- Rinse measuring containers three times, adding rinse water to the tank.
- Consider ready-to-use products to avoid the hassles / hazards of mixing.
- Use care when filling the sprayer to avoid splashes.

Applying

- Apply at the recommended rate for the application method used (e.g. delivery rate of sprayer).
- Don't eat, drink or smoke while applying pesticides.
- Avoid pesticides coming into contact with your eyes, mouth, skin or breathing spray mists.
- Don't use your mouth to siphon liquids from containers or to blow out clogged lines, nozzles, etc.
- Minimize drift by reducing the distance between the nozzle and the target area.
- Spray the undersides and tops of the leaves for the best results.

Clean-up

- Keep pets and children out of the area until the pesticide dries.
- Wash off any furniture, play equipment, etc., that may have been exposed to the spray.
- Wash gloves with soap and water before removing them.
- Wash hands and face immediately after spraying and before drinking, eating or smoking.
- Remove clothing worn during spraying and wash in a separate load before wearing them again (run an empty "rinse cycle" before washing other clothing).
- Wash eyeglasses and / or goggles.
- Shower after spraying.

Spills

- Wash and change clothes immediately if concentrated pesticide is spilled or splashed on clothing.
- Use cat litter, sawdust, soda ash or an absorbent cleaning compound to soak up spilled pesticide on the floor or ground.
- Sweep or shovel absorbent contaminated material into a plastic bag; dispose of contaminated material following the requirements of your local waste management authority.

Pesticide Storage

- Buy only enough pesticide to carry you through the use season; check expiration dates on the label (applicable to products with active ingredients that may not be stable over time).
- Store pesticides in their original containers; don't reuse an empty pesticide container.
- Never store pesticides in unmarked containers.
- Store pesticides out of reach of children and pets, in a dry, dark, well-ventilated location.
- Store flammable liquids outside your living area and away from ignition sources such as a furnace, vehicle, outdoor grill, or gas-powered tools.
- Store containers in an area protected from flooding or where they might spill or leak into wells, drains, ground water, or surface water.
- Put pesticides away immediately after use; be sure to close containers tightly.

Pesticide Disposal

- Never dispose of pesticides in storm drains or sewers, dry wells, sinks, or toilets.
- Clean pest control equipment in a location where rinse water cannot flow into gutters, storm drains or sewers, or open waterways.
- Rinse the pesticide container carefully three times and drain the rinse water back into the sprayer or the container used to mix the pesticide. Use the rinse water as a pesticide, following label directions.
- If you can't finish using a pesticide, check with your local waste management authority for appropriate pesticide disposal procedure. You can also call 1-800-CLEANUP or go to www.cleanup.org to get this information.
- Empty, triple-rinsed pesticide containers can possibly be recycled but not reused; check with your local recycling program to confirm local ordinances.

Pesticide Choices

Pesticides Allowed for Use on Roses

The changing environment of pesticide regulation at both the federal and state level, make it challenging to provide a comprehensive printed list of pesticide products that are approved for use on roses. Rather than include a printed list of acceptable materials in this Manual, go to www.ars.org for current, up-to-date information.

Non-Toxic Approaches to Pest Control

Beneficial Insects: green lacewings, ladybugs, trichogramma parasite and beneficial nematodes are some of beneficial insects that can be purchased and brought into the garden.

Low Toxicity Pesticides

Biologically-based pesticides such as microbial pesticides are becoming increasingly popular and often are safer than traditional chemical pesticides. Biological control agents (except for certain microorganisms) are exempted from pesticide regulation by EPA. Products which contain certain low-risk ingredients like garlic and mint oil are also exempt from Federal pesticide registration requirements, although State regulatory requirements may still apply.

- ***Anti-transpirants:*** used to prevent most fungus diseases. Anti-transpirants were developed to protect plants from frost, but have been found to reduce infection of fungal diseases. The anti-transpirants place a film between a fungal spore and the plant cells, providing a mechanical means of preventing fungal infection. It is important to reapply as new growth occurs.
- ***Diatomaceous earth:*** Highly effective fine dust produced from the fossilized remains of single shell aquatic plants. Soft-bodied insects come into contact or ingest these sharp edges, interfering with breathing, digestion and reproduction. It is especially good for slugs. Dust mask should be used; may contribute to pulmonary fibrosis. Signal word – Caution. Oral LD_{50} is 22,500 mg/kg.
- ***High purity horticultural oil:*** Won't harm plants, wildlife or the environment; kills primarily by suffocating insects and their eggs. It also repels insects for as long as a week. It can be used throughout the growing season but can burn foliage in hot weather.
- ***Insecticidal soap*****:** A very safe product made of the salts of fatty acids. It controls soft-bodied insects that come into contact with the wet spray and breaks down quickly with no residue. Signal word – Caution.

Biological / Mineral Pesticides

- ***Copper:*** controls common leaf spots, rust, downy mildew, anthracnose and scale. Signal word - Caution as 7% $CuSO_4$. Oral LD_{50} is 300 mg/kg.

- ***Neem oil:*** made from the extract of the seed of the Neem tree, this insecticide disrupts the hormonal balance of juvenile insects, inhibiting the desire to feed, causing death. It has a very low toxicity rating and not harmful to earthworms and animals. (Not for use on edible crops.) Signal word – Caution. Oral LD_{50} is 5,000 mg/kg, dermal LD_{50} is 50-2,000 mg/kg.

- ***Pyrethrum*****:** general-purpose insecticide from chrysanthemums. Signal word - Caution, oral LD_{50} is 75 mg/kg.

- ***Rotenone:*** general-purpose insecticide made from the roots of tropical plants. It comes in various strengths and both liquid and dust. Signal word - Danger/Caution, oral LD_{50} is 132-1,500 mg/kg.

- ***Ryania:*** An insecticide that is a stomach poison made from a South American shrub. It is very toxic to dogs, signal word – Caution. LD_{50} is 1200 mg/kg.

- ***Sabadilla:*** A broad-spectrum contact poison - dust or spray that controls hard shell insects by affecting the nerve cells of insects, causing paralysis and death. It degrades quickly in air and sunlight. Highly irritating to the eyes and can produce sneezing if inhaled. Toxic to bees. Signal word – Caution. Oral LD_{50} is 500-5,000 mg/kg.

- ***Spinosad:*** produced from the fermentation of the soil microbes; a fast-acting insecticide that is effective at low concentrations. Signal word – Caution.

- ***Sulfur:*** remedy for fungus diseases. It comes in a dust form or liquid and is especially effective in a combination formula with lime. Signal word – Caution.

The American Rose Society is not responsible for any recommendations made by Consulting Rosarians that are contrary to the Consulting Rosarian Manual. The American Rose Society cautions all Consulting Rosarians to abide by their state and federal laws concerning chemical control.

PESTICIDES ALLOWED FOR USE ON ROSES

The following pesticides have been approved for use on ornamentals and roses. However, there may be some restrictions or special licenses required for their use. Please check with your state or local county agriculture departments before using or recommending to others. For mixing instructions, please refer to the pesticide label. NEVER use more than the label recommends. It is a violation of federal law to use any of these products in a manner inconsistent with its labeling. For further information, labels and Material Safety Data Sheets (MSDS), go to the www.greenbrook.net/free.asp website.

INSECTICIDES & MITICIDES	FUNGICIDES
Avid 0.15 EC (2.0% Abamectin)	**Aliette** (Aluminum Tris)
Azatin EC (3.0% Azadirachtin)	**Banner Maxx** (14.3% Propiconazole)
Bioneem (Same as Margosan-O)	**Bayleton** (25% Triadimefon)
Conserve SC (Spinosad)	**Benomyl** (50% ai)
Cygon 2E (Dimethoate)	**Captan 50W**
Diazinon (25% ai)	**Cleary's 3336-F** (Thiophanate-Methyl)
Di-Pel (bacillus thuringiensis)	**Compass** (50% Trifloxystrobin)
Isotox Formula IV (Orthene and Vendex)	**Daconil 2787** (29.6% Chlorothalinol)
Margosan-O (0.25% Azadirachtin)	**Eagle** (40% Myclobutanil)
Malathion (50% ai)	**Fore** (80% Mancozeb)
Mavrik Aquaflow (22.3% Fluvalinate)	**Fung-Away** (0.88% Triadimefon)
Merit (0.2% Imidacloprid)	**Fungi-gard** (11.24% Chlorothalinol)
Orthene (9.4% Acephate)	**Funginex** (6.5% Triforine)
Orthene 75% WP	**Funginil** (11.24% Chlorothalinol)
Orthenex Formula III	**Immunox** (1.55% Myclobutanil)
Ortho Bug-B-Gone (0.075% Diazinon)	**Mancozeb** (75% ai)
Ortho Rose & Flower (0.012% Bifeuthrin)	**Pace** - (Combination of 7.0% Metalaxyl and 70.0% Mancozeb)
Safer Insecticidal Soap (Potassium salts of fatty acids, or Pyrethrum)	**Rubigan EC** (Fenarimol)
Sevin (22.5% Carbaryl)	**Sentinel** (Cyproconazole)
Stirrup M - Pheromone (sex attractant)	**Strike** (Same as Bayleton)
Sunspray Ultra-Fine Spray Oil (Refined petroleum distillate)	**Subdue 2E** (25.1% Metalaxyl)
Vendex 50 WP (Feubutalin Oxide)	
Volck Oil (97% Petroleum Oil)	

Credit: Robert B. Martin, Jr.

ai-active ingredient; **DF**-dry flowable; **E/EC** emulsifiable concentrate; **F/FL**-flowable; **G**-granule; **W/WP**-wettable powder

ACKNOWLEDGEMENTS
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Southern Agricultural Insecticides, Inc.
Robert B. Martin, Jr., Escondido, California

Notes

Notes

Chapter 9 – Major Insect Pests

Identifying insects by the damage they do is an important first step in dealing with the problem. Most chewing and sucking insects such as aphids, rose chafers, leafhoppers, etc., are easily identified by the damage they do.

However, there are a few insects that are more difficult to identify and may require specific treatment to control or eliminate. If there is a particular insect that presents a problem in your area, learn about it so you can share that knowledge with others.

Some insects are very localized and will not be covered by this chapter. The insects mentioned here are those that affect roses and are prevalent across most of the United States. If you have an insect you are not sure about, contact the local entomologist at your county or state agricultural extension department for positive identification. There are also several excellent web sites on the internet with photos of rose pests. See IPM Table on Rose Insects and Color Plate on Rose Insects at the end of this Chapter.

As described in Chapter VII, *Pest Control Basics*, the progressive approach to managing the major insect pests of roses begins with the least toxic method and moves up the pyramid - cultural, mechanical and physical, biological and finally, chemical methods.

Approaches for Managing Sucking and Chewing Insect Pests

Cultural Methods:

- Maintain healthy and vigorous plants through proper soil health and cultivation, watering, fertilizing, pruning, mulching and good garden sanitation.
- Go light on chemical fertilizers high in nitrogen - lush new growth is an attractant to both sucking and chewing pests; use less soluble forms of nitrogen and apply it in small portions throughout the season rather than all at once.

Mechanical and physical methods

- Knock soft-bodied insects to the ground with a blast of water.
- Prune damaged areas out of the plant and dispose of them.
- Hand-pick adult forms of pests and drop them in a container with soapy water.
- Put a band of sticky material (e.g., *Tanglefoot* or Teflon products) around the base of the plant to prevent the ants from getting up.

Biological methods

- Improve the habitat for natural enemies – predatory insects such as ladybugs, soldier beetles and green lacewings, and parasitoid insects that lay eggs in pests.
- Create or enhance habitats for birds, lizards and toads.
- Use microbial based products such as *Dipel DF*; they contain bacteria (*Bacillus thuringiensis*) pathogenic for a range of caterpillars, leafrollers and Japanese beetles.
- Beneficial nematodes may offer control for some types of caterpillars, leafminers and rose chafers.

Chemical methods

- Apply a dormant spray with horticultural oil to help reduce pests from overwintering.
- Use an insecticidal soap that contains potassium salts of fatty acids as the active ingredient to manage soft-bodied pests.
- Try products made from neem seed (with the active ingredient azadirachtin); they are approved to control a range of insects when in the larval, pupal and nymphal stages; the active ingredient is a growth regulator / inhibitor and does not affect beneficial insects.

For more specific information on individual insecticides and miticides, see the Pesticide Table available on the ARS website.

Aphids

Aphids are small insects that may have wings, about 1/8-inch long. There are a variety of shades from lemony yellow through greens into pinks and reddish-brown. They are the most common of all rose insects, and appear throughout the spring and fall. They suck the plant juices from tender parts of the plant, with new foliage, buds and peduncles being the most common locations.

Aphids are also found on other plants. They excrete honeydew, a sweet sticky substance that attracts ants and favors the growth of sooty mold. They are prolific breeders and multiply rapidly in warm weather.

Symptoms: Damage is rather minor compared to other insects. The sticky honeydew makes foliage unsightly, and the mass of aphids on a plant are just as unsightly.

Control: Aphids are easily managed; washing the plant with a stream of water will knock the aphids off the plant, and since most cannot fly, they will not be able to return to the plant.

[Rose aphid -*Macrosiphum rosae*, cotton aphid - *Aphis gossypii*, potato aphid - *Macrosiphum euphorbiae]*

Cane Borers

There are several wasps and bees that nest in the pith of cut rose canes. These insects bore a hole down the middle of the pith in order to make their nests; thus they are often called "cane borers." The two most common "cane borers" are small wasps. They are active boring their nests in cut rose canes from spring through early fall.

***Symptoms*:** Damage from the borer is easily seen. Even a casual observer will notice the hole in the center of a cut cane. The hole may only be a few inches deep or down to the crown of the plant.

***Control*:** Because the most common "cane borers" are predators of aphids and use them as food for their young in the nest, keeping aphids under control will remove the food source and the wasps will go somewhere else where there is plenty of food to supply their nests. In the meantime, damaged canes should be cut below the nest to prevent a new crop of twig nesting wasps from maturing. It makes more sense to prevent the borer damage by sealing each cut cane with a waterproof product. Many rosarians find waterproof wood glue effective with no damage to the cut cane. Pruning paint may cause damage and is unsightly, so test it on a few cuts first.

[Flatheaded borers -*Chrysobothris* spp., raspberry horntail - *Hartigia cressoni*]

Chilli Thrips

The chilli thrips or yellow tea thrips is an extremely successful invasive species of pest-thrips that have expanded rapidly from Asia over the last twenty years, and is gradually achieving a global distribution. It is a pest of economic significance with a broad host range, with prominent pest reports on crops including pepper, mango, citrus, strawberry, grapes, cotton, tea, peanuts, and roses.

Symptoms: Chilli thrips appear to feed preferentially on new growth, and infested plants usually develop characteristic wrinkled leaves, and a distinctive brown scarring along the veins of leaves, the buds of flowers, and the calyx of fruit. Feeding damage from pests in sufficient numbers can kill plants already aggravated by environmental stress. This thrips has also been implicated in the transmission of three tospoviruses, but there is some controversy over its efficiency as a vector. With its rapid life cycle, it can develop from egg to adult in slightly less than two weeks under optimal weather conditions.

Control: Without a good control strategy, chili thrips can be a difficult pest to manage. There are a number of insecticides available to control this pest. Foliar applications of systemic insecticides have proven more effective in controlling this pest than soil drenches. Since chili thrips feed on new growth, it is important to spray when the plant is actively growing. The thrips are generally not present on older damaged leaves, thus pruning of infected plant to stimulate new growth may be warranted. Systemic insecticides should be applied as a foliar spray.

Resistance management strategies must be used. Such strategies may include, but are not limited to, rotation of products with different modes of action, avoid treatment of successive generations with the same products. On severely infested plants, an initial spray program may include a treatment with a spinosad product, followed 7 to 10 days later by a neonicotinoid, and 7 to 10 days afterwards by the application of an organophosphate. Non-chemical alternatives such as beneficial arthropods and various cultural practices are recommended.

[Chilli thrips or yellow tea thrips - *Scirtothrips dorsalis HOOD*]

Flower Thrips

Flower thrips are very active, tiny, slender brownish yellow winged insects, just visible with the naked eye. They hide inside buds and blooms and damage the petals with their rasping mouthparts. They seem to prefer lighter colored blooms and attack the bloom when it is still a bud. This makes control difficult as they hide inside an unopened bloom.

Symptoms: Damage to the petals caused by the rasping mouthparts of thrips as they suck sap from the petals. On examination the small slender insects can be found inside the flower.

Control: When using an insecticide, the buds and top foliage should be sprayed.

Western flower thrips - *Frankliniella occidentalis*, Madrone thrips - *Thrips madroni*

Grasshoppers

Grasshoppers chew holes as they feed on new rose foliage. Longhorned grasshoppers or katydids are most common on roses from young psychedelic-looking nymphs to adults. Their green color makes them difficult to see on rose foliage, but, as with other grasshoppers, they are often seen hopping from one leaf to another from spring to fall months.

***Symptoms*:** Large irregular sections of leaf edges removed.

Control: Grasshoppers are controlled better by hand picking, birds and animals than spraying for them.

[Grasshoppers – too many species to list]

Japanese Beetles

The Japanese beetle actually came from Japan in the early 1900s and was first discovered in New Jersey. Today it is found in more than half of the states, largely in the eastern half. It is a medium-sized, beautiful insect until you see many of them clustered on a rose bloom. They feed on many plants besides roses and appear from June through August. They will feed on rose buds, blooms and leaves with a great appetite.

The female lives 30 to 45 days, lays 40 to 60 eggs, mostly under grass roots in lawns. The grubs hatch in 10 to 12 days, feed on grass roots until cold weather, then move down in the soil 8 to 10 inches to avoid freezing. They move upward in spring, feed on grass roots until pupation and then mature. The grubs are grayish white with brown heads and are usually found in a curved position. When the weather warms up in June - July, they emerge from the soil to devour flowers and foliage.

Symptoms: Dead spots in the lawn may be an indication of a colony of Japanese beetle grubs and should be treated. The beetles are visible during the day, feeding on the foliage and blooms.

Control: The bacterial milky diseases, *Bacillus popilliae* Dutky, has been quite effective at controlling the grubs in certain areas of the eastern United States. The spore count must build up for 2 to 3 years to be very effective and during this time you should not use an insecticide against the grubs that are needed to complete the bacterium cycle. In Ohio and Kentucky, test trials have not produced satisfactory results. Additional experiments are needed to determine the lack of efficacy of milky disease in these soils.

Insect parasitic nematodes are commercially available. Products that contain strains of *Steinernema carpocapsae* have been marginally effective against white grubs in turf. Preparations containing *Heterorhabditis* spp. seem to be more effective. Apply the nematodes when the white grubs are small. Irrigate before ***and*** after applying the nematodes.

The grubs are best controlled when they are small and actively feeding near the soil surface, usually late July to mid-August. (e.g., Control of grubs in late-fall or early-spring is difficult, at best, because the grubs are large and may not be feeding. The key to good control is to make an even application and water thoroughly.

Japanese beetles are members of the scarab beetle family. There are localized members of this family such as hoplia beetles, which are indigenous to the Sierra foothills in California. Other scarab beetles are the southern and northern rose chafers, Chinese rose beetles (Hawaii) and Asian garden beetle.

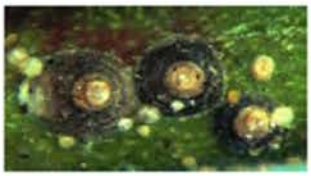
[Japanese beetles - *Popillia japonica*]

Rose Insects

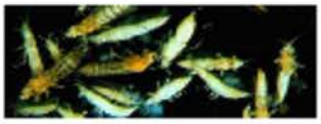
Aphids

Whiteflies

Bristly Rose Slug



San Jose Scale



Thrips

Midge Damage

European Rose Slug

Katydid

"Cane Borer" Wasp

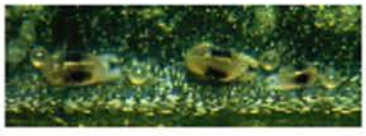
Rose Weevil

Japanese Beetles

Cucumber Beetle

Raspberry Stem Sawfly - Adult

Leafcutter Bee - Adult



Two-Spotted Spider Mite

Credit: Baldo Villegas, Orangevale, California

Leaf Cutter Bees

These bees are rarely seen, but they leave signs of foliage damage behind. They cut sections out of rose foliage and use it to line their nests. About the size of a honeybee, these bees are excellent pollinators of crops like alfalfa.
Symptoms: Perfectly cut semi-circles on leaf edges. Little other damage; more aesthetic.
Control: These insects are difficult to control. Often they prefer the leaves of a particular rose. Control by insecticides is questionable.
[Leafcutter bees - *Megachile* spp.]

Leafhoppers

These tiny hopping insects are about 1/4-inch long. They suck juices from the undersides of rose foliage.
Symptoms: Small white or brown stippled areas show on the top leaf surfaces as leafhoppers mainly feed underneath the leaves.
Control: Spray roses with a systemic insecticide. If a contact insecticide is used, make sure to cover the undersides of the leaves.
[Rose leafhoppers - *Edwardsianna rosae*]

Rose Midge

The rose midge was found in gardens in the early 1900s and is now found throughout many states. The adult is minute (less than 1/8 of an inch long) and lays eggs on succulent new growth and under sepals of flower buds. In two days they hatch and feed on the new growth causing it to turn brown and die, preventing the development of a bud. Midges reach maturity in about a week and fall to the ground to pupate in tiny cocoons. In three to seven days new adults emerge to start the cycle over again. A garden infested with midge will have few if any blooms, as most immature buds will be destroyed.
Symptoms: The telltale sign, a tiny crisp, burnt-like bit of foliage at the tip of new growth, is often the first sign of a midge infestation.
Control: Weekly examination (monitoring) of the rose plants in the early spring is essential in areas known to be infested with rose midge. At the first indication of midge, it is advisable to treat the rosebeds and roses with insecticidal treatments as recommended on the product label for rose midge.
[Rose midge - *Dasineura rhodophaga*]

Rose Slugs

These are the larvae of primitive plant feeding wasps called sawflies. Rose slugs look like caterpillars but they are not. When fully grown they are about half inch in length.

There are two main members of this family, the bristly rose slug, which is covered with small hair-like bristles, and the European rose slug, which is smooth and greenish-yellow in color. Depending on the species they may skeletonize the rose leaves and may chew holes on the leaves when fully grown. They are among the earliest of the insects to emerge in the spring.
Symptoms: The larvae of the European rose slug feed on the upper surface of the leaves causing skeletonizing damage where the green tissue is eaten away. Larvae of the bristly rose slug are found on the undersides of the leaves where they skeletonize the leaves in the early stages and cause holes on the leaves when the larvae are larger.
Control: Act quickly to stop their extensive damage. Most contact insecticides are very effective when the foliage is thoroughly sprayed.
[Rose slug - *Endelomyla aethiops,* bristly rose slug, *Cladius difformis*]

Scale

Scale insects do not look like typical insects but more like a disease. There are several species that attack roses. They are round, hard dirty white, gray or brown shell-covered insects that suck sap from the stems and foliage of roses.
Symptoms: They are evident singly or in clusters on mature rose stems and may cause stem discoloration, wilting of foliage, and a general weakening look to rosebushes.
Control: Prune out and destroy all infested stems and leaves. . If this is a serious problem in your area, horticultural oil sprays can be very effective.

There are numerous members of this family; they range from the virtually harmless cottony cushion scale to the devastating San Jose scale. Proper identification is key here.
[Cottony cushion scale, *Icerya purchasi*, rose scale – *Aulacaspis rosae,* San Jose scale – *Quadraspidiotus perniciosus*]

Spider Mites

Spider mites are not insects, but relatives of the true spider (arachnids). The two-spotted spider mite is the most common species found on roses. They are especially prevalent in hot dry weather and difficult to control if they get a foothold. They feed by sucking sap from leaves and other tender parts and can eventually defoliate the plant. It is important to recognize the symptoms and deal with the problem before the infestation gets out of hand.

Symptoms: The first sign will be a lightening of the lowest foliage as the mites suck the sap. If the affected leaves are shaken over a piece of white paper the tiny spider mites can be seen as small dots. Under a microscope or a strong magnifying glass, two dots are seen on the mite's back. Many tiny webs (webbing) and eggs will also be noticed on the underside of the leaf.

Control: A light infestation may be easily controlled with a forceful spray of water to the undersides of the leaves. This must be done three to four times per week for effective control. There are several miticides available, some more effective than others. Miticides that do not kill the spider mite eggs must be sprayed at frequent intervals for a period of time to eliminate the mature and hatching mites. Eggs will hatch in two to three days at 75 degrees and above and in 21 days at 55 degrees.

Insecticidal soap and insecticidal oils can be used for the control of spider mites but since they have contact action they need to be sprayed toward the lower surfaces in order to cover the spider mites. It helps to remove the affected foliage before spraying. The spray material must be directed to the underside of the foliage.

Mites can become resistant to a chemical and it may be necessary to change miticides from time to time. Spraying before applying winter protection is advisable as mites winter over in protected spots in the garden. Many plants can serve as alternate hosts for spider mites. They should be checked and treated if necessary to keep spider mites under control. Because insecticides used for other rose pests also kill the natural enemies of spider mites, diminish the use of broad-spectrum insecticides and only spray insecticides when absolutely necessary.

[Spider mites -*Tetranychus* spp. include two-spotted mite, Pacific mite and strawberry mite.]

Before Using Any Pesticide Suggestions Made in this Manual,
Check with Your State EPA or County Agriculture Department
For Restrictions.

Acknowledgements:
Diagram Reprinted with Permission from:
Root of the Problem, Jackson & Perkins, 2001
IPM Table Courtesy of:
Baldo Villegas, Orangevale, CA
Photographs Courtesy of:
Baldo Villegas, Orangevale, CA
Steve Jones, Valencia, CA

INSECT PROBLEMS

SYMPTOM	CAUSE	REMEDY
Masses of bugs on the buds and leaves	Aphids - green, red or black soft bugs, about 1/8th" long, found clustered mostly on new growth. They appear in spring and can remain all summer	Most insecticidal sprays, including insecticidal soap, are effective. Aerosol insecticides labeled for plant pests will also work: spray up-wind and allow the mist to drift through the plant. Or simply hose off the insects when you water
Blooms are shredded, discolored or buds distorted	Thrips -light brown insects, very slender, about 1/8". Squeeze an open bloom and watch the inside of the petals for movement Thrips move quickly. They are spread by wind	Apply systemics containing acephate at disulfoton when I" or more of new growth has occurred in spring. Contact treatments of pyrethrins, pyrerthroids or other pesticide types can be used on a rotational basis when buds are pea-sized.
Leaves stuck together, unopened buds with holes bored into them	Omnivorous leaf roller - a moth larvae that makes a cocoon-like structure with leaves	Use B.t. (*Bacillus thuringiensis*) or systemics as previously explained for thrips
Leaves appear fuzzy yellow on surface, under-side has small red specks, webbing or spider-like insects moving about. (Best seen with a magnifying glass.)	Spider-mite (red spider or 2-spotted mite). Microscopic in size, bur visible to the naked eye. Hot weather is prime spider-mite season. Activity increases or decreases with temperature changes.	Apply insecticidal soap, spray oils, miticides or high pressure hose water. All treatments must be applied to the underside of leaves in order to come in contact with the mites
Circular pieces cut from leaf margins.	Leaf cutter bees - they use the circular leaf pieces for egg partitions inside the burrowed cane	Controlled by applying white glue to the cane ends. NOTE: Leaf cutter bee is a beneficial, effective garden pollinator. Our suggested damage prevention measure is preferable to eradication.
Leaves have been eaten leaving either skeleton structure or mid-ribs. Unopened flower chewed and open buds dammed.	Beetles - most notorious is the Japanese beetle, metallic brown with a green head (Caterpillars can also cause the same symptoms).	Sprays, dust and 'shaking'. Sprays of Carbaryl (Sevin) or Rotenones are somewhat effective. Apply Bp (*Bacillus papilliae*) or 'milkly spore' when the problem is first detected in spring or late summer. Neem oil, a new natural insecticide, or its derivative Azadirachtin, has shown some limited control. A practical, yet effective approach is to spread cloth or plastic on the ground and sake the beetles off the plants. Traps can also be effective if placed away from your roses.
Drooping, unopened buds, accompanied by a small discolored stem slightly below the bud.	Rose Midge - a small fly that pupates in the ground below the bush, then flys up and lays eggs in the soft upper stem. The hatched larvae eat the stems and cause breakage. The worm then drops to the ground to complete the last stage of metamorphosis into a fly.	Spread systemic granules on the ground below the bush to control this pest. Sprays are of limited value here because of midge life stages in the ground.

Credit: *Root of the Problem,* Jackson & Perkins, 2001

IPM OF THE COMMON INSECT, SPIDER MITE, AND MOLLUSK PESTS OF THE ROSE GARDEN

PEST	CHEMICAL CONTROL MEASURES	OTHER ALTERNATIVE CONTROL MEASURES
Aphids - several species may be involved depending They feed on tender plant growth throughout the growing season. They are most common during the spring months.	1. Spray infested plants with insecticidal soaps or botanical insecticides like pyrethrum as needed. 2. Spray with contact or systemic insecticides for longer residual control.	1. Physically dislodge them by hand or with water sprays as needed. 2. Control ants that may interfere with beneficial natural enemies. 3. Conserve and augment native natural enemies e.g., parasitic wasps, lady-bugs, predaceous flower flies, etc. 4. Biological control, e.g., lacewings.
Spittlebugs - immature stage of a brown leafhopper-like insect makes the unsightly spittle-like froth. They appear to cause very little damage to the plant and might not need to be controlled.	If control is needed, wash spittle/froth with water spray; then either spray with a) insecticidal soaps or botanical insecticides or b) contact or systemic in-secticides for longer residual control.	Wash spittle/froth and immatures off the plants with water spray.
Leafhoppers - several species may be involved. Immatures and adults suck sap from the stems and leaves; immatures are usually found on the undersides of the leaves.	1. Spray infested plants with insecticidal soaps as needed. 2. Spray with miticides for longer residual control.	Conserve and augment native natural enemies e.g., parasitic wasps, and predaceous insects (e.g., small pirate bugs, big-eye bugs, predatory thrips, etc) and predaceous mites.
Scale insects - several species may be present and feeding on stems and leaves. In general scale insects take several seasons to build up populations high enough to cause death of rose canes. Sudden increases may be due to the presence of ants that interfere with natural biological control. Some common scales includes: rose scale, San Jose scale, black scale, soft-brown scale, cottony-cushion scale, etc.	1. Spray infested plants with a dormant oil spray. 2. Spray infested plants with insecticidal soaps or botanical insecticides like pyrethrum as needed. 3. Spray with contact or systemic insecticides for longer residual control.	1. Physically dislodge them by hand as needed. 2. Control ants with ant baits, sticky bands, or contact insecticides. Ants may interfere with natural control by beneficial natural enemies. 3. Conserve and augment native natural enemies e.g., parasitic wasps and flies, some species of lady beetles, etc. 4. Depending on species involved, biological control methods can be used.
Two-spotted spider mite - most common from May through fall; however, they may be endemic in the garden. They suck the sap from individual cells creating a bronzing appearance of the foliage. Spider mites produce distinctive webbing material on the under side of the leaves.	1. Spray infested plants with insecticidal soaps as needed. 2. Spray with miticides for longer residual control. Check the label of contact and systemic insecticides for miticidal action. Note: Certain insecticides like carbaryl (Sevin) and acephate (Orthene) have been recorded as inducing spider mite outbreaks. If you use these insecticides, monitor closely for spider mites.	1. Monitor garden for mite activity by checking the underside of leaves on a weekly basis. 2. Wash off the underside of the foliage with a water wand about three times per week or as needed. 3. Effective natural enemies are available commercially, but they need to be introduced into the garden early in the season.
Thrips - Immatures and adults feed by rasping petals of light colored roses. They may also feed on stems and foliage.	Same controls as above.	Same controls as above.
Snails and Slugs - stem and foliage feeders; they walk on their stomach and are active at night leaving a distinctive silver trail. During the day they hide in dark, moist protected areas. 1. Brown Garden Snail 2. Slugs - various species	Apply available slug and snail pesticides. Molluscicides like Sluggo appear to be the safer than those containing metaldehyde like Deadline.	1. Place physical barriers around rose beds, trunks, and even pots; Copper bands and a new stickum containing Copper Sulfate are available. 2. Decollate snails can be used as a biological control agent of brown garden snails in some areas. 3. Trap and dispose of them.
Leaf-cutter bees - these bees damage the rose leaves by cutting pieces of leaves from the margins from June through August.	No chemical control recommended as these insects are considered beneficial natural enemies.	No alternative controls known.

(IPM continued)

Rose Midge - Very tiny gnat-like insect found mainly In The NE United States, WA, OR, and now CA. Larvae feed on Immature buds of roses, turning the tips brownish. Several generations per year. Rose midge pupae are found on the soil near the rose plants.	1.Spray infested plants with botanical insecticides like pyrethrum as needed. 2. Spray with contact or systemic insecticides for longer residual control. While spraying, direct some of the spray toward the soil around the drip line of the rose plants to kill emerging adults.	1. Monitor/check the growing tips of roses containing the immature buds for sign of rose midge in early spring. Rose midge damage looks as if the growing tips were burned. Small rose midge larvae kill the immature buds. Yellow sticky traps may be used for monitoring adult emergence from the soil. 2. Monitor emergence dates of adults and larval activity on the immature buds for 2-3 years; apply soil sprays 2-3 weeks prior to adult emergence in the spring; time sprays with the presence of larval activity in the immature buds thereafter; do not apply sprays based on calendar dates.
Beetles - there are several beetles that may be pests of roses depending on the area. Not all of them occur in the same growing region. 1. Hoplia beetles - present only from late April through June. 2. Spotted cucumber beetles - occasional from May through fall.	1. Spray infested plants with botanical Insecticides like pyrethrumas needed. Inorganic insecticides such as *Kryocide* may be another less toxic alternative. 2. Spray with contact or systemic insecticides for longer residual control.	Physically dislodge them from the flower petals by hand and crush them as needed.
Rose Curculio [Rose weevil]- April through June. Adults drill feeding and ovipositing holes on buds; larvae feed on petals then fall to the ground to overwinter and pupate. This weevil may be a big problem among rosarians who don't cut back spent bloom.	Same chemical controls for hoplia and cucumber beetles apply to rose curculio.	1. Physically dislodge them from the flower petals by hand and crush them as needed. 2. Conserve and augment native natural enemies e.g., predaceous thrips, black hunter bugs, etc. 3. Parasitic nematodes might be used as a biological control. Rose curculio overwinters as larva/pupa in the soil. This is an alternate control strategy in rose gardens with endemic population of this weevil.
Caterpillars - several species may be involved depending on the season and region. They feed on stems, foliage, and flowers.. 1. Fruit-tree leafrollers - late March - April. 2. Tobacco budworms - occasional from mid April through fall	1. Spray infested plants with microbial insecticides containing Bacillus thuringiensis or with botanical insecticides like pyrethrum as needed. Inorganic insecticides such as Kryocide may be another less toxic alternative. 2. Spray with contact or systemic insecticides for longer residual control.	1. Dormant sprays on fruit and shade trees may have some control on overwintering egg masses of fruit-tree leafrollers. 2. Monitor/check rose bushes near fruit and shade trees from mid March - April for leaf-folding or leafroller activity. 3. Time sprays with the presence of caterpillar activity in the rose garden; do not apply sprays based on calendar dates.
Rose Slugs/Rose Sawflies - The larvae of these sawflies are commonly called roseslugs. They look like caterpillars and feed on foliage making holes on the leaves and skeletoniz-ing them. There are three species - bristly roseslug; Euro-pean roseslug; and curled roseslug. The adults are called sawflies; they are primitive wasps.	1. Spray infested plants with botanical insecticides like pyrethrum as needed. Inorganic insecticides such as *Kryocide* may be another less toxic alterna-tive. 2. Spray with contact or systemic insecticides for longer residual control.	1. Monitor/check rose foliage, especially lower leaves in early spring for roses-lug activity. 2. Time sprays with the presence of roseslug activity in the rose garden; do not apply sprays based on calendar dates. 3. Physically dislodge them from the flower petals by hand and crush them as needed.
Raspberry Stem Sawfly Wasps - active in late April through June. Female wasps lay eggs on tender canes about 4- inches from their tips. The larvae girdle the cane and the cane tip droops over due to lack of liquids from the base of the cane.	1. Spray infested plants with botanical insecticides like pyrethrum as needed. 2. Spray with contact or systemic insecticides for longer residual control.	1. Check plants for distinct egg punctures 4-inches from the tips of tender canes. The egg punctures look like raised blisters on the stems. The eggs can be punctured with a needle. 2. Time insecticide applications with the first sign of drooping canes. Systemic insecticides appear to give a better control than contact insecticides. The shorter spray interval on the insecticide label may be needed for adequate control.
Cane-borers [Twig-nesting wasps/bees] 1. Aphid predators - March through fall 2. Fly predators [Ectemnius spp.] - May through fall.	No chemical controls recommended as these insects are considered beneficial natural enemies.	This type of "cane borers" can be discouraged from coming into the rose garden by keeping the aphids under control. Without food, these wasps will go to somebody else=s rose garden that has lots of aphids and plenty of rose canes that can be used as nesting substrates. You can also exclude these twig nesting wasps by sealing the ends of recently pruned canes during a sunny day.

Credit: Baldo Villegas, Orangevale, California

Notes

Chapter 10 – Diseases

This chapter discusses the major diseases of roses. As with insects, identification is key importance to treatment. If you are not sure, contact other Consulting Rosarians or your local Agricultural Department representative. *See IPM Table on Rose Diseases and Color Plate on Rose Diseases at the end of this Chapter.*

Powdery Mildew

Causal Organism: *Sphaerotheca pannosa* (Wallroth ex Fr.) Lév. var. *rosae* Woronichine
Powdery mildew is one of the most prevalent and serious diseases of roses. It is usually serious in dry climates like California, but can occur as well in more humid regions over a wide range of temperate conditions. While no complete resistance is observed, some roses appear to be more susceptible than others.

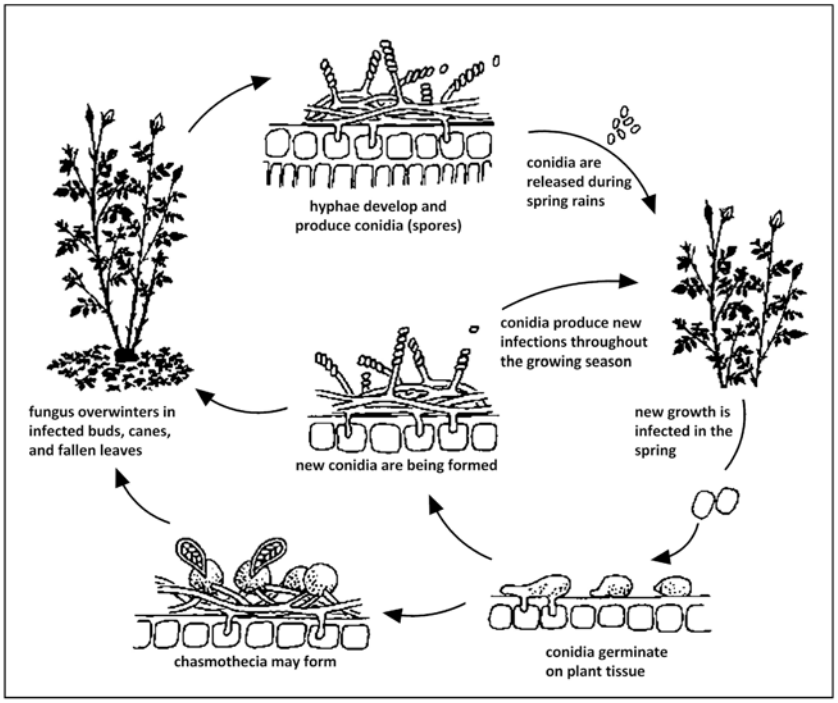
Symptoms: The first symptoms appear as slightly raised blister-like areas on the upper leaf surfaces. Later, the young expanding leaves become twisted, distorted and covered with a white powdery mass of mycelium and spores. Young peduncles, sepals, petals and stems may also show distortion while growing tips and buds may be killed. Infected older leaves and stems may remain symptomless.

Disease Cycle: The fungus can overwinter as spores on infected stems or leaves. As conditions warm in the spring, dormant spore become active. The white fuzzy growth on the leaf surface contains thousands of fungal spores. Wind carries these spores to young leaves, causing more infection.

Optimum conditions for spore germination are 71°F and 98% relative humidity. Temperatures above 90°F will inhibit spore germination. After spores germinate they penetrate the surface of the leaves forming a fungus structure that takes the nutrients from the plant. Successful infection will result in further development of the disease.

Air movement is important in dispersal of the spores. Closely planted gardens with some air movement are ideal conditions for spread of this disease. Spore maturation and release usually occurs during the day when relative humidity is low. At night an increase in relative humidity favors spore germination and penetration of the fungus. Cool damp nights and warm sunny days favor the development of powdery mildew.

Life Cycle and Stages (magnified) of *Sphaerotheca pannosa* Infecting a Rose

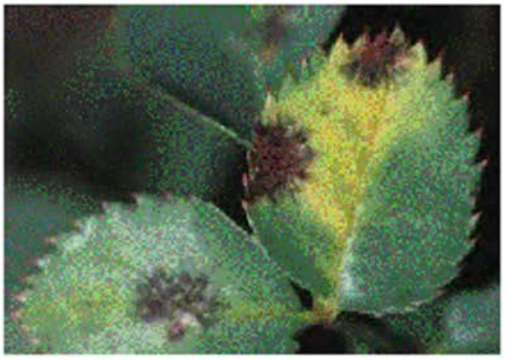


Credit: Adapted from IPM for Floriculture, Oakland: Univ. Agric. Nat. Res. Publ. 3402

Control: Dormant pruning and cleaning up old leaves can remove substantial amounts of primary inoculum. *Sanitation* should always be the initial means of control. When roses are pushing new spring growth, the conditions for disease development are also favorable. At this time, protection can be gained from the use of fungicidal sprays applied at seven to ten-day intervals. Removable of diseased foliage can be useful under certain conditions. Fungicides in a wettable powder formulation may provide better coverage if used with a spreader sticker; most flowable formulations already have this property. While the old standby lime sulfur is a good protectant fungicide, it may burn foliage under warm conditions. Several new fungicide products now claim to have some systemic and eradicative properties, but don't expect to cure a severe disease situation. Fungicides will work best in the initial stages of disease development, not after massive infection has already taken place. Remember, fungicides are chemicals that have a degree of toxicity and should only be used when needed and strictly according to the label.

Rose Diseases

Anthracnose



Blackspot

Powdery Mildew

Downy Mildew

Rose Virus

Rust

Rose Rosette

Botyritis

Credit: Baldo Villegas, Orangevale, California

Black Spot

Causal Organism: *Diplocarpon rosae*

This disease may also be called leaf spot, leaf blotch, star sooty mold and several other names. It is the most common or prevalent disease of outdoor roses on a worldwide basis. The fungus has probably been widely distributed with cultivated roses and no really complete resistance is believed to exist.

Symptoms: Small black spots of 2 mm (1/125-inch) diameter can be found on upper leaf surfaces as well as immature canes. These spots are black and sooty enlarging to 12 mm (1/20-inch) with generally circular appearance having a feathery edge. Further development involves the appearance of yellow margins around the spot and a yellow condition that can extend into the entire leaf. Late in the growing season, defoliation can occur along with purple red, raised irregular blotches on immature wood.

Disease Cycle: Black Spot is spread by splashing water. Infection occurs after leaves are wet for several hours. Therefore, the disease is more serious during periods of rainfall. The Black Spot fungus overwinters as spores on infected canes and leaves that have fallen and been left on the ground. Autumn cleanup is crucial, otherwise the entire cycle can repeat itself the following spring and summer. In the spring, overwintering spores are splashed up onto newly emerging foliage during rains or irrigation and cause primary infections on the new leaves. Within about two weeks after the primary infections, structures form within lesions and produce spores which cause secondary infections throughout the growing season. The fungus produces infectious spores throughout the year, causing repeated infections in warm, wet weather. Leaves less than two weeks old are the most susceptible to this disease. Defoliation brought on by Black Spot is worse during wet weather, especially humid weather. The fungus becomes active in a wet environment with a temperature of about 75 degrees Fahrenheit. It needs about 7 hours of these conditions to germinate and then symptoms will begin to appear on rose foliage within three to ten days. Usually the lower and inside areas of the plant are more likely to be infected because these areas have longer time periods when water is available on leaf surfaces allowing the germination and penetration of the fungus.

Control: Dormant pruning, removal of attached leaves and cleaning up old leaves under the bushes can do much to reduce the overwintering inoculum. A well-aerated site will do much to reduce disease incidence by preventing the occurrence of free water on the foliage for long time periods. Pruning to allow air movement and watering without wetting the foliage could also be important means of prevention. Some roses may be more resistant than others, but specialized races of the fungus quickly arise. When conditions are favorable in early spring, protectant sprays can be used on a one-week interval or after periods of rain to prevent infection. Surfactants may allow the active materials to spread more evenly on plant surfaces and persist longer during periods of precipitation.

Downy Mildew

Causal Organism: *Peronospora sparsa*

Downy mildew is a very common disease of roses which occurs under moist cloudy conditions. The disease is found throughout the United States, Europe and South America. All species of cultivated and wild roses seem to be susceptible.

Symptoms: Under cool and moist spring conditions, young leaves, stems and flowers may manifest purple to red or brown irregular spots. As the disease advances, lesions on leaves become angular and black with the possible appearance of white mycelium on the underside of the leaf. Advanced infections will have yellowing of leaves with brown necrotic areas and noticeable leaf abscission. The blotches tend to form between the interveinal areas. As the scientific name indicates, the production of spores is sparse and therefore this disease is difficult to diagnose. Along the coast of California where moist cloudy conditions persist through summer, the disease is severe and can occur on large canes as purple irregular blotches. One of the primary symptoms of downy mildew is that leaf drop begins at the top. No other disease seems to damage roses in this manner.

Disease Cycle: The fungus over-winters as spores in or on plant parts. Germinating spores swim in free water on the plant surfaces until re-infecting the plant. The infection progresses toward the development of new outbreaks. Cool, wet, high humidity weather favors downy mildew development. Dense canopy growth and tight plant spacing encourages downy mildew spore production on the

lower leaf surface. Splashing water from overhead irrigation or from rain fall not only splash downy mildew spores from leaf to leaf and from plant to plant, but also provide the wet leaf surface required for downy mildew spore germination. Again meticulous garden cleanup is necessary to reduce reinfection of plants.

Control: This disease can be especially severe on greenhouse-grown roses where humid conditions exist for long time periods. Ventilation and reducing humidity below 85% will reduce disease development. Sanitation in the garden will reduce the primary source of inoculum. Where damp, humid conditions exist, systemic fungicides containing metalaxyl will give some control. Other fungicides can also be used, but the persistence of the material through wet periods or rain is important to maintain protection.

Anthracnose

Causal Organism: *Sphaceloma rosarum*

Not much is known about this disease; however, it can be severe under cool, moist spring conditions. Wild roses, climbers and ramblers seem most susceptible, but hybrid tea and bush roses also get the disease.

Symptoms: Initially leaf spots are about 0.5 cm (1/4-inch) diameter and black, which makes them easily confused with blackspot. As the development progresses, the spots become purple to brown and finally light brown or tan with a red or purple margin. Stems, hips and pedicles can also be infected and as lesions mature small black dots will appear in the papery tan centers. These black dots are the spore producing acervuli (a tiny cushionlike or blisterlike structure produced by certain fungi on a plant host consisting of a mass of spores) of the fungus. Spotting, yellowing and severe defoliation and shot hole can result under moist spring conditions.

Disease Cycle: The fungus overwinters in old lesions on leaves and canes. Warm spring conditions promote the development and release of spores from the old lesions. The spores are believed to be carried by water or rain to new leaves and stems. Not much is known about the sexual stage of the fungus or conditions favorable for spore germination. It seems that cool moist conditions are favorable for this disease as for Black Spot.

Control: Removal of old leaves from around the base of plants and pruning out canes that have infections will do much to reduce the inoculum levels in spring. Generally, the same spray program that is also used for blackspot should work for anthracnose.

Botrytis Blight

Causal Organism: *Botrytis cinerea*

Botrytis blight is common in all parts of the world. This fungus is not a specific pathogen and can take advantage of many situations to produce a blight or rot condition on many hosts. It is an opportunist on cut or pruned rose canes and will infect flowers and buds.

Symptoms: The most common symptoms usually are seen on young flower buds which droop, turn black at the base and later produce the cottony grey-black mycelium of the fungus. Flowers can also be affected in the same way, and cut ends will have the black canker-like symptoms with presence of mycelium. Any time conditions are cool and wet, a grey-black mycelial growth will indicate botrytis.

Disease Cycle: Botrytis is a gray fungus that generally lives on dying tissue. With the right conditions, any dead plant tissue can release thousands of Botrytis spores. Botrytis infection occurs when water remains on leaves or buds for an extended period of time. This fungus is not specific to roses, but will grow on many different plants and plant debris. Under cool wet conditions, profuse spores are moved to roses by air currents or blowing rain. A minor wound in a bud or flower, or perhaps a pruning cut will provide the initial point of entry. As the infection progresses, additional sites become infected. The fungus is a low level parasite and will colonize wound sites as well as dead plant materials.

Control: Prevention is the best means of control. This can be accomplished through intense sanitation procedures. By elimination of opportunistic colonization on dead plant material, the amount of infection can be reduced. Good ventilation is also essential in reducing disease incidence. Some sprays may give short-term relief, but the fungus usually becomes quickly resistant. In greenhouse conditions, special covers are used to reduce the levels of ultraviolet light required by the fungus for infection. In most

cases, removal of infected plant parts and protection of wounds by chemicals is all that can be done until warmer and dryer conditions prove too unfavorable for continuing the disease.

Rose Cankers

Causal Organism: *Coniothyrium spp*.

After a long, cold, wet winter, roses can be expected to have some dead and cankered canes. While these pathogenic fungi are not very sophisticated, they can cause considerable damage. The problems can be especially acute on old, established roses that have lost some vigor and on young bare root roses emerging from cold storage.

Symptoms: In early spring, pruned stems provide wound sites which can be colonized by canker-causing fungi. The stems will yellow, often have red spots and later become brown or black. Black spots bursting through the tissue can often be found in discolored tissue which is the fruiting structures of the fungus-containing spores.

Disease Cycle: The fungus overwinters in infected canes and spores can be spread to healthy canes by splashing water, wind, and pruning tools. However, the pathogen can only enter plant tissue through wounds. The canker fungus is most active during the cold time of the year when roses are not actively growing. Pruning cuts or wounds on stems provide sites of entry for germinating spores. The fungi are not high level pathogens and cannot produce the disease when conditions are favorable for plant growth. During the dormant months, fungi colonize the tissues, and are spread to other pruning or wound sites. The disease can be extensive and severe under the ideal conditions for development.

Control: Promoting vigorous growth and removal of dead canes and stubs will help to reduce the primary source of infection. When pruning before winter, always make an angular cut close to an active bud so the callus can form a protective layer. A dormant spray could be used to protect pruning cuts and wounds during the cold and wet winter. In spring, removal of infected canes and a general spray program for fungal diseases should reduce canker problems and protect the plants until they can become vigorous growers once again.

Rust

Causal Organism: *Phragmidium spp.*

Rose rust is one of the most commonly found and easily identified diseases of rose. Severe outbreaks occur where cool temperatures and high moisture are found during the prime growing season. Where foliage is heavy, the first symptoms usually are found close to the ground and on the insides of plants. Nine species of the rust fungus are known to occur. The fungus is complex, having up to five different spore stages in its life cycle. The resistance of various cultivars is usually well documented because rust is a very common disease in some parts of the country.

Symptoms: In early spring, powdery pustules of light orange to yellow spores appear on the underside of leaves. Soon after, these aeciospores can be found on the upper side of leaves where they are more obvious. As we move into summer, the spore-producing organ of certain fungi is predominate forming the typical red brown to orange spores. This stage can repeat several times during the growing season usually in 10- to 14-day intervals. Finally, as fall approaches and evenings become cool, the overwintering clusters of spore cases-develop black spores of rust fungi. Leaves, succulent canes and flower parts are all susceptible to the rust fungus.

Disease Cycle: The fungus overwinters as spores of rust fungi on fallen leaves or on infected canes. The spores are wind borne and germinate to infect leaves through the surface of the leaves. As the infection proceeds, the various spore stages develop on roses. There is no alternate host for rose rust. Reinfection and spread occurs through spores. Spore germination requires cool summer temperatures and continuous moisture for at least two hours so the spores can enter the leaf surface. Spores serve as a means of overwintering on leaves and infected canes and careful removal and disposal of infected debris is important.

Control: In areas where rust is severe, sanitation should be practiced to reduce inoculums and prevent early season infections. Infected canes should also be spring pruned to reduce the initial levels. Pruning very dense bushes will help to reduce the moisture levels inside of plants and prevent some infections. Preventative fungicidal sprays should be applied every 7 to 10 days when conditions are favorable for Rust development.

Bacterial Crown Gall

Causal Organism: *Agrobacterium spp.*

This is really the only serious bacterial disease of roses. The bacteria is found worldwide wherever roses are grown and is especially severe in loose sandy or sandy loam soils.

Symptoms: On roses, the symptoms of overgrowths can occur at the crown, bud union or on the roots. Galls are usually round to irregular in appearance and may have a rough exterior. Upon cutting across a gall, a disorganized callus type of tissue is commonly found. The portions closest to the exterior usually contain the actively growing bacteria. However, once the tumor-inducing plasmid is introduced into a plant, disease can occur without the presence of the vectoring bacteria.

Disease Cycle: The bacteria causing the disease are soil borne and can survive in soils for many years. When roses are planted in infected soil, any wound sites on the roots or crown offer points of entry for the bacteria. Once in the host, the tumor-inducing principle carried on a small circular portion of DNA is incorporated into the plant cell and an overgrowth begins to form. In some plants, the bacteria can be systemic and galls may begin to form at many sites on the plant. As the galls develop, callus tissue is laid down which is susceptible to other types of breakdown, decay or sloughing. In this way, the soil around a plant can become infected with the bacteria. The bacteria survives many years in the soil and can be moved with water or other infected plant parts.

Control: Always inspect new plants thoroughly before placing them in your garden. Since wounds can be infected at the time of digging, some plants may have latent infections which could become evident several years after they were planted. If crown gall is detected, the plant may survive many years but could serve as a reservoir for the bacteria. Thus, removal of the plant as well as adjacent soil is recommended. In some cases, soil fumigation is used to kill the bacteria in the soil, but this is only effective where relatively porous and dry soils are involved. Plant surgery is also an option on specimen roses, but precautions should be taken to sterilize cutting equipment before and after use. These plants should probably be removed from the garden and watched closely for further development of disease. Any plants propagated from infected material should also be watched for the development of galls resulting from systemic contamination.

Rose Mosaic

Causal Organism: Prunus Necrotic Ringspot Virus

Mosaic is probably the most commonly found virus in roses, but many other virus diseases also exist. While mosaic is transmitted by propagation, other viruses can be transmitted by pollen, insect feeding or simply by mechanical contact. Symptoms of virus are usually dramatic manifestations of coloration, spotting or irregular, distorted growth of leaves, flowers or growing points.

Symptoms: Rose mosaic usually appears in spring as a distortion of growing tips or expanding leaves. Later the leaves can appear to be wavy and have yellow lightening patterns, oak leaf patterns or simply gold to yellow veins. Plants infected with virus usually are slower to develop in spring than healthy plants and usually produce fewer good quality blooms. During the warm summer, typical symptoms can disappear only to come back as fall and cooler temperatures arrive.

Control: Since there is no cure for the virus diseases, it is important to purchase only quality materials which have no symptoms of the disease. Some pathologists suspect that mosaic may be pollen transmitted which could prompt removal if other roses in the garden are valuable and not already infected. In some exhibition gardens, the disease can actually be very common. Propagation of buds from infected roses will probably result in transmission of the disease if the buds actually take.

Rose Rosette

This is a serious disease that is showing up in different parts of the country, in particular the middle section of the United States. The exact cause of rosette is unknown, and it has been suggested that it could be a virus that is carried from plant to plant by mites, or the reaction of the plant to substances injected by blister mites. In either case, it is noticed on *'Rosa multiflora'*, which is a common rootstock, and in some species like *'Rosa woodsii'*. The foliage on an affected plant will look like witch's broom; the leaflets looking distorted and wrinkled. Not to be confused with Spring Dwarf Virus.

Disease Cycle: Rose rosette disease is caused by a virus or virus-like pathogen yet to be characterized. Because the exact causal agent has not yet been identified, there is currently no laboratory test for confirming rose rosette disease. The disease is diagnosed based on characteristic symptoms or by grafting suspect plant material onto known healthy roses and demonstrating transmission of symptoms after a period of weeks to months.

The disease is known to be transmitted by the eriophyid mite or by grafting. The wild multiflora rose (*R. multiflora*) is very susceptible to the disease and is a common source of infection. Cultivated roses planted downwind of infected multiflora roses are especially at risk because the mite vector travels on wind currents from infected plants to healthy plants. Some growers have observed symptoms on previously healthy plants within four weeks of being planted downwind from diseased multiflora roses.

The causal agent of rose rosette disease is not soil-borne, so it is possible to successfully plant healthy roses in beds where diseased plants have been removed; however, the pathogen may persist in old root pieces that remain in the soil from previous diseased roses. If plants regrow from these old root pieces, as multiflora rose is apt to do, they can serve as an infection source for healthy plants. Therefore, it is important to remove old plants thoroughly and ensure that infected plants are not allowed to regrow from old, infected root pieces.

Control: There is no control once rose rosette is established in a plant. It is best to remove the plant before it spreads to other roses in your yard. Do not toss into a compost heap. There is no proof at this time that miticides help to control Rose Rosette Disease. Credit: *Dr. Mark Windham*

DISEASE PROBLEMS

SYMPTOM	CAUSE	REMEDY
Tumor-like growths on canes, roots or at bud union	Gall (aerial, crown or root) - a bacterial problem entering through a wound or contaminated pruning tool.	Prune away affected section, if possible. (Galls on the graft would kill the plant if pruned off) Be sure to sterilize pruners and other tools with bleach or alcohol to prevent bacteria from spreading. Destroy seriously weakened plants. Treat soil with bactericide or leave fallow for two seasons before re-planting.
Leaves fold at mid-rib, or are distorted. White powdery material appears on the forming buds and leaf tops or undersides	Powdery Mildew - a fungal disease fostered by cool nights, warm days and high humidity	Spray Triforine or myclobutanil (Immunox), dust with sulphur, or spray with baking soda and soap. Make sure plants have good air circulation and ample sunlight
Dark irregular splotches on the leaves, dropping of healthy leaves, yellowed leaf sections	Downy Mildew - this systemic fungus disease is present in the soil and will begin to cause problems when night temperatures reach 55'F to 65°F, with still air measuring 85% humidity	Cut back the defoliated plant. Clean up debris, dust with sulfur and spray with Aluminum tris (Aliethe) or Daconil 2787
Brown spots on petals, also red-pink spots on lighter colored flower buds. Brown dieback of cur canes; brown fuzzy mold on debris around the plant. In severe cases, the entire flower bud rots	Botrytis blight - high-humidity nights or rainy cool periods favor fungus growth	Spray with Daconil 2787'. Remove all damaged twigs on the plant, and clean up leaves and debris below to prevent fungus from spreading. Maintain good air circulation
Dark black spots on the leaves. The spots tend to be round, varying in size from pinpoint to quarter-sized. Half of leaf yellows or leaf drops completely from the plant	Black Spot - this is a fungus favored by rainy weather or improper watering	Sprays-Dusts-Watering Technique. Begin in winter with a dormant lime sulphur spray. Remove dropped leaves and other debris. Spray with Neemoil, Daconil2787, Triforine, Myclobutanil, or a sulphur-based fungicide on a rotational basis. Fungus spores are found on leaf undersides so spray upward from underneath. Spray in the early morning when weather is calm and cool. When watering, keep foliage dry or water in the morning so foliage dries by midday

Credit: *Root of the Problem*, Jackson & Perkins, 2001

VIRUS DESCRIPTIONS

Characteristics of virus and virus-like diseases of rose

Disease	Causal	Symptoms	Transmission	Test plants
Rose mosaic	Virus	Ringspotting, yellow line pattern chlorotic banding mosaic	Grafting	'Madame butterfly', 'Ophelia', 'Rapture' flowering cherry (Shirofugen)
Rose streak	Not established	Green/brown rings, brown vein banding in leaves, premature leaf drop	Grafting	'Madame Butterfly', 'Rapture', 'Ophilia'
Rose rosette	Probably virus	Reddening and crinkling of leaflets witches brooming, phyllody	Grafting, possibly Mites	'Burr' multiflora
Strawberry latent ringspot	Virus	Reduction in size of shoots and leaves	Grafting, mechanical inoculation, nematodes	*Rosa rugosa, Chenopodium maranticolor. C. quinoa* cucumber
Rose X	Not established	Severe stunting, small deformed leaflets, green mottling, fine line pattern, ringspot, shortening of intemodes	Grafting	*Rosa rugosa*, all major rootstocks
Rose ring Pattern	Probably virus	Rings, random line patterns yellow, bloching on leaflets and color break in 'Queen Anne'	Grafting	'Burr' multiflora 'Queen Anne'
Rose wilt	Not established	Downward leafroll, vein-clearing-premature abscission ,shoot proliferation from single bud	Grafting	Not established
Rose spring Dwarf	Not established	Rosesetting and balled appearance in new leaf growing in spring	Grafting	'Burr' multiflora
Rose leaf curl	Not established	Reduced size and curvature in young leaves, yellow flecking of veins in spring, leaves may drop prematurely	Grafting	'Queen Elizabeth' and 'Madame Butterfly'
Rose flower Break	Not established	Reduction in flower quality-flower break, marginal petal distortion	Grafting	Not established
Rose flower Proliferation	Not established	Flower proliferation phyllody	Not established	Not established

Credit: Roses, Inc.

Environmental Damage

Roses are affected by environmental pollution that may resemble diseases, heat stress or nutrient deficiencies. Damage by ozone, oxides of nitrogen, oxides of sulfur, particulate matter, etc., are commonly seen in heavy industrial areas. Where coal is burned, rain combines with oxides of nitrogen and sulfur to form an acid, hence, the term acid rain.

Using polluted water or planting roses over an old dump may damage roses just as well. Damage is noted on the blooms, foliage, and causes small, distorted plants.

ACKNOWLEDGMENTS

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Root of the Problem, Jackson & Perkins,, 2001
Roses, Roses, Inc., 1987
IPM Table Courtesy of Baldo Villegas, Orangevale, California
Photographs Courtesy of Baldo Villegas, Orangevale, California
and Steve Jones, Valencia, California

IPM OF ROSE DISEASES

PEST/PATHOGEN	FAVORABLE CONDITIONS	CHEMICAL CONTROL MEASURES	NON-CHEMICAL CONTROL MEASURES
Powdery Mildew (Fungus) - the white growth of the fungus consists of mycelium and conidiophores and appears as patches on leaves and stems. Young tissue is most susceptible. This is an obligate parasite.	Night temperature of 15°C [60°F] and relative humidity of 90-99%; Day temperature of 26°C [80°F] and 40-70% RH. **Note:** Warm season disease; does not require free moisture for spore germination.	1. Apply a dormant spray during the winter months. 2. Spray with available protectant or systemic fungicides. 3. Some anti-transpirants have shown fungicidal activity by acting as a barrier to invading spores.	1. Acquire resistant varieties of roses. 2. Remove infected plant material as soon as it is noticed and get rid of plant materials after pruning; practice winter sanitation. 3. Avoid overcrowding rose plants and choose open beds away from fences and wind obstructions. 4. Open the center of the plants when you prune to provide air circulation through the leaf canopy.
Blackspot (Fungus) - characteristic black spots develop on the upper leaf surfaces. Leaf spots are usually circular with characteristic fringed borders. Raised purple-red, irregular blotches may develop on young canes of susceptible varieties.	The fungal spores (conidia) must be immersed in water and must be continuously wet for at least seven hours for any infection to occur. **Note:** Spring and fall disease in most of CA; needs free moisture.	Same as above.	1. Follow above recommendations for powdery mildew. 2. Avoid overhead irrigation/sprinklers. 3. Water early in day to allow leaves to dry. 4. Leaves should not be allowed to remain wet or at very high humidity for more than -12 hours.
Rust (Fungus) - the powdery pustules of orange to orange-red spores (aeciospores/uredospores) on the undersides of the leaves in mid spring through fall are very diagnostic. Black pustules containing teliospores may be present during the winter months. This fungus is an obligate parasite.	The optimal conditions for disease development are temperatures of 18-21°C [64-70°F] and continuous moisture for two to four hours. **Note:** Spring and fall disease in most of CA; needs free moisture.	Same as above.	1. Follow recommendations for black spot, and avoid wetness of the leaves or high humidity around the foliage for longer than two hours. 2. Pick off some of the lower leaves near the ground from the rose bushes, but avoid sun burning the bud-union of the rose bush.
Spot Anthracnose (Fungus) - Circular spots are scattered or grouped, sometimes coalescing into one another; spots are reddish to purplish on upper surface of leaf; In order spots the center are whitish in color an margin is dark red/purplish.	Humid, cool conditions are ideal for this fungus.	Same as above	Follow above recommendations for rust and blackspot.
Downy Mildew (Fungus) - This fungus is characterized by purplish to black areas on leaves, stems, and peduncles. This is followed by yellowing of the leaflets and complete defoliation of the plant. The fungal mycelia are intercellular in rose tissue. This fungus is an obligate parasite.	Humid, cool conditions are ideal for this fungus. **Note:** Early spring and late fall disease; rarely if ever seen in CA during the summer; needs free moisture.	Same as above. In the past, fungicides like *Zyban* or *Duosan* and others containing chlorothalonil like *Daconil 2787* have been used for controlling this fungus.	Follow above recommendations for rust and blackspot.
Common Canker (Fungus) - Wounds are necessary for infection. Canker begins as small yellow to red spots in the bark and gradually expands. The centers of the cankers become light brown and the margin a darker brown.	Cold moist weather conditions	1. Apply dormant sprays after winter pruning. 2. Apply fungicidal sprays to cover wounds.	1. Practice sanitation by removing infected parts of canes on plants and by removing infected debris from the rose garden after winter pruning. 2. Seal pruning wounds. 3. Sterilize tools whenever they become in contact with infected parts of the plant. 4. Avoid injury to rose canes; use sharp tools to obtain clean cuts. 5. Pruning cuts should be made above bud-eyes and at an angle.

(IPM of Rose Diseases continued)

Pest/Pathogen	Favorable Conditions	Chemical Control Measures	Non-Chemical Control Measures
Botrytis Blight (Fungus) - the grayish brown mycelial growth is very characteristic of this fungus. It is a pest of stored/refrigerated roses, rose buds (that can't open), cut flowers, rose plants, and cuttings used for propagation. Also on canes as a secondary low-level pathogen on tissue or flower petals.	Cool temperatures, high humidity, and moisture. **Note:** Early season and late fall disease; needs free moisture.	Same as above.	1. Follow above re-commendations for rust. 2. Biological control methods are being looked at but they are not available commercially.
Crown Gall (Bacterium) - gall formations on the crown, roots, and even twigs are characteristic of this bacterial disease. Aerial galls may be found on tree roses.	Naturally present in most soils. Bacterial pathogen enters plant through wounds, either natural or caused by pruning, grafting, or mechanical injury by tools. **Note:** Bacteria persistent in soil for long time. Moving soil or transplanting can easily move spores to other places.	Use biological antagonists (e.g., *Gallex*, *Galltrol*, etc.). a) *Gallex* is a ready-to-use emulsion that canbe applied directly with a brush. b) *Galltrol* is aculture of live bacteria. It is applied as a dip or spray on seeds, cuttings, and bareroot plants.	1. Resistant varieties. 2. Exclusion - keep it out of your garden. 3. Sanitation - clean up/dispose of infected plants; sterilize tools if contaminated between pruning. 4. Refuse to purchase plants with galls.
Rose Mosaic (Virus) - visible symptoms are variable but include chlorotic line patterns, ring spots, and mottling of leaves and some flower break. No adverse effect on flower production has been reported, but foliar symptoms detract from the overall quality.	Virus transmission in roses appears to be limited to vegetative propagation when virus infected buds, scions, or rootstocks are grafted to healthy plants. However, Prunus Necrotic Ringspot Virus (PNRS) and Apple Mosaic Virus (APMOV) may be pollen transmitted.	No chemical controls are currently available.	1. Resistant varieties, if any. 2. Exclusion of infected plants from rose garden, but difficult, especially when one gets bareroot roses. 3. To be on the safe side, sterilize cutting tools when pruning infected plants. Graft or propagate only healthy plants. 4. Let your nursery dealer know you will not purchase roses from anyone selling infected plants.

NOTE: When using any pesticide READ THE LABEL! Mix and apply the pesticide according to what the label says. Be sure the label says the pesticide can be used on "roses" and "ornamentals." If the pest you are trying to control is not listed on the label, that particular pesticide may not be a good choice. Follow all safety precautions carefully – to protect yourself and the environment.

NOTE: When symptoms are recognized in obligate parasites (e.g., powdery mildew, rust, and downy mildew) it is best to use a systemic fungicide, which may have some eradicant properties.

BLACKSPOT
Characteristic black spots develop on the upper leaf surfaces. Leaf spots are usually circular with characteristic fringed borders. Raised purple-red, irregular blotches may develop on young canes of susceptible varieties.

POWDERY MILDEW
The white growth of the fungus consists of mycelium and conidiophores and appears as patches on leaves and stems. Young tissue is most susceptible. This is an obligate parasite.

RUST
The powdery pustules of orange to orange-red spores (aecio-spores/uredospores) on the undersides of the leaves in mid spring through fall are very diagnostic. Black pustules containing teliospores may be present during the winter months. This fungus is an obligate parasite.

DOWNY MILDEW
NOT REPRESENTED HERE!
This fungus is characterized by purplish to black areas on leaves, stems, and peduncles. This is followed by yellowing of the leaflets and complete defoliation of the plant. The fungal mycelia are intercellular in rose tissue. This fungus is an obligate parasite.

SPOT ANTHRACNOSE
This fungus is characterized by purplish to black areas on leaves, stems, and peduncles. This is followed by yellowing of the leaflets and complete defoliation of the plant. The fungal mycelia are intercellular in rose tissue. This fungus is an obligate parasite.

Credit: Baldo Villegas, Orangevale, California

Notes

Updates

6/9/15 Control of Rose Rosette Disease (10-7)

Notes

Chapter 11– Appendix

The following information is presented in this section for ease of use.

- ARS Endorsed Products
- Rose Grades
- Computer Internet Links
- MSDS for Pesticides
- Consulting Rosarian Information and Forms

ARS Endorsed Products

Check the ARS website (www.ars.org) for current product endorsements

Rose Grades

The rating or grade of a rose refers to a standard established by the American Association of Nurserymen. The grades only apply to grafted, field-grown roses as they are removed after two years of growing in the field, and not own root roses. The specifications differ among the various rose classes, and the measurements are taken within 3 in. (8 cm) of the grafting union. A strong cane is usually defined as ½ inch or larger.

There are three recognized grades:

Grade 1

Hybrid teas and grandifloras must have three or more strong canes, two of which are at least 18 in. (45 cm) long. Floribundas meet the same standards, but the canes need only be 15 in. (38 cm) long. Polyanthas must have four or more canes at least 12 in. (30 cm) long. Climbers and ramblers must have three or more canes 24 in. (60 cm) long.

Grade 1 1/2

Hybrid teas and grandifloras must have two or more canes at least 15 in. (38 cm) long. Floribundas must have two or more canes 14 in. (35 cm) long. Climbers must have two or more canes 18 in. (45 cm) long. [Note: Polyanthas which do not meet Grade 1 standards are not graded.]

Grade 2

All classes must have two or more canes 12 in. (30 cm) long.

Computer Links

- American Rose Society — www.ars.org
- District Pages and Local Societies - www.ars.org
- International (World Federation of Roses) & International Rose Societies www.worldrose.org
- American Nursery & Landscape Association (ANLA) – site for rose grading, patents and trademarks - www.anla.org
- USDA government site – site for hardiness maps http://www.usna.usda.gov/Hardzone/ushzmap.html
- Rose Hybridizers Association – site for rose hybridizing information http://rosehybridizers.org
- Help Me Find – site for finding information about roses and/or where to buy roses http://www.helpmefind.com/roses

MSDS Sheets

Material Safety Data Sheets (MSDS) are full reports on each and every chemical. They are required by federal law for each manufacturer's products. All pesticides have MSDS sheets available either from the manufacturer, distributor, and seller or from the Internet. The sheets contain chemical names, safety, precautions, special handling, mixing, and what to do in the case of poisoning. It is highly recommended for each rosarian to have MSDS sheets for each chemical that you use. In some states, it is required to have MSDS sheets available if you have a commercial spray permit.

Labels/MSDS information are available on www.greenbook.net or additional health and safety information can be found in a Material Safety Data Sheet (MSDS). Or contact the National Pesticide Information Center (NPIC) (1-800-858-7378; npic@ace.orst.edu) for information about pesticide products and their toxicity. Material Safety Data Sheets are available on most manufacture's website or by calling the 800 number on the label.

Pesticide disposal: Check with your local waste management authority for appropriate pesticide disposal procedure. You can also call 1-800-CLEANUP or go to www.cleanup.org to get this information.

Consulting Rosarian Information and Forms

The following Consulting Rosarians information, forms, etc. are available on the ARS website (www.ars.org) – Members Only Section – ARS resources

- CR Annual Report Forms (3 samples) [please contact your District CR Chair for the proper form] Form #1,Form #2,Form #3

  A list of Consulting Rosarians is no longer available. If you have a question about roses, please check http://www.ars.org/rose-growing-question/need-advice/ to see a list of Cyber rosarians who have agreed to make themselves accessible to those needing advice.

- CR School/Seminar Request Form
- CR Candidate Form
- CR Candidate Letter of Recommendation Form
- CR Emeritus Request Form

Outstanding Consulting Rosarian Rules and Forms

- Rules and Regulations
- Nominee Form
- Request Form
- Insecticide Table
- Fungicide Table

The following Master Rosarian information is available on the website as well:

- ARS MASTER ROSARIANS LIST (revised yearly)
- Master Rosarian Program –Letter to District Director and District CR Chair
- Master Rosarians – Excerpt from CR Manual
- Master Rosarian Nomination Forms are available in the following formats: Electronic form; PDF; Word Document

Notes

Updates

9/20/13 CR list removed: ARS Privacy Policy (11-2)
5/9/14 CR Candidate Form: minimum age requirement of 18 years of age (11-2)
5/9/14 CR Candidate Letter of Recommendation Form: minimum age requirement of 18 years of age (11-2)