Rose Propagation for Home Gardeners

By Dao Mai, Sydney, NSW, Australia, last revision Apr 2008

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Foreword

This is a document I intend for posting on the Internet. It is a short but precise and detailed documentation of my rose propagation method. I learned and further developed specifically for hobbyists who would be performing this hobby entirely in the home back yard using very limited tools and almost no technology. While I am extremely happy about the efficiency of my "system", it is not intended for those who want to become professional rose growers. It is perfectly suited for amateur rose breeders who only need to propagate limited number of plants every year. This document will be updated every time the author discovers new techniques or the need for revision.

Introduction

I started learning about rose propagation in 2001 starting with some tips from the Internet mainly from US posters in public gardening forums and their websites. These tips got me started with ideas like baggie, plastic pot with clear plastic cover, soda bottles ... to root roses. But I soon found out that it's a race between getting roots or rot, and rot is often the winner especially in warm months of the year. These creative inventions of the home gardeners often fail to provide consistent humidity and temperature required for roses to root well. So I started doing my own things while observing how roses responded to climate change over the seasons in a year. I also observed commercial products which are mainly grafted rose. I determined to work out my own ways to propagate roses in the home back yard that would match commercial quality. So that was where I got started.

I find that most beginners start with rooting roses by taking cuttings and stick them directly into the ground. This practice is fine for most Old Garden Roses, ramblers and climbers. But eventually growing a rootstock and learn to perform budding or grafting would be necessary to achieve a reliable rate of success and produce high quality plants for many modern roses like the Hybrid Teas (HTs) and Floribundas (clustered flower roses). By using rootstocks one no longer has to cope with too many variables because modern roses have different rooting habits (some would not root at all). The use of rootstocks also addresses several problems about the soil and plant vigour due to their superior root systems.

I also discover that propagation of roses should also be developed into a system where all steps are interconnected. It's not possible to use all the best tips from gardeners and expect the best final result. There are several stages, and what do you at each stage depends on what you do in the previous stage. There is no such thing as the "ultimate" or "correct" system. Naturally it's very important to work with nature rather than against nature in order to achieve the best possible outcomes.

Rose propagation

It is a hobby for me and many rose lovers. It's an art in a way when it involves budding and grafting of rose varieties over rootstocks. As I know that respecting the experience of professional growers for hundred of years is a must in this learning journey, I observed commercial products while I worked on my techniques.

Professional growers often do not divulge their trade secrets. Therefore we can only guess by looking at the final products being offered on the market. It's rather odd that there is no book talking specifically about rose propagation. What you often get, are a couple of pages in a gardening book mentioning about it in the most general terms. Occasionally you find articles on the Internet sites from more generous souls who would share more detail, but none appears to be complete or easy enough for the beginners. There are so many tips, but no definitive and detailed description of a system that might work universally. Some tips are excellent but they are in conflict as they belong to different systems.

So I concentrated on devising a complete *system* rather than a set of unconnected tips and techniques. To be a system it must have interconnected steps where what you do in the next step depends on what you do in the previous one.

I found the two main rose rooting strategies proven to be quite successful were (1) Semi-hardwood rooting which is performed in autumn (or winter in mild subtropical climate) at cool temperature and (2) Softwood rooting which was performed mainly in warm months from spring to summer. Softwood rooting was the most effective way but it required a lot more work to protect the young cuttings from wilting.

I prefer doing the rooting phase naturally in the open air rather than setting up an indoor artificial environment. The advantage of rooting in the natural environment is that the young plants will be strong and most will survive after they have roots. Many home gardeners find the open air too "variable" and the weather can change unexpectedly. That prompts them to set up more controllable artificial environments. Rooting in an artificial environment where temperature and relative humidity is maintained by artificial methods means that the rooted cuttings will have to be *hardened* later by gradual exposure to the natural environment. This process takes more time and may kill many of them as well as stunt the ones that survive. Another issue is the cost of energy (growth lights) and chemicals which can be very environmentally unfriendly.

From my observations, commercial growers for the garden rose market prefer the timing of autumn for rooting their rootstocks and do the rose budding in spring, but they can also use both semi-hardwood and softwood rooting simultaneously. We will deal with both methods in this document. These two rooting methods will form the basis for rooting in my proposed "system".

Relevant tools

There are many tools available for gardeners to use. However I like to use as few as possible because I want to work out a suitable system for the home gardener. The following table shows a list of tools that are commonly used by professional gardeners. I try to avoid most of them.

Tools	Description	Required
Budding tape	Tape used to tie scion to rootstock used in budding and grafting	Optional
Graft sealant	Wax like material to seal grafts to keep moisture and protect the grafts	No
Grafting knife	Razor sharp knife specifically designed for grafting	No
Green house	Green house environment to protect cuttings against wind, keep them warmer in cold climate	No
Growth light	There are many types; florescent ones are cheap but lack power. Professional growth lights at high power over 800W are better, but very expensive to buy and to run. Recently available of 23W energy saving bulbs is a blessing. These cool-white bulbs are very powerful and suitable for indoor growing over a short period of time.	No
Heat mat	Electric mat used to provide bottom heat for cuttings being rooted in cold climate	No
Misting system	A system with pipe, timer and spray nozzles to deliver fine mist of water to cool and keep cuttings moist	Optional
Patcher	A rubber band often used to tie scion and rootstock in T budding technique	No
Root hormone	Hormones that stimulate roots growth	Optional
Sterilisation	Process and chemicals to kill germs which may cause cuttings to rot	Optional

I use the following readily available tools found in discount stores: white paper masking tape (often used to mask surfaces when you paint), polyethylene yarns in place of budding tape, disposable paint scrapping razor blades, fruit knife and hand held water sprayer.

The semi-hardwood rooting process

Roses are semi hardwood plants (unsure here, very old rosewood looks like hardwood). The young buds initially grow softwood and harden over 2 growth seasons (over 8 months) to become semi-hardwood. The strategy of semi-hardwood propagation relies on Mother Nature almost entirely in the rooting phase where one takes cuttings and roots them. It's the easiest way to propagate with a limited rate of success and only available once every year. The general idea is to simply take healthy semi-hardwood cuttings and stick them into the soil in cool weather.

In Southern Hemisphere, the correct time is autumn when the peak daily temperature has gone lower than 25 degrees C. Most rose stems have hardened and the growth rate has slowed. Leaves start to fall and flowers are few. One would start taking semi-hardwood rose canes which is like early pruning of roses which ideally

should happen at the middle of winter (northern Hemisphere winter is severe, people tend to save the cuttings in the basement. Then root them at the **end of winter** when the temperature is **still cold** but **above freezing point**). These canes are suitable to root in free draining soil mix over winter, and some would have roots by winter, sleep over winter for a few coldest weeks and grow again early next spring.

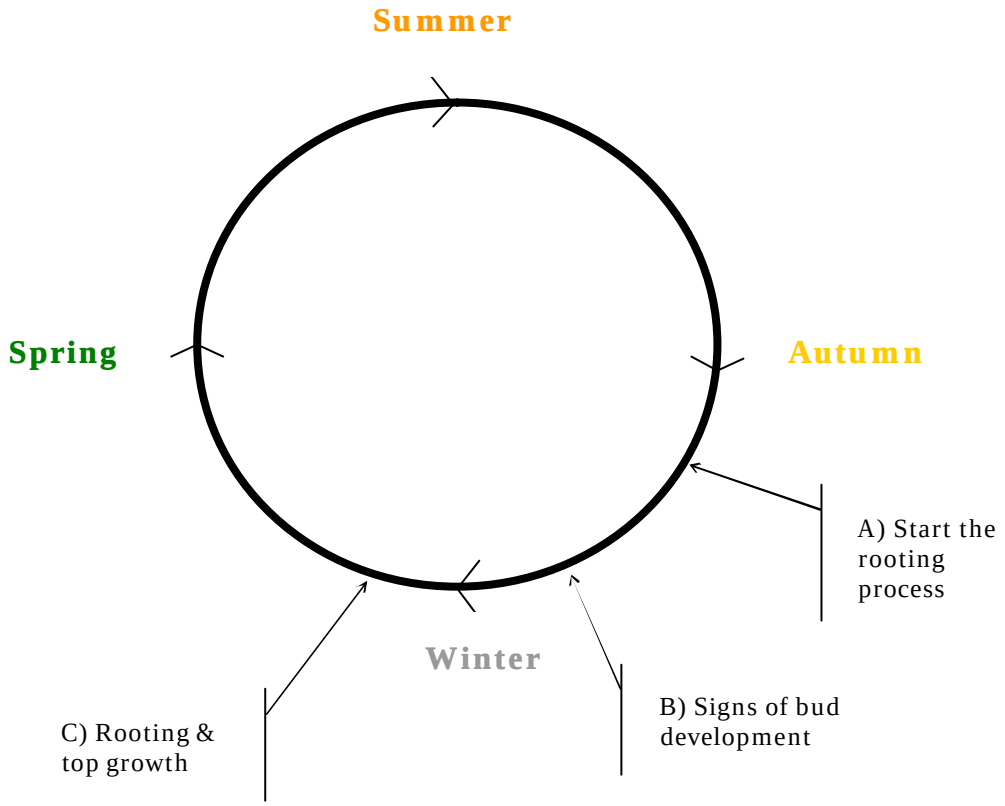
1. The canes should be semi-hardwood (between 6 - 18 months old). Discard all young stems. Each cane can be as long as 30cm or 1 foot in length. It's easier for longer canes to survive than short canes (when they are not over 30cm). You trim back most diseased leaves. There is no need to keep any leaves. If there are laterals, cut them back very short to about 4cm (about 1.5 inches), keep only 2 at the most.
2. Prepare a sandy mix by mixing 80% sand and 20% peat. However any clean and well composted garden mix would do if you add about 50% sand into it. Soak the soil completely wet the first time. As these cuttings are semi-hardwood cuttings, soil with garden compost would also be an acceptable potting medium when the air temperature is quite cool. However you must avoid composted animal manure as the nitrogen level is too high and tends to cause decay with a high level of micro-bacterial activities.
3. Take the rose canes out, recut the base close to a node and apply a powder rooting hormone (or rooting gel) at the base (if you believe in rooting hormones) and use a pencil to dip a hole into the mix then insert a cane. Repeat until the canes are packed densely into a container. There is no need for much space between the rose canes. However if you want to save potting effort later, one cutting in a pot (with 2 layers of soil mix: well-composted garden mix at the bottom and the sandy mix above it) is also a good idea. But the timing should be in winter to avoid rotting the cuttings when fertile soil is used (nitrogen is a nutrient supporting life and that causes decay).
4. Take the pot out to a moist place under shade that has some morning mild Sun shine. This spot should be sheltered from the wind.
5. Do not spray water the first 2 days, and then mist them very lightly with a garden hose a couple of times each week. There is no need to wet the soil mix as the canes have little or no leaves, the soil mix will remain wet naturally.

After a few weeks the rose canes will lose all leaves and the buds on the canes become plumb. This continues to slowly develop into little top growth by end of winter and at the early signs of spring, they would start to root. Only some of them will root. The sign of top growth does no mean roots have struck. But most of the cuttings with some top growth will eventually have roots.

Note 1: Semi-hardwood canes of some rootstocks are capable of forming callus and rooting on their own before the leaf growth starts. This is typical of Multiflora rootstock. The reserved energy stored in semi-hardwood cuttings are not simple sugars. When the condition is right, the cuttings convert this back into readily available nutrients and start the forming callus and roots at any spot that is warmer than the rest. We will see more on this later on (about Multiflora rootstock).

Note 2: In severe winter of some parts of the Northern Hemisphere, you would save cuttings in your basement and do this rooting at end of winter when temperature is above freezing point. In a wamter Southern Hemisphere winter you can start rooting at early winter or when you do your winter pruning.

Semi-hardwood propagation



This semi-hardwood rooting method can vary across different zones of temperatures in the world. The above chart is for temperate zones where the temperature does not get under 0 degrees C. For colder zones, one may have to start earlier in autumn and finish later in next spring. Some protection is probably required for them to survive the harsh winter.

This technique is one of the base techniques which will be used to build the promised "system" for rose propagation later.

The softwood rose rooting process

This is a more popular process because it's much faster and can yield better results. In this process you choose young rose stems for taking the cuttings. They should have just finish the main rose bloom. As soon as the rose bloom becomes spent, it's ready for softwood rooting. The cuttings are readily available from mid spring to mid autumn.

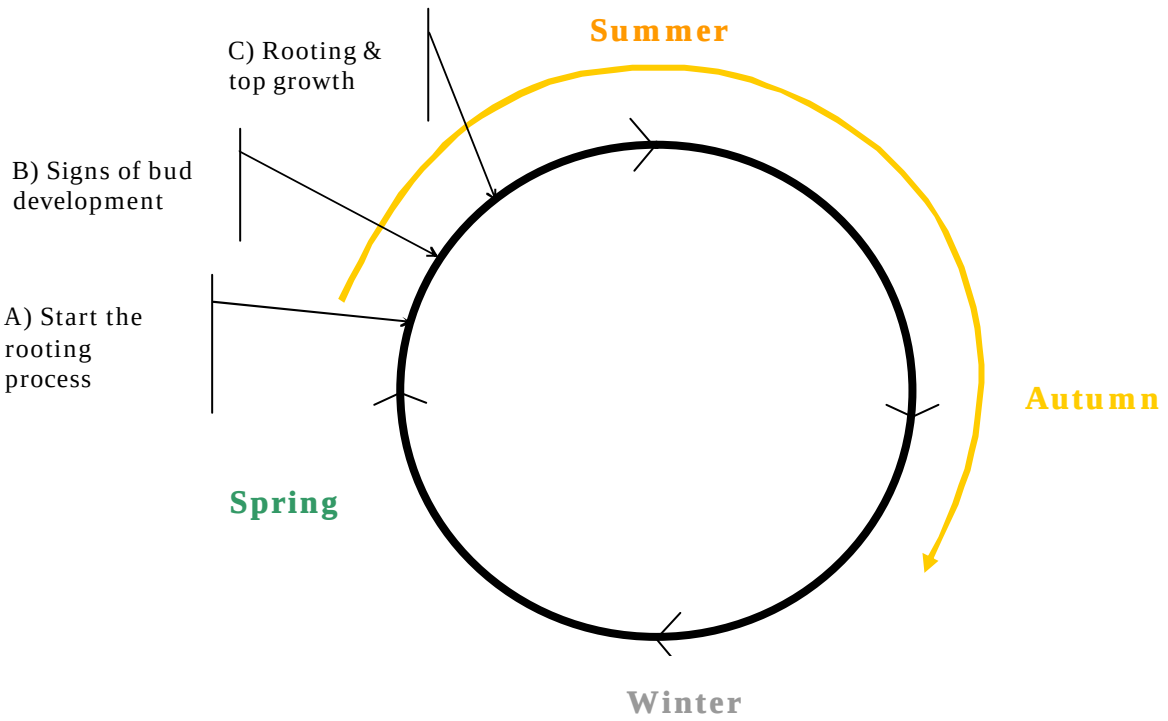
The major differences with the semi-hardwood propagation method are

- The choice of younger canes for cuttings.
- The warm temperature of the climate in spring, summer and early autumn.
- There must be healthy green leaves left on the cuttings.
- The cuttings need good light and humidity to do photosynthesis to be able to form callus and root.

All these three factors make it absolutely necessary to keep the cuttings from drying out by either misting or by placing them in a controlled environment like a plastic bag or a mini green house. However I advise against the use of plastic bags at all times. Plastic bags can result in poor air circulation or overheating which kills the cuttings rapidly. The environment should be of mild temperature and with good air circulation for the cuttings to achieve the best result. One can achieve this either by doing the rooting in the mild climate of early spring or mid autumn. The use of a simple timer to turn on and off a water misting/spraying system would also help to extend the rooting time into summer.

Note: It is worth mentioning that many home gardeners resort to using artificial lights and root roses indoor along with improvisations like baggie, clear plastic tub, soda bottles... While these improvisations work to a great extent if done carefully but they are labour intensive, yield poor result and finally the need for hardening the plants before they can survive in the open. These troubles really defeat the aim of making the job simple and easy for home gardeners. The only justification for this is when you try to do rooting in the freezing winter of some regions.

Softwood propagation process



This softwood rooting method can vary across different zones of temperatures in the world. However it works repeatedly over the warm months. It is preferred by many growers as they can rapidly propagate m any times in one year. However getting the high success rate requires much more work.

Let's have a look at the detail

1. Take cuttings of roses that have a spent main bloom (or blooms). The length should be about 7 nodes. These are still quite soft. Testing it by the finger nails is the best way. If your nail can crush it, it's too young (full of sap and nitrogen, can rot easily). If the nail cannot easily strip the bark, it's too old. Avoid thick canes especially basal/water shoots because they don't root very well. Any canes that come from a bush in a fast growing stage is not very good because they would have too much nitrogen which makes them rot easily in the rooting process. Being too young or two old is not good, the leaves tend to drop easily in the rooting process. This makes more trouble as you have to remove the dead leaves more often otherwise they will have mold and if not removed, will infect the cuttings and make them rot too.
2. Keep about 4 sets of leaves at the top and trim each set down to about 4 leaves. The bottom 2 sets can be trimmed down to 2 leaves making it easier to pack them densely. There is no hard and fast rule about how many leaf sets to keep.
3. Mix a very mild bleach solution to sterilise the rose canes. It only needs to smell strong like what you find at public swimming pools. Soak the canes in for 1 hour to kill off germs that exist on the rose cuttings. These tend to "pickle" your cuttings if left alive.
4. Prepare a sandy mix by mixing 80% sand and 20% peat. Soak the mix completely wet the first time. As these cuttings are softwood cuttings, a soil medium full of micro-bacterial activities is not acceptable. Ideally it's a clean and sterile sharp sand mix with moisture retaining agents.
5. Take the rose canes out, recut the base to about 1cm from a node, apply a powder rooting hormone (or rooting gel) at the base (if you believe in rooting hormones), use a pencil to dip a hole into the mix then insert a cane and firm the sand at the base. Many canes can share a container. There is a need for light to reach the leaves of each cane (It's also reported that a light shearing action with a sharp blade at the bark right near the bottom at a couple of spots would reveal more "growth" cells and help produce more roots. This is completely optional, if you decide to do it, you must be very careful not to go deep to the cambium layer. The rooting medium must also be very clean to avoid rot)
6. Take the pot out to a moist place under shade of a wall but has some bright morning Sun shine or put it under shade cloth of 50% at a sunnier spot. It is common sense, the warmer the climate the more shade you give to the cuttings. Erect a wind barrier to protect the cuttings from the drying effect of the wind. I find a fence made of chicken wire and clear plastic just perfect for this purpose.
7. Turn on your misting or a suitable automatic watering system. If you have none, try to spray them at least twice each day before going to work and immediately after you get home.

This method requires the misting of the top leaves to keep them from drying out. If they wilt, the rooting process will fail. In this softwood rooting process, it's a rapid race where the following things will happen

1. The cuttings' base must heal rapidly in 2 weeks to avoid rotting away in warm temperature. For this to happen the leaves must continue to work doing photosynthesis to produce nutrients. And that means they must never dry out, and they must also receive enough water and natural light for photosynthesis. The soil mix should be relatively sterile (mostly clean sand with a little peat to retain moisture)
2. The cuttings that have buds ready to grow are not good candidates. They tend to grow immediately into second week of rooting. As the cuttings still have no roots, this growth will drain the reserved energy in the cuttings. You expect dormant rose buds to become plumb, but not start to grow.
3. Then roots will grow within 6 weeks or a little longer depending on temperature and light. After that they can be repotted individually on good soil and allow to grow feeder roots. They will harden quickly in a few days and start to grow as independent plants in about 10 weeks. At this potting out step, you will truly appreciate the use of sharp sand as the rooting mix. Simply hose off the sand with a water spray, you get the cuttings with full root systems unaffected.

The requirement of keeping the top leaves fresh through out the rooting process is where most beginners fail. Obviously the easiest way is to use plastic to make a sealed chamber preventing moisture from getting out. But this has many associated problems in warm weather such as fungal diseases and over heating. Therefore setting up an automatic misting system and root them in the open air is the best method.

To be true with the premise that we need a technique for the home gardener to work with, I have found out that it's possible for the home gardener to set up a simple automatic watering system to achieve the same purpose at low cost.

All you would need is a battery-operated water tap that provides reasonable timing. The timing has 2 values (1) The Interval between each watering session and (2) The duration of each watering session. Some digital timer device will allow very fine settings. A simple device would allow "coarse" settings such as watering once every hour and minimum 1 minute for each session. That would be sufficient. My settings are to water once for every 3 hours and the duration is 1 minute. This is suitable for a shady spot with only a little morning Sun. For a 50% shade cloth spot, you would need once every ½ hour and 20 seconds for each time. You can do it in full Sun with 10 seconds misting every 10 minutes for the fastest result (this depends on your local conditions).

All the materials needed for setting the automatic watering/misting system are

1. A few meters of black plastic poly pipe for garden irrigation
2. A couple of screw-in nozzles for fine sprays/misting
3. A battery-operated timer water tap.
4. A few wooden stakes and few lock-ties cable for setting up and to tie the components together.

Nozzles

Battery-operated timer water tap

Note: Cheap timer-water tap like this only provides settings of minutes rather than seconds. This means you tend to over water the rooting bed. Cheap nozzles like these will not spray mist. They spray water droplets which will wash away all rooting hormone (if you use it) and cause problem for the rooting medium if you choose to put a layer of fertile mix at the bottom.

Pros and Cons of softwood rooting method

This method allows continuous rooting from early spring to mid autumn where rose cuttings are abundant. Rootstock cuttings are readily available in warm months. Once the method is fine tuned the success rate can be very high for some variety of roses and rootstocks.

There are a few problems. It requires better control of humidity to avoid the wilting of young cuttings. And it also requires the cuttings to be healthy, not too young and not too old. The warm temperature makes them become *spent* quickly after being severed from the parent plants. Therefore it's a fast race between rot and root. In short, it can be hard to get consistently high success rate for beginners.

I find rooting in the open air with a simple misting or automatic watering system helps to eliminate several major problems and raise the success rate dramatically. It makes sure there will be no overheating, no wilting because of dry wind and no mold from dead leaves. In many cases when the time is spring, one can complete the rooting process with a high success rate, and most of the original leaves of the cuttings stay intact. This is an excellent result because only the mature leaves are good "factory" manufacturing nutrients by photosynthesis. New leaves consume the reserved nutrients and take a while to become mature enough to do photosynthesis properly.

Own-root roses

For readers who only want to root roses directly to make own-root roses, the two rooting methods above are quite suffice. There is no need to read on. However I would like to point out a few tips to help rooting roses more efficient.

I have built a list of own-root roses by consulting what is being offered around the world. This list suggests that old roses and any roses those are close to their natural ancestors root easily and do well on their own roots. That is why they dominate the list. Modern roses with repeated large blooms like Hybrid Teas are limited on the list. What this means is the popular modern cut roses are often very hard to root and are likely to do poorly on their own roots. They are also likely to be very sensitive to different microclimates. Please refer to this URL for the name of the roses http://roseexchange.biz/roseexchange/ownroot.html

I have also described the behaviour of various parts of the rose bush and how easy they rooted. Please refer to the section “Miscellaneous notes” for more detail.

Finally I would just like to emphasize that rooting own-root roses can be quite inconsistent. The use of a good misting system will definitely increase the success rate. The use of small mature stems will definitely increase success rate. For extremely difficult modern roses to root, the best chance is to use mature stems without leaves and root them slowly over winter at the base of a wall that gets a little direct morning Sun light.

My proposed rose propagation system

The system for rose propagation I propose can use any of the two rooting strategies as basic building blocks. However, as they also focuses on using a rootstock of some type to achieve high efficiency and consistently high quality plants, they will require more skills than just rooting. We will deal with rooting rootstocks and budding or grafting rose buds on the rootstocks. This is the way professionals use to propagate commercial garden roses. What I have worked out is a system suitable for the home rose gardeners to produce similar or better plants using limited tools available around the house and common hardware stores. I will stay away from grafting in the true sense as this means using a scion with fresh leaves on. This means we will need to set up a more expensive misting system with fine timing such as 10 seconds every 10 minutes. The metal nozzles would cost a lot more than the cheap plastic ones. Such a set up is a little to pricey for a home gardener to buy just for making a few roses.

Why is it a system?

If one sees the propagation of commercial quality roses as just a method that would be too naive. It’s a whole system that exploits Mother Nature and the seasons to achieve the best outcomes. This is only possible where each of the steps in the whole propagation system works well and lends support to the next in the chain. If you get the best tips or instructions from many experienced rose propagators to mix and match hoping to get the best system, you will get nothing. They will not fit until you have enough time to alter them and massage them together to build your own system.

Therefore a system must have all the steps tuned well to support a logical progression from nothing to blooms (it's not good enough to get the roots).

Softwood rose propagation

In this method I use softwood rootstock cuttings for rooting then perform budding roses on these rootstock plants. It is a fast way to create grafted roses.

The stages

1. Growing of rootstocks such as Multiflora, Dr Huey, R. Canina or Fortuniana
2. Understanding your rootstock and rooting it efficiently
3. Budding roses on a young rootstock plant
4. Nurturing the buds for them to take off
5. Taking the young rose plant to 6 month maturity

My view is that a successful propagation process must cover all of the above or at least stages 2-5 above. Some beginners would think that rooting (2) and budding (3) are the only core components. That's far from the truth. The young plants may still fail badly at stage 4 and 5 that makes the whole exercise worthless.

Let's have a look at growing rootstocks. Any rootstocks would be fine as long as local commercial growers use them, so we will not discuss on the type of rootstocks. However the need to have an intimate understanding of the rootstock is very important for all phases of the system. First we need to obtain a rootstock. This could be by ordering young rootstock plants. You can also destroy the bud union of a rose bush and the rootstock will start to grow. You can look for suckers and root them. It all depends on how quick you want to get your hands on some rootstock to experiment this rooting game. For those who are fussy about virus-free rootstocks, they have to purchase from a reliable source.

For the purpose of rootstock identification, here are the photos

R. Canina

R. Multiflora

Dr. Huey

Fortuniana

Most of the time rootstocks can be obtained by killing a rose. A grafted rose has a graft union. By cutting off the rose graft, the root system which is of the understock will try to grow the understock to survive. You may get the most popular rootstocks like Multiflora and Dr Huey this way. It is just pot-luck about what type you will get. Alternatively you may find rootstocks suckering up in gardens, cemeteries, parks ... or order them from a rose grower.

Characteristics of rootstocks

R. Canina	Very large rootstock, thick and can be 3m tall. It is thorny but not too bad. Very compatible with most roses. It suckers rather badly. It's not very easy to root.
R. Multiflora	There are thin and thick varieties. Very easy to root and work with. Often suffer blackspot and powdery mildew.
Dr. Huey	Thick root stock. It can be very tall (2.3m). Easy to work with as the sap flow is generous. But it's not very easy to

	root like Multiflora. It can suffer blackspot and powdery mildew very badly in humid weather.
Fortuniana	I have no first hand experience. People claim that this rootstock has a better root system that resists some soil bugs well and copes well with dry sandy condition.

Understanding the rooting habit of rootstock is very important. The following are questions to guide the search for knowledge about your rootstock

1. What part of a long rootstock cane will root well? Young, medium or mature?
2. What is the ideal length for it to root well and also be reasonable for later budding/grafting considerations?
3. What is the lighting condition for it to root consistently, e.g.: giving near 100% success rate. This is a very important reason why professionals use rootstocks instead of making own root roses.
4. Where would the roots come out? At the base of the cutting or at the bottom node? Or at the bottom 2-3 nodes?

You will figure out that each rootstock has different habits. Only trying to root them will reveal that intimate knowledge which is essential for your later consistent rate of success. Here is my own experience for Multiflora and Dr Huey rootstocks

Type	**Part**	**Length**	**Light**	**Where**
Multiflora	Mature laterals and middle of a long water shoot	7 nodes	Bright shade to mild Sun light	At the last two nodes under the soil mix and the end of the cutting. Note **A** about suckering problem.
Dr Huey	Mature laterals and middle of a long water shoot	7 nodes	Mild Sun light to medium Sun light	Mostly at the base end of the cuttings

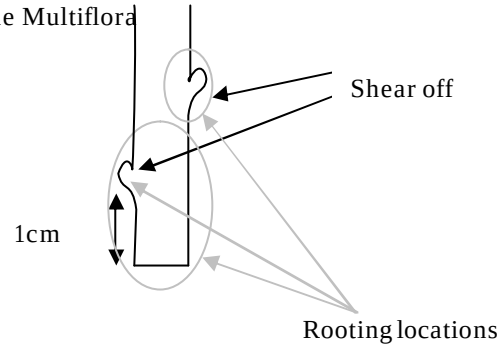
The information above is vital for the preparation of the rootstock cuttings for rooting not only to achieve near 100% success rate but also boost the vigour of the future rose plant. Using the information above for Multiflora, I would prepare the cuttings as follows

1. Take a long mature basal cane, throw away 14 nodes at the top and avoid 14 nodes at the bottom. Then cut each cutting at 7 nodes length.
2. After soaking in mild bleach for sterilisation of the germs, the cuttings have to be recut before applying hormone (optional) and insert into the sandy mix. Knowing that the roots come out best at the bottom two nodes, I shear lightly to remove the buds of the bottom two nodes, recut the base end to 1cm from the last node and apply rooting hormone at all three places.

3. Then finally I put the pot at a shady location with only 1-2 hours of mild filtered morning Sun light.

Now that's the difference between 100% success rates or probably 50% (if you do not really have intimate knowledge of your rootstock).

How to prepare the Multiflora cuttings



Note A: It is worth to take note that suckering (the rootstocks grow its own water shoot) is a really big problem for gardeners. Rootstock like Multiflora tends to sucker badly if there is any node under the soil line. Therefore getting a cutting to root best also introduces a suckering problem. That is why most professional gardener would cut out the bottom nodes completely to reduce the chance of suckering. In this case the roots might only appear at the very end of the rootstock. If one roots own-root roses, it's a good idea to have a couple of bud eyes under the soil line. It is probably best to remove the bud eyes altogether to avoid suckering.

Note B: One pre-rooting practice (in cool or cold climate) is to wrap them tightly together in bunches by newspapers then water them to keep moist. The cuttings are kept upside-down covered by an inverted carton box, placed in a part-sun warm spot. As the top of the carton box is warmer by the Sun light, callus and root will form at this end due to this extra warmth while the other end is still dormant. After callus and some roots are seen, they can be planted out into rooting medium. Alternatively, at late winter, the cuttings can be prepared by wrapping them in bunches by newspapers and sit them on heat-mat to keep the bottom side a little warmer than the top, they will form callus and root at the base while the top will start growing leaves. This pre-rooting is strictly for speeding up the process. You also will have a chance to throw away cuttings that do not seem to respond well.

As for Dr Huey, I only need to apply hormone at the base end. I also need to find a spot with more Sun light than I would use for Multiflora. I also avoid using young cuttings, so I would avoid more than 14 nodes at the top of a basal shoot. As laterals on Dr Huey are very big, I can use them freely as well.

The rooting part is easy. I use the softwood rose rooting method to root these rootstocks. If you do not get almost 100% success rate, the method should be further tuned for your climate to reach perfection. With a simple automatic misting/watering system, one can get near 100% success rate. Also it can help the cuttings root without losing the original leaves. These rooted cuttings with a lot of original leaves are excellent because they can be passed to the budding stage immediately for chip-budding (or other grafting techniques). They also have more reserved energy as they did not have to spend it for making new leaves in order to strike roots. This is the technique suitable for a very young rooted cutting of rootstock. It would not be succulent enough for other budding techniques.

Knowing how your rootstock roots can be of incredible advantage. With Multiflora and any rootstock that root strongly from the nodes, I can select a correct spot to cut the base of the cuttings so that there are two nodes close to the bottom, and the end is about 1cm (or less than ½ inch) from the last node. This cutting method allows the cutting to form 3 root systems at the same time. This vastly boosts the ability of the Multiflora rootstock to support a vigorous rose plant in later life. But this is only if you won't worry about suckering (be prepared to clean them up each spring and autumn). Otherwise this is only good for creating superior rootstock bushes.

Pre-rooting might also work on Dr Huey (see Note B for Multiflora above). This speeds up the rooting process and give you a chance to eliminate poor rootstock cuttings.

Budding of roses

This is an art in itself. It's quite easy to do budding, but to get it to work well requires experience and preparation at the rooting stage to lend much needed support for the budding process. We will discuss T-budding, patch budding and chip budding in this section. I feel it's important to clearly make a distinction between grafting and budding. Budding techniques can be considered to be grafting without leaves on the scion. When you take a scion with some leaves, you are doing grafting. Grafting techniques often require high humidity for the leaves not to wilt. This means the use of a misting system or plastic bag to keep the moisture. In this document we will not discuss any grafting techniques beside the three budding techniques.

But before we start, we should flash back at the rooting stage to make sure we have done the entire right thing to provide perfect support for the budding process. That also means we need to look at the requirements for successful budding.

Budding requirements for rootstocks

1. The rootstock plant must be actively growing and healthy. This means there will be sap flow. The plant is succulent. At this state, it's possible to separate the bark from the woody cane very easily so that the rose bud can slip in. In short, the mark has to slip for budding to be possible.
2. The rootstock plant must have saved enough reserved energy to survive and grow new leaves if you chop all top growth off.

In order to achieve this ideal state for budding, the following actions must be planned at the end of rooting process at the time you pot them out individually.

1. The pot must be of reasonable size. I often reuse soft drink bottles. At least it must be a cut-out 2L plastic bottle for the canes to have enough depth and soil to grow for 6 months.
2. The soil should be fertile to get the plants to grow rapidly. They are originally very weak. All energy has been depleted in the rooting process. Feeder roots are not available at that moment. Therefore good soil and a boost of soluble fertiliser in the second week after repotting would be ideal.
3. Give them enough time to grow the top growth well and the diameter of the cane is seen to have grown bigger. Having plenty of roots at the bottom of the pot is the sign that the plant has saved up some energy.

Now, we can look at the art of budding. We will start with choosing a method of budding. All three methods are fine but one would be preferred by some one and another will choose a different one. It depends on how good a person is with the hands and the speed s/he can manage. Before I describe in detail each of the method and how I improvise it, let's look at the pros & cons

Technique	Healing	Difficulty level	Speed	Graft union
T budding	Slow	Low	Very fast	Strong
Patch budding	Quicker	Low	Slow	Strong
Chip budding	Quicker	Medium	Medium	Weaker

Surely each person can perform certain things better than another, therefore one technique can be easy to one person could be quite difficult for another.

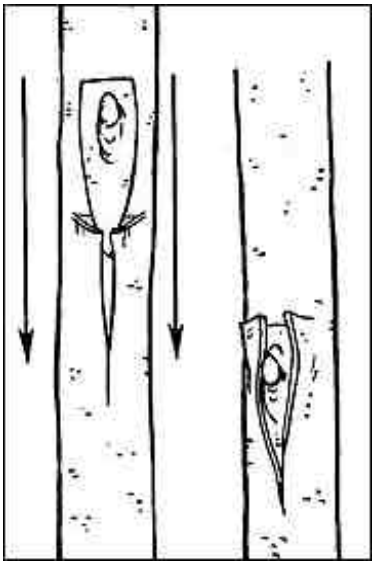
It's very important to make sure that in all methods of budding, the cuts are never allowed to dry out. People say you should not use clean water spray to keep them moist, I find this spray works fine! To be safe, use a mineral water bottle or boil your tap water than let it cool down for perfect hygiene. At the beginning you won't have the speed of an experienced budder who would get the job done quickly. Without the tying action, an experienced budder would be able to get the scion into place within 10 seconds. This is very important for high success rate. Fortunately there are also other tricks apart from the hand-sprayer that is rather too wet. You can put the scions in your mouth and use them slowly. The saliva won't cause any trouble even though the taste of the scions isn't great. Another way is to harvest and put your scions into a bowl of clean water.

T-budding

This is the method used by all professional rose growers. It's quick and efficient, suitable for mass production. It also produces a very strong graft union between the rootstock and the rose bud.

The tools required

1. A simple fruit knife or a paint scrapping razor blade
2. Some string to tie the graft area, budding tape may be too big? I prefer a small string like a polyethylene yarn (more later).
3. A roll of paper masking tape (often used in painting)



The picture at the right says it all even though it's not about roses. The T cut allows you to use the fruit knife tip to prop up the bark and slip the scion (rose bud) in. The bark

provides good protection and a moisture shield for the bud. It's a very good technique.

However there is a very important point about how to take the rose bud (scion) here. There are two ways to do it and each alters the procedure dramatically.

In the picture, what you see is a "chip" scion versus what I would call a "skin" scion (no one seems to make a distinction!). I came across one case where the gardener called the chip scion as the **shield scion**, and another case the gardener called the skin scion as the **snap shield scion**. The chip scion is a bud taken with a very thin slice of wood beneath the bud. This means

- The rose bud is Ok even if it's not dormant. If it has grown a little and formed strong attachment with the wood, that's fine
- The union will be weaker during the first few months.
- With wood-backing it can be slipped down that way without damaging the cambium layer of the scion.

However many people prefer cutting out a "skin" scion. They curve the fruit knife around, taking 4 cuts around the bud and push the bud off the rose cane. It pops up from the cane. In this way, if the rose bud already starts to grow, the bonding between the bud and the wood would break. This means the scion is damaged. You should always choose a dormant rose bud in this "skin" scion.

The pros and cons of chip scion and "skin" scion

Chip scion	The chip scion is a more flexible way to take the scion. Turn the budstick upside down when you cut the bud out. The union is not the strongest. It's sturdy and easy to handle when you have big fingers.
Skin scion	The skin scion is more fragile. It is pushed to snap off the budstick. You must get it at the right state, not growing and not too young. If it's too young, it will stay dormant for weeks and or even a couple of months before taking off. It is too soft and you must be very careful in slipping it in place. But it will produce the strongest graft union.

Note: One great tip for taking the chip scion is to select the rose canes two weeks before budding, trim the spent bloom off and also cut all the leaves off but keep the stalks. In two weeks the stalks fall off by themselves and the rose buds become plumb. These buds will grow quicker than completely dormant buds.

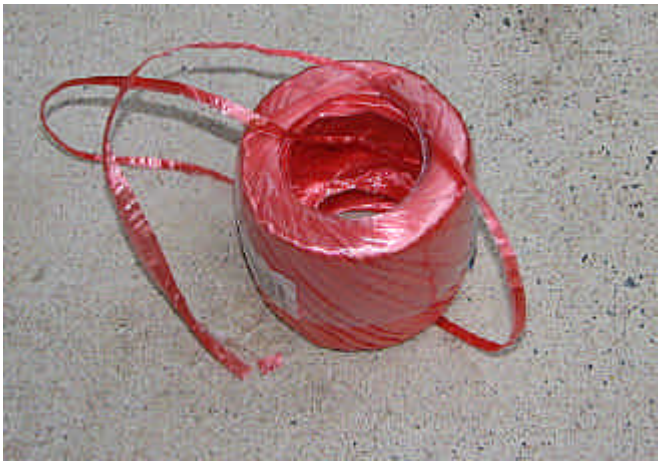
When it comes to tie the graft area, you can use grafting tapes which are designed mainly for grafting rather than budding. They are also better suited for bigger trees like apple, so using it for roses is a bit difficult. You start from the lower end first and wrap up to the other end. This action deposits the tape in a way similar to roof tiles shielding the rain water away. Then you wrap back down to tie at the bottom. It's Ok to cover the rose bud entirely, but remember to cut the tape after 3 weeks if you do.

I use dental floss when I first started, but now the polyethylene yarn is better. It's much easier to tie. Then I use the paper masking tape to seal the graft area to protect it. By leaving an air pocket at the rose bud area, the protection tape can be on for 5-6 weeks as the buds can start to grow inside this air pocket. The picture shows how this is done with dental floss and paper masking tape.

left

After 4 weeks the graft would heal and callus spills out at the cuts. It's safe to remove the budding tape or protective masking tape. The tie can be removed after 2 months by cutting only the knot at the bottom end.

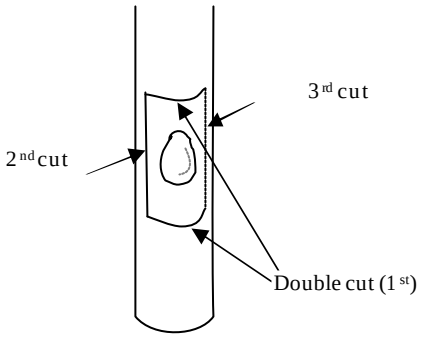
This roll of polyethylene yarn works very well. Each year can be split into 3-5 thinner yarns. So it depends on your taste and how strong you want the tie to be. This yarn also breaks down under the Sun. So if you don't want to remove, it will automatically break down within 6 months. About $2 will give you what looks like unlimited amount of budding yarn.



Patch Budding

This method is often used by people who is a bit clumsy at the little things or those who have big banana fingers. The patch is 2-3 times the size of the scion in T budding. Therefore it's easy to survive. The contact area between rootstock and scion is bigger. That also helps moisture to move across. The total contact area for cambium layers is also bigger and closer. In short this technique has better success rate even if you do a bad job! However it's very important to select a leaf bud that is dormant, otherwise the bud is ruined when the scion snaps away from the budstick.

To make the cutting of the scion and removing of the patch on the rootstock match perfectly, you need a double-blade knife. If you do not want to buy one, just make it yourself. I use a piece of timber, and a saw to carve out two grooves in parallel then attach two paint-scrapping razor blades. It works a wonder!



The cuts on the rootstock is identical, however the 3rd cut can be done later after matching the scion in first to know where to cut the 3rd cut to remove the patch. Then the wrapping is same as T budding.

It's arguable that patch budding is slower, and if done carefully, it's more complex. The success rate is generally higher, and the margin for error is also better. Care should be taken to pick a completely dormant bud eye; otherwise it is ruined when the patch is removed. A bud that already starts to grow will break off with the bud stick and never form a union with the host rootstock cane. Even if the patch survives, it will take many weeks for a new bud to develop next to the damaged bud.

A patch-budded graft union can look a little ugly for the first 6 months but it's actually the strongest union you can get.

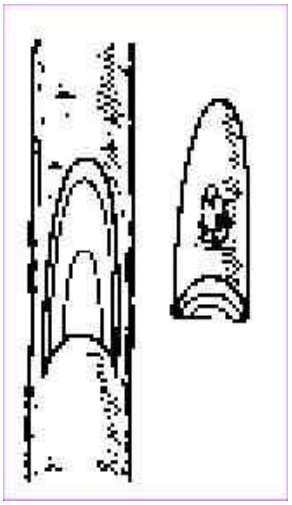
T budding

Patch budding

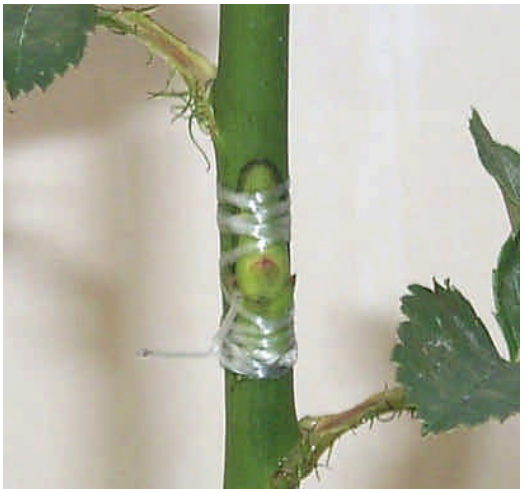
Chip budding

Chip budding is an excellent method to avoid the common difficulty of T and patch budding that the rootstock has to be succulent (plenty of sap flow and the bark slips). Chip budding can avoid this problem completely and allow you to bud on even older rootstock canes and less favourable seasons. This technique involves the removal of a chip similar to T budding with the chip style scion. However there is one constraint. The rootstock and rose bud stick where the scion chip is taken from should be

compatible in diameters. The ration should not be outside 90% of each other's diameters.



Rootstock & Chip



The scion and the rootstock should align perfectly at least one side and the bottom to match the cambium layers of the scion and the host cane. It's Ok to spray clean water to wet then recut the host socket to fit while it's still moist.

Chip budding is the only technique among the three that requires a razor sharp knife. I find it good enough to use the disposable paint scrapping razor blade to cut the chips. A heavy duty box-cutter/Stanley knife would also be appropriate as alternative to expensive grafting knife (which requires sharpening tools and a leather strobe to maintain the sharpness during the operations). I also find that a large surgeon knife (scalpel) for surgery that can be ordered from a Chemist shop, works very well. A bumpy cut is likely to reduce the strength of the union.

All three methods of rose budding are wonderful, and I take my hats off to the inventors. The way I improvise them can be a little different to others, but the essence is the same. All pros & cons stay the same. The use of dental floss and the paper masking tape is my idea for propagation at home. For beginners this will also show the development of graft. The use of paper masking tape to seal the graft helps to improve the success rate dramatically for home gardeners who do not have decent green house environment to control humidity and temperature.

Tying action

Tying action is probably the most consuming part of budding. It's vital to slip the scion into place quickly within seconds to achieve very high success rate. Then the tying action should be firm, quick and clean. Commercial growers need to save time, so they often use a rubber patcher. Normal gardener may choose to use a budding tape to wrap. This is probably the best option as it will provide firmest support and at the same time shield the scion from the elements.

Using a patcher is really fast, but the support is weak. As the callus tissues form to unit the scion with the host, the callus tissues will push the scion out a little making a weaker union. Also the rubber must be broken down by Sun light quick enough for the leaf but to grow. This may not happen when there is not enough direct Sun light causing the leaf bud to find other way to grow.

I use a cheap yarn for this purpose to achieve similar high success rate. The following set of pictures should how I can achieve a quick tying action when I am in a hurry to do many buds.

Start with a double loop

Simple bow tie

A single pull to take it off

Nurture the rose buds

That takes us to the 4th stage of the system. We now need to nurture the bud that has healed but still stayed dormant. Many beginners will be very frustrated. The budding works fine but the rose buds will not take after weeks. So what's the point of softwood "fast" propagation? You may ask! This means we need to flash back to the budding stage to see what support for this nurturing stage needs to work better. In the previous stage, you must have tried to avoid some fundamental mistakes

- Use the 'snap' method to get the scion without any wood-backing when the rose bud is NOT dormant
- Allow the scion or rootstock cuts to be partially dried out
- Do the budding when the rootstock plant's health is poor
- The cuts are just poor, bumpy and frayed.
- Picked a really bad time to do the budding when the summer heat makes all things snooze (or when it is already late into a cool autumn)
- Bud a rose that is well on its way into dormancy late autumn.

Provide that none of the above problems happens in the budding stage, then buds should be fine. They can look very plumb 3 weeks after budding. You can expect something like this

- Some of them, especially of the vigorous rose variety take immediately and grow quickly. You can safely cut off the top growth of the rootstock and let the rose take over.
- Some of them look very good; the rootstock's own top growth is fantastic. But the rose buds stay the same, sleeping like forever.
- Some rose buds sporadically take off in the weeks ahead

Why? This is simple. It's just a problem of "fast" propagation. If you do it over winter, the buds will sleep and mature slowly over 3 months. By spring all of them are ready to take off, and off they take! In this short-cut system of softwood propagation, one can expect that some roses will not behave well.

So it's time to feed and force (relocation into a sunny spot will also help). First you feed them well with water and fertilisers. Boost the rootstock plant with soluble fertilisers if needed to get excellent rootstock's own growth. This helps them to save the energy down the root system and trunk. There will come a time when they go to sleep briefly and then are ready to start growing new buds again. At this time, cut off the rootstock's top growth completely just above the graft area. The next wave of growth will force the rose bud to take off.

In some cases, if you use immature rose buds as scions, the rose bud may miss the boat until next spring. Even though this is rare (as you can pick decent rose buds to start with), if you are patient enough to wait, they will eventually take off.

In some cases if you did the budding poorly, or pick the rose buds that already start to grow a little, the result is not good. The main rose bud may wilt and become stunted but the graft is still Ok. It takes a couple of months for 2 invisible buds on the two sides of the main bud to become mature. They will show up and may take at the same time. If this happens, you can pinch one off for the other one to grow faster.

If you want to avoid this sporadic growth of the rose buds, do budding at the earliest possible time in spring when rootstock plants have grown strongly and become succulent. Alternatively you can do the budding about mid autumn and let the buds go dormant over winter. They will all start to grow nicely next spring.

Maturity at 6 months

This is the time where the plant can be doing well on its own without attention. Once you reach this stage, it is well on its way to become established. It can be put down into the ground or plant into big pots.

However before reaching this stage, many problems still can happen

1. Graft union can break off (especially with weaker ones like T budding with chip scion or chip budding)
2. It won't survive one attack of downy mildew (damping off).
3. Roots can be over heated by the summer Sun in a small pot and the plant is stunted.

So the best practice is to repot successful plants into a standard rose pot which holds about 2 gallon or about 4.5 liters of soil. Make sure the pot is not a black pot! White is best, or light colours should be used.

You can also bury the pots under straw or soil or mulch ... if required to avoid extremely hot summer climate

If downy mildew appears, spray the lot with Triforine and Mancozeb. I notice that even on the plant suffering downy mildew, a quick scrape off on the brown spot then apply concentrate Mancozeb by a brush will work.

I wait until at least 6 months after budding before I do a major prune allowing the big water-shoots/basal to break out. Pinching the first few blooms off to save the energy for the plants also help them to establish quicker.

The use of semi-hardwood rooting

This is just a variation of the system. It's the same thing like softwood rose rooting but the rootstocks will be semi-hardwood and rooted in autumn (or late winter) in the open (without misting). You can use smaller but mature laterals as rootstock in this case. The next spring they will grow well. The difference is that they already have semi-hardwood trunk, so the rootstock plants are quite tough. Also if you are in a climate where winter is not severe, you can start the rooting in autumn. This will give the rootstock plants an advantage of an extra 2-3 months of maturity which will help the rose buds to grow faster in spring budding.

When the rootstock grows very strong in spring, the bark will slip once again making T budding or patch budding possible. If you want to do budding a little earlier, chip budding is the logical choice.

The following steps describe rose propagation using semi-hardwood rootstock

- Taking the cuttings when you prune back rootstock bushes. Cut off all leaves and laterals. The cuttings are generally over 6 months old (2nd growth season). Keep about 7 nodes or more on each cutting.
- If the rootstock is rooted in autumn, they are likely to grow some roots by early winter but they are not ready for budding. The roots slowly develop over winter, and all the plants would grow vigorously next spring
- Next spring, when rose buds are available, you will do budding on them (or grafting if you have the skill and controlled environment that can provide appropriate humidity). You might be able to do T budding if the bark slips easily. I notice that if you use a slim Multiflora rootstock, it's quite easy to do T budding even on semi-hardwood rootstock in spring.
- The slow system like this allows you to do the best timing for budding and ensure best vigor in the rootstocks. The budding should be done when scions become available in early spring.

The techniques are almost identical to softwood propagation but much easier and more forgiving as it is much slower. The margin for error is very comfortable for the home gardener.

Budding on the bush

This is not a new system. It's just a variation of the softwood propagation system to achieve a different effect or to increase the success rate for an inexperienced gardener in rose propagation. One problem with a beginner is lacking skills in budding making it difficult to carry out budding after a new rootstock plant is no longer succulent enough for budding. The most popular technique of T budding cannot be performed at any time of the year. Another typical problem is the availability of rose buds (scions) may not coincide with a brief period in late spring that rootstocks plants may be succulent. And the time window for a new rootstock plant to be ready for budding is very short. The plants have to be succulent for the bark to slip, and this does not last very long while you wait for the availability of scions. This problem is similar for patch budding.

Depending on the skill level of the gardener, chip budding and other grafting methods are appropriate techniques for the period where the plant is not succulent. However not all gardeners are good at these techniques.

That's why I also employ budding-on-the-bush as a different method to help inexperienced gardeners. In this method, one would bring the budding stage of the softwood propagation system to become the first stage. So you do budding, rooting and finally nurse the plants toward maturity. The budding is carried out on a large rootstock bush you can always find young and healthy stems throughout the warm months from early spring to early autumn. This makes it so easy to carry out T budding. As a bonus, the budding on the bush often yield 100% success rate (due to the extra generous sap flow on the big bush) even if the gardener is very poor at budding skills. This almost guarantees success at all times.

Budding on the bush method

- Choose the time that rose buds are plentiful in mid spring, and those basal canes on the rootstocks that have stopped growing rapidly. Pick the rose buds from stems with a spent flower. Discard the first couple buds at the top, especially those that have started to grow. Take the next 3-4 buds depending on the length of the canes. These buds are best as they are not too immature.
- Carry out T budding to get the rose buds onto the rootstock water-shoots/basal at the interval of 7 nodes. Be careful to avoid snapping the basal. Thick laterals are just as good for this purpose.
- Wait for at least 3 weeks (best 5 weeks) for the grafts to heal properly.
- Take the cuttings at 7-8 nodes so that there are two nodes at the top before the rose graft. Then prepare the cuttings to root them with the softwood rooting process
- About 6 weeks later, the rooted cuttings would be ready for potting out.

In this method, the rose buds will grow sporadically in summer weather. Some rose varieties will start growing the buds immediately (and consistently) even though the rootstock is still quite immature. This is fine, just trim off the rootstock's top growth and let the rose take over. This often happens to vigorous rose varieties. Please refer to the section "Nurture the rose buds" for more information.

Budding on the bush is a great way for beginners to start and learn. The success rate is always decent even though the result can be a little sporadic. Experienced gardeners will get great results (better than the standard softwood propagation method). However one important caveat is the risk of virus infection. If you have a rose infected with Mosaic complex viruses, the rootstock bush will be infected and it transmits to all other young plants. Therefore it's good precaution to destroy this rootstock bush after you exploit it fully. In warm and mild climates, Mosaic complex viruses do not seem to affect the rose plants very much.

Note: I believe that this method can be commercialised. It will save a lot of time, increase success rate, save space, be appropriate at most times of the year and allow workers to work at comfortable heights instead of breaking the back doing budding at ground level. To combat virus infection problem, one can match one rose variety with one bush of rootstock. This one-to-one match will ensure no cross-infection between rose varieties.

Varying the timing to achieve better results

You can start with the softwood rose propagation system in spring, but you do the budding at mid autumn. By this time the rootstock has enjoyed the spring/summer growth, snooze at the hottest time of summer then grow again as the weather cools down between end summer/early autumn. The root system has a lot of reserve and the trunk is firm. The fresh top growth of early autumn would make the plants ready for budding (or at least chip budding)

At this time, the budding is done, and the rose buds will sleep and mature into winter till next spring. That's when the top growth of the rootstock is pruned back completely to let the rose buds take off. The vigour of this spring growth from the rose buds will be remarkably better than the sporadic growth of spring budding. And also the consistency is greatest. There is no sporadic immediate growth, but all of them will take off at the same time next spring. This is a method of choice by many growers to produce medium and high quality garden roses within 2 years. This is what they often call 2 years old roses with true 2 years old root system and 1 year old rose graft. These roses are often dug up in late autumn to be sold as bare roots.

Another strategy is to root more mature cuttings in autumn and let the cuttings sleep over to next spring. This allows you to do budding early in spring where the chance that the rose buds will take quickly is higher. They will grow consistently by late spring.

Rose formats

On the market each rose can be offered in various formats: bush, standard and weeper. The bush format is the most popular. It's just a short plant either own-root or grafted on a short rootstock cane. Standard and weeper are tall formats. A weeper is a very tall rose format with the understock alone measured to about 180cm or 6ft, and the rose is of a soft kind allowing it to weep down like an umbrella. Some roses are offered in all three formats. Most roses are offered in at least 2 formats. The bush and standard formats are most popular. A weeper requires the use of a rose with soft canes like the carpet roses (ground covers/crawlers).

Making standard (and weeper) roses

The only difference in making a standard rose is to root very tall rootstock canes. These canes can be between 40cm to 190cm or even taller. You need to root a cane longer than the standard you want to make. For example, if you want to make a 30cm tall rose, you need to root 40cm of rootstock for the bit that will go underground.

My tests show that rooting taller canes require a lot more work. If you get 100% success in rooting 12cm long canes, you will probably get 50% success at 40cm and 10% at 70cm. That is why you will need to learn how to root long canes properly.

Problems to resolve

1. The main problem is that water cannot easily travel far up a long cane especially when there is no root. Then the sap flow needs to go very far to reach the bottom of the cane to form callus (making rooting possible). Any initial growth at the top of the cane will soon suck all water out of the cane causing it to shrivel up and die before there is any root at the bottom.
2. The bottom of the cane is semi-hardwood and the top of the cane is softwood. The bottom is too slow to strike roots and the top is too quick to dry out.
3. It is hard to set up a misting system for the canes over 200cm tall in the backyard.

You can surely set up a very tall misting system if you really want to. It will need to be about 200cm tall to do the job properly. However I decided to find an easier method to do it at home without any fancy set up. The first job to do is to feed and water the rootstock water so that you can get water-shoots to over 180cm.

The milk container method

In this method I manage to root up to 10 long canes (any height) using a 2L milk container. It is probably as efficient as you would ever get.

1. The right time is late winter when temperature is over freezing and warning up steadily. In warm climate, late autumn is also fine.
2. The easiest rootstock to use is Multiflora. I have had similar success with other rootstocks. Harvest the water shoots when they have stopped growing.
3. Remove all leaves and cut the top back by about 20cm or the reasonable thickness (about ½ of the pencil thick). It is good to have different lengths of rootstock in one lot to space out the top growth later.
4. Get a 2L milk plastic container, punch many little holes at the bottom and cut open the top wider (to be able to fit 10 canes)
5. Prepare some mix of 80% sand and 20% peat. No fertile soil is allowed.
6. Use a yarn and tie the rootstock canes into a neat bunch. The top of the canes should be loose enough to allow them to fan out a bit.
7. Put the base of the canes into the 2L milk container and fill it up

with the sand mix. Leave a little space at the top for easy watering.

8. Find a location protected by shade and a wall. The hot Sun light should be on the other side of the wall. It should have bright indirect natural light. Lay the canes and the 2L milk container side way on the ground for weeks
9. When the leaf buds at the top start to look plumb. Use a block to raise the top of the bunch up. Keep doing this and raise the top of the bunch higher and higher as the leaf buds start to grow. Water the container weekly.
10. As the leaf buds grow very slowly the whole bunch can now lean against the wall. Water the container twice weekly. The top growth will try to make it higher to reach the Sun light from the other side of the wall. By now the canes will start to root.

The key to success is the slow growth of the leaf buds. They need to grow very slowly using only the energy reserve inside the canes and little water until they strike roots. Once the many white roots are seen through the semi-clear plastic, you can start add a little soluble fertiliser into the water to feed them. They will grow a lot faster this way.

Next step is to pot them out. Just cut the milk container open and hose off the sand to get the cuttings with the roots intact. Separate them and pot them out. It will take about 3 days for the separate plants to recover. Therefore putting a plastic bag on top of each plant to keep the leaves fresh is a good idea. Alternatively pick a rainy week to do this repotting. Use a stake to keep the rootstock upright.

Budding of standards

The budding of standards is very much the same as for bush roses. But one should take care to create perfect standards

1. First at the rooting phase of the understock, pick the rootstock that is slim (or at least the top must be slim). This will make sure the rose graft will eventually engulf the top of the rootstock.
2. Bud only 1 leaf bud right under a healthy lateral to ensure there is plenty of sap flow for the graft to take quickly.
3. If you want to make sure by doing 2 buds, remember to destroy the weaker one once both of them take.
4. After about 4 weeks, the graft should show signs of success or failure. If the budding is good, you can cut off the top growth of the rootstock to force the rose bud to grow. The position does not have to be right above the graft. It can be higher then you would cut it lower later after the rose has grown considerably.

Making ultra tall standards

Can you make ultra tall standards or weepers about 300cm? The answer is yes but it's difficult. Rooting ultra high rootstock canes is not easy. You can probably do it well using Multiflora but it's very hard to get Multiflora to grow to over 200cm. And even if this is not a problem, the base of the water-shoots will be so big and tough. It does not root very well at that age and toughness. Imagine that the top leaves must start to

grow before the base strikes root, it's very easy for such a long cane to run out of energy and water before the tough base decides to strike roots. It gets even harder with other rootstocks such as Dr Huey, Canina and Fortuniana. Dr Huey and Canina will throw water shoot over 200cm if they are fed and watered properly.

I have worked out a feasible method to make ultra tall standards and weepers in very small numbers.

1. First feed the rootstock well. Some times I get a sucker from a rose bush; I just leave it alone to grow very tall. They can reach over 200cm easily if the bush is vigorous.
2. I then bud a rose bud at the position I like and let it grow and stake the cane to hold it upright
3. Weeks later, when the grafted bud is already growing well, I dig into the soil to find where the cane starts from, use a saw to sever about 2/3 of the diameter of the cane so that it is only loosely attached to the parent plant to get just enough feeding to survive. I put the soil back to cover the wound and keep watering and feeding the bush like normal.
4. Wait until the end of next winter; sever the cane away from the parent bush. The chance is there will be some roots from the wounded base of the water-shoots. Trim the rose on top way back to a single stem just to keep the graft. Plant and stake this new plant carefully in shady area waiting for spring to make it grow.
5. In exceptional cases where no root can be found, I start the 2L milk container rooting procedure and wish for luck.

Making a tree rose like this will be a real challenge. It is left as an exercise for readers using all the information given in this guide. Whatever you might like to call it, a giant standard or tree rose or weeper, this plant is at least 260cm and still growing taller every year.

Quality of rose grafts

It is always a mistake to try to make more than one graft on a rose. Growers often do this to make the plant bushier and easy to sell without waiting for the full 2 years. The best grafted rose has a single perfectly balanced graft on a sturdy and woody understock. It takes about 2 years for the graft to completely engulf the rootstock top to create a round and balanced union crown. And Yes. It's very hard to find a highest quality standard rose on the current market even if you are prepared to pay the extra money.

Even though these two grafts look excellent, this standard rose will never be perfect. If one graft is broken, it will be forever unbalanced. One graft eventually dominates the other making the plant unbalanced.

The graft on this standard is well on its way to engulf the rootstock top and become a perfect union crown. It will make a perfectly balanced standard. This same quality extends to normal bush form even though it's less important for bush roses.

Note: For standard roses (or weepers), it is best to use slim rootstocks to make it possible for the single rose graft to engulf the top of the rootstock as soon as possible. This creates a perfect balanced standard rose. It is not worth it to use a thick rootstock, bud 3 grafts and end up with a plant that initially looks good, then one graft will become dominant (or another will break) destroying the balance forever.

Root grafting

Root grafting is a rose propagation method used extensively by Dutch growers to propagate roses for hot house production of cut flowers. Perhaps it is not used a lot for production of garden roses because it seems to take a little longer to produce a big plant suitable for sale. The philosophy of this method is to strike 1/2 way between producing an own-root rose by rooting a rose stem directly and a grafted rose where an understock is used. Eventually the rose will become an own-root rose but it has the advantage of being a grafted rose in the first few weeks or months of its life. And this also overcomes the fact that some roses are very difficult to root. The root graft helps

the plant to survive until it naturally grows its own roots from the rose cutting at the top part.

The picture below show a successful root graft baby rose. Note that white callus that formed and connected the root segment and the rose stem.

These root-grafted baby roses have lost all leaves because they are rooted across late autumn and over winter without misting. It's possible to do this at locations with a mild winter. They will grow in spring.

Advantage of root-grafted roses

1. You only use a 1 node or 2 nodes rose stem. This is a saving on disease-free rose materials
2. The technique creates a new plant rapidly because the root segment will automatically grow feeder roots in 3 days, and the rose part will produce callus to form the union within 1-2 weeks.
3. This technique overcomes the fact that some roses are very hard to root. So it allows the new plant to start a new life as a grafted rose.
4. The mature root segment stores much needed reserve energy to help the rose part to grow quickly

The only disadvantage of this method is the size of the plant. It cannot be big to start with because the union is *unstable*. The root segment will probably break away in the future months after the rose part grows its own roots and turns into a completely own-root rose. For this reason it will take longer for it to become a mature rose. And that's probably the reason why they are best for low wind growing environment inside a hot house for cut flower production. However this would change after 2 years when they are big enough to survive strong wind.

The method cleverly solves the most difficult problem which is the rooting of all kinds of roses in the same environment (low strike rate). This is achieved by using a very simple operation to graft the root segment and the rose cutting.

Root grafting procedure

The procedure is similar to the softwood rooting procedure, and misting is required to get the highest success rate. Softwood cuttings are used at all times.

The slow way is to do it in cool autumn weather with a misting system. There is not enough leaves to create enough sap flow for the root and the rose cutting to unite quickly. This is why we need some morning Sun light and misting to counter the drying effect of the Sun.

1. Prepare a rooting medium with 80% sand and 20% peat to help retaining moisture
2. Harvest disease free softwood rose cuttings, small in diameter and with completely healthy leaves. Keep only 1-2 leaf set(s) and trim it back down to about 4 leaves on each leaf set.
3. Harvest roots from any rose type, but roots from a rootstock is the best. Cut the roots into 3cm segments.
4. Grafting: simply slant-cut (with a razor sharp knife) the base of the rose cutting and the top of each root segment. (a) Make sure you know which end of the root segment is supposed to be the top end (closer to the trunk of the original plant). This top end must be grafted to the rose cutting. (b) The slant cut must be in the same direction of the stalk of a leaf set. This is important for the cut to get as much **sap flow** from the leaves as possible. (c) Also make sure the diameter of the rose stem and the root segment are as close as possible.
5. Bind the two using a **cotton** yarn for best result (cotton yarn will rot naturally in the soil after a couple of months). Using a strong cloth peg is a possibility but it's unreliable.
6. Use a pencil to dip a hole in a medium about 5cm deep, lower the root-grafted rose into the hole and firm up the sand.
7. Protect the location by using chicken-wire net and clear plastic sheet making a high fence surrounding the rooting bed (create a windshield).
8. Frequent misting is required to keep them fresh.

In the picture on the left, one-node rose stems are tied to root segments by dental floss (**not** recommended, a cotton yarn is preferred). The use of a razor sharp knife is vital for successful union of the rose cutting and the root segment.

The root-grafted is expected to grow roots and form callus within 2 weeks. They will grow feeder roots and new leaves very quickly. Therefore they need to be repotted after 4-5 weeks. Alternatively the growing medium can have 2 layers of soil mix. The

lower layer is rich soil with plenty of nutrients. The top layer is about 8cm thick. The root-grafted rose stay well above the bottom layer. Eventually the roots will go down to the bottom layer to feed.

I can foresee that the cut can be improved if you have the right tool. The cut must be sweet for the union to happen quickly. A crinkle cut using very sharp tool will help the root and rose segments to bite into each other and make the graft much more stable. Finding a tool that can do this is a difficult matter. The common kitchen potato/carrot cutting tool set does not have razor sharpness to cut rose roots and stems sweetly. This could be a good exercise for a handy toolmaker.

Rose stenting

Rose stenting is a time saving method to create small roses by grafting a rose with a rootstock cane and root it at the same time. It saves a lot of time. However there are shortcomings making these roses unsuitable for the garden

1. The roses are very small to start with.
2. The graft union is unstable, and unlikely to become stable enough for the garden.

This is why the stentlings (that's what they called the little plants) are mainly produced for the hot house cut rose production market. It's unlikely that home gardeners would want to do stenting in the back yard. I have simplified the idea to create a different method that works in the backyard without high quality misting system.

The original stenting method requires the use of a short 1-2 nodes rose stem and rootstock. They are grafted together and put under a good misting system in nearly full Sun light. They rapidly form a union and the rootstock strikes root quickly. This happens rapidly and demand that the set up must be perfect. The grafting skill must also be perfect.

I created a simpler method based on this idea. Instead of grafting I use T budding. To make it possible for the budding to work, I pick mature rootstock that is not too old. I make sure that the leaves are also mature and completely healthy. I leave 3-4 sets of leaves on the rootstock stem (with 4 leaves on each set). I seal the graft using paper masking tape to make sure it is not exposed to air and water. Finally these budded rootstock cuttings are rooted under direct morning Sun light and a simple misting system. This must be carried out in the cool climate of early spring to make sure that the leaves do not dry out. If the misting system is better, it should work in warmer times of the year.

The use of mature healthy leaves (and enough of them) will ensure there is enough sap flow across the budding graft when they are exposed to the direct morning Sun light in very cool air. This method effectively saves between 6-7 weeks comparing to the normal way of waiting for the rootstock plants to be mature enough for budding.

Rose Rustling

It is a hobby for many rose lovers to discover old forgotten roses. Some times you find a rose along the street that you like and want to have it. You can ask the owner for some bud-wood or canes to root. The only 100% reliable way is to get healthy bud-wood and do budding on a host rose plant at home. For this reason you will need rose budding skill.

The situation is the same when you see beautiful cut rose at a florist shop. You would like to grow it at home for you own enjoyment. In many countries this is completely legal as long as you don't plan to make money from propagation this plant. Again budding skill will be a sure way to get it. Rooting cut roses bought from a flower shop is a chancy business. You will be lucky to get 1 success out of 100 attempts.

It's very unlikely that you would have some rootstock plant ready for budding at the time you find an interesting rose. That's why you need to do budding on the bush. You will need to select a rose bush to be the host for this new rose to temporarily live on. After budding it will grow and you will have more bud-wood to work with at a more convenient time.

Rose rustling requirements

1. Keeping the bud-wood cool and moist on the way home
2. Designate a rose bush to be the host. This rose bush should have generous sap flow at most times of the year. Beware of virus contamination. If the new rose has a virus, it will infect this host. That's why you may not want to use a rootstock bush for this purpose.
3. Keep a budding kit ready with knife, yarn and tape.

I find Iceberg a wonderful rose for this purpose. It is very compatible with all roses. Roses budded on this bush will grow immediately. You can then have more bud-wood to root, bud or even take a cutting of Iceberg with this new on budded on it and root. Iceberg roots very easily and works as a decent rootstock too.

Rose Compatibility

Growers debate hotly over rootstocks probably because of turf war between competing growers. My experience shows that each rootstock has some advantages and disadvantages. Multiflora is the easiest rootstock to work with as it roots so easily. However it is true that the compatibility between a rose and a rootstock is also a concern. Picking the wrong rootstock for a rose may visibly affect its vigour. However we don't have any database for this purpose. I have started a small database of my own and are looking for contribution from others (available at http://roseexchange.biz/roseexchange/propagation.html). The positive effect of using the right rootstock can only be realised if we have at least three pieces of information: rootstock, rose variety and geographical location. What this means is that you can have a correct match between a rootstock and a rose variety, but the combination might not work very well in a particular climate and soil of your region. Rose growers may have some broad ideas about this for their own location but they don't release this information to the public domain.

One rose I had a great problem budding it on rootstock is Vesper. I finally got it to bud very well on R. Canina.

The budding/grafting of roses on a rootstock is like a marriage. The rootstock does one job and the rose does the other. The rose supplies the food to rootstock. The rootstock gets the water and minerals from the soil for the rose to do photosynthesis and make the food. As for all marriages, if one partner is unhappy, the whole lot will be in trouble. Many modern roses only do well on rootstock because they have lost the ability to grow good roots. It becomes worse when they loose the ability to fight diseases as well. As the result they often do not have enough leaves to manufacture enough food for itself and for the understock (rootstock). The rootstock is starved and the whole plant shrinks in size.

This is the reason why many modern roses need constant feeding and care. They also need chemicals to fight diseases. Hybrid Teas with large blooms and repeated blooming are typical of the modern roses that suffer this problem.

There has been a trend where some growers go back to own-root roses. This works very well with old roses but is questionable on modern roses. The main problem is the inconsistent rooting ability of modern roses along with a poor root system. Root-grafting can go a long way to help with the rooting inconsistent problem.

Some important observations

1. Rose care plays a more important role than the selection of rootstocks
2. Any rose can be a rootstock if it can root easily and have a good root system for your location
3. Having many rootstocks handy will help coping with an occasional difficult rose
4. Iceberg is strangely compatible with most roses even though it is not a known rootstock
5. Budding two (or more) different kinds of roses on the same rootstock to create a rose with multiple kinds of blooms would not work because one graft will be dominant. Even if you bud 2-3 grafts of the same rose on a rootstock, one graft will become dominant even though this happens in a slower manner.
6. If you use a sport of a rose as a rootstock for another sport of the same rose, you will get the best chance to create a plant with two kinds of blooms that will match in vigour. You can potentially have a rose bush with blooms of different colours with perfect balance. One great example of this is when you bud one sport of Iceberg on another Iceberg (as the understock) and let both the understock and the budded rose grow at the same time.

Miscellaneous notes

In this section I would like to mention about miscellaneous things that do not seem to fit under any other important heading.

Rooting mini-roses

Mini-roses are small rose varieties designed to grow well in small pots. These roses grow rapidly and flower generously over long period of time. They can be trimmed

aggressively in a warm season and still grow back quickly provided that they get plenty of water and feeding.

Mini-roses root very easily and almost never need to be budded on a rootstock. There are 3 popular ways to root mini-roses: rooting stems with leaves, stems without leaves and rooting under artificial lights. All three methods work very well (unlike normal roses).

When you root mini-roses in autumn or end of winter, you do not need the leaves. In this case you will pick the mature stems. When you root them in warm months, you must select healthy stems often only 3-4 weeks old just after they have flowered.

The medium for rooting should have 2 layers. The bottom layers has fertile soil. The top layer has 80% sand and 20% peat to keep moisture. The first layer will help the stems to root and when the roots reach the second layer, they can get proper feeding.

Rooting normal roses

Much has been talked about rooting roses or rootstocks (for budding). However one extra observation should be made about the behaviour of rootstock water shoots versus small laterals. The small laterals root very easily. The water shoots are much harder to root, especially the long ones. This is probably because the sap flow on short and leafy laterals is likely to be easier. Another possible reason is that these parts close to the leaves have more natural growth hormones produced by the rose leaves.

The general rule is the shorter the stems are the easier they root. And the more leaves they used to have, the better they root. And finally the more mature (but not old) the leaves are the better they root (provided that the leaves are completely healthy). The only reason why growers would choose to root large stems is because they would like to save on the time to get the products to the market. This looks very consistent with the observation that mini-roses with tiny short stems root so easily like vegetables.

If you have a good misting system to keep leaves from drying out, you will find that you can even root a single leaf stalk. However it won't grow to become a new plant.

When a rose wants to grow

Roses go through major phases across the seasons. However they also go through little phases of growth in one season. We can observe that in one rose bush, some stems want to grow and some want to sleep at the same times. Even when the climate is not ideal in summer or early winter, a large rose bush tends to have some growing stems and some dormant stems. Typically for repeat-bloomers, after a stem has produced all the blooms it has, it will go to sleep for a short time before starting to grow again. The sleeping period is quite short when the climate is ideal in spring. It is longer in summer and autumn. My guess is that a healthy growing rose bush has plenty of natural growth hormones.

This observation is important, because if we catch the growing wave, the rooting (or budding using the leaf bud) of that stem is so much easier. This observation leads to 2 practical considerations to save time

1. You can save time in budding by using nearly started leaf buds. You can pick a stem that you will harvest the leaf buds. Trim it back a little after flowering and wait for 2 weeks. The 3-4 leaf buds near the top of the stem will become plumb and ready to grow. This means the buds will grow shortly after budding. This

could save anywhere from 2 weeks to 6 weeks. Remember to take them as chip scion (also called shield scion). This means the scion will have a little wood backing just in case it has started growing.

2. The same thing can be used for rooting soft-wood stems under misting. When you have a misting system, there is no worry about the wilting (due to drying out). By using ready-to-grow cuttings, they will grow immediately within 2 weeks while they are in the rooting bed. That means the new leaves and existing leaves all work hard to help the cuttings strike roots.
3. The same thing can be said about rooting softwood cuttings without using a misting system. However one has to be very careful to pick the time when the climate is very cool. The quick growth may mean that the cuttings will dry out in the open. So it is probably safer to avoid this time saving measure.

How to reach budding stage quickly

When you root a rootstock for budding, the wait until the rootstock plant is ready for budding could be frustrating. If you root the rootstock late winter (in very cold climate) or in autumn (in warmer climate), you would be doing spring budding. This is what growers do. You don't have the problem of waiting because you give the rootstock so much time to be ready. This is what I call working with nature.

However I imagine that most home gardeners want to push our luck and root the rootstock in spring (and even early summer), by the time the rootstock is ready for budding it's high summer. It is too late for budding. So you wait until autumn to do the budding and get very frustrated when many of the rose buds just go into sleep due to the cool climate.

The answer to this is to use fairly young rootstock cuttings in your softwood rooting. You must have a decent misting system as well. Keep plenty of leaves on the rootstock. It allows you to get rootstock plants that have a lot of original leaves. And by the time they have roots, they are still succulent enough (the bark still slips easily) for budding. You can quickly do the budding at the same time that you put them in pots. Keep the pots under misting for another 2-3 weeks to keep them cool in summer. In this way you can get the budding done in summer and get the first blooms by autumn. That's a lot of time saving.

Another option is to get a green house. It will extend your autumn into winter allowing more time for growing. The rose buds won't go into sleep immediately at the end of autumn.

How to improve success rate when budding

It's very important to make sure that in all methods of budding, the cuts are never allowed to dry out. People say you should not use clean water spray to keep them moist, I find this spray works fine! To be safe, use a mineral water bottle or boil your tap water than let it cool down for perfect hygiene. At the beginning you won't have the speed of an experienced budder who would get the job done quickly. Without the tying action, an experienced budder would be able to get the scion into place within 10 seconds. This is very important for high success rate. Fortunately there are also other tricks apart from the handspray that is rather too wet. You can put the scions in

your mouth and use them slowly. The saliva won't cause any trouble even though the taste of the scions isn't great. Another way is to harvest and put your scions into a bowl of clean water.

Rooting machines

It's pretty simple to build a misting bed if you have misting nozzles, garden poly pipe and a water source with enough pressure. The major problem with a misting bed is what to do with the water. The automatic misting process will use a lot of water depending on how often you set the timer to deliver the water mist. The excess water must be discarded or collected into a tank and used to water the garden in other parts. It can be allowed to run and wasted. And if you decide to do it in full Sun to get faster result (or do stenting which requires Sun light), you need to run the misters every 10 minutes or more often. That's a lot of water to be wasted.

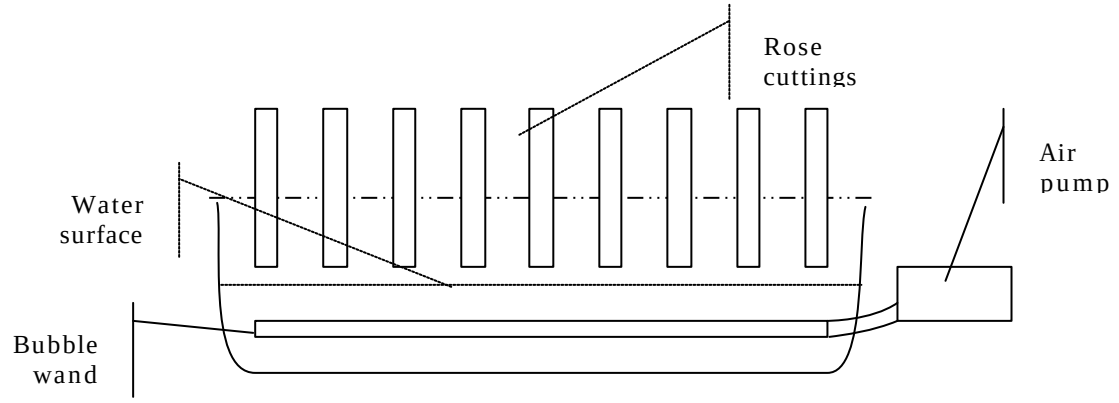
One idea that appeals to the imagination of many amateurs is the "rooting" machine. It's also often called the "cloning" machine. The idea is that we can build a simple machine to stick the rose cuttings in and in a few weeks, they all grow roots. The machine will consume some electricity and nothing else. This is a very nice idea but reality is more difficult than just imagination.

Aero-cloner with bottom misting

One invention is called the "aero-cloner". The way it works is the use of an aquarium pump to send air bubbles into water. As the bubbles burst on the water surface, little drops of water are splashes in the air. This is used to mist the bottom of plant cuttings providing the cuttings with fresh water. It's a very simple thing to design. Essentially you will need

- A dark coloured plastic box to hold water and the air bubble wand
- A small aquarium air pump and optional aquarium heater
- An optional timer to turn the whole thing on and off at intervals

You drill big holes on the lid of the box for the cuttings to slip through. You can use

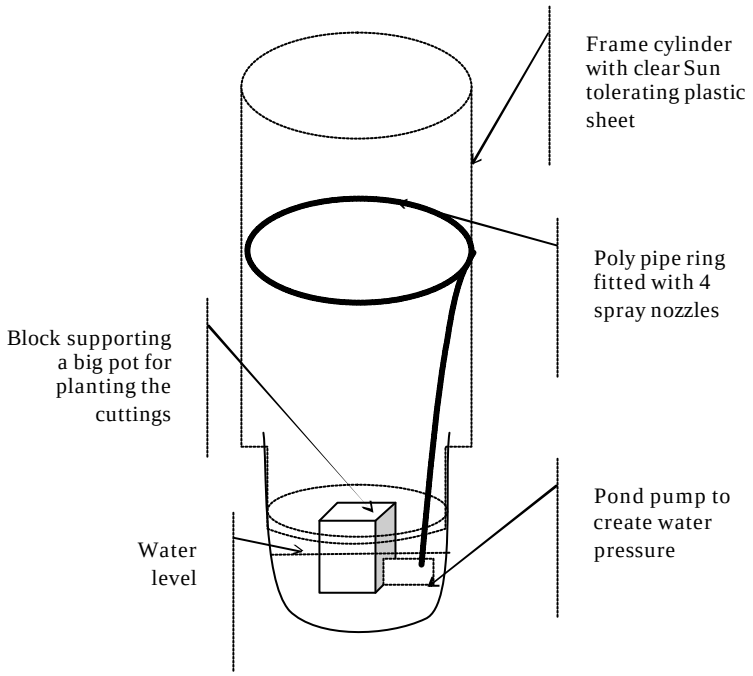


cloth pins to keep the cuttings upright.

It's reported that aero-cloner works reasonably well for many soft plants and to some degree for softwood roses. However the scale is small. It's designed mainly to propagate plants just for hydroponics. The box should be placed in indirect natural Sun light or under florescent lights and out of the wind. The top leaves of the cuttings will not survive direct Sun light or guts of wind. The misting is only at the bottom of the cutting which is enclosed entirely inside the plastic box. This means the cuttings should be recut freshly before being put into the cloner otherwise they will dry out and cannot absorb the water properly. For plants intended to grow in soil, not many people use this system.

Top mist cloner

The Aero-cloner is typically a small bottom-misting machine. I prefer building a bigger system that mimics a misting bed and can work in full Sun to speed up the rooting process as well as providing a better success rate. For this to be possible the strategy must be misting at the top of the cuttings. This strategy keeps the leaves fresh to do photosynthesis in bright natural light allowing rapid callusing and rooting. The advantage of this approach is also in the recycling of water. The size of the cloner can be very large depending on how you want to design it.



The design shown here uses a pond pump to create enough water pressure to force water through the misting nozzles. The pump should be at least 120W to be able to create substantial pressure for misting. However 40w is enough to create a drizzle suitable at above 2 feet height, suitable for rooting rose cuttings. In this design the tub at the bottom can be as large as required. The bigger it is, the more water it can hold and reduce the problem with algae. The frame cylinder should be about 5 feet in height to provide good wind shelter. The higher it is the more suitable the system is for rooting long rootstocks canes for making tree roses. It's Ok to use clear plastic to allow nearly 100% of Sun light to pass through. There should be no holes on the plastic to make sure all water is collected at the bottom and recycled completely. There will be minimal water loss to evaporation.

This system allows rooting roses in full Sun which is also the fastest method. The intense Sun light will not burn the leaves due to continuous wetting of the leaves. This allows you to cut back and keep fewer leaves, pack the cuttings much denser and as the result, save a lot of space. Over 100 cuttings can be packed comfortably in a shallow pot about 2 feet in diameter. You can also use a timer to turn on the misting

intermittently between 10am and 4pm where there is direct Sun light. At other times the pump can be turned off. The bottom tub can be painted black to help it to absorb the heat from the Sun light. This will provide better temperature during cool months. During hot months, simply shield the bottom part from Sun light to keep it cool.

The use of a rooting hormone is in question here when the water cycle wash it all into the tub. It's the same question in all misting beds. I prefer dealing with this problem by applying hormone, and then put the cuttings in a plastic bag to keep moisture over night giving a chance for the hormone powder to absorb into the base of the cuttings before I plant them in the rooting pot. In this way, there is a chance that the rooting hormone is actually used by the cuttings.

Conclusion

The propagation system of choice for the home gardener can be any of those described in this article. Slower systems generally give better quality for the root systems. All these systems can be carried out in the home back yard without a green house and fancy set up. The investment is virtually nothing. The use of a rootstock is definitely not beyond the ability of a hobby gardener. It helps to achieve better consistency at the rooting stage. Then later most modern roses tend to grow more vigorously if they are budded or grafted on a suitable rootstock for a particular climate. The intimate understanding of habits of a rootstock also helps a lot in producing a superior root system which is essential for a vigorous rose plant.

As home gardeners do not want to wait, the fastest softwood rose propagation system is ideal. It may be sporadic when the rose buds take off but for those that actually takes off, they will enjoy an advantage of rose graft growth at least 6 months over the other systems. Commercial growers who use a fast system tend to get a bad reputation if they cannot resist the temptation to sell the plants before the grafts reach 2 years maturity. This gives a hint to rose buyers on how to choose a product.

Rose propagation skills are great to have. People can save a rose they like with certainty when they have budding skill. The skills explained in this guide, once mastered, will give a gardener the ability to produce quality roses that are at least equal or better than what are available on the market.

Finally making a rooting machine can be good fun and will be a time saver later. There is no guarantee that a home made rooting machine will actually improve the success rate, however it can help saving water and gain better consistency.

Internet references

Most of the Internet references I originally have in this document are now out of date. The websites have gone forever or replaced by new websites. So I will leave them here just for history. It has been several years, and the information I get from my own experiments have eventually altered most parts of this original document.

The following articles freely available on the Internet are excellent resources for learning rose propagation. The authors provide excellent tips on the rooting stage of rose propagation as well as budding and grafting techniques. I found them very useful

as references while I developed my own system. Readers can refer to these articles for building a basic-skills set for rose propagation.

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