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Major Assignment 3

Vegetables on Improved Rootstocks.

One of a series of articles, especially for organic growers and enthusiastic gardeners who wish to get the best results with the minimal use of chemicals on plants and soil.

Article No.1. Greenhouse Tomatoes.

Greenhouse Tomatoes.

Background.

The current trend for commercial greenhouse tomatoes is to move completely away from soil grown crops to hydroponic and media module systems, fed directly by soluble nutrients.

Is it any wonder why the tomatoes you buy nowadays are pale and tasteless?

There is an opportunity in the market for organic growers to produce a quality tomato that tastes like tomatoes used to, with good color and good size. The real difference being the natural use of soil with no residual fumigation chemicals.

For growers who wish to produce quality soil grown fruit crops there is an answer to the soil borne disease problems and poor growth by using grafted plants on disease resistant rootstocks.

“ On diseased soil, known to be infected with root rots, tomato plants grafted on L. esculentum x L. hirsutum var. glabratum, gave total yields three to four times greater than those of ungrafted plants. (Smith and Proctor, 1965.)

This article is for growers who are looking for the detail of the advantages of using grafted plants. It will show you how to produce grafted plants, consider the costs and what materials are needed, and where to get them from.

This article is written with the view of using disease resistant rootstocks to assist the organic grower claim an advantage in the production of their crops rather than using the method to overcome the problems of years of soil neglect. There is an opportunity to build on techniques developed in the past but not fully exploited because it was too easy to use chemicals to solve the problem.

Justification.

The use of grafting as a technique to improve the vigour of the crop and the quality of the plant is not new to horticulture, as it is widely practiced in fruit production to achieve amazing results. The ability of specific rootstocks to be immune from soil pests and diseases, improve the cold hardiness of the plant, improve fruit size and quality, among other things, does not necessarily need to be reserved for the fruit industry.

In Japan and Korea, because of the small areas and intensive cultivation of the land available over many years, the disease build up has forced a change to these new production techniques to ensure farmers can continue to produce the crops of their choice. (Lee, 1994.)

Many of the specific benefits of grafting may be of interest to organic growers because selected rootstocks may be able to confer resistance to particular pest and disease and be easier to maintain a plant nutrition balance. The improved root activity of the rootstock is able to maintain the crops needs whilst operating in an environment of less soluble nutrients.

The tomato can readily be grafted on a multitude of related species of the Solanum plant family. Abdulhafeez et al 1975, studied whether tomatoes grown in hot and arid climates, (conditions) would benefit from being grafted on eggplant, unfortunately the results showed that fruit growth at high temperatures was not a good result.

For growers who want to retain the option of growing tomatoes in a greenhouse, and rotation or fumigation is not an option, the use of disease resistant rootstocks can solve the problem and maintain the organic status of the crop and soil.

The Benefits.

The rootstock effect is extensive. For the grower, the requirements of vigour, pest and disease resistance and improved fruit quality are all factors that can be introduced via the rootstock effect. The rootstocks have been selected and bred to handle a wide range of soil borne pests and diseases including nematodes. The standard tomato rootstock available from Egmont Seeds and known as TMVKF1+2F1C is effective against Tobacco mosaic virus, Corky root, Verticillium wilt, and Fusarium crown rot.

The secondary benefits come from the ability of the roots to explore a much larger volume of soil so that the nutrient levels are not so critical and much more in balance. The mechanism of disease resistance has not been seriously investigated. The disease tolerance in grafted seedlings may be due entirely to the tolerance of the stock plant roots to such diseases. However in actual plantings adventitious roots from the scion is very common. (Lee 1989). Plants sharing the root systems of the scion and the rootstock are expected to be easily infected by the soil borne diseases. Nonetheless, seedlings having dual root systems often exhibit excellent disease resistance, almost comparable to those having only rootstock roots. This observation partially supports the previous report that substances associated with fusarium tolerance are synthesized in the root and translocated to the scion through the xylem. (Biles et al 1988)

The Technique.

The production of grafted tomato plants involves growing the rootstock and the scion plants separately in the nursery until they are about 150mm in height. To achieve plants of the same height and stem size suitable to be grafted together there needs to be an adjustment in the sowing dates which depends entirely on season and variety. The seedlings should be pricked into a plastic cell tray in a way to ensure the plant is on one edge of the cell. This makes it easy to approach graft and the small root ball maintains enough undisturbed roots to keep the plant turgid through the whole operation.

Figure 1. Note plant position within the root ball.

Figure 2. The approach graft technique.

The approach graft is an oblique cut with a very sharp blade. For each plant, rootstock and scion, the cut is adjacent and in opposite directions, to the middle of the stem and slightly up the middle for about 1-1.5cm. When gently bent away each tongue is mutually accommodated into the opposite stem.

Figure 3. Tipping rootstock prior to grafting.

Prior to grafting the rootstock should be tipped to aid identification of which is which, and to terminate the apical growth.

Figure 4. The graft union can be secured with a clip.

The graft union is best secured with a clip that encircles the stem and prevents any movement but ensures there is an abundance of air around the graft zone. Any material that holds moisture is likely to encourage an abundance of adventitious roots so duck tape or similar materials to hold the graft are discouraged. Spring-loaded clothes pegs are partially suitable as they have the concave shape, but if the plants are soft the spring will be too strong and squash the stem. The proper grafting clips would be necessary if there were many plants to graft.

Figure 5. The test. The scion roots severed after 10 days. Not always practiced as the rootstock confers some protection to the scion.

Figure 6. The use of duck tape as a wound cover encourages adventitious roots at the graft.

Figure 7. The grafted plant potted into 75mm pot and ready for planting in ten days.

Graft Support.

It is inevitable that the graft union will come apart if there is not some support for the union in the early stages due to movement during handling, watering and so forth. A graft tie of some material that will expand with growth and remain relatively dry and well aerated is essential until the plant is well established in its permanent position. A clip that encompasses the graft over the graft tie and maintains a medium amount of pressure will doubly ensure the grafts stability until planting.

Problems associated with grafting.

The main problem associated with the production of grafted tomato plants is the cost.

However some grafted combinations have shown to induce magnesium deficiency on the K types of rootstock. It is not known if the deficiency symptoms resulted from insufficient uptake of the magnesium by the rootstock or from failure of magnesium to pass through the graft union. This experience supports reports of magnesium deficiency symptoms in commercial plantings of grafted plants. Magnesium deficiency was detected in scions grafted onto the interspecific F_1 hybrid rootstock when controls grafted onto *Lycopersicon esculentum* showed no symptoms. (Smith and Proctor 1965.)

Other problems include the changes need to be made to the management of the crop due to the changed performance of the growth. This relates primarily to fertiliser and moisture and possible nutrient deficiency or excesses that may exist. " Growers should note that the rootstocks will have a vigourous root system in conditions where growth would normally be limited; feeding and watering of the plants after planting should therefore be modified to allow for this increased vigour." (Smith and Proctor, 1965)

. **Costs of producing grafted plants.**

It could be claimed that the operation is laborious and expensive. From my own experience, a good operator could produce 100 plants per hour, which includes making the approach graft, clipping and repotting. At current nursery charge out rates of $25-$35/hr, grafting would increase the plant cost by 25c-35c each for labour and 30c-40c each for seed depending on germination rate for the rootstock and the scion seed.

It is more likely old open pollinated favorites from which seed may have been saved would be destined to be used to recover the old magic of quality. The cost of a grafted tomato plant taking into account labour, seed, and materials could be budgeted out between $1-$1.50 per plant depending on the numbers involved and the success rate of seed germination and the grafting technique.

Fertiliser requirements.

The rootstock effect will alter the fertiliser requirement that might be recommended for a conventional crop. The use of organic wastes would need to be applied cautiously as an excess of nitrogen will result in rampant growth and a poor balance between leaf and fruit.

It is important to realize that the rootstock will have an increased ability to extract nutrients from the soil and so the basic requirements of soil nutrient levels may be lower than previous targets.

Caution.

Tomato species will readily graft to many of its Solanum family members. As alkaloids may pass from the roots through to the scion, any fun test grafts of unknown result need to be treated with caution. In the southern USA it has become a common practice for home gardeners to use *Datura stromonium* rootstocks to overcome the effects of root knot nematodes that had made tomato growing very difficult. As *D. stromonium* contains poisonous alkaloids it is of public health interest to determine if the tomatoes grown on stromonium rootstock present a health hazard. A study by Lowman and Kelley, 1946, determined that “when normal quantities are eaten the probability of being seriously or fatally poisoned are probably remote, but the possibility of serious consequences following the use of such fruit under certain conditions must be recognized.”

Conclusion.

The fore going discussion of some minor problems associated with grafting of tomatoes should not deter growers from adopting the technique to improve production. There are available some very good specific rootstocks to overcome most soil-borne disease problems and the challenge is there to use well tried and proven technology to assist in the production of organically grown tomatoes.

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