

CONTROL OF SOIL-BORN DISEASES IN TOMATOES BY GRAFTING ON RESISTANT ROOTSTOCKS

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INTRODUCTION

Since crop rotation is not possible in vegetable-culture under glass, soil-born diseases occur very frequently. Apart from growing resistant varieties, control of these diseases can be achieved in two different ways :

- 1° by soil sterilization with steam or chemicals
- 2° by using resistant rootstocks.

In the Netherlands cucumbers have been grafted very succesfully on a large scale for many years on *Cucurbita ficifolia* rootstocks resistant to Fusarium wilt. Encouraged by this effective and practical method in cucumber growing, about ten years ago research was started at the Experimental Station for Fruit and Vegetable Growing under Glass at Naaldwijk in order to find rootstocks resistant to the various soil-born diseases affecting tomatoes. The first aim was to obtain resistance to corky-root, this being the main root disease of glasshouse tomatoes in Holland.

RESISTANCE TO CORKY-ROOT

For this purpose more than one hundred species of the Solanaceae-family were tested for resistance to corky-root. Although many of them proved resistant, none was suitable as a rootstock because of grafting incompatibility or insufficient growth of the grafted plants. Within the genus *Lycopersicum* several species showed resistance to corky-root and grafting incompatibility did not occur. But the growth of the grafted plants was not sufficiently vigorous to obtain satisfactory production. In order to obtain a better growth several *Lycopersicum* species were crossed with *Lycopersicum esculentum* using wild tomatoes as male parent. One of the hybrids, *L. esculentum* × *L. hirsutum*, when used as a rootstock, greatly outyielded the others. In this hybrid corky-root resistance is dominant. As a non-grafted plant this F₁ hybrid showed marked heterosis. The increase in production of tomatoes grafted on this rootstock is partly due to its resistance to corky-root, but probably heterosis is the more potent factor. In fig. I results are given of one of the experiments in which plants grafted on *L. hirsutum* and on the hybrid of *L. esculentum* × *L. hirsutum* were compared with non-grafted plants. Plants grafted on *L. hirsutum* produced less tomatoes than the non-grafted ones, because of poorer growth and occurrence of severe chlorosis. When the F₁ of *L. esculentum* and *L. hirsutum* was used, the produc-

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-○ grafted on F₁ of *L.esculentum* x *L. hirsutum*
- grafted on *L.hirsutum*
- - -○ non-grafted

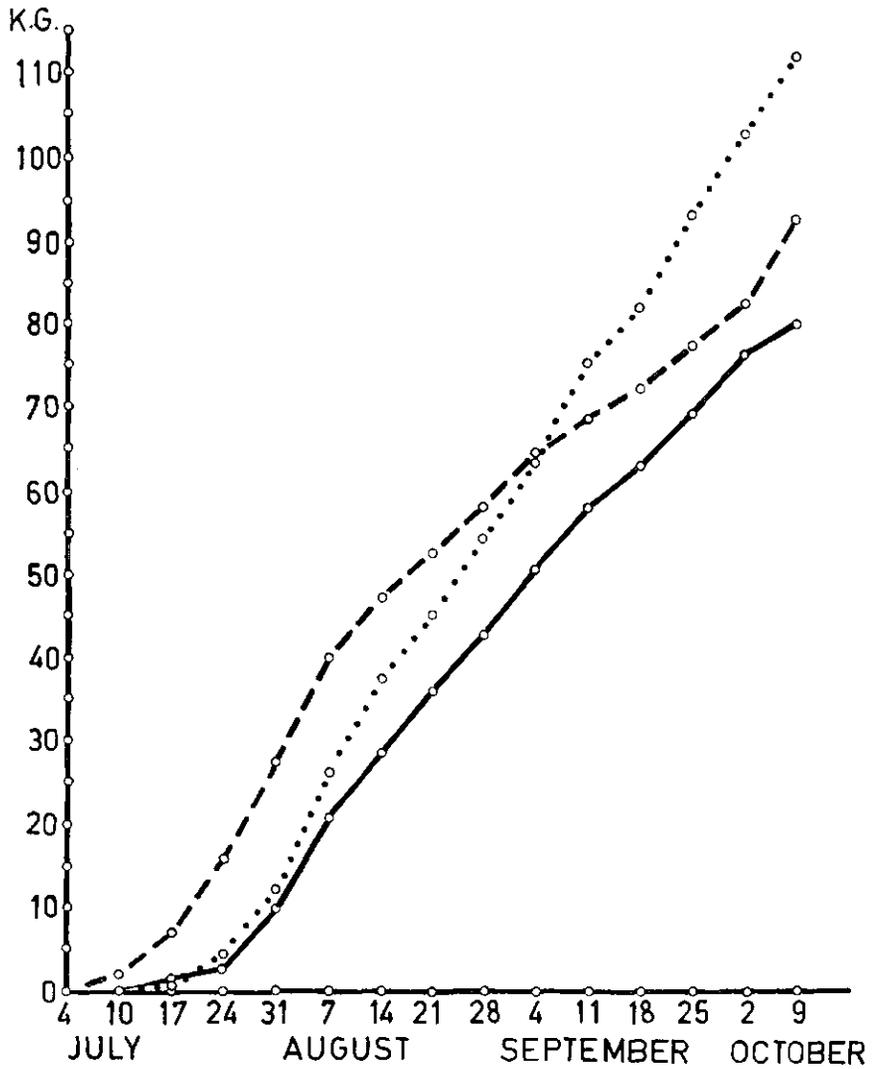


FIG. 1. — Production of grafted and non-grafted plants (24 plants)

tion was much higher than that of the non-grafted tomatoes. The increase in production can vary widely. In our experiments this increase ranged from 15 % to more than 100 %, depending on the growing conditions such as soil type, extent of soil infection etc.

The higher yields of the grafted plants are the consequence of :

1° greater number of flowers produced. This is clearly demonstrated in fig. 2. It is evident that on the lower 3-4 trusses no difference in flower production occurs, but on the grafted plants the higher trusses produce more flowers. The percentage of flowers set is equal on both grafted and non-grafted plants. As a result the number of fruits on the grafted plants is higher.

2° Higher mean fruit weight. Fig. 3 shows increases in fruit weight, in 4 experiments, ranging from 4 % to 16 %.

RESISTANCE TO OTHER SOIL-BORN DISEASES

It has been known for some years that *L. hirsutum* is resistant to *Didymella lycopersici* invading the roots from the soil. Resistance to this disease being dominant, the F₁ hybrid of *L. esculentum* × *L. hirsutum* will be resistant too, as has been confirmed in our experiments.

After introducing this rootstock into practice, it proved to be so susceptible to root-knot nematodes (*Meloidogyne* sp.) that on heavily infested soils the production of grafted plants was even lower than that of non-grafted ones. Investigations demonstrated that it was possible to combine resistance to corky-root with resistance to these nematodes. This was achieved by crossing *L. hirsutum* with lines of *L. esculentum* homozygous for resistance to rootknot nematodes. Fig. 4 shows the results of one of the experiments with a rootstock resistant to both corky-root and rootknot nematodes in comparison with plants grafted on a rootstock resistant to corky-root only and with non-grafted plants. Owing to the attack of rootknot nematodes the production of the plants grafted on the corky-root resistant rootstock was considerably lower than that of the rootstock with resistance to both diseases. However the attack was not so severe that the non-grafted plants outyielded the ones grafted on the rootstock resistant only to corky-root.

Although *Verticillium* wilt is not a large problem in tomato growing in Holland, in some cases it might be of importance to use rootstocks resistant to this disease. Plants grafted on the rootstock resistant to corky-root appear to be slightly less susceptible to wilt than non-grafted ones. This can be improved greatly by crossing *L. hirsutum* with lines of *L. esculentum* resistant to *Verticillium* wilt. In this way rootstocks combining resistance to corky-root and to *Verticillium* wilt are obtained.

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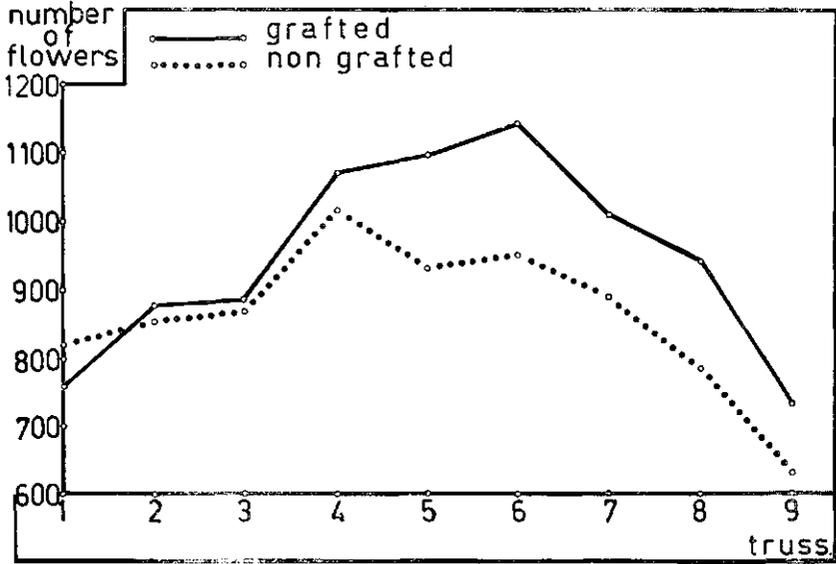


FIG. 2. — Number of flowers of grafted and non-grafted plants (120 plants)

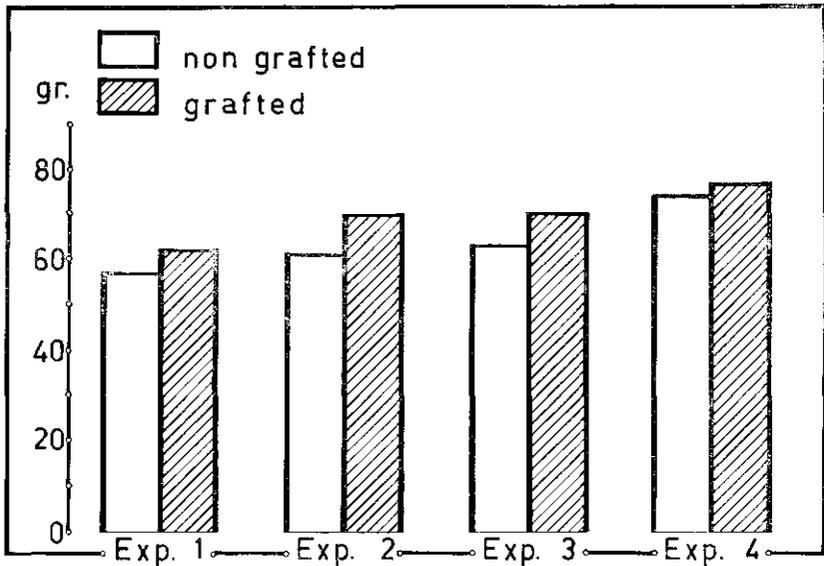


FIG. 3. — Mean fruit weight of grafted and non-grafted plants

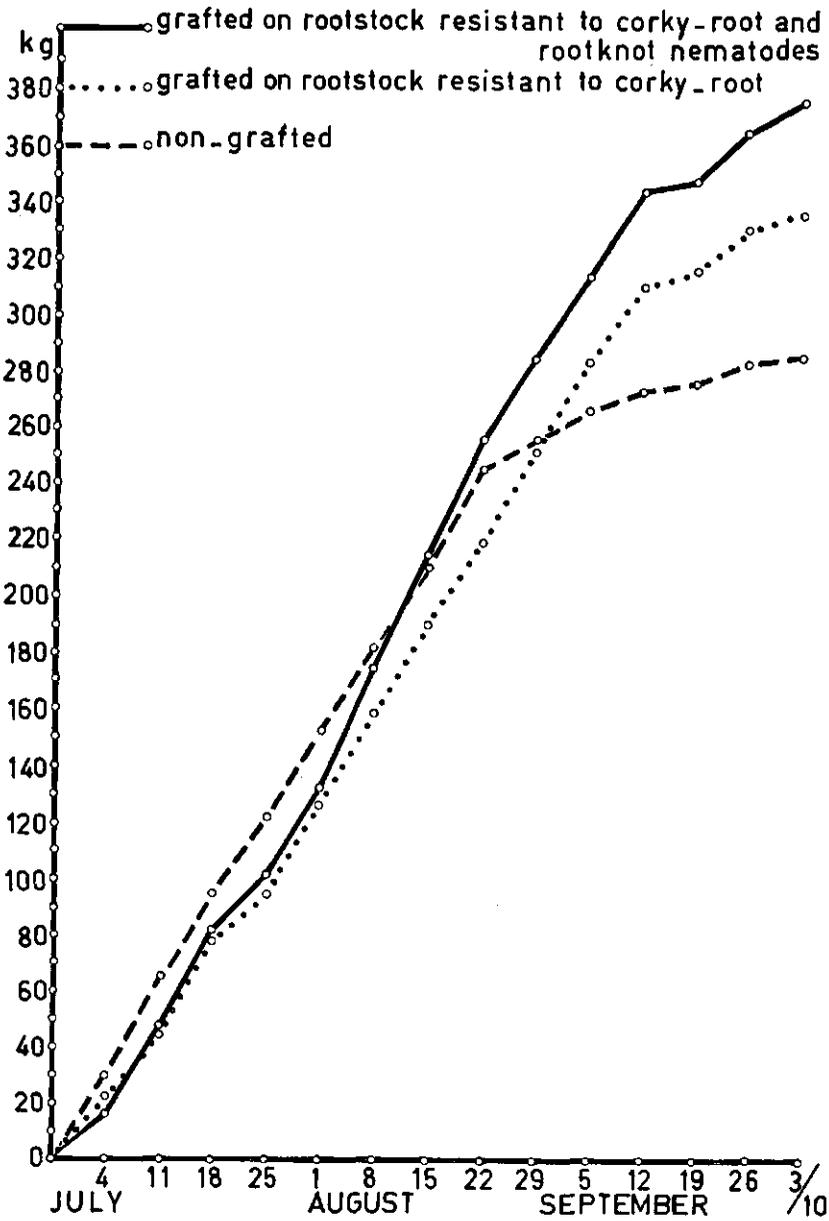


FIG. 4. — Production of plants grafted on different rootstocks (120 plants)

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GRAFTING-METHODS

The approach grafting method has been found to be the most suitable and has been generally adapted in commercial practice. Where only resistance to corky-root is required the rootsystem of the tomato is allowed to remain. But, in case of rootstocks resistant to *Verticillium* and *Didymella* it is necessary to sever the rootsystem of the tomato to prevent infection from the tomato roots to the scion. Detaching the tomato root is delayed until at least 4 weeks after grafting. In this way the resultant check and its adverse effect on earliness, is reduced to a minimum.

COMPARISON BETWEEN SOIL DISINFECTION AND GRAFTING

Grafting of tomatoes has to compete to a certain extent with soil disinfection. It is therefore necessary to know in terms of production which method gives the best results. A number of experiments were carried out in which the production of grafted plants was compared with non-grafted plants grown in steam sterilized soil and soil treated with chemicals such as chloropicrin, DD, etc. Fig. 5 gives the results of one of these experiments. From this, it is evident that the production of the grafted plants is at least as good as that of the plants grown in the chloropicrin-treated soil. In this experiment the grafted plants yielded slightly less than the plants grown in the steam-sterilized soil. Observations in practice indicate however that the opposite may also occur. It may therefore be stated that the production of grafted plants is as high as the production of plants in soils treated with steam or any chemical.

FINAL REMARKS

Grafting on resistant rootstocks has now become common practice in tomato growing in Holland. It is however not used for the production of early tomatoes planted in the beginning of January, as in this case grafted plants start their production later than non grafted ones. If planting is done at mid-February or later, retardation in production is of minor importance under the growing conditions in Holland. The longer the growing period, the more profit is drawn from grafted plants. For a short growing period e. g. up to five trusses, grafting is of little profit, as the increase in production of grafted plants only presents itself 1-2 month after the beginning of picking.

Although grafting can easily be done by the growers themselves, it proves to be more satisfactory if this is carried out on specialized nurseries. After the introduction of the grafting of tomatoes, a few of these nurseries have been set up. In 1962 they have produced 2-3 million grafted plants which have been delivered to the growers.

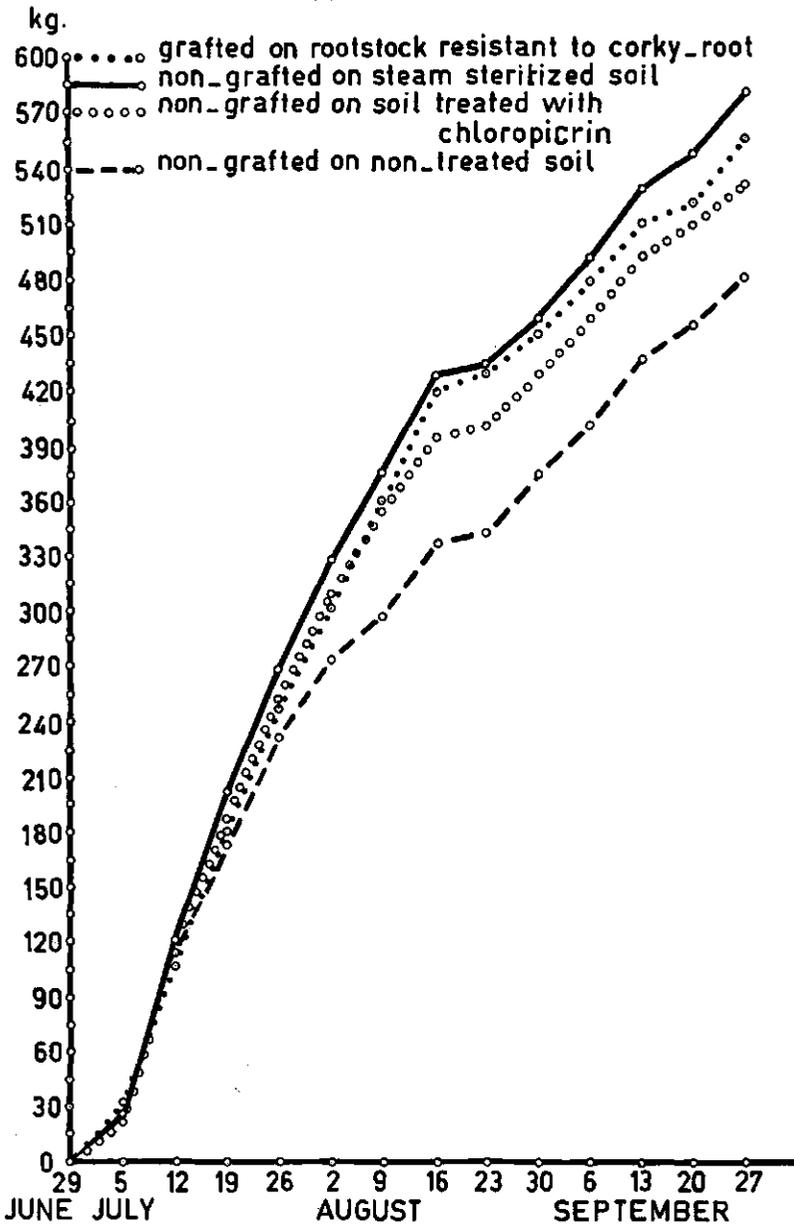


FIG. 5. — Production of grafted plants and non-grafted plants on sterilized soil (120 plants)

DISCUSSION

- Q. — MARTYR. (Great-Britain): Are the rootstocks developed at Naaldwijk resistant to all species of nematodes, particularly the two common in Britain, rootknot eelworm and potato root eelworm (*Heterodera rostochiensis*) ?
- R. — The rootstocks are not resistant to the potato root eelworm. As far as we know, up to now, they are only resistant to the root knot nematode *Meloidogyne incognita*.
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