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## SOIL DISINFECTION WITH FUMIGANTS IN GLASSHOUSE TOMATOES

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### SUMMARY

In the Netherlands the three main soil-borne diseases of glasshouse tomatoes are:

Corky-root (probably caused by a virus)

Root-knot nematode (*Meloidogyne* sp.)

Wilt-disease (*Verticillium*)

Before the second World War these diseases were controlled by steam sterilization or by carbon-disulfide and formaldehyde. After the war the fumigants DD (dichloropropane + dichloropropene), ethylene-dibromide, and chloropicrin were introduced. The former two are specific nematocides and can only be used for the control of the root-knot nematode. Chloropicrin gives control of all three soil-borne diseases, especially on light soils. Nowadays nearly every grower uses one of the chemicals once in 2-3 years. The fumigants are put into the soil by a motor injector or, if necessary, with a hand injector. The chemicals are applied in the months of August to December. The results are better in August and September than in October and November, as the soil temperature is higher in the first two months.

Besides the anti-parasitical action the fumigants possess a growth stimulating effect. This is especially the case with chloropicrin. The cause of this phenomenon cannot yet be explained entirely, though there are some indications as to the solution of this problem. For instance, after application of chloropicrin the bacterial population in treated soil proved to be much higher than in non-treated soil. Furthermore, the level of the N-mineralization appeared to be higher in treated soil than in non-treated soil. These two processes are probably closely connected with each other.

The aim of this paper is to give a general view of the use of fumigants in tomato growing in Holland and to show some results of experiments carried out at our Experiment Station.

### SOIL-BORNE DISEASES

In the Netherlands tomatoes have been grown under glass for about 50 years, and as crop rotation is impossible in glasshouse culture, the tomatoes are attacked by several soil-borne diseases. The most important of these are:

- A) *Corky-root*, which is probably caused by a virus (fig. 1). In nearly every glasshouse in Holland corky-root may be found, and every year it is a cause of considerable losses in the crops.
- B) *Root-knot nematode* (*Meloidogyne* sp., formerly *Heterodera marioni*) (fig. 2). Nowadays this nematode causes but little damage, as very effective chemicals can be applied.



FIG. 1



FIG. 2

C) *Wilt-disease* (*Verticillium albo-atrum* and *V. dahliae*), which occurs frequently, but in many cases it can be effectively controlled by cultural measures.

D) *Potato-eelworm* (*Heterodera rostochiensis*). In Holland this eelworm occurs only sporadically and it is practically no problem.

Roughly estimated, the first three diseases reduce the yield by about 10 %. This means that in 1954, when the total yield of tomatoes in Holland was about 110 mill. kg, more than 10 mill. kg were lost due to soil-borne diseases. For the individual grower the loss may even be higher; a yield reduction of 30–40 % is no exception.

Before the second World War, formaldehyde and carbondisulfide were used for soil sterilization (steam sterilization was and is still used on a large scale, but this is not dealt with in this paper). The results with these chemicals fluctuated and were unsatisfactory in comparison with the present-day fumigants.

#### FUMIGATION AS A CONTROL

After the second World War the application of fumigants for soil disinfection has increased enormously. It has completely changed the nature of soil disinfection in Dutch tomato-growing.

The control of the root-knot nematode is no longer a problem. Several fumigants can be used successfully. In sequence of decreasing activity they are:

DD (a mixture of 1.2-dichloropropane + 1.3-dichloropropene),

E.D.B. (ethylene dibromide),

Chloropicrin (trichloronitromethane),

Methylbromide.

Chlorobromopropene can also be used against this nematode. Up to this moment, however, little practical experience has been obtained with this chemical. The results

with methylbromide can be highly improved by covering the soil with sheets of plastic or paper after the treatment. In practice, however, this method meets with several difficulties.

The potato-eelworm can be effectively controlled with DD, though it is necessary to use double the dosage needed for the control of the root-knot nematode. Chloropicrin also gives good results against the potato-eelworm. The results with ethylene dibromide and methylbromide, on the other hand, are poor.

Application of fumigants is usually not necessary for the control of *Verticillium*. As already said, this disease can be controlled rather easily by cultural measures. If necessary, formaldehyde or chloropicrin may be used.

Among the soil-borne diseases here mentioned corky-root is the most difficult to control. Chloropicrin is the only chemical that controls this disease. This is to a certain degree also the case with formaldehyde, but only on sandy soils.

None of the above-mentioned soil-borne diseases can, however, be entirely eradicated by fumigants. Hence it is necessary to repeat the treatments regularly.

In practice nearly every grower has his soil disinfected every 2-3 years, while several growers sterilize their soil annually.

The application of fumigants is always done by contractors in Holland. Apparatuses designed for this special job, the so-called motor injectors, are used (fig. 3). On places where a motor injector cannot be used, the fumigant is put into the soil by a hand injector.

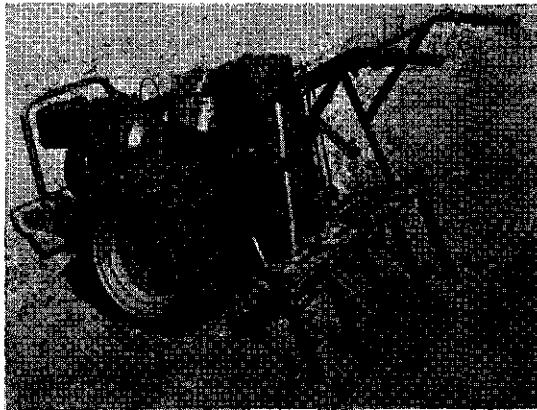


FIG. 3

#### FACTORS IN FUMIGANT ACTION

The action of these fumigants depends on several factors.

(1) *Temperature.* The higher the temperature, the better the results of soil-disinfection. One should, however, avoid too high a soil temperature. In this case the chemical would evaporate too quickly and hence remain too short in the soil to kill the parasite sufficiently. This may be redressed by covering the soil with plastic or paper. But as already said, in practice this is rather unfeasible. The best soil temperature without using covering materials is 15°-20°C. Even then one must use a water seal after treatment with fumigants such as E.D.B. and chloropicrin. If the soil temperature is lower than 10°C., the fumigants are usually less effective. This was clearly demonstrated by an inquiry among hundreds of growers. It was found that in case of application after the first of October the results of soil-disinfection were less effective in about 20 % of the cases, whereas this percentage was only 6 if the fumigants were applied before this date.