EFFECT OF SOME CULTURAL TREATMENTS ON THE CONTROL OF TOBACCO MOSAIC VIRUS

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INTRODUCTION

No direct method for the control of virus diseases is yet available. Most of the procedures that can be used effectively involves evasive measures designed to reduce sources of infection inside and outside the crop, to limit spread by vectors and to minimize the effects of infection on yield.

Generally speaking, such measures offer no pormenant solution to tobacco mosaic virus disease in a particular area. When a source of resistance or immunity to TMV has been found in, or successfully incorporated into an agriculturally useful cultivar, growers hastily use it. Even here, protection may not be permanent as new strains of the virus arise which can cause disease in a previously resistant variety. Thus attention has been given recently to the variations of normal cultural practices and chemotherapentic treatments as successful kinds of measures for the control of the disease.

Nutrition is a prime factor influencing host metabolism and is indirectly, therefore, a prime factor influencing susceptibility to virus infection and virus multiplication.

Many investigations indicate that there is generally a marked correlation between nitrogen nutrition and host susceptibility. The influence of other elements is less general and varies with the host and the virus.

Inhibition of plant viruses by chemotherapy is not an actual practice but research carried on this direction offers a promise of control. The great success of chemotherapy against bacterial diseases raised hopes that similar results would be forthcoming against virus infection. Very wide range of different substances has been shown to be capable of inactivating or inhibiting viruses in vivo without killing host cells.

Both light duration and light intensity were found to increase susceptibility in some cases, whereas, in other cases the reverse is true. In the quantitative work that has been done an light, there are two general situation in which light affects susceptibility, short term changes in light intensity or deviation over a period of no more than a day or two, and long term effects that may markedly influence the growth of plant.

This work was dosigned to investigate the pathological responses of infected tobacco plants to the different

levels of ammonium sulphate, postassium sulphate and calcium superphosphate. The effect of some inhibitors and time of application on the systemic spread of tobacco mosaic virus disease was given due consideration. In addition the effect of shading on the susceptibility of tobacco plants to infection by tobacco mosaic virus was investigated.

REVIEW OF LITERATURE

PART I

Nutrition and susceptibility to virus infection

A- Studies under water culture condition:

The effect of nitrogen, phosphorus and potassium in sand and water culture on growth and susceptibility to virus infection was thoroughly investigated, whereas, the literature on the effect of calcium, sulphur, magnesium, iron and manganese is scarce.

a) Growth

1- Effect of nitrogen:

Addition of nitrogen to tobacco plants increased the number of leaves per plant (Cuzin and Scwartz 1948) and fresh weight as shown by Holden and Tracey 1948 and Cibes and Samuels 1958 who concluded that reduction in the dry weight and the percentage decrease in growth of tobacco leaves was maximized by nitrogen deficiency.

The length, width and area of tobacco leaves increased by adding nitrogen supply (Cowaikar and Shaw 1961; Gupta et al 1961; Moursi et al. 1971 and Mahadix 1972).

Gore (1937, 1938, 1939, 1941), indicated that there was a definite correlation between nitrogen nutrition and host susceptibility to tobacco mosaic virus infection. He concluded that the highest susceptibility was acheived by adding more nitrogen than is required for good growth, whereas, the least susceptibility and growth rate of tobacco plants were obtained when the plants were grown in nitrogen deficient media. Furthermore, the investigator reported that with insufficient nitrogen the total TMV content decreased, whereas, with over abundance of nitrogen the virus content increased at a faster rate than at which plant grew. The increase in virus content showed no apparent correlation with the growth of plants.

On the other hand, Weathers and Pound (1954), Helms and Pound (1955), Papasolomontos and Wilkinson (1959), Sastry and Nariani and Singer (1970), demonstrated that susceptibility of tobacco plants to virus infection increased with raising nitrogen levels.

2- Effect of phosphorus:

Addition of phosphorus resulted in an increase in leaf size (Matusiewicz 1960; Parups et al. 1960; Chouteau 1961; Cowaikar and Shaw 1961; Matusiewicz 1962 and Choutean 1963), leaf and stalk weight (Parups et al.1960) and the growth of tobacco plants (Matusiewicz 1962 and

Koursi et al. 1971). Tobacco plants responded significantly to phosphorus in soils having less than 100 p.p.m phosphorus (Whitty 1965 and Asai et al. 1966). In addition, phosphorus accelarated development of tobacco plant (Merker 1959).

Spencer (1935, 1937) and Varma (1963), studied the effect of phosphorus supply on the susceptibility of tobacco plant to tobacco mosaic virus infection. They revealed that the susceptibility was correlated directly with tobacco growth.

On the other hand, Weathers and Pound (1954), Helms and pound (1955) and Papasolomontos and Wilkinson (1959), reported that the susceptibility to tobacco mosaic virus infection was directly related to the amount of phosphorus supplied by the host, even though marked stunting of plants occured at the highest phosphorus level. They also concluded that virus concentration was minimum and growth rate was retarded at the lowest level of phosphorus.

3- Effect of potassium.

Applying potassium to tobacco plants resulted in an increase the leaf dimensions (Cowaikar and Shaw 1961; Scnipher 1961; Ishizuka and Takagishi 1961; Chouteau 1964 and Oweida and El-Gamal 1971) and the number of leaves

per plant and the dry weight of leaves and stems of tobacco plants (Oweida and El-Gamal 1961).

Spencer (1937), reported that the susceptibility of tobacco plant to tobacco mosaic virus infection was influenced more by potassium supply than it was by the growth Growth was favoured by small and medium doses of potassium. Susceptibility increased by very small doses, but was decreased markedly by moderate and larger doses. Thus, susceptibility to infection can be lowered without retarding growth by increasing potassium supply within certain limits. Moreover, Spencer (1939) concluded that the high potassium treatment retarded the growth. Sastry and Nariani (1963), also reported that potassium supply had little effect on plant growth, but susceptibility to leaf curl was slightly lowered by increasing the potassium supply.

On the other hand, Allington and Laird (1954), indicated that low potassium nutrition increased the tendency of Nicotiana glutinosa to become infected with tobacco mosaic virus.

A third kind of effect was revealed by Papasolomontos and Wilkinson (1959), who indicated that potassium increases had no significant effect on the growth of TMV-infected tomato roots.

4- Effect of calcium:

Kacharava (1971), reported that addition of calcium had a favourable influence on the growth and leaf dimensions of tobacco plants. He concluded that the addition of magnesium to calcium increased the surface of leaves more considerably.

Chessin and Scott (1955), reported that calcium deficiency consistently and markedly reduced the number of local lesions (susceptibility) on Nicotiana glutinosa infected with TMV. In further experiment, Chessin (1957), also indicated that calcium deficiency reduced susceptibility to virus infection as well as host growth.

5- Effect of magnesium:

Kacharava (1971), indicated that the addition of magnesium supply resulted in an increase in tobacco growth as well as leaf dimensions. In a further experiment, Pinkerton (1972), found that the total dry weight was reduced when tobacco plants were grown in sand culture deficient in magnesium. The reduction was more considerable when the period without magnesium exceeded 6 days.

Chessin (1957), found that magnesium deficiency also tended to reduce susceptibility, but only after severe deficiency symptoms had appeared. Shepherd and Pound(1960)

came to the same conclusion. He reported that magnesium deficiency, however, limited virus concentration. In sand culture experiment, Varma (1963), found that the maximum growth rate of Turkish tobacco was obtained with 48 p.p.m. Mg; but virus concentration was highest when Mg was available at 480 p.p.m. Mg.

6- Effect of sulphur:

Tsai et al. (1969) and Oweida and El-Gamal (1971) found that the growth of tobacco plant increased by adding sulphur supply.

Studying the influence of sulphur deficiency on the susceptibility of Nicotiana glutinosa to infection by TMV, Chessin (1957), found that the effect of sulphur deficiency resulted in a reduction in both growth rate and susceptibility of winter grown tobacco plants infected by TMV.

7- Effect of iron:

Ryding (1965), found that small quantities of iron were essential for the normal growth of tobacco plants.

Chessin (1957), found that susceptibility to tobacco mosaic virus infection increased in iron deficient plant than in control tobacco plants. Furthermore, Pound and

Welsie (1958), studied iron nutrition of Nicotiana tabacum in relation to concentration of tobacco mosaic virus. They found that tobacco plants grown in water culture solutions containing various levels of iron, responded with a gradient of growth and characteristic deficiency symptoms. Infection with TMV resulted in decreased growth at all levels of iron. Mosaic symptoms were reduced in intensity when low levels of iron were used. Only at a low critical level deficiency of iron exerts a greater limitation of virus multiplication than on host growth.

8- Effect of manganese:

Kalenkenov (1961), reported that the addition of manganese increased the growth of tobacco leaves and stems and also enhanced the dry matter content during the entire vegetative period, as well as, stimulating photosynthesis Ryding (1965), came to the same conclusion. He added that small quantities of manganese, were essential for normal growth of tobacco plants. The effect of manganese on the growth of tobacco plant was also studied in solution culture with Arnon solution. It was found that 0.30 mg. of Mn/l showed maximum leaf area, plant height, dry matter and photosynthesis (Voica 1969).

Walkie and Young (1954), found that tobacco plant grown in water culture solutions containing various levels of manganese, responded with a gradient of growth and deficiency symptoms characteristic of this element. Inoculation of the two basal leaves of a plant with TMV when deficiency symptoms were established, resulted in decreased growth at all levels of Mn. Virus infection of deficient plants reduced the deficiency chlorosis of apical leaves. Mn-deficient tissues had a lower dry weight than normal ones and higher virus concentration. On the other hand, Rivera-Battle (1962), obtained a contradictory results. He found that when tobacco plants were grown in liquid culture at different levels of Mn, no marked effect on the susceptibility to TMV could be detected.

B- Chemical content

1- Nitrogenous compounds

Many investigators studied the effect of mineral nutrition on nitrogenous compounds of tobacco plants. Yohida and Takahashi (1960) and Mirouski (1971), indicated that with raising nitrogen supply, the total nitrogen content in tobacco leaf tissues increased. On the contrary, there was a reduction in nitrogen content by adding phosphorus supply (Parups et al 1960) as well as potassium supply (Chonteau and Renier 1959 and Chouteau 1964). Oweida