EFFECT OF FOLIAR APPLICATIONS OF ZINC, COPPER AND BORON ON THE INCIDENCE OF MANGO MALFORMATION

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The effect of foliar application of zinc, copper and boron on the incidence of malformed inflorescence in mango was studied during 1966 and 1967 on the bearing mango trees, growing in the West Pakistan Agricultural University, Lyallpur. Six different treatments having various combinations of monthly sprays were applied during January to September. In all, forty-two plants were under these investigations, with treatments replicated thrice in a randomized block system. Incidence of malformed inflorescence was not affected by any of the treatments. The percentage of malformed inflorescences was higher in 1967 than in 1966, after and before the application of treatments.

INTRODUCTION

Mango (*Mangifera indica* L.) is subjected to many serious disorders, some of which are of physiological nature and others are caused by different insects, fungi and bacteria. The most serious of them is malformation of inflorescence, which is responsible for considerable loss of mango crop every year.

In this case, the flowers of affected bunch, instead of developing into normal floral panicle, grow into bunchy masses and do not set fruit. The peduncle is shortened and thickened. The flowers often have enlarged discs and take long time to open and seldom set fruit. The affected inflorescences may persist long after the normal ones have fallen off the trees.

For the last many years many research workers have been engaged in research on various aspects of this disorder in many countries, but so far exact cause of the disorder is not known. The research work reported herein was undertaken to study the effect of foliar applications of zinc, copper and boron on the incidence of malformed inflorescence.

REVIEW OF LITERATURE

As reported by Khan and Khan (1960) malformation of inflorescences in mango was present in all the orchards of West Pakistan: Varieties like Langra, Karela, Neelam and Kishen Bhog were found to be fairly resistant. Khan Gari Bacha, Khera, Abdul Ahadwala were mediumly malformed.

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Varieties like Kashi, Sobeywali Ting, Saharni, Fajri, Sammar Bahishat, Gola, Ganesh Tori, Gulab Khas, Kherbusa, Sammer Hayat, Baramasi, Mohammadwala and other local varieties of Multan were highly susceptible. Jawanda (1963) found that extent of malformation varied in the plants of 100 grafted varieties. It was found that plants of Malda (Bombay green) and varieties like Alphanso and Pairi were the most susceptible, Langra and Dusehri were least affected and that percentage of panicles showing malformation was greater in "off" year than in "on" year.

Latif and Ahmad (1956) studied the possibility of spread of malformation through insects and found that mango Jassids, *Idiocerus clypealis* Leth and *Idiocerus atkinsoni* Leth and mango mealy bug, *Dorsicha stebbingi* (Gr) are not the causal or the transmitting agents of the disease. Latif *et al.* (1961) controlled insects and mites by the use of highly toxic chemical sprays at Lyallpur, Multan and Muzaffargarh and found that although the insects and mites were controlled by these chemicals, yet no reduction in the incidence of the disease was recorded, thus indicating a little or no role of insects or mites in causing the disease directly or through possible transmission of virus. Singh (1955) ascribed two species of mites, *Tyrophagus castarranii* (Hirst) and *Typhlodramus* probably *ariaticus Evens* (Phytoseidae), causing malformation of inflorescence on the vegetative shoots. Narasimhan (1959), Puttarudriah and Channa (1961) were able to produce the disease in healthy plants by the introduction of Eriophyid mites on just sprouting buds. As the mites were obtained from malformed twigs, they were, however, unable to differentiate between the disease caused by the direct result of the feeding injury or due to some virus. Sami and Anwar (1965) were also able to induce malformation of inflorescence by introducing the mites to the healthy bud. They, however, could not reach any conclusion whether the disease was due to the direct effect of mites in causing hypertrophy or it served as a virus vector, which might cause the malformation.

Sattar (1946) considered that the disease is not caused by fungi and it may be due to some virus or physiological disorder. Ahmad and Sattar (1950) could not find any fungus or bacterium associated with the disease. Kausar (1959) considered the probable virus nature of the disease. Sharma (1953) stated that this disease is non-pathogenic in nature. The incidence of the disease could not be reduced by injecting knop solutions or trace elements in the initial stages of the disease. He considered that disease may be due to some internal physiological disorder. Ahmad and Sattar (1950) reported that by adjusting C/N ratio or by the addition of nitrogen, phosphorus and potash as different fertilisers, the disease could not be controlled. Khan and Khan (1958) reported that foliar spray of urea at monthly intervals during winter considerably reduced the incidence of the disease. Tripathi (1955)

found that application of micro-nutrients; zinc, copper, boron and manganese by injection and sprays did not have any effect on the malformation in young or bearing trees. Shah (1964) reported that malformation of mango inflorescene is caused by the deficiency of zinc, copper and boron.

MATERIALS AND METHODS

Forty-two mature and bearing mango trees of *Langra* variety growing at the West Pakistan Agricultural University, Lyallpur were subjected to foliar application of zinc, copper and boron. The selected trees suffering from malformation of inflorescence were growing under uniform cultural conditions and were of the same age and vigour.

The experiment was laid out in the simple randomized block design with three replications. In all, the six treatments excluding control were applied. The experimental unit consisted of two trees.

In all, there were six treatments, which differed from each other in having various combinations of monthly sprays as given in the following schedule;

(*i*) *Spray in the middle of January:* Boric acid (1½ to 2 pounds), Copper dimethyl dithio-carbamate (2 pounds), Zerlate (1½ to 2 pounds), and Endrin (12 ounces to 1 pound) in 100 gallons water.

(*ii*) *Spray in the middle of February:* Boric acid (2-2½ pounds), Copper dimethyl dithio-carbamate (2 pounds), Zerlate (2 pounds) and Endrin (1 pound) in 100 gallons water.

(*iii*) *Spray in the middle of April:* Boric acid (1½ to 2 pounds), Copper dimethyl dithio-carbamate (2 pounds), and Endrin (1 pound) in 100 gallons water.

(*iv*) *Spray in the middle of May:* Copper dimethyl dithio-carbamate (2 pounds) and Endrin (1 pound) in 100 gallons water.

(*v*) *Spray in the middle of July:* Copper dimethyl dithio-carbamate. (1 pound), and Dipterix (1 pound) in 100 gallons water.

(*vi*) *Spray in the end of July:* Copper dimethyl dithio carbamate. (1 pound) and Endrin (1 pound) in 100 gallons water.

(*vii*) *Spray in the middle of August:* Copper dimethyl dithio-carbamate (1 pound), Zerlate (1 pound), and Endrin (1 pound) in 100 gallons water.

(*viii*) *Spray in the middle of September:* Boric acid (1½ to 2 pounds), Copper dimethyl dithio carbamate (1 pound), and Endrin (1 pound) in 100 gallons water.

The following were the treatments for the experiment:

T_1 = Eight sprays as mentioned in the above schedule.

TABLE 1. *Percentage of malformed inflorescence before* (1966) *and after* (1967) *the applications of zinc, copper and boron sprays.*

Treatments	Incidence of Malformation during	
	1966	1967
T_1	3.1	6.1
T_2	3.5	6.1
T_3	4.1	7.4
T_4	4.7	6.7
T_5	3.9	5.2
T_6	3.9	6.1
Control	4.1	5.3

The average incidence of malformed inflorescence for 1966 and 1967 was 3.9 and 6.1 per cent., Cd_2 and Cd_8 for these two years was 0.89 and 1.21 respectively.

T_2 = Four sprays in the middle of January, April, July and August.

T_3 = Four sprays in the middle of February, May, July and September.

T_4 = Eight sprays, boric acid was eliminated from all the sprays.

T_5 = Eight sprays, copper compound was eliminated from all the sprays.

T_6 = Eight sprays, zinc compound was eliminated from all the sprays.

The numbers of normal and malformed bunches were counted carefully on each tree. Diseased bunches were removed before the application of treatments with the help of long wooden handle secateur and percentage of malformed bunches was calculated. All the trees except control were sprayed during eight months of the year as given in the schedule. Next year at the time of flowering the normal as well as malformed bunches were again counted from both treated and control trees, respectively in each treatment and percentage were calculated.

RESULTS AND DISCUSSION

The data showing the percentages of malformed shoots before and after the application of various spray treatments are presented in Table 1. The incidence of malformation was almost alike on the treated as well as the control trees. The intensity of the malady was more accentuated during 1967 after the treatments were applied in 1966. The mean percentages of malformed inflorescences before and after the application of treatments in 1966 and 1967 were 3.9 and 6.1, respectively. The difference for years was statistically significant.

Different foliar spray treatments did not show any effect on the incidence of malformation and it appears that malformation most probably is not caused

due to any nutritional deficiency of zinc, copper and boron. These results find support from the studies of Ginai (1961), Singh (1961) and Tripethi (1955). However, the results did not agree with those of Shah (1964), who recommended that the malady could be cured by the application of these elements.

The difference in the incidence of the disease between the two years, 1966 and 1967, during which the experiment was conducted was highly significant. Higher percentage of malformed inflorescences were counted after the application of spray treatments in 1967, which was an "off" year season from production point of view. Jawanda (1963) reported similar observations that the percentage of panicles showing malformation was greater in the "off" year than in the "on" year.

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