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EFFECT OF ZINC ON GROWTH AND INCIDENCE OF POWDERY MILDEW DISEASE OF RUBBER SEEDLINGS IN NURSERY

The incidence of powdery mildew disease of rubber trees (*Hevea brasiliensis* Muell. Arg.) caused by *Oidium heveae* is very high at the time of refoliation after wintering in North Eastern parts of India (Mondal *et al* 1998). Due to continuous availability of tender susceptible leaves, the disease persists in the nursery throughout the year (Edathil *et al.*, 2000). The control of powdery mildew disease by dusting of agricultural grade sulphur powder is the standard practice adopted in mature rubber plantations. For nursery plants spraying of wettable sulphur or carbendazim is recommended (Rubber Board, 2001). There are some reports, which indicate a striking relationship between susceptibility to severe attack of *O. heveae* and zinc status of the plant (Bole-Jones and Hilton, 1956; Rubber Research Institute of Malaya, 1956). Therefore, application of zinc could be a prudent approach to manage powdery mildew disease. Hence, the present investigation was undertaken to find out the effect of zinc chelate on the growth of *Hevea* seedlings and the incidence and severity of powdery mildew disease in nursery.

The experiment was conducted during three consecutive years, 1993-94, 1994-95 and 1995-96. Germinated seeds of *Hevea brasiliensis* (40 nos.) were planted at a spacing of 30 x 30 cm in nursery beds (3.0 x 1.2 m) during August every year at the Regional Research Station of the Rubber Research Institute of India at Sorutari Farm in Kamrup district of Assam. Eleven treatments (Table 1) were imposed in a randomized block design with four replications per treatment. Before imposing treatments, the height (cm) and the diameter (cm) of the seedlings at the collar region were recorded from 16 sample seedlings from the inner rows of each plot. Spraying was carried out using a hand compression sprayer and screens were used to prevent drift.

The incidence of powdery mildew disease was assessed on 16 seedlings from the inner rows of each plot during March-April after the final round of all treatments. Disease severity was scored from five seedlings having immature top whorl of leaves, selected at random from each plot. For a visual scoring and classification of severity a scale of1-5 was used where 1 = 0% (no infection), 2 = 1-15%, 3 = 16-30%, 4 = 31-51% and 5 = 51% and above leaf area infected. For estimation of severity (S) the sum of infection grades of each sample was divided by the total number observed, which included both infected and non-infected leaves (Samaradeewa *et al.*, 1985). Disease incidence (I) was calculated by dividing the number of diseased plants (irrespective of grade of disease) by the total number of plants observed and expressed as percentage. The final height and diameter of 16 sample seedlings from each plot were recorded during June-July every year (Potty *et al.*, 1976). The data were subjected to analysis of variance (ANOVA) and the treatment means were compared by LSD ($P \leq 0.05$).

Incidence and severity of powdery mildew disease was found to be maximum in untreated control plots (T_1) and plots with treatments T_8, T_9 and T_4 (Table 1). On the other hand, the incidence of powdery mildew disease was checked completely in the plots treated with agricultural grade sulphur dust (T_2). Disease incidence was comparatively low in treatments T_6, T_7 and T_3, the former two being on par. Though the inci-

dence and severity of powdery mildew disease was reduced substantially in T_{10} and T_{11}, neither was as effective as treatments T_2, T_3, T_6 and T_7 (Table 1). Application of chelated Zn during October to November at dosages of 5 and 7.5 ml/L water in liquid form or 1.0 to 1.5 g/L in powder form reduced the incidence of powdery mildew disease in the subsequent disease seasons. It thus appears that zinc deficiency predisposes the plants to infection by *O. heveae*. Welch *et al.* (1982) reported that zinc deficient plants lost the membrane integrity, which stimulates the leakage of soluble organic substrates into the environment, which may attract the inoculum of *O. heveae* and also aid in the invasion process on immature leaves. According to Bolle-Jones and Hilton (1956) without a sufficiency of zinc, the rubber plant is unable to produce enough of a certain metabolite, which confers some degree of resistance to *Oidium*. Prasad (1979) reported that zinc conferred a form of tolerance to disease rather than resistance. Beneficial effects of added zinc in increasing host resistance against mildew and leaf spot diseases in other crops have been reported (Mehrotra and Claudius, 1973; Singh and Aggarwal, 1979; Reis *et al.*, 1982; Graham, 1983).

The maximum growth of rubber seedlings in terms of height (133.0 cm) and diameter (1.3 cm) was noticed in T_7 (Table 1). The growth of seedlings in other experimental plots except T_2 and T_3 were adversely affected due to the high incidence and severity of powdery mildew disease. Significantly better growth was noticed in sulphur

Table 1. **Effect of zinc on growth, incidence and severity of powdery mildew disease of rubber seedlings**

Parameter	Treatment (Mean of 3 years)											LSD (P=0.05)
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	
Disease incidence (%)	100 (0.0)	0 (-100.0)	21.4 (78.6)	100 (0.0)	90.6 (9.4)	14.6 (84.6)	14.3 (85.7)	100 (0.0)	100 (0.0)	45.8 (54.2)	39.9 (60.1)	5.59
Severity (S)	5 (0.0)	0 (100.0)	0.5 (90.0)	4.4 (12.0)	3.7 (26.0)	0.2 (96.0)	0.2 (96.0)	5 (0.0)	4.7 (6.0)	2.5 (50.0)	2 (60.0)	0.36
Height (cm)	89.9 (0.0)	110.5 (23.0)	103.8 (15.5)	103.3 (14.9)	108.1 (20.3)	129.7 (44.3)	133 (48.0)	92.7 (3.2)	98.9 (10.1)	105.6 (17.5)	110.2 (22.6)	3.06
Diameter (cm)	0.8 (0.0)	1.1 (37.5)	1 (25.0)	0.9 (12.5)	1 (25.0)	1.3 (62.5)	1.3 (62.5)	0.9 (12.5)	0.9 (12.5)	1 (25.0)	1.1 (37.5)	0.04

Figures in parentheses indicate the percent growth increase and reduction in powdery mildew disease over control.

T_1 : Untreated control
T_2 : Three rounds of dusting of sulphur (85%) at 21 day intervals (January-March)
T_3 : Four rounds of spraying of wettable sulphur (80 WP) at 2.5 g/L alternated with carbendazim (50 WP) at 1 g/L (February-March)
T_4 : Spraying (three rounds) of Chelazin liquid (0.5 ml/l) at 30 day intervals (October-December)
T_5 : Spraying (three rounds) of Chelazin liquid (2.5 ml/l) at 30 day intervals (October-December)
T_6 : Spraying (three rounds) of Chelazin liquid (5.0 ml/l) at 30 day intervals (October-December)
T_7 : Spraying (three rounds) of Chelazin liquid (7.5 ml/l) at 30 day intervals (October-December)
T_8 : Spraying (three rounds) of Chelazin powder (0.1 g/l) at 30 day intervals (October-December)
T_9 : Spraying (three rounds) of Chelazin powder (0.5 g/l) at 30 day intervals (October-December)
T_{10} : Spraying (three rounds) of Chelazin powder (1.0 g/l) at 30 day intervals (October-December)
T_{11} : Spraying (three rounds) of Chelazin powder (1.5 g/l) at 30 day intervals (October-December)

treated plots (T_2) over control as the incidence of powdery mildew disease was completely checked. The favourable effect of zinc chelate on the growth of *Hevea* seedlings reported in this study is in conformity with the findings of Dell and Wilson (1985). Ohki (1976) reported that the growth reduction is the overall effect of zinc deficiency and this may be related to the major effect of zinc deficiency on inhibition of chlorophyll synthesis.

Application of chelated zinc thus appear to be a viable alternative approach for powdery mildew disease control and consequent healthy growth of rubber seedlings. Among the formulations and dosages of chelated zinc the liquid formulation at 5 and 7.5 ml/L water was more effective.

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