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Effect of Captan and Carbendazim Fungicides on Nodulation and Biological Nitrogen Fixation in Soybean

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Abstract : Soybean (*Glycine max* (L) Merr.) seed treatments are recognized as useful in reducing losses from seed borne pathogens and seedling damping off agents. The seed treatment with fungicide is essential in the improved technology for increasing crop production. In the present investigation two seed protectant fungicides captan and carbendazim are used. Effect of fungicides on growth of *Rhizobium japonicum* has been studied. Soybean seeds of two varieties PK-472 and JS-72-44 were treated with the said fungicides. Observations are taken after 45 days. Results reveal that carbendazim is toxic to the nodule bacterium. Therefore, seed treatment with captan should be followed as a routine.

Key words : Captan, Carbendazim Fungicides, Nodulation, Biological Nitrogen, Soybean.

Introduction

Fungicidal seed dressing used to improve the early plant emergence are often damaging to Rhizobium applied as inoculants to legume seed. Some reports claim little damage, which may reflect the considerable variation within and in between different groups of Rhizobium in their sensitivity to fungicides (Curley, 1975). Nodulation, nitrogen fixation and growth of various legumes can be inhibited by fungicides. Generally, most efficient fungicides have been the most damaging to Rhizobium (Agarwal, 1986).

Materials and Methods

Research field of Biofertilizer Plant M.P.Agro Industries Indrapuri Bhopal was chosen for the study. Soil samples collected from upper layer of soil upto a depth of 15 cm. Samples were air dried and sieved through 20mm sieve. The physical and chemical analysis of soil was made by following standard procedures:

Fungicides Carbendazim and Captan were used in this investigation. The source of Carbendazim has been Kilpest India Ltd and chemically it is Methyl-2-benzimidazole Carbamate (MBC).

The source of Captan has been Rallis India Ltd., Bombay and chemically it is N-trichloromethylthio -4- cyclohexene-1, 2-dicarboximide

Organism : 30-40 days old Soybean plants were uprooted *Rhizobium japonicum* cultures isolated .Organism was grown and maintained on yeast extract mannitol agar medium. Ten days old nine cultures *i.e.*CH 1, 2, 3, 4, 5, 6, 7A, 7B, 7C incubated at 28±2°C were used throughout the investigation.

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Field Trial : Seeds of Soybean were inoculated with Rhizobium japonicum culture at the rate of 5 grams of inoculant to each Kg. of Soybean seeds and 4% of jaggery solution prepared in distilled water was used as a sticker. Following air drying, seed samples were dry dusted with 0.25% by weight each of the fungicides. The plants were uprooted after 45 days of their germination. In the control set fungicides were not used but seeds were inoculated with culture isolates.

Results and Discussion

Results reveal that Carbendazim is toxic to the nodule bacterium in comparison to Captan. As Carbendazim is reported to be persistent in the soil and it is biochemically specific inhibitor, therefore its effect on beneficial microorganisms cannot be ignored. The trichloromethylthio group (-$SCCl_3$) present in Captan fungicide is cleaved from the imides moiety in reaction with imidazole, thiol & amino groups (Lukens, 1958; Owens, 1959; Montic, 1962; Siegel, 1968, 1970; Richmond, 1968). Captan did not show any depressive effect on native Rhizobium colonization. Captan is observed to be compatible with nodule bacterium. Observation is supported by Duezek and Coworkers from Canada. In general inoculation of seeds with different strains of *R. japonica* resulted in an increase in nodulation. However, it can be seen from the results that all the strains did not perform equally well, may be due to strain variation. Both success and failure due to inoculation at the field levels have been well documented in literature from time to time (Hamdi, 1976; Subba Rao, 1971, 1976, 1977, 1979; Balasundram, 1977).

Among the different isolates CH-1, CH-2, CH-6, CH-7C provided better results. After 45 days of sowing Soybean plants were quiet healthy. Nodule size and colour was also dark pink indicative of effectiveness of nitrogen fixation in case of Captan treated seeds. Our finding suggests that Soybean

Table 1 : Influence of Captan fungicide and seed bacterization with test isolates of *Rhizobium japonicum* in field trial observed after 45 days. (Soybean seeds have been of PK-472 variety)

S. No.	Isolate No.	Shoot length in cm.	Root length in cm.	No. of Nodules
1	CH-1	45.3	26	62.7
2	CH-2	44.8	24.8	62.1
3	CH-3	41.2	23.7	44.4
4	CH-4	40.9	23.2	36.6
5	CH-5	39.3	24.6	41.5
6	CH-6	38.8	22.5	58.5
7	CH-7A	38.3	25.2	43.6
8	CH-7B	37.6	23.1	44
9	CH-7C	45.3	25	53.9
% Inc. over control		45.19	28.08	72.7

Table 2 : Influence of Captan fungicide and seed bacterization with test isolates of *Rhizobium japonicum* in field trial Observed after 45 days. (Soybean seeds of JS-72-44 variety)

S.NO.	Isolate No.	Shoot length in cm .	Root length in cm .	No. of Nodules
1	CH-1	44.2	25.2	59.5
2	CH-2	43.4	23.3	59.5
3	CH-3	40.8	22.5	43.0
4	CH-4	39.6	22.6	37.3
5	CH-5	38.2	23.0	40.2
6	CH-6	37.6	21.4	56.6
7	CH-7A	37.0	24.2	41.8
8	CH-7B	36.8	22.6	41.6
9	CH-7C	42.6	24.1	52.2
% Inc. over control		43.51	31.25	68.0

Table 3 : Influence of Carbendazim fungicide and seed bacterization with test isolates of *Rhizobium japonicum* in field trial observed after 45 days.

(Soybean seeds of PK - 472 variety)

S .No.	Isolate No.	Shoot length in cm.	Root length in cm.	No. of Nodules
1	CH – 1	37.6	33.5	40.8
2	CH-2	37.2	24.8	36
3	CH-3	33.3	24	31.7
4	CH-4	25.8	26.3	31.4
5	CH-5	36	27.1	27.3
6	CH-6	35.8	17.5	35.3
7	CH-7A	37.2	18,6	28.5
8	CH-7B	32.5	20.5	30.4
9	CH-7C	37.6	22.3	39.7
% Inc. over control		20.5	65.03	12.1

Table 4 : Influence of Carbendazim fungicide and bacterization with test isolates of *Rhizobium japonicum* in field trial observed after 45 days.

(Soybean seeds of JS-72-44)

S.No.	Isolate No.	Shoot length in cm.	Root length in cm.	No. of Nodules
1	CH-1	36.4	31.8	38.8
2	CH-2	35.4	22.6	33.8
3	CH-3	32.3	22.9	29.7
4	CH-4	24.1	24.6	27.8
5	CH-5	35	25.9	24.6
6	CH-6	34.8	16	35.3
7	CH-7A	36.2	17.2	26.2
8	CH-7B	30.9	18.9	26.5
9	CH-7C	35.3	20.5	36.2
% Inc.over control		18.18	65.6	9.6

seed treatment should be followed as a routine.

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