

Effect of Selected Pre-Emergence Herbicides on the Nodulation and Nitrogen Fixation of Soybean

By

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ABSTRACT

Legume nodulation is one of the important soil processes liable to be adversely affected by the application of herbicides. In the present study, five pre-emergence herbicides viz., methabenzthiazuron (1.0 and 2.0 kg/ha), fluchloralin (1.5 and 2.5 kg/ha), bentazon (1.0 and 2.0 kg/ha), alachlor (1.5 and 2.5 kg/ha), and chloramben (1.0 and 2.0 kg/ha) were tested under field conditions to know their effect on nodulation and nitrogen fixation of soybean inoculated with a composite culture of *Rhizobium japonicum*. None of these herbicides was found to have any significant effect on nodule number and dry weight, and dry weight of the plant top.

INTRODUCTION

One of the important soil processes likely to be affected by the application of herbicides is legume nodulation (Alexander, 1961). At normal field rates 2,4-bis (isopropylamino)-6- (methylthio) -s- triazine (Phometryn) caused an increase in the number of nodules on bean (*Phaseolus*) roots (Rankov *et al.*, 1966), but inhibited both the number and size of nodules on peas (Szabo, 1964; Avrov, 1966). Recently, Dunigan *et al.* (1972) reported that selected pre-emergence herbicides viz., Alachlor, BASF 3931 H, BAY 94337, CGA 10832, Chloramben, Chloroprotham + Dinoseb and DCPA in field studies had no adverse effect on both the dry weight and the iron content of the nodules of soybean.

The objective of the present study was to know the effect of selected

pre-emergence herbicides on the nodulation and nitrogen fixation of soybean inoculated with *Rhizobium japonicum* and grown under field conditions.

MATERIALS and METHODS

The experiment was conducted during *Kharif*, 1974 on a red sandy-loam soil. The following pre-emergence herbicides were tried at two concentrations: methabenzthiazuron, bentazon and chloramben each at 1 and 2 kg a.i./ha and fluchloralin and alachlor at 1.5 and 2.5 kg a. i./ ha.

The herbicides were sprayed a day after sowing. Soybean variety 'Davis' seeds were inoculated with a peat based composite culture of *R. japonicum* before sowing. The seeds were sown in plots of 3.0 m x 2.1 m with a plant spacing of 10 cm in bet-

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ween in rows spaced 30 cm apart. The experiment was laid out as randomized block design with three replications. The effect of herbicides on nodulation and nitrogen fixation was compared in plots kept weedy and weed-free throughout the crop growth. Treatment effect was evaluated in terms of nodulation and nitrogen fixation (as indicated by the dry weight of the plant tops) at two stages of plant growth viz., 30 days and 60 days after sowing. For this, the plants were carefully uprooted, thoroughly washed in tap water and nodules were removed. Nodule number per plant was determined. Dry weight of nodules and plant tops was determined after drying them to constant weight at 70°C in forced draft oven.

RESULTS and DISCUSSION

The results on number and dry weight of the nodules per plant and

dry weight of the plant top are presented in Table. The effect of herbicides and/or weed control treatments on the number of nodules per plant was not significant. However, it was always more in weed-free plots as compared to unweeded control plots. This may be due to the limitation of rhizobial activity in the rhizosphere of soybean plant which is faced with competition from weeds for space, water and light in unweeded plots. At 30 days of plant growth, all the herbicides except chloramben at higher concentration reduced the number of nodules per plant. Of all the herbicides, fluchloralin reduced the number of nodules to the maximum extent. Curiously enough, the inhibitory effect of herbicides was found to decrease with the increase in concentration. Similar trend was observed in the dry weight of the nodules per plant. Regarding their effect

TABLE. Effect of herbicides on nodulation and nitrogen fixation of soybean

Treatment	No. of nodules/ plant		Dry wt. of nodules/ Plant (mg)		Dry wt. of plant top (g)	
	30 days	60 days	30 days	60 days	30 days	60 days
Weed free	17.5	20.8	158.6	293.3	2.13	7.91
Unweeded control	14.5	12.1	100.0	181.6	2.25	5.78
Methabenzthiazuron a.i. 1 kg/ha	12.3	25.8	53.3	226.6	1.90	6.53
Methabenzthiazuron a.i. 2 kg/ha	14.6	18.6	40.0	148.6	1.65	3.88
Fluchloralin a.i. 1.5 kg/ha	5.3	19.5	71.6	89.2	2.23	4.83
Fluchloralin a.i. 2.5 kg/ha	5.7	25.2	35.0	245.0	2.15	6.76
Bentazon a.i. 1.0. kg/ha	11.0	24.3	51.6	251.6	2.30	7.93
Bentazon a.i. 2.0. kg/ha	14.5	10.3	80.8	141.6	2.50	5.36
Alachlor a.i. 1.5. kg/ha	12.6	25.5	54.6	193.3	2.50	4.68
Alachlor a.i. 2.5 kg/ha	12.0	11.6	73.3	75.3	1.83	5.91
Chloramben a.i. 1.0 kg/ha	8.0	17.2	56.6	130.0	1.85	5.93
Chloramben a.i. 2.0 kg/ha	24.8	17.2	130.5	161.6	1.88	8.00
C. D. at 5%	N.S.	N.S.	58.3	N.S.	N.S.	N.S.

N.S. — Not Significant

on dry weight of the plant top at 30 days of plant growth, it can be seen that the herbicides exerted no significant influence, although decrease in plant growth was observed in the plots sprayed with methabenzehiazuron (1.0 and 2.0 kg/ha), bentazon (2.0 kg/ha), alachlor (2.5 kg/ha) and chloramben (1.0 and 2.0 kg/ha).

At 60 days of plant growth, the herbicides, with the exception of methabenzehiazuron (1.0 kg/ha), fluchloralin (2.5 kg/ha), bentazon (1.0 kg/ha), and alachlor (1.5 kg/ha), reduced the number of nodules per plant. In general, all the herbicides at higher concentrations, except fluchloralin, showed an inhibitory effect on number of nodules. Similar effect was observed on dry weight of nodules per plant. This is in agreement with the report of Dunigan *et al.* (1972) that alachlor and chloramben at field rates had no significant adverse effect on dry weight of nodules. Dry weight of the plant top was more in weed-free plots as compared to unweeded control plots. There was little increase in plant growth with bentazon (1.0 kg/ha) and chloramben (2.0 kg/ha) treatments, whereas with other treatments the plant growth was reduced. The reduction was more in methabenzehiazuron (2.0 kg/ha) and alachlor (1.5 kg/ha) treatments. In methabenzehiazuron and bentazon treated plots, there was decrease in plant growth with increase in the concentration. Whereas, in other treatments, it was quite reverse i.e., plant growth increased with increase in concentration of the chemical. The reasons for this are not clear. However, am-

ong all the herbicides tested, methabenzehiazuron was found to have scorching effect on some young seedlings resulting in eventual death of the plants. This effect of methabenzehiazuron was more at higher concentration (15% damage) than at lower concentration (100% damage).

From the above results it can be seen that the different herbicides viz., methabenzehiazuron, fluchloralin, bentazon, alachlor and chloramben recommended for use in soybean fields were found to have no significant adverse effect on nodulation and nitrogen fixation. The adverse effect noticed in some treatments, might be due to the uneven distribution of the herbicide in the soil.

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