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Effect of bavistin and endocel foliar sprays on VAM colonization and growth of four blackgram cultivars

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ABSTRACT

The effect of one pesticide and one insecticide namely bavistin and endocel, respectively as foliar sprays on four cultivars of blackgram *viz*., LBG 20, LBG 402, LBG 17 and T 9 with respect to VAM colonization, nodulation, shoot dry matter, 100 grain weight, Phosphorus and nitrogen contents was studied in an field experiment. The bavistin and endocel sprays negatively affected all the parameters studied when compared to that of control ones. However, the bavistin spray resulted in comparatively greater reduction in all the parameters than that of endocel spray. The extent of reduction varied from cultivar to cultivar both in bavistin and endocel treatments.

Key words : Blackgram cultivars, Bavistin, Endocel, VAM infection

INTRODUCTION

Symbiotic microorganisms have an enormous advantage over free-living microorganisms in soil because of their protective niche in plant roots. This makes mycorrhizal fungi much better placed than phosphate-solubilizing fungi and bacteria for bringing about phosphorus (P) uptake by plant roots. The role of VAM fungi in 'P' cycling in natural ecosystems is vital. In crop production, mycorrhizal inoculation of plants which can utilize mycorrhizal association for nutrient uptake, may well be a practical alternative to large applications of fertilizer. The VAM fungi are also implicated in the uptake of other nutrient elements like zinc (Gilmore, 1971) and sulphur (Gray and Gerdemann, 1973). Besides the direct nutritional advantages, the mycorrhizae have also been accredited with other benefits like increasing the resistance to disease, drought and salinity (Levy and Kriken, 1980).

Legumes play a key role in many agricultural systems as sources of high protein grain and herbage as well as for maintaining and improving soil fertility. Leguminous grain crops (pulses) provide nearly one quarter of the world's dietary protein requirements at present, mostly in tropics and sub-tropics. In legumes, the VAM infection enhances nodulation (Asai, 1944; Carling *et al*., 1978). The legumes require high 'P' content for better nodulation, nitrogen fixation and optimum growth (Mosse,1977). Blackgram, *Vigna mungo* (L.) Hepper, is believed to be a native of India and considered to be as one of the most highly prized pulses in India. It is extensively cultivated in almost all states of the country and often as a mixed crop. Blackgram provides an excellent forage and the grain is consumed in various forms.

Changing agricultural practices have resulted in increased application of pesticides and fungicides for the control of diseases. The benefits of fungicides, increased crop growth via destruction of pathogens, may be diluted by harmful effects on beneficial microbes like mycorrhizal fungi (Trappe *et al*., 1984). Several systemic and non-systemic fungicides were tested against a variety of VA mycorrhizal fungi for their effect on the degree of infection and sporulation. Menge (1982) found that benzimidazole fungicides like bavistin are toxic to VAM fungi. In spite of common practice of spraying agricultural chemicals on crops, the repots on the effect of fungicides or insecticides on VAM fungi when applied as foliar sprays are few. In the present investigation, an attempt was made to find out the effect of bavistin and endocel foliar sprays on four selected blackgram cultivars with respect to VAM colonization, growth parameters and grain weight.

MATERIALS AND METHODS

A field plot of size 15 m x 7 m was prepared in Botanical garden of Acharya Nagarjuna Universtiy. Each main plot was sub-divided into nine blocks of 5 m x 2 m size with three blocks in each row. In each block, the four blackgram cultivars *viz.*, LBG 20, LBG 402, LBG 17 and T9, each in four rows, were raised in random distribution. Bavistin at a concentration of 1g/lit and Endocel at a concentration of 2 ml/lit or water (control) were sprayed on foliage, selecting three blocks for each treatment and control in a random manner, one week after the 30^{th} and 45^{th} days.

The plants of treatments as well as control were carefully uprooted at 45 days and 60 days, washed gently under tap water and cut into one cm pieces. These cut root bits were stained following the method of Phillips and Hayman (1970). The stained root bits were observed for the per cent VAM infection by the method of Giovanetti and Mosse (1980) and also number of vesicles/

spores per one cm root length. From the 45-day old sampled plants, nodule number, nodule fresh weight, shoot dry weight were determined. After a careful wash of the sampled plant roots, the nodules on the roots were counted. Later, nodules were separated from the roots, blotted dry and weighed immediately on a torsion balance for fresh weight. The shoot dry weight of the plants was determined after oven drying the washed and blot-dried sampled plants. At the harvest *i.e.* after 65 days, pods were collected from the plants, grains were separated, air dried and weight of the 100 grains was determined.

The phosphorus content of the shoots was estimated by the Vanado-molybdate yellow method (Jackson, 1973). The per cent nitrogen in the plant material was determined by micro-kjeldahl 'N' method as given in AOAC (1978).

RESULTS AND DISCUSSION

The per cent VAM infection was significantly reduced in all the cultivars of blackgram when the plants were sprayed with bavistin as well as with endocel (Table 1). But the reduction in root infection by VAM fungi over the control was more in bavistin treated plants when compared with endocel treated plants in all the four cultivars. Also, the extent of reduction varied from cultivar to cultivar both in bavistin and endocel treatments. With the increase of plant age root infection increased both in control and treated plants but with more increase in control plants than the treated plants. Greater reduction in per cent infection and per cent phosphorus at 45 days was observed in the cultivar of T 9 of blackgram when treated with either bavistin or endocel than in other three cultivars. Least reduction was in LBG 20 when treated with bavistin and in LBG 17 in treatment with endocel. The foliar sprays of bavistin and endocel also showed a negative effect on the number of vesicles and / or spores in the roots (Table 2).

The nodule number per plant, nodule fresh weight of plant (Table 3) and shoot dry weight (Table 4) were also reduced considerably in bavistin and endocel treated plants when compared to that of the control plants. The foliar sprays also exhibited a negative effect on the 100 grain weight determined at harvest period (Table 4). The bavistin spray showed more negative impact on all these parameters when compared to that of endocel spray. The foliar sprays of bavistin and endocel considerably affected the per cent 'P' and per cent 'N' in the treated plants. Both the 'P' and 'N' contents were reduced in treated plants when compared to that of control plants (Fig. 1 and 2).

Application of pesticides in agriculture is of common practice to control the various diseases. However, the toxic nature of these pesticides, in some way or other,

Table 1 : Effect of bavistin and endocel sprays on VAM fungal colonization in four cultivars of blackgram

Cultivars	Per cent infection					
	45 days			60 days		
	Control	Bavistin	Endocel	Control	Bavistin	Endocel
LBG 20	56.3	42.0	48.0	75.5	58.2	65.2
LBG 402	60.0	45.0	52.6	80.5	62.6	71.0
LBG 17	58.6	44.0	51.3	78.5	61.6	69.2
T 9	52.6	36.4	43.6	73.8	54.2	61.0
F value due to						
treatments :	1153.33*	413.58*	1549.83*	317.39*		
cultivars :	64.54*	84.95*	56.83*	40.39*		

* indicates significance of value at P=0.05

Table 2 : Effect of bavistin and endocel sprays on VAM fungal vesicles and/or spores in four cultivars of blackgram

Cultivars	No. of vesicles/spores (cm^{-1} root bit)					
	45 days			60 days		
	Control	Bavistin	Endocel	Control	Bavistin	Endocel
LBG 20	31.0	22.0	21.0	39.0	32.0	32.0
LBG 402	36.0	24.0	28.0	44.0	30.0	40.0
LBG 17	49.0	36.0	36.0	43.0	45.0	43.0
T 9	38.0	29.0	26.5	39.0	35.0	39.0
F value due to						
treatments :	108.76*	98.97*	32.83*	42.88*		
cultivars :	44.45*	41.11*	11.65*	22.80*		

* indicates significance of value at P=0.05

Table 3 : Effect of bavistin spray on nodulation (at 45 days) in four cultivars of blackgram

Cultivars	Nodule number (plant^{-1})			Nodule fresh wt. (mg/pl)		
	Control	Bavistin	Endocel	Control	Bavistin	Endocel
LBG 20	23.2	15.3	18.7	104.5	67.2	87.3
LBG 402	28.8	21.3	24.6	144.3	106.6	130.1
LBG 17	25.6	17.7	19.5	116.7	79.4	89.6
T 9	20.5	13.7	16.7	90.0	60.0	70.3
F value due to						
treatments :	908.90*	838.98*	369.15*	50.62*		
cultivars :	187.29*	45.33*	137.86*	77.07*		

* indicates significance of value at P=0.05

Table 4 : Effect of bavistin and endocel sprays on shoot dry wt. and 100 grain wt. in four cultivars of blackgram

Cultivars	Shoot dry wt. (g/pl) 45 days			100 grain wt. (g) 65 days		
	Control	Bavistin	Endocel	Control	Bavistin	Endocel
LBG 20	4.97	4.30	4.65	7.37	6.89	7.20
LBG 402	5.78	5.18	5.42	6.69	6.00	6.36
LBG 17	5.46	4.98	5.03	6.74	6.32	6.56
T 9	4.92	4.31	4.59	5.87	5.16	5.25
F value due to						
treatments :	219.62*	212.50*	61.56*	9.59		
cultivars :	117.69*	259.10*	82.76*	46.59*		

* indicates significance of value at P=0.05

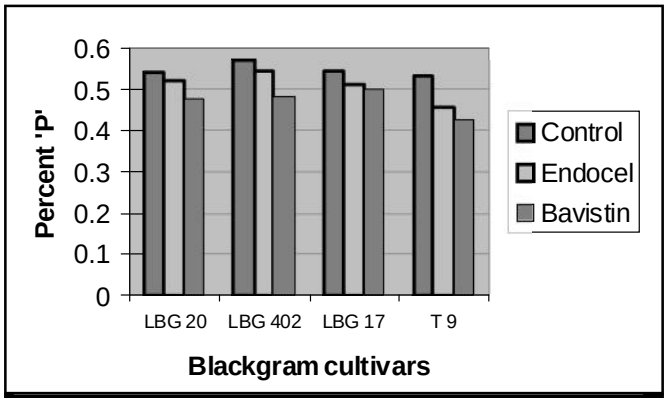

Fig. 1 : Effect of Endocel and Bavistin foliar sprays on Phosphorus content of shoot of blackgram cultivars

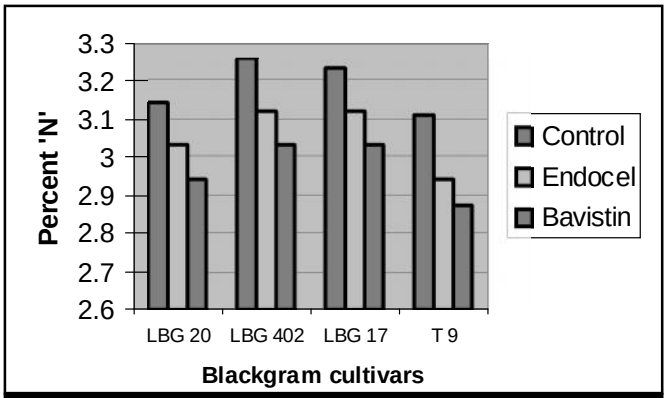

Fig. 2 : Effect of Endocel and Bavistin foliar sprays on Nitrogen content of shoot of blackgram cultivars

may be hazardous to non-target beneficial symbionts like VAM fungi and *Rhizobium*. Kumar and Jayaraman (1988) reported that application of three fungicides (Bavistin + Thiram, Difloton, Thiram) not only reduced the production of mycorrhizal spores but also retarded mycorrhizal formation formation in *Vigna mungo* in both cultivated and uncultivated alkaline soils. It was also reported by Jalali *et al*.(1990) that treatment of chickpea seeds with Aldrin and bavistin, significantly altered the plant height, dry matter, number of nodules, pods per plant, grain weight and population dynamics of mycorrhizal sporocarps, as compared to uninoculated plants or those inoculated with either *Glomus fasciculatum* or *Rhizobium* only. Manjunath and Bagyaraj (1984) reported that the application of four fungicides *viz.*, agrosan, benlate, ceresin and plantavax reduced the plant growth and phosphate uptake in onion, even at lower concentrations.

Jalali and Domsch (1975) observed that seed as well as foliar applications with conventional and systemic fungal toxicants restricted the development of mycorrhizal endophytes on host roots in wheat. Oliveira *et al*. (1987) observed that benomyl as well as copper oxychloride sprayings reduced the mycorrhizal infection and consequently growth stimulus of the inoculated plants.

The reduction in plant dry matter production in the field plots by the application of bavistin and endocel sprays may be due to their deleterious effect on VAM fungi rather than their direct effect on plant growth as brought out by the reduced VAM development in the treated plants. Systemic fungicides, by their virtue, provide an undesirable environment inside the plant system to the invading organisms. Jalali and Domsch (1975) postulated that since foliarly applied pesticides may not be translocated intact to the roots, but the side effects on mycorrhizae may be brought about by changes in the spectrum of root exudates as a result of the stress exerted by the pesticides. By and large, the systemic fungicides as a group appear to be more damaging to mycorrhizal symbiosis than non-systematic ones (Jalali, 1990). So, it is necessary to evaluate the impact of foliar sprays with plant protection chemicals on VAM development in crop plants that form mycorrhizal association in the field.

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