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Response of Rhizobium inoculation, phosphorus and carbendazim seed dressing in some rajmash cultivars

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Abstract

A field experiment was conducted during summers of 2000 and 2001 on rajmash (*Phaseolus vulgaris* L.) at Kukumseri in dry-temperate zone of Himachal Pradesh to evaluate three varieties for phosphorus, *Rhizobium* response in the presence and absence of fungicide carbendazim. Among three varieties Him-1 produced highest yield (37.5 q/ha) followed by Triloki (31.6 q/ha) and Kanchan (24.8 q/ha). All the three varieties responded significantly to phosphorus doses irrespective of *Rhizobium* inoculation. The interaction between phosphorus, *Rhizobium* and carbendazim was found to be positively significant for yield but interaction between *Rhizobium* and carbendazim was found non-significant.

Key words: Rajmash, phosphorus, *rhizobium* and carbendazim, dry-temperate zone.

Introduction

Rajmash (*Phaseolus vulgaris* L.) is an important pulse crop of Himachal Pradesh having 2037 hectares with 19,206 metric tonnes (Anonymous, 1999). The crop is mostly concentrated in dry-temperate zone of Himachal Pradesh. The coarse textured soils are medium to high in phosphorus and medium in nitrogen. The farmers are growing rajmash crop of different cultivars and web blight is common disease in the zone. Nodulation by local isolates is poor in this crop in the soils of this region. Therefore, an experiment was conducted to study the effect of phosphorus, *Rhizobium* inoculation and carbendazim on rajmash cultivars.

Material and Methods

Field experiment was conducted with rajmash at Regional Research Station, Kukumseri (32°44'15" N and 76°41'23" E at an elevation of 2672 m) during summers of 2000 and 2001on soil having pH 7.0 and available N:P:K :: 370: 22: 192 kg/ha, respectively. The treatments comprised of three rajmash vars. Triloki, Him-1 and Kanchan and fungicide carbendazim 50WP (control, treated) in the main plot having phosphorus levels (0, 30, 60 kg P_2O_5/ha) and rhizobium (with and without) in the subplots. Thirty-six treatment combinations with three replications were laid in factorial experiment in split plot design. The seed was treated with an isolate of *Rhizobium* (isolated from Sadarpur in district Kangra) and with carbendazim depending on type of treatment, sown in 2.7 m x 1.5 m plots by dropping seeds manually at a spacing of 45 cm x 5 cm on June, 2 and May, 23 during the 2000 and 2001, respectively.

A uniform dose of 25kg/ha K as muriate of potash and 20 kg/ha N as urea and P as single super phosphate was applied at the time of sowing. In the plots with carbendazim treatment, spraying was done first at 50% flowering and at fortnight interval after first spray till appearance of disease. The crop was irrigated with sprinkler irrigation as and when required. The crop was harvested on September, 19 and 17 during 2000 and 2001, respectively and seed yield was recorded.

Results and Discussion

Yield

Highest yield (37.5 q/ha) was recorded in var. Him-1 followed by Triloki and Kanchan (Table 1). All the three varieties responded significantly to phosphorus application irrespective of *Rhizobium* treatment and maximum yield (34.7q/ha) was recorded in P_2 treatment.

Table 1.Variety x phosphorus effect on yield

Variety/ Phosphorus	Yield (q/ha)			
	Kanchan	Triloki	Him-1	Mean
P_0	22.0	26.9	33.4	27.4
P_1	25.3	31.8	38.2	31.1
P_2	27.1	36.1	40.8	34.7
Mean	24.8	31.6	37.5	
CD (P=0.05)		0.55		

P_0-No P_2O_5; P_1-30 kg P_2O_5; P_2-60kg P_2O_5

Interactions

Variety x Phosphorus (P): Significant increase (Table 1) in yield was observed with each increment of phosphorus in all the three varieties. Carbendazim x P: Significant increase in yield was recorded with carbendazim over control (Table 2).

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Carbendazim x P interaction was found to be positive in case of yield of rajmash.

Rhizobium x P: Inoculation resulted in increased yield over uninoculated treatments at all the levels of P application (Table 3).

Table 2. Carbendazim x phosphorus effect on yield

Carbendazim / Phosphorus	Yield (q/ha)		
	Control	Carbendazim	Mean
P_0	26.5	28.3	27.4
P_1	30.9	31.8	31.4
P_2	33.9	35.4	34.7
Mean	30.4	31.8	
CD (P=0.05)		0.50	

P_0-No P_2O_5; P_1-30 kg P_2O_5; P_2-60kg P_2O_5

Table 3.Rhizobium x phosphorus effect on yield

Rhizobium/ phosphorus	Yield (q/ha)		
	Uninoculated	Inoculated	Mean
P_0	26.8	28.0	27.4
P_1	31.2	32.4	31.8
P_2	34.3	35.1	34.7
Mean	30.8	31.8	
CD (P=0.05)		0.45	

P_0-No P_2O_5; P_1-30 kg P_2O_5; P_2-60kg P_2O_5

Variety x *Rhizobium*: Inoculation treatment resulted in the higher yield than uninoculated treatments (Table 4). The three varieties differed in yield .Such type of differences may be due to genetic variation.Munns *et al.* (1979) observed that nodulation and nitrogen fixation by some strains of Bradyrhizobium differ with cultivar of mungbean used.

Variety x carbendazim: The application of carbendazim increased the yield of all the three varieties of rajmash over the control (Table 5).

Variety x carbendazim x *Rhizobium*: Carbendazim with *Rhizobium* inoculation proved better than control with uninoculated in each variety (Table 6).

Table 4. Variety x *Rhizobium* effect on yield

Variety/ Rhizobium	Yield (q/ha)			
	Kanchan	Triloki	Him-1	Mean
Uninoculted	24.6	30.9	36.9	30.8
Inoculated	25.2	32.4	38.0	31.9
Mean	24.9	31.7	37.5	
CD (P=0.05)		0.45		

Variety x carbendazim x P: Carbendazim X P interacted positively and significantly in all the three varieties in influencing the yield (Table 7).

Table 5. Variety x carbendazim effect on yield

Variety/ carbendazim	Yield (q/ha)			
	Kanchan	Triloki	Him-1	Mean
Control	24.3	30.6	37.0	30.7
Carbendazim	26.2	32.8	38.5	32.5
Mean	25.2	31.7	37.8	
CD (P=0.05)		0.71		

Table 6. Variety x carbendazim x rhizobium effect on yield

Treatment*	Yield (q/ha)			
	Kanchan	Triloki	Him-1	Mean
Control I_0	23.4	29.7	36.5	29.9
Control I	24.4	31.8	36.8	31.0
Carbedazim I_0	25.3	32.0	37.4	31.6
Carbendazim I	26.0	32.0	39.2	32.4
Mean	24.8	31.4	37.5	
CD (P=0.05)		0.14		

* I_0-Uninoculated; I-Inoculated

Table 7. Variety x carbendazim x phosphorus effect on yield

Treatment	Yield (q/ha)			
	Kanchan	Triloki	Him-1	Mean
Control x P_0	21.1	26.1	32.3	26.5
Control x P_1	24.3	30.9	37.5	30.9
Control x P_2	26.2	35.3	40.2	33.9
Carbendazim x P_0	22.9	27.7	34.5	28.4
Carbendazim x P_1	26.3	32.7	39.1	32.7
Carbendazim x P_2	27.9	37.0	41.5	35.5
Mean	24.8	31.6	37.5	
CD (P=0.05)		0.17		

P_0-No P_2O_5; P_1-30 kg P_2O_5; P_2-60kg P_2O_5

Carbendazim x *Rhizobium* x P: Positive interaction was found on yield (Table 9).The adoption of disease management with carbendazim and P application has a positive and significant effect on the yield of these varieties. Comparatively Triloki was found tolerant to web blight followed by Him-1 and Kanchan. The data on disease incidence were recorded and presented in Table 10. The seed treatment and spray with carbendazim proved effective in controlling disease incidence in each variety. Similar findings in rajmash have been reported by Banyal and Singh (2007).

Table 8. Carbendazim x *Rhizobium* x phosphorus effect on yield

Treatment	Yield (q/ha)		
	Control	Carbendazim	Mean
No rhizobium x P_0	25.9	25.6	25.8
No rhizobium x P_1	30.1	32.2	31.2
No rhizobium x P_2	33.6	34.9	34.3
Rhizobium x P_0	27.1	29.0	28.0
Rhizobium x P_1	31.7	33.2	32.5
Rhizobium x P_2	34.2	36.0	35.1
Mean	30.5	31.8	
CD (P=0.05)		0.15	

P_0-No P_2O_5; P_1-30 kg P_2O_5; P_2-60kg P_2O_5

Variety x *Rhizobium* x P: Positive and significant interaction was found on the yield of the crop (Table 9). Increase in yield with phosphorus and *Rhizobium* is quite obvious as with more N fixation; P requirement of plant increased because P is directly involved in energy synthesis process. High yields were associated with high nitrogen fixation and nodulation (Kundu *et al.*,1993). Increase in yield with phosphorus addition and *Rhizobium* inoculation in legumes e.g. green gram have been reported by Singh *et al.* (1994) and in chickpea by Sharma *et al.* (1995). Response to applied P in soybean in medium to high P soil is reported by Singh and Bishnoi, (1994).Kumar *et al.* (1999) and Parmar *et al.* (1999) reported significant increase with P application in rajmash grown in Lahaul and Kinnaur valleys respectively of Himachal Pradesh.

It is concluded from the study that these rajmash varieties responded significantly and positively to phosphorus and Rhizobium treatment in the presence of fungicide carbendazim.

Table 9. Variety x *Rhizobium* x phosphorus effect on yield

Treatment	Yield (q/ha)			
	Kanchan	Triloki	Him-1	Mean
No inoculation x P_0	21.8	26.1	32.5	26.8
No inoculation x P_1	24.7	31.2	37.7	31.2
No inoculation x P_2	26.6	35.5	40.8	34.3
Inoculation x P_0	22.2	27.6	34.2	28.0
Inoculation x P_1	25.9	32.5	38.9	32.4
Inoculation x P_2	27.6	36.9	40.9	35.1
Mean	24.8	31.6	37.5	
CD (P=0.05)		0.20		

P_0-No P_2O_5; P_1-30 kg P_2O_5; P_2-60 kg P_2O_5

Table 10. Per cent infestation as affected by different treatments

Treatment		Percent Infestation		
		Variety		
		Kanchan	Him 1	Triloki
Control (No Carbendazim)	Uninoculation	13.4	7.4	7.9
	Inoculation	17.1	10.7	10.8
Carbendazim	Uninoculation	8.3	3.9	6.0
	Inoculation	11.7	6.7	10.3

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