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Response of Rapeseed to Potassium, Nitrogen and Biofertilizer

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ABSTRACT

A field experiment was conducted during winter season of 1999-2000 at Instructional Farm, Jaguli, Bidhan Chandra Krishi Viswavidyalaya in an Entisol of neutral reaction (pH 7.1) to study the response of 3 levels each of K (0, 12.5 and 25 kg ha^{-1}) and N (0, 40 and 80 kg ha^{-1}) and biofertilizers (*Azotobacter, Azospirillum*) under irrigated condition. The crop responded significantly to K and N application. Seed inoculation with either of the bacteria significantly improved the yield attributes (number of siliqua/plant, number of seeds/siliqua and test weight) and yield of seed and oil, though the magnitude of increase was more with *Azotobacter*. Interaction between K and biofertilizer and between biofertilizer and N were found significant in increasing the yield of rapeseed. At highest level of N (80 kg ha^{-1}) and K (25 kg ha^{-1}), maximum yield of rapeseed was obtained followed by the yield obtained with 80 kg N ha^{-1} along with 12.5 kg K ha^{-1}.

Key words: Rapesed; potassium; nitrogeon; biofertilizer; yield components; yield; oil content.

INTRODUCTION

Rapeseed [*Brassica campestris* L.spp. Oleifer (Metzger) Sinsk. Var yellow sarson] is one of the most important oilseed crops of India. It is responsive to chemical fertilizers especially N and K. With the sky rocketing price of chemical fertilizers, use of alternative sources of fertilizers, which are cheaper and renewable, is not only going to be necessary but also inevitable. In this context, use of biofertilizers, in order to supplement the nutrient supply through chemical fertilizers is an excellent option. Non-symbiotic bacteria like *Azotobacter* and *Azospirillum* are potential biofertilizers. These are capable of contributing N to a number of non-legumes by the virtue of their ability to fix atmospheric N which is made available to plants, and thus indicating their exploitability in rapeseed also. Moreover, their activity may be influenced by supply of other nutrients like N and K. The present investigation was therefore, undertaken to study the response of rapeseed to K, N and biofertilizers.

MATERIALS AND METHODS

The field experiment was conducted during the winter season of 1999-2000 at Instructional Farm (22.93°N, 88.53°E and 9.75 m AMSL), Jaguli, Bidhan Chandra Krishi Viswavidyalaya, in sandy loam soil (70.54 sand, 14.10% silt and 15.36% clay) containing 0.075% total N, 8.70 kg ha^{-1} available P and 71.40 kg ha^{-1} available K and the soil reaction ws neutral (pH 7.1). The mean maximum and minimum temperature during the experimental period was 27.50°C and 13.85°C, respectively. Total rainfall received during the crop growing season was 384.4 mm and the maximum and minimum RH were 97.81% and 53.98%, respectively. The experiment was laid out in split plot design with 3 replications. The treatment consists of 3 levels each of K (O, 12.5 and 25 kg ha^{-1}) and N (0, 40 and 80 kg ha^{-1}) combining 9 in total in the main plots and 2 bacterial cultures (*Azotobacter* and *Azospirillum*) excluding control in the sub-plots. Rapeseed cv. B-9 (Binoy) was sown on 31.10.1999 in flat beds in rows (30 cm x 8 cm)

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and recommended agronomic practices were followed. The seeds were inoculated with bacterial culture and dried under shade for 30 minutes before sowing. A basal dose of 10 kg P ha^{-1} (through single super phosphate) was applied uniformly to all the plots.

RESULTS AND DISCUSSION

Reponse to Nitrogen

Number of siliqua/plant, seeds/siliqua, 1000 seed weight, dry matter production and seed yield (**Table 1**) increased significantly with each successive increment in N level from 0 to 80 kg N ha^{-1}. The increase in the level of N was responsible for increased leaf area index, causing higher photosynthesis, assimilation rates, metabolic activity and cell division which in turn was responsible for significant improvement in the growth and yield attributes and seed yield of yellow sarson. Pradhan *et al.*, (1994) also reported similar findings. Oil content was highest at moderate level of N (40 kg ha^{-1}) and decreased with further addition of N.

Response to potassium

Each successive increase in K level from 0 to 25 kg ha^{-1} significantly increased the number of branches/plant, dry weight accumulation, number of siliqua/plant, seeds /siliqua, 1000 seed weight, oil content and seed yield (Table1). This improvement in yield and quality with increased supply of K may be due to the role of K in protein synthesis and N use efficiency. The results are in confirmation with those of Ghosh *et al.*, (1984) and Rana *et. al.*, (1984).

Response to bacterial inoculation

Seed inoculation with either of the bacterial culture significantly increased yield attributes viz. number of branches/plant, siliqua/plant, seeds/siliqua, 1000 seed weight and yield of seeds (**Table 1**). However, magnitude of increase was better with *Azotobacter* than *Azospirillum.* In case of oil content, both the bacterial strains decreased the oil content and remained at par with each other. The increase in seed yield over the control was 8.5% and 10.3% with

Table 1. *Effect of K, N and biofertilizer on drymatter accumulation, siliqua/plant, seeds/siliqua, 1000 seed weight, oil content and seed yield of rapeseed.*

Treatments	Dry weight (gm^{-2}) at harvest	No. of siliqua per plant	No. of seeds per siliqua	1000 seed weight (g)	Oil content (%)	Seed yield (kg ha^{-1})	% incrase of yield over control
Level of K (kg ha^{-1})							
K_0	304.50	56.81	20.39	2.46	41.99	876.04	–
$K_{12.5}$	346.73	66.95	21.34	2.53	42.39	1000.07	14.2
$K_{25.0}$	359.60	72.94	21.68	2.61	42.69	1049.70	19.8
CD at 5%	2.33	0.63	0.12	0.01	0.07	11.37	–
Level of N (kg ha^{-1})							
N_0	269.12	42.24	19.24	2.35	41.64	677.04	–
N_{40}	349.96	69.81	21.52	2.56	42.88	1079.74	59.5
N_{80}	391.76	84.64	22.64	2.69	42.54	1170.04	72.8
CD at 5%							
Level of biofertilizer							
A_0 (control)	318.37	60.63	20.80	2.49	42.49	918.07	–
A_1 *(Azotobacter)*	348.56	69.16	21.41	2.58	42.26	1012.41	10.3
A_2 *(Azospirillum)*	343.91	66.91	21.19	2.53	42.32	996.33	8.5
CD at 5%	0.98	0.49	0.07	0.01	0.06	8.24	–

Azospirillium and *Azotobacter*, respectively (**Table 1**). This favourable effect of bacterial inoculation could be attributed to increased N supply in inoculated plots due to N-fixation ability of these bacteria. The ability of *Azotobacter* and *Azospirillium* to produce growth substances and antifungal substances in addition to fixed N made available to plants was probably the reason of higher yield. The results are in conformity with the findings of Mishustin and Shilnikova (1969) and Chauhan *et. al.* (1996).

Interaction effects of nitrogen and potassium

The yield differed significantly due to the interaction effect between N and K (**Table 2a**). At all levels of N, the yield significantly increased with increasing level of K Maximum yield of 1214 kg ha^{-1} was recorded when the crop was fertilized with highest level of N (80 kg N ha^{-1}) and K (25 kg ha^{-1}). This favourable effect was due to the availability of additional K that was needed for proper utilization of higher levels of N. The results are in close conformity with findings of Rout *et. al.*, (1993). Moreover, it also indicates that as the seed yield at N_{40} K_{25} and N_{80} $K_{12.5}$ were at par we could save 40 kg N by application of 12.5 kg of K.

Interaction effects of nitrogen and biofertilizer

Interaction effect between biofertilizers and N levels was found significant in increasing the yield of rapeseed (**Table 2b**). Seed incoulation with either *Azotobacter* or *Azospirillum* significantly increased the yield of rapeseed at all levels of N. The yield differences between *Azotobacter* and *Azospirillum* treatments were at par except where no nitrogen was applied. the yield obtained when the crop was fertilized with moderate level of N (40 kg ha^{-1}) and incoulated with *Azotobacter* was as good as the yield obtained when the crop was fertilized with 80 kg N ha^{-1} but not incoulated. Similar findings were reported by Chauhan *et. al.* (1996). This substantiate that application of *Azotobacter* could save up to 40 kg of N.

Interaction effects of potassium and biofertizer

The yield differed significantly due to the interaction effect between potassium and biofertilizer (**Table 2c**). At all levels of K, seed incoulation with either *Azotobacter* or *Azospirillum* significantly increased the yield. At all levels of biofertilizer, application of K increased the yield significantly. This increase may be due to the fact that incoulation with

Table 2a. *Interaction effect between N and K on seed yield (kg ha^{-1}) of rapeseed.*

Treatment	Seed yield (kg ha^{-1})		
	N_0	N_{40}	N_{80}
K_0	578.89	952.56	1096.67
$K_{12.5}$	698.44	1105.67	1199.11
$K_{25.0}$	753.78	1181.00	1214.33
CD at 5%			

Table 2b. *Interaction effect between N and biofertilizer on seed yield (kg-ha^{-1}) of rapeseed.*

Treatments	Seed yield (kg ha^{-1})		
	N_0	N_{40}	N_{80}
A_0 (control)	614.67	986.22	1153.33
A_1 (Azotobacter)	719.89	1133.33	1184.00
A_2 (Azospirillum)	696.56	1119.67	1172.78
CD at 5% (A in the same level of N)		14.27	
CD at 5% (N in the same or different level of A)		28.18	

Table 2c. *Interaction effect between K and biofertilizer on seed yield (kg ha^{-1}) of rapeseed.*

Treatments	Seed yield (kg ha^{-1})		
	N_0	N_{40}	N_{80}
A_0 (Control)	827.22	933.78	993.22
A_1 (*Azotobacter*)	910.00	1042.78	1084.44
A_2 (*Azospirillum*)	890.89	1026.67	1071.44
CD at 5% (A in the same levle of K)		14.27	
CD at 5% (K in the same or different level of A)		28.18	

biofertilizers helped in fixing atmospheric nitrogen and thus resulted in increased N availability in the soil. The increased supply of K helped in better N use efficiency.

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