

Effect of biofertilizers, gypsum and nitrogen on growth and yield of *raya* (*Brassica juncea*)

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ABSTRACT

A 2-year field experiment was conducted at Gurgaon (Haryana) on sandy-loam soil analysing low in organic carbon and available N to evaluate the response of biofertilizers, gypsum and nitrogen fertilizer in *raya* [*Brassica juncea* (L.) Czernj. & Cosson]. Results showed that seed inoculation with *Azotobacter* and *Azospirillum* significantly increased the seed yield in both the seasons, the mean increase (%) over the seasons being 8.2 and 10.9 respectively over no inoculation. Plant height, pod length, pods/plant and seeds/pod were markedly affected in one out of the two seasons where *Azospirillum* only recorded higher values of these attributes over no inoculation. Seed inoculation with *Azotobacter* and *Azospirillum* recorded bolder seeds in both the seasons. Application of 125 kg gypsum/ha favoured the development of yield attributes, viz. pods/plant, pod length and 1,000-seed weight, and consequently increased the seed yield. Gypsum application also resulted in increased oil content. Higher level of 80 kg N/ha recorded higher values of growth and yield attributes and seed yield over 60 kg N/ha. Oil content was, however, adversely affected at the higher level of N.

Raya [*Brassica juncea* (L.) Czernj. & Cosson] is one of the important oilseed crops grown extensively in Haryana state. The high-yielding variety 'RH 30' has been reported to be highly responsive to nitrogen application. Nitrogen is a costly input and a major share of it is used for cereal cultivation. In view of this, it was thought worthwhile to study the feasibility of use of biofertilizers like *Azotobacter* and *Azospirillum* to partially supplement the need of nitrogen to the crop. Besides, gypsum application in *raya* has also been reported to increase yield and oil content owing to its S content (Singh and Sandhu, 1986). Keeping this in view, the present study was undertaken to evaluate the response of *raya* to biofertilizer, gypsum and nitrogen application.

MATERIALS AND METHODS

A field study was conducted at Gurgaon

(Haryana) during the winter seasons of 1991–92 and 1992–93. The soil was sandy loam with pH 8.8 and contained 0.38% organic carbon and 190 kg/ha available N. The experiment was conducted in split-plot design replicated thrice, keeping 3 seed inoculation treatments (none, *Azotobacter* and *Azospirillum*) and 2 levels of gypsum (0 and 125 kg/ha) in main plots and 2 levels of N (60 and 80 kg/ha) in subplots. Full dose of gypsum and half dose of N as urea as per treatment were applied at sowing and the remaining half N was top-dressed at first irrigation. The seed was inoculated just before the sowing. *Raya* cv. 'RH 30' was sown on 23 and 20 October in 1991 and 1992 respectively.

RESULTS AND DISCUSSION

Effect of biofertilizer

Seed inoculation with *Azotobacter* and

Table 1. Effect of bacterial inoculation, gypsum and nitrogen on growth and yield attributes of *raya*

Treatment	Plant height at harvest (cm)		Primary branches/plant		Pod length (cm)		Pods/ plant		Seeds/ pod		1,000-seed weight (g)	
	1991— 92	1992— 93	1991— 92	1992— 93	1991— 92	1992— 93	1991— 92	1992— 93	1991— 92	1992— 93	1991— 92	1992— 93
<i>Bacterial inoculation</i>												
None	160	170	4.45	4.93	4.56	4.39	227	227	13.17	14.37	7.09	5.89
<i>Azotobacter</i>	162	174	5.02	5.23	4.60	4.50	237	240	13.54	14.82	7.37	6.23
<i>Azospirillum</i>	165	175	5.09	5.42	4.63	4.52	246	246	13.64	15.28	7.41	6.17
CD (P = 0.05)	4	NS	0.46	0.34	0.06	NS	16	NS	NS	0.54	0.26	0.24
<i>Gypsum (kg/ha)</i>												
None	161	170	4.72	5.10	4.52	4.24	227	226	13.28	14.62	7.07	5.97
125	164	176	4.99	5.28	4.67	4.70	246	249	13.61	14.97	7.52	6.22
CD (P = 0.05)	NS	5	NS	NS	0.04	0.26	13	20	NS	NS	0.21	0.20
<i>N (kg/ha)</i>												
60	160	170	4.69	5.01	4.58	4.34	224	226	13.03	14.42	7.10	6.18
80	165	176	5.02	5.38	4.62	4.61	250	246	13.87	15.19	7.49	6.01
CD (P = 0.05)	4	6	0.28	0.35	0.04	0.24	19	20	0.63	0.62	0.19	NS

Azospirillum markedly increased the seed yield of *raya* in both the seasons (Table 2). However, some variations existed in respect of growth and yield attributes in 2 years (Table 1). Plant height, pods/plant and pod length showed marked variations during 1991–92 only, whereas seeds/pod differed due to inoculation during 1992–93 only. Seed inoculation with *Azospirillum* being at par with *Azotobacter* recorded higher values of all these attributes over no inoculation. Primary branches/plant showed marked variations in both the seasons and had the similar trend. Both the inoculants produced bolder seeds as compared with no inoculation. In spite of the seasonal variations in some of the growth and yield attributes, seed yield increased with both the inoculants because of the cumulative effect of higher values of these attributes. Amongst 2 inoculants, the effects were comparatively more pronounced with *Azospirillum* than *Azotobacter*, though marked variation between

them did not exist in respect to any of the attributes studied. The ability of *Azotobacter* to produce growth substances and antifungal substances in addition to fixed N made available to plants was probably the reason of higher yields (Mishutin and Shilnikova, 1971). Similarly, *Azospirillum* is reported to produce indoleacetic acid, gibberellins and cytokinin like substances along with N fixation (Tein *et al.*, 1979). On an average, *Azotobacter* and *Azospirillum* gave 8.2 and 10.9% higher seed yield over no inoculation. This increase in yield may be equivalent to about 25–30 kg N/ha considering the response of crop to 80 kg N/ha over 60 kg N/ha in the present study.

Effect of gypsum

Application of 125 kg gypsum/ha significantly increased growth and yield attributes, seed yield and oil content of *raya*, except plant height during 1991–92, and primary branches/plant and seeds/pod in

Table 2. Effect of bacterial inoculation, gypsum and nitrogen on seed yield and oil content of *raya*

Treatment	Seed yield (q/ha)		Oil content (%)	
	1991–92	1992–93	1991–92	1992–93
<i>Bacterial inoculation</i>				
None	13.63	13.02	41.80	40.70
<i>Azotobacter</i>	14.84	13.99	41.76	40.68
<i>Azospirillum</i>	15.28	14.29	41.55	40.92
CD (P = 0.05)	0.87	0.57	NS	NS
<i>Gypsum (kg/ha)</i>				
None	14.26	13.08	41.38	40.02
125	15.09	14.45	42.03	41.51
CD (P = 0.05)	0.71	0.47	0.46	0.27
<i>N (kg/ha)</i>				
60	14.10	13.45	41.99	41.00
80	15.25	14.08	41.42	40.52
CD (P = 0.05)	1.09	0.62	0.52	0.48

both the seasons (Tables 1, 2). Over the seasons, gypsum application resulted in an 8% increase in seed yield. The beneficial effect of gypsum could be attributed to its sulphur content. Favourable responses of sulphur application in *Brassica* have also been observed earlier (Singh and Sandhu, 1986; Rathore and Manohar, 1989; Khanpara *et al.*, 1993). Singh and Saran (1987) also observed an increase in oil content by gypsum application.

Effect of nitrogen

Higher level of 80 kg N/ha recorded markedly higher values of growth and yield attributes and seed yield of *raya*, except 1,000-seed weight in 1992–93 over the lower level of 60 kg N/ha (Tables 1, 2). The seed yield increased by 8.1 and 4.7% with 80 kg N/ha over 60 kg N/ha during 1991–92 and 1992–93 respectively. The mean response at higher level of N over the lower level being 4.45 kg/kg N. Similar responses to N application have also been

reported by Singh and Saran (1987), Rathore and Manohar (1989) and Khanpara *et al.* (1993). The decrease in oil content in seed could be ascribed to increase in protein content of seed by application of N.

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