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Effect of organic inputs and biofertilizers on biomass, quality and yield parameters of vegetable pea (*Pisum sativum* L.)

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ABSTRACT
A field experiment was conducted in a Typic Ustochrept soil of Varanasi region (83^{0}0' E longitudes and 25^{0}10' N latitude) with Arkel, Azad P_1 and Azad P_3 varieties of pea under treatment combination of low cost organic inputs plus biofertilizers and compared to standard packages of practices. The total biomass, vegetable pea and grain yield of Azad P1 was significantly higher compared to Arkel and Azad P3. The supplementation of sulphur nutrient through pressmud significantly enhanced the yield attributes in all the three tested varieties. Application of *Azotobacter* alone or in combination with *Rhizobium* significantly influences the quantitative and qualitative traits in pea. The dual inoculation of *Rhizobium* / *Azotobacter* @ 200 g/10 kg seeds and PSB plus soil application of pressmud @ 5t/ha significantly enhanced the yield and quality traits of vegetable and grain pea.

Key words : Pea, Biofertilizer, Quality, Productia, Azotofacter, P.S.B., Azopirillum.

INTRODUCTION

Pea (*Pisum sativum* L.) has become a popular winter vegetable crop of eastern Uttar Pradesh. The farmers of Varanasi region are inclined towards the cultivation of vegetable pea because of consistent market demand and high economic return compared to other crops. Further, incorporation of legume in an intensive cropping system is preferred by the growers of this region for in situ N replenishment in the soil. The farmers of this region, however, were not acquainted with the uses of biofertilizers particularly *Azotobacter/Azospirillum* and phosphate-solubilizing bacteria (PSB) besides *Rhizobium* coupled with application of sulphur (S) in pea. The incorporation of locally available low cost organic inputs like pressmud (sulphinated by product of sugar factory) which is a rich source of S besides other major and micronutrients can accelerates the productivity of pea besides maintaining the soil health. The scientific literature on biomass, quality and yield parameters of vegetable pea as effected by free N fixers, P solubilizers and S nutrition through pressmud is limited especially with references to eastern Uttar Pradesh. The recycling of disposable organic waste and their utilization in crop production is gaining momentum with the increasing awareness in soil and environmental pollution. Hence, the present study was planned to generate information on the effectiveness of the integrated use of organic source and biofertilizers on the productivity and residual soil fertility status for widely grown pea varieties of eastern Uttar Pradesh.

MATERIALS AND METHOD

A field experiment was conducted for three consecutive years during rabi season of 2001-02, 2002-03 and 2003-04 at the institute's research farm (83^{0}0' E longitudes and 25^{0}10' N latitude), Varanasi, with three prominent varieties of pea (Azad P_1, Azad P_3 and Arkel). The soil of the experimental site was sandy loam, Indo-Gangetic alluvium of Inceptisol origin (Typic Ustochrept) with pH varying between 7.6-7.8, EC 0.41–0.52 dSm^{-1}, Organic carbon 0.38–0.41 % and available nitrogen 270–310 kg/ha, available phosphorus 18–23 kg/ha, potassium 297–310 kg/ha and sulphur 14–16 kg/ha. Seeds of these varieties were sown during 2 November 2001, 6 November 2002 and 8 November 2003. The treatment includes: T_1–control, T_2–Pressmud @ 5t/ha + *Azotobacter* @200 g/10 kg seed, T_3–Pressmud @ 5t/ha + *Rhizobium* @ 200 g/10 kg seed, T_4–Pressmud @ 5t/ha+PSB @ 5kg/ ha soil application, T_5–Pressmud @ 5t/ha+*Azotobacter* @200 g/10 kg seed+ PSB @ 5kg/ha soil application, T_6–Pressmud @ 5t/ ha+*Rhizobium* @ 200 g/10 kg seed+ PSB @ 5kg/ha soil application, T_7–Pressmud @ 5t/ha, T_8–FYM @ 5t/ha, in a split plot design with three replication. The full amount of FYM and pressmud were applied 20 days before sowing followed by pudding to ensure optimum soil moisture during land preparation and seed sowing of pea. Certified seeds were treated @ 200g /10 kg with individual N fixers, *Azotobacter* +PSB and *Rhizobium* +PSB, sown in each plot at a spacing of 30 x 10 cm and then covered with soil plus PSB @ 5 kg/ ha and finely ground compost mixture. The recommended fertilizer doses (N @ 30 kg/ha, P @ 60 kg/ha and K @ 60 kg/ha) were applied during the field preparation through urea, diammonium phosphate and muriate of potash. All the standard agronomic production and plant protection practices were followed for the better crop stand. The soil moisture regime was maintained by providing sprinkler irrigation at 28 and 49 days after sowing. The plants were uprooted at physiological maturity stage and observation related to biomass, yield and quality parameters were recorded and analyzed statistically. Ascorbic acid content of pea was estimated by titrimetry (AOAC, 1990), and carbohydrate content by both phenol sulfuric acid method and anthrone method (Sadasivam and Manickam, 1996) and the mean of replicate samples was reported. Total nitrogen was estimated by the micro-kjeldhal method according to AOAC (1990) and used for estimation of protein content by multiplying with a factor of 6.25 in a Kel –Plus 1002 model of FOSS-TECATOR.

RESULT AND DISCUSSION

Genetic performance of pea cultivars

The plant height of Azad P_3 and Arkel was at par and significantly higher to Azad P_1. The fresh root weight / plant, pod length, number of grain per pod, grain yield and fresh pod yield in Azad P_1 showed significantly higher value (0.718g, 9.1cm, 6.8, 11.98 q/ha and 99.6 q/ ha, respectively) as compared to Azad P_3 and Arkel (Table 1). The Arkel and Azad P_1 showed significantly higher number of pod per plant as compared to Azad P_3.

Treatment impact

Biomass and yield

The yield and yield attributes under lone and combined application of organic nutrients and biofertilizers was significantly different as compared to control (Table 2). A significantly higher plant height, fresh shoot weight, fresh root weight, fresh pod yield and seed yield was obtained when the crops grown under the combined application of pressmud @ 5t/ha, single and or dual inoculation of N fixers i.e. *Rhizobium, Azotobacter* @ 200 g/10kg seed and soil application of PSB @ 5 kg/ha. The inoculation of *Rhizobium* and/or *Azotobacter* incorporated in pea rhizosphere through seed treatment probably induced more amount of nitrogen fixation in nodules of pea *vis-a-vis* solubilisation of fixed N from non-available to exchangeable pool, which impart more vegetative growth. This corroborates with the findings of Daweny and Vankessel 1990, George and Vessey 2006. The significantly highest number of pod /plant (11.6), pod length (9.2

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Table 1: Genotypic performance on biomass, yield and quality of green pea.

Varieties	Plant height (cm)	Fresh shoot weight /plant	Fresh root weight /plant (g)	Number of Fresh Pod/ plant	Fresh weight/ 10 pod (g)	Pod length (cm)	Number of grain/ pod	Grain yield q/ha	Fresh pod yield q/ha	Vitamin C (mg/ 100gm)	Carbohy-drate (%)	Protein (%)	Phosphor us (%)	Sulphur (%)
Arkel	54.3	14.0	0.51	10.4	41.0	8.3	5.2	8.95	82.57	25.1	52.1	22.7	0.56	0.32
AP_1	42.3	12.7	0.71	9.6	45.2	9.1	6.8	11.98	99.6	23.7	51.7	22.7	0.60	0.36
AP_3	55.1	12.2	0.61	7.7	42.7	8.6	5.7	9.55	87.9	26.1	52.7	23.0	0.55	0.30
LSD=0.05	3.70	3.10 (ns)	0.08	1.6	3.2 (ns)	0.40	0.7	0.42	11.5	1.2	3.8 (ns)	0.4 (ns)	0.05 (ns)	0.02

cm), number of grain/pod (6.7), fresh pod yield (95.3 q/ha) and grain yield (12.8 q/ha), was observed with the dual inoculation of *Rhizobium* @ 200g/10 kg as seed treatment and PSB @ 5 kg/ha as soil application. All the yield attributes was significantly improved by dual inoculation significant variation in terms of carbohydrate, protein contents and phosphorus was noted among the tested varieties except a comparatively low, vitamin C contents in Azad P_1.

Table 2 : The combined impact of FYM, PM and biofertilizers on pod biomass, yield and nutritional status of pea grain.

Treatments	Plant height (cm)	Fresh shoot weight /plant (g)	Fresh root weight /plant (g)	Number of Fresh Pod /plant	Fresh Pod weight /plant (g)	Pod length (cm)	Number of grain /pod	Grain yield (q/ha)	Fresh pod yield (q/ha)	Vitamin aC (mg/ 100gm)	Carbohy drate (% grain)	Protein (%)	Phosp horus (%)	Sulphur (%)
Control	44.9	30.6	0.84	8.2	32.1	7.9	4.9	9.6	58.3	23.7	48.0	21.8	0.47	0.22
PM + Azo	55.3	36.3	1.01	9.6	44.3	8.8	6.1	11.9	87.9	25.4	50.9	23.0	0.53	0.33
PM + Rhz	56.4	48.2	1.44	9.4	53.0	8.6	6.1	11.2	92.0	27.6	51.1	22.9	0.57	0.36
PM + PSB	55. 4	39.1	1.06	9.1	45.8	8.7	6.4	12.3	92.4	24.0	55.7	22.8	0.64	0.35
PM +Azo + PSB	55.1	39.6	1.34	8.4	45.4	8.8	6.5	12.4	95.2	25.0	53.3	23.2	0.58	0.37
PM +PSB + Rhz	55.9	42.2	1.26	11.6	45.8	9.2	6.7	12.8	95.3	30.0	55.0	23.8	0.67	0.39
PM	50.4	33.9	1.18	9.0	39.6	8.4	6.1	11.4	79.6	23.0	51.2	22.5	0.53	0.33
FYM	50.1	33.3	1.24	8.8	37.9	8.8	6.1	10.8	79.1	21.3	52.0	22.4	0.53	0.26
LSD = $_{0.05}$	3.20	6.10	0.16	2.2	7.9	0.6	1.5	1.74	27.5	1.6	2.4	0.7	0.05	0.04

of *Rhizobium* and PSB. This result is also in conformity with the work of Bhandal et al 1989, Rudresh et al 2005. The dual inoculation of *Rhizobium* and PSB resulted more availability of nitrogen and phosphorus because of their associative effect plus solubilisation from non-exchangeable to labile form, which leads to significant increase in growth, and yield attributes as compared to single or un-inoculated plot. The increased availability of nitrogen and phosphorus in root zone of pea was favoured by combined inoculation has been reported in literature (Pers et al 1989, Singh and Singh 1992 and Rudresh et al. 2005).

Quality attributes

The effect of dual inoculation of *Rhizobium* and *Azotobacter* along with the pressmud was found superior on the performance of quality traits of pea grain (Table 2) Kumawat and Khorgarot, 2002. Significantly highest vitamin C content (30.0 mg/100gm), carbohydrate (55%), protein (23.8 %), phosphorus (0.67 %), and sulphur (0.39 %), in grain was obtained when the crops were grown under dual inoculation of *Rhizobium* and PSB along with the press mud @ 5t/ha. Associative effect of *Rhizobium* and PSB in dual inoculation treatment was resulted in significant increase in nitrogen content, which directly reflected in protein content, and the protein levels in grains. Further PSB mobilises more p in the labile pool, which accentuated the activity of N and S by synergistic mechanism. More pronounced effect of combined inoculation over single inoculation was observed by (Alagawadi and Gaur 1988, Tyagi et al 2003, Rudresh et al 2005). No

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