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Influence of different nutrients on growth and yield of garden pea (*Pisum sativum*)

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ABSTRACT

A field experiment was carried out in Grey Terrace soil (Albaquept) at the Gazipur, Bangladesh, during the winter (*rabi*) seasons of 2000–2001 and 2001–2002, to find out the proper combination of fertilizer nutrients that promotes better yield of 'BARI Motorsuti 1' garden pea (*Pisum sativum* L.). Yield and yield components of garden pea varied significantly due to variation of nutrients. Significantly highest yield and yield attributes were recorded under treatment N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 (kg/ha), followed by N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 Zn_1, N_{30} P_{50} K_{40} S_{20} Mo_1 and N_{30} P_{50} K_{40} S_{20} treatments. Germination (%), seedling length, dry weight of seedling and vigour index were also more when the crop was raised from these 4 treatments over the control. Treatments N_{30} P_{50} K_{40} S_{20} Mo_1, N_{30} P_{50} K_{40} S_{20} Mo_1B_1 and N_{30} P_{50} K_{40} $S_{20}Mo_1$ B_1Zn_1 (kg/ha) were not economical because of their higher cost investment. However, application of N_{30} P_{50} K_{40} S_{20} kg/ha would be economically profitable for enhancing growth parameters and yield of garden pea.

Key words : Pea, Nitrogen, Phosphorus, Potash, Sulphur, Molybdenum, Boron, Zinc, Growth, Yield

Garden pea is a protein rich vegetable grown in Bangladesh. In Bangladesh its yield/ha is very low compared to other countries of the world because the crop is rainfed, exposed to biotic and abiotic stresses, lack of high-yielding varieties and use of imbalance fertilizers. Yield, however, can be increased considerably by using high-yielding varieties and adopting judicious nutrient management. Application of NPK boosts production of pea (Saimbbi and Grewal, 1986; Singh *et al.*, 1992). Sulphur is also equally important for its production by virtue of its being a constituent of amino acid. Salinas *et al.* (1987) and Singh *et al.* (1992) reported significant response of vegetable pea to Mo, B and Zn. Therefore, balanced fertilizer plays key role in harnessing production potential.

Growth parameters like germination and seedling vigour are considered critical for raising crops successfully as they indirectly determine the stand density and consequently the yield of crop (Gelmond, 1978). Fertilizers during crop growth influence yield of crop. However, information on different nutrient management for the satisfactory yield of garden pea in Bangladesh is scanty or lacking. Therefore, the present experiment was undertaken to find out the proper combination of fertilizer nutrients to increase the productivity of garden pea.

MATERIALS AND METHODS

The field experiment was conducted at the Research Farm of Bangladesh Agricultural Research Institute, Gazipur, during the winter season of 2000–2001 at 2001–2002. The experimental soil was Grey Terrace soil under the agro-ecological zone 28. The initial soil samples collected from a depth of 0–20 cm were analysed in the laboratory following ASI method (Hunter, 1984). The soil was silty clay loam with pH 6.1, having organic matter 0.95%. total N 0.05%, available P 6.0 µg/ml, exchangeable K 0.15 meq/100 g soil, available S 8.0 µg/ml, boron 0.1 µg/ml and Zn 2.0 µg/ml, respectively.

Six treatments comprising N_{30} P_{50} K_{40}, N_{30} P_{50} K_{40} S_{20}, N_{30} P_{50} K_{40} S_{20} Mo_1, N_{30} P_{50} K_{40} S_{20} Mo_1 B_1, N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 Zn_1 (kg/ha) and absolute control were tested. The experiment was laid out in randomized complete block design with 4 replications. The unit plot size was 3 m × 5 m. Fertilizer N, P, K, S, Mo, B and Zn were applied in the field as urea, triple superphosphate, muriate of potash, gypsum (calcium sulphate), ammonium molybdate, boric acid and zinc oxide respectively. The whole amount of fertilizers was applied at the time of final land preparation. Seeds of 'BARI Motorsuti 1' were sown in line (30 cm × 15 cm) on 3 December 2000 and 28 November 2001. Irrigation, mulching and plant-protection measures were

taken whenever needed. The crop was harvested from 28 February to 11 March in 2001 and 12 February to 6 March in 2002 respectively. Ten randomly selected plants were taken to record yield attributes. Fresh pod yield as well as seed yield was recorded from an area of 8 m^2 avoiding border. Growth parameters like germination (%), seedling length, dry weight of seedling and vigour index were recorded at 8 days after germination. To measure the seedling vigour, dry weight of 10 normal seedlings was recorded and mean values were calculated. The vigour index was calculated by multiplying germination (%) with seedling length (Yadav and Singh, 2000). Data on yield and yield parameters were analysed statistically and the difference between mean was compared by using the Least Significant Difference (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Yield, yield attributes, growth parameters and economic analysis of garden pea showed similar results in both the years hence pooled data are discussed here.

Yield and yield attributes

Significant variation due to the application of different nutrients were found for plant height, pods/plant, seeds/pod, pod length, 100-seed weight and fresh pod yield as well as seed yield of garden pea (Table 1). Plants grown without fertilizer (control) were found to be significantly shorter than the plants grown with adequate amount of fertilizers. The tallest plants were found in N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 kg/ha treatment. Application of different nutrients increased pods/plant and were more with the treatment N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 (kg/ha), followed by N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 Zn_1 (kg/ha) and lowest at control treatment. The same trend was exhibited for pod length. Application of different nutrients also differed for seeds/pod and 100-seed weight. The treatment N_{30} $P_{50}K_{40}$ S_{20} Mo_1, N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 Zn_1 and N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 gave 65, 67 and 73% more seeds than control. Seed size or 100-seed weight showed almost similar trend or response to seeds/pod. The fresh pod yield of garden pea was also significantly influenced by the application of different nutrients (Table 1). Fertilizer application generally increased yield from 2.04 to 10.22 tonnes/ha. There was a large increase in fresh pod yield owing to different nutrients application, indicating that soil was originally poor or deficient in nutrients that is why yield responses was high. However, highest fresh pod yield was obtained from N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 treatment and it was significantly at par with N_{30} P_{50} K_{40} S_{20} and N_{30} P_{50} K_{40} S_{20} Mo_1 treatment. The yield advantages of different nutrient application was owing to their better growth and development and it was mainly contributed by more pods/plant, seeds/pod and higher 100-seed weight. Fresh pod yield was highly significant and positively correlated with pods/plant (r=0.97**), seeds/pod (r=0.98**) and 100-seed weight (r=0.99**). Plants treated with N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 Zn_1 (kg/ha) tended to have produced lower fresh pod yield than that of the highest yielding ones but the difference was not statistically significant. It was evident from soil analysis that the soil was not deficient in Zn and as such it might have an imbalance or antagonistic effect on plant nutrition that resulted in lower yield. The yield data (Table 1) show that application of Mo, B and Zn is not essential for the production of garden pea in the Grey Terrace soils of Joydebpur (Gazipur). Plants grown without fertilizer (control) had the lowest pod yield/ha. The yield difference between the highest and the lowest yielding treatments was nearly 400%. Seed yield/ha also followed a trend similar to that obtained for fresh pod yield.

Growth parameters

Nutrient application had significant influence on growth parameters (Fig. 1). Germination (%) differed significantly with respect to different nutrients application. The seeds obtained from N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 treatment showed more germination (%) and ranged between 86.7 and 97.7% among the treatments. Germination (%) increased with the additional of nutrients reaching maxi-

Table 1. Yield and yield attributes of garden pea as influenced by different nutrients (pooled data of 2000–2001 and 2001–2002)

Treatment (kg/ha)	Plant height (cm)	Pods/ plant	Seeds/ pod	Pod length (cm)	100-seed weight (g)	Fresh pod yield (tonnes/ha)	Seed yield (tonnes/ha)
Absolute control	38.9	9.1	4.8	3.7	17.16	2.04	0.92
$N_{30}P_{50}K_{40}$	55.1	16.8	7.4	7.4	34.68	7.59	1.18
$N_{30}P_{50}K_{40}S_{20}$	58.2	18.3	7.7	7.8	38.34	9.60	2.43
$N_{30}P_{50}K_{40}S_{20}Mo_1$	58.6	19.4	7.9	7.9	38.21	9.86	2.49
$N_{30}P_{50}K_{40}S_{20}Mo_1B_1$	61.1	22.5	8.3	8.5	40.74	10.22	2.68
$N_{30}P_{50}K_{40}S_{20}Mo_1B_1Zn_1$	57.4	20.7	8.0	8.1	38.51	9.97	2.51
CD (P=0.05)	3.4	3.1	0.3	0.3	3.50	0.88	0.24

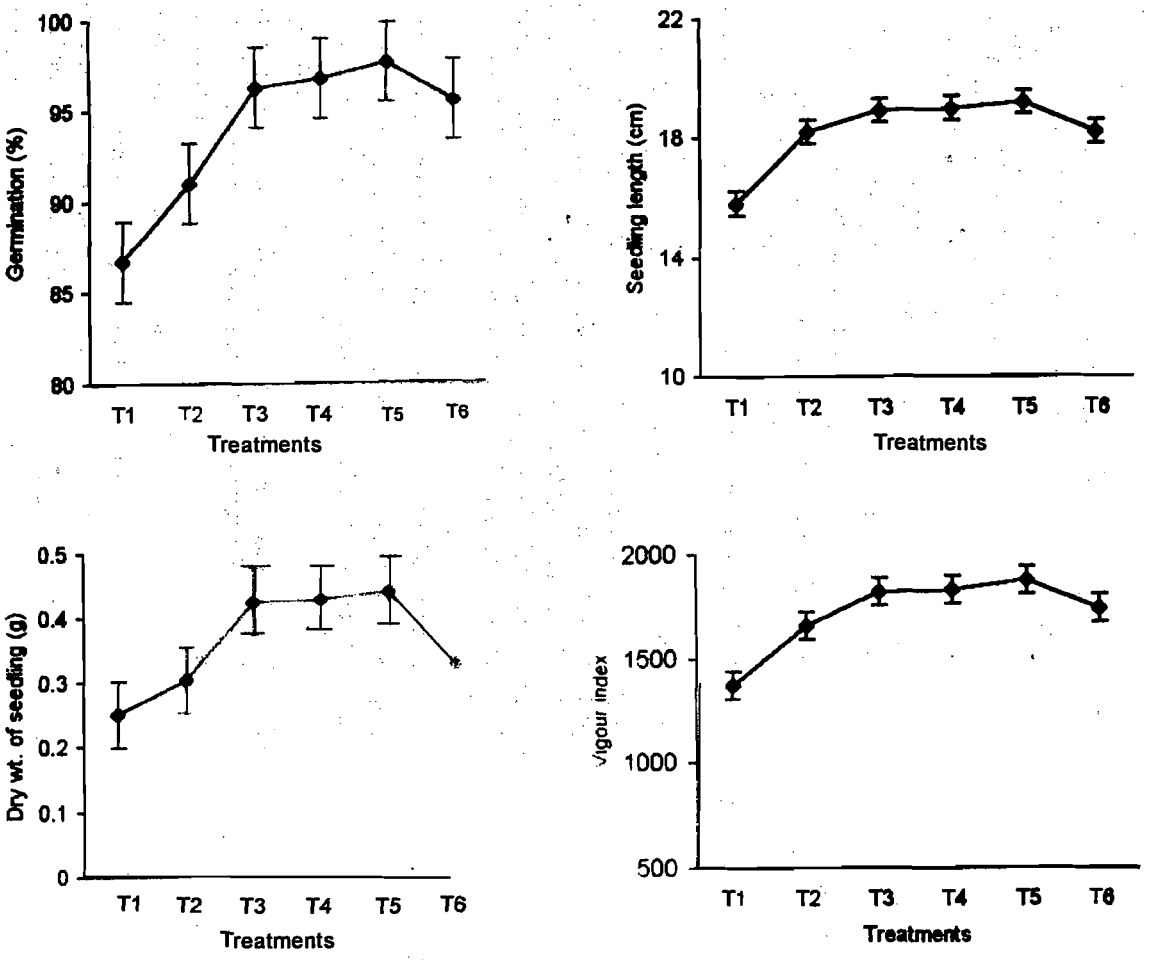

Fig 1. Effect of different nutrients on germination (%), seedling length, dry weight of seedlings and virour index of garden pea (Bar shows CD values at P=0.05) : T_1, Absolute control; T_2, $N_{30}P_{50}K_{40}$ (kg/ha); T_3, $N_{30}P_{50}K_{40}S_{20}$ (kg/ha); T_4, $N_{30}P_{50}K_{40}S_{20}Mo_1$ (kg/ha); T_5, $N_{30}P_{50}K_{40}S_{20}Mo_1B_1$ (kg/ha); T_6, $N_{30}P_{50}K_{40}S_{20}Mo_1B_1Zn_1$ (kg/ha)

mum at $N_{30}P_{50}K_{40}S_{20}Mo_1B_1$ (kg/ha) and thereafter declined. Addition of Zn fertilizer with $N_{30}P_{50}K_{40}S_{20}Mo_1B_1Zn_1$ (kg/ha) decreased germination (%) because of its higher availability in the soil that might have an antagonistic effect on plant nutrition that resulted in lower quality seed.

However, the trend of germination (%) did not differ significantly when the seed of $N_{30}P_{50}K_{40}S_{20}$, $N_{30}P_{50}K_{40}S_{20}Mo_1$ and $N_{30}P_{50}K_{40}S_{20}Mo_1B_1$ treatments were used. The lowest germination (%) was recorded from unfertilized plot (control). Variation in the germination (%) as evident in the study might be due to fertilization differences. Application of different nutrients or fertilizer generally increased seedling length and the effect was more pronounced when the seeds were used from $N_{30}P_{50}K_{40}S_{20}Mo_1B_1$ treatment while the differences were not significant among the $N_{30}P_{50}K_{40}S_{20}$, $N_{30}P_{50}K_{40}S_{20}Mo_1$, and $N_{30}P_{50}K_{40}S_{20}Mo_1B_1$ treatments. Plants grown without fertilizer had significantly shortest seedlings. Weight of seedling also showed significant variations due to application of different nutrients (Fig. 1). Dry weight of seedling increased gradually up to $N_{30}P_{50}K_{40}S_{20}Mo_1B_1$ (kg/ha) and thereafter decreased. Seedling dry weight was maximum when the crops was fertilized with $N_{30}P_{50}K_{40}S_{20}Mo_1B_1$ followed by $N_{30}P_{50}K_{40}S_{20}$ and $N_{30}P_{50}K_{40}S_{20}Mo_1$ (kg/ha). Other treatments produced significantly lower dry weight. Significant variation in vigour index was also observed among the treatments. Vigour index increased with the addition of nutrients and became highest when the crop was raised with $N_{30}P_{50}K_{40}S_{20}Mo_1B_1$ followed by $N_{30}P_{50}K_{40}S_{20}Mo_1$ and $N_{30}P_{50}K_{40}S_{20}$ treatments. The seedlings produced from $N_{30}P_{50}K_{40}S_{20}Mo_1B_1Zn_1$ (kg/ha) tended to decrease vigour index. However, vigour index varied from 1,362.9 to 1,875.8, the lowest being recorded from the control treatment.

Economics

Gross return was calculated from the price of garden pea. (Rs 7.7/kg). Variable cost was calculated from the fertilizer and its application cost. The partial budget

Table 2. Partial budget dominance analysis for different fertilizer response data of garden per (pooled data of 2000–2001 and 2001–20002)

Treatment (kg/ha)	Gross return (Rs/ha)	Variable cost (Rs/ha)	Gross margin (Rs/ha)	Remarks
Absolute control	15,670	0	15,670	Cost undominated
$N_{30} P_{50} K_{40}$	58,443	1,697	56,746	Cost undominated
$N_{30} P_{50} K_{40} S_{20}$	73,920	2,210	71,710	Cost undominated
$N_{30} P_{50} K_{40} S_{20} Mo_1$	75,922	5,059	70,863	Cost dominated
$N_{30} P_{50} K_{40} S_{20} Mo_1 B_1$	78,694	5,331	73,363	Cost undominated
$N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 Zn_1$	76,769	5,408	7,136	Cost dominated

Covert TK/ha into Rs/ha

Table 3. Marginal analysis of undominated fertilizer response data of garden pea (pooled of 2000–2001 and 2001–2002)

Treatment (kg/ha)	Gross margin (Rs/ha)	Variable cost (Rs/ha)	Marginal increase in gross margin (Rs/ha)	Marginal increase in variable cost (Rs/ha)	Marginal rate of return (%)
$N_{30} P_{50} K_{40} S_{20} Mo_1 B1$	73,363	5,331	1,653	3,121	53
$N_{30} P_{50} K_{40} S_{20}$	71,710	2,210	14,964	513	2,917
$N_{30} P_{50} K_{40}$	56,746	1,697	41,076	1,697	2,421
Absolute control	15,670	0			

Control all values of Tk/ha in Rs/ha

analysis of fertilizer revealed that maximum gross margin/ha was achieved with the treatment combination $N_{30} P_{50} K_{40} S_{20} Mo_1 B_1$ (Table 2). Though the treatment $N_{30} P_{50} K_{40} S_{20} Mo_1 B_1$ gave the highest gross margin, it was not profitable because of high cost investment. Dominance analysis shows that the treatment $N_{30} P_{50} K_{40} S_{20} Mo_1$ and $N_{30} P_{50} K_{40} S_{20} Mo_1 B_1 Zn_1$ (kg/ha) were cost dominated. Marginal analysis showed that the highest marginal rate of return (MRR) of 2,911 (%) was obtained when the crop was fertilized with $N_{30} P_{50} K_{40} S_{20}$ treatment (Table 3). Hence application of fertilizer at the rate of $N_{30} P_{50} K_{40} S_{20}$ (kg/ha) would be economical for garden pea production in terms of yield and quality seed in Grey Terrace soil Joydebpur (Gazipur). Results also indicate that the farmers who are not in a position to invest additional inputs may go for $N_{30} P_{50} K_{40}$ (kg/ha) to attain profitable yields.

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