Bangladesh J. Agri. 2022, 47(1):121-129 *DOI: https://doi.org/10.3329/bjagri.v47i1.60599*

Short Communication

EFFECTS OF ORGANIC MANURE AND CHEMICAL FERTILIZERS ON GROWTH AND YIELD OF GARDEN PEA

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Abstract

An experiment was conducted at Agronomy Farm of Bangladesh Agricultural University, Mymensingh (BAU) during rabi season of 2018−19 to see the response of garden pea to manure and fertilizers. The treatments were T_1: Control (no fertilizer or manure), T_2: Cowdung + Poultry manure + Mustard oilcake, T_3: Vermicompost + Poultry manure + Mustard oilcake, T_4: Urea + TSP + MoP + Gypsum and T_5: Cowdung + Urea + TSP + MoP + Gypsum. The experiment was designed in a factorial Randomized Complete Block Design (RCBD) with 4 replications. Urea, TSP, MoP and gypsum @ 45, 90, 40 and 50 kg ha^{-1} were used as sources of nitrogen, phosphorous, potassium and sulphur, respectively. Cow dung, poultry manure, vermicompost and mustard oilcake were applied @ 30, 25, 2.5 and 0.025 t ha^{-1}, respectively. The results showed that the treatment T_5 significantly gave the highest values of vegetative growth and yield attributing characters' i.e., plant height, number of branches per plant, number of pods per plant, pod length, pod breadth, number of seeds per pod, 100-seed weight, pod weight, pod yield and seed yield per hectare. The lowest values of growth and yield attributing characters were recorded with T_1. Sole chemical fertilizers (T_4) showed better performances than T_2 and T_3. Treatment T_5 gave higher result than T_4. So, for obtaining the highest growth and pod yield of pea (cv. BARI Motor3), treatment T_5 (Cowdung + Urea + TSP + MoP + Gypsum @ 30 t ha^{-1}, 45-90-40-50 kg ha^{-1}) could be the best combination.

Key words: Cowdung, Garden pea, Mustard oilcake, Pod, Poultry manure, Yield

Introduction

Pea (*Pisum sativum* L.) which belongs to family Fabaceae (formerly Leguminoseae) is one of the important winter vegetables grown in Bangladesh. rsally to fix atmospheric nitrogen with symbiotic activity of *Rhizobium leguminosarum*. Green pods are used for vegetable purpose and dried peas are used as pulse. Green peas straw is good source of nutritional fodder for livestock.In Bangladesh, the area under pea cultivation was 17,497 acres and the production was 7,191 metric tons (BBS, 2018). It is vegetable rich in protein, carbohydrates, phosphorus, iron, magnesium, calcium,

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riboflavin, niacin, thiamine and ascorbic acid (Watt and Merrill, 1993). Modern crop cultivation is getting more and more dependent upon the supply of synthetic inputs such as chemical fertilizers, pesticides and herbicides etc. which are inevitable to meet high food demand for growing population in the world. Chemical fertilizers are needed to get good crop yields but their abuse and overuse can be harmful to the environment and it would not be cost effective (Bobade *et al.,* 1992).

Several factors are responsible for low productivity, of them imbalance fertilization is an important one. So, to minimize the yield gap the use of organic manure and chemical fertilizers can play a good role in increasing nutrient availability to the plants, which in turn is reflected through the quality of the produce and yield maximization. The global trend is to words the use of organic materials with animal or plant origin as a source of fertilizer for the purpose of reducing environmental pollution as well as production of agricultural crops safe for humans and animals. Organic fertilizers additionally enhance soil physical and chemical properties and decrease the requirement for mineral fertilizers, which is reflected through increase of vegetative growth and yield of plants (Al-Taey *et al.,* 2018). The importance of FYM in increasing the yield and quality of crops on sustainable basis along with its residual effect on succeeding crops by improving the soil physical conditions and soil fertility is well recognized (Trudy *et al.,* 2018). Fertilizeris a key factor in influencing the growth, development and ultimately the yield of crops. Soil fertilization with chemical or organic fertilizer may lead to a significant increase in the number of pods per plant, pod length and seed yield of broad bean plants (Jasem *et al.,* 2015). Abo-Basha, (2016) found that addition 238 kg N ha^{-1} as chicken manure increased plant length, dry weight of vegetative growth, pod length, pod weight, seeds number per pod and total yield compared with NPK fertilizer (control). Therefore, the present investigation was undertaken to evaluate the effect of organic and chemical fertilizers on growth and yield of garden pea var. BARI motor-3.

Materials and Methods

The experiment was conducted during rabi season of 2018-2019 at Agronomy research farm of Bangladesh Agricultural University, Mymensingh. The field was moderately well drained with a silt loam soil texture and neutral soil pH . The land was prepared by ploughing and cross ploughing by a power tiller. The experiment was laid out in a factorial randomized complete block design with four replications. The pea variety used was BARI Motor-3. The experiment comprised 5 treatments i.e., T_1: Control (no fertilizer), T_2: Cowdung + Poultry manure + Mustard oilcake, T_3: Vermicompost + Poultry manure + Mustard oilcake, T_4: Urea + TSP + MoP + Gypsum and T_5: Cowdung + Urea + TSP + MoP + Gypsum. Urea, TSP, MoP and gypsum were used as sources of nitrogen, phosphorous, potassium and sulphur, respectively. They were applied @ 45, 90, 40 and 50 kg ha^{-1}, respectively. The rates of cowdung, poultry manure, vermicompost and mustard oilcake were 30, 25, 2.5 and 0.025 t ha^{-1}, respectively. All fertilizers except urea were applied during final land preparation. Urea was top dressed in two equal splits at 15 and 30 days after emergence. Seeds (var. BARI motor3) were sown on 12 December 2018 at a rate of 70 kg ha^{-1}. At 30 days after sowing (DAS) a light hoeing with

khurpi was done to remove the weeds along with the thinning operations maintaining a plant spacing of 8 to 10 cm. The second weeding was done at 60 DAS. The pods were harvested in three hand pickings at weekly intervals. Data were recorded on plant height (cm), number of branches plant^{-1}, number of pods plant$^{-1,}$ pod length (mm pod^{-1}), pod breadth (mm pod^{-1}), number of seeds pod^{-1}, 100- seed weight, pod weight (g pod^{-1}), pod yield (t ha^{-1}) and seed yield (t ha^{-1}). The results were statistically analysed and significance of the difference among the treatment means was determined by the Least Significant Difference (LSD) test at 5% level of probability.

Results and Discussion

Growth and yield parameters

Plant height

Plant height of BARI motor-3 was significantly influenced due to application of different organic and chemical fertilizers (Table 1). Plant height was measured at 30, 60 and 90 DAS. Plant height ranged from 12.6 to 22.3 cm at 30 DAS, 24.7 to 37.5 cm at 60 DAS and 35.11 to 52.13 cm at 90 DAS. The tallest plant was found in T_5 (Cowdung + Urea + TSP + MoP + Gypsum) at 90 DAS and the shortest plant was found in T_1 (control) at 30 DAS. Plant height increased with advancement of days after seeding up to 90 DAS. The highest plant height was recorded when the crop was grown with both organic and chemical nutrient sources. The plant height increased in the order of $T_5 > T_4 > T_2 > T_3 > T_1$. These results are in agreement with the findings of Sharma and Chauhan, (2011).

Table 1. Plant height of garden pea at different DAS under different treatments

Treatments	Plant height (cm)		
	30 DAS	60 DAS	90 DAS
T_1	12.6 e	24.7 d	35.1 e
T_2	16.80 c	31.3 c	45.1 c
T_3	16.0 d	30.6 c	43.3 d
T_4	18.4 b	34.2 b	48.1 b
T_5	22.3 a	37.5 a	52.1 a
LSD (0.05)	0.72	1.09	0.89
CV (%)	2.29	1.83	1.07

LSD (0.05) = Least significant difference at 5% level of probability, CV (%) = Coefficient of variation

Number of branches plant^{-1}

Number of branches (primary) plant^{-1} increased significantly at all growth stages as a result of application of different organic and chemical fertilizers (Table 2). The branches were counted from 55 DAS at 15 days' interval and it was completed at 100 DAS. At 55 DAS, the maximum number of branches plant^{-1} (1.3) was recorded in treatment T_5 (Cowdung + Urea + TSP + MoP + Gypsum) and the minimum number of

branches plant^{-1} (1.01) was found in treatment T_1 (control). At 100 DAS treatment T_5 showed higher (1.41) against the minimum number of branches plant^{-1} (1.04) in treatment T_1. Sowing 85 DAS and 100 DAS showed similar number of branches plant^{-1}. This result agrees with Chongtham *et al.,* (2018) who reported increased number of branches of pea plant.

Table 2. Number of branches plant^{-1} of garden pea at different DAS

Treatments	No. of branches plant^{-1}			
	55 DAS	70 DAS	85 DAS	100 DAS
T_1	1.01 e	1.06 e	1.05 e	1.04 e
T_2	1.12 c	1.15 c	1.18 c	1.19 c
T_3	1.09 d	1.11 d	1.13 d	1.13 d
T_4	1.20 b	1.23 b	1.3 b	1.31 b
T_5	1.30 a	1.38 a	1.41 a	1.41 a
LSD (0.05)	0.03	0.02	0.02	0.02
CV (%)	1.72	1.13	1.004	0.87

LSD (0.05) = Least significant difference at 5% level of probability, CV (%) = Coefficient of variation

Number of pods plant^{-1}

The number of pods plant^{-1} is an important factor among the yield contributing characters. Application of different organic and chemical fertilizers showed statistically significant variation in the number of pods plant^{-1} of BARI Motor-3 (Table 3). The maximum number of pods plant^{-1} (8.04) was recorded at 85 DAS under treatment T5 (Cowdung + Urea + TSP + MoP + Gypsum) which was close to 100 DAS whereas the minimum number of pods plant^{-1} (4.82) was found at 55 DAS under treatment T_1 (control). The findings pertaining to the number of grains pod^{-1} are in close agreement with those reported by Chopra *et al.*, (2008) and Paul *et al.* (2011).

Table 3. Number of pods plant^{-1} of garden pea at different DAS

Treatments	Number of pods plant^{-1}			
	55 DAS	70 DAS	85 DAS	100 DAS
T_1	4.82 e	4.87 e	4.98 e	5.00 d
T_2	5.80 c	6.26 c	6.37 c	6.38 c
T_3	5.50 d	6.15 d	6.25 d	6.27 c
T_4	6.55 b	7.05 b	7.76 b	7.75 b
T_5	7.15 a	7.45 a	8.04 a	8.00 a
LSD (0.05)	0.15	0.06	0.04	0.06
CV (%)	1.30	0.49	0.37	0.57

LSD (0.05) = Least significant difference at 5% level of probability, CV (%) =Coefficient of variation

Pod length

Significant variation was recorded due to application of different organic and chemical fertilizers in terms of pod length (Table 4). The maximum pod length (58.1 mm) was recorded under treatment T_5 at 100 DAS whereas the minimum pod length (44.15 mm) was found under treatment T1 at 55 DAS. These results agree with Chongtham *et al., (*2018) which supported improved pod length of garden pea due to manure and fertilizer application.

Table 4. Pod length of garden pea at different DAS

Treatments	Pod length (mm pod^{-1})			
	55 DAS	70 DAS	85 DAS	100 DAS
T_1	44.2 d	46.1 e	47.3 c	47.2 d
T_2	48.0 c	50.1 c	50.8 b	51.0 c
T_3	47.3 c	48.3 0d	50.1 b	49.9 c
T_4	52.1 b	55.3 b	56.1 a	56.0 b
T5	56.0 a	57.5 a	5.00 a	58.1 a
LSD (0.05)	1.67	1.67	2.17	1.14
CV (%)	1.80	1.73	2.19	1.22

LSD (0.05) = Least significant difference at 5% level of probability, CV (%) = Coefficient of variation

Pod breadth

Pod breadth has been presented in Table 5. Pod breadth was taken at 55, 70, 85 and 100 DAS. The maximum pod breadth (12.5 mm) was recorded in treatment T_5 (Cowdung + Urea + TSP + MoP + Gypsum) at 100 DAS which was found superior over other treatments, whereas the minimum pod breath (9.12 mm) was found in treatment T_1 (control).

Table 5. Pod breadth of garden pea at different DAS

Treatments	Pod breadth (mm pod^{-1})			
	55 DAS	70 DAS	85 DAS	100 DAS
T_1	9.12 c	9.34 d	10.0 e	10.0 d
T_2	10.10 b	10.18 c	11.0 c	11.0 c
T_3	10.03 b	10.10 c	10.5 d	10.7 c
T_4	11.07 a	11.12 b	11.7 b	11.6 b
T_5	11.25 a	11.86 a	12.1 a	12.5 a
LSD (0.05)	0.50	0.48	0.23	0.58
CV (%)	2.57	2.42	1.09	2.75

LSD (0.05) = Least significant difference at 5% level of probability, CV (%) = Coefficient of variation

Number of seeds pod^{-1} and pod weight

Significant variation was recorded due to the effect of different organic and chemical fertilizers on the number of seeds pod^{-1} (Table 6). The maximum number of seeds pod^{-1} (5.3) was observed from T_5 (Cowdung + Urea+ TSP + MoP + Gypsum) at 100 DAS and the minimum number (3.78) was found from T_1 at 55 DAS. The pod (fresh) weight varied significantly for different treatments and harvesting time. (Table 7). The maximum pod weight (2.65g) was recorded in treatment T_5 (Cowdung + Urea + TSP + MoP + Gypsum) which was found superior over other treatments, whereas the minimum pod weight (2.01g) was noted for treatment T_1 (Control).

Table 6. No. of seeds pod^{-1} of garden pea at different DAS

Treatments	No. of seeds pod^{-1}			
	55 DAS	70 DAS	85 DAS	100 DAS
T_1	3.78 d	3.95 d	4.07 d	4.09 d
T_2	4.50 c	4.67 c	4.80 c	4.79 c
T_3	4.42 c	4.60 c	4.74 c	4.75 c
T_4	4.63 b	4.75 b	4.84 b	4.90 b
T_5	4.85 a	5.03 a	5.20 a	5.30 a
LSD (0.05)	0.17	0.11	0.12	0.11
CV (%)	2.11	1.25	1.26	1.32

LSD (0.05) = Least significant difference at 5% level of probability, CV (%) =Coefficient of variation

Table 7. Pod weight of garden pea at different DAS

Treatments	Pod weight (g pod^{-1})			
	55 DAS	70 DAS	85 DAS	100 DAS
T_1	2.01 d	2.09 c	2.16 d	2.19 d
T_2	2.26 bc	2.31 b	2.37 c	2.41 c
T_3	2.2 c	2.29 b	2.34 c	2.35 c
T_4	2.35 ab	2.42 a	2.50 b	2.49 b
T_5	2.41 a	2.50 a	2.64 a	2.65 a
LSD (0.05)	0.10	0.09	0.15	0.13
CV (%)	2.39	2.25	3.42	3.18

LSD (0.05) = Least significant difference at 5% level of probability and CV (%) = Coefficient of variation

100-seed weight, pod yield and seed yield

The 100-seed weight differed significantly from one treatment to another (Fig 1A). 100 seeds weight ranged from 19.66 to 23.7g. The highest 100- seed weight (23.7g) was found in T_5 (Cowdung + Urea + TSP + MoP + Gypsum) and the lowest weight

(19.7g) was obtained from T_1 (control) because the plants grew small seeds. Fig. 1B indicates that the maximum pod yield (3.81 t ha^{-1}) was recorded in treatment T_5 (Cowdung + Urea + TSP + MoP + Gypsum) which was found superior over other treatments whereas the minimum pod yield 2 t ha^{-1} was found in treatment T_1 (no fertilizer).

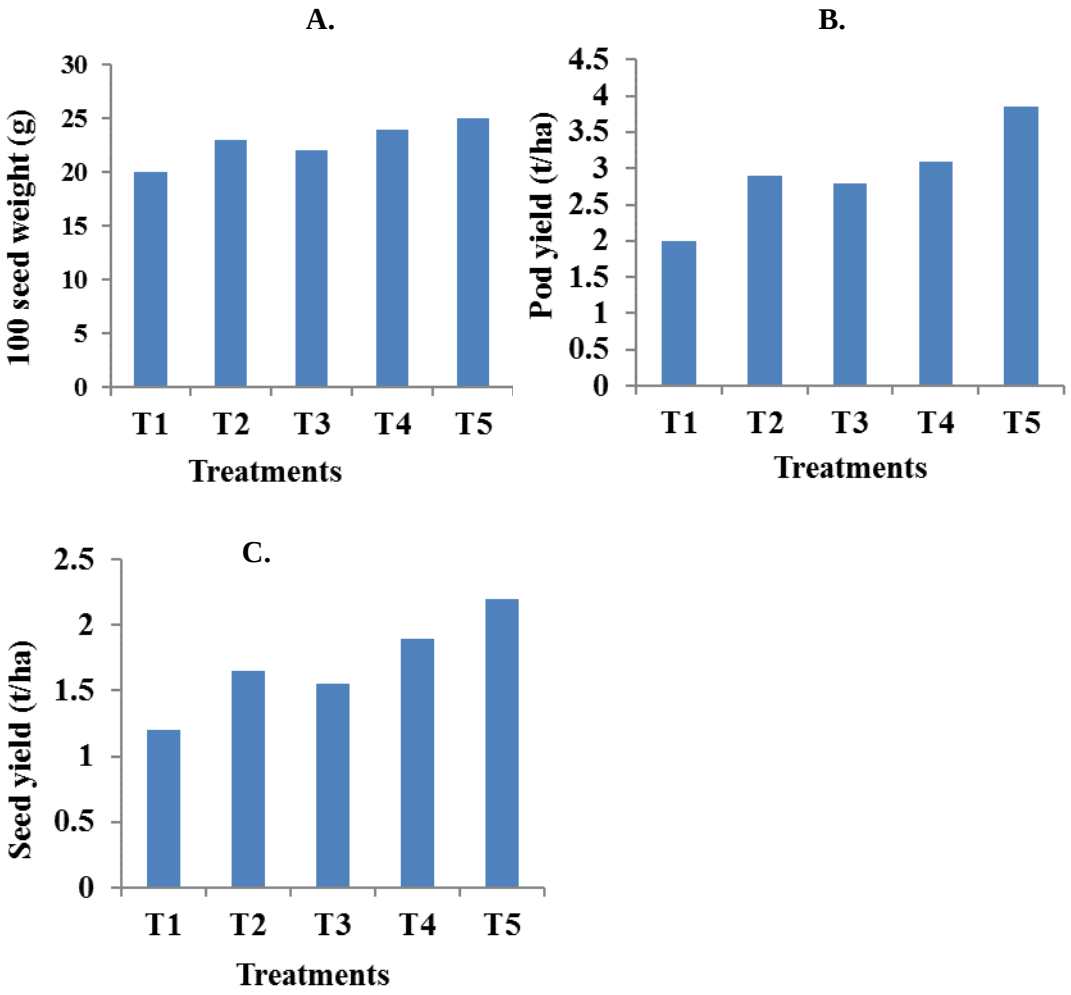

Fig. 1. Response of organic and chemical fertilizers on 100-seed weight, pod yield and seed yield of garden pea. A. 100-seeds weight; B. Pod yield and C. Seed yield

Seed yield is the ultimate result of the yield contributing characters of pea. It was found that the seed yield due to application of different organic and chemical fertilizers ranged from 1.16 to 2.06 t ha^{-1} (Fig. 1C). The highest seed yield was recorded in T_5 (Cowdung + Urea + TSP + MoP + Gypsum) and the lowest value (1.16 t ha^{-1}) in

T_1 (control). The seed yield in T_2 (Cowdung + Poultry manure + Mustard oilcake) and T_3 (Vermicompost + Poultry manure + Mustard oilcake) treatments with the value of 1.65 and 1.58 t ha^{-1}, respectively was identical, but lower than that of T_5 treatment.. The sink size gave significantly as reflected by more number of seeds per pod. Treatment T_5 comprises higher seed yield due to higher yield contributing characters. Only inorganic sources failed to show higher seed yield but combination of organic and inorganic fertilizer responded significantly. These results are in line with those reported by Hassan *et al.*. (2012); Feleafel and Mirdad, (2014).

Conclusion

Combined use of organic manure and chemical fertilizers (Cowdung + Urea + TSP + MoP + Gypsum) gave significantly the highest value of vegetative growth and yield attributing characters' i.e., plant height, number of branches $plant^{-1}$, number of pod length, pods $plant^{-1}$, pod breadth, number of seeds pod^{-1}, 100-seed weight, pod weight, pod yield and seed yield per hectare. The lowest value of growth and yield attributing characters were recorded with T_1. When only chemical fertilizers (T_4) were used for plants, they gave higher performance than only organic fertilizer (T_2 and T_3.). However, combination of organic and inorganic (Cowdung) and chemical fertilizer (T5) showed higher yield performances. So, cowdung 30 t ha^{-1}, 45-90-40-50 NPKS kg ha^{-1} could be used for higher productivity of pea (var. BARI Motor-1).

Conflicts of Interest

The authors declare no conflicts of interest regarding publication of this paper.

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