Influence of different organic sources on yield and economic feasibility of garden pea (Pisum sativum L. var. hortense) cv. Kashi Uday

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Abstract
Garden pea is one of the foremost important versatile leguminous vegetable that improves the soil fertility, yield level and quality of produce of succeeding crops. The present investigation was carried out at Bihar Agricultural University, Sabour during the Rabi season of 2010-11 in R.B.D., replicated thrice and variety used was Kashi Uday. The treatments comprised of different organic sources of nutrients which includes FYM, poultry manure, vermicompost, neem cake, mustard cake and chemical sources i.e. recommended dose N:P:K (50:60:60 kg/ha) and their combinations. Application of poultry manure @ 3 t/ha gave significantly maximum number of effective branches per plant. The minimum number of days taken from sowing to first pod set and least number of node bearing first pod setting and harvesting were noted under control. Moreover, application of poultry manure @ 3 t/ha or FYM @ 5 t/ha +poultry manure @1.5 t/ha was found to be most effective with respect to pod yield of garden pea and ultimately economics of pea cultivation for higher net income with higher B:C ratio (3.42) and proved its superiority over remaining organic manures.

Keywords: Organic sources; garden pea; yield; B: C ratio

Introduction
Garden pea (Pisum sativum L. var. hortense) is one of the popular and important vegetable grown in India. It improves the soil fertility, yield level and quality of produce of the succeeding crops. Being a cool season crop, pea is cultivated for vegetable as well as pulses in different part of the world ranging from temperate to subtropical regions. In India, pea is cultivated in an area of 0.42 MT with production of 4.01 MT whereas productivity of the crop is 9.5 MT/ha (Anonymous, 2013) [2]. Presently, organic sources of nutrients are preferred to synthetic chemicals in order to increase the productivity, quality of produce as well as improving the soil health. Intensive cultivation practices with the use of chemical fertilizers, pesticides and other inputs which directly influence harmful effect on the soil and environment. Therefore, for healthy soil, environment and life it is necessary to go for organic products. Today, it is not only a question of providing enough vegetables for balanced diet, but also to produce quality vegetables, that are acceptable and competitive in the international market. In recent years, organic combinations have emerged as a component of integrated nutrient supply system. The use of organic manures offers a great opportunity to increase the crop production as well as productivity at less cost with better quality. Organic crop production refers to organically grown crops which are not exposed to any chemicals right from the stage of seed treatment to the final post-harvest handling and processing. It is based on the recycling of natural organic matter and crop rotation. These methods sustain balance of the living organism (bacteria and earth worms) in the soil. The crop yield and microbial activity decreased with decreasing level of organic carbon status in soil.

Organic manures are the plant and animal wastes that are used as nutrients after decomposition. In that process, the nutrient held in organic combinations are slowly released in available forms besides improving the availability of nutrient elements present in the soil. In addition, the organic carbon level of the soil also increased, when the manures was used.
Continuous application of FYM over a period increased the micronutrient availability like iron, manganese and zinc. Moreover, the living phase of the soil is greatly stimulated. This would help not only is bio-degradation but in nitrogen fixation, phosphorus solubility and increasing the availability of plant nutrients to crops. The addition of nitrogenous fertilizers reduced soil organic carbon and can be brought into original level only through the addition of organic manures (Biswa, 2000). Organic farming is a production system which avoids, or largely excludes, the use of synthetic fertilizers, pesticides, growth regulators, and livestock feed additives. The objectives of environmental, social, and economic sustainability are the basics of organic farming (Stockdale et al., 2001) [14].

The present investigation was, therefore, carried out to see the performance of different organic sources and their combinations on yield attributes, yield and economics of garden pea cultivar ‘Kashi Uday’.

Materials and Methods

The present investigation was carried out at the Department of Horticulture (Vegetable & Floriculture), Bihar Agricultural University, Sabour, Vegetable Research Farm during Rabi season of 2010-11. The design of experiment was Randomized Block Design (R.B.D.), replicated thrice and variety used was Kashi Uday. A total of 13 treatment combinations were formulated to know the better response of organic sources of nutrients which comprised of T<sub>1</sub>-FYM @ 10 t/ha, T<sub>2</sub>-poultry manure (PM) @ 3 t/ha, T<sub>3</sub>-vermicompost (VC) @ 3 t/ha, T<sub>4</sub>-neem cake (NC) @ 1 t/ha, T<sub>5</sub>-mustard cake (MC) @ 1 t/ha, T<sub>6</sub>-FYM @ 5 t/ha + PM @ 1.5 t/ha, T<sub>7</sub>-FYM @ 5 t/ha + VC @ 1.5 t/ha, T<sub>8</sub>-FYM @ 5 t/ha + NC @ 0.5 t/ha, T<sub>9</sub>-FYM @ 5 t/ha + MC @ 0.5 t/ha, T<sub>10</sub>-PM @ 0.75 t/ha + VC @ 0.75 t/ha + MC @ 0.25 t/ha, T<sub>11</sub>-FYM @ 2 t/ha + PM @ 0.6 t/ha + VC @ 0.6 t/ha + NC @ 0.2 t/ha + MC @ 0.2 t/ha, T<sub>12</sub>-recommended dose of N:P:K (50:60:60 kg/ha) and T<sub>13</sub>-control. These organic manures viz., FYM, poultry manure, vermicompost, mustard cake and neem cake were applied before sowing as per the treatment and mixed thoroughly in the soil. Seeds were sown at the spacing of 30 x 10 cm. Nutrient compositions of different sources are presented in Table 1.

Table 1: Nutrient composition of different organic sources

| Sl. No. | Organic manures | N (%) | P:O (%) | K:O (%) |
|--------|----------------|-------|---------|---------|
| 1      | Farmyard manure (FYM) | 0.5   | 0.4      | 0.5     |
| 2      | Vermicompost (VC) | 0.4   | 0.6      | 0.7     |
| 3      | Poultry manure (PM) | 1.0   | 1.4      | 0.8     |
| 4      | Mustard cake (MC) | 5.1   | 0.2      | 0.3     |
| 5      | Neem cake (NC) | 5.2   | 1.0      | 1.4     |

Soil analysis

Initial and composite post-harvest surface (0-15cm) soil samples from the experimental plot is to be carried out, and dried and pulverized to pass through 2 mm sieve. All the samples were mixed to form a composite sample and brought to the laboratory for chemical analysis. The available nitrogen of soil was 283 kg/ha, phosphorus 51 kg/ha and potassium 289 kg/ha. The soil of the experimental field was alkaline in nature (pH 7.25) with organic carbon of 0.56%. The climate of this place is tropical to subtropical of slightly semi-arid in nature and is characterized by very dry summer, moderate rainfall and very cold winter. December and January are usually the coldest months where the mean temperature normally falls as low as 8.2°C whereas May and June are the hottest months, having the maximum average temperature of 29.6 °C. The major rainfall precipitates generally between June to October.

Observations recorded

Five plants in each treatment and in each replication were randomly selected and tagged properly. Tagged plants were used for recording various observations. The observation recorded for the aforesaid five plants were worked out to give mean in respect of all the parameters, which were utilized in statistical analysis for six yield contributing characters [number of effective branches per plant, days to first pod set, node bearing first pod, days to first harvest, pod yield per plant (g), pod yield (q/ha)] and economics [gross income (Rs/ha), net return (Rs/ha), benefit: cost ratio].

Statistical analysis

The data on growth and yield components were subjected to Fisher’s method of analysis of variance (ANOVA) as outlined by Panse and Sukhatme (1989) [8] where the ‘F’ test was significant for comparison of the treatment means, cd values were worked out at 5% probability level.

Results and Discussion

Yield and yield contributing traits

Noticeable effect in number of effective branches per plant was observed due to application of organic manures (Table 2). Application of poultry manure @ 3 t/ha (T<sub>2</sub>) gave significantly maximum number of effective branches per plant which was at par with T<sub>6</sub>-FYM @ 5 t/ha + PM @ 1.5 t/ha, T<sub>10</sub>-PM @ 0.75 t/ha + VC @ 0.75 t/ha + NC @ 0.25 t/ha + MC @ 0.25 t/ha, T<sub>11</sub>-FYM @ 2 t/ha + PM @ 0.6 t/ha + VC @ 0.6 t/ha + NC @ 0.2 t/ha + MC @ 0.2 t/ha, while minimum was recorded under control (T<sub>13</sub>). The increased number of effective branches per plant by application of Poultry manure is might be due to the availability of more plant nutrients and nitrogenous compounds to the plant from poultry manure which increase the foliage of the plant and number of vegetative buds and thereby increase in the photosynthesis rate resulting there is increase in number of effective branches per plant. Formation of taller plant under the supply of poultry manure directly relates to the function of major nutrients, NPK in plant’s metabolism. According to Russell (1963) [10] nitrogen is an energy store in plant body. Being a constituent of amino acids, nucleotides, nucleic acids, a number of coenzymes, auxins, cytokinines and alkaloids, it induces cell elongation, cell enlargement and cell division (Salisbury and Ross, 1969) [11]. Thus, adequate supply of the three major nutrients NPK is expected to regulate plant physiological functions and morphological responses favourably. The results of the present investigation in terms of number of effective branches per plant are in collaboration with the findings reported earlier by Jithe et al. (2007) [6] and Paul et al. (2011) [18].

The minimum number of days taken from sowing to first pod set (36.60 days) was noted under control (T<sub>13</sub>), however, it was at par with T<sub>3</sub>, T<sub>5</sub>, T<sub>7</sub>, T<sub>11</sub>, T<sub>12</sub> and T<sub>13</sub> (Table 2). The highest number of days (48.0 days) was noticed in the treatment T<sub>5</sub> (poultry manure @ 3 t/ha) which showed statistical equality with T<sub>3</sub> (FYM @ 5 t/ha + poultry manure @ 1.5t/ha) and T<sub>10</sub> (poultry manure @ 0.75 t/ha + vermicompost @ 0.75 t/ha + neem cake @ 0.25 t/ha + mustard cake @ 0.25 t/ha), taking 45.40 and 54.00 days, respectively. These results are in harmony with the findings by Jithe et al. (2007) [6], Paul et al. (2011) [18] and Falafel and Mirdad (2014) [19].
The least number of node bearing first pod was observed in plants grown without any chemical fertilizers or organic manures (Table 2) i.e. control (T13) which showed statistical equality with T5 (FYM @ 5 t/ha +NC @ 0.5 t/ha), T6 (neem cake @ 1 t/ha), T7 (mustard cake @ 1 t/ha), while maximum was obtained with application of poultry manure @ 3 t/ha (T2) which was at par with FYM @ 5 t/ha +PM @ 1.5 t/ha (T6), PM @ 0.75 t/ha + VC @ 0.75 t/ha +NC @ 0.25 t/ha +MC @ 0.25 t/ha (T16) and neem cake @ 1 t/ha (T4). The least number of node bearing first pod was obtained in plants grown without any chemical fertilizers or organic manures while maximum was obtained with application of poultry manure @ 3 t/ha. The plants grown in absence of chemical fertilizers or organic manures have stunted growth and completed early vegetative growth which caused early pod setting. Contrary to this the plants developed in presence of inorganic fertilizers or organic manures took more time to complete their vegetative growth. These results are in line with the findings of Hassan et al. (2012). The least number of days taken from sowing to first harvest (61.40 days) was found under control (T13) which showed statistical parity with T5, T6, T7, T8, T9, T10, T12 and T6 (Table 2). The plants developed under T2 (poultry manure @ 3 t/ha) significantly delayed in first harvest of pod (74.20 days) which showed statistical equality with T6 (FYM @ 2 t/ha +poultry manure @ 0.6 t/ha +vermicompost @ 0.6 t/ha +neem cake @ 0.2 t/ha +mustard cake @ 0.2 t/ha), T10 (poultry manure @ 0.75 t/ha +vermicompost @ 0.75 t/ha +neem cake @ 0.25 t/ha +mustard cake @ 0.25 t/ha) and T11 (FYM @ 2 t/ha +poultry manure @ 0.6 t/ha +neem cake @ 0.25 t/ha +poultry manure @ 0.6 t/ha +neem cake @ 0.2 t/ha) took 73.80, 72.20, 70.80 days, respectively. These results are in agreement with the findings of Sofi et al. (2006) 13, Meena et al. (2007) 7 and Sharma and Chauhan (2011) 12.

The plants developed with application of poultry manure @ 3t/ha produced significantly maximum yield per plant (66.33 g) and total yield (128.83 q/ha) which was statistically similar to T6 (FYM @5 t/ha +poultry manure @ 1.5 t/ha), giving the pod yield of 122.41 q/ha and this treatment was found outstanding being significantly superior to remaining treatments (Table 2). The lowest pod yield (38.21 q/ha) was noted under control (T13) and found inferior as compared to organic manure treatments. The increase in yield is due to the supply of more nutrients through organic manures as well as improvement in the physical and biological properties of soil (Table 2). The increase is also might be due to the fact that these nutrients are being important constituents of nucleotides, protein, chlorophyll and enzyme, involve in various metabolic process which have direct impact on vegetative and reproductive phase of plants. These results are in consonance with the findings of Sofi et al. (2006) 13 and Meena et al. (2007).

**Economics**

Application of poultry manure @ 3 t/ha produced maximum net return with higher benefit: cost ratio (3.42) and proved its superiority over remaining organic manures (Table 2). The application of FYM @ 5 t/ha +poultry manure @ 1.5 t/ha ranked second in merit in respect of benefit: cost ratio. Moreover, the lowest B: C ratio (0.43) was recorded with application of neem cake @ 1 t/ha and found inferior than control (T13). This was mainly due to lower cost of cultivation with the use of poultry manure. These results are also in conformity the results of Sofi et al. (2006) 13, Meena et al. (2007) 7 and Chopra et al. (2008) 3.

On the basis of present investigation it can be inferred that application of poultry manure @ 3 t/ha or FYM @ 5 t/ha +poultry manures @ 1.5 t/ha was found to be most effective with respect to yield and yield attributes traits of garden pea and ultimately economics of garden pea cultivation for higher net income with greater B: C ratio.

**Table 2:** Effect of different organic sources on yield and economics of garden pea cv. Kashi Uday

| Treatments                  | No. of effective branches/plant | Days to first set | Node bearing first pod | Days to first harvesting | Pod yield/plant (g) | Pod yield (q/ha) | Gross returns (Rs./ha) | Net returns (Rs./ha) | B:C ratio |
|-----------------------------|---------------------------------|-------------------|------------------------|--------------------------|--------------------|------------------|-----------------------|----------------------|-----------|
| T1-FYM @10 t/ha             | 5.80                            | 39.80             | 7.80                   | 64.00                    | 37.53              | 67.79            | 677900.0              | 331240.0            | 0.95      |
| T2-Poultry manure (PM) @ 3 t/ha | 8.20                           | 48.00             | 9.60                   | 74.20                    | 66.33              | 128830.0        | 128830.0              | 996640.0            | 3.42      |
| T3-Vermicompost (VC) @ 3 t/ha | 6.40                           | 40.80             | 8.20                   | 67.20                    | 39.79              | 717900.0        | 717900.0              | 321240.0            | 0.81      |
| T4-Neem cake (NC) @ 1 t/ha  | 5.40                            | 37.20             | 6.40                   | 65.60                    | 33.79              | 637500.0        | 637500.0              | 190840.0            | 0.43      |
| T5-Mustard cake (MC) @ 1 t/ha | 5.20                           | 38.00             | 7.40                   | 63.20                    | 30.68              | 608500.0        | 608500.0              | 281840.0            | 0.86      |
| T6-FYM @5 t/ha +PM @ 1.5 t/ha | 8.00                            | 45.40             | 9.40                   | 73.80                    | 64.38              | 122410.0        | 122410.0              | 904940.0            | 2.83      |
| T7-FYM @ 5 t/ha +VC @ 1.5 t/ha | 7.00                           | 40.80             | 8.40                   | 67.60                    | 42.99              | 954100.0        | 954100.0              | 582440.0            | 1.57      |
| T8-FYM @ 5 t/ha +NC @ 0.5 t/ha | 6.00                           | 38.80             | 6.80                   | 64.80                    | 39.48              | 683500.0        | 683500.0              | 286840.0            | 0.72      |
| T9-FYM @ 5 t/ha +MC @ 0.5 t/ha | 5.60                           | 38.60             | 8.00                   | 63.80                    | 35.31              | 676900.0        | 676900.0              | 292940.0            | 0.76      |
| T10-PM @ 0.75 t/ha +VC @ 0.75 t/ha +NC @ 0.25 t/ha +MC @ 0.25 t/ha | 7.80                           | 45.00             | 8.80                   | 72.20                    | 59.90              | 100980.0        | 100980.0              | 644390.0            | 1.76      |
| T11-FYM @ 2 t/ha +PM @ 0.6 t/ha +VC @ 0.6 t/ha +NC @ 0.2 t/ha +MC @ 0.25 t/ha | 7.60                           | 42.80             | 8.60                   | 70.80                    | 55.22              | 916500.0        | 916500.0              | 554840.0            | 1.53      |
| T12-Recommended dose of N:P:K (30:60:60 kg/ha) | 7.40                           | 41.20             | 8.60                   | 68.80                    | 45.67              | 782700.0        | 782700.0              | 508530.0            | 1.85      |
| T13-Control                  | 4.80                            | 36.60             | 6.40                   | 61.40                    | 22.79              | 582100.0        | 582100.0              | 343600.0            | 1.44      |
| C.D. at 5%                   | 0.69                            | 4.40              | 1.00                   | 7.64                      | 5.89              | 9.97           | 109170.0              | 67833.64            | 0.18      |

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