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Response of different organic sources on growth, yield and quality of garden pea (*Pisum sativum* L. var. hortense) cv. Kashi Uday

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Abstract

Garden pea is highly nutritive vegetable, containing high percentage of proteins, carbohydrates, vitamins and minerals. As a leguminous vegetable it improves the soil fertility, yield levels 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 different organic sources which includes FYM, poultry manures, 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 manures @ 3 t/ha. or FYM @ 5 t/ha + Poultry manures @ 1.5 t/ha was found to be most effective with respect to growth, yield attributes and yield of garden pea. However, for quality aspects like protein, sugars and shelling percentage, the use of Poultry manures @ 0.75 t/ha + Vermicompost @ 0.75 t/ha + Neem cake @ 0.5 t/ha + Mustard cake @ 0.25 t/ha gave better results in comparison to remaining treatments.

Keywords: Organic sources, garden pea, yield, quality

Introduction

Garden pea is a very common protein rich leguminous vegetable. It is highly nutritive vegetable containing high percentage of digestible proteins, carbohydrates, vitamins (A and C), thiamine, carboxylase, niacin and minerals (especially calcium and phosphorus). The green peas can be easily be canned frozen and dehydrated besides, its use in vegetable. It improves the soil fertility, yield levels and quality of produce 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 MHA with production of 4.01 MT whereas productivity of the crop is 9.5 MT/ha (Anonymous, 2013)^[2].

Green Revolution in India was mainly realized with the production of high yielding varieties of various crops and by following 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 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 are used continuously (Adhikari *et al.*, 1997) ^[1]. 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 nitrogen fertilizer reduced soil organic carbon and brought into original level only through the addition of organic manures (Singh and Biswas, 2000) ^[13].

These conditions thus make it necessary to the organic combination for getting maximum yield of garden pea cultivar 'Kashi Uday'. Keeping all the facts under consideration and visualizing the paucity of information's on these aspects, the present investigation was formulated to know the performance of different organic sources and their combinations on garden pea.

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 which comprised of T₁-FYM @ 10 t/ha, T₂-Poultry manures (PM) @3 t/ha, T₃-Vermicompost (VC) @ 3 t/ha, T₄-Neem cake (NC) @ 1 t/ha, T₅-Mustard cake (MC) @ 1 t/ha, T₆-FYM @5 t/ha +PM @1.5 t/ha, T₇-FYM @ 5 t/ha +VC @1.5 t/ha, T₈-FYM @5 t/ha +NC @0.5 t/ha, T₉-FYM @5 t/ha +MC @0.5 t/ha, T₁₀-PM @0.75 t/ha +VC @0.75 t/ha + NC @0.25 t/ha + MC @ 0.25 t/ha, T₁₁ - FYM @2 t/ha +PM

@0.6 t/ha +VC @0.6 t/ha +NC @0.2 t/ha +MC @0.2 t/ha, T₁₂-Recommended dose of N:P:K (50:60:60 kg/ha) and T₁₃-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 30x10cm. Nutrient compositions of different sources are presented in Table 1.

Table 1: Nutrient composition of different organic sources

Sl. No.	Organic manures	N (%)	P ₂ O ₅ (%)	K ₂ 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 alkali 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 (Fig. 1). 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 (Fig. 2)

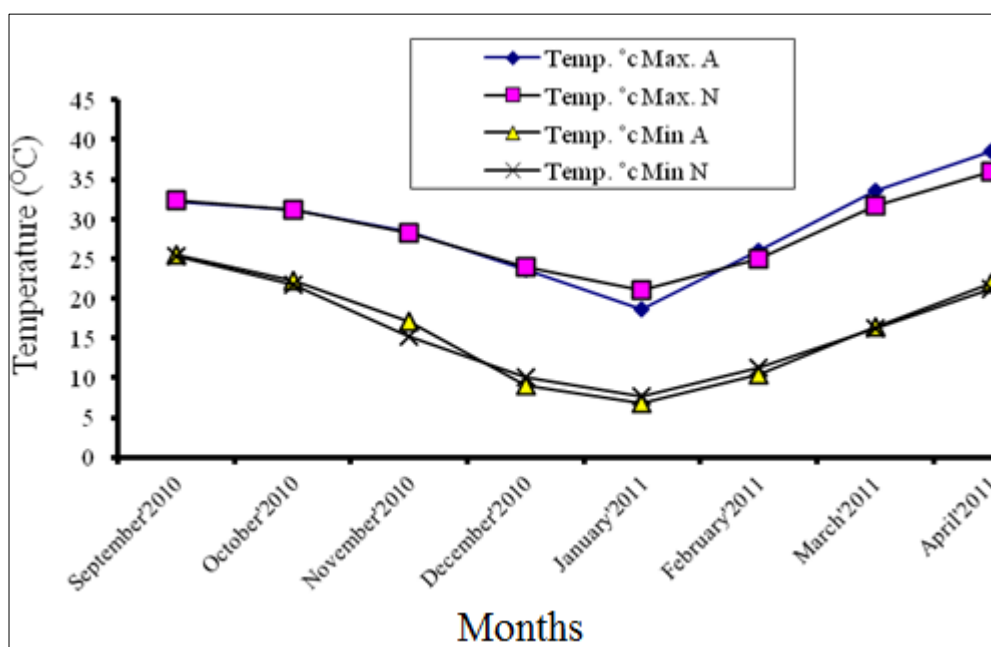


Fig 1: Temperature (°C) during the experimental period

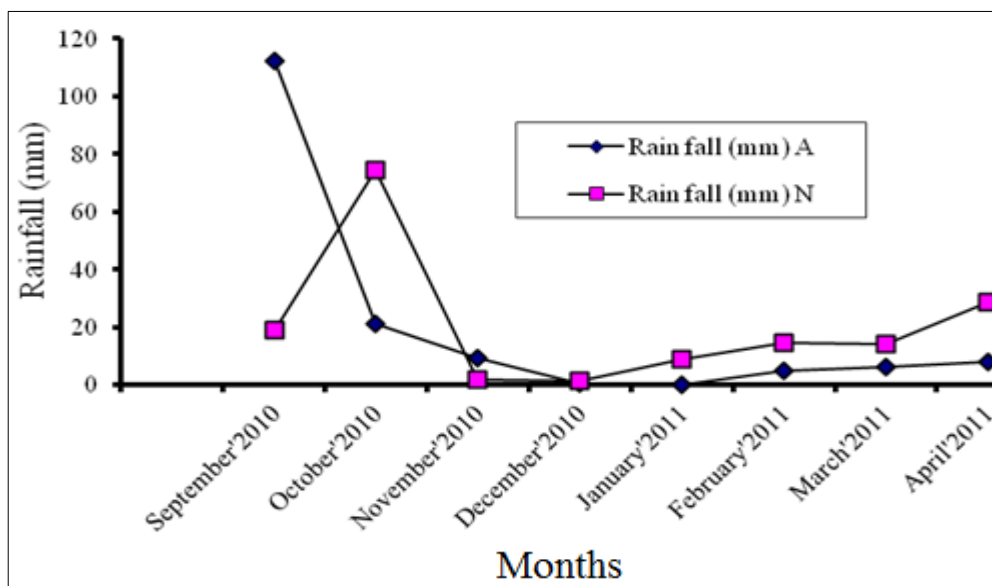


Fig 2: Rainfall during experimental period

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 vegetative, reproductive and nine growth and yield contributing characters [plant height (cm), days to first flowering, number of pods per plant, length of pod (cm), breadth of pod (cm), fresh pod weight, number of grains per pod, shelling (%), pod yield (q/ha)] and five quality characters [protein (%), reducing sugar (%), non-reducing sugar (%), total sugar (%), moisture content (%)]. Protein was estimated by Kjeldah method, reducing sugar and total sugars by copper titration method (AOAC, 1990). The non-reducing sugar was obtained by subtracting reducing sugar from total sugar.

Statistical analysis

The data on growth, yield and quality components were subjected to Fisher's method of analysis of variance (ANOVA) as outlined by Panse and Sukhatme (1989) [9] where the 'F' test was significant for comparison of the treatment means, CD values were worked out at 5% probability level.

Results and Discussion

Growth and yield contributing traits

Marked effect in plant height was observed due to application of organic manures (Table 2). Application of Poultry manures @ 3 t/ha (T_2) gave significantly maximum plant height which was at par with T_6 -(FYM @5 t/ha. +PM @1.5 t/ha), T_{10} -(PM @0.75 t/ha+ VC @0.75 t/ha +NC @0.25 t/ha +MC @0.25 t/ha), T_{11} -(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 (T_{13}). The increased plant height 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 photo synthesis rate resulting there is increase in height of plant. Formation of tatter plant under the supply of poultry manure directly relates to the function of major nutrients, NPK in plant's metabolism. Nitrogen is an

energy store in plant body. Being a constituent of amino acids, nucleotides, nucleic acids, a number of coenzymes, auxins, cytokines and alkaloids, it induces cell elongation, cell enlargement and cell division. Thus, adequate supply of the three major nutrients NPK is expected to regulate plant physiological functions and morphological responses favourably. These results are in harmony with the findings by Jithe *et al.* (2007) [7], Paul *et al.* (2011) [10] and Feleafel and Mirdad (2014) [5].

The highest pod length, pod width and weight of 10 pods were noticed with application of Poultry manures @3 t/ha (T_2) which showed statistical parity with (T_6) FYM @ 5 t/ha. +PM @ 1.5 t/ha., T_{10} -(PM @0.75 t/ha +VC @0.75 t/ha +NC @0.25 t/ha +MC @0.25 t/ha) and T_{11} -(FYM @2 t/ha. +PM @0.6 t/ha +VC @0.6 t/ha +NC @0.2 t/ha +MC @0.2 t/ha) and minimum were turned in the absence of organic manures or chemical fertilizers (T_{13}) which was at par with T_9 -(FYM @5 t/ha +MC @0.5 t/ha.), T_5 -(Mustard cake @ 1 t/ha.) and T_8 -(FYM @5 t/ha +NC @0.5 t/ha.) and T_4 -(NC @1 t/ha). The increase in pod length, pod width as well as weight of 10 pods with application of poultry manure may be attributed to the reason that the plants remained physiologically more active to build up sufficient food stock for the developing pods. The increase in starch and carbohydrates due to sufficient nutrients available in poultry manure might have resulted in the increase of pod length, pod width and weight of 10 pods. These results are in line with those reported by Hassan *et al.* (2012) and Feleafel and Mirdad (2014) [5].

The plants raised with application of Poultry manures @3 t/ha. (T_2) produced significantly maximum number of pods per plant and pod yield (q/ha) which showed statistical equality with T_6 -(FYM @5 t/ha +PM @1.5 t/ha.) and lowest were recorded in absence of organic manures or inorganic fertilizers (Table 2). The increase in the number of pods per plant with poultry manures in the present investigation was due to an increase in plant height, more number of leaves and effective branches, produced healthy and stockier plants which were physiologically more active to produce maximum number of pods. These results are in agreement with the findings of Sofi *et al.* (2006) [14], Meena *et al.* (2007) [8] and Sharma and Chauhan (2011) [12].

The plants developed with application of poultry manure produced significantly maximum pod yield (q/ha). The probable reason for increase in yield may be the cumulative

effect of all yield attributing characters discussed earlier. 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. 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) [14] and Meena *et al.* (2007) [8].

The maximum number of grains per pod was obtained when plants developed with application of PM @ 0.75 t/ha +VC @0.75 t/ha +NC @0.25 t/ha +MC @0.25 t/ha (T₁₀) which was statistically on equal footing with T₁₁-(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 (T₁₃) which was at par with T₅-(Mustard cake @1 t/ha). Neem cake is rich

in plant nutrients and in addition to that it contains alkaloids like nimbin and nimbidin, which have nitrification inhibiting properties and releases nitrogen slowly. Thus apart from the nutrient content in the Neem cake, the retention capacity of nutrients to a prolonged period and its balanced availability might have resulted in producing more number of grains per pod. The findings pertaining to number of grains per pod are in close agreement with those reported by Chopra *et al.* (2008) [4] and Paul *et al.* (2011) [10].

The highest shelling percent was noticed with the application of FYM @ 2t/ha +Vermicompost @0.6t/ha +Neem cake @0.2t/ha +Mustard cake @0.2t/ha, Poultry manure @0.75t/ha +Vermicompost @0.75t/ha +Neem cake @0.25t/ha +Mustard cake @0.25t/ha and poultry manure @ 3t/ha (Table 2). These results are in consonance with the findings of Meena *et al.* (2007) [8] and Chopra *et al.* (2008) [4].

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

Treatments	Plant height (cm)	No. of days taken to flowering	No. of Pods/plant	Pod length (cm)	Pod width (cm)	Fresh weight of 10 pods (g)	No. of grains/pod	Pod yield (q/ha.)	Shelling percentage
T ₁ -FYM @10 t/ha.	49.76	32.60	6.80	8.54	2.47	55.20	5.80	67.79	55.68
T ₂ -Poultry manure (PM) @3 t/ha.	61.18	38.60	9.80	9.56	2.68	73.72	6.80	128.83	62.04
T ₃ -Vermicompost (VC) @3 t/ha.	52.64	33.00	7.10	8.57	2.40	56.38	6.00	71.79	55.72
T ₄ -Neem cake (NC) @1 t/ha.	49.64	32.80	6.40	8.30	2.38	52.86	5.60	63.75	51.24
T ₅ - Mustard cake (MC) @1 t/ha.	47.38	31.40	6.10	8.06	2.35	50.32	5.20	60.85	49.62
T ₆ -FYM @5 t/ha. +PM @1.5 t/ha.	60.50	37.20	9.60	9.38	2.62	70.85	6.60	122.41	60.44
T ₇ -FYM @5 t/ha. +VC @1.5 t/ha.	54.02	33.20	7.40	8.67	2.45	58.14	6.20	75.41	56.15
T ₈ -FYM @5 t/ha. +NC @0.5 t/ha.	51.22	32.00	7.00	8.44	2.36	56.49	5.80	68.35	56.38
T ₉ -FYM @5 t/ha. +MC @0.5 t/ha.	48.80	31.60	6.60	8.38	2.32	53.58	5.60	67.96	53.83
T ₁₀ -PM @0.75 t/ha. +VC @0.75 t/ha. +NC @0.25 t/ha. +MC @0.25 t/ha.	56.28	36.00	9.00	9.12	2.58	65.78	7.40	100.98	63.36
T ₁₁ -FYM @2 t/ha. +PM @0.6 t/ha. +VC @0.6 t/ha. +NC @0.2 t/ha. +MC @0.2 t/ha.	57.87	34.80	7.80	8.92	2.49	62.45	7.20	91.65	66.18
T ₁₂ -Recommended dose of N:P:K (50:60:60 kg/ha)	54.66	33.60	7.60	8.78	2.42	60.12	6.30	78.27	56.30
T ₁₃ -Control	43.12	30.20	5.10	7.32	2.12	44.76	4.80	38.21	46.88
C.D. at 5%	5.35	3.26	0.85	0.88	0.26	7.13	0.64	9.97	5.62

Quality contributing traits

The plant rose with application of PM @ 0.75 t/ha +VC @0.75 t/ha +NC @ 0.25 t/ha +MC @0.25 t/ha (T₁₀) produced maximum protein percent in grain which was at par with T₁₁-(FYM @2 t/ha. +PM @0.6 t/ha +VC @0.6 t/ha +NC @0.2 t/ha +MC @0.2 t/ha) and lowest was obtained without organic manures (T₁₃) or inorganic fertilizers (Table 3). Poultry manures continued 60% of its nitrogen as uric acid and this is converted to ammonia form and the same could be absorbed by the plants in a better way at the reproductive stage of the crop resulting in better crude protein content. These results are in agreement with the findings of Raj and Kumari (2001) and Sofi *et al.* (2006) [14].

The maximum total sugar and reducing sugar (Table 3) were recorded with the use of FYM @2 t/ha. +PM @0.6 t/ha +VC @0.6 t/ha +NC @0.2 t/ha +MC @0.2 t/ha (T₁₁) which were on equal footing with T₁₀-(PM @0.75 t/ha +VC @0.75 t/ha +NC @0.25 t/ha +MC @0.25 t/ha) and T₇-(FYM @5 t/ha.

+VC @1.5 t/ha.), however, maximum non-reducing sugar was noticed with application of Poultry manures @3 t/ha (T₂) which was at par with FYM @5 t/ha. +NC @0.5 t/ha (T₈) and PM @ 0.75 t/ha +VC @0.75 t/ha +NC @0.25 t/ha +MC @0.25 t/ha (T₁₀). The increase in reducing and total sugar with application of organic manures may be due to increased physiological process like synthesis of carbohydrates. These results are in accordance with the findings of Chopra *et al.* (2008) [4].

On the basis of present investigation it can be inferred that application of Poultry manures @3 t/ha. or FYM @5 t/ha +Poultry manures @1.5 t/ha was found to be most effective with respect to growth, yield attributes and yield of garden pea. However, for quality aspects like protein, sugars and shelling percentage, the use of Poultry manures @0.75 t/ha +Vermicompost @0.75 t/ha +Neem cake @0.5 t/ha +Mustard cake @0.25 t/ha gave better results in comparison to remaining treatments.

Table 3: Effect of different organic sources on quality of garden pea cv. Kashi Uday

Treatments	Protein content (%)	Reducing sugar (%)	Total sugar (%)	Non reducing sugar (%)	Moisture (%)
T ₁ -FYM @10 t/ha.	19.28	2.85	9.46	6.61	68.12
T ₂ -Poultry manure (PM) @3 t/ha.	20.65	2.92	10.70	7.78	71.73
T ₃ -Vermicompost (VC) @3 t/ha.	20.14	3.00	9.66	6.66	68.75
T ₄ -Neem cake (NC) @1 t/ha.	19.93	2.86	9.28	6.42	67.69
T ₅ -Mustard cake (MC) @1 t/ha.	19.12	2.90	9.12	6.22	68.06

T ₆ -FYM @5 t/ha. + PM @1.5 t/ha.	23.11	3.08	9.26	6.18	71.21
T ₇ -FYM @5 t/ha. + VC @1.5 t/ha.	20.96	5.07	12.08	7.01	71.06
T ₈ -FYM @5 t/ha. + NC @0.5 t/ha.	21.87	3.32	10.87	7.55	68.02
T ₉ -FYM @5 t/ha. + MC @0.5 t/ha.	21.32	3.10	9.82	6.72	68.80
T ₁₀ -PM @0.75 t/ha. +VC @0.75 t/ha. +NC @0.25 t/ha. +MC @0.25 t/ha.	25.10	5.00	12.12	7.12	69.94
T ₁₁ -FYM @2 t/ha. +PM @0.6 t/ha. +VC @0.6 t/ha. +NC @0.2 t/ha. +MC @0.2 t/ha.	24.76	5.35	12.54	7.19	69.63
T ₁₂ -Recommended dose of N:P:K (50:60:60 kg/ha)	22.58	2.87	8.96	6.09	69.10
T ₁₃ -Control	18.90	3.76	8.89	5.13	67.07
C.D. at 5%	1.49	0.25	0.68	0.76	1.31

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