The Pharma Innovation Journal 2023; 12(3): 5494-5501

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 5494-5501

www.thepharmajournal.com
Received: 15-02-2023
Accepted: 14-03-2023

Vijay Kumar Singh
Head of Department, Department of Soil Science, School of Agricultural Science, SGRR University, Dehradun, Uttarakhand, India

Swati Bamrara
Research Scholar, Department of Soil Science, School of Agricultural Sciences, SGRR University, Dehradun, Uttarakhand, India

Ankur Sharma
Research Scholar, Department of Soil Science, School of Agricultural Sciences, SGRR University, Dehradun, Uttarakhand, India

Corresponding Author:
Vijay Kumar Singh
Head of Department, Department of Soil Science, School of Agricultural Science, SGRR University, Dehradun, Uttarakhand, India

Effect of organic sources of nutrients on growth, yield and quality of pea (*Pisum sativum* L.)

Vijay Kumar Singh, Swati Bamrara and Ankur Sharma

Abstract
The Present investigation entitled "Effect of organic sources of Nutrients on growth, yield and quality of Pea (*Pisum sativum* L.)" was carried out during Rabi season of 2021-2022. The experiment was laid out in randomized block design with three replicated and ten treatments viz., Control, Farm yard manure @ 5tonn/ha, Farm yard manure @ 10tonn/ha, vermicompost @ 5tonn/ha, vermicompost @ 10ton/ha, neem cake @ 0.5tonn/ha, neem cake + FYM @ 5tonn/ha, neem cake + FYM @ 10tonn/ha, neem cake + vermicompost @ 5tonn/ha and Neem cake + vermicompost @ 10tonn/ha. The observations were recorded on plant height (cm), number of branch per plant, number of nodules per plant, fresh and dry weight of nodule at 30, 60 and 90 days after sowing number of pod per plant, number of seed per plant, grain and straw yield (q/ha), protein content (%) in grains and straw, soil analysis before and after harvesting. The results revealed that Maximum number of height and branch, (25.70 cm, 51.69 cm and 64.59 cm) and (9.21, 10.86 and 11.82 respectively) was recorded at 30, 60 and 90 days after sowing in the treatment of neem cake + vermicompost @ 10tonn/ha T10. The maximum number of nodules was recorded T_5 (vermicompost @ 10tonn/ha) at different stages i.e. 30, 60 and 90 days after sowing. The maximum number grain and pods per plant found in Neem cake + vermicompost @ 10 tonn/ha T_{10}. Thus it can be concluded from the finding that application of neem cake + vermicompost @ 10tonn/ha can be recommended for commercial cultivation of *Pisum stivum* (variety Arkel). Thus the use of this combination, get good returns.

Keywords: Organic manure, farmyard manure, vermicompost, Neemcake, growth attributes, yield attributes

Introduction
Legume crops represent one of the most important components of the human diet. One of the major legume vegetable crops is garden pea (*Pisum sativum* L.). It belongs to the family leguminacea having chromosome no. 2n=14. It is native to Mediterranean region. Pea is an important vegetable crop and has acquired a place of prominence in diet of all section of the society. It is grown as both garden pea and field pea throughout the temperate region of the world. Garden pea is consumed as a raw or cooked vegetable can separated or mixed with other vegetables. India is ranking second next to China both in terms of area and production. In India, pea occupies 540 thousand ha area with 5427 thousand metric tons production. India is the second largest producer of pea in the world. Pea is mainly grown as a summer crops in hilly regionand as a winter crops in north Indian plains. In south it is grown in Karnataka and in the hilly regions like Ooty and Kodaikanal in Tamil Nadu. Uttar Pradesh is the leading state in the area (1.8 lakh ha) and production (18.8 lakh tonnes) followed by Madhya Pradesh (22.8 thousand ha; 5.34 lakh tonnes). Jammu and Kashmir is the leading state in productivity (20.8 t/ha) followed by Jharkhand (14.8 t/ha) Table 1 & 2. In the country, pea is grown in Uttar Pradesh, Madhya Pradesh, Assam, Jharkhand, Himachal Pradesh, West Bengal, Punjab, Rajasthan, Haryana, Uttarakhand, Bihar etc.Pea is mostly used in our diet throughout the world and it is rich in the digestible protein (7.2 g), carbohydrates (15.8 g), Vitamin A (139 I.U.), Vitamin C (9 mg), magnesium (34 mg) and phosphorus (139 mg) per 100 g of edible portion (Gopalkrishnan 2007) [7]. Vegetable pea is grown for their fresh green pods, for livestock forage and as soil enhancing green manure. Legumes, such as pea, are significant as it has the ability to fix atmospheric nitrogen through symbiotic nitrogen-fixing bacteria present in structures called root nodules. The nitrogen is one of the most important elements that cause intensive elongation growth of the main and lateral shoots (Tadeusz *et al.*, 2013) [13].

Vermicompost and Neem Cake on soil health, yield attribute and nutritional value of Field Pea (*Pisum sativum* L.) var. Kashi Mukti in research farm of Soil Science and Agricultural Chemistry SHUATS, Prayagraj (U.P). The treatment consiste of farmyard manure (0, 10, &20 kg ha^{-1}), vermicompost (0, 1 & 2 kg ha^{-1}) and neem cake (0, 0.25, & 0.5 t ha^{-1}). The result showed that application of different levels combination of farmyard manure, vermicompost and neem cake increased growth and yield of field pea. It was recorded from the application of bio-fertilizers in treatment T9(@ 100% farmyard manure, vermicompost + 100% neem cake) increased pH 7.44, Electrical conductivity 0.23 ds m^{-1}, organic carbon 0.69%, available nitrogen 339.4 kg ha^{-1}, phosphorus 38.60 kg ha^{-1}, potassium 206.35 kg ha^{-1}. It was also concluded that the application of fertilizers in treatment T_9 (@ 100% farmyard manure, vermicompost + 100% neem cake) was found in increased plant height, no. of leavesper plant, no. of branch, test weight (g $plot^{-1}$) and grain yield and as well as yield. Application of FYM improves soil fertility immensely. The Farm yard manure is enriched with substances having longer water retention capability for longer time there by helps the plant to survive longer in case of deficiency situation. Vermicompost improves soil aeration, enriches soil with micro-organisms (adding enzymes such as phosphate and cellulose), microbial activity in worm castings is 10 to 20 times higher than in the soil and organic matter that the worm ingests. Attracts deep- burrowing earthworms already present in the soil. Vermicompost can be used for sustainable agriculture practices easing food shortages hence improved food security. Pea can be grown on a variety of soil from light sandy loan to clay through best result results are obtained on well drained, loose friable loamy soil. The pH range falls in between 6.0 and 7.5. Neem cake is a natural NPK (Nitrogen, Phosphorus, and Potassium) and other micro nutrients that are needed for better growth of plants and better yield of fruits and vegetables. It improves plant root development and protects from nematodes, it act as a soil conditioner, pest & insect repellent and it enriches the soil and protect the plant due to its natural pesticide content. Neem cake contains more nitrogen (2-5%), phosphorus (0.5-1.0%), potassium (1-2%), calcium (0.5-3%) and magnesium (0.3-1.0%) than farmyard manure or sewage sludge. Neem seed cake not only provides nutrition to the plant, but increases the population of earthworms and produces organic acids, which helps in the reduction of soil alkalinity. Neem cake act as a nitrogen inhibitor means reduce the nitrification. It supplies the available nitrogen for a long time in the soil. There is therefore a need to reduce the use of inorganic fertilizers.

Materials and Methods

The trial was conducted at crop research centre SGRR University, School of Agriculture Sciences, Dehradun, Uttarakhand, during crop year (28 October 2021 to 3 March 2022). The randomized block design, consist of three rows for three replications and ten columns for ten combinations of the selected treatments i.e. Farmyard manure, Vermicompost and Neem cake. All crop residues and weeds were removed as necessary to control weeds during the growing period. Prepare the land to fine tilt, form beds and channels. A total of 30 blocks were made in the field for trial and the size of each block was 3m x 3m and each block had a total area of 9m2. Five rows were made in each block for sowing of seed. Cultivar “Arkel” of pea was used. On the basis of gross plot size Farmyard manure, vermicompost and neem cake were given at the time of sowing. In each plot/block the distance between two successive rows was 30cm and plant to plant spacing was 5cm. Canals were made around the field and in between the replication columns. Sowing of seed was done during last week of October. The cultural practices were followed at regular intervals as per the requirement of the crop. During the experimental trial, from each replicaton, randomly five plants were used for recording various observation on growth and yield promoting parameters at every 30, 60, 90 days after sowing and at final harvest stage.

Result and Discussion

Plant height (cm)

The observation of plant height was recorded at 30, 60 and 90 days after sowing. At 30 days maximum plant height was recorded in treatment T10 (25.70cm), whereas the minimum plant height was recorded in treatment T_1 (19.37 cm). At 60 days maximum plant height was recorded in treatment T10 (51.69 cm) whereas, the minimum plant height was recorded in T_1 (43.26 cm). At 90 days maximum plant height was recorded in treatment T_{10} (64.59 cm whereas the minimum plant height was recorded in the treatment T_1 (53.93 cm). All the treatments were found statistically significant with control (T_1). Maximum plant height was recorded at different stages 40, 80 and 120 days after sowing by the application of Neem cake + Vermicompost @ 10 tonn/ha (T_{10}) than all other treatments applied. This might due to application of neem cake and vermicompost may due rich content of micro nutrients, growth helper micro-nutrient and organic carbon. Apart from neem cake, vermicompost and their secretions in considerable quantities, there were reports that certain metabolites produced from earthworms may be responsible for stimulating plant growth. The present finding also supported by Reddy *et al.* (2004) [12] and Ghosh *et al.* (2001) [6].

Number of branches

The observation of number of branch per plant was recorded at 30, 60 and 90 days after sowing. At 30 days maximum number of branch was recorded in treatment T_{10} (9.21) whereas, minimum number of branch was observed T_1 (7.24). At 60 days maximum number of branch per plant was recorded in treatment T_{10} whereas, minimum number of branch was observed T_1 (8.27). At 90 days maximum number of branch per plant was recorded in treatment T_{10} (11.82). On the other hand minimum number of branch per plant was observed T_1 (8.59). The significantly maximum number of branch per plant was recorded at 40, 80 and 120 days after sowing in the treatment of Neem cake + Vermicompost @ 10tonn/ha (T_{10}). This might due to the increased availability of nitrogen, which is an important constitute of chlorophyll and protein thus causing more growth. All these factors contribute to cell multiplication, cell enlargement and differentiation which could have resulted in better photosynthesis and ultimately exhibited more number of branch. The improvement in number of branch parameter with combination of Neem cake + Vermicompost @ 10tonn/ha might have resulted better and timely availability of N and P. Vermicompost and neem cake contain higher amount of nutrients which slowly available upon decomposition and take longer time for plant. The findings are close with the finding of Asodariya (1994) [2] and Das *et al.* (2002) [5].

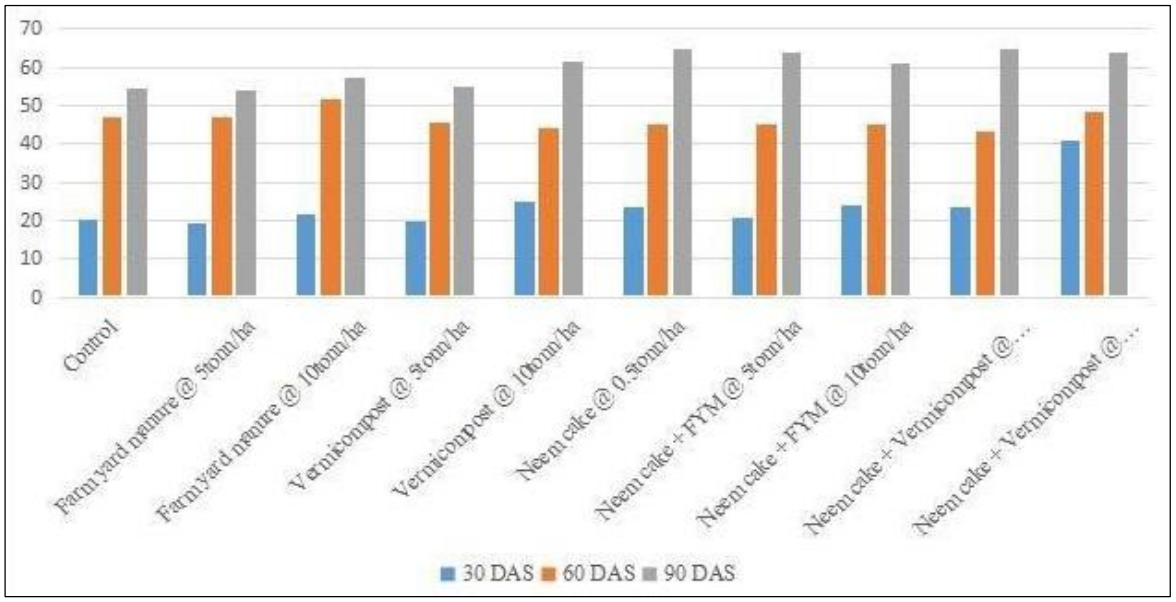

Fig 1: Plant height (cm)

Table 1: Shows Treatments, Plant height (cm) and Number of branch per plant

Treatments		Plant height (cm)			Number of branch per plant		
		30 DAS	**60 DAS**	**90 DAS**	**30 DAS**	**60 DAS**	**90 DAS**
T_1	Control	19.37	43.26	53.93	7.24	8.27	8.59
T_2	Farmyardmanure@5tonn/ha	20.29	46.93	54.22	7.64	8.4	9.4
T_3	Farmyardmanure@10tonn/ha	21.59	48.42	57.27	8.36	8.84	10.12
T_4	Vermicompost@5tonn/ha	19.62	45.38	54.91	8.41	9.78	11.08
T_5	Vermicompost@10tonn/ha	24.99	44.26	61.29	7.29	8.74	9.73
T_6	Neemcake@0.5tonn/ha	23.32	44.89	64.57	8.26	8.81	9.78
T_7	Neemcake+FYM@5tonn/ha	20.59	45.02	63.56	8.4	9.16	10.15
T_8	Neemcake+FYM@10tonn/ha	23.74	45.1	60.84	7.67	8.75	9.79
T_9	Neemcake+Vermicompost@5tonn/ha	23.46	46.74	63.89	9.15	10.49	11.28
T_{10}	Neemcake+Vermicompost@10tonn/ha	25.7	51.69	64.59	9.21	10.86	11.82
SE(m)		0.82	0.64	1.06	0.14	0.3	0.37
CD (0.05)		2.48	1.92	3.19	0.44	0.91	1.13

Number of nodules per plant

The observation of number of nodules were recorded at maturity stage after sowing and the results revealed significant differences among different treatments for average weight of bulb compared from control (T_1). At 30 days maximum number of nodules was recorded in treatment T5 (14.16) whereas, minimum number of nodules was observed T_1 (11.11). At 60 days maximum number of nodules was recorded in treatment T_5 (58.637) whereas, minimum number of nodules was observed T_1 (45.52). The data showed that all the treatments were significantly superior result over the control. At 90 days maximum number of nodules was recorded in treatment T_5 (61.68). On the other hand minimum number of nodules was observed T_1 (51.23). The different treatment, showed significantly variation with respect to number of nodules. In the present investigation, maximum nodules per plant was recorded in the treatment of Vermicompost @ 10 tonn/ha (T_5). This might be due to favourable physical conditions of soil and availability of plant nutrients in sufficient quantities. The rhizobium bacteria help to fix atmospheric nitrogen in the soil in nitrate form. These finding are in conformity with the Govindan and Thirumurugan (2005) [8].

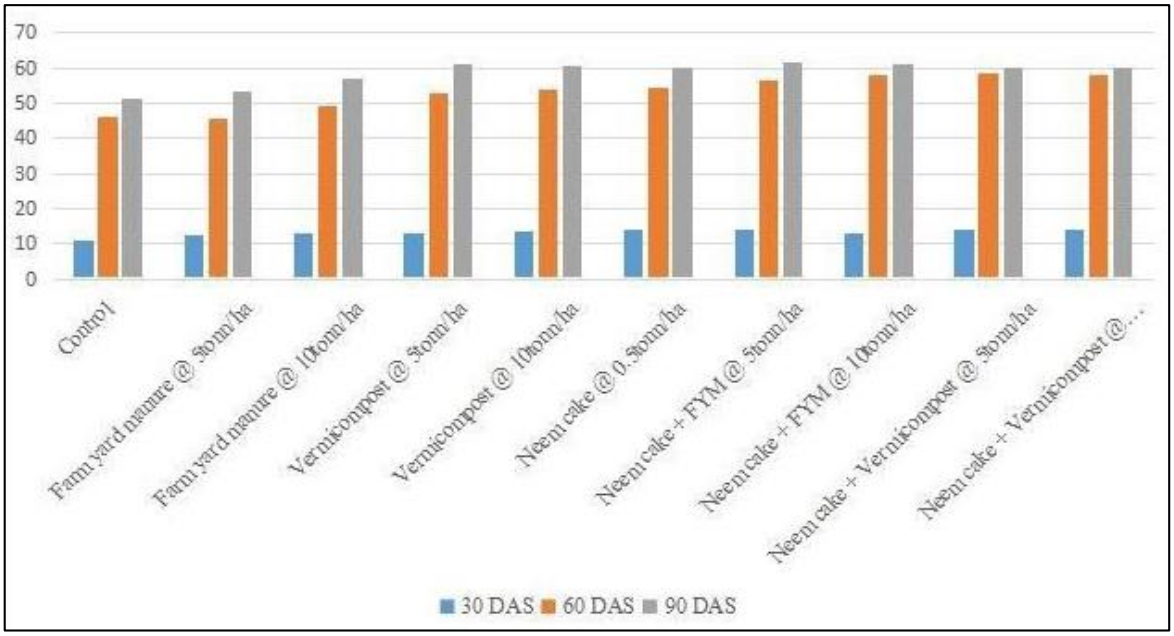

Fig 2: Number of nodules per plant

Fresh weight of nodules (g)

The observation of fresh weight of nodules were recorded at maturity after sowing and the result revealed significant differences among treatment for fresh weight of nodules compared with treatment T1 (Control). At 30 days maximum fresh weight of nodules was recorded in treatment T3 (3.01 g) whereas, minimum fresh weight was observed in T1 (2.01 g). At 60 days maximum fresh weight of nodules was observed in treatment T3 (4.33 g) whereas, minimum fresh weight of nodules was observed in T1 (2.81 g). At 90 days fresh weight of nodules was recorded in treatment T3 (4.13 g). On the other hand minimum fresh weight was observed T1 (2.18 g). The observation of fresh weight of nodule were recorded at maturity after sowing and the result revealed significant differences in different stages among the treatments Farm yard manure @ 10tonn/ha give maximum result at 30, 60 and 90. Increased fresh weight were recorded by the soil application of FYM might due to presence of mg might help to increase the rate of micronutrient by FYM. The results are in agreement with the findings of these findings corroborate the results of Arora and Gaur (1979) [1].

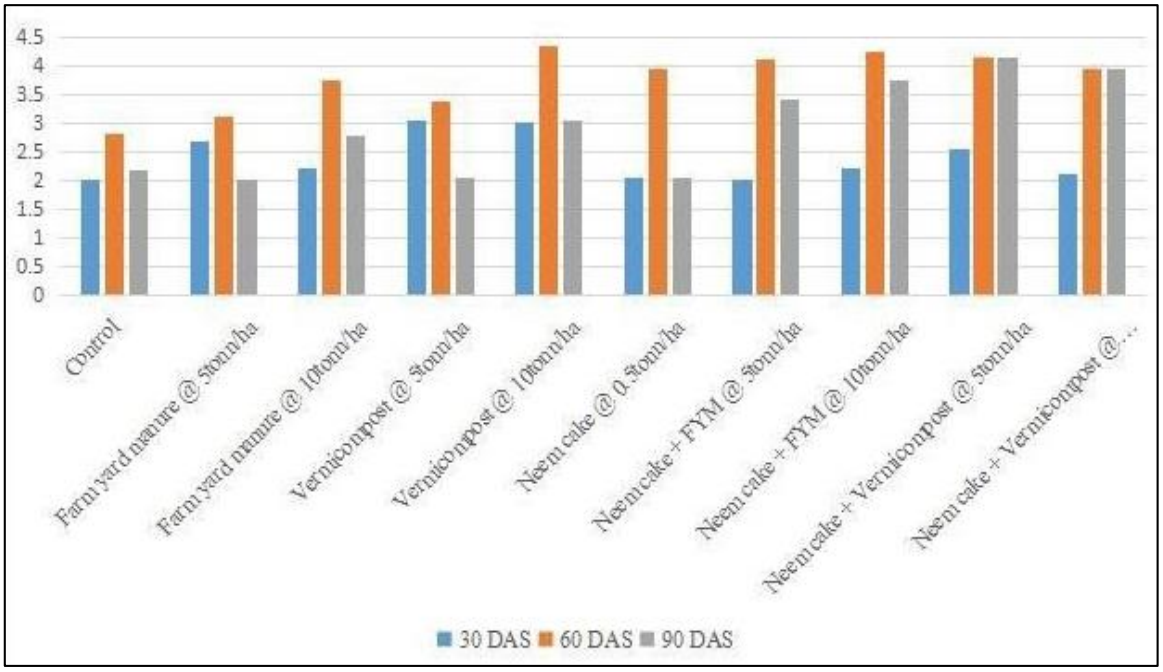

Fig 3: Fresh weight of nodules (g)

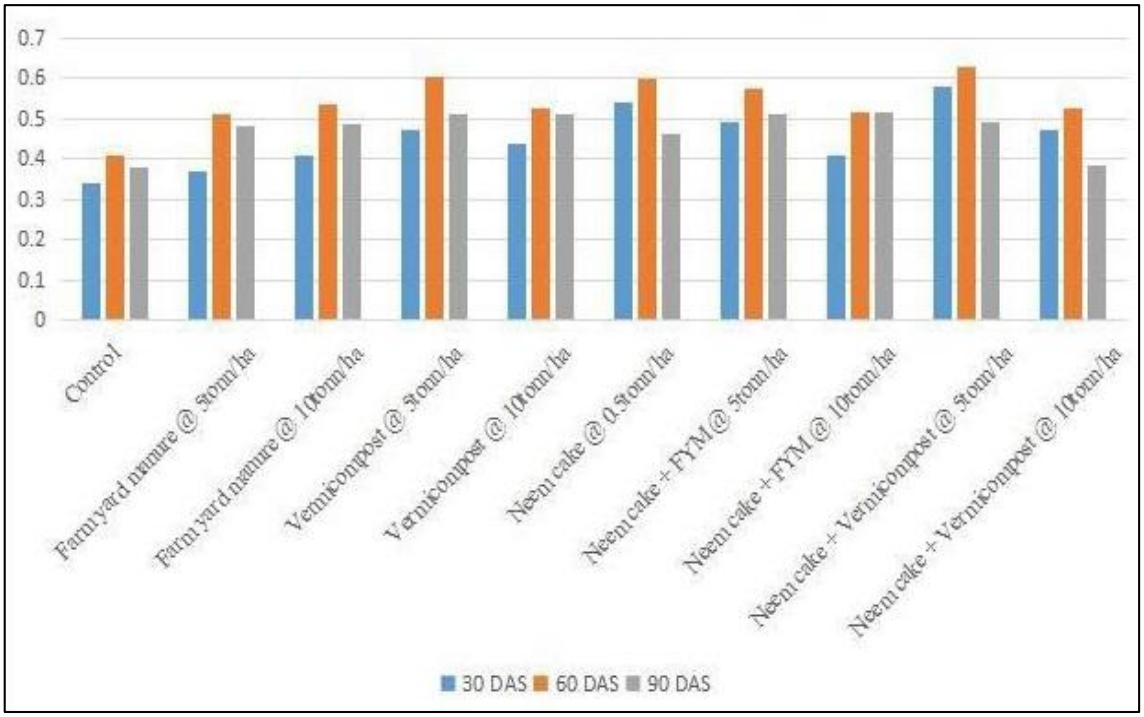

Fig 4: Dry weight of nodules (g)

Dry weight of nodules (g)

The observation of dry weight of nodules were recorded at maturity after sowing and the result revealed significant differences among treatment for dry weight of nodules compared with treatment T1 (control). At 30 days maximum dry weight of nodules was recorded in treatment T9 (0.58 g) whereas, minimum dry weight was observed in T1 (0.34 g). At 60 days maximum dry weight of nodules was observed in treatment T9 (0.62 g) whereas, minimum dry weight of nodules was observed in T1 (0.40 g). At 90 days dry weight of nodules was recorded in treatment T8 (0.517 g). On the other hand minimum dry weight of nodules was observed T1 (0.37 g). The observation of dry weight of nodule were recorded at maturity after sowing and the result revealed significant differences in different stages among the treatments Neem cake + Vermicompost @ 5tonn/ha give maximum result at 30, 60 and 90. Increased dry weight were recorded by the soil application of Neem cake + Vermicompost might due to presence of mg might help to increase the rate of micronutrient by Neemcake + Vermicompost. The results are in agreement with the findings of these findings corroborate theresults of Arora and Gaur (1979) [1]. Vermicompost acts as a chelating agent regulates the availability of micronutrients for plants thereby increase the growth and mass by providing nutrients in available arrangement. Similar results were also obtained by Khurana and Dudeja (1997) [10].

Table 2: Shows Treatments, Number of nodules per plant, Fresh weight of nodule and Dry weight of nodule

Treatments		Number of nodules per plant			Fresh weight of nodule			Dry weight of nodule		
		30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1	Control	11.11	45.52	51.23	2.01	2.81	2.18	0.34	0.4	0.37
T_2	Farmyardmanure@5tonn/ha	12.56	46.09	53.22	2.67	3.09	2.02	0.37	0.51	0.48
T_3	Farmyardmanure@10tonn/ha	13.03	49.19	56.72	3.04	4.33	4.13	0.41	0.53	0.48
T_4	Vermicompost@5tonn/ha	12.96	52.55	60.97	2.22	3.38	2.04	0.47	0.6	0.51
T_5	Vermicompost@10tonn/ha	14.16	58.63	61.68	3.01	3.74	3.03	0.44	0.52	0.51
T_6	Neemcake@0.5tonn/ha	13.52	54.23	60.23	2.03	3.93	2.04	0.54	0.6	0.46
T_7	Neemcake+FYM@5tonn/ha	14.02	56.27	60.63	2.01	4.09	3.4	0.49	0.57	0.51
T_8	Neemcake+FYM@10tonn/ha	13	58.08	60.98	2.22	4.23	3.73	0.41	0.51	0.51
T_9	Neemcake+Vermicompost@5 tonn/ha	13.96	54	59.91	2.54	4.13	2.79	0.58	0.62	0.49
T_{10}	Neemcake+Vermicompost@1 0tonn/ha	13.82	57.78	59.85	2.11	3.92	3.92	0.47	0.52	0.38
	SE(m)	0.41	0.63	0.63	0.19	0.3	0.25	0.05.	0.03	0.01
	CD (0.05)	1.23	1.9	1.89	0.62	0.92	0.75	0.06	0.03	0.02

Number pods per plant & Number of seeds per pods

The observation of number of pods per plant were recorded at maturity after sowing and the results revealed significant differences among different treatments for average of pods per plant compared from control (T1). Maximum number of pods was observed in treatment T10 (31.59) whereas, the minimum number of pods was recorded in treatment T1 (24.21). Maximum number of pods was observed in treatment Neem cake + Vermicompost @ 10tonn/ha. The difference in the yield and yield components could be related to improved vegetative growth and vigour of the plant as influenced by beneficial effects of organics on vegetative growth of crops as

reported by Tanwar *et al.* (2002). The observation of number of seeds per pod were recorded at harvesting after sowing and the results revealed significant differences among different treatments for average number of seeds per pod compared from control (T1). Maximum number of seeds per pod was observed in treatment T10 (6.21) whereas, the minimum number of seeds per pod was recorded in treatment T1 (4.42). In the present investigation, maximum seeds per pod was recorded in combination of Neem cake + Vermicompost@ 10tonn/ha seeds per pod differed significantly due to organic manure. This increased yield might be due to increased yield attributing characters like photosynthetic potential, total dry matter, number of seeds per plant average weight of seeds. The present results are in conformity with the finding of Khanna and Sharma (2011) [9].

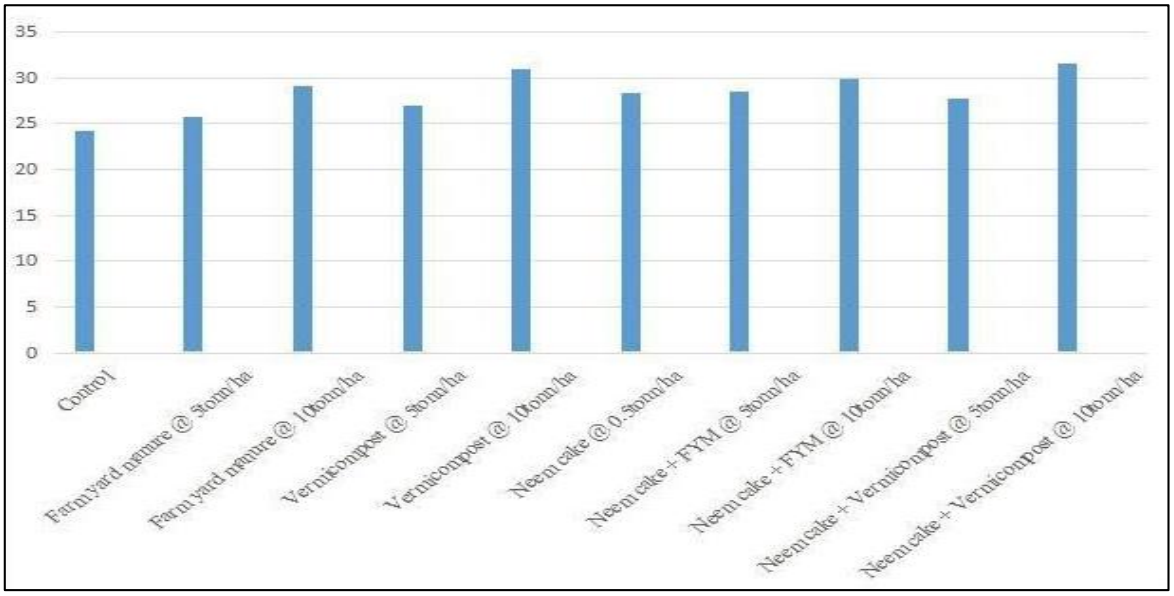

Fig 5: Number of pods per plant

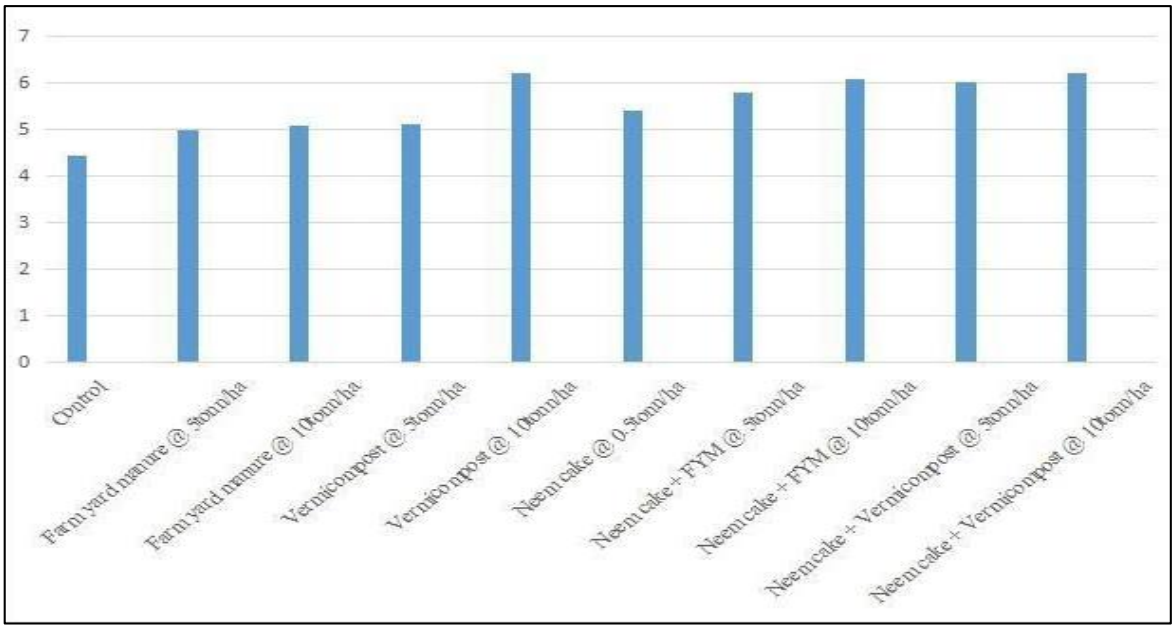

Fig 6: Number of seeds per plant

Grain and Straw yield (q/ha)

The observation of grain yield per hectare were recorded at maturity after harvesting and the results revealed significant differences among different treatments for grain yield per hectare compared from control (T1). Maximum grain yield in quintal per hectare was observed in treatment T10 (21.65 q/ha) whereas, the minimum grain yield in quintal per hectare was recorded in treatment T1 (16.15q/ha). A close perusal of data on grain yield indicated that Neem cake + Vermicompost @ 10tonn/ha produced significantly higher yield which was found statically at par with Neem cake + Vermicompost @ 5tonn/ha. While, significantly the lowest values were recorded in control. Since grain yield components which are dependent on complementary interaction between vegetative and reproductive growth of the crop. The timely availability of nitrogen and phosphporus as well as their higher uptake by plants might have stimulated the rate of various physiological processes in plant and led to increase the growth and yield parameters and resulted in increased seed yield. The results obtained in present study are in close conformity with the

findings of Namdeo and Gupta (1999) [11] and Chatterjee and Bhattacharjee (2002) [3]. The observation of straw yield per hectare were recorded at maturity after harvesting and the results revealed significant differences among different treatments for straw yield perhectare compared from control (T1). Maximumstraw yieldper hectare was observed in treatment T9 (20.52q/ha). Whereas, the minimum straw yield per hectare was recorded in treatment T1 (14.61q/ha). In the present investigation, maximum straw yield was recorded in combination of Neem cake + Vermicompost @ 5tonn/ha seeds per pod differed significantly due to organic manure. This increased yield might be due to increased yield attributing characters like photosynthetic potential, total dry matter, number of branch per plant average mass of the plant. The present results are in conformity with the finding of Zalate and Padmani (2010) [14].

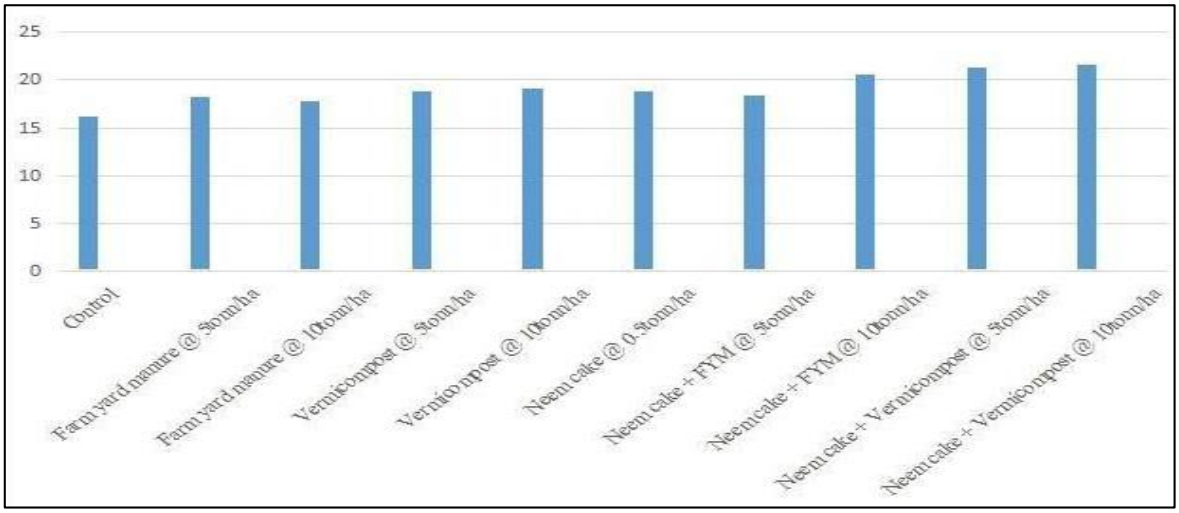

Fig 7: Green yield per hectare (q/ha)

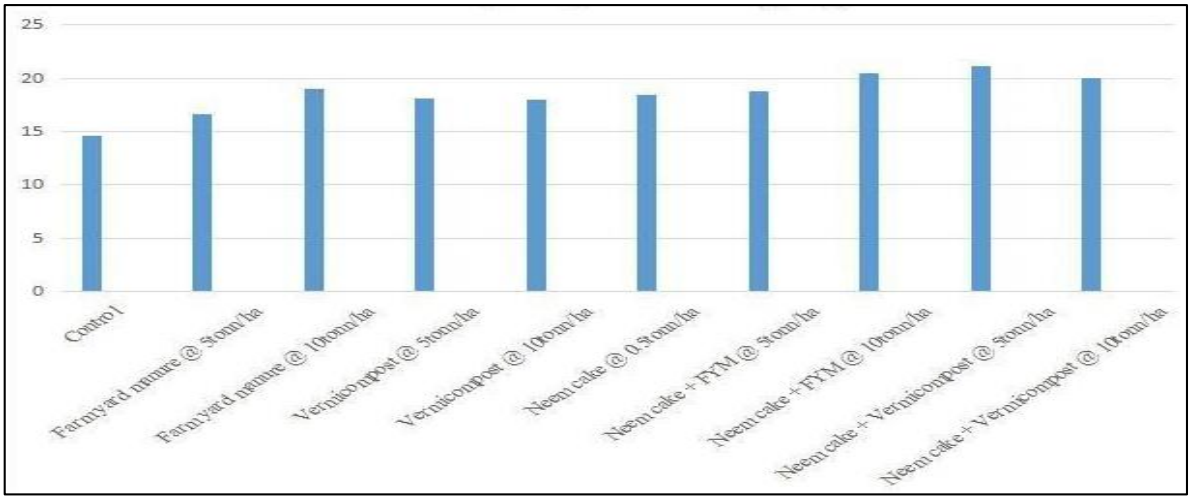

Fig 8: Straw yield per hectare (q/ha)

Table 2: Shows Treatments, Number of pods per plant, Number of seeds per pod, Grain yield per hectare (q/ha) and Straw yield per hectare (q/ha)

Treatments		Number of pods per plant	Number of seeds per pod	Grain yield per hectare (q/ha)	Straw yield per hectare (q/ha)
T_1	Control	24.21	4.42	16.15	14.61
T_2	Farmyardmanure @ 5 tonn/ha	25.83	4.99	18.17	16.68
T_3	Farmyardmanure @ 10 tonn/ha	29.19	5.08	17.86	19.03
T_4	Vermicompost @ 5 tonn/ha	26.96	5.12	18.86	18.14
T_5	Vermicompost @ 10 tonn/ha	30.93	6.19	19.19	18
T_6	Neemcake @ 0.5 tonn/ha	28.3	5.42	18.87	18.49
T_7	Neemcake + FYM @ 5tonn/ha	28.58	5.79	18.45	18.83
T_8	Neemcake + FYM @ 10tonn/ha	29.9	6.08	20.61	20.52
T_9	Neemcake + Vermicompost @ 5 tonn/ha	27.73	6	21.29	21.15
T_{10}	Neemcake + Vermicompost @ 10 tonn/ha	31.59	6.21	21.65	20.01
	SE (m)	1.06	0.13	0.45	0.36
	CD (0.05)	3.2	0.41	1.34	1.1

Conclusion

Results obtained from the present investigation "Effect of organic sources of Nutrients on growth, yield and quality of Pea (*Pisum sativum*)" revealed that organic manure and their combinations have a lot of benefits, apart from the increased yield and returns, it improves the soil structure and texture, reduces soil pollution. Among the different treatments applied best growth and yield parameters were found from the plants grown in the plots applied with vermicompost and combination of neem cake and vermicompost respectively whereas, some of the parameters viz. plant height, number of branch per plant, number of pods per plant, number of seeds and plant yield were seen superior in the neem cake + vermicompost. Thus can be concluded that use of organic manure with combination of Neem cake + Vermicompost @ 10tonn/ha can be recommended for the cultivation of *Pisum Sativum* (variety arkel).

References

1. Arora D, Guar AC. Microbial solubilization of inorganic phosphate. Indian Journal Expt. Biol. 1979;17(11):1258-1261.
2. Asodariya KB. Peanut (Arachis *hypogea* L.) performance under balanced use of fertilizer option and their residual effect on succeeding *kharif* maize. Ph.D. Thesis (unpublished), Gujarat Agricultural University, Sardarkrishinagar, Gujarat; c1994.
3. Chatterjee A, Bhattacharjee P. Influence of combined inoculation with Rhizobium and Phosphobacteria on mungbean in field. Journal of Mycopathological Research. 2002;40(2):201-203.
4. Dass A, Lenka NK, Patnaik US, Sudhishri S. Integrated nutrient management for production economics and soil improvement in winter vegetables. International Journal of Vegetables Science. 2008;14(2):104-120.
5. Das PK, Sarangi D, Jena MK, Mohanty S. Response of green gram (*Vigna radiata* L.) to integrated application of vermicompost and chemical fertilizer in acid lateritic soil. Indian Agrist. 2002;46(1/2):79-87.
6. Ghosh BN, Prakash V, Singh RD. Micronutrient status in soybean (*Glycine max*) – wheat (*Triticum aestivum*) cropping system in kumaon region of Uttaranchal. Indian Journal of Agricultural Sciences. 2001;71(3):149-152.
7. Gopalkrishnan TR. Vegetable crops. New India publishing agency, New Delhi. 2007;4:170.
8. Govindan K, Thirumurugan V. Synergistic association of *Rhizobium* with phosphate solubilizing bacteria under different sources of nutrient supply on productivity and soil fertility in soybean (*Glycine max*). Indian Journal of Agronomy. 2005;50(3):214-217.
9. Khanna V, Sharma P. Potential for enhancing lentil (*Lens culinaris*) productivity by co-inoculation with PSB, plant growth-promoting rhizobacteria and Rhizobium. Indian Journal of Agricultural Sciences. 2011;81(10):932-934.
10. Khurana AL, Dudeja SS. Biological Nitrogen Fixation Technology for Pulses Production in India. Indian Institute of Pulses Research, Kanpur, India, 1997.
11. Namdeo SL, Gupta SC. Efficacy of bio-fertilizers with different levels of chemical fertilizer on pigeonpea (*Cajanus cajan* L.). Crop Research Hisar. 1999;18(1):29-33.
12. Reddy GS, Maruthi V, Sree RM. Assessing the method of application of farm yard manure as dry land crops. Indian Journal of Agronomy. 2004;49(2):104-107.
13. Tadeusz Z, Agnieszk KK, Oleksy A. Effect of Rhizobium inoculation of seeds and foliar fertilization on productivity of Pea (*Pisum sativum* L). *Acta Agrobotanica.* 2013;66(2):71-78.
14. Zalate PY, Padmani RR. Effect of organic manure and bio-fertilizer on growth and yield attributing character of kharif groundnut (*Arachis hypogea* L.). International Journal of Agricultural Sciences. 2010;5(2):343-345.