**Organic and Inorganic fertilizers effects on the growth performance of Pea (*Pisum sativum L.*)**

**Abstract**

A field experiment was conducted in the field at Himalayan University, Jollang, Arunachal Pradesh during the rabi season of the year 2020- 2021. The field trial was designed based on Randomized Block Design (RBD) with four replications and six treatments. The treatments consist of three factors namely vermicompost (0, 1 & 2kg) Neem cake(0, 0.25 & 0.5 t/ha and SSP( single super phosphate) (4g). The result shows that the application of different levels of the combination of vermicompost and neem cake increased the growth of field peas. It was also concluded from the trial that the application of fertilizer in treatment T2 ( Vermicompost 50%+ neemcake 50% ) was found to increase growth attributes.

Key words: Vermicompost, neem seed cake, SSP, Pods, legumes, protein, growth

**Introduction**

Pea (*Pisum sativum L.*) is one of the most important ancient vegetables and belongs to the family Leguminaceae grown throughout the world. It is native to central or south-east Asia. Peas are recognized as one of the earliest crops domesticated by human beings. It ranks third or fourth in worldwide production among grain legumes (Farrington, 1974). Peas contain higher amounts of protein and an excellent human food. Pea is mostly used in our diet throughout the world and it is rich in digestible protein (7.2g), carbohydrate (15.8 g), vitamin A (139 I.U.), Vitamin C (9 mg), Magnesium (34 mg) and phosphorus (139 mg) per 100 gm of edible portion (Gandhi *et al.*, 2010).

It has a prominent place in the human diet, it provides a variety of vegetarian dishes and hence it is like throughout the world. Unripe pods are used as green vegetables and dry seeds are used for dal and chat after boiling. Pea is a highly nutritive and rich source of protein and carbohydrates along with minerals, and vitamins A, B and C (Pandita and Pratab, 1990). Each 100 g edibles portion of green pea contains moisture (72.9 g,) protein (7.2g), fiber (4.0 g), carbohydrate (15.9 g), energy (93 k cal), calcium (20 mg), phosphorus (139 mg), iron (1.5 mg), carotene (83μg) and dry pea contains moisture (16.0g), protein(19.7 g), fiber (4.5g), carbohydrate (56.5 g), energy (315 k cal), calcium (75 mg), phosphorus (298mg), iron (7.05 mg) and carotene 39μg. (Fageria *et al*.,2002)

In India, the area under green peas rose continuously from 177.7 thousand hectares in 1991-92 to 272.6 thousand hectares in 1999-2000. The percentage of an area under peas in India to a global area under peas has also risen from 3.2 per cent in 1991-92 to 4.5 per cent in 1999-2000. The production of green peas has increased from 1.30 million tonnes in 1991-92 to 3.20 million tonnes in 2003-04. However the productivity of green peas has shown an irregular trend, it declined from 14,326kg/ha in 1991-92 to 10,000 kg/ha in 1997-98 and further to 9143 kg/ha in 1999-00. The area under green peas in Punjab was 13.2 thousand hectares in 1995-96 which, increased to 13.5 thousand hectares in 2001-02. The production and productivity of green peas were 79.7 tonnes and 6040 kg/ha in 1995-96, respectively, while the corresponding figures for 2001-02 were 86.3 thousand tonnes and 6000 kg/ha, respectively (Anonymous, 2002).

Green peas cultivation is highly labour-intensive like all other vegetable crops ( Khunt and Desai, 1996) and requires high dosages of manure and fertilizers. The main constituent of the cost of the cultivation of peas is manure and fertilizers, followed by the cost and bullock/ human labour/ tractor and pesticides/chemicals. At the same time, the income per hectare from vegetable crops has been almost four times as compared to that of food crops (Thakur *et al.,* 1994). Thus the farmer should have to be motivated to diversify to more remunerative cropping patterns like vegetable cultivation instead of the traditional, less profitable ones (Singh, 1997). Similar types of results were reported by Maurya *et al.* (2001) and Sharma *et al.(*2000).

Phosphorus is one of the most important elements significantly affecting plant growth and metabolism. It is along with N, a major yield-limiting nutrient in many regions of the world. The crop production on more than 30% of the world's arable land is limited by phosphorus availability. Phosphorus may be the critical constraint of legumes under low-nutrient environments because there is a substantial need for phosphorus in the nitrogen fixation process ( Tsvetkova and Geogiev, 2007). The high requirement for phosphorus in legumes is consistent with the involvement of Phosphorus in the high rates of energy transfer that must take place in the nodule. In addition, phosphorus has an enhancing impact on plant growth and biological yield throughout its importance as energy storage and transfer necessary for metabolic processes (Srivastava *et al.,*1998).

The use of organic manure not only helps to sustain crop yield but also plays a key role by showing both direct as well as indirect influence on the nutrient availability in soil by improving the physical, chemical and biological properties of soil and also improving the use efficiency of applied fertilizers. The majority of studies have indicated that crop production has benefited from the application of organic residues due to the possibility of recycling organic matter, N, P and K and other nutrients (Ramana *et al*., 2011) reported that the use of soil amendment under a humid environment significantly increased the growth and yield of pea pods.

Vermicomposting is an environmentally friendly technique that is used for organic solid waste management. Waste corn pulp blended with cow dung and office paper was vermicomposted over 30 days to produce vermicompost which is solid bio with peas at the planting phase and after every four weeks. The impact of vermicompost on the soil was quantified. Application of vermicompost resulted in 33%, 40% and 67% increases in the soil nitrogen potassium, zinc and copper manganese and iron indicated at 91%, 675, 56% and 10% increases in nutrient composition. The pea showed vigor and vitality during the period of growth. Vermicompost can be used for sustainable agriculture practices easing food shortage and hence improving food security. Peas can be grown on a variety of soil from light sandy loam to clay through best result, results are obtained on well drained, loose friable loamy soil. The PH range falls between 6.0 and 7.5 (Anonymous, 2018).

Neem seed cake is the residual matter left after neem seed kernels are crushed to extract neem seed oil. Neem seed cake contains more nitrogen (2-5%), phosphorus (0.5-1.0%), potassium (1-2%), calcium (0.5-3%) magnesium (0.3-1.0%), (sulphur 0.2 to 3.0%), Zn(Zinc 15-60 ppm). 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 help in the reduction of soil alkalinity( Eifediyi *et al.*,2010).

Neemcake improves the organic matter content of the soil, helping improve soil texture, water capacity, and aeration for better root development (Lokanadhan *et al.,* 2012). Despite huge potential, it is being cultivated in limited areas due to its low productivity levels which can be attributed mainly to inadequate fertilization. Minimize the use of chemical fertilizers by the addition of organic manure and bio-fertilizers of microbial origin (Gandhi *et al.,* 2010). Application of Organic manure like vermicompost showed an increased growth in terms of height and yield of plant, it could be a better alternative to inorganic fertilizers.

**Materials and Methods**

The experiment was conducted in the field at Himalayan University, Jollang Arunachal Pradesh during the rabi season of the year 2020- 2021. Geographically, Arunachal Pradesh is situated in northeastern India in the Trans-Himalayan region between the latitude – 260 28’N to 290 33’N and longitude 910 31’E to 970 30’E.

Itanagar is in the northern hemisphere. The climate is warm and temperate in this region. In winter, there is less rainfall than in summer. The climate here is classified as Cwa by the Koppen-Geiger system. The temperature here averages between 20.80F to 69.50F. The annual rainfall is 2789 mm to 109.8 inch.

The experiment was laid out with a Randomized Block Design (RBD) with four replications. The experiment plot will be first divided into four blocks consisting of 6 units of plot.

List 1: Treatment details

|  |  |  |
| --- | --- | --- |
| **Treatments** | **%** | **Treatments combination** |
| T₁(V₀N₀SSP₀) | 0 | 0%(Vermicompost)+ 0%(Neemcake)+ 0%(SSP) |
| T₂(V₁N₂SSP₀) | 100 | 50%(Vermicompost) +50%(Neemcake) +0%(SSP) |
| T₃(V₂N₂SSP₃) | 75 | 35%(Vermicompost) +35%(Neemcake)+50%(SSP) |
| T₄(V₁N₁SSP₂) | 50 | 25%(Vermicompost) +25(Neemcake)+ 50%(SSP) |
| T₅(V₁N₁SSP₃) | 25 | 15%(Vermicompost) +15%(Neemcake)+ 70%(SSP) |
| T₆(V₀N₀SSP₃) | 0 | 0%(Vermicompost) +0%(Neemccake) +100%(SSP) |

1. Before sowing seed was soaked in water for 24 hours for early germination. The seed was sown in lines at a spacing of 30×10 cm and covered with the soil. Seeds were sown at a depth of 2-3 cm.The plant population were calculated at 90 DAS of plant per unit area land by spacing of plants.

 Area (m2)

Plant population =

 Spacing (m2)

For germination %.The number of seeds germinated was recorded in each treatment and the percentage was calculated by the formula given below:

Germination(%) = No. of germination seeds ×100

 Total No. of seed

Plant height was measured in each treatment from ground level to the tips of fully opened leaves of the main stem with the help of a meter scale at 30, 60 and 90 days after sowing. The fresh weight of five randomly selected plants from each plot was determined days after sowing and at the harvesting stage. After taking fresh weight, plants were dried in the sun for 4- 5 days at a temperature of 30⁰C drying till constant weight. Final weight was noted and the average was worked out at each stage. The date on which 50% of plants showed flowers was recorded in each plot sowing was counted and average values were worked out. The date on which 100% of plants showed flowers was recorded in each plot and days taken for hundred percent flowering were calculated.

**Results and Discussion**

**Table 1.Effect of different doses of fertilizer on plant population at 90 DAS**

|  |  |
| --- | --- |
| **Treatments** | **Plant population in 90 DAS** |
| T1 | 5.50 |
| T2 | 8.75 |
| T3 | 7.25 |
| T4 | 7.75 |
| T5 | 6.75 |
| T6 | 7.75 |
| G.M | 72.92 |
| CV | 5.38 |
| S.E.M | 0.20 |
| C.D(5%) | 0.59 |

The plant population was recorded at 90 DAS. The results presented in Table 1. showed the significant variation in the plant population of the pea variety. Maximum population was recorded at T2(8.75) with the treatment of organic fertilizer i.e (50%vermicompost + neemcake 50%) followed by T4(7.75)with combination fertilizer organic and inorganic (25% vermicompost + 25% Neemcake + 50% SSP), T6(7.75) with(100% SSP +0% vermicompost),T3(7.25) with(35% vermicompost+35% Neemcake + 30% SSP), and T6(6.75)with(100%SSP),T1(5.50) control show the least number of plant population.

**Table.2.Effect of different doses of fertilizer on Seedling Germination (%)**

|  |  |
| --- | --- |
| **Treatments** | **Seedling germination in 90 DAS** |
| T1 | 55.00 |
| T2 | 87.50 |
| T3 | 72.50 |
| T4 | 77.50 |
| T5 | 67.50 |
| T6 | 77.50 |
| G.M | 72.92 |
| CV | 3.62 |
| S.E.M | 1.32 |
| C.D(5%) | 3.98 |

The total number of seeds sown was 10, per plot and the number of seed germination was recorded in each treatment and maximum germination per cent was showed in T2(50% vermicompost+ 50% Neemcake + 0% SSP) followed by T6 (0% organic and 100% SSP)(77.50) T4(25% vermicompost + 25% Neemcake + 50% SSP)(77.50) and least germination percent was seen in T5(15% vermicompost +15% Neemcake +70% SSP)(67.50 and 55.00).

**Table 3.Effect of different doses of fertilizer on plant height at different stages**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments** | **30 DAS** | **60 DAS** | **90 DAS** |
| T1 | 10.92 | 24.80 | 51.64 |
| T2 | 12.48 | 28.73 | 52.13 |
| T3 | 11.78 | 27.81 | 50.74 |
| T4 | 11.17 | 26.82 | 48.78 |
| T5 | 11.46 | 26.99 | 48.91 |
| T6 | 11.48 | 27.43 | 49.74 |
| G.M | 11.55 | 27.09 | 50.33 |
| CV | 4.85 | 5.13 | 4.60 |
| S.E.M | 0.28 | 0.69 | 1.16 |
| C.D(5%) | 0.84 | 2.09 | - |

Plant height was recorded at 30, 60 and 90 DAS. The results presented in Table 3 . showed significant variation in the plant height of peas. Maximum plant height of 12.48 cm, 28.73 cm and 52.13 cm in 30, 60 and 90 DAS was found in T2 (50% vermicompost and 50 % of Neem cake) followed by T3(35% vermicompost +35% Neemcake+30% SSP) (11.78,27.81,50.74), T6(100% SSP) and least height was seen in T4(25% vermicompost + 25% Neemcake + 50% SSP)(11.17,26.82,48.78) and followed by T1(control).

**Table 4. Effect of different doses of fertilizer on days to 50% and 100% flowerings**

|  |  |  |
| --- | --- | --- |
| **Treatments** | **Days to 50%** | **Days to 100%** |
| T1 | 49.75 | 72.00 |
| T2 | 51.50 | 75.50 |
| T3 | 51.00 | 73.50 |
| T4 | 50.00 | 73.00 |
| T5 | 50.00 | 72.00 |
| T6 | 50.50 | 71.50 |
| G.M | 50.46 | 72.92 |
| CV | 3.22 | 5.03 |
| S.E.M | 0.81 | 1.83 |
| C.D(5%) | - | - |

The data is presented in Table 4. showed revealed significant influence of variety on days to 50% flowering. Minimum days (49.75) taken to 50% flowering was found at T1(control) followed by T3(25% vermicompost +25% Neemcake+ 50% SSP) maximum days to 50% flowering was showed inT2( 50% vermicompost+ 50% Neemcake) (51.50).

The data presented in Table 4. exhibited a significant effect of variety on days to 100% flowering. Minimum days to 100% flowering was recorded in T6 (100% SSP + 0% vermicompost+0%)(71.50) followed by T5 and T1(72.00,72.00) and maximum days to 100% flowering was recorded in T1 (50% vermicompost+ 50% Neemcake)(75.50) followed by T3 and T4 (73.50,73.00).

**Table.5.Effect of different doses of fertilizer on the fresh weight of the plant**

|  |  |
| --- | --- |
| **Treatments** | **Fresh weight of plant/plot without grain (g/m2 )** |
| T1 | 26.25 |
| T2 | 28.05 |
| T3 | 27.05 |
| T4 | 26.65 |
| T5 | 26.75 |
| T6 | 26.57 |
| G.M | 26.89 |
| CV | 4.27 |
| S.E.M | 0.57 |
| C.D(5%) | - |

The fresh weight of the plant was recorded at the harvest stage. The data is presented in Table 5. revealed the significant influence of different treatments on the fresh weight of plants at the harvest stage. The maximum fresh weight was observed in T2(28.05) followed by T3 and T5(27.05,26.75) and minimum weight was observed in T1(control) followed by T6(100% SSP)(26.25), T4 (25% vermicompost+ 25% Neemcake+ 50% SSP) (26.65).

**Table 6.Effect of different doses of fertilizer on dry weight of plant/plot after harvest**

|  |  |
| --- | --- |
| **Treatments** | **Dry weight of plant/plot after harvesting (g/m2 )** |
| T1 | 10.53 |
| T2 | 12.34 |
| T3 | 11.95 |
| T4 | 11.85 |
| T5 | 11.60 |
| T6 | 11.78 |
| G.M | 11.67 |
| CV | 4.46 |
| S.E.M | 0.26 |
| C.D(5%) | 0.78 |

The dry weight of the plant was recorded after harvest and the maximum dry weight of the plant was found in T2( 50% vermicompost+ 50% Neemcake) followed by T3, T4 and T6(11.95, 11.85, 11.78). minimum dry weight was observed in T1(control)(10.53) followed by T5 (15% vermicompost+ 15% Neemcake+70% SSP)

Observation on plant population, plant height, and number of leaves per plant were recorded at 30, 60 and 90 DAS and harvest stages. The fresh weight and dry weight of the plant were noted at the harvesting stage. The findings about growth parameters viz., plant height, number of leaves per plant, fresh weight of the plant and dry weight of plant, Days to 50% flowering and days to 100% flowering indicate the significant variation.

There was the increase in growth parameters with the advancement of the growth stage. The maximum plant height was recorded in T2(52.13 cm ) followed by T3( 11.78, 27.81,50.74 cm). T2 was complete with organic fertilizer followed by 100% vermicompost + Neemcake, and T3 was a combination of organic and inorganic fertilizer i.e 75% vermicompost + Neemcake with 25% SSP (single super phosphate) and minimum plant height at harvest stage was recorded in T4(48.78 cm) with 50% vermicompost + Neemcake.

Maximum days taken to 50% flowering was observed in T2 (51.50) with combination treatment of 100% Vermicompost+Neemcake and maximum days to 100% was recorded in T2 (75.50) with (100% vermicompost + Neemcake).

Results of the present study showed that nutrient lack sowing decreases growth and yield by exposing the plant to various environmental effects. The results of the present investigation have also shown that the highest growth rate and yield were obtained with pea variety arkel and the reverse was obtained in the same crop with fertilizer. This might be due to the physiological character of seeds in different nutrient requirements. Growth and development studies of mustard plants have shown that the yield depends greatly on the nutrients provided under which the plants are grown. Further, a lack of nutrients results in premature plant senescence and yield reduction similar to the other biochemical processes following a parabolic relationship (Chauchan *et al.,* 2010). The rate of photorespiration increases with available nutrients and increasing temperature which reduces net photosynthesis and probably the seed yield of the crop ( Sonawarne and Pawar, 2001.). Differences in yield are associated with a lack of nutrients and change in the growth rate a:b ratio due to premature leaf senescence ( Kumari and Usha, 2002). Sitaram *et al.*, (2002) reported that providing required nutrients in time increases crop yield and production significantly.

**Conclusion:**

It has been recorded in the investigation that maximum plant height at the harvesting stage was observed in the T2 (50% vermicompost and 50% neem cake)(52.13) followed by T1(control). It was also reported Singh *et al.* ( 2008) revealed that the application of vermicompost has significant and positive at three levels 0, 2.5 and 5 t/ha significantly increase the plant growth parameters viz. plant height, dry matter accumulation and other attributes. So it is concluded from the observation of my study that among all six treatments, the T2 was superior in the case of growth parameters.

Conflict of interest: None

**References:**

Anonymous, (2002). District wise Estimated Production of peas in Punjab. Punjab Horticulture Department (culled from www.punjabstat.com).

Anonymous, (2018). National Horticulture Board, New Delhi.

Chauhan, H.S., Joshi, S.C. and Rana, D.K. (2010). Response of vermicompost on growth and yield of pea ( *Pisum sativum* L.) cv. Arkel. *Nat and Sci*, 8(4); 18-21.

Eifediyi, K. and Remison, S.(2010). Growth and Yield of Cucumber (*Cucumis sativus* L.) as influence by farmyard manure and inorganic fertilizer. *J.Plant Breed. Crop Sci*., (2) ;216-220.

Fageria, M.S., Arya, P.S. and Choudhary, A.K. (2003). Vegetable crops production technology. Vol. II, *Kalyani Publishers*, Ludhiana, 126-136.

Gandhi, A. and Sivakumar, K.(2010). Impact of vermicompost carrier based bionoculants on growth, yield and quality of rice ( *Oryza sativa* L.) cv. Nlr 145. *The ecoscan*,4(1); 83-88.

Khunt, K. A and Desai,D.B. (1996) economic feasibility and marketing of perennial vegetable in south Gujarat. *Financing Agric*, 28:9-14.

Kumari, M.S. and Usha, K. K. (2002). Effect of vermicompost enriched with rock phosphate on the yield and uptake of nutrients in cowpea (*Vigna unguiculata walp*.). *J. of Trop. Agric*, 40(2);27-30.

Lokanadhan, S., Muthurkrishnan, P. and Jeyyaraman, S.(2012) Neem products and their agricultural operations level of Bio-pesticide. 5;72-76.

Maurya ,O.P., Singh,G.N. and Kushaha,R.K.S. (2001). An economic analysis of production and marketing of potato in district Varanasi (UP). In: *Encyclopeadia of Agricultural Marketing,* vol, 8,Ed: J.Prasad. New Delhi: *Mittal publications*.229-38.

Panditta, M.L. and Pratab, P.S. (1990). Pea and beans in:Bose, T.K. and M.G. Som,(Eds. Vegetable crops in India. Naya prakash, Calcutta, 470.

Ramana, V., Ramakrishna, P.K. and Balakrishna, R.K.(2011). Effect of biofertilzer on growth, yield and quality of French bean (*Phaseoulus vulgaris*). *Veg. Sci*.38(1);35-38.

Sharma, V.K., Inder, S. and Singh,G. (2000). Income and employment from summer vegetables vis- à-vis paddy in Punjab. *J. Agric.Dev. and Policy*, 12;38-43.

Singh, A,B., Ramesh, P., Panwar, N.R. and Ramana, S. (2008) nutrition quality of soybean (*glycine*  *Max)*, wheat (*Triticum durum*) and chickpea (*Cicer arietinum*) and soil biological properties as influenced by different organic manures. *Indian J. Agric. Sci*.78(9);781-784.

Singh, S., Dutt, O.M. and Satyavir, S.(1997). Utilization of phosphate by pea (*Pisum sativum L.*from single super phosphate applied in combination with inorganic and inorganic materials. *Indian J. of plant Physiology,* 2(1);90-92.

Sitaram, T., Sharma, S.K. and Reager, M.L. (2013). Growth attributes and nutrient uptake of greengram as influence by vermicompost and zinc in arid western Rajasthan. *Ad. Res. J. of crop improvement,* 4(1);65-69.

Sonawarne, S.S. and Pawar, N.B. (2001). Studies on biological management of chickpea wilt. *J. of Maharashtra Agric. University*, 26 (2); 215-216.

Srivastava, T.K., Ahlawat,I.P.S. and Panwar,J.D.S. (1998). Effect of phosphorus, molybdenum and biofertilizers on productivity of pea (*Pisum sativum* L.) *Indian. J. Plant Physiol*., 3(3);237.

Thakur, D.S., Sanjay, D.R., Thakur,A. and Sharma, K.D. (1994) Economic of off season vegetable production and marketing in hills. *Indian J. Agric. Mark.,* 8; 72-82.

Tsvetkova, G.E. and Georgiev,G.I. (2007). Changes in phosphate fractions extracted from different organs of phosphorus starved nitrogen fixing pea plants. *J. plant Nutr*.,30;2129-2140.