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Divya Sharma
Department of Biological Sciences, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Eugenia P Lal
Department of Biological Sciences, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Dr. Gaurav Pagire
Senior Researcher, Department of Agricultural Botany, MPKV., Rahuri Maharashtra, India

Corresponding Author:
Divya Sharma
Department of Biological Sciences, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Effect of organic manures and inorganic fertilizer on plant growth and yield of pea (*Pisum sativum* L.)

Divya Sharma and Eugenia P Lal and Dr. Gaurav Pagire

Abstract
A field experiment was conducted to study the effect of organic manures and inorganic fertilizer on plant growth and yield of pea. Altogether, 8 treatments were studied with FYM organic manure and inorganic fertilizer which was applied to every plot according to the treatments in two splits *i.e.*, once before sowing and another 40 days after sowing. The experiment was laid out in Randomized Block Design with 3 replications. The results revealed that the combination treatment of organic manures with inorganic fertilizer shows a significantly increased in growth and yield parameters of pea as compared to individual treatment.

Keywords: Pea, farm yard manure, vermicompost, NPK, growth, yield

Introduction
Pea (*Pisum sativum* L.) belongs to the family Leguminosae and sub-family Papilionaceae. Central Asia was regarded as the birthplace of all legumes including pea. Whereas, Asia minor is the secondary center of origin (Bose and Som, 1986) [2]. In India, it is cultivated mainly in Uttar Pradesh, Jharkhand, Punjab, West Bengal, Haryana, Andhra Pradesh, Bihar, Uttarakhand, Madhya Pradesh, and Himachal Pradesh, where it is grown for both vegetable and pulse purposes and is a highly remunerative crop (Singh *et al.*, 2005) [14].
Less soil fertility is considered to be one of the most important constraints on improved agricultural production. Fertilizers are used to improve fertility and are indispensable for sustained food production, but excessive use of mineral fertilizers has raised environmental concerns. Organic fertilizers coming from fermented and decomposed organic materials are generally nutritious and safe. Microbial fertilizers are environment-friendly, low cost and non-bulky agricultural inputs which play a significant role in plant nutrition as a supplementary and complementary factor to mineral nutrition. Therefore, fertilizer and plant nutrition research should establish a workable relationship between environmental preservation and fertilizers (Bhaskarrao *et al.*, 2015) [1].
The most useful factor is nutrient supply; organic farming is one of the fastest-growing sectors of agriculture worldwide. Its main objective of to create a balance between interconnected systems of the soil organism, plants, animals and humans. The choices of suitable forms of fertilizer for the crop growth of the plant are governed by local, natural conditions, and variations in soil and climate concerning their suitability for crop cultivation. Numerous tests and experience have shown that farm yard manure with its long-time effective nutrients is an ideal fertilizer for crop growth (Bhaskarrao *et al.*, 2015) [1].
Compost products have gained importance in organic farming to boost agricultural production to their important multi various features such as being rich in nutrients, vitamins, growth regulators, free from pathogens and containing immobilized microflora. These composts provide all nutrients in readily available forms and also enhance the uptake of nutrients by plants and play a major role in improving the growth and yield of different field crops (Hassan *et al.*, 2007) [5]. Pea occupies a position of considerable importance because of its palatability in the form of vegetable curry along with other vegetables. It is also widely used as pulse in daily diet. Pea contains a high percentage of digestible proteins (7.2 g/ l00g of edible portion) and Vita. A, Vita. B, Vita. C (Jitendra *et al.*, 2011) [9].
The low average yield diminished the commercial importance of this crop in our country. To overcome this problem the application of inorganic fertilizers in pea was included in the improved technology of cultivation.

Intensive method of cultivation of crops on the same land and continuous application of inorganic fertilizers resulted in the removal of macro as well as microelements from the soil. Thus, a crop that is grown on the soil under cultivation for decades could not get the required nutrients from the same soil as such soils are becoming deficient in the nutrients (Jitendra 2011) [9]. On average, well rotten farmyard manure contains 0.5 percent N, 0.2 percent P_2O_5, and 0.5 percent K_2O. Based on this analysis, an average dressing of 25 tonnes of farmyard manure per ha supplies 112 kg of N, 56 kg of P_2O_5 and 112 kg of K_2O (Javeed and Panvar 2013) [8].

Organic manure plays a direct role in plant growth as a source of all necessary macro and micronutrients in available forms during mineralization and improving the physical and chemical properties of soils (Bhaskarrao *et al.,* 2015) [1]. The target in the application of organic fertilizers should therefore two-fold- first to obtain reasonable yields and second to increase soil fertility, and water holding capacity to optimum levels (Teboh, 2009) [15]. Keeping the above points in view, the present investigation was undertaken to study the effect of organic manures and inorganic fertilizer on plant growth and yield of pea.

Materials and Methods

The data were recorded at 30, 45, and 60 days after sowing for growth measurements like plant height and the number of branches. The yield parameters *i.e.*, numbers of pods per plant, number of seeds per pod and 100 seed weight, were collected at the harvest stage. In biochemical analysis Chlorophyll a, and Chlorophyll b, was determined at physiological maturity according to Hiscox and Israelstam's, 1979 [6] method. Protein in seed was determined by using the method of Lowery *et al.,* (1951) [10].

Results and Discussion

The result of the present experiment indicates that the organic manures and inorganic fertilizer significantly increased the growth, yield and physiological parameters over the control of pea. The data recorded 60 days after sowing revealed that the plant height ranged from 39.44 cm to 50.44 cm. The highest plant height was measured in T7 (50.44) which was found significant with all the other treatments studied in the experiment. The lowest plant height was observed in T0 (39.44 cm). Negi *et al.,* (2006) [11] revealed that the application of inorganic (NPK 50%) and organic (vermicompost 50%) fertilizer recorded increase in plant height.

The maximum number of branches at 60 days (5.77) was found in T7 (VC 50% + NPK 50%), which was found statistically superior to all the treatments except T0 (control). The lowest number of branches was found significant in T0 (control). This might be attributed due to the gradual and steady release of both macro and micronutrients from the vermicompost, which might have helped in the plant metabolic activity, resulting in early vegetative growth. Thus, increases the number of branches per plant. (Jaipaul *et al.,* 2011) [7].

The result related to the number of pods per plant varied significantly among different treatments. The maximum number of pods per plant (12.2) was noted in T7 (VC 50% + NPK 50%) which was found significant. The minimum number of pods per plant (7.78) was noted under the treatment T0 (control). Integrated application of organic and inorganic fertilizer increases the numbers of pods per plant. This combination of fertilizer increased the photosynthetic area and physiological activities which resulted in the production of a greater number of pods per plant. These results are inline with Chandrakar *et al.,* (2001) [3].

The result related to the number of seeds per pod varied significantly among different treatments. The maximum number of seeds per pod (6.96) was noted in T7 (VC 50% + NPK 50%) which was found significant. The minimum number of seeds per pod (5.57) was noted under the treatment T0 (control). Gupta *et al.* (2000) [4] observed that inorganic application increased seed yield in pea.

The result related to 100 seed weight varied significantly among different treatments. The maximum 100 seed weight of 20.28 (g) was noted in T3 (NPK 100%) which was found significant. the application of inorganic fertilizer (NPK 100%) significantly improved the 100 seed weight. It might be attributed to better availability of nutrients at critical growth stages which facilitated improved crop growth, yield attributes and further translocation of nutrients which ultimately affect pod formation associated with increased seed per pod and seed weight. Similar results found by Rakesh and Verma (2011) [12].

The result related to Chlorophyll a, Chlorophyll b and Total Chlorophyll content varied significantly among different treatments. The maximum Chlorophyll a content (1.816) mg./g f.w. was noted in T6 (VC 50% + FYM 50%) which was found significant. The maximum Chlorophyll b content (0.783) mg./g f.w. was noted in T3 (NPK 100%) which was found significant. The maximum total Chlorophyll content (2.472) mg./g f.w. was noted in T3 (NPK 100%) which was found significant. The Compost and NPK are responsible for increasing the chlorophyll a, chlorophyll b and total chlorophyll content of pea plants under drought stress. This results are inline with Usman *et al.,* (2015) [16].

The result related to protein content (mg/g) varied significantly among different treatments. The maximum protein content of 19.25 (mg/g) was noted in T3 (NPK 100%) which was found significant. The inorganic source of NPK increases the metabolic activity and the synergistic effect of phosphorus which causes an increase in root growth and nodulation resulting in an increase in nitrogen and protein content in a green pod. Similar observations were also reported by Ramadan (1997) [13].

Table 1: Effect of organic manures and inorganic fertilizer on plant growth, yield and physiological parameters of Pea (*Pisum sativum* L.)

Treatments	Plant height (cm) at 60 DAS	No. of branches / plant at 60 DAS	No. of pods / plant	No. of seeds / pod	100 seed weight	Chlorophyll a (mg./g f.w.)	Chlorophyll b (mg./g f.w.)	Total chlorophyll (mg./g f.w.)	protein content (mg/g)
T_0: Control	39.44	3.77	7.78	5.57	14.06	0.944	0.350	1.295	15.38
T_1: FYM 100%	44.55	4.55	8.71	6.22	16.53	1.262	0.439	1.701	17.89
T_2: VC 100%	47.44	4.77	8.54	6.31	16.75	1.281	0.523	1.805	17.60
T_3: NPK 100%	47.66	5.44	10.44	6.79	20.28	1.688	0.783	2.472	19.25

T_4: VC 75% + NPK 25%	45.88	4.88	10.22	6.11	15.43	1.370	0.670	2.041	17.55
T_5: VC 75% + FYM 25%	41.88	5.10	10.39	6.49	15.02	1.291	0.526	1.817	16.45
T_6: VC 50% + FYM 50%	47.66	4.88	9.29	6.40	17.12	1.816	0.524	2.341	16.50
T_7: VC 50% + NPK 50%	50.44	5.77	12.2	6.96	18.12	1.740	0.688	2.429	18.69
F-test	S	S	S	S	S	S	S	S	S
SE. m	1.48	0.36	0.47	0.06	0.77	0.09	0.04	0.09	0.10
CD at 5%	3.17	0.77	1.02	0.12	1.65	0.18	0.08	0.19	0.21

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