Research Article

Impact of Integrated Nutrient Management on Seed Yield and Its Attributes in Field Pea (*Pisum sativum* L.)

Vineeta Pandey*, O.S. Dahiya, V.S. Mor, Rajesh Yadav, Jitender, Ovais Hamid Peerzada, Archana Brar

Department of Seed Science and Technology, CCS, HAU, Hisar, Haryana-12500

Abstract

The study was planned to see the impact of integrated nutrient management on seed yield and its attributes in field pea which comprised of various combination of manures (viz., FYM & Vermicompost), biofertilizers (viz., Rhizobium & PSB) and inorganic fertilizers. Among various treatments, rhizobium, PSB inoculation and 100% nitrogen performed better regarding days to 50% flowering, days to maturity, plant height(cm), number of branches/plant, number of pods/plant and seeds/pod. Combined inoculation of biofertilizers along with 100% nitrogen proved most effective for producing higher seed yield (29.94q/ha) as compared to control (23.93q/ha). The results clearly showed that conjunctive use of organic manure and inorganic fertilizers along with biofertilizers resulted in higher productivity of field pea.

Keywords: FYM, Vermicompost, Rhizobium, PSB

***Correspondence**

Author: Vineeta Pandey

Email: pandeyvini3@gmail.com

Introduction

Among the pulse crops, field pea is one of the most important grain legumes and commonly used in human diet throughout the world and is rich in protein, carbohydrates, vitamin A and C, Calcium, phosphorous and has high levels of amino acids lysine and tryptophan [1]. Its cultivation maintains soil fertility through biological nitrogen fixation in association with symbiotic rhizobium prevalent in its root nodules and thus plays a vital role in fostering sustainable agriculture [2]. Chemical fertilizers are needed to get good crop yields, but their abuse can be harmful for the environment and their cost cannot make economic agricultural products [3]. Under intensive cultivation increased use of chemicals has contaminated the ground water and also disturbed the harmony existing among the soil, plant and microbial population [4]. Bio-fertilizers on the other hand are cost-effective and renewable source of plant nutrients to supplement partly chemical fertilizers. Biofertilizers play a vital role for improving soil fertility by fixing atmospheric nitrogen both symbiotically with plant roots and asymbiotically; solubilize insoluble soil phosphates and produces plant growth substances in the soil [5]. Integrated nutrient management, which entails the maintenance of soil fertility to an optimum level for crop productivity to obtain the maximum benefit from all possible sources of plant nutrients-organic as well as inorganic- in an integrated manner is an essential step to address the twin concerns of nutrient excess and nutrient depletion [6, 7]. Thus, integrated approach of nutrient supply by chemical fertilizers along with bio-fertilizers is gaining importance, as this system not only reduces the excessive use of inorganic fertilizers, but also sustains the crop productivity by improving soil health besides being an environment- friendly approach. Integration of inorganic fertilizers and biofertilizers resulted in better growth, yield and nutrient uptake in field pea. This study was aimed to evaluate the effect of integrated application of bio-fertilizers and inorganic fertilizers on field pea in terms of seed yield and its attributes.

Material and Method

The present investigation was carried out with field pea variety HFP 529 during the year 2015-16 in the research area of Department of Seed Science & Technology, CCS Haryana Agricultural University. The experiment was comprised of twenty three treatment combinations viz., T_0-control, T_1-vermicompost, T_2-FYM, T_3-nitrogen, T_4-R+FYM 100%, T_5-R+FYM 75%, T_6-R+VC 100%, T_7-R+VC 75%, T_8-R+N 100%, T_9-R+N 75%, T_{10}-PSB+FYM 100%, T_{11}-PSB+FYM75%, T_{12}-PSB+VC100%, T_{13}-PSB+VC75%, T_{14}-PSB+N 100%, T_{15}-PSB+N 75%, T_{16}-R+PSB+FYM 100%, T_{17}-R+PSB+FYM75%, T_{18}-R+PSB+VC100%, T_{19}-R+PSB+VC75%, T_{20}-R+PSB+N100%, T_{21}-R+PSB+N75%, T_{22}-RDF. All the recommended cultural practices were done regularly during crop growth. The experimental data were analyzed statistically in Randomized Block Design replicated thrice. The plot size for each treatment was 4.0x3.0 m. The plant protection measures were taken up as and when required along with intercultural operations. The

biofertilizers, rhizobium and PSB were used as seed treatment @ 50ml/10kg seed while 20kgN & 40kg P_2O_5/ha used as recommended dose of inorganic fertilizer. FYM and vermicompost were used @ 20 t/ha and 5t/h, respectively. The field pea crop was analysed in various treatments for key characters i.e. number of days to 50% flowering, days to maturity, plant height (cm), number of branches/plant, number of pods/plant, seeds per pod by selecting randomly ten plants from each plot and averaged. The seed yield was recorded on whole plot basis and calculated as quintal per hectare (q/ha).

Result and Discussion

Growth and yield parameters of field pea were significantly affected by the application of integrated nutrients. Days to 50% flowering were appreciably influenced by the combination of organic and inorganic nutrients. Perusal of data (**Table 1**) indicated that minimum numbers of days were taken for 50% flowering by treatment T_{20} (71days) followed by T_{21} (71.3 days) and T_8 (72.3 days) whereas; late flowering was recorded in control (87.6 days). The earliness of flowering may be attributed to the presence of biofertilizers which consequently lead to flower initiation. This may be ascribed to easy uptake of nutrients and simultaneous transport of growth promoting substances like cytokinins to the axillary buds resulting in breakage of apical dominance. Eventually, they resulted in better sink for faster mobilization of photosynthates and early transformation of plant parts from vegetative to reproductive phase [8]. Studying days to maturity in different treatments showed that the least days of maturity in T_{20} (108 days) followed by T_{21} (108.3 days) and T_8 (109.3 days). The reason for earliness in maturity might be due to the fact that the plant treated with bio fertilizers become physiologically more active and enable to synthesize required amount of hormones or to build up adequate food reserves [9]. Combined application of N as chemical fertilizer along with biofertilizers increased the growth parameters like plant height and number of branches significantly than control. The maximum height and number of branches were observed in T_{20} compared with other treatments. This might be due to the fact that N-fixer and P-solubilizing bacteria secrete certain organic acids and some biochemical compounds, which are growth promoting in nature [10] all together nitrogen promote plant height by increasing the number and length of the internodes which result in progressive increase in plant height [11].

Other yield attributes namely, number of pods/plant and seed/pod were maximum in Rhizobium + PSB + 100% nitrogen followed by Rhizobium+ PSB+ 75% nitrogen and R+100% N. Dual application of Rhizobium+ PSB+ nitrogen showed a significant variation from those treatments where only pure inorganic and organic sources of nitrogen were applied in relation to different yield attributes. Related findings were obtained by [12] who reported significant increase in plant height and number of branches of field pea with full dose of RDF along with rhizobium and PSB. Likewise P-solubilizing bacteria are able to solubilize unavailable soil phosphorus and increase the yield of crops [13]. In this situation flow of assimilates from source to sink was high and might be the reason of more seeds per pod. A synergistic interaction among the inputs in the promising treatments might contribute to the better results of yield attributes as explained from the findings of [14] who found maximum grain yield of dwarf pea when seed inoculated with rhizobium + PSB +PGPR along with 100% RDF. Combined inoculation of biofertilizers along with 100% nitrogen (T_{20}) proved most effective in producing maximum seed yield (29.94q/ha) followed by T_{21}, T_8 and T_{14} as compared to control (23.93q/ha). The results clearly indicated the necessity of application of inorganic nitrogen in combination with the said bio-fertilizers. Besides, quick availability of plant nutrient from inorganic sources, fixation of the required amount of nitrogen, balanced C/N ratio, synthesis of auxin and other growth substances, due to inoculation of rhizobium and conversion of insoluble phosphate to soluble form by PSB, perhaps, helped to increase the yield of field pea in T_{20}. The present results are in accordance with the finding of [15] reported that 100% NPK + Vermicompost + Biofertilizers significantly increased the seed yield of pea.

Nitrogen application increased the efficiency of rhizobia for biological nitrogen fixation responsible for higher growth [16]. Usually, rhizobium inoculation increased the root nodulation through better root development and more nutrient availability which caused vigorous plant growth and dry matter production that resulted in better flowering and pod formation. Ultimately there was beneficial effect on seed yield. Since the available P was low in experimental field, PSB might have helped in reducing P fixation by its chelating effect and also solubilized the unavailable form of P leading to more uptake of nutrients and reflected in better growth attributes viz., pods per plant. Phosphate solubilizing bacteria led to increased absorption of other elements by increasing the ability to access phosphorus and thereby increasing crop yield [17].

Organic and inorganic combination of nutrient supply may be synergistic as organic source improve soil physical and biological environment which in turn increase the availability of nutrients from inorganic source. Further microbial activity brings about the transformation of insoluble inorganic nutrients to available forms which are easily taken up by the plant. The increase in seed yield is due to the cumulative effect of increased growth and yield

attributes. This increase in grain yield might be due to the effect of biofertilizer inoculations. It is well known that PSB produce vitamin and IAA, GA like growth substances [18]. These growth factors in combination with better nutritional condition have played a significant role for increasing the seed yield of field pea.

Table 1 Effect of integrated nutrient management (INM) on seed yield and its attributes in field pea

	Treatments	Days of 50% Flowering	Days of Maturity	Plant Height	Number of Branches/ Plant	Number of Pods/Plant	Number of Seeds/Pod	Seed Yield q/h
T0	Control	87.667	124.667	56.000	5.050	9.023	3.060	23.930
T1	Vermicompost (VC)	86.333	123.333	56.200	5.343	10.377	3.220	24.370
T2	FYM	86.000	123.000	56.467	5.593	11.393	3.423	24.550
T3	Nitrogen (N)	85.000	122.000	58.033	6.123	13.447	3.837	25.133
T4	R+FYM100	79.333	116.333	61.167	8.300	25.823	5.653	27.660
T5	R+FYM75	80.000	117.000	59.200	6.440	20.930	5.263	26.930
T6	R+VC 100	80.667	117.667	60.333	9.133	19.267	5.030	25.780
T7	R+VC75	81.333	118.333	59.467	6.910	17.467	4.600	25.373
T8	R+N100	72.333	109.333	68.633	9.600	28.870	6.460	29.420
T9	R+N75	74.000	111.000	67.667	8.700	25.300	5.880	28.993
T10	PSB+FYM100	75.333	112.333	61.667	9.800	24.893	4.183	27.557
T11	PSB+FYM75	77.000	114.000	60.467	9.233	21.477	3.940	26.797
T12	PSB+VC100	84.333	121.333	60.833	6.910	16.293	3.967	25.657
T13	PSB+VC75	82.333	118.667	58.233	6.190	14.573	3.900	25.277
T14	PSB+N100	73.333	110.333	68.033	9.467	27.370	6.057	29.197
T15	PSB+N75	75.000	111.667	66.800	7.867	23.293	5.607	28.133
T16	R+PSB+FYM100	77.333	114.333	64.967	8.100	22.613	6.220	28.577
T17	R+PSB+FYM75	78.667	115.667	64.000	8.033	22.300	6.127	28.337
T18	R+PSB+VC100	84.667	121.667	63.133	8.033	20.340	4.823	26.173
T19	R+PSB+VC75	83.667	120.667	62.633	7.433	19.833	4.640	26.070
T20	R+PSB+N100	71.000	108.000	70.333	11.100	33.307	7.233	29.940
T21	R+PSB+N75	71.333	108.333	69.667	10.400	32.350	6.917	29.610
T22	RDF	76.667	113.667	65.567	9.467	27.033	5.790	28.000
	C.D.	1.540	1.669	0.238	0.132	0.101	0.076	0.113
	SE(m)	0.539	0.584	0.083	0.046	0.035	0.027	0.039
	SE(d)	0.762	0.825	0.118	0.065	0.050	0.038	0.056
	C.V.	1.177	0.870	0.230	1.002	0.289	0.914	0.253

Conclusion

The present paper highlights the positive effect of INM modules on seed yield and its attributes. Biofertilizers both Rhizobium and PSB with nitrogen exhibited spectacular performance in growth and yield of field pea as compared to the rest of INM treatment combinations.

References

[1] Bhat TA, Gupta M, Ganai MA, Ahanger R.A and Bhat HA 2013. Yield, Soil Health and Nutrient Utilization of Field Pea (Pisum sativum L.) as Affected by Phosphorus and Biofertilizers under Subtropical Conditions of Jammu. International Journal of Modern Plant and Animal Science 1: 18.

[2] Negi S, Sing RV and Dwivedi OK 2006. Effect of Biofertilizers, nutrient sources and lime on growth and yield of garden pea. Legume research 29(4): 282-285.

[3] Bobade KP, Kolte SO and Patil BG 1992. Affectivity of cyanobacterial technology for transplanted rice. Phykos 31: 33–35.

[4] Bahadur A, Singh J, Singh KP, Upadhyay AK and Rai M 2006. Effect of organic amendments and biofertilizers on growth, yield and quality attributes of Chinese cabbage (Brassica pekinensis). Indian Journal of Agricultural Sciences 76: 596–598.

[5] Yousefi AA, Khavazi K, Moezi AA, Rejali F and Nadian HA 2011. Phosphate solubilizing bacteria and arbuscular mycorrhizal fungi impacts on inorganic phosphorus fractions and wheat growth. World Appl. Sci. J 15(9): 1310-1318.
[6] Aulakh MS and Grant CA 2008. Integrated nutrient management for sustainable crop production'. (The Haworth Press, Taylor and Francis Group: New York).
[7] Sangeeta, Singh VK and Kumar R. 2014. Effect of integrated nutrient management on yield and quality of cauliflower. The bioscan, 9(3):1053 -1058.
[8] Kabariel J, Subramanian S and Kumar M 2016. Integrated nutrient management on growth and yield of african marigold (Tagetes erecta L.) hybrid 3 grown as an intercrop in grand naine banana. International Journal of Science and Nature. 7(2): 291-295.
[9] Hnamte V, Chatterjee R and Chatterjee T 2013. Growth, flowering, fruit setting and maturity behaviour of coriander (coriandrum sativum l.) with organics including biofertilizers and inorganics. The bioscan 8(3): 791-793.
[10] Mishra N, Mahapatra P , Mohanty s and Pradhan M 2014. Effect of soil amelioration, inorganic, organic and bio-fertilizer application on yield, quality and economics of snow pea (pisum sativum l. var. macrocarpon). Journal of Crop and Weed10(1):48-52.
[11] Gasim SH 2001. Effect of nitrogen, phosphorus and seed rate on growth, yield and quality of forage maize (Zea mays L.). M.Sc. Thesis, Faculty of Agric., Univ. of Khartoum.
[12] Mukherjee D 2016 Integrated nutrient management practices on growth and yield of field pea (pisum sativum l.) under mid hill condition. International Journal of Agricultural Sciences 12(2): 309-313.
[13] Adesemoye AO, Kloepper JW 2009. Plant-microbes interactions in enhanced fertilizer-use efficiency. Appl Microbiol Biotechnol 85: 1-12.
[14] Mishra A, Prasad K and Rai G 2010. Effect of bio-fertilizer inoculations on growth and yield of dwarf field pea (Pisum sativum L.) in conjunction with different doses of chemical fertilizers. Journal of agronomy 9(4): 163-168.
[15] Sharma U and Chauhan JK (2011) Influence of integrated use of inorganic and organic sources of nutrients on growth and production of pea, Journal of farm science 1(1): 14-18.
[16] Erman M, Ari E, Togay Y and Cig F 2009. Response of Field Pea (Pisum sativum sp. Arvense L.) to Rhizobium Inoculation and Nitrogen Application in Eastern Anotolia. Journal of Animal and Veterinary Advances 8(4): 612-616.
[17] Mahfouz SA and Sharaf-Eldin MA 2007. Effect of mineral vs. biofertilizer on growth, yield, and essential oil content of fennel (Foeniculum vulgare Mill). Int. Agrophys. 21:361 366.
[18] Ponmurugan P and Gop C 2006. In vitro production of growth regulators and phosphatase activity by phosphate solubilizing bacteria. African Journal of Biotechnology. 5(4): 348-350.

Publication History
Received 21st June 2017
Revised 05th July 2017
Accepted 07th July 2017
Online 30th July 2017