

**Impact of Integrated Use of Inorganic, Organic and Biofertilizers on Growth, Yield and Quality of Pea (*Pisumsativum* L.)**

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**ABSTRACT**

**Aim:** The experiment was carried out , to find out the impact of integrated use of inorganic, organic and biofertilizers on growth, yield and quality of pea (*Pisumsativum* L.).

**Study design:** Experiment was laid out in randomized block design (RBD) with three replications. Azad P-3 variety was grown to evaluate the effect of different treatments.

**Place and Duration of Study:**It was conducted during 2021 at Experimental Farm of Faculty of Agricultural Sciences, DAV University, Jalandhar.

**Methodology:** Thirteen treatments were used for the study which consisted of different combinations of organic, inorganic and biofertilizers (FYM, Vermicompost, NPK, Azotobacter and PSB) at different levels (100%, and 75% of the recommended dose of each nutrient). Observations were recorded on days to germination, days to first flowering, days to 50% flowering, plant height (cm), number of branches per plant, number of leaves per plant, pod length (cm), number of pods per plant, pod weight (g), pod yield per plant (g/plant), pod yield per plot (Kg/plot), Shelling percentage (%), total soluble solids (TSS).

**Results:**Analysis of variance (ANOVA) revealed significant effect of integrated use of inorganic, organic and biofertilizer on growth, yield and quality under study. Lowest number of days to germination(10.63 days); days to first flowering(59.33 days);number of days to 50% flowering(78.26 days) was recorded in T4 (100% NPK+FYM+PSB). The same treatment also resulted in highest pod length (9.18cm);number of pods per plant (16.27); pod weight (8.49g);plant height (62.37cm);pod yield per plant (55.24 g); pod yield per plot (4.32 kg);TSS (16.48<sup>o</sup>B) andshelling percentage % (52.50).

**Conclusion:**It was observed that plants which were treated with the application of 100% NPK, FYM and PSB resulted in superior performance with respect to growth, yield and quality parameters of pea.

**Keywords:** Pea, Integrated fertilizers use, FYM, Vermicompost, NPK

## 36 1.INTRODUCTION

37 Pea (*Pisumsativum*L.) belonging to family Fabaceae is an important rabi season vegetable in  
38 Northern plains of India and in hills it is grown as summer vegetable. It is herbaceous,  
39 annual in habit and self-pollinated vegetable crop. It is the second important food legume of  
40 the world. India is the second largest producer of pea in the world and accounts for 21% of  
41 the world production. In India it is mainly grown in Uttar Pradesh, Madhya Pradesh, Assam,  
42 Jharkhand, Himachal Pradesh, Haryana, Bihar, Uttarakhand, Punjab etc. [1]. Punjab is fifth  
43 largest producer of pea in the country and accounts for 6.7% of India's production. It is  
44 second important vegetable crop of Punjab and is grown on an area of 43.89 thousand  
45 hectare with annual production of 467.01 thousand tonnes, In India it is grown on an area of  
46 575 thousand hectare with annual production of 5855 thousand tonnes[2].

47 It is cultivated for its pods and seeds which are used in fresh state as well as processed  
48 form. In fresh state, mainly snow pea and sugar snap are exports due to their high demand  
49 in the international market. Processed shelled peas are marketed in three ways frozen,  
50 canned and dehydrated but more than 95% of shelled peas are used in frozen form. It is  
51 grown for its pods and seeds. The green and dry foliage are used as cattle fodder and green  
52 pods of vegetable pea are highly nutritive so, preferred for culinary purpose.

53 With the increasing population there is ever increasing demand of food and to sustain the  
54 healthy population, there is need of ample supply of nutrient rich food such as vegetables. In  
55 order to meet the increasing demand of nutrition rich food, efforts are being made at national  
56 and international levels. Fertilizers play a vital role in maintaining the soil fertility and  
57 enhancing the production. Chemical fertilizers are conventionally used for increasing the  
58 production due their easy availability. But the main drawback of use of chemical fertilizers is  
59 their deleterious effects on soil structure, environment and human health. All these things  
60 have led to the search of alternative renewable source of nutrients for crop through fertilizers  
61 of biological origin which are bio-fertilizers. Biofertilizers are natural fertilizers which consist  
62 of micro organisms like bacteria, algae, fungi alone or in combination. They are the products  
63 containing carrier based (solid form or liquid form) living micro-organisms that are  
64 agriculturally useful which in turn fixes N, solubilization of P and mobilization of nutrient. A  
65 small dose of biofertilizer is sufficient to produce desirable results because each gram of  
66 carrier of biofertilizers contains at least 10 million viable cells of a specific strain as reported  
67 by [3]. The use of biofertilizers is safe, cost effective and easy in application. Another source  
68 of plant nutrients i.e. organic manures are known to sustain cropping systems through better  
69 nutrient recycling and improved physical, chemical and biological properties of soil. The  
70 organic manures have the advantage of supplying secondary and micro nutrient along with

71 NPK, which is important for sustainable production. Commonly used organic manures are  
72 FYM, vermicompost, poultry manure, biogas slurry, urine and liquid manure etc. FYM  
73 manure release nutrients slowly and steadily and activate soil microbial activity [4]. The  
74 vermicompost is reported to significantly increase micronutrients in field as compared to  
75 animal manure [5]. Thus organic manures can serve as an alternative source to mineral  
76 fertilizers for improving soil structure and microbial biomass. These promote the healthy  
77 population of beneficial organisms in the soil while, biofertilizers are cost-effective and  
78 renewable source of plant nutrients to supplement the parts of chemical fertilizers. Integrated  
79 Nutrient Management involves the combined use of all the sources of plant nutrients. It helps  
80 in maintaining the soil fertility and supply plant nutrient in balanced proportion [6]. As single  
81 nutrient source may not supply the rest of required nutrients for the plant therefore,  
82 integrated use of all sources is required for balanced plant nutrition and it is necessary to  
83 make the judicious use of fertilizers in right proportion for harvesting better yield. Thus it has  
84 been realized that chemical fertilizers must be integrated through more economic and eco-  
85 friendly organic manure and biofertilizers to achieve sustainable productivity with high quality  
86 and minimum deterioration of the environment. Increased yield of pea through integrated use  
87 of chemical fertilizers and biofertilizers in nitrogen fixers like pea have also been reported  
88 [7]. Thus keeping in view of importance of crop and need to integrate the use of inorganic,  
89 organic and bio-fertilizers, the present study was executed.

90

## 91 **2. MATERIALS AND METHODS**

92 The variety Azad P-3 was grown for the investigation and the experiment was laid out in  
93 Randomized Block Design and three replications. Thirteen treatments consisting of different  
94 combinations of organic, inorganic and biofertilizers (FYM, Vermicompost, NPK, Azotobacter  
95 and PSB) at different levels (100%, and 75% of the recommended dose of each nutrient),  
96 making combinations as T<sub>1</sub> (100% NPK); T<sub>2</sub> (100% NPK+ FYM); T<sub>3</sub> (100% NPK+ FYM+  
97 Azotobacter); T<sub>4</sub> (100% NPK+ FYM+ PSB); T<sub>5</sub> (75% NPK+ FYM+ Azotobacter); T<sub>6</sub> (75%  
98 NPK+ FYM+ PSB); T<sub>7</sub> (100% NPK+ Vermicompost); T<sub>8</sub> (100% NPK+ Vermicompost+  
99 Azotobacter); T<sub>9</sub> (100% NPK+ Vermicompost+ PSB); T<sub>10</sub> (75% NPK+ Vermicompost+  
100 Azotobacter); T<sub>11</sub> (75% NPK+ Vermicompost+ PSB); T<sub>12</sub> (FYM+ Vermicompost+  
101 Azotobacter); T<sub>13</sub> (FYM+ Vermicompost+ PSB). The organic manure (FYM and  
102 Vermicompost), inorganic fertilizers (Urea, DAP and MOP) were applied in the experimental  
103 field as per the treatments and all the cultural practices were done as per the package of  
104 practices of Punjab Agricultural University. The data on various growth, yield and quality  
105 parameters collected during the course of investigation was subjected to statistical  
106 analysis by adopting analysis of variance using Randomized Block Design [8]. The

107 interpretation of results was based on F test and critical difference (CD) at 5% level of  
108 significance.

### 109 **3. RESULTS AND DISCUSSION**

110 Analysis of Variance (ANOVA) revealed that the treatments significantly influenced all the  
111 characters viz, days to germination, days to first flowering, days to 50% flowering, number of  
112 leaves per plant, number of branches per plant, pod length (cm), number of pods per plant,  
113 pod weight (g), plant height (cm), pod yield per plant (g), pod yield per plot (kg), TSS (<sup>0</sup>B)  
114 and shelling percentage(%) (Table 1).

#### 115 **3.1 Growth parameters**

116 The data recorded on growth parameters as influenced by integrated use of inorganic,  
117 organic and biofertilizers has been presented in Table 2. Significantly lowest number of days  
118 to germination(7.25 days), days to first flowering (59.33 days), days to 50% flowering and  
119 significantly highest number of days to germination(10.63 days), days to first flowering (70.33  
120 days), days to 50% flowering 89.27 days was recorded in T<sub>4</sub> (100% NPK+FYM+PSB) and  
121 T<sub>1</sub>(100% NPK), respectively. Earliness is one of the most desirable characteristics in pea as  
122 this will in turn lead to early maturity and helpful in fetching high returns from the early  
123 market. It was observed T<sub>4</sub> (100% NPK+FYM +PSB) resulted in lowest number of days to  
124 germination, days to first flowering, and days to 50% flowering. The application of inorganic,  
125 organic and biofertilizer might have resulted in increased carbohydrate accumulation and  
126 their remobilization to reproductive part of the plant, being the closet sink and hence,  
127 resulted in right time flowering [9]. The earliness of flowering may be attributed to the  
128 presence of biofertilizers which consequently lead to flower initiation, this may be due to  
129 easy uptake of nutrients and simultaneously transport of growth promoting substances like  
130 cytokinin to the auxillary buds resulting in breakage of apical dominance which eventually  
131 resulted in better sink for faster mobilization of photosynthesis and early transportation of  
132 plant parts from vegetative to reproductive parts [10]. Similar findings are supported by  
133 [11,12, 13] in pea, [14] in dolichos bean, [15] in cowpea and [16] in french bean.

134 Significantly maximum number of leaves per plant (43.44), number of branches per plant  
135 (13.50) and plant height (62.37cm) was recorded in T<sub>4</sub> (100% NPK+FYM+PSB) which was  
136 significantly highest among all the treatments. It was revealed that significantly lowest  
137 number of leaves per plant (28.38), number of branches per plant (7.19) and plant height  
138 (49.29cm) were observed in T<sub>1</sub> (100% NPK).

139 Number of leaves per plant has an important influence on the growth of plants, development  
140 and production. The highest number of leaves per plant with application of (100% NPK)

141 supplemented by FYM and PSB can be attributed to the early and higher availability of plant  
142 nutrients in a soluble and easily absorbable form. In addition, presence of biofertilizer could  
143 have increased the available status of both macro and micro nutrients. The results  
144 corroborates with the findings of [17, 18,12, 11, 19] in pea, [20] in french bean,[14, 21] in  
145 dolichos bean, and [16] in french bean.

146 Number of branches per plant is a yield contributing character as it leads to increase in  
147 number of flowers and fruit and thus promises better yield and productivity. The number of  
148 branches significantly increased with the application organic and biofertilizer. It was noticed  
149 that comparatively higher number of branches per plant were found in integrated nutrient  
150 management than single or no chemical fertilizer application practices as also reported by  
151 [22]. [23] who observed that higher growth parameters with application of inorganic, organic  
152 and biofertilizers in an integrated use could be due to high initial microbial load supported by  
153 sufficient quantity of organic carbon which was later used for microbial proliferation and  
154 consequently releasing the nutrients that readily assimilates, supporting the biotic principle of  
155 carbon sequestration through biomass production.The results are in close conformity with  
156 the findings of [24] in pea, [22, 25] in cowpea. [14] in dolichos bean and [26] in moong bean.

157 Plant height greatly affects the yield as it influences the number of nodes per plant which  
158 leads to increased yield. The plant height was highest where plants were supplemented with  
159 FYM and PSB along with 100% NPK. Increase in plant height with the supplementation of  
160 inorganic fertilizers with FYM+PSB could be attributed to the increased availability of  
161 nutrients especially N and P leading to stem elongation due to cell development, rapid cell  
162 division and cell elongation in meristematic region of plants [27].The results are in line with  
163 the findings of [28, 29] in pea, [20,16] in French bean, [30,26] in chickpea, [31] in black gram,  
164 [32,33] in green gram, [34] in pigeon pea, [14] in dolichos bean, [15] in cowpea and [26] in  
165 moong bean

### 166 **3.2Yield parameters**

167 Yield parameters as influenced by integrated use of different inorganic, organic and  
168 biofertilizers are presented in Table 2. The highest pod length (9.18cm),number of pods per  
169 plant (16.27), pod weight (8.49g), pod yield per plant (55.24 g), pod yield per plot (4.32  
170 kg)and shelling percentage % (52.50) was observed in T4 (100%NPK+FYM+PSB) which  
171 was significantly highest among all treatments. The lowest pod length (6.47cm), number of  
172 pods per plant (10.07), pod yield per plant (35.40 g) and pod yield per plot (1.29kg) was  
173 observed in T1(100% NPK) which was significantly lowest among all the treatments. Lowest  
174 pod weight(6.21g) was also observed in T1(100% NPK)which was statistically at par with T6

175 (75% NPK+ FYM+ PSB) (6.48g).The lowest shelling percentage (41.40%) was recorded in  
176 T1 (100% NPK) which was statistically at par with T11(75% NPK + FYM+ PSB) (41.97%).

177 Pod length (cm) is the yielding character which affects the yield and product appearance.  
178 Enhanced pod length with the application of integrated nutrient management could be  
179 attributed to improved soil physical, chemical and biological properties and thus leading to  
180 higher availability of all plant nutrients which in turn results in higher yield contributing traits  
181 like pod length. Similar results were observed by [13, 35,36] in pea, [22] in cowpea and [14]  
182 in french bean. The number of pods per plant is a prominent determination of yield in pea.  
183 The highest number of pods per plant was observed when integrated use of fertilizers was  
184 done i.e 100% NPK was supplemented by FYM and PSB. The hiked number of pods per  
185 plant might be ascribed by the higher scales of other growth parameters in the same  
186 treatment like number of leaves per plant and number of branches per plant leading to  
187 increased photosynthesis and increased number of pods per plant. Similar findings were  
188 observed by [4] who observed that with the application of PSB there was greater root  
189 extension under higher availability of phosphorous and organic manure which might have  
190 helped in greater uptake of other nutrients especially micronutrients and secondary nutrients,  
191 enhanced photosynthesis, and increased number of pods per plant in pea. The results are in  
192 conformity with the findings of [11, 12,13, 19, 28, 29,35, 37, 38, 39] in pea.

193 Pod weight has direct correlation with pod yield in pea. The improved pod weight with the  
194 combined application inorganic, organic and biofertilizers was probably due to adequate  
195 supply of nutrients and then availability which in turn helped in the photosynthesis and  
196 partitioning of photosynthesis as reported by [40].The results are in close conformity with the  
197 findings of [9, 39] in pea, [41] in cluster bean and[20] in french bean

198 The increase in pod yield per plant and per plot might have been due to the better  
199 performance of the yield attributes. The application of (100% NPK + FYM + PSB) resulted in  
200 highest plant height, number of branches, number of pods, pod length, pod weight which  
201 might have resulted in higher pod yield per plant. These may be due to the adequate and  
202 balanced supply of integrated application of organic sources with chemical fertilizers, plant  
203 received large amount of nutrients throughout their growth period and nourished properly  
204 which enhanced the yield of plant [4]. The increased yield with the integrated use of  
205 inorganic, organic and biofertilizers have also been reported by earlier researchers viz. [9, 35,  
206 37] in pea.

207 Shelling percentage is a yield contributing trait,higher shelling percentage represents the  
208 higher yield as it is the percentage of ratio of weight of green seeds to the weight of pods.  
209 The highest value of shelling percentage(50.92%) was observed with the application of

210 (100% NPK + FYM + PSB) which could be due to improved soil quality and availability of  
211 nutrients which further led to better translocation of photosynthesis resulting in better pod  
212 formation and grains. The results are supported by [13,42] in pea.

### 213 **3.3 Quality Parameters**

214 Total soluble solids (TSS) as influenced by integrated use of inorganic, organic and  
215 biofertilizers has been presented in Table 2. It revealed that highest value of TSS  
216 (16.48<sup>0</sup>B) was recorded in T4 (100% NPK+FYM+PSB) which was significantly highest among  
217 all the treatments. T1 (100% NPK) resulted in minimum TSS (12.36<sup>0</sup>B) which was  
218 statistically at par with T11(75%NPK+Vermicompost+PSB) resulting in TSS (12.77<sup>0</sup>B).

219 Total Soluble Solids (TSS) is the quality character which is enhanced in favourable way due  
220 to integrated use of organic, inorganic and biofertilizers. The highest value(16.48<sup>0</sup>B) of TSS  
221 was observed with the application of (100% NPK + FYM + PSB). Similar enhancement of  
222 TSS was also reported by [13,43] in pea who suggested that with the addition of FYM and  
223 PSB along with 100% NPK enhanced availability of phosphorous which is constituent of  
224 ADP, ATP and other higher energy compounds thus leading to increased level of  
225 polysaccharides and sugars in soyabean.

226 **Table 1. Effect of Integrated Use of Inorganic, Organic and Biofertilizers on growth of pea (*Pisumsativum* L.)**

227

Treatments	Days to germination	Days to first flowering	Days to 50% flowering	No. of leaves per plant	No. of branches per plant	Pod length (cm)	No. of pods per plant
T <sub>1</sub>	10.63	70.34	89.27	28.38	7.19	6.47	10.07
T <sub>2</sub>	9.34	65.24	84.23	30.17	10.24	7.51	12.36
T <sub>3</sub>	8.94	61.21	82.43	32.16	9.43	8.40	14.06
T <sub>4</sub>	7.25	59.33	78.26	43.44	13.50	9.18	16.27
T <sub>5</sub>	8.31	64.33	80.42	35.37	11.47	7.30	13.09
T <sub>6</sub>	9.43	67.06	83.38	33.08	8.56	7.22	12.50
T <sub>7</sub>	8.28	62.20	81.47	37.42	12.43	8.19	12.04
T <sub>8</sub>	9.35	66.26	83.33	30.22	10.55	8.03	15.53
T <sub>9</sub>	8.57	60.32	80.48	31.52	11.38	8.44	11.58
T <sub>10</sub>	9.23	63.00	79.31	32.58	12.43	8.74	14.57
T <sub>11</sub>	8.39	65.57	83.48	41.47	10.10	7.60	13.08
T <sub>12</sub>	9.24	63.32	81.26	39.50	9.22	8.21	12.23
T <sub>13</sub>	8.40	67.39	86.16	33.30	8.99	8.43	12.68
C.D.	0.43	0.57	0.51	0.52	0.46	0.35	0.43
SE(m)±	0.14	0.19	0.17	0.17	0.15	0.12	0.15

228 T<sub>1</sub> (100% NPK); T<sub>2</sub> (100% NPK+ FYM); T<sub>3</sub> (100% NPK+ FYM+ Azotobacter); T<sub>4</sub> (100% NPK+ FYM+ PSB); T<sub>5</sub> (75% NPK+

229 FYM+ Azotobacter); T<sub>6</sub> (75% NPK+ FYM+ PSB); T<sub>7</sub> (100% NPK+ Vermicompost); T<sub>8</sub> (100% NPK+ Vermicompost+

230 Azotobacter); T<sub>9</sub> (100% NPK+ Vermicompost+ PSB);T<sub>10</sub> (75% NPK+ Vermicompost+ Azotobacter); T<sub>11</sub> (75% NPK+  
 231 Vermicompost+ PSB); T<sub>12</sub> (FYM+ Vermicompost+ Azotobacter);T<sub>13</sub> (FYM+ Vermicompost+ PSB)

232

233 **Table 2. Effect of Integrated Use of Inorganic, Organic and Biofertilizers on yield and quality of pea (*Pisumsativum* L.)**

234

Treatments	Pod weight (g)	Plant height (cm)	Pod yield per plant (g)	Pod yield per plot (kg)	Shelling percentage (%)	TSS (°B)
T <sub>1</sub>	6.21	49.29	35.40	1.29	41.40	12.36
T <sub>2</sub>	7.52	52.96	42.35	2.29	45.25	13.64
T <sub>3</sub>	6.54	58.25	46.08	2.37	47.67	15.20
T <sub>4</sub>	8.49	62.37	55.24	4.32	52.50	16.48
T <sub>5</sub>	7.09	51.47	37.40	3.17	43.33	14.52
T <sub>6</sub>	6.48	53.70	39.32	3.39	49.56	13.20
T <sub>7</sub>	7.18	55.43	39.14	3.31	50.13	13.14
T <sub>8</sub>	7.41	57.26	50.48	3.26	42.26	12.25
T <sub>9</sub>	7.98	59.42	45.49	4.08	48.20	15.15
T <sub>10</sub>	8.56	60.55	52.28	2.38	50.92	14.05
T <sub>11</sub>	7.86	52.24	49.17	3.42	41.97	12.77
T <sub>12</sub>	7.68	53.52	38.24	2.61	46.65	15.32
T <sub>13</sub>	7.29	55.38	40.25	2.18	44.07	13.13
C.D.	0.31	0.51	0.48	0.40	0.62	0.44

SE(m) ±	0.10	0.17	0.16	0.13	0.21	0.15
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235 T<sub>1</sub> (100% NPK); T<sub>2</sub> (100% NPK+ FYM); T<sub>3</sub> (100% NPK+ FYM+ Azotobacter); T<sub>4</sub> (100% NPK+ FYM+ PSB);  
236 T<sub>5</sub> (75% NPK+ FYM+ Azotobacter); T<sub>6</sub> (75% NPK+ FYM+ PSB); T<sub>7</sub> (100% NPK+ Vermicompost); T<sub>8</sub> (100%  
237 NPK+ Vermicompost+ Azotobacter); T<sub>9</sub> (100% NPK+ Vermicompost+ PSB); T<sub>10</sub> (75% NPK+ Vermicompost+  
238 Azotobacter); T<sub>11</sub> (75% NPK+ Vermicompost+ PSB); T<sub>12</sub> (FYM+ Vermicompost+ Azotobacter); T<sub>13</sub> (FYM+  
239 Vermicompost+ PSB)  
240

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241 **4. CONCLUSION**

242 The results and discussion mentioned earlier about the effect of integrated use of inorganic,  
243 organic and biofertilizers on growth, yield and quality attributes of pea lead to the conclusion  
244 that use of inorganic, organic and biofertilizers plays an important role in terms of growth,  
245 yield and quality. Among all the treatments the use of FYM, NPK and PSB favoured growth,  
246 yield and quality.

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