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Response of Integrated Crop Management on Growth, Yield Attributes and Grain Yield of Field Pea (*Pisum sativum* L.)

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A B S T R A C T

A field experiment was conducted during *Rabi* season of 2021-22 at Oilseed Research Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur entitled "Response of integrated crop management on growth, yield attributes and grain yield of field pea (*Pisum sativum* L.)". Result showed that the treatment T_8 (INM+IWM+IPM) gave the significantly higher grain yield of field pea. The treatment T_8 recorded the highest plant height (75.61cm), number of branches (5.67), dry matter production per plant (27.86 g), number of pods per plant (16.65), number of grains per pod (5.56), 100-grain weight (17.10 g), grain yield (2621.65 kg/ha), straw yield (4024.25 kg/ha) and harvest index (39.46 %) in comparison to rest of other treatments. The minimum plant height (62.40 cm), number of branches (3.90), dry matter production per plant (17.80 g), number of pods per plant (10.20), number of grains per pod (3.92), weight of 100-grain (15.09 g), grain yield (1700.72 kg/ha), straw yield 3216.26 kg/ha) and harvest index (34.60 %) was recorded with the control.

Introduction

Pulses have been an essential part of human diet for centuries. It is rich in proteins minerals, having high fiber content, low fat content and no cholesterol. It plays diverse role in development of agriculture. It is very essential for future scenario for sustainable global agriculture. It fixes atmospheric nitrogen and improve the turnover of phosphorus, enhancing soil nutrient cycle and contributing to better production and it also increases the resilience of farming system and providing a better life to the farmers in water scarce environment.

Pulses are edible dry seeds of plants which belongs to Leguminosae family. It is consumed in the form of whole grain, split grain, dehulled split grain as well as flour. Major pulses grown all over world are common bean, chick pea, dry pea, lentil, mungbean, urd bean, and pigeon pea. Worldwide total pulse

production was recorded as 92.28 million tonnes in2018, of which the contribution of major pulses were dry beans (32.98), chick pea (18.63%), pea (13.53%), cowpea (7.83%), lentils (6.86%) and pigeon pea (6.455%) (FAO, 2018). As per FAO, 2020 data record, 92.32 million tonnes of pulses are produced on an area of94.748 million ha of land with average productivity of 974 kg/ha (FAOSTAT 2020). Pulses are grown in many countries in the world such as Canada, China, Myanmar, Nigeria, Russian federation, Brazil, Ethiopia, USA and Niger etc. Canada ranks second in production of pulses, which produce 8.49% of total world pulse production, after India. China, Myanmar, Nigeria, Russian federation contributes 5.73%, 4.75%, 4.27%and 3.95% respectively.

India is the major producer of pulses and ranks first in world. It contributes 25.44% of total production of pulse in world. It produced 21.542 m tonnes of pulses on an area of 30.903 mha with average productivity of 697 kg/ha. Among different states of India five major pulse producing states are Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh and Karnataka which produced 20.60%, 16.75%, 16.715, 9.97% and 8.25%, respectively with area coverage of 16.95%, 21.32%, 15.49%, 8.24% and 10.82%, respectively. Uttar Pradesh produced 2.38 million tonnes of pulses on an area of 2.47 million ha with average productivity of 1040 kg/ha. (Directorate of economics and statistics, GoI, Min. of Agri. & FW (DA&FW) 2020-21.

Field pea (*Pisum sativum* L.) is also known as Dry pea or Matar in India. It is an important winter season grain legume crop largely confined to cooler region and belongs to family Leguminosae. It is a diploid species with 2n=14 chromosomes.

It is most popular *Rabi* pulse in India after chickpea and lentil. The most probable center of origin of pea is Mediterranean region of Europe and Western Asia (Prasad, 2018). Field pea provides a variety of vegetarian diet hence served throughout the world. It is mainly grown for tender green pods as a fresh vegetable and is a rich source of carbohydrate (62.1%), protein (22.5%), fat (1.8%), calcium (64mg/100g), phosphorous, iron (4.8mg/100g), vitamins A and C; also have amino acids lysine and tryptophan. it is an economically important grain legume and is grown in many countries of the world for both human consumption and provender.

Field pea is the third most important pulse crop at global level, after dry bean and chick pea. In global scenario the area of field pea is 78.78 lakh hectare and the world field pea production is 135.34 lakh tonnes. The productivity of field pea on global level is 1717.96 kg/ha. According to FAO Statistics 2018, the top five field pea growing country in the world are Canada, followed by the Russian Federation, China, India and Ukraine. Canada ranks first in area (18%) and production (26%) at Global level. India occupies 4th position in both area (9.98%) and production (7%) (FAOSTAT, 2018).

Uttar Pradesh, Madhya Pradesh, Jharkhand, Rajasthan and Assam are the top five field pea producing states in India. Uttar Pradesh is a major field pea growing state. It alone produces 3.98 lakh tonnes of field pea which is 45% of total field pea production of India, on an area of about 3.43 lakh ha which is 39% of total field pea area in India. The productivity of field pea in Uttar Pradesh is 1161 kg/ha. The area of field pea in Madhya Pradesh is 3.30 lakh ha (38%) having production 2.72 lakh tonnes with the productivity 825 kg/ha. Himachal Pradesh have highest productivity per hectare among major field pea growing states which is 2825 kg/ha (DPD Statistics Report 2020-21).

Field pea fixes atmospheric nitrogen through root nodules and improves soil health. Several abiotic and biotic factors affect the field pea production. Abiotic factors *viz.* rainfall, temperature, humidity, sunshine hours etc. and biotic factors such as insects, weeds and diseases. Abiotic factors are difficult to manage by human being but biotic factors can be managed. Several diseases such as powdery mildew, downy mildew, wilt, rust etc. and insects such as pea weevil, pea aphid, American boll worm, spiny pod borer etc. affects the field pea

production. Chemical controls are the only strategy being currently adopted by the farmers and rely on synthetic organic insecticides to manage the insect-pests in pulse crops. This increases the risk of environmental contamination, loss of biodiversity and development of insecticide resistance in pod borer, pod fly and other pests. To overcome the present crisis, the farmer to be paid more attention to integrated approach for pest management (Singh *et al.*, 2022).

In this experiment, to supply nutrient to crop integrated nutrient management is studied. Integrated nutrient management (INM) act as source of energy, organic carbon, and nutrient for growth of soil microbes and improvement of physical properties of soil and also have great effect on crops.

Today we have a big problem that farmer says their field soil not able to take nutrients from soil. This is because their regular use of chemical and pesticides more and more. So, the INM is technique of using minimum effective dose of sufficient and balanced quantities of organic and inorganic fertilizer with microorganism.

This makes nutrients to more available and most effective for high yield (Bhatia *et al.*, 2022). These are collectively known as integrated crop management. Integrated crop management is one of the ways which increases the production as well as sustainability. Amongst the different agro-techniques required to raise the production of field pea, a timely carried out crop management has emerged as one of the major constraints of production.

In recent years due to increased labour cost and their non-availability for weeding, insect-pest and disease management at peak requirement, the use of integrated crop management in field pea is indispensable. Integrated crop management is a pragmatic approach to the production of crops (Sharma *et al.*, 2021). Keeping this in view, the present experiment is conducted during the *Rabi* crop season of Agricultural year 2021-22.

Materials and Methods

The experiment was conducted during the *Rabi* season of 2021-22 at oilseed research farm, Kalyanpur of Chandra Shekhar Azad University of Agriculture and Technology Kanpur (UP). It is located on 26° 29'40" N latitude, 80° 15' 54" E longitude and the altitude from mean sea level is about 126 meters. This region falls in subtropical zone of Indo gangetic plain and is on right bank of the holy Ganga River. The normal timing for the onset of monsoon in this region is the fourth week of June which lasts up to the end of September. Occasionally, it extends to the first week of October. However, showers are also occurring during winter season too. The summer season is dry and hot with temperature ranging between 35 and 45°C during the day. The average annual rainfall is about 885.6 mm in which 88.70% rainfall is received during July to September. The soil of experimental field was sandy loam in texture, pH is slightly alkaline (7.72), low in organic carbon (0.45%), available nitrogen (202.5 kg/ha), available phosphorus (17.5 kg/ha) and available potassium (185 kg/ha). The experiment was laid out in Randomized Block Design with three replications. Treatments viz. T_1 (Control), T_2 INM (40:50:20:20 NPKS + *Rhizobium* + PSB), T_3 IWM (Pendimethalin @ 1kg. a.i./ha + HW 30 DAS), T_4 IPM {Seed treatment with Thiram @ 2 g/kg seed + 2 spray of insecticide (Profenofos 2 ml/l)}, T_5 (INM+IWM), T_6 (INM+IPM), T_7 (IWM+IPM) and T_8 (INM+IWM+IPM). Thus, total eight treatments were replicated thrice. The field pea variety KPMR 400 (Indra) was sown on November 30, 2021 at 30 cm apart in rows and harvested on march 25, 2022. Proper irrigation was applied and other cultural operations were as per the treatment. After sowing the observation related to growth, yield attributes and yield were recorded at different intervals as and when required. Plant height were measured at 30 DAS, 60 DAS, 90DAS and at harvest. Number of branches were recorded at 30 DAS, 60 DAS and 90 DAS. Dry matter production per plant was recorded at 30DAS, 60 DAS, 90DAS and at harvest. Yield attributes such as number of pods per plant, number of grains per pod, weight of 100-grain was recorded

at the time of harvesting. Grain yield and straw yield of crop was recorded after harvesting of crop of a particular plot after that converted into kg/ha. Harvest index was calculated by using following formula:

$$\textbf{Harvesting Index} = \frac{\text{Grain yield (kg/hg)}}{\text{Grain yield (kg/ha)}} \textbf{ x 100}$$

Results and Discussion

Growth parameters

The growth parameters *e.g.*, plant height, number of branches and dry matter production per plant are discussed individually. The height of plant continuously increased with the advancement in the age of crop irrespective of the different treatments. There was variation in the height of plant at different growth stages due to different treatments. But maximum height achieved in treatment T_8 (INM+IWM+IPM) at different growth stages of plant and the minimum height of plant was in control. Maximum increment in number of branches per plant was recorded at 60 DAS which showed a significant increment from 30 DAS and number of branches was almost stagnant at 90 DAS.

Around equal number of branches were obtained due to treatment T_8 (INM+IWM+IPM) and T_5 (INM+IWM) at different growth stages of plant. There was increase in Dry matter production per plant on advancement of plant stages. Highest dry matter was obtained in treatment T_8 (INM+IWM+IPM) followed by T_5 (INM+IWM).

From the above discussed experimental findings, it was observed that growth parameters *viz*. plant height, number of branches per plant, Dry matter accumulation, influenced by different management practices. Among the different management practices, significantly maximum growth attributes were found with the treatment T_8 (INM+IWM+IPM) which was statistically at par with (INM+IWM) and superior over the rest of the treatments.

Yield attributes

The yield attributes e.g., number of pods per plant, number of grains per pod and 100-seed weight, was influenced by different management practices. All yield attributes were increased with the application of treatment T_8 (INM+IWM+IPM) over the rest of the treatments.

Maximum number of pods per plant was obtained in treatment T_8 (INM+IWM+IPM) which was 63.23 % higher over control. Number of grains per pod was recorded maximum in T_8 (INM+IWM+IPM) among all the treatments, which was 41.83 % higher over control treatment. The 100-seed weight of field pea was weighed maximum in treatment T_8 (INM+IWM+IPM) which was 13.31% higher in comparison to control.

Yield

The significantly maximum grain yield was recorded under management practice INM+IWM+IPM followed by management practice INM+IWM which was 54.14 % and 39.14 % higher over control, respectively. The highest straw yield was recorded in T_8 (INM+IWM+IPM), 25.12 % higher over control.

The maximum value of harvest index was calculated in T_8 (INM+IWM+IPM) (39.46 %) followed by T_5 (INM+IWM) (38.83 %).

The treatment (INM+IWM+IPM) consist of RDF along with *Rhizobium* +PSB, Pendimethalin application + one hand weeding at 30 DAS and Seed treatment with Thiram @ 2g/kg + 2 spray of insecticide. From the above results it may be concluded that growth parameters such as height of plant, number of branches and dry matter production per plant was increased with integration of all the practices *viz.* INM+IWM+IPM. Similar result was found in yield attributes (number of pods per plant, number of grains per pod and weight of 100-grains) and yield of field pea, means treatment T_8 (INM+IWM+IPM) was found superior among all treatments.

Table.1 Growth and yield attributes influenced by different treatments.

Treatments	Plant height (at harvest)	Number of branches at 90 DAS	Dry matter production At harvest (gm)	Number of pods per plant	Number of grains per pod	Weight of 100 grain
T_1 Control	62.40	3.90	17.80	10.20	3.92	15.09
T_2 INM	68.64	4.20	22.79	12.47	4.28	16.56
T_3 IWM	68.69	4.39	21.43	12.34	4.19	16.32
T_4 IPM	65.29	4.06	18.58	11.69	4.00	15.76
T_5 INM+IWM	73.69	5.62	27.48	16.14	5.25	17.02
T_6 INM+IPM	71.37	4.93	26.74	14.93	5.02	16.91
T_7 IWM+IPM	70.11	4.76	24.95	13.62	4.70	16.40
T_8 INM+IWM+IPM	75.61	5.67	27.86	16.65	5.56	17.10
SEm ±	0.57	0.05	0.27	0.16	0.05	0.18
C.D. at 5%	1.757	0.169	0.847	0.492	0.164	0.569

Table.2 Influence of different treatments on yield.

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest Index (%)
T_1 Control	1700.72	3216.26	34.60
T_2 INM	2010.11	3482.68	36.59
T_3 IWM	2009.14	3436.11	36.89
T_4 IPM	1950.92	3424.33	36.29
T_5 INM+IWM	2366.54	3730.43	38.83
T_6 INM+IPM	2071.06	3649.96	36.20
T_7 IWM+IPM	2047.24	3625.30	36.10
T_8 INM+IWM+IPM	2621.65	4024.25	39.46
SEm ±	23.66	2.72	0.55
C.D. at 5%	72.46	8.33	1.67

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