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Effect of Integrated Crop Management Practices on Growth, Seed Yield and Economics of Field Pea (*Pisam sativum* L.)

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ABSTRACT

Background: Field pea (*Pisam sativum* L.) has high yield potential and is grown for food, feed and vegetable. To meet the need of pulses in human diet, the use of integrated crop management practices is indispensable. Therefore, integrated crop management practices are the only option for increasing the field pea production and sustainability. The current study aimed to study the effect the different crop management practices on growth, seed yield and economics of field pea crop.

Methods: In this field experiments were conducted during rabi 2013-14 to 2015-16 at Research Farm of Pulse Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar. The experiment consisted of eight crop management practices *viz*. control, NM (Nutrient Management): RDF (20:40 kg NP ha^{-1}), WM (Weed Management): Pendimethalin @ 1.0 kg a.i. ha^{-1} + one hand weeding at 30 DAS), PM (Pest Management): spray of quinalphos 25 EC one litre per ha in 250-300 litres of water as and when required, NM + WM, NM + PM, WM + PM, NM + WM + PM was laid out in a randomized block design with three replications.

Result: Our investigations under field study revealed that significantly taller plants and higher plant height, number of branches per plant, number of pods per plant, 100 seed weight, seed and straw yield were recorded under integration of NM + WM + PM being at par with that of integration of NM + WM over remaining crop management practices either singly or in combinations of both or control. Integration of NM + WM + PM recorded lower weeds dry weight (42.9 kg ha^{-1}) at harvest and higher weed control efficiency (92.2%) compared to all other crop management practices. The practice of integration of NM + WM + PM gave highest net returns of `49196 ha^{-1} compared to other crop management practices.

Key words: BC ratio, Field pea, Nutrient management, Pest management, Seed yield, Weed management, Yield attributes.

INTRODUCTION

Pulses are an integral part of many diets across the world and they have great potential to improve human health, conserve our soils, protect the environment and contribute to global food security. India is the largest producer (25% of global production), consumer (27% of world consumption) and importer (14%) of pulses in the world. Pulses account for around 20 per cent of the area under food grains and contribute around 7-10 per cent of the total food grains production in the country. Pulse grains are an excellent source of protein, carbohydrates, dietary fibre, vitamins, minerals and phytochemicals. Most of the people consume pulses as staple food in combination with cereals and depends on them for meeting their protein requirement. The high lysine and folate content makes pulses perfect for making the composite flours with cereals. In India, the area under pulses was >29 million ha with the total production of 25.23 million tonnes at a productivity of 841 kg ha^{-1} during 2017-18 (Anonymous, 2018). Field pea (*Pisum sativam* L.), one of the important pulse crop of winter season has great potential to contribute to the pulse basket in India. It provides protein rich food for majority of Indians. The major constraints that hinder the realization of potential yield of field pea in our country are well known. These include unavailability of the quality seeds of improved varieties in required quantities, traditional cultivation practices, improper weed management, inadequate supply of nutrients and biotic and abiotic stresses prevailing in the field pea growing areas besides the socio-economic factors. 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. Unlike integrated pest management which focuses on crop protection, integrated crop management includes more aspects. Yield of field pea can be increased by adopting improved varieties, fertilizer management, weed management, integrated pest management module (Ali and

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Kumar, 2007). In present study, different crop management practices either singly or in combinations were tested in field pea crop. The experiments were conducted with the objective to study the effect of different crop management practices on growth, seed yield and economics of field pea crop.

MATERIALS AND METHODS

Field experiments were conducted at Pulse Research Farm, Department of Genetics and Plant Breeding, Chaudhary Charan Singh Haryana Agricultural University, Hisar during 2013-14 to 2015-16 (20°-10′N, 75°-46′E and 215.2 m above mean sea level). A pre-sowing irrigation was given in the first week of November during respective years to facilitate proper ploughing and to ensure adequate soil moisture for seed germination, establishment and subsequent plant growth. The total rainfall received during the crop growing season was 70 mm, 148.7 mm and 30.5 mm during 2013-14, 2014-15 and 2015-16, respectively. The sandy loam soil of the experimental field was low in organic carbon (0.39%), available N (135 kg ha^{-1}), medium in available P (14.1 kg ha^{-1}) and high in available K (412 kg ha^{-1}) with pH 8.2. The experiment consisted of eight crop management practices *viz*. control, NM (Nutrient Management): RDF (20:40 kg NP ha^{-1}), WM (Weed Management): Pendimethalin @ 1.0 kg a.i. ha^{-1} + one hand weeding at 30 DAS), PM (Pest Management): spray of quinalphos 25 EC one litre per ha in 250-300 litres of water as and when required, NM + WM, NM + PM, WM + PM, NM + WM + PM was laid out in randomized block design with three replications. Gross and net plot sizes were 4.5 m x 4.0 m and 3.9 m x 3.0 m, respectively. HFP 715 genotype of field pea was sown during the third week of November and harvested in second week of April during the respective years. The seeds were sown in lines at 30 cm apart with recommended seed rate of 75 kg ha^{-1}. The recommended dose of fertilizers was applied as per treatments before sowing and irrigation was done as per requirement of the crop. The data on growth and yield attributes *viz*., plant height, number of branches, pods per plant and yields were recorded at maturity. Since similar trend was noticed during all the years, the data pertaining to all the three years were pooled. The economics of the treatments was worked out considering the prevailing cost of inputs and outputs. All the results were then analyzed statistically for drawing conclusion using Analysis of Variance (ANOVA) procedure.

RESULTS AND DISCUSSION

Growth and yield attributes

All the crop management practices either singly or in combinations had a significant effect on number of branches per plant, number of seeds per pod and 100 seed weight compared to control while the effects were non-significant on number of seeds per pod (Table 1). The plant height of field pea was significantly higher in treatments having combination of NM + WM, NM + PM, WM + PM and NM + WM + PM compared to control. Integration of NM + WM + PM practices being at par with that of NM + WM recorded significantly higher plant height, number of branches per plant, number of pods per plant and 100 seed weight of field pea than remaining crop management practices. Higher values of growth and yield parameters in the treatment having integration of NM + WM + PM were the result of better supply of all the essential nutrients in a balanced amount that resulted in better crop growth and development (Khan *et al.,* 2009). The lowest values of these attributes were, however, recorded under control owing to inadequate nutrient supply. In pulse crops number of pods per plant is the most important determinant of seed yield. The number of pods per plant ranged from 12.0 in control plot to 17.0 in treatment having integration of NM + WM + PM practices. This may be attributed to better crop growth environment along with less crop weed competition in these treatments than control. The results confirm the findings of Suresh (2015) and Pedde *et al.* (2013)

Number of seeds per pod is another important yield component of field pea. All the crop management practices had non-significant effect on number of seeds per pod. The

Table 1: Effect of different treatments on growth, yield attributes and weeds dry weight of field pea.

Treatments	Plant height (cm)	Number of branches per plant	Number of pods per plant	Number of seeds per pod	100 seed weight (g)	Weeds dry weight at harvest (kg/ha)	Weed control efficiency (%)
Control	81.4	1.3	12.0	4.5	17.1	550.5	-
Nutrient management (NM)	86.7	1.6	14.4	5.1	18.4	321.1	41.7
Weed management (WM)	86.0	1.6	13.2	4.8	18.2	92.6	83.2
Pest management (PM)	84.8	1.5	13.7	5.0	18.0	337.1	38.8
NM + WM	93.9	1.8	16.1	5.2	18.8	72.7	86.8
NM + PM	88.9	1.7	15.2	5.1	18.6	327.3	40.5
WM + PM	89.5	1.7	14.3	4.9	18.3	97.2	82.3
NM + WM + PM	95.8	1.9	17.0	5.4	19.4	42.9	92.2
CD at 5%	5.8	0.2	1.1	NS	0.8	31.1	

NM (Nutrient Management): RDF (20:40 kg NP ha^{-1}), WM (Weed Management): Pendimethalin @ 1.0 kg a.i. ha^{-1} + one hand weeding at 30 DAS), PM (Pest Management): spray of quinalphos 25 EC one litre per ha in 250-300 litres of water as and when required.

Table 2: Effect of different treatments on seed yield and economic returns of field pea.

Treatments	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)	Attraction index	Seed yield % increase over control	Seed yield % decrease over full package	Net returns (` ha^{-1})
Control	1799	3072	36.9	58.5	-	31.2	29719
Nutrient management (NM)	2231	3551	38.6	62.8	24.0	14.7	41511
Weed management (WM)	2110	3484	37.7	60.6	17.3	19.3	36610
Pest management (PM)	2040	3431	37.3	59.4	13.4	22.0	36340
NM + WM	2421	3754	39.2	64.5	34.6	7.4	43951
NM + PM	2282	3588	38.9	63.6	26.8	12.8	40892
WM + PM	2216	3542	38.5	62.6	23.2	15.3	38096
NM + WM + PM	2616	4002	39.5	65.4	45.4	-	49196
CD at 5%	207	312					

NM (Nutrient Management): RDF (20:40 kg NP ha^{-1}), WM (Weed Management): Pendimethalin @ 1.0 kg a.i. ha^{-1} + one hand weeding at 30 DAS), PM (Pest Management): spray of quinalphos 25 EC one litre per ha in 250-300 litres of water as and when required.

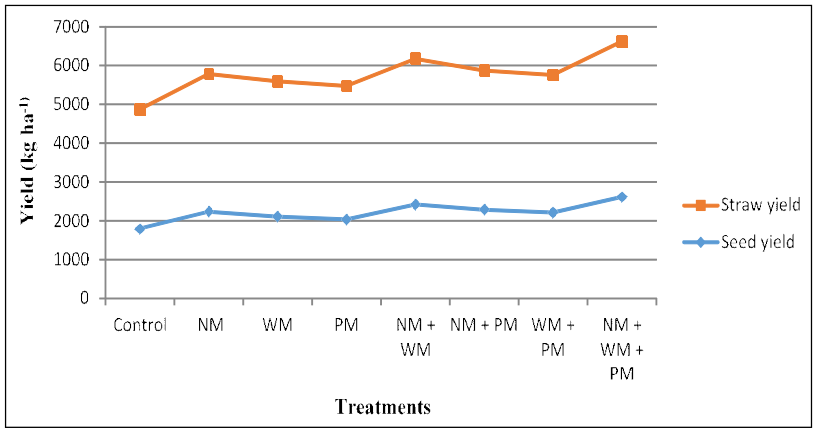


Fig 1: Effect of crop management practices on seed and straw yield of field pea.

number of seeds per pod varied from 4.5 in control plot to 5.4 in treatment having integration of NM + WM + PM practices. Variation in 100 seed weight of field pea from 17.1 to 19.4 g was also recorded from different crop management practices. Increase in growth and yield attributes of field pea was also recorded when integration of crop management practices of field pea was applied (Kumari *et al*., 2012).

Weeds dry weight

Different crop management practices had significant effect on weeds dry weight at harvest of field pea crop compared to control (Table 1). Weeds always compete with crop for nutrient, water and light which significantly affect the growth and development of crops and ultimately reduced the yield depending upon the severity of the weeds. The treatment having integration of NM + WM + PM being at par with NM + WM recorded least and significantly lower weeds dry weight (42.9 kg ha^{-1}) at harvest over rest of the treatments. Highest weed control efficiency (WCE) of 92.2% was recorded in treatment having integration of NM + WM + PM followed by NM + WM treatment. Herbicides showed significant reduction in weed growth thereby facilitated vigorous crop growth, increased photosynthesis and biomass accumulation and ultimately helped to smother weeds resulted in higher weed control efficiency (Awal and Roy, 2015).

Seed yield

Different crop management practices significantly influenced the seed and straw yield of field pea (Table 2 and Fig 1). Integration of NM + WM + PM practices being at par with that of NM + WM recorded significantly higher seed and straw yield of field pea compared to all other treatments. The trend observed for yield attributes perpetuated to build up the final outcome in terms of seed yield. Further, the nutrient management also facilitated a greater economic sink capacity as the yield had a highly significant correlation with yield attributes (Kushwaha 1994). In field pea, seed yield was most affected by nutrient management (NM) treatment as a single factor followed by weed management (WM) and pest management (PM). The increase in seed yield due to NM, WM and PM was recorded 24.0, 17.3 and 13.4 per cent over control (1799 kg ha^{-1}), while the decrease in seed yield was 31.2, 14.7 and 19.3 per cent over full package (NM + WM + PM) i.e. 2616 kg ha^{-1}, respectively. Among the single management practices, nutrient management recorded 24.0, 5.7 and 9.4 per cent increase in seed yield of field pea over control, weed management (WM) and pest

management (PM) treatments, respectively. The results are in conformity with the findings of Qureshi and Bashir (2016). Among the combined application of two treatments, NM + WM produced 6.1 and 9.2% more seed yield over NM + PM and WM + PM treatments, respectively. The increase might be due to improved photosynthetic efficiency, plant properties and better utilization of nutrients, moisture, light and space (Kumari *et al*., 2012). The increase in seed and straw yield due to integration is a clear reflection of increase in growth and yield attributes as the integrated crop management helps in better dry matter partitioning, increase net photosynthetic and nitrate reductase activity. The results are in conformity with the findings of Suresh (2015). Integration of NM + WM + PM practices recorded significantly 45.4 and 30.3% higher seed and straw yield over control. Crop performance was poor in control plot thus the yield recorded per hectare was lower than that obtained in other treatments. The results are in conformity with the findings of Rana *et al.* (2015) and Tripathi (2016). All the crop management practices had higher harvest and attraction index of field pea compared to control plot. However, highest harvest and attraction index was recorded in treatment having integration of NM + WM + PM followed by NM + WM practices. Similar results were also reported by Chaubey *et al.* (2016) and Corre-Hellou and Crozet (2005).

Economics

Among the various crop management practices, integration of NM + WM + PM practices produced higher net returns of ` 49196/ha over other crop management practices. This is in conformity with the results obtained by Khan *et al*., 2009. Thus, crop management practice of involving NM + WM + PM was the most remunerative for field pea. Among the single factor of production, NM (Nutrient Management): RDF (20:40 kg NP ha^{-1}) produced higher net returns of ` 41511/ ha over other single crop management practices

CONCLUSION

Based on the experimental findings it can be concluded that integration of NM (Nutrient Management): RDF (20:40 kg NP ha^{-1}) + WM (Weed Management): Pendimethalin @ 1.0 kg a.i. ha^{-1} + one hand weeding at 30 DAS) + PM (Pest Management): spray of quinalphos 25 EC one litre per ha in 250-300 litres of water as and when required is beneficial in terms of crop productivity of field pea.

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