

Effect of different fertilizers with intercropping on quality and yield on maize (*Zea mays* L.) and cowpea (*Vigna unguiculata* L.)

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Abstract

A field experiment was conducted at Campus for Research and Advanced Studies, Dhablan, P.G. Department of Agriculture, G.S.S.D.G.S Khalsa College, Patiala during Zaid season 2022-2023. The experiment was conducted in Split Plot Design (SPD) and total 15 treatments which were replicated three times. The treatment in main plot consisted of three intercropping with cowpea crop IC_1 (5:1), IC_2 (2:1) and IC_3 (3:1) and in sub plots five different organic manures and different levels of fertilizers. F_1 100% RDF, F_2 75% RDF + 10 t FYM ha^{-1} , F_3 50% RDF + 5 t FYM ha^{-1} + 2 t VC ha^{-1} , F_4 50% RDF + 5 t FYM ha^{-1} + 2 t PM ha^{-1} , F_5 50% RDF + 5 t FYM ha^{-1} + 2 t VC ha^{-1} 2 t PM ha^{-1} . Soil of the experiment field was clayey in texture had soil pH 7.45 (slightly alkaline), medium organic carbon, low in available nitrogen, medium in available phosphorous and high in available potassium. A data revealed that three intercropping with organic manures and levels of RDF both significantly influenced the growth parameters, yield parameters, quality parameters and economic parameters like gross return and net return was significantly highest at IC_2 maize + cowpea (2:1) with organic manures and different levels of RDF F_5 (50% RDF + 5 t FYM ha^{-1} + 2 t VC ha^{-1} + 2 t PM ha^{-1}) at all stages.

Key words: RDF Recommended dose of fertilizers, FYM farm yard manure, VC Vermicompost, PM poultry manure, IC intercropping

Introduction

Maize (*Zea mays* L.) is the world's most important cereal, providing as both human food and cattle feed. It is thought to have originated in Central America. It is a miracle crop. It is highly valued cereals in the world that is why it is known as "Queen of cereals". It is an important source of carbohydrates (70.4%), protein (10%), oil (4%), crude fiber (2.3%), albuminoids (10.4%). The maize crop is consumed by human and animals. Green cobs

are roasted and consumed by people. India has 6th rank in global maize production. In India, maize is the third important crop after rice or wheat, 70% of the feed industries depend on the maize crop. In India, the average area is 9.76 million hectares with production of 26.14 million tons and having productivity 2629.28 kg ha^{-1} (Mishra *et al.* 2019). Cowpea (*Vigna unguiculata* L.) commonly known as "Lobia" is used as pulse crop, a fodder and green

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manure crop. It is also known as black eye pea (Kaviraj *et al.* 2017). It is rich in protein that's why it is called vegetable meat. It is rich source of calcium and iron. In India the area under cowpea is 3.9 million hectares with annual production of 2.21 million tones with a national productivity of 638 kg ha⁻¹. Total seed protein content ranges from 23.2% to 32%. They are having high carbohydrates (60.3%) and fiber content (1.08%). The main objective of intercropping has been to maximize use of resources such as space, light and nutrients (Li *et al.* 2003) as well as to improve crop quality and quantity. Cereal and legume intercropping is more productive and profitable cropping system in comparison with solitary cropping (Evans *et al.* 2001).

Materials and Methods

The present experiment was carried out during *Zaid* season of the year 2022-2023 at Agronomy Research Farm Dhablan, Patiala. The experimental site is situated at about 30°19' North Latitude and 76°24' East Longitude at an altitude of about 250 m above the mean sea level. It is located in south eastern direction in Punjab state and North West India. The experiment site falls in Indo-Gangetic plains. During growing season (February to June), the weekly maximum and minimum temperature ranged from 24.7 °C – 44.4 °C and 10.4 °C – 27.7 °C, respectively. The average relative humidity ranged 90.2% to 43.0%. The total rainfall received during the crop period was 17.3 mm. The soil of experiment site was clayey having 0.71% organic carbon, 246.64 kg ha⁻¹, 21.6 kg ha⁻¹ and 282 kg ha⁻¹ of available N, P₂O₅, K₂O respectively. The experiment was laid out in a SPD (split plot design) and replicated thrice. The main plot having three intercropping and the sub plot having five organic manures and different levels of fertilizers. The intercropping IC₁ (5:1), IC₂ (2:1), IC₃ (3:1). The fertilizer levels F₁: 100% RDF, F₂: 75% RDF +10 t FYM ha⁻¹, F₃: 50% RDF +5 t FYM ha⁻¹ + 2 t VC ha⁻¹, F₄: 50% RDF +5 t FYM ha⁻¹ + 2 t PM ha⁻¹, F₅: 50% RDF +5 t FYM ha⁻¹ + 2 t VC ha⁻¹ + 2 t PM ha⁻¹. The maize and cowpea were sown in lines, row to row spacing is 45 cm and plant to plant spacing is 25 cm. The seed rate of Maize (20 kg ha⁻¹) or

Cowpea (18 kg ha⁻¹). Maize variety is (1899) or Cowpea (S 263). The data recorded for all the parameters. Harvesting is done after cobs had turned brownish and grain hardened. The harvesting of cowpea was done manually with the help of sickle when pods were matured (when nearly 75% pods had turned brown). Shelling of cobs was done and grains were kept in bags treatment. Threshing was done by beating the bundle with sticks. Seeds were separated by winnowing and kept treatment wise in bags.

Results and Discussion

Quality parameters

Protein content (%)

Protein content (%) of maize seeds did not differ significantly by different treatments (Table 1). It is crystal clear from the data that, different treatments failed to show significant effect on the protein content of maize seeds as it ranged (10.07% to 11.37%). However, the maximum protein content were observed (11.37%) with IC₂ maize + cowpea (2:1). Different levels of fertilizers or organic manures the highest protein content (11.36%) with F₅ (50% RDF + 5 t FYM ha⁻¹ + 2 t VC ha⁻¹ + 2 t

Table 1: Effect of different fertilization on protein content of maize (%) with cowpea intercropping

Treatment	Protein content (%)
Main plot Intercropping	
IC ₁ : Maize + Cowpea (5:1)	10.15
IC ₂ : Maize + Cowpea (2:1)	11.37
IC ₃ : Maize + Cowpea (3:1)	10.81
SEm(±)	0.10
CD 5%	0.38
Sub plot (Fertilizers)	
F ₁ : 100% RDF	10.07
F ₂ : 75% RDF +10 t FYM ha ⁻¹	10.42
F ₃ : 50% RDF +5 t FYM ha ⁻¹ + 2t VC ha ⁻¹	10.87
F ₄ : 50% RDF +5t FYM ha ⁻¹ +2 t PM ha ⁻¹	11.15
F ₅ : 50% RDF +5 t FYM ha ⁻¹ + 2 t VC ha ⁻¹ +2 t PM ha ⁻¹	11.36
SEm(±)	0.27
CD 5%	0.78

Table 2: Effect of different fertilization on yield parameters of maize with cowpea intercropping

Treatments	Yield parameters	
	Seed yield (q ha ⁻¹)	Stover yield (q ha ⁻¹)
Main plot Intercropping		
IC ₁ : Maize + Cowpea (5:1)	42.94	60.39
IC ₂ : Maize + Cowpea (2:1)	45.27	66.63
IC ₃ : Maize + Cowpea (3:1)	45.02	63.39
SEm(±)	0.07	0.10
CD 5%	0.29	0.40
Sub plot (Fertilizers)		
F ₁ : 100% RDF	43.48	61.24
F ₂ : 75% RDF +10 t FYM ha ⁻¹	44.22	62.40
F ₃ : 50% RDF +5 t FYM ha ⁻¹ + 2t VC ha ⁻¹	44.53	62.98
F ₄ : 50% RDF +5t FYM ha ⁻¹ +2 t PM ha ⁻¹	44.74	63.47
F ₅ : 50% RDF +5 t FYM ha ⁻¹ +2 t VC ha ⁻¹ +2 t PM ha ⁻¹	45.09	67.27
SEm(±)	0.11	0.51
CD 5%	0.32	1.48

PM ha⁻¹). At par values were (11.15 %) and (10.87 %) with F₄ (50% RDF + 5 t FYM ha⁻¹ + 2 t PM ha⁻¹) and F₃ (50% RDF + 5 t FYM ha⁻¹ + 2 t VC ha⁻¹). This is due to the combined application of organic manures, levels of RDF with intercropping of legume crop which led to more accumulation nitrogen in seeds due to increased activity of nitrate enzyme. Nitrogen is the main constituent of amino acids which are the building blocks of proteins. Therefore, it led to increase in protein content of maize seeds. The similar results were observed by Singh *et al.* (2005) and Verma *et al.* (2005).

Yield parameters

The data on seed yield and stover yield was increased with the organic manure and different levels of fertilizers with intercropping (Table 2). The maximum seed yield (45.27 q ha⁻¹) and stover yield (66.63 q ha⁻¹) were recorded with IC₂ maize + cowpea (2:1) and also seed yield (45.09 q ha⁻¹) and stover yield (67.27 q ha⁻¹) with F₅ (50% RDF + 5 t FYM ha⁻¹ + 2 t VC ha⁻¹ + 2 t PM ha⁻¹). The reason behind this proper vegetative and reproductive growth is better with combined application of fertilizers and manures with intercropping. These also stimulated the various physiological process and

metabolic activities which gave better growth and yield of crop.

Conclusion

On the basis of obtained results from the field experiment, it can be concluded that maximum quality parameters and yield parameters was achieved when the crops intercrop with IC₂ maize + cowpea (2:1) also with F₅ (50% RDF + 5 t FYM ha⁻¹ + 2 t VC ha⁻¹ + 2 t PM ha⁻¹). Further, the maximum gross return, net return and B:C ratio was obtained application of different organic manures and fertilizers levels with intercropping. Above conclusion are however, based on a single season research and it needs further confirmations by repetition of research trail draw valid and definite conclusion.

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