

Field performance of maize under pulses based intercropping

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Abstract

A field investigation was carried out during *Kharif* season (June to October, 2019), to find out the suitable combination of intercrops for sustainable maize production. The experiment was laid out in Randomized Block Design. Five treatments *viz.*, T₁ - Maize alone, T₂ - Maize + Black gram, T₃ - Maize + Green gram, T₄ - Maize + Cowpea, T₅ - Maize + Soybean with four replications were tested. The production efficiency indices of maize intercropping system *viz.*, Total Maize Equivalent Yield (TMEY), Production efficiency, Economic efficiency, total nutrient uptake and total nutrient efficiency ratio were recorded. Among the different treatments, T₂ - Maize + Black gram recorded the higher production efficiency indices *viz.*, Total Maize Equivalent Yield (3394 kg ha⁻¹), Production efficiency (32.33 kg ha⁻¹ day⁻¹), Economic efficiency (357.71 Rs. ha⁻¹ day⁻¹), total nutrient uptake (147.65, 28.55 and 167.16 kg N, P and K ha⁻¹) and total nutrient efficiency ratio (36.18, 172.25 and 35.49 kg N, P and K kg⁻¹).

Key words : Maize, TMEY, Production efficiency and Economic efficiency.

In the recent times, the primary objective of agriculture is to achieve sustainable food production without polluting the environment. Globally, intensive mono-cropping of cereals has improved output of staple crops, but at the

expense of disrupting the ecological balance through pollution, resource overuse, etc⁷. Intercropping is one of the best options to increase land utilisation by effectively selecting crop species that are complementary in terms

of space, radiation, and input usage. It has been demonstrated that intercropping helps to increase resource uptake and utilisation, soil fertility, and decrease soil erosion¹. By limiting the amount of light that reaches the ground, two crops with various canopy coverage, architectural styles, and growing seasons increase the efficiency of radiation use. The best suited intercrops are maize/soybean, maize/cowpea and maize/peanut³. In several countries like India, Mexico, China and Pakistan maize precedes before wheat. Since maize makes up 6.5% of the food supplies in Asia, it significantly contributes to the region's food security. It may be possible to increase the sustainability of maize-based cropping systems globally by identifying and developing agronomic manipulations and mechanisms through cereal + pulse intercropping. Intercropping of maize and pulses can help to concurrently increase the output of both crops by reducing the competition for land resources between maize and legumes. Intercropping can result in more pulses being generated, which could lead to overall pulse production.

There have been few researches done to quantify the impact of intercropping pulses with maize on the next crop in a planting system, despite the fact that it has been found to be beneficial to maize⁵. High carbon sequestration, better water usage efficiency, nitrogen transfer to the succeeding crop, improved soil biodiversity, and other positive benefits of intercropping pulses with cereals have all been observed. The purpose of the present study was to quantify the best suitable pulses for maize.

The experiment was conducted in Randomized Block Design consists of five

treatments, T₁ - Maize alone, T₂ - Maize + black gram, T₃ - Maize + green gram, T₄ - Maize + cowpea, T₅ - Maize + soybean with four replications. The plot size was 5.4m×4m and seeds of Maize variety "Co-1" were sown with a spacing of 60×20 cm. The intercrop, Black gram and Green gram "ADT-3" were sown with a spacing of 30×10 cm and Cowpea "Co-6", Soybean "Co-1" was sown with a spacing of 30×15 cm. The observations of Total Maize Equivalent Yield (TMEY), Production efficiency, Economic efficiency, total nutrient uptake and total nutrient efficiency ratio were recorded. The collected data was statistically analyzed. Recommended fertilizer dose of 135:62.5: 50 kg ha⁻¹ of N, P₂O₅ and K₂O was applied to the main crop of maize and 25:50: 25 kg ha⁻¹ of N, P₂O₅ and K₂O was applied to the pulse intercrop plot. Half of the recommended nitrogen, entire dose of phosphorus and half dose of potassium were applied as basal after sowing. The remaining half dose of nitrogen and potassium were applied in two equal splits at 35 and 45 DAS.

Production efficiency indices :

The treatments exert significant influence on Total Maize Equivalent Yield (TMEY) (Fig. 1), Production Efficiency (Fig. 2) and Economic Efficiency (Fig. 3).

Total Maize equivalent yield (TMEY) :

Adaptation of different intercropping practices depicted distinct variations on the height of plants at 60 DAS and at harvest stage. The TMEY was significantly influenced by all the treatments and its ranged from 2249 to 2481 kg ha⁻¹. Among various intercropped treatments T₂ - Maize + Black gram recorded significantly highest TMEY (3394 kg ha⁻¹) and



Fig. 1

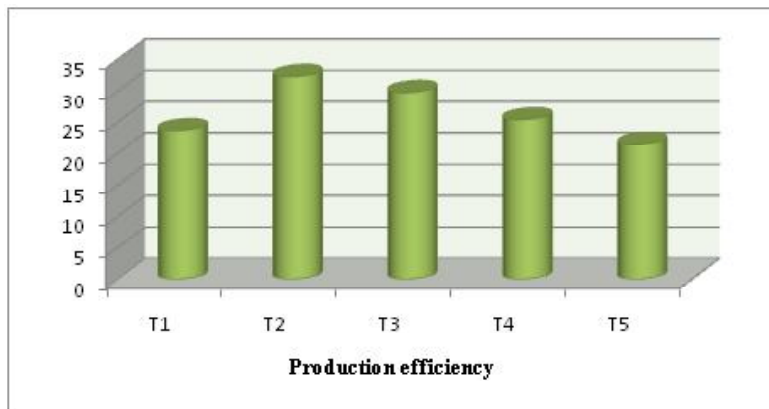


Fig.2

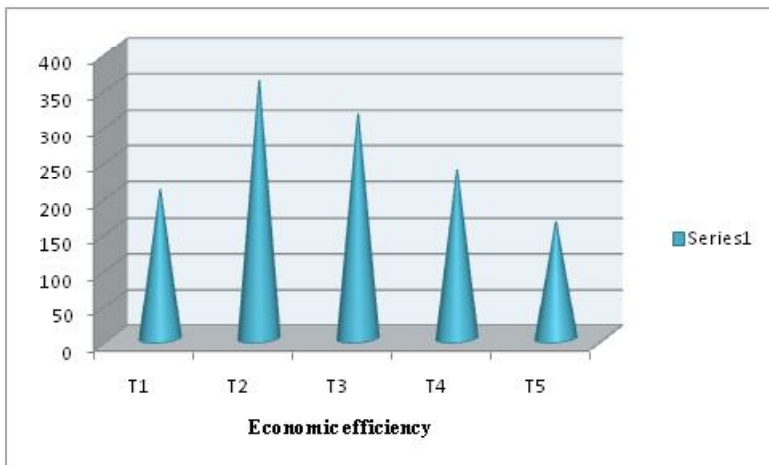


Fig. 3

Table-1. Influence of different intercropping practices on nutrient indices of maize and pulse intercropping systems

Treatments	Total nutrient uptake			Total nutrient efficiency ratio		
	N (kg ha ⁻¹)	P(kg ha ⁻¹)	K (kg ha ⁻¹)	N (kg kg ⁻¹)	P (kg kg ⁻¹)	K (kg kg ⁻¹)
T ₁ - Maize alone	122.02	20.24	146.31	20.33	122.58	16.96
T ₂ - Maize + Black gram	147.65	28.55	167.16	36.18	172.25	35.49
T ₃ - Maize + Green gram	139.24	26.92	157.05	35.27	168.68	34.49
T ₄ - Maize + Cowpea	136.92	26.28	155.87	35.05	167.98	33.39
T ₅ - Maize + Soybean	125.42	24.19	146.48	34.72	165.00	30.94
SEd	3.90	0.76	5.31	0.77	3.61	0.72
CD (p = 0.05)	8.46	1.64	11.53	1.67	7.84	1.56

it was on par with the treatment Maize + Green gram (T₃) of 3132 kg ha⁻¹ over other intercropping systems. Black gram was able to tolerate the shade produced by maize and, in addition, it fixed atmospheric nitrogen to the soil. Because maize and black gram have less nutrient competition than the other intercrops considered, yield improved in both main and intercrop crops. As a result of the increased biological yield produced by the inter crops, the maize equivalent yield of all intercropping regimens is higher than (2481 kg ha⁻¹) maize alone¹⁰. The least value 2249 kg ha⁻¹ of TMEY was registered in Maize + Soybean (T₅) intercropping system.

Production efficiency :

Among the treatments, Maize + Black gram (T₂) recorded the highest production efficiency of 32.33 kg ha⁻¹ day⁻¹ and was followed by treatment T₃ - Maize + Green gram (29.83 kg ha⁻¹ day⁻¹) which was on par with each other and significantly superior over other

treatments. This could be attributed to increased production from pulses such as black gram in maize-based farming systems⁴. The Maize + Soybean (T₅) recorded the lowest production efficiency of 21.42 kg ha⁻¹ day⁻¹.

Economic efficiency :

Among various intercropped treatments T₂ - Maize + Black gram recorded significantly highest economic efficiency of 357.71 Rs. ha⁻¹ day⁻¹ and it was on par with the treatment T₃ - Maize + Green gram (312.80 Rs. ha⁻¹ day⁻¹) over other intercropping systems. The economic value of various cropping systems is determined by the expense of inputs and the cost of economic products, especially the yield and price of black gram⁸. The least value 161.46 Rs. ha⁻¹ day⁻¹ of economic efficiency was registered in Maize + Soybean (T₅) intercropping system.

Nutrient indices (Table. 1) :

Total nutrient uptake :

Maize + Blackgram (T₂) recorded the highest total nutrients uptake of 147.65, 28.55 and 167.16 kg N, P and K ha⁻¹ respectively and was followed by treatment T₃ - Maize + Green gram of 139.24, 26.92 and 157.05 kg N, P and K ha⁻¹ respectively which was on par with each other and significantly superior over other treatments. This might be due to the fact that legume fixes the sufficient atmospheric nitrogen through the rhizobium present in root nodules and has a better nutrient saving capacity than cereal². The nutrients provided led to improve the root growth and subsequent development, which lead to enhanced absorption and increased the physiological activity of roots⁹. The lowest total nutrients uptake of 122.02, 20.24 and 146.31 kg N, P and K ha⁻¹ respectively were recorded in the treatment, Maize alone (T₁).

Total nutrient efficiency ratio :

Among various intercropped treatments T₂ - Maize + Black gram recorded significantly highest total nutrient efficiency ratio of 36.18, 172.25, and 35.49 kg N, P and K kg⁻¹ respectively and was followed by treatment T₃ - Maize + Green gram of 35.27, 168.68 and 34.49 kg N, P and K kg⁻¹ respectively which was on par with each other and significantly superior over other treatments. The variation in nutrient efficiency ratios between the intercropping systems were attributed to alterations in yield and nutrient uptake in each cropping system⁶. The lowest total nutrient efficiency ratio of 20.33, 122.58 and 16.96 kg N, P and K kg⁻¹ was registered in Maize alone (T₁).

Based on the capabilities of intercropping to increase income for farmers, this approach helps in sustaining the maize productivity. In

addition, it was able to reduce the environmental impacts such as soil erosion or chemical runoff.

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