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Influence of Pulses Intercropping on Growth and Productivity of Maize (*var* "Co-1") in Delta Region of Tamil Nadu

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ABSTRACT

Background: Intercropping legumes in cereals helps to increase crop yields and promotes sustainable agricultural system through complementarily effect through the effective utilisation of radiation, nutrients, plant root interactions and other resources.

Methods: The field experiment was conducted, during *Kharif* season (June to October 2019), at the multi-location field trials (Semmankudi village, Sirkali taluk, Nagapattinam district and Sivapuri village, Chidambaram taluk, Cuddalore district). The maize variety Co-1 was selected for the experiments. As intercrop, Black gram (*Vigna mungo* L.) (ADT-3), Green gram (*Vigna radiate* L.) (ADT-3), Cowpea (*Vigna unguiculata* L.) (Co-6), Soybean (*Glycine max* L.) (Co-1) were raised. Growth parameters, yield attributes, yield and economics were recorded.

Result: From the observation it is noted that growth characters such as leaf Area Duration, Crop Growth Rate and Root volume yield attributes and yield, were favourably influence by T_1- Maize alone. It was followed by Maize+Black gram (T_2). However, T_2 (Maize+Black gram) significantly recorded the maximum Net return and benefit cost ratio.

Key words: BCR, CGR, LAD, Maize, Net return, Root volume.

INTRODUCTION

Maize is one of the most versatile crops; it can grow in a range of agro-climatic situations. In many nations, maize is referred to as the "queen of cereals" because of its higher genetic yield potential when compared to other cereals. The basic raw material of maize used as starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries. Furthermore, it can be used as animal feed in addition to being a staple diet for people. Worldwide, maize production is greater than that of other cereal crops. Pulse is a nutritious grain that may be produced successfully anywhere (Parimaladevi *et al.,* 2019). It includes several necessary amino acids, minerals and vitamins in addition to a high percentage of digestible protein (Ashraf *et al.,* 2024).

Monocropping systems have minimum benefits which lead to low crop production and a higher probability of crop failure. Low nitrogen inputs, low crop yields and low land productivity are the main problems of cereal-based sole cropping systems. The maize (*Zea mays* L.), is planted with broad spacing, which allows for the possibility of intercropping. Legumes can be grown in the intervals between the rows of maize, which needs a lot of space to grow. Due to increased crop diversity and intensification, legumes as intercrops may be able to overcome these problems (Ashraf *et al.,* 2023).

The maize intercropping technique boosts productivity and profitability while also enhancing soil health, retaining soil moisture and improving overall output (Rahimi *et al.,* 2019). Therefore, keeping the above points in consideration and in order to sustain crop output; soil fertility management, the present study was conducted to determine the appropriate intercropping systems on maize by analysing their relative performance in terms of morphological character in the delta region.

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MATERIALS AND METHODS

The field experiment was conducted at the multi-location field trials (Semmankudi village, Sirkali taluk, Nagapattinam district and Sivapuri village, Chidambaram taluk, Cuddalore district). during *Kharif* season (June to Oct. 2019), The experiment was conducted in randomized block design consists of five treatments, T_1- Maize alone, T_2- Maize+black

gram, T_3- Maize+green gram, T_4- Maize+cowpea, T_5- Maize+soybean with four replication. The plot size was 5.4 m × 4 m and Maize variety "Co-1"was sown with a spacing of 60 × 20 cm. The intercrops *viz.,* black gram and green gram "ADT-3" were sown with a spacing of 30×10 cm; Cowpea "Co-6" and Soybean "Co-1" was sown with a spacing of 30×15 cm. The observations such as plant height, LAI, DMP and grain yield were recorded. Recommended fertilizer dose of 135:62.5:50 kg ha^{-1} of N, P_2O_5 and K_2O was applied to the main crop and 25:50:25 kg ha^{-1} of N, P_2O_5 and K_2O was applied to intercrops. 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.

RESULTS AND DISCUSSION

Yield attributes (Table 1)

The treatments exert significant influence on Cobs length and Number of grains cob^{-1}

Cob length

The cob length was significantly influenced by all the treatments. The treatment, Maize alone (T_1) recorded the highest cob length of 14.48 cm and was followed by treatment T_2- Maize+Black gram (14.39 cm) which was on par with each other and significantly superior over other treatments. It could be due to non-crop competition for resources, which limits crop development and also increase in nitrogen content. Similar findings were reported by Priya Dharshini *et al.,* (2019). The least cob length of 12.43 cm was recorded in the Maize+Soybean (T_5) treatment.

Number of grains cob^{-1}

Among the treatments, maize alone (T_1) recorded the highest number of grains cob^{-1} (143.67). It might be due to the supply and subsequent uptake of nutrients from the soil to generate a favourable environment condition for enhanced the growth and development, which improves yield qualities. This is in conformity with the findings of Rasheed *et al.* (2003). The least value 117.84 of number of grains cob^{-1} was registered in Maize+Soybean (T_5) intercropping system.

Yield (Table 1)

The treatments exert significant influence on Grain yield and Stover yield.

Grain yield

Among the treatments, T_1 (Maize alone) recorded the maximum grain yield of 2481 kg ha^{-1}. Among various intercropped treatments T_2- Maize+Black gram recorded significantly higher grain yield of 2411 kg ha^{-1} over other intercropping systems. Increase in plant height might be due to the availability of ideal space under the Sole maize and reduced competition for light and nutrients, which likely produced a suitable growing environment and contributed to boost plant height. Increases in plant height under sole maize were also observed by Hugar and Palled (2008). The minimum grain yield of 2031 kg ha^{-1} was registered in Maize +Soybean (T_5) intercropping system.

Stover yield

Maize alone (T_1) recorded the maximum stover yield of 4243 kg ha^{-1} and was followed by treatment T_2-Maize+Black gram (4184 kg ha^{-1}) which was on par with each other and significantly superior over other treatments. This might be due to enhanced availability of key plant nutrients from a balanced nutrient source. Complementary and synergistic relationships between nutrient supply and the growth of maize lead to increased stover yield. This was earlier reported by Sanjiv Kumar (2014). The Maize+Soybean (T^5) recorded the lowest stover yield of 3688 kg ha^{-1}.

Growth analysis (Table 2)

Leaf area duration (LAD)

Among the treatments, higher leaf area duration was observed with Maize alone (T_1) of 123.90 at 30-60 DAS and it was on par with the treatment T_2- Maize+Black gram (120.90). Leaf area duration is directly related to dry matter production and yield. It is related with the sink, the leaves and then related with the photosynthetic rate and efficiency of the leaf. This was in accordance with the results of Chen *et al.* (2013) and Prakash *et al.* (2023). Among the treatments leaf area duration was found least with Maize+Soybean (T_5) of 101.85 at 30-60 DAS respectively.

Table 1: Influence of different intercropping practices on yield attributes and yields of maize.

Treatments	Cobs length (cm)	Number of grains cob^{-1}	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
T_1- Maize alone	14.48	143.67	2481	4243
T_2- Maize+Black gram	14.39	136.80	2411	4184
T_3- Maize+Green gram	13.41	128.86	2223	3947
T_4- Maize+Cowpea	13.34	125.88	2199	3925
T_5- Maize+Soyabean	12.43	117.84	2031	3688
S.Ed	0.34	3.45	72.4	91.7
CD (P= 0.05)	0.74	7.48	157	199

Table 2: Influence of different intercropping practices on growth analysis and economics of maize.

Treatments	Leaf area duration (days)	Crop growth rate(g m^{-2} day^{-1})		Root volume (cm^3 $plant^{-1}$)		Net returns (Rs. ha^{-1})	BCR
	30-60 DAS	30-60 DAS	60 DAS-harvest	30 DAS	60 DAS		
T_1- Maize alone	123.90	7.32	4.99	46.32	98.23	21682	1.86
T_2- Maize+black gram	120.90	7.30	4.86	45.19	97.41	37560	2.45
T_3- Maize+green gram	113.70	6.95	4.48	41.70	90.89	32844	2.27
T_4- Maize+cowpea	110.25	6.91	4.44	40.89	85.03	24555	1.95
T_5- Maize+soybean	101.85	6.55	3.85	37.03	72.36	16953	1.66
SEd	3.18	0.16	0.12	1.52	2.99	-	-
CD (p= 0.05)	6.90	0.34	0.27	3.29	6.48	-	-

Crop growth rate (CGR)

The treatment, Maize alone (T_1) recorded the highest crop growth rate of 7.32, 4.99 g m^{-2} day^{-1} at 30-60 DAS and 60 DAS-harvest respectively. However, it was on par with treatment Maize+Black gram (T_2) *i.e.*, 7.30, 4.86 g m^{-2} day^{-1} at 30-60 DAS and 60 DAS harvest respectively. It might be due to the ability to enhance assimilatory capability by utilising an additional photosynthesis. The growth analysis was reduced at crop maturity due to a rapid decrease in green leaf area. This result was in conformity with Azarpour *et al.* (2014). The Maize+Soybean (T_5) treatment recorded the least crop growth rate of 6.55, 3.85 g m^{-2} day^{-1} at 30-60 DAS and 60 DAS harvest, respectively.

Root volume

Maize alone (T^1) recorded the highest root volume of 46.32, 98.23 cm^3 $plant^{-1}$ at 30 DAS and 60 DAS respectively. It was on par with treatment Maize+Black gram (T^2) *i.e.,* 45.19, 97.41 cm^3 $plant^{-1}$ at 30 DAS and at 60 DAS respectively. In general, this could be attributed to changes in maize root shape and root activity. Similar finding was earlier reported by Zhang *et al.* (2015). The lowest root volume of 37.03, 72.36 cm^3 $plant^{-1}$ at 30 DAS and 60 DAS respectively, were recorded in the treatment, Maize+ Soybean (T_5).

Economics (Table 2)

Regarding economics, the intercropping system registered the highest monetary advantages compared to sole crops. Among various intercropped treatments T_2- Maize+Black gram registered the maximum net returns of Rs. 37,560 and BCR of 2.45 over other intercropping systems. This is mainly due to higher grain yield and market price. These results are in conformity with the findings of Pandey and Prakash (2002). The lowest net returns of Rs. 16,953 and BCR of 1.66 was recorded in Maize+Soybean (T_5) intercropping system.

CONCLUSION

From the above observations among the treatments, Even though sole crop attained early maturity, maize and blackgram intercropping system achieved highest gross profit. The study clearly proved that intercropping was usually favourable in monocultures of maize and black gram, with a greater benefit-cost ratio.

Conflict of interest

All authors declare that they have no conflicts of interest.

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