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Potentiality, System Productivity and Economics of Maize + Plolebean/ French bean Intercropping System in Light Soils of Karnataka

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ABSTRACT

A field experiment was conducted during the Kharif season of 2015 at College of Agriculture, Shivamogga to study the effect of maize +pole bean/ French bean intercropping on crop productivity, system productivity and economics. The experiment consisted of ten treatments in combination of three row spacing for maize; 60 cm and 75/45 cm for paired row with intra row spacing of 30 cm for both sole and inter crop of maize with pole bean, 90 cm x 20 cm for maize intercropped with French bean. Recommended spacing of 120 cm x 30 cm for pole bean under sole and intercropping treatments; Two times of sowing of pole bean i.e. simultaneously with maize and 10 DAS of maize; two levels of fertilizers for pole bean viz., 100 per cent and 50 per cent of RDF. Among the treatments, maize sole crop at 60 cm x 30 cm spacing and sole crop of pole bean at 120 cm x 30 cm spacing recorded significantly higher grain yield of 83.01 q ha^{-1} and fresh bean of 102 q ha^{-1} respectively, over the intercropping treatments. Significantly higher MEY was obtained under maize + pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing (174.55 q ha^{-1}) along with the higher net returns (130331.9 Rs. ha^{-1}).

Key words: *Maize, Pole bean, Yield, System productivity (MEY), Economics.*

INTRODUCTION

The greatest challenge of 21st century in many developing countries is to meet the ever increasing demand for basic necessities namely food, fodder, fibre and fuel from the limited available land. Nearly 90 per cent of food requirements are being met from land based farming systems. But, day by day shirnking of agriculture land is demanding for development of new high intensive cropping systems including intercropping. Intercropping is recognised as potential beneficial system of crop production; provides substantial yield advantages over sole cropping[11] especially intercropping with legumes[3] and it is also true that legumes play important role in maintaining the soil fertility. Keeping these advantages in view many intercropping systems have been recommended for different zones.

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The southern transition zone of Karnataka also have such recommendations where maize growing area is more and the soil is of light red sandy loam and poor in nitrogen. But, the area under recommended maize + legume (green gram/blackgram/cowpea etc) is negligible because of simple reason that all these systems are under replacement series and farmers do not want to loose maize yield. Further, most of the short duration pulse crops could not perform well under high rainfall, situation. Considering these problems the study was conducted by maintaining 100 per cent population of maize, pole bean as an intercrop was included under additive series. Pole bean is a climbing legume and need support to trail. In the experiment maize acted as a live staking material. Literature showed that staking with intercropped maize was the most efficient technique to grow pole bean[6]. According to the literature; Maize intercropped with haricot bean gave yield advantage of 99 per cent as compared to the sole cropping[7]. Roy and barun suggested that supplying the recommended dose of fertiliser for both the component crops could increase the yield of intercropping system. Bavec *et al*.[1] concluded that maize/bean mixture has promise for producing valuable yield of maize and bean.

MATERIAL AND METHODS

The field experiment was conducted under rainfed condition at College of Agriculture, Shivamogga, during the *Kharif*, 2015 to assess yield performance of maize and component crops under maize + pole bean/French bean intercropping system as influenced by spacing, fertiliser levels and time of sowing of pole bean under additive series.

The experimental site is situated at 14^0 to $14^0.1^I$ North latitude and $75^0.45^I$ to $75^0.42^I$ East longitude with an altitude of 650 meters above from mean sea level and is located under Southern Transition Zone of Karnataka.

The average temperature during the cropping period was (25.47 ^{0}C), rain fall received was 848.4 mm and average relative humidity was of 79.66 per cent and 5.15 of bright sunshine hours.

The experimental site was fairly uniform with unidirectional fertility. The soil was red sandy loam, having the pH of 5.66, Electrical Conductivity (dSm^{-1}) of 0.71 dSm^{-1}, lower in organic matter content (0.40 %), lower in available nitrogen (175.61 kg ha^{-1}), higher in available phosphorus (192.41 kg ha^{-1}) and medium in available potassium (303 kg ha^{-1}) in soil.

After receiving the first rain of south west mansoon the land was ploughed with disc and harrowed twice. A common dose of FYM @ 7.5 t ha^{-1} was applied and mixed in to the soil prior to ten days of sowing. The land was smoothened to prepare fine seed bed. The plots were laid out with Randomised Block Design with ten treatments replicated thrice. The treatments under study were T_1: Maize + Pole bean simultaneous sowing at 60 cm x 30 cm spacing, T_2: Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing, T_3: Maize + Pole bean at 60 cm x 30 cm spacing; pole bean sowing at10 DAS of maize, T_4: Maize + Pole bean under paired row at 75/45 cm x 30 cm spacing; pole bean sowing at 10 DAS of maize, T_5: Maize + Pole bean simultaneous sowing at 60 cm x 30 cm spacing with 50% RDF for pole bean, T_6: Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing with 50% RDF for pole bean, T_7: Maize + French bean simultaneous sowing at 90 cm x 20 cm spacing, T_8: Maize sole crop at 60 cm x 30 cm spacing, T_9: Maize sole crop at 75/45 cm x 30 cm spacing, T_{10}: Pole bean sole crop at 120 cm x 30 cm spacing.

The hybrids used were, CP818 of maize, NZ an exotic hybrid of pole bean and Arka Komal, a variety of French bean. The recommended doses of NPK were 100:50:25 kg ha^{-1} and 63:100:75 kg ha^{-1} for maize and pole bean respectively. For intercropping treatments, respective recommended dose of nutrients as per the treatment were applied.

For both sole and intercrops 50 per cent of N and 100 per cent of P and K were applied as basal dose and remaining 50 per cent of N was applied at 45 DAS as top dress for both the crops.

In the well prepared seed bed 5 cm deep furrows were opened to place maize seeds and Pole bean seeds were sown in alternate maize row at the distance of 5 cm from maize seed at 2.5 cm depth. After 45 days of sowing both the crops were top dressed with remaining 50% of N. *Statistical analysis* for the proper presentation of data of all yield and yield parameters was analyzed statistically by standard analysis of variance (ANOVA) and differences were separated by standard error means (S.Em). To find out error mean sum of squares (EMSSq), Microsoft-Excel software (Microsoft Corporation, USA) was used and significant differences were determined at LSD (p = 0.05) as per the number of treatments[4].

The total yield obtained in the intercropping system from the component crops was expressed in terms of maize equivalent yield considering the prevailed market price and was calculated by using the formula,

$$\text{MEY} = \text{Maize yield (kg ha}^{-1}\text{)} + \frac{\text{Intercrop yield (kg ha}^{-1}\text{) x price (Rs. kg}^{-1}\text{)}}{\text{Maize price (Rs. kg}^{-1}\text{)}}$$

RESULTS AND DISCUSSION

The results of the study revealed that the treatments either of sole or of intercrop had significantly influenced the yield and yield attributes of the component crops.

Yield performance of maize

The yield differed significantly among the treatments under study.

The treatment under sole maize crop sown at 60 cm x 30 cm spacing was found significantly more potential w.r.t. maize grain yield which could be attributed to superiority of maize yield components namely cob length (20.65 cm), cob girth (15.72 cm) number of rows per cob (15.57), number of grains per row (42.87), weight of cob plant^{-1} (264.53 g), weight of kernels plant^{-1} (234.42 g) and weight of 100 seeds (41.22 g). However, this was on par with the yield produced under paired row spacing of 75/45 cm x 30 cm are equally efficient (81.09) qha$^{-1.}$ The higher values with respect to yield is obvious under sole cropping but the equally efficient yield was produced under said intercropping system may be due the application of complete dose of fertilizer for both and availability of space and light under paired row system. These findings are in conformity with the findings of Shri *et al*.[10] and Yogesh *et al*.[12] (Table 1).

Vegetable bean yield

Among the treatments of intercropping with pole bean, significantly higher fresh bean yield (102 q ha^{-1}) was recorded under the sole crop of pole bean sown at its regular spacing of 120 cm x 30 cm. (Table 2). This could be attributed to higher number of pods per plant (48.20), weight of fresh pods per pant (362.21 g), pod length (19.67 cm) and pod girth (2.42 cm) (Table 2). The results are similar with the results obtained by Yogesh *et al*.[12] in case of maize + soybean intercropping. The probable reason was lack of competition for natural resources and obstruction to trail, more number of flowers produced and availability of space to expand the branches as compared to the bean plants in intercropping. Which intern resulted in better growth and yield parameters of pole bean.

***System productivity in terms of maize equivalent yield (MEY)*:**

Table No. 3 clearly indicates that among all the treatments, statistically higher MEY was recorded under maize + pole bean simultaneous sowing under paired row at 75/45 x 30 cm spacing (174.55 q ha^{-1}). Which was 108.90 and 110.31 per cent higher on an average over the maize yields under sole crop of either of spacings respectively. This increase was attributed to additional yield advantage of intercropping system as well as higher market price of the pole bean than that of the maize alone. The results are in line with Sing and Tenua *et al*. [5]in maize+ soybean under additive series. Shri *et al*.[10] reported the higher MEY in maize + soybean (1:2) which

was at par with maize + soybean (1:1). It was also in line with the results of Rana *et al.*[8].

Profitability:

Regardless of the row space and level of fertilizers applied, intercropping of maize + pole bean and maize + French bean established a definite increase in gross returns and net returns as compared to the sole crop of maize. The higher gross and net returns were obtained in Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing (Rs.209464 ha^{-1}) followed by maize + pole bean under paired row at 75/45 cm x 30 cm spacing; pole bean sowing at 10 DAS of maize (Rs. 206808 ha^{-1} and Rs. 112475.94 ha^{-1} respectively). In terms of percentage, the treatment gained 110.27 cent gross returns and 115.95 per cent net returns. The higher gross returns realized in this intercropping systems was attributed to better growth and yield performance of component crops. The net returns was found higher because of maize which acted as a natural staking material for pole bean, which is less labour intensive and cost effective technology. Hence, the net return obtained is higher. Regarding benefit cost ratio (B:C ratio), higher B:C ratio was recorded under sole maize crop at 60 cm x 30 cm spacing (2.90) This may be due to better performance of component crops, higher returns helping in getting higher B:C ratio.

Table 1: Yield and yield attributing characters of maize as affected by maize + pole bean and French bean intercropping system

Treatments	Cob length (cm)	Cob girth (cm)	Number of rows cob^{-1}	Number of grains row^{-1}	Weight of cob $plant^{-1}$ (g)	Weight of kernels $plant^{-1}$ (g)	Weight of 100 seeds (g)	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest Index
T_1 : Maize + Pole bean simultaneous sowing at 60 cm x 30 cm spacing	17.03	15.48	13.80	38.07	196.60	164.54	40.56	74.70	109.58	0.40
T_2: Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing	19.03	15.68	15.27	42.53	243.07	221.07	40.92	82.22	123.59	0.39
T_3: Maize + Pole bean at 60 cm x 30 cm spacing; pole bean sowing at10 DAS of maize	16.91	15.40	13.78	37.60	186.03	156.83	40.52	74.41	106.56	0.41
T_4: Maize + Pole bean under paired row at 75/45 cm x 30 cm spacing; pole bean sowing at10 DAS of maize	18.96	15.60	15.17	41.50	233.35	207.63	40.71	81.84	121.98	0.40
T_5: Maize + Pole bean simultaneous sowing at 60 cm x 30 cm spacing with 50% RDF for pole bean	15.87	15.39	12.83	35.80	165.80	133.95	38.81	73.34	100.78	0.42
T_6: Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing with 50% RDF for pole bean	16.18	15.49	13.30	36.73	172.53	139.13	39.24	73.68	101.35	0.42
T_7: Maize + French bean simultaneous sowing at 90 cm x 20 cm spacing	16.34	15.33	13.57	37.43	183.00	150.54	40.39	74.36	104.08	0.41
T_8: Maize sole crop at 60 cm x 30 cm spacing	20.65	15.72	15.57	42.87	264.53	234.42	41.22	83.01	126.21	0.39
T_9: Maize sole crop at 75/45 cm x 30 cm spacing	19.59	15.62	15.20	42.20	252.67	223.51	41.05	81.93	122.36	0.40
SEm±	0.63	0.54	0.44	1.14	11.77	9.69	2.46	2.35	3.43	0.02
C.D at 5 %	1.90	NS	1.32	3.42	35.28	29.06	NS	7.05	10.31	NS

Table 2: Yield and yield attributing characters of maize as affected by maize + pole bean intercropping system

Treatments	Number of pods $plant^{-1}$	Fresh weight of pods $plant^{-1}$ (g)	Pod length (cm)	Pod girth (cm)	Cumulative vegetable bean yield (q ha^{-1})
T_1 : Maize + Pole bean simultaneous sowing at 60 cm x 30 cm spacing	20.09	143.32	15.29	2.14	41.20
T_2: Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing	24.71	194.44	17.39	2.29	55.40
T_3: Maize + Pole bean at 60 cm x 30 cm spacing; pole bean sowing at10 DAS of maize	19.40	142.20	14.99	2.11	40.90
T_4: Maize + Pole bean under paired row at 75/45 cm x 30 cm spacing; pole bean sowing at 10 DAS of maize	24.40	190.48	17.82	2.32	54.30
T_5: Maize + Pole bean simultaneous sowing at 60 cm x 30 cm spacing with 50% RDF for pole bean	22.64	150.66	15.34	2.24	43.20
T_6: Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing with 50% RDF for pole bean	22.10	153.40	15.49	2.27	44.00
T_7: Maize + French bean simultaneous sowing at 90 cm x 20 cm spacing	26.20	32.20	8.15	2.15	35.80
T_{10}: pole bean sole crop sown at 120 cm x 30 cm spacing	48.20	362.21	19.67	2.42	102.00
SEm±	0.56	5.07	0.28	2.14	0.88
CD (p=0.05)	1.69	15.39	0.86	**NS**	2.68

Table 3: maize equivalent yield as affected by maize + pole bean intercropping system

Treatments	Maize grain yield (q ha^{-1})	Cumulative vegetable bean yield (q ha^{-1})	Maize equivalent yield (q ha^{-1})
T_1 : Maize + Pole bean simultaneous sowing at 60 cm x 30 cm spacing	74.70	41.20	143.36
T_2: Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing	82.22	55.40	174.55
T_3: Maize + Pole bean at 60 cm x 30 cm spacing; pole bean sowing at10 DAS of maize	74.41	40.90	142.57
T_4: Maize + Pole bean under paired row at 75/45 cm x 30 cm spacing; pole bean sowing at10 DAS of maize	81.84	54.30	172.34
T_5: Maize + Pole bean simultaneous sowing at 60 cm x 30 cm spacing with 50% RDF for pole bean	73.34	43.20	145.34
T_6: Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing with 50% RDF for pole bean	73.68	44.00	147.01
T_7: Maize + French bean simultaneous sowing at 90 cm x 20 cm spacing	74.36	35.80	104.19
T_8: Maize sole crop at 60 cm x 30 cm spacing	83.01	-	83.01
T_9: Maize sole crop at 75/45 cm x 30 cm spacing	81.93	-	81.93
T_{10}: pole bean sole crop sown at 120 cm x 30 cm spacing	-	102.00	170
SEm±	2.35	0.88	4.19
CD (p=0.05)	7.05	2.68	12.44

Table 4: profitability of the intercropping systems as influenced by the maize + pole bean

Treatments	Cost of production (Rs. ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	B:C ratio
T_1: Maize + Pole bean simultaneous sowing at 60 cm x 30 cm spacing	79132.06	172040	92907.94	2.17
T_2: Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing	79132.06	209464	130331.9	2.65
T_3: Maize + Pole bean at 60 cm x 30 cm spacing; pole bean sowing at10 DAS of maize	80132.06	171092	90959.94	2.14
T_4: Maize + Pole bean under paired row at 75/45 cm x 30 cm spacing; pole bean sowing at10 DAS of maize	80132.06	206808	126675.9	2.58
T_5: Maize + Pole bean simultaneous sowing at 60 cm x 30 cm spacing with 50% RDF for pole bean	74143.75	174408	100264.3	2.35
T_6: Maize + Pole bean simultaneous sowing under paired row at 75/45 cm x 30 cm spacing with 50% RDF for pole bean	74143.75	176416	102272.3	2.38
T_7: Maize + French bean simultaneous sowing at 90 cm x 20 cm spacing	63332.06	125032	61699.94	1.97
T_8: Maize sole crop at 60 cm x 30 cm spacing	33964.88	99612	65647.12	2.93
T_9: Maize sole crop at 75/45 cm x 30 cm spacing	33964.88	98316	64351.12	2.89
$T_{10:}$ pole bean sole crop sown at 120 cm x 30 cm spacing	88762.18	204000	115237.8	2.30

CONCLUSION

From the study it was concluded that the yielding potentiality of sole maize planting was higher but, w. r. t. system productivity and economic returns intercropping of maize with pole bean under paired row spacing of 75/45 cm x 30 cm, sown simultaneously was found better.

REFERENCES

1. Bavec, F., Živec, U., Mlakar, S. G, Bavec, M. and Radics, L., Competitive ability of maize in mixture with climbing bean in organic farming. University of Maribor, Faculty of Agriculture, Vrbanska, Maribor, Slovenia, 1-4 (2000).
2. Geno, L., and B. Geno, Polyculture Production: Principle, benefits and risk of multiple cropping. A report for the Rural Industry Research and Development Corporation (RIRDC), Publication, No. 01134 (2001).
3. Giller, K.E. and Wilson, K.F. Nitrogen fixation in tropical cropping systems. *CAB International. UK.* 313 (1991).
4. Gomez, K. A. and Gomez, A. A., Statistical Procedures for Agric. Res. 2nd Ed. John Wiley & Sons, New York (1984).
5. Jasbir Singh, and. Thenua, O.V.S., Growth and yield of soybean as influenced by maize + soybean intercropping systems and nitrogen levels. *Ann. Agric. Res. New Series*, **35 (1):** 32-36 (2014).
6. Ntukamazina, N., Ruraduma, C. and Ntibashirwa, S., Relative performance of

staking techniques on yield of climbing bean in highlands of Burundi. *African Crop Sci. J.*, **22(4):** 997-1001 (2014).

7. Nugusse, T. M., cropping system research status and future trends in rift valley: II. Weed insect pest and disease in: proc. 25th anniversary of Nazareth agriculture research centre, 20-23 september 1995. (Ed. Habtu, A.). *Nazareth, Ethiopia*, 98-105 (1995).
8. Rana, K. S., Kumar, Ashok, Sharma and Rajvir, Effect of crops and root system for drought tolerance, water accessibility and water use efficiency in Rhizospere: *Stratagies for augmenting soil fertility and productivity*. (Ed.) Shivdhar, K. M., Mahajan, Annapurna, K. and Rai. R. K. Agronomy Division, IARI, New Delhi. 479-493 (2008).
9. Roy, R. N. and Barun, H., fertilizer use under multiple cropping systems: a review. FAO fertilizer. *Plant Nutr. Bull*., **6:** 9-10 (1983).
10. Shri, S., Jha A. K. and Shirvastava, A., Evaluation of different intercropping systems for productivity and economics in maize (*Zea mays* L.). *Ann. Agric. Res. New Series*, **35 (2):** 200-204 (2014).
11. Tsubo, M., Ogindo, H. O. and Walker, S., Yield evaluation of maize-bean intercropping in a semi-arid region of South Africa. *African Crop Sci. J.*, **12:** 351- 358 (2004).
12. Yogesh, S. Halikatti, S. I., Hiremath, S. M., Potdar, M. P., Harlapur, S. I. and Venkatesh. H., Light use efficiency, productivity and profitability of maize and soybean intercropping as influenced by planting geometry and row proportion. *Karnataka J. Agric. Sci.*, **27 (1):** 1-4 (2014).