INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

www.scienceandnature.org

PERFORMANCE OF MAIZE- URDBEAN INTERCROPPING AS INFLUENCED BY WEED MANAGEMENT IN BHADRA COMMAND AREA OF KARNATAKA

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ABSTRACT
Paired row of maize with two rows of urdbean recorded 30.41% increase in system productivity and 23.87% increase in monetary returns over the sole maize crop. Pooled land equivalent values for intercropping under each of the weed control methods indicate their biological efficiency. Paired row of maize with two rows of urdbean exhibited its effective utility of the natural resources compared to other intercrops by recording land equivalent ratio ranged from 1.38 to 1.68 under the weed control methods evaluated. Weed control through integrated approach method was found to be more advantageous by recording 64.43% more yield and 71.56% higher returns over the weedy check. Dominance of main crop in the system is exhibited through the positive sign of aggressivity index under all the weed control methods. Maximum relative net returns of 1.28, 1.48, 1.56 and 1.40 recorded paired rows of maize with two rows of urdbean under all the weed control method indicates its economic viability among intercropping.

KEYWORDS: productivity, monetary return, aggressivity index, urdbean.

INTRODUCTION

Maize is a heavy feeder of plant nutrients, growing of this crop alone over the years will barren the land and cause for decline in productivity. Inclusion of legumes in rotation or raising them in association with maize crop has been advocated by various workers to sustain the soil health and due importance was given for achieving higher productivity. Intercropping of legume with cereals has been recognized as very common practice in India. Weeds in the field during the growing period of a crop also contributed for the low productivity. Weed infestation posing competition for natural and applied inputs such as space, nutrients and water. These warrens to take care of soil health with increase sustainability in productivity. Large numbers of field studies were made to compare economically the sole crop yield when taken along with other crops in the system (Rao and Willey, 1980). The general finding has been that intercropping gives total higher yield as compared to sole crops. Problem of assessing the degree of advantages in terms of land equivalent ratio, crop dominance (aggressivity), economic advantage and benefit of intercropping is the matter of investigation. Improper spatial arrangement under intercropping not only reduces the yield component but also induces high degree of rolling topography. Productivity per unit area could be increased through suitable crops having higher yield stability and adoption of appropriate intercropping patterns. Intercroppings will always have an edge over the pure cropping pattern, since they will effectively utilize the available resources. Pulse crop not only fixes nitrogen for its use but could provide part of nitrogen to companion crop. A suitable intercropping provides a yield advantage over sole cropping, because the component crops utilize the natural resources in such a way that they are able to complement with each other. Since no information is available on recommendable row ratio of intercropping with proper weed control technology in this region, the study was initiated to assess the influence of intercropping and effectiveness of weed control methods on yield, economic advantage, aggressivity and benefit of intercropping.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* seasons of 2003 to 2005 consecutively under rain fed situation of Agricultural Research Station, Kathalagere by considering different intercropping treatments (Table-1). The treatment combinations of different intercroppings viz., 1:1, 2:1 and 2:2 row ratios are considered with four weed control methods viz., Weedy check, Hand weeding at 25 DAS, Alachlor @ 2 kg a.i/ha and Alachlor @ 1.5 kg a.i/ha + Hand weeding at 40 DAS. An experiment with the intercropping treatments along with the above four weed control methods was conducted to evaluate suitable geometry of intercrop of maize and urdbean under rain fed condition and to know the suitability of weed control as an additional study. The experiment with treatment combination of planting pattern and four weed control methods were laid out in split plot design with 3 replications for each treatment combination by having four weed control methods on the main plot and intercropping treatments on the sub plot.

The experimental site was situated at an elevation of 561 m above the mean sea level with a latitude of $13^{o}\,2^{1}$ N and longitude of $76^{o}\,5^{1}$ E. The soil of the experimental site was red loamy in texture having pH of 6.8, EC of 0.18 ds/m, OC of 0.64% available NPK were 292, 28.5 and 195 kg/ha respectively.

Maize cv. Pioneer Hybrid and urdbean variety Rashmi (LBG-625**)** were sown with recommended spacing for the sole crops and spacing as framed for the intercropping

treatment combinations. Intercrops were taken without sacrificing to the specified plant density. The crops were raised by following the recommended package of practices. Total fertilizer dose required for the sole crops and intercrops were provided to the crops as per the specified schedule. N, P_2O_5 and K_2O were supplied in the form of DAP and Muriate of potash. Need based plant protection measures were under taken as and when disease and pest load were noticed.

TABLE-1A: Comparison of sole/intercropping patterns

Sole / Inter crop treatments	Mean maize Equivalent yield(q/ha)	% increase Over T1	B: C ratio	% increase Over T1
T1: Sole Maize	52.55	-	1.55	-
T2: Sole Urd	31.34	-	0.92	-
T3: Maize +Urd(1:1)	59.36	16.05	1.60	3.22
T4: Maize +Urd(2:1)	66.56	23.71	1.76	13.54
T5: Maize +Urd(2:2)	70.11	30.41	1.92	23.87
SEm(±)	0.96			
CD@5%	2.70			

b: Comparison of weed control methods

Weed control treatments	Mean maize Equivalent yield(q/ha)	% increase Over W1	B: C ratio	% increase Over W1
W1: Weedy check	38.49	-	1.02	-
W2: Hand weeding @ 25 DAS	62.50	62.38	1.73	69.60
W3: Alaochlor @ 2 kg/ ha	57.19	48.58	1.59	55.88
W4: Alaochlor @ 1.5 kg/ ha + HW @ 40 DAS	63.29	64.43	1.75	71.56
SEm(±)	1.38			
CD@5%	4.09			

Pooled statistical analysis and economic analysis for the grain yield was made by having maize crop equivalent yield and results are presented in table-1. Further, competition indices such as land equivalent ratio (LER) and partial land equivalent ratio (PLER) were worked out as suggested by Shinde and Ghanabhadur (2002). Similarly as suggested by them, aggressivity indices an index of crop dominance in intercropping and economic indices such as relative net ratios which are more appropriate for comparison in intercropping systems were computed by having the actual yield values. Rates of crop produce to work out the economic indices were obtained from the District Agricultural Produce Marketing committee yard, Government of Karnataka. Competition and economic indices worked out under each of the weed control methods separately are presented in table-2 a, b, c and d.

TABLE- 2: Biological (LER) and Economical (RNR) parameters in weed control methods

(a) Weedy check

Treatments	Mean yield (q/ha)		Land equivalent Ratio			CoC (Rs/ha)	Relative net returns	Aggressivity
	Maize	Urd	Maize	Urd	pooled			
T1	40.34	-	1.00	-	1.00	9106	-	-
T2	-	6.75	-	1.00	1.00	6246	-	-
T3	35.97	1.80	0.89	0.27	1.16	12230	0.87-1.16	0.62
T4	39.27	2.19	0.97	0.32	1.29	10185	1.07-1.18	0.65
T5	36.97	3.09	0.92	0.46	1.38	12230	0.99-1.28	0.45

(b) Hand weeding at 25 DAS

Treatments	Mean yield (q/ha)		Land equivalent Ratio			CoC (Rs/ha)	Relative net returns	Aggressivity
	Maize	Urd	Maize	Urd	pooled			
T1	57.20	-	1.00	-	1.00	10571	-	-
T2	-	11.78	-	1.00	1.00	7711	-	-
T3	58.00	3.50	1.01	0.30	1.31	14427	1.06-1.32	0.71
T4	65.41	3.80	1.14	0.32	1.46	12209	1.28-1.39	0.82
T5	64.61	4.33	1.12	0.33	1.45	14427	1.22-1.48	0.76

(c) Alachlor @ 2kg/ ha

Treatments	Mean yield (q/ha)		Land equivalent Ratio			CoC (Rs/ha)	Relative net returns	Aggressivity
	Maize	Urd	Maize	Urd	pooled			
T1	51.27	-	1.00	-	1.00	10450	-	-
T2	-	9.67	-	1.00	1.00	7590	-	-
T3	55.96	3.01	1.09	0.31	1.40	14306	1.12-1.40	0.78
T4	54.74	5.19	1.07	0.54	1.61	11167	1.33-1.38	0.53
T5	56.39	5.62	1.10	0.58	1.68	14306	1.27-1.56	0.52

(d) Alachlor @ 1.5kg/ ha + Hand Weeding at 40DAS

Treatments	Mean yield (q/ha)		Land equivalent Ratio			CoC (Rs/ha)	Relative net returns	Aggressivity
	Maize	Urd	Maize	Urd	pooled			
T1	62.54	-	1.00	-	1.00	11579	-	-
T2	-	11.32	-	1.00	1.00	8719	-	-
T3	62.94	2.90	1.01	0.26	1.27	15435	1.02-1.25	0.75
T4	54.98	5.19	0.88	0.47	1.35	14123	1.04-1.20	0.42
T5	65.70	5.07	1.05	0.45	1.50	15435	1.17-1.40	0.60

RESULTS AND DISCUSSION

Maize equivalent yield analysis

Pooled statistical analysis (over years) for planting pattern treatments indicates significant differences between the planting pattern treatments. Results presented in Table-1a reveals higher productivity of 70.11 q/ha in 2:2 row ratio followed by 66.56 and 59.36 q/ha in 2:1 and 1:1 row ratios of maize with urd intercropping, respectively. Increase in these is to the extent of 30.41, 23.41 and 16.05% over the sole maize. This indicates gain for having intercropping and in particular, paired row of maize with two rows of urdbean compared to other intercropping. Velayutham and Somasundaram (2000) indicated that, scientific intercropping of pulses with cereals and other non-legume companion crops have certain in built advantage over pure cropping. Further they have recorded that, pulses leave 20-25kg/ha of nitrogen in the soil at the time of harvest, which is utilized by the subsequent crop and tremendous leaf fall will form best source of organic matter.

Statistical analysis revealed significant differences among weed control methods. Results in Table-1b revealed higher productivity of 63.29 q/ha in Alachlor @ 1.5 kg /ha + HW at 40 DAS followed by 62.50 and 57.19 q/ha in hand weeding at 25 DAS and Alachlor @ 2kg /ha respectively. Increase of productivity in these over the weedy check was noticed to the extent of 64.43, 62.58 and 48.58% respectively. Higher productivity noticed in Alachlor @ 1.5 kg /ha + HW @ 40 DAS and hand weeding @ 25 DAS compared to Alachlor @ 2kg /ha indicates beneficial effect of integrated approach in weed control. Thiyagarajan and Balasubramanian (2000) concluded that, productivity can be easily increased and sustained provided intercropping approach is handled.

The purpose of intercropping is not only to grow more than one crop together but to obtain higher productivity per unit area with better economic monetary returns. Results presented in table-1 in respect of cost benefit ratios indicated that, among the planting pattern treatments row ratios 2:2, 2:1 and 1:1 recorded higher BC ratio of 1.92, 1.76 and 1.60 respectively compared to the sole crops (1.55 & 0.92 respectively). Economical advantage is noticed to be more in 2:2 and 2:1 row ratios. This implies that, better spacing provided in 2:2 and 2:1 row ratio caused for effective utilization of resources such as land, moisture, nutrients, light etc.,. Hence efficiency in productivity and profitability can be accounted in these planting patterns. Similarly, among weed control methods hand weeding without chemical (1.73) and with chemical (1.75) recorded higher B:C ratio than weedy check (1.02) and only chemical (1.59).

The results of economic indices indicated that, intercropping and weed control through integrated approach are economically advantageous compared to rest of the planting pattern treatments and weed control methods. It is also noticed that, Intercropping also suppresses weeds better than sole cropping and thus provides an opportunity to utilize crops themselves as tools of weed management

COMPETITION INDICES

Land equivalent and partial land equivalent ratios

Results of land equivalent ratios, partial land equivalent ratios, Relative net returns and aggressivity indices are presented in table- 2 a, b, c and d. Partial land equivalent ratios of maize under the **weedy check** for the intercropping ratio of 1:1, 2:1 and 2:2 were noticed to be 0.89, 0.97 and 0.92 respectively. Reduction in yield of maize in all ratios to the extent of 10.70, 2.62 and 8.30% in 1:1, 2:1 and 2:2 row ratios respectively compared to sloe crop of maize(40.34 q/ha) is the reflection of low record for partial land equivalent ratios of maize. Results indicated that, uncontrolled weed in crop duration caused for the ineffective utilization of the land resources as component crop in the intercropping. Partial land equivalent ratios of Urdbean ranged from 0.27 to 0.46 indicated marked reduction in its yield as a component crop compared to its sole Urdbean yield. Yield advantage of Urdbean is not noticed in all the row ratios.

Under the hand weeding at 25 DAS, all row ratios have recorded higher partial land equivalent ratio with 1.14 and 1.12 in 2:1 and 2:2 row ratios respectively over sole

maize. This indicated that, maize has effectively utilized natural resources as a component crop in the intercropping. Because of the better utility of land resources, increase in yield over sole maize crop (57.20 q/ha) was noticed to the extent of 14.35 and 12.95% in the row ratios of 2:1 and 2:2 respectively. Partial land equivalent ratio value of 1.01 recorded in row ratio 1:1 indicated that maize crop as a component crop in this row ratio has not much effectively utilized the resources in improving its yield. Partial land equivalent ratios of urdbean ranged from 0.30 to 0.37 indicating marked reduction in yield as a component crop compared to its sole Urdbean yield.

Under Alachlor @ 2 kg a.i/ha, partial land equivalent ratio was noticed to be more i.e., 1.09, 1.07 and 1.10 in the row ratio of 1:1, 2:1 and 2:2 respectively. The results indicated that, maize as a component crop in these row ratios has appreciable resources utilization capacity with increase in its yield recording to the extent of 9.15, 6.78 and 9.99% over its sole crop(51.27 q/ha) for the same row ratios respectively. Partial land equivalent ratios of urdbean ranged from 0.31 to 0.58 indicating marked reduction in yield as a component crop compared to its sole Urdbean yield.

Under Alachlor @ 1.5 kg a.i/ha +hand weeding at 40 DAS, partial land equivalent ratio was noticed to be more in 2:2 row ratio i.e., 1.05 but in1:1 and 2:1 row ratios partial land equivalent ratio was 1.01 and 0.88 respectively. This indicated, maize as a component crop in 2:2 row ratio has a better utilization of land resources for providing higher yield compared to that of 1:1 and 2:1 row ratios. Better utilization of land resources by 2:2 row ratio resulted in an increase of the maize yield to the extent of 5.05% compared to that of the sole crop of maize. In this weedicide treatment also, partial land equivalent ratios of Urdbean ranged from 0.26 to 0.47 indicating marked reduction in yield as a component crop compared to its sole urdbean yield.

Pooled land equivalent ratios of maize and urdbean intercropping presented in Table 2a, b, c & d. ranged from 1.16 to 1.38 in weedy check, 1.31 to 1.45 for hand weeding at 25 DAS, 1.40 to 1.68 for Alachlor @ 2.0 kg/ai and 1.27 to 1.50 in Alachlor @ 1.5 kg/ai +hand weeding at 40 DAS**.** This indicated that, intercropping crops of maize and urdbean jointly have an effective utilization of land resources compared to their sole crops. Though the yield of urdbean has a lower yield compared to its sole crop, it has provided a beneficial effect to the maize crop in the intercropping. Better utilization of land resources is reflected with higher pooled land equivalent ratios compared to the respective sole crops. Efficiency of total yield productivity observed to be enhanced by having the mixture crop of maize and urdbean rather than sole crop. The results indicated productive efficiency of the intercroppings. Similar advantage of having intercropping of maize with soybean has been noticed by Singh and Singh (2001).

Among the intercropping, paired row of maize with 2 rows of urdbean recorded higher land equivalent ratio compared to other row ratios and their sole crops, higher values in land equivalent ratio were noticed in all the weed control methods for the above row ratio (2:2). Values of LER ranged from 1.38 to 1.68 for this row ratio indicated that, this planting pattern for maize and urdbean intercropping has a biological efficiency compared to other treatment combinations. Same row ratio has recorded higher mean maize equivalent yield (table-1: 68.90q/ha) compared to other intercropping and sole crops. These findings of biological efficiency of having intercrops are in agreement with the findings of Shivay *et.al*.,(2001) and Sharma and Singh (2004)

Relative net returns

Relative net return values worked out under each of the weed control methods presented in the Table-2a, b, c and d are in the range of 0.87 to1.16, 1.07 to1.18 and 0.99 to 1.28 under 1:1, 2:1 and 2:2 row ratios respectively for weedy check, 1.06 to1.32. 1.28 to1.39 and 1.22 to1.48 under 1:1, 2:1 and 2:2 row ratios respectively for hand weeding at 25 DAS, 1.12 to1.40, 1.33 to1.38 and 1.27 to1.56 under 1:1, 2:1 and 2:2 row ratios respectively for Alachlor @ 2kg/ha 1.02 to1.25, 1.04 to1.20 and 1.14 to1.40 under 1:1, 2:1 and 2:2 row ratios respectively for Alachlor @ 1.5kg/ha + hand weeding at 40 DAS.

Maximum relative net returns of 1.28, 1.48, 1.56 and 1.40 recorded under all the weed control method for paired rows of maize with two rows of urdbean indicates its economic viability among intercropping. Singh and Singh (2001) in their study of intercroppings of maize with soybean noticed similar advantage in paired row of maize with two rows of soybean.

Aggressivity

Aggressivity indices worked out for the 1:1, 2:1 and 2:2 row ratio intercrops under each of the weed control methods are presented in the Table-2a, b, c and d. Values recorded are 0.62, 0.65 and 0.45 under weedy check, 0.71, 0.82 and 0.76 under hand weeding at 25 DAS, 0.78, 0.53 and 0.52 under Alachlor @ 2kg/ha, 0.75, 0.42 and 0.60 under Alachlor @ 1.5 kg/ha + hand weeding at 40 DAS. From the above results it could be noticed that all the aggressivity indices values have positive sign, this indicates dominance of the main crop in the intercrop. Mishra *et.al*., (2001) in a study of intercropping of Niger with pulse and oilseed crops recorded dominance of main crop in the intercropping.

Based on the study it could be inferred that, intercropping of maize + Urdbean in Bhadra command area have provided higher productivity with better monetary advantage. As a companion crop, urdbean has contributed for the high productivity in the intercroppings Among the various intercroppings evaluated, paired row of maize with two rows of urdbean noticed to be superior over rest of the intercropping and sole crops. Same row ratio has recorded higher relative net returns which is the indicative of economic viability of it. Maize crop dominance has been noticed in all the intercroppings in view of the benefit provided to it by the companion crop. Similar advantages of intercropping were also recorded in each of the weed control methods evaluated for their efficacy. Among the weed control methods, integrated approach of weed control method can be thought as an advisable weed control method compared to rest of the methods evaluated.

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