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STATISTICAL ANALYISIS FOR PLANT DENSITY AND WEED MANAGEMENT PRACTICES IN MAIZE-URDBEAN INTERCROPPING

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ABSTRACT
Bartlett test for homogeneity of variances confirms homogeneity of variances among the data of years for components i.e., main plot and sub plot components namely weed control treatments and sole/intercropping row ratio treatments. Pooled analysis of variance for the data exhibited significant result between the sole/intercropping treatments, weed control treatments and combination (interaction) of sole/intercropping treatments with weed control treatments. Among the various intercroppings evaluated, paired row of maize with two rows of urdbean noticed to be significantly superior productivity (69.85q/ha) over rest of the intercropping and sole crop of maize. Among the weed control practices Alachlor @ 1.5kg/ha + Hand weeding at 40 DAS recorded significantly superior yield (65.245q/ha) over rest of the weed control practices. Indicating efficiency of integrated weed management practices. Paired row of maize with two rows of urdbean (2:2) in combination with Alachlor @ 1.5kg/ha + Hand weeding at 40 DAS recorded significantly superior yield (80.30 q/ha) over the rest of the combination.

KEYWORDS: Plant density, weed management, urdbean, maize, intercropping etc.

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 sustainability in productivity.

Large number of field studies was 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 productivity, profitability and optimum natural resources utilizing 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. Intercropping 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 productivity, profitability and optimum natural resources utilizing 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 combination of intercropping treatments. The experimental site was situated at an elevation of 561 m above the mean sea level with a latitude of $13^0\ 2^1$ N and longitude of $76^0\ 5^1$ 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.

The treatment combinations (Table 1) 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. Factorial combination of the 4 main and 5 sob plot treatments were laid out in Split Plot design with 3 replications for each of the year. Detailed sole/intercropping treatments were imposed in the sub plots to provide higher precision in estimation of those treatments, whereas weed control treatments tried in main plot have been considered with low precision.

In the intercropping treatment data is based on two crops, the yields of main (maize) and intercrop (urd bean) were converted into a common (maize) unit to get a value for single crop, and the statistical analysis was performed on this new transformed variable. One such scale which is widely used is crop equivalent yield (CEY). CEY is defined as the sum of equivalent yield of main and intercrops. The yield of main and intercrops are converted into equivalent yield of anyone crop (preferably to maize crop) based on sale price of produce of both the crops.

Evaluation of significance among the sole/intercropping treatment, weed control treatments and combination of these two were made using statistical analysis of yield (crop equivalent yield). Normally, non statistician will conclude about the technology without in depth of statistical analysis of the data. In this study an attempt has been made by subjecting the data for test of homogeneity before application of the suitable statistical analysis. Pooled analysis variance of the replicated data generated over years for split plot design is done as per the procedure of group (series) of experiments out lined by Gomez and Gomez (1983)

RESULTS AND DISCUSSION

Three year replicated data has been subjected to Bartlett test for testing of homogeneity of variances between the years. Results for the test are presented in table 1.

TABLE 1 Bartlett test for testing homogeneity of variances

Component	Year	Error mean sum of square	χ^2 calculated	χ^2 table
Main plot	2003	32.447		
(Weed control treatment)	2004	16.810	2.137^{NS}	5.99
	2005	59.364		
Sub plot (sole/intercropping				
treatments)	2003	2.052	4.953^{NS}	5.99
	2004	1.679		
	2005	2.413		

NS: non significant at 5% level of significance

From the table 1 it could be realized that, variances between the periods were observed to be homogeneous (calculated χ^2 value of is less than its table value) for both the components i.e., main plot and sub plot components namely weed control treatments and sole/intercropping row ratio treatments. This has enabled to perform regular combined (pooled) analysis of variances. Results of split plot ANOVA table of regular combined analysis over years has been presented in table 2

TABLE 2: Combined ANOVA of Spilt plot design

Source of variation	Degrees of freedom	Sum of square	Mean sum of square	F value	
				Calculated	Table
Year	2	34284.691	17142.346	463.963	
Replication within year	6	221.686	36.947646		
Main plot Factor A(W)	3	19556.741	6518.914	180.044*	3.160
Y*A	6	1608.855	268.142	7.406	
E_a	18	651.731	36.207		
Sub plot Factor B (IC)	4	41034.635	10258.659	1054.474*	2.490
Y*B	8	6670.972	833.87144	85.712	
A*B	12	2377.802	198.150	20.368*	1.875
Y*A*B	24	3135.106	130.629	13.427	
E_b	96	933.955	9.729		

*: Significant at 5% level of significance,
Test made only for Factor A, Factor B and interaction AB

Sole/intercropping

Table 2, of pooled statistical analysis (over years) for weed control treatments, sole/intercropping treatments and interaction between both the components were found to be significant. Maize equivalent yield mean values of the main plot factor (WC), sub plot factor (IC), and interaction component (W*IC) along with SEm, critical difference (CD) value are presented table 3. Results

presented in table 3 reveals intercropping fared better in terms of productivity over the sole crop. Significantly superior productivity of 69.85 q/ha in paired row of maize with 2 rows of urd bean (2:2) row ratios over 67.64 and 62.29q/ha of 2:1 and 1:1 row ratios respectively and also in sole maize (52.42q/ha). This indicated that paired row of maize with 2 rows of urd bean is significantly superior among the other intercropping. From the results it could be realized that performances of intercropping are better than the sole crop and among the intercrop paired row of maize with 2 rows of urdbean (2:2) is a better performing intercropping system. Yield benefit of intercropping over sole crop and over the intercrops was presented in table 4.

TABLE 3: Mean of maize equivalent yield of S/IC treatment, WC and S/IC*WC

Sole/intercropping Treatment (S/IC)	WEED CONTROL PRACTICES(WC)				Mean
	Weedy check	Hand weeding at 25 DAS	Alachlor @ 2kg/ha	Alachlor @ 1.5kg/ha + Hand weeding at 40 DAS	
Sole Maize	40.33	53.09	53.71	62.54	52.42
Sole Urd	19.51	27.884	32.44	33.86	28.42
Maize and Urd bean (1:1)	41.20	68.08	68.57	71.30	62.28
Maize and Urd bean (2:1)	45.55	71.17	75.61	78.22	67.63
Maize and Urd bean (2:2)	45.86	74.36	78.87	80.30	69.85
Mean	38.49	58.92	61.84	65.24	
Components	S/IC treatment	WC treatment		S/IC * WC Interaction	
F test	Significant	Significant		Significant	
SEm(±)	0.735	1.269		1.470	
CD ($p \leq 0.05$)	1.463	2.668		2.95	

S/IC: Sole / Intercropping treatment, WC: Weed control treatment, S/IC * WC: Weed control treatment

TABLE 4: Percent increase in Sole /intercropping treatments

Sole /intercropping treatments	Mean	Percent increase over		
		T1	T3	T4
T1: Sole maize	52.42	-	-	-
T2: Sole urd (converted)	28.42	-	-	-
T3:Maize and Urd (1:1)	62.28	18.82	-	-
T4:Maize and Urd (2:1)	67.63	29.04	8.59	-
T5:Maize and Urd (2:2)	69.85	33.25	12.13	3.27

Significant increase in yield in intercropping over sole maize are observed with an increase (table 4) to the extent of 33.25, 29.04 and 18.82 percent over the sole maize in the intercropping row ratio of 2:2, 2:1 and 1:1, this indicated gain for having intercropping. Paired row of maize with 2 rows of urd bean (2:2) has 12.13 and 8.59 percent increase in productivity over 2:1 and 1:1. Same row ratio has recorded 3.27 percent increase over 2:1 row ratio of maize and urdbean. This clearly indicated that among the intercropping paired row of maize with two rows of urdbean has significant increased productivity 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. Thiyagarajan and Balasubramanian (2000) concluded that, productivity can be easily increased and sustained provided intercropping approach is handled. Singh and Singh (2001) in their study revealed that, Paired row of Maize with two rows of Soybean recorded statistically significant higher yield (29.6 q/ha). Significant higher yield indicates feasibility for having the intercropping. Shivay *et al.* (2001) in study of intercrop of maize legume, Avil Kumar et al. (2003) in the study of maize and soybean intercropping, Meena et al. (2006) in maize soybean, Lingaraju et al. (2008) in study of maize pigeon pea system noticed similar results of beneficial effect of intercrops. Shekhawat et.al, (2002) in their study indicated that planting in 2:2 rows of maize- black gram (urd) intercropping proved superior in all observations recorded.

Weed control practices

Pooled statistical analysis revealed significant differences among weed control methods (table 2). Results in table 3 revealed significantly higher productivity of 65.24 q/ha in Alachlor @ 1.5 kg /ha + HW at 40 DAS compared to 61.84 and, 58.92 q/ha in Alachlor @ 2kg /ha and hand weeding at 25 DAS respectively. Similarly productivity realized in Alachlor @ 2kg /ha is significantly superior over, hand weeding at 25 DAS. Yield benefits of weed control practices in intercropping were presented in table 5.

Significant increase in yield in weed control treatments over weedy check and others are observed with percent increase (table 5). Alachlor @ 1.5kg/ha + Hand weeding at 40.DAS, Alachlor @2kg/ha and Hand weeding at 25 DAS have recorded an increase in yield to the extent of

69.51, 60.67 and 53.07 percent respectively over unweeded. Alachlor @ 1.5kg/ha + Hand weeding at 40.DAS and Alachlor @2kg/ha have recorded an increase in yield to the extent of 30.98 and 14.30 percent over the Hand weeding at 25 DAS. Alachlor @ 1.5kg/ha + Hand weeding at 40 DAS has an increase in yield to the extent of 14.59 percent over Alachlor @2kg/ha**.**

TABLE 5: Percent increase in weed control treatments

Weed control treatments	Mean	Percent increase over		
		W1	W2	W3
W1:Weedy check (unweeded)	38.49	-	-	-
W2:Hand weeding at 25 DAS	58.92	53.07	-	-
W3: Alachlor @2kg/ha	61.84	60.66	14.30	-
W4: Alachlor @ 1.5kg/ha + Hand weeding at 40.DAS	65.24	69.51	30.98	14.59

This indicated gain in having the integrated weed control practice compared to the rest, this might be due to pre-emergent application of the herbicide (Alachlor @ 1.5kg/ha) and removal of any germinated weed after 25 DAS. Chalka and Nepalia (2006) in their study noticed, weed control through pre-emergence application of metolachlor 1 kg/ha, alachlor 2 kg/ ha and hand weeding at 30 DAS significantly reduced the weed dry matter. Muhammad Azim Khan (2011) et.al, in their study on weed control efficiency of intercropping legumes in maize observed that, weeds density/sq mt was significantly reduced by hand weeding and maize-mungbean simultaneous seeding in two rows as compared to weedy check and sole maize with herbicide use. In case of maize, maximum biological yield was recorded in hand weeded plots, followed by maize intercropped with 1 row of soybean seeded 3 weeks later.

Combination of sole/intercrops/weed control practices

Pooled statistical analysis revealed significant differences among combination of weed control treatments and sole/intercrop treatments (table 2). The productivity in the intercrops (table 3) row ratios are 45.86, 45.55 and 41.20 q/ha respectively in 2:2, 2:1 and 1:1 row ratio against 40.33 q/ha of sole maize tried with weed check. Productivity observed are 74.36, 71.17 and 68.08 q/ha respectively in 2:2, 2:1 and 1:1 row ratio intercrop against 53.09 q/ha. of sole maize tried with hand weeding at 25 DAS. Productivity observed are 78.87, 75.61 and 68.57 q/ha respectively in 2:2, 2:1 and 1:1 row ratio intercrop against 53.71 q/ha of sole maize tried with chemical weed control treatment Alachlor @ 2kg/ha. Productivity observed are 80.30, 78.22 and 71.30q/ha respectively in 2:2, 2:1 and 1:1 row ratio intercrop against 62.54 q/ha. of sole maize tried with Alachlor @ 1.5kg/ha + Hand weeding at 40 DAS. From the above result it could be noticed that, productivity is more in the combination of intercropping row ratios with integrated weed control treatment of Alachlor @ 1.5kg/ha + Hand weeding at 40 DAS. The productivity is particularly more in the 2:2 row ratio of intercropping combination with the above weed control treatment (80.30 q/ha). Regarding to weed control, Hamdollah Eskandari and Kamyar Kazemi (2011) observed that, intercrops were more effective than sole crops and it was related to lower availability of environmental resources for weeds in intercropping systems.

CONCLUSION

Based on the study and with support of the previous works it could be inferred that, intercropping of maize + Urdbean have provided higher productivity. 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 significantly superior productivity over rest of the intercropping and sole crop of maize. Among the weed control practices Alachlor @ 1.5kg/ha + Hand weeding at 40 DAS recorded significantly superior yield over rest of the weed control practices. Indicating efficiency of integrated weed management practices. Paired row of maize with two rows of urdbean (2:2) in combination with Alachlor @ 1.5kg/ha + Hand weeding at 40 DAS recorded significantly superior yield over the rest of the combination.

REFERENCES

Avil Kumar, K., Reddy, M.D., Shivasankar, A. and Reddy, N.V. (2003) Yield and economics of maize and soybean in intercropping under different row proportions. Indian J. Agril. Scis., 73 (2):69-71.

Chalka, M.K. & V. Nepalia (2006) Nutrient uptake appraisal of maize intercropped with legumes and associated weeds under the influence of weed control, Indian J. Agric. Res., 40 (2): 86 – 91

Gomez, K.A. & Gomez, A.A. (1983) Statistical procedures for agricultural research. John Wiley and Sons series, Second edition.

Hamdollah Eskandari & Kamyar Kazemi (2011) Weed Control in Maize-Cowpea Intercropping System Related to Environmental Resources Consumption, Notulae Scientia Biologicae, 3(1):57-60,

Lingaraju, B.S., Marer, S.B. & Chandrashekar, S.S. (2008) Studies on intercropping of maize and pigeon pea under rain fed conditions in northern transitional zone of Karnataka. Karnataka J. Agric. Sci., 21 (1):1-3.

Meena, C.P., Gaur, B.L. & Singh, P. (2006) Effect of row ratio and fertility levels on productivity, economics and nutrient uptake in maize + soybean intercropping system. Indian J. Agron., 51(3):178-182.

Muhammad Azim Khan, Anwar Nawaz Khan, Rahamdad Khan, Umm-E-Kalsoom & Muhammad Anwar Khan (2011) Weed control efficiency of intercropping legumes in maize, Pak. J. Weed Sci. Res. 17(4): 303-312.

Shekhawat, V.S., M.S. Shaktawat & S.P.S. Tanwar (2002) Effect of weed management on growth and productivity of maize-blackgram intercropping system, Agric. Sci. Digest, 22 (1): 36 - 38

Shivay, Y.S., Sing, R.P. & Madan Pal (2001) Productivity and economics of maize as influenced by intercrops with legumes and nitrogen levels. Ann. Agric. Res. series Vol 22(4): 576-582

Singh, N.P. & Singh, V.K. (2001) Competitive functions and economic viability of maize and soybean intercropping pattern under rainfed regions of Uttar Pradesh, Ann. Agric. Res. New series V.22 (4): 457-61

Thiyagarajan, T.M. & Balasubramanian, T.N. (2000) dry land techniques for increasing production of pulses in Tamil Nadu, Centre for advanced studies in Agronomy CAS training on recent advances in pulse crop production technology, held at Centre for advanced studies in agronomy, Tamilnadu Agricultral University, Coimbatore (TN) on 13-9-2000 to 30-10-2000, p.12

Velayutham. A. & Somasundaram. E. (2000) Change of management for pulses intercropping system. Centre for advanced studies in Agronomy CAS training on recent advances in pulse crop production technology, held at Centre for advanced studies in agronomy, Tamilnadu Agricultral University, Coimbatore (TN) on 13-9-20