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Maize and Soybean Intercropping under Various Levels of Soybean Seed Rates

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Abstract: An experiment was conducted with an objective to study the land use efficiency and economic return in maize-soybean intercropping system under various seed rates of soybean. Intercropping significantly reduced the thousand grains weight and grain yield of soybean at all seed rates. Maize thousand grain weight and grains yield remained unaffected in intercropping. The relative yield total of maize and soybean was greater in intercropping than monoculture. The highest land equivalent ratio (LER) of 1.52, net income of Rs. 29978 ha^{-1} and BCR value (return per rupee invested) of Rs. 2.41 were obtained from intercrop maize soybean at soybean seed rate of 80 kg ha^{-1}. Intercropped maize and soybean resulted in greater LER and higher economic returns as compared to monoculture at all seed rates of soybean. It could be concluded that soybean can successfully be intercropped with maize for an efficient use of land and higher economic return.

Key words: Maize, soybean, intercropping, inter planting, seed rates, plant population

Introduction

Intercropping (growing two or more than two crops simultaneously on the same field) is one of the way ameliorating the productivity of land and other inputs (Andrew and Kassam, 1976). Intercropping can be used by small farmers primarily to increase the diversity of their products and the stability of their annual output through effective use of land and other resources (Faris *et al.*, 1983). Enyi (1973) reported that small farmers in many countries are seriously constrained by low productivity and limited land resources. Therefore, preliminary research has shown that possible means of increasing the productivity through intercropping. Willey and Osiru (1972) recommended that intercropping of maize with legumes appears to be more profitable, when legumes are intercropped at proper stand.

Mixtures of cereals and legumes have shown higher yields as compared to their sole cultivation. Crookston and Hill (1979) reported that when corn and soybean were drilled in alternating rows and alternating pairs rows, land equivalent ratios (LER) of 1.3 were obtained for both the treatments. Thiyagarajan (1994) reported decrease in the 100 grains weight of soybean in intercrop with maize. Huges and Metcalfe (1972) reported reduction in grain yield of intercrop soybean as compared to monoculture. Odango *et al.* (1990) observed that Maize depressed the grain yield of intercrop soybean. Cunared (1976) obtained LER ranging from 1.2- 1.5 from growing corn and edible soybean togather. Khan *et al.* (1999) reported that net income of Rs. 22789 ha^{-1} was obtained from intercropping maize and soybean. Pardaker *et al.* (1993) who observed clear monetary advantage of maize and soybean intercropping over monoculture.

The shortage of edible oil is the burning problem of the country. Soybean is an oil seed crop and has the potential to overcome the shortage of oil. During 1998-99 maize was grown on 962.2 thousand hectares. (Anonymous, 1998-99). If this area is brought under the intercropping of soybean with maize, enormous increase in soybean production can be achieved. To obtain the maximum yield of the component crops in the intercropping system, optimum seed rate is very important. The objective of this study was to determine the production effectiveness of soybean intercropping with maize under various seed rates of soybean.

Materials and Methods

This intercropping experiment was carried out at the research fields of NWFP Agricultural University, Peshawar, during kharif season, 2000. The experiment was carried out in randomized complete block (RCB) design with a net plot size of 5x4.5 m^2. A basel dose of 60 kg nitrogen and 60 kg phosphorus per hectare was applied at the time of sowing, while 60 kg nitrogen per ha was applied only to the maize crop with first irrigation. Maize (Kisan) was sown with row to row distance of 75 cm while two rows of soybean (wahab-93) were intercropped among maize rows having a row to row distance of 30 cm with treatments Table 1.

Table 1: Maize and soybean intercropping and monoculture treatments under various seed rates of soybean

Treatments	Maize seed rates (kg ha^{-1})	Soybean seed rates (kg ha^{-1})
T_1	40	80
T_2	40	60
T_3	40	40
T_4	40	00
T_5	00	80
T_6	00	60
T_7	00	40

T_1, T_2, T_3= Inter croping; T_4= Maize monoculture;
T_5, T_6, T_7= Soybeen monoculture.

Data were recorded on thousand grains weight (g), grain yield (kg ha^{-1}) and land equivalent ratios (LER) of both the crops. Economic analysis was also performed to judge the economic effectiveness of the treatments.

LER is the land required for sole crops to produce the yield achieved in intercropping mixture. This provides measure of efficiency of particular crop association relative the sole crop (Willey, 1979) and is the most important index of measuring biological advantage of intercropping as compared to corresponding mono cropping system. This parameter is derived by calculating the absolute yield of each inter planted species to its yield in monoculture i.e. its relative yield and then summing the relative yields of all inter planted species to get the land equivalent ratios. LER greater than one indicated a more efficient use of land by the intercrops and the larger this value, the greater the efficiency of land use. Economic analysis was calculated by using the market prices of the crops prevailed at the time of harvest. To perform the economic analysis, first of all adjusted yield was worked out as prescribed by CIMMYT (1988) with the help of following formula:

Adjusted yield = Actual yield x 0.9

Gross income was calculated by multiplying the adjusted yield of each treatment by the current per kg price of the crop which was Rs. 10 kg^{-1} for soybean and Rs. 7 kg^{-1} for maize. Net income was computed by subtracting the cultivation cost from gross income. Cultivation cost includes seed cost, fertilizer (urea, DAP cost) land preparation charges, pesticide charges, ploughing, planking, sowing cost, weeding (two times) irrigation, harvesting, threshing
and transportation charges. BCR values (return per rupee invested) were calculated as follows (Akhtar *et al*., 2000):

$$\text{Return per rupee invested} = \frac{\text{Gross income}}{\text{Total (variable) cost of cultivation}}$$

Results and Discussion

Thousand grains weight: Analysis of variance showed that there was non significant effect on thousand grain weight of maize when intercropped with soybean at any seed rate. Thousand grain weight of soybean was recorded significantly ($P \leq 0.05$) higher in sole plots as compared to intercrop. Thousand grain weight of soybean in mono culture was recorded from 109.66 to 114.66 g, while thousand grain weight of soybean was decreased from 103.33 to 101.33 g when intercropped with maize at various seed rates (Table 2). The possible reason could be that in intercrop soybean, competition among the plants of two species was intensified that affected the growth of soybean resulted in poorly filled grains. This finding is confirmed by Thiyagarajan (1994), who reported a significant decrease in 100 grains weight of intercrop soybean.

Grain yield (kg ha^{-1}): Results indicated that there was a non-significant effect of intercropping on the yield of maize. Soybean yield was significantly ($P \leq 0.05$) reduced in intercrop with maize as compared to monoculture at all seed rates of soybean. Highest grain yield of soybean of 4131.00 kg ha^{-1} was obtained in monoculture at seed rate of 80 kg ha^{-1} (Table 2). Minimum grain yield of soybean of 1092 kg ha^{-1} was recorded in intercrop soybean seeded at 40 kg ha^{-1}. Among intercrop treatments, maximum grain yield of 2382 kg ha^{-1} of soybean was recorded at seed rate of 80 kg ha^{-1}. Monoculture recorded higher grain yield as compared to intercrop at all seed rates of soybean. These findings are with close conformity with those reported by Huges and Metcaife (1979) and Odango *et al*. (1990), who stated that intercrop maize depressed the grain yield of soybean.

Land utilization efficiency: The land equivalent ratios (LER) of intercrops provides an accurate assessment of the competitive relationship between the component crops, the best usage of land as well as the over all productivity of the intercropping system.

It is evident from the data that maize-soybean interropping produced significantly greater LERs than monoculture. LERs in intercropping ranged from 1.39-1.52 by using different seed rates of soybean (Table 2). These results agree with those reported by Cunared (1976) and Crookston and Hill (1979).

Economic analysis: Agro-economic feasibility of intercropping system is ultimately determind by its monetary gain. No single index is capable of giving a good comparison of intercropping system and so a number of indices are used togather to assess the economic viability of the system. The agronomist decides on the biological efficient, while the economist decides on the economic worthiness of the system using one or more than one of the economic indices. In general, a biological efficient system is also economically effective but quite often it so happens that a biologically efficient system is not economically viable and can not be recommended for wide scale adoptation by farmers.

An estimate of the economic aspect of the present studies were computed and the data regarding monetary gain along with all relevant calculations and interpretation is presented in Table 3. It is evident from the data that maximum gross income of (Rs. ha^{-1}) 51236, net income of Rs. 29978 and return per rupee invested of Rs 2.41 was obtained in maize and soybean intercropping sown at soybean seed rate of 80 kg ha^{-1}. Next in order was also

Table 2: Thousand grains weight, grains yield (kg ha^{-1}) and LER values of maize and soybean intercropping at various seed rates of soybean

Seed rates (kg ha^{-1})			1000 grains weight (g)		Grain yield (kg ha^{-1})		
Maize	:	Soybean	Maize	Soybean	Maize	Soybean	LER
40	:	80	203.66	102.33C	4732.00	2382.0b	1.52
40	:	60	203.00	101.33C	4601.00	1941.0c	1.48
40	:	40	203.33	103.33C	4780.00	1092.0d	1.39
40	:	00	204.33	–	4980.00	–	1.00
00	:	80	–	109.66b	–	4131.0a	1.00
00	:	60	–	114.66a	–	3764.0a	1.00
00	:	40	–	113.33a	–	2440.0b	1.00
LSD (P≤ 0.05)			NS	2.418	NS	401.613	–

LER: Land equivalent ratio, NS: Non significant at 5% probability level. Means followed by different letters are significantly different from each other using 5% level of probability

Table 3: Economic analysis of maize and soybean intercropping under various seed rates of soybean

Seed rates (kg ha^{-1})								
Maize	:	Soybean	Average yield (kg ha^{-1})	Adjusted yield (kg ha^{-1})	Gross income (Rs. ha^{-1})	Cultivation cost (Rs. ha^{-1})	Net income (Rs. ha^{-1})	Return per rupee (Rs.)
40	:	80	4732+2382	4258+2143	51236	21258	29978	2.41
40	:	60	4601+1941	4140+1746	46440	20503	25943	2.26
40	:	40	4780+1092	4302+982	39934	19783	20151	2.01
40	:	0	4980	4482	31374	19150	12224	1.64
0	:	80	4131	3717	37170	18660	18150	1.99
0	:	60	3764	3387	33870	18450	15520	1.84
0	:	40	2440	2196	21960	17050	04910	1.28

intercrop at soybean seed rate of 60 kg ha^{-1}, which gave gross income of Rs. 46440, net income of Rs. 25943 and return per rupee invested of Rs. 2.26. Intercrop recorded higher economic return as compared to monoculture at all seed rates of soybean. These findings are with close conformity with those reported by Khan *et al.* (1999) and Pardaker *et al.* (1993), who observed clear monetary advantage of intercropping over monoculture. It is concluded from the present findings that intercropping resulted in greater productivity per unit of land and greater economic return as compared to monoculture, especially when raised at proper stand of companion crop. However, further research is suggested to devise a viable intercropping system regarding planting geometry of these crops.

References

Akhtar, N., M. Hassan, A. Ali and M. Raiz, 2000. intercropping maize with cowpeas and mungbean under rainfed conditios. Pak. J. Biol. Sci., 3: 647-648.

Andrews, D.J. and A.H. Kassam, 1976. The importance of multiple cropping in increasisng world food supplies. Am. Soc. Agron. Spea. Publc., 22: 1-10.

Anonymous, 1998-99. Agricutlural Statistics of Pakistan. Ministry of Food, Agriculture and Livestock, pp: 18-19.

CIMMYT, 1988. From agronomic data to farmer recommendations. An economics training manual. Completely revised edition. Mexico, D.F., R.K. Crookston and D.S. Hill, 1979. Grain yield and land equivalent ratios from intercropping corn and soybean in Minnesota. Agron. J., 71: 41-44.

Cunared, A.C., 1976. The influence of interplanting on yield partners of components (corn and edible soybean). In: J. Ruhle (Ed) Interplanting. Rodale Press, Inc. Emmaus, Pennysylvania.

Enyi, B.A.C., 1973. Effect of interplanting of maize or sorghum with cowpeas, pigeon peas or beans. Expt. Agric., 9: 83-90.

Faris, M.H., H.A. Burity, D.V.D. Reis and R.C. Mafra, 1983. Economic Analysis of bean and maize system in monoculture vs associated cropping. Field Crop, 1: 319-335.

Huges, H.D. and D.S. Metcalfe, 1972. Crop Production 3rd Ed. Macmillon Publishing Comp. Inc. New York.

Khan, A., S. Khan, M. Asrar and M. Khan, 1999. Efficiency of intercropping maize, soybean and sunflower on grain yield Pak. J. Bio. Sci., 2: 1611-1613.

Odango, J.C.W., D.S. Veresoglo and A.G. Sficas, 1990. Effects of population density, nitrogen fertilization and inocculation on the yield of intercropped maize and soybean. Field Crop Abst., pp: 043-055619.

Pardaker, V.K., R.K. Sharma and P.C. Upadhyay, 1993. Legume planting as a bonus crop in rainfed maize. Current Research; University of Agricultural Sciences, Banglore, 22: 53-54.

Thiyagarajan, C.R., 1994. Studies on the quality of seeds of component crops in maize based intercropping. Madras Agric. J., 81: 46-47.

Willey, R.W., 1979. Intercropping, its importance and research needs. 1 Competition and yield advantage. 2. Agronomy and Reaserch approaches. Field Crop, 32: 1-10, 73-85.

Willey, R.W. and D.S.O. Osiru, 1972. Studies on mixture of maize and beans with particular refrence to plant population. J. Agric. Sci. Canb., 79: 519-529.