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BIO-ECONOMIC RELATIONSHIP OF COMPONENT CROPS IN SOYBEAN-MASH INTERCROPPING SYSTEMS

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A field study pertaining to intercrop relationships in different soybean-mash intercropping systems was conducted on a sandy clay loam soil. The treatments comprised soybean alone, mash alone, soybean + one row of mash, soybean + two rows of mash, soybean + three rows of mash and soybean + four rows of mash. The results revealed that intercropping of mash in patterns of one, two, three and four rows between the soybean strips reduced the soybean yield by 3.55, 8.36, 20.04 and 23.48 %, respectively over soybean alone. By contrast at the cost of this much reduction in soybean yield an additional harvest of 2.72, 3.16, 3.51 and 3.72 q/ha of mash was obtained from the respective intercropped treatments which compensated more than the losses in soybean production. The highest land equivalent ratio (LER) of 1.31 was recorded for an intercropping system comprising soybean + two rows of mash which indicated 31 % yield advantage over sole cropping.

Key words: Intercropping, Land equivalent ratio, Economic analysis, *Vigna mungo, Glycine max.*

Introduction

Soybean (*Glycine max*) and Mash (*Vigna mungo*) are important Kharif pulses. The harvest potential of both soybean and mash is too low to be grown as sole crop. There is a need to develop an appropriate intercropping system for these crops in order to get the maximum yield per unit area. The present method of planting soybean in 45 cm. apart rows does not permit convenient intercropping because of narrow row spacing. Thus a new method of planting soybean in 100 cm spaced four row strips (20/100 cm) to facilitate intercropping was designed.

According to Kaul *et. al.* [5] arhar (*Cajanus cajan*) grown in pure stand or in double rows 75 cm apart alternating with one row of mash, green gram (*V. radiata*), soybean, ground nut or maize gave average yields of 1.72, 1.83, 1.79, 1.63, 1.57 and 0.92 t/ha, respectively. Similarly Giri [4] and Gahlot *et. al.* [3] stated that seed yields of arhar (*Cajanus cajan*) grown at a spacing of 50 x 20 cm in pure stands or when intercropped with green gram (*Vigna radiata*) between the rows were 1.70 and 1.58 t/ha, respectively. Choudhary *et. al.* [2] concluded that intercropping of green gram, moth bean, black gram, cow peas, soybean or gram in cotton, castor bean, pearl millet, pigeon pea, sugarcane, sesamum and maize had no adverse effects on the yield of main crop and gave additional seed yields. Rajasekaram *et. al.* [8] and Singh *et. al.* [9] obtained the maximum maize yield with *V. mungo* or onion followed by cow peas.

Nasrullah [7] reported that in mung-mash intercropping system seed yield and harvest index of mash crop were affected significantly, while 1000-seed weight of mung was not affected to a significant extent.

The present study has been designed to determine the feasibility and productive efficiency of soybean-mash intercropping systems in different combinations under the irrigated conditions at Faisalabad.

Materials and Methods

The study was conducted on a sandy clay loam soil with initial fertility status of 0.053% N, 4.71 ppm P_2O_5 and 111.85 ppm K_2O at the Agronomic Research Area, University of Agriculture, Faisalabad during the Autumn, 1987. The experiment was laid out in a randomized complete block design with four replications. Net plot size measured 4.8 x 8.0 m.

The intercropping systems comprised of soybean alone, mash alone, soybean plus one row of mash, soybean plus two

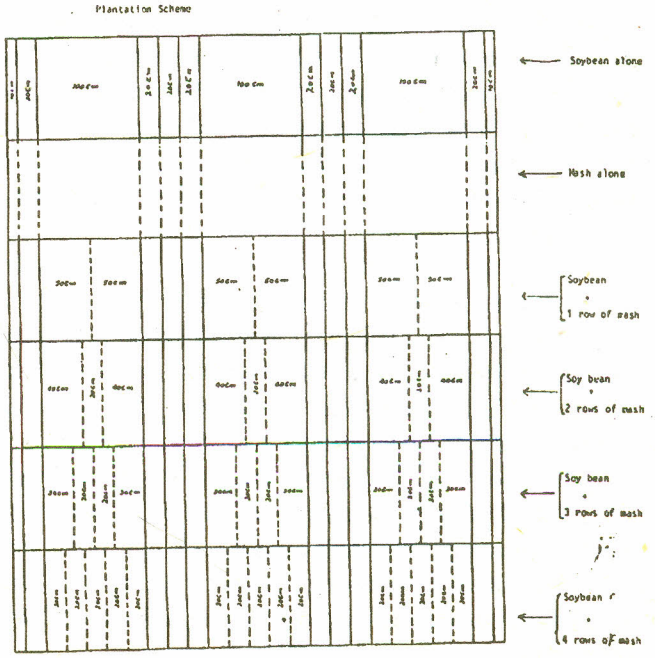

Fig. 1. Plantation scheme.

rows of mash, soybean plus three rows of mash and soybean plus four rows of mash. Soybean crops was sown in 4-row strips with 20 cm between rows and 100 cm between strips. The plantation scheme of different soybean-mash intercropping systems is given in Fig. 1 for ready reference. Soybean crop was sown on a well prepared seed bed in the first week of August. Mash crop was intercropped according to the layout plan on the same day in respective treatments. The seed rate used was 60 kg/ha for soybean and 20 kg/ha for mash. Uniform soybean seed rate and number of rows per plot was maintained in all the experimental plots for valid comparisons. A basal application of 50-100-50 kg NPK/ha in the form of Urea, SSP and SOP, respectively was applied at the time of sowing. All other agronomic practices were kept normal and uniform for all the intercropping treatments.

Observations on plant height at harvest, number of plants per unit area at harvest, number of pods per plant, number of seeds per pod, 1000-seed weight, seed yield, harvest index and land equivalent ratio were recorded by using standard procedures. The data collected were analysed by using Fisher's analysis of variance techniques. Duncan's New Multiple Range test at 5% probability was used to compare the differences among treatments means [10].

Results and Discussion

Data showing the number of plants per unit area of soybean and mash are given in Table 1 and 2 , respectively. The plant population of both the component crops varied significantly. The stand density of soybean ranged from 9.33 to 13.50 m^{-2}.The number of plants of mash were recorded 21.15, 8.35, 13.11, 15.74 and 16.19 in case of mash alone, one, two, three and four rows of intercropping systems, respectively. This happened because of variable planting density in different intercropping systems.

Maximum plant height of 48.82 cm was observed in case of soybean alone while the minimum of 42.22 cm was recorded in case of soybean + 4 rows of mash. Plant height decreased progressively as the intercropping intensities were increased. This clearly indicated that growth behaviour of soybean plant is affected by its surrounding environment. Similarly plant height of mash ranged between 32.09 to 38.25 cm (Table 1). Significantly taller plants were observed in mash alone plots than rest of the intercropped treatments, while other treatments were at par with one another. These results are in line with those of Nasrullah [7].

The perusal of Tables further indicated that soybean sown alone produced significantly more pods (33.02) per plant than other intercropping systems. There was a progressive decrease in the number of pods per plant of soybean with the increasing density of mash intercropping (Table 1). The minimum number of pods per plant was recorded in plots intercropped with four rows of mash which was due to severe competition between the component crops because of increased number of plants per unit area. By contrast the number of pods per plant of mash was not affected significantly in the various intercropping intensities.

TABLE 1. YIELD AND YIELD COMPONENTS OF SOYBEAN AS AFFECTED BY VARIOUS SOYBEAN MASH INTRCROPPING SYSTEM.

Intercropping system	Plant population (m^2)	Plant height (cm)	No. of pods/plant	No. of seeds/pod	1000 Seed weight (g)	Seed yield (q/ha)	Harvest index (%)	Land equivalent ratio (LER)
Soybean alone	(1)	(1)	(1)	NS	NS	(1)	(1)	
	13.50a	48.82a	33.02a	2.83	74.85	8.73a	31.98c	–
Soybean +1 row of Mash	12.81ab	47.55ab	26.6b	2.47	75.08	8.42ab	36.89ab	1.298
Soybean +2 row of Mash	9.75cd	47.55ab	23.07bc	2.44	75.83	8.00b	39.85a	1.305
Soybean +3 row of Mash	9.33cd	43.11bc	22.57bc	2.29	75.76	6.98c	35.29bc	1.228
Soybean + 4 row of Mash	11.25bc	42.22c	20.95c	2.13	76.50	6.68c	36.64ab	1.215

N.S. = Non-significant, (1) = Any two means not sharing a letter differ significantly at 5% level of probability (DMRT)

TABLE 2. YIELD AND YIELD COMPONENTS OF MASH AS AFFECTED BY VARIOUS SOYBEAN MASH INTRCROPPING SYSTEM.

Intercropping system	Plant population (m^2)	Plant height (cm)	No. of pods/plant	No. of seeds/pod	1000 Seed weight (g)	Seed yield (q/ha)	Harvest index (%)
Mash alone	(1)	(1)	NS	(1)	NS	(1)	(1)
	21.15a	38.25a	18.22	2.49a	39.25a	6.43a	25.64a
Soybean +1 row of Mash	8.35d	32.09b	17.47	2.50a	39.38	2.72b	25.15a
Soybean +2 row of Mash	13.11c	32.98b	15.47	2.20ab	37.65	3.16b	21.92c
Soybean +3 row of Mash	15.74b	34.98b	15.35	1.93b	37.06	3.51b	21.74c
Soybean +4 row of Mash	16.19b	37.36a	12.67	1.88b	37.03	3.72b	22.34bc

N.S. = Non-significant, (1) = Any two means not sharing a letter differ significantly at 5% level of probability (DMRT)

TABLE 3. ECONOMIC ANALYSIS OF SOYBEAN MASH INTERCROPPING SYSTEM.

Intercropping system	Yield (q/ha)		Combined yield (q/ha)	Income (Rs/ha)		Gross income (Rs/ha)	Total expenditure (Rs/HA)	Net income (Rs/ha)	Benefit cost ratio (BCR)
	Soybean	Mash		Soybean	Mash				
Soybean alone	8.73	–	8.73	4365.00	–	4365.0	2997.49	1367.51	1.46
Mash alone	–	7.43	7.43	–	6315.5	6315.5	2847.51	3467.99	2.22
Soybean + 1 row of Mash	8.42	2.72	11.14	4210.00	2310.0	6520.0	3289.34	3230.66	1.98
Soybean + 2 row of Mash	8.00	3.16	11.16	4000.00	2686.0	6686.0	3481.54	3204.46	1.92
Soybean + 3 row of Mash	6.98	3.51	10.49	3490.00	2983.5	6473.5	3654.92	2818.58	1.77
Soybean + 4 row of Mash	6.68	3.72	10.40	3340.00	3162.0	6602.0	3840.24	2761.76	1.72

The number of seeds per pod of soybean was not affected to a significant extent by the various intercropping systems. The maximum number of seeds per pod (2.83) was found in case of soybean alone where as lowest (2.13) was recorded for soybean plus four rows of mash intercropping systems. As regards mash, the higher number of seeds per pod of mash in one and two rows intercropping systems was probably due to more space and comparatively low plant population per unit area which decreased the intercrop competition to a reasonable extent.

The perusal of the Table 1 and 2 further indicated that the 1000 grain weight of soybean and mash on an average ranged between 74.85 to 76.5 and 37.03 to 39.38 grams, respectively. This clearly indicated that the seed development potential of soybean and mash was not affected by growing them in association with each other when compared to their respective pure stands.

Soybean alone produced the maximum seed yield of 8.73 q/ha as against 8.42, 8.00, 6.98 and 6.68 q/ha for the intercropping intensities of one, two, three and four rows of mash, respectively (Table 1). At the same time, additional seed yields of 2.72, 3.16, 3.51 and 3.72 q/ha of mash were obtained from the respective treatments which compensated for the losses in soybean yield. Similarly the highest seed yield (6.43 q) of mash per ha was recorded in mash alone against 2.72, 3.16, 3.51 and 3.72 per hactare for the intercropping intensities of one, two, three and four rows, respectively. These yield differences occurred probably due to variable plant population of mash crop under various intercropping systems. Almost similar results were reported by Kaulend Sekhon [5] Gablot *et.al.* [3], Ahmad and Rao [1] and Nasiullah [7].

It is evident from Table 1 that the maximum harvest index value of soybean was recorded in case of intercropping systems comprising soybean plus two rows of mash which was probably attributed to comparatively less vegetative growth and more fruiting of soybean crop. On the other hand, the harvest index value for mash ranged between 21.74 to 25.64% which showed that harvest index of mash tended to decrease with an increase in intercropping intensity from one to four rows (Table 2).

The data given in Table 1 indicated that land equivalent ratio (LER) was more than "One" in all the soybean-mash intercropping systems. The highest LER value of 1.305 was recorded in case of soybean + two rows of mash as against 1.298, 1.228 and 1.215 for one, three and four rows of intercropping systems respectively.

The economic analysis together with all relevant calculations are given in Table 3. Perusal of Table indicated that all the soybean-mash inter-cropping systems gave less income per hectare than mash alone due to the sudden rise in the market price of mash. However, the combined seed yields of the various intercropping systems were much higher than sole crop yield which amounted to 8.73, 6.43, 11.14, 11.16, 10.49 and 10.40 q/ha for soybean alone, mash alone, soybean + one row of mash, soybean + two rows of mash, soybean + three rows of mash and soybean + four rows of mash intercropping systems, respectively. The highest net income of Rs. 3230.66/ha was obtained from an intercropping system comprising soybean + one row of mash as against the lowest of Rs. 1367.51/ha for soybean alone.

In terms of benefit cost ratio, the highest benefit cost ratio of 2.22 was recorded in case of mash alone as against 1.46, 1.98, 1.92, 1.77 and 1.72 for soybean alone, one, two, three and four rows of mash intercropping intensities, respectively. Almost similar results were reported by Chaudhry and Singh [2], Rajase Karan *et.al.* [8] and Nasirullah [7].

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