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Bio-Economic Assessment of Different Sunflower Based Intercropping Systems at Different Geometric Configurations

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Abstract: Studies to see the comparative productive efficiency and feasibility of different sunflower based intercropping systems were conducted at Agronomic Research area, University of Agriculture, Faisalabad. Intercropping systems included sunflower alone, sunflower + mash and sunflower + mung. Sunflower was sown in 90 cm apart single rows as well as 90 cm apart double row strips. The results of studies indicated that when sunflower grown alone gave the maximum yield of 2.89 t ha^{-1} followed by 2.75 t ha^{-1} in 90 cm apart single row and 90 cm apart double row strips respectively as against when sunflower sown in combination with mung and mash, gave the yield of 2.41 and 2.24 t ha^{-1}. It is disserted that intercropping is more beneficial than sole cropping, although it has adverse effect on the main crop but this loss is compensated by additional harvest of intercrops in the term monetary returns. Among the various intercropping treatments sunflower-mashbean was appeared to be highly profitable and gave the highest income of Rs. 37995.51 with the highest BCR value of 3.72 was recorded in case of sunflower + mashbean as against minimum income of Rs. 27618.75 with BCR of 3.02 for sunflower alone in 90 cm apart double rows strips. Therefore intercropping can be practiced to maximize the crop production from the unit area under pertaining condition.

Key words: Sunflower, intercropping mung and mash

Introduction

Developing countries of the world are facing pressure on their agriculture, due to ever-increasing human and livestock populations. Farmers in Pakistan are constrained by low crop productivity due to limited land resources. A possible way of increasing the productivity on small farms would be through intercropping, as it provides security against potential losses of monoculture. Moreover, there is a need for increased production of pulses and oilseeds as we are deficient in proteins and fats in our daily diet and huge amount of foreign exchange is spent annually on the import of these commodities. An alternative to increase the production of oilseed and pulses could be through intercropping them with sunflower. Despite vast potential for increased agricultural production, Pakistan is still not producing enough to meet even the basic needs of population for bridging the chasm of food deficiency. Intercropping is a wise pre time management for increasing potentiality of soil and production per unit area as well as income.

The development of a feasible and economically viable intercropping system depends largely on the selection of compatible crops. The advantage can further be enhanced by proper arrangement of component crops. Maximum benefits are obtained when component crops have the least competition. In this study we discussed, utilization of the row space of tall plants without reducing their density in order to ensure maximum utilization of resources by the dwarf crop. This concept of intercropping is primarily to maximize the farm production and monetary returns and suggests the recommendation and future strategies for the improved farming system. Intercropping is primarily adopted by the farmers to addition their farm income and diversity of products. As our land is facing twin problem of salinity and water logging. Land under cultivation is shrinking and it is imperative need to increase per acre yield by adopting intercropping system. Better interception of solar radiation, effective utilization of nutrient and water, risk reduction and high exploration of the growth factors in an intercropping system has also been repotted by Jozsa, *et al.* (1987). Sunflower (*Helianthus annuus* L.) is an important oil seed crop of the world and contributes about 14% of edible oil requirements.

In Pakistan sunflower was first introduced as an oil seed crop in the 1960's. Moreover, sunflower oil is quite palatable and contains soluble vitamin A, D, E and K. It's seed contains high oil content ranging from 40 to 47 percent and is rich in protein. Furthermore, its quality is better due to higher percentage of linoleic acid and lower percentage of linolenic acid, which is the most desirable character, lacking in other oil seeds and sunflower is also a good source of nectar for honey production. The planting of sunflower in well-spaced rows with other suitable intercropping like mash and mung is followed to get additional income per unit area without declining the yield of sunflower crop. Gill (1987). Pulses are rich source of protein and are essential to balance our diet. At Present, there is a need for increased production of pulses. The area under kharif pulses is limited to the rainfed area and cannot be increased due to competition with other kharif crops.

Therefore, alternative to increase the production of kharif pulses may be through intercropping with other crops. Nevertheless, the losses in sunflower production by the respective intercops were compensated by additional harvests of intercrops (Sherazi, 1993); However, conventional methods of planting wheat don not permit easy and systematic intercropping because of narrow row spacing. Consequently, a new method of planting sunflower in 90 cm apart single row and 90 cm of double row strips has been developed which has made it feasible to practice intercropping in sunflower conveniently without too much intercrops competition. Thus the best way of simultaneous increase in sunflower and pulses productivity is to grow these crops in association with each other. The present study was designed to see the effect of intercropping on the seed yield of sunflower planted in autumn season under the irrigated conditions at Faisalabad.

Materials and Methods

The studies were carried out to see the effect of different mungbean and mashbean intercropping systems on seed yield and various growth parameters during kharif season of 2000 at University of Agricultural Faisalabad. Replicated three times the experiment was laid out in split plot design randomizing the planting patterns in main plots and intercropping in subplots. The net plot size measured 3.6 x 7m. Intercropping system comprised sunflower alone in 90 cm apart single rows with 20 cm plant spacing and 90 cm apart double row strips with 30 cm plant spacing. Mung bean and Mash bean were inter-planted in between the rows and strips of sunflower. Sunflower hybrid 64-A-93 was used as the medium of the trial. The crop was sown in double row strips 90 cm apart and single rows 90 cm apart with the help of dibbler on a well prepared seed bed o August 21, 2000. The associated crops of mashbean and mungbean were intercropped on the same day. Urea and diammonium phosphate were used as a source of N and P. Nitrogen and phosphorous were applied @ 100 and 70 kg ha^{-1}. Whole phosphorus and half of N were applied at the time of seedbed preparation an subsequent N was applied with first irrigation. In all, four irrigation were applied. All other agronomic practices were kept uniform and normal for all the treatments. The data collected were subjected to Fisher's analysis of variance technique and LSD was used to compare differences among the treatment means (Steel and Torrie, 1984).

Results and Discussion

The data pertaining to the number of plants per unit area are presented in Table 1 that the plant population of sunflower were not effected to a significant extent by various intercropping systems. Non-significant differences in plant population may be attributed to uniform seed germination. Almost similar results were reported by Jozsa *et al.* (1987).

Plant height at harvest (cm) is shown in Table 1. It is evident from the Table 1 that both the planting patterns and intercropping systems did not influence the sunflower plant height to a significant extent. This clearly indicated that growth behavior of sunflower plant is mainly controlled and regulated by its genetic constitution rather than by a change in ornament as a result of various intercropping systems. These results are in line with those of Gill (1987), Narwal and Malik (1986) Akram (1989).

Stem diameter of sunflower was affected significantly by planting geometry and intercropping systems under study. Regarding intercropping systems sunflower grown alone recorded the significantly more stem diameter (2.62 cm) as against the minimum (2.09) for sunflower + mungbean intercropping system. It might be due to reason that sunflower in various intercropping system faced inter and intera-specific competition for growth resources which resulted in significant reduction in stem diameter of sunflower intercropping systems compared to sole sunflower at two geometric configuration. Similar results were reported by EL- Sayed *et al.* (1984).

Maximum head diameter (18.08 cm) was recorded in case of 90 cm apart single rows. The summer legumes seem to offer the same degree of competition to sunflower which resulted the non significant variation in head diameter of sunflower variation in head diameter of sunflower in different intercropping systems. Different head diameter of sunflower at various geometric configuration might be due to intra-specific competition among the sunflower plants. Interaction between these two factors was found to non-significant. The results are in agreement with those reported by EL Sayed *et al.* (1984), Gill (1990) and Ogunermi (1983).

It is evident from the Table 1 that the numbers of achenes per head were not influenced significantly by different combinations of summer legumes such as mash and mung

Table 1: Growth and yield parameters of sunflower as affected by different intercropping systems

Intercropping system	Number of plants m-2 at harvest	Plant height at maturity (cm)	Stem diameter (cm)	Head diameter (cm)	Number of achenes/head	1000-achene weight (g)	Seed yield (t ha^{-1})	Stalk weight (t ha^{-1})	Achene oil content (%)	Harvest index(%)
Sunflower 90 cm apart single rows										
	134.2	138.2	2.41a	18.03a	1235.98	41.02	2.56a	6.77a	41.23	27.51
Sunflower 90 cm apart double row strips										
	134.7	137.1	2.15b	17.5b	1234.03	40.46	2.41b	6.43b	41.17	27.27
I_1: Sunflower alone										
	135.0	138.9	2.62a	19.32a	1247.01	42.53a	2.82a	7.11a	41.35	28.37a
I_2: Sunflower + Mashbean										
	134.8	137.8	2.14b	17.14b	1230.01	40.25b	2.41b	6.54b	41.19	27.02b
I_3: Sunflower + Mungbean										
	134.5	136.3	2.09b	16.98b	1228.0	39.45b	2.24c	6.15c	41.09	26.78b

Figures sharing similar letter(s) do not differ statistically at P = 0.05

Table 2: Economic analysis of sunflower based mungbean and mashbean intercropping systems at different plating geometry

Intercropping systems		Yield (kg ha^{-1})			Income (Rs ha^{-1})			Gross Income (Rs ha^{-1})	Total expenditure	Net Income (Rs ha^{-1})	B.C.R
		I_1	I_2	I_3	I_1	I_2	I_3				
P1 (90/20) cm	I_1 : Sunflower alone	2.89	-	-	43350.00	-	-	43350.00	13631.25	29718.75	3.18
	I_2: Sunflower + Mash	2.51	474.89	-	37650.00	14296.70	-	51946.75	13951.25	37995.51	3.72
	I_3: Sunflower + Mung	2.29	-	665.28	34350.00	-	16632.00	50982.00	14191.25	36790.75	3.59
P2 (90/30) cm	I_1 :Sunflower alone	2.75	-	-	41250.00	-	-	41250.00	13631.25	27618.75	3.02
	I_2: Sunflower + Mash	2.31	436.56	-	34650.00	13096.80	-	47746.80	13951.25	33795.55	3.42
	I_3: Sunflower + Mung	2.19	-	613.35	32850.00	-	15333.75	48183.75	14191.25	33992.25	3.39

Sunflower @ Rs. 600/40 kg Mashbean @ Rs. 1200/40 kg Mungbean @ Rs. 1000/40 kg

with sunflower and different planting patterns. These results revealed that planting patterns and inter cropping systems had non-significant effect on the treatments under study. There results were supported by Akram (1989) and Saleh *et al.* (1984).

Among the various parameter contributing towards the final seed yield, 1000 – achanes weight in key factor. The data pertaining to 1000-achene weigh given in Table 1 revealed that the significantly higher achne weigh (42.5 g) was found in sunflower alone, while mash and mung inter cropped in sunflower did not influence the achene size showing the 1000-achene weigh range from 1234.03 to 1235.98 in case of 90 cm apart double row strips respectively. Similar 1000-achnes weigh might be attributed due to similar genetic characteristics of the achenes of sunflower. These results are in accordance with those observed be EL- Sayed *et al.* (1984) and Gill (1987).

The final seed yield per hectare is a function of the cumulative effects of various yield components developing under the influence of a particular set of environment condition. Perusal of the table indicated that there were significant differences among the treatment under study. It might be due to reason that sunflower faced severe inter and intra specific competition for growth factors when grown in association with mung and mash various intercropping and at different planting geometry which resulted in significant reduction in yield of sunflower. These results are in agreement with those of Majid *et al.* (1976) and Ibrar (1995).

Table 1 indicated that sunflower grown alone produced maximum stalk weight (7.11 t ha^{-1}) which was significantly higher than rest of the treatments under study. On the other hand the planting geometry i.e. 90 cm apart single row or 90 cm spaced double row strips showed statistically different stalk weight per hectare recording the stalk of 6.77 and 6.43 t ha^{-1}, respectively Shafashak *et al.* (1986).

Data regarding harvest index as influenced by planting patterns and intercropping systems are presented in Table 1. A perusal of the Table revealed that harvest index (HI) was not affected significantly by different planting geometry. These conclusions are in confirmation with those reported by Gill (1987).

Data regarding to achene oil content revealed that planting pattern and intercropping systems has non-significant affect on achene oil content. These findings are in collaboration with those of El-Sayed *et al.* (1984) and Ibrar (1995).

Economic analysis of sunflower based intercropping systems: Both the feasibility and profitability of an intercropping system is reflected to ultimate economic return. Data regarding the details of economic analysis along with all relevant calculation presented in Table 2, revealed that both the intercropping systems under study considerably gave higher net income per hectare than sunflower alone amongst the various intercropping systems, the highest net return of Rs. 37995.5 ha^{-1} was obtained from sunflower + mash against the minimum of Rs. 27618.25 ha^{-1} for sunflower alone. In term of benefit cost ratio, all the system of intercropping system showed higher BCR than sunflower alone. The highest BCR value of 3.72 was recorded in case of sunflower + mash against the minimum 3.02 for sunflower alone. These results are supported by the findings of Ahmad (1990).

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