http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences, 2(4): 1611-1613,1999 Research Article

Efficiency of Intercropping Maize, Soybean and Sunflower on Grain Yield

Aslam Khan, Sartaj Khan, Muhammad Asrar and Munir Khan
NWFP Agriculture University, Peshawar, Pakistan

bstract

n experiment was conducted with an objective to study the land use efficiency and economic return under maize, (*Zea ays* L.) soybean [*Glycine max* (L.) Merr.] and sunflower (*Helianthus annuus* L.) sown alone and in four possible tercropping systems. The results indicated that intercropping substantially affected grain yield. In monoculture the grain elds of soybean was higher by 23 to 42 percent than grain yields of soybean in different intercropping combinations. tercropping of sunflower significantly affected grain yields of maize and soybean. The relative yield total of different ecies in intercropping was greater than their yields in monocultures. The highest land equivalent ratio (LER) of 1.48 and gross income of Rs. 23197 ha^{-1} were obtained from maize + soybean intercropping system. This suggests 48 percent crease in production during one season of intercropping. Intercropped maize and soybean resulted in greater LER and gher economic returns than those of monocultures. More research is suggested to devise a viable and profitable tercropping system in different agro-ecological zones of NWFP.

troduction

kistan's population is increasing at the alarming rate of arly 3 percent annually and food production do not cope th its ever growing demands. As social and economic essures cause agricultural land to shrink and more pensive, hence the farmers' may ill afford the luxury of nocropping with less land use efficiency. Cropping stems which result in two or more harvested crops per it of land during one year, are called multiple cropping. pping indexes of 1.5 to 2.000 are prevailing through out e northern areas of the country (Quresh *et al.*, 1979). search work reported on intercropping has shown ssible means of increasing the productivity on small rms. Willey and Osiru (1972) recommended that ercropping of maize with legumes appear to be more fitable and the economic returns will be more. Andrew d Kasam (1975) has reported that intercropping has proved indigenous farming systems in India and other rts of Asia by fully utilizing the growing season and oducing two or more crops of rice, corn and legumes in single year and markedly increasing the yield per unit of nd per unit of time.

lal (1979) suggested that in Egypt soybean can be only oduced as such as in intercrop with maize, because of the mpetition created by the principal summer crops. fferent cultivars of soybean and corn and several plant pulation of corn were intercropped under different tterns. Grain yields of intercropped corn increased and at of soybean decreased compared to the monocrop ecies as single crop. Gunasena *et al.* (1980) compared me important cereal legume intercropping systems and ncluded that although the total yield of maize + soybean tercropping system was higher than that of their nocuture, yet the yield of both the component crops nded to decrease. Motha and De (1980) studied several stems of intercropping of maize and sorghum with ybean and concluded that maize yields were not affected intercropping with soybean but sorghum yields were duced. Though the yield of soybean when intercropped as less than that of a sole crop, the combined grain yield of two crops in an intercropped systems were more than the individual components. Land equivalent ratios increased to a maximum of about 48 and 31 percent by intercropping maize and sorghum, with soybeans. James and Robert (1983) reported that both dry matter and seed yield of the monocrops were higher than the individual components in the intercrops, and intercropping resulted greater productivity per unit of land than monocultures of the intercrop components. Chaudhry and Mehraj (1986) reported that the intercropping improves the physical as well as the chemical properties of the soil with sugarcane. Maize is a good companion of soybean because of similarity in planting time, soil and irrigation requirements. Perera (1987) reported that maize yield under intercropping was not reduced as long as the optimum population of 56000 plants/ha maintained, seed yield of the legumes were reduce by 50 percent but combined yield from intercropping made the most productive system. Khan (1989) studied intercropping experiment of soybean with maize and reported income of Rs. 9872/ha which was 10 percent and 15 percent more income than that of sole crop of soybean and maize, respectively.

Intercropping is one major form of multiple cropping systems. A wide variety of intercrop combinations exist in this zone but land equivalent ratio (LER) have never been worked out. Recently sunflower (Helianthus annuus L.) and soybean (Glycine max (L.) Merr.) were introduced in the North West Frontier Province. The intercropping of maize (*Zea mays* L.) with soybean was initiated by innovation farmers in some pockets of this area but the grain yield, LER and economic return have never been reported. The objectives of this study were to determine production effectiveness per unit land area and economic return as influenced by intercropping of maize, soybean and sunflower.

Materials and methods

This intercropping experiment was carried out at the research fields of NWFP Agricultural university Peshawar during Kharif season 1993. The treatments consisted of

maize (alone), soybean (alone) sunflower (alone), maize + soybean, maize + sunflower, sunflower + soybean and maize + soybean + sunflower. The experiment design used was a randomized complete block design with six replications using a net plot size measuring 5x4.5 meters ($22.5m^2$). Maize variety Kisan-90, soybean variety Swat-84 and sunflower SF-187 were planted on July 6, 1993. A basal dose of 100 kg N + 100 kg P_2O_5-ha $^{-1}$ was applied at sowing time for all treatments, except for soybean sole crop where 35 kg N was applied. Weed control and other agronomic practices were followed uniformly in the experimental fields. Harvesting of the crops was done after they had reached physiological maturity. They were sun dried for several days when the moisture content of the grains reached a constant level and then Threshed. Grain yield data for each crop was recorded separately. The land equivalent ratio (LER) reported by Balasubramanion and Sekayange (1990) was used as under.

Where:

LER = $^{n}\Sigma$ (y^{i}_{1}/Yi_{m})
Y_{i} I = Yield of crop i in intercropping
YiM = Yield of crop i in monocroppping
n = Total number of crops in association.

The relative yield total (RYT) which is analogous to LER was computed as LER x 100.

Result and Discussion

Grain yield: Intercropping is an appropriate crop management technology that can improve the farm output average due to the fact that land is used efficiently. Maximum grain yield of maize (kg ha ^{1}) was observed when maize was sown alone, followed by maize intercropped with soybean (Table-1). Minimum grain yield of maize was observed when maize was sown with soybean + sunflower. This might be due to the fact that both maize and sunflower are exhaustive crops with great competition for nutrients, water, light and also due to the fact that here the plant population is doubled with great competition existed between the species. These results support the idea of James & Robert (1983) who reported that both dry matter and seed yield of monocrops were higher than the yields of the individual components in intercropped system.

Maximum grain yield of soybean was obtained when sown alone while minimum grain yield was obtain and when soybean sown with sunflower. It might be due to the fact that sunflower plants have broad and thick leaves which intercept more sunlight and due to this soybean plants were not able to intercept sufficient light and decreased yield. The result agrees with Motha and De (1980) who reported that the yield of soybean, when inter-cropped with maize or sorghum was less than the yield of its sole crop. Whereas sunflower gave the maximum grain yield when sown alone and minimum grain yield was obtained when intercropped with sunflower + soybean. This may be due to the fact this treatment the population of maize and sunflower was doubled in the same plot. So there was great competition among the plants of the different species for resources esp. light, nutrient, and moisture.

Land use efficiency: It can be seen from Table No.1 that the highest LER value was obtained in treatment maize + soybean. This suggests 48 percent increase in production during one season of intercropping. These results are in line with the conclusion of Zar *et al.* (1979) who obtained highest LER value of 1.35 from soybean and maize intercropping and suggested 35 percent increase in production. The relative yield data revealed that maize and sunflower used the land efficiently when they were intercropped with soybean. Soybean results in more efficient land use when it intercropped with maize. Gunasena *et al.* (1980) also observed that the total yield of maize and soybean intercropped was higher than their yields in monocultures. Other researchers also reported that N fixed by cowpea (*Vigna Unguiculata* L. probably benefitted maize, sorghum intercropped with cowpea (Morris *et al.* 1990) and maize intercropped with soybean (Chaudhry and Mehraj, 1986).

Comparative productivity and economic return: The magnitude of the yield advantage is clearly apparent from component crop in mixture in comparison with their yield of sole crops (Table-1). The performance of maize intercropped with soybean was better than the intercropped maize in other combinations. In maize + soybean, cropping system the yields reduction is only 13 percent and 38 percent of maize and soybean, respectively. Whereas yield reduction of maize is 38 percent and soybean is 42 percent with sunflower, which revealed that sunflower did not perform well in intercropping. From comparative study it was apparent that less reduction in yield occurred in both the species when maize and soybean intercropped.

From Table-1 it is evident that the total economic return of intercropped combinations were greater than those of sole crops.

The maximum economic return amounting to Rs. 22789.00/ha was obtained from intercropping maize and soybean. In this system the performance was superior, may be due to the fact that both maize and soybean are companion crops and there was symbiotic relationship between the two crops. That is maize has provided physical support to the soybean and soybean has provided N for maize by fixing atmospheric nitrogen with the help of *Rhizobium japanicum* an N fixing bacteria associated with soybean. The results support the idea of Chaudhry and Mehraj (1986) who report that maize is a good companion of soybean because of similarity in planting time, soil and irrigation requirements. These results are in agreement wel those of Khan (1989) who reported 10 and 15 percen higher income from soybean and maize intercropped tha their yields in respective monoculture crops. The lowes economic return Rs. 17126 kg ha^{-1}) among th intercropped systems was given by maize and sunflowe combination. It may be concluded that maize and soybea intercropping system appears to hold promise for th

able 1: Grain yield (kg ha^{-1}), land use efficiency (LER),relative yield total (RYT) comparative productivity and economic return (Rs. /ha) of intercropped maize, soybean and sunflower.

ropping ystem	Maize (Mz)	Soybean (Sb)	Sunflower (Sf)	LER	RYT	%decrease in inter-cropped yield.			Total Economic return♪.
						Mz	Sb	Sf	
	---- yield (kg ha^{-1}) ----								(Rs. /ha)
aize (alone)	3186	-	-	1.00	100	-	-	-	15130D*
ybean (alone)	-	2359	-	1.00	100	-	-	-	17456 C
unflower (alone)	-	-	1867	1.00	100	-	-	-	14700 E
z + Sb	2749	1562	-	1.48	148	13.07	38.47	-	22789 A
z + Sf	1985	-	977	1.15	115	39.00	-	48.00	17126 CD
+ Sf	-	1468	1422	1.34	134	-	12.18	24.00	21276 B
z + Sb + Sf	1399	1501	726	1.42	142	56.00	41.00	-	22686 AB

Prices used were for maize Rs. 4.75, soybean Rs. 6.87 and sunflower Rs. 7.87 per kg, prevails at the time of harvest in the market.

Values are significantly different using LSD at 5% level of significance.

rmers of NWFP and may be adopted under conditions nilar to those of this study.

eferences

ndrew, D.J. and A.H. Kassam, 1975. Importance of multiple cropping in increasing world food supplies. p. 1-10. In R.I. Papendick, P.A. Sanchez and G.N. Triplet (ed.). Multiple cropping. ASA, Spec. Publ. No. 27. ASA, CSSA, and SSSA, Madioon, WI.

lasubramanian, J.and L. Sekayange, 1990. Area harvest equivalency ratio for measuring efficiency in multiseason intercropping. Agron. J., 2: 519-522.

haudhry, A.H. and K.N. Mehraj. 1986. Maximizing oil seed production through intercropping. Prog. Farming, 6: P. 6-18.

lal, R.C. 1979. Effect of intercropping of maize with soybean on grain yield. Tropical Agriculture, 54: 189-191.

glesham, A.R.J., A.Ayanaba, V.Ranaga Rao, and D.L. Eskew, 1981.Improving the nitrogen nutrition of maize by intercropping with cowpea. Soil Biol. Biochem., 13: 169-171.

nasena, H.P., Sungakkara and P.Wicker, 1980. Studies on cereal legume intercropping system Inati. Sci. Counc. Srilanka, 1979: 68784.

James, R.Allen and Robert K. Obsura, 1983. Yield of corn, cowpeaand soybean under different systems Agron. J., 75: 105-108.

Khan, A.R. 1989. Intercropping experiment of soybean with maize. Kharif farming programme oil seed crops for 1988-89. Agric. Res. Inst. Tarnab, pp: 34.

Morris, R.A., A.N. Villegas, A. Polthanee, and H.S. Centeno, 1990. Water use by monocropped and intercropped cowpea and sorghum grown after rice. Agron. J., 82: 664-668.

Motha, N.K. and R.De. 1980. Intercropping maize and sorghum with soybean. J. Agric. Sci., 95: 117-122.

Perera, L. A. 1987.Weed control studies on corn Legume intercropping system. Field Crop Abstracts, 40: 73.

Quresh,Z., Q., N. Khan and A.Q. Syed, 1979. Row spacing and land utilization efficiency of soybean and corn intercropping. Fr. J. Agril. Res., : 34-40.

Willey, R.W. and D.S.O.Osiru,1972. Studies on mixtures of maize and beans (*Phaseolus vulgaris*) with particular reference to plant population. J.Agric. Sci. Camb., 79: 510-529.