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ECONOMICAL USE OF LAND AND AGRICULTURAL RESOURCES UNDER DIFFERENT CROPPING SYSTEM

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ABSTRACT

Response of cotton and cowpea intercropping with different doses of NPK fertilizers was investigated. Cotton, cowpea (sole) and cotton + cowpea produced best result at maximum (150, 70, 70) fertilizer level but Land Equivalent Ratio was maximum (1.28) at 75, 70, 70 NPK level followed by 1.27 at no fertilizer, suggesting that low fertilizer level with intercropping of cotton + cowpea is more economical than sole crop and high fertilizer level.

Key Words: Cotton, cowpea, intercropping and land equivalent ratio.

INTRODUCTION

Cotton (*Gossypium hirsutum* L) is a major cash crop of Pakistan occupying an area of over 2794 thousand hectares and production of 10211 thousand bales of cotton lint with an average 622 kg/ha yield (Anonymous, 2003). Farmers in Pakistan are constrained by crop productivity due to limited land resource. A possible way of increasing the productivity on small farms would be through intercropping, as it provides security against potential losses of monoculture.

The population is increasing at the rate of 3% per annum. compared to the almost fixed resources and available cultivated land, which is also decreasing due to salinity and other hazards. The resources other than land like inputs are also limited and expensive with respect to the present economic situation of the grower. Considering all these factors and impediments intensive cultivation like intercropping is the best way to utilize the land to its maximum potential in a more economical manner.

Agriculture is the largest and most important single sector of Pakistan's economy, employing some 80% of the total population either directly or indirectly. Agriculture accounts for about 31% of the gross domestic product and 70% of the total foreign exchange earnings of the country. Therefore, productivity of agriculture sector is a key factor for economic development of the country. Pakistan achieved impressive crop productivity increase following the Green Revolution during the mid 60s but after that crop production got stagnant in spite of high/increased inputs (except cotton). At present crop yield per hectare is alarmingly low. Among others, presence of high concentration of salt in the soil water system is considered to be the main reason for low crop yields causing an annual loss of approximately 4.3 billion rupees in Punjab and Sindh province. Apart from economic damage due to production loss, substantial financial resources have been diverted to programmes for the alleviation of salinity problem (Aslam, 2001).

Nazir *et al.,* 1992 reported the feasibility and mode of interaction of different gram interlay cropping system and concluded that on the basis of monetary gain the highest net income of Rs. 6150.04/ ha with benefit cost ratio (BCR) of 2.81 was obtained in case of gram-methra intercropping recording a net income of Rs. 5964.30/ha with a BCR of 2.75 as against Rs 2040.70/ ha with a BCR of 1.68 for gram alone. We are also advocating the legumes intercropping systems to get an extra income from same piece of land and resources. It also covers the risk in case of failure of major crop like cotton to some extent. The present study was designed to determine the economic feasibility and mode of interaction of cowpea (lobia) cotton intercropping systems

MATERIALS AND METHODS

The experiment was laid out in a split plot design with four replications at the experimental farm of NIAB, Faisalabad during the season 2003-2004. Plot size was 3.6x8 meter. The planting pattern and intercropping treatments were randomized in the main and sub-plots, respectively. Planting patterns were 75 cm apart single rows. Intercropping system was cotton alone, cotton + cowpea and cowpea alone. Cotton was sown in the last week of May. Cowpea was intercropped and sown alone soon after cotton sowing. NPK fertilizers levels were 0:0:0, 150:70:70 and 75:70:70. Whole P and K and half doze of N were applied before the time of cotton flowering i.e. after 45 days of sowing only where it was needed. Cotton mutant line NIAB-98 and NIAB cowpea mutant-1

(NCPM-1) were used. The cowpea mutant is erect growing, early maturing and high yielding (Yousaf *et al.*, 2004). Data on seed cotton and grain yield were recorded at maturity. The data were analyzed by using analysis of variance (ANOVA).

RESULTS AND DISCUSSION

At zero percent fertilizer level, cotton sole produced 1117 kg ha^{-1} and cowpea 273 kg ha^{-1} seed yield as compared to 1422 kg ha^{-1} of combined cotton and cowpea Table 1. At 150:70:70 NPK cotton as a sole crop produced 5678 kg ha^{-1} and cowpea 1228 kg ha^{-1}. Where as cotton and cowpea together both as inter crop produced 7000 kg ha^{-1}. At 75:70:70 NPK cotton sole produced 5242 kg ha^{-1}, cowpea sole 1121 kg ha^{-1} and cotton + cowpea as inter crop 6723 kg ha^{-1}. On the basis of overall mean performance of cotton produced 5460 kg ha^{-1} and cowpea 1175 kg ha^{-1} as sole crop and cotton + cowpea 5048 kg ha^{-1} as inter crop. Overall the land equivalent ratio was 1.26% of cotton + cowpea. The impact of intercropping was also worked out in other fertilizers level in terms of land equivalent ratio which was almost similar like overall average. This indicated that intercropping is equally beneficial and more economical even at no or almost low fertilizers level. The yield increased over control (no fertilizer) at 150:70:70 NPK level was maximum in case of cotton sole (408.33%), followed by combined i.e. cotton + cowpea (392.26%) and cowpea sole (349.82%). The similar trend was observed in other fertilizer level but difference was narrowed when increase in mean over fertilizer was computed. In case of sole cotton it was (388.81%) followed by cotton +cowpea (382.56%) and sole cowpea (330.40%). Overall result of intercropping along with fertilizer indicated that combined cropping system such as leguminous along with non leguminous like cowpea + cotton is more beneficial with more economical return. Further with a small dose of fertilizer i.e. 75:70:70 NPK the yield may be increased to a substantial economical level (372.78%). Such types of experiments are clear and sound examples where maximum benefit can be achieved from the same peace of land by employing minimum inputs. So the agro-economic efficiency may be increased to a substantial level by following the methodology of such types of experiments. This is one way of estimating the fertilizer use efficiency in quantitative terms. The parameter discussed here actually determines the vehemence of certain input on per unit basis.

Land equivalent ratio is the relative land area under sole crops that is required to produce the yield achieved in intercropping. It is usually stipulated that the level of management must be the same for intercropping as for sole intercropping. The results indicated that land equivalent ration (LER) was more than one in all the intercropping system. The mean LER value of 1.26 indicated that cotton/cowpea intercropping is good to cover the risk. Many researchers have placed the usefulness of cereal- legumes intercropping system in terms of increased crop production as reflected from the increased land equivalent ration (Ashraf, 1982, Khan, 1984)

There are reports showing no effect of cropping on the yield of associated crop (Ashraf, 1982, Singh *et al.*, 1983). In some cases the reduction in companion crop yield e.g. wheat has been reported upon intercropping (Khan, 1984). Nevertheless, the losses in wheat production by the respective intercrops were compensated by additional harvests of intercrops (Ahmed, 1990, Nazir *et al.*, 1988). Osman and Osman (1982) reported that mixture of sorghum and legume (lobia) produced higher yield of total dry matter the sorghum forage grown as a monoculture.

For increasing farm productivity per unit area intensive cropping practices are becoming imperative in the present day agriculture. Efforts are therefore, required to identify various plant species which can be profitably grown in the multiple cropping systems. Cowpea by virtue of its short duration sowing season can fit very well in a wide array of niches available in the existing crop rotation practices. An extra crop of cowpea can be obtained by following rotations like wheat-cowpea rice or wheat cowpea-maize or from fallow fields preceding major crops like cotton and sugarcane. Cowpea can also be intercropped with sugarcane, maize, sorghum, vegetables and fruit gardens. This is possible provided very early maturing (65-75 days) and high yielding cultivars become available so that the crop can be lifted in time leaving sufficient period to prepare field for succeeding crop or to perform cultural operations in the companion crop. The most of the cowpea cultivars unfortunately do not fit in the above niche due to their late maturity (90-110 days) characteristics and are usually caught up by monsoon rains at pod filling stage, attack of pod borer, different diseases like yellow mosaic virus, cercospora leaf spot disease. The most of the cowpea varieties are in-hornet by shy producer and also suffer the draw backs of indeterminate excessive growth and asynchronous maturity.

In spite of its great importance cowpea like many other pulses has never received the kind of research attention in the past that has been given to other food crops. This has led to the situation characterized by the non-availability of high yielding varieties desired characteristics of early and uniform maturity. Cognizant of the situation this research work was initiated. The farmers who grown the new lines are very much satisfied about their performance. They not only fetch additional income by growing an extra crop of cowpea from the same piece of land with negligible inputs but also the fertility of their fields is improved to benefit the companion succeeding crop.

Table 1. Agro-economic efficiency of cotton and cowpea in intercropping system combined with NPK fertilizer.

Cropping system	0,0,0	LER	150,70,70	LER	75,70,70	LER	Mean over fertilizers	Mean over all treatments including control	LER
Cotton (sole)	1117	-	5678	-	5242	-	5460	4012	-
Cowpea (sole)	273	-	1228	-	1121	-	1175	874	-
Cotton + cowpea	1422	1.27	7000	1.23	6723	1.28	6862	5048	1.26

Table 2. Percentage increase over control (no fertilizer).

Cropping system	0,0,0	150,70,70	75,70,70	Mean over fertilizers
Cotton	-	408.33	369.29	388.81
Cowpea	-	349.82	310.62	330.40
Combined	-	392.26	372.78	382.56

LER= Land equivalent ratio

CONCLUSION

Despite advancement in agriculture science and consistent efforts of the research workers, Pakistan is lagging behind the target of attaining self sufficiency. The self sufficiency may be achieved with limited resources of land and minimum utilization of inputs/resources if the available resources are utilized efficiently. The present research finding provides an approach that can improve per acre productivity without additional inputs.

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