



Long-term Cotton Based Crop Rotation Experimentation

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ABSTRACT

Cotton is the main cash crop of temperate regions in Punjab, Pakistan, accounting for 60% of total foreign exchange earnings and providing above 55% of total employment. Cotton-fallow-cotton and cotton-wheat-cotton are traditional rotations of the region. Introduction of maize, sunflower and soybean has necessitated the development of new cotton based crop rotations with higher returns. Seven cotton-based rotations were tested over five years. Data were recorded on yield and yield components, fiber traits and soil nutritional status. Cotton-fallow (T-1) gave the lowest net annual return but the soil fertility improved. Cotton-wheat (T-2) gave the highest annual returns except in 1991-92 and also the highest five-year average. Cotton-sunflower (T-3) gave the highest returns in 1991-92 and was the second highest five year average but after 1991-92, returns and soil fertility declined. Allelic effect on next crop was also observed. Although cotton-maize (T-6) was ranked third on five year average, it was ranked second, second and first position during, 1991-92, 1994-95 and 1995-96, respectively. The five-year average second position of T-3 was due to high price of sunflower and cotton during 1991-92 so this rotation is unsuitable for farmers. Although T6 was third in five-year average, it is replacing T-2, the most common rotation of area.

Introduction

Pakistan has an annual population growth rate of more than 3% but land holdings are shrinking and the total cultivated area is not increasing. To feed the rapidly growing populations, the only option left is to increase the production through increasing per unit productivity and cropping intensity.

A rotation is considered good or bad by its effects on soil productivity and total economic return. For example, soybean, being a legume, may benefit the next cotton crop by fixing nitrogen in the soil. Experiments have shown that the cotton growing areas are suitable for successful cultivation of sunflowers and soybeans. However, the effect of introducing these crops and their effects on soil nutrient and economic return has not been studied. The main objective of this experiment was to determine the comparative economic returns and investigate the effects of potential crop rotations on crop productivity and soil fertility in the cotton based cropping system.

Bagayoko *et al.* (1992) concluded that soybean in a crop rotation can contribute to soil $\text{NO}_3\text{-N}$. Varvel and Peterson (1992) stated that soybean grown in a rotation may help reduce the leaching of $\text{NO}_3\text{-N}$ into ground water. Copeland *et al.* (1993) found that the yield was increased by 30% when corn followed soybean and 11% when soybean followed corn. Rotation allows these crops to increase root activity

and hence to improve grain yields. Eghball and Varvel (1997) stated that continuous corn had less yield variability than corn following soybean, soybean had the greatest yield variability. Timsina *et al.* (1998) found that the optimum N rate was from 90 to 135 kg/ha. At higher N rates (180 kg/ha), irrigation promoted higher yields. Rice yields trends increase over years but wheat yield had no definite trend. Vyn *et al.* (1998) reported that soybean seed yields were negatively correlated with surface residue but positively correlated with soil aggregates.

Materials and methods

Seven-crop rotation experiment were planted, at the Cotton Research Station, Multan, Pakistan during the years 1990-91 to 1995-96. The experiment was initiated in 1990-91 by planting wheat in winter and sunflower, soybean and maize in spring 1990. Cotton was planted summer 1991. Plot sizes were variable and ranged from 506 m² to 760 m². Seed and fertilizer were applied according to the standard recommendations for each crop. Four randomly selected samples of 15 m² each, were drawn from all treatments to determine yields. Soil samples were taken before sowing and after harvesting of each crop to monitor the fertility levels of the soil. The Soil and Water Testing Laboratory, Multan analyzed representative composite soil samples from each treatment, taken at 0-6 and 6-12 inches soil depth.

On the completion of five and a half years of the rotation experiment, a comparative economic analysis of each rotation determined gross returns, using support prices of different crops.

Results and Discussion

In 1991-92, T-3 (cotton sunflower rotation) gave the highest net return of Rs. 25054 while in 1992-93 and 1993-94, T-2 (cotton wheat rotation) gave the highest return of Rs. 15,762 and 24,253/ha, respectively. In 1994-95, T-6 (cotton-maize-rotation) produced the highest net return of Rs 18,832/ha while T-2 gave the highest net return of Rs. 19623/ha in 1995-96. The five-year average of T-2 (cotton wheat rotation) gave the highest net return of Rs. 20,027/ha. (Table 2) Clearly, cotton wheat is the best rotation in Multan region

Conclusion

A cotton-wheat rotation gave the highest net return (Rs. 20,027 / ha), while the lowest net return of Rs. 13,789 / ha was recorded in cotton-fallow rotation. The cotton-wheat rotation gave 45 % more net economic return than the cotton-fallow rotation.

References

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Table 1. Crop rotations for cotton based cropping system.

Rotation	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96
T-1	F	C-F	C-F	C-F	C-F	C-F Traditional
T-2	W	C-W	C-W	C-W	C-W	C-W Traditional
T-3	SF	C-SF	C-SF	C-SF	C-SF	C-SF Proposed
T-4	SB	C-SB	C-SB	C-SB	C-SB	C-SB Proposed
T-5	SF	C-W	C-SF	C-W	C-SF	C-W Proposed
T-6	M	C-M	C-M	C-M	C-M	C-M Proposed
T-7	M	C-W	C-M	C-W	C-M	C-W Proposed

F = Fallow C= Cotton SB = Soybean W= Wheat SF = Sunflower M= Maize

Table 2. Net economic return (total of each year) of seven different crop rotations at Cotton Research Station, Multan, Pakistan in cotton based system (1991-92 to 1995-96) .

Treatments	Total return (Rs. Per hectare)					
	1991-92	1992-93	1993-94	1994-95	1995-96	Av.
T1 (F-C-F-C-F-C-F-C-F-C-F)	16680	8608	15725	12842	15092	13789
T2 (W-C-W-C-W-C-W-C-W-C-W)	21965	15762	24253	18732	19623	20027
T3 (SF-C-SF-C-SF-C-SF-C-SF-C-SF)	25054	15116	23864	17651	17446	19826
T4 (SB-C-SB-C-SB-C-SB-C-SB-C-SB)	23670	12865	24209	18584	15723	19010
T5 (SF-C-W-C-SF-C-W-C-SF-C-W)	21145	15212	22699	15767	16892	18343
T6 (M-C-M-C-M-C-M-C-M-C-M)	24769	12254	22847	18832	17783	19297
T 7 (M-C-W-C-M-C-W-C-M-C-W)	23374	13926	20317	16905	16008	18106