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Production Potential and Economics of Intercropping in Autumn-Planted Sugarcane

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ABSTRACT

In a field experiment, the agro-economic benefits of some autumn sugarcane based intercropping systems were determined at the University of Agriculture, Faisalabad. The intercropping systems comprised sugarcane + sarsoon, sugarcane + sunflower, sugarcane + wheat, sugarcane + gram, sugarcane + lentil, sugarcane + peas, sugarcane + garlic and sole sugarcane. Cane yield was reduced by 21.8, 17.9, 18.0, 11.7, 4.8, 2.6 and 1.4% with intercropping of the respective crops. However, at the cost of this much reduction in cane yield additional harvests of 1702, 2609, 4398, 1719, 526, 1033 and 1645 kg ha^{-1} of the respective intercrops were obtained which enhanced the net income substantially over pure stand of sugarcane with the maximum of Rs. 1,13,188 ha^{-1} for sugarcane intercropped with garlic followed by sugarcane + gram (Rs. 96, 207 ha^{-1}), sugarcane + peas (Rs. 94,399 ha^{-1}) and sugarcane + sunflower (Rs. 92,622 ha^{-1}). By contrast sucrose content in cane juice was not affected significantly by different intercrops.

Key Words: Production potential; Economics; Intercropping; Autumn sugarcane

INTRODUCTION

In this age of rapid and remarkable technological change in the production systems of both the irrigated and rainfed regions of Pakistan, intercropping has evinced as one of the most efficient and profitable production system especially for small farmers with limited land and inputs resources (Nazir *et al.*, 1988; Bajwa *et al.*, 1992). Intercropping if properly managed and looked after, can go a long way to solve the problems of low productivity per unit area and sustainability of a production system (Nazir *et al.*, 1997; Ahmad & Saeed, 1998). It helps in maintaining the soil fertility and making efficient use of nutrients (Aggarwal *et al.*, 1992; Nazir *et al.*, 1997) and ensures economic utilization of land, labour and capital resources (Moris & Garrity, 1993; Singh, 1996). Intercropping either reduces or increases (Verma *et al.*, 1981) or has no effect on cane yield of sugarcane (Kandasami *et al.*, 1997).

Autumn-planted sugarcane occupies the land for more than one year and hence the farmers have no chance to take an other crop in both the rabi and kharif season. The only way to harvest another crop during this period is to grow intercrops in it. Autumn-planted sugarcane is very suitable for intercropping because of its slow growth rate during the winter and early spring due to prevalence of low temperature. This period can safely be utilized for raising suitable rabi intercrops maturing up to the end of April without doing much damage to the associated cane crop. Consequently the present study explored the possibility of intercropping in sugarcane and determined the effect of different associated cultures on the production potential and juice quality of autumn-planted sugarcane.

MATERIALS AND METHODS

The study was conducted at the University of Agriculture, Faisalabad. Intercropping treatments comprised sugarcane + sunflower, sugarcane + wheat, sugarcane + gram, sugarcane + lentil, sugarcane + peas, sugarcane + garlic, sugarcane + sarsoon and sugarcane alone. The experiment was laid out in a randomized complete block design with four replications. The net plot size was 4.8 m x 8 m. A recommended sugarcane cv. BF-162 was planted in 90-cm spaced 2-row strips on 25th of September, 1990 and harvested at the end of December, 1991. Double budded setts were placed end to end in each furrow. Lentil (*Lens esculenta*), gram (*Cicer arietinum*), wheat (*Triticum aestivum*), and peas (*Pisum sativum*) were intercropped on November 1, while sunflower (*Helianthus annuus*), garlic (*Alium sativum*) and sarsoon (*Brassica compestris*) were interplanted on October 18, 1990. A basal dose of 150-100-100 kg NPK ha^{-1} was used in the form of urea, Single Super Phosphate and Sulphate of Potash, respectively. All the phosphorus, potash along with half of nitrogen was applied at the time of planting while the remaining half of nitrogen was top-dressed after the harvest of intercrops before earthing up in the month of May. Total 18 irrigations, each of 10 cm, were applied during the entire growing period of the sugarcane crop. Observations on relevant parameters of the component crops were recorded by using standard procedures. Pol reading of the extracted juice of canes in each treatment was separately recorded with the help of a polarimeter. The cane juice sucrose content (%) was calculated using the Schmitz's table.

The data collected were subjected to Fisher's analysis of variance technique and LSD test at 0.05 P was used to

compare the differences among treatment means (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

The data on number of canes m^{-2} indicated that there were significant differences among the intercropping treatments (Table I). Sugarcane intercropped with garlic, peas, lentil and gram produced statistically the same number of canes m^{-2} as for sugarcane alone but differed significantly from rest of the intercropping treatments. The minimum canes m^{-2} (9.77) were recorded in case of sugarcane intercropped with sarsoon which were statistically equal to that intercropped with sunflower and wheat. The reason for less number of canes m^{-2} in these treatments was continuous exhaustive competition between the component crops.

Reduction in tillering capacity of sugarcane by 13.47 and 3.53% as a result of berseem and wheat intercropping respectively has also been reported by Ahmad (1982). Similarly, Bukhtiar and Muhammad (1988) observed a significant suppression effect of mustard, alfalfa and sunflower intercropping on tillering of sugarcane. The cane length was reduced significantly by all the associated crops as compared to pure stand of sugarcane. The maximum reduction in cane length was recorded in sugarcane intercropped with sarsoon against the minimum in that intercropped with garlic. However, the differences among the rest of the intercropping treatments were found to be non-significant. The maximum cane length (2.89 m) was recorded in sole sugarcane. By contrast, cane diameter was not affected significantly by any of the intercrop and it varied from 2.34 to 2.42 cm. Adverse effects of different intercrops on cane length have also been reported by Nazir *et al.* (1988) and Khanzada *et al.* (1989). The various intercrops showed significant effect on weight per stripped cane. Although the highest weight per cane (1.40 kg) was recorded in pure stand of sugarcane but it was at par with cane intercropped with garlic, peas or lentil recording on an average 1.35, 1.31 and 1.24 kg per stripped cane, respectively against the minimum of 1.19 kg in case associated with sarsoon which in turn was statistically equal to that intercropped with sunflower, wheat or gram. The results reported by Nazir *et al.* (1988) and Ahmad *et al.* (1988) and Kathiresan and Karan (1990) are quite in line with these findings.

Stripped cane yield ha^{-1} was influenced differently by the various intercrops (Table I). Although the highest cane yield (149.94 t ha^{-1}) was obtained from sole sugarcane but it was at par with sugarcane intercropped with garlic, peas and lentil giving on an average 147.92, 146.09 and 142.70 t ha^{-1}, respectively. The minimum cane yield of 117.25 t ha^{-1} was recorded for sugarcane intercropped with sarsoon which was statistically equal to that intercropped with sunflower and wheat producing on the average 123.26 and 122.92 t ha^{-1}, respectively. Reduction in cane yield as a result of sarsoon, sunflower and wheat was attributed to exhaustive competition between the component crops for essential nutrients, water and other growth factors. However, at the cost of this much reduction in cane yield, the additional harvest of 1702.11, 2609.90, 4398.90, 1719.90, 525.70, 1032.61 and 1645.22 kg ha^{-1} of sarsoon, sunflower, wheat, gram, lentil, peas and garlic, respectively was obtained which compensated more than the reduction losses in cane yield by the respective intercrops (Table II). Reduction in cane yield as a result of different intercrops has also previously been reported by Singh and Singh (1974), Rathi and Singh (1981), Khanzada (1989), Bukhtiar and Muhammad (1988) and Nazir *et al.* (1988). But the results reported by Kandasami (1997) are not in agreement with these findings who stated that intercroping of sugarcane with early cultivars of wheat did not reduce the cane yield.

The cane tops' weight was also affected significantly by intercropping. Significantly the minimum tops weight of 16.77 t ha^{-1} was recorded for sugarcane associated by peas, which was at par with sugarcane intercropped with garlic (17.77 t ha^{-1}), gram (18.83 t ha^{-1}) and sole sugarcane (18.63 t ha^{-1}). Rest of the intercropping combinations produced

Table I. Agronomic traits and sucrose contents in cane juice of autumn planted sugarcane as affected by associated cultures

Intercropping treatments	Millable canes m^{-2}	Cane length (m)	Cane diameter (cm)	Weight/ stripped cane (kg)	Stripped cane yield (t ha^{-1})	Yield of intercrops (kg ha^{-1})	Tops weight (t ha^{-1})	Harvest Index (%)	Sucrose contents in cane juice (%)
Sole sugarcane	11.17 a	2.89 a	2.42 NS	1.40 a	149.94 a	-	18.63 abc	82.91 ab	16.93
Sugarcane + sarsoon	9.97 d	2.48 c	2.34	1.19 c	117.25 d	1702.11	19.85 ab	80.08 d	15.43
Sugarcane + sunflower	10.44 bcd	2.50 bc	2.37	1.21 bc	123.06 cd	2609.90	20.13 ab	80.58 cd	16.97
Sugarcane + wheat	10.34 cd	2.50 bc	2.36	1.20 bc	122.92 cd	4390.00	19.89 ab	81.11 d	16.86
Sugarcane + gram	10.99 abcd	2.57 bc	2.38	1.21 bc	132.36 bc	1719.90	18.83 abc	80.48 d	15.93
Sugarcane + lentil	11.59 abc	2.60 bc	2.38	1.24 ab	142.70 ab	525.70	20.63 a	82.03 bcd	16.69
Sugarcane + peas	11.35 abc	2.63 bc	2.39	1.31 a	146.09 a	1032.61	16.77 c	84.52 a	16.26
Sugarcane + garlic	11.29 abc	2.66 bc	2.39	1.35 a	147.92 a	1645.22	17.77 bc	82.64 abc	16.59

Means in a column not sharing a letter differ significantly at P = 0.05; NS = Non Significant

Table II. Economic analysis of different autumn sugarcane-based intercropping systems

Intercropping systems	Crop yield		Income (Rs. ha^{-1})					
	sugarcane (t ha^{-1})	Intercrops (kg ha^{-1})	Sugarcane	Intercrops	Total income (Rs. ha^{-1})	Total expenditure (Rs. ha^{-1})	Net profit (Rs. ha^{-1})	Benefit cost ratio (BCR)
Sole sugarcane	149.94	1702.11	131197.50	-	131197.50	50149.00	81048.00	-
Sugarcane + sarsoon	117.25	2609.90	102593.75	34042.20	136636.00	53001.00	83635.00	2.20
Sugarcane + sunflower	123.06	4390.00	107677.50	39148.50	146727.00	54104.00	92622.00	2.58
Sugarcane + wheat	122.92	1719.90	107555.00	32985.00	140540.00	55588.00	84952.00	2.04
Sugarcane + gram	132.36	525.70	115727.50	34398.00	150125.50	53919.00	96207.00	2.41
Sugarcane + lentil	142.70	1032.61	124862.50	13142.50	138005.00	52482.00	85523.00	2.78
Sugarcane + peas	146.09	1645.22	127828.80	20653.20	148481.00	54082.00	94399.00	2.63
Sugarcane + garlic	147.92		129430.00	49357.00	178787.00	65741.00	113188.00	2.72

Means in a column not sharing a letter differ significantly at P = 0.05; NS = Non-significant.

Market rates

Sugarcane	Rs. 0.875 kg^{-1}	Gram	Rs. 20.00 kg^{-1}
Sarsoon	Rs.2 0.00 kg^{-1}	Lentil	Rs. 25.00 kg^{-1}
Sunflower	Rs. 15.00 kg^{-1}	Peas	Rs. 20.00 kg^{-1}
Wheat	Rs. 7.50 kg^{-1}	Garlic	Rs. 20.00 kg^{-1}

statistically similar tops weight ranging between 18.63 and 20.63 t ha^{-1}. These results are not in consonance with those of Ahmad (1982) who reported that tops weight ha^{-1} was not affected significantly by the different intercrops in his experiment probably because of variable soil and climatic conditions. The different intercrops had significant effect on harvest index of the cane crop. Although the maximum harvest index of 84.52% was recorded for sugarcane intercropped with peas due to significantly less weight of tops ha^{-1} but it was at par with mono-cropped sugarcane (82.91%) and that intercropped with garlic (82.64%). Rest of the intercropping treatments, however, gave statistically similar harvest index varying from 80.08 to 82.03%, which was ascribed to almost similar pattern of cane growth and development in these treatments. Similar results have been reported by Nadagoudar *et al.* (1981). As regards sucrose content in cane juice, the different intercrops had no significant effect on juice quality and the sucrose content in cane juice varied from 15.93 to 16.97%. These results are in line with those reported by Rathi and Singh (1979) and Nazir *et al.* (1988).

Economics of intercropping. Detailed analysis of sugarcane intercropping with different intercrops presented in Table II revealed that all the intercropping combinations gave considerably higher net income ha^{-1} than sole sugarcane. However, sugarcane + garlic intercropping system gave the highest net income of Rs. 1,13,188 ha^{-1} followed by sugarcane + gram (Rs. 96,207 ha^{-1}), sugarcane + peas (Rs. 94,399), sugarcane + sunflower (Rs. 92,622 ha^{-1}) while rest of the intercropping system intermediated generating net income ranging between Rs. 83,625 and 85523 ha^{-1} with the minimum of Rs. 81048 ha^{-1} in case of pure stand of sugarcane. By contrast, Benefit Cost Ratio (BCR) was the maximum (2.78) in case of sugarcane + lentil closely followed by sugarcane + wheat (2.77) and sugarcane + garlic (2.72) against the minimum of 2.20 in sole sugarcane. Higher total crop value of sugarcane with intercropping than without intercropping has also been reported by Kandasami (1997), Rathi and Singh (1981), Nazir *et al.* (1988), Khanzada (1989) and Kathiresan and Karan (1990).

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