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PERFORMANCE OF LEGUME CROPS UNDER SUGARCANE BASED INTER-CROPPING SYSTEM

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ABSTRACT

A field experiment was conducted at R and D farm, VSI, Pune in collaboration with Bhabha Atomic Research Center, Trombay during the year 2019-20, 2020-21 and 2021-22 crop season with seven treatments including three intercrops namely groundnut, black gram and green gram and each intercrop having two varieties were evaluated in the Randomized block design with three replications. On the basis of pooled results obtained from experimentation it can be concluded that, the treatment T_1 (sugarcane + groundnut var.TG 37) intercropping system (124.45 t/ha) recorded higher cane yield, but cane equivalent yield (261.87 t/ha) was observed in treatment T_6 (Sugarcane + Green gram var. Pusa Vaisakhi)
Keywords **:** Sugarcane, groundnut green gram, black gram, cane yield, quality, crop equivalent yield

Introduction

In agriculture, management practices are usually formulated for individual crops. However, farmers are cultivating different crops in different season for domestic needs and profitability. A cropping system refers to a set of crop systems, making up the cropping activities of farm system. Cropping system comprises all the components required for production of a particular crop and the interrelationships between them and environment (Anonymous, 1978). In other words, a cropping system usually refers to a combination of crop in time and space. According to industry body ISMA, India is the world's second-largest sugar-producing nation after Brazil. Over five million farmers are involved in the cultivation of sugarcane in tropical and subtropical India, the two distinct agro-climatic regions of the crop in the country. At present, the area under sugarcane is 5.88 million hectares with production and productivity of 468.8 Mt and 84 t/ha, respectively. There had been considerable improvement in the productivity levels in the past, but they have more or less stagnated over the last two decades (Sundara, 2011).

In the case of sugarcane, much of the space between two rows of sugarcane remains unutilized for an initial period of 90-120 days, due to slow crop growth. Companion cropping offers an opportunity for profitable utilization of available space. Sugarcane growers take advantage of this and grow various short duration crops like cereals, pulses, vegetables and spices as intercrops to obtain interim return. Small sugarcane growers need not wait until the harvest of the sole crop to obtain financial returns. Intercropping of economically important short duration crops with sugarcane through utilization of the present limited land resources would help to sustain sugarcane cultivation and provide interim return to marginal and small farmers, besides meeting the ever-increasing demand for vegetables and pulses. Due to slow establishment of sugarcane during the first 90-120 days, the greatest scope for complementary effect lies in the addition of annual intercrops to the temporal system to improve resource use efficiency in the early crop growth period (Gopalasundaram and Kailasam, 2003).

Legume crops in cropping systems enhance soil fertility through the excretion of amino acids into the rhizosphere. The nitrogen fixed by the legume intercrop may be available to the associated sugarcane in the current season itself, as sugarcane remains in the field for over nine months after the harvest of the

legumes. A further possibility of soil fertility improvement is through addition of crop residues, which on decomposition adds to the fertility of the soil. Since considerable addition of nutrient occurs through intercrop, there is a possibility of reducing N application through fertilizer (Kailasam, 1994).

Although intercropping has been practiced traditionally for thousands of years and is widespread in many parts of the world, it is still poorly understood from an agronomic perspective and research in this area is far less advanced than comparable work in monoculture. So, the present investigation was tried to better understand how intercrops function and to develop intercropping systems that are compatible with sugarcane.

Materials and Methods

The experiment was conducted at the Research & Development Farm of Vasantdada Sugar Institute, Manjri, Pune (Latitude: 18.52. Longitude: 73.97). The experimental material consisted of seven treatments namely T1: Sugarcane + Groundnut (Var. TG 37), T2: Sugarcane + Black gram (Var. TU-94-2), T3: Sugarcane + Green gram (Var. TMB 962), T4: Sugarcane + Groundnut (Var. SB 11), T5: Sugarcane + Black gram (Var. TPU-4), T6: Sugarcane + Green gram (Var. Pusa Vaisakhi) and T7: Sugarcane sole (Var. Co 86032) were evaluated in the Randomized Block design with three replications. Each treatment had plot size 8.00 m (L) X 5.40 m having 4 rows at 1.50 meters row to row distance. The first, second- and third-year sugarcane crop were planted fourth week of February, third week of January and third week of December respectively by adopting all the recommended agronomical practices. Two budded sets were planted in single row system. Recommended dose of suru season sugarcane crop were applied i.e., 250: 115: 115 Kg N, P_2O_5 and K_2O/ha. The three-year average nutrient status of soil tested before planting of crop which gives 8.17 pH (slightly saline), 0.26 EC, high Organic Carbon (0.72), low nitrogen (244.63) and very high phosphorus (49.68) and potassium (718.86) having medium deep black in nature. The three intercrops with two variety of each were dibbled after next week of sugarcane planting on bed with recommended plant spacing. The growth and yield performance and other yield attributed characters were observed as per schedule and at time of maturity. The observations were taken in field on germination percentage at 30 DAP, tiller count at 120 DAP, number of millable cane at harvest, total cane height, no. of internodes, girth of internodes, single cane weight and cane yield tons per hectare, cane equivalent yield, CCS yield, intercrop economic and biological yield at harvest and other quality parameters viz. brix percentage, sucrose percentage, CCS percentage and economics of the intercropping system was calculated**.** The data were analyzed statistically using analysis of variance and LSD test was applied to discriminate the superiority of the means of different varieties as suggested by Gomez and Gomez (1984).

Sugarcane Equivalent Yield (SEY)

On the basis of Govt. minimum support prices (MSP/FRP) of sugarcane, groundnut, black gram and green gram yield of each treatment for both component crops converted into crop equivalent yield of sugarcane crop. The sugarcane equivalent yield (SEY) (t ha^{-1}) is calculated as follows:

$$SEY = \sum_{i=0}^{n} Y_i e_i$$

Where,

Yi is the yield of i^{th} component

ei is equivalent factor of i^{th} component of price i^{th} crop

or

$$SEY = S_{ab} + \frac{N_{ab} \times N_{mp}}{S_{mp}}$$

Where,

SEY = Sugarcane equivalent yield (t ha^{-1})

Sab = Yield of Sugarcane in intercropping system (t ha^{-1})

Nab = Yield of groundnut, black gram and green gram in intercropping system (kg ha^{-1})

Nmp = Groundnut, black gram and green gram market price (kg ha^{-1})

Smp = Sugarcane market price (t ha^{-1})

Pooled Results and Discussions

Yield attributing and yield parameters

The pooled data on tiller count at 120 DAP, NMC count at harvest and growth attributes as influenced by different intercropping system are presented in Table 1. The data on Tiller count at 120 DAP was found non-significant. However, millable cane population was influenced significantly by different intercropping system. Significantly higher NMC count (81.00 thousand/ha) was observed under treatment T1 (sugarcane + groundnut var.TG 37) intercropping system and similar results were found in treatment T7 sole sugarcane (81.00 thousand/ha), treatment T_3 (sugarcane + green gram var. TMB 962) (78.00 thousand/ha) and T_6 (sugarcane + green gram var. Pusa

Vaisakhi) (79.00 thousand/ha). This may be due to the high tillering and low tiller mortality in wide row spacing helped an achieving such higher number of millable cane at harvest (Nagendran and Palanisamy 1997).

Pooled data from the Table 1 revealed that the yield attributing character of the cane as influenced by different intercropping system was found to be non-significant except single cane weight and it was significantly higher (1.47 kg) in treatment T_1 (sugarcane + groundnut var.TG 37) cropping system. This might be due to utilization of wide row spacing and converting solar radiation, soil moisture and nutrients in to sink by the crop. Also, addition of leguminous intercrops leads to natural increase in the available soil nitrogen which ultimately increased the absorption of other essential plant nutrients which may reflect into yield (Tosti and Guiducci, 2010).

Yield, quality and economics

The yield of different intercropping system of sugarcane was noted in terms of cane yield, CCS yield, intercrop yield and cane equivalent yield are presented in table 2. The data indicated that the treatment T_1 (sugarcane + groundnut var.TG 37) intercropping system recorded significantly higher (124.45 t/ha) cane yield and it was at par with several intercropping system except sugarcane + black gram intercropping system. The similar results were reported by Yadav et al (1987), Yadav and Prasad (1990), Kumar et al. (1990) and Rao and Veeranna (1998).

Significantly higher cane equivalent yield (261.87 t/ha) was observed in treatment T_6 (Sugarcane + Green gram var. Pusa Vaisakhi), but it was remained at par with treatment T_3 (sugarcane + Green gram var. TMB 962) (260.53 t/ha), T_1(sugarcane + groundnut var. TG 37) (232.31 t/ha) and T_4 (Sugarcane + Groundnut var. SB 11) (222.46 t/ha). As equivalent yield was calculated from multiplying seed yield of intercrop into price of intercrop and dividing with prices of sole/main crop. The differential behavior in SEY was on account of productivity of crops in intercropping system and their relative market prices (Ahlawat *et al.,* 2005 and Tripathi and Kushwaha, 2013). Among the different intercropping system T_1 (sugarcane + groundnut var.TG 37) recorded significantly higher (15.95 t/ha) CCS yield and it was at par with several intercropping system except sugarcane + black gram intercropping system.

Juice quality worked out in terms of Brix (0^0), Sucrose (%) and CCS (%) and depicted in Table 2 and it was observed non-significant, but numerically higher for Brix (20.78^0) and for Sucrose (18.68%) and CCS (13.16%) in treatment T_1 (sugarcane + groundnut var.TG 37).

The pooled data on B: C ratio depicted in table 2 revealed that the intercropping system T_6 (Sugarcane + Green gram var. Pusa Vaisakhi) was recorded the maximum (1:3.39) benefit cost ratio followed by T_3 (sugarcane + Green gram var. TMB 962) (1:3.34) intercropping system.

Conclusion

Intercropping in sugarcane is efficacious when appropriate crop management practices were followed. Inclusion of legume crops in sugarcane based intercropping system was found most remunerative by considering the overall sustainable soil health, system productivity, net returns than sole cropping.

Table 1: Tiller count at 120 DAP, NMC count and growth attributes at harvest as influenced by different sugarcane-based cropping system

Treatment	Tiller count at 120 DAP (000'/ha)	NMC count at harvest (000'/ha)	No. of internodes	Girth of internode (cm)	Total cane height (cm)	Single cane wt. (kg)
T1: Sugarcane + Groundnut (Var. TG 37)	96.00	81.00	21.40	9.80	227.05	1.47
T2: Sugarcane + Black gram (Var. TU-94-2)	93.00	77.00	21.81	9.63	221.26	1.29
T3: Sugarcane + Green gram (Var. TMB 962)	95.00	78.00	20.58	9.74	213.70	1.33
T4: Sugarcane + Groundnut (Var. SB 11)	94.00	75.00	20.92	9.76	210.85	1.33
T5: Sugarcane + Black gram (Var. TPU-4)	91.00	73.00	21.12	9.62	207.55	1.28
T6: Sugarcane + Green gram (Var. Pusavaisakhi)	94.00	79.00	21.46	9.78	222.60	1.40
T7: Sugarcane sole (Var. Co 86032)	96.00	81.00	20.50	9.61	217.61	1.37
Sem±	3.00	1.00	1.05	0.13	8.08	0.08
CD @ 5%	NS	3.00	NS	NS	NS	0.25
CV%	4.82	4.17	7.09	4.00	6.48	9.00

Table 2 : Yield, quality and economics as influenced by different sugarcane-based cropping system

Treatment	System yield		Sugarcane equivalent yield (t/ha)	% Increase in cane equivalent yield over sole cane	CCS yield (t/ha)	Brix (0^0)	Sucrose (%)	CCS (%)	B:C ratio
	Cane yield (t/ha)	Intercrop yield (kg/ha)							
T1: Sugarcane + Groundnut (Var. TG 37)	124.45	680.22	232.31	96.12	15.95	20.78	18.34	12.85	2.75
T2: Sugarcane + Black gram (Var. TU-94-2)	103.78	612.88	195.93	65.41	13.36	20.38	18.33	12.95	2.63
T3: Sugarcane + Green gram (Var. TMB 962)	116.07	725.28	260.53	119.94	14.83	20.16	18.29	12.88	3.34
T4: Sugarcane + Groundnut (Var. SB 11)	120.17	715.70	222.46	87.81	15.40	20.46	18.26	12.86	2.75
T5: Sugarcane + Black gram (Var. TPU-4)	100.95	510.74	190.52	60.84	13.26	20.73	18.68	13.16	2.46
T6: Sugarcane + Green gram (Var. Pusavaisakhi)	120.13	680.67	261.87	121.08	15.63	20.42	18.38	13.00	3.39
T7: Sugarcane sole (Var. Co 86032)	118.45	-	-	-	14.78	20.08	17.75	12.44	1.89
Sem±	5.36	-	15.24	-	0.78	0.18	0.29	0.16	-
CD @ 5%	16.50	-	46.96	-	2.39	NS	NS	NS	-
CV%	7.58	-	9.66	-	8.78	2.69	3.19	3.79	-

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