



Adoption of Low Cost Technologies for Improving the Productivity of Sugarcane and Farmers Income in Vizianagaram District of Andhra Pradesh

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Abstract: Sugarcane cultivation in Vizianagaram district is confined to rainfall dependent with little tankfed situation under low fertile red sandy loam soils. Out of 20,865 ha of sugarcane cultivation 60% of area is under complete rainfed cultivation. The productivity of sugarcane in Visakhapatnam district was very low as compared to other sugarcane growing districts in the state because of certain weather constraints viz., continuous moisture stress, prolonged dry spells and waterlogged conditions in rainy season besides poor adoption of new technologies. Based on the constraints need based on-farm demonstrations, skill demonstrations and training programmes were conducted by Acharya N.G. Ranga Agricultural University extension wing, DAATT Centre, Vizianagaram on various agro-techniques which were effective and economical for sugarcane farmers of the district. The results revealed that productivity of sugarcane was increased to 29.4% by good agricultural practices in rainfed sugarcane including set treatment in 1% lime solution+ trash mulching+ recommended dose of balanced fertilizers, 18.1% increased cane yields by using drought resistant varieties under rainfed situations and 24.1% increase by whip smut disease management. Adopting paired row system of planting increased number of millable canes which in turn increased the cane yield up to 14.7%, besides achieving additional income of Rs.10,583 through intercrop blackgram. The onfarm demonstrations indicated an increase in cane yield of sugarcane from existing 56.2 t ha⁻¹ to 79.8 t ha⁻¹ by adopting appropriate management practices duly considering the climate conditions with efficient transfer of technology.

Keywords: Sugarcane, rainfed, smut, intercropping

1. Introduction

Sugarcane is the world's largest crop and is grown in over 110 countries, an estimated 1,683 million metric tons were produced worldwide which amounts to 22.4% of the total world agricultural production by weight (FAO, 2009). India ranks second in cane area and sugar production after Brazil. The states of Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh together produce nearly 90 per cent of the cane and sugar in the country. Andhra Pradesh ranks fifth in sugar cane area of the country with a share of 4.83 per cent. The average production of Andhra Pradesh is about 20.30 million tons contributing to 5.83 per cent of the total production of the country. In Andhra Pradesh, the major sugarcane growing districts are Chittoor, Krishna, Visakhapatnam, Vizianagaram and Srikakulam. The crop is cultivated both under irrigated and rainfed situations. The cane produced in Vizianagaram district is being supplied to two sugar factories viz., Sri Vijaya Rama Gajapathi Cooperative Sugars Ltd,



Bheemasinghi and Parry Sugars, Sankili and NCS Sugars Lachchyya peta, besides sizable quantity (28%) subjected for jaggery preparation.

The productivity of the sugarcane crop was 56.2 t ha⁻¹ in Vizianagaram the district (Anonymous 2011) which was very low as compared to other sugarcane growing districts in the state. Since major area of sugarcane in the district is under rainfed situations, the farmers are harvesting poor cane yields in view of continuous moisture stress conditions due to prolonged dry spells. This situation causes stunted internodes and drying of bottom leaves in sugarcane early stages of growth. Moreover, prolonged dry spells reduces cane elongation about 30% reduces sucrose content. The tillering and grand growth stages known as formative stage have been identified as the critical water demand period (Ramesh, 2000), during this phase 70–80% of cane yield is reduced if crop suffers for water. It was observed that moisture deficit was critical during the first four months of growth as moisture stress at this stage reduces population density, stalk diameter, cane height and ultimately reduces cane yield (Carta, 1995). Reduction in cane yield and sugar content were more when water stress occurred during the period having highest evaporation and the least amount of rainfall (Wiedenfeld, 2000).

Sugar cane whip smut is an important disease causing some concern in recent years on important commercial varieties like Co6907, CoR8001, 87A298 and Co975 as it aggravated by moisture stress. The incidence was noticed mostly in ratoon crop in frequent dry spells of warmer months from March to May. In ratoons numerous diseased tillers sprout from stubbles resulted reduction in number of millable canes and the stalks are thin and lanky. This situation warns management of the disease at proper time. To educate farmers on importance of balanced fertilization in sugarcane especially under rainfed situation, On-farm demonstrations were conducted consecutively for three years during 2004 to 2006. Recommended dose of 75-50- 50 kg ha⁻¹ N-P₂O₅ -K₂O was applied as basal and top dressing management of the disease with vitavax (Agnihotri et al., 1973) and benomyl (Liu, 1980) reported earlier. Nageswararao and Patro, (2004) also recommended the use of propiconazole or hexaconazole for sett treatment and spraying after 30 days after planting for control of sugarcane smut disease. Keeping the knowledge gaps and available technical solutions for existing problems, attempts were made to manage the sugarcane with good agronomic practices under different situations to realize the maximum cane yields and increase farmers' income.

2. Materials and Methods

District Agricultural Advisory and Transfer of Technology (DAATTC), Vizianagaram made a study on identified the various extension gaps and constraints for low productivity in sugarcane by the Scientists of District Agricultural Advisory and Transfer of Technology Centre (DAATT Centre) in coordination with scientists of Regional Agricultural Research Station, Anakapalle, Officers of Department of Agriculture and Officers of Cane commissionerate. This includes cultivation of sugarcane under marginal and sub-marginal lands, cultivation of sugarcane completely rainfed conditions, non-practice sett treatment before planting, use of seed material from the mature crop rather than short crop of 6–8 months old, use of single variety for longer periods, lack of adequate irrigation facilities, water logged conditions during rainy season, non adoption of suitable planting methods, improper nutrient management, poor ratoon management and prevalence of whip smut disease in Vizianagaram district.

Keeping the technology adoption gaps at farmer level, certain onfarm demonstration on low cost technologies were taken up in farmers fields viz., ratoon management in sugarcane, popularization of drought resistant sugarcane varieties in rainfed conditions, whip smut management in sugarcane,



balanced fertilizer management in rainfed sugarcane, paired row method of planting and intercropping in sugarcane, best agricultural practices in rainfed sugarcane.

The demonstrations were conducted in predominant sugarcane growing mandals of vizianagaram district viz., Jami, Gantyada, Gajapathi nagarm, Bobbili, Seethanagarm, Cheepurupalli, Garividi, Ramabhadrapuram, Badangi and Terlam mandals. In ratoon management of sugarcane demonstrations, the techniques adopted were stubble sheaving, gap fillings by planting of sugarcane nursery of 30 days duration, trash mulching and spraying of propiconazole @ 1ml L⁻¹ at 30 days old ratoon crop. In case of popularization of drought resistant sugarcane varieties, 93A145, Co6907 and 93A125 were tested against check of 81A99. In case of whip smut management of sugarcane, set treatment of propiconazole @ 1ml L⁻¹ and spray of same chemical at 30 days after planting. Recommended dose of 75-50- 50 kg ha⁻¹ N-P₂O₅ -K₂O was applied as basal and top dressing compared to farmers practice of indiscriminate use of N and low use of K fertilizers. In paired row planting demonstration, a spacing of 120cm between pair rows and 30 cm with in rows of a pair and intercropping of short duration vegetable (bendi)/pulse crops(black gram) in the wide spacing between paired rows. In case of best agricultural practices of rainfed sugarcane demonstration, soaking of setts for one hour in saturated lime water (10%) before planting, adoption of 60 cm spacing in between rows, trash mulching @ 3 t ha⁻¹ immediately after planting and recommended dose of fertilizers 75-50-50 kg ha⁻¹ N-P₂O₅ -K₂O (Nitrogen will be applied in two equal splits on 30 and 60 days after planting, half of K₂O and entire P₂O₅ will be applied as basal and remaining K₂O in October after cessation of rains). Spray of Urea and potash (2.5 kg each in 100 L water) on foliage during severe drought situations twice at 15–20 days interval.

3. Results and Discussion

Introduction of drought resistant sugarcane varieties under rainfed situation

Three improved drought resistant varieties were identified by Regional Agricultural Research Station, Anakapalle viz., Co6907, 93A125 and 93A145 were demonstrated in farmer fields under rainfed situation in comparison with local sugarcane variety 81 A 99 as check during 2005-06 and 2006-07 the performance was presented in (**Table 1**). It was found an increase of cane yield up to 35.8%. The varieties performed well by possessing good drought tolerance under farmer field conditions and recorded increased mean yields of 10.5% and 18.1% respectively over local check 81A99, however 93 A 145 variety gave marginal increase (1.8%) of cane yields.

Balanced fertilizer management in rainfed sugarcane

Farmers in the district used to apply only nitrogen fertilizer rather than balanced fertilizers of NPK to sugarcane crop. To educate farmers on importance of balanced fertilization in sugarcane especially under rainfed situation, On-farm demonstrations were conducted consecutively for three years during 2004 to 2006. Recommended dose of 75-50- 50 kg ha⁻¹ N-P₂O₅-K₂O was applied as basal and top dressing to the sugarcane (variety 81 A 99) under rainfed situations. Increased cane yield of 19.5% to 33.6% was obtained in demonstrated plots as compared to farmers practice over three years of study (**Table 2**). The average yield of 55.5 t ha⁻¹ was recorded in demonstrated plot which is 28.6% increase over farmers practice (43.2 t ha⁻¹). This clearly indicated that balanced fertilization in sugarcane cultivation increases the mean cane yield by 28.6%.



Management of smut disease in sugarcane

Smut disease is a major problem in the district in major growing sugarcane varieties Co6907 and 87A298 especially in ratoon crop affecting cane yield and juice quality. Farmers are not aware of chemical control and are not adopting any control measures. To educate the farmers on periodical rouging of affected clumps and chemical treatment with propiconazole against smut control, on-farm demonstrations were carried out in three locations in ratoon plots during 2010–13, with one acre plot size which are hot spot for smut incidence in Vizianagaram district. On-farm study has been taken up with two treatments of farmers method of controlling smut in sugarcane is by removing the infected stubbles without using any chemical as farmers practice and spraying of propiconazole fungicide @ 1 ml L⁻¹ at the time of stubble shaving and again at 30 days after ratoon as on-farm demonstration practice (**Table 3**).

The results of the demonstrations significantly reduced the smut disease incidence and increased cane yield by 19.6% to 28.9% in OFD plots compared to farmers practice over three years of study. The average cane yield of 76.9 t ha⁻¹ was recorded on demonstration plots with smut disease controlled by using propiconazole chemical which is 24.1% superior over farmers practice (55.6 t ha⁻¹). Farmers impressed with the technology and some of the progressive farmers are adopting chemical treatment with propiconazole against smut control in ratoon sugarcane.

Best agricultural practices (BAP) in sugarcane under rainfed situation

Result demonstrations were conducted in the farmer fields of Visakhapatnam district under complete rainfed situation during pre-*kharif* season of 2009–2010, 2010–2011 and 2011-12 to work out the maximum cane yields under rainfed situations with recommended agronomic practices for management of sugarcane. Good agricultural practices like soaking of setts for one hour in saturated lime water (10%) before planting, adoption of 60 cm spacing in between rows, trash mulching @ 3 t ha⁻¹ immediately after planting and recommended dose of fertilizers 75-50-50 kg ha⁻¹ N-P₂O₅ -K₂O (Nitrogen will be applied in two equal splits on 30 and 60 days after planting, half of K₂O and entire P₂O₅ will be applied as basal and remaining K₂O in October after cessation of rains). Urea and potash (2.5 kg each in 100 L water) spray during severe drought situations at 15–20 days interval (**Table 4**).

The results revealed that the planting of sugarcane setts in 60 cm spacing under rainfed situation during the month of June with the recommended agronomic rainfed package recorded 24.3%, 28.6% and 35.3% cane yield increase over three years in different locations of the district as compared to farmers practice. Farmers impressed with the technology and most of the progressive farmers are adopting the rainfed sugarcane package and popularizing among themselves.

Intercropping in Sugarcane

On-farm demonstrations were conducted in farmer fields of sugarcane under paired row planting with pulses (blackgram var T9) during 2010–2011, 2011–2012 and 2012-13. The results revealed that the mean yield of sugarcane increased by 14.7 percent (**Table 5**), besides getting additional income of Rs. 10,583 through intercrop of black gram. Hence an attempt was made to educate the farmers on the benefit of intercropping with pulses, vegetables, groundnut and also its superiority over normal practice of sole sugarcane cultivation.

The results revealed that the planting of sugarcane in paired row planting method of 120×60 cm² spacing and inter cropping with blackgram in wide spaces recorded an additional cane yield of 14.7 compared to



sole crop of sugarcane in addition to additional monetary benefit of INR 10,583 compared to farmers practice of sole sugarcane. It is observed that due to the intercropping in sugarcane, weed population is controlled. Farmers impressed with the technology and most of the progressive farmers are adopting intercropping in sugarcane and popularizing among themselves.

Overall impact of technologies demonstrated

It clearly shows that various technologies and extension programmes reached the farmer level and changes in the cultivation practices brought the farmer in profit oriented sugarcane cultivation by achieving good yields (**Table 6**)

4. Conclusion

The efforts made by DAATT Centre in coordination with state department of Agriculture for the last half decade helped in increasing the productivity of sugarcane from 56.2 t ha⁻¹ to 79.8 t ha⁻¹ in the Vizianagaram district by introducing drought resistant varieties like 85A261, 87A298 and 93A145 occupy certain area in rainfed situation in the district. Farmers got awareness on the beneficial effects of trash mulching and spraying propiconazole against whip smut disease and 80% of the farmers in rainfed areas are adopting the technology. Paired row planting with intercropping in sugarcane was adopted by about 15% of irrigated farmers. Skill demonstrations and training programmes were conducted on value addition in jaggery inspired some progressive farmers to prepare jaggery in ½ kg and 1 kg cubes and they realized an additional amount of INR 5.0 to 8.0 kg⁻¹. Intercropping with black gram in sugarcane under paired row planting was well accepted by farmers and adopting under irrigated conditions.

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Table 1. Performance of drought resistant Sugarcane varieties under rainfed situations in Vizianagaram district.

Year	Varieties	Cane yield (t ha ⁻¹)		% increase
		Demonstration plot	Check(81A99)	
2003- 04	93A125	43.4	41.5	4.6
	93A145	57.6		35.8
2004-05	93A125	57.4	49.7	15.5
	93A145	50.1		1.8
Mean	93A125	50.4	45.6	10.5
	93A145	53.9		18.1

Table 2: Effect of recommended fertilizers on cane yield in rainfed sugarcane

Year	Cane Yield (t ha ⁻¹)		% Increase over farmers practice
	Demonstration plot	Farmers practice	
2003–2004	60.2	45.2	32.7
2004–2005	52.5	39.3	33.6
2005–2006	53.9	45.1	19.5
Average	55.5	43.2	28.6

Table 3: Chemical control of smut and its effect on cane yield

Year	Average yield (t ha ⁻¹)		Percent increase
	OFD plot	Farmers practice	
2010–11	73.7	61.6	19.6
2011–12	70.5	54.7	28.9
2012–13	62.5	50.5	23.8
Average	68.9	55.6	24.1

Table 4: Effect of Best Agricultural practices rainfed sugarcane cane yield in Vizianagaram district.

Year	Average yield (t ha ⁻¹)		Percent increase
	Demonstrated plot	Farmers practice	
2009-10	65.5	52.7	24.3
2010-11	41.8	32.5	28.6
2011-12	58.2	43.0	35.3
Average	55.2	42.7	29.4



Table 5: Impact of paired row planting and intercropping in sugarcane on cane yield and intercrop yield compared to normal planting method.


Year	Average yield (t ha ⁻¹)			Percent increase in sugarcane yield	Additional income (Rs)
	OFD plot	Intercrop	Farmers practice		
2010-11	74.3	0.180 (Blackgram)	61.8	20.23	9,000
2011-12	78.7	0.245 (Blackgram)	69.5	13.24	12,250
2012-13	69.1	0.210 (Blackgram)	62.5	10.56	10,500
Average	74.0	0.217	64.6	14.7	10,583


Table 6: Impact of technologies adopted for improving the productivity of sugarcane.


Technology	Cane yield (t ha ⁻¹)		% increase
	Farmers plot	OFD plot	
Drought resistant varieties	45.6	53.9	18.1
Balanced fertilizer management	43.2	55.5	28.6
Smut disease management in sugarcane	55.6	68.9	24.1
Good Agricultural practices rainfed sugarcane cane yield	42.7	55.2	29.4
Intercropping with Paired row planting method compared to normal planting.	64.6	74.0	14.7 (+Rs.10,583)



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