Adoption of Low Cost Technologies for Improving the Productivity of Sugarcane in Visakhapatnam District of Andhra Pradesh

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Abstract

Sugarcane cultivation in Visakhapatnam district is confined to rainfall dependent with little tankfed situation under low fertile red loamy soils. Out of 37,865 ha of sugarcane cultivation 65% 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, frequent prolonged dry spells and waterlogged conditions in rainy season besides poor transfer of technology. Based on those constraints on-farm demonstrations, skill demonstrations and training programmes were conducted by ANGR Agricultural University extension wing, DAATT Centre, Visakhapatnam continuously from 2001 to 2011 years on various agro-techniques which are really effective and economical for sugarcane farmers. The results revealed that productivity of sugarcane was increased to 29.7% by timely pocketing of recommended nutrients and 38.8% by using drought resistant varieties under rainfed situations. The good agricultural management practices increased the cane yield by 36% and timely control of smut disease with propiconazole increase live cane number which in turn increased the cane yield up to 34.8%. Farmers of Visakhapatnam are reaping an additional income of INR 2125.0 to INR 5000.0 by adopting paired row planting and intercropped with pulses or vegetables in sugarcane against sole sugarcane cultivation. It clearly indicates that, cane yield of sugarcane can be increased from 51 t ha^{-1} to 81 t ha^{-1} by adopting appropriate management practices by duly considering the climate conditions with efficient transfer of technology.

Keywords: Drought, GAP, income, rainfed, smut, yields

1. Introduction

Sugarcane is an important commercial crop grown in Andhra Pradesh in an area of 1.8 lakh ha. with average production of 140.4 lakh tonnes contributing to 3.58% of total area and 4.10% of total production of the country during 2011-12. Among major sugarcane growing districts in the state, Visakhapatnam occupies prime position in an area of 37865 ha and produced 19.7 lakh tonnes. The crop is cultivated both under irrigated and rainfed situations.

Four cooperative sugar factories are functioning in the district viz., M/s Chodavaram cooperative sugars, Gowada; M/s Thandava cooperative sugars, Payakaraopeta; M/s Etikoppaka cooperative agricultural and industrial society limited, Darlapudi and M/s The Anakapalle cooperative sugars, Thummapala. Out of the total cane produced in the district, 55−60% is used for sugar production and 35−40% for jaggery making.

The productivity of the sugarcane crop was 51 t ha^{-1} during 2001 in the district which was very low as compared to other sugarcane growing districts in the state. The farmers of Visakhapatnam district are realizing poor yields in sugarcane due to continuous moisture stress conditions or frequent prolonged dry spells. This situation causes stunted inter nodes and drying of bottom leaves in sugarcane early stages of growth. Moreover, prolonged dry spells reduces cane elongation about 30% reduces cane yield especially sucrose percent. 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).

Smut is an important disease causing some concern in recent years on important commercial varieties like Co6907,

CoR8001, 87A298 and Co975. 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. Fungicidal management of the disease with vitavax (Agnihotri et al., 1973) and benomyl (Liu, 1980) reported earlier. Recently smut disease was effectively controlled by using propiconazole or hexaconazole for sett treatment and spraying after 30 days of planting (Nageswararao and Patro, 2004). Hence an attempt was made to manage the sugarcane with good agronomic practices under different situations to realize the maximum cane yields.

2. Materials and Methods

A three years study was conducted in Visakhapatnam district of Andhra Pradesh from 1998 to 2000 years and 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 commission. This includes cultivation of sugarcane under marginal and sub-marginal lands, cultivation of sugarcane purely under rainfed conditions, lack of 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 in monocropping for longer periods, lack of adequate irrigation facilities, cultivation of sugarcane under moisture stress, water logged conditions, non adoption of suitable planting methods, improper nutrient management, poor ratoon management and Abiotic stresses like iron & zinc deficiency and biotic stresses like pest and diseases.

Based on the constraint analysis and extension gaps identified, action plans were prepared by the scientists of DAATT Centre every year from 2001 onwards for conducting on-farm demonstrations, training programmes, diagnostic field visits, group discussions, skill demonstrations, rythu sadassus, farmer-scientist interaction meetings and field days continuously from 2001 to 2012. Various technologies were demonstrated and various extension programmes were organized in the farmer fields over 12 years to educate the farmers on sugarcane cultivation for getting higher productivity. A brief account on extension efforts made by scientists of DAATT Centre, Visakhapatnam for transferring different agro techniques in sugarcane for the improvement of cane yield and value addition in jaggery are furnished hereunder.

3. Results and Discussion

3.1. Balanced fertilizer management in rainfed sugarcane

Farmers in the district used to apply only nitrogen fertilizers rather than Nitrogen, Phosphorus and Potassium fertilizers to sugarcane crop. To educate farmers on importance of balanced fertilization in sugarcane especially under rainfed situation, On-farm demonstrations were conducted consecutively for five years during 1999 to 2004. Recommended dose of 75-50-50 kg ha^{-1} N-P_2O_5-K_2O 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. The average yield of 58.4 t ha^{-1} was recorded in demonstrated plot which is 29.7% increase over farmers practice (45.1 t ha^{-1}). This clearly indicated that balanced fertilization in sugarcane cultivation increases the cane yield. Farmers impressed with the technology demonstrated and some of the progressive farmers are applying recommended fertilizers especially potash under rainfed situation (Table 1).

Table 1: Effect of recommended fertilizers on cane yield in rainfed sugarcane

Year	Cane Yield (t ha^{-1})		Increase over farmers practice
	Demonstration plot	Farmers practice	
1999–2000	60.0	45.2	32.7%
2000–2001	52.5	39.3	33.6%
2001–2002	53.9	45.1	19.5%
2002–2003	57.9	44.0	31.6%
2003–2004	67.8	51.7	31.2%
Average	58.4	45.1	29.7%

3.2. Introduction of drought resistant sugarcane varieties under rainfed situation

Five improved drought resistant varieties were identified by Regional Agricultural Research Station, Anakapalle *viz.,* Co6907, 92A123, 93A125, 93A145 and 97V97 were demonstrated in farmer fields under rainfed situation in comparison with local sugarcane variety 81 A 99 as check during 2003-04 and 2004-05 years for the benefit of the farmers as well as extension personnel (Table 2).

Table 2: Performance of drought resistant varieties under rainfed situations

Year	Varieties	Cane Yield (t ha^{-1})		Percent increase
		Demonstrated plot	Check	
2003–04	93A125	43.4	41.5	4.6
	Co6907	54.1		30.3
	93A145	57.6		38.8
2004–05	92A123	57.4	49.7	15.5
	97A97	50.6		1.8

Varieties 93A145, Co6907 and 93A125 performed well by possessing good drought tolerance under farmer field conditions and recorded increased yields of 38.8%, 30.3% and 4.6% respectively over local check 81A99 during 2003-04. Whereas 92A123 performed well in 2004-05 year with an increased yield of 15.5% over 81A99. This clearly indicates that 93A145, Co6907 and 92A123 varieties performed well under drought situation with prominent yield advantage. Farmers are well accepted the new varieties in sugarcane which are yielding better besides drought resistance.

3.3. 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 two locations in ratoon plots during 2005-06, 2006-07 and 2007-08, 2008-09 and 2009-10 with one acre plot size which are hot spot for smut incidence in Visakhapatnam 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).

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

Year	% incidence of smut		Average yield (t ha^{-1})		Percent increase
	OFD plot	Farmers practice	OFD plot	Farmers practice	
2005–06	5.6	38.9	88.2	70.2	25.6
2006–07	5.1	29.9	86.3	74.1	16.5
2007–08	5.7	36.0	84.7	71.6	18.3
2008–09	4.5	56.4	84.5	62.7	34.8
2009–10	11.0	63.5	62.5	50.5	23.8
Average	6.4	44.9	81.2	65.8	23.4

Spraying propiconazole (1 ml l^{-1}) twice at the time of ratooning and other at 30 days later effectively reduced disease incidence from 38.9% to 4.5% and increased cane yield by 16.5% to 34.8% in OFD plots compared to farmers practice over five years of study. The average cane yield of 81.2 t ha^{-1} was recorded with smut disease controlled by using propiconazole chemical which is 23.4% superior over farmers practice (65.8 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.

3.4. Good agricultural practices (GAP) 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 2008–2009, 2009–2010 and 2010–2011 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-P_2O_5-K_2O (Nitrogen will be applied in two equal splits on 30 and 60 days after planting, half of K_2O and entire P_2O_5 will be applied as basal and remaining K_2O in October after cessation of rains). Urea and potash (2.5 kg each in 100 lt water) spray during severe drought situations at 15–20 days interval (Table 4).

Table 4: Effect of rainfed management on cane yield under rainfed situation

Year	Average Yield (t ha^{-1})		Percent increase
	Demonstrated plot	Farmers practice	
2008-09	58.5	43.0	36.0 %
2009-10	35.5	29.0	22.4 %
2010-11	39.0	32.5	20.0 %
Average	44.3	34.8	27.3

2009 and 2010 average cane yields in the district are low due to scanty and uneven distribution of rainfall

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 36%, 22.4% and 20% 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.

4. Intercropping in Sugarcane

On-farm demonstrations were conducted in farmer fields of sugarcane under paired row planting with pulses (blackgram or greengram) or bhendi as intercrop during 2010–2011 and 2011-2012. Farmers in the district growing sugarcane and other crops like green gram, black gram, bhendi, maize as sole crops and realizing low yields due to uneven distribution of rainfall and frequent dry spells. Intercropping is an approach to overcome the yield losses from single crop besides efficient land utilization. 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 growing (Table 5).

Table 5: Impact of intercropping in sugarcane on cane yield

Year	Average yield (t ha^{-1})			PI	Additional income (₹)
	OFD plot	Intercrop	Farmers practice		
2010–11	81.3	0.950 (Bhendi)	73.8	10.2	5000.0
2011–12	78.7	0.499 (Blackgram)	69.5	13.2	2125.0

PI: Percent increase

The results revealed that the planting of sugarcane in paired row planting method of 120×60 cm^2 spacing recorded an additional cane yield of 10.2% and 13.2% compared to sole crop of sugarcane in addition to additional monetary benefit of INR 2125.0 and INR 5000.0 in 2010–2011 and 2011–2012 years respectively in different locations of the district as compared to farmers practice of sole sugarcane. It is observed that due to the intercropping in sugarcane, weed population is controlled and number of irrigations also reduced. Farmers impressed with the technology and most of the progressive farmers are adopting intercropping in sugarcane and popularizing among themselves.

4.1. 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 and Figure 1).

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

Technology	Cane yield (t ha^{-1})		% increase
	Farmers plot	OFD plot	
Balanced fertilizer management	45.1	58.4	29.7
Introduction of drought resistant varieties	41.5	57.6	38.8
Smut management in ratoon crop	65.8	81.2	23.4
Good agricultural practices	34.8	44.3	27.3
Intercropping with paired row planting	71.7	80	11.6

1.6. Other extension programmes

Conducted need based training programmes to farmers, adarsha rythus, sugar factory field workers and extension personnel's in the district on improved cane varieties and methods of planting, fertilizer and water management in sugarcane, weed management in sugarcane, management of cane under rainfed as well as water logged situations, ratoon cane management, plant protection in sugarcane, quality jaggery making and value addition in jaggery, intercropping in sugarcane and post harvest technologies.

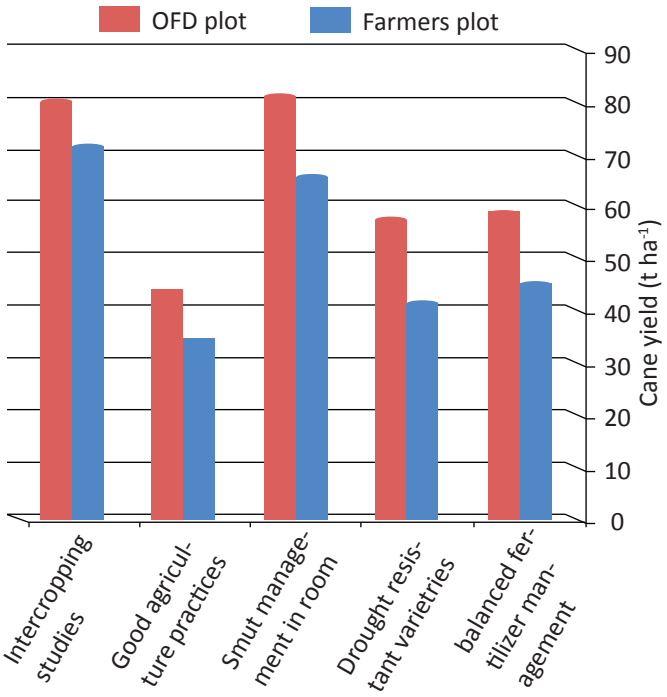

Figure 1: Impact of technologies in improving the productivity of sugarcane in Visakhapatanam

Campaigns were organized by DAATTC Scientists in collaboration with scientists of RARS, Anakapalle for the management of yellow mite and red rot disease in sugarcane (81V48 variety). The DAATTC also actively participated during cyclone or flood affected areas as well as severe drought situations immediately and suggested ameliorative measures for quick revival of crop and thereby averting crop losses. Method demonstrations were conducted and educated the farmers on sett treatment in sugarcane, planting with sugarcane planter, manuring by pocketing, stubble shaving in ratoon crop, trash mulching, paired row planting with intercropping in sugarcane, chemical weed management and quality jaggery making and preparation of jaggery in the form of cubes and blocks.

3. Conclusion

The efforts made by DAATT Centre in coordination with line departments for the last ten years helped in increasing the productivity of sugarcane from 51 t ha^{-1} to 81 t ha^{-1} in the 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 90% of the farmers in rainfed areas are

adopting the technology. 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 2.0 to 4.0 kg^{-1}. Intercropping with black gram or bhendi in sugarcane under paired row planting was well accepted by farmers and adopting under irrigated conditions.

4. References

Agnihotri, V.P., Singh, K., Budhiraja, T.R., 1973. Persistance and degradation of vitavax in soil and sugarcane sett and its effect on soil fungi. Proceedings of Indian National Science Academy 30, 561–568.

Carta, T., 1995. Water requirement CENICANA. Rept. Centro de Investigacion de la Cana de Azucar de Colombia 17, 5–9.

Liu, L.J., 1980. Sugarcane rust: Taxonomy, epidemiology, chemical control and relative resistance of sugarcane varieties in Puerto Rico. Proc. 1st International Am. Sugarcane seminar, Vanguard. Florida, 54–58.

Nageswararao, G.V., Patro T.S.S.K., 2004. Management of smut through fungicidal sett treatment. Paper presented in 26th Annual conference and symposia conducted by Indian Society of Mycology and Plant Pathology held at Goa University, Goa on October 7–9, 2004.

Ramesh, P., 2000. Effect of different levels of drought during the formative phase on growth parameters and its relationship with dry matter accumulation in sugarcane. Journal of Agronomy and Crop Science 185, 83–89

Wiedenfeld, R.P., 2000. Water stress during different sugarcane growth periods on yield and response to N fertilization. Agricultural Water Management 43, 173–182.