

CONSERVATION TILLAGE PRACTICES FOR ENHANCED PRODUCTIVITY IN SUGARCANE-PADDY SYSTEM

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ABSTRACT

A field study was carried out at Regional Agricultural Research Station farm, Anakapalle from 2022-23 to 2024-25 for three years to study the feasibility of conservation tillage practices and its impact on crop establishment, growth of crop and weed, and productivity of Sugarcane in Sugarcane-Paddy cropping system. The trial was carried out using a strip plot design with three replications. The main plot factor comprised of conservation tillage practices and weed management techniques in sub plots. The cropping cycle of sugarcane planting in furrows with ridgemark in rice fallows + Cowpea during first year followed by Sugarcane (ratoon)+Cowpea during second year and taking up Pulse-Green manure-Paddy with minimal tillage and sowing during the third year in addition to chemical weed control methods for effective weed management was found suitable to improve the overall productivity of Sugarcane-paddy system (217.47 t ha⁻¹) and economically profitable instead of the normal conventional system.

Key words: Conservation tillage, Paddy, Sugarcane, System productivity

INTRODUCTION

Sugarcane is an important commercial crop in North Coastal Zone. The Conventional method of tillage is not only laborious but is also expensive. Besides, this it does not allow more crops to be taken in rotation unlike in Conservation agriculture. Sugarcane-Paddy being the predominant system in this zone needs to be exploited well for improving its system productivity. By following conservation tillage practices, there will be more scope for taking more crops in a cropping cycle enabling to cover the soil for longer time besides improving the net returns. The area under sugarcane crop has significantly decreased in

recent years as land preparation is extremely expensive and insufficient rainfall during growth stages. Therefore, the current investigation was undertaken to work out conservation agriculture methods and the efficiency of different weed management methods to improve the overall productivity of Sugarcane-Paddy system.

MATERIAL AND METHODS

A three year experiment was carried out at Regional Agricultural Research Station farm, Anakapalle from 2022-23 to 2024-25 to study the feasibility of conservation tillage practices and its impact on crop establishment, crop and weed growth and sugarcane productivity in

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Sugarcane-Paddy cropping system. The trial was taken up with conservation tillage practices in main plots and weed management techniques in sub plots in strip plot design replicated thrice. The main plot treatments were M₁-Monocropping of Sugarcane (Sugarcane plant-ratoon-ratoon), M₂-Sugarcane (Plant)-Sugarcane(ratoon)-pulse-greenmanure – Paddy under conventional tillage and sowing, M₃-Sugarcane(working with ridgemar and planting in furrows in rice fallows)-Sugarcane(ratoon)-Pulse-Green manure-Paddy under minimum tillage and sowing, M₄-Sugarcane(working with ridgemar and planting in furrows in rice fallows)+trash mulching-Sugarcane(ratoon)+ trash mulching-Pulse-Green manure-Paddy under minimum tillage and sowing and M₅-Sugarcane(Planting in furrows with ridgemar in rice fallows) + Cowpea-Sugarcane(ratoon)+Cowpea-Pulse-Green manure-Paddy under minimum tillage and sowing. The sub plot treatments were S₁- Chemical weed control, S₂- Mechanical Weed control through Power weeder +row weeding and S₃-Chemical weed control+ Mechanical weed control. The weather conditions were favourable for the crop growth during these three years. The experimental site soil was sandy loam with pH (7.08), E.C (0.40dS/m), OC (0.68), available nitrogen (196Kg ha⁻¹), phosphorus (63Kg ha⁻¹) and potassium (312Kg ha⁻¹). All the recommended package of techniques were used for raising a good and healthy crop. Number of tillers were counted at 120 DAP and shoot population was counted at 240 DAP. Weeds were collected per sq.m randomly in plot area, oven dried and expressed as weed dry weight. Cane samples were crushed and the percentage of sucrose was noted on sucrolyzer. Cane yield and number of millable canes were recorded at harvest on plot basis and expressed in numbers and tons ha⁻¹ respectively. Three years data was pooled and statistical analysis was done as suggested by Panse and Sukhatme (1986).

RESULTS AND DISCUSSION

Growth parameters

As per table 1, pooled mean of tiller population at 120 days did not vary among the main plots and sub plot treatments. However, significantly higher shoot population at 240 days and lowest dry weight of weeds in conservation tillage practices were noted with the treatment Sugarcane(Planting in furrows with ridgemar in rice fallows) + Cowpea-Sugarcane (ratoon)+ Cowpea-Pulse-Green manure-Paddy under minimum tillage and sowing and with Chemical weed control among weed management techniques which was comparable with chemical weed control+ Mechanical weed control. Gepolani *et al.* (2020) reported higher profitability of intercropping of corn and cowpea than sugarcane monocropping implying suitable intercrops to ratooned sugarcane. Geetha *et al.* (2019), observed that Weed smothering efficiency (WSE) was considerably greater in sugarcane + cowpea (36.3%) intercropping system followed by sunnhemp (32.3%) and soybean (32.0%) compared to the sole sugarcane (control). Considerably more number of millable canes (93,260 ha⁻¹) were noted with pre-emergence herbicide (atrazine @1.00 kg/ha) and post emergence herbicide (Metribuzin @0.75 kg/ha) @ 60 DAP compared to mechanical options by Nageswari *et al.* (2022).

Yield attributes, Yield and System productivity

Table 1 revealed that among the conservation tillage techniques, millable cane number and cane yield were significantly highest with Sugarcane (Planting in furrows with ridgemar in rice fallows) + Cowpea-Sugarcane(ratoon)+Cowpea-Pulse-Green manure-Paddy under minimum tillage and sowing and with Chemical weed control method which was on par with Chemical weed control+ Mechanical weed control among weed

Table 1. Yield and quality of Sugarcane under Sugarcane-Paddy system as influenced by conservation tillage and weed management practices (Pooled mean)

| Treatments | No. of Tillers/ha at 120 days (thousands ha ⁻¹) | Shoot population at 240 days ('000/ha) | Weed dry wt (gm ⁻²) | No. of Millable Canes (thousands ha ⁻¹) | Sucrose (%) | Cane Yield (tha ⁻¹) | System productivity (tha ⁻¹) |
|---|---|--|---------------------------------|---|-------------|---------------------------------|--|
| Main plots- Conservation tillage practices | | | | | | | |
| M1 | 110.18 | 79.41 | 632 | 60.61 | 17.58 | 65.73 | 197.19 |
| M2 | 115.35 | 83.28 | 522 | 65.07 | 16.96 | 65.30 | 186.41 |
| M3 | 104.82 | 72.38 | 575 | 64.16 | 16.65 | 66.11 | 186.06 |
| M4 | 103.46 | 74.94 | 471 | 66.94 | 16.19 | 70.36 | 200.49 |
| M5 | 107.95 | 89.59 | 383 | 77.49 | 16.70 | 77.20 | 217.47 |
| CD (5%) | NS | 7.43 | 105 | 5.68 | NS | 3.78 | 9.78 |
| CV (%) | 16.88 | 8.54 | 18.72 | 7.81 | 6.93 | 5.04 | 4.56 |
| Sub plots- Weed Management practices | | | | | | | |
| S1 | 108.21 | 81.90 | 413 | 71.04 | 17.00 | 72.81 | 206.67 |
| S2 | 107.78 | 77.11 | 615 | 62.07 | 16.95 | 64.37 | 186.64 |
| S3 | 109.07 | 81.46 | 523 | 67.45 | 16.49 | 69.64 | 197.50 |
| CD (5%) | NS | 3.47 | 83 | 3.77 | NS | 5.00 | 11.09 |
| CV (%) | 8.32 | 5.7 | 21.00 | 7.41 | 5.27 | 9.53 | 7.39 |
| Interaction | NS | S | NS | NS | NS | NS | NS |

management practices. Comparative yields of sugarcane under zero till system combined with trash mulching as against conventional tillage was reported by Surendran *et al.* (2016). According to Shukla *et al.* (2020) sugarcane (96.32 t ha⁻¹) and sugar yields (12.14 t ha⁻¹) were significantly enhanced with the minimum tillage through subsoiling in contrast to conventional tillage/mouldboard ploughing. Srivastava *et al.* (2023), reported more cane yield (79211 kgha⁻¹) with sugarcane + cowpea intercropping than sugarcane mono-cropping (72239.5 kgha⁻¹). De Oliveira *et al.* (2022), reported higher cane productivity with no tillage system. The productivity of greengram and paddy were highest among the Sugarcane paddy cropping system with Sugarcane

(Planting in furrows with ridgemark in rice fallows) + Cowpea – Sugarcane (ratoon)+ Cowpea-Pulse-Green manure-Paddy under minimum tillage practice and sowing and with Chemical weed method which was on par with Chemical weed control+ Mechanical weed control among weed management practices. Ghorai and Ghorai (2023) reported rice yield of 3-5 t ha⁻¹ with Zero till green manure which added 35- 60 tonnes bio mass ha⁻¹ and saved 20-27 kg (30 per cent) nitrogen ha⁻¹ in different locations of Paschim Medinipur and Purulia districts of West Bengal. Pooled mean of sucrose percent did not differ by the main and sub plot treatments. On computation, the system productivity in terms of cane equivalent yield was also found significantly highest with

Table 2. Effect of conservation tillage practices on post-harvest soil properties

| Treatment | pH | EC (dSm ⁻¹) | OC (%) | Available Nutrient Status (Kgha ⁻¹) | | | Bulk density (gcc ⁻¹) |
|---|------|----------------------------|-----------|--|-------|-----|---|
| | | | | N | P | K | |
| Initial | 7.08 | 0.40 | 0.68 | 196 | 63 | 312 | 1.34 |
| Main plots- Conservation tillage practices | | | | | | | |
| M1 | 7.28 | 0.170 | 0.69 | 212 | 86.50 | 320 | 1.35 |
| M2 | 7.42 | 0.260 | 0.71 | 225 | 81.20 | 321 | 1.35 |
| M3 | 7.26 | 0.150 | 0.69 | 230 | 91.20 | 328 | 1.36 |
| M4 | 7.27 | 0.195 | 0.72 | 242 | 88.50 | 342 | 1.37 |
| M5 | 7.21 | 0.165 | 0.69 | 228 | 83.60 | 338 | 1.35 |
| CD (5%) | NS | NS | NS | NS | NS | NS | NS |
| Sub plots- Weed Management practices | | | | | | | |
| S1 | 7.24 | 0.24 | 0.69 | 215 | 88.0 | 324 | 1.35 |
| S2 | 7.28 | 0.18 | 0.69 | 220 | 91.0 | 322 | 1.35 |
| S3 | 7.25 | 0.20 | 0.70 | 212 | 90.0 | 321 | 1.36 |
| CD (5%) | NS | NS | NS | NS | NS | NS | NS |

Table3. Economics of Sugarcane-Paddy system as influenced by conservation tillage and weed management practices

| Treatments | System productivity (tha ⁻¹) | Gross Returns (Rs. ha ⁻¹) | Net Returns (Rs. ha ⁻¹) | B:C ratio |
|---|--|---|---|--------------|
| Main plots- Conservation tillage practices | | | | |
| M1 | 197.19 | 586633 | 60685 | 1.12 |
| M2 | 186.41 | 554565 | 78785 | 1.17 |
| M3 | 186.06 | 545490 | 81854 | 1.18 |
| M4 | 200.49 | 596467 | 130331 | 1.28 |
| M5 | 217.47 | 647004 | 181368 | 1.39 |
| Sub plots- Weed Management practices | | | | |
| S1 | 206.67 | 611502 | 134253 | 1.28 |
| S2 | 186.64 | 555398 | 71649 | 1.15 |
| S3 | 197.50 | 591196 | 113912 | 1.24 |

conservation tillage practices in the cropping system Sugarcane (Planting in furrows with ridgemark in rice fallows) + Cowpea-

Sugarcane(ratoon)+Cowpea-Pulse-Green manure-Paddy under minimum tillage and sowing and among weed management

techniques with Chemical weed control method which was however found to be on par with Chemical weed control+ Mechanical weed control. Ishita and Vaidya (2020) concluded that intercropping of legumes in addition to offering higher system profitability, also enhances soil quality and creates a sustainable plant-ratoon system.

Effect on Soil Physico-Chemical properties

An analysis of the data (Table 2) showed that the soil's physical and chemical characteristics (pH, EC, Organic carbon content and available nutrient status) did not differ among conservation tillage practices and weed management practices. There was no difference in bulk density of the soil also among the treatments implying that these conservation practices have not increased the soil compaction and were congenial for growth of sugarcane and paddy in this cropping cycle.

Economics

On Computation of the system economics (Table 3), it is observed that gross returns, net returns and benefit cost ratio among the conservation tillage practices were the highest with the cropping system Sugarcane (Planting in furrows with ridgemark in rice fallows) + Cowpea–Sugarcane (ratoon)+ Cowpea-Pulse-Green manure-Paddy under minimum tillage and sowing and among weed management techniques with Chemical weed control. Higher net field benefits were obtained when lentil was intercropped in sugarcane (Nadeem *et al.*, 2020). Singh *et al.*, 2015 reported higher net returns in summer planted sugarcane in the absence of pre-planting tillage in contrast to conventional tillage. The findings of experiments carried out at farmer's field by ICAR-RCER, Patna reported by Singh and Meena, 2013 suggested that zero tillage technology in rice has proved more remunerative to farmers.

CONCLUSION

The cropping cycle of planting of sugarcane in furrows with ridgemark in rice fallows + Cowpea during first year followed by Sugarcane(ratoon)+Cowpea during second year and taking up Pulse-Green manure-Paddy under minimum tillage and sowing during the third year along with Chemical weed control method for efficient weed management was found suitable to enhance the overall productivity and profitability of Sugarcane-paddy system in contrast to normal conventional system of practices for Sugarcane-Paddy sequence in North Coastal Zone of Andhra Pradesh.

REFERENCES

- De Oliveira, I.N., De Souza, Z.M., Bolonhezi, D., Totti, M.C.V., De Moraes, M.T., Lovera, L.H., De Souza Lima, E., Esteban, D.A.A., Oliveira, C.F. 2022. Tillage systems impact on soil physical attributes, sugarcane yield and root system propagated by pre-sprouted seedlings. *Soil and Tillage Research*, 223. <https://doi.org/10.1016/j.still.2022.105460>.
- Geetha, P., Tayade, A.S., Chandrasekar, C.A., Selvan T and Rajesh Kumar. 2019. Agronomic response, weed smothering efficiency and economic feasibility of sugarcane and legume intercropping system in Tropical India. *Sugar Tech* 21, 838-842. (<https://doi.org/10.1007/s12355-018-0689-9>).
- Gepolani, M.E., Aguilar, E.A., Sanchez, P.B and Supangco, E.P. 2020. Potential of intercropping Corn and Cowpea to ratooned Sugarcane for food and forage. *International Journal of Nutrition and Food Engineering*, 14(01):1.
- Ghorai, A.K and Ghorai, A.K. 2023. Low Cost Zero till In situ Green Manuring for Kharif

- Rice-A Success Story. International Journal of Environment and Climate Change, 13(7): 317-323.
- Ishita and Vaidya, P. 2020. A review on intercropping effects on growth and yield of sugarcane. Journal of Pharmacognosy and Phytochemistry,9(5): 2992-2995
- Nadeem, M., Tanveer, A., Sandhu, H., Javed, S., Safdar, M.E., Ibrahim, M., Shabir, M.A., Sarwar, M and Arshad, U. 2020. Agronomic and economic evaluation of autumn planted sugarcane under different planting patterns with lentil intercropping. Agronomy,10:644.
- Nageswari, R., Dhanushkodi, V., Chitra, K., Dhanalakshmi, K., AnandhaKrishnaveni, S. Shanmuganathan, M., Baskaran, V and Saranraj, T. 2022. Chemical and mechanical options for management of weeds in sugarcane in Cauvery Delta Zone of Tamil Nadu. Agricultural Mechanization in Asia, Africa and Latin America, 53(11) : 10501-10506.
- Panse V.G and Sukhatme P.V. Statistical methods for Agricultural workers. Indian council of Agricultural Research, New Delhi. 1986.
- Shukla, S.K., Jaiswal, V.P., Sharma, Lalan Sharma, A. D. Pathak, Akhilesh Kumar Singh, Rajendra Gupta, S. K. Awasthi, Asha Gaur, AdilZubair and Raghvendra Tiwari. 2020. Sugarcane Yield Using Minimum Tillage Technology Through Subsoiling: Beneficial Impact on Soil Compaction, Carbon Conservation and Activity of Soil Enzymes. Sugar Tech 22, 987–1006. <https://doi.org/10.1007/s12355-020-00860-9>.
- Singh, K.M and Meena, M.S. 2013. Economics of Conservation Agriculture: An Overview, ICAR-RCER, Patna, Zonal Project Directorate, Jodhpur, India.
- Singh, G., Kumar, L., Chandra, S., Bhatnagar, A and Raverkar, K.P. 2015. Response of summer planted sugarcane (*Saccharum officinarum* L.) to tillage practices and planting methods. Madras Agricultural Journal, 102 (1-3): 46-51.
- Srivastava, R., Meena, K, Rai, A.K., Singh, S., Chaudhary, R.P., Chaturvedi, A.K and Singh.N. 2023. Intercropping of cowpea with spring sugarcane: A proven technology toward the doubling income of sugarcane growers in eastern part of Uttar Pradesh. The Pharma Innovation Journal,12(8): 1748-1751.
- Surendran, U., Ramesh, V., Jayakumar, M., Marimuthu, S and Sridevi, G. 2016. Improved sugarcane productivity with tillage and trash management practices in semi-arid tropical agroecosystem in India. Soil and Tillage Research, 158: 10-21.

K. Ramana Murthy, K.V., Gouri, V., Sireesha, A., Jagannadha Rao, P.V.K., Adilakshmi, D. and Mukunda Rao, Ch. 2025. Conservation tillage practices for enhanced productivity in sugarcane–paddy system. The Journal of Research ANGRAU, 53(5): 46-51