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Productivity enhancement in rainfed sugarcane through tillage and moisture conservation methods

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Abstract
Sugarcane productivity at the farm level has been stagnant in India, at around 54-72 t ha^{-1}. One of the main reasons for this low productivity is the yield gap between ratoon and plant cane yield. To improve the ratoon yield and bridge the yield gap, a field experiment was conducted for two seasons with different tillage systems and trash management practices. The experiment was laid with two treatments *vise*., T_1-Improved practices (Chisel plough at 1m interval fb MB plough, Lime water dipping, mulching and spraying of urea and MOP in post monsoon season, Water harvesting through farm pond and providing supplemental irrigation) and T_2-Farmers practice. In improved rainfed sugarcane method (Chisel plough at 1m interval followed by MB plough, Lime water dipping of setts before planting, mulching and spraying of urea and MOP in post monsoon season, Water harvesting through farm pond and providing supplemental irrigation), the germination count at 35th DAP(Days after Planting), shoot population recorded at 60DAP, 90DAP and 120DAP, moisture content of the soil at 60DAP, 120DAP, 240DAP and Harvest were found significantly higher in improved practice when compared to farmers practice. The NMC (64386 No. of Millable canes ha^{-1}), Length of the cane (224.5cm), Girth of the cane (2.3cm) were recorded significantly 13.80, 7.11 and 4.56% higher in improved practice in comparison with farmers practice. Root volume (171 cc), Root weight (51.36gm) were also found significant in improved method of cultivation. Cane yield (56.43t ha^{-1}) found significant in improved rainfed sugarcane method and 11.83% increase in yield was observed when comparison to farmer practice (50.46 t ha^{-1}). The results suggest that the tillage with adoption of trash management practices assisted in improving the profitability by way of higher sugarcane ratoon productivity.

Keywords: Rainfed sugarcane, tillage, moisture content, shoot population, millable canes and yield

Introduction
Rainfed sugarcane occupies around 45 per cent of total cane area in North coastal districts of A.P. The average productivity of sugarcane is very low in North Coastal districts and more so under rainfed situation. Hence a quantum jump in productivity cannot be achieved unless the productivity constraints of cane under rainfed situation are adequately addressed. It has been found that farmers of this region are not resorting to the tillage methods for rainfed situation which would enhance the moisture conservation and thereby enable in improving the productivity in this region. Hence there is an urgent need to find out the methods of tillage and conservation to address such an important problem also keeping in view the continuous decrease in cane area in this zone.

A two-year field experiment was conducted to investigate the effect of sub-soiling on plant growth, root morphology and yield of rainfed pigeon pea (Ramana *et al.* 2015) [1] indicated that sub-soil tillage sustained higher shoot, root growth and seed yield during the year 2013-14, which coincided with end of season drought compared to conventional tillage treatment. Similarly sub-soiling recorded significant increase in drought tolerant traits, viz. root length (234%), root dry weight (274%) and relative water content (37%). Sub-soil tillage proved efficient method of mechanical intervention for drought mitigation under rainfed pigeonpea cultivation. As sugarcane is also a long duration crop the effect of subsoiling might have beneficial effect on crop productivity.

More than 45 percent of total cane area in A.P. is under rainfed situation but the average productivity of cane is only 35-40 t ha^{-1}. At present farmers are adopting land preparation with the help of cultivator. It is well known that this crop needs deep ploughing for every plant crop as on an average 2-3 ratoon crops are being taken up and hence deep ploughing should be compulsorily done to enhance productivity. Tillage methods in combination with moisture conservation methods would boost up the cane yield. Crop residues left intact help both natural

precipitation and irrigation water infiltrate the soil where it can be used (Friedrich *et al*., 2009) [2]. The crop residue left on the soil surface also limits evaporation, conserving water for plant growth (Thierfelder and Wall, 2009) [3]. In view of this situation the present study was proposed with the following objectives.

Objectives

1. To improve the productivity of soil through different tillage methods
2. To sustain the moisture levels for growth and yield of rainfed sugarcane
3. To achieve sustainable and economic production of rainfed sugarcane

Materials and Methods

A field experiment was conducted at the Regional Agricultural Research Station, Anakapalle, Visakhapatnam of Acharya N.G. Ranga Agricultural University (ANGRAU), in the North - Coastal Agro-Climatic Zone of Andhra Pradesh. The experiment was laid with two treatments *vise*., T_1- Improved practices (Chisel plough at 1m interval fb MB plough, Lime water dipping, mulching and spraying **o**f urea and MOP in post monsoon season , Water harvesting through farm pond and providing supplemental irrigation) and T_2- Farmers practice. The statistical design followed is Field Scale trial (T-test). The crop is grown in an area 1000 m^2 each. Nitrogen is applied in two equal splits at 30 and 60 DAP (on a rainy day). The crop was sown during June-July, 2017, 2018 and 2019 and harvested during March–April, 2019. The data collected on initial soil analysis for nitrogen, germination count at 35th day after planting, tiller population at 60, 90 and 120 DAP, root length and root volume, moisture content of the soil at 60, 120, 240 DAS and at harvest, amount of rainfall and rainy days, juice quality at harvest, number of millable canes, length and girth of the cane and cane yield at harvest.

Results and Discussion

The data indicates in table 1 that, the parameters *viz*., Germination count at 35th DAP was higher in improved practice (85.16) in comparison with farmers practice (64.73). In case of shoot population in improved practice recorded at 60DAP, 90DAP and 120DAP significantly 19.50, 30.43, 12.60% higher in comparison farmers practice respectively. The moisture content of the soil at 60DAP, 120DAP, 240DAP and Harvest is also 24.14, 32.60, 73.37 and 54.83% significantly higher in improved practice when compared to farmers practice. The NMC (64386 No. of Millable canes ha^{-1}), Length of the cane (224.5cm), Girth of the cane (2.3cm) were recorded significantly 13.80, 7.11 and 4.56% higher in improved practice in comparison with farmers practice. Root volume (171 cc), Root weight (51.36gm) were also found significant in improved method of cultivation. The sucrose content didn't influence by the treatments, but found superior quality in improved method of cultivation (19.86%). Cane yield (56.43t ha^{-1}) found significant in improved rainfed sugarcane method (Chisel plough at 1m interval followed by MB plough, Lime water dipping of setts before planting, mulching and spraying of urea and MOP in post monsoon season, Water harvesting through farm pond and providing supplemental irrigation) and 11.83% increase in yield was observed when comparison to farmer practice (50.46 t ha^{-1}).

Table 1: Summarized Data of 2017-18, 2018-19 & 2019-20 on Yield attributes, quality and yield of sugarcane

Sl. No.	Parameter	T_1: Rainfed sugarcane with Improved practices	T_2: Rainfed sugarcane with Farmer practices	Percentage Increase	T stat
1	Germination count at 35th DAP	85.16	64.73	31.56	2.63
2	Shoot population at 60DAP	109611	91722	19.50	3.18
3	Shoot population at 90DAP	129674	99420	30.43	2.28
4	Shoot population at 120DAP	79495	70600	12.60	2.40
5	Moisture content of the soil at 60DAP	9.36%	7.54%	24.14	2.68
6	Moisture content of the soil at 120DAP	8.46%	6.08%	32.60	2.69
7	Moisture content of the soil at 240DAP	7.16%	4.13%	73.37	3.23
8	Moisture content of the soil at Harvest	7.85%	5.07%	54.83	3.17
9	NMC(No.of Millable canes/ha)	64386	56580	13.80	2.24
10	Length of the cane(cm)	224.5	209.6	7.11	2.74
11	Girth of the cane(cm)	2.3	2.2	4.56	1.85
12	Root volume(cc)	171	159	7.55	2.09
13	Root weight(gm)	51.36	46.45	10.57	3.17
14	Sucrose (%)	19.86	19.70	0.81	NS
15	Cane yield(t/ha)	56.43	50.46	11.83	2.19

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