SHORT COMMUNICATION

# RESPONSE OF SUGARCANE TO PLANT GEOMETRY AND IRRIGATION METHODS IN SOUTHERN AGRO-CLIMATIC ZONE OF ANDHRA PRADESH

**N.V. Sarala*, M. Subba Rao, M. Hemanth Kumar and K.V. Nagamadhuri**

**Abstract**

Field experiments were conducted at Agricultural Research Station, Perumallapalle, during 2008-2009 and 2009-2010 with two plant crops and one ratoon crop to study the response of sugarcane crop to different planting geometry and irrigation methods. Sugarcane crop was planted in three planting geometry methods, viz. normal uniform row planting (80 cm), paired row (75/105 cm) planting and wide row planting (150cm) with conventional furrow, surface drip and sub-surface drip methods of irrigation. Planting sugarcane in paired rows at 75/105 cm recorded better yield attributes like number of millable canes, cane length and cane yield. Both surface and subsurface drip irrigation methods gave 18 – 20% higher cane yield and greater water economy of 24% saving in irrigation water over conventional furrow method of irrigation. Therefore, adoption of 75/105 cm paired row planting and drip irrigation can be recommended to improve cane yield and save irrigation water.

**Key words:** sugarcane crop, plant geometry, irrigation methods

Sugarcane being a long duration crop producing huge amount of biomass, requires adequate supply of water. In tropical region of the country, it is mostly grown as an irrigated crop. The total water requirement depends on various factors such as soil type, climatic conditions like rain fall, temperature, wind etc., cultivation practices and crop duration. Furrow irrigation is the most common conventional method of irrigation and is particularly effective for early plant crop. During germination phase, light irrigations are given at frequent intervals for proper germination of buds. Any shortage of water during the tillering phase would reduce tillering and result in lower number of millable canes. Grand growth phase is the most crucial one, when actual cane yield build up takes place and the crop needs more water, with crop coefficient values of more than 1.0. Shortage of water during the grand growth phase leads to shortening of internodes, reduction of cane length and weight, and lower cane yield. Thus sugarcane requires adequate soil moisture throughout its growth for optimum yield. Under field conditions, water requirement is met by adequate rainfall, contribution from groundwater (if the water table is within the reach of the root system) and irrigation. It is estimated that about 200 tonnes of water is required to produce one tonne of cane. Therefore adoption of suitable water management practices to maximize water use efficiency (WUE) and minimize losses of irrigation water needs no emphasis. Drip irrigation in sugarcane is a relatively new innovative technology that can conserve water,

N.V. Sarala*, M. Subba Rao, M. Hemanth kumar and K.V. Nagamadhuri
* Agricultural Research Station, Perumallapalle - 517 505, Andhra Pradesh
email: saralaangrau@gmail.com

increase WUE and help to solve the major problem of water scarcity. New management practices like planting geometry, drip design, fertigation, irrigation scheduling, etc. inducted with drip technology have led to significant increases in cane and sugar yield (Parikh *et al*. 1993; Venugopal and Rajkumar 1998; Narayanamoorthy 2004 and Palanisamy et al. 2012). Adoption of wide row and paired row planting will substantially reduce the cost of installation of drip system by reducing the length of laterials, besides facilitating intercropping. It is also necessary to develop suitable planting geometry for wide adoption of drip irrigation in sugarcane. Hence the present study on the performance of sugarcane under different plant geometry (row spacing) and irrigation methods was taken up.

The experiments were laid out in strip plot design with three main plot treatments (plant geometry) viz., normal uniform row planting (80cm), paired row planting (75/105 cm) and wide row planting (150 cm) and three sub plot treatments (irrigation methods) viz., surface drip irrigation, sub surface drip irrigation and conventional furrow method of irrigation. There were three replications. The experimental field was sandy loam with low organic carbon, low available nitrogen, low available phosphorus and high available potassium. For the furrow method of irrigation, ridges and furrows were formed at a spacing of 80 cm using tractor drawn ridger. For paired row planting, two cane rows were brought together with a spacing of 75 cm within the pair and wide gap of 105 cm between the pairs. For wide row planting, furrows were opened at a distance of 150 cm. For the drip irrigation system, 16 mm laterials with an emitter spacing of 40 cm and discharge rate of 2 lit/h were used. The quantity of irrigation water applied was recorded using a water meter and it was regulated based on the ET calculated from Open Pan Evaporimeter readings. Laterals were placed along each furrow in the normal and wide row plantings while in the paired row planting, one lateral was placed in the centre of the two rows within the pair. Sugarcane variety 93 A 145 (Sarada) was used as the test variety. The crop was fertilized with 224 kg N, 112 kg $P_20_5$ and 112 kg $K_2O$ per hectare. Nitrogen was applied in two equal splits at 45 and 90 DAP and $P_2O_5$ and $K_2O$ were applied as basal at the time of planting / ratoon initiation. The data on yield attributes, juice quality and cane yield were recorded at the time of harvest.

**Yield attributes and yield**

Among the three planting geometries, paired row planting at 75/105 cm recorded longer and greater number of millable canes than the normal uniform row spacing of 80 cm and 150 cm wide row planting (Table 1). Higher cane diameter was recorded with wide row method of planting and paired row planting as compared to the normal spacing. Wide row and paired row plantings were on par. Higher cane diameter under wide row spacing has been reported by (Sundara 1998; Srivastava and Johari 1979; Kumar and Srivasatava 1994). The highest cane yield was recorded in paired row planting in all the three crops (two plant and one ratoon) raised. This is mainly because of the higher number of millable canes and longer canes under this treatment. The wider spacing available between two sets of paired rows could have permitted better light interception under paired row spacing and also would have

**Table 1. Effect of planting geometry and irrigation methods on yield and yield attributes of sugarcane**

| Treatments | Cane length (m) | Cane diameter (cm) | No. of millable canes/ha | Cane yield (t/ ha) | Sucrose (%) | CCS (%) |
|---|---|---|---|---|---|---|
| **Main plots : Irrigation methods** | | | | | | |
| Conventional furrow method | 2.40 | 2.82 | 93484 | 102.3 | 19.15 | 13.42 |
| Surface drip | 2.75 | 3.07 | 98642 | 122.8 | 19.26 | 13.65 |
| Sub surface drip | 2.74 | 2.98 | 95758 | 120.6 | 19.32 | 13.55 |
| SE ± | 0.01 | 0.02 | 1485 | 0.76 | 0.19 | 0.12 |
| CD @5% | 0.04 | 0.07 | NS | 2.12 | NS | NS |
| **Sub plots: Planting geometry** | | | | | | |
| Uniform rows(80 cm) | 2.58 | 2.88 | 99659 | 108.6 | 19.15 | 13.24 |
| Paired rows(75/105 cm) | 2.74 | 3.00 | 104277 | 123.3 | 19.25 | 13.52 |
| Wide rows(150 cm) | 2.54 | 2.98 | 81658 | 96.3 | 20.01 | 13.37 |
| SE± | 0.10 | 0.03 | 2701 | 1.09 | 0.21 | 0.19 |
| CD @5% | NS | 0.09 | 7502 | 3.47 | NS | NS |
| Interaction | NS | NS | NS | NS | NS | NS |

facilitated good earthing-up to minimize lodging. Among the irrigation methods, both surface and subsurface irrigation recorded significantly higher number of millable canes with longer millable canes and higher cane diameter than the conventional furrow irrigation. Between the two methods of drip irrigation, surface drip recorded marginally higher values for the number of millable canes and cane diameter. The highest cane yield was recorded in surface drip method indicating that the method supplied adequate moisture for cane growth. The sub surface drip irrigation also gave significantly higher cane yield than the furrow irrigation. Similar results have been reported by several earlier workers (Sankpal et al. 1998; Narayanamoorthy 2001; Srivastava and Johari 1979; Saini 2007; Nair 2011; and Palanisamy et al. 2014). The interaction between planting methods and irrigation methods was not significant.

**Quality parameters**

Sucrose % and CCS% were not significantly influenced by the planting geometry as well as the irrigation methods (Table 1). Similar results were reported by Roodagi *et al.* 2001.

**Water economy**

The quantity of irrigation water applied under surface drip and sub-surface drip irrigation was only

**Table 2. Effect of irrigation methods on cane yield in plant and ratoon crops**

| Treatments | I plant (t/ha) | II plant (t/ha) | Ratoon (t/ha) | Mean yield | |
|---|---|---|---|---|---|
| | | | | t/ha | Increase over furrow method(%) |
| Conventional furrow method | 112.2 | 102.5 | 90.4 | 102.3 | — |
| Surface drip | 129.0 | 130.6 | 108.8 | 122.8 | 20.5 |
| Sub surface drip | 127.6 | 128.4 | 105.8 | 120.6 | 18.3 |

**Table 3. Effect of irrigation methods on quantity of irrigation water used (ha-cm) and water use efficiency**

| Treatments | I plant | II plant | Ratoon | Mean | Saving in irrigation water (%) | Water use efficiency (t/ha-cm) |
|---|---|---|---|---|---|---|
| Furrow method | 115.6 | 122.6 | 102.6 | 113.6 | — | 0.90 |
| Surface drip | 95.6 | 88.2 | 84.6 | 89.6 | 24 | 1.37 |
| Sub surface drip | 95.6 | 88.2 | 84.6 | 89.6 | 24 | 1.34 |

89.6 ha-cm against 113.6 ha- cm for the conventional furrow method of irrigation. Thus drip irrigation helped to save 24% of irrigation water. The water use efficiency (tonnes of cane/ha-cm of water) was 0.90 in furrow irrigation as compared to 1.37 in surface drip and 1.34 in sub surface drip irrigation indicating 52 and 49% improvement under surface and sub-surface drip respectively (Table 2 & 3). These results are in accordance with the earlier findings by Venugopal and Rajkumar (1998).

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