INCREASING WATER AND FERTILIZER USE EFFICIENCY THROUGH RAIN GUN SPRINKLER IRRIGATION IN SUGAR CANE AGRICULTURE

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ABSTRACT

Water and fertilizers are two major inputs in sugarcane productivity. The micro irrigation techniques like drip and rain gun sprinkler irrigation (RGSI) have an advantage over the surface method of irrigation to increase the water and fertilizer use efficiency. Two experiments were conducted at Vasantdada Sugar Institute, Pune during 1999 to 2006 for performance evaluation of RGSI and to optimize the dose of NPK fertilizer through RGSI for sugarcane crop. Both the experiments were conducted for one plant cane and two ratoon crops. In first experiment the performance of RGSI was studied in comparison with drip and surface irrigation. The RGSI has recorded 32 % water saving, 15 % increase in cane yield, and 1.70 times more water use efficiency as compared to surface irrigation. In second experiment the NPK fertilizer levels of 125%, 100%, 75% and 50% of recommended dose were applied through RGSI and the results were compared with 100% recommended dose of fertilizers under surface irrigation as a control. A fertilizer level of 75% has recorded 151.79 t/ha cane yield which is significantly superior to control, while 50% level has recorded 137.36 t/ha of cane yield, which is non-significant as compared to control. There was 25% NPK fertilizer saving in RGSI as compared to surface irrigation. From both the studies it is concluded that the rain gun sprinkler irrigation was effective in sugarcane crop for 32 % water saving, 25% NPK fertilizer saving, 15 % increase in cane yield, and 1.70 times more water use efficiency as compared to surface irrigation.

INTRODUCTION

Sugarcane is the most important cash crop of India occupying about two per cent cultivable area. The sustained sugarcane production depends upon efficient water management throughout the crop growth period. Large variations in cane yields are noticed in the country from year to year and place to place due to many production constraints. Timely availability of irrigation as per the need of the crop is one of the serious constraint among these. The cultivators are adopting drip and rain gun sprinkler irrigation (RGSI) techniques in sugarcane crop for increasing water and fertilizer use efficiencies. The sprinkler irrigation is an accepted method of irrigation not only in developed countries but also in the developing countries. Due to high initial investment of this system, the adoption is very slow. More than 10 M ha area is under sprinkler irrigation in the world (Sivanappan, 1998). In India there is a increasing trend for adoption of RGSI in sugarcane crop. The fertigation through micro irrigation systems is also gaining a momentum in the country, as this technique has advantage of application of fertilizers at appropriate rate and in desired concentration. This technique also provides flexibility of fertilization, which enables specific requirements of the crops to be met at different stages of its growth (Shinde *et al.* 2005).

The fertilizer losses such as leaching, volatilization and dentrification are avoided and there is a

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improvement in fertilizer use efficiency. Looking to the importance of RGSI and fertigation technology in sugarcane agriculture, the present study was under taken.

MATERIALS AND METHODS

Experiment No. 1

With a view to evaluate the performance of Rain gun sprinkler irrigation in sugarcane crop, an experiment with sugarcane variety Co 86032 was conducted at Vasantdada Sugar Institute, Pune during 1999 to 2002 for one plant cane and two ratoon crops. The treatments were as follows

T1- Rain gun sprinkler irrigation.
T2- Drip irrigation.
T3- Surface irrigation (Control).

The paired row sugarcane planting with row spacing of 0.75 x 1.50 m was used in drip and sprinkler irrigation while 1.0 x 1.0 m sugarcane planting was used in surface irrigation. The standard recommended practices of cultivation were followed throughout crop growth period.

Experiment No. 2

With a view to optimize the dose of NPK fertilizers through rain gun sprinkler irrigation for sugarcane an experiment with sugarcane variety Co 86032 was conducted at Vasantdada Sugar Institute, Pune during 2003 to 2006 for one plant and two ratoon crops in complete randomized design with four replications. The fertilizer levels were varied as as per the following treatment details as compared to 315 kg N, 140 Kg P2O5 and 140 kg K2O per ha of recommended dose.

T1-125% of recommended dose of NPK through RGSI.
T2-100% of recommended dose of NPK through RGSI.
T3 - 75 % of recommended dose of NPK through RGSI.
T4- 50% of recommended dose of NPK through RGSI.
T5 - 100% recommended dose of NPK under surface irrigation (Control).

The wider spaced sugar cane planting of 1.2 m was used for the experimentation. The NPK fertilizers were applied in the form of Urea, Diammonium phosphate and Muriate of potash. In rain gun sprinkler irrigation fertilizers were applied in four equal splits up to 4.5 months of crop age while in surface irrigation it was applied by hand application as per recommended splits. The specifications of RGSI were as follows

- Make: Premier Irrigation
- Model no.: ZNO 23 LOPS W part Circle Single Nozzle.
- Operating Pressure range: 2.8 to 3.8 Kg per sq. cm.
- Diameter of spray: 53 to 62 m.
- Discharge: 280 to 310 liters per minute.

RESULTS AND DISCUSSION

Sugarcane Yield

The cane yield of 118.5 t/ha was obtained in drip irrigation followed by 117.2 t/ha in RGSI. The surface irrigation has recorded 101.6 t/ha of cane yield (Table 1). The increase in cane yield in drip irrigation was 16.6 % while in RGSI it was 15.3 % as compared to surface irrigation.

Water aving and Water Use Efficiency

The total quantity of water applied in RGSI and drip irrigation was 1744 and 1312 mm respectively while in surface irrigation it was 2565 mm (Table1). There was water saving of 32.0 % in RGSI while 48.8 % in drip irrigation as compared to surface irrigation. The water use efficiency in RGSI and drip irrigation was 0.0672 and 0.0903 t/ha/mm respectively as against 0.0396 t/ha/mm in surface irrigation. The RGSI has recorded 1.7 times more water use efficiency as compared to surface irrigation.

Table 1. Quantity of Water Applied , Cane Yield and Water Use Efficiency
(Pooled data of one plant and two ratoon crops)

Treatment	Particulars of treatment	Quantity of water applied, mm	Cane yield, t/ha	Water use efficiency, t/ha/mm
T1	Rain gun sprinkler irrigation	1744	117.2	0.0672
T2	Drip irrigation	1312	118.5	0.0903
T3	Surface irrigation	2565	101.6	0.0396

Uniformity of Water Distribution

The uniformity of water distribution in RGSI was 75.89% while in drip irrigation it was 93.29 %. The drip irrigation was found more effective in uniform distribution of water as compared to RGSI.

Fertilizer Saving

The cane yield obtained in fertilizer levels of 125%, 100% and 75% of recommended dose of NPK through RGSI was significantly superior over control. A fertilizer level of 75% of recommended dose through RGSI has recorded 151.79 t/ha of cane yield, which is 14.80 % more as compared to control. Reducing the dose to 50% has recorded 137.30 t/ha of cane yield, which is non-significant as compared to control (Table 2). This indicates that 25% NPK fertilizers can be saved if applied through RGSI for sugarcane. These results are in conformity with those reported by Aiyanna*, et al.* (2001).

Table 2. Effect of NPK Fertilizer Levels on Cane Yield
(Pooled data of one plant and two ratoon crops)

Treatment	NPK fertilizer levels	Cane yield t/ha
T1	125% of recommended dose through RGSI	156.05*
T2	100% of recommended dose through RGSI	154.09*
T3	75% of recommended dose through RGSI	151.79*
T4	50% of recommended dose through RGSI	137.30
T5	100% recommended dose under surface irrigation (Control)	132.21
SE ±		2.47
CD at 5%		7.46

* Significantly superior over control

CONCLUSION

The data obtained in these studies shows that Rain gun sprinkler irrigation was found effective in sugarcane crop for saving of irrigation water by 32%, saving of NPK fertilizer by 25%, increase in cane yield by 15% and 1.7 times more water use efficiency compared to surface irrigation.

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