SUMMARY AND CONCLUSION
CHAPTER VI

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India and Brazil account for 50 per cent of the world’s sugarcane production. Though the productivity of India could be increased by 100 per cent, the current level is stagnant around 70 t ha\(^{-1}\). The situation in Tamil Nadu is precarious with a negative trend in area, production and productivity. The major factors attributed to the above situation are declining water availability for cultivation of sugarcane, increasing cost of inputs especially fertilisers and increasing cost of labour besides non availability. Subsurface drip irrigation in sugarcane has come as a saviour for the sugar industry through which the above issues could be addressed. Though subsurface drip irrigation may be a new concept in India, several counties have adopted the technology two decades earlier. In Hawaii, SDI was introduced and had taken off after lot of field experimentation and grown with years of experience and now a time tested technology. In India, if well designed and properly maintained and irrigation given scientifically, cane and sugar yields are bound to witness a quantum jump.

In this context, an attempt was made to evolve a judicious combination of irrigation regimes, levels of nutrients and conventional and water soluble fertilisers being supplied to the SDI.

Field investigations were carried out in the Research and Development Farm of M/s Jain Irrigation Systems Ltd., Elayamuthur, Tiruppur District of Tamil Nadu during 2009 to 2011 to optimise irrigation regimes and nutrients for higher sugarcane productivity under SDI.

The experiments were laid out in split plot design with 3 replications. The main plot treatments consisted of 3 subsurface drip irrigation regimes viz.

A. Irrigation levels
   \( I_1 \) – subsurface drip irrigation at 125 per cent of \( ET_C \) levels
   \( I_2 \) – subsurface drip irrigation at 100 per cent of \( ET_C \) levels.
   \( I_3 \) – subsurface drip irrigation at 75 per cent of \( ET_C \) levels.

B. Combinations of fertilisers at the recommended dose of nutrients (RDN), N:P:K ratio of 275:62:112.5 kg per hectare (100 percent of the recommended dose of nutrients as below.

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S₁ – 100 per cent of RDN as conventional fertilisers (CF).
S₂ – 75 per cent RDN as CF and 25 per cent as water soluble fertilisers (WSF).
S₃ - 50 per cent RDN as CF and 50 per cent as WSF.
S₄ - 25 per cent RDN as CF and 75 per cent as WSF.
S₅ - 125 per cent RDN as CF.

The conventional fertilisers used were urea, Di-ammonium phosphate and muriate of potash. The water soluble fertilisers used were potassium nitrate and polyfeed (13 : 40 : 13) besides, urea.

The important findings of experiments and the conclusions drawn out of the investigations are summarised hereunder.

- Germination of sugarcane was not influenced by the effect of the treatments.
- Irrigation at 125 per cent of ETₑ had influenced to increase tiller production.
- The interaction of treatments between irrigation at 125 per cent of ETₑ with fertigation at a higher level of 125 per cent of RDN with all conventional fertiliser (CF) recorded higher tiller production followed by irrigation at 100 per cent of ETₑ with irrigation at 100 per cent of ETₑ with 75 per cent of RDN using WSF and the balance CF.
- Use of water soluble fertiliser as per S₄ had encouraged tiller conversion till 270 days. Fertigation of 125 per cent of RDN using all CF helped to sustain the conversion of millable canes till harvest.
- Drip irrigation at 125 per cent of ETₑ along with fertigation at 125 per cent of RDN with all CF showed higher length of internodes as well as cane followed by the same irrigation regime along with RDN using 75 per cent of WSF and 25 per cent of CF.
- There was no effect of treatments on girth of cane.
- The individual cane weight was found to be positively correlated with irrigation at 125 per cent of ETₑ.
- Fertigation at 100 per cent RDN with 75 per cent WSF produced cane stalk of higher weight.
- All these factors were greatly improved due to higher leaf area indices, chlorophyll values and sheath moisture contents throughout the period of study.
• In the plots where fertigation at 125 per cent of ETc with all CF was provided, the index tissue analysis showed higher availability of iron, manganese, zinc, calcium, sodium and sulphur out of the 9 elements for which they were analysed.

• Irrigation at lower levels i.e. 75 per cent of ETc accumulated lesser micro nutrients only namely iron, zinc, copper sodium and boron.

• The quality of cane recorded superior values when irrigated at the least ETc of 75 per cent while significantly lower CCS per cent was recorded in the treatments where irrigation was given at 125 per cent of ETc.

• No significant loss of cane quality was observed due to interaction effect of the treatments. However, use of WSF at higher proportion reported the least CCS per cent from 300 days till harvest.

• Fibre being an important input for the activity of the cogeneration of sugar factory, fibre per cent was studied. S5 recorded significantly superior value of fibre in terms of per cent throughout the period of experimentation. While considering the interaction effects, I5S5 recorded higher fibre per cent.

• Cane yield was favourably influenced by irrigation at higher than 75 per cent of ETc.

• Fertigation using water soluble fertilisers (at 75 per cent and balance through CF) at 100 per cent RDN and fertigation at 125 per cent of RDN with all CF reported high cane yields.

• Irrigation at higher than 75 per cent of moisture regimes along with fertigation for 125 per cent of RDN with all CF reported high cane yields.

• The highest sugar yield was recorded in irrigation at 100 per cent ETc as well as fertigation at 125 per cent of RDN with all CF individually.

• Fibre yield is a function of cane yield and fibre per cent. Irrigation levels did not influence the fibre yield. However, fertigation at 125 per cent of RDN using all CF showed the lowest fibre yield, significantly inferior to all other treatments.

• The lowest fibre yield was also obtained in the lowest irrigation regimes with fertigation at 100 per cent RDN with all CF (I3S1).

• Uptake of N, P and K were found to be positively correlated with cane yield. Higher uptake of N was obtained in the present study.
• The partial factor productivity (PFP) of N, P and K were higher in irrigation at 75 per cent of ETc. It was also found to be significantly higher in S5. When comparing the interaction effects the best PFP was obtained in I3S4 for macro nutrient.

• Uptake of nutrients namely N, P and K have helped to improve the cane yield.

• The water use efficiency was realised to be the best in I3 where the lowest irrigation regime was maintained. With respect to fertigation treatments the best water use efficiency was obtained in S5.

• While considering the interaction effects, irrigation at 75 per cent ETc and fertigation for 125 per cent of RDN with all CF reported the best water use efficiency while the lowest water use efficiency was perceptible in I1S1 which revealed the luxury consumption of water for sugarcane.

• The cost of cultivation of sugarcane for the treatments imposed varied among themselves because of the differences in the cost and quantities of fertilisers namely conventional and water soluble fertilisers, quantity and resultant cost of water consumed as per the treatments in the experimentation and the cost of cane harvest and transportation payable in terms of tonnes of cane.

• The costs of WSF vis-a-vis CF influenced the profitability of cultivation perceptibly.

• With respect to irrigation treatments in the plant crop, the cost of cultivation per tonne of cane was the lowest (Rs.1018) in the treatment where irrigation was at 100 per cent of ETc and the highest cost of production was found in I3 (Rs.1049). In ratoon, the lowest was in I1 (Rs.1044) and the highest in I3 (Rs.1252).

• Fertigation at 125 per cent of RDN with all CF reported the lowest cost per tonne of cane. This was, however, on par with S4. While considering the interaction effect, I2S5 recorded the lowest cost of production per tonne of cane.

• Irrigation at lesser than the recommended ETc (100 per cent ETc) reported significantly lower gross profit.

• Fertigation at 125 per cent of RDN with all CF reported higher gross profits.

• Fertigation at 125 per cent of RDN with all CF and irrigation regime at 125 per cent of ETc reported the highest gross profit.
• The net profit was high in I₂ and the lowest in I₃. Reduction in net profit was due to reduced cane yield caused by maintaining lower irrigation regimes. Though maintaining irrigation regimes higher than 100 per cent of ETᵣ (I₁) recorded the highest cane yield, the net profit was reduced by the increased cost of water, cost of harvest and transport of cane.

• Fertigation at 125 per cent of RDN with all CF reported significantly higher net returns in both plant and ratoon.

• The higher yield obtained in S₄ did not make up for the increased cost of water soluble fertiliser. Therefore, net profit was lesser.

• The highest net return in interaction effect was perceived in both plant and ratoon in fertigation level of 125 per cent of RDN with all CF at 100 per cent ETᵣ and 125 per cent ETᵣ.

• I₃ though had reported the lowest cane yield, the highest cost of production per tonne of cane and the lowest net profit, offered the highest return per rupee of investment.

• The highest net return per rupee of investment with respect to interaction effect was obtained upon irrigation at 75 per cent ETᵣ with S₃, S₄ or S₅.

• The cost of cultivation for I₃S₅ was the lowest in plant. When comparing the fertigation treatments, the return per rupee of treatment was the best in S₃ where fertigation was considered at 100 per cent RDN with 50 per cent WSF.

• The best B : C ratio worked out by discounted cash flow technique was obtained in I₁, S₅ and I₁S₅. (1.42, 1.41 and 1.49 respectively in irrigation, fertigation and interaction treatments).

• The repayment period was the lowest in I₂ S₅ and I₂S₅ respectively two years and one month, one year and nine months and one year and eight months in irrigation, fertigation and interaction treatments.

• For a sugar factory in India which relies on cane production and supplies received from farmers, recommendation for high cane production will naturally be for irrigation at higher than 100 per cent of ETᵣ and fertigation at 125 per cent of RDN using all CF for ensuring higher cane supplies for the factory. This can be possible only where sufficient water is available for cultivation of sugarcane throughout the year.

• The recommendation will help to improve not only the cane supply to the
factory, but also improve the sugar recovery and fibre yield.

- If there is insufficiency of water, fertigation at 125 per cent RDN with all CF with irrigation at 75 per cent of ET<sub>C</sub> will be the next best choice of recommendation to the farmers.

- For a farmer to have the best return, it will be worthwhile to consider irrigation at higher than the recommended moisture regime (125 per cent ET<sub>C</sub>) in combination with fertigation at 125 per cent of RDN using all CF or fertigation at 100 per cent of RDN with 75 per cent of WSF and balance by CF. The choice has to be made between WSF or CF based on the water availability for irrigation for the crop cycle and the cost of these fertilisers. The price of conventional fertilisers has to be compared with that of water soluble fertiliser in relation to the present cane prices and the targeted cane yields to achieve higher net returns. If there is a heavy shortage of water for SDI, the next best choice for the farmer will be to go for WSF in combination with irrigation at 75 per cent of ET<sub>C</sub>.

**Conclusion**

Subsurface drip fertigation provides a great opportunity to farmers as well as the factory to increase cane area, production and productivity. Irrigation should not be less than 100 per cent of ET<sub>C</sub> to improve productivity. Fertigation at 125 per cent of the RDN (in the N:P:K ratio of 345:80:140 kg ha<sup>-1</sup>) increases cane yield and can be the best fertiliser recommendation for fertigation when conventional fertilisers are cheaper. When the price of conventional fertilisers are higher, use of water soluble fertilisers at 75 per cent levels and 25 per cent through conventional fertilisers at 100 of the RDN (in the N:P:K ratio of 275:62:112.5 kg ha<sup>-1</sup>) will be sufficient to get the same yield.

Irrigation at 125 per cent of the ET<sub>C</sub> has advantage over irrigation at 100 per cent of ET<sub>C</sub>. However, if there is scarcity of irrigation water, irrigation at 100 per cent of ET<sub>C</sub> with the fertiliser schedule of 125 per cent of RDN using conventional fertilisers or 100 per cent of RDN using 75 per cent of water soluble fertilisers will make up for the yield.
Future line of works

The current study has thrown open the following areas for further research.
1. Dry spells occur during the months of June and July creates a temporary period of drought. Normally this period coincides with higher crop evapotranspiration but during the same period water scarcity also prevails and compels reduction in irrigation less than the ETc values. Research to nullify this temporary drought by suitably modifying the fertiliser dose to make up for losses of cane growth and thereafter revert back to original schedule when water availability increases needs to be studied for impact on crop growth and yield.
2. Micro nutrient uptake and standardisation of micro nutrition for best yields under SDI.
3. Screening and selection of varieties suitable for mechanical harvester with high fibre and higher tillering ability for cultivation under SDI.
4. Total automation of irrigation and fertigation for precision in sugarcane cultivation under SDI.
5. Studies to advance maturity of sugarcane to facilitate harvest of crop at eight months with 80 per cent on cane yield and harvest three crops in two years.