Enhancing sugarcane yield per hectare through improved virus-free seed nursery programme

Varietal degeneration

Under Indian scenario, the serious viral diseases mosaic and YLD occur in all the sugarcane growing regions and the varieties under cultivation exhibit varying intensities of the diseases. *Sugarcane yellow leaf virus* (SCYLV) a phloem limited virus is associated with YLD, and the virus is primarily transmitted through infected setts and sugarcane aphid *Melanaphis sacchari* transmits the virus plant to plant in the field. Mosaic in sugarcane is caused by *Sugarcane mosaic virus* (SCMV) and *Sugarcane streak mosaic virus* (SCSMV) either alone or together under Indian conditions. Due to vegetative propagation these viral pathogens along with other non-fungal pathogens causing RSD and GSD gradually increase in their load in the canes over the generations. Such a high population of different pathogens inside the canes cause a decline in the performance i.e. loss in vigour of sugarcane varieties and this progressive decline in varietal performance, referred to as 'varietal degeneration'. Due to this, longevity of many elite sugarcane varieties was reduced in the past. Further, impact of these diseases was ignored in the past due to lack of precise diagnostic techniques and clarity in symptoms caused by different viral diseases in sugarcane.

Typical mid rib yellowing of leaves in the whorl in YLD affected cane

Combined infection of two or more viral/bacterial pathogens accelerates the damage to the crop in the field and this is due to infection of one pathogen which makes the plant more susceptible to another. In this way, a variety degenerates faster and its potential comes down over the years. Hence detailed studies were taken up at ICAR-SBI to assess the impact of SCYLV infection on different sugarcane varieties established that virus-infected varieties recorded significant reductions in growth/yield parameters, such as stalk height, stalk thickness and number of internodes in popular varieties. It is estimated that severe infection of the virus reduces cane yield by 30 to 50 % and juice yield by 34%. Since the loss caused by the disease is phenomenal in the field as well as in the mills, both the cane growers and millers suffer due to the disease.

Virus elimination

Of the different methods used for virus elimination, meristem tip culture is the most widely used method to eliminate the virus/phytoplasmas from the mother plants. Successful elimination of three RNA viruses infecting sugarcane SCYLV, SCMV and SCSMV and GSD phytoplasma from infected sugarcane has been established at the Institute and this cannot be guaranteed in tissue culture raised plants unless they are ensured free of the pathogens by molecular assays. At ICAR-SBI sensitive diagnostic techniques such as RT-PCR and PCR techniques were developed for the specific detection of the RNA viruses and phytoplasmas infecting sugarcane, respectively. These techniques have been applied to detect the pathogens in the tissue culture derived *in vitro* clones before rooting. Although the pathogen titre is expected to be very low, these techniques are highly sensitive to detect such low titre in young plantlets. When tissue culture derived seedlings are utilized for commercial planting without diagnosis for the designated pathogens, the process also facilitates spread of the diseases far and wide and this will have a catastrophic effect in the field on crop health. Hence production of disease-free plants through tissue culture should be indexed for the designated viruses and phytoplasmas. The Institute through Accredited test lab (ATL) for virus indexing of tissue culture raised sugarcane seedlings under NCS-TCP of DBT offered virus indexing services in the past to different sugarcane tissue culture production units across the country. Currently also, the service is being extended to various tissue culture production units in different states. By which, several hundreds of batch cultures or mother plants

Degenerated crop of the popular variety Co 86032 in the field due to severe YLD

Sugarcane seedlings raised from single bud setts of YLD-free canes

Healthy and vigorous growing Co 86032 free from YLD at the time of harvest

were indexed for sugarcane viruses / GSD phytoplasma and the labs were able to produce healthy planting materials free of these pathogens. In addition, the Institute also supplies virus indexed mother cultures of sugarcane varieties for the tissue culture production units for multiplication and production of virus-free planting materials.

Impact of virus-free planting materials on sugarcane production

The popular sugarcane variety Co 86032 is being cultivated in about one million hectares in the tropical region. The variety is in the field for nearly two decades and during the course of time it succumbed to YLD. Lack of healthy seed nursery programme led to severe degeneration in the field. Further, conventional heat therapy practiced in the sugar mills is ineffective against viral diseases. Hence we have recommended virus-free planting materials derived through tissue culture for the sugar industry to manage the disease and to achieve potential yield of the popular variety. This has been adopted in different districts of Tamil Nadu and sugar industry has realized the benefit of virus-free planting material in achieving higher yield. Since tissue culture derived plants cannot be directly planted for commercial cultivation the seedlings were used as breeder seed in the three tier seed nursery programme. Canes from this nursery were used to raise single bud settlings in protrays under shade-net and such healthy settlings were used for planting in the field either for commercial cultivation or subsequent multiplication. Large scale adoption of such nurseries in Erode and Namakkal Districts in Tamil Nadu resulted in significant jump in cane yield as compared to the conventional planting. Further, planting of these settlings under wide row has reduced seed cane requirement by one sixth of conventional planting of setts. Critical monitoring of YLD-free fields revealed that the disease-free fields always maintained a vigorous crop stand and the farmers realized an average increase of 37.5 tonnes/ha in cane yield in the region. Recently a farmer who planted the popular variety Co 86032 free from YLD recorded an yield of 250 tonnes/ha cane yield at Vellode village in Erode Dtwhich is more than 100% of the state average in cane productivity. This has amply demonstrated that achieving the potential yield of 250 t/ha is very much possible through improved nursery programme and this also helps to maintain varietal vigour in the field. Since the variety is cultivated in about one million ha in different states by large-scale adoption of the nursery programme would increase cane production to the tune of nearly 37.5 million tonnes in the same land area in the region. Ultimately this approach would increase land productivity, increase in farmer's income and sustaining sugarcane productivity.

Virus-free canes of Co 86032 show robust growth of more than 2 kg single cane weight at the time of harvest

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