

## SUMMARY

Sweet sorghum (*Sorghum bicolor* (L.) Moench) belongs to the same species as grain sorghum and is characterised by tall stems with sweet juice. In Botswana, sweet sorghum is grown mainly for its sweet stems which are chewed as a snack. It is commonly grown by small scale farmers in mixtures of crops. Recently the crop has attracted interest as a potential cash crop and growers are faced with problems of poor crop establishment, poor stem quality and low concentrations of sucrose in the juice. The aim of this study was to investigate factors that can be utilized to improve crop yields and sucrose content. This was achieved through the following:

1. Collection of seed from small scale farmers to determine germination capacity
2. Study the effect of harvesting sweet sorghum seed before physiological maturation
3. Characterisation of collected germplasm
4. Investigation of deheading and tiller removal on juice quality
5. Study the effect of planting date, nitrogen and spacing on the stem yield and juice quality

Sixty five landraces of sweet sorghum were collected and the seed quality determined by using the standard germination and the Accelerated Ageing (AA) test. The standard germination test results showed that 61% of the accessions had a germination percentage in excess of 85%, while the AA test showed that only 20% of the accessions had a germination percentage of above 80%. These results showed that seed quality of sweet sorghum seed in Botswana was generally of a low standard. Low seed quality may be the result of harvesting seed before physiological maturity, drying and threshing seed under unfavourable ambient temperatures and poor storage facilities.

Effects of harvesting seed before physiological maturity on seed development and maturation in sweet sorghum were studied. Seed attained mass maturity 31 days after anthesis (DAA) and 38 DAA in the case of grain sorghum. Maximum seed quality occurred 14 days after mass maturity in sweet sorghum whilst in grain sorghum it occurred 7 days after mass maturity. This coincided with maximum seed germination in sweet sorghum. These results indicate that harvesting before physiological maturity may lower seed quality.

Ten out of the sixty-five landraces, ranging from early to late maturing landraces were characterised. Differences in the morphology of vegetative and reproductive structures, as well as differences in phenology were documented. The late maturing landraces had better juice quality than the early types, with high brix values and high sucrose content. From these results it was evident that there was a range of genetic diversity in Botswana sweet sorghum landraces which can be utilised in future for improvement of yields and quality through breeding and selection programmes.

The effects of panicle, floret and tiller removal on the juice quality of sweet sorghum were investigated. Reduction in the number of developing seeds in the inflorescence improved juice quality. Deheaded plants were significantly higher in brix value, juice purity and sucrose (pol percentage). Early deheading (boot stage) produced higher brix and sucrose (pol percentage) than late deheading (flowering and milk stages). Removal of tillers did not result in significant differences in juice quality and stem mass of the main stems. Establishing whether male sterile varieties may be sweeter and juicier than male fertile varieties is justified. Another alternative would be to breed and select for plants with small panicles and

reduced tillering to benefit stem size and quality. This does not exclude possibilities of investigating chemically induced barenness.

Early planting in October resulted in higher stem yields, more tillers and taller plants than late planting in November and December. These results suggest that increase in stem yield per plant in sweet sorghum may be expected when the planting date is advanced as close as possible to the onset of the rains because this gives a longer growing season. Late planting resulted in the highest pol percentage, juice purity and stalk fibre. Brix value was not affected by planting date. Although stem appearance is more important in sales of stems, the negative relationship between stem yield and juice quality requires more research in order to optimise yield and quality.

Nitrogen increased stem yields and improved juice quality. However, for small scale farmers in Botswana fertilisation with readily available organic manures (kraal, poultry) may be preferred and this needs to be assessed in on-farm demonstration trials. Sweet sorghum is an agronomically viable cash crop for small scale farmers in Botswana. However, price elasticity in the supply demand functions will determine the economic viability of this crop.