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Optimisation of regeneration systems for a range of Cassava (Manihot Esculenta Crantz) cultivars suitable for growth in South Africa and transformation with SACMV N-REP gene

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Chapter 6

GENERAL CONCLUSIONS

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Plant virus diseases, including CMD continue to cause severe constraints on the productivity of a wide range of economically important crops worldwide. The application of genetic transformation for increased resistance to cassava begomoviruses is a major priority. In SA, cassava production interest has grown astronomically with CSM taking the lead in Dendron, Limpopo Province. CSM is a privately owned commercial company that belongs to Mr Jim Casey. The company has dedicated more that 2000ha of land to cassava production. In addition, CSM has contracted small-scale farmers to produce the crop for processing purposes. The main markets for the starch are food, textile, paper, corrugated cardboard and mining industries in SA. There are plans to establish a second factory in the Nkomazi district of Mpumalanga Province also using contracted farmers.

Strategies for the management of viral diseases normally include control of vector population using insecticides, use of virus-free propagating material, appropriate cultural practices and use of resistant cultivars. Currently in SA, Agricultural Research Council (ARC) is actively involved in carrying out breeding work aimed at producing new cultivars for household income. However, cassava is notoriously difficult to breed using conventional methods due to low seed set and a phenology that is highly influenced by the environment thus affecting its time to flower. In addition, cassava suffers from inbreeding depression and therefore requires a high degree of heterozygosity.

In order to achieve general objectives of improvement cassava germplasm, this study successfully developed a method to infect cassava and

tobacco with SACMV dimers A and B using biolistics. This method is currently being used in our laboratory to infect various crops with SACMV in order to screen for resistance. This study also conclude that SACMV symptoms have visual similarity to EACMV but no early recovery after SACMV infection as opposed to other geminiviruses. We believe that biolistic inoculation of SACMV dimers infectious to cassava will save time by quickly being able to screen for SACMV resistance without having to rely on whitefly inoculation.

Somatic embryogenesis from young leaves and meristems remains the only system at present that shows potential for transformation and regeneration of cassava plants. Locally grown SA cassava cultivars have never been tested for their transformation and regeneration capabilities before. As a result this study successfully screened four local South African cultivars for genetic capability to induce embryogenic tissue namely; T200, T400, P4-4 and P4-10. This part of work was aimed at optimizing conditions for generating embryogenic structures in different southern African cassava cultivars if effective transformation systems are to be established for the crop. SA cv. T200 has proven to have optimum capability with T400 having poor capability in OES production. This developed capability to produce OES from selected southern African cassava cultivars has now been transferred to fellow scientists in our laboratory. Further cultivars with high starch, high protein and those with high yields need to be selected for screening their potential to generate OES. This current study also succeeded in establishing a transformation system for transfer of SACMV N-Rep gene into tobacco and cassava FEC tissues. Further studies are continuing in our laboratory wherein improved various developed SACMV

constructs are being transformed into cassava using more infectious *Agrobacterium* strains obtained from CIAT.

In South Africa, cassava transformation capability is still underdeveloped amid a concern about declining cassava yields due to infection by begomoviruses. In order for the cassava farmers to benefit from cassava biotechnology advances already achieved by well established overseas laboratories, e.g. ILTAB, Wageningen University, ETH and CIAT, there has to be a strong technology transfer programme that will support local scientists in the transfer of already existing cassava transformation systems. Although these results have made a contribution, it is strongly recommended that effective partnerships with the Cassava Advanced Transformation Group be maintained. Our country is also good to test for efficacy of transgenic cassava as issues concerning Intellectual property rights (IPR) and biosafety implications are already legislated and in place. These issues can be a bottleneck in many African countries as recently experienced by ILTAB while trying to deploy a field test on their cassava replicase transgenic event. For African farmers to benefit from this technology, the already mentioned laboratories must start forming meaningful collaborations with identified African laboratories to establish a critical mass of scientists and deployment of transgenics in the farmer's fields.

Our laboratory continues to enjoy close cooperation with ILTAB and CIAT in order to ensure that full potential and capability in cassava biotechnology rest in the hands of southern African scientists.