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Competitive Project #9: Development of low-cost technologies for pyramiding useful genes from wild relatives of cassava into elite progenitors

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Mid-year report

1. *Delayed Post Harvest Deterioration (PPD)*

Three backcross populations (BC_1), from controlled crossing of the PPD resistant genotype CW 429-1 to two elite genotypes (MTAI 8 and SM 909-25) and open pollination, were developed to identify molecular markers associated with delayed PPD for efficient transfer into cassava gene pools. The BC_1 populations were established *in vitro* from embryo axes, micro-propagated, and 4-10 plants per genotype established in the field. The BC_1 populations were harvested in March 2007 and evaluated for PPD at the 7th and 14th day after harvest.

In the BC_1 family B1PD280, derived from open-pollinated (OP) seeds from CW429-1, 23% of individuals showed delayed PPD trait at 14 days after harvest (DAH). In the BC_1 families B1PD 284, cross of CW 429-1 and MTAI 8, and B1PD289, cross of CW 429-1 and SM 909-25, 14.3% and 5.8% respectively of genotypes revealed resistance to PPD. Frequency distributions of delayed PPD in these families are shown in Appendix 1 and 2. The evaluations will be repeated for a second year in a replicated trial of 8 plants per plot and 3 replications.

BC1 genotypes with delayed PPD were selected and crossed with CMD resistant genotypes to combine the two traits and thus facilitate the testing and use of PPD delayed lines in breeding programmes by NARs partners in Africa. Currently a total of about 6000 crosses have been made and fruits are being harvested for embryo rescue to facilitate shipping of *in vitro* plants to project partners.

2. *Cassava Green mites (CGM)*

Good levels of resistance to CGM have been found in ***M. esculenta sub spp flabellifolia*** and its inter-specific hybrids. Crosses have been made to identify markers for the trait and to transfer CGM resistance to cassava. Higher levels have been reported in other wild *Manihot* species and a study was conducted to assess resistance. Field evaluations were carried out for several crop cycles (3 or more years) and genotypes that consistently showed a low damage rating were selected for further study under controlled conditions. Cassava leaves taken off plants in the screen house were placed on water-saturated cotton in plastic petri-dishes and one female mite (***M. tanajoa***) placed on each leaf lobe. There were 30 repetitions for each genotype.

Female mites are allowed to feed and oviposit for three days (72 hours) on the selected genotypes and the number of eggs oviposited counted and compared with oviposition on the susceptible control (CMC-40).Ten separate experiments involving 35 genotypes from inter-specific crosses and 8 wild *Manihot*

species were carried out. The inter-specific hybrids CW 235-72, CW 257-10 and CW 259-43 from *M. esculenta sub spp flabellifolia* showed a reduction of 51 to 49% in oviposition compared to the susceptible check, CMC-40 (Annex 5). Evaluation of several wild *Manihot* species revealed reduction in oviposiition of 45-69% (Appendix 5-9).

3. *Whiteflies*

Recent studies indicate that high levels of whitefly (*A. socialis*) resistance may exist in accessions of wild *Manihot* species such as *M. esculenta sub spp flabellifolia*. Genetic mapping of resistance to whiteflies is ongoing; another study to evaluate additional accessions of *M. esculenta sub spp flabellifolia* namely: MFla 61, MFla 52, MFla 33, MFla 19, MFla 21, MFla 25, MFla 75, MFla 15 for the ovipositional preference (or non-preference) of *A. socialis* together with the commercial control CMC-40 was conducted. Field and screen house plants were evaluated for free choice and non-free choice of ovipositional preference with adult whiteflies obtained from the CIAT colony. In general *M. esculenta sub spp flabellifolia* accessions had very low population levels (1.5 to 2.0 on a 1 to 6 scale). Leaf damage symptoms were absent (1.0 on a 1 to 6 scale). Previous studies have shown that whitefly oviposition is a reliable indication of resistance/susceptibility in cassava accessions. Results of free choice oviposition tests and non-free choice oviposition tests are presented in Appendix 3 and 4 respectively.

4. *Neo-tropical germplasm resistant to cassava mosaic disease (CMD) for Africa*

Improved Neo-tropical cassava germplasm bred for resistance to CMD at CIAT have been introduced to project partners in Nigeria (NRCRI), Ghana (CRI), and Uganda (NARO) and are in different stages of evaluation. A new set of 507 genotypes bred for resistance to CMD and for high protein/beta carotene content at CIAT is being prepared for introduction into Nigeria as tissue culture plantlets. The introductions will be evaluated for the target nutritional traits at NRCRI and in selected sites representative of the agro-ecologies where cassava is grown. Selections amongst the introductions with the desired traits will be sent for on-farm trials and to a crossing block for crosses to local Nigerian varieties to deploy widely the high protein and beta-carotene traits. Non-selected genotypes will be transferred to the regular breeding scheme.

Tangible outputs delivered

- The delayed PPD trait reported in a wild *Manihot* species and confirmed in a F1 progeny has been recovered in BC_1 derivatives
- Three BC_1 families evaluated for delayed PPD at 7 and 14 days after planting showed between 5 and 23% of genotypes resistant to PPD
- Several BC_1 genotypes showing excellent delayed PPD have been crossed to CMD resistant lines to generate BC_2 progenies and seeds are being harvested in preparation for establishment in vitro and shipment to partners in Africa
- Evaluation of several wild *Manihot* species and inter-specific hybrids for resistance to cassava green mites revealed reduction in oviposition of between 45 and 69%
- Discovery of high levels of resistance to whiteflies in several accessions of *M. esculenta sub spp flabellifolia* suggesting the trait is widely spread in the wild species gene pool
- Development of a new set of CMD resistant materials with enhanced nutritional quality for shipment to partners in Africa

Deviations from the workplan

There have been no deviations from the Workplan during this period of the project

Data availability

Data sets produced in the last six months include:

- PPD evaluations of BC_1 families at 7 and 14 days after planting
- Genetic crossed between PPD resistant BC_1 genotypes and CMD resistant parental lines

- Field and screen house evaluations from cassava green mites and whiteflies in many wild *Manihot* species and inter-specific hybrids

This data is being prepared at CIAT for submission to the GCP database.

Competitive Project #12: Drought tolerant rice cultivars for North China and South/Southeast Asia by highly efficient pyramiding of QTLs from diverse origins

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Mid-year report

1. Research activities and progresses at ICS of CAAS and Chinese collaborators

A total of 197 DT pyramiding lines derived from 7 DT pyramiding populations were progeny tested under stress and non-stress conditions during the dryseason of the of 2006-2007 in the Hainan province. Genotyping on these pyramiding DT lines were conducted with 53-111 differentiating SSR markers. Based on the analysis on genotype of 2 DT pyramiding crosses, a total of 22 DT QTLs from CDR22 and Yue-Xiang-Zhan, and 30 from Zhong413 and Teqing were pyramiding into C418. The progeny testing showed that a small portion of the pyramiding lines performed better than the parental DT ILs under drought. The detail analysis on genotype and phenotype data is in progress.

Table 1. Progeny test and genotyping for DT pyramiding lines derived from 7 crosses between DT introgression lines from different BC populations

Cross	Recipient	Donor for IL1 (female parent)	Donor for IL2 (male parent)	Individuals selected	No. of polymorphic SSR markers for genotyping
051F15	C418	Yue-Xiang-Zhan	C71	9	53
051F26	C418	Zhong413	Teqing	34	91
051F28	C418	CDR22	Yue-Xiang-Zhan	32	56
051F43	C418	Nipponbare	Yue-Xiang-Zhan	22	60
051F53	C418	Teqing	Yue-Xiang-Zhan	13	64
051F58	C418	Teqing	Q5	31	111
051F65	C418	Yue-Xiang-Zhan	Teqing	56	79