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AVOCADO BREEDING: A PROGRESS REPORT

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ABSTRACT

The new breeding programme was initiated in 1991 after a visit of Dr Du Plooy to California. This new breeding programme consists of two parts namely rootstock breeding and scion breeding. Both of these programmes are based on the establishment of a genesource, introduction of promising overseas materials, self-pollination, cross pollination and poly-cross nurseries. Satisfactory progress was made since the strategy for the new breeding programme was announced. This progress is discussed in the various sections that were mentioned.

INTRODUCTION

The new breeding strategy was introduced at the Institute for Tropical and Subtropical Crops (ITSC) of the Agricultural Research Council (ARC) after a visit of Dr Du Plooy, to California in 1991. This strategy and the necessity for a local breeding programme on avocado were discussed in detail by Du Plooy, Marais & Sippel (1992). In short, this strategy is based on an extensive introduction programme, the consolidation and reestablishment of the genesource, open, self and cross pollination followed by a Phase I, Phase II and Phase III evaluation. The progress will be discussed under these headings.

INTRODUCTION PROGRAMME

Before this new strategy was implemented, two trees of each of the imported cultivars and selections were planted at Nelspruit, Levubu and Burgershall. These introductions are listed in Table 1. The new strategy implies that introductions in the future will immediately be incorporated in a Phase II evaluation programme as it is more time and cost effective. The existing orchards at Nelspruit and Levubu will be kept for the time being and will be called introduction orchards. Seeing that the planting at Burgershall is a replication of the planting at Levubu and to save on costs, it was decided to keep only the best of the two, namely the orchard at Levubu. As soon as the trees at Levubu come into production, it will be evaluated and the best selections will then be utilized in the breeding programme.

The introduction orchard (C4) at Nelspruit, which was planted in 1983, was already evaluated for two consecutive years (1991 & 1992). This orchard will however be consolidated as the rootstocks that were used were Edranol seedlings which lead to deterioration of the trees because of *Phytophthora cinnamomi* as well as to great

variation. New trees grafted on clonal Duke 7, will thus be established in the field within six months. Promising cultivars and selections from this orchard have however been identified and utilized in the pollination programme.

Recently imported cultivars and selections from California are listed in Table 2. The selections marked with an asterisk have already been released from quarantine and are now being multiplied for inclusion in the Phase II evaluation programme. In November 1992 these introductions were amplified, after a visit to Profs. Bergh and Gray Martin, with another six selections, namely: BL122, 329-5, 10-58, S16, 4601, 4602, 4603 and 4604, all of which will be included in the Phase II evaluation programme during 1993.

GENESOURCE

The old genesource orchard (D4) was planted around 1970 and is thus outdated, as well as in a bad condition, because of *P. cinnamomi.* This orchard was also evaluated for two consecutive years (1991 & 1992). The best material from this orchard, as well as those from orchard C4 were identified for re-establishment of the genesource along with other important cultivars from various sources. The cultivars that are included in the new genesource are listed in Table 3. Most of the trees have been made and it is expected to be planted during 1993 in orchard J9 at Nelspruit.

TABLE 1 Avocado cultivars and selections in the introduction orchards of the ITSC.

INTRODUCTION ORCHARD:	**NELSPRUIT (1983)**	
NA 526	NA 66	GWEN
H222	#86	HX 48
H287	TX 531	G755B
H670	T 142	BARR DUKE
H709	DUKE	WHITSELL
PT 37	DUKE 9	G755A
HAYES	ESTER	
INTRODUCTION ORCHARD:	**LEVUBU & BURGERSHALL (1987)**	
BALBOA	J241	NUMIHO 70
BORCHARD	LYON	NUMIHO 111
H670	LOHNEISS HASS	TORO CANYON
HX204	NABAL/NR	P-3
HILCOA 5 (HASS)	PT 37	P-6
HAZZARD	THOMAS	REED
IRVINE 388	OA 184	4-GEN HASS
IRVINE 392	NA 37	NN63
IRVINE 399	NA 565	P-PARENT
IRVINE 413	NDLC	COLIN V-33
IRVINE 414	NN 10	

TABLE 2 Recently imported avocado cultivars and selections available for Phase 11 evaluation.

INTRODUCTIONS STILL IN QUARANTINE:		
COLIN V-101	M1	* STEWARD
CRIOLO (O)	P-I	* T 205
143 PLS	RINCOATI	* WB 200
148 PLS	* I 373	* GORDO
XX3	* L 137	* BL 149
96PJ	* L 35	* BL 135
119	* REGAL R	BL 122
M2160 PFI	* NA 37	BL 5-552

TABLE 3 Cultivars for inclusion in the new consolidated genesource at Nelspruit in orchard J9.

ALLBOYCE	ESTER	JOVO	SHARWIL
BENIK	FERDYN	KARIKA	SCOTLAND
BACON	FUERTE	LATA	STEWARD
BALBOA	GWEN	LINDA	TAFT
BARR DUKE	GORDO	LULA	TEAGUE
BENEDICT	G22	MAYAPAN	THOMPSON
BORCHARD	G6	MAC ARTHUR	TOPA TOPA
CANADA	G755A	MEKSICOLA	TORO CANYON
COLLINSON	G755B	McDONALD	THOMAS
DICKY-A	G755C	MURIETTA GREEN	WHITSELL
DUKE	HASS	PUEBLA	WURTZ
DUKE 6	HORSHIM	POLLOCK	YON
DUKE 7	HAYES	QUEEN	ZUTANO
DUKE 9	HAZZARD	RYAN	
ETTINGER	ITZAMNA	RINCON	
EDRANOL	JALNA		

POLLINATION PROGRAMME AND PHASE I EVALUATION

a) Scion breeding

As there were no organized breeding strategies in the past, the only existing seedlings to be evaluated in Phase I are 200 seedlings of open pollinated sources. These trees are located at the Burgershall experimental farm and were planted in 1987. After girdling of these trees in 1991, some of the trees bore fruit that could be evaluated. This was done according to the Phase I evaluation form and six selections were identified: one each of Ettinger and Wurtz and two each of Edranol and Hass. Two of these

selections are already incorporated in the Phase II evaluation programme and the other four will be included during 1993. This small planting of 200 trees have already shown a great degree of variation and promising characteristics and this emphasises the potential of a well documented breeding programme.

During the past season pollination efforts were concentrated on open pollination and self-pollination. In Table 4 a report is given on the seed collected in 1991 from open pollinated sources and in Table 5 the situation for 1992 is given. The success rate of self pollination was not very satisfactory as can be seen in Table 6. This most probably has to do with the synchronized dichogamy nature of the avocado flower. However, other factors could also have been involved. The self-pollination programme will be continued and the problems in connection with this mode of pollination will be investigated and rectified.

For the cross pollination programme trees have already been made to be replanted in large pots and to be used as cross pollinators. Poly-cross nurseries will also be established during 1993. Trees made to be planted in pots are listed in Table 7.

b) Rootstock breeding

In Fig. 1 the rootstock selection programme is outlined. This past season only seed from open pollinated trees were collected. A total of 6000 seedlings were obtained from cultivars that are known to be tolerant to *P. Cinnamomi.* These seedlings were planted in containers that were flooded suspension of *P. cinnamomi.* The results of this elimination process are given in Table 8. The next step, as can be seen in Fig. 1, is the clonal propagation of the selected 105 plants in order to do a further *in vitro* screening on the roots of these selections. After this second screening the best selections will be grafted with Hass for the final screening. During this whole screening process, Duke 7 will be used as the control. Only selections that are better than Duke 7 will be kept. The selections that pass the last screening successfully will be incorporated in a field test and at the same time in a Phase II evaluation.

PHASE II EVALUATION PROGRAMME

This part of the breeding programme is also active and the first trees will be planted in March 1993 at Burgershall and Levubu.

TABLE 4 Number and source of open pollinated seed collected in 1991 and the number of seedlings that have been planted from these collections.

CULTIVAR/SELECTION	SEED	SEEDLINGS	PLANTED
H709	90	53	53
H222	6	3	3
GWEN	151	132	128
#86	154	129	129
H287	8	4	4
T142	13	6	5
PT37	78	53	53
Tx531	43	31	31
TOTAL	543	411	406

a) Scion evaluation

This evaluation consists of 10 scions and each of these is grafted on three different rootstocks, namely Duke 7, Thomas and Barr-Duke. The 10 scions that are included are Hass, Pinkerton, Ryan, Gwen, 87-7-1 (Wurtz Phase I seedling), 87-17-1 (Edranol Phase I seedling) and four selections of Fuerte. In the next season more cultivars and selections will be included in the programme. These will include some of the introductions listed in Table 2.

b) Rootstock evaluation

This evaluation consists of five rootstocks that will each be grafted with three standard scions namely Fuerte, Hass and Ryan. The rootstocks that are currently included are Thomas, Duke 7, G6, Duke 9 and Martin Grande (G775 A/B/C). This rootstock evaluation programme will be supplemented from the rootstock breeding programme as were shown in Fig. 1. The introductions in Table 2 and the dwarfing rootstocks that will be imported during 1993 will also be included in this evaluation programme.

CULTIVAR IDENTIFICATION METHODS

A database for the identification of different avocado cultivars by means of isoenzymes will be completed in the coming season. A new technology namely RAPD's is already put to use to group existing cultivars in an effort to find markers for specific characteristics such as resistance to *Phytophthora.*

TABLE 5 Number and source of open pollinated seed collected in 1992 and seedlings grown from these collections.

CULTIVAR/ SELECTION	SEED	SEEDLINGS
WHITSEL	100	100
#86	40	35
GWEN	107	104
PT37	150	145
H670	80	78
H709	42	9
Tx531	100	75
H222	100	44
EDRANOL	100	97
FUERTE	150	110
WURTZ	200	165
ETTINGER	200	159
HASS	400	400
PINKERTON	250	193
HASS (E4)	174	174
VAN WYK	12	12
DAVID	3	3
TOTAL	2208	1903

TABLE 6 Number and source of self-pollinated seed collected in 1992 and seedlings grown from the collections.

CULTIVAR/ SELECTION	SEED	SEEDLINGS
H287	7	5
T142	9	5
Hx48	49	17
TOTAL	65	27

CONCLUSION:

The necessity and implementation of a local breeding programme for avocados in South Africa can not be over emphasized. The reasons for this were outlined on various occasions. The Institute already has most of the promising material from other breeding programmes available and with the infrastructure and knowledge that are available at the ITSC, satisfactory progress has been made since the new breeding programme was implemented in 1991.

Since 1991 a total of 2336 seedlings have been planted for a Phase I scion evaluation of which 27 were self-pollinated. From the existing 200 seedlings, six have already been identified as promising. With the breeding for *Phytophthora* resistant rootstocks in view, a total of 6000 seedlings were screened and a 100 promising selections were made. The rate of success of this breeding programme increased from 1991 to 1992 and it is predicted that this trend will be maintained.

With this success in mind it could safely be said that with a continuous breeding programme backed by a team of breeders, the local breeding programme could well be rated the best in the world within a very short time.

REFERENCES

DUPLOOY, C.P., MARAIS, ZELDA & SIPPEL, A.D. 1992. Breeding and evaluation strategy on Avocado. *South African Avocado Growers' Association Yearbook* 15: 75 - 77.