PROGRESS IN DEVELOPING COFFEE BERRY DISEASE (*Colletotrichum kahawae*) RESISTANT COMPACT HYBRID VARIETIES (*Coffea arabica*) IN TANZANIA

MTENGA, Damian J.; KILAMBO, Deusdedit L.; TERI, James M.; MASUMBUKO, L.;

Tanzania Coffee Research Institute (TaCRI) P.O.BOX 3004 MOSHI, TANZANIA
E-mail: tacriced@kicheko.com Fax no: +255 27 2756773

Summary

A crossing programme to develop compact-dwarf varieties was initiated in 2003/04 whereby 32 Colombian (dwarf) and 61 tall hybrid lines were involved. Lines involved in the crossing programme are good sources of coffee berry disease (CBD) and coffee leaf rust (CLR) resistance. A total of 67 compact hybrid lines were developed. Out of 67, 15 lines considered as the best crosses were subjected to CBD Pre-selection test at hypocotyls stage to study inheritance of resistance. VC 298, VC 506 and HdT 1593 (CBD resistant candidate), and N 39 and KP 423 (CBD susceptible varieties) were included as check varieties. Results show that Disease Intensity Reaction (DIR) of hybrid compact lines ranged from 0.0 to 3.5. Line with DIR < 25 is considered to be CBD resistant candidate. Resistance inherited appears to be controlled by VC 298, VC 506, HdT 1593 from tall hybrid lines, and Colombian 086, 088, 089 and 090 lines used as female parents. The resistance of these compact lines will be qualified with CBD attached berry test at fruit bearing stage.

Introduction

Since 1880s tall coffee varieties have been the most popular planted by growers in Tanzania (Robinson, 1964). The varieties; N 39, KP 423 and H 66 produce fine coffees and are preferred by buyers and roasters, but are highly susceptible to anthracnose of green berries (CBD) caused by *Colletotrichum kahawae* Waller & Bridge and CLR incited by *Hemileia vastatrix* Berk et Br. In addition, for easy management tall varieties are trained as single or double stem capped. But the system results in excessive production of shoots, increasing turns of handling and pruning and therefore labour costs. Experience from other countries shows that compact varieties assist in easy management, and can accommodate 2.5 more plants per unit area than tall varieties (Njoroge, 1991; van der Vossen and Walyaro, 1981). Njoroge (1991) also revealed that compact-dwarf varieties have 3 times economic benefits compared to conventional varieties.

Accordingly, TaCRI initiated hybridization programme to breed new varieties of Arabica coffee that combined resistance to CBD and CLR with improved yield and quality, and more compact to suit close-spaced plantings. This report covers the progress made so far in getting compact varieties for the benefits of farmers in Tanzania.

Materials and methods

Parentage

Parents involved as tall varieties in the crossing programme represents a composite of hybrids already indicated resistance to CBD and CLR (Kilambo and Swai, 1998; 1999).

The hybrids involves combinations of N 39, KP 423, SL 28 and SL 34 to impart attributes of flavour and yield (Millot, 1969); and VC 298, VC 506 and HdT 1593 to impart genes for CBD resistance (van der Vossen and Walyaro, 1980). These were used as male parents. Summary of characteristics of Colombian lines accumulated from 2001 to 2003 before initiation of the crossing programme in 2004 are presented in Table 1. They were used as female parents to impart compactness; thick and strong laterals, internodes on both main stem and laterals very short.

Crossing

Technique used for emasculation was that developed by Krug (1935) of removing the petals. Branches of emasculated flowers (in this case Colombian lines) were pollinated by tall hybrid lines then enclosed in muslin sleeves supported on a frame of wire. Fruits were then harvested, seeds processed eventually sown.

CBD test

Hypocotyls (5-6 weeks) were sprayed inoculated twice at 48 hrs intervals with suspension of *C. kahawae* at 2.0 x 10^6 spores/ml using the method by van der Vossen *et al.* 1976. To allow infection a temperature of about 22 – 24^0C was required during the first four days, and R.H in the boxes maintained at 100 %, followed by an incubation period of three weeks at 19 – 20 ^{0}C. Coffee seedlings were individually scored for CBD symptoms developed on the hypocotyls stem using a scale with a range of 0 – 4 developed by van der Graff (1981).

Data analysis

For each genotype DIR was determined by counting number of hypocotyls in disease description multiplied by numerical value of disease description divide by number of hypocotyls in all descriptions multiplied by 4. Four is a factor of categories: Resistance (DIR 0 – 25), Moderately Resistance (DIR 26 – 50), Moderately Susceptible (DIR 51 – 75) and Susceptible (DIR 76 – 100).

Results and discussion

Although the hybrids are still at seedling stage, leaves shows typical characteristics of compact type of varieties. They are broad and fairly large and darkish green, thick and leathery when mature; a typical characteristic for leaves of compact varieties (Njoroge, 1991). Their genetic heterogeneity is of considerable advantage as it is expected to confer stability of resistance with regard to protection against diseases but also imparts hybrid vigour and improves on the liquor quality. This is possible because tall lines selections involving multiple crosses of VC 298 and or VC 506 and or HdT 1593 were back-crossed to N 39 and or KP 423 and or SL 28 and or SL 34 (Ndondi and Nyange, 1990). The lines are expected to be highly resistant to CBD because the population contains genotypes carrying different combinations of disease resistance genes from VC 298, VC 506, HdT 1593 (Millot, 1969) and Colombian varieties (containing HdT 1343) (van der Vossen, 2005). A high level of rust resistance is derived from HdTs and Colombian varieties. CBD hypocotyls test revealed DIR scores between 0.0 and 3.5, indicating high level of resistance (Table, 2). These seedlings will be established in clonal mother garden to produce true to type seedlings for on-station, multi-locational and on-farm trials establishment to confirm their resistance to CBD and CLR, compact characteristics, yield potential and liquor quality attributes.

References

Kilambo, D. L. and Swai, F. B. (1998) Coffee Pathology Progress Report. Presented during the National Coffee Research Coordinating Committee Meeting, at Selian Agricultural Research Institute Arusha, February 1998. Lyamungu miscellaneous reports.

Kilambo, D. L. and Swai, F. B. (1999) Coffee Pathology Progress Report. Presented during the National Coffee Research Coordinating Committee Meeting, at Uhuru Hostel Moshi, February 1999. Lyamungu miscellaneous reports.

Krug, C. A. (1935) Hybridization of coffee. Journal of Hered. 26: 325 – 330.

Millot, F. (1969) An Inventory of the coffee varieties and selections imported into and growing within East Africa. Records of previous selections and breeding work. Kawanda Agricultural Research Station miscellaneous reports.

Ndondi, R. V. and Nyange, N. E. (1990) A review of coffee breeding programme; Lyamungu Research Institute. An occasional publication presented to the Coffee Coordinating Committee Meeting held in Moshi at Kahawa House.

Njoroge, J. M. (1991) Management of Hybrid Ruiru II Arabica coffee-A review. In Kenya Coffee Volume 56 no 652 February 1991.

Robinson, J. B. D. (1964) A handbook on Arabica coffee in Tanganyika. Tanganyika Coffee Board.

Van der Graaff (1981) Selection of Arabica coffee types resistant to coffee berry disease in Ethiopia. Mgen Landbouwhogeschool. Wageningen 110 pp.

Van der Vossen, H. A. M. (2005) Report on coffee advisory mission to TaCRI, Lyamungu, Tanzania. UM Project 33166 MTZ.

Van der Vossen, H. A. M and Walyaro, D. J. (1981) The coffee breeding programme in Kenya: A review of progress made since 1971 and Plan of action for the coming years. Kenya coffee, 46 (541):113 – 130.

Van der Vossen, H. A. M. and Walyaro, D. J. (1980) Breeding for resistance to coffee berry disease in coffee Arabica L. II Inheritance of the resistance. Euphytica 29: 777 – 791.

Van der Vossen, H. A. M. and Cook, R. T. A and Mukaku, G. N. W (1976) Breeding for the resistance to coffee berry disease caused by *Colletotrichum coffeanum* in coffee Arabica. Euphytica 25: 733 – 745.

Table 1: Summary of characteristics of Colombian lines; CBD and CLR, and liquor scores 2001 – 2003.

S/ no	Line	Details of the line	Mean % CBD incidence (Semi Detached Berry)	Mean % CLR incidence (Field assessment)	Mean cupping taste results
1	PNI 086 10/5	Cattura x HdT 1343/219 F_{5-6}	0.0	0.0	6
2	PNI 088 10/2	Cattura x HdT 1343/219 F_{5-6}	0.0	0.0	6
3	PNI 089 208/16	Cattura x HdT 1343/219 F_{5-6}	2.3	0.0	5
4	PNI 090 2/10	Cattura x HdT 1343/219 F_{5-6}	0.0	0.0	5
5	HdT 1593		0.8	0.0	NA
6	VC 298		0.0	0.0	NA

7	VC 506		0.0	0.0	NA
8	KP 423		87.3	85.0	5
9	N 39		90.4	97.2	4
Mean SE ±			20.0 12.99	20.24 13.42	5 0.30

Key: Beverage quality: 2 = Good; 3 = Fair to Good; 4 = Fully Fair; 5 = Fair Average Quality (FAQ); 6 = About Fair; 7 = Poor to Fair; 8 = Poor.
CBD incidence: < 5 % Resistance; > 75 % Susceptible. CLR incidence: < 5 % Resistance; > 75 % Susceptible.

Table 2: Disease Intensity Reaction (DIR) of the best compact lines

S/ No.	Line	DIR
1	(HdT 1593 x N 39) x SL 28 x (N 39 x VC 298) x PNI 108/10	3.0
2	PNI 090 2/19 x (N 39 x HdT 1593) x (HdT 1593 x N 39) x VC 298	0.7
3	PNI 090 2/10 x (N 39 x HdT 1593) x (HdT 1593 x N 39) x VC 298	2.5
4	PNI 086 x (N 39 x VC 298)	3.5
5	PNI 089 101/13 x SL 34 x (HdT 1593 x N 39) x VC 506	3.5
6	PNI 089 101/13 x KP 423 x (HdT 1593 x N 39) x VC 298	0.0
7	(N 39 x HdT 1593) x (HdT 1593 x N 39) x VC 298 x PNI 089	0.0
8	PNI 087 15/11 x (SL 34 x (HdT 1593 x N 39) x VC 506	0.0
9	(N 39 x HdT 1593) x (HdT 1593 x N 39) x VC 298 x 089 203/3	0.0
10	(HdT 1593 x N 39) x SL 28 x VC 506 x PNI 089 107/13	0.0
11	(HdT 1593 x N 39) x SL 28 x VC 506 x PNI 089 10/5	0.0
12	(N 39 x HdT 1593) x (HdT 1593 x N 39) x VC 298 x PNI 089 108/10	1.0
13	Padang x (KP 423 x HdT 1593) x PNI 089 10/5	1.0
14	PNI 089 208/15 x Padang x (HdT 1593 x N 39) x VC 506	0.0
15	PNI 089 101/13 x KP 423 x (KP 423 x HdT 1593) x N 39 x VC 298	0.0
16	HdT 1593	2.6
17	VC 298	2.3
18	KP 423	72.4
19	N 39	75.6
Mean SE ±		8.8 5.3

Key DIR: Resistance (DIR 0 – 25), Moderately Resistance (DIR 26 – 50), Moderately Susceptible (DIR 51 – 75) and Susceptible (DIR 76 – 100).