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A search for anthracnose resistant cashew cultivars in Mozambique

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ABSTRACT

Dwarf and common cashew (*Anacardium occidentale*) genotypes were screened separately for resistance against anthracnose (*Colletotrichum gloeosporioides*). Disease incidence was assessed on emerging leaves over three consecutive crop seasons in Mocuba, Meconta and Pebane districts of northern Mozambique. Evaluation the disease using leaf incidence is presented as a new field method for screening cashew genotypes resistant to anthracnose. It is fast, precise and consistent in ranking cultivars over several tree seasons. Seasonal, cultivar and disease incidence means were compared using Fishers' LSD test. The method enabled the differentiation of highly infected cultivars from those consistently tolerant across seasons and locations. No a single clone with a high level of resistance was identified out of 229 entries. However, hierarchical tables of clonal sensitivity ranked clones 1.12PA, 12.8PA and 1.18PA as tolerant and 11.9PA and 2.3BG as susceptible among the dwarfs. Among the common genotypes, clones NA7, MB77, 1.5R and MCH-2 ranked tolerant and IM1 and MU3 susceptible. Tolerant clones were therefore recommended to be used in the national cashew breeding program for further development of cashew cultivars with durable resistance to anthracnose. Further, clones such as 2.5VM, 1EM, MB75 and others that revealed incidence consistency over seasons can be used as susceptibility or tolerance standards in screening trials.

1. Introduction

Cashew, *Anacardium occidentale* L., is a crop with demonstrated potential for foreign exchange and job creation throughout the world (Cardoso et al., 1999; Freire et al., 2002). In Mozambique, cashew supports more than 1 million small holder farmers, in excess of 6000 employees and it earns over 20 million US dollars per year (Anonymous, 2007).

It was during the 16th century that European travelers introduced cashew from Brazil in the form of seed (Milheiro and Evaristo, 1994; Behrens, 1996). In Mozambique, later introductions were recorded from the 1970's and 90's, as seed of Brazilian cultivars CCP09, CCP76, CCP1001 and Matriz 96 genotypes. Seed introductions were also made from India and Zambia (Prasad et al., 2000) and most recently, from Tanzania. Continuous seeding returned heterozygous orchards throughout Asia, Africa and Latin America (Araujo and Silva, 1995) with heterogenous sensitivity to diseases.

Anthracnose disease has become seriously damaging in Mozambique (Dhindsa and Mondjana, 1984). Tolerant genotypes have been identified in Brazil (Cardoso et al., 1999), Guinea Bissau and Cameroon (Anonymous, 1999) and Tanzania (Intini, 1987). But importation of tolerant clones is subjected to international regulations on trans-boundary movement of germplasm. In addition, variation on pathotypes and environmental conditions between regions would expose risk to the tolerance of the imported material. Therefore, the objective of this study was to identify anthracnose tolerant cashew clones among locally available germplasm.

2. Material and methods

2.1. Locations and experimental design

Cashew orchards used for this study consisted of a range of cloned dwarf and common cashew types located at different trial sites as indicated in Fig. 1. At the Mocuba and Pebane sites, the trials on common and dwarf types were established parallel to one another with only a 6-m wide road between the two types. At Nassuruma in the Meconta district, only one trial consisting of dwarf progenies was used in this study.

All trials were laid out in randomized complete block designs (Gomez and Gomez, 1984) with cultivar as treatment. Each trial

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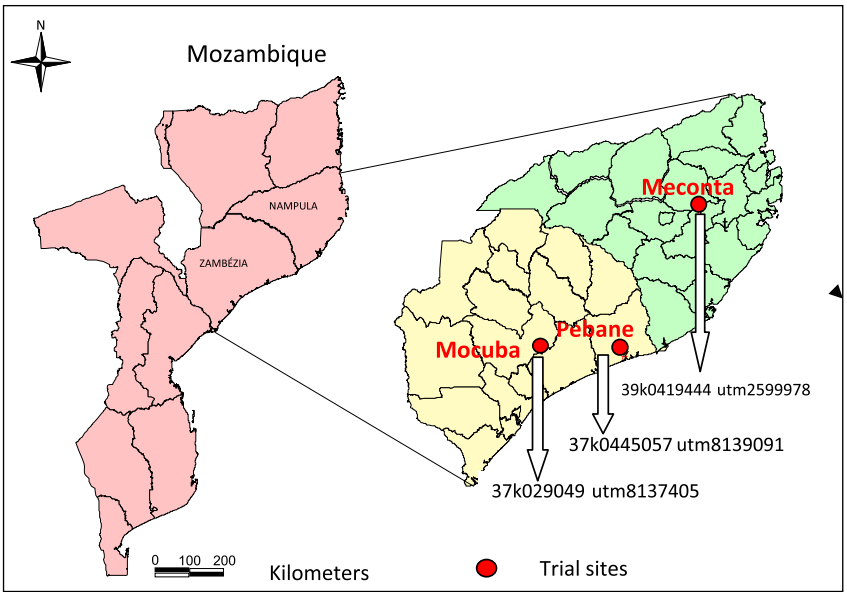

Fig. 1. Map of Mozambique, with inset showing anthracnose cashew genotypes screening trial sites, 2006–2008.

consisted of three replications of three plants each. Other details on the orchards are provided in Table 1.

2.2. Field data collection and statistical treatment

For each growing season, five shoots from each cultivar located on the northern and southern sides of individual trees, were tagged with a sisal cord. This was intended to mark the shoots under investigation and facilitate repeated scoring (Masawe et al., 1997). Disease assessments were made for three consecutive crop seasons from 2006 (beginning in May or June and ending in September) as per the development and maturation of new flushes. Weekly or fortnightly intervals for observations were considered depending on the size of the trial. From individual shoots, all emerging leaves from the same crop season were counted and each assessed for the presence or absence of anthracnose necrotic lesions. Readings were made up to the tenth leaf whenever shoots grew beyond this level. Therefore, in this trial disease incidence reflected the proportion of visually diseased leaves (percentage) (McRoberts et al., 2003). Leaf severity scores were recorded from the Nassuruma trial based on the scale developed by Nathaniels (1996) for powdery mildew which has been further detailed by Sijaona et al. (2001) and was found practical also for anthracnose necrosis evaluation.

Disease scores were initially processed to return plant mean scores as detailed by Masawe et al. (1997). For individual cropping seasons, incidence data were tabulated in excel spreadsheets according to location, date of observation, replicate, cultivar and plant. Data were analyzed using the statistical program GenStat (2003). Analysis of variance (ANOVA) was used to test differences between the disease incidence responses of cultivars per cropping season. The data were acceptably normal with heterogenous treatment variances. Thus, Fishers' protected *t*-test of least significant difference (LSD) at 1 or 5% levels of significance could be used to separate incidence means (Snedecor and Cochran, 1980) with respect to each year during the study. At Nampula, data were log transformed before mean separation. Annual means were ranked by giving numbers from the smallest to the largest values in the range of means obtained. An overall mean was calculated as the sum of cultivar ranks divided by the number of seasons (3). Final ranking of cultivars was made on cultivar overall means.

3. Results

3.1. Cloned dwarf progenies

At Nassuruma, cashew genotype reactions to anthracnose infection were variable over the 3 years and between clones (Table 2). Overall ranks obtained indicated that clone 11.8PA expressed consistently the lowest levels of anthracnose incidence on leaves varying from 4.77 to 21.59% over the 3 years under the study period while clone11.9PA ranked the highest with anthracnose incidence levels on leaves varying from 35.24 to 66.40% (Table 2).

Incidence and severity relationships of leaf anthracnose over crop seasons, germplasm variation, locations and fungicide spray systems have been established (subject for specific publication). Field data proved to be robust for the use of disease incidence as a

Table 1
Germplasm screening trial sites and related data in randomized complete block design, Mozambique, 2006–2008.

Trial site	Distance from Nassuruma (km)	Type of grafted cashew progenies	Number of cultivars	Plant spacing (m)	Plant age (years)	Owned by
Nassuruma	0	Dwarf	10	8 × 6	9	IIAM[a]
Mocuba	460	Dwarf	39	10 × 10	7	NGO[b]
Mocuba	460	Common	33	10 × 10	7	NGO
Pebane	512	Dwarf	67	10 × 10	8	INCAJU[c]
Pebane	512	Common	80	10 × 10	8	INCAJU

[a] Agriculture Research Institute of Mozambique.
[b] Non-governmental organization.
[c] National Institute for Cashew Development.