Research Application Summary

Phenotypic diversity of Ugandan pigeonpea landraces and their reaction to Fusarium wilt in Uganda

Okot, F.[1], Edema, R.[1] & Mukankusi, C.M.[2]
[1]College of Agricultural and Environmental Sciences, Makerere University, P. O. Box 7062, Kampala, Uganda
[2]Center for International Tropical Agriculture (CIAT), Kampala -Kawanda, P. O. Box 7065, Kampala, Uganda
Corresponding author: frankotrix@yahoo.com

Abstract

This study characterised 68 pigeonpea accessions in terms of morphological traits and resistance to Fusarium wilt. Two broad phenotypic clusters were identified, and 16 appeared to possess some resistance to Fusarium wilt.

Key words: Fusarium wilt, landraces, pigeonpea

Résumé

Cette étude a caractérisé 68 accessions de pois d'Angole en termes de traits morphologiques et de résistance à la fusariose. Deux grands groupes phénotypiques ont été identifiés et 16 semblaient posséder une certaine résistance à la fusariose.

Mots clés: Fusariose, variétés locales, pois d'Angole

Background

Pigeonpea (*Cajanus cajan* (L.) Millspaugh) is one of the oldest but under-researched food crops (Snapp *et al*., 2003). In Uganda pigeonpea grain yields remains low, averaging 0.5-0.7 t/ha compared to the research average of 2 t/ha (Areke *et al*., 1995). Therefore pigeonpea improvement efforts will require an assessment of genetic diversity of germplasm in Uganda, both landraces, the elite and other introductions. Additionally, Fusarium wilt (*Fusarium udum*) of pigeonpea is a major problem in Southern and Eastern Africa (Minja *et al*., 1999) including Uganda (Manyasa *et al*., 2009). Few resistant elite cultivars are available but they lack quality traits acceptable to processors and farmers (Silim, 2000; Snapp and Silim, 2001). Landraces have not been evaluated for their reaction to Fusarium wilt, yet they could have good sources of resistance.

The overall objective of this study was to contribute to pigeonpea improvement by determining the extent of phenotypic diversity and identifying sources of resistance to Fusarium wilt among Ugandan pigeonpea land races. The specific objectives were: (i) to assess the phenotypic diversity among Ugandan pigeonpea

land races under 2 agro-ecological zones in Uganda, and (ii) to identify sources of resistance to Fusarium wilt in Ugandan pigeonpea landraces.

Literature Summary

Pigeonpea (*Cajanus cajan* (L.) Millspaugh) is an important, drought tolerant, multi-use crop. It is one of the major grain legume crops in Eastern and Southern Africa, Asia and Central America (Hillocks *et al*, 2000; Silim, 2000; Souframanien *et al*., 2003). It is an ideal crop for the semi-arid areas due to its drought tolerance (Odeny, 2000; Owere *et al*., 2000). It has a wide range of products including the dried seed, pods and immature seeds used as green vegetables, leaves and stems used for fodder and soil improvement, and the dry stem as fuel (Snap *et al*., 2003,). Being a legume, it fixes atmospheric nitrogen (Adu-Gyamfi *et al*., 2007) and thus improves soil fertility. It is also reported to be able to to solubilize fixed phosphorus (Ae *et al.*, 1990).

Pigeonpea is mostly consumed locally, with limited amounts entering international trade, and trade statistics are hardly available (Van der Maesen, 2006). Pigeonpea productivity is severely affected by a number of biotic constraints such as sterility mosaic disease, fusarium wilt, and pod borer (*Helicoverpa armigera*). Fusarium wilt is by far the most important. Kannaiyan *et al*. (1984) reported an incidence of 5-60% in Kenya and 36.3% in Malawi (range 0-90%). It is also a major major problem in other southern and eastern African countries (Minja *et al*., 1999; Manyasa *et al*., 2009). Pigeonpea are used within complex systems involving intercropping and double cropping and quality traits are frequently as important as yield (Jones *et al*., 2003). There is a great potential to grow pigeonpea more widely in Africa if varieties that are more acceptable to farmers and adaptable are made available. This research characterized Ugandan pigeonpea landraces using morphological traits and reaction to Fusarium wilt in order to select potential parents for use in the pigeonpea improvement programme of Makerere University.

Study Description

The study was conducted in two sites: Makerere University Agricultural Research Institute, Kabanyolo (MUARIK) (0º 28’N 32º 37’E, 1200m) in central Uganda and Ngetta Zonal Agricultural Research and Development Institute, Lira district in the North of Uganda.

This research assessed phenotypic diversity of representative lines and the MUARIK gene bank. Trials were planted in the two locations for two seasons and data collected on 15 quantitative and 12 qualitative traits according to pigeonpea descriptors. For quantitative traits, analysis of variance was done using Genstat in both environments separately and in combination. Patterns of variation and major traits contributing to the delineation will be determined using principal component (PC) analyses. The germplasm are also evaluated for their reaction to Fusarium wilt. This was carried out in a screen house at MUARIK.

Research Application

The Ugandan pigeonpea landraces revealed a diversity in a number of quantitative parameters (Table 1). Cluster analysis for phenotype for one season showed two distinct groups with many sub-groups (Fig.1). Reaction to fusarium wilt also varied significantly ($P \leq 0.05$) with a number of entries identified to be resistant to the wilt (Table 2). From the study, the diversity seen in pigeon pea in Uganda is promising and shows great potential for initiating an improvement programme for both agronomic and resistance to biotic constraints.

Table 1. Diversity in pigeonpea quantitative parameters assessed in field trials in two locations in Uganda (2010-2011).

Season	2011A	2011A	2010B	2010B
Parameter	Lira	Kab	Lira	Kab
Days to 100% flowering	(123-173)**	(129-197)**	(122-166.4)**	(134.6-202.0)***
Plant height(cm)	(135.9-305.6)***	(130.7-270.6)*	(194.1-240.8)*	(150.1-265.5)***
Pod length(cm)	(4.2-7.5)*	(4.5-8.1)*	(4.3-7.3)*	(3.6-6.1)***
Primary branches No.	(6.7-20.6)***	(7.8-25.6)***	(8.1-25.7)***	(10.8-29.6)***
Raceme No.	(32.5-366.7)**	(88.9-599.8)**	(20.7-333.8)***	(122.7-534.8)***
Secondary branches No.	(3.9-25.8)*	(4.9-28.9)*	(4.7-34.4)*	(4.3-35.1)*
Tertiary branches No.	(0-1.4)NS	(0-15) NS	(0-13.6) NS	(0-7.2) NS
Pods per plant	(14.2-556.3)**	(20.8-800.3)***	(10.8-480.9)**	(93.9-832.1)**

A, B refer to the first (March - July) and second (September - December) growing seasons, respectively.

Table 2. Response of pigeonpealand races to Fusarium wilt disease.

Level	No. of entries	Outstanding entries identified
Resistant	14	10, 14, 29, 61-2, ICEAP00554, ICEAP 00557
Moderately Resistant	26	13-2,15,19-2,26,3,32-2,42,51,54,60
Susceptible	25	1,12,13,16,18,19,20,30,32,34,36, 49, 56, 58
Highly susceptible	3	15-2, ICEAP 00902,KAT 60/8

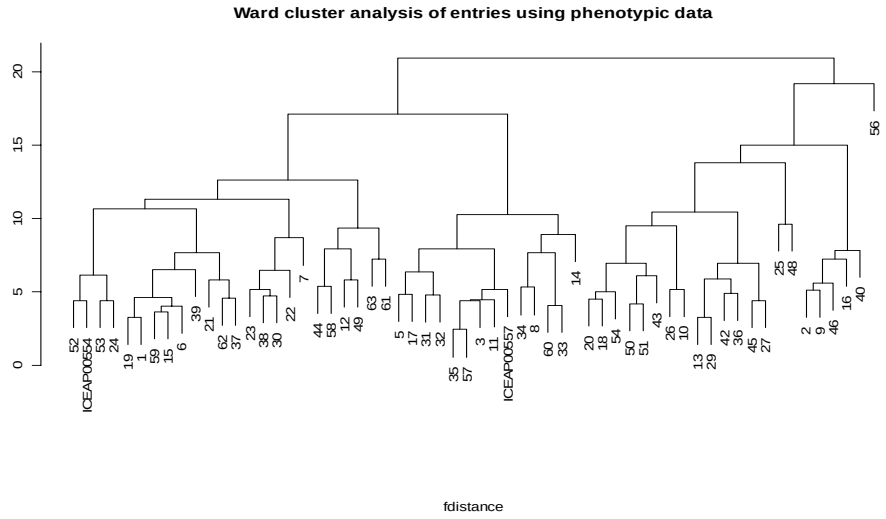

Figure 1. Ward cluster analysis of entries using phenotypic data for one season

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