Variability patterns in Ugandan pigeonpea landraces

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Abstract

In-situ evaluation of pigeonpea cropping system and management in Uganda and agro-morphological characterization of 29 pigeonpea landraces were studied in 2001 and 2004/05, respectively. Results showed that pigeonpea in Uganda is predominantly intercropped with finger millet and to some extent with maize and sorghum. Farmers largely used saved grain as seed and appreciated the damage by insect pests, but only farmers in Apach and Lira districts practiced any form of pest control. Observations across the collection districts indicated low levels of Fusarium wilt disease. Agronomic evaluation of the 29 accessions revealed differential adaptation at the two test locations in Kenya with accessions expressing a delayed phenology at the cooler Kabete relative to the warmer Kampi ya Mawe. Lower 100-seed weight was reported at Kabete relative to Kampi ya Mawe possibly due to excessive vegetative growth at Kabete. Cluster analysis delineated the germplasm into four clusters all separated from the adapted medium- and long-duration checks. Although overall two distinct diversity groups were observed separating the short, medium-maturing types from the tall late- and very late-maturing types, the separation was relatively marginal suggesting a closer genetic relation between the Ugandan pigeonpea germplasm. Relatively low diversity in qualitative traits was observed in the accessions. The predominance of accessions with pubescent pods, a trait associated with resistance to pod damaging insects may provide an opportunity to identify materials for insect pest resistance for use in breeding.

Introduction

Eastern Africa is a secondary center of pigeonpea (*Cajanus cajan*) diversity as the crop occurs wild in this region (van der Maesen 1990). It is an important crop in dry areas of northern and northeastern Uganda with main production areas being Apach, Lira, Gulu, Kitgum, Arua, Soroti and Kotido districts. The crop is also found in other areas of Uganda but as a backyard crop (Areke et al. 1995). Area under pigeonpea is estimated at 71,000 ha (Joshi et al. 2001). The varieties grown are mainly medium and to a lesser extent long duration (6–9 months) local landraces which give low yields. The crop is intercropped mainly with finger millet (*Eleusine coracana*) and occasionally with maize (*Zea mays*), cassava (*Manihot esculenta*), sorghum (*Sorghum bicolor*) and groundnut (*Arachis hypogaea*) or sole cropped in rotation with cereals (Areke et al. 1995, Esele 1995, Ugen and Silim 1995). Pigeonpea grain is consumed as either dry whole grain or green peas with dry grain occasionally split into dhal. Grain yields are low averaging 0.5–0.7 t ha^{-1} and production is made difficult by lack of improved quality seed, insect pests, diseases, and poor marketing and utilization options (Areke et al. 1995). However, pigeonpea in Uganda is steadily increasing following research collaboration between the National Agricultural Research Organization (NARO) and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) with the crop extending to new areas in eastern and northwestern Uganda. Diversity in a crop will be affected by farmer selection of agro-morphological traits and management (Jarvis and Hodgkin 1998). With the anticipated uptake of new improved varieties by farmers, it is expected that local germplasm may be lost and there was a need to undertake collection and better understanding of genetic diversity of existing local germplasm. Based on this, a germplasm collection mission was organized by NARO, ICRISAT and University of Copenhagen, Denmark in 2001 in four districts (Apach, Gulu, Lira and Pader) in Uganda where pigeonpea is a major crop. In all, 29 accessions were collected together with information on farmer preferences for the landraces, cropping systems, agronomic characteristics and reaction of the landraces to pests and diseases, seed selection procedures, preservation methods and grain utilization. The accessions collected were grown at two sites in Kenya and evaluated for agro-morphological traits. This paper presents the synthesized in-situ information and results of the ex-situ agro-morphological evaluation with the aim of understanding production systems and the genetic variability in the Ugandan pigeonpea germplasm. This will ensure that proper conservation and utilization strategies are developed for the germplasm to benefit the breeding program in Uganda and other East African countries.

Materials and methods

Germplasm collection and in-situ information. Pigeonpea landraces were collected from four districts (Apach, Gulu, Lira and Pader) of Uganda. Collections were made at least 1 km from the roadside and 10–20 km between any two collection sites. In all, 29 accessions were collected at altitudes ranging from 1024 to 1175 m above mean sea level (msl) with mean temperature about 26°C. Structured interviews with farmers were carried out to obtain information on cropping systems, agronomic characteristics and reaction of the landraces to pests and diseases, seed selection procedures, preservation methods and grain utilization.

Ex-situ characterization. In all, 29 pigeonpea landrace accessions from Uganda and 7 medium- and long-duration checks were evaluated for agro-morphological traits at two sites in Kenya: Kampi ya Mawe (1250 m altitude, 1°57’ S, mean temperature 23°C and mean annual rainfall 500–600 mm) and Kabete (1960 m altitude, 1°14’ S, mean temperature 18°C and mean annual rainfall 1046 mm). The trials were conducted during the 2004/05 cropping season. At both the sites, the accessions were planted in a 6 × 6 square lattice design with three replications. Plots were 4 m length and interrow and intra-row spacings were 1.5 m and 0.5 m, respectively.

Agro-morphological traits and data collection. Data were collected on 15 quantitative and 12 qualitative traits according to descriptors for pigeonpea (IBPGR and ICRISAT 1993). Qualitative data were recorded on each plant within the plot except for seed traits which were recorded on a sample from a whole plot. Data on quantitative traits were taken on five randomly selected plants in each plot. Pod length, pod width and number of seeds per pod were recorded on 10 pods selected randomly from five plants in the plot whereas pods per raceme and raceme length were recorded on 10 racemes randomly selected from five plants in the plot. Time to flower, time to maturity, and pod and grain yields were taken on plot basis.

Qualitative traits

Shannon-Weaver diversity index (Shannon and Weaver 1949) was calculated based on phenotypic frequencies (proportions) of each qualitative trait category to estimate phenotypic diversity among the accessions and within collection regions.

Quantitative traits

Analyses of variance were done using Genstat 9.0 statistical package in both environments separately and combined. Patterns of variation and major traits contributing to the delineation were determined from principal component (PC) analyses (Fundora et al. 2004). Only PCs with Eigen values more than one (Kaiser 1960) were considered in determining the agro-morphological variability in the accessions. The first two PCs were plotted to enhance the dispersion of the 29 accessions using R-2.1.1 statistical software. A cluster analysis (to generate dendrograms) using traits with significant variability (12 at Kabete and 11 at Kampi ya Mawe) was carried out based on Euclidean distance matrix in a hierarchical way (Fundora et al. 2004) using unweighted pair group method with arithmetic mean (UPGMA). UPGMA creates phylogenic trees where distance between any two clusters is an average of all distances between pairs of objects.

Results and discussion

Management practices and utilization. Farmers in the three districts plant their pigeonpea crops before onset of rains (dry planting) or when rains have started (wet planting) and are predominantly intercropped with finger millet in Apach and Lira districts and with maize and sorghum in Gulu district The predominant seed sources were own seed and purchases, though seed gifts also contribute significantly. No seed selection is practiced and part of the grain is used to plant a new crop. About 8 to 11% of the farmers ratoon their pigeonpea crop in Apach and Lira districts but not in Gulu. Pod borers, pod suckers and bruchids were the predominant insect pests. Twenty-three percent (Lira) and 67% (Apach) of the farmers treated their grain in storage using indigenous methods and inorganic chemicals respectively, but farmers in Gulu did not practice any pest control during storage. All farmers visited reported low levels of Fusarium wilt disease. Pigeonpea is used for food as green peas or whole dry grain or dhal.

Agronomic traits. Most genotypes were medium to very tall in stature, medium to high yielding and medium to late in maturity. Most farmers identified and valued their varieties based on maturity and seed size. From the farmer variety names given across the collection districts, there were apparent similarities among the accessions.

Quantitative traits: Effect of location. Analysis of variance showed significant genetic variability in 12 traits and 11 traits at Kabete and Kampi ya Mawe, respectively. The response of accessions varied with environment; all Ugandan accessions flowered and matured early in the warm environment at Kampi ya Mawe and late in the cool environment at Kabete (Table 1). In addition the accessions were taller and had more primary and secondary branches at Kabete than Kampi ya Mawe (Tables 1 and 2). This behavior at Kampi ya Mawe placed 72.4% of the accessions in the medium-duration maturity group and 27.6% in the long-duration maturity group. In contrast, the Kabete results show that the same germplasm has only 20.7% in the medium-duration maturity group and 79.3% in the long-duration maturity group. Previous studies (Silim and Omanga 2001, Silim et al. 2006) indicated that for accelerated time to flower and mature, optimum temperature for short-duration genotypes was high (24°C); intermediate (22.5°C) for medium-duration genotypes; and low (18°C) for long-duration genotypes. The work of Silim et al. (2006) in addition indicated that greatest delay for time to flower in short-duration genotypes occurred under low temperature and long-duration genotypes exhibited delay under increasing temperature and failed to flower when mean temperature reached 26°C. Short-duration genotypes used in the above study were bred under high temperatures; hence their high optimum temperature. Accessions from Uganda exhibited behavior similar to short-duration varieties most likely because they evolved and are now adapted to warm conditions of northern Uganda where mean temperature is above 24°C. All previous studies show that plant height is positively correlated to temperature; under high temperatures plants are tall and a decrease in temperature results in reduction in plant height. In contrast however, the present studies show that Ugandan accessions were shorter at Kampi ya Mawe (mean plant height 130 cm and where mean temperature is high) than at Kabete (mean plant height 169 cm) where mean temperature is low (Tables 1 and 2). In most areas of eastern and southern Africa other than Uganda, the main cropping system is intercropping pigeonpea with maize. In cool areas, most of the maize varieties mature just a little earlier than the pigeonpea cultivars thus causing competition between the components of the intercropping system and resulting in low pigeonpea yields. The Ugandan pigeonpea accessions are an important source for our breeding effort targeting high elevation areas and will be used to incorporate late maturity into large-seeded varieties for high altitude areas such as Babati and Karatu districts in Tanzania. These accessions thus have potential as a source for late maturity types for intercropping with maize in our breeding efforts for the cool highlands.

At Kabete, large variability was observed in number of secondary branches per plant (10–32), racemes per plant (101–542), pods per plant (190–952) and pod yield (775–5310 kg ha^{-1}) (Table 2). High coefficient of variations (CVs) were recorded in number of racemes per plant (38%), pods per plant (45%), pod yield (51%) and grain yield (43%) depicting the variability in these traits. The test accessions had delayed phenology at Kabete compared to the long-duration adapted checks (mean time to flower 101 days and time to maturity 162 days. Most of the accessions were therefore observed to be very late (>200 days to maturity), medium to tall in height, with high number of racemes and pods per plant except accessions 1, 5, 8, 18 and 26, which were short and medium in maturity. At Kabete, the mean 100-seed weight (9.2 g) (Table 2) recorded in the germplasm was much lower than that recorded in the check varieties (mean 16.1 g) and was also lower than that reported in Tanzanian and generally in East African landraces (Upadhyaya et al. 2007, Manyasa et al. 2008) but compares with 100-seed weight observed in Indian landraces (Reddy 1990). However, relatively higher 100-seed weight (range 8.7–12.3 g) (Table 2) was recorded at Kampi ya Mawe than at Kabete (range 7.6–11.2 g) and this contrasts with previous studies (Ong and Monteith 1985, Manyasa et al. 2008) that showed higher 100-seed weight in cooler environments because of a longer seed filling duration. Compared to long-duration types from Kenya and Tanzania (Manyasa et al. 2008), the Ugandan accessions had lower grain yield. Medium-duration types have been known to have relatively wide adaptability (Mligo and Craufurd 2005); hence, the observed phenological pattern as mentioned earlier in accessions 1, 5, 8, 18 and 26 at the two locations. From the combined analysis, there was significant genotype (G) × environment (E) interaction in number of primary branches per plant, number of secondary branches per plant, number of racemes per plant, plant height, pod length, pods per plant, pod width, pod yield, seeds per pod, time to maturity and 100-seed weight.

Quantitative traits: Principal components. Principal component analysis based on significantly different (from ANOVA) quantitative descriptors in each testing environment is shown in Table 3. At Kabete the first two PCs accounted for 76.9% of the original variability with uneven loadings. The variability on the first PC (59.7%) was accounted for by high positive loadings for time to flower, time to maturity, number of secondary branches per plant, number of racemes per plant, plant height and pods per plant whereas pod length, seeds per pod and 100-seed weight contributed more to the variability on second PC with high negative loadings. The bi-plot of the first two PCs delineated the germplasm into patterns that reflected phenotypic trait similarities regardless of collection district. The medium maturity accessions (1, 5, 8, 18, 26 and 28) were closely associated and delineated from the rest of the test accessions that were late/very late in maturity. Gulu accessions were lower on second PC resulting from their slightly higher pod length and seeds per pod. Wide diversity was observed between the test

Table 1. Time to flower and maturity and plant height of pigeonpea accessions from Uganda evaluated at Kabete (mean temp. 18.4°C) and Kampi ya Mawe (mean temp. 22.8°C) in Kenya.

		Time to flower (days)		Time to maturity (days)		Plant height (cm)	
Accessions	District of collection	Kabete	Kampi ya Mawe	Kabete	Kampi ya Mawe	Kabete	Kampi ya Mawe
1	Lira	101	93	152	128	99.1	65.8
2	Lira	156	151	231	175	187.0	143.3
3	Lira	161	140	240	172	142.9	153.0
4	Lira	165	150	245	194	189.3	139.7
5	Lira	94	88	144	142	98.3	85.7
6	Lira	140	124	214	163	128.9	113.0
7	Lira	138	125	213	150	164.0	133.0
8	Lira	112	116	169	154	124.9	102.7
9	Lira	162	126	236	154	185.7	133.0
10	Pader	161	135	237	169	182.7	118.8
11	Pader	165	130	240	168	177.9	136.7
12	Lira	152	132	234	166	158.7	143.3
13	Lira	156	150	231	195	180.6	135.3
14	Apach	163	149	237	186	188.3	169.3
15	Apach	175	166	255	211	198.7	163.3
16	Apach	130	122	193	162	139.4	113.7
17	Gulu	179	164	263	200	213.2	113.7
18	Gulu	106	100	159	138	120.5	104.3
19	Gulu	171	145	253	179	194.0	149.0
20	Gulu	167	135	245	169	185.4	147.7
21	Gulu	175	148	260	219	199.4	161.7
22	Gulu	167	156	244	179	182.0	130.3
23	Gulu	160	173	236	208	194.2	164.7
24	Gulu	181	143	264	179	236.2	138.0
25	Apach	161	135	235	174	200.3	143.0
26	Apach	107	111	160	148	93.4	76.0
27	Apach	163	143	238	178	190.5	122.7
28	Apach	107	103	163	151	116.4	91.0
29	Apach	176	153	245	222	214.7	167.3
Checks[1]							
30 (ICEAP 00554)		98	106	161	149	104.8	83.0
31 (ICEAP 00557)		95	98	153	126	91.2	99.7
32 (ICPL 87051)		98	109	155	153	115.0	117.7
33 (ICEAP 00068)		112	95	170	132	73.4	87.7
34 (ICP 12734)		94	95	152	130	90.7	103.7
35 (ICEAP 00040)		104	207	161	243	123.0	216.7
36 (ICP 13076)		109	200	181	240	130.3	218.7
Mean (N=29)[2]		150	135	222	174	168.5	129.7
SE±		6.58	15.76	9.57	16.13	20.58	23.9
CV (%)		4.7	11.7	4.6	9.30	12.2	18.5

1. Accession nos. 30 to 34 are medium-duration types and 35 and 36 are long-duration types.
2. For Ugandan landrace accessions.

Table 2. Mean and range of quantitative traits of Ugandan pigeonpea collections, 2005, at Kabete and Kampi ya Mawe, Kenya.

	Kabete				Kampi ya Mawe			
Parameter	Range	Mean	SE±	CV (%)	Range	Mean	SE±	CV (%)
Time to 50% flower (days)	93–181	150	7.17	4.8	88–173	135	15.76	11.70
Time to 75% maturity (days)	144–264	222	10.28	4.6	128–222	174	16.13	9.30
Primary branches per plant	10–19	14	3.24	23.3	4–11	6	2.34	39.40
Secondary branches per plant	10–32	24	5.61	23.6	1–10	3	2.45	71.70
Racemes per plant	101–542	341	129	38.0	11–66	30	15.87	53.70
Raceme length (cm)	4–8	6.8	0.79	11.6	3–5	3.87	1.11	28.80
Pods per raceme	3–4	4	0.51	14.2	2–4	3	0.88	29.50
Pods per plant	190–952	523	234.80	44.9	14–165	45	36.13	80.60
Pod length (cm)	6–8	6.6	0.36	5.5	4–7	5.40	0.70	13.00
Pod width (cm)	1	1.1	0.06	5.4	0.8–1.2	0.95	0.17	17.60
Plant height (cm)	93–236	168.5	20.58	12.2	68–169	129.70	23.94	18.50
Seeds per pod	4–5	5	0.23	4.7	3–5	4	0.54	12.90
Pod yield (kg ha^{-1})	775–5310	2419	1227.90	50.8	124–653	248.00	177.80	71.70
Grain yield (kg ha^{-1})	457–1644	1118	481.10	43.0	66–370	142.00	104.80	73.90
100-seed weight[1] (g)	7.6–11.2	9.2	0.66	7.2	8.7–12.3	10.84	1.34	12.40
	(14.1–20.6)	(16.1)			(13.0–23.3)	(16.6)		

1. 100-seed weight of check varieties is given in parentheses.

accessions and the check varieties. Check varieties were well separated to the left bottom corner of the scatter largely due to their higher seed weight and grain yield and they were early, short and also had fewer racemes and pods.

At Kampi ya Mawe, the first two PCs accounted for 66.4% of total variability with the first PC accounting for 44.4% variability with high positive scores contributed by time to flower, time to maturity, plant height, pod bearing length and pod length (Table 3). The 22.0% variability accounted by second PC had high positive loadings from pod yield, grain yield, 100-seed weight, number of seeds per pod and number of racemes per plant. The bi-plot scatter separated the accessions with no district pattern except for check varieties where medium maturity types (30–34) were closer to the test accessions but with higher grain yield and seed weight which is an indication of similarity between the collection sites in Uganda and Kampi ya Mawe. However, the two long-duration check varieties (35 and 36) were widely separated from the test accessions and the medium maturity checks as they were very late and very tall. The behavior of the two long-duration checks was typical of long-duration cultivars under warm lowland environments (Silim et al. 2006).

Results from the UPGMA at Kabete clustered the accessions into four groups with check varieties in their own group (Fig. 1). The results in the cool environment depict uniqueness in the Ugandan accessions distinct from Tanzanian and Kenyan accessions that were used as check varieties. The test accessions were grouped together based on trait similarities irrespective of district of collection. Cluster 1 had medium maturity accessions with least mean plant height and lowest mean number of secondary branches per plant. Accessions in cluster 2 had least mean number of racemes per plant, longest pods and highest mean seed weight. Cluster 3 had high mean plant height, high mean number of racemes per plant and high mean number of pods per plant. The latest and tallest accessions with highest mean number of racemes per plant and mean number of pods per plant were placed in cluster 4. Five diversity groups were observed at Kampi ya Mawe (Fig. 2). Cluster 1 had accessions with least mean plant height, mean number of racemes per plant, mean pods per plant and mean pod bearing length. The medium maturing accessions again separated together with the medium maturing check varieties. Cluster 3 had late accessions, long mean pod bearing length and high mean plant height. Accessions in cluster 4 had the least mean seed weight but with highest number of pods per plant. Cluster 5 had two late maturing checks which were the tallest and with highest mean seed weight. Although two distinct diversity groups were observed separating the short, medium maturing types from the tall, late and very late maturing accessions at both locations, generally however, the Ugandan pigeonpea accessions were observed to be more related with a marginal separation between late-medium and very late types. This could possibly be due to similarities in agro-ecologies and communities across districts of collection and/or similarities in origin/lineage of the accessions. Upadhyaya et al. (2007) and Manyasa et al. (2008) also reported effect of

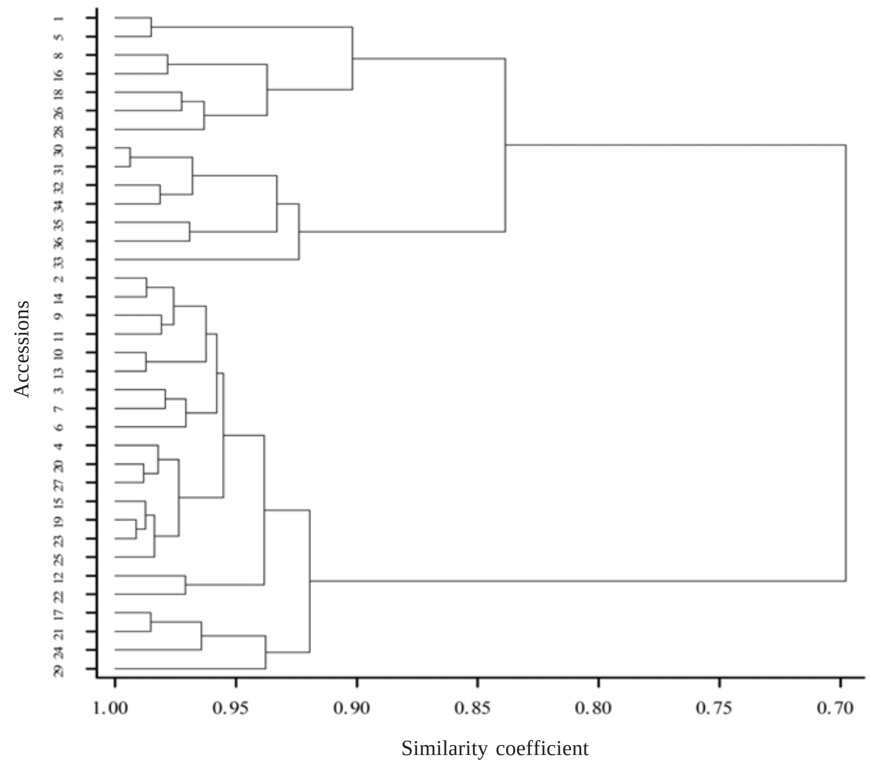

Figure 1. Dendrogram for 29 pigeonpea accessions and 7 checks based on average linkage for 12 quantitative traits means at Kabete in Kenya.

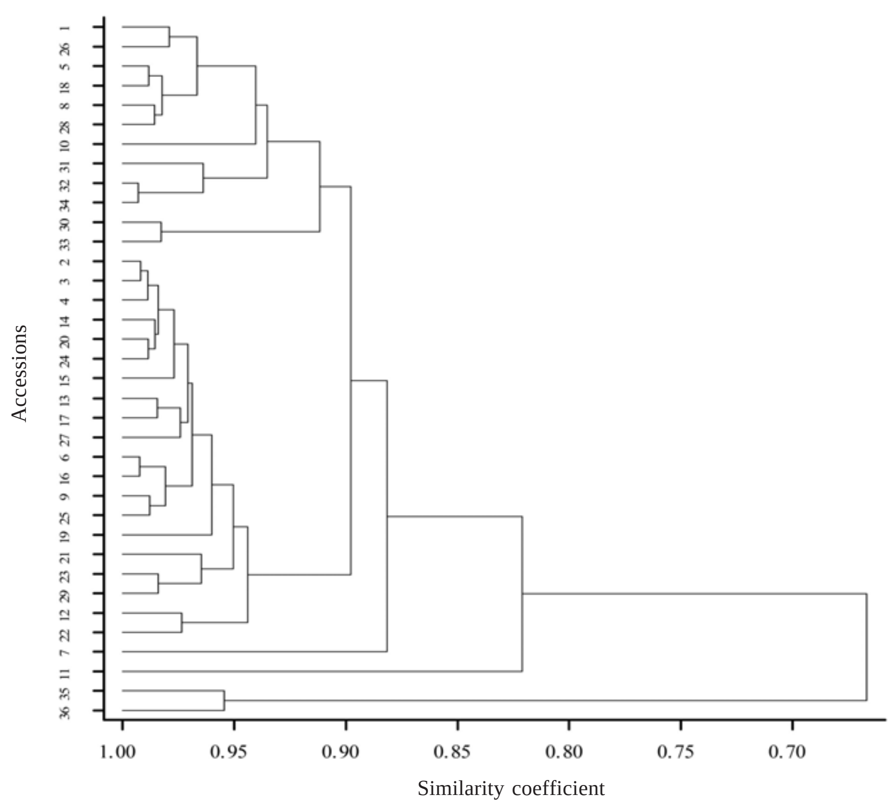

Figure 2. Dendrogram for 29 pigeonpea accessions and 7 checks based on average linkage for 11 quantitative traits means at Kampi ya Mawe in Kenya.

Table 3. Principal component (PC) analysis of quantitative traits recorded on 29 Ugandan pigeonpea landraces, 2005, at Kabete and Kampi ya Mawe, Kenya.

Parameter	PC1	PC2	PC3	PC4	PC5
Kabete					
Eigen value	8.96	2.58	0.98	0.70	0.39
Proportion of variance	59.7	17.2	6.5	4.7	3.3
Total variance	59.7	76.9	83.4	88.1	91.4
Eigenvectors (loadings)					
Plant height	0.3034	–0.0794	0.1123	–0.0562	–0.2059
Time to 50% flower	0.3078	–0.0753	0.1935	–0.0845	–0.1732
Primary branches per plant	0.1776	–0.1818	–0.3246	0.5024	–0.2960
Seeds per pod	0.0556	–0.4561	–0.01256	–0.4158	0.5057
Time to 75% maturity	0.3033	–0.1130	0.1933	–0.0926	–0.1667
Grain yield	0.1891	–0.0681	–0.6183	–0.1744	0.0784
100-seed weight	–0.2229	–0.3422	–0.1668	–0.2089	–0.2539
Pod length	–0.1743	–0.4570	0.0173	–0.1979	–0.3146
Pods per plant	0.2949	0.0827	–0.2118	0.0465	–0.1530
Secondary branches per plant	0.2557	–0.0380	–0.1162	0.0735	0.5840
Racemes per plant	0.2927	–0.0486	0.2028	–0.0683	–0.1316
Pod yield	0.2521	0.0069	–0.4236	–0.0422	–0.0443
Kampi ya Mawe					
Eigen value	5.33	2.64	1.95	0.58	0.43
Proportion of variance	44.4	22.0	16.3	4.9	3.9
Total variance	44.4	66.4	82.7	87.6	91.5
Eigenvectors (loadings)					
Plant height	0.4019	–0.1600	–0.0184	0.0161	–0.1771
Time to 50% flower	0.3734	–0.2458	0.0976	–0.1626	–0.0881
Seeds per pod	0.0045	0.2899	0.5185	0.4746	0.0313
Time to 75% maturity	0.3632	–0.2583	0.1089	–0.1572	–0.0669
Grain yield	0.2317	0.4678	–0.1401	–0.3515	–0.0068
100-seed weight	0.2288	0.3397	0.3953	–0.0192	–0.2982
Pod bearing length	0.3405	–0.2163	–0.1068	0.2469	0.0145
Pod length	0.2635	0.0985	0.4051	0.0439	0.6303
Pods per plant	0.2150	0.1335	–0.4799	0.2655	0.5569
Racemes per plant	0.2339	0.2704	–0.3196	0.5601	–0.3986
Pod yield	0.2227	0.4709	–0.1555	–0.3901	–0.0096

elevation of collection on variation in Kenyan and Tanzanian pigeonpea germplasm. This result also agrees with observations made during collection that most of the accessions had similar names across the collection districts suggesting similar varieties are grown across the collection districts.

Qualitative traits. Analysis of Shannon-Weaver diversity index (H`) revealed significant diversity in growth habit, flowering pattern, flower streak pattern, flower streak color, pod color, pod form, pod hairiness, base seed color and seed eye color. Relatively low diversity (H`=0.325) was observed in the accessions but high diversities were recorded within flower streak pattern (H`=0.472), growth habit (H`=0.459), flowering pattern (H`=0.518), pod form (H`=0.470) pod hairiness (H`=0.474) and seed eye color (H`=0.532) (Table 4). The lowest diversity was recorded in stem color (H`=0.021)

Table 4. Shannon-Weaver diversity index (H`) for qualitative traits in pigeonpea.

Trait	Diversity index (H`)
Stem color	0.021
Growth habit	0.459
Flowering pattern	0.518
Base flower color	0.115
Second flower color	0.239
Streak pattern	0.472
Pod color	0.245
Pod form	0.470
Pod hairiness	0.474
Base seed color	0.269
Seed shape	0.080
Seed eye color	0.532
Mean (H`)	0.325

and seed shape (H`=0.080). The overall relatively low diversity observed points to the possible close relationship between the Ugandan pigeonpea landraces. The predominant traits were: stem pigmentation green (99%), yellow base flower color (93%) with dense lower streaks (72%), mixed pods (86%), hairy pods (87%) and cream seeds (83%). These trait patterns are similar to those observed in Tanzanian pigeonpea landraces (Manyasa et al. 2008). The expression of growth habit at Kabete could be attributed to the high moisture and cool temperatures that led to high branching, dense foliage and a prolonged vegetative phase. About 20% and 79% of the accessions were indeterminate and semi-determinate respectively at Kabete, whereas 70% were indeterminate and 26% determinate at Kampi ya Mawe. Although this observation was not made on landraces from Tanzania, it reflects the uniqueness of the Ugandan pigeonpea landraces. The predominance of the semi-spreading habit observed at Kampi ya Mawe, a warmer location akin to the areas of collection in Uganda is a manifestation of suitability of the accessions for intercropping. Pubescence has been reported to reduce egg laying by bruchids on mature pods (Silim-Nahdy et al. 1999). The predominance of accessions with pubescent pods may provide an opportunity to identify accessions for hybridization for insect pest resistance.

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