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Full Length Research Paper

The groundnut client oriented research in Tabora, Tanzania

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A client oriented groundnut research was carried out in Tabora, Tanzania. Objectives were to solicit farmers' preferences on groundnut production and evaluate groundnut varieties under varying environments and conditions. Semi structured questionnaires and focus groups were used to solicit farmers' opinions. On-station and on-farm trials were conducted based on recommendations suggested by farmers. On-station trial had 3 replications with 5 plots each laid in a randomized complete block design. Plot size was 25 m^2. The net harvested area was 15 m^2. The spacing used was 0.9 × 0.15 m. On-farm trials involved 9 farmers each planting 5 varieties. Varieties used were Johari, Pendo, Nyota, Sawia and farmer. SPSS and Genstat computer software were used to analyse survey and field trials data, respectively. Drought and low yielding varieties were observed as the most serious problems in the area. Pendo and Johari varieties constantly out yielded other varieties and ranked first and second, respectively, under research and farmers managements. Genotypes sum of squares accounted for 54.93% of the variability. This study also revealed that, under some conditions, researchers and farmers' variety selection criteria coincided. Based on the information generated by this study, Pendo and Johari were recommended.

Key words: *Arachis hypogea*, client oriented research, groundnuts, stability, Tanzania.

INTRODUCTION

Sustainable agricultural production in Tanzania is resting at delicate balance due to abiotic, biotic and socio-economic factors (Katinila et al., 1998; Pixley et al., 2006). In Tabora which is one of the 21 regions of Tanzania, smallholder farmers had been depending on tobacco, maize and groundnuts for livelihood earnings (Ramadhani et al., 2002). Currently, maize production is declining due to soil degradation, drought, lack of credit facilities support and unavailability of farm inputs (Mwakalobo and Kashuliza, 1999; Morris, 2001). On the other hand, tobacco, the number one cash crop in Tabora region, is threatening the environment due to excessive deforestation for tobacco leaf curing (Siddiqui, 2001; Sauer and Abdallah, 2007). At the same time, majority of farmers stopped growing groundnuts due to low return per capital, low yield, lack of reliable market and lack of improved varieties (Mwakalobo and Kashuliza, 1999). Only one groundnut variety called Mamboleo which was released in the 1960s can be found in the area and is no longer meeting farmers demand and objectives. Farmers are forced to recycle seeds for longer time due to lack of alternative varieties (Doss et al., 2003). This has led to the concern on the breeding for more groundnut varieties and hence the need for the introduction of new varieties. Introduction of new varieties needs careful planning and

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Abbreviations: RCBD, Randomized complete block design; **SS,** genotypes sum of squares; **AMMI,** additive main effects and multiplicative interaction analysis; **DF,** degree of freedom; **F,** frequency.

suitable methodologies to achieve high rate of adoption. Magigi and Majan (2006), Obeng and Ugboro (2008) reported that, effective breeding needs the incorporation of community opinions and perceptions that begins with society diagnosis. This ensures farmers hand to hand access to information which would affect the rate of adoption (Matuschke et al., 2007). Moreso, farmers have peculiar ways of cultivar evaluation which normally targets multiple uses (Abebe et al., 2005). All these should be sorted out before a new variety is introduced to the community.

Effective planning that involves clients and the subsequent participation of clients in the variety developments are the chief features of client oriented research which aims at increased rate of adoption and reduced variety abandonment. The use of client oriented research has been reported elsewhere as an effective breeding methodology, integrated pest managements in cowpeas in Uganda (Nabirye et al., 2003), superior cassava selection in Ghana (Manu-Aduening et al., 2006) and rice breeding in Nepal (Gyawali et al., 2007; Joshi et al., 2007). Therefore, the client oriented research on groundnuts varieties was conducted in Tabora, Tanzania. Three villages with 20 respondents each were selected for the survey study. Based on recommendations from survey findings, on-station and on-farm trials were conducted. Objectives were to solicit farmers' preferences on groundnuts production and evaluate groundnut varieties under varying environments and conditions.

METHODOLOGY

Study area description

Tabora is one of the 21 regions of Tanzania. It has a uni-modal type of rainfall with average of 928 mm y^{-1} which mostly falls between November and May. Tabora is located between 4 and 7°S of the equator and between 31 and 34°E of the Greenwich line. It is situated at about 1300 masl with the mean temperature of 23.8°C (Nyadzi et al., 2003a, b). Soils are mostly sandy loams which are classified as Ferric Acrisol according to FAO soil classification.

About 80% of Tabora population depends on agricultural production (Byerlee and Heisey, 1996). Majority of them frequently suffer from unstable agricultural production and food insecurity problems (Mugo et al., 2005). Tobacco (*Nicotiana tabacum*) and maize (*Zea mays*) are the main crops and acts as sources of income in the region (Ramadhani et al., 2002). Farmers in Tabora are characterized by growing unimproved varieties, less access to credit facilities, inadequate input use and frequently experience low crop yields (De Groote et al., 2002; Doss et al., 2003). Low returns per capital, lack of agricultural incentives and frequent food shortages constantly applies pressure of seeking for other sources of income and sustainable food production in the area (Mwakalobo and Kashuliza, 1999).

Survey respondents and village selection

The study was carried out in Tabora region in Tanzania from January to June 2003. A total of 60 respondents were selected from three villages. The selected villages include Mole, Kaliua and Ulimakafu. A random selection procedure was employed to select respondents that constituted the focus group. The focus group consisted of farmers, farmers by gender, village leaders, district leaders and NGO members.

Survey data collection and analysis

Semi structured questionnaires were used to collect data. These were supplemented with focus group, informal discussion, secondary data and personal observations. SPSS (2006) computer software was used to analyse data gathered from the study.

Field trials

Both on-station and on-farm field trials were conducted from 2003 to 2006. On-station trials had 3 replications with 5 plots each laid in a randomized complete block design (RCBD). Plot size was 2.5 m x 10 m (25 m^2). The net harvested area was 3 central rows (1.5 m x 10 m). The spacing used was 0.9 m x 0.15 m (two rows per ridge, one plant per hill) which gave plant population of 148148 plants /ha. On-farm trials involved 9 farmers; each planted 5 varieties as one replicate. Varieties used were Johari, Pendo, Nyota, Sawia and farmer variety. Genstat (2006) statistical software was used to analyse data from field trials.

RESULTS

The focus group discussions revealed several crops grown in the area. This includes tobacco (*N. tabacum*), maize (*Z. mays*), cassava (*Manihot esculenta*), groundnuts (*Arachis hypogea*), cucumber (*Cucumis sativus*), sweet-potatoes (*Ipomea batatas*), sorghum (*Sorghum bicolor*), sim-sim (*Sesamum indicum*), sun-flower (*Heliathus anuus*), beans (*Phaseolus vulgaris*) and bambara-groundnuts (*Vigna subterranean*). Mamboleo groundnut was the only groundnut variety grown since 1960. Table 1 presents the most serious groundnut problems in the area. Farmers ranked drought and low yielding varieties as the most serious problems in the area. The least was lack of processing industries. The three most stresses in the area were food shortages, high fertilizer and seeds demand; and the most stressful period were between November and January by which at least two of the stresses occurs together (Table 2). Figure 1 presents main sources of income. Results revealed that more than 70% of farmers' earnings come from cropping followed by livestock keeping (11.67%). On-station trial revealed that, Pendo variety out yielded other varieties with the yield range of 1309 - 1512 while the local varieties had the lowest yield of 499 - 772 Kg/ha (Table 3).

Based on the on-station and on-farm results (Table 4), Pendo and Johari varieties constantly out yielded other varieties and ranked first and second, respectively. Sawia which ranked third under research management, performed poorly under farmers condition. Local variety which performed poorly under research management, ranked fourth under farmers fields and managements.

Table 1. Pair-wise ranking of the most important constraint in groundnut production in three villages in Tabora, Tanzania.

Constraint	Villages			Total score	Ranks
	Kaliua	Mole	Ulimakafu		
Low yielding varieties	4	3	4	11	2
Insect-pest	1	2	3	6	5
Lack of processing industries	1	1	2	4	7
Weed invasion	2	3	3	8	4
Drought	4	5	3	12	1
Unavailability of seeds	3	4	2	9	3
Competition with other crops	1	1	2	4	7
Lack of market	2	1	2	5	6
Diseases	2	3	1	6	5
Low prices	1	2	2	5	6

Scores: 1 = Minor; 5 = Important problems.

Table 2. Farmers' three most stresses during the year.

Level/Month	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
High	F S T	F S T	F T	T								F
Medium				F					T	T	F T	S T
Low			S	S	F S T	F S T	F S T	F S T	F S	F S	S	

F = Food insecurity; S = Seeds acquiring; T = Fertilizer acquiring.

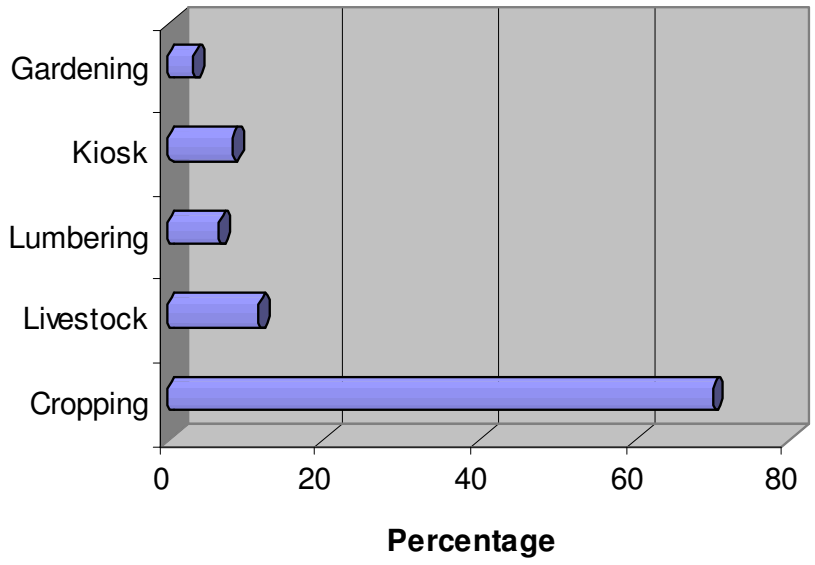

Figure 1. Sources of income in three villages, Tabora, Tanzania.

Table 3. On station three years yield (Kg/ha) analysis of five groundnut varieties

Variety	Range	Minimum	Maximum	Mean	STD	CV
Johari	1087.00	415.00	1502.00	1160.89	100.37	25.90
Pendo	203.00	1309.00	1512.00	1418.44	19.73	14.60
Sawia	385.00	615.00	1000.00	745.56	42.14	12.40
Local	273.00	499.00	772.00	598.78	29.22	4.20
Nyota	240.00	518.00	758.00	665.11	27.58	17.00

Table 4. On-station and on-farm yields (Kg/ha), ranks and on-station to on-farm % yield advantage for three seasons and three villages, Tabora, Tanzania.

Variety	On-station		On-farm		% yield increase
	Yield	Rank	Yield	Rank	
Johari	1161	2	639.4	2	44.92
Pendo	1418	1	776.3	1	45.25
Sawia	746	3	540.5	5	27.55
Local	599	5	541.3	4	9.63
Nyota	665	4	548.2	3	17.56
SED	75.60		29.20		
CV	17.50		17.60		

Table 5. AMMI analysis of variance for five varieties across nine environments.

SOV	DF	SS	MS	F	F pr	SS or GE X SS%
Blocks	18	670771	37265	5.11	< 0.001	32.58
Genotypes	4	1131017	282754	38.79	< 0.001	54.93
Environment	8	49728	6216	0.17	0.99457	2.42
G x E	32	207346	6480	0.94	0.49923	10.07
IPCA1	11	90623	8238	1.13	0.35138	1.93
IPCA2	9	61449	6828	0.94	0.49923	1.31
IPCA3	7	39054	5579	0.77	0.61806	0.83
Residual	5	16220	3244	0.45	0.81553	0.34
Total treat	44	1388092	31548	4.33	< 0.001	29.51
Error	72	524861	7290			11.16
Total	134	2583724	19282			54.93

Genotypes sum of squares (SS) accounted for 54.93 of the variability which was followed by blocks (32.58%) (Table 5). Results further revealed that, environments were inferior to G X E interactions. Figure 2 presents IPCA scores against genotypes and environment means. The result showed that, varieties were more dispersed than environments. Pendo and Johari varieties were placed on the high yield environments while Local, Sawia and Nyota varieties were placed on the lower yield environments. Results further revealed that, Pendo variety was placed far from zero and showed instability due to environmental changes while Local variety showed high G X E stability. Farmers' assessment ranked Pendo and Johari varieties high (Table 6). They ranked first and second for Pendo and Johari, respectively. Local variety was ranked third while Sawia had the least rank.

DISCUSSION

The results clearly demonstrated that, farmers were aware of the major constraints facing groundnut productivity in their respective environments. This implies that, farmers possess an accumulated knowledge on the farming system they operate (Kaliba et al., 1998a, b). Ranking drought and low yielding varieties as the most serious problems in the area further demonstrate the

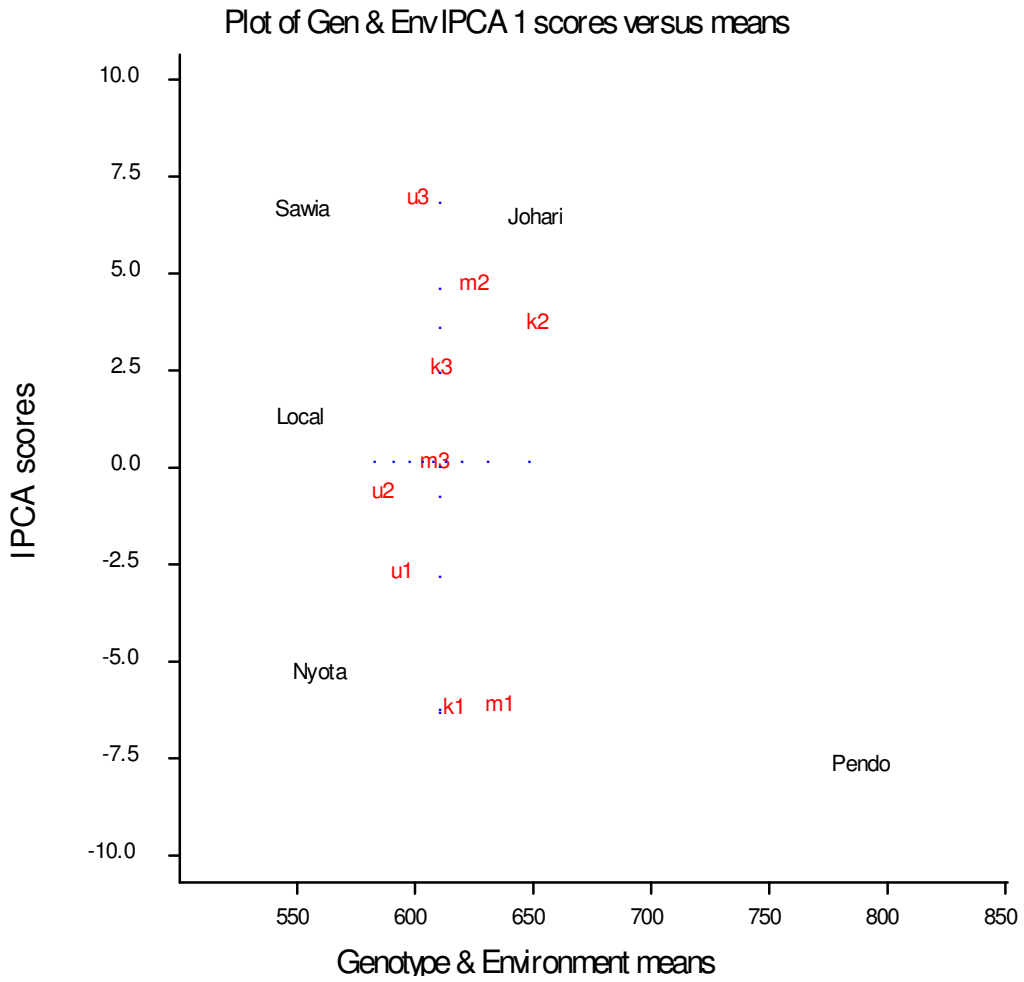

Figure 2. IPCA1 scores of five varieties, nine environments and genotype x environment means.
u1, 2 and 3 = Ulimakafu for season 1, 2 and 3; m1, 2 and 3 = Mole for season 1, 2 and 3; k1, 2 and 3 = Kaliua for season 1, 2 and 3.

Table 6. Farmers' assessment on five groundnut varieties.

Variety	Preferred characteristics	Undesired characteristics	Overall ranking
Johari	1. High oil content 2. High yield 3. Good taste	Small seed size	2
Pendo	1. Large seed size 2. Good colour 3. High market 4. High yield 5. Good taste	Low oil content	1
Sawia	Short cooking time	1. Long maturity 2. Small seed sizes	5
Local	1. High shelf life butter 2. Good taste	1. Low yielding 2. Drought susceptibility	3
Nyota	Gives high shelf life butter	Small seed sizes	4

reliance of farmers' knowledge on effective agricultural interventions. These findings are in accordance with Nkonya et al. (1998). The three most stresses mentioned in this study suggests food insecurity that occurs in the period between November and January. This implies that technologies, like early maturing crop varieties, should be introduced to ensure early food availability in the area (Kaliba et al., 1998c). On the other hand, the high proportion of farmers depending on cropping activities further demonstrate the importance of improving agricultural technologies to benefit majority of farmers. Other researchers observed similar results (Ramadhani et al., 2002).

Field trials revealed significant differences among varieties conducted on-station and on-farm under farmers' managements. The high yield of Pendo and Johari clearly indicated the superiority of these new varieties over the local variety. Furthermore, these varieties had a yield percent increase of about 45% based on the on-farm and on-station comparison. These findings were within the ranges of 35 - 70% observed by Sall et al. (1998). Further analysis of on-farm and on-station trials based on statistical and farmers' assessments revealed that, researchers and farmers' variety selection are equally important. Ranking Pendo and Johari first and second for both researchers and farmers indicates that, sometimes researcher and farmers' selection criteria coincide (Abebe et al., 2005). However, this study found a reversed order of some varieties like Local variety when grown under farmers' condition. This indicates that, some varieties might not be adapted to farmers' environment which are characterized by low use of farm inputs and sub-optimal managements (Sumberg, 2005; Marenya and Barrett, 2007; Matuschke et al., 2007). The reversed orders of merits among cultivars were also reported by other researchers (Abebe et al., 2005).

Stability analysis revealed that, genotypes contributed significantly to the yield variability and were more scattered than environment. This implies that genotypes were potential breeding materials (Falconer and Mackay, 1996; Ji-chun et al., 2007). The generated information could help researchers to allocate genotypes according to environments. Generally, this study found two varieties, Pendo and Johari as having high yielding potential and possessed preferred traits by clients. To increase groundnut production in the area, the two varieties were highly recommended.

Conclusion

Tobacco, maize and groundnuts which are the major sources of income for majority of the people of Tabora region in Tanzania are currently experiencing a sharp yield decline. Varieties grown are older than ten years.

Mamboleo, the only groundnut variety which was introduced in the 1960s has lower yield capacity and has forced farmers to abandon it. There was need for introducing new varieties. To curb this situation, a client oriented research was conducted. Two varieties, Pendo and Johari were identified by clients as high yielding and possessed preferred traits. These varieties were recommended to be grown by farmers in the region.

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