Farmer participation in groundnut rosette resistant varietal selection in GHANA

Hans K. Adu-Dapaah, James Y. Asibuo, Opoku A. Danquah, Henry Asumadu , Joyce Haleegoah and Baffour Asafo Agyei.

Crops Research Institute P.O.Box 3785,Kumasi, Ghana. Email: hadapaah@cropsresearch.org

Abstract

Farmer participation in the development of improved groundnut varieties is the most effective way of ensuring acceptability and adoption. A study was conducted to involve farmers in planning, evaluation and selection of high yielding rosette resistant varieties and to determine the relative importance of genotype and environment interaction effects on rosette. Two communities were selected from each of two districts. Participatory rural appraisal techniques were used to set goals and elicit consumer preferences and perceptions on an ideotype groundnut variety. Twenty genotypes were evaluated on-station for yield and reaction to rosette and on farmers fields. Twenty farmers were invited to select, based on their own criteria on-station. Seeds from five genotypes selected by each of the farmers were given to 50 farmers (30 women and 20 men). Each farmer grew the genotypes, observed and selected based on their own criteria. Results from the study indicated that 100% of the farmers (60% women and 40% men) indicated rosette was a major constraint. Farmers' criteria for selection complimented that of researchers. Farmers selected genotype MDR-8-19 as the best performer. Variation among locations within years was significant for pod yield and reaction to rosette as well as among genotypes. Broad sense heritability was low for pod yield (48%) high for seed weight (80%) and shelling percentage (86%) and intermediate for rosette (54%). The results gave credence to the need to evaluate breeding lines for resistance to rosette in more years and locations. Two rosette resistant lines have been recommended for release to farmers.

Media summary

Farmers' expectations met by the development of two new groundnut varieties with resistance to groundnut rosette virus for poverty alleviation in endemic areas in Ghana.

Key words

Arachis, hypogaea L, disease, resistance, breeding, yield.

Introduction

Groundnut is an important source of vegetable protein and oil in sub-Saharan Africa. It can fix high amount of atmospheric nitrogen and enhances the sustainability of the farming system in Ghana. Its haulm is used as fodder (Marfo *et al* 1999). Biotic and abiotic stresses reduce yield. Groundnut rosette virus (GRV) is one of the most devastating diseases of groundnut in Africa and Ghana in particular. It is sporadic and unpredictable but causes significant yield loss of up to 100% (Anon, 2003, Dwiveli et al 2003). Three synergistic agents cause rosette disease. These include GRV, a satellite RNA of GRV and groundnut rosette assitor virus (GRAV) (Bock *et al*. 1990). All these agents need to be present in the plants for aphid (*Aphsi craccivora*) transmission. GRV may be controlled by the use of insecticides. However, the most cost effective and environmentally–friendly method of control is the use of rosette resistant lines. Following a planning workshop in Ghana farmers requested for groundnut varieties resistant to rosette. The objective of the study was to involve farmers in the evaluatuon and selection of groundnut varieties resistant to rosette and determine the relative importance of genotype by environment effects on groundnut rosette.

Methods

Participatory rural appraisal was used to assess farmers' preferences. Two ccmmunities were selected from Nkoranza and Ejura Districts in Ghana. Fifty women and fifty men were interviewed. Following needs assessment, twenty local and advanced breeding lines received from ICRISAT Station in Mali were evaluated in a replicated trial at Ejura and Nkoranza on-station in 2000 and 2001. The randomized block design with four replication was used on four-row plot at the spacing of 50cm x 50cm. Before sowing, a susceptible variety was planted at the borders of each plot to serve as a source of inoculum 10 days before the test lines were planted. Sowing was done manually in April and harvesting in August each year. Neither fungicides nor insecticides were applied. Disease assessment was done 20 days before harvesting. Visual rating for each plot were on a 1-5 subjective scale where 1 = highly resistant and 5 = highly susceptible. At harvest, all plants in a plot were hand-pulled, maturity of the pods was indicated by the blackening of the internal shell wall (according to Williams and Drexler,1981). The pods were separated from the haulms and sun-dried until constant weight. Soil, insect and pegs were removed from the pods. Shelling percentage was estimated from a 200g sample of pods, 100 sound mature kernels from each plot were weighed to determine the seed weight. Statistical analysis was done using the procedures outlined by Ntare and Waliyar (1999) and (Niyquist,1991).

Farmers evaluation and selection

During the on-station evaluation, twenty farmers (10 men and 10 women) were invited to select based on their own criteria at flowering and harvest. Two sets of 5 groundnut genotypes each selected by the farmers on-station were evaluated by ten farmers from each district on $10m^2$ plots. Farmers observations on traits of interest were noted. Farmers were interviewed after harvest using an open –ended questionnaire. The pair-wise and matrix ranking methods (Ashby 1987) was used to establish farmer's ranking of genotypes.

Fifty farmers were interviewed for their selection criteria and compared with that of researchers.

Results

Results from the needs assessment indicated that 100% of the farmers (60% women and 40%men) complained that rosette was a major constraint. They also ranked groundnut as both food and an industrial crop. Results from farmers ranking are presented in Table1. Farmers mean ranking of genotypes for reaction to rosette, seed and fodder yields as well as weed suppression differed for different genotypes. Genotype MDR-8-19 gave the overall best performance (Table 1). Farmers and researchers differed in the criteria for selection in four traits (Table 2). A genotype resistant to rosette is presented in Figure 1 while susceptible local check Manipintar is indicated in Figure 2. Significant genotype differences were observed in all the traits that were evaluated. (Table 3). The devastating nature of rosette attack was reflected in the low yields recorded in the local check. Variation among locations within years was significant for pod yield, reaction to rosette and among the genotype. The genotype x year interaction variance for rosette was one quarter the magnitude of the genetic variance, with genotype x location variance larger than the genetic variance. The genotype x year x location variance was two thirds the magnitude of genetic variance. Broad sense heritability for pod weight was low (48%) high for seed weight (80%) and shelling percentage (86%) and intermediate for rosette resistance (54%).

Table 1. Farmers' mean ranking of genotypes for rosette resistance, seed and fodder yields, weed suppression and preference ranking.

Genotypes	Rosette	Seed yield	Fodder yield	Weed suppression	Preference ranking
RMP-12	2	4	4	1	3
MDR-8-19	1	1	2	2	1
M576-79	1	2	1	3	2
M578-79	2	3	3	4	4

manipintar	4	6	6	6	6
shitaochi	3	5	5	5	5

[Rank 1 = Liked most 6 = did not like at all]

Table 2. Farmers'and researchers'criteria for evaluating groundnut genotypes for multi-purpose use

Criteria	Farmer	Researcher	Criteria	Farmer	Researcher
Germination	+	+	Kernel size	+	+
Disease Reaction	+	+	Kernel colour	+	-
Earliness	+	+	Weed Suppression	+	-
Maturity	-	+	Fodder Yield	+	+
Growth Habit	+	+	Marketability	+	-
Drought Tolerance	+	+	Oil Content	+	+

Table 3. Genotype means for rosette (scale 1-5) pod yield (t/ha^{-1}) seed weight and shelling (percentage averaged over locations in 2000 and 2001)

Ge4notype	Rosette resistance	Pod yield	Haulm yield	Seed weight	Shelling %
RMP –12	1.5	1.60	2.50	43.10	62.07
MDR-8-19	1.0	1.80	3.08	55.20	71.40
M576-79	1.0	1.95	3.21	51.10	77.20
M578-79	2.0	1.46	2.61	42.90	68.20
Manipintar	5.0	0.90	1.59	29.10	59.10
Shitaochi	3.0	1.20	2.21	38.50	63.10
SE ($\pm$)	0.50	0.35	1.38	1.59	1.63

Figure 1. Genotype MDR-8-19 showing rosette resistance

Figure 2. Local check Manipintar showing susceptibility to rosette

Conclusion

Farmers ranked groundnut as both a food and an industrial crop. All the farmers indicated their preference for multi-purpose groundnut varieties with resistance to GRV. Farmers ranked genotype MDR-8-19 the best overall performer in terms of yield and resistance to rosette. Involving farmers complemented the selection criteria of researchers and should enhance adoption. The significant genotype by year interaction observed for GRV indicated that the reaction of genotypes changed significantly from year to year. Genotype by location interaction indicated that the genotype reacted differently to GRV at the two locations. It is therefore necessory to evaluate genotype in many years and locations. Farmers expectations have been met initially by the identification of two groundnut varieties for release to farmers.

References

Anon (2003). Annual Report, Crops Research Institute for 2002.

Ashby J (1987). The effects of different types of farmer participation on management of on-farm trials. Agricultural Administration and Extension 25: 235-252.

Bock KR, Murant AF and Rajeshwari R (1990). The nature of resistance in groundnut to rosette disease. Annals of Applied Biology 117: 379-384.

Dwivedi SL, Gurtu S, Chandra S, Upadhyaya HD and Nigam S (2003). AFLP diversity among selected rosette resistant groundnut germplasm. Int. Arachis Newsletter 23: 21-23.

Marfo KO, Denwar NN, Adu-Dapaah HK, Asafo Agyei B, Marfo KA, Adjei J and Haleegoah J (1999). Groundnut Production in Ghana. Proceedings of a national workshop on groundmised groundnut aflatoxins, Kumasi Ghana pp 11-16.

Nature BR and Waliyar T, (1999). Genotype and environmental effects on resistance to late leaf spot in groundnut. Africa Crop Science Journal 7:109-115.

Nyquist WE (1991). Estimation of heritability and prediction of selection response in plant populations. Critical Reviews in Plant Science 10: 235-322.

William E and Drexler JS (1981). A non-destructive method for determining peanut pod maturity Peanut Science 8:134-141.