Recent Results with Early-maturing Groundnut Genotypes

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Abstract

*Greater emphasis has recently been placed on the need for groundnut (*Arachis hypogaea *L.) genotypes that are able to give high yields in short growing seasons. In some areas of the Southern African Development Coordination Conference (SADCC) region the rainy seasons are short, while in some other areas of the region slow growth rates caused by low temperatures require early-maturing groundnut genotypes.*

Recent evaluation of a group of early-maturing groundnut breeding lines at Chitedze Research Station, Lilongwe, Malawi, has shown that there are genotypes available that have the ability to produce encouraging yields in short seasons and when sown late.

Use of the concept of thermal time to estimate growing season length for genotypes at Chitedze has shown a considerable degree of consistency across seasons. There was, however, a lack of consistency in thermal season length among different locations.

Sumário

Resultados Recentes com Genótipos de Amendoim de Maturação Precoce. *Maior ênfase tem sido posta recentemente na necessidade de genótipos de amendoim (*Arachis hypogaea *L.) capazes de produzir altos rendimentos em estações de crescimento curtas. Nalgumas áreas da região da Conferência Coordenadora do Desenvolvimento da África Austral (SADCC) a estação das chuvas é curta, enquanto que nalgumas outras áreas da região, baixas taxas de crescimento causadas por baixas temperaturas requerem genótipos de amendoim de maturação precoce.*

A recente avaliação de um grupo de linhas de melhoramento de amendoim de maturação precoce, na Estação de Investigação de Chitedze, Lilongwé, Malávi, mostrou que existem genótipos disponíveis com a habilidade de produzir rendimentos encorajadores em estações curtas e quando semeados tarde.

O uso do conceito de tempo termal para estimar a duração da estação de crescimento, em Chitedze, mostrou um considerável grau de consistência em relação às estações. Houve, contudo, uma falta de consistência na duração da estação termal em relação aos diferentes locais.

Introduction

The SADCC/ICRISAT Groundnut Project recognizes two major constraints to groundnut (*Arachis hypogaea* L.) production in the Southern African Development Coordination Conference (SADCC) region. These are diseases, of which early leaf spot (*Cercospora arachidicola* Hori) is the most serious, and

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Results

The first (normal) sowing of the IEGVT in the 1988/89 cropping season was harvested on two dates: the first, when the crop had accumulated about 1200°C days [at 107 days after sowing (DAS)], and the second at about 1350°C days (117 DAS).

All the 23 test entries outyielded the local control Natal Common, in the early-harvested plots (plant stand of Natal Common was only 76% of normal). The highest-yielding entry was ICGV 86061 (Table 2). Natal Common recorded only 59.2% shelling, whereas 16 test entries recorded more than 65% shelling, and ICGV 86061 more than 70% shelling.

All entries again outyielded Natal Common on plots harvested after 1350°C days. The highest-yielding entries were ICGV 86061 and ICGV 86105 with yields of 859 kg ha^{-1}, whereas the yield of Natal

Table 2. Mean seed yields of entries in Third International Early Groundnut Variety Trial, Chitedze, Malawi, 1988/89.

Identity	Mean seed yield (kg ha^{-1})		
	Season A[1]	Season B[1]	Season C[1]
ICGV 86038	489	586	566
ICGV 86042	595	762	461
ICGV 86045	522	809	577
ICGV 86053	650	706	558
ICGV 86055	674	786	616
ICGV 86056	535	695	483
ICGV 86060	560	773	581
ICGV 86061	704	871	687
ICGV 86063	411	555	456
ICGV 86066	578	678	510
ICGV 86014	466	732	553
ICGV 86015	424	526	429
ICGV 86081	526	659	537
ICGV 86086	529	698	555
ICGV 86016	572	522	429
ICGV 86017	430	579	509
ICGV 86091	545	777	493
ICGV 86092	372	581	515
ICGV 86094	531	673	451
ICGV 86103	500	639	465
ICGV 86105	637	859	652
ICGV 86112	595	639	406
ICGV 86117	415	538	447
Controls			
Chico	488	422	445
Natal Common	212	395	338
SE	±48.5	±52.4	±33.3
Trial mean (25 entries)	518	659	509
CV (%)	16.9	13.8	11.3

1. Season A = Normal sowing (7 Dec 1988), early harvest (1200 °C day, 107 days after sowing).
B = Normal sowing (7 Dec 1988), normal harvest (1350 °C day, 117 days after sowing).
C = Late sowing (6 Jan 1989), early harvest (1200 °C day, 110 days after sowing).

the lack of suitable genotypes adapted to the many and varied agroecological requirements of the region. One such requirement is that of genotypes adapted to short rainy seasons or areas that frequently experience drought spells during the growing period.

The areas most affected by short seasons are Botswana, southern Mozambique, and southern Tanzania, where the rainy seasons are short. Lesotho experiences a similar constraint in that the season length of groundnut is extended by low temperatures which reduce growth rate and delay maturity.

The incorporation of fresh seed dormancy into early-maturing genotypes would be of great benefit because of poor and unpredictable rainfall distribution in Botswana, with rains often falling at end of the season when groundnuts are mature.

It has not been possible for the SADCC/ICRISAT Groundnut Project to place much emphasis on screening and breeding for drought resistance, but it has attempted to evaluate germplasm for early maturity and to make this material available to national programs. Promising lines have also been used as parents in the breeding program.

We have evaluated entries in the Third International Early Groundnut Varietal Trial distributed by ICRISAT Center and the results of trials conducted at the Chitedze Research Station are reported in this paper. We also report our attempts to use temperature parameters as an index for season length, and to establish a base-line for season length that can be used to select, at Chitedze, early-maturing germplasm likely to be adapted to other areas.

Materials and Methods

The International Early Groundnut Variety Trial (IEGVT) was first conducted at the Chitedze Research Station in the 1987/88 cropping season. On the basis of the results, it was decided to repeat the trial in the 1988/89 cropping season but at two sowings, normal and late, and to harvest each trial on two dates, early and normal.

A mean season length for the spanish cultivar Malimba was established for Chitedze from data recorded on groundnut varietal trials conducted from 1982/83 to 1987/88 cropping seasons (Table 1). Mean season length was estimated by time (days) and thermal time °C day (Ong 1986). A mean value of 1350°C day was used as a standard for spanish genotypes and entries in the first sowing were harvested at 1200°C days (early) and 1350°C days (normal) to determine performance under short-season conditions and to identify those entries that did not require extended season length to realize their full potential.

The second sowing was made to determine the effect of delayed sowing on these entries and to identify any entries that were relatively insensitive to delayed sowing.

Temperature data for the past few seasons have been assembled for selected locations in the SADCC region to estimate respective thermal season lengths. These locations were selected to cover a wide range of latitudes and altitudes and represented some of the areas identified above.

Table 1. Season length for groundnut cv Malimba at Chitedze, Malawi, 1982/83 to 1987/88.

Season	Sowing date	Time to maturity (days)	Time to maturity (°C day)
1982/83[1]	29 Nov 82	129	1603
1983/84	13 Dec 83	120	1425
1984/85	16 Nov 84	116	1364
1985/86	20 Nov 85	113	1301
1986/87	8 Dec 86	109	1337
1987/88	7 Dec 87	108	1359
Mean		116	1398

1. Trial was dry sown; first significant rain fell on 9 Dec 1982.

Results

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Common was 395 kg ha^{-1}. Shelling percentages were more than 68% in all entries, the highest (74.1%) recorded by ICGV 86061.

Only one harvest (early) was taken from the late-sown trial as all entries approaching maturity had severe defoliation by early leaf spot. Some entries were harvested after 97 days when only 1094°C days had accumulated. In spite of an improved plant stand in Natal Common, it was outyielded by all other entries. The highest-yielding lines were ICGV 86061 and ICGV 86105. Both recorded seed yields more than 650 kg ha^{-1}. Shelling percentage was 70% for ICGV 86061 and 72% for ICGV 86105. These entries have shown remarkable yield stability at Chitedze.

Comparison of season lengths for selected locations (Table 3) indicates a lack of agreement of data for Sebele (Botswana) and Umbeluzi (Mozambique) with that of Chitedze (Malawi) and Maseru (Lesotho), although in terms of days, Sebele, Umbeluzi, and Chitedze compare reasonably well. High thermal unit values at Sebele could be attributed to high daily maxima, although the reason for reduced growth rate is reported to be low daily minima. At Umbeluzi, high thermal unit values are because of the high daily minima recorded. However, season length does not appear to be reduced accordingly.

Discussion and Conclusions

These results indicate the availability of groundnut genotypes that could be well adapted to areas of short rainfall duration and also to areas or cropping systems where sowing of groundnut is delayed until after cash crops have been sown. Two genotypes in this trial series show particular merit.

Use of the concept of thermal time to establish an index for selection for early maturity seems possible, but lack of agreement in values among locations deserves further investigation. The need to consider different base temperature values in the calculation of thermal unit values is suggested.

Evaluation of early-maturing germplasm from the ICRISAT Center Breeding Unit will continue. We have selected promising early-maturing lines to include as parents in crosses and we have also recently included dormant spanish germplasm lines in crosses.

There will be a greater need in the future to screen and evaluate for earliness of growing numbers of germplasm lines and breeding populations. We look forward to delegating some of this responsibility to national programs, which are better located geographically than our Project, to undertake this work.

Table 3. Season length for spanish groundnut genotypes at four selected SADCC locations, 1986–89.

Location	Genotype	Season	Sowing date	Time to harvest (days)	Time to harvest (°C day)
Sebele, Botswana[1]	Sellie	1986/87	10 Nov 86	113	1914
		1987/88	30 Nov 87	128	1973
		1988/89	11 Nov 88	124	1736
Maseru, Lesotho[2]	All entries	1987/88	4 Dec 87	193	1437
		1988/89	18 Dec 88	195	1287
Umbeluzi Mozambique	Bebiano Branco	1987/88	2 Dec 87	131	2292
		1988/89 (1)	30 Aug 88	141	1932
		1988/89 (2)	31 Oct 88	105	1577
		1988/89 (3)	31 Dec 88	110	1725
Chitedze, Malawi	Malimba	1986/87	8 Dec 86	109	1337
		1987/88	7 Dec 87	108	1359
		1988/89	7 Dec 88	121	1403

1. Severe rainfall deficits occurred at critical stages of growth in 1986/87 and 1987/88 seasons.
2. Thermal unit values estimated from mean monthly temperatures.

Reference

Ong, C.K. 1986. Agroclimatological factors affecting phenology of groundnut. Pages 115–125 *in* Agrometeorology of groundnut. Proceedings of an International Symposium, 21–26 Aug 1985, ICRISAT Sahelian Center, Niamey, Niger. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

Discussion

Freire: The use of thermal units for the evaluation is a good approach to assess groundnut duration. To make the method of evaluation uniform, the time to get a certain percentage of mature seeds could be used instead of the harvest date. In this way, various SADCC countries could use the same methodology.

Hildebrand: This is what we are doing. In the 1989/90 cropping season, we have a lifting date trial, where we harvested two varieties on eight dates to plot trends of yield and seed size to establish optimal season length.

Bulafu: It is true that many countries in Africa experience dry spells of varying lengths during the growing season, thus affecting the yields of the groundnut crop. As a result, many breeding programs have started to breed for resistance to drought per se, or for earliness, so that the varieties can grow within the rainfall pattern. What would you consider to be the lowest acceptable yield expected in these early-maturing varieties?

Hildebrand: That is a difficult question. We have not considered the lowest acceptable yield, but I agree with you that there must be a limit. This would depend on the partitioning of assimilates and on the type of groundnut the farmer wants to grow.

Mayeux: Which parents are you using for your dormancy breeding program?

Hildebrand: 73–30 and ICG 944 are being used.

Mayeux: Do you intend to submit your selected lines to physiological tests?

Hildebrand: We would welcome additional evaluation of our material.

Mayeux: It will be a pleasure to test your new early-maturing material.

Syamasonta: What are the possibilities of separation of dormancy from early-maturity period?

Hildebrand: True spanish varieties do have dormancy of up to 42 days which is being used in the hybridization program at Chitedze.

Chigwe: Can some of the variation in time to harvest between Maseru and the other three sites (Table 3) be attributed to the use of all entries at Maseru compared to a single genotype at the other sites?

Hildebrand: No, all the entries used were harvested on the same day in both seasons. The differences are therefore true variations in days to harvest among the sites.