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NEW PEANUT VARIETIES FOR CALCAREOUS MEDITERRANEAN SOILS

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SUMMARY

Confectionery peanut lines, introduced from the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) were evaluated, during 1992-97 with the aim to select high yielding varieties, with large kernels, adapted to calcareous soils. In addition, a between - row spacing trial was conducted in 1996, using Local and three recently released varieties, in order to investigate possible specific requirements for plant population density of the new varieties. All trials were grown under irrigation during the dry period of May-October. The studies confirmed that the new varieties already grown by farmers, namely GK 3 (USA variety) and three ICRISAT lines, named Nikokleia, Kouklia and Gigas, are superior to Local. Four new lines, Timi, Koloni, Yeroskipou and Mandria, gave very high yields and they are recommended to be released for cultivation. Timi gave 23, 27 and 16% higher pod, kernel and 1000-kernel weight, respectively, than Local. Five other promising lines, could be maintained as improved germplasm in order to be released in case unpredicted negative factors, e.g. new diseases, new races of existing disease pathogens etc. affect the production of other varieties. All the selected lines are tolerant to lime-induced iron chlorosis, common in calcareous soils of the Mediterranean countries. The availability of varieties superior to Local and the possible loss of Local emphasizes the need for description and conservation of this rare and valuable genetic resource. There are no special requirements for spacing of the new varieties.

ΠΕΡΙΛΗΨΗ

Η αξιολόγηση ποικιλιών φυστικιάς, καταλλήλων για χρήση σαν ξηρός καρπός, που εισήχθησαν από το Διεθνές Κέντρο Ερευνας για Φυτά Τροπικών Χωρών (ICRISAT) την περίοδο 1992-97, αποσκοπούσε στην επιλογή ποικιλιών ψηλών αποδόσεων, μεγαλόκαρπων και προσαρμοσμένων στα ασβεστούχα εδάφη. Επίσης, το 1996 δοκιμάστηκαν διάφορες αποστάσεις φύτευσης των τριών νέων ποικιλιών που δόθησαν στους γεωργούς για τον προσδιορισμό τυχόν ειδικών αναγκών πυκνότητας των ποικιλιών αυτών. Σ' όλα τα πειράματα δίδονταν οι αναγκαίες αρδεύσεις κατά την ξηρά περίοδο Μαΐου- Οκτωβρίου. Οι μελέτες επιβεβαίωσαν την υπεροχή των νέων ποικιλιών που ήδη καλλιεργούνται από γεωργούς (GK3, Νικόκλεια, Κούκλια, και Γίγας) σε σύγκριση με τη Ντόπια ποικιλία. Τέσσερεις νέες ποικιλίες (Τίμη, Κολώνη, Γεροσκήπου και Μαντριά) έδωσαν πολύ ψηλές αποδόσεις και συστήνονται για να δοθούν στους γεωργούς. Η Τίμη υπερείχε κατά 23, 27 και 16% της Ντόπιας, στην απόδοση σε θυλάκια, ψύχα και βάρος 1000-σπόρων. Αλλες πέντε ποικιλίες πολύ ψηλών αποδόσεων, θα μπορούσαν να διατηρηθούν σαν βελτιωμένο γενετικό υλικό για διάδοση στους γεωργούς σε περίπτωση απρόβλεπτων καταστάσεων όπως η εμφάνιση νέων ασθενειών, νέων φυλών των γνωστών παθογόνων, κλπ. Ολες οι επιλογές είναι ανθεκτικές στη χλώρωση λόγω έλλειψης σιδήρου και ψηλής περιεκτικότητας σε ασβέστιο στα ασβεστούχα εδάφη των Μεσογειακών χωρών. Η Ντόπια ποικιλία κινδυνεύει να εξαφανιστεί μετά τη διάδοση νέων, πολύ αποδοτικών ποικιλιών, και γι' αυτό πρέπει να γίνουν προσπάθειες να περιγραφεί και να διατηρηθεί η ποικιλία αυτή, που είναι από τις λίγες προσαρμοσμένες στα ασβεστούχα εδάφη. Οι νέες ποικιλίες έχουν παρόμοιες ανάγκες σε ότι αφορά την απόσταση φύτευσης.

INTRODUCTION

Peanut cultivation in Cyprus is restricted to the Paphos area where soils are deep, calcareous vertic Cambisol (Orphanos, 1992). Only confectionery varieties are grown, because peanuts in Cyprus are consumed roasted rather than used for oil extraction. Peanut germplasm, especially when introduced from countries where soils are low in active lime, suffer from lime-induced iron chlorosis (Hadjichristodoulou, 1993). Even the Local

variety when grown on highly calcareous soils suffers from chlorosis. Iron chelates were effective in correcting chlorosis (Papastylianou, 1990).

Efforts to select higher yielding varieties were initiated in 1970, but this work was intensified in the 1980's with introductions from Israel, USA and recently from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India (Hadjichristodoulou 1987, 1990, 1993 and 1994).

Several promising varieties were identified between 1970 and 1994, but their release was postponed as more promising material was becoming available year after year. Among the most promising lines identified were the commercially grown in USA varieties NC2, NC7 and GK3 and the ICRISAT line HYQ(CG)S-25 (Hadjichristodoulou, 1994). Also, the line ICGV 88412 Sel A was selected for its high yield and 1000-kernel weight and ICGV 91098 for its 1000-kernel weight (Hadjichristodoulou, 1994).

Three selected lines, ICGV 88438 named Nikokleia, ICGV 89214, named Kouklia and ICGV 91098, named Gigas, were recommended for release in Cyprus, because they combine superior traits compared to Local (Anonymous, 1996). The parents and the pedigrees of these varieties are given by Hadjichristodoulou *et al*. (1997). The three varieties were also released in India by the ICRISAT Plant Material Identification Committee because of their high yield, high 1000-kernel weight and longer shelf life. The original material of Nikokleia was introduced from North Carolina State University at Raleigh (USA) and it is reported to be resistant to several insects (Hadjichristodoulou *et al*., 1997). Kouklia and Gigas were developed by ICRISAT and have been released also in India and Sri Lanka.

Other material, first screened for tolerance to lime-induced iron chlorosis (Hadjichristodoulou, 1993), was further evaluated with promising material from previous studies in yield trials.

Papastylianou (1995) studied row spacing using Local Cyprus and the USA variety GK 3. He concluded that growers can achieve near maximum yields by securing at harvest plant population density ranging between 7 and 14 plants/m^2.

The aim of this work was to obtain data on the agronomic performance, by comparing all new selections in yield trials, and also to assess the quality of the product. As there was information on the plant spacing requirements of the new varieties, a between-row study using the recently released varieties and Local was conducted to examine differences due to spacing.

MATERIALS AND METHODS

Variety evaluation

The material for this study originated from a special nursery of 102 lines of confectionery peanuts provided by ICRISAT, India, in 1992. After the first screening for tolerance to lime-induced iron chlorosis and for 1000-kernel weight, the selected lines were evaluated in yield trials. Five of those lines were introduced by ICRISAT, India, to the USA. The USA commercial variety NC7, tested in earlier studies, was reintroduced by the Department of Agriculture and for this reason it was included again in the Institute's trials to see whether the genetic material was the same. All trials were conducted at the Experimental Station of the Institute at Acheleia, Paphos. Each year, the best lines (combining high pod yield, high kernel yield and high 1000-kernel weight) were promoted for further evaluation in yield trials. The pedigrees of the twelve best lines are given in Table 1.

Sowing was done in early May and harvesting in early October. In preliminary screenings in the nurseries, Local was included as a check every 10 entries. Promising lines were evaluated for yield in Triple Lattice Designs, with three replications. Plots consisted of six, 4 m-long rows, spaced 0.45 m apart. Within row spacing was 10 cm. Only the four central rows of each plot were harvested for yield and other data. Finally, the selected 15 lines were evaluated in Randomized Complete Blocks with four replications, and the same plot size as in Lattice Designs.

At sowing 130 kg $P_2 0_5$, 130 kg K and 60 kg N/ha were applied. In addition, 70 kg N/ha were applied as top dressing at the beginning of flowering. There was practically no rain during the growing period, but irrigation was provided (around 5000 m^3/ha), as recommended by Metochis (1992).

Table 1. Names and pedigrees of selected peanut varieties

	Variety	Cross No.	Pedigree
1	Timi	ICGV 88412 sel A	ICG4906xICG3043
2	Nikokleia	ICGV 88438	GPNC343xNC17367
3		ICGV 88429	*A. hypogaea x A. cardenasii*
4		ICGV 88451	Florunner x Va 70 Gourp
5	Koloni	ICGV 88454	NCAc17922xNC18016
6	Kouklia	ICGV 89214	ICGV87123xICG6150
7	Gigas	ICGV 91098	ICGV86564xICGV87152
8		ICGV 91101	ICGV87124xICG6440
9	Yeroskipou	ICGV 90296	ICG6427XICG8325
10	Mandria	ICGV 90305	ICGS21XICG11193
11		ICGV 90295 Sel A	ICG6427XICG5984
12		ICGV 88456	NCAc17922 x NC17969
13	NC7	USA variety	
14	Local	Cyprus	
15	NC7(sel)	(USA) # 6400-S	

Source of material: ICRISAT crosses, Nos: 1, 6, 7, 8, 9, 10, 11; Crosses made at NCSU, USA (Dr. J. C. Wynne), Nos: 2, 3, 4, 5, 12.

Data were recorded on flowering date (when 50% the plants in a plot flowered), pod and kernel yields (sun dried, 5 to 8% moisture content), shelling percentage, 1000-kernel weight, number of plants/m^2, oil content and crude protein content (% N x 5.3). Chlorosis was recorded visually as percentage of yellow leaves in a plot. The colour of the mature kernel was also recorded. The number of pods per plant was computed from pod yield, pod weight and number of plants/ha.

Long shelf life is an important commercial requirement for peanuts. This is affected by the ratio (R) of oleic to linoleic acid in the kernel (Monzingo *et al*., 1988). R values below 1.0 characterize lines with short shelf life, R values between 1.0 and 1.6 lines with satisfactory shelf-life and over 1.6 lines with long shelf life. The R values of the best lines in the present study were provided by Dr. S. N. Nigam and Dr. S.L. Dwivedi, ICRISAT, India.

Spacing trial

In 1996, a spacing trial was conducted at Aheleia for the three new varieties (Kouklia, Nikokleia and Gigas) and Local. Three between-row spacings (45, 60 and 75 cm) were tested, with a uniform within-row spacing of 10 cm, corresponding to 22.2, 16.7 and 13.3 seeds/m^2, respectively. The design was split-plot, with row spacings as main plots and varieties as sub-plots. Plots consisted of 6, 5 and 4.4 m-long rows for between-row spacing of 45, 60 and 75 cm, respectively. The two outer rows of each plot were not harvested. Management of the spacing trial and data recorded were as in the case of the variety trials.

RESULTS

Variety evaluation

As a result of the selection procedure it was not always possible to test all the varieties in the same trial. Therefore, results (Table 2) are expressed as percentages of the common control, the Local variety. Test of significance, conducted in each trial, is not possible with selected varieties from different trials. The results in Table 3 refer to a set of varieties tested together in six trials, where such a test was possible.

Kouklia, one of the three new varieties already grown by farmers, continued to be superior to Local in all three major traits (Table 2). On average over 11 trials, it outyielded Local by 17% in pod yield, 11% in kernel yield and 22% in 1000-kernel weight. Nikokleia was also superior to Local, especially in 1000-kernel weight, giving over 1.0 g weight per kernel. The striking superiority of Gigas was expressed in all three traits, but especially in its 1000-kernel weight (1.2 g weight per kernel).

Other promising lines are also listed in Table 2, which are superior to Local in all traits, especially 1000-kernel weight, a crucial requirement for confectionery peanuts. Line ICGV 88412 Sel. A is by 23, 27 and 16% superior to Local in pod yield, kernel

Table 2. Relative performance of selected varieties tested in different (Local=100)

ICRISAT No. (ICGV)	Local name	Pod yield	Kernel yield	1000-kernel weight
88438 (11)	Nikokleia	103	111	130
89214 (11)	Kouklia	117	111	122
91098 (7)	Gigas	110	106	145
88454 (11)	Koloni	111	117	111
88451 (11)	-	102	112	119
88412 (10)	Timi	123	127	116
88429 (11)	-	101	104	114
Local (kg/ha)		5088	3470	0.819

No. of trials in parentheses.

yield and 1000-grain weight.

A set of promising lines, tested in six trials, were all superior to Local, some of them in all three significant traits (Table 3). The best line in yield was ICGV 88412 Sel. A which gave 23% higher pod yield and 28% higher kernel yield than Local. Its 1000-kernel weight was 967 g, significantly higher than that of Local, 841 g. Larger kernels were produced by Gigas and ICGV 90305 with 1000-kernel weight 1.22 g and 1.05 g, respectively. In addition, line ICGV 90305 outyield Local in pod yield (15%) and in kernel yield (19%). Line ICGV 90296 was superior to weight Local by 18% in pod yield, 21% in kernel yield and 17% in 1000-kernel weight.

The USA variety NC7 was evaluated during 1995-97. The source of seed for these studies was from the original material, which was tested in our trials during 1983-88. New stock of NC7 seed was introduced by the Department of Agriculture. Seed from the old stock was evaluated in three trials and NC7 was superior to Local by 10% in pod yield, 19% in kernel yield and 21% in 1000-kernel weight. The new stock of NC7 gave lower pod yield (6%) and kernel yield (2%), but higher 1000-kernel weight (1069 g) compared to Local (896 g).

The number of plants/m^2 was high in all varieties (16 to 21) and differences in flowering date (Table 4) did not exceed four days. Significant differences were found between varieties in the number of pods per plant (11 to 15). Small differences were found in shelling percentage (66 to 72%), crude protein content (25 to 27%) and oil content (49 to 54%) (Table 3).

Shelf life data provided by ICRISAT show that most of the promising varieties have long shelf life, R>1.6 (Table 4). Nikokleia, with an R value of 2.39 has the longest shelf life among the varieties tested. Four varieties (Gigas (ICGV 91098), Koloni (ICGV 88454), Timi (ICGV 88412) and ICGV 88456 have satisfactory shelf life with R values ranging between 1.0 and 1.6.

Kernel colour of the selected lines was pale, light red, red and intermediate deviations from these colours (Table 4). Cypriots have been used to the light red of Local, the only variety grown traditionally in the island, but consumers seem to accept other colours as well.

Row spacing

There was no significant effect of between-row spacing on the yield of pods or kernels, 1000-kernel weight and flowering date. Number of plants/m2 decreased with increasing between-row spacings. On average over varieties, 12.7 15.3 and 20.1 plants/m^2 were harvested from the between - row spacings of 75, 60 and 45 cm, respectively. The only yield component which was affect-

Table 3. Comparison of promising peanut lines during 1994-97 at Acheleia (six trials)

ICRISAT ICGV No	Local name	Pod yield (kg/ha)	Kernel yield (kg/ha)	1000-kernel weight (g)	Shelling (%)	Protein (%)	Oil (%)
88412 Sel A	Timi	6297	4518	967	71.5	24.6	50.3
88429		4821	3410	943	70.3	27.5	50.7
88451		5138	3856	976	74.7	26.3	51.5
88454	Koloni	5628	4055	929	71.7	27.0	52.7
91101		5556	3725	918	66.2	24.8	52.4
90296	Yeroskipou	6036	4282	987	70.6	27.1	52.1
90305	Mandria	5917	4203	1049	70.7	26.1	51.4
91098	Gigas	5502	3710	1220	66.9	25.9	52.5
Local		5133	3537	841	68.7	26.5	50.5
Sx		237	172	21.9	0.54	1.27	1.17

Table 4. Kernel quality and other characteristics of peanut lines

Variety		Kernel colour	Number of Plants/m^2	Pods/plant	Flowering date*	Shelf life (R)
Timi	ICGV 88412 Sel A	Red	19	15	15	1.49
Nikokleia	ICGV 88438	Pale	19	11	17	2.39
	ICGV 88429	Pale to Light Red	20	11	16	1.82
	ICGV 88451	Pale to Light Red	16	15	18	1.67
Koloni	ICGV 88454	Light Red	21	13	14	1.48
Kouklia	ICGV 89214	Pale to Light Red	20	12	17	1.58
Gigas	ICGV 91098	Pale	20	11	15	1.12
	ICGV 91101	Light Red	21	13	14	1.45
Yeroskipou	ICGV 90296	Light Red	20	14	15	1.77
Mandria	ICGV 90305	Pale to Light Red	20	12	15	1.82
	ICGV 90295 Sel A	Light Red to Red	20	11	16	1.67
	ICGV 88456	Light Red	20	14	17	1.28
NC7	USA variety	Pale	20	13	15	-
Local	Cyprus	Light Red	20	13	15	-
NC7(sel)	(USA) # 6400-S	Pale to Light Red	-	-	-	-
Sx			0.4	1.06	0.19	

* (1= 1st June)

ed by row spacing was the number of pods/plant, being 11, 14 and 17 for the 45, 60 and 75 cm spacings, respectively. For all traits recorded the effect of between-row spacing was the same in the four varieties tested (no significant row spacingxvariety/interaction).

There were significant differences among varieties for kernel weight, being for Gigas 1.3 g, Nikokleia 1.2 g, Kouklia 1.1 g and Local 0.90 g. Local produced the maximum number of pods/plant (16) and Gigas the lowest (12). Shelling percentage of Nikokleia was the highest (75%) and of Gigas the lowest (68%). Kouklia, Nikokleia, Gigas and Local reached flowering on 14, 15, 17 and 19 June.

DISCUSSION

Before initiation of the screening work on confectionery peanut germplasm, the choice of farmers was limited to only one variety, called Local. The reasons were primarily the absence of any scientific effort to improve the variety, but also the special need for germplasm tolerant to lime-induced iron chlorosis for the calcareous soils of Cyprus. Also, breeding for confectionery types (large kernels, long shelf life) is limited to only certain Institutes (North Carolina, ICRISAT) compared to breeding for oil content, which is practised in many countries.

As a result of the screening work conducted in Cyprus, today, many lines tolerant to chlorosis are available (Hadjichristodoulou, 1993). Also, the application of iron-chelates can correct chlorosis of peanuts grown on highly calcareous soils (Papastylianou, 1990).

The varieties NC2, GK3 and NC7 released in the USA in 1952, 1976 and 1978, respectively, were introduced by the Department of Agriculture and were evaluated at the Institute, with very good results (Hadjichristodoulou, 1994). The expansion of the area sown with of NC7 and GK3 has resulted in the elimination of the Local variety. The danger of loosing the germplasm of Local increased following the release of Nikokleia, Kouklia and Gigas in the last 3 to 4 years. Cyprus Local and the Israel line Hazera 234/73, are tolerant to chlorosis. Therefore, the variety Local must be described and preserved as valuable germplasm for adaptation to calcareous soils. The international center ICRISAT, has used the variety Local of Cyprus in its crossing programs (Dwivedi, personal communication).

As prices of peanut pods in Cyprus are more or less controlled by the Government, high pod yielding varieties are favored by the grower, high kernel yielding lines by the processor and high 1000-kernel weight lines by the consumer. The results of this study, show that there is variation in the relative

performance of the varieties, when these trails are considered separately, but some lines combine satisfactorily two or all of them.

For example:

Kouklia : pod, kernel yield, 1000-kernel wt
Gigas : pod, 1000-kernel wt
Nikokleia : kernel, 1000-kernel wt
ICGV 88451: kernel, 1000-kernel wt
ICGV 88412: pod yield, kernel yield, 1000-kernel wt
ICGV 88454: pod, kernel yield, 1000-kernel wt
ICGV 90296: pod, kernel yield, 1000-kernel wt
ICGV 90305: pod, kernel yield, 1000-kernel weight

The last four lines are the best considering all traits (Tables 2 and 3). They were given local names and were recommended for release as Timi (ICGV 88412 Sel. A), Yeroskipou (ICGV 90296), Mandria (ICGV 90305) and Kolon (ICGV 88454). Gigas continues to be the best variety in 1000-kernel weight, followed by Nikokleia, Kouklia and ICGV 90305. All lines listed in Table 1, constitute valuable germplasm and should be maintained for future crossing programs aiming at high yield, high shelling percentage, large kernels, long shelf life, but above all when aiming at tolerance to lime-induced iron chlorosis.

Unpredictable problems, like new races of pathogens, nematodes, new market demand, etc., commonly affect field crops production. To cope with such situations it is necessary to have the possibility of replacing old varieties with new ones, as soon as possible. In the present situation, the existence of several varieties, better than Local can play a significant role in safeguarding the successful production of peanuts in Cyprus. One of the selected varieties can replace problematic ones in the shortest possible time.

Shelf life for most of the promising varieties is excellent, making them suitable as confectionery peanuts, because they combine long shelf and high 1000 kernel weight. Nikokleia is the best (R=2.39).

The new varieties, Nikokleia, Kouklia and Gigas have similar requirements for population density as the variety Local. As shown by earlier studies with Local (Hadjichristodoulou, 1987; Papastylianou, 1995), peanuts have the plasticity for increasing branching and pod production, thus giving similar yield over a wide range of plant density. Growers should aim at around 12 to 15 plants/m^2 at harvesting, in order to be able to secure their crop against negative factors that affect stand establishment.

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