Pak. J. Bot., 41(5): 2217-2222, 2009.

HIGH YIELDING GROUNDNUT (*ARACHIS HYPOGEA* L.) VARIETY "GOLDEN"

NAEEM-UD-DIN[1], ABID MAHMOOD[1], GUL SANAT SHAH KHATTAK[2*], IQBAL SAEED[2] AND MUHAMMAD FIDA HASSAN[1]

[1]Barani Agricultural Research Institute, P. O. Box 35, Chakwal, Pakistan
[2]Nuclear Institute for food and Agriculture (NIFA), P.O. Box 446, Tarnab, Peshawar, NWFP, Pakistan

Abstract

Kernels of a groundnut variety No. 334 were irradiated at 0.2, 0.4 and 0.6 KGys doses of gamma rays using ^{60}Co gamma cell at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabd in 1990. Raised M_1 to M_7 generations followed by consecutive selection for high yield and good plant type at Barani Agricultural Research Institute (BARI), Chakwal from 1990 to 1996. Mutant 96CG010 was selected on high pod yield basis and evaluated its performance along with standard varieties in various replicated yield trials. On the basis of its superb performance in yield trials, Punjab Seed Council approved it as a commercial variety in 2002 under the name "**Golden"** for general cultivation in Punjab. Average and potential pod yield of "Golden" is 2413 and 4100 kg ha^{-1}, respectively. It has resistance against *Cercospora* leaf spot (Tikka disease). Reddish seed coat color of this variety is the distinct character to distinguish it from other approved groundnut varieties.

Introduction

Groundnut is a summer season cash crop grown on well-drained sandy or sandy loam soils in marginal lands in Pakistan. It is important for its oil and protein and is a valuable commodity for both human use and livestock feed. Its kernel is rich in both oil (43-55%) and protein (25-28%). In Pakistan, it is mostly used as roasted nuts and confectionery.

Chakwal, Attock, Jhelum and Rawalpindi in Punjab, Karak and Swabi in NWFP and Sahngar in Sindh are the groundnut major growing areas in the country. Per acre yield of this crop in the country is very low due uncertain rains, low input application to the crop by the growers due to unpredictable environmental conditions, and unavailability of high yielding adopted varieties.

Induced mutations can provide beneficial variations to breed high yielding groundnut genotypes. More than 2252 mutant varieties of different crops have been officially released in the world (Maluszynski, *et al*., 2000). Ahloowalia *et al*., (2004) and Khatri *et al*., (2005) reported the fruitful application of gamma rays for the development of new varieties. Micke (2004) reported beneficial use of grain legume mutation breeding for the development of improved cultivars. A brachytic chickpea mutant named JGM 1 was reported by Gaur *et al*., (2007). One variety of groundnut, BARI-2000 has already been developed through induced mutation (Naeem *et al*., 2005). Three desi and one kabuli chickpea varieties have been developed through induced mutations and evolved for general cultivation in NWFP on the basis of high yield potential (Hassan *et al*., 2001; Khattak *et al*., 2007).

*Corresponding author E-mail: gssktt@yahoo.com

High yielding variety **"Golden"** has been developed through induced mutation and approved in 2002 for general cultivation in Punjab. Development and evaluation of this variety is presented herein.

Materials and Methods

Local and well adopted groundnut variety "No.334" seed (kernel) were irradiated at 0.20, 0.40 and 0.60 KGy doses of gamma rays using ^{60}Co gamma cell and planted M_1 generation at Barani Agricultural Research Institute (BARI), Chakwal during 1990. M_2 to M_4 generations were raised by consecutive visual selection on the basis of semi erect plant type and more pods per plant as plant progeny row along with parents and checks from 1991 to 1993.

In M_4 generation, uniform mutant lines were selected on the basis of desired traits and confirmed their breeding behaviour as line progeny rows in M_5 to M_7 generation from 1994 to 1996 prior to their evaluation in replicated yield trials. Ten mutants were selected on the basis of desired traits and evaluated in preliminary and advanced lines yield trials at BARI, Chakwal from 1997 to 2000. A high yielding mutant "96CG010" among 10 mutants in these yield trials derived at 0.40 KGy was further evaluated in advanced lines yield trial, multi-location yield trials and National Uniform Yield Trials (NUYT) during 2000 and 2001. All replicated yield trials were conducted using Randomized Complete Block Design (RCBD) with plant-to-plant and row-to-row spacing of 15 and 45 cm, respectively. The row was 4m long and numbers of rows in RYT and NUYT were 4, and in all others trials, 6 rows per plot per replication. The yield trials data were analyzed according to Steel & Torrie (1980).

Based upon the desired plant type and superb yield performance, "96CG010" was approved as commercial variety "Golden" by the Punjab Seed Council, Government of the Punjab for general cultivation in the province.

Results

Development and evaluation of the mutant "96CG010" took 12 years to release as commercial groundnut variety under the name **"Golden"** (Table 1). In preliminary yield trials conducted during 1997 and 1998 at BARI, Chakwal, the mutant 96CG010 produced 10.96% higher pod yield over the check variety Chakori (Table 2). Similarly, in regular yield trial conducted at BARI, Cakwal, 96CG010 produced 7.44% higher seed yield in 1999 (Table 3) and 23.83% higher seed yield over an average yield of check variety Chakori in advanced yield trials during 2000 and 2001 (Table 4). Mutant 96CG010 showed an inherent high yielding capability by producing the highest seed yield in National Uniform Yield Trials conducted by National Oil Seed Coordinator, National Agricultural Research Council, Islamabad during 2000 and 2001 (Tables 5 & 6). This mutant showed tolerance to Tikka disease (*Cercospora personatum*) under natural conditions (Table 7). Important agronomic and morphological characteristics of 96CG010 are presented in Table 8. It exhibit large seed size (51g/100 seed weight) and can easily be distinguished from other commercial varieties by its attractive reddish seed coat colour.

Table 1. Breeding history of the groundnut variety "Golden" is described in chronological order as follow.

Year	F. Gen./Trial	Remarks
1990	M_1	Planted M_1 in closed spaces and picked all plants seperately
1991-1993	$M_2 – M_4$	Advanced generation as plant progeny row by consecutive selection on the basis of semi erect plant type and more pods
1994-1996	$M_5 – M_7$	Generation advancement and confirmation of breeding behavior as line progeny rows
1997-2000	Evaluation in trial	Evaluated **96CG010** in preliminary and advanced lines yield trials at BARI, Chakwal
2000-2001	Evaluation in trials	Evaluated **96CG010** in advanced lines yield trials at BARI, Chakwal, and multi-location yield trials and NUYT at different locations
2002	Approval as variety	"**96CG010**" was approved as commercial variety "**Golden**" by the Government of Punjab for general cultivation in the province.

Table 2. Pod yield performance of 96CG010 in preliminary yield trials conducted during 1997 and 1998 at BARI, Chakwal.

Entry	Dry pod yield (kg ha^{-1})			Yield increase/decrease (%) over Chakori
	1997	1998	Mean	
96CG008	2634	2917	2775.5	+ 19.32
96CG010	**2315**	**2847**	**2581.0**	**+ 10.96**
96CG004	2417	2500	2458.5	+ 5.70
96CG001	2579	2153	2366.0	+ 1.72
Chakori (Check)	2130	2523	2326.0	-
96CG002	2454	2130	2292.0	- 1.46
96CG003	2361	2083	2222.0	- 4.47
96CG005	1828	2176	20007.0	- 13.71
96CG007	2361	1597	1979.0	- 14.92
96CG009	2065	1620	1842.5	- 20.79
96CG006	1343	1366	1354.5	- 41.77
Cd_1	265	328		
Cd_2	-	448		
CV (%)	17.24	8.86		

Table 3. Pod yield performance of 96CG010 in regular yield trial conducted during 1999 at BARI, Chakwal.

Entry	Pod yield (kg ha^{-1})	Yield increase/decrease (%) over Chakori
96CG010	**3681**	**+ 7.44**
96CG002	3477	+ 1.49
Chakori (Check)	3426	-
96CG004	3370	- 1.63
96CG003	3148	- 8.11
96CG008	2861	- 16.49
96CG009	2847	- 16.90
96CG005	2815	- 17.83
96CG006	2375	- 30.68
96CG001	2171	- 36.63
96CG007	2023	- 40.95
Cd_1	641.9	
Cd_2	875.5	
CV (%)	12.88	

Table 4. Pod yield performance of 96CG010 in advanced line yield trial conducted during 2000 and 2001 at BARI, Chakwal.

Entry	Pod yield (kg ha^{-1})			Yield increase/decrease (%) over Chakori
	2000	2001	Mean	
96CG010	**1275**	**2222**	**1748.5**	**+ 23.83**
96CG008	1410	1620	1515.0	+ 7.29
96CG005	1179	1821	1500.0	+ 6.23
96CG004	1219	1728	1473.5	+ 4.36
Chakori (Check)	1219	1605	1412.0	-
96CG002	1157	1636	1396.5	- 1.10
96CG004	1095	1636	1365.5	- 3.29
96CG003	1130	1451	1290.5	- 8.60
P.W.	1157	1420	1288.5	- 8.75
96CG001	1065	1379	1219.0	- 13.67
96CG005	833	1574	1203.5	-14.77
96CG002	725	1620	1172.5	- 16.96
Cd_1	221.4	512		
Cd_2	300.9	696.1		
CV (%)	11.65	18.4		

Table 5. Pod yield performance of 96CG010 in NUYT conducted by coordinator (Oilseeds), Islamabad during 2000.

Entry	Pod yield (kg ha^{-1})						Yield increase /decrease (%) over BARD-479
	1	2	3	4	5	Mean	
96CG010	**2347**	**1690**	**3366**	**1736**	**4064**	**2641**	**+ 12.48**
BARD-479 (Check)	1937	1505	2532	1991	3778	2348	-
ICGV-88474	2049	1690	2463	1481	3842	2305	- 1.83
SP-2000	2236	1505	2468	1042	3749	2200	- 6.30
ICGV-89235	1150	1331	3079	1551	3611	2144	- 8.69
93-7	1518	833	2884	1088	4420	2149	-8.48
SP-2002	2204	1852	2588	1944	1989	2115	- 9.92
ICGV-90123	2172	1134	2594	1643	2683	2045	- 12.90
BM-19	2093	926	2685	1528	2684	1983	- 15.54
LSD (0.05)	ns	519.7	9.39	316.0	711.1		
CV (%)	-	21.68	8.04	11.73	11.67		

1: NARC, Islamabad 2: AARI, Faisalabad 3: ARI, Mangora 4: BARI, Chakwal 5: BARI, Bahawalpur

Table 6. Pod yield performance of 96CG010 in NUYT conducted by coordinator (Oilseeds), Islamabad during 2001.

Entry	Pod yield (kg ha^{-1})						Yield increase /decrease (%) over BARD-479
	1	2	3	4	5	Mean	
96CG010	**2919**	**1481**	**2523**	**2617**	**1990**	**2306**	**+ 8.77**
BM-19	2836	1713	2269	2615	1806	2248	+ 6.04
SP-2002	2715	1667	2569	2315	1760	2205	+ 4.01
ICGV-89235	2602	1366	2384	2685	1806	2169	+ 2.31
BARD-479 (Check)	2706	1250	1991	2754	1898	2120	-
93-7	2752	1667	1505	2107	2500	2106	- 0.66
SP-2000	2724	1227	1736	2407	2360	2091	- 1.37
ICGV-90123	2875	1343	1620	2685	1620	2029	- 4.29
ICGV-88474	2736	718	1343	2708	1806	1862	- 12.17
LSD (0.05)	Ns	321.5	639.0	Ns	402.0		
CV (%)	-	13.45	18.52	34.76	11.92		

1: NARC, Islamabad 2: AARI, Faisalabad 3: BARI, Chakwal 4:ARS, Attock 5: BARI, Bahawalpur

Table 7. Reaction of 096CG010 to Tikka disease (*Cercospora personatum*) under natural condition at BARI, Chakwal during 2001.

Line/Entry	Reaction to Tikka disease (%)
96CG010	**0.4**
98CG003	0.9
Chakori	2.0
BARI-2000	1.0
96CG004	1.0
98CG002	1.5
96CG008	3.0

Table 8. Important agronomic/morphological/qualitative characteristics of groundnut variety "Golden".

Characters	Description
Days to flowers initiation (days)	45
Days to maturity (days)	165-175 days
Plant height (main stem)	33.2 cm
Pods per plant (average)	54.0
Seed per pod	1.71
100 seed weight (g)	51.0
Seed protein (%)	26.7
Oil content (%)	50.36
Average pod yield	2413 kg ha^{-1}
Potential pod yield	4100 kg ha^{-1}
Distinct character	Reddish seed coat colour
Sowing date	20th March to 30th April

Discussion

Groundnut variety "Golden" has bean developed through induced mutation following pedigree method from M_1 to M_7 generations. Groundnut mutants with different traits have been developed through induced mutation and their direct and indirect utilization has resulted in the release of commercial varieties (Murty *et al*., 2004). Improvement in seed yield and its components through induced mutation have also been reported in chickpea and mungbean (Khattak *et al*., 2007, 2008).

"Golden" manifested improvement in the form of increase in seed size and pods per plant. Branch (2002) detected large–seeded mutant breeding lines in the "Georgia Browne" cultivar of peanut. Large seed size has also been reported an important seed yield contributing factor in chickpea by many researchers (Mehla *et al*., 2000; Waldia *et al*., 1996). This variety exhibited tolerance to a famous groundnut disease Tikka caused by *Cercospora personatum*. The distinct character of "Golden" is its reddish seed coat colour which distinguishes it from the rest of the groundnut varieties cultivated in the area. Earlier many seed coat colours have been identified through induced mutations in groundnut (Suvendu *et al*., 2007).

References

Ahloowalia, B.S., M. Aaluszynski and K. Nichterlein. 2004. Global impact of mutation derived varieties. *Euphytica*, 135: 187-204.

Branch, W.D. 2002. Variability among advanced gamma-irradiation induced large-seeded mutant breeding lines in the 'Georgia Brownw' peanut cultivar. *Plant Breeding*, 121:275

Gaur, P.M., V.K Gour and S Srinivasan. 2007. An induced brachytic mutant of chickpea and its possible use in ideotype breeding. *Euphytica*, 159(1-2): 35-41.

Hassan, S., A.J. Khan, R. Zamir, G.S.S. Khattak and M. Tariq. 2001. Gamma rays induced high yielding Kabuli type chickpea mutant variety "Hassan-2K". *Pak. J. Bot*., 33: 703-707.

Khatri, A., I.A. Khan, M.A. Siddiqui, S. Raza and G.S. Nizamani. 2005. Evaluation of high yielding mutant of *Brassica juncea* cv. S-9 developed through gamma rays and EMS. *Pak J. Bot*., 37(2): 279-284.

Khattak, G.S.S., I. Saeed and S.A. Shah. 2008. Breeding high yielding and disease resistant mungbean (*Vigna radiata* (L.) Wilczek) genotypes. *Pak. J. Bot.*, 40(4): 1411-1417.

Khattak, G.S.S., M. Ashraf, R. Zamir and I. Saeed. 2007. High yielding desi chickpea (*Cicer arietinum* L.) variety "NIFA-2005". *Pak. J. Bot*., 39(1): 93-102.

Maluszynski, K.N., L.V. Zanten and B.S. Ahlowalia. 2000. Officially released mutant varieties. The FAO/IAEA Databse. *Mut. Breed. Rev*., 12: 1-12.

Mehla, I.S., R.S. Waldia, V.P. Singh, V.S. Lather and S.S. Dahiya. 2000. Association of seed mass groups and seed yield in kabuli chickpea. *International Chickpea Newsletter*, 7: 7-8.

Micke, A. 2004. Mutation breeding of grain legumes. *Journal of Plant and Soil*, 152 (1): 81-85.

Murty, G.S.S., A.M. Badigannavar, S. Mondal and D.M. Kale. 2004. Research and impact of groundnut mutation breeding in India. In: *Groundnut Research in India*, (Eds.): M.S. Basu and N.B. Singh, NRCG, Junagadh, India pp. 57-69

Naeem-ud-Din, G. Shabbir, M. Ramzan and A. Mahmood. 2005. BARI-2000: A new bold seeded, semi bunch groundnut variety. *PJST*., Vol. 1(6).

Steel, R.G.D and J.H. Torrie. 1980. *Principles and procedures of statistics*. Mc Graw Hill, New York.

Suvendu M., A.M. Badigannavar, D.M. Kale and G.S.S. Murty. 2007. Induction of genetic variability in a disease-resistant groundnut breeding line. *BARC. Newsletter*. Issue No. 285: 237-247.

Waldia, R.S., V.P. Singh, D.R. Sood, P.K. Sardana and I.S. Mehla. 1996. Association and variation among cooking quality traits in kabuli chickpea (*Cicer arietinum* L.). *J. Food. Sci. Tech*., 33(5): 397-402.

(Received for publication 17 July 2009)