

DEVELOPMENT OF BARI-2011: A HIGH YIELDING, DROUGHT TOLERANT VARIETY OF GROUNDNUT (*Arachis hypogaea* L.) WITH 3-4 SEEDED PODS

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ABSTRACT

BARI-2011 is the first groundnut variety in Pakistan which was developed through hybridization procedure. This high yielding groundnut variety recently approved was developed from a cross PW x Chico. The cross was attempted during 1992 at BARI, Chakwal. F₁ to F₇ generations were raised at Barani Agricultural Research Institute (BARI), Chakwal. Selection was done following pedigree method for high yield, more number of seeds per pod and good plant type. On the basis of its performance in yield trials, Punjab Seed Council approved it as a commercial variety under the name BARI-2011 for general cultivation in January, 2011. This variety on an average gave 26.1% better yield than all check varieties; No.334, Chakori, BARD- 479, BARI-2000 and Golden. Average and potential pod yield of BARI-2011 is 2500 and 6300 kg ha⁻¹, respectively. In addition, BARI-2011 is drought tolerant, has more shelling percentage and has resistance against *Cercospora* Leaf Spot (Tikka disease) and root rot. Variegated seed coat colour and 3-4 seeded pods are the distinguishing characteristics from other existing groundnut varieties.

Key words: Groundnut, High yielding, Drought tolerant, Variegated, Seed Coat Colour, 3-4 seeded pods.

INTRODUCTION

Groundnut is a kharif cash crop grown on well-drained sandy loam soils in marginal lands of Pakistan. It is important oil seed crop as well as food and feed crop. Its kernel is rich in both oil (43-55%) and protein (25-28%). In Pakistan, it is utilized as roasted nuts, salting and in confectionery. It is not only grown for grain yield but also the haulm is important by-product used for livestock feed.

In Punjab, Rawalpindi region (Chakwal, Attock, Jhelum and Rawalpindi) is major groundnut growing area in the country where unpredictable environmental conditions, uncertain rainfalls and water shortage are limiting factors due to which per hectare yield of this crop is very low. Other limiting factors include unavailability of high yielding adapted varieties having characters like more pod length, more number of seeds per pod (3-4), larger seed size and more shelling percentage. For these areas there is dire need to develop such high yielding varieties having resistance to biotic and abiotic stresses, especially drought stress which limit the crop productivity.

New variety development in field crops has significantly role to enhance the production of different field crops (Sadiq et al, 1999, Haq et al., 2002, Naeem-ud-Din et al. 2005, Naeem-ud-Din et al., 2009). Groundnut yield in rain fed areas has been limited by drought stress because pod yield and other growth parameters have been severely affected (Pimratch et al., 2008;; Awal and Ikeda, 2002; Nautiyal et al., 2002;

Reddy et al., 2003; Nigam et al., 2005). The groundnut is mostly self pollinated crop, however, somewhat out crossing occurs. The natural out crossing measured in groundnut at 0.27% (1969) and 0.99% (1970) have been reported (Stone, 1973). Although in groundnut it is very difficult to hybridize. But hybridization method is main procedure in plant breeding to create genetic variability. The basic crossing techniques and numerous aids and modifications have been reviewed (Norden, 1980).

The major objective of development of BARI-2011 was to give a variety alternate to Valencia (Parachannar variety), which have three to four seeded pods with red seed coat color but not adaptable in pothwar region, for the farmers of the Punjab.

MATERIALS AND METHODS

BARI-2011 (2KCG020) is an elite high yielding groundnut variety which was developed from a cross PW x Chico. The cross was attempted during 1992 at Barani Agri. Research Institute, Chakwal. PW; pink and white is vergenia type, variegated seed coat colour as shown by its name, medium leaf size and 10-15% 3-seeded pods. Chico is Spanish type early maturing, small and compact pods Indian variety. Selection following pedigree method was continued up to F₅ generation. F₁ to F₄ generations were raised for consecutive selection as plant to progeny rows along with parents from 1993-1996. Selection was made on the basis of semi-spreading/semi-erect plant type, number of seeds/pod, pod length, number of pods per plant and drought tolerance under natural drought

conditions. In F₅ generation, uniform promising lines were selected on the basis of desired traits and their breeding behavior confirmed as progeny rows in F₆ and F₇ generation from 1997-1999. Twenty-two lines were selected and evaluated in replicated yield trials along with standard checks in preliminary yield trials at BARI Chakwal. After continuous selection these lines were tested in regular and advanced yield trials at BARI, Chakwal during 2000 to 2003. The line 2KCG020 along with existing varieties as check was further evaluated in advanced varietal, zonal varietal and national uniform yield trials at BARI, Chakwal and different locations in groundnut areas of the country during 2002 to 2009 as mentioned in Table.1.

All replicated yield trials were conducted using RCBD with plant and row spacing of 15 and 45 cm, respectively. All the results of yield trials were analyzed according to the Steel *et al.* (1997) and Singh and Chaudhry (2004). On the basis of desirable traits and better yield performance, 2KCG020 was approved as a commercial variety 'BARI-2011' for general cultivation during the year 2011.

RESULTS AND DISCUSSION

BARI-2011 was developed at the Barani Agricultural Research Institute, Chakwal from a cross between PW and Chico. Selection following pedigree method was continued up to F₇ generation. It was further evaluated in different yield trials for nine years from 2000 to 2008 under the name of 2KCG020/ BC-176. Developmental history of 'BARI-2011' is given in Table-1. BARI-2011 has distinct characters to distinguish from other approved groundnut varieties viz., variegated seed coat color, 3-4 seeded long pods and more shelling percentage. BARI-2011 was evaluated for pod yield in preliminary (A), regular (B) and advance (C) yield trials for 2000 to 2003 (Table 2).

The data show that in preliminary yield trial, 2KCG020 yielded 2014 kg pods/ha which is 19.17 % higher than variety Chakori (Check) in regular yield trial, it gave the highest pod yield of 2092 kg/ha which is 15.33 % higher than the check variety. In advance yield trials, on the basis of average of two years (2002-03), 2KCG020 gave 17.45% higher pod yield over the check variety but in 2002 (21.26%) and 2003(14.62%) higher pod yield (Table.2). The data presented in Table-3 indicate that on the average of two years (2004-05), in advance varietal yield trial at BARI, Chakwal, 2KCG020 (BARI-2011) produced the highest pod yield (2841.5 kg/ha) which is 10.50, 26.15 and 54.43% higher than check varieties BARI-2000, Golden and No.334, respectively.

On an average of twenty different locations in zonal varietal yield trial, 2KCG020 gave the highest pod yield (2038 kg/ha) which is 9.69, 19.81 and 63.69% higher than check varieties; Golden, BARI-2000 and

No.334, respectively (Table.4). Yield performance of 2KCG020 (BARI-2011) was also found better in National Uniform Yield Trials during 2002, 2003 and 2008 as compared with check varieties; BARD-479 and BARI-2000 (Table-5). Where on the average of three years, 2KCG020 showed 7.89 and 24.67% higher pod yield than check varieties BARD-479 and BARI-2000, respectively.

2KCG020 also gave the highest shelling percentage among all test entries as shown in Table 6. High pod yield is coupled with more shelling percentage (Liang *et al.*, 1996). It is revealed from the data as shown in Table 7, that 2KCG020 (BARI-2011) gave higher pod yield when sown from 20th March to 20th May at BARI, Chakwal. In addition, 2KCG020 has also resistance against Cercospora Leaf Spot (Tikka disease) and root rot as presented in Table 8. The data showed that new groundnut cultivar (BARI-2011) has resistance to diseases, Cercospora Leaf Spot (Tikka disease) and root rot as indicated resistance pattern by Nasir and Novita (1996).

Fifty experiments were conducted for yield evaluation of 2KCG020 in different trials and locations during nine years (2000-2008). This genotype gave 26.1% more yield over all existing check varieties viz. No.334, Chakori, BARD-479, BARI-2000 and Golden as shown in Table 9.

Important agronomic and morphological characteristics of 2KCG020 (BARI-2011) are given below:

Description of agronomic and morphological traits of the variety

Days to flowering	30
Seed colour	Variegated (Pink & white colour)
Seed length	1.60 cm
Seed width	0.70 cm
100-Seed weight	55-60 g
Seeds per pod (Av)	2.4
20-pods length	70-75 cm
Pods per plant	50
Leaf size	Medium
Plant height	30.0 cm
Tolerant	Early Tikka disease
Shelling percentage	65-70
Days to maturity	155-170
Oil contents	50%
Protein contents	27.3%
Calcium	57.5 mg/100g
Yield potential	6300 kg/ha
Average yield	2499 kg/ha

Approval of the line 2KCG020 as new variety: BARI-2011 is not only a high yielder, drought tolerant variety having 3-4 seeded pods and more shelling percentage but is also best suited for late sowing. BARI-2011 is more

popular in farmers and traders due to its market value and demand. The variety has the potential of replacing

approved groundnut varieties. It was approved for general cultivation during 2011 by Punjab Seed Council, Lahore.

Table 1: Different developmental stages of BARI-2011

S. No.	Year	Generations/Trials
1-	1992	F ₀ 42 Crosses attempted (Hybridization work)
2	1993	F ₁ 42 Generations
3-	1994	F ₂ 32 Progenies evaluated and selection of single plants
4-	1995	F ₃ 235 Progenies evaluated and selection for yield and other characters
5-	1996	F ₄ 207 Progenies evaluated and selection for yield and other characters
6-	1997	F ₅ 191 Progenies evaluated and selection for yield and other characters
7-	1998	F ₆ 74 Progenies evaluated and selection for yield and other characters
8-	1999	F ₇ 50 Progenies evaluated and 22 lines were selected for inclusion in PYT
9-	2000	PYT Preliminary Yield Trial (2 sets)
10-	2001	RYT Regular Yield Trial
11-	2002	Advance Yield Trial + National Uniform Yield Trial
12-	2003	Advance Yield Trial + National Uniform Yield Trial + Fertilizers Trial
13-	2004	Advance Varietal Yield Trial + Sowing Date Trial + Fertilizers Trial
14-	2005	Advance Varietal Yield Trial
15-	2006	Zonal Varietal Yield Trial (4 Rainfed and 5 irrigated conditions) + Fertilizers Trial
16-	2007	Zonal Varietal Yield Trial (7 Locations) + Fertilizers Trial
17-	2008	Zonal Varietal Yield Trial (4 Locations) + National Uniform Yield Trial
18-	2009	Spot Examination

Table 2: Pod yield performance of 2KCG020 (BARI-2011) in yield trials at BARI, Chakwal

Trials	Year	2KCG020	Chakori	Yield increase (%) over Check	LSD (0.05%) Kg/ha	CV%
Preliminary (A)	2000	2014	1690	+ 19.17	918.0	14.43
Regular (B)	2001	2092	1814	+ 15.33	570	19.76
Advance (C)	2002 2003	2852	2352	+21.26	429	11.02
		3630	3167	+14.62	518	9.85

Table 3: Pod yield performance (kg/ha) of groundnut genotypes in advance varietal yield trial

S. No.	Entries	Pod yield 2004	Pod yield 2005	Mean yield increase (%) over Checks
1.	2KCG020	2280a	3403a	-
2.	BARI-2000	1824b	3319a	+10.50
3.	Golden	1609b	2896b	+26.15
4.	No.334	-	1840c	+54.43
LSD (0.05)		369	284	
CV%		12.99	10.90	

Table 4: Pod yield (kg/ha) of groundnut cultivars in zonal varietal trial

S. No.	Entries	2006 (Rainfed)	2006 (Irrigated)	2007	2008	Yield increase (%) over Checks
1-	2KCG020	2331a	1721a	2595a	1506a	-
2-	02CG005	1996b	1199b	-	-	+27.61
3-	BARI-2000	1983b	1507a	1930b	1385b	+19.81
4-	Golden	2148ab	1651a	2201b	1432ab	+9.69
5-	No.334	1245c	-	-	-	+63.69
LSD (0.05)		296.1	241.0	291.0	165.0	
CV%		9.90	11.51	10.57	6.62	

Table 5: Overall yield performance (kg/ha) of 2KCG020 in NUYT during 2002, 2003 and 2008.

Year	Locations	2KCG020	BARD-479	BARI-2000
2002	5	4050	4286	-
2003	6	2568	2183	-
2008	7	2815	2398	2258
Mean		3076	2851	2258
Yield increase (%) over BARD-479		+ 7.89		
Yield increase (%) over BARI-2000		+ 24.67		

Table 6: Shelling percentage of groundnut genotypes in NUYT at five different locations during 2003

Entries	NARC	Faisalabad	Chakwal	Quetta	Mingora	Mean
2KCG020	73 ab	65 a	69 a	75 a	63 d	69.0 a
ICGV-92023	75 a	65 a	63 b	69 ab	67 b	67.8 ab
ICGV-92028	59 d	63 ab	68 a	76 a	72 a	67.6 ab
ICGV-92052	72 ab	62 ab	55 d	73 ab	66 bc	65.6 ab
ICGV-93128	70 b	64 ab	66 ab	65 b	59 e	64.8 ab
01CG009	62 d	55 ab	64 b	74 a	65 bc	64.0 ab
BARD-479 (c)	66 c	60 ab	63 b	69 ab	60 e	63.6 ab
ICGV-93164	60 d	57 ab	59 c	72 ab	64 cd	62.4 ab
LSD (0.05)	3.49	10	3.25	8.63	2.96	5.72
CV%	2.93	9.27	2.93	6.89	2.62	6.73

Table 7: Average pod yield (kg/ha) at different sowing dates during 2004

S. No.	Genotypes	Ist. March	20 th March	10 th April	30 th April	20 th May	10 th June	30 th June	Mean
1.	Golden	1766	1657	1526	1585	1596	1526	1402	1580 c
2.	2KCG020	1763	1870	2067	1907	1763	1598	1524	1789 a
3.	BARI-2000	1648	1737	1826	1793	1644	1533	1454	1662 b
Sowing Date	Genotype	Sowing date x Genotype	LSD (0.05)	99.2	52.9	140.0	CV%	4.99	

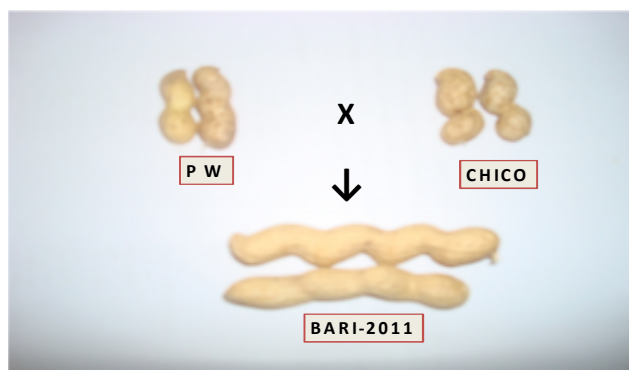
Table 8: Observations regarding disease incidence

Variety/candidate line	Wilt %	Root Rot %	Alternaria %	Tikka %	Mosaic or virus disease	Remarks
BARI-2011 (2KCG020)	1	-	2	1	-	At BARI, Chakwal
BARI-2000 (c)	4	-	10	4	-	-do-
Golden (c)	3	-	7	3	-	-do-
BARI-2011 (2KCG020)	2	-	2.5	1	-	At farmer's field Spot 1
2KCG020	1.5	-	2.0	1.50	-	Spot 2
Local variety (No.334)	40	10	25	80	-	Near Spot 2

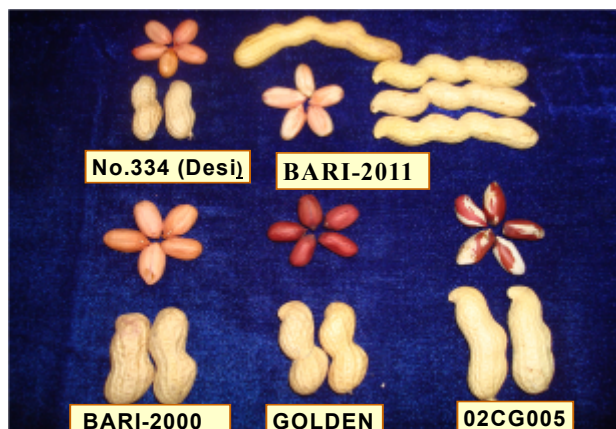
Table 9: Average yield performance (kg/ha) of 2KCG020 (BARI-2011) in 50 experiments

Year	Name of Trial	Trials	2KCG020	Golden	BARI-2000	Chakori	BARD-479	No.334
2000	PYT	1	2014	-	-	1690	-	-
2001	RYT	1	2092	-	-	1814	-	-
2002	AYT	1	2852	-	-	2352	-	-
2003	AYT	1	3630	-	-	3167	-	-
2002	NUYT	5	4050	-	-	-	4286	-
2003	NUYT	6	2568	-	-	-	2183	-
2008	NUYT	7	2815	-	2258	-	2398	-

2004	AVYT	1	2280	1609	1824	-	-	-
2005	AVYT	1	3403	2896	3319	-	-	1840
2006	ZVYT(RF)	4	2331	2148	1983	-	-	1245
2006	ZVYT (Irri)	5	1721	1651	1507	-	-	-
2007	ZVYT	7	2595	2201	1930	-	-	-
2008	ZVYT	4	1505	1432	1385	-	-	-
2004	S. D. Trial	1	1789	1580	1662	-	-	-
2006	S. D. Trial	1	1857	1367	1734	-	-	-
	(Karor)							
2003	Fert. T.	1	2455	-	-	-	-	-
2004	Fert. T.	1	1888	-	-	-	-	-
2006	Fert. T.	1	1135	1016	-	-	-	-
2007	Fert. T.	1	2088	2034	-	-	-	-
Average % increase over check varieties				12.76	20.85	17.33	7.89	86.58
Overall % increase on checks				+ 26.1				



3-4 SEEDED PODS OF BARI-2011



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