RESEARCH ARTICLE

SABRAO Journal of Breeding and Genetics
54 (4) 733-741, 2022
http://doi.org/10.54910/sabrao2022.54.4.5
http://sabraojournal.org/
pISSN 1029-7073; eISSN 2224-8978

ATTOCK-2019: A HIGH-YIELDING AND DISEASE-TOLERANT PEANUT (*ARACHIS HYPOGAEA* L.) CULTIVAR FOR BARANI TRACT OF PUNJAB, PAKISTAN

M. HUSSAIN[1], S. ALI[2], M. ZEESHAN[3*], G. NABI[1], SAADIA[1], W. MUZAFFAR[1], M. SAEED[4], and B. AHMAD[5]

[1]Groundnut Research Station, Attock, Pakistan
[2]Barani Agricultural Research Institute, Chakwal, Pakistan
[3]Barani Agricultural Research Station, Fatehjang, Pakistan
[4]Plant Pathology Research Institute, AARI, Faisalabad, Pakistan
[5]Soil and Water Testing Laboratory, Attock, Pakistan
*Corresponding author's email: mzee713@gmail.com
Email addresses of co-authors: shirazbars@gmail.com, drgnabi1965@gmail.com, saadia_true@yahoo.com, grsattock057@yahoo.com, wardah.muzaffar@gmail.com, muhammadsaeedsri271@gmail.com, swtlatk@gmail.com

SUMMARY

Attock-2019 (11AK011) is an elite high-yielding, disease-tolerant, bunch-type (decumbent-2) groundnut (*Arachis hypogaea* L.) cultivar, developed at the Groundnut Research Station, Attock, Punjab, Pakistan. The cultivar resulted from the local crossing between two advanced lines, i.e., 01CG001 and 02CG005. The first cross attempt occurred during the 2005 cropping season at the Groundnut Research Station, Attock, and the selection underwent the pedigree method that continued up to the F_6 generation. Attock-2019 underwent evaluation regarding its performance concerning yield, disease resistance, and adaptability to numerous yield trials like preliminary, regular, micro-, and national uniform yield trials, including evaluation at farmer fields and agronomic parameters, during 2012-2018, under the varietal code 11AK011. It out-yielded the check cultivar BARI-2011 in micro-yield trials for two consecutive years in Punjab by producing 19.52% and 17.96% yields higher than the said cultivar. Similarly, at the national level, during the national uniform groundnut yield trials in 2016 and 2017, it surpassed the check cultivars Golden and Pothowar by 30.74% (Golden) and 3.46% (Golden and Pothowar), respectively, in different ecological zones of Pakistan. This genotype is of medium duration, with 20%–25% three-seeded pods per plant. The average number of pods per plant ranged from 85–95. Its shelling percentage is high (70%–72%), with a good 100-seed weight (62-66 g). It also possessed good taste, oil content (40.5%), and protein content (21.6%). The cultivar also showed good performance under drought-stress conditions and tolerance to diseases like the Tikka disease and collar rot of groundnut. Attock-2019 can be sown from 1 April to 15 May under Barani conditions of Punjab, with 30:80:30 NPK kg ha^{-1} at sowing time and an application of 500 kg ha^{-1} gypsum at the flowering stage. Attock-2019 gained approval for general cultivation in the Punjab Barani tract during the 2021 in 54th Punjab Seed Council Meeting as the approving authority.

Keywords: Attock-2019, disease resistant, groundnut, high yielder, variegated seed-coat color

Key findings: Attock-2019 is the prime find of the Groundnut Research Station, Attock that proves beneficial for the farming community in the Barani tract of the Punjab Province.

Communicating Editor: Dr. Osama Osman Atallah

Manuscript received: July 18, 2022; Accepted: October 10, 2022.

To cite this manuscript: Hussain M, Ali S, Zeeshan M, Nabi G, Saadia, Muzaffar W, Saeed M, Ahmad B (2022). Attock-2019: A high-yielding and disease-tolerant peanut (*Arachis hypogaea* L.) cultivar for barani tract of Punjab, Pakistan. *SABRAO J. Breed. Genet.* 54 (4) 733-741. http://doi.org/10.54910/sabrao2022.54.4.5

INTRODUCTION

Peanut (*Arachis hypogaea* L.), widely grown worldwide (Aninbon *et al*., 2016), serves as the world's 13th most important food crop. Considered the fourth essential source of edible oil, it also ranks the third most central source of vegetable protein. Asia and Africa produce 58.3% and 31.6%, respectively, comprising about 90% of the world's total production. China ranks the highest producer with 18.08 million t, while India and Nigeria produce 9.9 million t and 4.49 million t, respectively (FAOSTAT, 2020). Groundnut seeds supply rich sources of high quality edible oil (43%–55%), easily digestible protein (25%–32%), and carbohydrates (20%). Worldwide, 50% of the total produced peanuts serve for oil extraction, 37% for direct food use, and 12% for seed purposes (ICRISAT, 2008). Groundnut crop receives great priority around the globe due to abundant benefits in different aspects. The haulms of the groundnut crop were reported as important sources of animal feed and high crude protein (Tolera, 2008; Yami *et al*., 2008). Being a leguminous crop, it fixes atmospheric nitrogen into soil through the nodules in its roots and also aids in soil fertility and less dependency on artificial application of nitrogen fertilizer (Mokgehle *et al*., 2014).

In Pakistan, the growing area of peanuts covered about 98,600 ha, with a total production of 97,300 t during 2018–2019 (Table 1). About 94.22%, 5.17%, and 0.60% area lies in the Punjab, KPK, and Sindh provinces, respectively (Anonymous, 2018-19). Pakistan accounts for only 0.4% of the global groundnut area and 0.2% of its production. Groundnut contributes 70% to the total edible oil production in India, whereas in Pakistan, its contribution as edible oil seemed negligible due to its consumption mostly as roasted nuts and usage in confectionery products. The national average yield of Pakistan ranged from 800 to 1,100 kg ha^{-1}, which is one-fourth less than the potential yield of existing cultivars. The low yield mainly results from the non-cultivation of high-yielding approved cultivars, good quality seed, and non-adaptation of crop production technologies.

Table 1. Groundnut (*Arachis hypogaea* L.) area, production, and yield (kg ha^{-1}) in various years.

Year	Area (000 ha)		Production (000 t)		Yield (kg ha^{-1})	
	Punjab	Pakistan	Punjab	Pakistan	Punjab	Pakistan
2012-13	74.4	81.7	71.7	81.3	964	919
2013-14	86.1	93.8	90.0	100.8	1045	1075
2014-15	89.2	96.3	76.8	86.0	861	893
2015-16	84.0	91.9	80.6	91.7	960	998
2016-17	83.2	91.1	63.7	74.7	766	820
2017-18	92.8	99.1	78.7	86.1	848	869
2018-19	92.9	98.6	90.7	97.3	976	987

In Pakistan, the conventional use of peanut includes raw, roasted nimko, and confectionery products. Aside from its grain as an economic product, the use of its haulm feeds domestic livestock (Naeem-Ud-Din *et al*., 2012). Groundnut is cash crop of the Kharif season, usually grown on sandy loam and well-drained soils in Pakistan. The country's districts of Chakwal, Jhelum, Attock, Rawalpindi, Sahngar, Karak, and Swabi composed the major groundnut-growing areas (Naeem-Ud-Din *et al*., 2009; Ahmed *et al*., 2016). Rawalpindi division, including districts of Attock, Jehlum, Chakwal and Rawalpindi itself, served as the major producing area of peanut crops in Punjab. The districts of Chakwal and Attock cover 43% and 30% of the total area of Punjab, cultivating and producing 61% and 30% of total peanut production, respectively (Anonymous, 2021-22). However, peanut per hectare pod yield in the country exhibited low due to uncertain rainfall, insufficient application of inputs, unpredictable environmental factors, and unavailability of quality seeds of new disease-resistant high-yielding cultivars.

New genetic material and cultivars contribute significantly to overall quality and efficiency in crop production (Naeem-Ud-Din *et al*., 2005). Being a highly self-pollinated crop, the hybridization of peanuts becomes difficult (Naeem-Ud-Din *et al*., 2009). But on the other hand, hybridization is a key method to create genetic variation in crop plants (Kalve and Tadege, 2017) for better yield and yield components. The development of new and improved high-yielding and disease-resistant cultivars is always needed by farmers worldwide.

The main objective in the development of Attock-2019 focused on providing a cultivar that has major market characteristics, such as, long pods, number of seeds/pod, and pod color. In addition, Attock-2019 has resistance against *Cercospora* leaf spot (Tikka disease). Attock-2019 has distinct characteristics to easily and clearly distinguish it from the other available and approved commercial groundnut cultivars in the area, with its variegated seed-coat color (white-pink), elongated seed, and presence of three-seeded pods up to 20%–25%. The latest study presents the findings on the development of Attock-2019 (11AK011), suitable for general cultivation in the Barani tract of Punjab Province.

MATERIAL AND METHODS

Location

The experimental site situates within an elevation range of 33° 46′ 20″N latitude 72° 22′ 6″E longitude, above sea level, with temperature typically varying from 3.9°C to 40°C, but rarely below 1.1°C or above 43.9°C, with an annual average rainfall of 902 mm. Field experiments proceeded on sandy loam soil at the research area of the Groundnut Research Station, Attock Punjab, Pakistan.

Soil analysis

Composite soil samples collection at depths of 0–15 and 16-30cm before planting ensued. The soil profile comprised sandy loam, non-saline, and non-sodic, having a neutral pH of 7.9. The soil of the experimental area contained 0.61% organic matter, 0.038% nitrogen (N), 11.5 ppm available phosphorus, and 1.45 ppm available potassium (K), with EC 0.25 dS/m.

Developmental procedure

Attock-2019 emerged as an elite high-yielding groundnut (*Arachis hypogaea* L.) line, derived from the cross of 01CG001 × 02CG005, which took place in 2005 at the Groundnut Research Station, Attock, Pakistan. Selection through the pedigree method continued up to the F_6 generation for disease resistance, number of pods per plant, high shelling percentage, and other agronomic parameters like growth habit and pod formation. Further evaluation occurred in different yield trials for seven years, from 2012 to 2018, under the name 11AK011. Preliminary and regular yield trials transpired at the Groundnut Research Station, Attock, in 2012 and 2013. The sown trials included randomized complete block design (RCBD) in three replications, with a row-to-row spacing of 45cm and plant-to- plant distance maintained at 10cm. The regional level studies also materialized in 2014 and 2015, as well as, micro yield trials, at two different locations, i.e., the Barani Agricultural Research Institute (BARI), Chakwal, and the Groundnut Research Station (GRS), Attock was pitted against a check cultivar, BARI-2011, in RCBD with sandy loam soils and natural field conditions.

Continued evaluation of genotype 11AK011 took place in the National Uniform Yield Trial in 2016 and 2017, all over the country, under different climatic conditions. In the same years, genotype testing ensued in three different locations of Punjab viz., BARI, Chakwal; GRS, Attock; and AZRI, Bahawalpur, against two check cultivars, Golden and Pothowar. In 2016, eight entries, including 11AK011 and check cultivar, underwent evaluation in RCBD, with a plot size of 7.2 m^2, while in 2017, 10 groundnut lines evaluation included two check cultivars at a plot size of 7.2 m^2. Application of basal dose of fertilizer NPK @ 30:80:30 kg ha^{-1} to all the experiments over the years transpired while gypsum application @ 500 kg ha^{-1} ensued to the trials at the time of flowering to facilitate the peg penetration into the soil and to form healthy pods.

Further evaluation on the genotype 11AK011 progressed in 2017 and 2018, at different farmer fields in district Attock, against the latest check cultivar, BARI-2016. The conduct of experiments related to seed rate, sowing dates, and fertilizer requirements of the line determined production technology optimization through various agronomic studies. Evaluation of different sowing dates (beginning 10 March to 30 April) proceeded over two consecutive years at the research station, as well as, studies on different seed rates, ranging from 125 to 200 kg ha^{-1} dry pods. Identifying the optimum fertilizer dose for 11AK011 took place for recommendation to farmers for general cultivation, using different combinations of fertilizers of NPK kg ha^{-1} (0:0:0, 10:80:30, 20:80:30, 30:80:30, 30:0:30, 30:40:30, 30:120:30, 30:80:0, 30:80:10, and 30:80:20). Data gathering on the disease resistance for Tikka disease (*Cercospora* leaf spot) ensued due to its crucial effect on yield reduction. Likewise, the determination of oil and protein parameters at maturity used the Nuclear Magnetic Resonance (NMR) spectrophotometer and Bunchi Auto

Kjeldhal Model K-370, respectively (Anonymous, 1995).

Layout and statistical analysis

The main yield contributing factors included the number of primary branches per plant, number of pods per plant, yield per plant, 100-kernel weight, and shelling percentage. The evaluation period recorded observations from 10 randomly selected plants. The data recorded throughout the developmental period for each trait underwent statistical analysis of variance to establish the significant means of values following Steel *et al*. (1997) and the least significant difference (LSD) test at 5%, using the Statistixs 8.1 software.

RESULTS AND DISCUSSION

The breeding history of a peanut (*Arachis hypogaea* L.) cultivar, Attock-2019 (11AK011), and its hybridization program began in 2005 (Table 2). From 2006 to 2011, its evaluation in filial generation and selections proceeded for desirable traits during filial generations up to F_6. From F_6, the selection of a promising line resulted, and was given the code name 11AK011. Its evaluation continued in station yield trials in 2012 and 2013, then progressed at the provincial level in 2014 and 2015, along with agronomic studies. Its evaluation at the National Uniform Groundnut Yield Trial transpired in 2016 and 2017, simultaneously with farmer field evaluations also during 2017 and 2018. Through an event of spot examination on 26 September 2019, all requirements for cultivar evolution at field experiments were satisfied.

Station Yield Trial Evaluation

The results regarding yield data appear in Table 3. In 2012, the Preliminary Groundnut Yield Trial showed 11AK011 with an average dry pod yield of 3,421 kg ha^{-1} outperforming BARI-2011 (check) by 5.44% more yield, with only 3,034 kg ha^{-1}. Based on Table 3, genotype 11AK011 gave 15.47% more yield than the check cultivar BARI-2011 by producing 2,686 kg $ha^{-1}$and 2,326 kg ha^{-1}, respectively, in regular groundnut yield trials during 2013.

Micro Groundnut Yield Trial

After the Station yield trials exhibiting the 11AK011 performed better than the check cultivar, a decision to further evaluate it in different ecological conditions of the Punjab followed. Hence, its study in the Micro Groundnut Yield Trial in Chakwal and Attock conditions during 2014 and 2015 took place. Genotype 11AK011 showed 19.52% and 17.96% yield increases against BARI-11 (check cultivar) at both locations during the years,

Table 2. Developmental history of the new groundnut advance line, 11AK011.

No.	Year	Generations/Trials
1	2005	Hybridization work
2	2006–2011	Segregating filial generations
3	2012	Preliminary Groundnut Yield Trial
4	2013	Regular Groundnut Yield Trial
5	2014 and 2015	Groundnut Micro Yield Trial + Agronomic Studies
6	2016	National Uniform Yield Trial
7	2017	National Uniform Yield Trial + Farmer Field Evaluation
8	2018	Farmer Field Evaluation
9	2019	Spot examination on 26t September 2019
10	2020	80th Expert Sub Committee Meeting on 27 July 2020
11	2021	54th Punjab Seed Council Meeting on 28 January 2021

Table 3. Yield performance of Attock-2019 (11AK011) in PYT, RYT, and MYTs.

No.	Year	Name of trial	Attock-2019	BARI-2011 (C)	% increase over check
1	2012	Preliminary Yield Trial	3930	3727	+5.44
2	2013	Regular Yield Trial	2685	2326	+15.47
3	2014	Micro Yield Trial	3236	2920	+19.52
4	2015	Micro Yield Trial	3833	3166	+17.96
Average yield (kg ha^{-1})			3421	3034	12.75
% increase over check				12.75	

Table 4. Yield performance of Attock-2019 at the National Uniform Groundnut Yield Trial (NUGYT) 2016 to 2017 in Punjab.

No	Locations	Dry pod yield (kg ha^{-1})				
		2016		2017		
		Attock-2019	Golden (C)	Attock-2019	Golden (C)	Pothowar (C)
1	GRS, Attock	2977	1888	5468	4876	4721
2	BARI, Chakwal	740	623	880	1360	1366
3	AZRI, Bahawalpur	2700	2397	2608	2638	2352
	Average	2139	1636	2985	2958	2813
Percent increase over check		-	+30.74	-	+0.91	+6.11

Table 5. Yield comparison of Attock-2019 and check cultivars.

Year	Trial	Locations	Dry Pod Yield (kg ha^{-1})			
			Attock-2019	BARI-2011 (Check)	Golden (Check)	Pothowar (Check)
2012	PYT	1	3930	3727	-	-
2013	RYT	1	2685	2326	2328	-
2014	MYT	2 (Attock, Chakwal)	3403	2847	-	-
2015	MYT	2 (Attock, Chakwal)	3500	2967	-	-
2016	NUGYT	3 (Attock, Chakwal, Bahawalpur)	2139	-	1636	-
2017	NUGYT	3 (Attock, Chakwal, Bahawalpur)	2985	-	2958	2813
Mean (kg ha^{-1})			3107	2967	2307	2813
Yield increase (%) over checks				+4.71	+34.67	+10.45
Over all yield increase (%)			+15.24			

respectively (Table 3). Collectively, genotype 11AK011 exhibited a 12.75% yield increase over check cultivar in the Preliminary, Regular, and Micro Yield Trials. A higher yield of Attock-2019 (11AK011) than the check cultivar (BARI-11) seemed due to a higher shelling percentage and more 100-seed weight. Attock-2019 also possessed up to 20%–25% three-seeded pods with variegated seed-coat color (white-pink).

National Uniform Groundnut Yield Trial (NUGYT)

After satisfactory performances in the station and provincial yield trials, an evaluation of 11AK011 (Attock-2019) proceeded in the National Uniform Groundnut Yield Trials, for two consecutive years (2016 and 2017), at three locations in Punjab (Table 4). Attock-2019 was tested against the competitive check cultivar "Golden."

On average, Attock-2019 gave a higher pod yield (2,139 kg ha^{-1}) over the check cultivar Golden (1,636 kg ha^{-1}) and remained at first position out of the other seven entries under evaluation, in 2016, by yielding a 30.74% increase over the check. Attock-2019 gave a maximum dry pod yield (2,977 kg ha^{-1}) at the Attock location in 2016. In 2017, the NUGYT also at three locations in Punjab, showed genotype 11AK011 against two check cultivars, i.e., Golden and Pothowar. In that year, testing with seven other different advanced lines, genotype 11AK011 displayed 0.91% and 6.11% more yield than Golden and Pothowar, respectively, the only entry that yielded better than both checks (2,985 kg ha^{-1}).

Summary of yield performance of 11AK011 (Attock-2019)

The summary of the average yield performance of Attock-2019 in different experiments appears in Table 5. The yield performance of Attock-2019 displayed better in different yield trials from 2012 to 2018 as compared with the three different check cultivars, i.e., BARI-2011, Golden, and Pothowar. On average, for all years, Attock-2019 showed 4.71%, 34.67%, and 10.45% higher pod yields than the check cultivars BARI-2011, Golden, and Pothowar, respectively. An overall 15.24% increase in yield of Attock-2019 over the check cultivars showed during all the years.

Agronomic trials

The conduct of agronomic trials noted the optimum sowing date, seed rate, and fertilizer dose of the newly-developed line for the area. All the agronomic trials happened in 2014 and 2015 at GRS, Attock. Significant differences showed among the various sowing dates and

Table 6. Dry pod yield of Attock-2019 in various sowing dates.

Sowing Dates	Dry pod yield (kg ha^{-1})			
	2014		2015	
	Golden	11AK011	BARI-11	11AK011
20 March	2053	2328	2153	2328
30 March	2394	2794	2494	2804
10 April	2739	3264	2895	3310
20 April	2186	2511	2626	2836
30 April	1915	2240	2034	2136
Year 2014			Year 2015	
$LSD_{0.05}$ Sowing dates = 218.7			$LSD_{0.05}$ Sowing dates = 184.1	
$LSD_{0.05}$ Genotypes = 145.1			$LSD_{0.05}$ Genotypes = 201.7	
$LSD_{0.05}$ Genotype × Sowing date = 325.9			$LSD_{0.05}$ Genotype × Sowing date = 348.5	
CV% = 10.75			CV% = 9.35	

Table 7. Dry pod yield of 11AK011 (Attock-2019) to various fertilizer levels.

Fertilizer rate (NPK kg ha^{-1})	Dry pod yield (kg ha^{-1})			
	2014		2015	
	Golden	Attock-2019	BARI-11	Attock-2019
0:0:0	1310	1290	1715	1890
10:80:30	1570	1660	2050	2140
20:80:30	1770	2055	2170	2675
30:80:30	2635	2875	3035	3295
30:0:30	1525	1505	2125	2105
30:40:30	1700	1810	2240	2350
30:120:30	1905	2180	2415	2575
30:80:0	2125	2180	2215	2370
30:80:10	2070	2255	2470	2655
30:80:20	2275	2490	2695	2890
Mean	1889	2030	2313	2495
Year 2014			Year 2015	
$LSD_{0.05}$ Fertilizer rates =248.7			$LSD_{0.05}$ Fertilizer rates =218.6	
$LSD_{0.05}$ Genotypes = 85.7			$LSD_{0.05}$ Genotypes = 101.3	
$LSD_{0.05}$ Genotype × Fertilizer rate = 390.4			$LSD_{0.05}$ Genotype × Fertilizer rate = 356.4	
CV% = 9.78			CV% = 11.85	

genotypes for pod yield (Table 6). The data revealed that during 2014, genotype 11AK011 gave a higher pod yield (3,264 kg ha^{-1}) when sown on 10 April, and the lowest pod yield (2,240 kg ha^{-1}) came out when sown on 30 April. Similar results were also obtained for best sowing dates against BARI-2011 during 2015, where genotype 11AK011 produced 3,310 kg ha^{-1} than BARI-2011 (2,895 kg ha^{-1}).

Similarly, fertilizer dose requirement trials for 11AK011 (Attock-2019) took place in 2014 and 2015 with various doses combination at GRS, Attock. The results, presented in Table 7, indicated that the fertilizer combination of NPK @ 30-80-30 kg ha^{-1}, along with gypsum @ 500 kg ha^{-1}, displayed the most optimal fertilizer dose for both years. The various sowing dates and genotypes for pod yield showed significant differences. The results revealed that Attock-2019 gave a higher pod yield of 3,215 kg ha^{-1} when sown with a seed rate of 175 kg ha^{-1} and the lowest pod yield of 2,440 kg ha^{-1} when sown at 200 kg ha^{-1}. Attock-2019 produced a relevant average pod yield (2,768 kg ha^{-1}) than the check cultivar Golden (2,480 kg ha^{-1}).

In 2015, another experiment setup confirmed the optimum seed rate for Attock-2019. The results, presented in Table 8, revealed that Attock-2019 gave a significantly high yield (3,540 kg ha^{-1}) than the check cultivar BARI-2011 (3,175 kg ha^{-1}) when sown at a seed rate of 175 kg ha^{-1}. Significant differences showed among the various rates and genotypes for pod yield. The data unveiled that the best seed rate for sowing of genotype 11AK011 was at 175 kg ha^{-1} dry pods, giving a higher pod yield of 3,215 kg ha^{-1} and 3,540 kg ha^{-1} over the check cultivars in 2014 and 2015 (Table 8).

Table 8. Dry pod yield of 11AK011 (Attock-2019) at various seed rates.

Seed rate (kg ha^{-1})	Dry pod yield (kg ha^{-1})			
	2014		2015	
	Golden	Attock-2019	BARI-11	Attock-2019
125	2190	2475	2350	2815
150	2300	2940	2430	3015
175	2805	3215	3175	3540
200	2625	2440	2965	2895
Mean	2480	2768	2730	3066
Year 2014			Year 2015	
$LSD_{0.05}$ Seed rates = 243.5			$LSD_{0.05}$ Seed rates = 261.2	
$LSD_{0.05}$ Genotypes = 114.8			$LSD_{0.05}$ Genotypes = 164.8	
$LSD_{0.05}$ Genotype × Seed rate = 327.3			$LSD_{0.05}$ Genotype × Seed rate = 381.3	
CV% = 10.34			CV% = 11.14	

Table 9. Dry pod yield in 2017 and 2018.

Year	Lines / cultivars	Pod yield (kg ha^{-1})			Mean (kg ha^{-1})	% Increase over check
		Attock	Jand	Pindi Gheb		
2017	11AK011	3245	3050	3315	3203	-
	BARI-2016	2540	2280	2415	2412	+32.79
2018	11AK011	3329	3120	3418	3289	-
	BARI-2016	2695	2514	2715	2641	+24.53

Table 10. Disease rating of 11AK011 in 2016 at NARC, Islamabad.

No.	Entries	Tikka disease severity (0-9) / reaction	Fusarium wilt incidence (%)
1	12CG005	1HR	1
2	J U Si Hao	3MR	1
3	Golden	7S**	1
4	ICGV-92040	1HR	1
5	PLYF-80-3	2R	2
6	ICGV-01432	2R	2
7	11AK011	1HR*	0
8	PLYF-80-2	1HR	1
9	PG-1090	3MR	2

*HR (Highly Resistant), **S (Susceptible)

Farmer field evaluation

Genotype 11AK011 evaluation on farmer fields took place, at three different Tehsils of Attock District, over two consecutive years (2017 and 2018). Table 9 presents the dry pod yield performance. Genotype 11AK011 showed a considerable yield increase (32.79%) over the check cultivar, i.e., BARI-2016, in 2017. Based on the presented data in Table 9, in 2018, 11AK011 again showed a 24.53% increase over the check cultivar BARI-2016 at farmers' fields in three different locations in district Attock.

Disease reaction

Most importantly, developing a cultivar requires consideration of resistance/tolerance to major diseases prevailing in the area. In this connection, an independent department also studied the disease reaction of 11AK011 in 2016 in field conditions against a check and susceptible cultivar (Golden). The data, presented in Table 10, revealed that 11AK011 was highly resistant (1HR) against *Cercospora* leaf spot (Tikka disease) and Fusarium Wilt (0), under a disease-scoring scale of 0-9, which shows high resistance against diseases as compared with check cultivar (Golden 7S) in 2016.

Quality analysis

An oilseed crop groundnut is mainly grown in the world for oil purposes and is a source of protein, as well. Therefore, quality analysis of 11AK011 was also mandatory for its approval

Table 11. Quality parameter analysis of Attock-2019 (11AK011).

Cultivars / Lines	Moisture (%)	Ash (%)	Oil Contents (%)	Protein (%)	Fiber (%)
BARI-2016	3.04	2.36	39.7	21.6	2.56
11AK011	4.16	2.41	40.5	21.6	2.70
10AK003	3.96	2.45	44.2	21.4	2.68
10AK002	2.86	2.47	40.0	20.1	2.77

Table 12. Pods and other yield-contributing traits of 11AK011.

Traits	BARI-2011	BARI-2016	11AK011
100-seed weight (g)	55–60	60–65	65–70
Shelling % age	65–70	65–70	70–72
Avg. pods per plant	70–80	80–90	85–95
Seeds per pod	2–4	2–3	2–3
Average pod yield (kg ha^{-1})	2499	2900	3200
Yield potential (kg ha^{-1})	6300	4100	5400

in the Barani tract. Genotype 11AK011, along with other advanced lines of the research station, also underwent analysis for quality parameters against the check cultivar (BARI-2016). Genotype 11AK011 showed an increase of 2% in oil contents against the check cultivar and displayed, at the same point, compared with the check cultivar (Table 11).

Salient Features of 11AK011

The results revealed that 11AK011 showed high 100-seed weight, shelling %, and average seeds per pod, compared with the check cultivars (BARI-2011 and BARI-2016) (Table 12).

Punjab Seed Council Meeting

Genotype 11AK011 was presented for spot examination on 26 September 2019 and deliberated upon at the 80th meeting of the Expert Sub Committee of the Punjab Seed Council on 27 July 2020. Attock-2019 (11AK011) received approval for general cultivation in the Punjab Barani tract during the 54th Punjab Seed Council Meeting in Lahore on 28 January 2021.

CONCLUSIONS

Attock-2019 has a medium duration, decumbent-2 growth habit, high yielding, and better adaptability than the existing cultivars in local climate conditions. It also has a high disease resistance against *Cerospora* leaf spot (Tikka disease) and Fusarium Wilt. Groundnut (*Arachis hypogaea* L.) cultivar Attock-2019 has a charming variegated seed-coat color (white-pink) with a high yield potential (5,400 kg ha^{-1}), with a 20%–25% three-seeded pod per plant. Attock-2019 proves suitable for edible purposes having oil contents at 40% and a rich source of protein (25%). Attock-2019 shows a bold-seeded cultivar (65-70 g for 100-seed weight) with high shelling percentage (70%–72%). Therefore, the promotion of Attock-2019 for general cultivation in Punjab needs an immediate recommendation.

REFERENCES

Ahmed J, Saleem LM, Reki AR, Seed M, Marri FA (2016). Performance evaluation of different groundnut genotypes under climatic condition of Quetta. *Life Sci. Int. J*. 1(1): 21-24.

Aninbon C, Jogloy S, Vorasoot N, Patanothai A, Nuchadomrong S, Senawong T (2016). Effect of end of season water deficit on phenolic compounds in peanut genotypes with different levels of resistance to drought. *Food Chem*. 196:123-129.

Anonymous (1995). Official methods of analysis. (12th Ed). William Storwertzled, A.O.A.C. Publications, Washington, D.C. pp. 506-508.

Anonymous (2018-19). Government of Pakistan, Agricultural Statistics of Pakistan Ministry of Food, Security and Research, Government of Pakistan, Islamabad.

Anonymous (2021-22). Government of the Punjab. Final Estimates of Groundnut Crop in Punjab Crop Reporting Services, Punjab. Lahore.

FAOSTAT (2020). FAOSTAT, statistical data base. Rome: Food and Agricultural Organization of the United Nations.

ICRISAT (2008). ICRISAT Archival Report 2008. Documentation. International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh, India.

Kalve S, Tadege M (2017). A comprehensive technique for artificial hybridization in

Chickpea (*Cicer arietinum* L). *Plant Methods.* 13: 52. DOI. https://doi.org/10.1186/s13007-017-0202-6.

Mokgehle SN, Dakora FD, Mathews C (2014). Variation in N2 fixation and N contribution by 25 groundnut *Arachis hypogaea* varieties grown in different agro-ecologies, measured using N natural abundance. *Agric. Ecosyst. Environ*., 195: 161-172. https://doi.org/10.1016/j.agee.2014.05.014.

Naeem-Ud-Din, Mahmood A, Khattak GSS, Saeed I, Hassan M (2009). High-yielding groundnut (*Arachis hypogea* L) variety "golden". *Pak. J. Bot*. 41(5): 2217-2222.

Naeem-Ud-Din, Shabbir G, Ramzan M, Mahmood A (2005). BARI-2000: A new bold-seeded semi- bunch groundnut variety. *Pak. J. Seed Tech*. 1(6): 49-52.

Naeem-Ud-Din, Tariq M, Naeem MK, Hassan MF, Rabbani G, Mahmood A, Iqbal MS (2012). Development of BARI.2011: A high-yielding, drought- tolerant variety of groundnut (*Arachis hypogaea* L) with 3-4 seeded pods. *The J. Anim. Plant Sci*. 22(1): 120-125.

Tolera A (2008). Feed resources and feeding management: A manual for feedlot operators and development workers. Ethiopia SPS-LMM-Texas Agricultural Experiment Station (TAES)/TAMU, Addis Ababa.

Yami A, Sheep E, Merkel RC (2008). Sheep and goat production handbook for Ethiopia, sheep and goat productivity improvement programme, Addis Ababa (Ethiopia), Eng. Merkel.