



Karan guar 14: A new high-yielding and quality gum content variety

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Guar [*Cyamopsis tetragonoloba* (L.) Taubert] (2n = 14) is an important annual legume that belongs to the family Fabaceae. It is mainly cultivated under resource-poor conditions in arid and semi-arid regions (Kumar 2005). Major guar producing countries are India, Pakistan, USA, Brazil, South Africa, Malawi, Zaire, Sudan, Australia, and China (Sindhuja *et al.* 2022). In India, about 250,000 to 300,000 hectares of land are covered by guar cultivation, contributing about 80% of the total world's production (Annual Report, 2021–22). It is a healthy legume because its soft, green pods are high in fibre (3.7 g/100 g), protein (3.0 g/100 g), and carbohydrates (5.3 g/100 g). It also provides essential minerals such as calcium (156 mg/100 g) and iron (3.96 mg/100 g). Guar flour and seeds are used in a high-protein cattle diet (Rai and Dharmatti 2013). The dicotyledonous seeds of the guar consist of three main parts from the outer to the inner side: the seed coat or husk (14.0–17.0%), endosperm (35.0–42.0%), and embryo (43.0–47.0%) (Sharma *et al.* 2017). The discovery of galactomannan gum in the endosperm made it a viable source of industrial gum and positioned it as an industrial crop with export potential (Ashoka *et al.* 2021). It is now a cash crop due to the more than 150 guar gum industries operating in India. Thus, there is a dire need to upgrade the cultivation of guar, mainly for seed (gum) purposes. Efforts are being made toward the development of guar varieties with high grain yield, early maturity, resistance to major biotic factors, high gum content and viscosity. The new guar variety RGr 18-1 notified in 2022 by the Durgapura centre is suitable for all guar growing areas of India and has been widely accepted among different stakeholders.

The cluster bean variety Karan Guar 14 (RGr 18-1) was developed by crossing two genotypes, RGC 1038 (RGC 516 × HG 75) and RGC 1017 (Naveen × HG 75) at Rajasthan Agricultural Research Institute, (Sri Karan Narendra Agriculture University, Jobner, Rajasthan) Durgapura,

Jaipur, Rajasthan during 2021–22. The parent RGC 1038 is a high-yielding genotype, suitable for semi-arid, sandy loam soils and the rain-fed conditions of northern India. This parent is medium maturing (95–105 days), branched, and medium-height, with a pink flower and serrated leaves. The genotype RGC 1017 is also a good yielder with a high gum content (30.5–32.5%), medium maturing (92–96 days), medium-tall and suitable for double cropping eco-systems in India. After crossing in both genotypes, the F₁ hybrid seeds were grown with proper spacing and harvested in bulk at maturity. The harvested F₁ bulk seeds were planted over a large area during the F₂ generation. Segregating plants were selected and maintained with the proper pedigree record. Further generations (F₃ to F₇) were also handled using the pedigree breeding method (Fig 1). After the F₇ generation, the bulk seeds of entry RGr 18-1 were evaluated in station trials at RARI, Durgapura, Jaipur during the rainy (*kharij*) season of 2016 and 2017 for required traits. On the basis of its stable yield, RGr 18-1 was promoted to the All India Network Research Project (AINP) testing programme handled by the project coordinator, Arid Legumes, Indian Institute of Pulse Research Kanpur, Uttar Pradesh. During the 2018 rainy season, RGr 18-1 was assessed in an initial varietal trial (IVT) at the all-India level in 7 environments in a randomized block design (RBD) with a plot size of 7.2 m² against popular checks varieties RGC 1033, RGC 1066 and HG 2-20 under rain-fed conditions. Further, the genotype was evaluated in advanced varietal trials (AVTs) continuously for 3 rainy (*kharij*) seasons (2019, 2020 and 2021) at 7, 6 and 6 locations, respectively, at the all India level in RBD with 4 replications and 8 rows of 4 m length. The entry was also characterized for different varietal identification traits.

Concomitantly, testing material was also tested for bacterial blight (*Xanthomonas axonopodis* pv. *cyamopsidis*), root rot (*Rhizoctonia solani*) and alternaria blight (*Alternaria cucumerina* var. *cyamopsidis*) throughout the yield evaluation process under natural conditions. The disease occurrence was assessed using the Nene *et al.* (1981) rating scale, and genotypes were classified as disease-free (0% infected plants), highly resistant (0.1–5% infected parts), resistant

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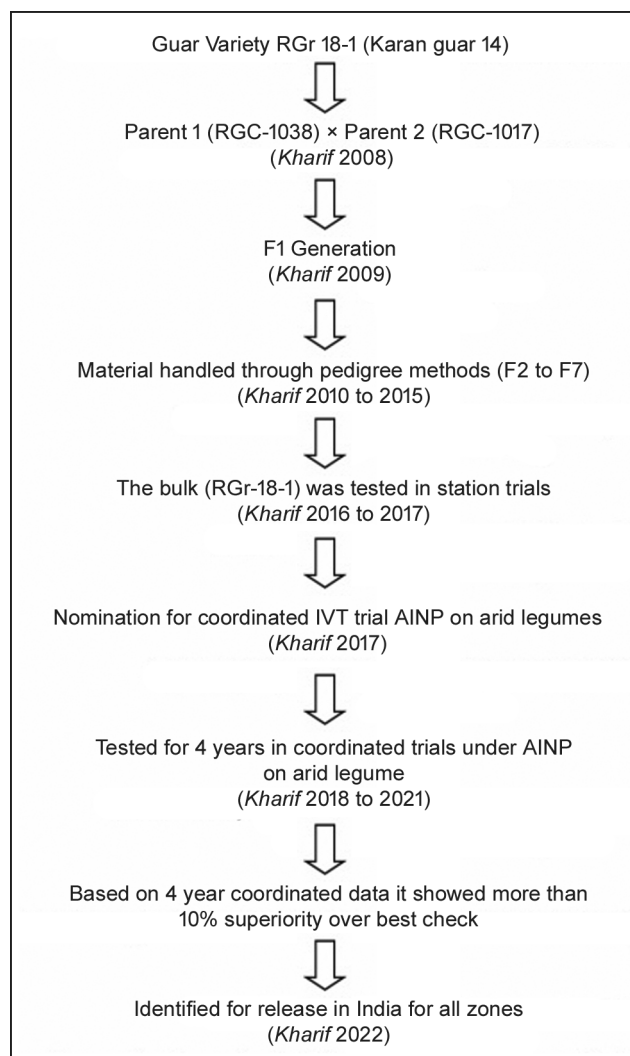


Fig 1 Details of development of cultivar RGr-18-1.

(5.1–10% infected parts), moderately resistant (10.1–20% infected leaves or plant parts), susceptible (21–50% infected leaves or plant parts) and highly susceptible (>50% infected leaves or plant parts). Screening for insect pests was also performed and leaf populations of leafhoppers, and white flies were counted per leaf. Rating for aphid infestation on a 0–9 scale was carried out according to Litsinger *et al.* (1977). Quality attributes such as protein content (%),

carbohydrate content (%), endosperm content (%), gum content (%) and viscosity profile (cp) were estimated as per procedures (Das *et al.* 1977, AOAC 1990 and AOAC 2005). SAS Institute (2011) was used for statistical analysis.

Plants of RGr 18-1 are erect in habit, pubescent and of the intermediate, branched type, matures in 90–95 days (medium maturity). The flowers are pink and it has a tripinnate leaf with a serrated margin, a straight and hairy pod, and a flat and round seed that ranges in colour from light grey to black brown. This variety's seeds are bold medium in size, weighing 2.74–3.34 g per 100 seeds (Table 1). Compared to check varieties (RGC 1033, RGC 1066 1nd HG 2-20), RGr 18-1 (1105 kg/ha) significantly out-yielded in the NIVT trial during rainy season 2018 (Table 2). It recorded yield of 1099 kg/ha which was superior but at par with checks during rainy season 2019 (AVT-I). During the AVT II (rainy season 2020 and 2021) of its evaluation, the variety consistently (1296 kg/ha, 1430 kg/ha, respectively) proved its superiority in comparison of all checks. On average, RGr 18-1 gives higher grain yield (1222 kg/ha) with + 16.7% over check RGC 1066 (1047 kg/ha) followed by 14.5% over check HG 2-20 (1067 kg/ha) and 14.3% over RGC 1033 (1069 kg/ha). The average yield of RGr 18-1 (1222 kg/ha) was compared with the mean value of the check varieties and it was observed that RGr 18-1 yield was significantly superior to all checks.

The samples of RGr 18-1 and check cultivars were assessed for quality parameters like per cent carbohydrate, endosperm, gum content and viscosity profile. The variety recorded good quality traits like protein content (27.97%), carbohydrate content (42.90%), endosperm content (32.26%) and gum content (29.00%) with a high viscosity profile (3412 cp). It had a high viscosity profile (3412 cp), indicating better gum quality for the international market (Table 3). The variety has a high degree of resistance to key diseases like bacterial leaf blight (BLB), root rot and alternaria blight. Moreover, a lower incidence of whitefly, leafhopper and aphid was observed as compared to the check varieties (Table 3). Several RAPD primers were used to profile RGr-18-1 and its two parents, RGC-1038 and RGC-1017. RAPD primers, demonstrated the distinctness of new entries with checks (Fig 2). However, not many differences can be observed with respect to parental lines,

Table 1 Ancillary and morphological description of cluster bean cultivar RGr 18-1

Ancillary trait	Description	Morphological trait	Description
Days to 50% flowering	38–42 Days	Habit	Branched, erect and indeterminate plant type
Days to maturity	90–95 days	Flower colour	Pink
Plant height (cm)	73–89 cm	Seed colour	Light grey to black brown eye
Number of branches per plant	5–6	Leaf type	Trip innate type
Number of pods per plant	47–64	Leaf serration	Serrated margin
Pod length (cm)	4.9–6.0 cm	Plant pubescence	Pubescent
100-seed weight (g)	2.74–3.34 g	Seed shape	Flat and round
		Pod shape	Straight and hairy

*Plant to plant and row to row spacing, 45 cm × 10 cm.

Table 2 Grain yield of the cultivar RGr 18-1 compared to the three check cultivars in coordinated varietal trials conducted in 26 environments in 4 crop seasons

Location	Crop season	RGr 18-1	Check Cultivars			Trial mean	CV (%)	CD (P=0.05)
			RGC-1033 (NC)	RGC 1066 (NC)	HG 2-20 (NC)			
Mandor	Rainy/2018	652	444	444	511	573	15.7	129.0
CAZRI Jodhpur	Rainy/2018	1504	1378	1246	1360	1316	13.5	299.2
Bikaner	Rainy/2018	1124	1003	1000	992	945	10.6	169.0
Gwalior	Rainy/2018	1518	1577	1369	1043	1344	10.0	225.8
Ajmer	Rainy/2018	977	1069	997	1079	981	10.3	169.9
Durgapura	Rainy/2018	977	926	1093	870	969	13.0	212.0
Bawal	Rainy/2018	986	556	1083	1111	805	8.1	109.5
Hisar	Rainy/2019	718	667	#	759	660	4.3	47.5
S K Nagar	Rainy/2019	564	351	#	523	505	9.8	83.1
Pandharpur	Rainy/2019	799	672	#	616	781	14.0	53.1
CAZRI Jodhpur	Rainy/2019	1085	1085	#	1180	973	11.4	186.0
Bikaner	Rainy/2019	1765	1773	#	1651	1188	7.5	149.4
Ajmer	Rainy/2019	954	1125	#	1027	1063	6.2	110.2
Durgapura	Rainy/2019	1806	1667	#	1535	1265	20.7	437.3
S K Nagar	Rainy/2020	1162	998	736	1033	814	11.2	152.4
Pandharpur	Rainy/2020	883	1177	839	706	873	13.4	194.7
Bikaner	Rainy/2020	1825	1329	1934	1385	1656	13.6	376.3
Gwalior	Rainy/2020	1343	1404	1248	741	1251	7.4	154.6
Ajmer	Rainy/2020	1382	1024	837	1240	1037	8.8	129.8
Durgapura	Rainy/2020	1181	764	847	926	1095	6.9	126.1
S K Nagar	Rainy/2021	1079	892	682	1161	1103	16.9	275.4
Pandharpur	Rainy/2021	849	954	841	810	838	7.0	103.5
Bikaner	Rainy/2021	1763	1229	1150	1438	1451	15.1	322.8
Gwalior	Rainy/2021	1620	1235	1077	1154	1233	10.1	220.0
Ajmer	Rainy/2021	1882	1441	1431	1628	1631	12.8	309.1
Durgapura	Rainy/2021	1385	1059	1035	1255	1255	9.4	174.4
Mean yield (kg/ha)	Rainy/2018 (7)	1105	993	1033	995			
	Rainy/2019 (7)	1099	1049	-	1042			
	Rainy/2020 (6)	1296	1116	1074	1005			
	Rainy/2021 (6)	1430	1135	1036	1241			
	Weighted mean (26)	1222	1069	1047	1067			
Per cent increase/decrease over checks and qualifying varieties over the year/locations			(+)14.3	(+)16.7	(+)14.5			

*NC, National check; # in the year 2012–13, data on yield were not reported; CD, critical difference; CV, coefficient of variation.

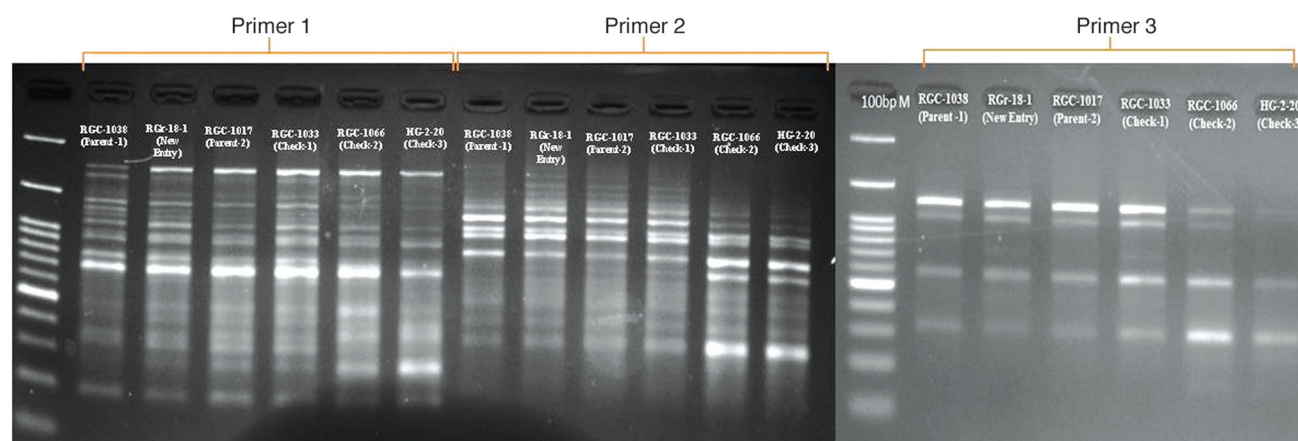


Fig 2 DNA finger printing report of variety RGr 18-1.

Table 3 Quality traits and major diseases and insects reactions in RGr 18-1 (Karan guar 14) variety with comparison to the 3 check cultivars

Particular aspect	Trial	RGr 18-1 (Karan Guar 14)	Check cultivar		
			RGC-1033	RGC 1066	HG 2-20
<i>Quality traits</i>					
Protein content (%)	7	27.97	26.27	25.78	25.56
Carbohydrate content (%)	12	42.90	44.68	43.13	43.11
Endosperm content (%)	12	33.26	33.04	32.50	33.13
Gum content (%)	11	30.2	29.32	29.59	29.76
Viscosity profile (cp)	12	3412	3133	3279	3051
<i>Disease reactions</i>					
% BLB severity	22	R	MR	MR	R
% RR severity	20	R	R	R	R
% AB severity	22	MR	MR	MR	R
<i>Insect score</i>					
Leafhopper (No/leaf)	15	2.21	2.82	3.42	2.27
Whitefly (No/leaf)	15	2.40	2.70	2.96	2.03
Aphid (0–9 scale)*	15	3.00	3.30	3.30	1.60

R, Resistant; MR, Moderately resistant; BLB, Bacterial leaf blight; RR, Root rot; AB, Alternaria blight.

which might be due to the dominant nature of the RAPD marker (Fig 2). Cultivar Karan Guar 14 (RGr 18-1) was released by the central sub-committee on crop standards, notification, and release of varieties on 24th October, 2022. The Rajasthan Agricultural Research Institute (SKN Agricultural University), Durgapura, Jaipur, Rajasthan, is the maintainer of this cultivar and the producer of the nucleus and breeder seeds.

SUMMARY

Guar is a valuable industrial crop, widely grown in India and Pakistan. The industrial potentialities of guar seed are based on a complex polysaccharide called galactomannan (gum) which is present in its endosperm. The newly developed variety Karan Guar-14 has good galactomannan (gum) content (30.2%) and high viscosity profile (3412 cp) which increases its export values. It is medium maturing (90–95 days) and on an average, it gives a higher grain yield (1222 kg/ha) with the superiority of 14.31% over the best check RGC 1033 (1069 kg/ha). This variety also gives higher fodder yield (2567 kg/ha) with a superiority of 18–45% over the check RGC 1066 (1773 kg/ha), RGC 1033 (2110 kg/ha) and HG 2-20 (2180 kg/ha). Seeds are medium bold (2.7–3.3 g/100 grain). It also showed resistance/tolerance to important diseases and insects and was recommended for different states of India, including Rajasthan, Haryana, Gujarat and Maharashtra.

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