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GADC 4 (WAGAD RESHAM): FIRST COTTON (*Gossypium herbaceum*) VARIETY WITH SUPERIOR FIBRE CHARACTERISTICS

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ABSTRACT

The *herbaceum* cotton variety Gujarat Anand Desi Cotton 4 (GADC 4: Wagad Resham), designated during testing as GVhv 936, was developed through systematic breeding at the Regional Cotton Research Station, Anand Agricultural University, Viramgam. The variety was officially released and notified in 2021 for commercial cultivation in the North West Agro-Climatic Zone-V and the Bhal and Coastal Agro-Climatic Zone-VIII of Gujarat. GADC 4 has demonstrated a consistent yield advantage over existing check varieties, coupled with superior fiber quality traits, making it a suitable choice for enhancing productivity and profitability in desi cotton-growing regions of the state. The variety, Gujarat Anand Desi Cotton 4 (GADC 4: Wagad Resham), is a derivative of the inter-specific varietal cross of GVhv 585 × 824. It is an early maturing, long-linted, bold-seeded, open-boll type *herbaceum* cotton with red-coloured anther filaments. The variety was developed at the Regional Cotton Research Station, Anand Agricultural University, Viramgam, and represents the first-ever long staple desi cotton variety released from this centre in 2021. In multi-location trials, GADC 4 recorded an average seed cotton yield of 1403 kg/ha under rainfed conditions of Gujarat. It exhibited yield superiority of 14.9, 30.8, 11.0, and 11.4% over the check varieties G. Cot. 21, GADC 2, G. Cot. 23, and GN. Cot. 25, respectively. Similarly, lint yield was enhanced by 4.4, 10.8, 14.0, and 16.0% over the same checks, demonstrating its potential as a high-yielding and superior quality desi cotton variety for the target region. It recorded an upper half mean length of 29.4 mm, fibre fineness of 4.5 µg/inch, and bundle strength of 30.6 g/tex under HVI fibre quality testing. The seeds contain 17.1% oil. Field screening for biotic stresses revealed that GADC 4 exhibits moderate tolerance to root rot, bacterial leaf blight, and alternaria leaf blight.

Keywords : *Gossypium herbaceum*, GADC 4, Superior fibre quality, *Desi* cotton.

Introduction

Cotton (*Gossypium spp.*) is the most important fibre crop of India, contributing significantly to the national economy, rural livelihood, and textile industry. Among the four cultivated species, *G. herbaceum* (*desi* cotton) holds a unique position owing to its adaptability to drought-prone and marginal environments, tolerance to biotic and abiotic stresses, and suitability for sustainable farming systems. Despite these advantages, productivity and fibre quality of *desi* cotton have remained relatively inferior compared to upland cotton (*G. hirsutum*), resulting in a decline in its cultivation area over the last few decades. Now, India holds a prominent position in the global cotton market,

with the largest cotton area of 114.47 lakh hectares, 294.25 lakh bales production and productivity of 437 kg/ha (Anonymous, 2025). Gujarat produces approximately 71.34 lakh bales of cotton lint from 23.92 lakh hectares, with a productivity of 507.02 kg/ha (Anonymous, 2025).

However, poor performance of Bt hybrids in rainfed, marginal and shallow saline soil, reddening of leaves, para wilt, pest and diseases are causing serious concern not only to the farmers but textile industries too. It has added enormous indispensable socio-economic problems to the cotton cultivation due to which sustainability of cotton farming is at stake. Whereas, at present apart from *G. hirsutum*, *G.*

herbaceum is grown on sizable area (5.5 lakh hectares) in Gujarat and witnessed nil socio-economic problems due to sustainable, low-cost desi cotton cultivation. *G. herbaceum* has better drought tolerance and immense resistance against insect pest. At present, it is not correct to say that desi cotton is low yielder with inferior fibre quality.

In Gujarat, desi cotton has deep cultural and economic importance, particularly in the Wagad, Bhal, and coastal regions, where its resilience under limited inputs makes it a preferred choice for resource-poor farmers. However, the availability of high-yielding, long-staple, and superior fibre quality varieties has been a longstanding demand to strengthen its competitiveness in the domestic and export textile markets.

To address this need, the Regional Cotton Research Station (RCRS), Anand Agricultural University, Viramgam, developed a new *desi* cotton variety, Gujarat Anand Desi Cotton 4 (GADC 4: Wagad Resham), through interspecific hybridization followed by rigorous selection and evaluation. This is the first-ever long staple variety of *G. herbaceum*, combining higher seed cotton yield, superior fibre properties, and adaptability to North West Agro-Climatic Zone-V and Bhal and Coastal Agro-Climatic Zone-VIII of Gujarat. The present paper describes the development, evaluation, and performance of GADC 4, highlighting its potential for enhancing productivity and profitability of *desi* cotton cultivation.

Material and Method

In order to improve cotton crop yield and superior fibre properties, hybridization programme was initiated in *kharif*-2010 at Regional Cotton Research Station, Anand Agricultural University, Viramgam. The genotype GVhv 936 was evolved from the cross between Parents GVhv 585 (*G. herbaceum*) and 824 (*G. arboreum*). The elite plants were selected from F₂ generation onwards and they were evaluated for development of high yielding and better fibre quality genotypes through pedigree method of plant breeding under rainfed condition. At advance generations, these segregants were multiplied using boll to row concept in order to make it fully uniform. The genotype GVhv 936 was first evaluated in preliminary evaluation trial (PET) at station level during *kharif* 2016-17. The genotype was found promising, hence it was evaluated for its potentiality at different research stations of SAU's of Gujarat situated in three agro-climatic zones over three years in randomized block design in different categories of state trials viz., Small Scale Varietal Trial-Fibre quality (SSVT-FQ) during *kharif* 2017-18 to and Multilocation Trial (MLT) during

kharif 2019-20. Simultaneously, the performance of the genotype GVhv 936 was evaluated in initial evaluation trial (IET-32b) of AICCIP (Central Zone) during 2019-20. This genotype was also screened for disease and major pest in field conditions like root rot, bacterial leaf blight, alternaria leaf blight as per standard scale. The DNA fingerprinting of GVhv 936 along with four check varieties G.Cot.21, GADC 2, G.Cot.23 and GN.Cot.25 were performed by using AFLP primers. The recommended packages of practices were followed to raise cotton crop for conducting the trials. The data were analyzed by methods developed by Panse and Sukhatme (1985).

Result and Discussion

Seed yield: The genotype GVhv 936 (GADC 4) was tested in preliminary evaluation trial at Viramgam during *kharif* 2016-17 and found promising, hence it was promoted to multilocation trials from 2017-18 to 2019-20 at different centres of Gujarat situated in three agroclimatic zones under rainfed conditions. The genotype GVhv 936 (GADC 4) has been tested at 05 different research stations/centres of Gujarat under *kharif* season. The mean performance of GVhv 936 (GADC 4) for seed yield was 1403 kg/ha with a tune of 14.9, 30.8, 11.0 and 11.4 per cent higher than check varieties G.Cot.21, GADC 2, G.Cot.23 and GN.Cot.25, respectively (Haidar and Aslam, 2016; Khan *et al.*, 2006; Tariq *et al.*, 2003) (Table 1).

Lint yield: The proposed variety Gujarat Anand Desi Cotton 4 (Wagad Resham) was consistently exhibited superior lint yield performance across trials and locations. It out-yielded G. Cot. 21, GADC 2, G. Cot. 23, and G. Cot. 25 by 4.4, 10.8, 14.0 and 16.0 percent, respectively, with an overall mean of 497 kg/ha. The variety remained in the top non-significant group in all seven trials, indicating stable and reliable performance across environments (Table 2).

AICCIP trial: In All India Co-ordinated Cotton improvement project, the variety Gujarat Anand Desi Cotton 4 (Wagad Resham) was tested in IET (Initial Evaluation Trial) in the year 2019-20 and it recorded 1039 kg/ha seed yield over three locations which was 39.8, 31.4 and 18.2 per cent higher than the check varieties G. Cot. 25, GADC 2 and G. Cot. 23, respectively (Table 3). Likewise, 36.47, 26.45 and 14.49 percent lint yield over the local checks, G. Cot. 25, GADC 2 and G. Cot. 23, respectively.

Ginning outturn: The ginning out turn (%) of variety GADC 4 showed consistent performance across different trials and locations with an average yield of 34.3 %, comparable to the standard checks. Its GOT ranged from 27.9 to 42.2 %, indicating wide

adaptability under varied testing conditions. It remained superior or at par with G. Cot. 23 (32.2 %) and G. Cot. 25 (33.7 %). This reflects the stability and potential of GADC 4 as a promising *desi* cotton variety (Table 4).

Traits comparison: The proposed variety GADC 4 exhibited distinct agronomic superiority over the check varieties. It matured earlier (184 days) compared to G. Cot. 21 (198 days), GADC 2 (200 days), G. Cot. 23 (217 days) and G. Cot. 25 (215 days). The variety flowered in 101 days, which was 8–14 days earlier than the checks. It produced a higher number of bolls per plant (35.5) which is superior to G. Cot. 21 (32.7), G. Cot. 23 (25.0) and G. Cot. 25 (23.5). The boll weight (2.2 g) was slightly higher than G. Cot. 21 and GADC 2 (2.1 g). It recorded 11.7 sympodia/plant, on par with G. Cot. 21 (11.8), and higher than other checks. The variety maintained a moderate plant height (136.2 cm). Importantly, GVhv 936 exhibited the highest seed index (10.3 g) and maximum oil content (17.1%), surpassing all check varieties (Table 5).

Quality parameters: Compared to existing *desi* cotton checks, GADC 4 demonstrated a clear advantage in fibre quality. It recorded UHML of 30.5 mm, which is substantially higher than the prevailing *G. herbaceum* varieties (<24 mm) (Iqbal et al. (2015), establishing it as the first long-staple *desi* cotton. The variety also showed UI of 83% and tenacity of 29.2 g/tex, both superior to checks, along with a desirable micronaire value of 4.2 µg/inch. Spinning performance confirmed its suitability up to 30s count, with CSP values of 2454 (20s) and 2319 (30s), thereby surpassing the checks in yarn quality and strength (Table 6). The variety GADC 4 has recorded fibre length (upper half mean length) of 29.4 mm, fibre fineness of 4.5 µg/inch and bundle strength of 30.6 g/tex (Mankar et al. (2021) (Table 7). The variety GADC 4 was screened for disease and

major pest in field conditions and found moderate tolerant to root rot disease and tolerant to bacterial leaf blight, alternaria leaf blight and moderately tolerant to major pests including sucking pests and boll worm complex in recommended ecology (Table 8 & 9).

Morphological description

GADC 4 shared several vegetative and floral traits with the check varieties but differed in having semi-digitate leaves, sparse stem hairiness, anther filament colouration, smooth boll surface and open boll opening. While seed and boll features were largely similar [Ranjan et al. (2014) and Erande et al. (2014)] the variety was distinguished by long fibre length, very strong strength, medium fineness, and good uniformity (Photo 1), clearly superior to the checks in fibre quality attributes (Table. 10).

DNA fingerprinting profile of cotton varieties generated by AFLP marker system showed that variety GADC 4 is genetically distinct from its checks i.e. G Cot 21 and GADC 2. (Photo 2).

Conclusion

The long-linted *desi* cotton variety *Gujarat Anand Desi Cotton 4 (GADC 4: Wagad Resham)* demonstrated a mean seed cotton yield of 1403 kg/ha, exceeding the check varieties G. Cot. 21 (1221 kg/ha) and GADC 2 (1073 kg/ha) by 14.9% and 30.8%, respectively. In addition to yield advantage, the variety exhibited superior fibre characteristics (with an average ginning out-turn of 34.3%), upper half mean length of 29.4 mm, micronaire value of 4.5 µg/inch, and tenacity of 30.6 g/tex under HVI testing. On the basis of its yield performance and superior fibre quality, the variety is recommended for release and cultivation in Agro-Climatic Zones V and VIII of Gujarat.

Table 1: Performance of cotton variety GADC 4 in comparison to checks in different trials in the state:

Comparison	GADC 4	G.Cot. 21 (a)	GADC 2 (b)	G. Cot 23 (c)	GN. Cot 25 (d)	% Increase of GADC 4
Overall Mean	1403	-	-	-	-	-
Over G. Cot. 21 (6 trials)	1424	1221	-	-	-	+14.9 %
Over GADC 2 (6 trials)	1310	-	1073	-	-	+30.8 %
Over G. Cot 23 (1 trials)	1962	-	-	1767	-	+11.0 %
Over GN. Cot 25 (1 trials)	1962	-	-	-	1762	+11.4 %
Frequency in top groups	7/7	3/6	4/6	0/1	0/1	-

Table 2: Performance of cotton variety GADC 4 in comparison to checks in different trials in the state

Comparison	GADC 4	G.Cot. 21 (a)	GADC 2 (b)	G. Cot 23 (c)	GN. Cot 25 (d)	% Increase of GADC 4
Overall Mean	497	-	-	-	-	-
Over G. Cot. 21 (6 trials)	499	478	-	-	-	+4.4 %
Over GADC 2	473	-	427	-	-	+10.8 %

(6 trials)						
Over G. Cot 23 (1 trials)	645	-	-	566	-	+14.0 %
Over GN. Cot 25 (1 trials)	645	-	-	-	556	+16.0 %
Frequency in top groups	7/7	5/6	4/6	1/1	1/1	-

Table 3 : Yield performance of GADC 4 in the AICCIP Trial (Br. 32b)

Year/ Season	Name of Trial	Variety	Seed Cotton Yield (kg/ha)	% Increase over Check	Frequency in Top Group
2019-20	IET	GADC 4	1039	–	3/3
		GN. Cot. 25	612	+39.8	0/2
		GADC 2 (LC)	1069	+31.4	0/1
		G. Cot. 23 (LC)	879	+18.2	1/3
		Lint Yield (kg/ha)			
		GADC 4	324	–	-
		GN. Cot. 25	213	+36.47	-
		GADC 2 (LC)	310	+26.45	-
		G. Cot. 23 (LC)	283	+14.49	-

Table 4 : Ginning Out Turn (%) of GADC 4 along with checks:

No. of trials	Genotype	Mean Value	Range	Remarks
Eleven (11)	GADC 4	34.3	27.9 – 42.2	Consistently stable across years
	G. Cot. 21	40.1	37.4 - 45.3	Lower than checks
	GADC 2	39.3	29.0 - 43.8	Lower than checks
	G. Cot. 23	32.2	27.3 - 35.7	Comparable to GADC 4
	GN. Cot. 25	33.7	31.4 - 35.7	Comparable to GADC 4

Table 5 : Major yield contributing and other ancillary observation characters of proposed variety along with checks:

Characters	GADC 4	G. Cot. 21 (C)	GADC 2 (C)	G.Cot.23 (C)	GN.Cot.25 (C)
Days to maturity	184 (171-204)	198 (184-210)	200 (192-216)	217	215
Days to 50% flowering	101 (80-124)	113 (89-128)	115 (95-131)	109	106
No. of bolls/plant	35.5 (31.0-39.2)	32.7 (25.9-39.5)	35.5 (26.7-41.4)	25.0 (15.6-39.7)	23.5 (11.7-38.0)
Boll weight (g)	2.2 (1.9-2.5)	2.1 (1.9-2.4)	2.1 (1.9-2.2)	2.6 (2.4-2.7)	2.5 (2.3-3.0)
No. of sympodia	11.7 (9.0-14.5)	11.8 (9.6-15.5)	10.9 (8.5-15.1)	9.1	9.3
No. of monopodia	3.6 (2.3-5.3)	4.0 (3.3-4.6)	3.9 (2.3-6.1)	5.0	3.9
Pl. height (cm)	136.2 (108.2-174.0)	137.1 (120.9-153.3)	128.0 (113.1-143.8)	157.0	166.3
Seed Index (gm)	10.3 (10.2-10.3)	9.7 (9.5-9.8)	9.5 (9.4-9.6)	8.5	8.3
Oil content (%)	17.1 (16.8-17.6)	15.9 (15.6-16.4)	16.6 (14.9-17.5)	-	-

Table 6: Full Spinning Test Report:

Sr. No.	Institute sample No.	Marked as	HVI (HVI mode) ASTM D 5867: 2005				Full Spinning (CIRCOT method)			
			UHML (mm)	UI (%)	Mic	Tenacity (g/tex)	Nominal Count (Ne)	Actual		C.S.P.
								Count (Ne)	Strength (lb)	
1	F203490	GVhv 936	30.5	83	4.2	29.2	20.0	20s	124.6	2454
							30.0	30s	77.3	2319

Table 7: Fibre quality parameters of GADC 4 along with check varieties:

No. of trials	Upper Half Mean Length (mm)			
	Genotype	Mean Value	Range	Remarks
Ten (10)	GADC 4	29.4	27.5–31.2	Superior, long-staple
	G. Cot. 21	23.8	19.8–25.6	Short-staple, inferior
	GADC 2	24.9	22.3–27.6	Medium, inferior
	G. Cot. 23	24.7	22.9–26.7	Medium, inferior
	GN. Cot. 25	24.3	23.9–25.1	Medium, inferior
	Micronaire value (µg/inch)			
	GADC 4	4.5	3.3–5.8	Optimum fineness; stable
	G. Cot. 21	5.0	3.5–5.8	Coarser fibre; less desirable for quality yarn
	GADC 2	4.3	3.5–5.0	Within acceptable range; moderate stability
	G. Cot. 23	3.6	3.0–4.2	Relatively finer fibre
	GN. Cot. 25	3.5	2.4–4.3	Fine fibre; but variable across locations
	Bundle strength (g/tex)			
	GADC 4	30.6	26.5–35.8	Superior and consistently stronger fibre
	G. Cot. 21	25.7	20.4–31.9	Moderate strength
	GADC 2	25.1	19.5–32.3	Variable, lower than GADC4
	G. Cot. 23	24.8	21.6–29.2	Relatively weaker
	GN. Cot. 25	23.8	21.6–27.1	Lowest fibre strength

Table 8: Incidence of root rot diseases (%) at Viramgam:

Year/Name of Variety	GADC 4	G. Cot. 21	GADC 2
2018-19	0.00	0.00	0.00
2019-20	0.00	0.00	0.00

There was no incidence of BLB, Wilt, Alternaria Blight and Grey mildew in the experimental field during the year.

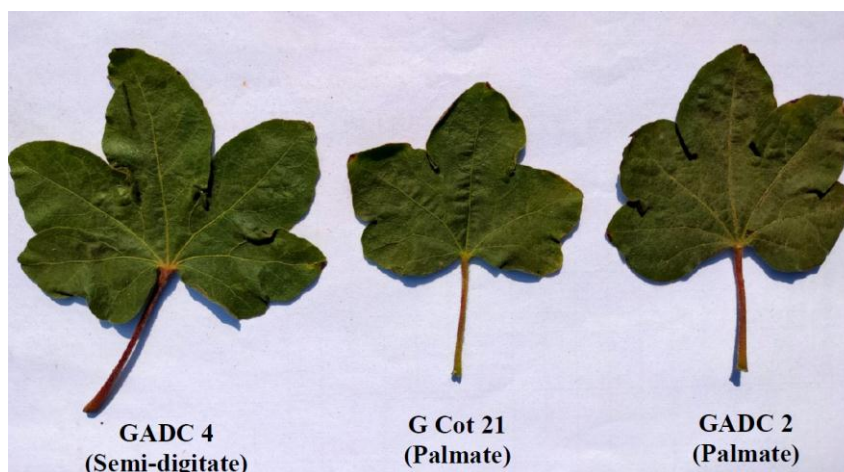
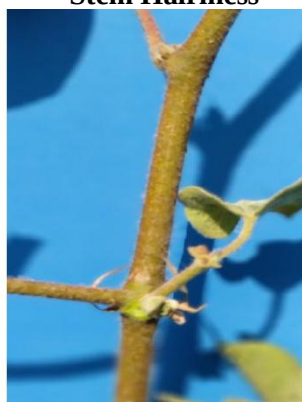
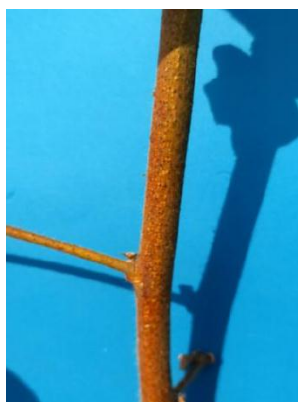
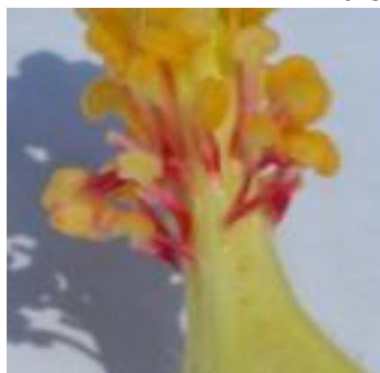
Table 9: Infestation of insect-pests at Viramgam (2019-20):

Particular	GADC 4	G. Cot. 21	GADC 2
Bollworm damage at Square stage (%)	2.65	2.08	1.98
Bollworm damage at Bud stage (%)	2.43	2.17	2.03
Bollworm damage at Green Boll stage (%)	3.24	2.78	2.38
Bollworm damage at Open Boll stage (%)	3.93	3.30	3.12
Whitefly / 3 leaves	1.88	1.56	1.18
Aphid / 3 leaves	4.68	3.28	3.08
Leaf hopper / 3 leaves	2.53	2.05	1.92

Table: 10 The DUS characters for GADC 4 with checks:

S.N.	Characteristics	GADC 4	G. Cot. 21	GADC 2
1.	Hypocotyl pigmentation	Absent	Absent	Absent
2.	Leaf: Colour	Green	Light Green	Light Green
3.	Leaf: Pubescence	Medium	Medium	Medium
4.	Leaf: nectarines	Present	Present	Present
5.	Leaf: Petiole Pigmentation	Present	Present	Present
6.	Leaf: shape	Semi-digitate (Semi okra)	Palmate (Normal)	Palmate (Normal)
7.	Plant : stem hairiness	Sparse	Dense	Dense
8.	Plant: stem pigmentation	Present	Present	Present
9.	Plant: time of flowering	Late	Late	Late
10.	Flower: Petal colour	Yellow	Yellow	Yellow
11.	Flower: Petal Spot	Present	Present	Present
12.	Flower: Stigma	Exerted	Exerted	Exerted
13.	Flower: Anther Filament Colouration	Present	Absent	Absent
14.	Flower: pollen colour	Yellow	Yellow	Yellow
15.	Flower: Male sterility	Absent	Absent	Absent
16.	Boll: Colour	Green	Green	Green

17.	Boll: shape	Ovate	Ovate	Ovate
18.	Boll: Surface	Pitted	Pitted	Pitted
19.	Boll: Prominence of Tip	Pointed	Pointed	Pointed
20.	Boll: Opening	Open	Semi-open	Semi-open
21.	Boll: weight of seed cotton / boll (g)	Medium	Medium	Medium
22.	Seed: Density of fuzz	Dense	Dense	Dense
23.	Seed: Fuzz colour	Grey	Grey	Grey
24.	Seed: index (100 seed Weight in gm)	Very Bold	Very Bold	Very Bold
25.	Ginning %	High	Very high	Very high
26.	Fibre: Colour	White	White	White
27.	Fibre: Length (Upper Half Mean Length) mm	Long	Medium	Medium long
28.	Fibre: Strength (g/tex)	Very Strong	Medium	Medium
29.	Fibre: Fineness (Micronaire value)	Medium	Coarse	Medium
30.	Fibre: Uniformity (%)	Good	Average	Good
31.	Fibre: Maturity Index (MI)	Very good	Very good	Very good

**Stem Hairiness****Anther Filament Colouration****GVhv 936
(Sparse)****Boll Opening**

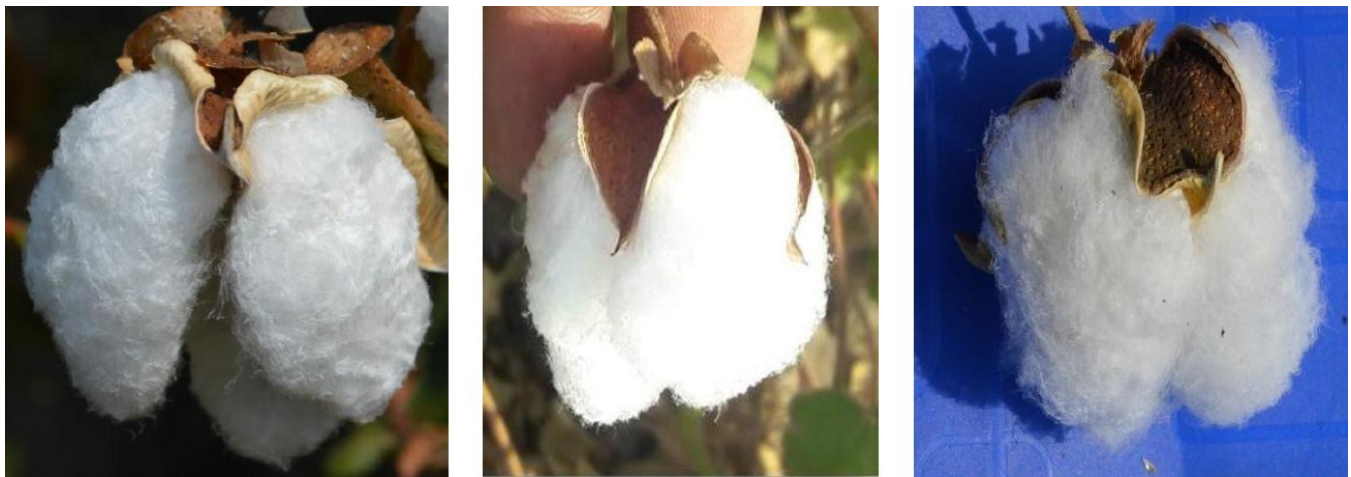


Photo 1: DUS traits of GADC 4 in compare with checks

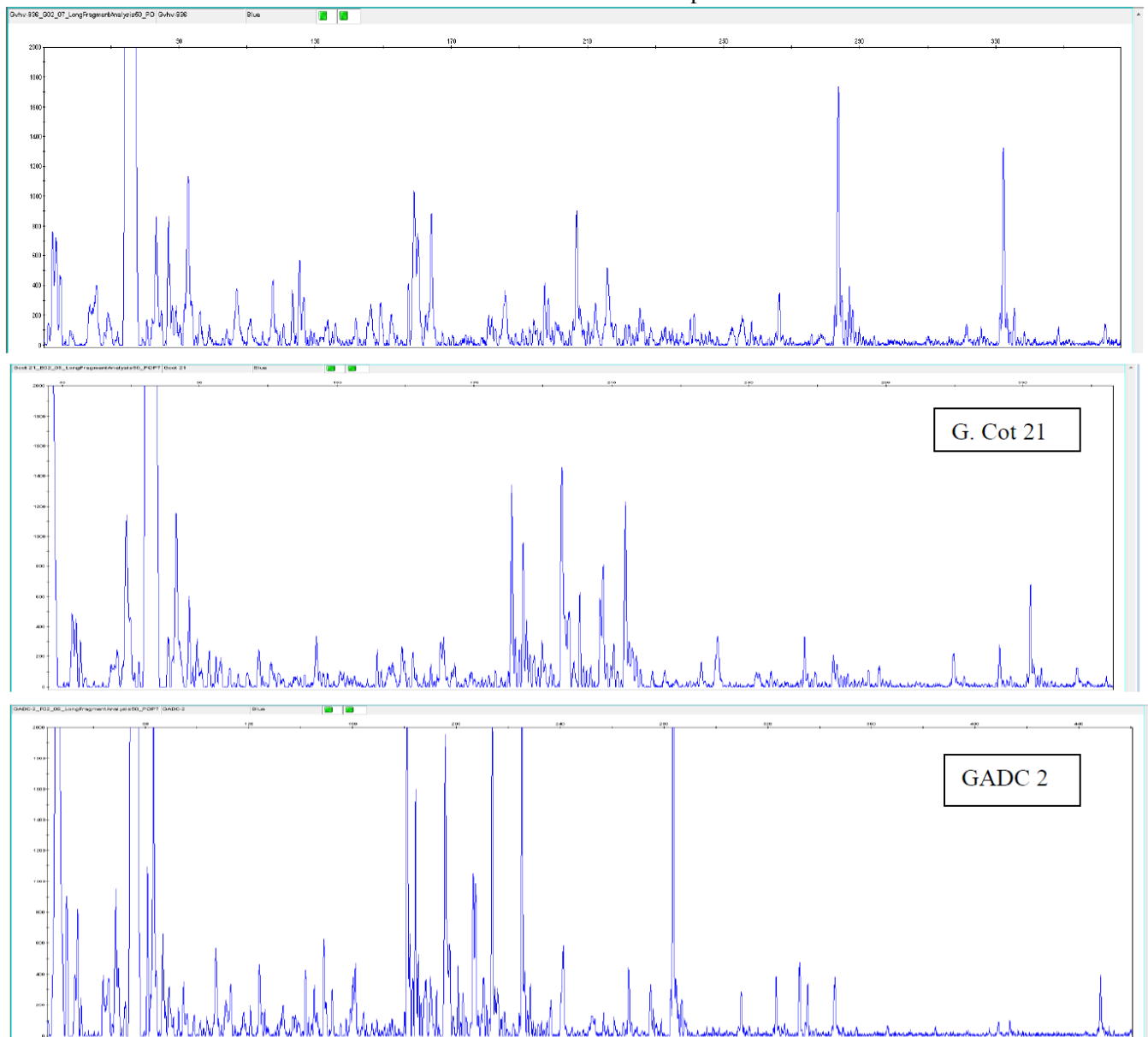


Photo 2: DNA fingerprinting profile of variety GADC 4 along with checks generated by AFLP marker

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