



Study about GAU 4: A New High Yielding Ymv Resistant Urdbean Variety

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

GAU 4 is a high yielding, YMVD resistance variety developed through selection from germplasm maintained (GP No. 6) at ARS, AAU, Jabugam, Dist : Chotta Udaipur, Gujarat and tested as JAUG 2 in trial. JAUG 2 recorded 21.03 and 24.48 per cent higher yield (961 kg/ha) over the checks T 9 and GU 1, respectively under middle Gujarat. In *kharif* season, JAUG 2 recorded 1005 kg/ha seed yield which was 19.08 and 23.92 per cent higher over T 9 and GU 1, respectively under middle Gujarat. In summer, JAUG 2 recorded 864 kg/ha seed yield which was 22.21 and 23.42 per cent higher over T 9 and GU 1, respectively under middle Gujarat. The proposed genotype JAUG 2 has semi-erect plant type and medium maturity duration. It has deltoid leaf shape, green hairy pod with 5-7 seeds per pod, dark black and medium seed size (seed index.:4-5 g). On quality point of view, this genotype contains 24.66% protein, 55.58% total carbohydrate, 4.77% total soluble sugar, 0.946% phenol and 8.89 mg/100g flavonoid, which is comparable to check varieties T 9 and GU 1. In mineral contains 49.97 Fe, 29.28 Zn and 7.29 Cu mg kg⁻¹ which is higher than both check varieties viz., T 9 and GU1. The genotype JAUG 2 is found resistant to Yellow Mosaic Disease under natural field condition as compared to check T 9 and GU 1. The special feature of newly develop variety is medium maturity, semi-erect plant type, hairy pod, dark black, drum shape seed, resistant to YMD with higher yield.

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1. INTRODUCTION

Urdbean (*Vigna mungo* L. (Hepper) is an important short duration pulse crop of Gujarat. It is cultivated in an area of 1 lakh ha with a production of 0.73 lakh tonnes with average productivity of 736 kg/ha (DA, Gandhinagar Gujarat, 2019-20). At present, farmers of Gujarat are growing T9 and GU1 varieties of Urdbean, which are highly susceptible to Yellow Mosaic Disease (YMD) which is major factor for low productivity of urdbean in Gujarat. Mungbean Yellow Mosaic Virus (MYMV) disease is one of the most devastating diseases of black gram causing 85 – 100 per cent yield loss and transmitted by the white fly, *Bemisia tabaci*. The most effective way to prevent the occurrence of this disease is to develop genetically resistant cultivars [1]. In middle Gujarat, urdbean is mainly cultivated in Dahod, Chhota-udepur districts during *kharif* season in about 19000 ha. area. Due to lack of availability of YMD resistant cultivars, the productivity is very low (565 kg/ha). Recently, in tribal area, the farmers had also started to grow urdbean during summer season due to short duration crop hence; there is an urgent need to develop YMD resistant and better-quality variety with higher yield potential. To address the needs of the farmers of middle Gujarat, GAU 4 variety is identified which is high yielding, and YMV disease resistant.

2. MATERIALS AND METHODS

JAUG 2 developed through selection from germplasm maintained (GP No. 6) at ARS, AAU, Jabugam, Dist: Chotta Udaipur, Gujarat and tested as JAUG 2 in trial. The material was identified as high yielding, good agronomic traits with YMD resistant culture and named as JAUG2. This entry was tested in preliminary evaluation trial, Zonal and state varietal trial during summer 2017 to summer 2019 in Randomised Block Design (RBD). Further, based on its superiority in zonal trials it was tested under state varietal trial at different research station of the SAU's of Gujarat in kharif 2019 & 2020. JAUG2 culture was screened for YMD under natural field condition. As per format, in PET plot size was 0.9 x 4.0 m (2 rows), ZVT-I has 1.8 x 4.0 m (4 rows), ZVT-II has 3.6 x 4.0 m (8 rows), whereas LSVT having 3.6 x 4.0 m (8 rows). The culture was also screened for major disease and pest in natural field condition. The

DNA fingerprinting of variety Gujarat Anand Urdbean 4 (GAU 4) along with check varieties (T9 & GU1) were done using SRAP primers. Based on yield performance and disease resistance in comparison of local dominating varieties i.e. T 9 & GU 1. It was proposed for release as summer and kharif urdbean growing farmers of middle Gujarat. In 2021, state variety release committee approved and released in the name of GAU 4 (Gujarat Anand Urd bean 4)

3. RESULTS AND DISCUSSION

The urdbean culture JAUG2 is a local selection made by ARS, Jabugam and maintained as GP 6 which is highly resistant to YMV and matured in 83 (75-91) days during *kharif* whereas in summer it takes 74 (68-83) days for maturity. It is suitable for summer and kharif urdbean cultivated farmers of middle Gujarat. In Gujarat, JAUG2 is tested 52 times and the average performance over seasons and locations is 985 kg/ha which is 14.40 and 15.07 per cent higher than checks viz., T9 and GU1 respectively (Table 1).

In middle Gujarat, overall performance in *kharif* and summer season, the culture JAUG2 gave 961 kg/ha with 21.03 and 24.48 per cent yield increase over the checks varieties. In *kharif* season, this culture gave 1005 kg/ha yield which is 19.08 and 23.92 per cent yield advantage over check varieties viz., T 9 and GU 1 whereas in summer, 864 kg/ha which is 22.21 and 23.42 per cent yield superiority over checks. In north Gujarat and Saurashtra region, this is performing at par with check varieties whereas in South Gujarat conditions, JAUG 2 gave 12.37 per cent higher yield over check GU 1 (Table 2 & 2a).

JAUG2 variety have some economical attributes like higher plant height (71.60 cm), more number of branches per plant (5.80), seeds per pod (6.87), number of pods per plant (44.82), pod length (4.93 cm) and test wt (4.94 g) as compared to both check varieties viz., T 9 and GU 1 in *kharif* season and same trend observed in summer too (data not given here). Important physio-morphological attributes are deltoid leaf shape, green with purple splashes on stem, hairy pod with 6-7 seeds per pod, medium sized dull black seed while T9 have deltoid leaf, green stem and pod is non hairy; GU1 has obviate leaf, green stem and hairy pod. More characters as per DUS are given in Table 3.

The newly developed urdbean culture JAUG 2 (GAU 4) has protein, carbohydrates and total soluble sugar content 24.66, 55.58 and 4.77 per cent respectively. In mineral contains 49.97 Fe, 29.28 Zn and 7.29 Cu mg kg⁻¹ which are higher than both check varieties viz., T 9 and GU 1 (Table 4). It has bold seeded with good attractive grain quality (Table 4). Nutritional quality evaluation of improved varieties of black gram (*Phaseolus mungo*) and variety Pant U 31 contain higher protein, fiber and mineral nutrient content (Anjali et. al., 2021) and AU4 also contain equal amount protein and carbohydrates but higher amount of mineral content viz., Fe, Zn and Cu. VBN 8 contain only 21.9% protein which was lower than GAU 4 [2].

Urdbean variety Gujarat Anand Urdbean 4 (GAU 4) was tested for YMV under natural field condition. In this condition, we observed that from summer 2018 to kharif 2020, JAUG 2 culture has maximum 9.76 while T 9 has up to 100 and GU 1 has up to 95.73 per cent YMV disease which is indicate resistance to YMV disease. Middle Gujarat consider as hot spot for YMV disease and this disease appear more in summer as compared to *kharif* season. The

variety ADT6 has moderate resistance to Yellow Mosaic Virus a vector (whitefly) mediated viral disease that occurs normally during summer and *kharif* season [3]. It was observed that whitefly, thrips, aphid and pod borer damage comparatively lower as compare to check varieties viz., T9 and GU1 (Table 5 & 6).

An interesting modified marker technology termed as Sequence-Related Amplified Polymorphism (SRAP) [4] was similar to RAPD, but it was a preferential random amplification of coding regions in genome are being applied extensively in genetic diversity analysis [5] and comparative genetics [6] of different species. DNA fingerprinting carried out for JAUG2 (GAU4) for differentiated variety from other farmer dominating varieties i.e. T 9 and GU 1 using SRAP markers. The variety differentiated by using three polymorphic markers i.e. SRAP 10 (SRAP Me2 + SRAP eM4, SRAP 12 (SRAP Me2 + SRAP 6), and SRAP 22 (SRAP Me4 + SRAP eM4). The results indicated that JAUG-2 is genetically distinct from two checks T 9 and GU 1 (Fig.1). SSR markers were used to distinguished between blackgram varieties i.e. VBN 11, VBN 6 and VBN 8 [7].

Table 1. Yield performance of Urdbean GAU 4 (JAUG 2) with check varieties in the Gujarat state

Sr. No.	Year /Season	Name of Trial	Number of trials / location	Seed Yield (kg/ha)		
				JAUG 2	T 9	GU 1
1	S 2017	PET	01	1374	907	901
2	S 2018	ZVT	06	902	803	724
3	K 2018	ZVT	06	1170	1023	1016
4	S 2019	ZVT	05	861	630	712
5	K 2019	ZVT	06	1002	787	738
6	K 2019	S + L	09	953	874	905
7	S 2020	ZVT	04	810	660	649
8	K 2020	ZVT	06	923	797	773
9	K 2020	S + L	09	1084	1083	1089
Weighted mean (52)				985	861	856
Per cent yield increase					14.40	15.07
Frequency in top non-significant groups				33/52	12/52	15/52

Table 2. Yield performance of Urdbean GAU 4 (JAUG 2) with check varieties in the in middle Gujarat

Sr. No.	Year /Season	Name of Trial	Number of trials/location	Seed Yield (kg/ha)		
				JAUG 2	T 9	GU 1
Summer Season						
1	S 2017	PET	01	1374	907	901
2	S 2018	ZVT	06	902	803	724
3	S 2019	ZVT	05	861	630	712
4	S 2020	ZVT	04	810	660	649
Weighted mean (16)				864	707	700

Sr. No.	Year /Season	Name of Trial	Number of trials/location	Seed Yield (kg/ha)		
				JAUG 2	T 9	GU 1
Per cent yield increase Kharif season					22.21	23.42
1	K 2018	ZVT	06	1170	1023	1016
2	K 2019	ZVT	06	1002	787	738
3	K 2019	S + L	03	876	699	668
4	K 2020	ZVT	06	923	797	773
5	K 2020	S + L	03	974	837	764
Weighted mean (24)				1005	844	811
Per cent yield increase Overall (Kharif + summer)					19.08	23.92
Weighted mean (40)				961	794	772
Per cent yield increase					21.03	24.48

Table 2a. Yield performance of Urdbean GAU 4 (JAUG 2) with check varieties in the other zone of Gujarat

Sr. No.	Year /Season	Name of Trial	Number of trials/location	Seed Yield (kg/ha)		
				JAUG 2	T 9	GU 1
Saurashtra						
1	K 2019 & 2020	S + L	04	1345	1361	1344
Per cent yield increase					-	0.11
North Gujarat						
1	K 2019 & 2020	S + L	06	992	1006	1164
Per cent yield increase					-	-
South Gujarat						
1	K 2019 & 2020	S + L	02	727	763	647
Per cent yield increase					-	12.37

Table 3. Morphological characters of proposed entry as per DUS Guidelines

Sr. No.	Characteristics	JAUG 2 (GAU 4)
1	Hypocotyl: Anthocyanin colouration	: Present
2	Time of flowering	: Medium (>40)
3	Plant: Growth habit	: Semi-erect
4	Plant: habit	: Determinate
5	Stem: Colour	: Green with Purple splashes
6	Stem: Pubescence	: Present
7	Leaflet: Shape (terminal)	: Deltoid
8	Foliage: colour	: Green
9	Leaf: Vein colour	: Green
10	Leaf: Pubescence	: Present
11	Petiole: Colour	: Green with Purple splashes
12	Pod: Intensity of green colour of premature pod	: Green
13	Pod: Pubescence	: Present
14	Peduncle: Length	: Medium (5-10 cm)
15	Pod: Length	: Small (<5 cm)
16	Pod: Colour of mature pod	: Black
17	Plant: Height	: Long (>60 cm)
18	Seed: Colour	: Black
19	Seed: Luster	: Dull
20	Seed: Shape	: Drum
21	Seed: Size (seed index) g	: Medium (3 to 5 gm)

Table 4. Biochemical parameters of proposed entry JAUG 2 (GAU 4) along with checks

Sr. No.	Quality parameters	JAUG 2	T 9	GU 1
1.	Protein content (%)	24.66	25.90	25.39
2.	Total Carbohydrates (%)	55.58	56.10	58.50
3.	Total Soluble Sugars (%)	4.771	4.568	5.537
4.	Fe (mg Kg ⁻¹)	49.97	47.64	44.81
5.	Zn (mg Kg ⁻¹)	29.28	17.80	24.24
6.	Cu (mg Kg ⁻¹)	7.29	3.80	3.05

* Minerals are total content (as per dry weight basis)

Table 5. Yellow Mosaic Disease (YMD %) of proposed entry JAUG2 (GAU4) along with checks over the year and locations

Season / Year /	Name of trials	Number of trial	Varieties		
			JAUG 2	T 9	GU 1
S 2018	ZVT	6	0.00-5.49	26.59-94.09	22.00-80.00
K 2018	ZVT	6	0.00-0.57	0.00-100.00	0.00-80.00
S 2019	ZVT-II	4	1.70-9.76	1.21-97.49	1.64-95.73
K 2019	ZVT-II	5	0.00-5.00	0.00-55.30	0.00-80.00
K 2019	L + S	3	0.00-3.00	0.22-5.00	0.55-6.00
S 2019	ZVT-II	4	0.36-4.00	8.00-33.16	13.00-18.00
K 2020	ZVT-II	6	1.00-8.33	7.00-19.00	5.28-46.67
K 2020	L + S	6	0.00-3.00	0.22-5.00	0.55-6.00
Mean range of 40 location			0.00-9.76	0.00-100.00	0.00-95.73
Reaction			R	S	S

*In individual year range is given for all locations

Grade	YMD incidence (%)
Resistant (R)	0-10%
Moderately Resistant (MR)	11-30%
Susceptible (S)	>30%

Table 6. Incidence of insect-Pest of entry JAUG2 (GAU4) along with checks at Vadodara during 2018 to 2020

Insect-pests	Genotypes/Varieties		
	JAUG 2	T 9	GU 1
Whitefly/ 3 leaves	5.0-8.0	5.0-15.0	6.0-14.0
Aphid/ 3 twig	4.0-10.0	3.0-15.0	1.0-12.0
Thrips/ flower	6.0-13.0	5.0-21.0	5.0-22.0
Pod borer damage % (<i>M. vitrata</i>)	8.0-11.0	7.0-14.0	9.0-14.0

* Range is given for three years data 2018,2019 & 2020

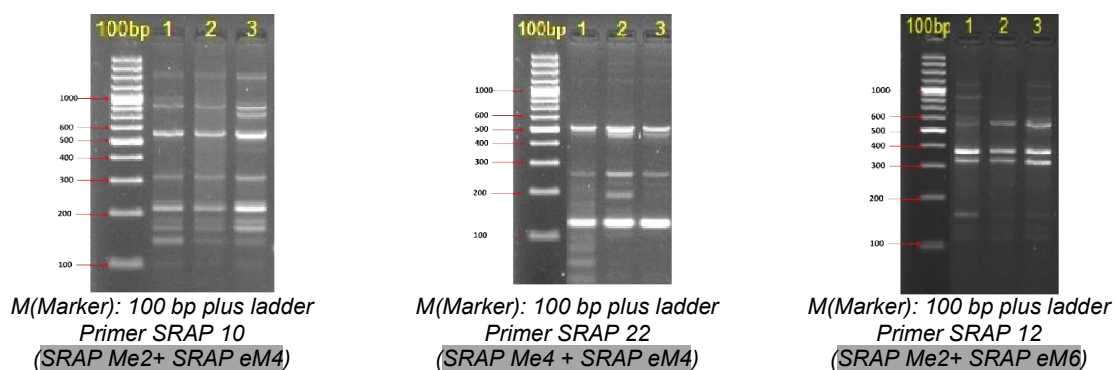


Fig.1. DNA Fingerprinting report of Urdbean variety JAUG 2 (GAU 4) using SRAP marker

4. CONCLUSION

It has higher seed yield and YMV disease resistance, JAUG 2 genotype will be released as Gujarat Anand Urdbean 4 (GAU 4: Shyamal) by the SVRC held during 2021. It is recommended that "The farmers of middle Gujarat growing Urdbean are recommended to grow variety Gujarat Anand Urdbean 4 (GAU 4: Shyamal) during summer and *kharif* season. The proposed genotype gave 1005 kg/ha and 864 kg/ha seed yield in *kharif* and summer season, respectively in middle Gujarat. It exhibited yield advantage of 19.1 and 23.9% in *kharif* as well as 22.2 and 23.4 % in summer over the checks T 9 and GU 1, respectively. The variety is medium maturity, *semi-erect* in nature and resistant against YMV disease under natural field condition".

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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ANNEXURE-I

Photograph of Urdbean genotype JAUG 2 (GAU 4)

Field view of JAUG 2



GREEN POD

DRY POD



DIFFERENCES IN SEED QUALITY



Field view of JAUG 2 with checks (T9 & GU1)



Pod photographs



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