

Electronic Journal of Plant Breeding



Research Article

GPUF 3: A new high yielding foxtail millet variety (*Sateria italica*)

T. E. Nagaraja, C. Nandini, Sujata Bhat, K. B. Palanna, Prabhu C Ganiger, T. S. Sukanya, H. S. Saritha, S. Gazala Parveen and D. N. Vinutha*

Project Coordination Unit, ICAR-AICRP on small millets, University of Agricultural Sciences, GKVK, Bengaluru

*E-Mail: nandini.vinutha@gmail.com

Abstract

GPUF 3, a new foxtail millet variety was developed at the Project Coordinating unit, ICAR- AICRP on Small Millets, University of Agricultural Sciences, GKVK, Bengaluru for cultivation in zone 5 and zone 6 of Karnataka state. It has been evolved through pureline selection from germplasm IC 479864. This new variety matures in 85-90 days. This variety has semi compact and oblong shaped inflorescence. The grains are oval in shape and yellow in colour. This variety is moderately resistant to leaf blight and rust diseases and it is tolerant to shoot fly damage. GPUF 3 grain contains high calcium than check SiA 3156 and it contains iron content of 39.4 ppm, 11.6 *per cent* protein and 43.2 ppm of Zinc. Fodder contains high crude fiber, crude protein and crude fat content than check variety SiA 3156. New variety GPUF 3 recorded an average grain yield of 29.89 q/ha in station trials, 26.33 q/ha in Multilocation trials and 15.16 q/ha in farm trials with a mean grain yield of 23.79 q/ha across all the trials. GPUF 3 registered an average grain yield of 23.79 q/ha with a 19.12 *per cent* increased yield over check variety SiA3156. In All India Co-ordinated trials, GPUF 3 yielded 2753 kg/ha across the locations and ranked 11th across the locations in AICRP trials. This new variety is recommended for release in the Annual Plant Scientists Group meeting held at UAS, GKVK, Bengaluru on 1-3rd March 2021, Annual ZREP workshop of Zone-6 held on 5th April 2021, Annual ZREP workshop of Zone-5 held on 8th April 2021 and State varietal evaluation committee (SVEC) meeting held on 13th to 16th December 2021. NBPGR, New Delhi has issued national identity number IC 635733 for this variety. Because of its superior performance in zone 5 and zone 6 of Karnataka, this variety has been recommended for cultivation in the southern (Zone 6) and eastern (zone 5) dry zones of Karnataka state.

Keywords: Coordinated trials, Foxtail millet, Grain yield, Inflorescence, Variety

INTRODUCTION

Foxtail millet (*Setaria italica* L.) is an important small millet crop with a short growing season and this makes it suited to the farming conditions of the semi-arid climate, which belongs to the grass family of Poaceae (Obidiegwu *et al.*, 2013). It is known for its drought tolerance and can withstand severe moisture stress and also suited to a wide range of soil conditions (Ravi *et al.*, 2010, Nandini *et al.*, 2021). It is of the shortest duration and low cost consumptive crop, nutritionally superior, providing cheap protein, minerals and vitamins and forms staple food of

the poorer sections of the society (Malleesh, 1986). It's grain used for human consumption and a feed for poultry and cage birds. It is used in several food preparations like chapati, fermented bread, biscuits, malts, etc. the stalks are used as fodder and for thatching. It is rich in micronutrients and good for diabetic patients. It protects against cancer and related heart diseases (Anon., 1993). In India, it is grown mainly in Andhra Pradesh, Karnataka, Telangana, Rajasthan, Maharashtra, Tamil Nadu, Madhya Pradesh, Uttar Pradesh and in a small extent in

the northeast states of India. India is the leading country in small millet production with acreage of around 7.0 lakh ha and productivity of 633 kg/ ha (Maitra and Shankar, 2019). In Karnataka foxtail millet is grown in Tumkuru, Haveri, Dharwad, Bengaluru rural, Ramnagara, Belgaum and Chitradurga districts of Karnataka.

Foxtail millet grains are rich in protein, minerals (calcium, iron, potassium, magnesium, and zinc) and vitamins (Rai, 2002). It is not only widely used as an energy source for pregnant and lactating women, but also for sick people and children and especially for diabetics. It reduces blood sugar concentration in women diabetics (Sema and Sarita, 2002). The grains have a long shelf-life, a preferable attribute (Ravi *et al.*, 2010). 100 g of foxtail millet grains contain 9.9 g protein, 72 g carbohydrates, 2.5 g fat, 3.5 g ash, 10 g crude fiber, 0.27 mg potassium, 0.01 mg thiamine, 0.099 mg riboflavin, 0.82 mg pantothenic acid, 3.70 mg niacin, 0.02 mg folacin and 351 kilocalories of energy (Nandini and Sridhara, 2019).

Genetic improvement and cultivar development of Foxtail millet have been achieved through a direct selection of promising germplasm and also by hybridization followed by the selection method. In India, 23 cultivars have been released, of which ten were developed by hybridization followed by selection and the remaining by selection from landraces.

Generally lower yields in Foxtail millet are due to a lack of high yielding varieties and non-adoption of improved cultural practices by the dry land farmers. There is a need to improve the genetic yield potentiality and evolve new high yielding varieties with shootfly and rust disease resistance suitable for Foxtail millet growing areas (Nandini *et al.*, 2020). Keeping this objective in view, pureline selection has been carried out in germplasm to select high yielding, disease and insect resistance to evolve new high yielding Foxtail millet varieties to

promote the cultivation of this crop in different agro climatic conditions. The new culture GPUF 3, is a pureline selection from germplasm IC 479864.

MATERIALS AND METHODS

The Foxtail millet variety GPUF 3 was developed at the Project Coordinating unit, AICRP on Small Millets, University of Agricultural Sciences, GKVK, Bengaluru for cultivation in Zone 5 and Zone 6 of Karnataka state. It is developed by pure line selection breeding method. GPUF 3 is a selection from IC 479864. Different individual plants were selected from IC 479864 and they were multiplied and evaluated in preliminary yield trials and station trials and among them GPUF 3 was found to be the best one.

GPUF 3 was evaluated with local and national checks in station trials at Project Coordinating unit, AICRP on Small Millets, University of Agricultural Sciences, GKVK, Bengaluru starting from 2017 to 2020 and All India Co-ordinated trials during 2019-20. Besides this, this variety was also screened for rust, leaf blight diseases and shoot fly incidence as per the standard scale. This entry was tested in different locations of Zone 5 (Eastern dry zone) and Zone 6 (Southern dry zone) of Karnataka state. In zone 5 this entry was evaluated in Agricultural Research Station Tiptur, ARS Balajigapade and ARS Kunigal. Similarly, in Zone 6 it was evaluated in ARS, Mandya, KVK, Chamaraja Nagara and ARS, Madenur. Farm trials were conducted in 49 farmer's field of Zone 5 and Zone 6 of Karnataka state. In each farmer's field test entry and check variety were evaluated in 5 guntas each. Details of the farm trial conducted in the district are mentioned in **Table 1**.

RESULTS AND DISCUSSION

Yield performance of variety GPUF 3 in station trials: GPUF3 was evaluated for yield and other ancillary characters in station trials from 2017 to 2020 along with check variety SiA 3156. GPUF 3 recorded a mean seed

Table 1. Details of Farm trials conducted at different locations of Zone 5 and Zone 6 of Karnataka

Zone 5			Zone 6		
S. No.	District/Organization	Trials conducted	S. No.	District/Organization	Trials conducted
1	KSDA, Kolar	3	1	KSDA, Mysuru	2
2	KSDA, Chikkaballapur	2	2	KSDA, Mandya	4
3	EEU, Bengaluru	5	3	KSDA, Chamarajanagara	4
4	KVK, Hadonalli	5	4	EEU, Nagenahalli	4
5	KVK, Chintamani	5	5	KVK, Mandya	5
6	KVK, Ramanagara	5	6	KVK, Chamarajanagara	5
	Total	25		Total	24

KSDA: Karnataka State Department of Agriculture

KVK: Krishi Vignana Kendra

EEU: Extension Education Unit

yield of 29.89 q/ha. While check SiA 3156 recorded a mean seed yield of 25.73 q/ha. The new variety GPUF 3 recorded 16.15 per cent increased seed yield over the check SiA 3156. Days to maturity over years ranged from 88 to 91 days. Similarly, the number of productive tillers ranged from 3 to 4.3, plant height ranged from 118 to 142.3 cm and straw yield ranged from 4.2 to 4.31 t/ha. Mean seed yield and other ancillary characters of GPUF 3 over years in station trial is presented in **Table 2**.

Yield performance of GPUF 3 in All India Coordinated trials: In All India Co-ordinated trials, a new variety GPUF 3 was tested in the Initial varietal trial during *kharif* 2019. Summary grain yield data of Coordinated Varietal Trials were presented in **Table 3**. New variety GPUF 3 yielded 2753 kg/ha across the locations. GPUF 3 ranked 11th across the locations in AICRP trials.

Yield performance of GPUF 3 for grain yield in

Multilocations of Zone 5 (Eastern dry zone) and Zone 6 (Southern dry zone) of Karnataka: In zone 5, the new variety GPUF 3 was evaluated in Bengaluru, Tiptur, Balajigapade and Kunigal along with check variety SiA 3156. Centre-wise grain yield data of GPUF 3 and check SiA3156 is presented in **Table 4**. GPUF 3 registered a grain yield of 32.96 q/ha in Bengaluru, 30.55 q/ha in Tiptur, 25.52 q/ha in Balajigapadae and 20.26 q/ha in Kunigal with a mean grain yield of 27.32 q/ha. While, SiA3156 registered 28.96 q/ha, 20.18 q/ha, 19.52 q/ha and 18.44 q/ha in Bengaluru, Tiptur, Balajigapade and Kunigal respectively mean grain yield of SiA 3156 was 21.78 q/ha. New variety GPUF 3 recorded 25.47 per cent increased yield over check SiA3156 in zone 5 of Karnataka.

In zone 6, GPUF 3 was evaluated in Mandya, Chamaraja Nagara and Madenur along with check variety SiA3156. GPUF 3 registered a grain yield of 31.85 q/ha, 24.22 q/ha and 19.96 q/ha in Mandya, Chamaraja Nagara and

Table 2. Mean seed yield and other ancillary characters of proposed variety GPUF 3 over years in station trial

Entries	Kharif 2017					Kharif 2018				
	Grain yield (q/ha)	Straw yield (t/ha)	Number of tillers	Days to maturity	Plant height (cm)	Grain yield (q/ha)	Straw yield (t/ha)	Number of tillers	Days to maturity	Plant height (cm)
GPUF 3	28.15*	4.23	3.4	88	135.5	19.76*	4.31	3.0	91	134.6
SiA 3156 (C)	22.52	3.92	2.4	86	126.2	15.9	4.61	4.0	89	129.5
Mean	21.46	3.8	2.7	87	138.2	12.58	3.06	2.68	94	119.5
CD at 5%	3.6	0.45	0.54	2.1	5.5	3.37	0.38	0.45	2.34	5.8
CV (%)	10.34	7.21	12.1	1.27	5.24	13	7.38	10.08	1.48	4.6

Continued.....

Entries	Kharif 2019					Kharif 2020					Mean grain yield (q/ha) over years	% increase over check
	Grain yield (q/ha)	Straw yield (t/ha)	Number of tillers	Days to maturity	Plant height (cm)	Grain yield (q/ha)	Straw yield (t/ha)	Number of tillers	Days to maturity	Plant height (cm)		
GPUF 3	33.14	4.2	4.3	90	142.3	38.5	4.2	4.2	88	118	29.89	16.15
SiA 156(C)	29.11	4.0	3.4	88	135.2	35.4	3.4	4.6	89	122	25.73	
Mean	27.69	3.88	3.74	86.95	137.6	32.08	3.6	3.9	86	116.5		
CD at 5%	4.75	0.46	0.45	1.65	8.06	6.69	0.52	0.51	1.83	8.17		
CV (%)	11.48	7.7	5.3	1.23	9.8	11.91	6.8	4.2	1.33	5.8		

*Check

Table 3. Performance of GPUF 3 in AICRP Coordinated trial during Kharif 2019

S. No.	Entries	Seed yield (kg/ha)	Duration (days)	All India Rank
1	GPUF-3	2753	90	11
2	SiA 3156 (C)	2938	88	
		15		
		349		

Table 4. Performance of proposed variety GPUF 3 in multilocation trials conducted in Zone 5 (grain yield q/ha) during *kharif* 2019

S. No.	Entries	Bengaluru	Tiptur	Balajigapade	Kunigal	Mean (q/ha)	% increase over check variety SiA 3156
1	GPUF 3	32.96	30.55	25.52	20.26	27.32	25.47
2	SiA 3156 (C)	28.96	20.18	19.52	18.44	21.78	
	CD (5%)	4.75	3.17	3.72	2.71		
	CV (%)	11.48	9.94	11.77	10.46		

Madenur, respectively. The mean grain yield of GPUF 3 was 25.35 q/ha. While, SiA3156 registered 29.69 q/ha, 16.04 q/ha and 19.19 q/ha in Mandya, Chamaraja Nagara and Madenur, respectively. The mean grain yield of SiA3156 was 21.64 q/ha. GPUF 3 recorded 17.13 *per cent* increased yield over check SiA3156 in zone 6 of Karnataka. Centre-wise grain yield data of GPUF 3 and check SiA3156 is presented in **Table 5**.

Across the locations of zone 5 and zone 6 GPUF 3 recorded the mean grain yield of 26.33 q/ha and SiA3156 recorded 21.71 q/ha. Across the locations GPUF3 recorded 21.31 *per cent* increased grain yield over check SiA3156. The mean performance of GPUF 3 and check SiA 3156 across zones is presented in **Table 6**.

Performance of GPUF 3 in farm trials: Farm trials are used to validate small plot research with larger field scale evaluation. Farm trials are conducted in farmer's field in collaboration with Krishi Vignana Kendra and the Karnataka State Department of Agriculture. New variety and check variety were evaluated in farmer's field of different hobli and taluks of each district.

In Zone 5, farm trials were conducted at KSDA Kolar, KSDA Chikkaballapur, EEU Bengaluru, KVK Hadonalli, KVK Chintamani and KVK Ramanagara. New variety GPUF 3 registered 19.01 *per cent* increased grain yield

over SiA3156 in KSDA Kolar. Similarly, 55.42 *per cent* in KSDA Chikkaballapur, 27.52 *per cent* in EEU Bengaluru, 14.21 *per cent* in KVK Hadonalli, 15.10 *per cent* in KVK Chintamani and 6.97 *per cent* in KVK Ramanagara. Overall new variety GPUF 3 showed 20.29 *per cent* increased yield over check SiA 3156 in zone 5. Centre-wise grain yield data of GPUF 3 and check SiA 3156 in farm trials is presented in **Table 7**.

In Zone 6, farm trials are conducted at KSDA Mysuru, KSDA Mandya, KSDA Chamarajanagara, EEU Nagenahalli, KVK Mandya and KVK, Chamarajanagara. Centre-wise grain yield data of GPUF3 and check SiA3156 in farm trials is presented in **Table 8**. GPUF 3 registered 20.38, 22.44, 31.01, 12.53, 25.89 and 11.68 *per cent* increased grain yield over SiA3156 at KSDA Mysuru, KSDA Mandya, KSDA Chamarajanagara, EEU Nagenahalli, KVK Mandya and KVK, Chamarajanagara, respectively. In Overall, new variety GPUF 3 recorded 22.98 *per cent* increased yield over check variety SiA3156 in zone 6. Across the zones GPUF 3 recorded 21.26 increased yields over a check. The overall mean grain yield of farm trials results of GPUF 3 in Zone 5 and Zone 6 is presented in **Table 9**.

Overall performance of GPUF 3 in Station trials, Multilocation trials and Farm trials: New variety GPUF 3 recorded an average grain yield of 29.89 q/ha in station trials, 26.33 q/ha in Multilocation trials and 15.16 q/ha in

Table 5. Performance of proposed variety GPUF 3 in multi-location trials conducted in Zone 6 (grain yield q/ha) during *kharif* 2019

S. No.	Entries	Mandya	Chamaraja Nagara	Madenur	Mean (q/ha)	% increase over SiA 3156
1	GPUF 3	31.85	24.22	19.96	25.35	17.13
2	SiA 3156 (C)	29.69	16.04	19.19	21.64	
	CD (5%)	3.73	2.62	3.01		
	CV %	8.35	9.4	11.98		

Table 6. Mean performance of proposed variety GPUF 3 in multilocation trial across zones (grain yield in q/ha)

S. No.	Entries	Zone 5	Zone 6	Mean(q/ha)	% increase over SiA 3156
1	GPUF 3	27.32	25.35	26.33	21.31
2	SiA 3156 (C)	21.78	21.64	21.71	

Table 7. Performance of GPUF 3 in Farm Trials conducted in Zone 5 (Mean grain yield q/ha) during Kharif 2020

S. No.	District/Organization	Trials allotted	Trials conducted	GPUF 3	SiA 3156 (C)	% increase over check
1	KSDA, Kolar	5	5	13.96	11.73	19.01
2	KSDA, Chikkaballapur	5	2	12.90	8.30	55.42
3	EEU, Bengaluru	5	5	15.20	11.92	27.52
4	KVK, Hadonalli	5	5	16.68	14.60	14.21
5	KVK, Chintamani	5	5	16.73	14.54	15.10
6	KVK, Ramanagara	5	5	15.96	14.92	6.97
	Total	30	27	15.24	12.66	20.29

Over all per cent increase over check : 20.29

Table 8. Performance of GPUF 3 in Farm Trials conducted in Zone 6 (Mean grain yield q/ha) during Kharif 2020

S. No.	District/Organization	Trials allotted	Trials conducted	GPUF 3	SiA 3156 (C)	% increase over check
1	KSDA, Mysuru	5	2	12.76	10.60	20.38
2	KSDA, Mandya	5	4	9.55	7.80	22.44
3	KSDA, Chamarajanagara	5	4	10.35	7.90	31.01
4	EEU, Nagenahalli	5	4	19.07	16.95	12.53
5	KVK, Mandya	5	5	21.20	16.84	25.89
6	KVK, Chamarajanagara	5	5	17.78	15.92	11.68
	Total	30	24	15.11	12.29	22.98

Over all per cent increase over check : 22.98

Table 9. Overall mean of farm trial GPUF 3 results in Zone-V and Zone-VI (Mean grain yield q/ha) during kharif 2020

Varieties	Zone-V		Zone-VI	
	Mean yield	% yield increase	Mean yield	% yield increase
GPUF-3	15.24	20.29	15.11	22.98
SiA 3156(C)	12.73		12.29	

farm trials with a mean grain yield of 23.79 q/ha. While, check variety SiA3156 recorded 25.73 q/ha, 21.71 q/ha and 12.47 q/ha in station trials, Multilocation trials and farm trials, respectively with a mean grain yield of 19.97 q/ha. Across all the trials GPUF 3 registered an average yield of 23.79q/ha with 19.12 *per cent* increased yield over check variety SiA3156. Overall Mean grain yield of Station trials, Multilocation trials and Farm trials are presented in **Table 10**. GPUF 3 has performed good in all trials and given increased grain yield over a check. Hence, this new variety is recommended for release in the Annual Plant Scientists Group meeting held at UAS, GKVK, Bengaluru on 1-3 March 2021, Annual ZREP workshop of Zone-6 (Southern dry zone) held on 5th April 2021 through Zoom meeting, Annual ZREP workshop of Zone-5 (Eastern dry zone) held on 8th April 2021 and State varietal evaluation committee (SVEC) meeting held on 13th to 16th December 2021.

Because of the superior performance of this variety in zone 5 (Eastern dry zone) and zone 6 (Southern dry zone) of Karnataka this variety has been recommended for cultivation in zone 5 and zone 6 of Karnataka state. The eastern dry zone includes districts *viz.*, Bengaluru urban, Bengaluru rural, Chikkaballapur, Kolar, Ramanagara and some taluks of Tumkur districts. Similarly, The southern dry zone includes districts *viz.*, Mandya, Mysuru and Chamrajanagara.

Grain yield: GPUF 3 exhibited a grain yield of 1261.83 kg/ha and 36.99 *per cent* increased grain yield than check SiA3156. A summary of grain and straw yield data of the Agronomic Trial (2020) is presented in **Table 11**.

Straw yield: Under agronomic trial new variety GPUF 3 recorded an increased straw yield of 2745.75 kg/ha. While check SiA3156 recorded 2309.33 kg/ha.

Table 10. Over all Mean grain yield (q/ha) of Station trials, Multilocation trials and Farm trials

Entries	Yield (q/ha)			Mean	% increase over check
	Station trial	MLT	Farm Trial		
GPUF 3	29.89	26.33	15.16	23.79	19.12
SiA 3156 (C)	25.73	21.71	12.47	19.97	

Table 11. Agronomic evaluation of proposed variety GPUF 3 and check variety SiA 3156 during *kharif* 2020 at Project Coordinating Unit, Small millets, UAS, GKVK, Bengaluru

Name of Experiment	Treatments	Grain yield (kg/ha)		Straw yield (Kg/ha)		
		Proposed variety GPUF3	SiA 3156 (C)	Proposed variety GPUF3	SiA 3156 (C)	
Fertilizer levels	F1 (75% RDF)	1139.23	728.18	2622.62	1852.31	
	F2 (100% RDF)	1441.11	1051.91	2928.68	1539.42	
	F3 (125% RDF)	1205.16	465.52	2685.95	1536.25	
	Mean	1261.83	748.54	2745.75	2309.33	
	% increase over check in F2 (100% RDF) = 36.99					
	SEm±		77.72		249.66	
CD @ 5%		227.97		732.24		
Spacing (cm)	S1 (22.5 x 10)	1245.22	896.86	3099.65	2247.85	
	S2 (30 x 10)	1278.45	600.23	2391.84	2370.81	
	Mean	1261.83	748.54	2745.75	2309.33	
	% increase over check in S1 (22.5 x 10)= 38.84					
	SEm±	63.46		203.85		
	CD @ 5%	186.13		597.87		

Reaction to disease and insect pests: Foxtail millet crop is generally affected by shootfly incidence and with respect to diseases it is affected by rust and leaf blight. Hence, variety GPUF 3 is screened for insect shootfly and diseases like rust and leaf blight during *kharif* 2018 and 2019. Variety GPUF 3 showed moderate resistance to rust (3.40) and leaf blight (3.97) diseases. GPUF 3 exhibited less infestation of shoot fly and showed a tolerant (13.75) reaction. Reactions to diseases and insect pests were represented in **Tables 12 and 13**, respectively.

Distinguishing traits of GPUF 3: This new variety matures in 85 to 90 days and has a decumbent plant type with medium height (120-130 cm) and the plant is not pigmented. This variety has semi compact and oblong shaped inflorescence. The grains are oval in shape and yellow in colour with a test weight of 3.2 g. The variety is suitable for sowing in both *Kharif* (June-July) and summer (January). Descriptors of the new variety GPUF 3 are presented in **Table 14**. The field view of new variety GPUF 3 and its seed is depicted in **Fig 1 and Fig 2**, respectively. Grain and Fodder quality parameters of GPUF 3: Foxtail

millet is one of the important small millet crops with high nutritional value. Consumption of this millet has a lot of health benefits like preventing cardio vascular diseases, diabetes, cancer and managing liver diseases. GPUF 3 contains more grain calcium (108.6 ppm) content compared to the check SiA3156. This variety has an iron content of 39.4 ppm, 11.6 per cent protein, and 43.2 ppm of Zinc. Grain quality characteristics of variety GPUF 3 and check SiA 3156 are presented in **Table 15**. Fodder contains high crude fiber (39.16 %), crude protein (3.50%) and crude fat (0.16 %) content than check variety SiA 3156. Fodder quality characteristics of variety GPUF 3 and check SiA 3156 are presented in **Table 16**.

DNA finger printing of new variety GPUF 3: New variety GPUF 3 along with check variety SiA 3156 were used for DNA finger printing using SSR markers. Three SSR markers viz., GB-PMM 111, GB-PMM 031 and GB-PMM- 106 were differentiated between variety GPUF 3 and check variety SiA3156. Gel pictures depicting polymorphism between new variety and check variety were depicted in **Fig. 3**.

Table 12. Screening of Leaf blight and Brown spot disease at Project Coordinating Unit, Small Millets, UAS, GKVK, Bengaluru

S. No.	Entries	2018		2019		Mean	
		Rust	Leaf blight	Rust	Leaf blight	Rust	Leaf blight
1.	GPUF 3	3.23 (MR)	3.85 (MR)	3.58 (MR)	4.10 (MR)	3.40 (MR)	3.97 (MR)
2.	SiA 3156 (C)	3.75 (MR)	4.12 (MR)	4.00 (MR)	4.25 (MR)	3.87 (MR)	4.18 (MR)

Note: Disease rating scale for brown spot/ leaf blight (1-9 scale) (Palanna & Das, 2018)

Table 13. Reaction against insect pest infestation at Project Coordinating Unit, Small millets, UAS, GKVK, Bengaluru (per cent)

S. No.	Entries	2018	2019	Mean
		Shoot fly	Shoot fly	
1.	GPUF3	14.25 (T)	13.25 (T)	13.75
2.	SiA 315 (C)	13.56 (T)	12.5 (T)	13.03

Note: Rating scale for shoot fly infestation (Taneja and Leuschner, 1985)

Tolerant: 10-20 per cent dead heart

Table 14. Characteristics of proposed variety GPUF 3 and check variety SiA 3156

S.No.	Characters	GPUF 3	SiA 3156
1.	Growth habit	: Decumbent	Decumbent
2.	Pigmentation	: Absent	Present
3.	Days to flowering	: 44-47 days (medium)	42-45days (medium)
4.	Plant height (cm)	: 120-130	125-130
5.	Inflorescence shape	: Oblong	Oblong
6.	Inflorescence bristles	: Present	Present
7.	Inflorescence apical sterility	: Absent	Absent
8.	Inflorescence compactness	: Medium	Medium
9.	Grain colour	: Yellow	Yellow
10.	Grain shape	: Oval	Oval
11.	Test weight (g)	: 3.2	3.0

Table 15. Grain quality parameters

Variety	Iron (ppm)	Zinc (ppm)	Calcium (ppm)	Protein %
GPUF3	39.4	43.2	108.6	11.6
SA3156	51.0	65.5	93.9	13.8

The new variety GPUF 3 produced a significant increased yield over check in three years of station trials, multilocation trials and farm trials. This new variety is medium height and medium duration. This new variety matures in 85 to 90 days and has a decumbent plant type with medium height and the plant is not pigmented. This variety has semi compact and oblong shaped inflorescence. The grains are oval in shape and yellow in colour. This variety

is moderately resistant to leaf blight and rust diseases and it is tolerant to shoot fly damage. The variety is suitable for sowing in both *Kharif* (June-July) and summer (January). It yields 15-20 q/ha under protective irrigation. GPUF 3 grain contains, high calcium than check SiA 3156 and it contains iron content of 39.4 ppm, 11.6 per cent protein and 43.2 ppm of Zinc. Fodder contains high crude fiber, crude protein and crude fat content than check variety



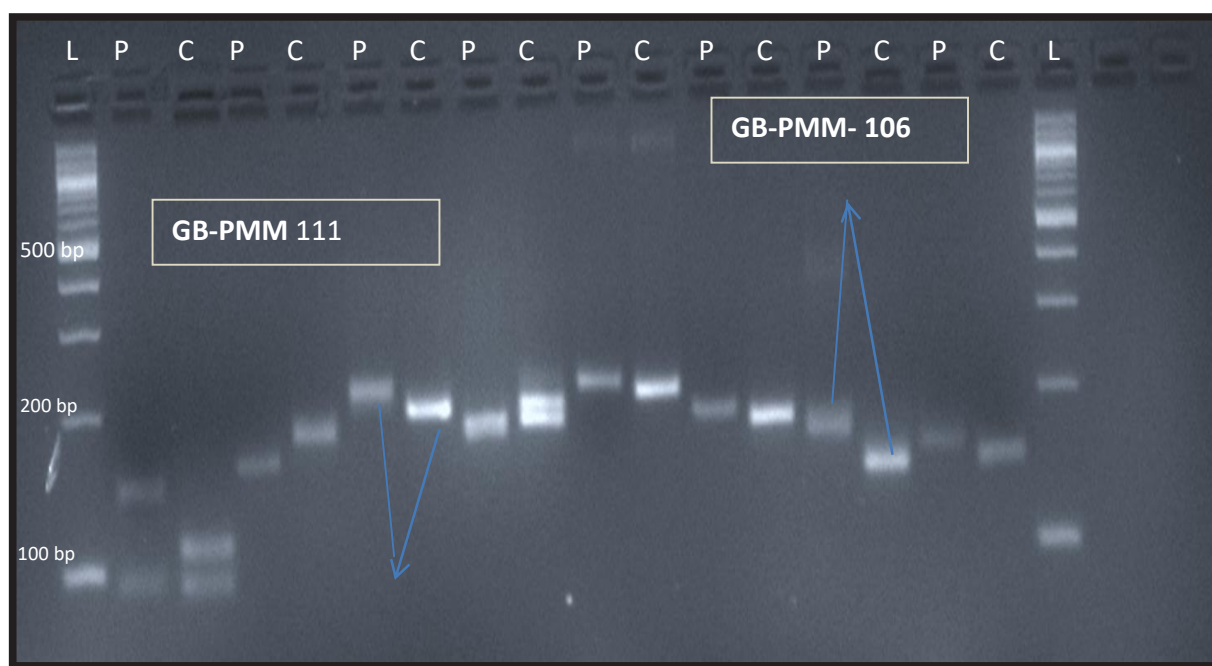
Fig.1. Field view of new variety GPUF 3



Fig. 2. Seed of new variety GPUF 3

Table 16. Fodder quality parameters of proposed variety GPUF 3 and check variety SiA 3156

S. No.	Parameters	GPUF 3	SiA 3156
1	Moisture (%)	6.34	6.75
2	Crude protein (%)	3.50	3.25
3	Crude fat (%)	0.16	0.15
4	Crude fibre (%)	39.16	35.74
5	Total ash (%)	9.54	8.99
6	Acid insoluble ash (%)	6.72	6.88



L: ladder, P: GPUF3, C: SiA3156

Fig. 3. Molecular profile of proposed variety GPUF 3 and check variety SiA 3156

SiA 3156. Hence, this new variety is recommended for release in the Annual Plant Scientists Group meeting held at UAS, GKVK, Bengaluru on 1-3 March 2021, the Annual ZREP workshop of Zone-6 held on 5th April 2021 through Zoom meeting, the Annual ZREP workshop of Zone-5 held on 8th April 2021 through Zoom meeting and State varietal evaluation committee (SVEC) meeting held on 13th to 16th December 2021, NBPGR, New Delhi has issued IC 635733 for this variety. Because of the superior performance of this variety in zone 5 (Eastern dry zone) and zone 6 (Southern dry zone) of Karnataka this variety has been recommended for cultivation in zone 5 and zone 6 of Karnataka state.

REFERENCES

- Anonymous. 1993. Annual Progress Report of the All-India Co-ordinated Research Projects on small millets, ICAR Co-operating centers, Bangalore. 36-38.
- Mallesha, N.G. 1986. In: Small millets in Global Agriculture (Sitharam, A.K.W. Riley and Harinarayana, G. eds.).Oxford and IBH Publishing Co. Pvt. Ltd., India, 305-339.
- Maitra, S. and Shankar. T. 2019. Agronomic management in little millet (*Panicum sumatrense* L.) for enhancement of productivity and sustainability. IJBS, 6(2): 91-96. [Cross Ref]
- Nandini, K.M. and Sridhara S. 2019. Performance of foxtail millet (*Setaria italica* L.) genotypes to sowing dates in Southern transition zone of Karnataka. *Journal of Pharmacognosy and Phytochemistry*, 8(1): 2109-2112.
- Nandini, C., Sujata Bhat, Prabhakar, Jayaramgowda, Krishnappa, M., Srinathareddy, S., Prabhu C Ganiger, Palanna, K.B., Sukanya, T. S., Boraiah B., Kiran, Lavanya Bai, T. and Vinay.N. 2020. A

- new high yielding Proso millet variety (*Panicum miliaceum* L.): PMV 442 (GPUP 25). *Electronic Journal of plant breeding*, Vol 12(1);9-16. [\[Cross Ref\]](#)
- Nandini, C., Sujata Bhat, Saritha, H.S, Chithra Devi Pandey, Sushil Pandey, Prabhakar, Lavanya Bai and Jayaram Gowda, 2021. Characterization of barnyard millet (*Echinochloa frumentaceae* (Roxb.) Link) germplasm for quantitative traits to enhance its utilization, *Electronic Journal of Plant Breeding*, **11**(4):1066-1072. [\[Cross Ref\]](#)
- Obidiegwu, O.N. *et al.* 2013. Development of SSR for foxtail millet (*Setaria italica* (L.) P. Beauv.) and its utility in genetic discrimination of a core set. *Genes Genome.*, **35**: 609 - 615. [\[Cross Ref\]](#)
- Rai, M. 2002. Nutritive cereals. In: *Survey of Indian Agriculture*, the Hindu, Chennai, Tamil Nadu, India, pp. 59–62.
- Ravi, S.B., Hrideek, T.K., Kumar, A.T.K., Prabhakaran, T.R., Mal, B. and Padulosi, S. 2010. Mobilizing neglected and underutilized crops to strengthen food security and alleviate poverty in India. *Indian J. Plant Genet. Resour.*, **23**: 117–121.
- Sema, A. and Sarita, S. 2002. Suitability of millet-based food products for diabetics. *J. Food Sci. Technol.*, **39**: 423–426.