Plant Archives Vol. 26, Supplement 2, 2026 pp. 2435-2442 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.supplement-2.306

CLIMATE RESILIENT PEARL MILLET HYBRID GHB 1294 (*Maru moti*): ENTITLE FARMERS FOR BETTER CULTIVATION

K.D. Mungra*, S.K. Parmar, D.V. Kandoriya, S.N. Galani, P.M. Sondarava, R.J. Chaudhari and J.S. Sorathiya

Pearl Millet Research Station, JAU, Jamnagar - 361006, Gujarat, India
*Corresponding author E-mail: kdmungra@jau.in

(Date of Receiving : 16-04-2026; Date of Revision : 02-06-2026; Date of Acceptance : 29-06-2026)

ABSTRACT

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is a climate-resilient nutricereal crucial for food and nutritional security in the arid and semi-arid regions of India. To address malnutrition and hidden hunger, the Pearl Millet Research Station, Junagadh Agricultural University, Jamnagar, developed GHB 1294, a high-yielding, biofortified, early-maturing single-cross hybrid ($ICMA_1$ 93333 × J-2632) utilizing an A_1 cytoplasmic male-sterility source. The development and evaluation of this nutrient-dense, climate-smart hybrid directly support global sustainability initiatives by aligning with United Nations Sustainable Development Goals, specifically SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), and SDG 17 (Partnerships for the Goals). GHB 1294 was evaluated across multi-location trials from 2020 to 2022 against standard national checks for yield, micronutrient (Fe and Zn) content, and biotic stress resistance. In Gujarat state trials, GHB 1294 recorded a grain yield of 2717 kg/ha and a dry fodder yield of 7306 kg/ha, out-yielding the group check GHB 538 by 20.0% and 46.8%, respectively. In national AICRP-PM A_1 zone trials, the hybrid achieved a grain yield of 2223 kg/ha, which was 24.5%, 32.0%, 24.2%, and 31.0% higher than the checks MPMH 21 (1786 kg/ha), RHB 177 (1684 kg/ha), HHB 272 (1790 kg/ha), and HHB 67 Improved (1698 kg/ha), respectively. It also exhibited a superior dry fodder yield of 5184 kg/ha, outperforming the same national checks by 18.8%, 26.6%, 20.4%, and 23.1%. Furthermore, GHB 1294 demonstrated robust resistance to major diseases (downy mildew, blast, and rust) and key insect pests (shoot fly, stem borer, and *Helicoverpa*), making it an ideal climate-smart variety for sustainable cultivation in the dry zones of India.

***Keywords*:** Heterosis breeding, Biotic resistance, Biofortification, Marginal environment, Cytoplasmic male-sterility

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is an important cereal crop in arid and semi-arid tropical regions of Gujarat and Rajasthan. It serves as a resilient choice for these environments, demonstrating superior heat tolerance and moisture utilization compared to sorghum and maize (Nambiar *et al.*, 2011). This crop provides vital dietary energy and nutritional security for resource-poor farmers and consumers. Globally, this crop covers 26 million hectares (mha). India accounts for 7.4 mha of this total, with cultivation concentrated in the highly marginal, dry zones of Rajasthan, Uttar Pradesh, Haryana, Gujarat and Maharashtra (Directorate of Economic and Statistics, 2025). Pearl millet is a rich source of protein, calcium, phosphorus, iron, while offering a superior, gluten-free amino acid profile compared to other cereals (Uppal *et al.*, 2015 and Weckwerth *et al.*, 2020). Often dubbed the “camel crop” for its exceptional drought tolerance, pearl millet is inherently climate-smart and dryland-resilient. Beyond its toughness, it delivers high metabolizable energy, making it a highly efficient food source.

According to the 2025 Global Hunger Index (https://www.globalhungerindex.org/india.html), India ranks 102nd out of 123 countries with a score of 25.8, placing its hunger severity in the "serious" category. This index tracks nationwide undernutrition by looking

at child mortality, undernourishment, stunting and wasting. The inadequate intake of energy-providing organic macronutrients (largely carbohydrate, followed by protein and fat, in that order), leads to under-nutrition, with a consequent feeling of hunger (Webb *et al.*, 2018). Unlike the macronutrients mentioned above, which are consumed in larger quantities for proper growth and development, there are several micronutrients which are needed in trace amounts, but they play vital roles in various physiological functions. Among these, iron (Fe) and zinc (Zn) are the most critical elements required to prevent widespread nutritional deficiencies and sustain vital metabolic pathways.

The changing climate is leading to an increase in global average temperature affecting agricultural production world-wide (Saleem *et al.*, 2025). Further, it directly influences biophysical factors such as plant and animal growth along with the different areas associated with food processing and distribution. Assessment of effects of global climate changes and deployment of new tools and strategies to mitigate their effect is crucial to maximizing agricultural production to meet out food demands of the increasing population. In this context, pearl millet is most useful as it is a nutritious, climate change-ready crop with enormous potential for yielding higher economic returns in marginal conditions in comparison with other cereals even in case of climate change with harsh temperature conditions. Moreover, it has greater ceiling temperatures for grain yield and is an underutilized crop with huge nutritional potential, which needs to be utilized fully (Krishnan and Meera, 2018). It is more resilient to extreme climatic events such as drought and water scarcity and can play a vital role in ensuring food and nutritional security in changing climatic scenarios, which is mounting to frightening proportions. To address these critical challenges, this study presents the development and comprehensive evaluation of the newly released pearl millet variety GHB 1294, focusing on its grain yield performance, disease-pest resistance profile and biofortification traits.

Materials and Methods

Plant material

The pearl millet hybrid GHB 1294 is a single cross combination of $ICMA_1$ 93333 (female parent) × J-2632 (male parent) developed in the year 2018 at Junagadh Agricultural University, Jamnagar. Hybrid GHB 1294 was developed using heterosis breeding while its parents were developed by pedigree and backcross breeding. The female line, $ICMA_1$ 93333, was originally developed at ICRISAT, Patancheru by backcrossing ICMB 93333 to ICMA 88006 (A_1) cytoplasm source. ICMB 93333 was developed from (843B x ICMPS 900-9-3-8-2)-21-8-4. Male (restorer) parent J-2632 was developed at All India Coordinated Research Project on Pearl Millet (AICRP-PM), JAU, Jamnagar.

Testing environments

For agronomic and field evaluation, the hybrid was tested in state trials from 2019 to 2023 across 33 locations in Gujarat. In these state trials, it was evaluated alongside the relevant early-segment national-level check GHB-538 and the national-level biofortified check variety *Dhanshakti*. Additionally, the hybrid was evaluated under the testing code MH 2555 in the AICRP-PM A1 zone (drier parts of India) trials from 2020 to 2022 across 26 locations. In the national trials, its performance was compared against four check varieties: MPMH 21, RHB 177, HHB 272, and HHB 67 Improved. Throughout all evaluation locations, the standard recommended package of practices was strictly followed to conduct the trials and raise a healthy crop.

Observations recorded

To comprehensively evaluate the agronomic performance, nutritional quality, and biotic stress tolerance of the hybrid, data were systematically recorded on various agro-morphological, biochemical, pathological, and entomological parameters across all test locations using standard evaluation protocols. The agro-morphological and yield-related traits included grain yield (kg/ha), dry fodder yield (kg/ha), days to 50% flowering, days to maturity, plant height (cm), number of tillers per plant, earhead diameter (cm), earhead length (cm), and 1000-grain weight (g). Nutritional and grain quality traits were assessed by analyzing biochemical parameters, specifically iron (Fe) content (ppm), zinc (Zn) content (ppm), total protein (%), and fat (%). Host plant resistance to major diseases was evaluated by recording downy mildew (%) incidence at both 30 and 60 days after sowing (DAS), alongside scores for blast (on a 0–9 scale), rust (%) at 60 DAS, smut (%) at 60 DAS, and ergot (%) at 60 DAS. Furthermore, insect pest pressure and associated damage were monitored by documenting shoot fly infestation (%) at both the vegetative and earhead stages, stem borer infestation (%) at both the vegetative and earhead stages, the absolute number of *Helicoverpa* larvae per 5 earheads, and the leaf roller damage score at the earhead stage.

Statistical analysis

All state and national-level (AICRP) multi-location field trials were conducted using a Randomized Block Design (RBD) with three replications at each respective location. The experimental data were subjected to analysis of variance (ANOVA) While the complete ANOVA summary tables are not explicitly shown in this manuscript, the evaluation of the hybrid GHB 1294 was performed through a direct comparison of mean values against the respective local and national check varieties. The superiority of the hybrid was quantified by calculating the percentage increase over the check varieties specifically for grain yield and dry fodder yield (kg/ha).

Results

Yield performance of GHB 1294

The hybrid GHB 1294 was evaluated in Gujarat state trials from 2019 to 2023 under the kharif season. The results revealed that the pearl millet hybrid GHB 1294 has recorded 2717 kg ha^{-1} grain yield and 7306 kg ha^{-1} fodder yield which is 20.00% and 46.80%, respectively higher over check GHB-538 (Table 1).

In All India Coordinated Research Project on Pearl Millet (AICRP-PM) A_1 zone (drier part of India) trials under rainfed condition, the GHB 1294 recorded average grain yield 2223 kg/ha which was 24.50%, 32.00%, 24.20% and 31.00% higher than checks MPMH 21, RHB 177, HHB 272 and HHB 67 Improved, respectively (Table 2). It has also given average 5.21% higher grain yield over other qualifying hybrid MH 2553 which was tested along with this hybrid from 2020 to 2022. GHB 1294 also recorded high dry fodder yield (5184 kg/ha) which was 18.80%, 26.60%, 20.40% and 23.10% higher than the checks MPMH 21, RHB 177, HHB 272 and HHB 67 Improved, respectively. It has also given average 2.99% higher dry fodder yield over other qualifying hybrid MH 2553 which was tested along with this hybrid from 2020 to 2022 (Table 2).

Table 1 : Yield performance of proposed pearl millet hybrid GHB 1294 in comparison with check in the Gujarat state during *kharif* season (2019 to 2023)

Year	No of testing location	Grain yield (kg ha^{-1})		% increase over check	Dry fodder yield (kg ha^{-1})		% increase over check
		GHB 1294	GHB-538 (c)		GHB 1294	GHB-538 (c)	
2019	4	**2581**	2125	21.50	7875	5107	54.20
2020	8	**2073**	1956	6.00	6882	3873	77.70
2021	6	**2741**	2558	7.10	7109	5193	36.90
2022	7	**3169**	2607	21.60	7971	5602	42.30
2023	8	**3016**	2247	34.20	7013	5306	32.20
Mean	**33**	**2717**	**2265**	**20.00**	**7306**	**4976**	**46.80**

Table 2 : Yield performance of proposed pearl millet hybrid GHB 1294 (MH 2555) in comparison with checks in the AICRP trials during *kharif* season (2020-2022)

Year of testing	No. of trials	GHB 1294	Check hybrids				% increase over check			
			MPMH 21	RHB 177	HHB 272	HHB 67 Imp.	MPMH 21	RHB 177	HHB 272	HHB 67 Imp.
Grain yield (kg ha-1)										
2020	6	**2555**	2166	1724	2129	2005	17.9	48.2	20.0	27.4
2021	9	**2111**	1694	1673	1616	1543	24.6	26.1	30.6	36.9
2022	11	**2134**	1655	1670	1746	1657	29.0	27.8	22.2	28.8
Mean	26	**2223**	**1786**	**1684**	**1790**	**1698**	**24.5**	**32.0**	**24.2**	**31.0**
Dry fodder yield (kg ha-1)										
2020	6	**6348**	5118	4634	5580	5636	24.0	37.0	13.8	12.6
2021	9	**5494**	4660	4560	4319	4042	17.9	20.5	27.2	35.9
2022	11	**4295**	3709	3422	3595	3570	15.8	25.5	19.5	20.3
Mean	26	**5184**	**4363**	**4096**	**4304**	**4210**	**18.8**	**26.6**	**20.4**	**23.1**

Agro-morphological performance of GHB 1294

The maturity duration of this hybrid and checks was almost at par (77-78 days) in both state and AICRP-PM trials. In spite of the same crop duration, considerable yield superiority of GHB 1294 over checks highlights that its growth rate and per day productivity is higher than checks. Its matures, on an average in 77-78 days and flowers in 46 days in state and AICRP-PM trials. It produces compact panicles with medium size grains (test weight of 8.1 g) of hexagonal shape and grey brown in colour (Figure 1

and 2). The hybrid attains height of (185 cm and 169 cm) and panicle length (21.8 cm and 22 cm) with thickness of (3.1 cm and 2.8 cm) in state and AICRP-PM trials, respectively (Table 3). Further, the added advantage for this hybrid is that its parental lines have well synchronized flowering which is essential for higher productivity of commercial hybrid seed.

Table 3 : Ancillary traits of pearl millet hybrid GHB 1294 along with checks

Traits	State trials (*Kharif* 2020-2022)		AICRP on Pearl Millet A_1 zone trials (*Kharif* 2020-2022)				
	GHB 1294	GHB-538 (c)	GHB 1294	MPMH 21 (c)	RHB 177 (c)	HHB 272 (c)	HHB 67 Imp. (c)
Days to 50% flowering	**46.0**	44.0	46	46	44	45	42
Days to maturity	**78.0**	76.0	77	76	76	76	73
Plant height (cm)	**185.0**	178.0	169	168	170	164	160
No. of tillers / plant	**2.7**	3.3	2.2	2.3	2.1	2.3	2.2
Earhead diameter (cm)	**3.1**	2.7	2.8	2.9	2.8	2.8	2.5
Earhead length (cm)	**21.8**	22.0	24.0	22	22	22	21
1000 grain weight (g)	**9.4**	9.6	8.1	8.4	8.5	8.6	8.8

Biofortification traits of GHB 1294

In respect to grain quality of hybrid GHB 1294 contains higher Fe (53.1 ppm) and Zn (37.3 ppm) which was higher than the all the checks as well as the bench mark levels (42 ppm Fe and 32 ppm Zn). It also contains 11.1% of protein which is almost at par with all the checks against it is tested (Table 4 and 5).

Disease reaction of GHB 1294

Another distinctive advantage of GHB 1294 is its high level of resistance to major diseases downy mildew, blast, rust and other diseases. The disease incidence was recorded under artificially created epiphytotic conditions at 15 hot-spots for downy mildew, 5 hot-spots for blast and 5 hot-spots for rust during 2019 to 2023 in state trials while, 7 hot-spots for downy mildew at 30 DAS, 8 hot-spots for downy mildew at 60 DAS, 9 hot-spots for blast, 7 hot-spots for rust, 7 hot-spots for blast and 5 hot-spots for ergot during 2020 to 2022 in AICRP-PM trials. The GHB 1294 showed only 1.0 % downy mildew incidence which was less than the check hybrid GHB-538 (4.1%) in state trials. In AICRP trials GHB 1294 showed only 0.4% and 1.6% downy mildew incidence at 30 and 60 DAS, respectively when compared with checks MPMH 21 (1.3% and 2.1%), RHB 177 (1.6% and 11.8%), HHB 272 (1.2% and 2.2%) and HHB 67 Imp.(1.1% and 2.5%), respectively. The incidence of blast (1.7 score), smut (4.7%), rust (3.4%) and ergot (0.5%) which are either lower or comparable to check hybrids (Table 6). This hybrid is resistance to moderately resistant against major insect-pests of pearl millet *viz*., shoot fly at earhead stage (5.7 % and 3.4 %), stem borer at earhead stage (4.5 % and 0.6 %) and *helicoverpa* (0.8 % and 1.3 % larvae/5 earhead) incidence were observed in state and AICRP-PM trials, respectively under natural condition (Table 6 and 7).

Discussion

Considering its grain and dry fodder yields and disease resistance, GHB 1294 is proposed for identification in the rainfed conditions of *Kharif* for drier part of Rajasthan, Gujarat and Haryana states. The superior grain and dry fodder yield of GHB 1294 over national checks across multiple environments highlights its robust crop architecture and high heterosis. This aligns with the findings of Dangaria *et al.* (2013) and Sumathi *et al.* (2023), who reported that pearl millet single-cross hybrids exhibit high yield stability and vegetative vigor under marginal environmental conditions.

The elevated levels of iron (53 ppm) and zinc (37 ppm) in GHB 1294 confirm its high nutraceutical value. According to Govindaraj *et al.* (2011) and Gaoh *et al.* (2023), biofortified pearl millet hybrids can effectively bridge the micronutrient deficiency gap in dryland populations without compromising grain yield potential. GHB 1294 demonstrated robust resistance to downy mildew and low blast scores across the test locations. This durable resistance is likely inherited from its stable parental lines, supporting the observations of Andrews *et al.* (1985) that utilizing diverse, disease-resistant backcross lines effectively suppresses downy mildew outbreaks in the field. Furthermore, the early maturity and stable performance of GHB 1294 across the dry A_1 zone confirm its utility as a climate-smart crop. As noted by Shrestha *et al.* (2023), early-maturing pearl millet genotypes are highly efficient at escaping terminal drought stress caused by unpredictable seasonal temperature shifts.

This research directly contributes to global sustainable development frameworks. By improving crop productivity and nutritional quality in climate-stressed areas, the development and deployment of

GHB 1294 aligns with United Nations Sustainable Development Goals (SDGs), specifically supporting SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), and SDG 17 (Partnerships for the Goals). Developing high-yielding, biofortified staple crops like pearl millet helps secure stable food supplies and improves the incomes of poor smallholder farmers.

Table 4 : Biochemical parameters of pearl millet hybrid GHB 1294 along with check in the Gujarat state trials during *kharif* season

Name of Hybrid	Iron (Fe) Content (ppm)			Zinc (Zn) Content (ppm)			Protein (%)	Fat (%)	Carbohydrate (%)
	2022 (n=24)	2023 (n=21)	Mean (n=45)	2022 (n=24)	2023 (n=21)	Mean (n=45)			
GHB 1294	53.0	60	56.5	35.1	31.3	33.2	8.3	5.4	75.5
Dhanshakti (c)	74.6	77	75.8	38.7	36	37.4	10.3	5.3	76.2

*****Figures in parenthesis is number of samples (n) from different locations

Table 5 : Biochemical parameters of pearl millet hybrid GHB 1294 along with check hybrid in the AICRP A_1 zone trials during *kharif* season

Parameters	Year of testing	No. of trials	GHB 1294	Check Hybrids			
				MPMH 21 (c)	RHB 177 (c)	HHB 272 (c)	HHB 67 Imp. (c)
Iron (Fe) Content (ppm)	2020	6	56	51	57	53	55
	2021	4	51	49	51	51	51
	2022	8	52	48	41	50	47
	Mean	18	**53.1**	49.2	48.6	51.2	50.6
Zinc (Zn) Content (ppm)	2020	6	40	36	38	37	39
	2021	4	36	32	32	32	33
	2022	8	36	32	31	32	34
	Mean	18	**37.3**	33.3	33.6	33.7	35.4
Protein (%)	2021	2	11.3	11.2	12.5	11.4	12.5
	2022	2	10.8	10.8	11.2	11.2	12.8
	Mean	4	**11.1**	11.0	11.9	11.3	12.7
Fat (%)	2021	2	6.2	5.8	5.8	6.2	5.6
	2022	2	5.1	5.2	5.8	5.7	5.4
	Mean	4	**5.7**	5.5	5.8	6.0	5.5

Table 6 : The reaction of disease incidence under artificially epiphytotic condition during *kharif* season of pearl millet hybrid GHB 1294 comparison with checks

Diseases	State trials (*Kharif* 2019-2023)				AICRP on Pearl Millet A_1 zone trials (*Kharif* 2020-2022)					
	No. of trials	GHB 1294	GHB -538 (c)	7042 S (DM Susceptible)	No. of trials	GHB 1294	MPMH 21 (c)	RHB 177 (c)	HHB 272 (c)	HHB 67 Imp. (c)
Downy mildew (%) at 30 DAS	-	-	-	-	7	**0.4** (0.0-1.5)	1.3 (0.0-1.7)	1.6 (0.0-2.2)	1.2 (0.0-2.7)	1.1 (0.0-2.4)
Downy mildew (%) at 60 DAS	15	**1.0** (0.0-6.7)	4.1 (0.0-14.3)	90.2 (23.3-100.0)	8	**1.6** (0.6-2.2)	2.1 (2.0-2.2)	11.8 (3.4-22.4)	2.2 (1.2-3.8)	2.5 (1.6-3.4)
Blast (Score 0-9)	5	**1.0** (0.0-1.8)	2.1 (1.0-3.1)	6.3 (5.0-7.3)	9	**1.7** (1.0-2.1)	2.1 (1.7-2.5)	2.6 (2.3-3.2)	2.5 (2.0-2.9)	2.4 (2.0-3.3)
Rust (%) at 60 DAS	5	**6.0** (0.0-26.0)	3.5 (0.0-16.0)	9.3 (0.0-33.5)	7	**3.4** (0.0-11.8)	2.5 (0.0-8.3)	0.2 (0.0-0.8)	0.2 (0.0-0.8)	0.7 (1.0-1.8)
Smut (%) at 60 DAS	-	-	-	-	7	**4.7** (0.7-8.3)	3.9 (1.8-8.3)	4.4 (2.0-10.0)	2.3 (1.0-5.0)	3.5 (2.0-6.0)
Ergot (%) at 60 DAS	-	-	-	-	5	**0.5** (0.0-2.5)	1.2 (0.0-3.0)	1.5 (0.0-3.0)	2.3 (0.5-3.5)	1.8 (0.4-3.0)
Downy Mildew DM)	:	0.1-5.0 % highly resistant; 5.1-10.0 % moderately resistant; 10.1-25.0 % Susceptible; >25 % highly susceptible								
Blast	:	1-3.0 score resistant; 3.1-5.0 score moderately resistant; 5.1-7.0 score susceptible; > 7 score highly susceptible								
Rust	:	0 to 20.0 % resistant; 21.0 to 25.0 % moderately resistant; > 25.0% susceptible								

Table 7 : The reaction of insect-pest incidence of pearl millet hybrid GHB 1294 comparison with checks during *kharif* season

Insect-Pests	State trials (*Kharif* 2019-2023)			AICRP on Pearl Millet A_1 zone trials (*Kharif* 2020-2022)					
	No. of trials	GHB 1294	GHB-538 (c)	No. of trials	GHB 1294	MPMH 21 (c)	RHB 177 (c)	HHB 272 (c)	HHB 67 Imp. (c)
Shoot fly at Vegetative stage (%)	-	-	-	7	7.7 (4.6-9.0)	8.6 (5.8-15.3)	6.5 (3.7-12.0)	6.6 (4.0-12.7)	7.4 (5.8-11.2)
Shoot fly at earhead stage (%)	5	**5.7** (2.5-8.0)	5.3 (2.5-8.8)	7	**3.4** (0.0-4.8)	6.8 (2.4-12.3)	4.3 (0.7-5.7)	6.6 (0.9-9.5)	6.9 (3.0-9.4)
Stem borer at Vegetative stage (%)	-	-	-	3	3.0 (0.0-6.2)	2.3 (0.0-4.7)	2.9 (0.0-8.7)	4.5 (0.0-7.8)	1.1 (0.0-2.3)
Stem borer at earhead stage (%)	5	**4.5** (2.5-6.0)	5.4 (0-10.5)	3	**0.6** (0.0-1.0)	1.3 (0.7-1.7)	1.1 (0.0-2.2)	2.3 (1.7-2.9)	2.0 (1.4-2.7)
Helicoverpa larvae per 5 earheads	5	**0.8** (0-1.5)	1.7 (0-5.5)	5	**1.3** (0.3-2.5)	1.0 (0.0-2.3)	1.5 (0.0-3.0)	1.1 (0.0-2.7)	0.4 (0.0-1.0)
Leaf roller damage score at earhead stage	-	-	-	2	**1.5** (1.0-2.0)	1.0 (1.0-1.0)	1.0 (1.0-1.0)	0.5 (0.0-1.0)	2.0 (1.5-2.5)
Shoot Fly and Stem Borer	:	0.0% resistant; 0.1 to 5.0 % moderate resistant; 5.1 to 10.0 % tolerant; 10.1-20.0 % susceptible; > 20.0% highly susceptible							
Helicoverpa **larvae damage limit**	:	< 1 larva per 5 earheads: resistant; 1 to 5 larvae per 5 earheads: tolerant; 5.1 to 25 larvae per 5 ear heads: susceptible.							

Fig. 1 : Field view of pearl millet hybrid GHB 1294 (*Maru Moti*)

Fig. 2 : Grains and Panicles of Pearl Millet Hybrid GHB 1294 (*Maru Moti*)

Conclusions

The development and evaluation of GHB 1294 confirm its potential as a premier dual-purpose pearl millet hybrid for resource-poor farming zones. This early-maturing hybrid ($ICMA_1$ 93333 × J-2632) features thick, compact panicles with high-quality, bold, grey grains. A major advantage of GHB 1294 is its comprehensive resistance to major diseases (downy mildew, blast, and rust) and its moderate-to-high resistance against critical insect pests like shoot fly, stem borer, and *Helicoverpa*. For seed producers, the well-synchronized flowering pattern of its parental lines facilitates high seed multiplication efficiency. This study establishes GHB 1294 as a resilient, high-yielding alternative that effectively satisfies both agricultural production and food security demands under changing climatic scenarios.

Conflict of interest

The authors declared no conflicts of interest

Acknowledgements

We extend our gratitude to the entire team of Pearl Millet Research Station and Junagadh Agricultural University for their direct and indirect involvement in the development, evaluation, and screening of this hybrid. We are also sincerely thankful to ICAR-AICRP on Pearl Millet, ICRISAT and other testing locations for their cooperation and support.

References

AICRP on Pearl Millet. Report on the Project Coordinator Review 2019. 54th Annual Group Meeting, ICAR- Indian Agricultural Research Institute. New Delhi, 2019, pp. 1-12.

Andrews, D. J., King, S. B., Witcome, J. R., Singh, S. D., Rai, K. N., Thakur, R. P., Talukdar, B.S., Chavan, S. B. & Singh, P. (1985). Breeding for disease resistance and yield in pearl millet. *Field Crops Research*, **11**, 241-258.

Dangaria, C. J., Dhedhi, K. K., Raghavani, K. L., Mungra, K. D., Sorathia, J. S., Atara, S. D., & Bunsa, B. D. (2013). A high yielding downy mildew resistant pearl millet hybrid GHB-732 for Gujarat, India. *Agricultural Science Digest*. **33**(3): 219-222. https://doi.org/10.5958/j.0976-0547.33.3.012

Directorate of Economic and Statistics (2025). Department of Agriculture and Farmers Welfare, Government of India, Available online: https://eands.dacnet.nic.in> (accessed on 2 December 2025).

Gaoh, B. S. B., Gangashetty, P. I., Mohammed, R., Ango, I. K., Dzidzienyo, D. K., Tongoona, P., & Govindaraj, M. (2023). Combining ability studies of grain Fe and Zn contents of pearl millet (Pennisetum glaucum L.) in West Africa. *Frontiers in Plant Science*, **13**, 1027279.

Govindaraj, M. (2011). *Genetics of grain iron and zinc concentration in pearl millet (Pennisetum glaucum (L.) R. Br.)* (Doctoral dissertation, Tamil Nadu Agricultural University).

Krishnan, R. and Meera, M. S. (2018). Pearl millet minerals: effect of processing on bioaccessibility. *J. Food Sci. Technol.*, **55**, 3362-3372.

Nambiar, V. S., Dhaduk, J. J., Sareen N., Shahu T. and Desai R. (2011). Potential functional implications of pearl millet (Pennisetum glaucum L.) in health and disease. *J. Appl. Pharm Sci.*, **1**, 62-67.

Saleem, A., Anwar, S., Nawaz, T., Fahad, S., Saud, S., Ur Rahman, T., Khan, M. N. R. & Nawaz, T. (2025). Securing a sustainable future: the climate change threat to agriculture, food security, and sustainable development goals. *Journal of Umm Al-Qura University for Applied Sciences*, **11**(3), 595-611.

Shrestha, N., Hu, H., Shrestha, K., & Doust, A. N. (2023). Pearl millet response to drought: A review. *Frontiers in Plant Science*, **14**, 1059574.

Sumathi, P., Muthiah, A. R., Veerabadhiran, P., Thiyagarajan, K., Raveendran, T. S., Selvi, B., Karthikeyan, G. &

Santhi, P. (2023). New High Yielding Short Duration Pearl Millet Hybrid: TNAU Cumbu Hybrid CO 9. *Madras Agricultural Journal*, **99**, 14-17. https://doi.org/10.29321/MAJ.10.100005

Uppal R. K., Wani S. P., Garg K. K. and Alagarswamy G. (2015). Balanced nutrition increases yield of pearl millet under drought. *Field Crop Res.*, **177**, 86-97.

Webb, P., Stordalen, G. A., Singh, S., Wijesinha-Bettoni, R., Shetty, P., Lartey, A. (2018). Hunger and Malnutrition in the 21st Century. *B. M. J.*, **361**, 2238.

Weckwerth W., Ghatak A., Bellaire A., Chaturvedi P. and Varshney R. K. (2020). PANOMICS meets germplasm. *Pl. Biotechnol. J.*, **18**, 1507-1525.

Welch, R. M. and Graham, R. D. (2004). Breeding for micronutrients in staple food crops from a human nutrition perspective. *The Journal of Experimental Botany*, **55**, 353-364.