

Original Research Article

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Pearl Millet Bio-fortified Hybrid: GHB 1129

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ABSTRACT

The earlier released hybrid GHB 558 and latest released hybrid GHB 732 become susceptible to downy mildew disease. Though recently released hybrid GHB 732 is popular but it is susceptible to lodging because of its thin stem. However, in view of versatility of downy mildew fungi for its changes in virulence, farmer based choice differences in different pearl millet growing area of the state and to diversify the genetic base of cultivated public bred pearl millet hybrids. There is an urgent need and demand for a medium duration kharif hybrid with downy mildew and lodging resistance. The hybrid GHB 1129 has got attractive seed colour, acceptable seed size, appealing ear head, downy mildew resistance and high grain yield potential as compare to check hybrids. Hence, it is recommended for general cultivation during the kharif (medium maturing) and summer seasons as a biofortified hybrid in Gujarat state with high yield and good quality parameter Fe and Zn.

Keywords

Pearl millet,
Downey mildew
and Biofortification

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Introduction

Pearl millet is a climate smart crop by itself-dryland resilient with high metabolizable energy, high gluten-free protein, and more balanced amino acids. 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.

Iron and zinc deficiencies are widespread and serious public health problems worldwide, including India (Kramer *et al.*, 2015). Biofortification is scientifically proven to be a sustainable and cost-effective approach to address malnutrition. This approach targets the root cause of the malnutrition. Looking to this alarming situation, the ICAR-AICRP on Pearl

Millet has already decided on a minimum of 42 ppm of iron and zinc 32 ppm. Any variety or hybrids to be sold to farmers by public or private seed producers should follow these micronutrient standards, apart from giving a higher yield (Anonymous, 2018).

None of the presently Gujarat state recommended hybrids have more than 70 ppm Fe and 30 ppm Zn. Looking to above facts, the work on development of high Fe and Zn content hybrids has been intensified at pearl millet research station, JAU, Jamnagar in collaboration with ICAR and ICRISAT and which resulted in to GHB 1129, a High Fe and Zn content hybrids which has been released at state level both for kharif and summer season cultivation.

Material and Methods

The pearl millet hybrid GHB 1129 is developed at Junagadh Agril. University, Jamnagar (Gujarat) from cross combination of ICMA 99222 x J-2565 female line ICMA 99222 is developed at ICRISAT and it is a identified high Fe and Zn content line. The restorer line J-2565 is developed at Pearl Millet Research Station, JAU, Jamnagar and its pedigree is (J-2340 x J-2480)-8-5-6-2-2-1-B-B and designated in the year 2012. The hybrid GHB 1129 has been tested from 2013 to 2018 during kharif and 2014 to 2018 during summer season at various testing location of Gujarat. It has been also tested as a MH-2118 at national level under AICRP trials during kharif 2015-16 at 27 different locations of Zone A and B of India and during kharif 2016-17 at 12 different locations of zone B. During kharif and summer seasons trials at state and national level this hybrid has been tested against recommended state and national level yield and biofortified checks. The recommended package of practices were followed to conduct the trial and to raise the good crop.

Results and Discussion

The GHB 1129 is a medium maturing biofortified hybrid which has given higher average grain yield over presently recommended relevant group checks GHB 744 (8.0%), latest relevant group hybrid GHB 905 (6.9%) and private sector relevant group check hybrid 86M11(20.1%) during kharif season. The dry fodder increase of GHB 1129 over relevant group checks during kharif season was to the tune of 12.9%, 11.7% and 30.0% over GHB 744, GHB 905 and 86M11, respectively (Table 1). In the summer season this hybrid has also given 15.7% and 7.3% higher grain and dry fodder yield, respectively over GHB 558 and at par grain and 6.2% higher dry fodder yield over GHB 732. Moreover, the grains of this hybrid have higher amount of micronutrient Fe and Zn over all the public and private sector check and comparable Fe and Zn with biofortified check variety Dhanshakti (Table 2 and 3).

This hybrid also tested during kharif 2015-16 and 2016-17 in AICRP-PM trials as a testing code MH 2118. During first year 2015-16 testing in IHT-Medium (A/B) trial, it has given marginal higher yield over checks in A-zone but in B (Southern India) zone it has given 9.61%, 19.42% and 30.38 higher yield over private sector checks NBH 5767, PAC 909 and public sector check GHB 558, respectively and promoted to second year testing in B zone. In second 2016-17 AHT(M) trial it has given 9.56%, 9.15% and 5.05% higher grain yield over private sector check hybrids PAC 909, Pratap and public sector check hybrid GHB 558, respectively. The dry fodder yield of proposed hybrid was higher than check hybrids PAC 909, GHB 558 and Pratap during its testing period under B zone. This hybrid found resistance against downey mildew when tested under sick plot condition at different locations during kharif (Table 4) and summer season (Table 5).

Table.1 Grain and dry fodder yield data in large scale hybrid trial

Name of check hybrid	No of trials	Average grain yield (kg/ha)	% increase over check	Average dry fodder yield (kg/ha)	% increase over check
Kharif (2013-18)					
GHB 1129	47	2957		6210	
GHB 1129	43	3012		6350	
GHB 1129	8	3059		7225	
GHB 744 (c)	47	2739	8.0	5502	12.9
GHB 905 (c)	43	2817	6.9	5685	11.7
86M11 (c)	8	2546	20.1	5557	30.0
Summer (2014-18)					
GHB 1129	20	5303		9179	
GHB 1129	4	5610		8441	
GHB 558 (c)	20	4583	15.7	8557	7.3
GHB 732 (c)	20	5409	-	8645	6.2
9444 (c)	4	5701	-	9262	-
Nandi 72 (c)	4	6041	-	8929	-

Table.2 Data on Fe and Zn content of GHB 1129 against checks hybrids during kharif

Hybrid	Fe Content (ppm)				Zn Content (ppm)			
	2016	2017	2018	Mean	2016	2017	2018	Mean
GHB 1129	71	72	74	72	35	48	45	43
GHB 744 (C)	47	59	53	53	37	32	29	33
GHB 905 (C)	44	46	46	45	40	32	34	35
Dhanshakti (C)	90	88	96	91	47	32	43	41
86M11 (C)			65	65			34	34

Table.3 Data on Fe and Zn of GHB 1129 in comparison with checks hybrids during summer (2016-2018)

Quality character	Proposed hybrid	Check hybrids	
	GHB 1129	GHB 558	GHB 732
Fe Content (ppm)	74	60	53
Zn Content (ppm)	33	25	22

Table.4 The mean of reaction of disease in percentage under artificially epiphytotic condition during kharif 2013 to 2018 season at Jamnagar, Anand and S. K. Nagar

Hybrid of hybrid	Downy mildew (%) (60 DAS)	Blast (%)	Smut (%)	Rust (%)
GHB1129	0.63(0-2.6)	15.97(0-31)	4.38(0-14)	16.60(0-59)
GHB744(c)	4.34(0.6-11.5)	13.29(0-28)	1.21(0-6)	14.49(0-39)
GHB905(c)	2.29(0-9.1)	19.71(0-39)	0.95(0-5)	14.73(0-59)
Dhanshakti(c)	4.17(1.5-6.9)	43.05(41-45)	0.00	0.00
86M11(c)	3.69(3.7-3.7)	11.67(11-11)	0.00	0.00
7042 S	90.92	47.48	13.18	30.83

Figure in parenthesis is range

Table.5 The mean of reaction of disease in percentage under artificially epiphytotic condition during summer 2014 to 2018 season at Jamnagar, Anand and S.K. Nagar

Hybrid of hybrid	Downy mildew (%) (60 DAS)	Rust (%)
GHB 1129	2.35(0-4)	-
GHB 558 (c)	5.76(2-13)	2.1(0-8)
GHB 732 (c)	3.63(0-7)	3.8(0-7)
9444 (c)	2.40(0-5)	-
Nandi 72 (c)	2.43(0-6)	-
Indicator line	85.9	-

Figure in parenthesis is range

Table.6 Data on grain quality parameter of proposed hybrid GHB 1129 in Comparison with checks

Sr. No.	Hybrid of hybrid	Protein (%)	Fat (%)	Carbohydrate (%)
1	GHB 1129	9.27	6.21	70.48
2	GHB 744 (C)	9.87	5.90	64.41
3	GHB 905 (C)	8.88	5.19	69.70
4	Dhanshakti(C)	9.17	5.88	68.64
5	86M11 (C)	8.83	4.92	70.66

Table.7 Data on dry fodder quality characteristics of GHB 1129 with checks hybrids (On DM basis)

Sr. No.	Hybrid of hybrid	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Total Ash (%)	NFE (%)	IVDMD (%)
1	GHB 1129	3.74	0.55	43.90	6.77	45.04	53.18
2	GHB 744 (C)	4.34	1.29	47.76	11.00	35.61	57.09
3	GHB 905 (C)	4.41	1.33	46.31	10.04	37.91	54.91
4	Dhanshakti(C)	4.53	1.17	43.43	7.77	43.10	55.60
5	86M11 (C)	5.20	0.73	47.73	6.25	40.09	49.87

Table.8 Distinguish morphological traits descriptions of proposed hybrid GHB 1129 along with latest check GHB 905 as per DUS guidelines

Sr.	Characters	GHB 1129	GHB 905
1	Plant anthocynin pigmentation of 1 st leaf sheath	Absent	Absent
2	Plant growth habit (30 DAS)	Erect	Erect
3	Time of spike emergence (Days)	Medium	Early
4	Leaf sheath pubescence	Absent	Absent
5	Leaf sheath length (cm) (Forth leaf from top)	Medium	Medium
6	Leaf length (cm) (Forth leaf from top)	Very long	Medium
7	Leaf width (cm)(Forth leaf from top)	Broad	Medium
8	Anther colour	Yellow	Yellow
9	Node pubescence	Present in upper two nodes	Absent
10	Number of node on main stem	Medium	Low
11	Node Pigmentation	Green	Green
12	Internode pigmentation	Green	Green
13	Spike Exertion	Complete	Complete
14	Spike length (cm)	Medium	Medium
15	Anthocynin pigmentation of glume	Absent	Absent
16	Bristles presence	Absent	Present
17	Bristle colour	NA	Brown
18	Spike diameter (cm)	Thick	Medium
19	Spike shape	Cylindrical	Cylindrical
20	No. of effective tillers per plant	Low	Medium
21	Plant height(excluding spike) (cm)	Medium tall	Short
22	Spike tip sterility	Absent	Absent
23	Spike density	Compact	Semi-compact
24	Seed colour	Grey brown	Grey brown
25	Seed shape	Globular	Globular
26	1000- grain weight (g)	Medium	Medium



Field View of Bio-fortified pearl millet hybrid GHB 1129



Grains of Bio-fortified pearl millet hybrid GHB 1129



Panicles of Bio-fortified pearl millet hybrid GHB 1129

This hybrid also found resistance against Blast, Smut and rust. The ergot disease was not observed during its testing period. It is

also found more resistance against shoot fly (3.6%) and stem borer (1.4%) and *Helicoverpa* (1.5 larva/5 earhead) as

compared to checks. Further, this hybrid also found resistance against lodging when tested against its checks during both the season.

The quality parameter test of grain (Table 6) and dry fodder (Table 7) indicated that, this hybrid possess good or comparable quality parameters when tested against its checks.

The organoleptic quality parameters evaluation of pearl millet chapatti of GHB 1129 was carried out against all its checks by taking the response from 22 respondents. The result indicated that the overall 1st preference recorded by GHB 1129 against all its check.

The mean ancillary data suggest that this hybrid flower in average 48 days and mature in 80 days, average plant height is 186 cm, the average number of tillers are 2.5 per plant. The average earhead length, girth and test weight is 21.3 cm, 3.0 cm and 8.8 g,

respectively. The distinguish morphological traits of GHB 1129 as per the DUS guidelines in comparison with latest check GHB 905 are mentioned in Table 8.

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