Original Research Article

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

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 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.

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).
### 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   |      |      |      |      |      |      |

### 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<sup>st</sup> 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      |
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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