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AHMM/BR-8, a Unique Muskmelon (*Cucumis melo* L.) Genotype with Breeding Value

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Muskmelon (*Cucumis melo* L.) is a vital cucurbitaceous crop grown worldwide. It is known for its heterotic traits such as earliness, fruit size, weight, flavor, and yield. F_1 hybrids, offering high yield and consistent quality, are the focus of current breeding efforts. The AHMM/BR-8 breeding line exhibited a stable monoecious sex form, presents a promising alternative for hybrid production. The developed breeding line AHMM/BR-8 demonstrates early maturity, round fruit with orange flesh, and full slip at ripening. Its stable monoecious trait, coupled with excellent horticultural attributes, makes it highly suitable as female line in F_1 hybrid production without emasculation.

Muskmelon (*Cucumis melo* L.) is an important cucurbitaceous crop cultivated as a dessert crop in the warmer regions of the world. As a cross-pollinated crop, it exhibits heterosis for traits such as earliness, fruit size, fruit weight, flesh thickness, total soluble solids (TSS), fruit flavor, transportability, and overall fruit yield. Currently, significant attention is focused on the development of F_1 hybrids, which offer high yield, uniform fruit shape and size, and consistently excellent quality. The presence of various sex expression (monoecy and gynoecy) and genetic male sterility offers valuable opportunities for economic F_1 hybrid production. A key advantage of using gynoecious lines over male sterile lines in heterosis breeding is the elimination of the labor-intensive process of identifying and rouging of 50% of male fertile plants from a mixed population. Although gynoecious lines have the potential to lower significantly the hybrid seed production costs compared with other methods, their maintenance is a tedious job.

On the other hand, using male sterile lines does not allow for the production of 100% pure seed. However, contamination by self- or sib-seed can be minimized by strict care during identification and by incorporating tightly linked marker genes to rouging 50% of fertile plants. More et al. (1980) reported the use of monoecious genetic stock in hybrid seed production. When M1 and M2 genetic stock were used as female parents, the fruit set was 38.8% and 41.62%, respectively. However, it ranged 10.05% to 23.05% in three andromonoecious female parents. The use of monoecious lines offers the advantage, in hybrid seed production, of reducing the time of emasculation.

Keeping in mind of the limitations of gynoecious and male sterile lines for hybrid production, we developed the round-fruit monoecious breeding line AHMM/BR-8. It exhibited stable sex expression during 2016 to 2018 and is a potential seed parent for F_1 seed production.

Origin

The material was collected in a heterogenous condition from Dhrubana, Shivganj, Sirohi, Rajasthan, India (lat. 25°02.92′N, long. 73°04.05′E, elevation 1018 feet above sea level) in 2011 and was designated as collection

Table 1. Distinctness, uniformity and stability characterization of AHMM/BR-8.

No.	Characteristic	State of expression	Note as per DUS descriptor[i]
1	Cotyledon length (cm)	Short	3
2	Cotyledon width (cm)	Narrow	3
3	Leaf blade length (cm)	Medium	5
4	Leaf blade width (cm)	Medium	5
5	Leaf blade depth of terminal lobes	Weak	3
6	Leaf blade length of terminal lobes (cm)	Long	7
7	Leaf blade dentation of margin	Weak	3
8	Leaf blade petiole length (cm)	Long	7
9	Appearance of first pistillate flower in 50% of plants from date of sowing (d)	Medium	5
10[ii]	**Sex expression (at full flowering)**	**Monoecious[iii]**	**1**
11	Male sterility	Absent	1
12	Ovary length (cm)	Medium	5
13	Ovary width (cm)	Medium	5
14	Ovary pubescence	Dense	2
15	Fruit length (cm)	Medium	5
16	Fruit diameter (cm)	Medium	5
17[ii]	**Fruit shape in longitudinal section**	**Oblate (flat globe)**	**5**
18[ii]	**Fruit rind color**	**Yellow**	**2**
19	Fruit patches	Absent	1
20[ii]	**Fruit peduncle at maturity**	**Slippable**	**1**
21	Fruit shape at peduncle end	Rounded	2
22	Fruit shape at blossom end	Intermediate	2
23	Fruit diameter of blossom end scar (cm)	Medium	5
24	Fruit surface	Smooth	1
25[ii]	**Fruit sutures**	**Present**	**9**
26	Fruit suture color	Green	2
27[ii]	**Fruit surface netting**	**Absent**	**1**
28	Fruit flesh thickness at position of maximum fruit diameter (cm)	Thick	7
29[ii]	**Fruit flesh color**	**Orange**	**5**
30	Fruit flesh texture	Intermediate	5
31	Fruit flavor	Strong	7
32	Seed length (cm)	Short	3
33	Seed width (cm)	Narrow	3
34	Seed color	Yellowish	2

[i] Descriptor state note.
[ii] Grouping character.
[iii] Distinct character.
DUS = distinctness, uniformity, and stability.

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Fig. 1. Fruits of AHMM/BR-8 breeding line.

no. 8. It was evaluated at the Vegetable Experimental Block, Indian Council of Agricultural Research (ICAR)-Central Institute for Arid Horticulture, Bikaner, Rajasthan, India (lat. 28°N, long. 73°18′E, elevation 234.84 m above sea level). Being a heterogenous population, the evaluated material was segregated in both monoecious (only two plants) and andromonoecious sex forms, flesh color (green and orange), rind pattern (sutures, devoid of sutures), and fruit shape (round, oblong). Among the material, two plants (PL_1 and PL_2) were identified as having a monoecious sex form and were self-pollinated. Their single-plant progenies were grown the next year. The single-plant selection was exercised based on sex form (monoecious), earliness, fruit shape (round), fruit weight, flesh thickness, flesh color (orange), and high TSS coupled with high fruit yield. Selfing and single-plant selection based on monoecious sex form and other horticultural desirable traits was continued up to five generations to attain homozygosity. Through repeated selfings and single-plant selection cycles the material (PL_1) was purified and had a stable monoecious sex expression. Five selection cycles were carried out to stabilize the monoecious sex trait in the AHMM/BR-8 breeding line. This unique breeding line, designated AHMM/BR-8, has been registered with the ICAR-National Bureau of Plant Genetic Resources, New Delhi, as INGR 14043, in recognition of its significance in horticulture for its distinct monoecious sex form trait.

Description

The AHMM/BR-8 breeding line demonstrated a monoecious sex form, which was stable during 2016 to 2018 [Table 1 (Sharma et al. 2014)]. It exhibits a monoecious flowering pattern and produces round fruit with orange flesh. In addition, the fruit develop a full slip at ripening, as illustrated in Fig. 1. The biochemical analysis yielded total sugar (336.97 $mg \cdot g^{-1}$), tannin content (0.12 $mg \cdot g^{-1}$), phenol content (34.73 $mg \cdot g^{-1}$), and flavonoid content (1.05 $mg \cdot g^{-1}$) on a dry-weight basis (Haldhar et al. 2013). The developed monoecious breeding line exhibited stability in sex expression (Choudhary et al. 2013, 2018). Single-plant selection was exercised based on earliness, fruit size, flesh color, and TSS. Last, the obtained population was tested for stability and observed stable monoecious sex form (Choudhary et al. 2013). Thus, the presence of a stable monoecious sex form of AHMM/BR-8 could be used in F_1 hybrid production of muskmelon.

The developed breeding line was evaluated for its distinctness, uniformity, and stability (DUS), as described by Sharma et al. (2014) and Choudhary et al. (2015) for 34 traits (Table 1).

The AHMM/BR-8 breeding line is distinguished by its monoecious sex expression, a trait rarely documented in muskmelon. It exhibited a unique monoecious sex form, in contrast to all the released varieties in India, which display andromonoecious sex expression. The grouping traits of AHMM/BR-8, as outlined in Table 1 based on the DUS descriptors for muskmelon, are provided to facilitate the assessment of its distinctiveness from other varieties. The AHMM/BR-8 breeding line is readily identifiable by its unique characteristics, including monoecious sex expression, fruit shape in longitudinal section (oblate or flat globe), yellow fruit rind color, the presence of fruit sutures, the absence of surface netting, and orange fruit flesh color.

Other important horticultural traits of AHMM/BR-8 include early maturity, with first harvest occurring 75 to 80 d after sowing; fruit weight ranging from 0.8 to 1.0 kg; the presence of 10 green sutures; a slippable peduncle at maturity; and a TSS content of 11% to 12%.

In summary, the AHMM/BR-8 breeding line exhibits a stable monoecious sex form, producing round fruit with orange flesh and a full slip at ripening. The stable monoecious sex expression makes this breeding line unique from other cultivars and is considered an ideal trait for F_1 hybrid production.

Availability

For further information and availability of seed of the AHMM/BR-8 breeding line, please contact the ICAR-Central Institute for Arid Horticulture, Bikaner, Rajasthan, or the ICAR-National Bureau of Plant Genetic Resources, New Delhi, India.

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