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# Morphological characterization of bottle gourd [*Lagenaria siceraria* (Mol.) Standley] genotypes

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## Abstract

An experiment comprising of 31 genotypes was conducted at Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar during spring-summer season of 2015. The genotypes were planted in randomized block design with three replications. Considerable amount of variability was noticed for the 10 morphological traits of leaf and fruit *viz*., leaf shape, leaf length (cm), leaf width (cm), leaf pubescence, leaf blade, fruit shape in longitudinal section, fruit neck, fruit skin color, shape of fruit at blossom end, shape of fruit at peduncle end.

**Keywords:** Bottle gourd, genotypes, morphological traits

## Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standley], a monoecious self-compatible annual climber species of Cucurbitaceae family, can easily be distinguished from other cucurbits varieties due to its white flowers and characteristic fruit, seed and leaf shapes (Cutler and Whitaker 1967). Tropical Africa is the primary gene centre of bottle gourd (Singh 1990), which is the only species that has been used worldwide since prehistoric times. It is widely cultivated in tropics and subtropics for its fruits used as vegetable, container, bowl, decoration, musical instrument or fishing floats. Its seeds, tendril, leaves and immature fruits are also utilized for medical treatments (Herklots 1972), as the fruits are known to lower cholesterol, triglyceride, low density lipoproteins, pain and inflammation (Ghule et al. 2006a, b), free radicals and oxidation (Deshpande et al. 2008). Diversity is found in its leaf shape, leaf colour, leaf pubescence, fruit shape, fruit colour and fruit pubescence. Bottle gourd variability has been studied by many authors (Marimoto and Mvere 2004; Marimoto et al. 2005 and Achigan-Dako et al. 2008). Studies in India demonstrated the significant regional variability (Sivaraj and Pandravada 2005). Yetisir (2008) observed most apparent morphological variation in fruit shape and size of bottle gourd genotypes collected from Turkey. Therefore, an experiment was conducted to characterize and conserve genotypes of bottle gourd in Hisar condition for further use in future breeding programme.

## Materials and Methods

The experimental field was brought to a fine tilth by repeated ploughing after applying recommended dose of farmyard manure. Half dose of nitrogen along with full dose of phosphorus and potassium was applied at the time of land preparation and the remaining half dose of nitrogen was top dressed 30 days after sowing. The seed of bottle gourd genotypes GH 28, GH 29, GH 30, GH 31, GH 32, GH 33, GH 34, GH 35, GH 36, GH 37, GH 38, GH 9, GH 20, GH 27, HBG 34 and HBG 36 procured from Department of Vegetable Science, CCS H.A.U., Hisar and of IC 042345, IC 092363, IC 092371, IC 092372, IC 092404, IC 092414, IC 092420, IC 092424, IC 092426, IC 092428, IC 092436, IC 092462 and IC 092465 from ICAR-Indian Institute of Vegetable Research, Varanasi and two commercial varieties Pusa Naveen (PN) and Pusa Summer Prolific Long (PSPL) from Indian Agricultural Research Institutes, New Delhi was sown in third week of March 2015 in a plot size of 2.5 m x 3.3 m at 250 x 60 cm spacing with three replications. Before sowing, the seed was treated with Captan at the rate of 3 g per kg of seed. After sowing, the field was irrigated lightly. Other agronomic practices and plant protection measures were undertaken as per the university package of practices for vegetable crops (Anonymous 2017). The observations were recorded on morphological traits of leaf and fruit *viz*., leaf shape,

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leaf length (cm), leaf width (cm), leaf pubescence, leaf blade, fruit shape in longitudinal section, fruit neck, fruit skin color, shape of fruit at blossom end, shape of fruit at peduncle end. The observation on leaf characters were recorded on ten leaves (between 15 to 20$^{th}$ nodes) were taken from three randomly selected plants of each genotype and visually assessed for different characters per replication. Whereas, the five marketable sized fruits were taken randomly and visually assessed for different characters like fruit shape in longitudinal section, fruit neck, fruit skin color, shape of fruit at blossom end and shape of fruit at peduncle end and the observations were recorded and scored as per the characteristics given in standard descriptors (DUS guidelines). The data of different quantitative traits were recorded as per visual assessment of a group of plants/plant parts as per DUS guideline for bottle gourd crop, and there is no need for statistical analysis of these visual observed characters.

## Results and Discussion

**Categorization based on leaf shape:** Based on leaf shape, out of thirty one genotypes, one genotype had the cordate, six oblong, seven ovate, one obovate, eight orbicular and eight reniform shaped leaves (Table1). The results are also confirmed by the findings of Mladenovic et al. (2012) and Gurcan et al. (2015) who characterized the morphology of bottle gourd leaf and Mashilo et al. (2016) who characterized the morphology of 36 landraces in South Africa and found all the landraces exhibiting leaf shape hearty.‘

**Table 1:** Categorization based on leaf shape

| Leaf shape | Score | Genotypes | Total |
|---|---|---|---|
| Cordate | 1 | IC 092426 | 1 |
| Oblong | 2 | GH 28, GH 31, GH 32, GH 35, IC 092462 and PSPL | 6 |
| Ovate | 3 | GH 29, GH 33, GH 34, GH 37,GH 38, IC 092420 and IC 092371 | 7 |
| Obovate | 4 | IC 092424 | 1 |
| Orbicular | 5 | GH 30, GH 36, IC 042345, IC 092363, IC 092372, IC 092414,IC 092465 and GH 27 | 8 |
| Reniform | 6 | IC 092404, IC 092428, IC 092436, GH 9, GH 20, HBG 34, PN and HBG 36 | 8 |

**Categorization based on leaf length:** The genotypes based on leaf length were categorized into small, medium and large. Nine genotypes were in the category of small leaves, twenty one genotypes in medium and one genotype in the catogery of large leaves (Table 2). Yetisir et al. (2008) and Mladenovic et al. (2012) also reported the leaf blade length from 14.49 to 23.01 cm, while Leo et al. (2014) and Mashilo et al. (2016) reported the leaf length varing from 12.81 to 22.5 cm.

**Table 2:** Categorization based on leaf length

| Leaf length | Score | Genotypes | Total |
|---|---|---|---|
| Small (<15 cm) | 3 | GH 31, GH 33, IC 092404, IC 092414, IC 092420, IC 092436, HBG 34, HBG 36 and PN | 9 |
| Medium (15-20 cm) | 5 | GH 28, GH 29, GH 30, GH 32, GH 34, GH 35, GH 36, GH 37, GH 38, IC 042345, IC 092363, IC 092371, IC 092372, IC 092424, IC 092426, IC 092428, IC 092465, GH 9, GH 20, GH 27 and PSPL | 21 |
| Large (>20 m) | 7 | IC 092462 | 1 |

**Categorization based on leaf width (cm):** The genotypes according to leaf width were grouped into narrow, medium and broad. Out of thirty-one genotypes, one genotype was found narrow, fourteen medium and sixteen broad leaved (Table 3). Mashilo *et al*. (2016) reported the leaf width varing from 16.53 to 31.1 cm.

**Table 3:** Categorization based on leaf width (m)

| Leaf width | Score | Genotypes | Total |
|---|---|---|---|
| Narrow (<0.15 m) | 3 | HBG 36 | 1 |
| Medium (0.15-0.20m) | 5 | GH 28, GH 29, GH 31, GH 33, GH 37, IC 092372, IC 092414, IC 092424, IC 092436, IC 092465, GH 9, GH 20, GH 27 and HBG 34, | 14 |
| Broad (>0.20 m) | 7 | IC 092462, GH 30, GH 32, GH 34, GH 35, GH 36, GH 38, IC 042345, IC 092363, IC 092371, IC 092404, IC 092420, IC 092426, IC 092428, PSPL and PN | 16 |

**Categorization based on leaf pubescence:** According to nature of leaf pubescence, the twenty-one genotypes were grouped as soft and ten as hard (Table 4), while Yetisir et al. (2008) categorized the leaf pubescence into small, medium and large.

**Table 4:** Categorization based on leaf pubescence

| Leaf pubescence | Score | Genotypes | Total |
|---|---|---|---|
| Soft | 1 | GH 28, GH 29, GH 30, GH 31, GH 33, GH 37, GH 38, IC 042345, IC 092363, IC 092372, IC 092404, IC 092414, IC 092426, IC 092428, IC 092436, 092465, GH 20, GH 27, HBG 34, HBG 36 and PSPL | 21 |
| Hard | 2 | GH 32, GH 34, GH 35, GH 36, IC 092371, IC 092420, IC 092424, IC 092462, GH 9 and PN | 10 |

**Categorization based on leaf blade shape:** With respect to leaf blade shape, twenty nine genotypes showed three lobes, two genotypes 5 lobes and no genotype showed seven lobed leaves (Table 5). While Mladenovic *et al*. (2012), recorded the leaf blade shape as handle length (5-17 cm), leaf blade width (17.89-30.13 cm), leaf blade length (14.49-23.01 cm) in bottle gourd.

Table 5: Categorization based on leaf blade

| Leaf blade | Score | Genotypes | Total |
|---|---|---|---|
| 3 lobes | 3 | GH 28, GH 29, GH 30, GH 31, GH 32, GH33, GH 34, GH 35, GH 36, GH 37, GH 38, IC 042345, IC 092363, IC 092371, IC 092372, IC 092404, IC 092414, IC 092420, IC 092428, IC 092436, IC 092462, IC 092465, GH 9, GH 20, GH 27, HBG 34, HBG 36, PN and PSPL | 29 |
| 5 lobes | 5 | IC 092424 and IC 092426 | 2 |
| 7 lobes | 7 | -------- | 0 |

**Categorization based on longitudinal fruit shape:** The genotypes revealed significant variation for the character fruit shape in longitudinal section. Out of thirty-one genotypes, four genotypes showed elongate-straight, nine elongate-curved, five cylindrical, three oval, five club, two pyriform and three round fruits (Table 6). Morimoto et al. (2005) described the bottle gourd fruits at edible stage oblate, spherical ovoid, or pyriform shaped and at non-edible stage dipper, club, or elongated cylindrical shaped. Mahato et al. (2010) observed most of the bottle gourd lines producing globular to elongated fruits. Mladenovic et al. (2012) found all the 40 genotypes of bottle gourd predominantly pear or elongated shaped. Leo et al. (2014) reported three out of five landraces cylindrical fruited and two bottled shaped. In South Africa out of 36 landraces, Mashilo et al. (2016) observed majority of bottle gourd landraces cavate shaped and others oblate, pyriform, elongated pyriform and cylindrical shaped.

**Table 6:** Categorization based on longitudinal fruit shape

| Fruit shape in longitudinal section | Score | Genotypes | Total |
|---|---|---|---|
| Elongate-Straight | 1 | GH 29, GH 33, GH 35 and IC 092436 | 4 |
| Elongate-Curved | 2 | GH 32, IC 092465, IC 092462, PSPL and IC 092404, HBG 34, IC 092363, IC 092371 and IC 092428 | 9 |
| Cylindrical | 3 | GH 28, GH 30, GH 31, GH 34 and IC 092426 | 5 |
| Oval | 4 | GH 36, GH 37 and PN | 3 |
| Club | 5 | GH 38, GH 9, GH 20, GH 27 and IC 092424 | 5 |
| Pyriform | 6 | HBG 36 and IC 092420 | 2 |
| Round | 7 | IC 042345, IC 092372 and IC 092414 | 3 |

**Categorization based on shape of fruit neck:** Based on observation for shape of fruit neck, twenty genotypes were recorded straight and eleven crooked neck (Table 7). Mashilo et al. (2016) in South Africa found majority of the landraces (33) with crooked neck and only 3 landraces without neck.

**Categorization based on fruit skin colour:** Out of thirty-one genotypes, sixteen genotypes showed light green, eight genotypes green, four genotypes mottle green, three genotypes with striped green colour and no genotype showed dark green coloration of fruit (Table 8). Mahato et al. (2010) found the bottle gourd genotypes varying in fruit skin colour (whitish to deep green with or without patches). Mladenovic et al. (2012) categorized the 40 bottle gourd genotypes based on fruit skin colour ranging from light to dark green with few spots. Mashilo et al. (2016) reported 64% of the entries (23 landraces) exhibiting dark green the dominant primary fruit colour and 25% entries (Nine landraces) light green the primary fruit colour.

**Table 7:** Categorization based on fruit neck

| Fruit neck | Score | Genotypes | Total |
|---|---|---|---|
| Straight | 1 | GH 28, GH 29, GH 30, GH 31, GH33, GH 34, GH 35, , GH 36, GH 37, GH 38, IC 042345, IC 092363, IC 092371, IC 092372, IC 092414, IC 092436, IC 092462, GH 20, PSPL and PN | 20 |
| Crooked | 2 | GH 32, IC 092404, IC 092420, IC 092424, IC 092426, IC 092428, IC 092465, GH 9, GH 27, HBG 34 and HBG 36 | 11 |

**Table 8:** Categorization based on fruit skin colour

| Fruit skin colour | Score | Genotypes | Total |
|---|---|---|---|
| Light green | 1 | GH 28, GH 29, GH 31, GH 32, GH 34, GH 20, GH 37, IC 092363, IC 092420, IC 092424, IC 092426, IC 092428, IC 092436, GH 9, GH 27and PN | 16 |
| Green | 2 | PSPL, HBG 36, GH 35, GH 30, GH 33, IC 042345, IC 092414, IC 092404, and IC 092462 | 9 |
| Dark green | 3 | ----- | 0 |
| Mottle green | 4 | HBG 34, GH 38 and IC 092371 | 3 |
| Striped green | 5 | IC 092372, GH 36 and IC 092465 | 3 |

**Categorization based on fruit shape at blossom end:** The genotypes revealed significant variation for this character. Out of thirty-one genotypes, six genotypes showed acute, twelve semi-blunt, nine blunt and four depressed (Table 9). Based on fruit shape at blossom end, Sivaraj and Pandravada (2005) grouped 54 accession of bottle gourd in Telangana (A.P.) into four

**Table 9:** Categorization based on fruit shape at blossom end

| Shape of fruit at blossom end | Score | Genotypes | Total |
|---|---|---|---|
| Acute | 1 | IC 092404, IC 092420, 092436, IC 092465, GH 27 and PSPL | 6 |
| Semi blunt | 2 | GH 29, GH 31, GH 32, GH 34, GH 35, GH 38, IC 092371, IC 092424, IC, IC 092462, GH 9, HBG 34 and GH 34 | 12 |
| Blunt | 3 | GH 28, GH 30, GH 33, GH 36, GH 37, IC 092426, GH 20, HBG 36 and IC 092428 | 9 |
| Depressed | 4 | IC 042345, IC 092372, IC 092414 and PN | 4 |

groups, *i.e*., 21 depressed, 8 flattened, 17 pointed and 8 round shaped fruits. Out of 36 landraces Mashilo et al. (2016) reported 14 landraces with smooth stem end, 14 with round stem end and 8 with pointed stem end.

**Categorization based on fruit shape at peduncle end:** Based on shape of fruit at peduncle end, the genotypes were grouped intothree categories, *i.e.*, (i) raised, (ii) flat and (iii) depressed. Eleven genotypes showed raised character, eighteen flat and two depressed (Table 10). Based on fruit shape at peduncle end, Sivaraj and Pandravada (2005) categorized 54 accession of bottle gourd in Telangana (A.P.) into three groups, *i.e*. 18 flattened, 24 depressed and 12 round shaped fruits.

**Table 10:** Categorization based on fruit shape at peduncle end

| Fruit shape at peduncle end | Score | Genotypes | Total |
|---|---|---|---|
| Raised | 1 | IC 042345, IC 092372, IC 092404, IC 092414, IC 092420, IC 092462, IC 092465, GH 9, IC 092424 and PSPL | 11 |
| Flat | 2 | GH 28, GH 29, GH 30, GH 31, GH 32, GH33, GH 34, GH 35, GH 36, GH 37, GH 38, IC 092363, IC 092371, IC 092426, IC 092428, GH 20, GH 27, HBG 34 and HBG 36 | 18 |
| Depressed | 3 | IC 092436 and PN | 2 |

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## सारांश

लौकी के 31 जीनप्ररूपों का प्रयोग चौधरी चरण सिंह हरियाणा कृषि विश्वविद्यालय, हिसार के सब्जी विज्ञान विभाग में 2015 के बसंत–गर्मियों के मौसम मे किया गया। इस अनुसंधान कार्य को यादृच्छिक प्रखण्ड परिकल्पना अभिन्यास के अंतर्गत संचालित किया गया। इस अनुसंधान कार्य के परिणामों से स्पष्ट हुआ कि वानस्पतिक स्तर पर फसल के अध्यनरत इसमें शामिल 10 गुणों यथा पत्तियों का आकार व लम्बाई, पत्ती की चौड़ाई (सेन्टी मीटर), पत्ती की तन्तुमयता, पत्ती का किनारा और फलों का अनुदैर्ध्य खण्ड आकार, फल ग्रीवा, फल की त्वचा का रंग, फलों में नीचे वाले भाग का आकार और नाकू के पास के आकार में सर्वाधिक परिवर्तन पाया गया और ये सभी गुणों का प्रयोग आगे आने वाले समय में इस फसल के विभिन्न सुधार के कार्यों में किया जा सकता हैं।

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