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Evaluation of genotypes for quantitative traits in bottle gourd (*Lagenaria siceraria* (Mol.) standl.)

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Abstract
Low yield of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] is due to use of low-yielding cultivars adopted by the farmers for cultivation. Use of adaptable, high-yielding genotypes in may enhance bottle gourd productivity. This experiment was conducted with bottle gourd to evaluate genotypes for yield and contributing characters. The genotypes exhibited high ranges of variation. Among all genotypes cv. Punjab Round was best for average fruit weight (0.93 kg), fruit diameter (15.90 cm), fruit yield/plant (9.10 kg) and total fruit yield (60.60 t·ha^{-1}) followed by cv. Pusa Summer Prolific Long for minimum days to first male (55.89) and female flower (58.45), and had the highest fruit yield (48.93 t·ha^{-1}) and longest fruit (44.16 cm).There was notable difference between genotypes regarding growth, development and yield. Genotypes Punjab Round and Pusa Summer Prolific Long performs best among the all the genotypes. Both the genotypes have earliness and yield characters. These two genotypes could be utilized for further breeding programmes and recommended to the farmers for commercial cultivation.

Keywords: *Lagenaria siceraria*, breeding programme, evaluation, genotypes, performance, quantitative, traits

Introduction
Bottle Gourd [*Lagenaria siceraria* (Mol.) Standl.] (2n = 2x = 22) is a vegetable crop cultivated in many countries. Bottle gourd exhibits great morphological and genetic variability and wide environmental adaptation in nature (Uddin *et al*, 2014) [11]. Poor genetic make-up of open pollinated mixed seed, or local landraces, leads to poor productivity and production (Ara *et al*., 2014) [1]. Goals for bottle gourd improvement are: high yield, greater fruit weight, earliness, fruit morphology, edible quality, and resistance to diseases and insect-pest (Behera *et al*., 2015) [2]. Bottle gourd fruit vary widely in shape and size, and this is within or among cultivars, exhibits the widest variations in fruit shape; these are either long, cylindrical, necked, oblong flat or round, conical pyriform to club shaped, while skin texture varies from warted to smooth (Ilyas *et al*., 2017).
The desire of any farmer is to see the germination and growth of all seeds planted in a field. This way the farmer is assured to obtain reasonable yield if all growing conditions are optimal (Ilyas *et al*., 2017). Farmers used different local cultivars and varieties of bottle gourd released from different organisation, but yield is not as expected. There is need of the farmers to develop early maturing and high yielding genotypes. The proper evaluation of different bottle gourd variety might be helpful to overcome this problem. Considering these circumstances the present study was undertaken with a view to evaluate the yield contributing traits of bottle gourd genotypes.

Material and Methods
The study was carried out at the vegetable research farm of the Lovely Professional University, Phagwara, Punjab during summer season from month of March to July 2017. Experimental field is located at 31.13°N and 75.47°E at an elevation of 234 m. There is a little rainfall 686m throughout the year. The annual temperature is 24.1°C, highest temperature 43.6°C in month of June and lowest temperature 6.2°C in month of January. The soil of experimental land is Loamy soil (pH: 7.5) that is well drained, highly fertile and productive in nature.
The genotypes of bottle gourd used were cv. Pusa Summer Prolific Long, Punjab Round, Punjab Komal, Ankur Amit, Nandani, Gopika, Vardan and Chutki. The experiment was arranged in Randomised Complete Block Design (RCBD) with 3 replications. In each replication, each variety was represented by 1 row containing 10 plants. The field was prepared by one deep ploughing followed by three diskings, clod breaking, hoeing, and levelling of the soil.

Seedlings were produced in seedling trays and after 30 days seedlings were transplanted to the field. The row-row spacing was 2.5 m and plant-plant spacing was 0.6 m. Fertilizer applied as N:P:K – 100:60:50 kg/ha. Half of nitrogen and full dose of phosphorus and potassium were applied during soil preparation and rest of the nitrogen applied one month after sowing. Five plants were randomly selected from each row and evaluated for yield and yield contributing characters.

The vine length and internodal length of the main stem of the five plants every genotype was measured in cm with the help of meter scale and total value was averaged. The days to first appearance of male and female flower was counted from sowing date to first appearance of male and female flower. The number of nodes for first appearance of male and female flower was counted to first appearance of male/female flower nodes. Total harvested (tender, maximum sized and eatable) fruits of every genotypes were counted and thereafter average was calculated to find number of fruits/plant. The length of harvested fruits was measured with the help of meter scale in cm. Diameter of the same fruits which was used for measuring length was recorded with the help of Vernier Calipers. The weight of five tender fruits from each genotype was measured with the help of weighing balance in kg, and then average was calculated. The cumulative fruit yields of five tagged plants were added and it was divided by five to calculate the fruit yield/plant in every genotype. Yield (t/ha) was calculated on the basis of yield per plot. Average fruit weight was worked out by dividing the total weight of all harvested fruits with total number of fruits harvested plot-1 in each treatment to arrive at average fruit weight.

Irrigation was applied at weekly interval. Weeds are controlled by hand weeding. Systemic insecticide and fungicide were used at an interval of 15 days to control attack of insect-pests and fungal diseases. The data were analysed by OPSTAT open data analysis software (Sheoran *et al*., 1998) [8].

Results and Discussion

Genotypes affected all measured variables (Table 1). Genotype Ankur Amit produced flowers on the lowest node and 'Chutki' had the flowers on the highest node. The node to first female flower was lowest in 'Ankur Amit' followed by 'Pusa summer prolific long'; the highest node to female flower was in Vardan followed by Punjab Komal. The results are supported by the findings of Janaranjani *et al*., (2015).

'Pusa summer prolific long' had the fewest days for male flower induction followed by 'Nandani'; 'Chutki' had the most days followed by 'Punjab Round' for male flower induction. 'Pusa summer prolific long' had the fewest days followed by 'Ankur Amit' to female flower induction; 'Chutki' had the fewest followed by 'Vardan'. Tirumalesh *et al*., (2016) [10] observed that bottle gourd takes 50.30-82.00 days for male flower induction and 53.33-87.50 days for female flower. The early and late female flower appearance help in the development of early or late flush of the yield which is profitable for market to collect the higher price in bottle gourd.

The tallest plants were in 'Nandani'; the shortest plants were in 'Punjab Komal' followed by 'Chutki'. Vine length ranged from 0.74-0.77 m in bottle gourd genotypes (Harika *et al*., 2012) [3]. Vine length is considered as an important yield contributing trait, because it leads to more number of branches and ultimately result in increased productivity. The longest internodes were in 'Nandani' followed by 'Pusa summer prolific long'; the shortest internodes were in 'Punjab Komal' followed by 'Gopika'.

The longest fruit were in 'Pusa summer prolific long'; the shortest fruit was in 'Punjab Round' followed by 'Punjab Komal'. Fruit length ranges from 0.84-0.14m in genotypes of bottle gourd (Kalyanrao *et al*., 2016) [5]. Ilyas M., *et al*. (2017) bottle gourd fruit lengths from 0.49-0.38m.Fruit length directly contributes to the fruit weight, thereby affecting the total yield. The widest fruit were in long type 'Ankur Amit' and in round type 'Punjab Round'; the most narrow fruit was in 'Vardan' followed by 'Chutki'. Results were supported by the findings of Singh and Singh (2014) [9]. The most fruit/plant was in 'Nandani' followed by 'Ankur Amit'; the fewest fruit/plant was in 'Vardan' followed by 'Chutki'. The number of fruit/plant range from 14.5-3.5 in different genotypes (Harika *et al*., 2012) [3]. Higher number of fruits/plant with maximum fruit weight accounted for higher fruit yield/plant and fruit yield·ha^{-1}.The heaviest fruit was in 'Punjab Round', followed by 'Pusa summer prolific long'; the lightest weight was in 'Nandani' followed by 'Vardan'. Results obtained were supported by the findings of Uddin *et al*. (2014) [11]. Fruit weight range from 0.29-2.112 kg (Mladenovic *et al*., 2012) [6]. More the fruit weight more will be the yield/plant and yield·ha^{-1}. Maximum fruit yield/plant was in 'Punjab Round' followed by 'Pusa summer prolific long'; minimum fruit yield/plant was recorded in 'Vardan' followed by 'Chutki'. Fruit yield in bottle gourd range from 2.27-15.81 kg (Harika *et al*., 2012) [3]. Higher fruit yield/plant resulted into greater the fruit yield·ha^{-1}. Maximum fruit yield·ha^{-1} was recorded in 'Punjab Round' followed by 'Pusa summer prolific long'; the lowest yield·ha^{-1}was in 'Vardan' followed by 'Gopika'.

Conclusion

All the genotypes exhibited considerable variations in the morphological, phenological, yield contributing and quality characters of bottle gourd. On the basis of present investigation 'Punjab Round' was recorded superior among all other genotypes for yield contributing traits by showing Maximum average fruit weight, Fruit diameter, Fruit yield/plant and fruit yield/ha followed by 'Pusa Summer Prolific Long' with minimum Days to first male flower, Days to first male & female flower and maximum for fruit length, fruit yield/plant and fruit yield·ha^{-1}. So, they can be recommended to farmer for commercial cultivation for assessing its potential to harvest early and high yield. When selecting the best hybrids for yield in bottle gourd, more emphasis should be given to number of fruit per vine, fruit flesh thickness, days to first male and female flower an thesis, fruit weight.

Table 1: Yield contributing characters of Bottle Gourd Genotypes.

Genotype	Node no. of first male flower	Node no. of first female flower	Days to first male flower	Days to first female flower	Plant height (m)	Internodal length (cm)	Fruit length (cm)	Fruit diameter (cm)	No. offruit/ plant	Average fruit weight (kg)	Fruit yield (kg/plant)	Fruit yield (t/ha)
PSPL	7.67	8.89	55.89	58.45	5.23	20.58	44.16	5.72	10.22	0.71	7.34	48.93
Punjab Komal (R)[a]	7.00	12.33	63.58	66.22	3.70	8.71	16.40	10.70	9.33	0.67	6.42	42.79
Vardan	8.67	12.89	66.89	72.11	4.17	12.05	34.30	4.84	6.34	0.52	4.10	27.33
Chutki	8.90	11.67	70.33	74.33	3.94	16.03	36.70	5.00	7.11	0.54	4.57	30.50
Punjab Round (R)	8.89	11.00	67.11	66.00	5.55	16.55	14.63	15.90	9.89	0.93	9.10	60.62
Nandani	7.67	10.67	62.58	65.00	7.50	23.48	31.85	5.79	13.00	0.50	6.68	44.52
Ankur Amit	6.44	6.89	63.67	64.11	4.03	17.12	28.70	7.27	10.67	0.65	6.98	46.48
Gopika	7.78	11.11	64.78	67.89	4.76	11.35	32.35	5.09	7.78	0.55	4.44	29.58
C.D.	1.30	1.58	5.85	6.43	0.52	1.46	2.57	0.75	1.08	0.07	0.67	4.47
SE(m)	0.42	0.52	1.91	2.10	0.17	0.67	0.84	0.24	0.35	0.02	0.22	1.46
C.V.	9.33	8.37	5.14	5.44	6.03	5.24	4.87	5.63	6.60	6.17	6.12	6.12

[a] R = Round type genotype

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