



A NOVEL STUDY OF PUMPKIN (*CUCURBITA MOSCHATA*) ON MORPHOLOGY AND ITS YIELD ATTRIBUTING CHARACTERS IN PAKISTAN

Muhammad Amin^{1*}, Shereen Niaz², Sadia Sardar¹, Amir Hussain³, Muhammad Aslam Korai⁴, Muhammad Burhan⁵, Sajid Ali¹, Farman Ali⁶, Hafiz Tassarwar Abbas⁷, Aiman Umar⁸, Muhammad Zahid Aslam⁶

¹Vegetable Research Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan

²Department of Biological Sciences, Faculty of Fisheries and Wildlife, University of Veterinary and Animal Sciences (UVAS), Ravi Campus, Pattoki, Pakistan

³Pulses Research Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan

⁴Institute of Chemistry, Shah Abdul Latif University, Khairpur, Sindh, Pakistan

⁵Plant Pathology Research Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan

⁶Cotton Research Station, Bahawalpur 63100, Pakistan

⁷Department of Plant Pathology, Faculty of Agriculture, Lasbela University of Agriculture, Water and Marine Sciences, Uthal, Balochistan

⁸Department of Food and Nutrition, Shaheed Benazir Bhutto Women University, Peshawar, Pakistan

***Corresponding Author:** Muhammad Amin (Senior Scientist, AARI)

E-mail: aminpbg@gmail.com, Tel: +92-333-5699182

Abstract

Genotypes (20) of pumpkin were studied for morphological and yield characters during 2019-20. Flowering days were ranged from 51.0-71.1 days. Early maturity and flower was observed in Variety VF-309. Different ranges were observed for different parameters. Morphological traits recorded were leaf diameter, branches, leaf length and length of vine at harvest. The genotype VF-242 produced maximum vine length i.e. 396.1 cm. Vine length was lowest i.e. 165.6 cm in genotype VF-255. Range of leaf length was from 27.4 cm to 44.2 cm in different pumpkin genotypes. Branches were ranged from 2.0-4.1. The branches number was found maximum 4.1 in genotype VF-270. Fruit per plant was showed maximum 13.7 by genotype VF-268. The fruit was minimum 2.0 in genotype VF-311. The average fruit weight 3.2 kg was given by genotype VF-250. The average fruit weight was minimum 1.0 kg in genotype VF-257. Pumpkin lines behaved differently for different parameters. Yield per plant 32.0 kg/plant was recorded in genotype VF-422 and it was on top ranked. Minimum yield 1.9 kg/plant was observed in genotype VF-270. Fruit color and flesh color of all the studied genotypes showed variations. Out of the 20 studied 7 genotypes including VF-422, VF-268, VF-242, VF-116, VF-423, VF-250, VF-309 may be used in future breeding program to develop pumpkin hybrids/varieties.

Keywords: Pumpkin; Plain area; Qualitative attributes; Varieties; Pakistan

INTRODUCTION

To counter population spread, it is the hour of need to fulfill food demand and eliminate poverty. It is a moral duty of scientists to serve the world. It is a big challenge to feed almost 9 billion people

across the globe. It demands diversification in agricultural production systems (crops). Modern advancements are visiting major crops (rice, wheat and maize). Large portion of food is being met from major crops. There is huge gap in food demand. Vegetable breeding can put its share to a bridge the gap.

Pumpkin belongs to family cucurbitaceae. It is a very important vegetable in different countries of the globe. In Pakistan, it stands after bottle gourd, brinjal and cucumber crop. In Pakistan, it has 3618 hectares cultivated area with 40591tons/ annum production (crop reporting service Punjab; Fruits, Vegetable and condiments statistics of Pakistan 2018-19). It contains sufficient amount of vitamin A. It can fulfill the vegetable demand as well as nutritional deficiencies. There are different recommended local varieties of pumpkin in Pakistan e.g. Faisalabad goal, Faisalabad local and local No. 1. Different advanced lines of pumpkin are in pipelines to be approved in next one or two years for general cultivation. Naik (1949) observed cross pollination in pumpkin with varietal differences. Pumpkin is one of the most neglected food vegetable. Its production is low due to non availability of good quality seed. It has lot of potential to be used as a valuable food item. Its peels and flesh contain β -carotene, total flavonoid and total phenolic elements. These elements can help to improve the immunity. Its seeds are rich in zinc element. The Zn element has both oxidizing as well as mediating effect. Zinc element also stimulates enzymes in the body (Hosen et al, 2021).

Cucurbits have large group of vegetables including pumpkin (Hidayatullah et al., 2012). Crops have annual life cycle. It has vine type growth habit. It has deeply grooved stem. Plants have 5-6 branches. It has branch type leaves. Morphologically its flowers are monoecious. It has male and female flowers on different positions (Ilyas et al., 2017). Its female flowers are short-stalk type. Cucurbits have important species due to the diversity of fruit shapes. It is being grown as vegetable for cooking purpose. (Sherma and Sengupta, 2012). Cucurbits fruit has solid covering. It has a beautiful flesh. Seeds have different ranges i.e. flat rectangular, narrow trapezoidal whitish and dark brown. Its fruit is full of sufficient quantity of fixed oils and proteins (Hegazy and El Kinawy, 2011). Its Fruit is being used to treat different diseases like bronchial disease and constipation (Gorasiya et al., 2012). Its fruit has orange or yellow color. It has complex plant from the stem to the bottom. Its seed is enclosed inside fruit. Pulp is present inside fruit. Pumpkin plants are placed in monoecious group. Female flower has small ovary. It has colorful flowers having limited life cycle. The flowers may open for a short time. (Ahamed *et al.*, 2011). Pumpkin color is associated with inner orange pigments. It contain nutrients i.e. lutein, alpha and beta carotene.

Different pumpkin varieties are being sown in Pakistan. Varieties being cultivated in the countries are not according to seed standard. It also needs standardization in nomenclature. The vegetable research institute Faisalabad is highly desirous to conduct research work on pumpkin crop. Therefore, this trial was conducted to inquire different parameters of pumpkin to strengthen the crossing and hybridizing programme.

MATERIALS AND METHODS

The trial was conducted at the vegetable research institute Faisalabad during the two consecutive Kharif season of 2019-2020. Randomized complete block design was used to conduct the experiment. Three (3) replications were used. Its plot area contained 4m x 3.6m dimension. Healthy seeds were grown during March 4, 2019 for 1st year and next year 4 March, 2020. In evaluation phase, twenty genotypes were studied along with one local check. (Table1). The plant to plant distance was 60 cm. The soil texture was clay loam in type. Farm yard manure was applied @ 12 ton/ha. The half doze of urea fertilizer was applied as basal dose. The remaining 50% doze of urea fertilizer was applied at one month plant stage. The cultural practices were applied according to trial needs.

Data on different parameters were recorded. It was recorded by using the methods of International Board for Plant Genetic Resources (IBPGR). Fruit data was recorded on fruit maturity stage. Yield data was recorded and compiled. It included matured fruit, fruit per plant, plant yield, matured fruit weight and circumference. Inflorescence data were recorded. It was included flower color, 50% flowering and observation on maturity days. Observations were taken on morphological traits. It was included leaf diameter, branches, vine length and leaf length. Qualitative traits were recorded. It was included fruit shape, flesh color and fruit color. The recorded data was statistically analyzed for understanding its results and its interpretation. The treatment means were separated by using Duncan's Multiples Range Tests. It was worked out by using the method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Flowering (Days): Solid differences among the accessions were recorded towards days to 50 % flowering. (Table1). Highest 50% flowering days 71.1 were observed. Early flower (51 days) was observed in the variety VF 309. Ahamed *et al.* (2011) evaluated 20 genotypes. It was observed days to flowering (days) takes 52.0 to 73.7.

Maturity detail (Days): Genotypes under study depicted differences for maturity (Table 1). The fruit maturity was ranged from 101 to 120 days. The genotype VF 309 observed the shortest maturity period. The genotype VF 270 observed the longest maturity days. Ahamed *et al.* (2011) also observed days taken to maturity. It was founded from 104.0 to 123 days.

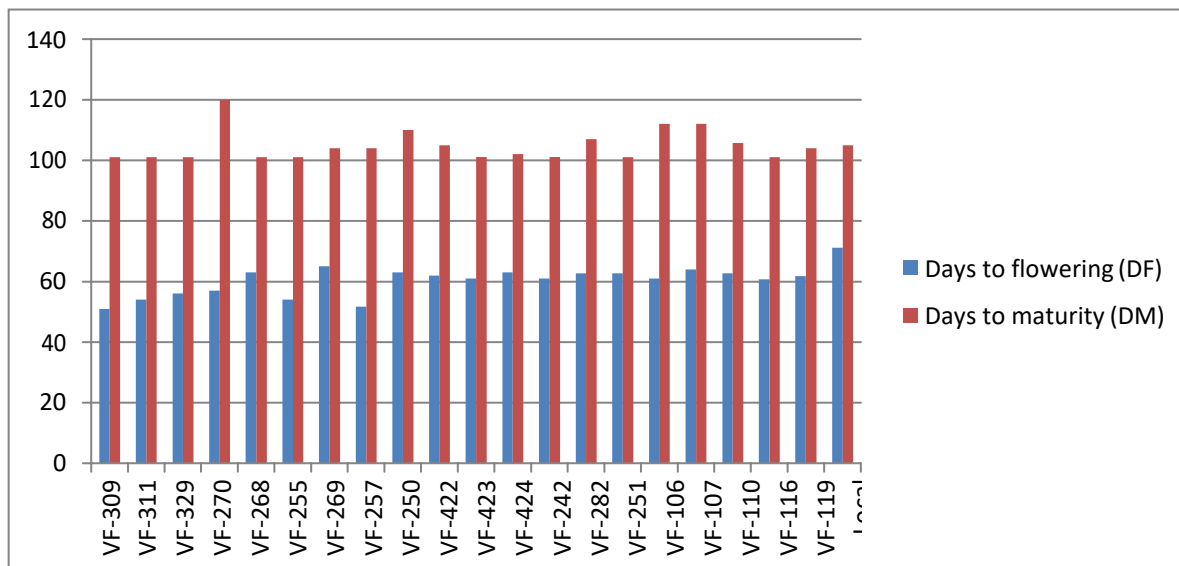
Vine length at harvest observation (cm): Vine length ranged 165.6 to 396.1 cm in different varieties (Table 2). The 1st ranked highest (396.1cm in length) pumpkin plant was observed in genotype VF 425. The genotype VF 116 got 2nd position with vine length 388.9cm. The genotype VF 329 (378.2cm) ranked at 3rd position. Ng (1993) observed that Ridged Gourd is commonly grown in Asiatic countries. It can attain length to 0.6m. Ahamed *et al.* (2011) also evaluated 20 genotypes. It was reported that vine length range from 169.6.0 to 400.1 cm at maturity stage. In trailing types stem length can cross 140 feet.

Table 1: Observation on inflorescences (Twenty-one pumpkin genotypes)

Sr. No.	Pumpkin Genotypes	Days to flowering (DF)	Days to maturity (DM)
1	VF-309	51.0 i	101.0 f
2	VF-311	54.0 h	101 f
3	VF-329	56.0 g	101 f
4	VF-270	57.0 g	120 a
5	VF-268	63.0 cd	101.0 f
6	VF-255	54.0 h	101.0 f
7	VF-269	65.0 b	104.0 de
8	VF-257	51.7 i	104.0 de
9	VF-250	63.0 cd	110.0 b
10	VF-422	62.0 def	105.0 cd
11	VF-423	61.0 ef	101.0 f
12	VF-424	63.0 cd	102.0 ef
13	VF-242	61.0 f	101.0 f
14	VF-282	62.7cde	107.0 c
15	VF-251	62.7 cde	101.0 f
16	VF-106	61.0 ef	112.0 b
17	VF-107	64.0 bc	112.0 b
18	VF-110	62.7 cdf	105.7 cd
19	VF-116	60.7 f	101.0 f

20	VF-119	61.7 def	104.0 de
21	Local	71.1 a	105.0 cd
	<i>Mean</i>	<i>60.39</i>	<i>104.74</i>
	<i>LSD value</i>	<i>1.64</i>	<i>2.21</i>
	<i>CV %</i>	<i>1.56</i>	<i>1.29</i>
	<i>Range</i>	<i>51.0-71.1</i>	<i>101.0-120.0</i>

VF= Vegetable Faisalabad, Figures in a column with the same letter do not differ significantly at 5% level of probability



Graphical representation of inflorescence parameters

Leaf Length (cm): The highest leaf length 39.2 cm was observed in genotype VF-329 (Table 2). Minimum 27.7cm leaf length was observed in genotype VF-423. Ahamed *et al.* (2011) also reported that leaf length ranged from 27.6 to 44.2 cm. Gruben and Ngwerme (2004) also recorded 9-24 cm leaf length per plant.

Leaf diameter (cm): Varieties showed different range regarding leaf diameter (Table 2). It was ranged 15 to 23cm in different genotypes. Maximum leaf diameter (23cm) was observed in genotype VF-270. The genotype VF-329 stands 2nd having 22cm leaf diameter. Minimum leaf diameter was recorded in genotype VF-0242. Ng (1993) observed that *C. trigonus* leaves had diameter 2.5-5cm. It was observed 7.5cm diameter in *C. melo* pumpkin leaves. The range of 7.5-12.7 cm diameter was observed in *C. sativus* pumpkin leaves. Grubben and Ng (2004) observed 20-35cm leaf diameter in *C. Moschata*. Ahamed *et al.* (2011) also evaluated different pumpkin genotypes. It was reported that leaf diameter ranged from 15.3 to 23.7 cm.

Branches/plant (Number): Branches showed significant deviations among genotypes (Table 2). The genotype VF-257 showed least number of branches per plant 2.0. The genotype VF-270 exhibited highest number of branches per plant 4.1. Ahmed *et al.* (2011) also evaluated and reported that total branches from one plant ranged 2.0 to 4.7.

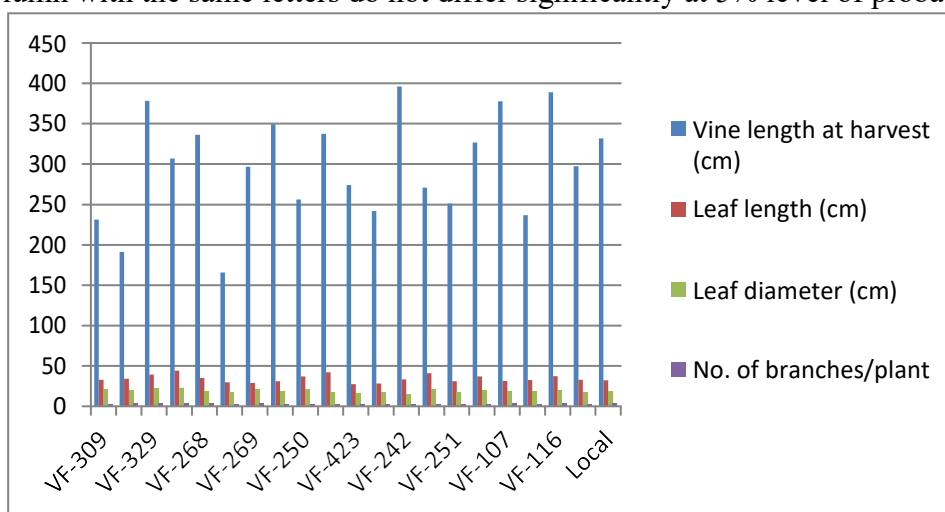
Yield characters: The highest fruit weight 3.2 kg was observed in genotype VF-250. The smallest fruits (1.0 kg) were observed in genotype VF-257. Ahmed *et al.* (2011) also evaluated and reported in pumpkin varieties that fruit weight ranged from 1.5.0 to 4.2. Dry weight of 100-seed showed significant differences. It was observed that 100 seed weight (dry 100-seed) fluctuated 3.4 gram to 10.6 gram. Yield and its contributing traits observed significant variations as shown in Table 3. The maximum fruits per plant (13.7) were obtained from genotype VF-268. The minimum fruits per plant

(2.1) were obtained from genotype VF-251. Labrada *et al.* (1997) also studied 34 pumpkin genotypes. It was confirmed that out of 34 genotypes, 25 genotypes produced 4-5 fruits per plant. The genotype VF-309 produced circumference per fruit 71.1cm. The accession VF-257 produced minimum circumference 40.3cm. Ahamed *et al.* (2011) also evaluated different range of number of fruits per plant. It was reported that total fruits taken from one plant ranged 2.0 to 15.7.

Table 2: Mean performance of different morphological traits (Twenty-one red gourd pumpkin genotypes)

Genotypes	Vine length at harvest (cm)	Leaf length (cm)	Leaf diameter (cm)	No. of branches/plant
VF-309	231.0 h	33.0 ghi	21.0 b	3.0 c
VF-311	191.0 i	34.0 fgh	20.0 d	4.0 b
VF-329	378.2 a	39.2 cd	22.0 b	4.0 b
VF-270	306.8 de	44.2 a	23.0 a	4.1 a
VF-268	336.3 c	35.0 efg	19.0 f	4.0 b
VF-255	165.6 i	30.0 jkl	18.1 h	3.0 c
VF-269	296.5ef	29.1 klm	21.0 c	4.0 b
VF-257	349.3bc	31.1 ijk	19.0 g	2.0 de
VF-250	256.2gh	37.0 de	21.0 b	3.0 c
VF-422	337.5 c	42.0 ab	17.0 i	3.0 c
VF-423	274.0fg	27.4 m	16.0 j	3.0 c
VF-424	241.8 h	28.1 lm	17.2ij	2.0 e
VF-242	396.1 a	33.5hij	15.0 k	3.0 c
VF-282	270.7fg	41.0bc	21.0 b	3.0 c
VF-251	250.9gh	31.0jkl	17.0 h	3.0 b
VF-106	326.6 cd	37.1ef	20.0 c	3.0 c
VF-107	377.9 ab	31.4ijk	19.0 e	4.0 b
VF-110	236.8 h	32.7hij	19.0 e	3.0 c
VF-116	388.9 a	37.4 e	20.0 d	4.0 b
VF-119	297.4ef	33.1hij	17.0 i	2.0 cd
Local	331.9 cd	32.3ij	19.0 d	4.0 b
Mean	297.20	34.26	19.10	3.23
LSD value	26.24	2.64	0.30	0.37
CV %	5.11	3.64	1.01	6.76
Range	165.6-396.1	27.4-44.2	15.0-23.0	2.0-4.1

Figures in column with the same letters do not differ significantly at 5% level of probability



Graph A: Graphical representation of mean performance of different morphological traits

Genotypes under observation expressed significant variations for fruit yield (Table 3). The genotype VF-422 produced highest yield per plant 32.0 kg. The genotype VF-116 got 2nd position with yield 27.1 kg. The genotype VF-242 ranked at 3rd with yield 24.9 kg. The genotype VF-270 produced

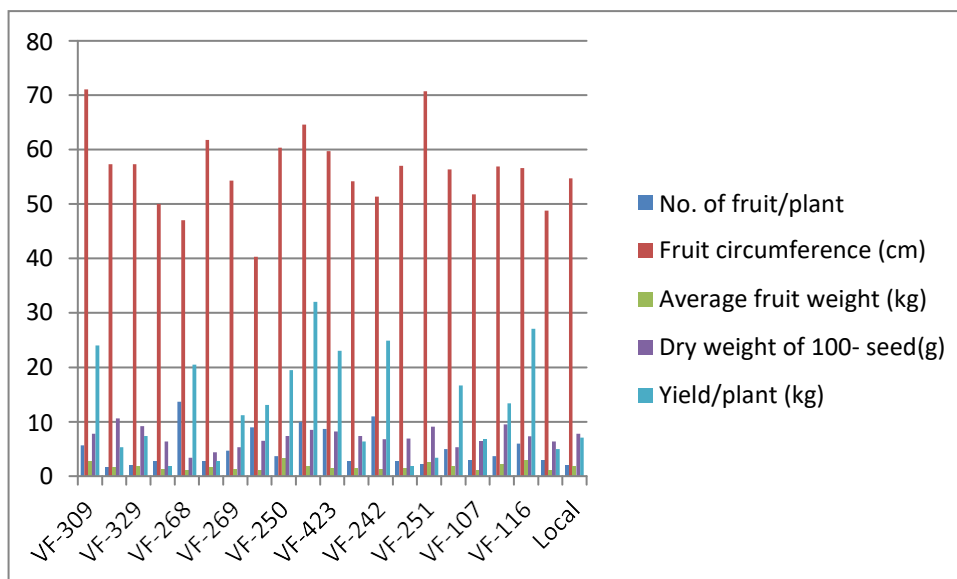
minimum yield 1.9 kilogram from single plant. Precheuret *et al.* (2009) also observed 32 pumpkin genotypes in USA. He categorized pumpkin cultivars into 3 groups. Twenty one (21) genotypes were included in medium size group. Eight (8) genotypes were included in small novelty group. Three (3) genotypes were included in mini-pumpkins. Out of top 5 varieties, Phatso Jr was at No. 1(13.6kg/fruit). Mustang PMR stands at 2nd position (13.6kg/fruit). Phatso II ranked at No. 3rd (12.3kg /fruit). Out of top 5 varieties Phatso II got maximum yield of 49.40 t/ha. The genotype solid gold got 2nd position with yield 37 t/ha. Pumpkin is a kharif crop. It is 4-6 months vegetable. It can not tolerate frost. In South African countries, seed is being used for crop production (Chigwe and Saka 1994, Gwanama *et al.* 2000).

Quality parameters of red gourd fruits: Flower yellow color was observed in all studied varieties (Table 4). Green yellow to brown fruit color was observed. Green, orange and deep orange fleshy colors were observed in studied genotypes. Three fruit shapes were observed including pyriform, elliptical and round. Labrada *etal.* (1997) also studied 34 accessions. Predominant fruit types were observed including crookneck and pyriform. Ahamed *et al.* (2011) also evaluated and reported that branches from single plant vary 2.0 to 4.7.

Table 3: Quantitative parameters of fruits (Pumpkin red gourd germplasm)

Entries	No. of fruit/plant	Fruit circumference (cm)	Average fruit weight (kg)	Dry weight of 100- seed(g)	Yield/plant (kg)
VF-309	5.7ef	71.1 a	2.7abc	7.8bcdef	24.0abc
VF-311	1.7jk	57.3cdef	1.6efgh	10.6 a	5.3fghi
VF-329	2.0ij	57.3cdef	1.8defg	9.2abc	7.4fghi
VF-270	2.7 kl	50.0hij	1.3efghi	6.4fg	1.9 i
VF-268	13.7 a	47.0 j	1.0ij	3.4 i	20.5bcd
VF-255	2.7 kl	61.8bc	1.6efg	4.4 hi	2.7 i
VF-269	4.7fg	54.3efghi	1.3efghij	5.3gh	11.2efgh
VF-257	9.0 cd	40.3 k	1.0 j	6.5fg	13.1defg
VF-250	3.7gh	60.4bcd	3.2 a	7.4cdef	19.5bcd
VF-422	10.0bc	64.6 b	1.9cdef	8.5bcde	32.0 a
VF-423	8.7 d	59.7bcde	1.5efgh	8.2bcdef	23.0bc
VF-424	2.7hij	54.2efghi	1.4efghi	7.4cdef	6.4fghi
VF-242	11.0 b	51.4ghij	1.2fghij	6.8efg	24.9 ab
VF-282	2.7 kl	57.0cdef	1.5efgh	6.9efg	1.9 i
VF-251	2.1 l	70.7 a	2.5abcd	9.1abcd	3.4 hi
VF-106	5.0ef	56.4cdefg	1.8defg	5.3gh	16.7cde
VF-107	3.0 hi	51.8fghij	1.1ghij	6.4fg	6.8fghi
VF-110	3.7gh	56.9cdefg	2.1bcde	9.5 ab	13.4def
VF-116	6.0 e	56.6cdefg	2.9 ab	7.3def	27.1 ab
VF-119	3.0 hi	48.8ij	1.0hij	6.4 g	5.0ghi
Local	2.0ij	54.7defgh	1.8efg	7.8bcdef	7.1fghi
Mean	4.65	56.3	1.72	7.17	13.01
LSD value	1.16	5.20	1.60	1.70	7.60
CV %	9.60	5.51	16.01	10.11	2.10-32.0
Range	2-13.7	40.3-71.1	1.0-3.2	3.4-10.6	1.9-32

Figures in column with the same letters do not differ significantly at 5% level of probability



Graph B: Graphical representation of quantitative parameters of fruits

Table 4: Fruit parameters (Qualitative) of different pumpkin red gourd

Genotypes	Fruit skin color	Flesh color	Fruit shape
VF-309	Green	Deep orange	Broad elliptical
VF-311	Green	Orange	Pyriform
VF-329	Yellow	Orange	Elliptical
VF-270	Brown	Orange yellow	Round
VF-268	Green	White	Flat
VF-255	Brown	Deep orange	Round
VF-269	Yellow	Orange	Oblong
VF-257	Brown	Pale green	Round
VF-250	Green	Orange	Broad elliptical
VF-422	Brown	Yellow	Broad elliptical
VF-423	Yellow	Deep orange	Elliptical
VF-424	Brown	Pale green	Elliptical
VF-242	Green	Deep orange	Oblong
VF-282	Brown	Yellow	Pyriform
VF-251	Yellow	Yellow	Broad elliptical
VF-106	Brown	Deep orange	Pyriform
VF-107	Green	Orange	Round
VF-110	Yellow	Deep orange	Broad Elliptical
VF-116	Yellow	Orange	Broad Elliptical
VF-119	Yellow	Yellow	Pyriform
Local	Green	Deep orange	Round

CONCLUSION

Twenty genotypes (*Cucurbita moschata L.*) were used to study the morphological and yield attributes. It was laid out in Faisalabad Pakistan. It was observed that first flowering takes 51-71.1 days. The genotype VF-309 expressed early ripeness and flowering. It was found variability for different morphological parameters. It was number of branches, leaf diameter, leaf length and vine length at harvest. Genotype VF 268 produced highest fruits/plant 13.7. Genotype VF-250 produced maximum fruit weight 3.2 kg. Genotype VF-422 produced maximum fruit yield 32 kg. Studied varieties expressed variations in flesh color and fruit color.

Author Contributions

MA and SS designed the project, MA, SS, AH, and SA planned the experiments, S.N, H.TA, M.A.K, MB and SA interpreted the results and analyzed the data, MA, FA, and MZA made the write up, AU, M.Z.A, and M.A did critical revision and editing. All authors have read and agreed to the published version of the article.

Conflicts of Interest

The authors declare no conflict of interest.

Data Availability

The data will be available on fair request to the corresponding author.

Ethical Approval

Not applicable to this paper.

REFERENCES

1. <http://www.amis.pk/files/Fruit%20&%20Vegetable%20Condiments%20of%20Pakistan%202018-19>.
2. Ahamed K.U., B. Akhter, M.R. Islam, N.Ara and M.R.Humauan.2011. An assessment of morphology and yield characteristics of pumpkin (*Cucurbita moschata*) genotypes in northern Bangladesh. 2011. *Tropical Agricultural Research & Extension* 14(1):
3. Chigwe C.F.B and V.W. Saka 1994. Collection and Characterization of Malawi Pumpkin Germplasm. *Zim. J. Agric. Res.* 32(2): 139-149.
4. Fruits, Vegetable and condiments statistics of Pakistan 2018-19.
5. Gomez K.A. and A.A. Gomez, 1984. *Statistical Procedure for Agricultural Research*. 2nd ed., Intl. Rice Res. Inst., John Willy and Sons, New York, Chichester, Brisbane, Toronto, Singapore. PP. 187-240
6. Gorasiya, S.J., A. Paranjape and K. Murti. 2012. Pharma cognostic and pharmacological profile of *Lagenaria siceraria* (Molina) Standley. *Pharm. Newsl.* 3: 317-324.
7. Gwanama C., M.T. Labuschagne and A.M. Botha. 2000. Analysis of genetic variation in *Cucurbita moschata* by random amplified polymorphic DNA (RAPD) markers. *Euphytica* 113: 19–24.
8. Hosen M, M.Y Raffi, Norida M, M.Josuh, M.F.N.Chawdhury, I.Muhammad, Y.Oladosu and M.M.H.Khan. 2021. Pumpkin(*Cucurbita* spp.) A crop to mitigate food and nutritional challenges. *J. Horticulturae*, 7(10) 352; <https://doi.org/10.3390/horticulturae7100352>
9. Hidayatullah., T. Mahmood, M. Farooq, M.A. Khokhar and S.I. Hussain. 2012. Plant growth regulators effecting sex expression of bottle gourd (*Lagenarria siceraria* Molina) plants. *Pak. J. Agric. Res.* 25: 50-54.
10. Hegazy, E.M. and O.S. El-Kinawy, 2011. Characteristics of pumpkin and bottle gourd in Egypt and potentially their contamination by mycotoxins and mycotoxigenic fungi. *J. Am. Sci.* 7(9): 615-622.
11. Ilyas, M., G. Nabi, S. Ali, M.M. Anjum, N. Ali, W. Zaman, S. Jan, I. Samar, M. Sadiq and S. Akbar. 2017. Evaluation of bottle gourd genotypes (*Lagenaria siceraria* Mol.) varieties in Agro climatic conditions of Peshawar Valley. *Int. J. Environ. Sci. Nat. Res.* 3(1): 1-3.
12. Iqbal M., K.Usman, M. Arif, S. A. Jatoi, M. Munir and I. Khan. 2019. Evaluation of Bottle Gourd Genotypes for Yield and Quality Traits. *Sarhad Journal of Agriculture*, 35(1): 27-35. DOI | <http://dx.doi.org/10.17582/journal.sja/2019/35.1.27.35>
13. Labrada H.R, A.F. Almirall and O.B. de la Carrera. 1997. Cuban Pumpkin Genetic Variability under Low Input conditions. *Cucurbit Genetics Cooperative Report* 20:48-49 (article 21) 1997
14. Lucas E.O. 1988. The potential of leaf vegetables in Nigeria. *Outlook Agr.* 17:163-168.
15. Naik K.C. 1949. *South Indian Fruits and their culture*. P.Varadachary& Co., Madras. Martin and Ruberte, 1978.

16. Ng T.J. 1993. New opportunities in the Cucurbitaceae. p. 538-546. In: J. Janick and J.E. Simon (eds.), new crops. Wiley, New York.
17. Precheur B, J.Jasinski, M .Riedel, L.Rhodes and R. Pack. 2009. Pumpkin cultivar evaluation in Ohio. Dept. of Horticulture and Crop Science, Southwest Extension IPM, Department of Plant Pathology, The Ohio State University, Columbus, OH 43210.
18. Sherma, A. and S.A. Sengupta. 2012. Evaluation of genetic variability in bottle gourd genotypes. Veg. Sci. 39 (1): 83-85.