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EVALUATION OF PHYSICAL CHARACTERISTICS OF SOME OFF-SEASON JACKFRUIT GERMPLASMS FROM SOUTH-WESTERN REGION OF BANGLADESH

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Abstract: An investigation was carried out to study the physical characteristics of 28 selected off-season jackfruit germplasm of south western region of Bangladesh. There was significant variation among the germplasms in relation to fruit characteristics. Better performance was showed by germplasm no. 6 in respect of total fruit weight, weight of rind, weight of axis, weight of bulbs, weight of seed, number of seed, length and breadth of fruit. Germplasm no. 9 showed better performance in respect of percentage of edible portion. In respect of length of seed and breadth of seed better performance was showed by germplasm no. 11 and 3 respectively. Germplasm no. 26 showed better performance in relation to length and breadth of bulb.

Key words: Physical characteristics, jackfruit, germplasm, south-western region, Bangladesh

Introduction

Jackfruit (*Artocarpus heterophyllus* Lam., Family: Moraceae) is one of the most popular and indigenous fruit of Bangladesh having some special organoleptic features such as excellent flavor, pleasant aroma, attractive color, and taste. It is rich sources of vitamins, minerals and total soluble solids etc. (Paramanik, 1995). It is also a moderate source of carbohydrate. It is now widely cultivated in the tropics of both hemispheres. It is widely grown in Bangladesh, Burma, India, Malaysia, Philippines, Srilanka, and Thailand and to some extent in Brazil and Queensland (Australia). The jackfruit is famous for producing the largest edible fruits, which may weigh as much as 50 kg or more.

Generally the texture of bulbs becomes juicy and the taste of pulp is medium sweet in off-season jackfruit. Flavor of fruit is good to average and sometimes develop bad smell. The size and shape of fruits vary with time of harvesting. The shape of fruits is mostly regular and uniform in off-season jackfruit. The seeds at the late harvest are found to be viviparous (Azad, 1989). Bangladesh is the rich source of variable germplasm of jackfruit due to its universal practice of seed propagation.

The information on the physical characteristics of fruit such as weight, size, shape, skin color, number of bulbs per fruit, color, nature, flavor and sweetness of bulbs are important for the fruits

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harvested at off-season. The jackfruit serves as a food for millions of poor people in the countryside during the months from May to July where there remains a scarcity of food in the rural areas of Bangladesh. A large quantity of jackfruit comes to the market at this time. But due to the lack of storage facilities a major portion of this becomes damaged. On the other hand, a huge scarcity of fruits occurs during October to March. Jackfruit is also produced out of season in Bangladesh (Hossain, 1976). There is a scope to select superior off-season germplasm of jackfruit from field survey and collection of the same to mitigate the fruit and nutritional shortage. The present study was undertaken to study the pattern of physical properties of off-season jackfruit.

Materials and Methods

A study on the physical characteristics of 28 germplasms of off-season jackfruit was carried out during the period from July 2003 to March 2004. The off-season jackfruit germplasms were selected from southwestern part of Bangladesh. Mature jackfruits were harvested at different time from August 2003 to December 2003. Three fruits were collected from each germplasm. The collected fruits were brought to the Horticulture Laboratory of Agrotechnology Discipline, Khulna University, Khulna and kept in ambient condition for ripening.

Physical characteristics of off-season jackfruits were determined under quantitative characters such as Fruit Weight (kg), Weight of Rind (kg), Weight of Axis (kg), non-edible portion (%), Weight of Bulb (kg), Edible portion (%), Weight of Seed (kg), Number of seed/ fruit, no of spine (cm^{-2}), Skin thickness (cm), Length of fruit (cm), Breath of fruit (cm), Length of seed (cm), Breath of seed (cm), Length of bulb (cm), Breath of bulb (cm), Individual bulb weight (g) were observed appropriately. The study was laid out in a completely randomized design. The collected data were statistically analyzed by standard statistical package. Duncan's Multiple Range Test (DMRT) was used to compare the means of different parameters.

Results

The physical characteristics of 28 jack fruit germplasms are shown in Table 1.

Weight of individual fruit: The fruit weight was significantly varied among the 28 germplasms. The germplasm no. 6 gave the maximum fruit weight (13.63 kg) followed by germplasm no. 27 (10.48 kg), no. 21 (10.27 kg), no. 17 (9.72 kg) and no. 2 (9.36 kg), while it was the minimum (3.00 kg) in germplasm no.16, preceded by germplasm no. 28 (3.36 kg), no. 22 (3.36 kg) and no.19 (3.57 kg) (Table 1).

Weight of rind: The rind weight varied significantly among the 28 germplasms studied. The rind weight of jackfruit influenced the fruit weight. The highest rind weight was found in germplasm no. 6 (5.69 kg) followed by no. 10 (4.58 kg), no. 21 (4.36 kg), and no. 27 (4.28 kg). The lowest rind weight was obtained from germplasm no.16 (1.20 kg) preceeded by germplasm no. 22 (1.39 kg), no. 19 (1.58 kg) and no. 28 (1.64 kg) (Table 1).

Weight of axis: There was a significant variation among the 28 germplasms regarding weight of axis. The axis weight of jackfruit influenced the fruit weight. It was observed that the germplasm no. 6 gave the maximum axis weight (0.91 kg) followed by germplasm no. 27 (0.77 kg), no. 11 (0.74 kg) and no. 21 (0.73 kg), while it was the minimum (0.21 kg) in germplasm no. 16 preceded by germplasm no. 28 (0.22 kg), no. 19 (0.23 kg) and no. 22 (0.23 kg) (Table 1). Average axis weight of off- season jackfruits was found 0.47 kg.

Non-edible portion (%)**:** It was measured as the percentage of weight in comparison with total fruit weight. Significant variation was observed among the 28 germplasms in relation to the non-edible portion. The maximum weight of non-edible portion (76.78%) was found in germplasm

no.10 followed by germplasm no. 11 (69.11%), no. 20 (66.47%) and no. 24 (64.46%), and the minimum weight (44.35%) was measured from germplasm no. 9 preceded by germplasm no. 25 (44.40%), no. 8 (46.15%) and no. 22 (46.70%) (Table 1).

Table 1. Physical characteristics of off-season jackfruit germplasm from the South-western region of Bangladesh.

Germ. no.	Fruit Wt. (kg)	Rind Wt. (kg)	Axis Wt. (kg)	Non-edible part (%)	Bulb Wt. (kg)	Edible part (%)	Seed Wt. (kg)	Seed/ fruit (No.)	Spine (cm^{-2})	Skin thickn (cm)	Fruit Length (cm)	Fruit Breadth (cm)	Seed Length (cm)	Seed breadth (cm)	Bulb length (cm)	Bulb breadth (cm)	Bulb weight (g)
1	8.83 bcd	3.69 bcdef	0.47 bc	47.08 e	3.68 bcd	52.92 a	0.99 abc	224.3 abcd	3.00 bcde	1.03 bcde	31.67 bc	15.18 abcd	3.00 ef	2.73 ab	6.43 cdef	5.06 cd	16.43 cdefgh
2	9.63 abc	3.91 abcde	0.64 abc	47.33 e	4.42 ab	52.67 a	0.64 abcd	214.3 abcd	3.33 bcd	1.16 abcd	36.33 b	17.09 abc	3.10 def	2.80 ab	6.46 cde	5.46 c	20.26 cd
3	7.39 bcdef	3.06 bcdefgh	0.49 abc	48.05 e	3.19 bcde	51.95 a	0.64 bcd	172.0 bcdef	2.33 de	0.91 cde	31.00 bcd	15.07 abcd	3.00 ef	2.86 a	6.53 cde	5.23 cd	18,59 cdefg
4	4.91 defg	2.01 defghi	0.34 bc	47.76 e	2.11 defg	52.24 a	0.43 bcd	154 cdefg	3.33 bcd	1.03 bcde	29.00 bcd	14.44 bcd	3.00 ef	2.60 b	6.10 efg	4.86 de	13.30 efghij
5	6.23 bcdef	2.48 cdefghi	0.49 abc	47.86 e	2.49 bcdeh	52.14 a	0.76 abcd	252.3 ab	6.00 a	1.26 ab	29.33 bcd	15.07 abcd	3.00 ef	1.85 de	5.43 hij	4.00 hij	9.87 ij
6	13.63 a	5.69 a	0.91 a	48.30 e	5.75 a	51.70 a	1.27 a	291.7 a	3.00 bcde	1.00 bcde	51.67 a	20.81 a	3.00 ef	2.80 ab	6.53 cde	5.46 c	19.77 cde
7	8.64 bcde	3.68 bcdef	0.63 abc	49.47 e	3.47 bcd	50.53 a	0.86 abcd	157.3 bcdef	3.00 bcde	1.00 bcde	32.33 bc	13.38 bcd	2.46 h	1.21 h	6.83 c	5.36 c	22.39 bc
8	7.33 bcdef	2.86 bcdefghi	0.52 abc	46.15 e	3.12 bcde	53.85 a	0.81 abcd	206.3 abcde	2.33 de	0.83 de	30.67 bc	15.82 abc	2.93 fg	1.50 fg	5.93 fgh	4.53 efg	15.11 defghi
9	6.26 bcdefg	2.39 cdefghi	0.42 bc	44.35 e	2.89 bcdefg	55.65 a	0.55 bcd	171 bcdefg	3.33 bcd	1.00 bcde	31.67 bc	13.16 bcd	3.00 ef	2.78 ab	5.93 fgh	4.53 efg	16.76 cdefgh
10	6.51 bcdef	4.58 ab	0.41 bc	76.78 a	0.56 h	23.22 e	0.94 abcd	67.0 hi	2.00 e	1.00 bcde	30.67 bcd	11.46 cde	2.96 fg	1.48 g	5.53 hij	4.06 ghi	8.42 j
11	6.70 bcdef	3.89 abcde	0.74 ab	69.11 ab	1.11 gh	30.89 de	0.95 abcd	91.67 fghi	3.66 bc	1.00 bcde	35.33 b	18.58 ab	3.96 a	2.03 d	6.23 defg	3.46 k	12.10 ghij
12	6.65 bcdefg	2.99 bcdefghi	0.44 bc	52.43 de	2.49 bcdefgh	47.57 ab	0.71 abcd	249 abc	2.33 de	1.03 bcde	32.00 bc	12.00 cde	3.03 def	1.50 g	5.13 j	4.23 fgh	9.82 ij
13	7.22 bcdefg	2.98 bcdefghi	0.44 bc	47.25 e	3.03 bcdefg	52.75 a	0.76 abcd	138.3 defgh	2.66 cde	1.00 bcde	30.33 bcd	14.92 abc	2.40 hi	1.25 h	6.76 c	4.30 fgh	21.81 bc
14	6.64 bcdefg	2.74 bcdefghi	0.41 bc	47.45 e	2.80 bcdefg	52.55 a	0.69 abcd	155 bcdefgh	2.33 de	1.03 bcde	30.67 bcd	13.06 bcd	2.93 fg	2.70 ab	5.50 hij	4.26 fgh	18.70 cdefg
15	6.43 bcdefg	3.00 bcdefghi	0.47 bc	54.25 cde	2.35 cdefgh	45.75 ab	0.60 bcd	117 efgh	2.33 de	1.00 bcde	30.33 bcd	13.69 bcd	2.21 ijk	1.53 fg	6.16 efg	4.23 fgh	20.23 cd
16	3.00 g	1.20 i	0.21 c	47.39 e	1.24 fgh	52.61 a	0.33 d	74.33 ghi	3.33 bcd	0.91 cde	32.00 bc	13.59 bcd	2.03 k	1.46 g	5.56 hij	4.30 fgh	16,68 cdefgh
17	9.72 abc	4.02 abcd	0.57 abc	47.54 e	4.17 abc	52.46 a	0.95 abcd	186.7 bcdef	3.00 bcde	1.00 bcde	36.33 b	16.99 abc	2.96 fg	2.76 ab	6.70 cd	5.56 bc	22.05 bc
18	4.23 efg	1.79 fghi	0.25 c	48.43 e	1.76 defgh	51.57 a	0.42 bcd	151.7 cdefgh	3.00 bcde	1.03 bcde	30.00 bcd	9.07 de	2.26 hij	1.53 fg	5.43 hij	4.10 fgh	11.59 hij
19	3.57 fg	1.58 gfi	0.23 c	51.28 e	1.37 efgh	48.72 a	0.39 cd	106 fghi	3.00 bcde	1.03 bcde	23.00 cd	12.85 bcd	3.46 c	1.76 e	5.56 hij	4.50 efgh	12.66 fghij
20	5.10 defg	2.83 bcdefghi	0.54 abc	66.47 abc	1.22 fgh	33.53 cde	0.49 bcd	108.7 fghi	3.33 bcd	1.20 abc	32.33 bc	15.92 abc	2.96 fg	1.75 e	5.56 hij	4.60 ef	11.28 hij
21	10.27 abc	4.36 abc	0.73 ab	49.69 e	4.20 abc	50.31 a	0.97 abcd	157.7 bcdef	3.00 bcde	1.00 bcde	36.33 b	13.59 bcd	2.23 jk	1.50 g	7.36 b	5.96 b	26.63 b
22	3.36 fg	1.39 hi	0.23 c	46.70 e	1.37 efgh	53.30 a	0.36 cd	105.7 fghi	3.00 bcde	1.10 abcd	27.33 bcd	13.27 bcd	2.90 fg	1.80 e	5.10 j	4.00 hij	13.27 efghij
23	4.67 defg	1.93 efghi	0.33 bc	48.78 e	1.95 defg	51.22 a	0.44 bcd	225 abcd	3.00 bcde	0.95 bcde	33.33 b	17.62 abc	2.46 h	1.78 e	5.23 ij	4.06 ghi	8.56 ij
24	5.90 cdefg	3.35 bcdefgh	0.45 bc	64.46 bcd	1.42 efgh	35.54 bcd	0.66 abcd	174.3 bcdef	2.66 cde	1.13 abcd	29.33 bcd	13.80 bcd	2.96 fg	2.00 d	5.53 hij	3.60 ijk	8.17 j
25	7.72 bcdef	3.05 bcdefghi	0.48 abc	44.40 e	3.29 bcde	55.65 a	0.89 abcd	220 abcd	3.00 bcde	0.75 e	30.67 bcd	19.00 ab	3.00 ef	2.71 ab	5.06 j	3.53 jk	14.53 defghij
26	7.02 bcdefg	3.51 bcdefg	0.37 bc	56.86 bcde	2.57 bcdefgh	43.14 abcd	0.57 bcd	158 bcdefgh	3.66 bc	0.83 de	20.67 bcd	16.14 abc	3.75 b	2.25 c	10.10 a	6.83 a	17.61 cdefgh
27	10.48 ab	4.28 abc	0.77 ab	48.32 e	4.39 ab	51.68 a	1.03 ab	229.7 abcd	3.33 bcd	1.40 a	37.00 b	13.69 bcd	3.23 d	2.75 ab	5.76 ghi	3.58 ijk	19.11 cdef
28	3.36 fg	1.64 fghi	0.22 c	57.67 bcde	1.10gh	42.33 abcd	0.38 cd	23.0 i	4.00 b	0.83 de	21.33 d	6.58 e	2.75 g	1.70 ef	7.70 b	5.30 cd	48.59 a
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**= Significant at 1% level

Total bulb weight (per fruit): Significant variation was observed among the 28 germplasms in respect of bulb weight. The results showed that the germplasm no. 6 produced the highest bulb

weight (5.75 kg) followed by no. 2 (4.42kg), no. 27 (4.39 kg) and no. 21 (4.20 kg), and the lowest bulb weight was found in germplasm no. 10 (0.56 kg) preceded by the germplasm no. 28 (1.10kg), no. 11 (1.11kg) and no. 20 (1.22kg) (Table 1).

Seed weight (per fruit): The germplasms were significantly different in respect of seed weight. The highest seed weight (1.27 kg) was obtained from germplasm no. 6 followed by germplasm no. 27 (1.03 kg), no. 1 (0.99 kg) and no. 21 (0.97 kg), while the lowest seed weight (0.33 kg) was found in germplasm no.16 preceded by germplasm no. 22 (0.36 kg), no. 28 (0.38 kg) and no. 19 (0.39 kg) (Table 1). Average seed weight was found 0.69 kg per fruit.

Weight of edible portion (%)**:** Significant difference was found in regard to edible portion of the 28 germplasms. The maximum weight of edible portion (55.65%) was found in germplasm no. 9 followed by germplasm no. 25 (55.65%) and no. 8 (53.85%), while the minimum weight of edible portion (23.22%) was noted from germplasm no. 10 preceded by germplasm no. 11 (30.89%), no. 20 (33.53%) and no. 24 (35.54%) (Table 1).

Number of seed (per fruit): Number of seed also significantly varied in the studied germplasms. The highest number of seed (291.70) was found in germplasm no. 6 followed by germplasm no. 5 (252.30), no. 12 (249.00) and no. 27 (229.70), and the lowest number of seed (23.00) was counted from germplasm no. 28 preceded by germplasm no. 10 (67.00), no. 16 (74.33) and no. 11 (91.67) (Table 1).

Number of spine (per square centimeter): Number of spine significantly varied among the germplasms. The maximum number of spine (6.00) per square centimeter was found in germplasm no. 5 followed by germplasm no. 28 (4.00), no. 26 (3.66) and no. 11 (3.66), while the minimum number of spine per square centimeter (2.00) was obtained from germplasm no.10 preceded by germplasm no. 14 (2.33), no. 12 (2.33) and no. 8 (2.33) (Table 1). The average number of spine per square centimeter was 3.08. Number of spine may be varied due to different physiological activities of plant.

Skin thickness: There was significant difference among the 28 germplasms in respect of skin thickness of fruit. The thickest skin (1.40 cm) was found in germplasm no. 27 followed by germplasm no. 5 (1.26 cm), no. 20 (1.20 cm) and no. 2 (1.16 cm), while the thinnest skin (0.75 cm) was noted from germplasm no. 25 preceded by germplasm no. 26 (0.83 cm), no. 28 (0.83 cm) and no. 8 (0.83 cm) (Table 1). The average skin thickness was observed 1.01 cm. Skin thickness may be varied from fruit to fruit due to different physiological activity of different germplasms.

Length of fruit*:* Significant difference was observed among the germplasms in respect of length of fruit. The longest fruit (51.67 cm) was found in germplasm no. 6 followed by germplasm no. 27 (37.00 cm), no. 2 (36.33 cm) and no. 21 (36.33 cm), while the shortest fruit (21.33 cm) was measured from germplasm no. 28 preceded by germplasm no. 19 (23.00 cm), no. 22 (27.33 cm) and no. 4 (29.00 cm) (Table 1). The average length of fruit was found 31.84 cm. Various length of fruit occurred due to the variation in fruit shape.

Breadth of fruit: Significant variation was found in breadth of fruit among the germplasms. The broadest fruit (20.81 cm) was found in germplasm no. 6 followed by germplasm no. 25 (19.00cm), no. 11 (18.53 cm) and no. 23 (17.62 cm), while the narrowest fruit (6.58 cm) was measured from germplasm no. 28 preceded by germplasm no. 18 (9.07 cm), no. 10 (14.46 cm) and no. 12 (12.00 cm) (Table 1). The average breadth of fruit was found 14.53 cm.

Length of seed**:** Length of seed varied significantly in the studied germplasms. The longest seed (3.96 cm) was found in germplasm no. 11 followed by germplasm no. 26 (3.75 cm), no. 19 (3.46 cm) and no. 27 (3.23 cm), while the shortest seed (2.03 cm) was measured from germplasm no.16

preceded by germplasm no. 21 (2.13 cm), no. 15 (2.21 cm) and no. 18 (2.26 cm) (Table 1). The average length of seed was found 2.89 cm.

Breadth of seed: Breadth of seed varied significantly in the germplasms. The broadest seed (2.86 cm) was obtained from germplasm no. 3 followed by germplasm no. 2 (2.80 cm), no. 6 (2.80 cm) and no. 9 (2.78 cm), while the narrowest seed (1.21 cm) was measured from germplasm no. 7 preceded by germplasm no. 13 (1.25 cm), no. 16 (1.46cm) and no. 10 (1.48 cm) (Table 1). The average breadth of seed was found 2.05 cm.

Length of bulb: There was significant variation among the germplasms in respect of length of bulb. The longest bulb (10.10 cm) was found in germplasm no. 26 followed by germplasm no. 28 (7.70 cm), no. 21 (7.36 cm) and no. 7 (6.83 cm), while the shortest bulb (5.06 cm) was recorded from germplasm no. 25 preceded by germplasm no. 22 (5.10 cm), no. 12 (5.13 cm) and no. 23 (5.23 cm) (Table 1). The average length of bulb was measured by 6.15 cm.

readth of bulb: Breadth of bulb was significantly varied among the germplasms. The widest bulb (6.83 cm) was obtained from germplasm no. 26 followed by germplasm no. 21 (5.96 cm), no. 17 (5.56 cm) and no. 2 (5.46 cm), while the narrowest bulb (3.46 cm) was measured from germplasm no. 11 preceded by germplasm no. 25 (3.53 cm), no. 17 (3.58 cm) and no. 24 (3.60 cm) (Table 1). The average breadth of bulb was found 4.64 cm. Most of the jackfruit had medium to large size bulb. Bhatia *et al*. (1955) reported that the bulb varied in size being 2.54 to 6.35cm in length and 0.64 to 3.81 cm in breadth. This variation might be due to the varietal difference or unbalanced nutrient supply. Haque (1977) stated that the size of pericarp was variable.

Individual bulb weight*:* The germplasms were significantly different in respect of individual bulb weight. The heaviest individual bulb (48.59 g) was found in germplasm no. 28 followed by germplasm no. 21 (26.63 g), no. 7 (22.39 g) and no. 17 (22.05 g), while the lightest individual bulb (8.17 g) was obtained from germplasm no. 24 preceded by germplasm no. 10 (8.42 g), no. 23 (8.56 g) and no. 12 (9.82 g) (Table 1). The average individual bulb weight was 16.94 g.

Discussion

Average fruit weight of off- season jackfruits was found 6.83 kg. The present result fairly agrees with the report of Hossain *et al.* (1979). He found 5.09 kg as mean weight of fruits ranging from 3.24 to 7.39 kg. Mowry *et al*. (1953), Corner (1951) and Neal (1948) expressed that the weight of jackfruit ranged from 4.50 to 18.00 kg or more. Kamaluddin (1966) mentioned the weight of fruits of some plants to be 1.86 to 2.79 kg while some other plants bear fruits whose weight was as high as 18.6 to 37.3 kg. The average rind weight was found 3.03 kg. The results of the present study were supported by the findings of Hossain (1976).

The weight of non-edible portion was found 51.84% of total fruit weight. The present results have been found to be more or less similar to that of Bhatia *et al*. (1955). He reported that the non-edible portion constituted 59.1% of the weight of fruit. The average bulb weight was 2.62 kg per fruit. The present results were in agreement with the findings of Bhatia *et al*. (1955) and Purseglove (1968). Seed content was found to be in the range from 8.17% to 9.19% (average) in weight basis. The present study is close to the findings of Hossain (1976) who reported that the average percentage of seed weight was 10.44% while Bhatia *et al*. (1955) recorded 11.5%.

The average weight of edible portion was obtained 48.15% per fruit (Table 1). The present outcomes are close to the findings of Bhatia *et al*. (1955).They reported that the bulbs and seeds together formed 40.2% of fruit. This variation may be due to climatic, edaphic and also varietal differences. The average number of seed was 163.6 per fruit. The number of seed varied might be

attributed due to varietal effect. It might also be due to the unbalanced nutrient supply, unfavourable wind velocity at the period of flowering and the presence of more sterile flower in the inflorescence. Present findings were agreed with the findings of Sharma (1964) and Hayes (1953). Sharma (1964) reported that the single fruit borne 50 to 200 normal bulb or seed. Hayes (1953) stated that the number of bulbs to be 100 or it could be up to 500 bulbs or seeds in a single jackfruit.

Conclusion

The physical characteristics of 28 selected off-season jackfruit germplasms of south western region of Bangladesh was studied with mature jackfruits harvested at different time from August 2003 to December 2003. Three fruits were collected from each germplasm for the study. Physical characteristics of off-season jackfruits were determined under quantitative characters (e.g. weight of fruit, weight of rind, weight of seed, weight of edible portion etc.) and qualitative characters (e.g. shape of fruit, size of fruit, skin colour of fruit, skin thickness etc.). Significant variation was found among the germplasms in relation to fruit characteristics. Better performance was showed by germplasm no. 6 in respect of total fruit weight, weight of rind, weight of axis, weight of bulbs, weight of seed, number of seed, length and breadth of fruit. Germplasm no. 9 showed better performance in respect of percentage of edible portion and germplasm no. 5, 18 and 24 produced very sweet, juicy and agreeable flavoured bulb. In respect of length of seed and breadth of seed better performance was showed by germplasm no. 11 and 3. Germplasm no. 26 showed better performance in relation to length and breadth of bulb.

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