GENETIC VARIABILITY, HERITABILITY, GENETIC ADVANCE AND PHENOTYPIC CORRELATION IN SOME ONION VARIETIES

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ABSTRACT

This study was carried out at Sids Research Station, Agricultural Research Center, Bani-Suef Governorate during 2006/2007 and 2007/2008 seasons, to estimate genetic variability, heritability, genetic advance and phenotypic correlation in seven onion genotypes. These varieties were Giza 6 Mohassan, Giza 20, Composite 8, Composite 16, PUSS, Yellow Creol and Beth Alpha. The main results could be summarizes as follow:

All the studied characters significantly affected by different cultivars. The highest means of bulb weight were recorded for composite 16 cultivar, while, the lowest means were recorded for Beth alpha cultivar in both seasons. The highest means of marketable yield/fed and total yield/fed were obtained by Giza 20 and composite 16 cultivars in the first and second seasons, respectively. The lowest means of bulb weight, marketable yield/fed and total yield/fed were obtained by Beth Alpha cultivar in both seasons.

Weight loss% at 60 days exhibited the highest values of coefficient of phenotypic and genotypic variance in both seasons, while days to maturity and bulb weight exhibited the lowest values in the first and second seasons, respectively. The maximum estimates of heritability in broad sense (H^2_{bs}) were obtained for dry matter% and plant weight, while the minimum ones were obtained for weight loss% at 120 days and culls yield, in the first and second seasons, respectively. Weight loss% at 60 days gave the highest values of genetic advance percentage (GS%) in both seasons, while days to maturity and bulb weight gave the lowest ones in the first and second seasons, respectively.

Bulb weight had highly significant positive correlation with plant weight, dry matter% and TSS% in both seasons. The significant positive correlation was obtained between bulb weight and each of plant height and number of leaves/plant in both seasons. Marketable yield had highly significant positive correlation with plant height and total yield in both seasons. The significant positive correlation was obtained between marketable yield and each of number of leaves/plant, bulb length, dry matter% and TSS% in both seasons. Total yield had highly significant positive correlation with plant height, plant weight, days to maturity and marketable yield in both seasons. Significant positive correlation was obtained between total yield and each of number of leaves/plant, bulb length, dry matter% and TSS% in both seasons. The negative and significant correlation was obtained between total yield and weight loss% at 120 days in the second season.

INTRODUCTION

Onion (*Allium cepa*) is one of the most important and widely used vegetables in the world. It is an important crop in Egypt for local consumption processing and exportation. Onion is one of the most

variable species of plants. Great differences exist in the size, shape, color, firmness, percentage of dry matter, pungency, and sweetness of the bulb. This variability is fortunate for the onion breeder as well as for the onion industry, so the number of cultivars that can be developed is almost endless and these can be adapted to grow satisfactory in most lands where crops can be cultivated **(Jones and Man, 1963).** It is essential for onion breeder to introduce new substitute varieties characterized by high yielding ability and better bulb quality than the alternative commercial cultivated varieties **(Gomaa, 2006)**. Also, it is essential to evaluate the superiority of new introduced line over the local cultivated ones. **Abd El-Hafez *et al.* (1976)** tested 12 cultivars. They recorded that Beharry cultivar showed the highest values of total soluble solids in the two growing seasons, followed by Giza 6 Mohassan, followed by the American cultivar and hybrids "Texas Yellow Grano and New Mexico Early Grano". In Venezuela, **Diaz (1994)** evaluated 12 onion cultivars for fresh and dry matter content. He found that the highest dry matter content was 14% in White Creole, 13% in Primero and 11% in Dehidrator cultivars. **Pal *et al.* (1988)** found a significant variation among cultivars for number of leaves, plant height, maturity, bulb weight, bulb diameter, total soluble solids and drying ratio. **Iortsuun and Khan (1989)** evaluated 3 onion cultivars, red Kano, Bermuda and Texas Grano. The cultivar Red Kano had significantly more leaves, greater leaf area, larger bulbs, and fresh and dry weights than the others. **Leilah *et al.* (2003)** reported that, Moshtohor and South El-Tahrir strains gave the highest marketable and total bulb yields/ha, followed by the New Nucleus 961 strain. **Mostafa (1998)** cleared that earlier maturity occurred with Fayoum and Bani-Sweif. Whereas, culls yield/fad decreased with Nobareia and Bani-Sweif seeds. Planting Mansoura or Gemmeiza seeds increased marketable and total bulb yields, average bulb weight and bulb diameter.

It is essential for breeders to have information about the genetic variability in the population. In this respect, **Haydar *et al.* (2007)** pointed out that among the parameters, plant height, bulb yield and bulb length were found to show high broad sense heritability. Bulb yield per hectare and number of green leaves per plant had high broad sense heritability estimates with high genetic gain. **Yaso (2007)** reported that high values of heritability, GCV%, and GS% were observed for total and marketable yield and bulb weight. While, moderate to high estimates of heritability coupled with low GCV% and GS% were noticed for days to maturity. **Mohanty (2001)** recorded a moderate to high estimates of heritability, genotypic coefficient of variation (GCV) and genetic gain from selection (GS%) for weight of bulb and number of leaves/plant.

Estimates of simple correlation among various onion characters may provide good information necessary for onion breeders, when selection is based on two or more traits simultaneously. **Rahman *et***

***al.* (2002)** reported that, bulb weight had significant positive correlation with plant height and number of leaves/plant. **Mc Collum (1968)** found a negative genetic correlation between dry matter content and bulb weight, with an increase in the dry matter content of 1% the productivity decreased by 10%. **Ahmed *et al.* (1977)** recorded that, a highly significant and positive correlation between bulb weight and bulb diameter was existed, indicating a strong association between weight and size of bulb. **Sidhu *et al.* (1986)** recorded that yield was positively correlated with bulb weight and diameter, and plant height. Dry matter content was positively correlated with total soluble solids (TSS%), while, it was negatively correlated with storage losses. **Haydar *et al.* (2007)** revealed that, bulb yield had highly positive significant correlation with bulb length and bulb diameter. Bulb diameter had positive significant association with plant height, fresh weight/bulb and bulb length. **Mohanty (2001)** stated that, phenotypic association of bulb yield was significantly positive with plant height, number of leaves/plant, diameter and weight of bulb but significantly negative with neck thickness.

MATERIALS AND METHODS

The present investigation was carried out in the experimental farm of sids Agricultural Research Station, Bani-Suef Governorate, Egypt to estimate genetic variability, heritability, genetic advance and phenotypic correlation in seven onion varieties during the two successive seasons of 2006/2007 and 2007/2008. These cultivars are representing a broad genetic base and all of them have been maintained for a number of years in Egypt by Onion Research Section, ARC, Egypt. The tested cultivars name, origin, bulb color and bulb form are presented in Table (1). Onion seeds of seven cultivars were sown in the nursery in 15 and 12th September, while the seedlings were transplanted in 11 and 9th November in the first and second seasons, respectively. A randomized complete block design with four replications was used. The plot size was 2 X 3 m (1/700 fed). Each plot was consisting of four rows, 3 m long and 50 cm wide. Seedlings within each row were spaced at 7 cm apart on both sides of row. The onion cultivars were randomly distributed in the blocks. The soil of the experimental field was clay. All cultural practices concerning onion production were followed as recommended in the area.

Table (1): Origin, bulb color and bulb form of onion cultivars used in this study.

Varieties	Bulb type		
	origin	Bulb color	Bulb form
Giza 6 Mohassan	Egypt	Yellow	Flat
Giza 20	Egypt	Yellow	High thick
Composite8	Egypt	Yellow	Flat
Composite16	Egypt	Yellow	Flat
PUSS	USA	Yellow	Globe
Yellow Creol	USA	Yellow	Globe
Beth Alfha	Israel	Yellow	Flat

The measured data were as follows:

A- Vegetative growth characters:

After 120 days from transplanting, ten guarded plants were selected randomly from each cultivar to measure plant height (cm), plant weight (g), number of leaves/plant and bulb length (cm). number of days from transplanting to bulb maturity was counted. Maturity stage was determined based on both softing of bulb neck and 50% top-down of bulb leaves.

B- Bulb yield and its components:

Onion bulbs were harvested at maturity. Onion plants were cured in the field for two weeks, roots and tops were cut. Plant samples were collected for yield, yield components and the following data were recorded:

1- Average bulb weight (g) was calculated by dividing weight of single bulbs by its number.
2- Marketable yield (ton/fed) was determined as the weight of single bulbs yield.
3- Culls yield (ton/fed), which included bulbs less than 3 cm diameter, doubles, bolters, off-color and scallions.
4- Total yield/fed (ton/fed), which consists of marketable and culls yield/fed.

C- Bulb quality:

1- Dry matter percentage was calculated by estimating the loss of weight of fresh bulb sample when drying for four hours at 105°c and then at 70°c in drying oven with ventilator until the reach of constant weight. It was calculated according to the formula:

Dry matter percentage = (sample dry weight/sample fresh weight) x 100.

2- Percentage of total soluble solids (T.S.S) was determined at the end of the storage period, by using a hand refractometer.

3- Weight loss percentage:

Marketable yield of each plot were placed in common burlap bags and kept under normal storage conditions. Weight loss% of bulbs after 60, 120, and 180 days were calculated according to the following formula:

$$\text{Weight loss \%} = \frac{\text{initial weight – weight at specific period of storage}}{\text{initial weight}} \times 100$$

Statistical analysis:

Analysis of variance for randomized complete block design was done according to **Gomez and Gomez (1984).** Significance among means was tested using LSD method. Estimates of phenotypic and genotypic variance were obtained from the analysis of each season for the seven cultivars. The expected mean squares were calculated according to **Snedecor and Cochran (1967).**

The phenotypic coefficient of variation (PCV) was calculated as:

$PCV = (\sigma_{ph}/\bar{x}) \times 100$

The genotypic coefficient of variation (GCV) was calculated as:

$GCV = (\sigma_g/\bar{x}) \times 100$.

Broad sense heritability (H^2_{bs}) was calculated according to **Falconer (1981)** as follows:

$$H^2bs = \sigma^2_g/\sigma^2_{ph} \times 100$$

Where: σ^2_g is the genotypic variance = $(MS_g - Ms_e)/r$, σ^2_{ph} is the phenotypic variance = $\sigma^2_g + (\sigma^2_e)/r$ and $\bar{x}$ =Grand mean of all genotypes.

Predicted genetic advance under selection in absolute units (GS) and as percentage of grand mean (GS%) was computed according to **Johnson *et al.* (1955)** as follows:

$GS = K \times H^2_{bs} \times \sigma_{ph}$.

Where: K is the selection differential and equals 2.06 at selection intensity of 5%.

$GS\% = GS/\bar{x} \times 100$

Phenotypic correlation between different onion characters for each season was determined as described by **Burton (1952).**

RESULTS AND DISCUSSION

Performance of onion cultivars:

A- Vegetative growth characters:

Differences among averages of plant height, plant weight, number of leaves/plant, bulb length, bulb diameter and days to maturity were significant in both seasons (Table 2). Data revealed that Giza 20 had the greatest means of plant height in both seasons, and bulb length and days to maturity in the second season. Composite 16 gave the highest means of plant weight and number of leaves/plant in both seasons, and bulb diameter and days to maturity in the first season. Giza 20 and Composite 16 gave the same and the highest means of bulb length in the first season. Composite 8 and Composite 16 gave the same and the highest means of bulb diameter in the second season. These results might be attributed to genetic variation between

cultivars, similar results were obtained by **Pal *et al.* (1988), Mohamed and Gamie (1999), El-Damarany and Obiadalla-Ali (2005), and Gamie and yaso (2007).**

B- Yield and yield components characters:

Data in Table (3) indicated significant differences among the averages of seven cultivars for average bulb weight, marketable yield/fed, culls yield/fed and total yield/fed in both seasons. The highest means of bulb weight of 162.35 and 162.18 (g) were recorded for Composite 16 cultivar, while, the lowest means of 65.05 and 69.13 (g) were recorded for Beth alpha cultivar, in the first and second seasons, respectively. The maximum values of marketable yield of 21.60 and 21.65 (t/fed) and total yield of 26.56 and 26.43 (t/fed) were recorded for Giza 20 and composite 16 in the first and second seasons, respectively. The minimum values of bulb weight, marketable yield, culls yield and total yield were obtained by Beth Alpha cultivar in both seasons. The highest means of culls yield/fed were obtained by Giza 20 in both seasons. Genotypic differences in onion yield and yield components were reported by many investigators (**Mohanty and Prusti, 2001; Leilah *et al.*, 2003; El-Damarany and Obiadalla-Ali, 2005 and Yaso, 2007).**

Table (2): Means of vegetative growth characters for some onion varieties evaluated in 2006/2007 and 2007/2008 seasons.

Varieties	Season 2006/2007						Season 2007/2008					
	Plant height (cm)	Plant weight (g)	No of leaves /plant	Bulb length (cm)	Bulb diameter (cm)	Days to maturity	Plant height (cm)	Plant weight (g)	No of leaves /plant	Bulb length (cm)	Bulb diameter (cm)	Days to maturity
Giza 6 Mohassan	56.25	165.73	9.15	5.05	5.93	116.75	56.45	166.08	8.70	4.60	5.90	116.75
Giza 20 Original	82.43	242.48	14.65	5.95	5.93	145.75	83.30	245.80	13.45	6.00	6.55	150.00
Composite8	66.28	204.05	15.65	5.65	6.68	140.50	71.60	225.95	15.20	5.60	6.60	137.00
Composite16	71.75	266.25	16.75	5.95	6.75	151.25	74.03	272.48	15.75	5.58	6.60	148.50
PUSS	59..63	153.50	8.43	4.53	4.80	132.75	56.38	143.43	8.08	4.43	4.68	133.50
Yellow creol	64.10	173.55	7.43	4.40	4.45	135.50	56.80	179.33	7.83	4.43	4.25	137.50
Beth alfha	50.08	144.73	8.60	4.30	3.80	125.50	51.38	136.65	8.00	4.30	3.58	121.75
$LSD_{5\%}$	8.25	22.26	1.25	0.76	0.51	5.72	7.11	12.08	1.28	0.92	0.45	4.96

Table (3): Means of bulb yield and its components for some onion varieties evaluated in 2006/2007and 2007/2008 seasons.

Varieties	Season 2006/2007				Season 2007/2008			
	Bulb weight (g)	Mark. yield (t/fed)	Culls yield (t/fed)	Total yield (t/fed)	Bulb weight (g)	Mark. yield (t/fed)	Culls yield (t/fed)	Total yield (t/fed)
Giza 6 Mohassan	104.15	14.41	3.27	17.68	130.65	12.84	3.55	16.38
Giza 20 Original	135.80	21.60	4.96	26.56	147.78	21.10	5.07	26.16
Composite8	120.10	15.93	4.21	20.14	122.75	16.60	3.69	20.29
Composite16	162.35	21.19	4.78	25.97	162.18	21.65	4.78	26.43
PUSS	94.18	13.70	4.50	18.20	77.74	14.55	3.52	18.06
Yellow creol	101.80	16.25	3.82	20.07	84.44	15.97	4.56	20.52
Beth alfha	65.05	12.68	3.14	15.81	69.13	10.67	2.95	13.61
$LSD_{5\%}$	21.07	1.90	0.49	2.03	29.81	3.26	1.11	2.82

C- Bulb quality characteristics:

Data in Table (4) manifested that dry matter%, TSS%, weight loss% at 60 days, weight loss% at 120 days, weight loss% at 180 days were significantly affected by different genotypes in both seasons. Composite 16 and Giza 20 cultivars gave the highest means of dry matter% in the first and second seasons, respectively. Giza 20 had the superiority for obtaining the highest means of TSS% in both seasons. The lowest means of dry matter% and TSS% were obtained for Beth Alpha in both seasons. For the onion storability, data revealed that Giza 20 attained the lowest means of weight loss at 60, 120, and 180 days% in both seasons. While Beth Alfa attained the highest means of weight loss% at 60 and 180 days in both seasons and at 120 days in the second seasons. Composite 8 attained the highest values of weight loss% at 120 days in the first season. The differences in weight loss during storage could be attributed to differences in skin permeability, differences in complete sealing of the neck and differences in cell structure and bulk density. These are influenced by growing environment and genotypes (**Naito *et al.*, 1981**). Many investigators reported that the differences between studied genotypes in storageability may be due to the genetic

variation between them **(Warid and Loaiz, 1993; El-kafoury *et al.*, 1996; Abbey *et al.*, 2000 and Leilah *et al.*, 2003).**

Table (4): Means of bulb quality characters for some onion varieties evaluated in 2006/2007and 2007/2008.

Varieties	Season 2006/2007					Season 2007/2008				
	Dry matter %	T.S.S (%)	Weight loss at 60 days%	Weight loss at 120 days%	Weight loss at 180 days%	Dry matter %	T.S.S (%)	Weight loss at 60 days	Weight loss at 120 days	Weight loss at 180 days
Giza 6 Mohassan	14.89	14.42	12.68	31.81	54.41	15.38	14.58	13.18	35.66	55.31
Giza 20 Original	15.73	15.75	9.79	23.14	40.22	16.08	15.94	9.34	26.62	42.73
Composite8	13.76	13.79	16.12	43.29	58.90	14.75	13.68	16.88	42.16	61.01
Composite16	16.05	14.90	25.94	30.79	57.55	15.61	14.74	24.67	31.27	60.40
PUSS	13.48	11.84	26.83	30.89	59.55	13.48	12.09	28.00	32.17	59.11
Yellow creol	13.16	12.05	20.92	33.30	53.46	13.45	12.39	26.88	34.99	53.78
Beth alfha	9.89	8.84	40.06	40.44	82.94	10.52	8.93	39.12	46.35	82.03
$LSD_{5\%}$	0.54	0.88	5.12	11.53	6.56	1.28	0.89	3.37	5.16	6.75

Genetic parameters:

Data in the Table (5) showed the estimates of phenotypic coefficient of variation (PCV), genetic coefficient of variation (GCV), broad sense heritability (H^2_{bs}), genetic advance (GS) and genetic advance as a percentage of mean (GS%) for all the studied characteristics.

Weight loss% at 60 days and number of leaves/plant exhibited the highest values of coefficient of phenotypic and genotypic variances in both seasons. Days to maturity exhibited the lowest values of phenotypic and genotypic variances in first season, while, bulb weight exhibited the lowest values in second season. The relatively high coefficient of variance for weight loss% at 60 days and number of leaves/plant indicated that these traits might be more genotypically predominant and, it would be possible to achieve further improvement in them. Phenotypic coefficient of variance was greater

than the genotypic coefficient of variance in all the studied traits. The most contributing portion of phenotypic coefficient of variance was contributed by the genotypic component, while environment played fewer roles in modifying the genotypic coefficient. These results were in accordance with that found by **(yaso, 2007)**.

The maximum estimates of broad sense heritability were obtained for dry matter (99.22), number of leaves/plant (98.88), TSS% (98.41) and plant weight (97.38), in the first season; and for plant weight (99.40), weight loss% at 60 days (98.75), number of leaves/plant (98.58) and bulb diameter (98.58) in the second season, while, the minimum ones were obtained for weight loss% at 120 days and culls yield, in the first and second seasons, respectively. High heritability estimates for these traits revealed that, they were least affected by environmental modification and hence, selection based on phenotypic performance would be reliable.

Highest values of GS were obtained by plant weight, while, lowest values were obtained by bulb length, in both seasons. Data also revealed that, weight loss% at 60 days attained the highest values of GS% in both seasons, while days to maturity and bulb weight attained the lowest values in the first and second seasons, respectively.

Greater estimates of heritability coupled with higher genetic advance were noticed in plant weight, number of leaves/plant and weight loss% at 60 days in both seasons, these results provided the evidence that these plant parameters were under the control of additive genetic effects, and phenotypic selection for their improvement could be achieved by simple selection method like mass selection **(Mohanty, 2001)**. Values of heritability was greater in case of dry matter% and TSS%, whilst the values of genetic advance was moderate, in both seasons, so careful selection for these traits may lead to towards improvement. High values of heritability coupled with low GS% were observed for days to maturity and bulb weight, in the first and second seasons, respectively, and these results indicated that, these characters might be governed by non-aditive gene action and high interaction between genotypes and environment. Therefore, these traits could be improved by development of hybrid varieties. These results were in conformity with those of **Wall and Corgan (1999), Mohanty (2001), Trivedi *et al.* (2006) and Yaso (2007)**.

Table (5): Estimation of phenotypic and genotypic coefficients of variation, heritability (H^2_{bs}) and expected genetic advance for the studied characters for some onion varieties in 2006/2007and 2007/2008 seasons.

Characters	Means	MS varieties	Error	PCV	GCV	H^2_{bs}	GS	GS%
Season 2006/2007								
Plant height (cm)	64.36	451.30	31.03	16.50	15.93	93.12	20.38	31.66
Plant weight (g)	192.90	8632.21	225.79	24.08	23.77	97.38	93.19	48.31
No of leaves/ plant.	11.52	63.13	0.709	34.48	34.29	98.88	8.09	70.24
Bulb length (cm)	5.12	2.139	0.261	14.29	13.39	87.80	1.32	25.84
Bulb diameter (cm)	5.48	5.188	0.117	20.80	20.57	97.74	2.29	41.88
Days to maturity	135.43	558.14	14.92	8.72	8.60	97.33	23.68	17.49
Bulb weight (g)	111.92	3903.21	202.42	27.91	27.18	94.81	61.01	54.52
Marketable yield (t/fed)	16.54	50.17	1.64	21.41	21.06	96.73	7.06	42.66
Culls yield (t/fed)	4.10	2.04	0.11	17.45	16.97	94.62	1.39	34.01
Total yield (t/fed)	20.63	68.02	1.88	19.99	19.71	97.23	8.26	40.04
Dry matter%	13.85	17.13	0.13	14.94	14.88	99.22	4.23	30.54
TSS%	13.09	22.20	0.35	18.00	17.86	98.41	4.78	36.50
Weight loss at 60 days	21.76	424.13	11.96	47.32	46.65	97.18	20.61	94.73
Weight loss at 120 days	33.38	178.90	60.56	20.04	16.30	66.15	9.11	27.30
Weight loss at 180 days	58.15	649.90	19.60	21.92	21.59	96.98	25.47	43.80
Season 2007/2008								
Plant height (cm)	64.28	571.06	23.02	18.59	18.21	95.97	23.62	36.75
Plant weight (g)	195.67	11123.22	66.55	26.95	26.87	99.40	107.98	55.19
No of leaves/ plant.	11.00	52.75	0.75	33.01	32.78	98.58	7.37	67.04
Bulb length (cm)	4.99	2.00	0.39	14.18	12.73	80.61	1.17	23.54
Bulb diameter (cm)	5.45	6.41	0.09	23.23	23.06	98.58	2.57	47.17
Days to maturity	113.52	5343.86	404.94	32.20	30.95	92.42	69.59	61.30
Bulb weight (g)	135.00	618.92	11.23	9.21	9.13	98.18	25.16	18.64
Marketable yield (t/fed)	16.20	65.72	4.84	25.03	24.09	92.63	7.73	47.76
Culls yield (t/fed)	4.02	2.47	0.56	19.58	17.21	77.27	1.25	31.16
Total yield (t/fed)	20.21	91.45	3.63	23.66	23.19	96.03	9.46	46.81
Dry matter%	14.18	14.53	0.74	13.44	13.09	94.89	3.72	26.27
TSS%	13.19	21.40	0.36	17.53	17.39	98.30	4.68	35.51
Weight loss at 60 days	22.58	414.66	5.17	45.09	44.81	98.75	20.71	91.73
Weight loss at 120 days	35.60	180.20	12.13	18.85	18.21	93.27	12.90	36.22
Weight loss at 180 days	59.19	561.05	20.74	20.01	19.63	96.30	23.50	39.69

Correlation coefficient:

The results obtained from the analysis of phenotypic simple correlation coefficient among all possible combinations of the studied characters are presented in Table (6).

Plant height had highly significant positive correlation with plant weight, marketable yield and total yield in both seasons; with number of leaves/plant and bulb length in the second season; and with culls yield in the first season. Significant positive correlation was obtained between plant height and each of bulb weight, days to maturity, dry matter% and TSS% in both seasons; with bulb length in the first season; and with bulb diameter and culls yield in the second season. The negative and significant correlation was obtained between plant height and weight loss% at 180 days in the first season.

Plant weight had highly significant positive correlation with number of leaves/plant, bulb length, bulb weight and total yield in both seasons and with marketable yield in the second season. Significant positive correlation was obtained between plant weight and each of bulb diameter, days to maturity, dry matter, TSS% and culls yield in both seasons.

Number of leaves/plant had positive and highly significant correlation with bulb length in both seasons and with bulb diameter in the second season. Also, number of leaves/plant had positive and significant correlation with bulb weight, marketable yield and total yield in both seasons; and with bulb diameter and days to maturity in the first season.

Bulb length had highly significant positive correlation with bulb diameter in both seasons and with bulb weight and TSS% in the first season. Significant positive correlation was obtained between bulb length and each of dry matter, marketable yield and total yield in both seasons; and bulb weight, days to maturity and TSS% in the second season.

Bulb diameter had highly significant positive correlation with TSS% in both seasons, and with bulb weight and dry matter% in the second season. The significant positive correlation was obtained among bulb diameter and each of bulb weight and dry matter% in the first seasons. The significant negative correlation was obtained among bulb diameter and weight loss at 60 days% in the second season.

Bulb weight had highly significant positive correlation with dry matter% and TSS% in both seasons; and with marketable yield and total yield in the first season. The significant positive correlation was obtained between bulb weight and each of days to maturity and culls yield in the first season, and marketable yield and total yield in the second seasons.

Days to maturity had highly significant positive correlation with culls yield and total yield in both seasons; and with marketable yield in the

second season. Significant positive correlation was obtained between days to maturity and marketable yield in the first season.

Table (6): Phenotypic correlation coefficients among the studied characters of onion in 2006/2007 and 2007/2008 seasons.

Character	Season	Plant weight (g)	No of leaves /plant.	Bulb length (cm)	Bulb diamet. (cm)	Bulb weight (g)	Days to matur.	Dry matter%	TSS%	Market. yield (t/fed)	Culls yield (t/fed)	Total yield (t/fed)	Weight loss at 60 days%	Weight loss at 120 days%	Weight loss at 180 days%
Plant height (cm)	2006/07	0.864**	0.710**	0.803**	0.601**	0.823**	0.822**	0.758**	0.791**	0.933**	0.864**	0.951**	-0.621**	-0.614**	-0.808**
	2007/08	0.913**	0.873**	0.987**	0.841**	0.814**	0.828**	0.754**	0.782**	0.901**	0.752**	0.888**	-0.669**	-0.566**	-0.602**
Plant weight (g)	2006/07		0.895**	0.916**	0.769**	0.958**	0.856**	0.768**	0.777**	0.959**	0.764**	0.956**	-0.407**	-0.421**	-0.558**
	2007/08		0.927**	0.916**	0.838**	0.881**	0.815**	0.748**	0.755**	0.930**	0.786**	0.918**	-0.536**	-0.486**	-0.485**
No of leaves/ plant.	2006/07			0.945**	0.853**	0.838**	0.772**	0.608**	0.677**	0.757**	0.668**	0.766**	-0.338**	-0.085	-0.345**
	2007/08			0.923**	0.858**	0.809**	0.692**	0.636**	0.625**	0.787**	0.515**	0.752**	-0.468**	-0.242*	-0.268**
Bulb length (cm)	2006/07				0.910**	0.896**	0.683**	0.795**	0.867**	0.834**	0.684**	0.835**	-0.581**	-0.325**	-0.581**
	2007/08				0.879**	0.834**	0.757**	0.737**	0.759**	0.847**	0.660**	0.827**	-0.668**	-0.448**	-0.516**
Bulb diameter (cm)	2006/07					0.854**	0.506**	0.819**	0.867**	0.628**	0.540**	0.633**	-0.627**	-0.148	-0.543**
	2007/08					0.929**	0.520**	0.912**	0.899**	0.732**	0.533**	0.709**	-0.819**	-0.472**	-0.585**
Bulb weight (g)	2006/07						0.787**	0.891**	0.865**	0.906**	0.768**	0.911**	-0.513**	-0.453**	-0.654**
	2007/08						0.530**	0.883**	0.886**	0.777**	0.647**	0.765**	-0.725**	-0.539**	-0.542**
Days to maturity	2006/07							0.507**	0.480**	0.830**	0.871**	0.864**	-0.153*	-0.275**	-0.411**
	2007/08							0.525**	0.544**	0.940**	0.857**	0.939**	-0.298**	-0.639**	-0.534**
Dry matter%	2006/07								0.966**	0.775**	0.684**	0.784**	-0.750**	-0.655**	-0.849**
	2007/08								0.994**	0.751**	0.689**	0.751**	-0.894**	-0.728**	-0.832**
TSS%	2006/07									0.777**	0.629**	0.776**	-0.849**	-0.570**	-0.863**
	2007/08									0.764**	0.726**	0.768**	-0.912**	-0.747**	-0.856**
Marketable yield (t/fed)	2006/07										0.781**	0.994**	-0.472**	-0.611**	-0.681**
	2007/08										0.909**	0.998**	-0.507**	-0.728**	-0.643**
Culls yield (t/fed)	2006/07											0.844**	-0.358**	-0.555**	-0.632**
	2007/08											0.935**	-0.502**	-0.792**	-0.761**
Total yield (t/fed)	2006/07												-0.468**	-0.621**	-0.695**
	2007/08												-0.513**	-0.748**	-0.670**
Weight loss at 60 days %	2006/07													0.452**	0.897**
	2007/08													0.557**	0.830**
Weight loss at 120 days%	2006/07														0.724**
	2007/08														0.846**

*, ** significant and highly significant at 5% and 1% probability, respectively.

Dry matter% had highly significant positive correlation with TSS% in both seasons. Significant positive correlation was obtained among dry matter and each of marketable yield and total yield in both seasons. The highly significant negative correlation was obtained among dry matter% and weight loss% at 60 days in the second season. The significant negative correlation was obtained between dry matter% and each of weight loss% at 60 days in the first season and weight loss% at 180 days in both seasons.

TSS% had significant positive correlation with marketable yield and total yield in both seasons. The highly significant negative correlation was obtained between TSS% and each of weight loss at 60 days in the second season and weight loss% at 180 days in both seasons. The significant negative correlation was obtained between TSS% and each of weight loss% at 60 days in the first season and weight loss% at 120 days in the second season.

Marketable yield had highly significant positive correlation with culls yield in the second season and with total yield in both seasons. The significant positive correlation was obtained between marketable yield and culls yield in the first season.

Culls yield had highly significant positive correlation with total yield in the second season, while it had significant positive correlation with total yield in the first season. The significant negative correlation was obtained between culls yield and each of weight loss% at 120 days and 180 days in the second season.

Total yield was significantly and negatively correlated with weight loss% at 120 days in the second season.

The correlation between weight loss% at 60 days and weight loss% at 180 days was highly significant and positive in the first season, while it was significant and positive in the second season.

Significant and positive correlation was observed between weight loss% at 120 days and weight loss% at 180 days in the second season.

In general, the significant and highly significant correlation coefficient among most characters revealed that, these characters were governed by some genetic systems of coupling linkage in an equilibrium phase. Hence, selecting plants for better plant type and other characters may lead to more improvements in onion yield. This result was in accordance with that found by **Mohanty (2001), Rahman *et al.* (2002) Trivedi *et al.* (2006) and Yaso (2007).** On other hand, data revealed that, the relation between weight loss% at different storage periods and other traits was negative, in both seasons. This result was in harmony with that obtained by **Saimbhi and Randhawa (1982)** who found that large bulbs sprouted at faster rate than smaller ones.

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الملخص العربى

التباين الوراثى وكفائة التوريث والتحسين الوراثية المتوقع بالانتخاب والارتباط المظهرى لبعض اصناف البصل

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أقيمت هذه الدراسة فى محطة البحوث الزراعية بسدس، مركز البحوث الزراعية، محافظة بنى سويف، خلال موسمى ٢٠٠٦/٢٠٠٧ و٢٠٠٧/٢٠٠٨، لدراسة التباين الوراثى وكفاءة التوريث والتحسين الوراثى المتوقع بالانتخاب والارتباط المظهرى للصفات فى سبعة أصناف من البصل. وقد كانت هذه الأصناف عبارة عن جيزة ٦ محسن، وجيزة ٢٠، وكومبوست ٨، وكومبوست ١٦، وPUSS ، ويولو كريول، وبيث الفا. وتتلخص أهم النتائج المتحصل عليها فيما يلى:

- تأثرت جميع الصفات المدروسة معنوياً بمختلف الأصناف المستخدمة فى التجربة.
- تم الحصول على اعلى قيمة لمتوسط وزن البصلة من الصنف كومبوست ١٦، بينما تم الحصول على اقل قيمة من الصنف بيث الفا، وذلك فى كلا الموسمين.
- تم الحصول على اعلى القيم لكلا من المحصول التسويقى والمحصول الكلى من الصنف جيزة٢٠ فى الموسم الأول ومن الصنف كومبوست ١٦ فى الموسم الثانى.
- تم الحصول على اقل القيم لكلا من وزن البصلة و المحصول التسويقى والمحصول الكلى عن طريق الصنف بيث الفا، وذلك فى كلا الموسمين.
- أعطت صفة نسبة الفقد فى الأبصال بعد ٦٠ يوم من التخزين اعلى القيم لمعامل التباين المظهرى والتباين الوراثى، فى كلا الموسمين. بينما أعطت صفتى عدد الأيام حتى النضج ووزن البصلة اقل القيم وذلك فى الموسم الأول والثانى على التوالى.
- تم الحصول على اعلى القيم لكفاءة التوريث بالمعنى العريض فى صفتى نسبة المادة الجافة للأبصال ووزن النبات، بينما تم الحصول على اقل القيم فى صفتى نسبة الفقد فى الأبصال بعد ١٢٠ يوم من التخزين و محصول النقصة وذلك فى الموسم الأول والثانى على التوالى.
- أظهرت صفة نسبة الفقد فى الأبصال بعد ٦٠ يوم من التخزين اعلى القيم من التحسين الوراثى المتوقع من الانتخاب، فى كلا الموسمين. بينما أظهرت صفتى عدد[الأيام حتى النضج ووزن البصلة اقل القيم، وذلك فى الموسم الأول والثانى على التوالى.
- أوضحت النتائج بان صفة وزن البصلة قد ارتبطت ايجابياً وبصورة عالية المعنوية بكل من وزن النبات، ونسبة المادة الجافة للبصلة، ونسبة المادة الصلبة الذائبة. بينما ارتبطت ايجابياً ومعنوياً بكل من طول النبات وعدد الأوراق فى النبات. وذلك فى كلا الموسمين.
- أظهرت صفة المحصول التسويقى ارتباطاً ايجابياً وعالى المعنوية بكل من طول النبات والمحصول الكلى. فى حين أظهرت ارتباطاً موجبا ومعنويا بكل من عدد الأوراق فى النبات، وطول البصلة، ونسبة المادة الجافة للبصلة، ونسبة المادة الصلبة الذائبة الكلية. وذلك فى كلا الموسمين.
- ارتبطت صفة المحصول الكلى ايجابياً وبصورة عالية المعنوية بكل من طول النبات، ووزن النبات، وعدد الأيام حتى النضج، والمحصول التسويقي. بينما ارتبطت ايجابياً ومعنوياً بكل من عدد الأوراق للنبات، وطول البصلة، ونسبة المادة الجافة للبصلة، ونسبة المادة الصلبة الذائبة الكلية. وذلك فى كلا الموسمين.
- كان هناك ارتباط سالب ومعنوى بين المحصول الكلى و نسبة الفقد فى الأبصال بعد ١٢٠ يوم من التخزين، فى الموسم الثانى.