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SCREENING OF LOCAL AND EXOTIC ONION (*ALLIUM CEPA* L.) CULTIVARS FOR SEED PRODUCTION POTENTIALITY

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SUMMARY

An experiment was conducted aiming to find out the seed production potentiality of 19 local and exotic onion cultivars. The analysis of variance showed significant differences among the genotypes for all characters except sprouting percentage, number of flowers per umbel and number of umbel per bulb. Maximum number of days to 50% bolting (52.67) was exhibited by the genotype G2 and minimum by G6 (27.00 days). The larger bulb size after harvest was obtained from G14 and G19 (18.11 g). Genotypes G4 and G11 required the maximum (16.66) and the minimum (9.00) days for 100% sprouting, respectively. The highest stalk length was found in the genotype G1 (67.23 cm) and the lowest in G8 (38.47 cm). Maximum number (5.75) of stalk was produced by the genotype G7 and minimum number (2.09) of stalk by the genotype G11. The genotype G1 produced the highest number of seeds per umbel (1395.92) and seed yield per plant (4.29 g). The lowest (0.45 g) seed yield per plant and maximum bulb weight was obtained by the genotype G8.

Key-words: onion (Allium cepa L.), seed yield, bulb size, seed size, spices crop

INTRODUCTION

Onion (*Allium cepa* L., 2n=16) is a cross-pollinated and biennial short type vegetable and most of the important spice as well as vegetable crops throughout the world. Bulb is the main edible portion of onion plant, which is a modified organ and constituted by the thickened fleshy leaf sheaths and stem plate (Purseglove, 1988). The leading onion producing countries of the world are China, India, Poland, Japan, Turkey, Brazil and United States of America (FAO, 2007). In Bangladesh, it is widely cultivated in the larger districts of Faridpur, Pabna, Rangpur, Rajshahi, Dinajpur Jessore, Dhaka, Comilla, Mymensingh and Barisal (Rashid, 1976). It ranks first among the spice crop grown in Bangladesh and occupies an area of 40, 842 hectare with total production of 2, 10,000 tons of bulb during the period 2006-2007 (BBS, 2008) against the estimated annual demand of 4,50,000 tons (Ara et al., 2000).

Onion production sometimes hampers due to scarcity of seeds. Enormous differences are observed on the average seed yield as it depends on genotype, locality, season and method of seed production (Brewster, 1994). Bulb size influences the plant growth in onion as well as the splitting of bulb (Brewster, 1994). Planting of suitable size bulbs increases the yield of onion (Singh and Sachan, 1998; Abedin et al., 1999; Khokhar et al., 2001). The average seed yield in our country varies from 370 to 500 kg per hectare, (HRDP, 1995) which is very low compared to other countries of the world (1000 to 1200 kg/ha) (Rahim, 1991; Brewster, 1994). Bangladesh produced only 150 metric tons of onion seed per annum against the requirement of 300 metric tons (Abedin et al., 1999). Therefore a great scarcity of onion seed is noticed every year, limiting its cultivation in Bangladesh. Due to shortage of onion seeds, Bangladesh has to import huge quality of seeds at the cost of hard-earned foreign currency every year. Seed production of onion is one of the crucial problems associated with onion production in Bangladesh. Seed

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yield of local onion cultivar is remarkably poor compared to other onion growing countries (Rahim, 1991). Due to shortage large quantity of onion bulbs are imported every year from different countries. As a result various types of onion are available at the market. Seed production potentialities of these onions under Bangladesh conditions are not known. Information in the above mentioned could be the prerequisites for effective improvement of bulb onion and seed production. Therefore, an attempt was made to study aiming to find out the seed production potentiality of exotic and local onion cultivars.

MATERIAL AND METHODS

The research was conducted on the experimental farm, Department of Genetics and Plant Breeding, Banghabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during November – March in the period 2007-2008. The climate of the experimental site is sub-tropical characterized by heavy rainfall during the April - September period and scanty rainfall during the rest period of the year. The soils of BSMRAU farm belong to Salna series of shallow Red Brown Terrace soil type (Brammer, 1971; Shaheed, 1984). The bulbs of nineteen onion cultivars (Table 1) obtained from the Department of Genetics and Plant Breeding were sown in the experimental field. The unit plot size was 115.2m^2 with 30 cm apart between rows and 15 cm between bulbs. Each plot consisted of 36 rows. The experiment was laid out in a Randomized complete Block Design (RCBD) with 3 replications. Manure and fertilizer were applied per recommendation of Krishi Projokti Hatboi (BARI, 2006). Intercultural operations (weeding, mulching, irrigation, pest control) were done whenever necessary to keep the crop free from insect pest. Stalking was provided in each plant using bamboo stick to keep the plant erect and to protect them from the damage caused by storm and high winds. The seeds were harvested by cutting off the umbels when about 15-20% of the black seeds exposed (Vandermeer and Vanbennekom, 1968). Harvesting was done early in the morning to prevent shattering of seeds. After harvesting, the umbels were dried in scorching sunlight for 3-4 days and then threshed manually. After threshing, seeds were cleaned and dried properly and kept in paper bags, stored properly at room temperature.

Ten plants were selected randomly from each plot and data were recorded on individual plant basis from the selected plants in respect to the following characters: days to 100% sprouting, sprouting percentage, days to 50% bolting, length of stalk (cm), diameter of stalk, bulb size (original), bulb size (after harvest), number of stalk per plant, number of flowers per umbel, number of umbel per bulb, number of seeds per umbel, 1000- seed weight and seed yield per plant (g).

Table1. Origin and characteristics of nineteen onion genotypes

Tablica 1. Porijeklo i svojstva devetnaest genotipova luka

Name of the genotypes	Origin	Bulb characteristics
Onion-1	Bangladesh	Medium, brown red, closed neck
Onion-2	Bangladesh	Light brown red, medium, closed neck
Onion-3	Bangladesh	Light brown, branched
Onion-4	India	Deep pink, elongated, closed neck
Onion-5	Bangladesh	Brown red, medium, flat type, closed neck
Onion-6	India	Pink, elongated ,closed neck, large
Onion-7	India	Light pink, almost flat, large, open neck
Onion-8	India	Large, brown, closed neck
Onion-9	India	Brown red, medium, closed neck, flat
Onion-10	Burma	Round, brown red, closed neck, medium
Onion-11	Unknown	Round, brown red, closed neck, medium
Onion-12	Burma	Round, medium, light brown red, closed neck
Onion-13	Unknown	Brown red, flat type, open neck, branched
Onion-14	Burma	Brown red, flat, open neck, medium
Onion-15	India	Brown red, flat, closed neck, medium
Onion-16	Burma	Round, high red, medium, closed neck
Onion-17	India	Elongates, high brown red, closed neck, medium
Onion-18	India	Small, brown red, closed neck
Onion-19	Burma	Brown red, round, open neck.

Analysis of variance was done individually by a statistical package SAS, version 9.01 (2008) and test of significance was done by F-test (Panse and Shukhatme, 1978; Steel and Torrie 1980; Singh and Chaudhary, 2006).

RESULTS AND DISCUSSION

A summary of the analysis of variance in respect to all the characters studied, together with the source of variation and the corresponding degrees of freedom have been shown in Table 2. The mean values are presented for individual character in Table 3. The analysis of variance showed significant differences among the genotypes for all the studied seed yield related traits except sprouting percentage, number of flowers per umbel and number of umbel per bulb (Table 2a and 2b).

Table 2a. Analysis of variance of different plant characters of onion on seed yield

Tablica 2a. Analiza varijance različitih svojstava biljke luka na prinos sjemena

Sources of variation	df	Days to 100% sprouting	% Sprouting	Days to 50% bolting	Length of stalk (cm)	Diameter of stalk (mm)	Bulb size (original) (g)	Bulb size (after bared) (g)
Replication	2	0.54^{NS}	26.83^{NS}	12.33^{NS}	39.89^{NS}	1.29^{NS}	8.07^{NS}	28.07^{NS}
Variety	18	10.30**	21.82^{NS}	286.86**	92.62**	0.32**	1656.75**	82.06**
Error	36	1.41	11.78	29.72	24.08	0.12	7.45	28.79
CV%		9.35	3.53	12.64	8.77	9.44	12.08	40.68

Table 2b. Analysis of variance of different yield contributing characters of onion on seed yield

Tablica 2b. Analiza varijance različitih svojstava luka na prinos sjemena

Sources of variation	df	Stalk/plant (no)	Flowers /umber (no)	Umbels /bulbs (no)	Seeds /umbel (no)	1000-seed weight (g)	Seed yield/ Plant (g)
Replication	2	0.77^{NS}	5876.8^{NS}	1.3^{NS}	38020.89^{NS}	0.223^{NS}	0.3^{NS}
Variety	18	2.70**	3349.78^{NS}	0.53^{NS}	362470.45**	0.204	3.80**
Error	36	0.68	1930.95	0.56	77201.22	0.299	0.71
CV%		27.90	16.70	30.00	35.42	19.08	33.89

** Significant at 1% level of probability, ^{NS}= not significant

Seed production potentiality

The longest duration (16.67 days) for 100% sprouting was required by G4 and the shortest one (9 days) by the genotype G11 (Figure 1). The genotype had no significant effects on the sprouting percentage (Table 2). However, the highest sprouting percentage (100%) was obtained in the genotypes G7, G8, G11, G12 and G15 whereas the lowest (91.70%) by the genotype G14 (Table 3). Significant differences among the genotypes were observed from the analysis of variance for this character (Table 2). The minimum duration (27 days) for 50% bolting was observed in the genotype G6 and the maximum duration in G2 (52.66 days) (Figure 2).

Table 3. Mean performance of 19 onion varieties for seed yield related characters

Tablica 3. Prosječni potencijal 19 kultivara luka za prinos sjemena

Genotype	SP	LS	DS	BS (BM)	BS (H)	SPP	FPU	UPB	TSW
Onion-1	97.43	67.23	4.18	15.77	10.97	2.73	338.33	2.66	3.15
Onion-2	99.56	59.72	3.98	14.61	14.82	2.44	284.33	2.35	3.09
Onion-3	93.60	56.43	3.64	16.28	11.46	2.21	297.00	2.21	2.92
Onion-4	94.60	52.67	3.56	28.20	10.19	2.58	239.00	1.76	3.02
Onion-5	98.23	56.56	3.74	18.48	9.89	2.39	291.67	2.41	2.83
Onion-6	93.50	56.45	4.18	25.74	30.80	2.71	278.67	2.00	3.28
Onion-7	100.00	56.34	3.19	33.88	9.29	5.75	241.33	3.16	2.67
Onion-8	100.00	38.17	3.16	116.48	9.37	5.08	317.00	2.33	2.08
Onion-9	98.50	61.14	3.84	19.74	11.63	2.83	291.00	2.60	2.99
Onion-10	95.83	58.71	4.08	15.62	15.27	2.23	278.67	2.20	2.99
Onion-11	100.00	58.87	3.96	11.54	12.56	2.09	304.67	2.03	2.94
Onion-12	100.00	55.57	4.00	16.34	11.22	2.96	310.67	2.66	3.01
Onion-13	96.47	57.17	4.39	18.19	10.69	2.49	264.33	2.48	2.93
Onion-14	91.70	54.39	3.81	10.87	18.11	3.03	271.00	2.85	3.04
Onion-15	100.00	54.68	3.51	12.82	11.91	2.22	197.00	2.56	2.59
Onion-16	95.27	56.18	3.48	14.65	10.09	2.86	287.33	2.66	2.71
Onion-17	96.67	49.68	3.53	13.21	16.74	2.93	236.33	2.27	2.64
Onion-18	100.00	58.46	3.83	14.25	7.49	3.57	303.33	3.54	2.83
Onion-19	94.87	54.36	3.72	12.65	18.11	3.19	257.00	3.00	2.86
SE (±)	-	2.83	0.79	1.58	3.10	0.48	-	-	-
LSD(0.01)	-	10.90	0.21	6.06	11.91	1.84	-	-	-

Sprouting Percentage= SP, Length of stalk (cm)= LS, Diameter of stalk (mm)= DS, Bulb size (base material) in (g)= BS (BM), Bulb size (after harvest (g)= BS (H), Stalk per plant (no)= SPP, Flowers per umbel (no)= FPU, Umbel per bulb (no)= UPB, 1000 seed weight (g)= TSW

The mean square due to genotypes was statistically significant indicating variations existed among genotypes for stalk length (Table 2). The genotypes G1 and G8 were found out to produce the longest (67.23 cm) and the shortest (38.47cm) flower stalk, respectively. It was observed that genotype G1 was significantly different from genotype G4, G17, and G8 but statistically identical to the rest of the genotypes (Table 3). The maximum stalk diameter (4.38 mm) was observed in genotype G13 while the minimum stalk diameter (3.16 mm) was observed in genotype G8. The genotypes varied significantly for bulb size (Table 2). The largest original bulb size was recorded in G8 (116.47 g) and the smallest one was recorded in the genotype G14 (10.86 g) (Table 3). No relationship was found out with the mother bulb size and seed production as the genotype with smaller bulb produced higher amount of seeds per plant (Table 3). The genotype (G8) with larger size bulb (116.48 g) produced the lowest (0.45 g) seed yield per plant. The bulb size recorded after harvest was significantly influenced by different genotypes (Table 2). It was observed that the genotypes with larger mother bulb produced smaller bulb after harvest as well as seed yield per plant (G4, G8 and G18, exceptional in case of G6). Ambulkar et al. (1995), Oladiran and Ifere (1996) and Mondal and Chowdhury (1980) also reported similar results with the present findings.

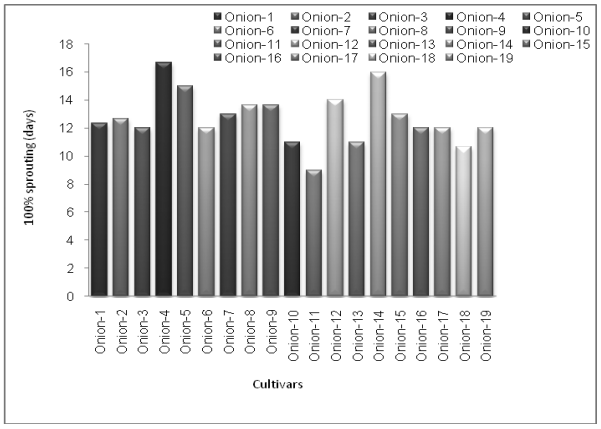

Figure 1. Mean performance of 19 local and exotic onion cultivars for days to 100% sprouting

Slika 1. Prosječni potencijal 19 domaćih i stranih kultivara luka za broj dana do 100% naklijavanja

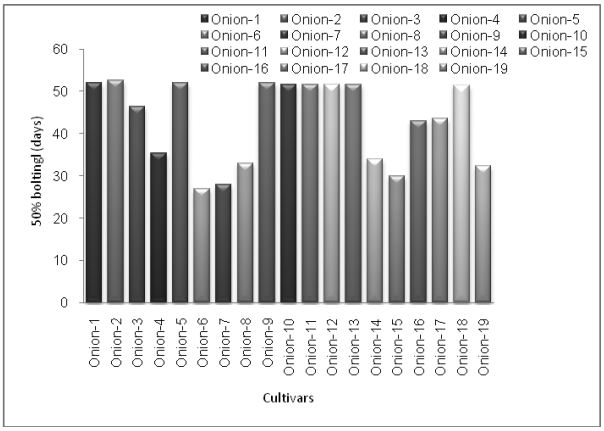

Figure 2. Mean performance of 19 local and exotic onion cultivars for days to 50% bolting

Slika 2. Prosječni potencijal 19 domaćih i stranih kultivara luka za broj dana do 50% naklijavanja

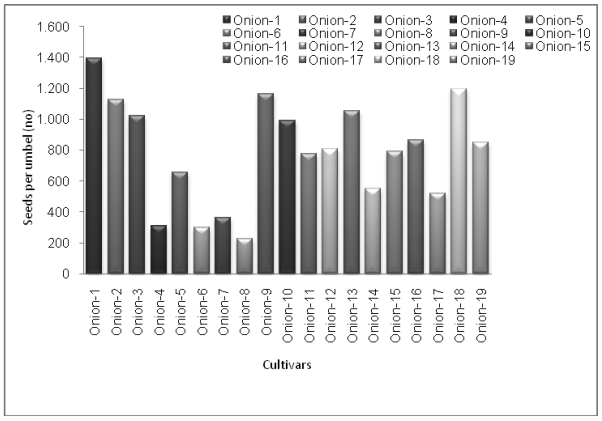

Figure 3. Mean performance of 19 local and exotic onion cultivars for number of seeds per umbel

Slika 3. Prosječni potencijal 19 domaćih i stranih kultivara luka za broj sjemena po štitastom cvatu

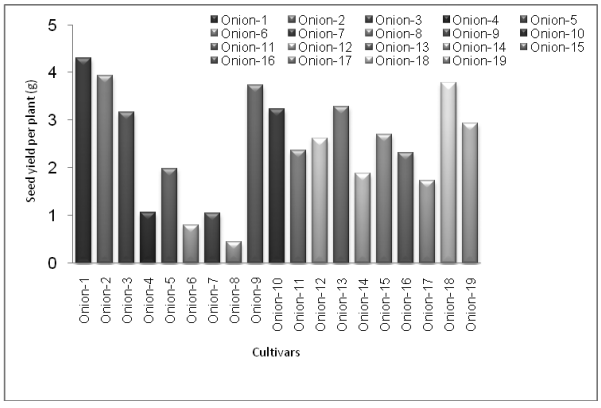

Figure 4. Mean performance of 19 local and exotic onion cultivars for seed yield per plant (g)

Slika 4. Prosječni potencijal 19 domaćih i stranih kultivara luka za prinos sjemena po biljci

The highest bulb size (30.79 g) was obtained with genotype G6 being significantly different from the rest of the genotypes. The smallest bulb size (7.48 g) was observed in G18 compared to original bulb size and it was due to bolting and seed production. Number of stalk per plant was an important parameter for seed production in onion. Significant variations were also observed among the genotypes for this trait (Table 2). The genotype G7 produced the highest number of seed stalks/plant (5.75), which was at par with G8 (5.08). The lowest number of stalks per plant was found out in genotype G11 (2.09). Similar results were evident from the findings of Naik and Srinivas (1992), Shah and Rehman (1995) and Shinde and Sonotakke (1986). There was no significant effect of genotypes on the number of flower per umbel (Table 2b) but it is an important factor for higher seed yield per plant. The maximum number of flowers per umbel (338.33) was born on genotype G1 while the lowest number of flowers per umbel (197.00) was found out in G15 (Table 3). Ali et al. (1984), Ali (1985) reported significant variation among different lines of bulb union for flowers per umbel. Shinde and Sontakke (1986) and Naik and Srinivas (1992) marked 50 to 2000 flowers per umbel in onion. Non significant variation was observed among the genotypes for number of umbel per bulb (Table 2). The highest number of umbels per bulb (3.53) was obtained from the genotype G18 and the lowest number of umbel per bulb (1.75) was found out in G4 (Table 3). Mollah et al. (1987) observed significant variation in number of umbels per plant due to cultivar variation.

A remarkable variation was observed for number of seeds per umbel among the local and exotic genotypes of onion (Figure 3). The genotype G1 produced the maximum number of seeds (1395.93) per umbel followed by the genotypes G2, G3, G9, G13 and G18, which was significantly different from other genotypes. The minimum number (228.33) of seeds was obtained from genotype G8 (Figure 3) followed by genotypes G6 (298.80), G4 (308.560) and G7 (364.083). 1000- Seed weight also affect seed yield per plant in any crops. The highest thousand seed weight was observed in G6 (3.28 g) and the lowest thousand seed weight was found in G8 (2.08 g) (Table 3). Mohanty (2000) also achieved similar results in onion for 1000-seed weight in onion.

Analysis of variance showed significant differences among the genotypes for seed yield per plant (Table 2). The highest seed yield was recorded in the genotype G1 (4.29 g) and the lowest in genotype G8 (0.45 g) (Figure 4). The genotypes G1, G2, G9 and G18 produced seed yield per plant within the rang 3.50 g to 4.50 g and was statistically identical with the highest seed yielder genotype. These genotypes could be selected for further breeding program in onion seed yield improvement. The above findings were in the close agreement with those of Currah (1981), Mollah et al. (1987), Sidhu et al. (1996) and Mohanty (2000).

CONCLUSION

Seed production of onion is one of the crucial problems associated with onion production in Bangladesh. Seed yield of local onion cultivar is remarkably poor compared to other onion growing countries in the world. Therefore, the present research was conducted to find out the seed production potentiality of local and exotic onion cultivars. The genotype G1 produced the highest number of seeds per umbel and seed yield per plant. The lowest seed yield was recorded in genotype G8 with larger size bulb. There was no relationship found with the mother bulb size and seed production. The smaller bulb genotype produced higher amount of seeds per plant. The genotypes with higher seed yield would be selected for further breeding program in onion seed yield improvement.

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PRIKAZ DOMAĆIH I STRANIH KULTIVARA LUKA (*Allium cepa* L.) ZA POTENCIJAL PROIZVODNJE SJEMENA

SAŽETAK

Istraživanje je provedeno s ciljem utvrđivanja potencijala sjemenske proizvodnje 19 domaćih i stranih kultivara luka. Analiza varijance pokazala je signifikantne razlike između genotipova za sva svojstva, osim postotka naklijavanja, broja cvjetova po štitastom cvatu i broja štitastog cvata po lukovici. Maksimalan broj dana do 50% naklijavanja (52,67) je svojstvo genotipa G2, a minimalan (27,00 dana) je svojstvo genotipa G6. Nakon vađenja utvrđena je veća lukovica kod genotipova 14 i 19 (18,11 g). Genotipovi G4 i G11 trebali su maksimalno 16,66 dana, odnosno minimalno 9,00 dana za 100% naklijavanja, redosljedom. Genotip G1 imao je najdulju (67,23 cm), a G8 najkraću (38,47 cm) stabljiku. Maksimalan broj stabljika (5,75) ustanovljen je kod genotipa G7, a minimalan (2,09) kod genotipa G11. Ustanovljeno je da G1 ima najveći broj sjemena po štitastom cvatu (1395,92) i prinosa sjemena po biljci (4,29 g). Najniži prinos sjemena (0,45 g), kao i najteža lukovica po biljci dobiveni su od genotipa G8.

Ključne riječi: luk (Allium cepa L.), prinos sjemena, veličina lukovice, veličina sjemena, začinsko bilje

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