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Effect of Screening of Onion (*Allium cepa*) Ecotypes of Southern Iran on Bulb Yield and Bolting

N. Alamzadeh Ansari and R. Mamghani
Department of Horticulture, Agronomy and Plant Breeding, Faculty of Agriculture,
Shahid Chameran University, Ahwaz, Iran

Abstract: For finding resistant onion cultivars against bolting can use screening, selecting and open pollination methods. In first stage 12 cultivars which are cultivated in South region namely Raamhormozy, Bh3, Azarshahar, Daaman, Pari 80, Shahdad, Bardseer, Sarkareh, Primavara, Texas Yellow Grano, Texas Early Grano, G1, were sown in Shahid Chamran University in Autumn 2002. Results this experiment shown high significants difference between cultivars. After screening and selection desirable samples during second stage of experiment open pollinated seed were collected from them in 2003, in second stage, seeds of 8 cultivar from selected plant and 2 foreign improved seeds sown in 2003-2004. Results in the second stage indicated no significant difference between cultivars 58 days after emergence. Primavara was the best cultivar by the time of transplanting, but Bh3 showed some superiority after transplanting. Primavara was the early mature cultivar in both years, while the others produced bulbs more early in the second stage compared to the first year. In second stage of breeding program, bulb yield and quality, resistance to bolting, dormancy of bulb were better than last stage, but to compete bulb quality of foreign cultivars at harvesting time, this project needs to be continue by screening and selection of the best bulbs and controlled polycross pollinations.

Key words: Onion, polycross, mature, bulbing, bolting

INTRODUCTION

Onion evolution started more than 5000 years ago. At the present time, onion is adapted to various environments for example it is cultivated around the majority of cities in Iran with one or several cultivars with acceptable yield (Alemzadeh Ansari, 2007b). Nevertheless, genetic information's about this plant is relatively limited (Brewester, 1994). One of the important breeding objectives of onion is resistant to bolting (Hu *et al*., 2003). One factor of escaping from bolting is the genotype and the other is the plant age when it confronts low temperature (Berwester, 1994).

With suitable screening and selection methods among a population having genetic variations, more potent plants can be obtained. Onion is a biennial or perennial plant with loses his vigor when it is selfed (Havey, 1993; McDonald *et al*., 2003). Previous researches have showed that open pollination causes remarkable changes in size, form, pungency, soluble solid materials, presser viability, the sulfur amount in bulbs, flesh color, maturation time and reaction to day length in this plant (Havey, 1993; Randle, 1992; Rees, 1993). Crossing between onion populations also has increased heterosis for economically important characters (Shigyo and Kik, 2007). As hybrid varieties were taller and plants had more leaves than open pollination varieties. But this difference in height and leaf number did not correlate with a difference in marketable yield or bulb size. Open pollination varieties possessed a greater percent marketable yield and total marketable yield than hybrid varieties (Cramer, 2001). Selection in onion, like any other plant, is finding and separating desirable plants among a heterogeneous population to save their sought characters. By using selection methods, new onion varieties were obtained from local onion populations in Japan (Shigyo and Kik, 2007). Without selection in an onion population, plants tend to produce multiple bulbs, also softer and wider bulbs (Havey, 1993).

By comparing different hybrids and inbred lines of onion reported that their yields did not have a significant difference with best economic cultivars obtained from open pollinations such as Taka-Nishiki (Shigyo and Kik, 2007).

Bulb production in onion depends on genotypes, temperature, photoperiod and their interactions (Alemzadeh Ansari, 2007b; Brewster, 1994). Thus, each landrace variety is adapted to a specific climatic conditions. Many of qualitative characters in onion have a clear genetic basis and can be changed by onion breeders (Havey, 1993).

Corresponding Author: Naser Alemzadeh Ansari, Department of Horticulture, Agronomy and Plant Breeding, Faculty of Agriculture, Shahid Chameran University, Ahwaz, Iran

The origin of onion is known to be Iran and neighboring countries (Hanelt, 1990; Havey, 1993). So a great genetic variation among onions in this region is expected (Alemzadeh Ansari, 2007b). The significant differences between populations for the majority of characters proved the existence of genetic variation in the Iranian onion germplasm (Azimi *et al*., 2000). The results of another experiment at Esfahan showed that the phenotype and genotype were correlated (Dehdari *et al*., 2001). These varieties have some variations within themselves which can be more distinguished in new climatic conditions (Rees, 1993).

During the experiments in previous years at Ahwaz, it has been found that produced onions in Shahid Chamran University, in spite of their preference for early maturity and resistance to bulbing, have moderate storage capability. These varieties are susceptible to some local pests like thrips, onion fly and diseases like mildew (Alemzadeh Ansari, 2007c). However, in some of varieties of Khuzestan province, resistance has been observed for some pests and diseases (Alemzadeh Ansari, 2007b).

The most important purpose of the present research is to allow readers to known, the effect of screening and selection on the characteristics of studied cultivars during two experiments.

MATERIALS AND METHODS

At the first year of experiment, 12 varieties were planted. These were Ghermez- Azarshahr from Azarbaijan province; Five other native varieties from southern provinces of Iran {Bardseer and Shahdad from Kerman, Sarkareh from Booshehr, Ramhormozy from Khouzestan, Daaman from Seestan-Balouchestan} (No Loc); three samples ready to be released from Shahid Chamran University as new samples {P80, G1, Bh3} (Loc) and three foreign varieties which are being cultivated in Southern areas of Iran, i.e., Texas Early Grano, Texas Yellow Grano and Primavara (Impro). Except for lines of Shahid Chamran University and foreign varieties, the seed of other entries were obtained from Iran's Plant Gene Bank. All varieties were planted at Nov. 19th, 2002.

Eight superior samples from first year were selected which had suitable bulbs include four samples (No Loc) which were produced in Shahid Chamran University by open pollination with Southern origin included B1 selected from Bardseer and Sh1 selected from Shahdad varieties of Kerman, Sr1 selected from Sarkareh from Booshehr, D1 selected from Daaman from Seestan-Balouchestan provinces; three varieties (Loc) from produced entries in Shahid Chamran University i.e., P83 selected from Pary 80, G83 selected from G1 and Bh4 selected from Bh3; two foreign onions i.e., Texas Yellow Grano and Primavara (Impro) ; and a local variety named Ramhormozy from Khouzestan (Loc) were planted early in season (October 4th 2004). The experiments of both years had Randomize Complete Block Designs (RCBD) with three replications. The analysis of variance were on the basis of RCBD and the means were compared using Duncan's multiple range test. SPSS software has been used for statistical analysis of data and EXCEL was used to draw the graphs.

RESULTS

During the first year of experiment, the average, maximum and minimum temperatures were 20.5, 47 and 4°C, respectively, while in the second stage, these were as, 21.4, 44 and 6.8°C. The average temperature in both years were ideal for plant and bulb growth of onion because the optimum degree for this crop is 20-25°C. But temperatures higher than 35°C and lower than 10°C will cause undesirable changes in its growth and development. Temperatures lower than 10°C caused the plant to vernalize and produce flowering stem in some varieties. In the order hand, temperatures higher than 35°C decreased and even stopped plant growth and development, especially producing leaves, number of flowering stems and number of flowers in inflorescences (Brewster, 1994; Alemzadeh Ansari, 2007b).

Some characters such as plant height and bulb size showed different trends among local, non- local cultivars and improved varieties during first experiment (Alemzadeh Ansari, 2007a), but in the second experiment, these variation were not similar the first experiment, specially between growth and development speed for bulbing rate, bulb size, whereas within improved varieties, local and non-local cultivars showed significant different.

Some other characters, like leaf production and bulb formation index had clear trends during plant growth and development. Improved early maturing varieties had short and fast leaf production period in first experiment, while local varieties needed more time for leaf production. In some non local varieties, this function did not finish at the end of the growing season. The similar phenomena occurred between local and improved cultivars in set formation period, improved cultivars very fast formatted set than local cultivars, with increasing length photoperiod and temperature (Alemzadeh Ansari, 2007d). In the second experiment, plants had relatively more vegetative growth period, but the number of produced leaves of non local varieties was in general less than first experiment. However, in second experiment with increasing bulbing rate and period growth and

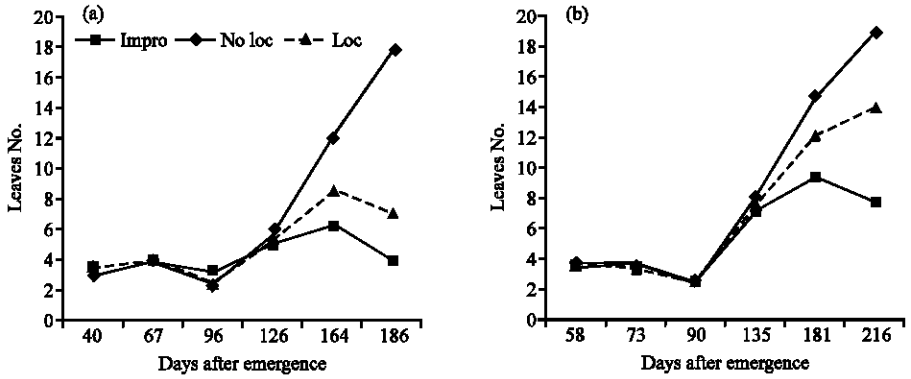

Fig. 1: The pattern of leaves numbers onion cultivars in the first (a) 2002 and second stage of experiment (b) 2004

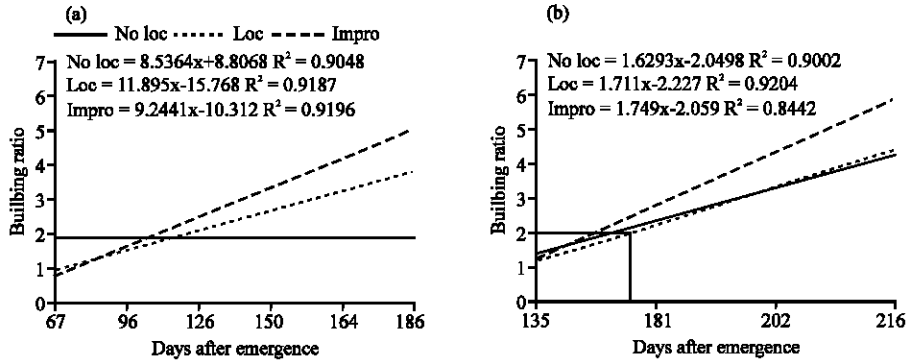

Fig. 2: The pattern of bulbing ratio onion cultivars in the first (a) 2002 and second stage of experiment (b) 2004

Table 1: Bulb characteristics in different onion genotypes at harvesting time in first experiment (2002)

Genotypes	Total bulb yield/m² (g)	Bulbs with diameter 5 cm or greater		Bulbs with diameter 3-5 cm		Bulbs with diameter 3 cm		Flowering
		Weight (g)	(%)	Weight (g)	(%)	Weight (g)	(%)	(%)
Texas yellow grano	1970.6e*	1230.3f	43d	490.3a	30a	250.0ab	27a	0c
Sarkarrh	2891.6e	2555.0bcd	71abc	203.3abc	14abcd	133.3abcd	15abcde	53a
Gharmez Azar shahr	2005.3de	1418.3ef	50cd	351.0abc	21abcd	236.0ab	29a	65a
Daaman	2735.3de	2354.6bcde	71abc	134.1abc	7de	246.6	22abc	45ab
Shahdad	2431.3de	1968.0cdef	64bcd	283.3	17abcd	180.0abcd	19abcd	38ab
Pary 80	3078.3dc	2884.6b	87ab	172.1abc	10bcd	21.6cd	3ed	0c
Texas early grano	2357.3de	1785.3def	51cd	366.6abc	24abc	205.4abc	25ab	0c
Ramhormozy	3430.3ab	3162.0ab	85ab	268.3abc	15abcd	0.0d	0e	0c
Primavar	1935.0e	1196.6f	42d	473.3ab	28ab	265.1a	30a	0c
G1	3948.3a	3783.3a	88a	105.0c	6d	60.0bcd	6bcde	3c
Bh3	2826.6cd	2356.6bcde	69abc	393.3abc	22abcd	76.7abcd	9bcdee	2c
Bardersir	3062.6bc	2725.0bc	75ab	217.6abc	12abcd	120.0abcd	13abcde	26b
Average	2722.7	2284.9	66.3	288.2	17.2	149.6	16.5	19.3

*Within each column a different letter(s) above indicates a significant difference by the Duncan's Multiple range test, p = 0.05

development, yield bulb increased, it means more materials were transferred to bulbs in these varieties. Bulb formation in non local varieties had a very slow trend compared to improved varieties which was very fast and had enough time to preserve materials in bulbs during first year. In second experiment, all three groups of onions had a relatively acceptable trend, resulting in relatively good yield (Fig. 1, 2).

Comparing these data shows a yield increase of in second experiment which can be due to the difference of in planting dates. Primavara and Texas Yellow Grano yielded 3 times more in second year compared to the first experiment. The other varieties also showed significantly higher yield in the second experiment. The analysis of variance did not show significant differences among varieties for bulb yield, but there were some differences at

Table 2: Bulb characteristics in different onion genotypes at harvesting time in second experiment (2004)

Genotypes	Total bulb yield/m^2 (g)	Bulbs with diameter 5 cm or greater		Bulbs with diameter 3-5 cm		Bulbs with diameter 3 cm		Flowering (%)
		Weight (g)	(%)	Weight (g)	(%)	Weight (g)	(%)	
B1	6871.25ab	6800.88ab	97ab	70.37a	3ab	0.00a	0a	6.00b
Sr1	6148.83ab	6101.78ab	96ab	47.05a	4ab	0.00a	0a	7.76a
Sh1	5073.86ab	4961.51ab	93ab	111.33a	6ab	1.01a	1a	0.00b
D1	6020.35ab	5971.97ab	97ab	46.20a	2ab	2.18a	1a	0.00b
Texas yellow Grano	6909.06ab	6909.06ab	100a	0.00ba	0b	0.00a	0a	0.00b
G83	6135.56ab	6132.85ab	100a	0.00ba	0b	2.72a	0a	1.56ab
Ramhormozy	6691.79ab	6676.20ab	98a	11.00a	1b	4.58a	1a	0.68ab
Primavar	7877.90a	7860.06a	98a	17.84a	2ab	0.00a	0a	0.00b
P83	4721.29b	4541.63b	87b	163.81a	11a	15.86a	2a	2.70ab
Bh4	4602.33b	4449.02b	89ab	149.45a	10ab	3.85a	1a	6.34ab
Average	6105.22	6040.50	96	61.70	4	3.02	0	2.32

*Within each column a different letter(s) above indicates a significant difference by the Duncan's Multiple range test, p = 0.05

5% level of significance when Duncan's multiple range test was used.

Comparing bulb size in two experiments, some differences have been observed. In the second experiment, 96% of the bulbs had diameters more than 5 cm, while only 66.4% of the bulbs in the first experiment were more than 5 cm in diameter. 17.2% of the bulbs in first year were 3-5 cm in diameter, while in the second experiment only 4% the of bulbs were in this range. The bulbs having less than 3 cm of diameter in first and second experiments were 16.5% and less than 1% of all bulbs, respectively. The other important character was the percentage of bolting plants. Some varieties showed more than 53% bolting in the first year, while in the second year; it was less than 8% (Table 1, 2).

DISCUSSION

Results these experiments showed that by screening variable genetic materials and selections, desirable onion cultivars with higher fruit yield and non-bolting type. The results supported by Cardoso and Costa (2003). They showed that high heritability estimates are obtained for all characters. Also this results supported by Cramer (2003) shown that bolting resistant cultivar was less than the bolting-susceptible cultivars. In the second experiment, that the seeds were sown 45 days earlier than the first experiment, the tested varieties came across with relatively low temperature and had more growth and development than the first experiment. So, a high percentage of vernalized and bolted plants were expected, but the second experiment showed 800% less bolting than first experiment. Serkareh, Daaman and Shahdad cultivars had 53, 45 and 38% bolting, respectively in first experiment, but the second experiment these cultivars decreased to 7.7, 5.0 and 0.0% bolting, respectively. These results disagree by Khokhar *et al.* (2007). They indicated that bolting percentage increase significantly by increasing cool temperature durations. They worked on similar material but in experimental periode we selected material, that resistance to bolting. Other hand stage of complete bolting was varied in plants vernalised of different shallote cultivars (Tabor *et al.*, 2005) and genotypes varied significantly in their response to cold induction (Krontal *et al.*, 2000), also these results indicated that fruit yield and bolting percent of tested varieties had similar fruit yield and bolting percentage to local cultivars and improved varieties. Cardoso and Costa (2003) showed that selection for maturity was highly efficient and the population selected for early maturity has potential to originate adapted cultivars, with bulb yield and quality superior to the available cultivars.

Although Cramer (2003) indicated that the mechanism of resistance for bolting-resistant cultivars is not well known. But appearance that bolting in onion is dominant character which can be eliminated from an onion cultivar by one cycle screening, selecting resistant plants, open pollination and produce resistance cultivar.

CONCLUSIONS

- By screening desirable plants from different cultivars and open pollinations between them, several early maturing cases were obtained
- Selection and open pollination resulted in improving several characteristics such as plant height, bulb diameter, bulbing rate and onion yield in non local varieties
- Because of increase in variation within entries, isolation of desirable samples for further breeding programs is more possible

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