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Effect of Density, Cultivars and Sowing Date on Onion Sets Production

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Abstract: Main aim of this experiment is production of the set onion from late winter to early spring in the Khuzestan (the Western Southern province) of Iran. The effects of sowing date of seed was studied at the present work has been chosen at three levels which are January, 21, February, 21 and March, 21 2005, at density (2, 4, 6 and 8 g m^{-2}) and cultivars were used are Primavera, Taxes Yellow Grano, Ramhormozy and Behbahany on emerging date seeds and onion set production. Results have shown that onion set can be produced at late winter in Khuzestan province. Sowing date had affected on set size. The best date of set production for bulbs was late February. The biggest and smallest of set onion, respectively acquire in low and high density. The best density of set production for bulbs was 6-8 g m^{-2} and for green onion production 2-4 g m^{-2}. Cultivars reaction to produce set was various. Reaction of Primavera' to environmental changes were faster than others cultivars and this promote the individual 'Primavera' cultivar faster enter in to the rest phase.

Key words: Onion set, density, cultivars, sowing date, local

INTRODUCTION

Onion bulb decreases occasionally at winter season in Iran. Using onion set is a method for early producing of bulb onion. Onion set production is affected by cultivar, density and environmental conditions (Barkauskiene, 2002; Cheema *et al*., 2003).

The main environmental factors which affect on onion bulb and set production are temperature, photoperiod and interaction between them (Lim-ChaeShin *et al*., 2002; Diaz-Perez *et al*., 2003; Huh *et al*., 2002; Mettananda, 2003).

Temperature affects on all functions of onion plant (Coolong and Randle 2003; Abu-Rayyan and Abu-Irmaileh, 2004). Suitable temperature causes to growth and development in each step, but it would be unsuitable this process may be limited or changed. For example plants did not flower when sets were maintained at 30°C; but when sets are maintained for the long period at 10°C, more percentage of them will bolting (Khokhar *et al*., 2007).

Optimum temperature for germinating onion seed is 20°C (Parmar *et al*., 2001), but suitable temperature which 70% of seeds germinate 13-28°C. Minimum temperature which onion seed can germinate is determined 1.8°C (Voss *et al*., 1999).

Time needs for 50% of germinating onion seed determined 219°C degree days. Low temperature is the main limited factor for germinating at early spring season. Relative growth rate of onion leaf depends to temperature changes. Minimum temperature for leaf growth is 6°C. Relative growth rate of onion leaf increases linear 6 to 20°C. If environmental temperature reaches above 27°C, relative growth rate of leaf decreases, in this condition, high yield is obtained in high density which 1000-4000 plants per m^2 are grown (Brewster, 1997). In warm region of Pakistan and Israel, onion set produced at spring season then it is used for producing bulb at late summer. This onion bulb is harvested at December.

Onion set format earlier then onion bulb, because high density of plants causes to accelerate in the producing set (Brewster, 1997).

Onion set yield is increased by high density, because light absorption percentage is increased by leaf canopy (Brewster, 1997).

Before plant entering to the bulb growth step, delay in time of cultivars maturation, cause to increasing leaf area index, that result of it causes to increasing light absorption percentage by leaf canopy, which this fact cause to increasing onion bulb yield (Brewster, 1997).

The main of aim of this study is introduction of the best time of set onion production with regarding cultivar and density in southern Iran.

MATERIALS AND METHODS

This study was carried out in the experimental field of Agricultural Faculty in Shahid Chamran University of Ahwaz, Iran. The experimental design was as a split spilt plot in randomized complete blocks with 3 replications. Sowing date was chosen as main plot with three levels which are: January 21, February 21 and march 21 2004. Planting density was also chosen as sub plot with four levels which are: 2, 4, 6 and 8 g seeds per m^2 and cultivars

has been also chosen as sub sub-plot with four levels which are Primavera, Texas Yellow Grano, Ramhormozy and Behbahany which those are cultivated in regions. Aerolog data obtained from research station of irrigation faculty of Shahid Chamran University of Ahwaz. All care agronomy operations such as irrigating, weeding out were carried out in all treatments similarly. In harvesting time, sampling of plants was carried out, measured and compared with view of set diameter, neck diameter, set formation index which calculated from division of diameter set to diameter neck, harvested set in 1 m^2 and total yields. Statistical analysis of experimental data was accomplished with using the MSTATC software package and the means were separated by Duncan's multiple range test.

RESULTS

Sowing date: The changes of temperature from 21 January to last June has shown in Fig. 1 from seed germination up to harvesting date. Minimum, average and maximum of temperature were 17.7, 24.7 and 34.7°C, respectively. During experiment period, average of temperature was optimum for growth and development of onion. By study showed that contrast, onion plants were not influenced by temperature stress at three sowing date. Results of experiment showed that emerging initiated at three sowing date was 22, 10 and 7 days, respectively. This indicated that delaying, at sowing date, can cause to accelerate seed emerging. A main problem is due to when early sowing in spring time has negative effect on seed germination and seed emergence. This phenomenon happened to low temperature in spring (Gray and Steckel, 1983).

At harvesting time, sowing date showed that it affected all measured characters ($p = 0.01$). Maximum and minimum measured characters (weight, height, neck and bulb diameter, Rate of bulbing and yield per m^2 of fresh set) were in first and third sowing date, respectively. But maximum and minimum set numbers per m^2 were in third and first sowing date (Table 1).

Cultivar: At harvesting time, effect of cultivars on all measured characters was significant at 1% level. Maximum and minimum weight, diameter of set were obtained in Primavera and Behbahany cultivar, respectively.

But maximum and minimum set neck diameter were Behbahany and Primavera cultivar, respectively. The maximum and minimum set numbers per m^2 were showed B1 and Texas Yellow Grano cultivar, respectively. The maximum and minimum set yield per m^2 was Primavera and Ramhormozy cultivar, respectively (Table 2).

Sowing density: Effect of sowing density on some of morphological characters such as height, neck diameter,

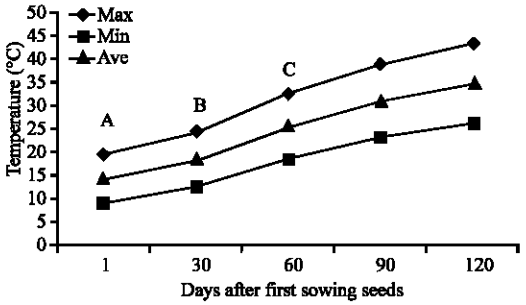

Fig. 1: Changes dynamics of temperature from sowing date to harvesting date onion set at 2006. A, B, C, first, second and third sowing date, respectively

Table 1: Effect of various sowing date on mean of some morphological characters at harvesting time of onion set

Sowing date	Set fresh weight (g)	Set height (cm)	Set diameter (cm)	Set neck diameter (cm)	Set formation index	Set No. per m^2	Set yield per m^2 (g)
January 21	21.06^{a}*	4.03^{a}	3.41^{a}	0.53^{a}	8.50^{a}	254.47^{c}	2666.52^{a}
February 21	9.78^{b}	3.51^{b}	2.07^{b}	0.36^{b}	6.53^{b}	343.36^{b}	783.57^{b}
March 21	3.31^{c}	2.72^{c}	1.50^{c}	0.33^{b}	5.07^{c}	419.93^{a}	434.87^{c}
Average	13.79	3.59	2.59	0.43	7.16	328.92	1405.08

*: Different letter(s) within a column indicates a significant difference by Duncan's multiple range test, $p = 0.05$

Table 2: Mean of some morphological characters of various cultivars of onion sets at harvesting time

Cultivars	Set fresh weight (g)	Set height (cm)	Set diameter (cm)	Set neck diameter (cm)	Set formation index	Set No. per m^2	Set yield per m^2 (g)
Taxes yellow grano	14.456^{b}	4.000^{a}	2.618^{b}	0.394^{b}	7.780^{b}	285.93^{b}	1204.46^{c}
Ramhormozy	12.470^{c}	3.482^{d}	2.506^{c}	0.484^{a}	5.591^{c}	279.67^{b}	1333.46^{cb}
Behbahany	12.064^{c}	3.233^{c}	2.484^{c}	0.512^{a}	5.368^{c}	332.78^{b}	1474.90^{ba}
Primavara	16.515^{a}	3.810^{b}	2.766^{a}	0.329^{c}	10.214^{a}	428.44^{a}	1641.76^{a}
Average	13.791	3.587	2.589	0.435	7.158	328.92	1405.08

*: Different letter(s) within a column indicates a significant difference by Duncan'smultiple Range test, $p = 0.05$

Table 3: Effect of various sowing density on mean some of morphological characters at harvesting time of onion set

Seed density gram per m^2	Set fresh weight (g)	Set height (cm)	Set diameter (cm)	Set neck diameter (cm)	Set formation index	Set No. per m^2	Set yield per m^2 (g)
2	17.65^{a}	3.55^{b}	3.55^{b}	0.48^{a}	6.64^{a}	285.93^{b}	1204.46^{c}
4	13.55^{b}	3.37^{c}	3.37^{c}	0.40^{c}	7.45^{a}	279.67^{b}	1333.46^{cb}
6	13.29^{b}	3.61^{b}	3.61^{b}	0.44^{b}	6.97^{a}	332.78^{b}	1474.90^{ab}
8	11.39^{c}	3.78^{a}	3.78^{a}	0.42^{bc}	7.49^{a}	428.44^{a}	1641.76^{a}
Average	13.79	3.59	3.59	0.43	7.16	328.92	1405.08

*: Different letter(s) within a column indicates a significant difference by Duncan's multiple range test, p = 0.05

Table 4: Interaction effects of cultivar and sowing date on mean some of morphological characters at harvesting time of onion set

Cultivars	Sowing date	Set fresh weight (g)	Set height (cm)	Set diameter (cm)	Set neck diameter (cm)	Set formation index	Set No. per m^2	Set yield per m^2 (g)
Taxes yellow	January 21	22.99^{a}	4.52^{a}	3.60^{a}	0.49^{ab}	10.26^{ab}	257.58^{ef}	2086.56^{c}
Grano	February 21	12.05^{abc}	3.94^{abc}	2.26^{b}	0.36^{ab}	6.86^{bc}	289.81^{def}	757.34^{de}
	March 21	3.85^{bc}	3.12^{abc}	1.63^{b}	0.30^{b}	5.31^{c}	270.00^{ef}	522.12^{def}
Ramhormozy	January 21	20.35^{ab}	3.92^{abc}	3.42^{a}	0.61^{ab}	6.24^{c}	206.30^{f}	1991.48^{c}
	February 21	7.87^{abc}	3.45^{abc}	1.90^{b}	0.38^{ab}	5.59^{c}	346.46^{bcde}	840.48^{d}
	March 21	3.04^{c}	2.65^{bc}	1.52^{b}	0.38^{ab}	4.29^{c}	405.00^{abc}	339.79^{f}
Behbahany	January 21	20.32^{ab}	3.73^{abc}	3.44^{a}	0.71^{a}	5.35^{c}	254.63^{ef}	2822.00^{b}
	February 21	9.06^{abc}	3.24^{abc}	2.19^{b}	0.40^{ab}	6.15^{c}	397.59^{abcd}	843.93^{d}
	March 21	3.05^{c}	2.54^{c}	1.40^{b}	0.33^{b}	4.73^{c}	453.74^{a}	407.46^{ef}
Primavara	January 21	21.42^{a}	4.15^{ab}	3.30^{a}	0.36^{ab}	11.75^{a}	299.63^{cdef}	3717.68^{a}
	February 21	10.27^{abc}	3.37^{abc}	1.92^{b}	0.28^{b}	7.86^{bc}	339.82^{bcde}	697.26^{de}
	March 21	3.95^{bc}	2.98^{bc}	1.64^{b}	0.28^{b}	6.93^{bc}	437.78^{ab}	646.18^{def}

*: Different letter(s) within a column indicates a significant difference by Duncan's multiple range test, p = 0.05

number per m^2 and yield per m^2 of set were significant at 1% level. Maximum and minimum set neck diameter, set diameter, set fresh weight, set yield per m^2 were in low and high density, respectively. Maximum and minimum set height, set number per m^2 and set yield per m^2 were in high and low density, respectively (Table 3).

Interaction effects of cultivar and sowing date: The main interaction effects between cultivars and sowing date appeared and all characters such as fresh weight set, height set, diameter set, neck diameter set were significant (p = 1%), other interaction effects between factors had not important.

Maximum and minimum fresh weight, height and diameter of set were Texas Yellow Grano cultivar at January 21 and Ramhormozy cultivar at March 21, respectively. Maximum and minimum set neck diameters were Behbahany at January 21 and Primavera at March 21, respectively. Maximum and minimum rate of bulbing were Primavera at January 21 and Ramhormozy cultivar at March 21, respectively. Maximum and minimum set number per m^2 were Behbahany cultivar at March 21 and Primavera at January 21, respectively. Maximum and minimum set yield per m^2 were 'Primavera' at January 21 and Ramhormozy cultivar at March 21 and respectively (Table 4).

DISCUSSION

Results of this experiment showed that big and small onion sets were obtained at the first and third sowing date, respectively. Even improved cultivars (Primavera and Texas Yellow Grano) at third sowing date, produced very small onion sets, therefore they could not be harvest and store. At first and third sowing date, harvested set numbers were minimum and maximum, respectively. This phenomenon is causes of reactions onion cultivars to photoperiods and temperatures changes, because at first sowing date, low temperature conditions for germinating did not suitable but after germinating probability growth and development stage property at long periods, but third sowing date, against of it was seen. It means, at third sowing date, germinating conditions was suitable, but high temperature growth and development conditions were not suitable. The second sowing date, environmental conditions for germinating and growing seedling relative prepared. Because set numbers and its size in improved cultivars were better for production set then other sowing date. This also confirms the finding of Cheema *et al.* (2003), who observed on November, gave the greatest average set size, whereas sowing on the 1st week of March gave the highest average number of sets kg^{-1}. Cultivars reactions to the changes of photoperiod and temperatures were different. Improved cultivars after 2 leaves formatted mini sets where as local cultivar (Ramhormozy and Behbahany) tolerated this condition and they could store more assimilate, they could harvested and stored.

Onion set size is one of main factor for producing onion bulb or green onion. Large onion sets produce bolting plant in field (Khokhar *et al.*, 2001). Because at storage and growth and development stages, can be stimulated low temperature and vernalized, but small onion set can not be vernalized in storage period and at

growth and development stage. Because they did not complete juvenile phase and they have slow growth and delay sensitivity to low temperature, therefore onion sets percentage which produce bolting, reduce. Big and small sets formatted in low and high density. This confirms previous findings (Rajesh-Kumar *et al*., 2003) that increasing the total number of sets and sets small size with increase in seed rate. However, the number large and very large sets decreased.

A main aim of this experiment was to determine the best sowing date for producing set from each cultivar at spring season. If production set used for producing green onion, the best date is first sowing date and low density especially for local cultivars. Because at autumn sowing sets, they are very fast growth and development in early season, but at winter, they will be vernalized and produce scap. But if this set used for producing bulb, the best date is second date sowing, high density especially for improved cultivars. These cultivars have higher resistant to bolting, then local cultivars and can produce bulb 45 days earlier then others methods if they are sown 30 days after normal sowing date.

CONCLUSIONS

- Probity production onion set after removing chilling winter exit in the Khuzestan province.
- Various sowing date affect on onion set size and the best sowing date for producing set is for producing bulb onion middle February but for producing green onion last January.
- Various density effects on onion set maximum and minimum size set obtain in low and high density, respectively.
- Various cultivars reaction to changes conditions difference. Primavera cultivar react earlier then other cultivars.

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