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Onion Sets' Yield and Quality as Affected by Seed Rate of Two Onion (*Allium cepa* L.) Cultivars.

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Abstract: Onion bulb crop production using sets as planting material has been increasing for the last decade in response to the high demand and because of their high yielding capacity and adaptability to the continuously changing growing environment. The objective of this experiment, therefore, was to investigate the effect of seed rate on the yield and quality of onion sets as a highly demanded planting material. Treatments comprised two cultivars (Kamlin and Saggai) and three seed rates (60,120 and 180 kg/ha.). They were arranged in a split plot design with three replications. Cultivars were in the main plots and seed rates in the subplots. Average set weight and total set yield decreased with increasing seed rate. The highest yield was produced at 60 kg/ha and the lowest at 180 kg/ha. seed rate. Yield of the set size distribution categories was significantly affected by seed rate; seed rate of 120kg/ha resulted in the highest yield of medium set (best for production of bulbs), followed by 60 and 180 kg/ha. Yield of set size categories decreased with increasing seed rate except for small set size category which significantly increased with increasing seed rate.

Key words: common onion, *Allium cepa* L., onion set, seed rate

INTRODUCTION

Sets are small, dry bulbs, which are produced from seeds at high density in the first season and planted in the second season for production of green onion or dry bulbs. They typically weigh 2-3 g with less than 25mm in diameter per set. In many parts of the world, use of onion sets is considered a

profitable specialized method for bulb crop production. Sets are easier to grow and handle in the field especially for early season crop. However, the possibility for premature bolting and splitting of produced bulb crop is slightly higher compared with seedlings or direct seeding (Matlob and El-habar 1983; Koriem and Farag 1990; Gamie, 1997); yet the extent of these two undesirable traits is a function of set size, their storage, growing environment and cultivar used.

More recently in Sudan, use of sets to produce bulb crop has been increasing because of its high yield, easiness to handle and adaptability to the changing growing environments in the main production areas. Nevertheless, research addressing onion set production and use is meager and little is known about the optimum management practices for sets' production. The objective of this experiment was, therefore, to determine the appropriate seed rate that produce the maximum optimum set size (medium) for production of onion bulb crop.

MATERIALS AND METHODS

The experiment was conducted at the research Farm of the Faculty of Agriculture at Shambat, University of Khartoum for two consecutive seasons 2010/11, 2011/12. Shambat lies at 15° 40´N and 32° 32´E; its climate is semi-arid tropical with mean maximum and minimum temperature as high as 41.6° c in summer and as low as 14.1°c in winter (Adam 1996). Treatments comprised three seed rates (60, 120 and 180 kg/ha) and two cultivars (Kamlin and Saggai). They were arranged in a split plot design with three replications; cultivars were in the main plots and seed rates in the subplots. Seed germination percent of both cultivars was 85 %. Seeds were sown in December 16 for both seasons. Phosphorus in the form of superphosphate at the rate of 70kg P_2O_5/ha was applied to plots prior to sowing. Irrigation was initially kept at 4 days intervals until most of the seeds had uniformly germinated; thereafter, a weekly interval was maintained. Nitrogen fertilizer in the form of urea was applied at the rate of 80 kg N/ha in two doses 3 and7 weeks after sowing. All other cultural practices required were applied as needed.

When most of the foliage had begun to collapse (plants' neck breaking), harvesting of sets was done on April 20 and 30 for the first and second seasons, respectively. One square meter from the middle of each plot was harvested, cured for two weeks, topped and data for total yield was calculated and transformed into Tons/ha (t/ha.). Sets were then graded into 4 categories according to their bulb diameter *i e* > 2.7cm as very large, 2.2 – 2.6 cm as large, 1.6 – 2.1 cm as medium and 1.0 – 1.5cm as small. The average set weight was determined by dividing the total yield of the harvested area by the total number of sets. Less than small and larger than 2.7 cm sets were discarded.

Data collected were statistically analyzed using SAS (2000) soft ware, version 9.00.

RESULTS AND DISSCUSSION

Total yield and average set weight were significantly different among treatments in both seasons (Table 1). Total yield of sets from Kamlin cultivar significantly exceeded that of Saggai; however, potentially useable set categories represented 73 %- 79 % of the total yield of Saggai while that of Kamlin was 72 %-73 % in both seasons. It was observed that cultivars responded differently to increasing plant population. That is, the growth and yield of Saggai cultivar was more adversely affected by the high population density (180 kg/ha.) than Kamlin, such that all seedlings of Kamlin produced useable set size for propagation, while approximately about 30 % of those of Saggai died or failed to produce sets. This might explain the fact that total set yield was not significantly different between the seed rate treatments 120 and 180 kg/ha. The highest total set yield and average set weight was obtained with the 60 kg/ha seed rate compared with 120 and 180 kg/ha. Such increase in yield was probably because plants from lower population density did not suffer competition for growth requirements (nutrients, water, light…….etc) *compared* to higher seed rate (high population density). That is, plants (seedlings/ sets) from lower population density produce taller plants with higher number of leaves capable of producing high percent of useable

sets/bulbs due to less competition. In fact the proportion of useable sets categories to the total sets yield was 67 % - 69 %, 85 % - 93 % and 56 % - 72 % from the seed rates 60, 120 and 180 kg/ha respectively. Several reports indicated that size of the bulbs/sets decreased as the plant density increased (Smith 1961; Moursi *et al.* 1975; Hrtridge and pannet 1980; Koriem and Farag 1990; Nourai *et al.* 2015).

Table 1. Average set weight(g) , Total set yield (t/ha) and yield of useable sets categories (t/ha) of cultivars Kamlin and Saggai as affected by seed rate in seasons 2010/11 and 2011/12.

Treatments	Average set weight	Total set yield	Yield of useable set categories
Cltivars		First season 2010/11	
Kamlin	5.5[a]	13.2[a]	9.8 (74)
Saggai	5.1[a]	10.2[b]	8.1 (79)
SE±	0.18	0.19	
Seed Rates			
60 kg/ha.	6.5[a]	14.2[a]	9.8 (69)
120.kg/ha.	5.2[b]	11.2[b]	9.6 (85)
180 kg/ha.	4.4[b]	10.7[b]	7.7 (72)
SE±	0.36	0.13	
Cultivars		Second season 2011/2012	
Kamlin	5.6	10.6	7.6 (72)
Saggai	4.5	8.2	6.0 (73)
SE±	0.56	0.32	
Seed Rates			
60. kg/ha.	5.7	11.4	7.8 (68)
120 kg/ha	4.9	8.2	7.6 (93)
180 kg/ha.	4.5	8.6	4.8 (56)
SE±	0.43	0.29	

Means within columns followed by the same letter(s) are not significantly different at $P \leq 0.05$ according to Duncan Multiple Range Test.
Values in parentheses are percentages of the specific parameter to the total yield.

Response of cultivars to production of the different set categories was not consistent. Yet, Kamlin produced the highest exra large, large and small sets' yield in the first season and also the highest, yet not significant, set yield of the four categories in the second season. Saggai was superior to Kamlin in producing higher medium set size yield in the first season (Table2). In both seasons' yields of extra large and large sets significantly decreased with increasing seed rate while that of small sets significantly increased with increasing seed rate. Medium set size production maintained an intermediate response with the highest yield being at 120 kg/ha seed rate (Table 2). From bulb quality point of view, large set size is associated with high bulb splitting and pre-mature bolting (Robinowitch 1979; Matloub and El-Habar 1983; Shalaby *et al.* 1991), small set is associated with low bulb yield (Nourai 1993; Pandey *et al*. 1992; Ali 1998) and medium set size have been preferred for high total and marketable yields (Shalaby *et al.* 1991, Nourai 1993; Ali 1998).

The above discussion suggests that seed rate of 120 kg/ha. Produces the highest yield of the preferred medium size sets for bulb crop production depending on the cultivar and the prevailing environment.

Table 2. Yields (t/ha) of set size distribution categories of cultivars Kamlin and Saggai as affected by seed rates for seasons 2010/11 and 2011/12.

Treatments	Extra Large	Large	Medium	Small
Cltivars		First season 2010/11		
Kamlin	2.2[a] (22)	3.6 (37)	1.8 (18)	2.2 (22)
Saggai	1.6[b] (20)	2.9 (36)	2.0 (25)	1.6 (20)
SE±	0.04	1.40	1.10	0.04
Seed Rates				
60 kg/ha.	2.6[a] (27)	4.1a (42)	1.8[ab] (18)	1.3[c] (13)
120.kg/ha.	1.9[b] (20)	3.3[b] (34)	2.5[a] (26)	1.9[b] (20)
180 kg/ha.	1.3[c] (17)	2.3[c] (30)	1.5[b] (19)	2.6[a] (34)
SE±	0.09	0.90	0.13	0.08
Cultivars		Second season 2011/2012		
Kamlin	1.7 (22)	2.8 (37)	1.3 (17)	1.8 (24)
Saggai	1.3 (22)	2.3 (38)	1.1 (18)	1.3 (22)
SE±	0.87	0.87	0.10	1.00
Seed Rates				
60. kg/ha.	2.1[a] (27)	3.3[a] (42)	1.4[ab] (18)	1.0[c] (13)
120 kg/ha	1.5[b] (20)	2.6[b] (34)	2.0[a] (26)	1.5[b] (20)
180 kg/ha.	1.0[c] (21)	0.5[c] (10)	1.2[b] (25)	2.1[a] (44)
ES±	1.5	1.5	0.50	0.45

Means within columns followed by the same letter(s) are not significantly different at P ≤0.05 according to Duncan's Multiple Range Test.
Values in parentheses are percentages of the specific parameter.

CONCLUSIONS

- Seed rate of 120 kg/ha. is the optimum to produce the highest yield of the preferred medium size set.
- Decreasing the seed rate, increases the yield of extra large and large set sizes and increasing the seed rate increases the yield of small set sizes.
- Onion cultivars vary in their capacity to produce onion sets depending on the growing environments.

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تأثير معدل البذر على إنتاجية ونوعية البصيلات فى صنفين من البصل (*Allium cepa* L.)

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المستخلص: تزايد إنتاج البصل بإستخدام البصيلات خلال العقد الماضي نتيجة لإنتاجيته العالية وسهولة تكيفه لبيئة الإنتاج المتغيرة دوماً.عليه أدى ذلك إلى تنامي الطلب على البصيلات للإستخدام كتقاوي. هدفت هذه التجربة للإرتقاء بإنتاجية ونوعية البصيلات وذلك بالتحقق من أثر معدل البذر على ذلك. تكونت معاملات التجربة من صنفين من البصل (كاملين وسقاي) وثلاثه معدلات بذره (60، 120، 180 كجم /هكتار). نُظمت المعاملات في تصميم القطاعات المنشطرة بثلاثة مكررات، بحيث أن وضعت الاصناف في القطع الرئيسة ومعدل البذور في قطع الإنشطار الاول. تدنى متوسط وزن البصيلة والإنتاج الكلي للبصيلات مع الزيادة في معدل البذور. أعلى إنتاجية للبصيلات كانت 14.2 طن/هكتار من معدل البذر 60 كجم/ هكتار وأدناها 10.7 طن/هكتار من معدل البذر 180 كجم/ هكتار. تاثر إنتاج مجموعات أحجام البصيلات معنوياً بمعدل البذر؛ فاعطى معدل 120 كجم/ هكتار أعلى إنتاجية من أحجام الأبصال المتوسطة (الافضل لإنتاج البصل)، تلاه معدل البذر 60 كجم و 180 كجم/ هكتار. تدنت إنتاجية مجموعات احجام البصيلات (كبير جداً، كبير، متوسط) بزيادة معدل البذر إلا مجموعة البصيلات الصغيرة التي زادت إنتاجيتها إحصائياً مع زيادة معدل البذر.