Asian Journal of Plant Sciences

ISSN 1682-3974

Asian Journal of Plant Sciences
Volume 1 Number 6: 657-658, 2002

Bulb Yield and Quality as Affected by Set Size in Autumn Season Onion Crop

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Abstract: The study was conducted to examine the effect of set size on bolting, bulb yield and quality in onion cultivar 'Phulkara' during autumn season 2001. Highest percentage of bolting (31.1 %) and doubles (69.4 %) was recorded in large sets of 29 mm diameter. In large size sets (29 mm diameter) bulbs matured in minimum time (134.5 days). Highest marketable bulb yield (26 t ha^{-1}) was obtained with 17 mm diameter set followed by 20 and 23 mm diameter yielding 22.9 and 20.0 t ha^{-1}, respectively. Large size sets (26 and 29 mm diameter) produced significantly higher un-marketable bulb yield of 13.9 and 14.9 t ha^{-1}, respectively.

Key words: Onion, bulb yield, quality, bolting, splitted bulbs

Introduction

Onion (*Allium cepa* L.) is an important condiment consumed in all households all the year round. Onions are rich in phosphorus, calcium and carbohydrates and are used in soups, sauces and for seasoning foods. Total area under cultivation of onion in Pakistan was 109.8 thousands hectares with production of 1648 thousand tones (Anonymous, 2001). Among the vegetables, maximum area is grown under the onion of which 45 % occurs in Sindh, 26 % in Balochistan, 21 % in Punjab and 8 % in NWFP (Anonymous, 2001). The varying agro-climatic conditions prevailing in the country make it possible to produce onions all the year round. The main supply of onion from all provinces continues arriving in the market from May to December. Onion cultivation during autumn season would ensure its supply from January onward and help the producer in getting remunerative price for his produce. For autumn crop of onion it is difficult to manage nursery seedlings because of high temperature and monsoon rains. It was therefore, planned to use onion sets for direct planting of onion and to eliminate the step of nursery raising which is not only time consuming but laborious as well. In many countries, onions are largely planted as sets.

Size of onion set is closely related to subsequent yield (Khokhar *et al.*, 2001). Khokhar *et al.* (2001) found that bulbs developing from large sets (21-25 mm) showed significantly higher percentage of bolting (40 %) than those of medium and small sets with 29.4 and 20.8 % bolting, respectively. Madisa (1993) compared three sizes of onion set and reported highest yield of 45.4 t ha^{-1} with medium sets (18-25 mm) following large (25-30 mm) and small (12-18 mm) sets producing 37.6 and 30.6 t ha^{-1}, respectively. Khokhar *et al.* (2001) reported that medium (16-20 mm diameter) and large sets (21-25 mm diameter) produced significantly higher bulb yield than small sets (10-15 mm diameter). It was, therefore, considered appropriate to investigate the effect of set size on bulb yield and quality in onion with the objective to find out suitable set size for the higher production of yield and quality bulbs in autumn season crop.

Materials and Methods

The study was conducted at Horticultural Sciences Institute, NARC, Islamabad during autumn season 2001. Variety 'Phulkara' of onion was used for autumn season crop because it proved better in bulbing response under decreasing temperature and photoperiod (Khokhar *et al.*, 2001). Six set sizes of onion measuring 14, 17, 20, 23, 26 and 29 mm diameter were sown on Ist September, 2001. For raising sets, the seed was sown in the nursery bed during last week of February 2001. The sets were harvested at the end of May 2001 and were placed in a well-ventilated store till planting in the field. The experiment was designed as a randomized complete block design. The data were recorded for each treatment in respect of time to bulb maturity, percentage of doubles, marketable, un-marketable and total bulb yield. The percentage of un-marketable bulb yield for each treatment was also calculated. The autumn season onion crop because of low temperature does not ripen properly and the majority of plants do not show sign of neckfall whereas in normal season crop, the crop mature properly due to higher temperature and the maturity time is considered when 80 % of the plants show neckfall (Mondal *et al.*, 1986) Therefore, the maturity time in autumn crop under study was taken when neckfall was observed in few plants and in rest of the plants it was done manually.

The data collected were subjected to analysis of variance technique and means were compared by using Duncan's multiple range test (Steel and Torrie, 1980)

Results and Discussion

Days to maturity: The time to bulb maturation increased from 142 to 155.5 days with increasing size of sets (14 to 23 mm diameter) and then decreased from 140.8 to 134.5 days in sets with 26 to 29 mm diameter (Table 1). The crop sown with sets of 29 mm diameter took minimum time of 134.5 days to mature. Results of these studies are in conformity with those of Jones and Mann (1963) who reported that large sets accelerate maturity. Early maturity in large sets might be due to competition for assimilates for higher number of shoots normally produced by large sets. The small/medium sets normally produce single shoots and it could be that no competition between shoots for nutrients occurred and as a result small/medium size sets took relatively longer time to mature than large size sets (26 and 29 mm diameter).

Percentage of bolting: Results indicate that set size had a significant effect on percentage of bolting which increased with increasing set size (Table 1). Large size sets (29 mm diameter) resulted in higher percentage of bolting (31.1 %). Minimum percentage of bolting (3.0 %) was recorded in small size sets (14 mm diameter). Such findings are in conformity with the reports of Brewster (1987) who showed that relative rate of vernalization increased with increasing bulb weight/size, which favoured floral initiation. This is why the large sets gave higher percentage of bolting than either small or medium sets. Khokhar *et al.* (2001) also reported the same results that large sets were more prone to bolting than small sets.

Percentage of doubles/splitted bulbs: Statistical analysis of the data (Table 1) revealed that size of set had a significant ($P<0.01$) effect on percentage of doubles. Bulbs grown from large sets showed a stronger tendency to double than those from small sets. Highest percentage of doubles (69.4 %) was recorded in large size sets (29 mm diameter) while lowest percentage (6.1 %) was observed in small sets (14 mm diameter). These results substantiate the findings of Chipman and Thorpe (1977) and Khokhar *et al.* (2001) who reported that plants growing from large sets were more prone to doubling than those developing from smaller sets.

Table 1: Effect of set size on bulb yield and quality in autumn season onion crop

Set size (mm diameter)	Days to maturity	Percentage of bolting	Percentage of doubles	Marketable yield (t ha^{-1})	Un-marketable yield (t ha^{-1})	% age of un-marketable yield	Total yield (t ha^{-1})
14	142.0d	03.0e	06.1e	18.0d	02.2d	12.0e	20.2c
17	144.5c	04.8e	09.6e	26.0a	02.5d	09.5e	28.5b
20	150.0b	08.1d	17.2d	22.9b	04.9c	21.5d	27.8b
23	155.5a	16.2c	47.2c	20.0c	11.7b	58.6c	31.7a
26	140.8d	25.8b	55.8b	18.8cd	13.9a	73.7b	32.7a
29	134.5e	31.1a	69.4a	17.5d	14.9a	85.5a	32.3a

Means followed by different letters differ significantly at $P < 0.01$

Marketable bulb yield: Statistical analysis (Table 1) showed that size of set had significant ($P<0.01$) effects on the marketable bulb yield. Maximum marketable bulb yield (26 t ha^{-1}) was obtained with 17 mm diameter sets followed by set sizes of 20 and 24 mm diameter yielding 22.9 and 20.0 t ha^{-1}, respectively. The result agreed with those of Madisa (1993) and Khokhar *et al.* (2001) who observed that size of set affected the subsequent yield in onion.

Un-marketable bulb yield: Large size sets (26 and 29 mm diameter) produced significantly higher un-marketable bulb yield (13.9 and 14.9 t ha^{-1}, respectively). Lowest un-marketable bulb yield of 2.2 and 2.5 t ha^{-1} was recorded in small size sets of 14 and 17 mm diameter, respectively (Table 1). Large sets are prone to bolting/splitting and higher un-marketable bulb yield in these sets was due to higher percentage of double/splitted bulbs which lowered their marketable appeal. This has also been confirmed by Rabinowithch (1979).

Percentage of un-marketable bulb yield: Statistical analysis of the data (Table 1) revealed that size of set had significant effect on percentage of un-marketable bulb yield. Highest percentage of un-marketable bulb yield (85.5 %) was recorded in large size sets (29 mm diameter) while lowest (9.5 %) was recorded in small size sets (14 mm diameter). The tendency to develop double bulbs in large size sets affecting their consumable appeal has been reported by Rabinowithch (1979) and Khokhar *et al.* (2001).

Total bulb yield: Total bulb yield recorded in large size sets of 23, 26 and 29 mm diameter was statistically at par with one another but was significantly higher than either of small or medium sets used in the experiment (Table 1). In large sets, though the total bulb yield was higher but marketable bulb yield was lower due to higher percentage of un-marketable yield.

In conclusion, medium size sets of 17 mm diameter are suitable for obtaining higher marketable bulb yield in autumn season crop of onion. Furthermore, these sets are also suitable for producing quality bulbs with relatively low percentage of bolting and doubles.

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