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Short Communication

EFFECTS OF PLANT DENSITY AND CULTIVAR ON GEOMETRICAL PROPERTIES OF BULB AND BULB YIELD OF CLUSTER ONION (*ALLIUM CEPA* L.)

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INTRODUCTION

Onion (*Allium cepa* L.) is considered as the second most important vegetable and the most widely used spice in the world. China is the major onion producer in the world which produces about 20,907,759 mt (Nisha, 2016). Sri Lanka produced 1,505,30 mt of onion in 2015 (DCS, 2015). Red onions are a major component in the diet of Sri Lankan households and a high value cash crop of the Dry and Intermediate Zones (Selvarajah and Sivarajah, 2014). Cluster onion (Red onion) production in Sri Lanka is 61,200 mt in 2015 (DCS, 2015). Vethalan, Thinnavely Red, Jaffna Local and Thelulla Selection are the cultivars that are cultivating in Sri Lanka. Rambawa White is not cultivated and it has a tendency for popularized in cultivated area. These cultivars are grown at different spacing in each location. Therefore, finding of best plant density for different cultivars is important for the quality and yield of the cluster onion. Geometrical properties such as size, shape and area are essential for analysis of the behaviour of the onion product during processing or during design of any equipment for processing and storage (Kaveri and Thirupathi, 2015). This study aimed at investigating the effect of plant density and cultivars for geometrical characters of the bulb and yield of the cluster onion.

MATERIALS AND METHODS

The held experiment was conducted at the Regional Agricultural Research and Development Centre, Aralaganwila (DL 2b), Sri Lanka during the 2014 *Yala* season. Treatments were arranged in randomized complete block design with three replicates. Plot size was 1m × 1m. Factorial combination is consisted with two factors having three row spacing (8 cm ×8 cm, 10 cm × 10 cm and 15 cm × 15 cm) with 156, 100 and 44/m^2

plant densities with five cultivars (Jaffna Local, Vethalan, Thinnavely Red, Rambawa White and Thelulla Selection). All the other cultural practices were done according to the Department of Agriculture recommendation. Bulbs were separated 2 weeks after harvesting from the cluster and 10 randomly selected bulbs were used to measure geometrical characters *viz.*, polar diameter (mm), equatorial diameter (mm) and shape index. Polar diameter (Dp) and equatorial diameter (De) of bulbs were measured with 0.01 mm least count of digital vernier caliper. Polar diameter is the distance between the onion crown and the point of root attachment to the onion, whereas, equatorial diameter is the maximum width of the onion in a plane perpendicular to the polar diameter (Kaveri and Thirupathi, 2015). Shape index (SI) was defined as the ratio of the equatorial diameter to the polar diameter (Equation 1). A spherically shaped onion having a shape factor of one. Oblate onions have a shape factor > 1 and < 1 for the prolate shape (Essa and Gamea, 2003).

SI = Polar diameter/ Equatorial diameter (Equation 1)

Total bulb yield was measured and the mean values subjected to the Analysis of Variance (ANOVA) using SAS version 9.1 computer software (SAS, 2008) and mean separation was done using Duncan Multiple Range Test at $\alpha = 0.05$.

RESULTS AND DISCUSSION

Results indicate that there were no significant interaction ($P > 0.05$) between variety and plant densities (row spacing) on total yield, polar diameter, equatorial diameter and shape index at 0.05 % probability level. Main effect of variety did not significantly affect ($P > 0.05$) on total bulb yield whereas plant density significantly affected ($P < 0.05$) on the total yield of the cluster onion (Table 1). The total bulb yield has decreased with the increase of the row spacing from 8 cm to 15 cm. Kahsay *et al.* (2013) also found the decreasing of onion yield with the increasing of intra row spacing. But Gashua and Abbator (2013) indicated the opposite result to this.

Raw spacing did not significantly ($P > 0.05$) affect on the polar diameter while variety had an effect (Table 2). Kahsay *et al.* (2013) also revealed this result whereas found the significant effect of the intra raw spacing to the bulb length. Variety Vethalan showed the highest polar diameter (25.9 mm) and the highest equatorial diameter (23.8 mm). Variety and raw spacing significantly affect for the equatorial diameter and shape index. Row spacing 15 cm × 15 cm gave the highest equatorial diameter (20.6 mm). Thelulla Selection, Jaffna Local and Rambawa White showed the highest shape index.

Row spacing 8 cm × 8 cm showed the highest shape index (1.43) and row spacing 15 cm × 15 cm showed lowest shape index (1.15). When raw spacing increases equatorial diameter of bulb tended to increase, decreasing the shape index of the bulb.

Table1. Effect of variety/cultivar and row spacing for total yield of cluster onion.

Treatments	Total Yield (t/ha)
Variety/Cultivar	
Jaffna Local	8.6 a
Vethalan	8.8 a
Thinnavely Red	6.6 a
Rambawa White	8.1 a
Thelulla Selection	6.5 a
CV%	37.2
Row spacing	
8cm x 8cm	11.0 a
10cm x 10cm	7.0 b
15cm x 15cm	5.5 b
CV%	37.2

Note: Means followed by the same letter in each column are not significantly different at p = 0.05.

Table 2. Effect of variety and row spacing for Polar diameter, equatorial diameter and shape index.

Treatments	Polar diameter (mm)	Equatorial diameter (mm)	Shape index
Variety/cultivar			
Jaffna Local	22.8 bc	18.0 bc	1.29 ab
Vethalan	25.9 a	23.8 a	1.09 b
Thinnavely Red	23.7 b	20.1 b	1.18 b
Rambawa White	23.1 bc	16.5 cd	1.44 a
Thelulla Selection	21.2 c	14.9 d	1.47 a
CV %	9.64	13.6	19.1
Row spacing			
8cm × 8cm	23.7 a	17.3 b	1.43 a
10cm × 10cm	22.8 a	18.1 b	1.29 ab
15cm × 15cm	23.5 a	20.6 a	1.15 b
CV %	9.64	13.6	19.1

Note: Means followed by the same letter in each column are not significantly different at $\alpha = 0.05$.

CONCLUSION

High bulb yield could be obtained by planting cluster onion at 8 cm × 8 cm spacing (156 plants/m^2) irrespective of the cultivar used in the study. Therefore, 8 cm × 8 cm spacing is suitable for all the cultivars. Plant density did not affect on the polar diameter and plant density and cultivar affect for equatorial diameter. Polar diameter depends on the cultivars. Therefore, designing of grading machine depends on the cultivar and plant density. Big bulbs can be taken by decreasing plant density and Vethalan is suitable for production of large size bulbs. Shape index of all the cultivars with the different densities get > 1value. Therefore, they all take oblate shape.

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