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Nisha Jangre
Department of Vegetable Science, COA, IGKV, Raipur, Chhattisgarh, India

Deepshikha
Ph.D. Research Scholar, College of agriculture, IGKV, Raipur Chhattisgarh, India

Corresponding Author:
Nisha Jangre
Department of Vegetable Science, COA, IGKV, Raipur, Chhattisgarh, India

Influence of pruning, gibberellic acid and planting densities on quality parameters of onion (*Allium cepa* L.) Var Agrifound Light Red

Nisha Jangre and Deepshikha

Abstract
The experiment was conducted at the Sant Kabir College of Agriculture and Research Station, Kabirdham (C.G.), during the rabi seasons of 2017–18 and 2018–19 in the Chhattisgarh plains to ascertain the quality parameters of rabi onions as effected by various pruning techniques, GA3 foliar spray, and transplant densities. Three factors, including pruning (P0- no pruning, P1- leaf pruning, P2- root pruning, and P3- leaf and root pruning), two levels of GA3 application (G0- no GA3 application and G1- GA3 at 150 ppm), and three levels of transplant density (D1- 20X15 cm, D2- 20x10 cm, and D3- 15X10 cm) comprised the treatments. The outcome showed that transplant densities, GA3 application, and pruning techniques all significantly impacted onion quality parameters. While the minimum bolting percent was recorded in P1G0D3 i.e. leaf pruning, no GA3, and planting densities (D3- 15X10 cm), and the maximum bolting percent was recorded in treatment P0G1D1 i.e. no pruning, GA3 150 ppm, and spacing D1- 20X15 cm, respectively, these treatments had different effects on the dry weight of the bulb, neck diameter, and ascorbic acid content.

Keywords: Onion, pruning, GA3, bolting, dry matter

Introduction

The family Alliaceae includes the onion (*Allium cepa* L.) (Hanelt, 1990) [11]. The most significant bulb crop grown commercially in the majority of the world is the onion.

The some of its relatives still grow in the wild in Central Asia, somewhere between Turkmenistan and Afghanistan. According to Grubben and Denton (2004) [10] and Bagali *et al*. (2012) [3], the alleged ancestor of the onion, who originated in central Asia, moved from that region to the Near East. The bulb of the widely used crop onion is used raw, diced for flavouring salads, and cooked alongside other vegetables and meat. It is one of the richest sources of flavonoids in the human diet, and studies have linked flavonoid consumption to a lower risk of diabetes, heart disease, and cancer. It also has antiviral, antibacterial, antiallergenic, and anti-inflammatory properties. In order to satisfy the requirements of both processing and fresh market purchasers, one onion quality parameter—the proportion of single-center bulbs—has become crucial (Brewster *et al*., 1980) [4]. Cultural practices and growing techniques can have an impact on the yield and quality of bulbs. Pruning is a direct method of positioning various plant components so that food materials can be distributed into the foliage or reproductive organs (Gardner, 1966) [7]. Pruning is mostly done to balance and affect the hormones and minerals. One of the key growth-stimulating compounds, GA3, encourages cell division and elongation, aiding in the growth and development of several plants. The concentration of plant growth regulator and the timing of administration, however, are the key factors that influence crop yield and quality enhancement (Singh, 1995) [21]. One of the cultural approaches to control bulb size, shape, and output is plant spacing management (Geremew *et al*., 2010) [8]. Optimal plant density will result in a higher yield and better control of over or undersized bulbs. As population density rose, so did bulb neck diameter, mean bulb weight, and plant height As population density rises, total bulb yield can also rise (Kantona *et al*., 2003) [14]. Purwal and Dargan (1962) [19], Badaruddin and Haque (1977) [2], and Rahim *et al*. (1983) [20] all reported similar results. The purpose of the current work was to ascertain the impact of transplant densities, Gibberellic acid, and seedling pruning on onion quality attributes in the plains of Chhattisgarh.

Materials and Methods
During the Rabi seasons of 2017–18 and 2018–19, the experiment was conducted in the Sant Kabir College of Agriculture's research field and station at Kawardha, Kabirdham (C.G.). The experiment used a Factorial Randomize Block Design (FRBD) with three replications, statistical analysis for all parameters, with four levels of pruning (no pruning, leaf pruning, root pruning, and leaf and root pruning), two levels of GA_3 (without GA_3 application and GA_3 at 150 ppm), and three levels of transplant densities (20X15 cm, 20x10 cm, and 15X10 cm).

Quality parameters
The information on the qualitative characteristics, including dry bulb weight (g), bolting %, ascorbic acid content (mg 100 g-1), and neck diameter (mm), as affected by pruning, GA3, and transplant densities, is shown in Table 1 and in Fig 1.

Dry weight of bulb (g)
Effect of pruning
The dry weight of bulb of onion varied from 5.52 to 13.81 g during first year(2017-18), 5.55 to 14.01 g during second year (2018-19) and 5.53 to 13.91 respectively in case of mean data due to influences of different pruning methods.

The minimum dry weight of the bulb was noted under treatment P0, which is no pruning (5.52, 5.55, and 5.53 g), followed by P3i.e. Root and leaf pruning (8.07, 8.39, and 8.23 g), in the respective years (2017-18 and 2018-19), and on the basis of mean data. Among pruning treatments, P_1 i.e. leaf pruning obtained significantly maximum dry weight of the bulb (13.81, 14.01, and 13.91 g) during both years. The significant improvement in dry weight of bulb under leaf pruning could be attributed to its positive impact on plant growth and development in the present investigation.

Effect of GA_3
The analysis of the data revealed that, among Gibberellic acid treatments, treatment G1, or GA3 at 150 ppm as foliar spray, considerably increased maximum dry weight of bulb (10.11, 10.39, and 10.25 g) during years (2017–18 and 2018–19), and on the basis of mean data. However, the minimal dry weight of the bulb under treatment G0, or no GA3spray, was reported (8.94, 9.07, and 9.00 g) in the corresponding years and based on mean data.

Similar result have been reported by Magaino (1961) [17] who observed the effect of Gibberellic acid at 100 ppm in inducing leaf elongation and bulb growth which resulted into higher weight of bulb.

Effect of transplant densities
On the basis of mean data, treatment D1-20 x 15 cm among transplant densities produced bulbs with considerably higher dry weights (9.99, 10.17, and 10.08 g, respectively) than other treatments in both the 2017–18 and 2018–19 seasons. On the basis of mean data, treatment D3-15 x 10 cm had the lowest dry weight of bulb (9.08, 9.26, and 9.17 g, respectively) in both years (2017–18 and 2018–19).

Interaction effect
The interactions among pruning, GA_3 and transplant densities showed significant effect on dry weight of bulb in both years (2017-18 and 2018-19) and on the basis of mean data are presented in Table 1(b).

Following P1 i.e. leaf pruning XG1 i.e GA3 150 ppm XD2-20 x 10cm and P1 i.e. leaf pruning XG1 i.e GA3 150 ppm XD3-15 x 10 cm, the interactions between P1 i.e. leaf pruning XG1 i.e GA3 150 ppm XD1-20 x 15 cm recorded considerably increased dry weight of bulb (14. According to mean data, P0, which stands for no pruning XG0, which stands for no GA3 spray, X D3-15 x 10 cm, came in second, followed by P0, which stands for no pruning XG0, which stands for no GA3 spray, X D2-20 x 10 cm, and P0, which stands for no pruning XG0, which stands for no GA3 spray, X D1-20 x 15 cm.

The enhancement in dry weight of bulb under combined effect of Leaf pruning, Gibberellic acid at 150 ppm as foliar spray and transplant densities could be attributed to the marked influence on plant height, number of leaves, bulb diameter and bulb weight as a result of accumulation of more photosynthesis in bulb. Similar result were reported by Anwar (1995) [1} in garlic.

Bolting percentage of onion
Effect of pruning
Among pruning treatments, P_0*i.e.* no pruning obtained significantly maximum bolting percentage (8.22, 8.55 and 8.39 percent) followed by P_3*i.e.*root and leaf pruning (6.38, 6.89 and 6.64 percent) in comparison to rest of the treatments during both years (2017-18 and 2018-19) and on the basis of mean data while the minimum bolting percentage was noted under treatment P_1*i.e.* leaf pruning (3.26,3.75 and 3.51 percent) in respective years (2017-18 and 2018-19) and on the basis of mean data.

The bolting percentage of onion varied from 5.58 to 5.67 percent during first year (2017-18), 5.64 to 6.08 percent during second year (2018-19) and 5.76 to 5.93 percent respectively in case of mean data due to influence of Gibberellic acid.

Effect of GA3
Among Gibberellic acid, perusal of data indicated that treatment G_1 *i.e.* GA_3 at 150 ppm recorded significantly higher bolting percentage (5.67, 6.06 and 5.87 percent) during both years (2017-18 and 2018-19) and on the basis of mean data. However, the lower bolting percentage was noted under treatment G_0 *i.e.* no GA_3 (5.58, 5.64 and 5.61 percent) in respective years and on the basis of mean data.

Maximum bolting in the present study through Gibberellic acid treatment as foliar spray has been reported by Sachs *et al.* (1959) and Lang (1970). Loper and Waller (1982) [16] showed that Gibberellic acid as foliar spray treatment at higher rate significantly increased the bolting.

Effect of transplant densities
Among transplant densities, treatment D_1-20x 15 cm recorded significantly higher bolting percentage (6.12, 6.30 and 6.21 percent) bulbs respectively, than others in both years (2017-18 and 2018-19) and on the basis of mean data. However, the lowest bolting percentage (5.08, 5.84 and 5.46 percent, respectively) bulb was recorded in treatment D_3-15x 10 cm in both years (2017-18 and 2018- 2019) and on the basis of mean data.

The higher plant populations produced lower bolting percentage in comparison to lower plant population because the plants had sufficient leaf number to response to this condition and enter a sexual phase on the study. The similar results were also reported by Brewster (1994) [4].

Interaction effect

The interactions of data between P_1-leaf pruning X G_0- no GA_3 X D3-15x10 produced minimum bolting percentage (2.88, 3.41 and 3.15 percent respectively) during both years (2017-18 and 2018-19) and on the basis of mean data followed by P1-leaf pruning X G_0- no GA_3 X D2-15x10 (3.20 3.46 and 3.33 percent respectively). However, the maximum bolting percentage was recorded in P_0- no pruning X G_1- GA_3 150 ppm X D_1-20x15 (8.58, 9.30 and 8.94 percent respectively).

The interaction effect showed significant influence on percentage of bolted plants, due to pruning, no Gibberellic acid application and transplant densities. In support of the current result Hassen (1978) [12], Mohamodali (1988) and Khalid (2009) elucidated that at closer spacing, small bulbs are produced which are less susceptible to incidence of bolting.

Neck- diameter (mm)

Effect of pruning

According to the data, P1, or leaf pruning, had the largest neck diameter in bulbs for both the 2017–18 and 2018–19 growing seasons (11.38, 11.31, and 11.35 mm, respectively), and P1, or root pruning, came in second place (11.05, 10.84, and 10.94 mm). The treatment P0, which involved no pruning (10.31, 10.31, and 10.31 mm), was followed by P3, which involved pruning the leaves and roots (10.76, 10.55, and 10.65 mm, respectively) in both the 2017–18 and 2018–19 growing seasons.

The larger bulb diameter under this treatment in the current experiment may be the cause of the rise in neck thickness.

Effect of GA3

Among, Gibberellic acid treatment G1 i.e.GA3 at 150 ppm as foliar spray recorded significantly higher neck- diameter (10.97, 10.84 and 10.91 mm) during both years (2017-18 and 2018-19) and on the basis of mean data. However, the lower neck- diameter was noted under treatment G0 i.e.no GA3 spray (10.78, 10.66 and 10.72 mm) in respective years and on the basis of mean data.

There was significantly greater improvement under Gibberellic acid in respect to neck thickness. This may be attributed to greater bulb diameter in the present investigation. Anwar (1995) [1] reported that Gibberellic acid had marked influence on bulb diameter and neck thickness besides other vegetative growth and yield parameter were also improved in garlic. Bulb diameter and neck thickness, as well as other vegetative growth and yield parameters.

Effect of transplant densities

When comparing transplant densities, treatment D1-20 x 15 cm significantly increased neck diameter over other treatments in both years (2017–18 and 2018–19) and based on mean data (10.93, 10.80, and 10.86 mm, respectively). On the basis of mean data, treatment D3-15 x 10 cm had the smallest neck-diameter (10.82, 10.69, and 10.76 mm, respectively) in both years (2017–18 and 2018–19). These findings are comparable to those of Dawar *et al*. (2007) [6], who found that the neck thickness generally rose as planting density dropped. The cause may be because there is less competition from onion plants growing farther apart for moisture and nutrients. According to Chaudhry *et al*. (1990) [5] and Dawar *et al*. (2007) [6], reduced planting density considerably increased bulb neck thickness, and the current finding is consistent with their findings. Jilani (2004) [13] similarly discovered thick-necked bulbs in the plots with the fewest plants (20 plants m-2), whereas the plots with the most plants (40 plants m-2) produced bulbs with a narrower neck. Neck thickness and bulb diameter have a favorable correlation, according to Patil and Kale (1985). Increases in the neck-thickness in onion plants with wider spacing could be the result of less competition for moisture, nutrients, and light, which could have led to an increase in leaf development and tissue senescence (Jilani, 2004) [13].

Interaction effect

The interactions between P1- leaf pruning XG1 -GA3 150 ppm XD1-20 x 15 cm recorded considerably greater neck-diameter values (11.49, 11.42, and 11.46 mm), which were followed by P1- leaf pruning XG1 -GA3 150 ppm XD2-20 x 10cm and P1-GA3 150 ppm XD3-15 x 10 cm. On the basis of mean data, the minimum neck-diameter was discovered under the treatment combination of all planting densities without pruning and without applying GA3.

These findings are consistent with those made by Dawar *et al*. (2007) [6], who found a substantial decrease in onion neck diameters as plant population grew from 40 to 80 plants. According to Jilani *et al*. (2009) [13], plots with the fewest plants per square meter (20 plants m-2) were where thick neck onion bulbs were discovered. Bulb neck diameter shrank with increasing population density. As population density grew, the mean bulb weight and plant height dropped (Kantona *et al*., 2003) [14].

Ascorbic acid content in bulb

Effect of pruning: The data pertaining the results revealed that P_1*i.e.* Leaf pruning had maximum value of ascorbic acid content (3.85, 3.98 and 3.92 mg 100 g^{-1} respectively) in bulbs during both years (2017-18 and 2018-19) and on the basis of mean data followed by P_2*i.e.*root pruning (3.16, 3.26 and 3.21 mg 100 g^{-1}). The minimum value of ascorbic acid content (1.55, 1.74 and 1.65 mg 100 g^{-1}, respectively) was observes P_0 *i.e.* no pruning during both years (2017-18 and 2018- 19) and on the basis of mean data.

Effect of GA3

Examining the data for gibberellic acid revealed that treatment G1, or GA3 at 150 ppm as a foliar spray, had considerably greater ascorbic acid content (2.89, 3.03, and 2.96 mg 100 g-1) in both the 2017–18 and 2018–19 growing seasons, according to mean data. However, with treatment G0, i.e., no GA3 spray, the ascorbic acid concentration was found to be lower (2.53, 2.69, and 2.61 mg 100 g-1) in the corresponding years and based on mean data.

The vitamin is produced in plants through a process that involves converting hexose, primarily glucose and galactose, into ascorbic acid. This mechanism results in the greatest ascorbic acid content in GA3 at 150 ppm as foliar spray. Similar results were published in 1994 by Veena Kumari *et al*. 1994 [22] Maximum ascorbic acid (12.85 mg/100g) was found in onion bulbs when gibberellic acid was given at an 80 ppm concentration, according to Singh *et al*. (2013) [23].

Effect of transplant densities

Among transplant densities, treatment D1-20x 15 cm recorded considerably greater ascorbic acid content than others in both years (2017–18 and 2018–19) and on the basis of mean data

(2.92, 3.01, and 2.96 mg 100 g^{-1} correspondingly) bulbs. On the basis of mean data, treatment D3-15 x 10 cm had the lowest ascorbic acid content (2.67, 2.74, and 2.70 mg 100 g^{-1}, respectively) bulb over both years (2017–18 and 2018–2019).

Interaction effect: In both years (2017–18 and 2018–2019), the interactions between pruning, Gibberellic acid, and transplant density had a substantial impact on the ascorbic acid concentration; on the basis of mean data, these interactions are shown in Table 1 (b). The perusal of data observed that P1-leaf pruning X G1- GA3 150 ppm X D1- 20x15 cm produced maximum ascorbic acid content (3.99, 4.20 and 4.09 mg 100 g^{-1}, respectively) bulbs as compared to other followed by P1-leaf pruning X G1- GA3 150 ppm X D2-20x10 cm (3.93, 4.02 and 3.98 mg100 g^{-1}), P1-leaf pruning X G1- GA3 150 ppm X D3-15x10 cm (3.87, 3.99 and 3.93 mg 100 g^{-1}).

The combined effects of the treatments may be responsible for the considerable increase in ascorbic acid concentration brought on by leaf trimming, Gibberellic acid, and transplant densities.

Table 1(a): Effect of seedling pruning, Gibberellic acid and transplant densities on dry weight of bulbs, bolting percentage, neck diameter and total soluble solids in onion

Treatment	Dry weight of bulbs (g plant $^{-1}$)			Bolting percentage			Neck Diameter (mm)			Ascorbic acid content in bulb(mg/100 g)		
	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean
Pruning methods												
P_0	5.52	5.55	5.53	8.22	8.55	8.39	10.31	10.31	10.31	1.55	1.74	1.65
P_1	13.81	14.01	13.91	3.26	3.75	3.51	11.38	11.31	11.35	3.85	3.98	3.92
P_2	10.69	10.98	10.84	4.64	5.08	4.86	11.05	10.84	10.94	3.16	3.26	3.21
P_3	8.07	8.39	8.23	6.38	6.89	6.64	10.76	10.55	10.65	2.27	2.47	2.37
SE±	0.05	0.06	0.05	0.07	0.07	0.07	0.15	0.15	0.15	0.07	0.05	0.06
CD (5%)	0.15	0.16	0.15	0.21	0.20	0.21	0.44	0.44	0.43	0.21	0.14	0.18
Gibberellic acid concentration												
G_0	8.94	9.07	9.00	5.58	5.64	5.61	5.85	10.66	10.72	2.53	2.69	2.61
G_1	10.11	10.39	10.25	5.67	6.49	6.08	6.06	10.84	10.91	2.89	3.03	2.96
SE±	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.11	0.11	0.05	0.04	0.04
CD (5%)	0.10	0.11	0.11	0.15	0.14	0.15	0.31	0.31	0.31	0.15	0.10	0.13
Transplant densities												
D_1	9.99	10.17	10.08	6.12	6.30	6.21	10.93	10.80	10.86	2.92	3.01	2.92
D_2	9.49	9.77	9.63	5.67	6.06	5.87	10.88	10.76	10.82	2.77	2.84	2.77
D_3	9.08	9.26	9.17	5.08	5.84	5.46	10.82	10.69	10.76	2.67	2.74	2.67
SE±	0.05	0.05	0.01	0.06	0.06	0.06	0.13	0.13	0.03	0.06	0.04	0.01
CD (5%)	0.13	0.14	0.03	0.18	0.17	0.17	0.38	0.38	0.08	0.18	0.12	0.03

Table1(b): Interaction effect of seedling pruning, Gibberellic acid and transplant densities on Dry weight of bulbs, Bolting percentage, Neck Diameter and Ascorbic acid content in bulb(mg/100 g) in onion

Treatment	Dry weight of bulbs (g plant $^{-1}$)			Bolting percentage			Neck Diameter (mm)			Ascorbic acid content in bulb(mg/100 g)		
	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean	2017-18	2018-19	Mean
$P_0G_0D_1$	5.74	5.75	5.74	8.76	8.03	8.40	10.27	10.22	10.25	1.56	1.74	1.65
$P_0G_0D_2$	4.69	4.78	4.74	8.31	7.98	8.15	10.23	10.21	10.22	1.38	1.51	1.45
$P_0G_0D_3$	4.63	4.60	4.62	7.95	7.86	7.91	10.10	10.13	10.12	1.22	1.46	1.34
$P_0G_1D_1$	6.33	6.38	6.36	8.58	9.30	8.94	10.54	10.47	10.51	1.76	2.05	1.90
$P_0G_1D_2$	5.86	5.91	5.89	8.20	9.19	8.70	10.38	10.41	10.40	1.73	1.94	1.84
$P_0G_1D_3$	5.85	5.87	5.86	7.49	8.95	8.22	10.32	10.40	10.36	1.68	1.75	1.72
$P_1G_0D_1$	13.77	13.95	13.86	3.49	3.88	3.69	11.33	11.33	11.33	3.81	3.93	3.87
$P_1G_0D_2$	13.30	13.53	13.42	3.20	3.46	3.33	11.30	11.28	11.29	3.77	3.89	3.83
$P_1G_0D_3$	12.81	12.87	12.84	2.88	3.41	3.15	11.25	11.07	11.16	3.75	3.85	3.80
$P_1G_1D_1$	14.73	15.02	14.88	3.55	4.02	3.79	11.49	11.42	11.46	3.99	4.20	4.09
$P_1G_1D_2$	14.36	14.66	14.51	3.44	3.98	3.71	11.47	11.40	11.44	3.93	4.02	3.98
$P_1G_1D_3$	13.89	14.03	13.96	2.98	3.73	3.36	11.44	11.36	11.40	3.87	3.99	3.93
$P_2G_0D_1$	10.37	10.63	10.50	5.28	5.03	5.16	11.03	10.84	10.94	2.97	3.08	3.03
$P_2G_0D_2$	10.11	10.17	10.14	4.60	4.28	4.44	11.00	10.71	10.86	2.96	3.07	3.02
$P_2G_0D_3$	9.11	9.43	9.27	3.69	4.05	3.87	10.94	10.64	10.79	2.87	2.93	2.90
$P_2G_1D_1$	12.09	12.16	12.13	5.42	5.94	5.68	11.17	11.00	11.09	3.73	3.82	3.77
$P_2G_1D_2$	11.27	12.14	11.71	4.98	5.74	5.36	11.12	10.94	11.03	3.26	3.42	3.34
$P_2G_1D_3$	11.21	11.33	11.27	3.87	5.45	4.66	11.06	10.88	10.97	3.16	3.23	3.20
$P_3G_0D_1$	8.00	8.23	8.11	6.73	6.69	6.71	10.67	10.50	10.59	2.15	2.36	2.26
$P_3G_0D_2$	7.87	7.87	7.87	6.32	6.65	6.49	10.66	10.48	10.57	2.03	2.31	2.17
$P_3G_0D_3$	6.83	7.08	6.95	5.74	6.40	6.07	10.59	10.48	10.54	1.89	2.19	2.04
$P_3G_1D_1$	8.93	9.19	9.06	7.17	7.54	7.36	10.93	10.62	10.78	2.72	2.92	2.82
$P_3G_1D_2$	8.46	9.07	8.76	6.32	7.21	6.77	10.88	10.61	10.75	2.52	2.52	2.52
$P_3G_1D_3$	8.32	8.88	8.60	6.02	6.85	6.44	10.83	10.59	10.71	2.32	2.51	2.42
SE±	0.13	0.14	0.13	0.18	0.17	0.18	0.38	0.37	0.38	0.18	0.12	0.16
CD (5%)	0.36	0.39	0.37	0.51	0.48	0.50	1.08	1.07	1.06	0.52	0.35	0.44

P_0 - (No pruning), P_1 -LP (Leaf pruning), P_2- RP (Root Pruning), P_3- LP+R (Leaf+Root Pruning), G_0 - (No GA3 spray), G_1- (GA3 150 ppm), D_1 - (20X15cm), D_2 - (20X10cm), D_3 - (15x10cm)

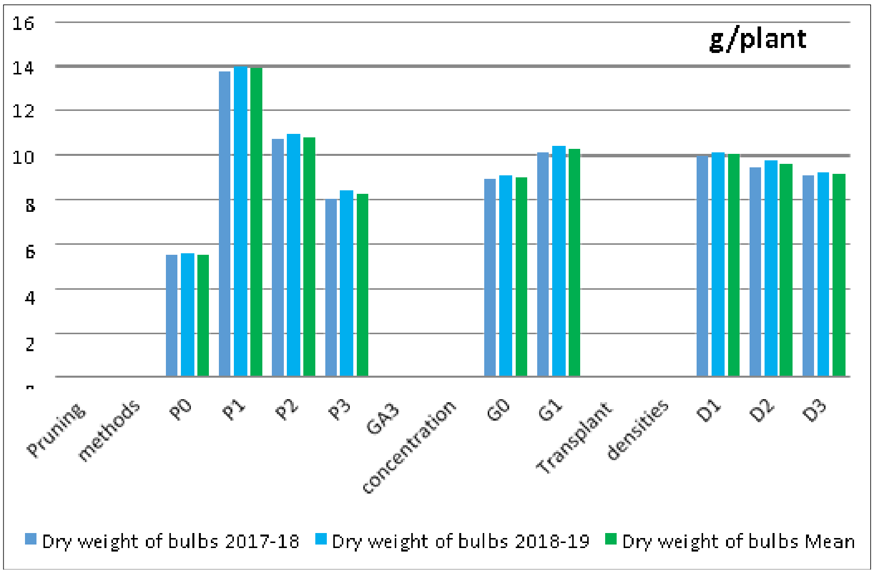

Fig 1: Dry weight of bulbs (g/plant)

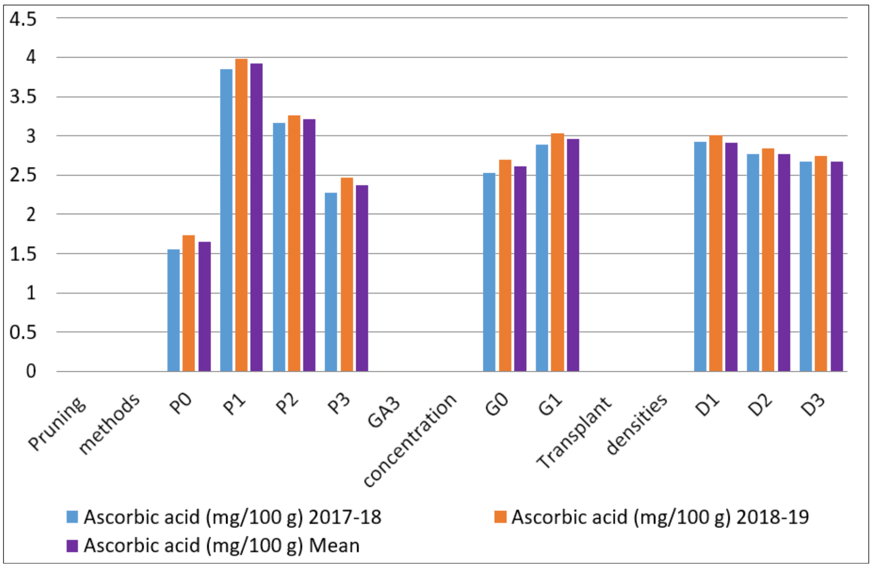

Fig 2: Ascorbic acid (mg/100 g)

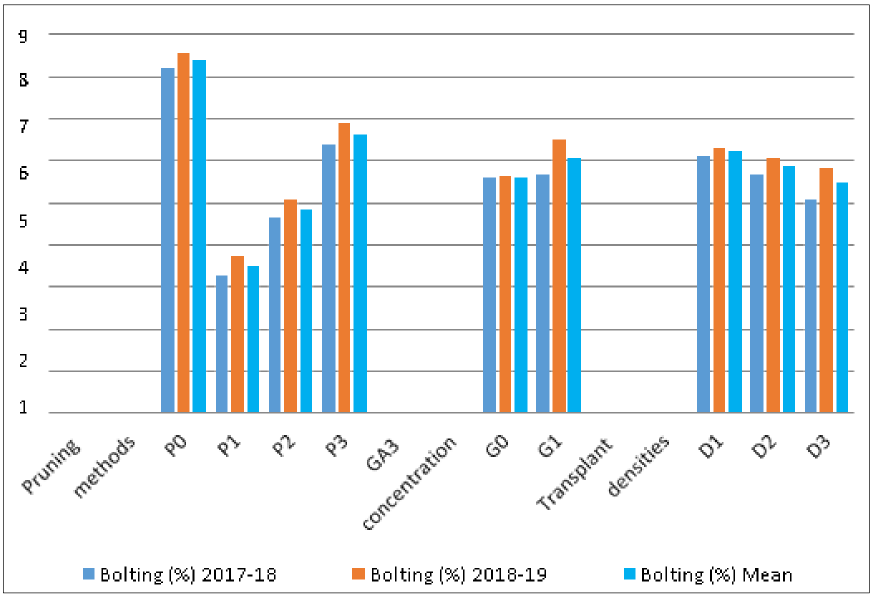

Fig 3: Bolting (%)

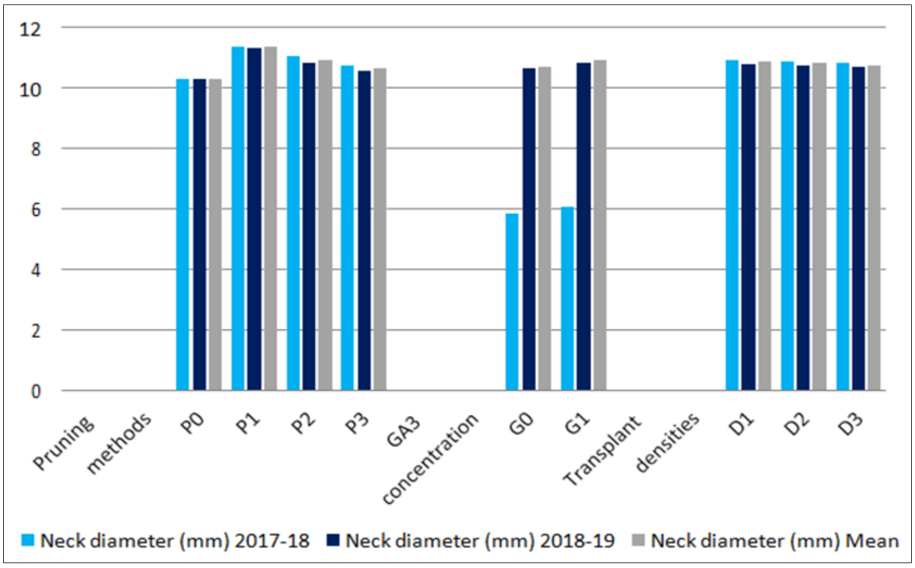

Fig 4: Neck diameter (mm)

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