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INFLUENCE OF PLANT BIO-REGULATORS ON THE GROWTH, YIELD AND PHYSICO-CHEMICAL CHARACTERISTICS OF ONION *(ALLIUM CEPA* L.)

S. Krishnaprabu

Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar-608 002 (Tamilnadu) India.

Abstract

This experiment was conducted at Trichy held to study about the efficacy of concentration of plant bio regulators on vegetative growth, yield and quality characters of onion cv. NHRDF-RED-2 having dry climate and high pH soil (8.2) during 2018-2019. The experiment comprised of 13 treatments [Control (water spray), GA_3 @ 50, 100 ppm, 150 ppm; NAA @ 50 ppm, 100 ppm, 150 ppm and combination of GA_3 and NAA] laid out in the Randomized Block Design with three replications. The observations revealed that the application of T_{11} [GA_3 @ 100 ppm + NAA @ 100 ppm] was better for improvement of growth *i.e.* plant height (76.50 cm), number of leaves (8.27), length of leaves (60.60) and basal diameter (2.05 cm) at 90 DAT. It also recorded the highest bulb yield (60.34 t/ha), fresh weight (90.51 g), dry weight (10.89 g), diameter (6.87 and 6.87 cm equatorial and polar, respectively) of onion bulb. Similarly, chemical properties like TSS (12.03° B) and pH (6.99) was found better under treatment T_{11} (GA_3 @ 100 ppm + NAA @ 100 ppm) followed by T_9 (GA_3 @ 50 ppm + NAA @ 150 ppm). Thus, the study suggested that combined application of bio regulators (GA_3 @ 100 ppm + NAA @ 100 ppm) may be followed to get better growth, yield and quality of onion cv. NHRDF-RED-2 under drier subtropical climate.

Key words : Bio-regulators, GA_3, Growth, NAA, Onion, Quality, Yield.

Introduction

Onion (*Allium cepa* L.) is one of the most commercial bulbous vegetables which is originated in Central Asia and belongs to family Alliaceae. The total area of onion in India was 834 mha and production 13565 mt in year 2008-09 and increased to 958-68 mha area and 16308.99 mt in production during 2012-13 (Anonymous, 2014). Onion is used in form of vegetable as well as salad although it has medicinal and preservative value. Fresh leaf and compact stem is edible part whereas green and spring onion are eaten as immature bulb and green foliage (Adamicki, 1998). It is highly adaptable because of its volatile flavors (containing sulfur) released during tissue disruption (Abbey and Joyee, 2004). This green onion is nutritively rich containing 87.6 per cent moisture, 0.9 per cent protein, 0.2 per cent fat, 8.9 percent carbohydrates, 41 kcal energy, and 0.05 per cent mg. 922IU vit. A. Matured bulb of 100 g onion contain 86.69 g moisture, 1.2 g protein, 0.1 g fat, 11.1 g carbohydrate, 50 kcal energy, 47 mg calcium, 50 mg, 0.7 g iron, 0.08 mg thiamine 0.01 mg riboflavin and 11 mg vit. C (Fageria *et al.,* 2006). Now-a-day, the main problem of onion is high price in the market. Increase in production can minimize this problem little bit. For this, the present experiment has been conducted to see the effect of plant bio regulators to increase the production. We know that among the bio regulators GA_3 and NAA increase the rate of photosynthesis, enlargement of cells and elongation of cells, so it can regulate the production and quality value of onion bulbs. GA_3 is synthesized from geranyl diphosphate is a multibenzyme pathway that is subject to complex regulation (Ouzounidoue/a/., 2008; Yamaguchi, 2008 and Yu *et al.,* 2009). GA_3 level is influenced by other hormones such as ethylene (Santner *et al.,* 2009). By modulation of lipids, perodoxidation through maintaining high level of such cellular scavengers as sod and catalase inhibits senescence by GA_3 (Dhindsa *et al.,* 1982). It is reported that ethephon decreased

***Author for correspondence :** E-mail : prabu1977krishna@gmail.com

photosynthesis by increasing ethylene levels (Davies, 1995). NAA spraying is significantly superior in the case of length of flower per plant, number of seed per umbel etc. in onion and which showed that effect of different concentration of plant growth regulators (PGRs) on onion production (Salah and Abd, 1989). Therefore, this experiment was aimed to study efficacy of different concentrations of NAA and GA_3 on growth, yield and quality characteristics of onion bulb grown under dry climate and high pH soil of Lucknow.

Materials and Methods

The presented experiment was conducted at farmers field at Trichy during 2018-2019. The experimental site was located at 26°50'N latitude, 80°52' E longitudes and at alleviation of 111 meter above-mean sea level. Bulbs of onion (*Allium cepa* L.) cv. NHRDF- RED-2 was obtained from National Horticulture Research Development Foundation (NHRDF), Kanpur. The field study was estimated with 13 treatments *i.e.* GA_3 (50, 100 and 150 ppm), NAA (50,100 and 150 ppm) and their combinations to each other in different concentrations were replicated three times following Randomized Block Design. In this experiment the treatment combinations were as follow- T_0- control (water spray), T_1- Gibberellic acid (GA_3) @ 50 ppm, T_2- Gibberellic acid (GA_3) @ 100 ppm, T_3- Gibberellic acid (GA_3) @ 150 ppm, T_4- Naphthalene acetic acid (NAA) @ 50 ppm, T_5- Naphthalene acetic acid (NAA) @ 100 ppm, T_6- Naphthalene acetic acid (NAA) @ 150 ppm, T_7- Gibberellic acid (GA_3) @ 50 ppm + naphthalene acetic acid (NAA) @ 50 ppm, T_8- Gibberellic acid (GA_3) @ 50 ppm + naphthalene acetic acid (NAA) @ 100 ppm, T_9- Gibberellic acid (GA_3) @ 50 ppm +naphthalene acetic acid (NAA) @ 150 ppm, T_{10}- Gibberellic acid (GA_3) @ 150 ppm + naphthalene acetic acid (NAA) @ 150 ppm, T_{11}- Gibberellic acid (GA_3) @ 100 ppm + naphthalene acetic acid (NAA) @ 100 ppm and T_{12}- Gibberellic acid (GA_3) @ 100 ppm + naphthalene acetic acid (NAA) @ 150 ppm. Onion seedlings were raised in a nursery and transplanted at the spacing of 10 x 15 cm accommodating 36 plants per plot and a light irrigation was given just after transplanting to maintain the soil moisture and better condition of onion seedlings. The plant bio regulators *viz.,* NAA and GA_3 were applied in the form of foliar spray at 30, 45 and 60 days after transplanting. GA_3 and NAA solutions were prepared by dissolving required amount of bio regulators in 1 (N) NaOH and pH was adjusted. In the whole experiment observations were recorded at regular intervals from 5 randomly selected plants in each replication and treatments on vegetative growth and yield parameters. The quality attributes of onion *viz.,* TSS, ascorbic acid, pH and moisture percentage were studied after harvesting of bulb. The bulbs of onion were dried at 65- 70° C for 72 hrs to calculate the biomass and moisture content. All quality analysis of onion bulbs which are related to this experiment were analyzed in the laboratory of the department. The observed data were statistically analyzed using analysis of variance as formulated at 5 per cent level of significance (Panse and Sukhatme, 1985).

Results and Discussion

The findings of the present study as well as relevant discussion have been presented under following heads:

Effect of plant bio regulators on vegetative growth of onion

Table 1 clearly showed that vegetative growth *viz.,* plant height, number of leaves, maximum length of leaves and basal diameter of onion were improved by spraying at plant bio regulators. It was noted that plant height was maximum at all stages (46.47, 71.37 and 76.50 cm at 30, 60 and 90 DAT, respectively) under T_{11} (GA_3 @ 100 ppm and NAA@ 100 ppm). Similarly, the number of leaves was also increased by T_{11} however, the change in number of leaves was statistically at par (Non-significant at 30 and 90 DAT). It was observed that the length of leaves was significantly varied at early (30 DAT) and late (90 DAT) period of 60 DAT. However, in all stages T_{11} recorded the maximum length of leaves (36.97, 59.87 and 60.60 cm at 30, 60 and 90 DAT, respectively). The data presented in Table 1 showed that the basal diameter was increased by application of GA_3 @ 100 ppm + NAA @ 100 ppm followed by T_9 (GA_3 @ 50 ppm + NAA @ 150 ppm). It was also observed that the basal diameter did not improved significantly at 90 DAT. The improvement in vegetative growth with the application of bioregulators particularly foliar spray of GA_3 @ 100 ppm + NAA @ 100 ppm might be due to the positive effect of bio regulators on enhancement of growth and apical dominance. The bioregulators are efficiently involve in enhancing metabolic activity specially photosynthetic activity, efficient assimilation of photosynthates which results rapid cell division and enlargement in growing portion of the plant. The present result corroborates with the finding recorded maximum vegetative growth of garlic cv. YAMUNA SAFED 4 (G- 323) with the application of GA_3 @ 50 ppm in terms of plant height, basal girth, number of leaves etc. as also found by Singh *et al.* (2014) and similarly in some fruit crops also as reported by some workers (Kumawat *et al.,* 2014; Rajwar *et al.,* 2007; Sen *et al.,* 1990 and Maji, 2010).

Effect of plant bio regulators on bulb yield of onion

Table 1: Effect of PGRs on growth parameters of onion.

Treatments	Plant height (cm)			Number of leaves			Length of leaves (cm)			Basal diameter (cm)		
	30DAT	60DAT	90 DAT	30 DAT	60DAT	90DAT	30DAT	60DAT	90DAT	30DAT	60DAT	90DAT
T_0	35.07	63.37	69.97	4.40	5.00	7.14	33.07	53.43	53.80	0.91	1.32	1.84
T_1	35.73	61.67	70.10	4.53	5.07	7.40	29.83	51.13	52.46	0.83	1.40	1.85
T_2	32.97	64.70	64.75	4.20	5.47	7.43	34.23	54.24	54.73	0.91	1.57	1.87
T_3	35.10	57.97	64.43	4.60	5.44	7.00	32.73	48.13	49.09	0.84	1.44	1.81
T_4	34.83	56.37	60.63	4.53	5.07	7.34	31.20	44.30	45.35	0.81	1.38	1.82
T_5	36.83	61.33	70.87	4.40	5.25	7.27	33.33	47.30	47.83	0.76	1.40	1.80
T_6	38.50	65.63	71.10	4.26	5.07	7.60	34.23	54.83	55.63	0.83	1.44	*1.88
T_7	40.00	68.87	73.47	4.60	5.44	7.67	34.90	56.17	57.06	0.93	1.56	1.89
T_8	39.53	69.23	74.30	4.66	5.67	7.68	35.37	57.30	58.03	0.95	1.66	1.90
T_9	40.07	69.43	75.07	4.80	5.93	7.87	36.03	58.80	59.20	1.05	1.71	1.93
T_{10}	37.07	60.93	66.53	4.26	5.20	7.39	33.63	49.93	50.77	0.83	1.56	1.86
T_{11}	46.47	71.37	76.50	5.35	6.26	8.27	36.97	59.87	60.60	1.12	1.84	2.05
T_{12}	36.27	58.50	66.63	4.53	4.94	7.60	33.77	46.67	51.13	0.84	1.41	1.84
S.E.±	1.508	1.25	1.67	0.355	0.360	2.312	1.530	9.291	2.161	0.30	0.077	3.10
C.D.(P=0.05)	2.18	3.21	3.98	NS	0.74	NS	3.16	NS	5.232	0.06	0.16	NS

NS= Non-significant.

Table 2: Effect of PBRs on the yield and quality parameters of onion.

Treatments	Equatorial Diameter of bulb (cm)	Longitudinal length of bulb (cm)	Number of Average weight of £ individual bulb (g)		Yield		TSS	Ascorbic acid	pH	Moisture content (%) Bulb
			Fresh	Dry	kg /plot	t/ha	— V			
T_0	5.37	5.37	6.00	58.31	6.4	2.10	38.87	8.93	8.01	6.13	88.99
T_1	5.82	5.82	5.70	63.18	8.94	2.27	42.12	9.02	8.33	6.43	85.86
T_2	5.64	5.64	5.60	73.11	8.90	2.63	48.74	9.03	9.39	5.80	87.82
T_3	5.90	5.90	5.97	65.00	7.85	2.34	43.33	8.72	8.37	6.27	91.29
T_4	5.90	5.90	5.61	67.67	8.94	2.44	45.11	8.70	9.20	6.57	86.79
T_5	6.35	6.35	6.23	70.87	8.61	2.55	47.24	8.83	8.77	6.81	87.84
T_6	5.96	5.96	6.03	74.98	8.96	2.70	49.99	9.80	9.03	6.30	88.05
T_7	6.13	6.13	6.00	84.22	8.42	3.03	56.15	9.70	10.26	6.37	90.01
T_8	6.57	6.57	6.74	85.53	8.91	3.08	57.02	10.40	10.09	6.67	89.58
T_9	6.19	6.19	6.07	90.36	9.47	3.25	60.24	10.90	11.07	6.80	89.52
T_{10}	6.27	6.27	6.09	66.16	6.43	2.38	44.10	8.59	9.30	6.90	90.29
T_{11}	6.87	6.87	6.97	90.51	10.89	3.26	60.34	12.03	11.80	6.99	87.97
T_{12}	5.90	5.90	5.97	63.49	9.48	2.29	42.33	9.00	9.36	6.77	85.08
S.E.±	0.401	0.401	0.562	2.917	0.476	0.191	2.191	0.501	0.491	0.409	5.4
C.D. (P=0.05)	NS	NS	NS	8.912	0.98	0.51	5.92	1.23	1.15	NS	NS

NS= Non-significant.

Table 2 represented the bulb yield of onion as influenced by different bio regulators treatments. The data showed that the average fresh weight of individual bulb was greatly influenced by all the treatments over control. Among the treatments, T_{11} and T_9 produced onion bulb having maximum fresh weight of 90.51 g and 90.36 g, respectively and were found statistically at par. Similarly, the dry matter or biomass content was also the highest under treatment T_{11} followed by T_9. Similar tendency was also observed in case of bulb yield (3.26 kg/plot, 60.34 t/ha) under T,. Increase in bulb yield with GA_3 application might be due to the fact that GA_3 initiate the physiological process and permeability of cell to produce more food for reserve (Das *et al.,* 2006).

Effect of plant bio regulators on physico-chemical characteristics of onion

It was very interesting to see that the physical characters of onion bulb did not vary significantly.

However, equatorial diameter of bulb was found maximum under T_{11} followed by T_8 whereas longitudinal length of bulb was measured under similar treatments. Similarly, no variability was observed in terms of number of scales per bulb due to application of various bio regulators over control. But, maximum number of scales (6.97) per bulb was counted under treatment T_{11} (Table 2).

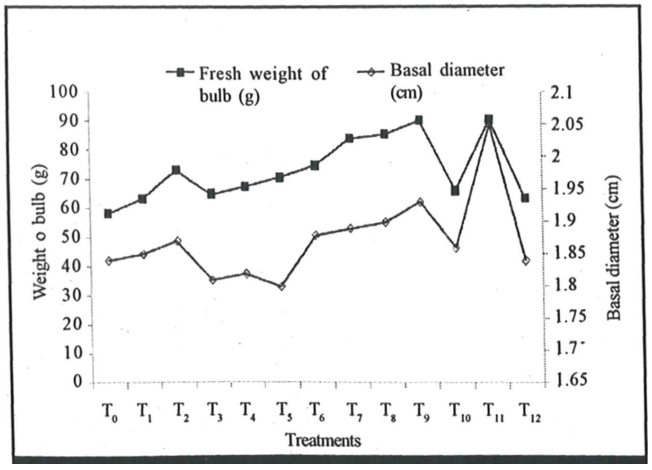

Fig. 1: Relation between bulb weight and basal diameter.

In quality characteristics TSS was greatly influenced by the bio-regulator application among the various bio-regulators studied T_{11} (GA_3 @ 100 ppm + NAA @ 100 ppm) showed the highest TSS (12.03 °B) significantly. The bio-regulators have some positive effect on quality of onion bulb which was reported earlier by Pundir and Yadav (2001) in tomato fruit, Mishra *et al.,* (2012) in litchi; Singh *et al.* (2012) in papaya and Maji *et al.* (2015) in guava. They all believed that bio-regulators play a significant role in conversion of sugars and moisture loss and also on oxidation-reduction phenomenon of organic acids which ultimately determine the quality of onion. Likewise, the ascorbic acid content in bulb was also improved by with application of GA_3 @ 100 ppm + NAA@ 100 ppm in T_{11} followed by T_9. Although, the pH of various bulbs improved by application of various bio-regulators but, it was non-significant. Similarly, moisture content in bulb did not improved significantly due to various bio-regulators. Fig. 1 to 4 also showed the relation of various parameters of which Fig. 1 clearly showed that fresh weight was positively correlated with basal diameter of pseudostem whereas, basal diameter and bulb diameter were not so correlated (Fig. 2). Regarding the quality parameters, TSS and ascorbic acid content both were positively influenced by the bulb fresh weight (Fig. 3 and 4).

Conclusion

The experiment showed that application of bio-regulators had better influence on vegetative growth, yield and quality of onion bulb grown under Lucknow condition. It may be concluded from the investigation that among the treatments under study, foliar application of GA_3 @ 100 ppm in combination with NAA @ 100 ppm (T_{11}) was better for improvement of growth, yield and quality of onion bulb cv. NHRDF-RED-2 grown under Lucknow subtropical area.

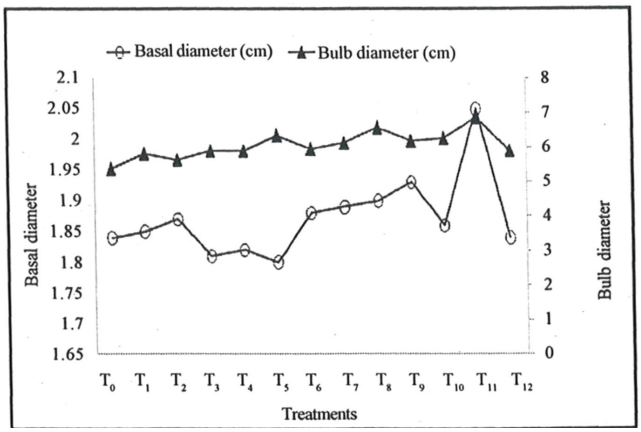

Fig. 2: Relation among the basal diameter and bulb diameter.

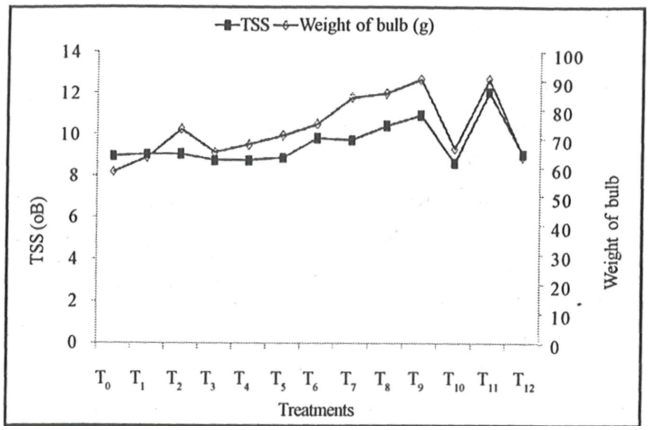

Fig. 3: Positive relation between TSS and bulb weight.

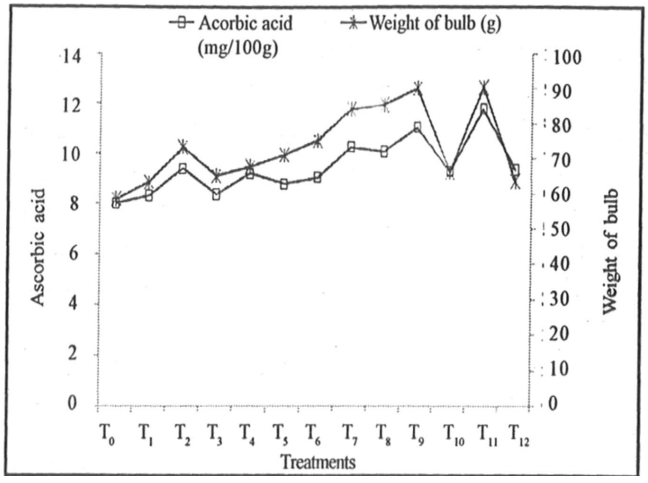

Fig. 4: Relation between bulb weight and ascorbic acid content.

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