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Effect of Humic Acid and Ascorbic Acid on Growth and Yield of Onion (*Allium cepa* L.) under Valley Conditions of Garhwal Himalaya

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ABSTRACT

An experiment was conducted at Horticultural Research Center, Chauras Campus, Department of Horticulture, H.N.B Garhwal University, Srinagar (Garhwal), Uttarakhand to assess the impact of humic acid and ascorbic acid on growth and yield of onion bulb. The experiment was formulated with foliar application of humic acid 0, 30, 50 and 70 ppm and Ascorbic acid 0, 25, 40 and 60 ppm concentration at 30 and 45 days after transplanting with three replications under Randomized Block Design. The maximum plant height (39.44 cm), number of leaves per plant (10), highest bulb length (5.93 cm), bulb diameter (5.47 cm), bulb fresh weight (88.20 g), bulb dry weight (13.88 g) and bulb yield per plot (6.39 kg) were obtained with the spray of Humic acid 70 ppm + Ascorbic acid 40 ppm (T_{15}), while minimum were recorded with control (T_1).

Keywords Humic acid, Ascorbic acid, Yield, Onion.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the important bulb crops belongs to family Alliaceae. It is grown under wide range of climatic conditions with a world production of about 93.17 million tonnes. In India, onion are cultivated on 1.20 million hectare with production of 19.42 million tonnes which have estimated around 18.09 % of total world production (FAOSTAT 2018). In addition to its medical properties, onions are a great source of carbohydrates, protein, minerals, antioxidant vitamins, and preservatives. The distinctive quality of onions is their pungency, which comes from a volatile oil called allyl-propyl disulfide. Globally, the production of organic vegetables has increased in recent years (Madail *et al*. 2015), spurred on by a significant increase in customer demand for foods with higher nutritional content and free from chemicals (Barański *et al*. 2017). Moreover, (Ren *et al.* 2017) observed that organically grown bulbs had a greater

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level of flavonoids and antioxidant activity. Humic acid is often added to the soil to boost the availability of nutrients. Also, the presence of these acids plays a vital role in the link between the soil and plants since it converts numerous nutrients into forms that plants can absorb (Ampong *et al.* 2022).

Humic acid has demonstrated tangible outcomes in agriculture, making it a suitable biofertilizer source (Canellas *et al.* 2015). Experiments using humic compounds applied to onions and tomatoes demonstrate increased production as well as significant accumulations of amino acids, vitamin C, and sugars (Bettoni *et al.* 2016, Husein *et al*. 2015). Ascorbic acid serves as a co-factor and signals the plant's regulators of biosynthesis in plants. Ascorbic acid, often known as vitamin C, is a non-enzymatic substance that functions as an antioxidant, a detoxification for reactive oxygen species, and an accelerator of plant growth and development (Smirnoff 2018). In addition, it was discovered that the administration of exogenous ascorbic acid to dormant mother bulbs, promoted root elongation and development through altering onion cell division and DNA synthesis. Similarly, fresh dry mass in onion roots increased as ascorbic acid level in plant tissues increased (Salih and Kka 2022). As a result, at various growth phases, ascorbic acid may move through plant organs and serve as a plant regulator. When ascorbic acid was fed to a miniature tomato plant, it was discovered that the ascorbic acid was transported from the accumulating sources (the leaves) to the sink sources (the immature green fruits) (Fenech *et al*. 2019).

MATERIALS AND METHODS

The experiment was carried out at Horticultural Research Center, Chauras Campus, Department of Horticulture, H.N.B Garhwal University, Srinagar (Garhwal), Uttarakhand during *rabi* season, 2019-2020. Srinagar (Garhwal) is located in the heart of Alaknanda valley (78° 47' 30" E longitude and 30° 13' 0" N latitude and at an elevation of 540 m above MSL), a semi-arid, subtropical climate with dry summer and rigorous winters with occasional dense fog in the morning hours from mid-November to February.

The experiment consisted of two factors as Humic acid (0, 30, 50 and 70 ppm) and Ascorbic acid (0, 25, 40 and 60 ppm) and their combination viz. T_1=Control, T_2=Ascorbic acid@25ppm, T_3=Ascorbic acid@40ppm, T_4=Ascorbic acid@60ppm, T_5=Humic acid@30ppm, T_6=Humic acid@30ppm + Ascorbic acid@25ppm, T_7=Humic acid@30ppm + Ascorbic acid@40ppm, T_8=Humic acid@30ppm + Ascorbic acid@60ppm, T_9=Humic acid@50ppm, T_{10}=Humic acid@50ppm + Ascorbic acid@25ppm, T_{11}=Humic acid@50ppm + Ascorbic acid@40ppm, T_{12}=Humic acid@50ppm + Ascorbic acid@60ppm, T_{13}=Humic acid@70ppm, T_{14}=Humic acid@70ppm + Ascorbic acid@25ppm, T_{15}=Humic acid@70ppm + Ascorbic acid@40ppm, T_{16}=Humic acid@70ppm + Ascorbic acid@60ppm were spayed at 30 and 45 days after transplanting. The recommended dose of fertilizer viz., nitrogen, phosphorus and potassium was applied in the form of urea containing 46.2 % N, super phosphate containing 16 % P_2O_5 and muriate of potash containing 60 % K_2O. The full quantity of phosphorus, potassium and half dose of nitrogen applied as basal dose before transplanting and remaining half dose of nitrogen use as broadcasting after 30 days of transplanting of crop. The experiment were carried out in Randomized Block Design with three replications. The land was thoroughly prepared. The entire experimental field was divided into three blocks and each block consisted of 16 plots of equal size. A plot size of 1 X 2.25 m^2 was used for the experiment. The row to row distance was 20 cm while plant to plant distance was 15 cm. Seedlings of Nashik red variety were obtained from HRC Chauras, Department of Horticulture, H.N.B Garhwal University, Srinagar Garhwal), Uttarakhand. All the essential intercultural operations and plant protection measures recommended for the quality crop growth were followed and proper irrigation was given for better growth and development of the crop. Randomly eight selected plants from each plot per replication were tagged for the following data viz., plant height, number of leaves, bulb length, bulb diameter, bulb fresh weight, bulb dry weight, bulb yield per plot. The data were analyzed using analysis of variance (ANOVA) under RBD according to the method of Panse and Sukhatme (1985).

RESULT AND DISCUSSION

Foliar applications of humic acid and ascorbic acid

Table1. Effect of humic acid and ascorbic acid on growth and bulb yield of onion (*Allium cepa* L.).

Replications	Plant height (cm) at 60 days	No. of leaves at 60 days	Bulb length (cm) at harvest	Bulb diameter (cm) at harvest	Bulb fresh wt (g) at harvest	Bulb dry wt (g) at harvest	Bulb yield per plot (kg) at harvest
T_1 (Control)	30.33	6.08	4.10	3.60	42.75	5.5	3.10
T_2 (Ascorbic acid@25 ppm)	31.89	6.58	4.18	3.65	44.29	5.57	3.21
T_3 (Ascorbic acid@40 ppm)	32.75	6.92	4.45	3.95	49.87	5.85	3.61
T_4 (Ascorbic acid@60 ppm)	32.00	6.68	4.30	3.80	46.70	5.70	3.38
T_5 (Humic acid @30ppm)	33.29	7.21	4.61	4.15	46.77	7.68	3.39
T_6 (Humic acid@30 ppm + Ascorbic acid@25 ppm)	34.19	7.72	4.92	4.52	60.65	9.81	4.39
T_7 (Humic acid@30 ppm + Ascorbic acid@40 ppm)	33.96	7.35	4.72	4.22	54.23	8.15	3.98
T_8 (Humic acid@30 ppm + Ascorbic acid@60 ppm)	34.00	7.43	4.82	4.34	57.05	8.60	4.13
T_9 (Humic acid@50 ppm)	37.13	8.70	5.43	4.93	72.80	9.74	5.27
T_{10} (Humic acid@50 ppm + Ascorbic acid@25 ppm)	36.08	8.23	5.20	4.65	64.98	7.98	4.71
T_{11} (Humic acid@50 ppm + Ascorbic acid@40 ppm)	36.04	8.08	5.08	4.53	61.95	9.73	4.49
T_{12} (Humic acid@50 ppm + Ascorbic acid@60 ppm)	36.15	8.43	5.33	4.83	68.13	9.23	4.94
T_{13} (Humic acid@70 ppm)	39.42	9.75	5.80	5.35	84.67	13.82	6.13
T_{14} (Humic acid@70 ppm + Ascorbic acid@25 ppm)	39.00	9.45	5.68	5.23	81.14	12.24	5.88
T_{15} (Humic acid@70 ppm + Ascorbic acid@40 ppm)	39.44	10.00	5.93	5.47	88.20	13.88	6.39
T_{16} (Humic acid@70 ppm + Ascorbic acid@60 ppm)	38.96	9.28	5.57	5.12	79.89	11.50	5.79
SEm±	0.93	0.42	0.13	0.15	0.89	0.28	0.07
CD	2.66	1.19	0.38	0.44	2.52	0.79	0.19

has often recommended as a method to improve crop production in various crops by controlling physiological processes. Table 1 shows the impact of foliar treatments with humic acid and ascorbic acid on onion vegetative growth. Humic acid and ascorbic acid were significantly influenced vegetative growth by increasing plant height, number of leaves. The maximum plant height (cm) and number of leaves were recorded as 39.44 and 10, respectively with the spray of Humic acid@70ppm+Ascorbic acid@40ppm (T_{15}), while the lowest plant height and number of leaves were recorded as 30.33 and 6.08, respectively with the control group (T_1).

Humic acid and ascorbic acid treatment dramatically changed the onion bulb characteristics. In comparison to the control, the application of humic and ascorbic acid enhanced bulb yield. When compared to untreated control plants, the increases in bulb length, bulb width, fresh weight, dry weight, and bulb yield per plot were in every case often highly significant. The results showed that humic acid and ascorbic acid application improved bulb characteristics of onion. The highest bulb length (5.93 cm), bulb diameter (5.47 cm), bulb fresh weight (88.20 g), bulb dry weight (13.88 g) and bulb yield per plot (6.39 kg) were obtained with the spray of Humic acid@70ppm+Ascorbic acid@40ppm (T_{15}), while the lowest bulb length (4.10 cm), bulb diameter (3.60 cm), bulb fresh weight (42.75 g), bulb dry weight (5.50 g) and bulb yield per plot (3.10 kg) were obtained with the control group (T_1).

Humic acid might increase the output and vegetative development of onions, which would enhance the crop's photosynthetic capacity. Humic acid spraying on plants significantly increased photosynthesis (Bettoni *et al*. 2014). The activation of enzymes, photosynthesis, water and nutrient absorption, protein synthesis, cationic exchange capacity, and antioxidant metabolism are some of the ways through which humic acid has been proven to promote plant growth and productivity (Klein *et al*. 2014). Plants spread with humic acid showed a rapid increase in cell division and cell elongation in the meristematic area, which improved plant development (Bettoni *et al*. 2016).

Along with playing a crucial part in the ascorbate-glutathione pathway, ascorbic acid also plays a crucial function in cell wall growth and cell division, which contribute to its superiority. Similar outcomes were made by (Farooq *et al*. 2020).

CONCLUSION

On the basis of experimental finding it is concluded that foliar application of humic acid and ascorbic acid significantly increased all growth characters (i.e. Plant height, number of leaves) and bulb yield characters (i.e. Bulb length, bulb diameter, bulb fresh weight, bulb dry weight, bulb yield per plot) compared to untreated control plants. Among different treatment of humic acid and ascorbic acid combination, humic acid 70 ppm+Ascorbic acid 40 ppm (T_{15}) was better than control group (T_1).

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