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EFFECT OF FOLIAR APPLICATION OF GA_3 AND NAA ON ONION – A REVIEW

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Abstract

Growth regulators are organic compounds other than nutrients, small amount of which are capable of modifying growth. Gibberellic acid and NAA are the important growth regulators which in little concentration stimulate growth and enhances yield. Gibberellin is such a compound that has gibbane skeleton and that stimulate cell division or cell elongation or both. NAA belongs to synthetic forms of auxins. It plays key role in cell elongation, cell division, vascular tissue differentiation, root initiation, apical dominance, leaf senescence, leaf and fruit abscission, fruit setting and flowering. Onion is one of the important crop which gives good response to foliar application of GA_3 and NAA. The important principle like allicin, ajoene, allixine thiosulfnates and sulphites present in onion makes it a potential herb. There is a great need to increase the productivity of onion. Gibberellic acid when used for foliar spray, it increases the number of marketable bulbs in the total yield. Application of GA_3 @ 50 ppm increases plant height and improved leaf length and number of leaves per plant while GA_3 @ 100 ppm increases weight and volume of bulb. The highest bulb yield can be obtained with 200 ppm GA_3 followed by 200 ppm IAA. GA_3, NAA and combination treatments as pre-harvest foliar application have gained prominence.

***Key words*:** GA_3, NAA, Onion

Introduction

Onion is vital commodity of masses and used as salad and cooked in various ways in curies, fried, boiled, baked and used in soup making and pickles. Besides fresh consumption, onion provides very good raw material for processing industry as it is processed in the form of dehydrated powder, rings, shreds and onion in vinegar or brine. They are highly valued for their flavour and nutritional value in supplying minor constituents such as minerals and trace elements. The important principle like allicin, ajoene, allixin thiosulfinates and sulphites etc. present in onion to make it potential herb. The outstanding characteristic of onion is its pungency, which is due to a volatile oil known as allyl-propyl disulphide. The productivity of onion is low as compare to other countries. The use of improved varieties, nutrition and irrigation contributes for higher productivity. PGR is also one of the easiest and cheapest source to enhance the production of onion to some extent.

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Effect of GA_3 and NAA on growth parameters of onion

Maximum and early germination was recorded by Maurya *et al.* (1975a) in onion by use of 40 ppm of NAA. He laid out an experiment on Poona Red variety of onion and soaked onion seeds in 20, 40 and 60 ppm of GA, NAA and IAA for 12 hours. Rapid increase in the germination was found with 60 ppm of NAA, 20 and 40 ppm of GA and 20 ppm of IAA.

Maurya *et al.* (1975b) also reported that increase in the number of roots was recorded under 20 ppm of NAA and IAA. NAA at 20 ppm was proved to be most effective in improving almost all the growth characters of onion.

GA_3 100 ppm significantly increased fresh weight of bulb, dry weight of bulb and leaf and percentage of dry matter in leaf reported by Hore *et al.* (1988).

Saleh *et al.* (1989) noticed that NAA and GA_3 at 150 ppm increases the vegetative growth of onion as measured by the plant height, leaf length, number of leaves per plant, plant weight and percent dry matter under the

Iraq condition.

Abu – Grab *et al.* (2000) investigated the effect of gibberellic acid (GA_3), indole-acetic acid (IAA), indole-butyric acid (IBA), α-naphthalene-acetic acid (NAA), uniconazole (UC) and cycocel (CCC) on growth, chlorophyll content, nutritional status, and seed yield and quality of onions and showed that GA result highest value of scape length and NAA induces highest increase in the dry weight per plant, chlorophyll a, chlorophyll a+b, total carbohydrates, mineral contents (N, P, K), seed yield, 1000 seed weight and seed germination of onion under Egyptian conditions.

Shaikh *et al.* (2002) conducted an experiment to evaluate the performance of different size bulbs *viz.*, large (>60 g), medium (30-60 g) and small (<30 g) and five growth regulators with two concentrations *i.e.* GA_3 (25 and 50 ppm), miraculan (1000 and 2000 ppm), NAA (100 and 200 ppm), MH (10 and 20 ppm) and CCC (500 and 1000 ppm). The results showed that large size bulbs gave significantly higher plant height, number of leaves per plant, umbels per plant, umbel diameter, seed weight per umbel, seed yield per plant and per hectare, seed germination and seedling vigour. Among growth regulators, GA_3 50 ppm or miraculan 2000 ppm or MH 20 ppm sprayed at 30 DAP gave higher seed yield, germination and vigour.

Benkeblia (2006) concluded that in dormant bulbs, the strongest induction of sprouting was observed with auxin treatment (0.1 mg NAA per bulb, sprouting after 12 weeks), followed by cytokinin (0.1 mg BA per bulb, sprouting after 14 weeks), Gibberellin (0.1 mg GA_3 per bulb) was least effective (21 weeks).

Alam *et al.* (2007) evaluated the effect of IAA at various concentrations *i.e.* 0, 50, 100 and 200 ppm on onion crop. Highest leaf length and leaf number per plant were found from 200 ppm IAA in onion. Maximum yield reported when double spray with 200 ppm IAA in Bangladesh.

Islam *et al.* (2007) conveyed that GABA at 1.0 mg/l increased the growth and yield attributes than 0.5 and 2.0 mg/l. the results suggested that application of GABA at 1.0 mg/l is suitable for onion but 2.0 mg/l may be harmful for plant growth under the conditions of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh.

Tyagi *et al.* (2007) carried out an experiment to study the effect of IAA, NAA and GA_3 each at 20, 40 and 60 ppm. The results revealed that GA_3 at 60 ppm proved to be the best for number of leaves per plant, leaf length, weight of green leaves per plant, fresh weight of bulb, number of scale per bulb and yield. Effect of GA_3 was significantly superior to NAA as well as IAA.

Ud- deen *et al.* (2009) studied the root and shoot emergence and root and shoot length of onion by the use of GA_3, Uniconazol, CCC and 2, 3, 6- TBA with different concentrations *i.e.* 100, 150, 200, 250 and 300 ppm and reported that GA_3 required minimum days to root and shoot emergence and promote vegetative growth of onion whereas uniconazole and CCC retards and 2, 3, 6- TBA showed little retarding effect under the conditions of Bangladesh.

Experiment was carried out during the Rabi season to study the effect of GA_3 and NAA at 50, 100 and 150 ppm concentrations on growth and yield parameters of onion crop by Patel *et al.* (2010a). He suggested that the application of GA_3 50 mg/l significantly increased plant height and improved leaf length and number of leaves per plant as compared to control. While GA_3 100 mg/l significantly increased weight and volume of bulb as well as equatorial and polar diameter of bulb and finally bulb yield.

Shukla *et al.* (2010) revealed that root dipping with GA_3 40 or 60 ppm was superior than 20 ppm GA_3 and NAA 200,300 and 400 ppm for growth characters *viz.*, plant height, leaf length and culm width of onion. Root dipping with GA_3 20 ppm increased the bulb weight (43.90 g). Marketable yield and total yield were significantly higher in GA_3 40 ppm followed by GA_3 60 ppm and 20 ppm.

Raoofi *et al.* (2014) suggested that naphthalene acetic acid can be used for enhancement of growth and yield of cereals. It produces significant effect on the development of pointed ends for the root system. NAA can increase fruit setting ratio, prevent fruit dropping, promote flower sex ratio.

Tsiakaras *et al.* (2014) examined the effect of GA_3 with 0 and 50 mg/l for first and second sowing and 0 and 25 mg/l for third sowing on yield and earliness of production of lettuce. The results shown that the medium concentration of GA_3 at 25 mg/l should be applied during spring (third sowing date) as it results in plants with higher number of leaves, total fresh weight and marketable height.

Govind *et al.* (2015) laid out an experiment comprised with 9 treatments *i.e.* GA3 @ 30 ppm,40 ppm and 50 ppm, NAA @ 275 ppm, 300 ppm, and 325 ppm, GA3 @ 30 ppm + Liquid manure (LM) @ 100 ppm and NAA @ 275 ppm + Liquid manure (LM) @ 100 ppm and were replicated thrice. He revealed that application of Gibberellic acid (GA_3) @ 30 ppm + Liquid manure (LM) @ 100 ppm improving vegetative growth (plant height-

68.24 cm, leaf number- 9.09, basal diameter- 14.17 cm at 120 DAP), bulb yield (10.10 t/ha)and fresh (27.58g) and dry weight (7.51g) of bulb and TSS (32.42^0B). He concluded that treatment with GA_3 @ 30 ppm and Liquid manure (LM) @ 100 ppm may be suggested for better growth and yield of garlic cv. G-282 under Lucknow subtropical condition.

Effect of GA_3 and NAA on yield parameters

Singh (1983) concluded that application of 40 ppm of GA_3 improved the number, length and weight of green leaves. The number of roots was maximum with 40 ppm GA_3 followed by 40 ppm and 3 ppm GA_3. The maximum weight of fresh roots was observed in 40 ppm GA_3 treatment followed by 40 ppm NAA and 30 ppm GA_3.

Singh (1992) investigated the effect of nitrogen, gibberellic acid and benzyl adenine on yield and quality of onion for two years. Treatment consists of nitrogen at 80 and 160 kg/ha, gibberellic acid at 50 and 100 ppm and benzyl adenine at 30 and 60 ppm. Application of nitrogen at 160 kg/ha significantly increased the yield, fresh and dry weight of bulb together with allyl sulphide in both the years of experimentation.

Nirmal *et al.* (1994) studied that the effect of GA (30, 60 ppm) and NAA (10, 20 ppm) in root dip, foliar spray and combination of both methods in onion crop. He found that NAA gave response to increase in yield in root dip and foliar spray treatment only. The spray of GA_3 at 60 ppm treatments increased the diameter of the bulb.

Singh *et al.* (1995) examined that GA_3 and NAA increased plant height, number and size of leaves and umbels per plant when their concentrations were increased from 150 to 300 ppm, whereas higher concentration (450 ppm) had depressive effect. NAA 300 ppm treated plants produced highest seed weight and yield of onion seeds.

Wagh and Deore (1995) recorded that 50 ppm GA_3 gave highest seed yield followed by 100 ppm NAA. GA_3 50 ppm recorded highest seed yield with lower sterile seed in onion. The highest germination percentage was from treatment Godrej 2000 ppm (58%) followed by NAA and GA.

Bhople *et al.* (1999) carried out an experiment to study the effect of Triacontanol (2.5, 5.0, 7.5 and 10 ppm), NAA and GA (25, 50 and 75 ppm) on onion seed production. The highest seed yield per plant and per hectare and better quality was obtained from 75 ppm GA_3.

Hye *et al.* (2002) discovered that GA_3 200 ppm resulted highest bulb diameter and bulb weight of onion followed by IAA 200 ppm. Root treatment followed by spray at 28 DAT has much pronounced effect than root treatment and spray ay 28 DAT under the conditions of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh.

Russo (2003) suggested that leaf and bulb weight were lighter, and bulb diameter were smaller, from plants treated with growth regulators applied at the 7- leaf stage than those from plants treated at 20- leaf stage.

Tiwari *et al.* (2003) invented that the application of GA (50 ppm) produced maximum number of leaves per plant both as spray (12.33) and root dip (12.53). TSS content of bulbs was highest (13.33^0B) under spray of GA (25 ppm).

Ibrahim and Sanna (2005) done an experiment with NAA at 25 and 50 ppm, Salicylic acid at 10 and 20 ppm and spermidine at 10 and 20 ppm on growth and bulbing of onion. The highest bulbs fresh weight was attained by NAA at 25 ppm. Spermidine at 10 ppm and NAA at 50 ppm showed significant increase in total sugars and vitamin C in bulbs at harvesting time.

Mondal and Shukla (2005) conducted an experiment with 20, 40 and 60 ppm of GA_3 and 200, 300 and 400 ppm of NAA and each dose applied through three different methods *i.e.* soaking of seeds, seedlings root dipping and foliar spray. Total yield and marketable bulb yield of bulbs were positively influenced by the application of GA_3 specially in root dipping treatments.

Singh (2006) studied three growth regulators IAA, GA_3 and NAA with five concentration *i.e.* 0, 20, 30, 40 and 50 ppm on bulb yield of onion under the conditions of Jawahar Lal Nehru Krishi Vishwa Vidyalya, College of Agriculture, rewa (M.P.) India and found that GA_3 most effective growth regulator, whereas 40 ppm concentration enhancing the bulb yield.

Sultana (2006) concluded that the highest seed yield and germination of onion obtained from 200 ppm GA_3 and lowest from 80 ppm PP333. The positive effect of growth regulators found in order of 200 ppm GA_3 followed by 40 ppm of paclobutrazol under the conditions of Bangladesh Agricultural University, Mymensingh.

Bose *et al.* (2009) carried out an experiment to study the response of micronutrients *viz;* zinc, iron and copper along with growth regulator NAA 30 and 50 ppm on growth and yield of onion. He revealed that growth regulator NAA 50 ppm gave the highest plant height, number of leaves, neck diameter, fresh weight of bulb, bulb diameter and yield per hectare as compared to NAA 30 ppm over control.

Patel *et al.* (2010b) observed that application of GA_3 50 mg/l as root dipping and foliar spray significantly increased volume of bulb, equatorial and polar diameter of bulb as well as bulb yield of onion, while GA_3 100 mg/l as root dipping and foliar spray increased the average weight of bulb. NAA 100mg/l significantly reduce the physiological loss of weight, spoilage loss and finally total loss under the conditions of College of Agriculture, Anand Agricultural University, Anand.

Rashid (2010) conducted an experiment with four levels of sulphur at 0, 15, 30 and 45 kg/ha and four concentrations of GA_3 at 0, 50, 75 and 100 ppm. He showed that 100 ppm GA gave maximum bulb yield on onion. The maximum bulb dry matter content and bulb yield of onion were produced from sulphur at 30 kg/ha with 100 ppm GA_3 under the conditions of Bangladesh Agricultural University, Mymensingh.

Waghmonde *et al.* (2010a) revealed that application of GA_3 50 ppm significantly reduced the number of days for the sprouting, 50 per cent flowering, days for seed harvesting and plant height of flower stalk. He concluded that application of gibberellic acid 100 ppm along with biofertilizer (Azospirillium and PSB 6 kg/ha and VAM @ 10 kg/ha) was effective in increasing yield.

Waghmonde *et al.* (2010b) investigated the effect of combined use of biofertilizer and gibberellic acid on seed production of onion cv. Phule Samarth and revealed that the yield contributing characters such as number and seed weight per umbel and per bulb and seed yield per hectare were significantly increased at higher concentration of gibberellic acid 100 ppm.

Haque (2013) investigated that the maximum height was obtained from IBA 100 ppm at 60 DAP whereas highest bulb yield was recorded from IBA 25 ppm with BARI peaj-2 variety under the conditions of Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh.

Sharma *et al.* (2013) proved that foliar spray of 80 ppm GA_3 and NAA at 40 and 60 DAT produced significantly higher bulb yield of 316.7 and 311.5 q/ha, respectively, which was 24.7 and 22.7% higher over control.

Asgharzadeh (2014) indicated that among various concentrations of gibberellic acid *i.e.* 0, 25, 50, 150 and 450 ppm, greatest effects obtained from 50 and 150 ppm and seed yield increased by about 25 % through application of gibberellic acid at 50 ppm in onion.

Lokhande *et al.* (2014) made an attempt to study the effect of pre-sowing soaking treatments with GA, SA, BA and CCC on seed germination, seedling growth and vigour index of onion variety Local white and N-53. He observed that the seedling biomass was considerably increased in N-53 and Local White onion variety due to presoaking treatment of GA_3, methionine and cysteine under Maharashtra conditions.

Safdari *et al.* (2014) showed that onion had the highest yield at 500 milligrams per liter concentration of gibberellin. Reproductive traits and yield showed that 12 hours treatment and 500 milligrams per liter hormonal concentration had the greatest impact on the number of small-sized, medium-sized and total number of onions as well as weights of small-sized and medium-sized onions. 500 milligrams per liter hormonal concentration had the highest impact on the number, weights and total weight of large-sized onions.

Geetharani *et al.* (2008) reported that spraying of NAA (100ppm) at first flowering stalk emergence and second spray at 10 per cent flowering stage (*i.e.* 35 and 45 DAP) enhanced seed recovery and yield by 22.7 per cent. The seed protein content was also 7 per cent higher in NAA 100 ppm and GA_3 100 ppm spray treatments as compared to the unsprayed plots.

Effect of GA_3 and NAA on Quality parameters

Ouzounidou *et al.* (2011) found that the shoot length and biomass expressed in fresh or dry weight of onion and garlic increased under GA_3 while decreased under prohex-ca and ethephon. Production of ascorbic acid, glucose and fructose content enhanced under GA_3 while depressed under prohex-ca and ethephon. GA_3 supply leads to vigorous onion and garlic growth and yield under Greece conditions.

Singh *et al.* (2013) studied the effect of gibberellic acid at 0, 20, 40 and 80 ppm and sulphur at 0, 10, 20 and 40 kg/ha on physio- chemical quality of onion bulbs. He observed that the maximum anthocyanin, ascorbic acid, total phenol, total sugar, allyl propyl disulphide and TSS were recorded from the application of gibberellic acid @ 80 ppm with sulphur 40 kg/ha.

Conclusion

Onion is one of the most important bulb crop cultivated all over India. Being one of the most important crop, there is necessity to increase the yield and quality of onion. Judicious application of different growth regulators at appropriate concentrations increases the plant height, number of leaves, chlorophyll content, diameter, marketable bulb yield and total yield of onion. Among growth regulators gibberellic acid and NAA gives good results in increasing the yield parameters of onion.

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