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Assessment of Performance of Foliar Application of GA_3 and NAA on Growth and Yield Attributes of Onion (*Allium cepa*. L) cv. Nashik Red (N-53)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

In order to ascertain the assessment of performance of foliar application of NAA and GA_3 on growth and yield attributes of Onion (*Allium cepa*. L). A field trial was conducted at the Horticultural Research Farm of Baba Farid Institute of Technology (BFIT), Dehradun, India, 2021–2022. Significant differences in results were observed. With nine treatments and three replications of each growth regulator—NAA and GA_3—at various levels (50, 100, 150, and 200 parts per million—the research was set up in a Randomized Complete block design. The superior growth attributes like maximum plant height (47.38 cm) at 45 DAT, (51.01 cm) at 60 DAT and (54.04 cm) at 90 DAT, maximum number of leaves per plant (6.32) at 45 DAT and (8.84) at 60 DAT were recorded from the application of NAA 150 PPM (T_3). The superior yield attributes like highest fresh weight of bulb

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per plant (60.12 gm), bulb polar distance (4.75 cm) and bulb equatorial distance (5.45 cm) were recorded from the application of GA_3 100 PPM (T_6).

Keywords: Onion; NAA; GA3; growth; yield.

1. INTRODUCTION

Onion (*Allium cepa*) is a herbaceous biennial crop commonly known as 'Pyaj' in Hindi. Because of the flavors released during tissue rupture, onions are one of the most widely utilized vegetables in the world, whether they are used as green leaves, fresh bulbs, or even as a powder in different condiments [1,2]. The sharpness in onion is due to small quantity quantity of volatile oil allyl propyl disulphides[3,4]. India is the largest producer of onion followed by China. India has produced 30.208 Million Tones in the year 2022-2023. In India approximately 90% of the nation's onion crop is produced in Maharashtra, Madhya Pradesh, Karnataka, Rajasthan, Bihar, Gujrat, Andra Pradesh, Haryana, West Bengal, and Uttar Pradesh [5].

Onion requires a balance of both organic and inorganic fertilizers in various stages according to the requirement for increase in production. Plants also need organic compounds in small amount other than mineral nutrinets to inhibit physiological response in plant such as formation of leaves and flowers, stem elongation, ripening of fruits etc [6].The application PGRs has been effective in promoting the different growth and yield attributes in onion.Gibberelic acid is a important growth hormone that stimulates cell division or cell stimulation while A synthetic auxin called napthalene acetic acid facilitates fruit setting, flowering, leaf senescence, apical dominance, root initiation, and fruit absiccison.Research carried out globally showed that different concentrations of IAA, NAA, IBA, GA3, and 2, 4-D had remarkable effects on leaf production, plant height, number of flowers per umbel, umbel size, and onion seed quality [7]. The highest bulb weight was obtained with foliar application of Gibberelic acid at 200 ppm [8]. The application of Gibberelic acid at 100 ppm increase plant height, count of leaves per plant, bulb diameter and bulb length in onion [9]. NAA application at 50 ppm gave the highest bulb weight, bulb diameter and yield per hectare [10]. Therefore, the current investigation was carried out to study the asseseement of foliar application of Napthalene acetic acid (NAA) and Gibberellic acid(GA_3) on growth and yield attributes of onion cv. Nashik Red (N-53).

2. MATERIALS AND METHODS

2.1 Experimental Details

The field trial entitled, "Performance of Foliar Application of GA_3 and NAA on Growth and Yield Attributes of Onion (*Allium cepa*. L) cv. Nashik Red (N-53)" was conducted at Horticultural Research Farm, Baba Farid Institute of Technology,Dehradun during winter season during 2021-2022.Geographically, the Horticultural Research Centre is situated in Doon valley which is 15 km away from the city of Dehradun. The research site is situated at 30.3373^0 N latitude and 77.9532^0 E longitudes and an elevation of 640m above msl .The soil sample was analyzed at the laboratory of the Department of Agriculture, Nanda ki Chowki, Dehradun. The soil is found to be sandy loam with pH 6.22 and EC 0.28 ds m^{-1}. The experiment was laid out in Randomised Block Design with application of PGR which consisted of nine treatments and three replications.

Table 1. Descriptions of the treatments

S.N.	Treatments	Concentrations (ppm)
1.	Control(R.DF)	0 (T_0)
2.	R.D.F+NAA	50 (T_1)
3.	R.D.F+NAA	100 (T_2)
4.	R.D.F+NAA	150 (T_3)
5.	R.D.F+NAA	200 (T_4)
6.	R.D.F+GA_3	50 (T_5)
7.	R.D.F+GA_3	100 (T_6)
8	R.D.F+GA_3	150 (T_7)
9	RD.F+GA_3	200 (T_8)

R.D.F=Recommended dose of fertilizers

2.2 Agronomical Practices

Generally, the suitable time for transplanting the onion seedlings in the Doon Valley is from the last week of November to January. The seeds of onion cultivar N-53 were sown in nursery beds during November and transplanted in January. The recommended dose of N:P: K of 150:50:80

kg/ha in the form of urea, DAP, and MOP was incorporated during different stages of crop production. The recommended dose of N:P: K of 150:50:80 kg/ha in the form of urea, DAP and MOP, During the basal application, 50 % of urea and 100 % of DAP and MOP were administered. Thirty days after transplantation, the last nitrogen dosage was administered. Different concentration of growth regulators as mentioned in Table 1 was applied through foliar application with the use of knap sack sprayer 30 days after transplanting. Intercultural operations such as hoeing, weeding, irrigation, and thinning were carried out according to the requirements and field conditions during the cultivation process. Three hand weeding was conducted during the cultivation. The data was collected 120 DAT and observation was carried out on 10 plants from each plot. In addition to the count of leaves each plant at 45, 60, and 90 days after planting, additional data included plant height (cm) at each of these times, Total fresh bulb weight (g), bulb polar diameter (cm), and bulb equatorial diameter (cm).

2.3 Statistical Analysis

Data from observations were analyzed using ANOVA of 5% significance level [11]. The average value of each treatment in each parameter was tested differently using (DMRT) Duncan multiple range analysis on R-studio.

3. RESULTS AND DISCUSSION

The data collected from the current experiment were documented and thoroughly discussed below:

3.1 Growth Attributes

3.1.1 Plant height

Foliar application of NAA and GA_3 at different concentration showed effect on all the vegetative parameters of onion cultivar. N-53. The maximum plant height 47.38cm ,51.01cm and 54.04 cm was noted with the application of NAA @150ppm followed by 47.25 cm, 50.53 cm and 53.17 with GA_3 @100ppm at 45,60 and 90 days respectively (Table 2). The treatment T_1 (50.37 cm), T_5 (50.36 cm) and T_8 (50.53 cm) were found statistically similar at 60 DAT. The least height was recorded in control (T_0) was recorded 45.87 cm, 48.79 cm at 45 and 60 DAT. The height reported in T_0 is statistically similar to T_2 (45.88 cm), T_4 (46.20 cm) and T_8 (46.04 cm) at 45 DAT while plant height at 90 DAT was found to be NS.

3.1.2 Number of leaves per plant

The number of leaves per plant increased significantly with the increasing crop growth duration. After 45 DAT, the maximum (6.32 cm) number of leaves was recorded in T_3 using NAA @ 150ppm followed by T_1 (6.25 cm), T_4 (6.04 cm) and T_5 (6.04 cm) respectively at 45 DAT (Table 3). However, the minimum (5.78) number of leaves was recorded in control (T_0) with only RDF at 45 DAT. The data recorded in both T_4 and T_5 are statistically similar. In the case of numbers of leaves at 60DAT, the maximum (9.26) number of leaves was recorded at T_3 and at 90 DAT the maximum (13.16) number of leaves was recorded in T_3. While the least (7.94) number of leaves was observed from control (T_0) 7.94 cm (Table 2). At 60 DAT, T_1 (8.84) and T_4 (8.80), T_3 (9.26) and T_8 (9.22) are statistically similar. Furthermore, at 90 DAT, T_0 (10.89) and T_9 (11.07), T_1 (11.29) and T_2 (11.54), T_4 (12.63), T_7 (12.56) and T_8 (12.94) are statistically similar.

The results of the present experiment show congruence with the observations of Saleh et al. [12], Singh et al. [13] Singh [14], Gupta et al. [15], Bose et al. [10], and Meena et al. [16]. The enhancement of cell division and elongation in the meristematic zone may be the cause of the rise in onion growth parameters resulting from foliar application of NAA, such as plant height and leaves count per plant.

3.1.3 Yield Parameters

The yield parameters such as Fresh bulb weight (g), bulb polar distance (cm) and bulb equatorial distance (cm) were also found to be significantly affected by the application of growth regulators at various concentrations as shown in Table 3. The highest (60.12 g) fresh weight of bulb was recorded in treatment T7 with the application of GA_3 @100ppm followed by T6 (59.99 g) and T3 (58.68 g) with the application of GA3 @50ppm and NAA @150ppm respectively. The lowest (50.90 g) bulb weight was recorded in control T0 as shown in Table 3. The treatment T2 (55.37 g), T3 (58.68 g) and T8 (58.34 g) were found to be significantly similar. The maximum (4.75 cm) Bulb polar distance was recorded in T7 (GA_3 100 PPM) and the maximum (5.66 cm) bulb equatorial distance was also recorded in T7with the foliar application of GA_3 @100 ppm. The minimum (4.11 cm) bulb polar distance and

Table 2. Assessment of Performance of foliar application of GA_3 and NAA on onion (*Allium cepa* L.) cv.N-53 plant height and number of leaves per plant

Treatments	PH (cm)			NOL (cm)		
	45 DAT	60 DAT	90 DAT	45 DAT	60 DAT	90 DAT
T_0	45.87^{d}	48.79^{d}	51.63	5.78^{d}	7.94^{d}	10.89^{d}
T_1	46.62^{c}	50.37^{ab}	52.38	6.25^{ab}	9.26^{a}	13.16^{a}
T_2	45.88^{d}	49.44^{cd}	52.76	5.92^{cd}	8.46^{bcd}	11.54^{cd}
T_3	47.38^{a}	51.01^{a}	54.04	6.32^{a}	8.84^{ab}	11.29^{cd}
T_4	46.20^{d}	49.57^{c}	51.54	6.04^{abcd}	8.80^{ab}	12.63^{ab}
T_5	47.03^{ab}	50.36^{ab}	53.13	6.04^{abcd}	8.36^{bcd}	12.11^{bc}
T_6	47.25^{a}	50.53^{ab}	53.17	6.00^{bcd}	8.71^{abc}	12.56^{ab}
T_7	46.78^{bc}	50.01^{bc}	52.72	6.19^{abc}	9.22^{a}	12.94^{ab}
T_8	46.04^{d}	50.07^{bc}	53.10	5.88^{d}	8.01^{cd}	11.07^{d}
LSD (0.05	0.373	0.679	NS	0.27	0.69	0.93
SEM (±)	0.038	0.0694		0.028	0.071	0.095
F-probability	>0.001	>0.001		>0.001	>0.001	>0.001
CV%	0.425	0.721		2.45	4.29	4.10
Grand Mean	46.56	50.01	52.71	6.04	8.62	12.02

Note: Different letters in the same column represents significant difference using Duncan's Multiple Range test (P≤ 0.05) and average was calculated from three replicates

Table 3. Assesement of Performance of foliar application of GA_3 and NAA on the: Fresh Bulb weight per plant(g), Bulb polar distance (cm) and Bulb equatorial distance (cm) of onion (*Allium cepa* L.) cv.N-53

Treatments	Fresh Bulb weight per plant (g)	Bulb polar diameter (cm)	Bulb equatorial diameter (cm)
T_0	50.90^{f}	4.11^{a}	4.47^{g}
T_1	55.37^{d}	4.18^{a}	4.86^{f}
T_2	58.43^{b}	4.21^{a}	4.96^{ef}
T_3	58.68^{b}	4.36^{a}	5.10^{de}
T_4	57.08^{c}	4.60^{a}	5.15^{cde}
T_5	59.99^{a}	4.74^{a}	5.66^{a}
T_6	60.12^{a}	4.75^{a}	5.45^{ab}
T_7	58.34^{b}	4.51^{a}	5.30^{bcd}
T_8	54.30^{e}	4.35^{a}	5.35^{bc}
LSD (0.05)	4.448	0.313	0.228
SEM (±)	0.454	0.032	0.023
F-probability	>0.001	0.01	>0.001
CV%	4.14	3.76	3.363
Grand Mean	57.022	4.42	5.14

Note: Different letters in the same column represents significant difference using Duncan's Multiple Range test (P≤ 0.05) and average was calculated from three replicates

minimum (4.47 cm) bulb equatorial distance was recorded in T0 (control) with RDF. The bulb polar distance data in all treatment were found to be statistically similar, (Table 3). The result from the data was in conformity with Hye et al. [17], Tiwari et al. [18], Singh [14], Tyagi et al. [19], Patel et al. [9], Rashid [6], Islam et al. [20], Shukla et al. [21], Safdari et al. [22] and Bista et al. [2]. Gibberellic acid (GA_3) was found to boost vegetative growth, yield and dry weight inducing rapid cell division and elongation causing increase in bulb size as reported by Islam et al. [17].

4. CONCLUSION

The results of the study concluded that, at varying concentrations, both NAA and GA_3 had positive effects on onion growth and yield. While GA_3 @100ppm was shown to be considerably superior in terms of yield qualities like fresh bulb weight, polar diameter, and equatorial diameter,

NAA @ 150ppm was found to be significantly superior in growth attributes like plant height and number of leaves per plant.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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