

Performance of Foliar Application of GA₃ and NAA on Growth and Yield Attributes of Onion (*Allium cepa*. L) cv. Nashik Red (N-53).

ABSTRACT

In order to ascertain the performance of foliar application of NAA and GA₃ 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 GA₃—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 (T₃). The superior yield attributes like highest fresh weight of bulb per plant (60.12 gm), bulb polar distance (4.75 cm) and bulb equatorial distance (5.45 cm) were recorded from the application of GA₃ 100 PPM (T₆).

Keywords: Onion, NAA, GA₃, Growth, Yield

1. INTRODUCTION

Onion (*Allium cepa*), a herbaceous biennial crop commonly known as 'Pyaj' in Hindi.

Comment [U1]: Grammar correction.

Because of the explosive 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]. The sharpness in onion is due to small quantity quantity of volatile oil allyl propyl disulphides [5].

Comment [U2]: delete

China is the largest producer of onion followed by India and has produced 26,738 MT in the year 2019-2020. In India, approximately 90% of the nation's onion crop is produced in Maharashtra, Madhya Pradesh, Karnataka, Rajasthan, Bihar, Gujarat, Andhra Pradesh, Haryana, West Bengal, and Uttar Pradesh [11].

Comment [U3]: Use updated data

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 nutrients to inhibit physiological

response in plant such as formation of leaves and flowers, stem elongation, ripening of fruits etc [14]. The application of PGRs has been effective in promoting the different growth and yield attributes in onion. Gibberelic acid is an important growth hormone that stimulates cell division or cell stimulation while a synthetic auxin called naphthalene acetic acid facilitates fruit setting, flowering, leaf senescence, apical dominance, root initiation, and fruit abscission. 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 [12]. The highest bulb weight was obtained with foliar application of Gibberelic acid at 200 ppm [4]. The application of Gibberelic acid at 100 ppm increase plant height, count of leaves per plant, bulb diameter and bulb length in onion [14]. NAA application at 50 ppm gave the highest bulb weight, bulb diameter and yield per hectare [2]. Therefore, the current investigation was carried out to study the effect of foliar application of Naphthalene acetic acid (NAA) and Gibberellic acid (GA₃) on growth and yield attributes of onion cv. Nashik Red (N-53).

Formatted: Subscript

2. MATERIAL AND METHODS

2.1 Experimental details

The field trial entitled, "Performance of Foliar Application of GA₃ 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° N latitude and 77.9532° 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 R.B.D with application of PGR which ~~consists~~ consisted of nine treatments and three replications.

Comment [U4]: Fully expand

Table 1. Descriptions of the treatments

S.N.	Treatments	Concentrations (PPMppm)
1.	Control(R.D.F)	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

The onion cultivar N-53 was 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. 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 operation such as hoeing, weeding and thinning were carried out based on observation. 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).

Comment [U5]: What is the suitable time of planting in the area?

Comment [U6]: Complete the sentence.

Comment [U7]: ???????

2.3 Statistical analysis

Data from observations were analyzed using ANOVA of 5% significance level [6]. 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 GA₃ at different concentration showed effect on all the vegetative parameters of onion cultivar- N-53. The maximum plant height 47.38 cm, 51.01 cm and 54.04 cm was noted with the application of NAA @150 ppm followed by 47.25 cm, 50.53 cm and 53.17 with GA₃ @100 ppm at 45, 60 and 90 days respectively (**Table 3**). The treatment T₁ (50.37 cm), T₅ (50.36 cm) and T₈ (50.53 cm) were found statistically similar at 60 DAT. The least height was recorded in control (T₀) was recorded 45.87 cm, 48.79 cm at 45 and 60 DAT. The height reported in T₀ is statistically similar to T₂ (45.88 cm), T₄ (46.20 cm) and T₈ (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 T₃ using NAA @ 150 ppm followed by T₁ (6.25 cm), T₄ (6.04 cm) and T₅ (6.04 cm) respectively at 45 DAT (**Table 3**). However, the minimum (5.78) number of leaves was recorded in control (T₀) with only RDF at 45 DAT. The data recorded in both T₄ and T₅ are statistically similar. In the case of numbers of leaves at 60DAT, the maximum (9.26) number of leaves was recorded at T₃ and at 90 DAT the maximum (13.16) number of leaves was recorded in T₃. While the least (7.94) number of leaves was observed from control (T₀) 7.94 cm (**Table 3**). At 60 DAT, T₁ (8.84) and T₄ (8.80), T₃ (9.26) and T₈ (9.22) are statistically similar. Furthermore, at 90 DAT, T₀ (10.89) and T₉ (11.07), T₁ (11.29) and T₂ (11.54), T₄ (12.63), T₇ (12.56) and T₈ (12.94) are statistically similar.

Comment [U8]: Table 3 or 2?

The results recorded are hence in align with the result of Saleh et al. [16], Singh [18], Gupta et al. [7], Bose et al. [2] and Meena et al. [10]. The enhancement of cell division and

Comment [U9]: Rewrite the sentence.

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.

Table 2: Performance of foliar application of GA₃ 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	45.87d	48.79d	51.63	5.78d	7.94d	10.89d
T ₁	46.62c	50.37ab	52.38	6.25ab	9.26a	13.16a
T ₂	45.88d	49.44cd	52.76	5.92cd	8.46bcd	11.54cd
T ₃	47.38a	51.01a	54.04	6.32a	8.84ab	11.29cd
T ₄	46.20d	49.57c	51.54	6.04abcd	8.80ab	12.63ab
T ₅	47.03ab	50.36ab	53.13	6.04abcd	8.36bcd	12.11bc
T ₆	47.25a	50.53ab	53.17	6.00bcd	8.71abc	12.56ab
T ₇	46.78bc	50.01bc	52.72	6.19abc	9.22a	12.94ab
T ₈	46.04d	50.07bc	53.10	5.88d	8.01cd	11.07d
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

Comment [U10]: Superscript, Follow everywhere.

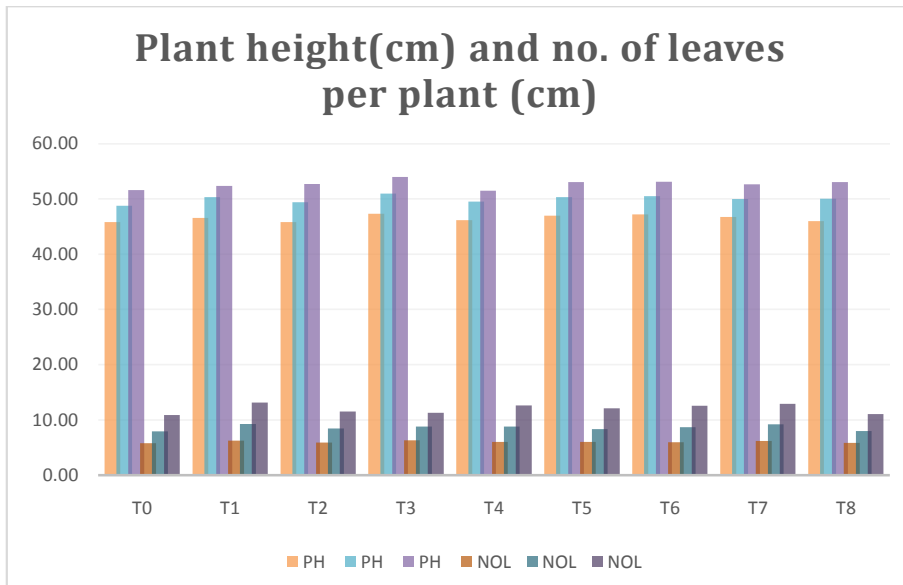


Figure 1: Performance of foliar application of GA₃ and NAA on onion (*Allium cepa* L.) cv. N-53 plant height and number of leaves per plant

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 GA₃ @100ppm followed by T6 (59.99 g) and T3 (58.68 g) with the application of GA₃ @50 ppm and NAA @150 ppm 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 (GA₃ 100 PPM) and the maximum (5.66 cm) bulb equatorial distance was also recorded in T7 with the foliar application of GA₃ @100 ppm. The minimum (4.11 cm) bulb polar distance and 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.* [8], Tiwari *et al.* [20], Singh [18], Tyagi *et al.* [21], Patel *et al.* [13], Rashid [14], Islam *et al.* [9], Shukla *et al.* [19], Safdari *et al.* [15]. Gibberellic

acid (GA₃) 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. [9].

Table 3. Performance of foliar application of GA₃ 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 distance (cm)	Bulb equatorial distance (cm)
T ₀	50.90f	4.11a	4.47g
T ₁	55.37d	4.18a	4.86f
T ₂	58.43b	4.21a	4.96ef
T ₃	58.68b	4.36a	5.10de
T ₄	57.08c	4.60a	5.15cde
T ₅	59.99a	4.74a	5.66a
T ₆	60.12a	4.75a	5.45ab
T ₇	58.34b	4.51a	5.30bcd
T ₈	54.30e	4.35a	5.35bc
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

Comment [U11]: Check whether it is distance?

Comment [U12]: Check whether it is distance?

Comment [U13]: Superscript, follow everywhere in the table.

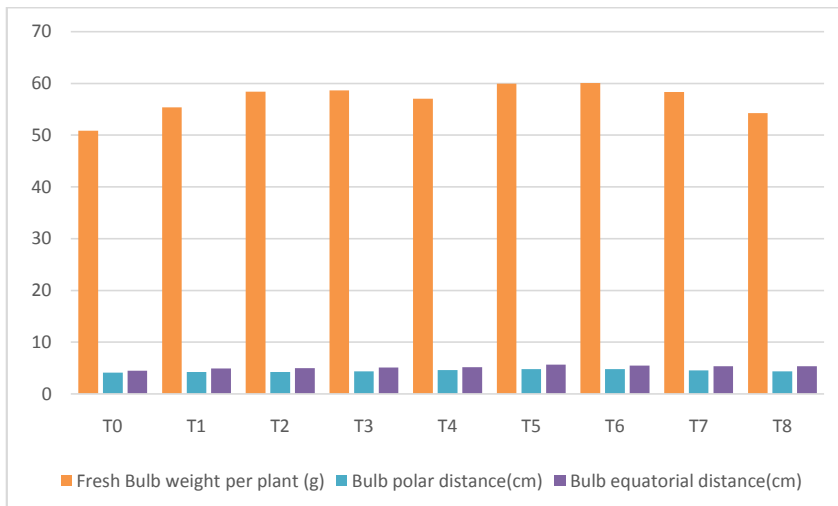


Fig 2: Performance of foliar application of GA₃ and NAA on the: Fresh Bulb weight per plant(g), Bulb polar distance (cm) and Bulb equatorial distance (cm)of onion (*Allium cepa* L.) cv.N-53

4. CONCLUSION

The results of the study concluded that, at varying concentrations, both NAA and GA₃ had positive effects on onion growth and yield. While GA₃ @100 ppm was shown to be considerably superior in terms of yield qualities like fresh bulb weight, polar diameter, and equatorial diameter, NAA @ 150 ppm was found to be significantly superior in growth attributes like plant height and number of leaves per plant.

REFERENCES

- [1] Abbey, L and D.C. Joyee. (2004). Water deficit stress and soil. *J. Veg. Crop Prod.* , 10: 5-18.
- [2] Bose, U.S., Bisen, A., Sharma, R.K. and Dongre, R. (2009). Effect of micro nutrient along with growth regulator on growth and yield of onion. *International Journal of Applied Agricultural Research* , 4(3): 267-271.

- [3] DA, N. (1992). Note on effect of growth regulators on growth, yield and quality of kharif onion. *Indian Journal of Horticulture* , 49(3): 267-269.
- [4] Devi J, Singh J and Walia, I. (2018). EFFECT OF FOLIAR APPLICATION OF GA₃ AND NAA ON ONION – A. *Plant Archives* , Vol. 18 No. 2, 2018 pp. 1209-1214.
- [5] Dwivedi, B., Diwan, G. and Asati, K.P. (2019). Effect of plant growth regulators and their methods of application on growth of kharif onion (*Allium cepa* L.) Cv. Agrifound Dark Red. *International Journal of Current Microbiology and Applied Sciences* , 8(09): 1597-1610.
- DOI: <https://doi.org/10.20546/ijcmas.2019.809.183>
- [6] Gomez K. A, Gomez A. A. *Statistical procedures for agricultural research (2nd ed.)*. John Wiley & Sons.
- [7] Gupta M, Rahman T, Ahmed Z, Kabir M. H. (2022). Effect of nitrogen and naphthalene acetic acid on the growth and yield of summer. *GSC Advanced Research and Reviews*, 2022, 10(01), 166–176. DOI: <https://doi.org/10.30574/gscarr.2022.10.1.0033>
- [8] Hye, M.A., M.S. Haque and M.A. Karim (2002). Influence of growth regulators and their time of application on yield of onion. *Pakistan Journal of Bio. Sci.*, 5(10): 1021-1023.
- [9] Islam, S., Islam, M.O., Alam, M.N., Ali, M.K and Rahman, M.A. (2007). Effect of plant growth regulator on growth, yield and yield components of onion. . *Asian J. PL.Sci.*, 6(5):849-853 .
- [10] Meena R.K., Dhaka R.S, Meena N. k and Meena Sunil. (2017). ffect of Foliar Application of NAA and GA₃ on Growth and Yield of Okra. *Int. J. Pure App. Biosci.* 5 (2): 1057-1062 , ISSN: 2320 – 7051. DOI: <http://dx.doi.org/10.18782/2320-7051.2660>
- [11] Monthly Report Onion. (2020). *Horticulture Statistics Division*. New Delhi: Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and farmers Welfare, Government of India.
- [12] Nandekar, D.N.; Sawarkar, S.D.(1992). Note on effect of growth regulators on growth, yield and quality of kharif onion. *Indian Journal of Horticulture* 49(3): 267-269. <https://eurekamaq.com/research/002/444/002444023.php>

- [13] Patel .M.J, Patel, H.C. and Chavda, J.C. (2010). Influence of Plant Growth Regulators and Their Application Methods on yield and quality of onion(*Allium cepa* L.). *Asian J.Hort.*,5(2)0:263-265 .
- [14] Rashid, M.H.A. (2010). Effect of Sulphur and GA₃ on the growth and yield of onion . *Progressive Agriculture* , 21(1-2): 57-63.
- [15] Safdari M, Dardar A, Khaniki G. B. (2014). The Independent Effect of Time and Hormonal Concentration Treatments on Reproductive Traits in Onion. *Indian J. of Fundamental and Applied Life Sciences* , 4(4), 3009-3015.
- [16] Saleh, M.M.S. and Q.J. Abed (1989). Effect of gibberellic acid and naphthalene acetic acid on growth, yield and quality of onion. *Dirasat Journal*, 16(9): 39-51
- [17] Singh L, Barholia A.K, BAjpai R, Bhadauria N.S and Singh V.B. (2019). Response of Kharif Onion (*Allium cepa* L.) for Growth and Yield to Different Doses of Sulphur, GA₃ and NAA. *Int.J.Curr.Microbiol.App.Sci*(2019)8(1):2362-2372.
Doi: <https://doi.org/10.20546/ijcmas.2019.801.248>
- [18] Singh, M. (2006) Response of growth regulators on bulb yield of onion (*Allium cepa* L.). *International Journal of Agricultural Sciences*, 2(2): 589-591.
- [19] Shukla, N., S. Mondal, S.N. Dikshit, J. Trived, S. Tamrakar and P. Sharma, (2010). Effect of different concentration of GA Effect of Foliar Application of GA₃ and NAA on Onion – A Review 1213 and NAA and their methods of application on growth and yield of onion. *Progressive Horticulture*. 42(1): 225-230.
- [20] Tiwari, R.S., A. Agarwal and S.C. Sengar (2003). Effect of Bioregulators on Growth Bulb Yield, Quality and Storability of Onion cv. Pusa Red. *Indian J. Plant Physiol.*, 8(4) : 411-413.
- [21] Tyagi, A.K. and S.K. Yadav (2007). Effect of Growth Regulators on Growth and Yield of Onion (*Allium cepa* L.) cv. Pusa Red. *Plant Archives*. 7(1) : 371-372