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Influence of foliar application of GA_3 and NAA on morphophysiological, yield and yield contributing characters in mungbean (*Vigna radiata* L.)

Samruddhi Madavi, PV Shende, Nikita Landge, Sapana Baviskar and Sudhir Patil

Abstract
An experiment was carried in field section of Agricultural Botany, College of Agriculture, Nagpur, during *Kharif* season 2022 based on a RBD with three replications, variety PKV Green Gold with thirteen treatments were taken. The foliar sprayed of GA_3 @ 200 PPM + NAA @ 200 PPM was found most effective for increasing the plant height, number of branches per plant, days to flower initiation, days to 50% flowering, days to maturity, total dry weight per plant, leaf area per plant, leaf area index and number of pods plant^{-1}, pod length, seed yield, test weight, harvest index over rest of the treatments. Generally, the use of growth regulators as foliar application increased the yield and yield components.

Keywords: Mungbean, GA_3, NAA, morphophysiological

Introduction
Mungbean (*Vigna radiata* L.) is also known as green gram, it is an important pulse crop of India and grown in *Rabi* (South India), *Kharif* and *Summer* seasons. It is green with husk and yellow when dehusked. The beans are small, ovoid in shape and green in color. The mungbean is mainly cultivated in India, Pakistan, Bangladesh, Nepal, China, Korea, South Asia and Southeast Asia. It has many effective uses, green pod is cooked as peas, sprout rich in vitamins and amino acids. This crop can be used for both seed and forage since it produces a large amount of biomass and then recover after grazing to yield abundant seeds and then can be used in broilers diets as a non-traditional feed stuff (Navya *et al*., 2021) [6]. Mungbean is third most important pulse crop of India after chickpea and pigeonpea. The nutritive value of mungbean is a high with easily digestible protein (approximately 25-28%), oil 1.0-1.5%, fiber 3.5-4.5%, ash 4.5-5.5%, carbohydrate 62-65%, water 9.1%, and vitamins on dry weight basis (Prakash *et al.* 2019) [9]. Green gram is the third most important pulse crop in India. It is quite versatile crop grown for seeds, green manure and forage and it is also considered as "Golden Bean" because of its nutritive values and suitability for increasing the soil, by the way of addition of nitrogen to the soil. It has high nutritive value, and due to this, has advantage over the other pulses (Pagire and John. 2016) [7]. Mungbean is botanically recognized as (*Vigna radiata* L.) and belong to the family Fabaceae (Leguminaceae). The genus Vigna has been broadened and include about 155 species but only twenty – two species are native to India. Where they are grown in large numbers and are often grouped under distinct varieties and sub species. One of most important among these species is *Vigna radiata* with dark-green foliage, spreading and green seeds (Mishra *et al*. 2021) [4].

Materials and Methods
The field experiments were carried out during *kharif* seasons of 2022 in field section of Agricultural Botany, College of Agriculture, Nagpur. Total number of treatments were thirteen *viz.*, T_1 (control), T_2 (GA_3 @ 50 PPM) T_3 (GA_3 @ 100 PPM) T_4 (GA_3 @ 150 PPM) T_5 (GA_3 @ 200 PPM), T_6 (NAA @ 50 PPM), T_7 (NAA @ 100 PPM), T_8 (NAA @ 150 PPM), T_9 (NAA @ 200 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM). Solution of treatments were prepared. Foliar applications done at 25 and 35 days after sowing with the help of hand sprayer as per treatment. While in untreated control distilled water was sprayed.

The experiment was planned with randomized block design in three replications morpho-physiological parameter were taken, germination (%) = (number of seeds germinated/total number of seeds) x100, plant height (30, 45, 60 DAS), dry weight per plant**,** days to maturity,

Harvest Index (%) = [(Economic yield)/(Biological Yield)] ×100.

Results and Discussion

Plant height

Plant height of mungbean significantly increased by application of different concentrations of GA_3 and NAA at 30, 45 and 60 DAS. Among the treatments plant height was maximum due to foliar application of T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM) followed by treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_5 (GA_3 @ 200 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), T_4 (GA_3 @ 150 PPM). Remaining treatments were also increasing plant height significantly over control (T_1). Plant growth regulator particularly GA_3 played important role in enhancement of stem elongation, it stimulates cell proliferation and elongation at intercalary meristem stem level, thus leading to internodal growth. NAA have important role in cell division and cell elongation. A similar result was reported by Mishra *et al.* (2021) [4] found more plant height at all stages by the foliar application of GA_3 @ 75 PPM as compared to control at all the stages of crop growth (30, 45, 60 DAS and at harvest stages). Parveen *et al.* (2023) [8] showed that application of two phytohormones *i.e.*, IAA and GA_3 individually or in combination, significantly influenced the growth of mungbean plants.

Number of branches plant^{-1}

Number of branches plant^{-1} increased significantly over control at 30, 45 and 60 DAS. Significantly highest number of branches plant^{-1} found in treatment T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM) followed by treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_9 (NAA @ 200 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), T_8 (NAA @ 150 PPM). Remaining treatments were also increasing plant height significantly over control (T_1). NAA enhances cell division. When NAA paired with another phytohormone like GA_3 it enhances the cellulose fibre formation.GA_3 enhances photosynthates translocation and growth. Sharvani *et al.* (2022) [13] conducted experiment on Pigeonpea and observed that Significant and highest number of branches per plant was record were recorded with increase in concentration of NAA. The highest number of branches were observed in plant which was treated with NAA @ 80 PPM as compared to others. Parveen *et al.* (2023) [8] showed that application of two phytohormones *i.e.*, IAA and GA_3 individually or in combination, significantly influenced the growth of mungbean plants. A significant increase was observed under IAA (60 mg $L^{-1)}$ + GA_3 (60 mg L^{-1}) treatment in number of branches plant^{-1} by 22.9%.

Days to flower initiation

The number of days for flower initiation was recorded earlier in treatments T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM). GA_3 have important role in induction of flower, induce early flowering, controlling flowering time. Sandhya *et al.* (2012) [11] conducted an experiment on mungbean with growth regulators and observed that flower initiation was early in case of PGR applied plant as compared to stressed plant.

Days to 50% flowering

The days to 50% flower was recorded earlier in treatments T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM). GA_3 have important role in increase in number of flowers, induction of flower, induce early flowering, controlling flowering time. Sharma *et al.* (2020) [12] conducted an experiment on mungbean with growth regulators and observed that 50% flowering and days to maturity were early in treatment T_2 (GA_3 @ 100) compared to other treatments of GA_3 and NAA.

Days to maturity

Days to maturity was recorded earlier in treatments T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM). GA_3 have important role in maturation phase by mobilising food reserves, organ development. Sandhya *et al.* (2012) [11] conducted an experiment on mungbean with growth regulators and observed that flower initiation was early in case of PGR applied plant as compared to stressed plant. Sharma *et al.*, (2020) [12] conducted an experiment on mungbean with growth regulators and observed that 50% flowering and days to maturity were early in treatment T_2 (GA_3 @ 100) compared to other treatments of GA_3 and NAA.

Total dry weight plant^{-1}

Total dry weight plant^{-1} production was recorded at 30, 45 and 60 DAS. Maximum dry weight was recorded in treatment T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM) followed by treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), T_5 (GA_3 @ 200 PPM). Remaining treatments were also increasing plant height significantly over control (T_1). Significant increase in total dry weight plant^{-1} might due to stem elongation, increase in cell size of leaves, photosynthetic activity and another possible growth factors as influenced by GA_3 application. NAA plays important role in increase in number of leaves per plant, cell division and cell elongation. Mishra *et al.* (2021) [4] conducted an experiment on mungbean with growth regulators and observed that the maximum increase in total biomass was observed with foliar spray of GA_3 @ 75 PPM as compared to other treatments. Bhargav *et al.* (2023) [1] in an experiment on mungbean observed that GA_3 (45 PPM) gave highest dry weight plant $^{-1}$ as compared to other treatments.

Leaf area: Leaf area was recorded at 30, 45 and 60 DAS. Foliar application of T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM) followed by treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), T_5 (GA_3 @ 200 PPM), noted significantly maximum leaf area over control (T_1). GA_3 plays important role in organ elongation, increasing total area of leaf surface, inducing mitosis in leaves and NAA have important role in cell elongation. Rahman *et al.*, (2018) [10], conducted an experiment on mungbean by applying foliar spray of gibberellic acid and conducted that increased in leaf area (cm^2) was observed in GA_3 @ 100 PPM as compared to other concentration at 15, 25, 35, 45, and 55 DAS. Sharvani *et al.*, (2022) [13] conducted an experiment on mungbean and concluded that NAA @ 80 PPM gave more leaf area (cm^2) as compared to other treatments.

Leaf area index

The data recorded about the LAI were found statistically significant at 30, 45 and 45 DAS. The most pronounced effect observed in plant expose to the treatment T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM) followed by T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM). These results are in accordance with the findings of the following scientists. Singh and Jambukiya (2020) [14] examined the influence of NAA on the growth of mungbean. The increase in treatment showed higher value of leaf area index at T_3 i.e., NAA @ 75 PPM.

Net assimilation ratio

NAR increased with foliar spray of GA_3 and NAA over control but significant increase was recorded by in treatment T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM) followed by treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), T_5 (GA_3 @ 200 PPM), when compared control and rest of the treatments (T_9, T_8, T_7, T_6, T_4, T_3, T_2). GA_3 enhances metabolic activity, photosynthetic activity also lead to increase leaf area, dry weight in plant. NAA also contribute to cell elongation, contribute to photosynthetic activity. Verma *et al.*, (2018) [15], conducted an experiment in chick pea and concluded that Net assimilation rate was higher in higher concentration of NAA i.e., NAA @ 40 PPM and in GA it was higher at GA @ 20 PPM as compared to other treatments. Singh and Jambukiya (2020) [14], conducted an experiment inn mungbean and concluded that higher concentration of NAA i.e., NAA @ 50 PPM gave higher result of NAR.

Relative growth rate

Data regarding RGR at 30-45 and 45-60 have shown significant variation. RGR increased with foliar spray of GA_3 and NAA over control but significant increase was recorded by in treatment T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM) followed by treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), T_5 (GA_3 @ 200 PPM), when compared control and rest of the treatments (T_9, T_8, T_7, T_6, T_4, T_3, T_2). Singh and Jambukiya (2020) [14], conducted an experiment in mungbean and concluded that Relative growth rate was higher in higher concentration of NAA i.e., NAA @ 75 PPM as compared to other treatments. Esther and Gautam (2020) [2], conducted an experiment on blackgram and concluded that relative growth rate was higher in case of GA_3 i.e., GA_3 @ 50 PPM as compared to NAA.

Yield and yield attributing characters

Pods plant^{-1}: Among all the treatments significantly highest number of pods plant^{-1} was registered in treatment T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM), followed by treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), over control and rest of the treatments. GA_3 prevent premature falling of fruits, organ elongation. NAA contribute to increase fruit setting ratio, prevent abscission, prevent fruit dropping and also increases fruit size. Mishra *et al.* (2021) [4] conducted an experiment on mungbean with foliar application of GA_3 and NAA and concluded that the number of pod plant^{-1} was higher in plant treated with GA_3 @ 75 ppm followed by foliar application of NAA @ 150 PPM as compared to other treatments of GA_3 and NAA.

Pod length

Pod length was significantly enhanced by treatment receiving T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM) followed by treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), when compared with treatment T_1 (control) and rest of the treatments. GA_3 enhances organ elongation. NAA contribute to increases fruit size and enhances cell division. Jadhav *et al.* (2020) [3] in their experiment on mungbean conducted that pod length (cm) was longest in treatment T_4 (GA_3 @ 30 PPM) as compared to rest of the treatment. Mishra *et al.*, (2021) [4] conducted an experiment on mungbean with foliar application of GA_3 and NAA and concluded that the length of pod was longest in plant treated with GA_3 @ 75 ppm followed by foliar application of NAA@ 150 PPM as compared to other treatments of GA_3 and NAA.

Test weight

Among all the treatments tested the highest 1000 seed weight was obtained in treatment T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM), over control and rest of the next to these treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), NAA contribute to increase fruit size, cell division. GA_3 enhances organ elongation, translocation of photosynthates, metabolic activities in plant. Mishra *et al.* (2021) [4] in their experiment in mungbean concluded that higher seed weight obtained from foliar spray of GA_3 @ 50 PPM followed by NAA @ 150 PPM.

Table 1: Influence of foliar application of GA_3 and NAA on morpho-physiological parameters in mungbean.

Treatments	Plant height (cm)			Number of branches plant^{-1}			Days to flower initiation	Days to 50% flowering	Days to maturity	Total dry weight plant^{-1} (gm)		
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS				30 DAS	45 DAS	60 DAS
T1(Control)	14.01	33.01	45.30	2.02	3.48	4.07	34.57	39.50	67.57	2.49	5.10	8.17
T2 (GA_3 @ 50 PPM)	16.62	37.03	50.71	2.15	4.00	4.82	32.56	38.52	65.17	2.89	5.59	10.10
T3 (GA_3 @ 100 PPM)	17.31	39.03	52.03	2.20	4.03	4.94	32.50	38.47	65.04	2.91	6.05	10.27
T4 (GA_3 @ 150 PPM)	17.58	39.25	52.13	2.42	4.08	5.17	32.46	38.42	64.64	3.60	7.12	11.23
T5 (GA_3 @ 200 PPM)	18.99	40.30	53.47	2.57	4.30	5.25	32.31	38.38	63.96	3.45	6.60	11.54
T6 (NAA @ 50 PPM)	14.66	34.37	46.44	2.21	4.25	5.30	33.31	39.03	66.31	2.52	5.33	9.45
T7 (NAA @ 100 PPM)	15.24	36.15	47.08	2.41	4.39	5.31	33.30	38.88	65.71	2.53	5.53	9.57
T8 (NAA @150 PPM)	16.49	37.03	47.91	2.60	4.57	5.37	33.25	38.83	65.58	2.55	6.75	10.31
T9 (NAA @ 200 PPM)	16.55	37.42	50.06	2.75	4.62	5.44	32.89	38.80	65.32	2.57	6.90	10.65
T10 (GA_3 @ 50 PPM+NAA @ 50 PPM)	17.76	39.60	54.92	2.62	4.26	5.52	32.27	38.18	63.94	3.79	8.46	12.19

T11 (GA_3 @ 100 PPM+ NAA @100 PPM)	19.45	42.61	57.94	2.77	4.68	5.57	32.22	37.77	63.84	4.24	8.55	12.33
T12 (GA_3 @ 150 PPM +NAA @ 150 PPM)	19.66	44.71	59.50	2.80	4.80	5.61	31.86	37.72	63.45	4.37	8.70	13.07
T13 (GA_3 @ 200 PPM + NAA @ 200 PPM)	20.32	45.21	60.68	2.90	4.96	5.95	31.79	37.63	62.55	4.40	9.56	13.15
SE (m) ±	1.29	2.54	3.58	0.20	0.28	0.34	2.29	2.69	4.11	0.20	0.43	0.69
CD at 5%	3.75	7.40	10.46	0.57	0.83	1.00	6.67	7.85	12.01	0.57	1.27	2.02

Table 2: Influence of foliar application of GA_3 and NAA on morpho-physiological parameters in mungbean.

Treatments	Leaf area plant $^{-1}$ (cm^2)			Leaf area Index			Net Assimilation Rate (mg dm^{-2} day^{-1})		Relative Growth Rate (g g^{-1} day^{-1})	
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS	30-45 DAS	45-60 DAS	30-45 DAS	45-60 DAS
T1(Control)	121.00	332.33	219.33	0.55	1.38	0.87	60.90	32.43	0.04146	0.02190
T2 (GA_3 @ 50 PPM)	158.00	388.00	317.33	0.73	2.20	2.04	66.63	35.17	0.04493	0.02366
T3 (GA_3 @ 100 PPM)	158.00	400.67	325.00	0.79	2.29	2.22	68.53	39.13	0.04526	0.02493
T4 (GA_3 @ 150 PPM)	168.00	410.33	335.33	0.82	2.33	2.26	69.17	39.93	0.04800	0.02653
T5 (GA_3 @ 200 PPM)	171.67	415.33	346.33	0.81	2.31	2.24	70.90	43.57	0.04860	0.03213
T6 (NAA @ 50 PPM)	144.33	375.33	271.67	0.69	2.09	1.65	62.77	34.77	0.04303	0.02506
T7 (NAA @ 100 PPM)	149.00	376.33	283.00	0.73	2.19	1.99	65.83	34.97	0.04326	0.02530
T8 (NAA @150 PPM)	149.33	389.67	288.67	0.76	2.21	2.04	67.87	37.33	0.04400	0.02576
T9 (NAA @ 200 PPM)	158.67	393.00	321.33	0.79	2.29	2.12	68.67	40.70	0.04513	0.02643
T10 (GA_3 @ 50 PPM+NAA @ 50 PPM)	179.67	459.00	369.00	0.83	2.34	2.27	72.63	48.43	0.05053	0.03430
T11 (GA_3 @ 100 PPM+ NAA @100 PPM)	182.00	462.67	369.67	0.84	2.42	2.32	76.53	50.80	0.05310	0.03500
T12 (GA_3 @ 150 PPM +NAA @ 150 PPM)	191.67	471.00	385.00	0.88	2.56	2.40	81.63	55.87	0.05693	0.03643
T13 (GA_3 @ 200 PPM + NAA @ 200 PPM)	210.67	483.00	390.67	0.90	2.97	2.50	84.50	56.97	0.05753	0.03826
SE (m) ±	14.99	24.44	26.26	0.05	0.15	0.12	3.72	3.00	0.003	0.004
CD at 5%	43.76	71.35	76.64	0.15	0.45	0.36	10.87	8.75	0.01	0.01

Table 3: Influence of foliar application of GA_3 and NAA on yield and yield contributing parameters in mungbean.

Treatments	Number of pods plant^{-1}	Pod length (cm)	Test weight	Harvest index	Seed yield plant $^{-1}$ (g plant^{-1})	Seed yield plant^{-1} (kg plot^{-1})	Seed yield (q ha^{-1})	B:C ratio
T1(Control)	11.08	5.77	2.91	21.01	6.323	0.306	6.376	2.27
T2 (GA_3 @ 50 PPM)	13.58	6.04	3.13	21.96	6.576	0.316	6.626	2.52
T3 (GA_3 @ 100 PPM)	14.28	7.07	3.19	23.54	6.580	0.316	6.626	2.52
T4 (GA_3 @ 150 PPM)	16.77	7.08	3.25	25.62	6.603	0.320	6.643	2.54
T5 (GA_3 @ 200 PPM)	15.77	7.15	3.29	24.62	6.636	0.323	6.686	2.58
T6 (NAA @ 50 PPM)	12.37	5.83	3.03	21.38	6.703	0.326	6.746	2.64
T7 (NAA @ 100 PPM)	14.13	6.50	3.04	21.73	6.706	0.326	6.746	2.64
T8 (NAA @150 PPM)	15.56	6.72	3.07	22.38	6.763	0.330	6.873	2.77
T9 (NAA @ 200 PPM)	16.37	6.93	3.11	23.12	6.833	0.333	6.973	2.87
T10 (GA_3 @ 50 PPM+NAA @ 50 PPM)	16.86	7.35	3.32	26.95	6.956	0.336	6.990	2.88
T11 (GA_3 @ 100 PPM+ NAA @100 PPM)	16.92	7.45	3.38	27.25	7.076	0.343	7.126	2.92
T12 (GA_3 @ 150 PPM +NAA @ 150 PPM)	17.19	7.60	3.41	28.24	7.206	0.346	7.256	2.95
T13 (GA_3 @ 200 PPM + NAA @ 200 PPM)	17.88	7.78	3.52	28.29	7.270	0.353	7.333	2.98
SE (m) ±	1.09	0.29	0.23	1.54	0.31	0.02	0.16	
CD at 5%	3.17	0.83	0.68	4.50	0.90	0.07	0.47	

Harvest index

Harvest index was significantly increased with treatment T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM), followed by treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), T_4 (GA_3 @ 150 PPM), T_5 (GA_3 @ 200 PPM) over control. NAA increases cell division, contribute to increase fruit size, fruit setting ratio. GA_3 induces mitosis, enhances organ elongation, translocation of photosynthates, increases growth in plant. Nandan *et al.* (2021) [5] in their experiment on mungbean concluded that GA_3 @ 100 PPM gave highest harvest index followed by NAA @ 100 PPM and rest of the treatments. Singh and Jambukiya (2020) [14] in their experiment on mungbean concluded that harvest index was higher in treatment NAA @ 75 PPM as compared to other treatments of NAA.

Seed yield

Seed yield plant^{-1}, plot^{-1} and ha^{-1} were significantly increased by the application of T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM) followed by treatments T_{12} (GA_3 @ 150 PPM + NAA @ 150 PPM), T_{11} (GA_3 @ 100 PPM + NAA @ 100 PPM), T_{10} (GA_3 @ 50 PPM + NAA @ 50 PPM), T_9 (NAA @ 200 PPM), T_8 (NAA @ 150 PPM) over control and rest of the treatments. Enhancement on yield contributing factors which might due to maximum net photosynthetic rate in leaves and better translocation of photosynthetic and metabolites. Higher number of seeds per plant may be because of increased cell division, promotion of orderly development of embryos of seeds and higher level of photosynthates that led to increase in

number of seeds per plant. Mishra *et al.* (2021) [4] in their experiment on mungbean concluded that maximum seed yield obtained from GA_3 @ 75 PPM followed by NAA @ 150 PPM as compared to other treatments. Also concluded that application of both GA_3 and NAA attributed maximum net photosynthetic rate in leaves and better translocation of photosynthetic and metabolism and also attribution of yield up to certain extent.

Conclusion

The present investigation concluded that foliar sprayed of T_{13} (GA_3 @ 200 PPM + NAA @ 200 PPM) was found most effective among all treatments to increase growth of mungbean, yield components for improving the yield of mungbean.

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