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Effect of Foliar Spray of Nitrogen and NAA on Growth and Yield Traits of Cowpea *(Vigna unguiculata* L.*)*

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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

A field experiment was conducted during *Kharif* (*wet*) season 2021 at experimental field of the Crop Research Farm, SHUATS, Praygraj, Uttar Pradesh, India. The experiment was laid out in randomized block design with twelve treatments replicated thrice on the basis of one year experimentation on sandy loam soil. To determine the "Effect of foliar application of nitrogen and NAA on growth and yield of cowpea (*Vigna Unguiculata* L.). The treatments consisted of three levels of Urea spray – 1.0 %, 1.5% and 2.0% and Four levels of Plant growth regulator [NAA] spray – 0ppm, 25 ppm, 50 ppm and 75 ppm. The Treatments were applied as Foliar spray after 20 and 40 days after sowing. The results showed that treatment with the application of Nitrogen (Urea) 2.0% + NAA at 25 ppm recorded significantly higher plant height (53.80 cm), number of branches (7.27), dry weight (39.10 g/plant), However, Maximum number of pods plant^{-1} (16.93), number of seeds pod^{-1} (14.33), pod dry weight (4.17 g), Seed index (18.42 g), seed yield (1436.26 kg ha^{-1}) and haulm yield (2651.97kg ha^{-1}) were also recorded in the same treatment with the application of Nitrogen 2.0% + NAA at 25 ppm.

Keywords: Growth; NAA; Urea; yield and cowpea.

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1. INTORDUCTION

Cowpea (*Vigna unguiculata* L.*)* is an important pulse crop that belongs to the family Fabaceae and also known as black-eyed pea, southern bean and yard long bean. It is a crop that can be used as fodder crop, green manure crop, catch crop, mulch crop, intercrop and mixed crop. Besides a rich protein, they maintain soil fertility through biological nitrogen fixation in soil and thus play a pivotal role in furthering sustainable [1]. Productivity of cowpea in our country is very low. So, there is need to take proper agronomic practices to enhance the productivity of cowpea and foremost important among them is foliar application of organic and inorganic sources of nutrients exploiting genetic potential of crop.

Nitrogen supply is essential for vegetative as well as reproductive growth of the crop. It is usually applied to field crops through soil application. During early development of grain legumes, the photosynthates are utilized for growth and functioning of root nodules, but at the onset of flowering the developing seed requires higher levels of nitrogen [2]. Therefore, leaf nitrogen gets diverted to grain filling, leading to flower shedding and poor realization of sink. Nitrogen at the time of flowering increases the pod setting and yield [3] and [4].

NAA (Naphthalene Acetic Acid) is synthetic auxin like growth regulator of higher efficiency which stimulates root initiation, initiation of cell division and vegetative growth, when it is applied in significant concentrations, it promotes adventitious root formation and promotes better rooting activities, promotes cell division and cell enlargement thus increasing nutrient absorption. The hormone supply from roots to the leaves, consequently resulting into growth inhibition [5].

2. MATERIALS AND METHODS

The experiment carried out during *kharif* season of 2021 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P.). which is located at 25^0 30' 42''N latitude, 81^0 60' 56" E longitude, and a height of 98 metres above sea level The soil texture in the experimental plot was sandy loam, with a practically neutral soil reaction (PH 7.1), low organic carbon (0.44 percent), available N (171.48 kg ha^{-1}), available P (27.0 kg ha^{-1}), and available K (291.2 kg ha^{-1}) [6] and [7]. The crop was sown on 16 June 2021 using variety Ankur Gomati. The experiment was set up in a Randomized Block Design with three replications and twelve treatments with total of 36 plots *Viz.,* T1: Nitrogen (Urea) at 1.0 % + NAA at 0 ppm (Water Spray), T2: Nitrogen (Urea) at 1.5 % + NAA at 0 ppm (Water Spray), T3: Nitrogen (Urea) at 2.0% + NAA at 0 ppm (Water Spray), T4: Nitrogen (Urea) at 1.0 % + NAA at 25 ppm, T5: Nitrogen (Urea) at 1.5 % + NAA at 25 ppm, T6: Nitrogen (Urea) at 2.0% + NAA at 25 ppm, T7: Nitrogen (Urea) 1.0 %+ NAA at 50 ppm, T8: Nitrogen (Urea) 1.5% + NAA 50 ppm, T9: Nitrogen (Urea) 2.0% + NAA at 50 ppm, T10: Nitrogen (Urea) 1.0 % + NAA at 75 ppm, T11: Nitrogen (Urea) 1.5 % + NAA at 75 ppm and T12: Nitrogen (Urea) 2.0% + NAA at 75 ppm. Urea, single super phosphate (SSP), and muriate of potash (MOP) were applied as a basal dose in all plots, and the treatments were applied as foliar spray at 20 and 40 days following sowing in the corresponding plots. The growth Parameters were measured at 15,30,45, and 60 days intervals, as well as at harvest stage, from randomly selected plants in each treatment. A statistical analysis was performed, and the mean was compared at a 5% probability level of significance [8].

Fig. 1. Field Evaluation

Table 1. Effect of Foliar spray of Nitrogen and NAA on growth attributes of Cowpea

S.no.	Treatment combinations	Plant height (cm) (60 DAS)	Branches per plant (No.) (60 DAS)	Dry weight (g/plant) (60 DAS)
1	Nitrogen at 1.0% + NAA at 0 ppm	43.51	4.20	28.15
2.	Nitrogen at 1.5% + NAA at 0 ppm	45.46	4.33	29.23
3.	Nitrogen at 2.0% + NAA at 0 ppm	48.46	4.40	29.61
4.	Nitrogen at 1.0% +NAA at 25ppm	50.03	4.93	34.10
5.	Nitrogen at 1.5% +NAA at 25ppm	52.08	5.53	37.87
6.	Nitrogen at 2.0% +NAA at 25ppm	53.80	7.27	39.10
7.	Nitrogen at 1.0% + NAA at 50ppm	49.21	4.87	32.03
8.	Nitrogen at 1.5% + NAA at 50ppm	50.91	5.47	37.63
9.	Nitrogen at 2.0% + NAA at 50ppm	53.70	6.80	38.61
10.	Nitrogen at 1.0% + NAA at 75ppm	48.74	4.80	30.83
11.	Nitrogen at 1.5% + NAA at 75ppm	50.73	5.07	35.61
12.	Nitrogen at 2.0% + NAA at 75ppm	53.10	6.00	28.15
	F test	**S**	**S**	**S**
	S.Em (±)	0.30	0.18	0.32
	CD (P=0.05)	0.87	0.52	0.93

Table 2. Effect of Foliar spray of Nitrogen and NAA on Yield traits of Cowpea

Yield Attributes							
Treatment Combinations	**Numberof pods plant^{-1}**	**Dry weight of the pod (gm)**	**seeds per pod (No.)**	**Seed Index (g)**	**Seed yield (Kg ha^{-1})**	**Haulm yield (Kg ha^{-1})**	**Harvest index (%)**
1. Nitrogen at 1.0% + NAA at 0 ppm	12.60	2.41	11.40	16.47	793.4	1400.04	36.16
2. Nitrogen at 1.5% + NAA at 0 ppm	12.73	2.85	11.43	16.71	800.8	1474.3	35.20
3. Nitrogen at 2.0% + NAA at 0 ppm	13.40	2.91	11.80	16.71	875.94	1570.21	35.80
4. Nitrogen at 1.0% +NAA at 25ppm	14.53	3.01	12.60	17.26	1082.7	1845.4	36.94
5. Nitrogen at 1.5% +NAA at 25ppm	16.20	3.82	13.80	17.70	1352.33	2110.01	39.05
6. Nitrogen at 2.0% +NAA at 25ppm	16.93	4.17	14.33	18.42	1436.26	2651.97	35.14
7. Nitrogen at 1.0% + NAA at 50ppm	14.20	3.00	12.40	16.94	998.73	1768.35	36.09
8. Nitrogen at 1.5% + NAA at 50ppm	16.13	3.48	13.33	17.69	1296.75	2063.3	38.56
9. Nitrogen at 2.0% + NAA at 50ppm	16.90	3.92	14.07	18.10	1413.93	2573.13	35.46
10. Nitrogen at 1.0% + NAA at 75ppm	13.80	2.93	11.87	16.92	915.32	1627.48	35.99
11. Nitrogen at 1.5% + NAA at 75ppm	16.00	3.39	12.87	17.60	1177.92	1978.03	37.31
12. Nitrogen at 2.0% + NAA at 75ppm	16.87	3.85	13.93	17.85	1391.78	2323.99	37.46
F test	S	S	S	S	S	S	S
S. Em (±)	0.14	0.25	0.15	0.24	23.38	27.72	0.45
CD (P=0.05)	0.41	0.74	0.44	0.71	68.56	81.29	1.33

3. RESULTS AND DISCUSSION

Growth and Yield traits influenced by foliar spray of different levels of Nitrogen and Naphthalene acetic acid (NAA)

3.1. Growth Attributes

3.1.1 Plant height (cm)

The results revealed that the treatment with the application of the Nitrogen (Urea) at 2.0% + NAA at 25 ppm at 60 Days after sowing recorded maximum (53.80 cm) plant height and which was statistically higher than other treatments. However, the treatment with (53.70 cm) Nitrogen (Urea) at 2.0% and NAA at 50 ppm in which was found to be statistically at par with Nitrogen (Urea) at 2.0% + NAA at 50 ppm. The foliar application of Nitrogen (Urea) at (pre-flowering and pod filling stages, i.e., 20 and 40 DAS) is thought to be the cause of the increased plant height. Nitrogen (urea) is involved in a number of physiological and biochemical processes that are necessary for plant growth and development. similar results obtained by [9] and [10].

3.1.2 Branches per plant (No.)

The results revealed that the treatment with the application of Nitrogen (Urea) at 2.0% + NAA at 25 ppm was recorded maximum (7.27) branches pe plant (No.) which was found significantly higher over the rest of treatments except with the treatment Nitrogen (Urea) at 2.0% + NAA (6.33) number of branches which was statistically at par to treatment with the application of Nitrogen (Urea) at 2.0% + NAA at 25 ppm. The availability of nitrogen may have boosted metabolic and enzymatic activity, resulting in improved plant development characteristics and, as a result, a higher number of branches / plants [11]. The use of NAA at 20 and 40 DAS enhanced the rate of photosynthetic products, which increased the rate of cell division and elongation in the growth section of the plant, resulting in increased plant height and the creation of additional branches. These findings are consistent with [10].

3.2 Dry Weight (g/plant)

The results revealed that the treatment with application of Nitrogen (Urea) 2.0% + NAA 25 ppm was recorded maximum (39.10g/plant) which was significantly higher than the other treatments. However, the treatment with the application of Nitrogen (Urea) at 2.0% + NAA at 50 ppm was recorded with (38.61g/plant) which were statistically at par with the treatment Nitrogen at 2.0% + NAA at 25 ppm. Higher nutrient uptake under 2 % urea and 25 ppm spray at pre - flowering and pod – initiation stages might be due to proliferation of root system which made to plant to get higher plant height and high number of branches made higher dry matter accumulation by individual plant. Similar findings were obtained by the [11] a [12] and [13].

3.3 Yield Traits

3.3.1 Pods plant^{-1}(No.)

Treatment with the application of Nitrogen (Urea) at 2.0% + NAA at 25 recorded maximum number of pods plant^{-1} (16.93) which was significantly higher over other treatments. However, the treatments (16.90) Nitrogen (Urea) at 2.0% + NAA at 50 ppm and Nitrogen (Urea) 2.0% + NAA 75 ppm (16.87) which were found significantly at par with the treatment application of Nitrogen (Urea) at 2.0% + NAA at 25 ppm. More number of branches at pod - filling stage might have yielded more photosynthates and transferred to pods and seeds. Findings were in harmony with [14] in case Urea and [15] in case of NAA.

3.3.2 Number of seeds pod^{-1}

Significantly highest number of seeds pod^{-1} (14.33) was recorded with the treatment application of Nitrogen (Urea) at 2.0% + NAA at 25 ppm which was highest over all the treatments. However, the treatments (14.07) Nitrogen (Urea) at 2.0% + NAA at 50 ppm and Nitrogen (Urea) at 2.0% + NAA at 75 ppm (13.93) which were found to be statistically at par with the treatment application of Nitrogen (Urea) at 2.0 + NAA at 25 ppm. Seeds pod^{-1} (No.) may be increased because of the fact that there might be a synergetic effect of both the factors (Urea and NAA). Similar findings were obtained by the [16] in cowpea, [17] in green gram.

3.4 Dry Weight of the Pod (g)

Significantly highest number of dry weight of pod (4.17 g) was recorded with the treatment of Nitrogen (Urea) at 2.0% + NAA at 25 ppm which was highest over all the treatments, whereas the treatment Nitrogen (Urea) at 2.0% at 50 ppm was recorded (3.92), Nitrogen (Urea) at 2.0% 75 ppm was recorded with (3.85g), and Nitrogen (Urea) at 1.5 %+ NAA at 25 ppm recorded (g)

which were found statistically at par with the treatment Nitrogen (Urea) at 2.0% + NAA at 25 ppm. Results recorded were in harmony with Bute et al. [18], Shukla et al. (2017) in chickpea and prajapat et al. (2003).

3.5 Seed Index (g)

The seed index was calculated for 100 seeds. The data reveals that there is a significant difference among the treatments. Significantly highest seed index (18.42g) was obtained in treatment of Nitrogen (Urea) 2.0% + NAA at 25 ppm. However, the treatments with (18.10g) application of Nitrogen (Urea) 2.0% + NAA at 50 ppm and treatment with (17.85 g) application of Nitrogen (Urea) 2.0% + NAA at 75 ppm found to be statistically at par with the treatment application of Nitrogen (Urea) 2.0% + NAA at 25 ppm. Similar results were reported by Kumar et al. [12] Jahan et al. [19].

3.6 Seed Yield (kg ha^{-1})

Significantly high seed yield (1436.26 kg ha^{-1}) was recorded with treatment application of Nitrogen (Urea)at 2.0% + NAA at 25 ppm over all the treatments. However, the treatments with (1413.93 kg ha^{-1}) Nitrogen (Urea) 2.0% +NAA at 50 ppm and treatment with (1391.78 kg ha^{-1}) were found statistically at par with Nitrogen (Urea) at 2.0% + NAA at 25 ppm. The results were in line with those of Bute et al. [13], Kumar et al. [12] and Ullah et al. [16].

Highest yield was observed with foliar spray of Urea at 2.0% and NAA 25 ppm, concentrations of Urea above 2.0% may have toxic effect and NAA at low concentration i.e., recorded higher yield in combination with Urea 2.0 %. Concentrations above 25 ppm NAA may result in reduced plant height, branching, lesser number of pods per plant which in turn reduces yield.

3.7 Haulm Yield (kg ha^{-1})

Significantly highest haulm yield (2651.97 kg ha^{-1}) was recorded with the treatment with the application of Nitrogen (Urea) 2.0% + NAA at 25 ppm over all the treatments. However, the treatment with (2573.13 kg ha^{-1}) Nitrogen (Urea) at 2.0% + NAA at 50 ppm which was statistically at par with Nitrogen (Urea) 2.0% + NAA 25 ppm.

3.8 Harvest Index (%)

Significantly highest harvest index (39.05%) was recorded with treatment with the application of Nitrogen (Urea) at 1.5 % + NAA at 25 ppm over all the treatments. However, the treatment with (38.56%) Nitrogen (Urea) at 1.5 % + NAA 50 ppm which was found to be statistically at par with Nitrogen (Urea) 1.5 % + NAA at 25 ppm. Higher seed yield and Haulm yield which is directly co-related with Harvest index. Similar results were reported by Ullah et al. [16] and Kalita et al. [20].

4. CONCLUSION

Based on a single season's worth of research, it's been determined that foliar applications of nitrogen (urea) at 2.0 percent + NAA at 25 ppm resulted in higher growth and yield qualities than the other treatments [21].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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