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Effect of foliar application of nutrients on growth and yield of chickpea

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Abstract
A field experiment was carried out during *Rabi* season of 2023-24 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj. To study the "Effect of foliar application of nutrient on growth and yield of chickpea". The soil of the experiment site was sandy loam in texture having 0.58% organic carbon, 219 kg/ha available nitrogen, 19.6 kg/ha available phosphorus and 239.2 kg/ha available potassium. Soil reaction was slightly alkaline (pH 7.50). The experiment was laid out (RBD) consisted of 12 treatments with three replication *i.e.* Water spray at 20 DAS (Vegetative stage) (T_1), Water spray at 35 DAS (Pre-flowering stage) (T_2), Water spray at 20 DAS (Vegetative stage) + 35 DAS (Pre-flowering stage) (T_3), 2% Urea at 20 DAS (Vegetative stage) (T_4), 2% Urea at 35 DAS (Pre-flowering stage) (T_5), 2% Urea at 20 DAS (Vegetative stage) + 35 DAS (Pre-flowering stage) (T_6), 1% KNO_3 at 20 DAS (Vegetative stage) (T_7), 1% KNO_3 at 35 DAS (Pre-flowering stage) (T_8), 1% KNO_3 at 20 DAS (Vegetative stage) + 35 DAS (Pre-flowering stage) (T_9), 0.5% Zinc at 20 DAS (Vegetative stage) (T_{10}), 0.5% Zinc at 35 DAS (Pre-flowering stage) (T_{11}), 0.5% Zinc at 20 DAS (Vegetative stage) + 35 DAS (Pre-flowering stage) (T_{12}) . The results showed that growth and yield attributing characters' *viz.* plant height (70.4 cm), dry matter accumulation (163.60 g/m^2), number of pods/plant (12.9), number of seeds/pod (1.47), seed index (18.3 g), straw yield (3.23 t/ha) and seed yield (2.42 t/ha) were significantly higher with foliar application of 2% Urea at 20 DAS (Vegetative stage) + 35 DAS (Pre-flowering stage) (T_6). Maximum gross return (INR 179090), net return (130514.6 INR/ ha), and BC (1:2.69), ratio was obtained highest in the treatment 2% Urea at 20 DAS (Vegetative stage) + 35 DAS (Pre-flowering stage) (T_6).

Objectives
1. To study the effect of nutrient spray on growth and yield of chickpea.
2. To work out the economics of different treatment combination in chickpea.

Keywords: 1% KNO_3, 2% urea, 0.5% zinc, foliar application, vegetative stage, pre-flowering stage

1. Introduction
Pulses hold a special place in oriental cuisine, particularly in countries like India, where a significant portion of the population follows a vegetarian diet (Kumar *et al.*, 2023) [25]. Chickpea (*Cicer arietinum* L.) also known as Bengal gram/Gram/Chana dal, plays a significant role in improving soil fertility by fixing the atmospheric nitrogen. Besides, it leaves substantial amount of residual nitrogen for subsequent crops and adds huge amount of organic matter to improve soil health (Kuldeep *et al.*, 2017) [4]. Chickpea is the third most important food legume crop of India contributing about 65% of the world production and pulses crop in the world after a dry bean and dry peels and its production in India has peaked to all time high at 11.23 million tonnes during 2017-18 and it was sustained to 10.32 million tonnes (FAOSTAT, 2019) which has ushered self-sufficiency for this main pulse crop in India. Foliar fertilization of pulses during the seed development stage had received considerable attention to increase their seed production. Additional nutrition through foliar feeding plays a vital role in pulse production by stimulating root development, nodulation, energy transformation, metabolic processes and pod setting (Krishna and Kaleeswari, 2018) [6]. Urea is one of the most widely used foliar N-fertilizers, characterized by high leaf penetration rate and low cost, and most plants can absorb it rapidly and hydrolyze in the cytosol (Witte *et al.*, 2002) [7]. Potassium is a major element important in many plant processes it usually influences the water economy and crop growth by water uptake,

enhance the root growth maintain the turgor and stomatal to the plants. Foliar feeding of K improves enzymatic systems, water use efficiency, protein formation, nitrogen assimilation and photosynthesis (Kumar and Rao, 2001) [8]. Among the micronutrients Zn, Fe, B, Mn and Mo improved the yield appreciably and foliar spray of micronutrients proved to be economical in pulses. Considering the importance of foliar application of nutrient in pulses, the present study was conducted to assess the impact of foliar application of 2% Urea, 1% KNO_3 and 0.5% Zinc on growth, yield attributes and yield of chickpea.

2. Materials and Methods

The field experiment was carried out during *Rabi* season of 2023-24 at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj. The maximum temperature ranged from 9.0 °C to 32.7 °C and minimum temperature 6.7 °C to 18.4 °C in the crop season. The experiment field's has sandy loam texture with pH (7.50) that was virtually slightly alkaline having 0.58% organic carbon, 219 kg/ha available nitrogen, 19.6 kg/ha available phosphorus and 239.2 kg/ha available potassium. The experiment was laid out in RBD with 12 treatment and three replication. The treatment combination are water spray at 20 DAS (Vegetative stage) (T_1), Water spray at 35 DAS (Pre-flowering stage) (T_2), Water spray at 20 DAS (Vegetative stage) + 35 DAS (Pre-flowering stage) (T_3), 2% Urea at 20 DAS (Vegetative stage) (T_4), 2% Urea at 35 DAS (Pre-flowering stage) (T_5), 2% Urea at 20 DAS (Vegetative stage) + 35 DAS (Pre-flowering stage) (T_6), 1% KNO_3 at 20 DAS (Vegetative stage) (T_7), 1% KNO_3 at 35 DAS (Pre-flowering stage) (T_8), 1% KNO_3 at 20 DAS (Vegetative stage) + 35 DAS (Pre-flowering stage) (T_9), 0.5% Zinc at 20 DAS (Vegetative stage) (T_{10}), 0.5% Zinc at 35 DAS (Pre-flowering stage) (T_{11}), 0.5% Zinc at 20 DAS (Vegetative stage) + 35 DAS (Pre-flowering stage) (T_{12}) . The crop was uniformly fertilized with 25 Kg N/ha, 50 Kg P_2O_5/ha in the form of urea and DAP as a basal application. The chickpea variety Pusa 362 was sown on 18th of November at 30 cm spaced rows and plant spacing of 10 cm with a seed rate of 60-75 kg/ha. The foliar spray of urea, KNO_3 and Zinc was done at 20 DAS (vegetative stage) and 35 DAS (pre-flowering stage) using spray volume of 600 l/ha. In order to make the spray more effective, Teepol was mixed at 0.5 ml/l with the spray solution.

3. Results and Discussion

3.1 Plant height (cm)

The application of 2% urea at 20 DAS (vegetative stage) + 35 DAS (pre-flowering stage) (T_6) significantly influenced plant height of chickpea from 20 to 80 DAS. The maximum plant height of 70.4 cm was recorded in T_6, statistically at par with T_5 and T_4 at 80 DAS. And the minimum plant height (42.2) was recorded in water spray at 20 DAS (vegetative stage) (T_1). Foliar application of urea improves the protein content in chickpea, indicating the improvement of N status of plant with the foliar spray of urea. Higher N content of the plant during the crop's reproductive phase results in a higher rate of photosynthesis, improving plant height (Pal *et al.*, 2019) [10].

3.2 Dry matter accumulation (g/m^2)

A gradual increase in dry matter accumulation was recorded in the experiment irrespective of treatments from 20 to 80 DAS. The application of 2% urea at 20 DAS (vegetative stage) + 35 DAS (pre-flowering stage) (T_6) significantly affected the dry matter accumulation. At 80 DAS, the highest dry weight (163.60 g/m^2) was recorded in T_6 which was statistically similar to T_5, and the lowest dry weight (124.66 g/m^2) was recorded in T_1. The increase in dry matter of chickpea with foliar application of nutrient especially with 2% urea at 20 DAS (vegetative stage) + 35 DAS (pre-flowering stage) T_6 is due to the increased number of branches per plant which ultimately increased dry matter accumulation.

3.3 Number of pods/plant

There was a significant difference in number of pods/plant between the treatments, and the maximum number of pods/plant (12.9) was recorded in T_6 where 2% urea at 20 DAS (vegetative stage) + 35 DAS (pre-flowering stage) was applied followed by T_5 and T_{12} whereas, the lowest number of pods/plant (5.87) was recorded in water spray at 20 DAS (vegetative stage) (T_1). The timely supply of nutrients through foliar spray during peak nutrient demand might have reduced shedding of flowers and fruits resulting in higher number of pods/plant.

3.4 Seed index (g/100 seeds)

The application of 2% urea at 20 DAS (vegetative stage) + 35 DAS (pre-flowering stage) (T_6) significantly influenced the seed index of chickpea. The maximum seed index (18.35 g) was observed in T_6 which was statistically at par with T_4, T_5, T_{11} and T_{12}. And the lowest seed index (14.88 g) was recorded in water spray at 20 DAS (Vegetative stage) (T_1). Due to application of 2% urea at 20 DAS (vegetative stage) + 35 DAS (pre-flowering stage) (T_6) there was an increase in photosynthates production and hence, their effective translocation from source to sink which caused the highest seed index in 2% urea at 20 DAS (vegetative stage) + 35 DAS (pre-flowering stage) (T_6).

3.5 Straw yield (t/ha)

There was a significant difference in straw yield between the treatments, and the highest straw yield of 3.23 t/ha was recorded in T_6 where 2% urea at 20 DAS (vegetative stage) + 35 DAS (pre-flowering stage) was applied followed by T_4, T_{12}, T_5, T_{11} and T_9 whereas, the lowest straw yield of 2.86 t/ha was recorded in water spray at 20 DAS (vegetative stage) (T_1). The straw yield increase is directly related to an increase in the plant's vegetative growth. Ample supply of nutrients through foliar sprays increases vegetative growth which in turns the straw yield.

3.6 Seed yield (t/ha)

The application of 2% urea at 20 DAS (vegetative stage) + 35 DAS (pre-flowering stage) (T_6) significantly influenced the seed yield of chickpea. The maximum seed yield (2.42 t/ha) was recorded in T_6, and the lowest seed yield (1.97 t/ha) was recorded in water spray at 20 DAS (Vegetative stage) (T_1). An 18.5% increase in seed yield was also observed in T_6 compared to T_1. This is because of increased nutrient intake and reduced nutrient losses through foliar application. Thus, it reduced flower drops, and ultimately improved pod set and resulted in higher seed yields.

Table 1: Effect of Nutrient spray on yield and yield attribute of chickpea.

S. No.	Treatment combinations	Yield attributes					
		Number of pods plant-1	No. of seed per pod	Seed Index (100seed)	Seed yield (t ha-1)	Straw yield (t ha-1)	Harvest index (%)
1	Water spray at 20 DAS (Vegetative stage)	5.87	1.07	14.88	1.97	2.86	40.29
2	Water spray at 35 DAS (Pre-flowering stage)	7.40	1.08	14.90	2.00	2.87	41.05
3	Water spray at 20 DAS (Vegetative stage) + at 35 DAS (Pre-flowering stage)	7.47	1.20	15.17	2.02	2.88	41.24
4	2% Urea at 20 DAS (Vegetative stage)	7.47	1.36	16.35	2.34	3.22	42.48
5	2% Urea at 35 DAS (Pre-flowering stage)	11.13	1.43	16.38	2.38	3.15	42.47
6	2% Urea at 20 DAS (Vegetative stage) + at 35 DAS (Pre-flowering stage)	12.93	1.47	18.35	2.42	3.23	42.80
7	1% KNO_3 at 20 DAS (Vegetative stage)	8.40	1.27	15.35	2.04	3.02	40.78
8	1% KNO_3 at 35 DAS (Pre-flowering stage)	8.40	1.31	15.85	2.15	3.02	41.53
9	1% KNO_3 at 20 DAS (Vegetative stage) + at 35 DAS (Pre-flowering stage)	8.60	1.43	15.62	2.23	3.04	42.35
10	0.5% Zinc at 20 DAS (Vegetative stage)	8.53	1.24	15.65	2.25	2.99	42.16
11	0.5% Zinc at 35 DAS (Pre-flowering stage)	9.20	1.02	16.18	2.26	3.13	41.97
12	0.5% Zinc at 20 DAS (Vegetative stage) + at 35 DAS (Pre-flowering stage)	10.20	1.34	16.24	2.31	3.16	42.24
	F-Test	S	S	S	S	S	S
	S. Ed	0.608	0.085	0.920	0.135	0.175	0.188
	C.D at 5%	1.262	0.177	1.908	0.279	0.363	0.391

Table 2: Effect of nutrient spray on economics of Chickpea.

S. No.	Treatment details	Total cost of cultivation	Gross return (INR/ha)	Net return (INR/ha)	B:C Ratio
1	Water spray at 20 DAS (Vegetative stage)	47405.38	146480	99074.62	2.09
2	Water spray at 35 DAS (Pre-flowering stage)	47405.38	148610	101204.6	2.13
3	Water spray at 20 DAS (Vegetative stage) + at 35 DAS (Pre-flowering stage)	47405.38	150040	102634.6	2.17
4	2% Urea at 20 DAS (Vegetative stage)	48575.38	173460	124884.6	2.57
5	2% Urea at 35 DAS (Pre-flowering stage)	48575.38	176050	127474.6	2.62
6	2% Urea at 20 DAS (Vegetative stage) + at 35 DAS (Pre-flowering stage)	48575.38	179090	130514.6	2.69
7	1% KNO_3 at 20 DAS (Vegetative stage)	50825.38	151860	101034.6	1.99
8	1% KNO_3 at 35 DAS (Pre-flowering stage)	50825.38	159560	108734.6	2.14
9	1% KNO_3 at 20 DAS (Vegetative stage) + at 35 DAS (Pre-flowering stage)	50825.38	165220	114394.6	2.25
10	0.5% Zinc at 20 DAS (Vegetative stage)	51833.38	166470	114636.6	2.21
11	0.5% Zinc at 35 DAS (Pre-flowering stage)	51833.38	167590	115756.6	2.23
12	0.5% Zinc at 20 DAS (Vegetative stage) + at 35 DAS (Pre-flowering stage)	51833.38	171180	119346.6	2.30

4. Conclusion

From the results of the present investigation, it was concluded that in chickpea the foliar application of 2% Urea at 20 DAS (Vegetative stage) + at 35 DAS (Pre-flowering stage) (Treatment 6). Recorded higher yield and benefit cost ratio.

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