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Agronomic study on cowpea growth and yield influenced by PGRs and foliar nutrition

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Abstract

An agronomic study on cowpea growth and yield impacted by PGRs and foliar nutrition was carried out in a field experiment at the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, during the 2021 *kharif* season. The experimental plot's soil had a clayey texture and an alkaline reaction. Eight treatment were tested in this experiment using a Randomized Block Design with three replications. The foliar spray of 2% urea at 35 and 50 DAS significantly influenced all the cowpea growth and yield parameters, including plant height, number of branches/plant, number of nodules/plant, pod length, number of pods/plant, number of seeds/pod, and seed and haulm yield. It was found to be statistically comparable to T4 (foliar spray of Pulse Wonder fertilizer at 5 kg/ha) and T2 (foliar spray of 1% Novel). Treatment T3 (2% Urea Foliar Spray) yielded the highest net return of 46659 ₹/ha. Treatments T4 (42215 ₹/ha) and T2 (40162 ₹/ha) came in second and third, respectively. Treatment T3 produced the greatest BC ratio (2.97), which was followed by treatments T4 (2.71) and T2 (2.64). Based on the results of a year-long experiment, it can be concluded that full doses of RDF (20:40:00 NPK kg/ha) should be used to grow *kharif* cowpea, along with foliar sprays of 2% urea or 5% Pulse Wonder fertilizer or 1% Novel (Nauroji organic product) at 35 and 50 DAS to increase yield and financial returns.

Keywords: Foliar spray of Urea, panchagavya, pulse wonder fertilizer, Novel (Nauroji organic product)

Introduction

Among various pulse crops cowpea is an important food legume and grown over an area of 0.5 million ha. It is adapted to wide range of soils, rainfall situations and fits as a crop in multiple and intercropping systems. Cowpea also has ability to withstand drought, which make it suitable for drought-prone areas with low rainfall. An age old practice of mixed cropping of cowpea for vegetable purpose with widely spaced crop such as cotton, pigeon pea maize, sorghum, pearl millet, sunflower, castor and plantation crops or its cultivation in cropping systems.

All pulse crops require healthy root systems to maximize growth and yield. Healthy nodulation of pulse roots is important to maximise the nitrogen fixation. In pulses such as chickpea and cowpea up to flowering stage the number of nodules per plant increases but in post-flowering stage there is sudden decline in number of nodules due to disintegration. Foliar application of water-soluble fertilizers may be a very good option under this situation to enhance the yield of pulse crops under reduced cost of cultivation. Positive effect of supplying legume plants with supplementary nitrogen or a balanced dose of nutrients particularly at pre flowering stage was found to have beneficial effect on increasing seed yield.

Foliar application is regarded as a preferred solution when quick supply of nutrients is hindered or the soil conditions are not conducive for the absorption of nutrients. Foliar spray technique helps the nutrients to reach the site of food synthesis directly, leading no wastage and quick supply of food and thereby reduce the requirement of fertilizers. Foliar nutrition can hasten the growth of a crop suddenly.

It is also known that active nodulation of pulse crop stops after 45 to 50 DAS and at that time, the positive effect of supplying legume plants with supplementary nitrogen was found to have beneficial effects on enhancing growth and increasing seed yield by quick supply of nitrogen. Palta *et al.* (2005) [10] and Zeidan (2003) [15] concluded that foliar application of urea at 50% flowering increased the yield and seed protein. In legumes, leaf senescence starts earlier before completion of maturity which break the source to sink relation, thereby reduces the yield. Nitrogen spray have been found to delay leaf senescence and improve yield.

Application of nutrients via foliage, in addition to recommended dose of fertilizers (RDF) and plant growth regulators (PGRs) at critical growth stages is a unique and easy way to increase the pulse productivity by curbing the barriers encountered during flowering and pod setting. PGRs like NAA, IBA, salicylic acid, brassinosteroids etc. are effective for foliar application. Providing nutrients as well as PGRs are known to enhance the yield by 15-25% compared to soil nutrition alone (Pooja and Ameena, 2021) [11].

Materials and Methods

The present study entitled “Agronomic study on cowpea growth and yield influenced by PGRs and foliar nutrition” was conducted at the College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari in *kharif* season 2021. The experiment was laid out in a Randomized Block Design (RBD) with eight treatments in three replications. The details of treatments are T₁: Foliar spray of Panchagavya (3%), T₂:Foliar spray of Novel (Nauroji organic product) (1%), T₃:Foliar spray of Urea (2%), T₄:Foliar spray of Pulse Wonder fertilizer (5 Kg/ha), T₅:Foliar spray of chelated micronutrients (Fe, Zn) (0.5%), T₆:Foliar spray of NAA (40 ppm), T₇:Foliar spray of Salicylic Acid (1%), T₈:Control. The details of experiment are given below:

Table 1: Treatment details

Treatments	
T ₁	Foliar spray of Panchagavya (3%)
T ₂	Foliar spray of Novel (Nauroji organic product) (1%)
T ₃	Foliar spray of Urea (2%)
T ₄	Foliar spray of Pulse wonder fertilizer (5 Kg/ha)
T ₅	Foliar spray of chelated micronutrients (Fe, Zn) (0.5%)
T ₆	Foliar spray of NAA (40 ppm)
T ₇	Foliar spray of Salicylic Acid (1%)
T ₈	Control

Note: RDF (20:40:00 NPK kg/ha) is common in each of the treatments.

Results and Discussion

1. Impact of PGRs, organic and inorganic source of nutrients on growth parameters

A. Plant height

The data on plant height recorded at 60 DAS and harvest are given in Table 2. Different treatments of plant growth regulators, organic and inorganic sources of foliar nutrition significantly influenced plant height at 60 DAS and at harvest. Significantly higher plant height (57.66 and 67.53 cm) at 60 DAS and at harvest respectively, were recorded with treatment T₃ (Foliar spray of 2% Urea) but, it was statistically

at par with treatment T₄, T₂, and T₁. Treatment T₈ (control) was found inferior with respect to plant height (41.45 cm and 48.95 cm) at 60 DAS and at harvest, respectively. Data showed that 39.10% and 37.95% of plant height increased at 60 DAS and at harvest, respectively by T₃ over control.

Nitrogen is one of the major element, which influenced the metabolic activities of the plants. This may be due to optimum level of nitrogen in the soil and also increased in plant height due to supplying of more nutrients at the critical growth stages. These results related with Kavitha *et al.* (2019) [8]. Growth parameters highly responded to foliar spray of urea with balanced sources NPK, so the application of 2% urea provided the higher plant height. The positive effect of supplying legume plants with supplementary nitrogen was found to have beneficial effects on enhancing growth which was corroborated with findings of Palta (2005) [10] and Zeidan (2003) [15] and Dey (2017) [6].

B. No. Of branches/plant

The number of branches/plant in cowpea was recorded at 60 DAS and harvest are presented in Table 2. Significantly higher number of branches/plant (7.40 and 7.85) at 60 DAS and harvest time, respectively were recorded with treatment T₃ (Foliar spray of 2% urea) but, it was statistically at par with treatment T₄ and T₂. Treatment T₈ (control) produced the lowest number of branches/plant (5.22 and 5.59) at 60 DAS and harvest time, respectively.

The increased in number of branches, number of functional leaves might be due to increased availability of nitrogen by urea and other organic sources of nutrients which enhanced production of photosynthetic assimilates. The present results are in close conformity with the findings of Darade (2019) [4] and Beulah and Ghosh (2020) [2].

C. Number of Nodules/Plant at Harvest

The number of nodules/plant in cowpea was recorded at 60 DAS and at harvest are presented in Table 2. Significantly higher number of nodules/plant (22.56 and 22.86) at 60 DAS and at harvest time respectively, were recorded with treatment T₃ (Foliar spray of 2% Urea) which was remain statistically at par with treatment T₄. About 72.11% and 63.40% high number of nodules increase by T₃ over the control at 60 DAS and at harvest time respectively.

The root nodules of the plant were significantly increased with foliar application can be attributed to the fact that nutrients enhance plant vigour and strengthen the stalk. The present results are in close conformity with the findings of Beulah and Ghosh (2020) [2].

Table 2: Impact of different treatments on growth parameters

Treatments	Number of branches/plant		Plant height (cm)		No. of Nodules/Plant			
	At 60 DAS	At harvest	At 60 DAS	At harvest	At 60 DAS	At harvest		
T ₁	Foliar spray of Panchagavya (3%)		6.02	6.41	49.82	57.70	17.77	18.11
T ₂	Foliar spray of Novel (Nauroji organic product) (1%)		6.61	6.95	53.27	62.47	19.65	20.01
T ₃	Foliar spray of Urea (2%)		7.40	7.85	57.66	67.53	22.56	22.86
T ₄	Foliar spray of Pulse wonder fertilizer (5 Kg/ha)		6.82	7.27	55.85	66.93	21.03	21.33
T ₅	Foliar spray of chelated micronutrients (Fe, Zn) (0.5%)		6.38	6.62	48.91	56.98	19.46	19.66
T ₆	Foliar spray of NAA (40 ppm)		5.97	6.27	48.54	56.93	15.83	16.65
T ₇	Foliar spray of Salicylic Acid (1%)		5.82	6.14	48.29	54.98	15.43	15.66

T ₈	Control	5.22	5.59	41.45	48.95	13.11	13.99
	S.Em ±	0.30	0.32	2.97	3.56	0.97	1.04
	CD at 5%	0.86	0.91	8.46	10.15	2.76	2.95
	CV (%)	8.37	8.33	10.21	10.45	9.28	9.70

2. Impact of PGRs, organic and inorganic foliar source of nutrients on yield parameters

A. Length of Pod (cm)

The mean pod length as influenced by different treatments of foliar application is furnished in Table 3. The application of treatment T₃ (foliar spray of 2% urea) significantly increased the length of pod of cowpea (15.95 cm) which were remains at par with the T₄ (15.67 cm), T₂ (15.51 cm), and T₁ (13.96 cm) treatments. While, lower length of pod (12.30 cm) at harvest time was recorded with the application of T₈ treatment.

B. Number of Pods/plants

Data presented in Table 3 showed significant effect of different foliar treatments on number of pods/plant recorded at 60 DAS and at harvest. Significantly higher number of pods/plant (27.53) were noted under treatment T₃ but it was remained at par with the treatments T₄ (26.02) and T₂ (24.93). The application of T₃ increased the number of pods/plant of cowpea 40.17% over control. The lowest number of pods/plant (19.64) was recorded under treatment T₈ at harvest time.

Optimum availability of all nutrients at crop growth might have caused efficient translocation of photosynthates from source to sink. Decreased the flower drop due to prolonged assimilatory activity of leaves might be another possible reason for higher number of pods/plant. The foliar application at the different stage might have been effectively absorbed and translocated to the pods resulting in more number of pods/plant. The results are in closely related with Das and

Jana (2015) [5] in different crops like greengram, chickpea and blackgram, Choudhary and Yadav (2011) [3] and Singhal *et al.* (2015) [14] in cowpea.

C. Number of Seeds/pod

Mean data presented in Table 3 indicated that different foliar treatments significantly influenced number of seeds/pod in cowpea. The application of treatment T₃ (foliar spray of 2% urea) significantly increased the number of seeds/pod of cowpea (13.95) which were remains at par with the T₄ (13.42) and T₂ (13.32) treatments. The application of T₃ increased the number of seeds/pod of cowpea 47.77% over control.

Almost all the yield attributing characters (Table 3) *viz.*, pod length, number of pods/plant, and number of seeds/pod, were favourably influenced by different foliar treatments. This might be due to different foliar treatments which provided better nourishment reflected in higher number of pods/plant, seeds/pod and pod length.

Increased all the yield attributing characters as effect of foliar spray of 2% urea, 1% Novel and Pulse wonder fertilizer might be due to the application of nutrients at flowering and reproductive stage which helped in more translocation of photosynthates to the developing pods and also helped in better filling of pods. Pronounced growth of plant tissue, formation of amino acid, synthesis of proteins and vitamins and their favourable effects causes by different foliar treatments might have led to increase all above yield parameters. Similar finding were also reported by Reddy *et al.* (2005) [13], Balaji *et al.* (2019) [1] and Reddy *et al.* (2020) [12] in blackgram.

Table 3: Impact of different treatments on yield parameters

Treatments	Length of pod (cm)	Number of pods/plant	Number of seeds/pod
T ₁ Foliar spray of Panchagavya (3%)	13.96	23.42	11.50
T ₂ Foliar spray of Novel (Nauroji organic product) (1%)	15.51	24.93	13.32
T ₃ Foliar spray of Urea (2%)	15.95	27.53	13.95
T ₄ Foliar spray of Pulse wonder fertilizer (5 Kg/ha)	15.67	26.02	13.42
T ₅ Foliar spray of chelated micronutrients (Fe, Zn) (0.5%)	13.50	23.35	11.48
T ₆ Foliar spray of NAA (40 ppm)	13.33	22.56	11.27
T ₇ Foliar spray of Salicylic Acid (1%)	13.16	22.24	11.39
T ₈ Control	12.30	19.64	9.44
	S.Em ±	0.79	0.82
	CD at 5%	2.25	2.33
	CV(%)	9.66	10.38

D. Seed yield and haulm yield (kg/ha)

The seed yield and haulm yield of cowpea significantly affected by different foliar treatments on cowpea are presented in Table 4.

Significantly higher seed yield (1149 kg/ha) was recorded with treatment T₃ (foliar spray of 2% urea) but, it was statistically at par with the treatment T₄ (1092.33 kg/ha) and T₂ (1062.67 kg/ha). Treatment T₈ (control) was found inferior with respect to seed yield (853.33 kg/ha). The increased in seed yield was to the tune of 34.64% by T₃ treatment over control.

An appraisal of data (Table 4) showed that haulm yield of cowpea was significantly higher (2588 kg/ha) was recorded

with treatment T₃ (foliar spray of 2% urea) but, it was statistically at par with treatment T₄ (2462.67 kg/ha) and T₂ (2303.67 kg/ha). Treatment T₈ (control) was found lowest with respect to haulm yield (1916.33 kg/ha). There is 35.04% haulm yield increase by T₃ treatment over control.

The increase in seed and haulm yields due to application of foliar spray of urea, pulse wonder and novel might be due to concomitant increase in number of pods/plant, number of seeds/pod, test weight of seed and plant growth characters *viz.*, as plant height, number of branches/plant, and number of nodules/plant. The increase in these attributes increased the seed and haulm yields.

Increasing the total seed yield may due to the increased

nutrient supply and reduced nutrient losses. Spraying of either 2% urea, Pulse wonder fertilizer and Novel helped in quick absorption of nitrogen, phosphorous and micronutrients, at the time of where the nutrients demand is at the peak due to foliar spray at 35 DAS and 50 DAS of the crop. Hence, it reduced the flower drop and ultimately enhanced the pod setting and resulted in higher seed yield. The results are corroborating with the findings of Choudhary and Yadav (2011) [3] in cowpea who revealed that foliar spray of 2% urea at branching and flowering stages recorded significantly higher growth and yield parameters and yield over other treatments. Kumar *et al.* (2008) [9], Karthikeyan *et al.* (2017) [7] and Balaji *et al.* (2019) [1] observed similar result in blackgram. Singhal *et al.* (2015) [14] and observed similarly result in cowpea crop. The haulm yield enhancement due to the different treatments might be due to continuous supply of nutrients which in turn increased the leaf area and dry matter production resulting in higher haulm yield. This was also attributed due to the higher nutrient uptake throughout the crop growth period. The higher haulm yield may be due to the beneficial effect of nitrogen on morpho-physiological characters, which influenced growth

attributes such as plant height and number of branches/plant. Das and Jana (2015) [5] in pulses and Kavitha *et al.* (2019) [8] in cowpea also found that significantly higher yield attribute like pod length, pods/plant and seeds/pod. The results are in line with findings of Choudhary and Yadav (2011) [3], Singhal *et al.* (2015) [14] and Dey *et al.* (2017) [6] in cowpea.

3. Impact of PGRs, organic and inorganic source of nutrients on economic parameters

Net Return

Scrutiny of data revealed that maximum net return of ₹46659/ha was realized with T₃ (Foliar spray of 2% Urea) followed by the treatment T₄ (₹42215/ha) and T₂ (₹40162/ha). The lowest net returns of ₹28583/ha was achieved under T₈ (control).

BCR

An appraisal of data showed that maximum BCR of 2.97 was obtained with the T₃ (Foliar spray of 2% Urea), followed by the treatment T₄ (2.71) and T₂ (2.64). The lowest BCR of 2.14 was accrued under T₅ (control).

Table 4: Impact of different treatments on yield and economic parameters

Treatments	Seed yield (kg/ha)	Haulm yield (kg/ha)	Net income (₹/ha)	BCR
T ₁ Foliar spray of Panchagavya (3%)	947.00	2158.67	32828	2.30
T ₂ Foliar spray of Novel (Nauroji organic product) (1%)	1062.67	2303.67	40162	2.64
T ₃ Foliar spray of Urea (2%)	1149.00	2588.00	46659	2.97
T ₄ Foliar spray of Pulse wonder fertilizer (5 Kg/ha)	1092.33	2462.67	42215	2.71
T ₅ Foliar spray of chelated micronutrients (Fe, Zn) (0.5%)	976.67	2110.67	31597	2.14
T ₆ Foliar spray of NAA (40 ppm)	930.33	2052.00	32892	2.38
T ₇ Foliar spray of Salicylic Acid (1%)	878.00	1959.67	29153	2.19
T ₈ Control	853.33	1916.33	28583	2.21
S.Em ±	58.95	122.13		
CD at 5%	167.78	347.61		
CV(%)	10.35	9.64		

Conclusion

From the results of one-year experimentation, it can be concluded that *kharif* cowpea crop should be fertilized with application of RDF (20:40:00 NPK kg/ha) along with foliar spray of 2% Urea or 5 kg/ha Pulse Wonder fertilizer or Novel 1% (Nauroji Organic product) at 35 and 50 DAS to obtain higher yield and monetary returns.

Author's contribution

Sachin Dodiya formulated the theory and conducted the calculations. Sachin Dodiya validated the analytical techniques. Under the guidance of Dr. Rahul Pisal. The results were collectively deliberated by all authors, and each played a role in shaping the final manuscript.

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