

## EFFECT OF FOLIAR NUTRITION ON YIELD, NUTRIENT CONTENT AND UPTAKE IN COWPEA [*Vigna unguiculata* (L.) Walp.]

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### ABSTRACT

The field experiment was conducted at the College Farm, College of Agriculture, Navsari Agricultural University, Bharuch (Gujarat) during *kharif* season of 2023 to study the effect of foliar nutrition on yield, nutrient content and uptake by cowpea [*Vigna unguiculata* (L.) walp.]. An application of RDF (20-40-00 NPK kg ha<sup>-1</sup>) + 1 % Novel (T<sub>6</sub>) at branching and flowering stage recorded significantly higher seed yield (1625 kg ha<sup>-1</sup>), stover yield (3004 kg ha<sup>-1</sup>), gross return (₹ 1,32,661 ha<sup>-1</sup>), net return (₹ 1,01,851 ha<sup>-1</sup>), B:C ratio (3.31) as well as N, P and K content and uptake in seed and stover of cowpea over control which was statistically at par with treatment T<sub>3</sub> (RDF + 2 % Panchagavya).

**Keywords:** Foliar nutrition, cowpea, novel, seed yield, net return, panchagavya

### INTRODUCTION

Cowpea is an important source of food, income and livestock feed forms like forage, hay, silage a major component of tropical farming systems because of its ability to improve marginal lands through nitrogen fixation and as cover crop. Nitrogen and phosphorus are applied through soil but nowadays these fertilizers are applied through water soluble fertilizer as foliar spray to avoid losses and increase efficiency of fertilizers. Foliar spray technique helps the nutrients to reach the site of food synthesis directly, leading to no wastage and quick supply of food and thereby reduce the requirement of fertilizers. Organic solutions such as panchagavya, cow urine and vermi bed wash, have demonstrated promising effects on pulses crops by enhancing growth and yield parameters while reducing the dependency on excessive fertilizer application. Panchagavya when used as a foliar spray, has been found to have significant effects on plant metabolism and crop yield. Cattle urine is a valuable resource rich in nutrients like nitrogen, potassium, calcium, magnesium, chlorite, and sulphate. Its application can improve soil texture, act as a plant hormone, correct micronutrient deficiencies and increase fertilizer use efficiency due to its organic nature (Prabhu and Mutnuri, 2014). Vermiwash contains valuable nutrients that are absorbed by plants, enhancing their health, yield and nutritional quality. The Novel organic liquid nutrient is derived from banana pseudostem sap. It includes vital macro and micro nutrients, along with growth-promoting substances like cytokinin and GA<sub>3</sub> (Gibberellic acid). Urea, a nitrogenous fertilizer in amide form, typically consists of

approximately 46 % nitrogen. When applied as a foliar spray, urea boosts crop yield by enhancing various metabolic processes in plants, resulting in improved yield and characteristics that contribute to yield enhancement. Water-soluble fertilizer NPK (19:19:19) offers an ideal blend of nitrogen, phosphorus, and potassium, being highly soluble in water. Hence, the present study was conducted to the effect of foliar nutrition on yield, nutrient content and uptake by cowpea [*Vigna unguiculata* (L.) walp.].

### MATERIALS AND METHODS

A field experiment was carried out at College farm, College of Agriculture, Navsari Agricultural University, Bharuch during *kharif* season of 2023. The soil of experimental plot was clayey (*Vertisols*) with low in available N (240.42 kg ha<sup>-1</sup>), medium in P<sub>2</sub>O<sub>5</sub> (39.58 kg ha<sup>-1</sup>) and high in available K<sub>2</sub>O (338.28 kg ha<sup>-1</sup>). The soil reaction (pH) was slightly alkaline (7.68). The experiment was arranged in a randomized block design (RBD) with nine treatments *viz.*, T<sub>1</sub> (Control), T<sub>2</sub> (RDF 20-40-00 NPK kg ha<sup>-1</sup>), T<sub>3</sub> (RDF + 2 % Panchagavya), T<sub>4</sub> (RDF + 2 % Cow urine), T<sub>5</sub> (RDF + 2 % Vermi bed wash), T<sub>6</sub> (RDF + 1 % Novel), T<sub>7</sub> (RDF + 2 % Urea), T<sub>8</sub> (RDF + 1 % 19-19-19 NPK kg ha<sup>-1</sup>) and T<sub>9</sub> (RDF + Nano urea 2 ml lit<sup>-1</sup>). Foliar nutrition was applied at branching and flowering stages of cowpea. The cowpea *var.* GC 3 was used for experimental purpose and sown on 6<sup>th</sup> July, 2023 at 45 cm x 10 cm spacing, by adopting the recommended seed rate @ 20 kg ha<sup>-1</sup> and RDF (20-40-00 NPK kg ha<sup>-1</sup>) given through urea and single super phosphate. The crop was harvested on 18<sup>th</sup> September 2023. Weeds were managed by herbicides and plant

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protection measures were taken up as and when required. The data on seed and stover yield was recorded from the net plot and converted on a hectare basis. The nitrogen content in cow pea seed was estimated by micro Kjeldahl's method as described by Jackson (1979). Chemical studies about nitrogen, phosphorus, potassium content and their uptake by seed and stover and available nitrogen, phosphorus, potassium status in the soil after harvest of the crop were determined as per different methods *viz.*, Modified Kjeldahl's method (For N), Wet digestion (Diacid) Vanado molybdo phosphoric acid yellow colour method (for P) and Flame photometric method (for K) (Jackson, 1979). The data were analyzed statistically by adopting the standard procedures described by Panse and Sukhatme (1985). The purpose of the analysis of variance was to determine the significant effect of treatments on cow pea. Uptake of nutrients by seed and plant was calculated by using following formula:

$$\text{Nutrient uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient content (\%)} \times \text{seed / stover yield (kg ha}^{-1}\text{)}}{100}$$

## RESULTS AND DISCUSSION

### N, P and K content in seed and stover

The data given in Table 1 indicated that N content in seed was not significantly influenced by different treatments, but numerically the highest N content (3.490 %) was found in treatment T<sub>6</sub> (RDF + 1 % Novel), while the lowest value of N content (3.091 %) obtained in T<sub>1</sub> (Control). Application of RDF + 1% Novel (T<sub>6</sub>) recorded the highest P (0.640 %) and K (1.247 %) content. However, P content was statistically at par with treatment T<sub>3</sub> (RDF + 2 % Panchagavya) and T<sub>8</sub> (RDF + 1 % 19-19-19), while K content in seed was statistically comparable with treatment T<sub>3</sub> (RDF + 2 % Panchagavya). N, P and K content in stover significantly affected by different foliar nutrition treatments. Significantly higher N (0.867 %), P (0.320 %) and K (1.095 %) content in stover was recorded by treatment T<sub>6</sub> (RDF + 1 % Novel foliar spray at branching and flowering stages) over control, however, N content in stover statistically at par with treatments T<sub>3</sub> (RDF + 2 % Panchagavya), T<sub>8</sub> (RDF + 1 % 19-19-19), T<sub>7</sub> (RDF + 2 % Urea) and T<sub>4</sub> (RDF + 2 % Cow urine). This might be due to the fact that plant absorbed proportionately high amount of N, P and K as the pool of available nutrients increased in the soil by adding combination of organic and inorganic fertilizers. The increased availability of these nutrients in the root zone coupled with increased metabolic activity at cellular levels might have increased nutrient uptake and their accumulation in the vegetative part of plants. An improved metabolism further helps in greater translocation of these nutrients to reproductive organs of the crop and ultimately increased the nutrients content in seed. This might be due to the fact that plant absorbed proportionately high amount of N, P and K as the pool of available nutrients increased in the soil by adding combination of organic and inorganic fertilizers.

The increased availability of these nutrients in the root zone coupled with increased metabolic activity at cellular levels might have increased nutrient uptake and their accumulation in the vegetative part of plants. An improved metabolism further helps in greater translocation of these nutrients to reproductive organs of the crop and ultimately increased the nutrients content in seed and straw. Moreover, along with this foliar spray of readily available form of nutrients to plant at critical growth stages further helps in increase the concentration of nutrients in plant. Patel *et al.* (2021) reported that 50 % RDF soil application + 2 % foliar spray of urea, urea phosphate and MOP at 30, 45 and 60 DAS recorded significantly higher N, P and K content in wheat grain (2.20, 0.390 and 0.344 %, respectively) and straw (0.738, 0.290 and 1.075 %, respectively) which was found on par with 50 % RDF soil application + 2 % foliar spray of soluble NPK (19:19:19) at 30, 45 and 60 DAS [ N, P and K contents in grain (2.14, 0.378 and 0.334 %, respectively) and straw (0.698, 0.276 and 1.073%, respectively)].

### N, P and K uptake by seed and stover

The data given in Table 1 indicated that among the different foliar nutrition treatments, treatment T<sub>6</sub> (RDF + 1% Novel) recorded significantly the highest total uptake of N (82.75 kg ha<sup>-1</sup>) by cowpea over rest of the treatments, but it was statistically at par with treatment T<sub>3</sub> (RDF + 2 % Panchagavya) and T<sub>8</sub> (RDF + 1% 19-19-19). Significantly higher total P (19.93 kg ha<sup>-1</sup>) and K (53.18 kg ha<sup>-1</sup>) uptake was reported by cowpea, which was statistically at par with treatment T<sub>3</sub> (RDF + 2 % Panchagavya). However, significantly the lowest total uptake of N (54.20 kg ha<sup>-1</sup>), P (11.08 kg ha<sup>-1</sup>) and total K (28.08 kg ha<sup>-1</sup>) by cowpea was registered under T<sub>1</sub> (Control). The higher uptake of all these nutrients by seed and haulm might be due to increase in concentration of these nutrients coupled with increasing the yield of seed and stover under the same treatment. Patel *et al.* (2021) found that 50 % RDF soil application + 2 % foliar spray of urea, urea phosphate and MOP at 30, 45 and 60 DAS recorded significantly higher uptake of N, P and K (140.46, 33.69 and 75.15 kg ha<sup>-1</sup>, respectively) followed by 50 % RDF soil application + 2 % foliar spray of soluble NPK (19:19:19) at 30, 45 and 60 DAS (131.64, 31.48, 72.43 kg ha<sup>-1</sup>, respectively) in wheat.

### Soil fertility status

The mean data pertaining to available N, available P<sub>2</sub>O<sub>5</sub> and available K<sub>2</sub>O status after the harvest of cowpea are presented in Table 1. Significantly higher available N (277.20 kg ha<sup>-1</sup>) after harvest of crop was recorded in treatment T<sub>6</sub> (RDF + 1% Novel) which was at par with treatments T<sub>3</sub> (RDF + 2 % Panchagavya) and T<sub>8</sub> (RDF + 1 % 19-19-19). However, data regarding available P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O was found non-significant due to different foliar nutrition, but numerically higher P<sub>2</sub>O<sub>5</sub> (46.37 kg ha<sup>-1</sup>) and K<sub>2</sub>O (353.23 kg ha<sup>-1</sup>) was noted in treatment T<sub>6</sub> (RDF + 1% Novel). This might be due to the additional nitrogen supplied through foliar nutrition of novel and panchagavya can stimulate the growth of cowpea plants, leading to increase in root biomass

and root nodulation. This can enhance the biological nitrogen fixation (BNF) process, further increasing the nitrogen content in the soil. Similar results were also obtained by Patel *et al.* (2022), Vijayakumari *et al.* (2012), Aher *et al.* (2019) and Kulkarni *et al.* (2024). Patel *et al.* (2022) reported that foliar spray of 2 % enriched banana pseudostem sap increased available N, P<sub>2</sub>O<sub>5</sub> and K<sub>2</sub>O. Vijayakumari *et al.* (2012) observed the higher N (88 kg ha<sup>-1</sup>), P (8.6 kg ha<sup>-1</sup>) and K (325 kg ha<sup>-1</sup>) content of post harvested soil of soybean with the application of panchagavya 10 % + humic acid 2 % + micro herbal fertilizer 10 g pot<sup>-1</sup> treated soil. At the time of soybean harvesting Aher *et al.* (2019) recorded higher available N (114.5 and 116.5 kg ha<sup>-1</sup>) and P (16.8 and 17.1 kg ha<sup>-1</sup>) with the application of organic manure on nitrogen equivalent basis + foliar spray of 3 % Panchagavya and organic manure on nitrogen equivalent basis + Biodynamic Preparation (BD 500 (Cow horn manure) as soil application @ 75 g ha<sup>-1</sup> + BD 501 (Cow Horn Silica) as foliar application @ 2.5 g ha<sup>-1</sup>) + foliar spray of 3 % Panchagavya, respectively. Kulkarni *et al.* (2024) obtained highest available values of nitrogen, phosphate and potassium (196.54, 21.11 and 281.69 kg ha<sup>-1</sup>) with the application of 100% GRDF + 2 foliar spray of 1% 19:19:19 and seed treatment of *Rhizobium*, PSB and KSB liquid form but it was found at par with 100% GRDF + 2 foliar spray of 1% 19:19:19 and seed treatment of *Rhizobium*, PSB and KSB solid form and 100% GRDF + 2 foliar spray of 2% DAP and seed treatment of *Rhizobium*, PSB and KSB liquid form and also with 100% GRDF + 2 foliar sprays of 2% DAP and seed treatment of *Rhizobium*, PSB and KSB solid form in case of N and P in soybean crop.

#### Seed and stover yield

The data clearly (Table 2) indicated that the yield of cowpea was significantly influenced by different foliar nutrition. Significantly the highest seed yield (1625 kg ha<sup>-1</sup>) and stover yield (3004 kg ha<sup>-1</sup>) of cowpea was observed under treatment T<sub>6</sub> (RDF + 1 % Novel), which was statistically at par with treatment T<sub>3</sub> (RDF + 2 % Panchagavya), T<sub>8</sub> (RDF + 1 % 19-19-19) in case of haulm yield which was statistically at par with T<sub>3</sub> (RDF + 2 % Panchagavya), T<sub>8</sub> (RDF + 1 % 19-19-19) and T<sub>7</sub> (RDF + 2 % Urea). The overall improvement in all the growth and yield attributing components may be due to adequate supply of nutrients with easy availability to plant at most critical growth period resulted into better growth and yield attributing characters. The better growth of crop ultimately

diverted more energy under sink source relationship which helped in providing more yield. The present findings are found in agreement with Patel *et al.* (2022), Saini *et al.* (2022) and Mallick and Kar (2023). Patel *et al.* (2022) observed that application of different foliar sprays had significant differences on seed yield and haulm yield of green gram. Significantly higher seed yield (1352 kg ha<sup>-1</sup>) and haulm yield (2280 kg ha<sup>-1</sup>) was recorded under foliar spray of 2 % enriched banana pseudostem sap along with recommended dose of fertilizer i.e. 20: 40: 00 N:P<sub>2</sub>O<sub>5</sub>:K<sub>2</sub>O kg ha<sup>-1</sup> which was statistically at par with 2 % urea foliar spray i.e. seed yield (1286 kg ha<sup>-1</sup>) and haulm yield (2153 kg ha<sup>-1</sup>). Saini *et al.* (2022) reported that the maximum seed (1438 kg ha<sup>-1</sup>) and haulm (3613 kg ha<sup>-1</sup>) yield was found under the treatment panchagavya @ 4 % spray at pre flowering + pod setting followed by panchagavya @ 4% spray at pod setting in fenugreek. Mallick and Kar (2023) observed significantly highest seed yield (2.77 t ha<sup>-1</sup>) under foliar application of NPK 10:26:26 (42.05 % higher than control) followed by NPK 19:19:19 (40.51 % higher than control). Patel *et al.* (2021) reported that 50 % RDF through soil + 2 % foliar spray of urea, urea phosphate and MOP at 30, 45 and 60 DAS recorded significantly higher grain and straw yield (4543 kg ha<sup>-1</sup> and 5527 kg ha<sup>-1</sup>, respectively) which was statistically at par with 50 % RDF soil application + 2 % foliar spray of soluble NPK (19:19:19) at 30, 45 and 60 DAS (4405 and 5383 kg ha<sup>-1</sup>, respectively) in wheat.

#### Economics

The maximum net return (₹ 1,01,851 ha<sup>-1</sup>) was achieved with foliar nutrition of RDF + 1% Novel (T<sub>6</sub>) along with BCR of 3.31. The increase in net return is due to higher seed yield obtained under this treatment as compared to cost involved under these treatments. Similar view in direction of present finding was also expressed by Singhal *et al.* (2015) and Champaneri *et al.* (2020), Singhal *et al.* (2015) reported that foliar spray of Banana pseudostem enriched sap @ 1% at 30, 45 and 60 DAS achieved the highest net return of ₹ 149347 ha<sup>-1</sup> with the benefit: cost ratio of 3.3:1 in cowpea cultivation and was closely followed by foliar spray of sprays of mixed fertilizer (19:19:19) @ 0.5% at 30, 45 and 60 DAS which registered net return of ₹ 146260 ha<sup>-1</sup> with the benefit: cost ratio of 3.4:1. Champaneri *et al.* (2020) found that the application of 0.5 % novel plus organic liquid nutrient increased the higher net income (₹ 1,05,178 ha<sup>-1</sup>) and BCR (1.21) of Indian bean.

Table 1. Effect of different foliar nutrition on N, P and K content, uptake and available nutrients of cowpea

Treatments	Seed			Stover			Total uptake (kg ha <sup>-1</sup> )			Available nutrients (kg ha <sup>-1</sup> )		
	N	P	K	N	P	K	N	P	K	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
T <sub>1</sub> : Control	3.091	0.490	1.083	0.757	0.230	0.686	54.20	11.08	28.60	239.13	39.31	336.94
T <sub>2</sub> : RDF (20-40-00 NPK kg ha <sup>-1</sup> )	3.113	0.520	1.091	0.777	0.237	0.704	58.86	12.39	30.99	241.94	39.71	338.58
T <sub>3</sub> : RDF + Panchagavya (2 %)	3.463	0.630	1.237	0.853	0.297	0.949	78.67	18.41	46.79	273.87	45.08	350.30
T <sub>4</sub> : RDF + Cow urine (2 %)	3.220	0.570	1.107	0.813	0.263	0.767	62.33	13.84	33.07	250.60	42.27	344.11
T <sub>5</sub> : RDF + Vermi bed wash (2 %)	3.190	0.550	1.110	0.803	0.267	0.750	61.05	13.56	32.31	245.60	41.71	342.95
T <sub>6</sub> : RDF + Novel (1 %)	3.490	0.640	1.247	0.867	0.320	1.095	82.75	19.93	53.18	277.20	46.37	353.23
T <sub>7</sub> : RDF + Urea (2 %)	3.260	0.580	1.113	0.827	0.270	0.815	66.37	15.08	36.98	251.67	43.14	347.74
T <sub>8</sub> : RDF + 19-19-19 (1 %)	3.327	0.613	1.127	0.843	0.287	0.820	74.40	17.24	39.89	256.80	44.70	349.22
T <sub>9</sub> : RDF + Nano Urea (2 ml lit <sup>-1</sup> )	3.183	0.543	1.103	0.777	0.247	0.737	59.66	13.02	31.90	243.60	40.42	339.48
SEm ±	0.090	0.017	0.035	0.020	0.007	0.028	3.21	0.73	2.26	8.46	1.59	11.88
CD (p=0.05)	-	0.050	0.105	0.060	0.021	0.083	9.63	2.19	6.78	25.36	-	-

Table 2. Economics of cowpea as influenced by different foliar nutrition

Treatments	Yield (kg ha <sup>-1</sup> )		Gross return (₹ ha <sup>-1</sup> )	Net return (₹ ha <sup>-1</sup> )	BCR (B:C ratio)
	Seed	Stover			
T <sub>1</sub> : Control	1197	2268	98217	71324	2.65
T <sub>2</sub> : RDF (20-40-00 NPK kg ha <sup>-1</sup> )	1307	2340	106015	76517	2.59
T <sub>3</sub> : RDF + Panchagavya (2 %)	1565	2890	127735	97682	3.25
T <sub>4</sub> : RDF + Cow urine (2 %)	1340	2370	108430	78782	2.66
T <sub>5</sub> : RDF + Vermi bed wash (2 %)	1330	2352	107618	77820	2.61
T <sub>6</sub> : RDF + Novel (1 %)	1625	3004	132661	101851	3.31
T <sub>7</sub> : RDF + Urea (2 %)	1349	2697	111958	82372	2.78
T <sub>8</sub> : RDF + 19-19-19 (1 %)	1531	2768	124427	93241	2.99
T <sub>9</sub> : RDF + Nano Urea (2 ml lit <sup>-1</sup> )	1315	2357	106688	76852	2.58
SEm ±	87.1	173.3			
CD (p=0.05)	261	519			

Selling Price: Seed-₹ 65.0 kg<sup>-1</sup>, Stover-₹ 9.0 kg<sup>-1</sup>

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