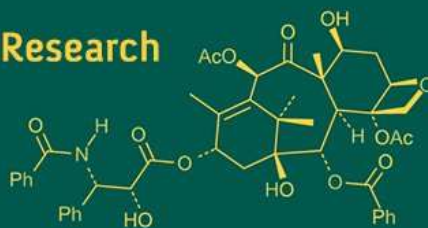
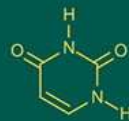


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## Effect of fertilizer levels and foliar application of nutrients on yield, quality and economics of cowpea [*Vigna unguiculata* (L.) Walp.]

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**Abstract**

The present investigation was carried out on “Effect of fertilizer levels and foliar application of nutrients on cowpea [*Vigna unguiculata* (L.) Walp.]” at Vegetable Research Farm, Regional Horticultural Research Station, ASPEE College of Horticulture, Navsari Agricultural University, Navsari during Summer-2023. It was laid out with two factors having fertilizer levels viz., F<sub>1</sub>: 100 % RDF (20-40-00 NPK kg ha<sup>-1</sup>), F<sub>2</sub>: 80 % RDF (16-32-00 NPK kg ha<sup>-1</sup>), F<sub>3</sub>: 60 % RDF (12-24-00 NPK kg ha<sup>-1</sup>) and foliar application of nutrients namely N<sub>1</sub>: No spray, N<sub>2</sub>: 2 % Novel Organic Liquid Nutrient, N<sub>3</sub>: 3 % *panchagavya*, N<sub>4</sub>: 0.5 % Water soluble fertilizer (19:19:19 NPK). All the treatment combinations were replicated thrice and laid out in a randomized block design with factorial concept in Gujarat Navsari Cowpea 9 variety. T<sub>2</sub> [100 % RDF (20-40-00) + 2 % Novel Organic Liquid Nutrient] produced superior results on yield and quality parameters viz., [number of clusters per plant, number of pods per cluster, average pod length (cm), average pod weight (g), pod girth (mm), pod yield (kg plant<sup>-1</sup>), total pod yield (kg plot<sup>-1</sup> and t ha<sup>-1</sup>), marketable pod yield (t ha<sup>-1</sup>), harvest index, protein content of immature seed (%) at 6<sup>th</sup> picking, moisture percentage of pod at 6<sup>th</sup> picking and TSS (°brix) at 6<sup>th</sup> picking] when compared to the other treatments.

**Keywords:** 19:19:19, Cowpea, Novel Organic Liquid Nutrient, *Panchagavya*, RDF

**Introduction**

Cowpea [*Vigna unguiculata* (L.) Walp.] has been cultivating since 5000 to 6000 years (Vavilov, 1951)<sup>[16]</sup>. The first evidence of cultivation, according to the record, was discovered in West Africa where it was intimately related to the growing of Sorghum and Pearl Millet (Ng and Marechal, 1985)<sup>[8]</sup>. Cowpea is widely grown in Africa, Latin America, South East Asia and in the Southern United States. Cowpea covers an area of 0.34 lakh hectare with the production of 3.53 lakh MT having productivity of 10.25 MT ha<sup>-1</sup> in Gujarat (Anon., 2022)<sup>[3]</sup>.

Cowpea is one of the most significant legume vegetable cultivated in India. It is an annual, herbaceous, warm-season crop that is grown throughout the India. Tender marketable pods contain 83.3 % moisture, 3.5 % protein, 2.0 % fibre, 8.1 % carbohydrates, 0.09 % mineral matter, 0.5 % niacin and 14.0 mg vitamin C 100 g<sup>-1</sup> of pods (Gopalkrishnan, 2007)<sup>[5]</sup>. The root nodules of cowpea can fix the atmospheric nitrogen. It only needs a little amount of inputs, making it a desirable crop for farmers with limited resources and suitable for intercropping with the other crops.

Cowpea being a leguminous crop, is able to fix atmospheric nitrogen with small amount of nitrogenous fertilizer implemented as basal dose. Phosphorous is critical to cowpea crop because it increases the plant growth, initiate nodule formation, root growth as well as influence the efficiency of the *rhizobium*-legume symbiosis (Haruna and Aliyu, 2011)<sup>[6]</sup>.

Foliar spray is the modern method of fertilizer application in vegetable crops due to nature of heavy feeder of nutrients (Vibhute, 1998)<sup>[17]</sup>. An application of nutrients through foliar spray has several advantages in supplementing the nutritional requirement of crops. Because of higher uptake efficiency, foliar application of nutrients can increase photosynthetic efficiency by delaying the leaf senescence viz., Novel Organic Liquid Nutrient, *Panchagavya*, 19:19:19 NPK are the products which are used as plant flowering and growth

enhancing substances. They are abundant in helpful microflora that promote and encourage plant growth and aid in achieving greater vegetative growth as well as high quality and yield.

### Materials and Methods

A field experiment on cowpea var. GVC-9 was conducted at Vegetable Research Farm, Regional Horticultural Research Station, ASPEE College of Horticulture, Navsari Agricultural University, Navsari during Summer-2023. The experiment was laid out in Randomized Block Design with Factorial Concept with total twelve treatments comprising of two factors viz., fertilizer levels  $F_1$ : 100 % RDF (20-40-00 NPK kg ha<sup>-1</sup>),  $F_2$ : 80 % RDF (16-32-00 NPK kg ha<sup>-1</sup>),  $F_3$ : 60 % RDF (12-24-00 NPK kg ha<sup>-1</sup>) and foliar application of nutrients namely  $N_1$ : No spray,  $N_2$ : 2 % Novel Organic Liquid Nutrient,  $N_3$ : 3 % *Panchagavya*,  $N_4$ : 0.5 % Water soluble fertilizer (19:19:19 NPK).

The combination of treatments comprised of 100% RDF (NPK 20:40:00 kg ha<sup>-1</sup>) + No Spray ( $T_1$ ), 100 % RDF (NPK 20:40:00 kg ha<sup>-1</sup>) + 2 % Novel Organic Liquid Nutrient ( $T_2$ ), 100 % RDF (NPK 20:40:00 kg ha<sup>-1</sup>) + 3 % *Panchagavya* ( $T_3$ ), 100 % RDF (NPK 20:40:00 kg ha<sup>-1</sup>) + 0.5 % Water Soluble Fertilizer (19:19:19) ( $T_4$ ), 80 % RDF (NPK 16:32:00 kg ha<sup>-1</sup>) + No Spray ( $T_5$ ), 80 % RDF (NPK 16:32:00 kg ha<sup>-1</sup>) + 2 % Novel Organic Liquid Nutrient ( $T_6$ ), 80 % RDF (NPK 16:32:00 kg ha<sup>-1</sup>) + 3 % *Panchagavya* ( $T_7$ ), 80 % RDF (NPK 16:32:00 kg ha<sup>-1</sup>) + 0.5 % Water Soluble Fertilizer (19:19:19) ( $T_8$ ), 60 % RDF (NPK 12:24:00 kg ha<sup>-1</sup>) + No Spray ( $T_9$ ), 60 % RDF (NPK 12:24:00 kg ha<sup>-1</sup>) + 2 % Novel Organic Liquid Nutrient ( $T_{10}$ ), 60 % RDF (NPK 12:24:00 kg ha<sup>-1</sup>) + 3 % *Panchagavya* ( $T_{11}$ ) 60 % RDF (NPK 12:24:00 kg ha<sup>-1</sup>) + 0.5 % Water Soluble Fertilizer (19:19:19) ( $T_{12}$ ) replicated thrice.

The experimental soil was loamy sand, with good drainage condition. As per recommended dose, whole quantity of well decomposed FYM (20 t ha<sup>-1</sup>) applied to the experiment field before sowing and mixed thoroughly with the soil and dose of N:P:K (20:40:00 kg ha<sup>-1</sup>) out of which half dose of the nitrogen (N) and full dose of phosphorus (P<sub>2</sub>O<sub>5</sub>) were applied as basal dose in the form of urea, single super phosphate (SSP) respectively as per the treatments. The remaining half dose of nitrogen was applied as top dressing in the form of urea at thirty days after sowing. The planting was done at the spacing of 45 cm × 30 cm with gross plot size 2.7 m × 2.4 m and net plot size 1.8 m × 1.8 m. Foliar application of nutrients was performed at 20, 40 and 60 DAS as per the treatments. For preparation of 2 % Novel Organic Liquid Nutrient solution, 200 ml of Novel Organic Liquid Nutrient dissolved in 10 liters of water with help of measuring cylinder. Prepared solution was poured in Knapsack sprayer and individual plant was sprayed thoroughly as per treatment. For preparation of 3 % *Panchagavya* solution, 300 ml of liquid nutrient mixed in 10 liters of water with help of measuring cylinder. Prepared solution was poured in Knapsack sprayer and individual plant was sprayed thoroughly as per treatment. For preparing solution of 0.5 % Water Soluble Fertilizer (19:19:19), take 50 g 19:19:19 dissolved in 10 liters of water. Total nitrogen percentage from immature cowpea seed was determined by Kjeldahl method. The percentage of protein in the immature seed was calculated by multiplying total nitrogen to factor 6.25 (Scheffelen *et al.*, 1961)<sup>[14]</sup>.

Moisture content was estimated in percentage by using the following formula (Sarma, 2015)<sup>[12]</sup>. Total soluble solids of green cowpea pods were recorded by using digital refractometer at room temperature and expressed in °Brix. For every treatment under investigation, the market prices and green pod yield were used to calculate the gross return in terms of ₹ ha<sup>-1</sup>. The variable cost was calculated on the basis of treatments and the total cost was calculated by summing up fixed cost and variable cost. Net return was worked out by subtracting the total cost of cultivation from gross realization for each treatment and recorded in rupees per hectare. Statistical analysis of the data pertaining to growth and flowering parameters were analyzed as per the methods described by Panse and Sukhatme (1985)<sup>[9]</sup>.

### Results and Discussion

#### Yield Parameters

The data on yield attributing character such as number of clusters per plant, number of pods per cluster, average pod length (cm), average pod weight (g), pod girth (mm), pod yield (kg plant<sup>-1</sup>), total pod yield (kg plot<sup>-1</sup> and t ha<sup>-1</sup>), marketable pod yield (t ha<sup>-1</sup>) and harvest index are depicted in tables.

#### Number of clusters per plant

Number of clusters per plant was significantly affected by different fertilizer levels and foliar application of nutrients. Maximum number of cluster plant (11.46) were observed with 100 % RDF ( $F_1$ ) whereas, minimum number of clusters per plant (10.24) were observed with 60 % RDF ( $F_3$ ). Maximum number of clusters per plant (12.57) were recorded with 2 % Novel Organic Liquid Nutrient ( $N_2$ ) whereas, minimum number of clusters per plant (8.47) were noted with no spray ( $N_1$ ). The interaction effect of fertilizer levels and foliar application of nutrients for this parameter was found significant for clusters per plant (12.94) with the treatment combination  $F_1N_2$  (100 % RDF with 2 % Novel Organic Liquid Nutrient).

**Table 1: Effect of fertilizer levels and foliar application of nutrients on number of clusters per plant of cowpea**

	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	10.17	12.94	11.65	11.07	11.46
F <sub>2</sub>	8.30	12.76	11.42	11.03	10.88
F <sub>3</sub>	6.93	12.03	11.10	10.92	10.24
Mean	8.47	12.57	11.39	11.01	
	F		N		F×N
S.Em. ±	0.22		0.25		0.44
C.D. at 5 %	0.64		0.74		1.29
C.V. %	7.00				

#### Number of pods per cluster

Number of pods per cluster was significantly affected by different fertilizer levels and foliar application of nutrients. The maximum number of pods per cluster (4.56) was recorded with 100 % RDF ( $F_1$ ). Whereas, the minimum number of pods per cluster (4.42) was recorded with 60 % RDF ( $F_3$ ). maximum number of pods per cluster (4.57) were found with 2 % Novel Organic Liquid Nutrient ( $N_2$ ). Whereas the minimum number of pods per cluster (4.33) were found in no spray ( $N_1$ ). The treatment combination  $F_1N_2$  (4.64) had recorded maximum number of pods per cluster. Whereas, the treatment combination  $F_3N_1$  (4.27) had recorded minimum number of pods per cluster.

**Table 2:** Effect of fertilizer levels and foliar application of nutrients on number of pods per cluster of cowpea

	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	4.41	4.64	4.61	4.56	4.56
F <sub>2</sub>	4.31	4.57	4.49	4.48	4.46
F <sub>3</sub>	4.27	4.50	4.46	4.44	4.42
Mean	4.33	4.57	4.52	4.49	
	F		N		F×N
S.Em. ±	0.093		0.108		0.187
C.D. at 5 %	NS		NS		NS
C.V. %	7.21				

**Average pod length (cm)**

Average pod length at 2<sup>nd</sup> and 4<sup>th</sup> picking was non-significantly influenced by different fertilizer levels and foliar application of nutrients. Maximum pod length (14.31 cm and 14.58 cm, respectively) at 2<sup>nd</sup> and 4<sup>th</sup> picking were observed with 100 % RDF (F<sub>1</sub>). Whereas, minimum pod length (13.90 cm and 14.01 cm, respectively) at 2<sup>nd</sup> and 4<sup>th</sup> picking were observed with 60 % RDF (F<sub>3</sub>). Foliar application of nutrients was also non-significantly influenced average pod length at 2<sup>nd</sup> and 4<sup>th</sup> picking. Maximum pod length (14.84 cm and 14.86 cm, respectively) at 2<sup>nd</sup> and 4<sup>th</sup> picking were recorded with 2 % Novel Organic Liquid Nutrient (N<sub>2</sub>). Whereas, minimum pod length (13.49 cm and 13.77 cm, respectively) at 2<sup>nd</sup> and 4<sup>th</sup> picking were noted with no spray (N<sub>1</sub>).

**Average pod weight (g)**

Average pod weight at 2<sup>nd</sup> and 4<sup>th</sup> picking was non-significantly affected by different fertilizer levels and foliar application of nutrients. Maximum pod weight (2.44 g and 2.42 g, respectively) at 2<sup>nd</sup> and 4<sup>th</sup> picking were observed with 100 % RDF (F<sub>1</sub>). Whereas, minimum pod weight (2.33 g and 2.31 g, respectively) at 2<sup>nd</sup> and 4<sup>th</sup> picking were observed with 60 % RDF (F<sub>3</sub>). Foliar application of nutrients was non-significantly influenced average pod weight at 2<sup>nd</sup> and 4<sup>th</sup> picking. Maximum pod weight (2.48 g and 2.46 g, respectively) at 2<sup>nd</sup> and 4<sup>th</sup> picking were recorded with 2 % Novel Organic Liquid Nutrient (N<sub>2</sub>). Whereas, minimum pod weight (2.27 g and 2.24 g, respectively) at 2<sup>nd</sup> and 4<sup>th</sup> picking were noted with no spray (N<sub>1</sub>).

**Pod girth (mm)**

Pod girth was non-significantly influenced by different fertilizer levels and foliar application of nutrients. Maximum pod girth (19.62 mm) was observed with 100 % RDF (F<sub>1</sub>). Whereas, minimum pod girth (18.78 mm) was observed with 60 % RDF (F<sub>3</sub>). Foliar application of nutrients was non-significantly influenced pod girth. Maximum pod girth (19.73 mm) was recorded with 2 % Novel Organic Liquid Nutrient (N<sub>2</sub>). Whereas, minimum pod girth (18.49 mm) was noted with no spray (N<sub>1</sub>).

**Table 3:** Effect of fertilizer levels and foliar application of nutrients on average pod length at 2<sup>nd</sup> picking and 4<sup>th</sup> picking of cowpea

	2 <sup>nd</sup> picking					4 <sup>nd</sup> picking				
NF	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	13.71	15.21	14.37	13.95	14.31	14.13	15.26	14.72	14.21	14.58
F <sub>2</sub>	13.52	14.71	14.08	13.82	14.03	13.61	14.73	14.04	13.84	14.05
F <sub>3</sub>	13.25	14.61	13.99	13.74	13.90	13.58	14.60	14.02	13.82	14.01
Mean	13.49	14.84	14.15	13.84		13.77	14.86	14.26	13.95	
	F		N		F×N	F		N		F×N
S.Em. ±	0.290		0.335		0.580	0.298		0.344		0.596
C.D. at 5 %	NS		NS		NS	NS		NS		NS
C.V. %	7.12					7.26				

**Table 4:** Effect of fertilizer levels and foliar application of nutrients on pod weight at 2<sup>nd</sup> picking and 4<sup>th</sup> picking of cowpea

	2 <sup>nd</sup> picking					4 <sup>nd</sup> picking				
NF	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	2.30	2.60	2.47	2.40	2.44	2.29	2.57	2.42	2.39	2.42
F <sub>2</sub>	2.27	2.44	2.42	2.37	2.37	2.25	2.43	2.40	2.35	2.36
F <sub>3</sub>	2.23	2.40	2.35	2.32	2.33	2.20	2.37	2.35	2.31	2.31
Mean	2.27	2.48	2.41	2.36		2.24	2.46	2.39	2.35	
	F		N		F×N	F		N		F×N
S.Em. ±	0.051		0.059		0.103	0.051		0.059		0.102
C.D. at 5 %	NS		NS		NS	NS		NS		NS
C.V. %	7.47					7.45				

**Table 5:** Effect of fertilizer levels and foliar application of nutrients on pod girth (mm) of cowpea

NF	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	18.60	20.27	19.87	19.73	19.62
F <sub>2</sub>	18.53	19.73	19.47	19.20	19.23
F <sub>3</sub>	18.33	19.20	18.93	18.67	18.78
Mean	18.49	19.73	19.42	19.20	
	F		N		F×N
S.Em. ±	0.403		0.465		0.805
C.D. at 5 %	NS		NS		NS
C.V. %			7.26		

**Pod yield (kg plant<sup>-1</sup>)**

Pod yield (kg plant<sup>-1</sup>) was significantly influenced by different fertilizer levels and foliar application of nutrients. Maximum pod yield (0.121 kg plant<sup>-1</sup>) was observed with 100 % RDF (F<sub>1</sub>). Whereas, minimum pod yield (0.100 kg plant<sup>-1</sup>) was observed with 60 % RDF (F<sub>3</sub>). Foliar application of nutrients was significantly affected pod yield (kg plant<sup>-1</sup>). Maximum pod yield (0.138 kg plant<sup>-1</sup>) was recorded with 2 % Novel Organic Liquid Nutrient (N<sub>2</sub>). Whereas, minimum pod yield (0.076 kg plant<sup>-1</sup>) was noted with no spray (N<sub>1</sub>). The interaction effect of fertilizer levels and foliar application of nutrients for this parameter was found significant. However, maximum pod yield (0.151 kg plant<sup>-1</sup>) had recorded with the treatment combination F<sub>1</sub>N<sub>2</sub> (100 % RDF with 2 % Novel Organic Liquid Nutrient) which was at par with F<sub>2</sub>N<sub>2</sub> (80 % RDF with 2 % Novel Organic Liquid Nutrient). Whereas, minimum pod yield (0.059 kg plant<sup>-1</sup>) had noted with the treatment combination F<sub>3</sub>N<sub>1</sub> (60 % RDF with no spray).

**Table 6:** Effect of fertilizer levels and foliar application of nutrients on pod yield (kg plant<sup>-1</sup>) of cowpea

	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	0.094	0.151	0.132	0.107	0.121
F <sub>2</sub>	0.074	0.142	0.114	0.107	0.109
F <sub>3</sub>	0.059	0.121	0.113	0.106	0.100
Mean	0.076	0.138	0.120	0.107	
	F		N		F×N
S.Em. ±	0.003		0.003		0.005
C.D. at 5 %	0.008		0.009		0.015
C.V. %	8.20				

**Total pod yield (kg plot<sup>-1</sup> and t ha<sup>-1</sup>)**

Total pod yield (kg plot<sup>-1</sup> and t ha<sup>-1</sup>) was significantly influenced by different fertilizer levels and foliar application of nutrients. Maximum total pod yield (2.674 kg plot<sup>-1</sup> and 8.25 t ha<sup>-1</sup>) were observed with 100 % RDF (F<sub>1</sub>). Whereas, minimum total pod yield (2.194 kg plot<sup>-1</sup> and 6.77 t ha<sup>-1</sup>) were observed with 60 % RDF (F<sub>3</sub>). Foliar application of 2 % Novel Organic Liquid Nutrient (N<sub>2</sub>) resulted in maximum total pod yield (3.036 kg plot<sup>-1</sup> and 9.37 t ha<sup>-1</sup>). Whereas, the minimum total pod yield (1.680 kg plot<sup>-1</sup> and 5.19 t ha<sup>-1</sup>) was noted in no spray (N<sub>1</sub>). The interaction effect of fertilizer levels and foliar application of nutrients for this parameter was found significant. However, maximum total pod yield (3.329 kg plot<sup>-1</sup> and 10.28 t ha<sup>-1</sup>) had recorded with the treatment combination F<sub>1</sub>N<sub>2</sub> (100 % RDF with 2 % Novel Organic Liquid Nutrient) which was at par with F<sub>2</sub>N<sub>2</sub> (80 % RDF with 2 % Novel Organic Liquid Nutrient). Whereas, minimum total pod yield (1.298 kg plot<sup>-1</sup> and 4.01 t ha<sup>-1</sup>) had noted with the treatment combination F<sub>3</sub>N<sub>1</sub> (60 % RDF with no spray).

**Marketable pod yield (t ha<sup>-1</sup>)**

Marketable pod yield (t ha<sup>-1</sup>) was significantly influenced by different fertilizer levels and foliar application of nutrients. Maximum marketable pod yield (7.49 t ha<sup>-1</sup>) was observed with 100 % RDF (F<sub>1</sub>). Whereas, minimum marketable pod yield (6.18 t ha<sup>-1</sup>) was observed with 60 % RDF (F<sub>3</sub>). Maximum marketable pod yield (8.44 t ha<sup>-1</sup>) was observed with 2 % Novel Organic Liquid Nutrient (N<sub>2</sub>). Whereas, minimum marketable pod yield (6.59 t ha<sup>-1</sup>) was observed with no spray (N<sub>1</sub>). The interaction effect of fertilizer levels

and foliar application of nutrients for this parameter was found significant. However, maximum marketable pod yield (9.10 t ha<sup>-1</sup>) had recorded with the treatment combination F<sub>1</sub>N<sub>2</sub> (100 % RDF with 2 % Novel Organic Liquid Nutrient) which was at par with F<sub>1</sub>N<sub>3</sub> (100 % RDF and 3 % *panchagavya*), F<sub>2</sub>N<sub>2</sub> (80 % RDF with 2 % Novel Organic Liquid Nutrient). Whereas, minimum marketable pod yield (3.73 t ha<sup>-1</sup>) had noted with the treatment combination F<sub>3</sub>N<sub>1</sub> (60 % RDF with no spray).

**Table 7:** Effect of fertilizer levels and foliar application of nutrients on total pod yield (kg plot<sup>-1</sup> and t ha<sup>-1</sup>) of cowpea

	Total kg plot <sup>-1</sup>					Total t ha <sup>-1</sup>				
NF	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	2.107	3.329	2.904	2.354	2.674	6.50	10.28	8.96	7.27	8.25
F <sub>2</sub>	1.635	3.117	2.515	2.352	2.405	5.05	9.62	7.76	7.26	7.42
F <sub>3</sub>	1.298	2.662	2.479	2.338	2.194	4.01	8.22	7.65	7.22	6.77
Mean	1.680	3.036	2.633	2.348		5.19	9.37	8.13	7.25	
	F		N		F×N	F		N		F×N
S.Em. ±	0.058		0.067		0.117	0.180		0.208		0.361
C.D. at 5 %	0.171		0.198		0.343	0.529		0.611		1.058
C.V. %	8.34					8.34				

**Harvest index**

Harvest index was non-significantly influenced by different fertilizer levels and foliar application of nutrients. Maximum harvest index (39.21 %) was observed with 100 % RDF (F<sub>1</sub>). Whereas, minimum harvest index (37.96 %) was observed with 60 % RDF (F<sub>3</sub>). Maximum harvest index (39.56 %) was recorded with 2 % Novel Organic Liquid Nutrient (N<sub>2</sub>). Whereas, minimum harvest index (37.52 %) was noted with no spray (N<sub>1</sub>).

**Table 8:** Effect of fertilizer levels and foliar application of nutrients on harvest index (%) of cowpea

	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	37.70	40.25	39.93	38.96	39.21
F <sub>2</sub>	37.59	39.84	39.13	38.59	38.79
F <sub>3</sub>	37.26	38.59	38.06	37.91	37.96
Mean	37.52	39.56	39.04	38.49	
	F		N		F×N
S.Em. ±	0.612		0.707		1.225
C.D. at 5 %	NS		NS		NS
C.V. %	5.48				

**Quality Parameters****Protein content of immature seed (%)**

It was observed that the protein content (%) of immature seed at sixth picking was significantly influenced by different fertilizer levels and foliar application of nutrients. Maximum protein content (6.05 %) of immature seed at sixth picking were noted with 100 % RDF (F<sub>1</sub>) which was at par with 80 % RDF (F<sub>2</sub>). Whereas, minimum protein content (5.80 %) of immature seed at sixth picking were observed with 60 % RDF (F<sub>3</sub>). Maximum protein content (6.06 %) were recorded with 2 % Novel Organic Liquid Nutrient (N<sub>2</sub>) which was at par with 3 % *panchagavya* (N<sub>3</sub>) and 0.5 % water soluble fertilizer (19:19:19) (N<sub>4</sub>). Whereas, minimum protein content (5.73 %) were noted with no spray (N<sub>1</sub>). The interaction effect of fertilizer levels and foliar application of nutrients for this parameter was found non-significant.



**Table 9:** Effect of fertilizer levels and foliar application of nutrients on protein content (%) of immature seed of cowpea

	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	5.86	6.19	6.10	6.04	6.05
F <sub>2</sub>	5.70	6.03	5.95	5.93	5.90
F <sub>3</sub>	5.62	5.96	5.83	5.80	5.80
Mean	5.73	6.06	5.96	5.92	
	F		N		F×N
S.Em. ±	0.065		0.075		0.131
C.D. at 5 %	0.192		0.221		NS
C.V. %	3.82				

**Moisture percentage of pod (%)**

It was observed that the moisture percentage of pod at sixth picking was non-significantly influenced by different fertilizer levels and foliar application of nutrients. Maximum moisture of pod (83.40 %) at sixth picking were noted with 100 % RDF (F<sub>1</sub>). Whereas, minimum moisture percentage of pod (83.22 %) at sixth picking were observed with 60 % RDF (F<sub>3</sub>). Maximum moisture of pod (83.45 %) at sixth picking were recorded with 2 % Novel Organic Liquid Nutrient (N<sub>2</sub>). Whereas, minimum moisture percentage of pod (83.05 %) at sixth picking were noted with no spray (N<sub>1</sub>).

**Table 10:** Effect of fertilizer levels and foliar application of nutrients on moisture percentage of pod (%) at sixth picking of cowpea

	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	83.15	83.52	83.49	83.46	83.40
F <sub>2</sub>	83.09	83.48	83.45	83.41	83.36
F <sub>3</sub>	82.92	83.36	83.32	83.28	83.22
Mean	83.05	83.45	83.42	83.38	
	F		N		F×N
S.Em. ±	0.336		0.388		0.672
C.D. at 5 %	NS		NS		NS
C.V. %	1.39				

**Total Soluble Solids (°Brix)**

Total Soluble Solids (°Brix) of immature pods at sixth picking was significantly influenced by different fertilizer levels and foliar application of nutrients. Maximum total soluble solids (7.68 °Brix) of immature pods at sixth picking were observed with 100 % RDF (F<sub>1</sub>) which was at par with 80 % RDF. Whereas, minimum total soluble solids (7.56 °Brix) of immature pods at sixth picking were observed with 60 % RDF (F<sub>3</sub>). Maximum total soluble solids (7.72 °Brix) of immature pods at sixth picking were recorded with 2 % Novel Organic Liquid Nutrient (N<sub>2</sub>) which was at par with 3 % *panchagavya* (N<sub>3</sub>) and 0.5 % water soluble fertilizer (19:19:19) (N<sub>4</sub>). Whereas, minimum total soluble solids (7.49 °Brix) of immature pods at sixth picking were noted with no spray (N<sub>1</sub>). The interaction effect of fertilizer levels and foliar application of nutrients for this parameter was found significant. However, maximum total soluble solids (7.77 °Brix) of immature pods at sixth picking had recorded with the treatment combination F<sub>1</sub>N<sub>2</sub> (100 % RDF with 2 % Novel Organic Liquid Nutrient). Whereas, total soluble solids (7.46 °Brix) of immature pods at sixth picking had noted with the treatment combination F<sub>3</sub>N<sub>1</sub> (60 % RDF with no spray).

**Table 11:** Effect of fertilizer levels and foliar application of nutrients on total soluble solids (°Brix) of immature pods at sixth picking of cowpea

	N <sub>1</sub>	N <sub>2</sub>	N <sub>3</sub>	N <sub>4</sub>	Mean
F <sub>1</sub>	7.51	7.77	7.74	7.69	7.68
F <sub>2</sub>	7.49	7.73	7.71	7.65	7.65
F <sub>3</sub>	7.46	7.66	7.58	7.56	7.56
Mean	7.49	7.72	7.67	7.63	
	F		N		F×N
S.Em. ±	0.032		0.037		0.064
C.D. at 5 %	0.094		0.108		NS
C.V. %	1.44				

**Economics**

Production cost of cowpea var. GVC-9 was distinctly influenced by different fertilizer levels and foliar application of nutrients. Results indicated that F<sub>1</sub>N<sub>2</sub> (100 % RDF (20-40-00) with 2 % Novel Organic Liquid Nutrient) had maximum net income (₹ 242696) with higher B:C ratio (1:2.00) per hectare. While, lower net income (₹ 71468) and B:C ratio (1:0.92) per hectare was recorded under treatment F<sub>3</sub>N<sub>1</sub> (60 % RDF (12-24-00) with no spray).

**Table 12:** Effect of fertilizer levels and foliar application of nutrients on economics and B:C ratio

Treatments	Fresh pod yield (kg ha <sup>-1</sup> )	Cost A	Cost B	Cost C	Gross income	Net income	B:C ratio
F <sub>1</sub> N <sub>1</sub>	5190	76997	14775	91772	236400	144628	1.58
F <sub>1</sub> N <sub>2</sub>	9100	106066	22750	128816	364000	235184	1.83
F <sub>1</sub> N <sub>3</sub>	8340	133910	20850	154760	333600	178840	1.16
F <sub>1</sub> N <sub>4</sub>	6600	84034	16500	100534	264000	163466	1.63
F <sub>2</sub> N <sub>1</sub>	4590	71309	11475	82784	183600	100816	1.22
F <sub>2</sub> N <sub>2</sub>	8750	104258	21875	126133	350000	223867	1.77
F <sub>2</sub> N <sub>3</sub>	7060	128382	17650	146032	282400	136368	0.93
F <sub>2</sub> N <sub>4</sub>	6600	83626	16500	100126	264000	163874	1.64
F <sub>3</sub> N <sub>1</sub>	3730	67310	9325	76635	149200	72565	0.95
F <sub>3</sub> N <sub>2</sub>	7470	98579	18675	117254	298800	181546	1.55
F <sub>3</sub> N <sub>3</sub>	6960	127423	17400	144823	278400	133577	0.92
F <sub>3</sub> N <sub>4</sub>	6560	82907	16400	99307	262400	163093	1.64

**Conclusion**

By considering scenario of present experiment, it can be concluded that the 100 % RDF along with 2 % Novel Organic Liquid Nutrient is the best in terms of yield, quality and economics in cowpea.

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