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Effect of organic and inorganic sources of nutrients on growth and yield of chickpea (*Cicer arietinum* L.) in central region of Uttar Pradesh

Alok Gupti and AS Yadav

Abstract
The study was conducted at Agriculture Research Farm of Faculty of Agriculture Sciences and Allied Industries, Rama University, Kanpur during the Rabi season of 2021-22 on "Response of organic and inorganic sources of nutrients on chickpea on growth and yield of chickpea (*Cicer Arietinum* L.)". Chickpea variety Ujjwal (IPCK 2004-29) was selected for the investigation. Total 11 treatment combinations in a Randomized Block Design (RBD) with three replications was laid out. The results revealed that the maximum plant population (32.00 and 25.00), after 30 days after sowing, significantly highest plant height (16.27cm), after 60 days after sowing, significantly highest plant height (33.07 cm), the significantly maximum number of leaves per plant (18.7), maximum number of leaves per plant (60.3 and 141.0), maximum number of nodules (24.30), maximum number of pods per plant (33.0), highest grain yield (2799.30 kg/ha), the highest test weight of chickpea (141.6 g) were recorded for treatment T8 (75% DAP + Vermicompost (2.5 t/ha)+ FYM (5 t/ha).

Keywords: Organic, inorganic, chickpea, RBD

Introduction
Chickpea (*Cicer arietinum* L.) is the most dominant pulse having a share of around 40 per cent in the general production followed by Tur/Arhar at 15 to 20 in keeping with cent and Urad/Black Matpe and Moong at around 8-10 per cent each. Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh and Karnataka are the top 5 pulses producing States. Productivity of pulses is 764 kg/ha. The various legumes, chickpea (*Cicer arietinum* L.) generally known as Bengal gram and regionally Chana is a crucial and precise food legume due to its use inside the form of meals products like snacks, chocolates, condiments, veggies and many others. it's also fed on inside the shape of processed complete seed (boiled, roasted, parched, fried, steamed sprouted and so forth.) or as dal flour (*besan*). Chickpea is a good source of protein (17-22.5%), carbohydrate (51-69 %), fat (4-10%), minerals and vitamins. It is also a splendid animal feed and it's stover has suitable forage cost.

Integrated nutrient supply or management systems involve efficient and really appropriate supply of all of the most important components of plant nutrients sources. Chemical fertilizers together with animal manures, compost, FYM, legume in cropping systems, biofertilizers, crop residues or waste recycle and other regionally available nutrient sources are used for sustaining soil fertility, health and productivity. Integrated supply and use of plant nutrients from chemical fertilizers and organic manures produce higher crop yield than their person application. A significant improvement in yield and organic nitrogen fixation because of Rhizobium inoculation has been reported in chickpea. Primary macronutrients are utilized in massive amount and complemented as fertilizers [Nitrogen (N), Phosphorus (P) and Potassium (K)] even as secondary macronutrients [Calcium (Ca), Magnesium (Mg) and Sulphur (S)] also are applied in massive portions however sufficiently furnished and are commonly conveniently available. It is decided that in crop increase supplementary foliar fertilization will increase plants mineral status and improves crop yield. Over the previous couple of years there was a consistent trend to lessen using mineral fertilizers, especially soil carried out nutrients consisting of - N, P and K and their use has reduced seven times (Kerin and Berova 2003). These facts create preconditions to growth the significance of foliar fertilization as an opportunity to meet plant nutrient needs for the duration of the developing season. Interest on foliar fertilization has risen due to many benefits related to methods of foliar nutrients. Application, which includes rapid and effective reaction to plant needs, irrespective of soil

conditions (Kerin and Berova 2003)
The role of biofertilizers is likewise properly recognized, which materials important nutrients like nitrogen and phosphorus important for the plant growth. Biofertilizers also develops a sustainable agriculture machine with the aid of preserving soil fertility, soil bodily properties, ecological stability and imparting stability to the manufacturing without polluting soil, water and the air. A number of the various biofertilizers, rhizobium inoculation is most inexpensive and simplest method of offering nitrogen to legumes thru widely recognized symbiotic nitrogen fixation technique. It increases the yield and improves the first-rate of legumes and also upload significant quantity of residual nitrogen inside the soil for subsequent plants. Rhizobium inoculation can boom the seed yield of pulse crops to the row of 11 to 16% (Ali and Chandra, 1985) [1].
Here an attempt is made to access the effect of organic and inorganic sources of nutrients on growth, yield attributes and yields of chickpea in central region of Uttar Pradesh.

Material and Methods
The experiment on chickpea *(Cicer arietinum* L.) was laid down to study the "Response of organic and inorganic sources of nutrients on chickpea on growth and yield of chickpea (*Cicer arietinum* L.)" is proposed to be undertaken at Agriculture Research Farm, Faculty of Agriculture Sciences and Allied Industries, Rama University, Kanpur during the Rabi season of 2021-22. Chickpea variety Ujjwal (IPCK 2004-29)was selected for the present research. This variety is evolved and released from Indian Institute of Pulses Research Institute during the year 2010 for general cultivation in Central zone. The following parameters was analyzed during the study

1. Treatment details
T1: Control (No Nutrient Application) T2: DAP (100 kg/ha)
T3: FYM (5 t/ha)
T4: Vermicompost (2.5 t/ha)
T5: FYM (5 t/ha) + Vermicompost (2.5 t/ha) T6: 75% DAP + Vermicompost (2.5 t/ha) T7: 75% DAP + FYM (5 t/ha)
T8: 75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha) T9: 50% DAP + Vermicompost (2.5 t/ha)
T10: 50% DAP + FYM (5 t/ha)
T11: 50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)

There were 11 treatment combinations applied to chickpea crop. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The experiment was conducted at the same site during the season without changing the randomization of the treatments.

2. Growth, Yield characteristics and Yield
a. Plant population
In every net plot, five spots of 1 meter row length have been selected randomly and flora were counted at 20 DAS and at harvest. The common of 5 spots became taken into consideration for plant populace per meter row period of each net plot.

b. Height of plant
Height (cm) of 5 randomly decided on plants became measured from the ground degree to the end of the principle shoot at 30, 60 and 90 DAS average cost of each plot changed into computed and recorded.

C. Number of branches per plant
The wide variety of branches of all of the five tagged plant life become counted and mean quantity of branches per plant turned into labored out at harvest.

D. Number of root nodules per plant
Five plant life from the net plot were dug out carefully at forty-five DAS. The roots have been washed out with smooth water in a sieve to get rid of the soil particles adhered to the roots. Then the basis nodules were eliminated, counted and average cost consistent with plant became worked out.

E. Number of pods per plant
The number of pods from the five marked pods in each section of the net was calculated and divided by five to determine the average number of pods per plant at harvest time.

F. Seed yield per plant
The suggest seed yield in gram per plant changed into additionally recorded from formerly 5 tagged plants on the time of harvest. in a while it was delivered to the seed yield of net plot.

G. Seed yield (kg/ha)
The produce of every net plot become threshed one at a time, cleaned and sun dried until the consistent weight become acquired. Then seed yield in kilogram according to net plot changed into recorded and transformed into kg per hectare.

H. Test weight
A representative seed sample became drawn randomly from the majority produce of each net plot and a hundred seeds had been counted from the sample and their weight in gram turned into recorded as a check weight for each treatment.

Harvest index (%)
1. The harvest index is the ratio of economic yield to the biological yield per plot. The harvest index for each treatment was worked out by using the formula given by Donald and Hamblin, 1976.

$$\text{Harvest Index (\%)} = \frac{\text{Economic yield (kg ha}^{-1})}{\text{Biological yield (kg ha}^{-1})} \text{X100}$$

Result and Discussion
The results from the study revealed that the following results:

1. Plant per meter square
The data for different treatment in respect to plant population is described in Table 1 depicted that the different treatments were non-significantly affected at 15 days and at harvest. The maximum plant population (32.00 and 25.00) was recorded with treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) followed by treatment T2 (DAP (100 kg/ha) with value of 31.67 and 23.67 followed by treatment T11 (50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) having 31.33 and 24.67 at 15 days after sowing and at harvest, respectively. The minimum plant population (27.67 and 16.67) was observed in T1(Control treatment)at both the growth stages. However, all the treatments were at par with each other for plant population at 15 DAS and at harvest stage.

Table 1: Effect of organic and inorganic treatments combination on pant population per meter square of chickpea

Plant population per m2			
Treatment	**Description**	**15 DAS**	**At harvest**
T1	Control (No Nutrient Application)	27.67d	16.67f
T2	DAP (100 kg/ha)	31.67a	23.67b
T3	FYM (5 t/ha)	29.33bc	21.33c
T4	Vermicompost (2.5 t/ha)	28.33cd	18.33e
T5	FYM (5 t/ha) + Vermicompost (2.5 t/ha)	28.67cd	20.00d
T6	75% DAP + Vermicompost (2.5 t/ha)	28.67cd	18.33e
T7	75% DAP + FYM (5 t/ha)	28.33cd	19.67d
T8	75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	32.00a	25.00a
T9	50% DAP + Vermicompost (2.5 t/ha)	30.67ab	18.67e
T10	50% DAP + FYM (5 t/ha)	31.33a	21.67c
T11	50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	31.33a	24.67a
	CD	1.57	0.726
	CV	3.09	2.057
	SE.m	0.53	0.25

2. Plant height (cm)

The data reflected in Table 2 featured those different treatments significantly affected the plant height at different growth stages.

After 30 days after sowing, significantly highest plant height (16.27cm) was observed with treatment T8(75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha))followed by T11(50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) and T10(50% DAP + FYM (5 t/ha)) was observed 15.90 cm and 15.80cm respectively whereas, lowest plant height 14.53cm was studied with T1(Control treatment).

After 60 days after sowing, significantly highest plant height 33.07 cm was observed with treatment T8(75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha) was significantly at par with T11(50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha))with 32.53 cm plant height. Treatment T2(DAP (100 kg/ha)) is significantly different from all other treatments and 31.40 cm plant height was observed. Lowest plant height (24.93 cm) was found for treatment T1(control treatment).

At 90 DAS the treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) recorded significantly highest plant height (42.33 cm) over other treatments followed by treatment T2(40.50 cm) and T11 (39.13 cm) however, both the follower treatments were statistically significantly different from with each other. But Treatment T11 is significantly at par with T10 (50% DAP + FYM (5 t/ha)). The significantly lowest plant height (23.81 cm)was depicted with treatment T1 (control). At harvest, the significantly highest plant height (56.73 cm) was observed with treatment T4 (RDF+ vermicompost) over other treatments followed by treatment T2 (DAP (100 kg/ha)) with plant height 54.33 cm.

Table 2: Effect of organic and inorganic treatments combination various plant heights of chickpea

Plant height					
Treatment	**Description**	**30DAS**	**60DAS**	**90DAS**	**At harvest**
T1	Control (No Nutrient Application)	14.53e	24.93g	33.60f	50.10i
T2	DAP (100 kg/ha)	15.57c	31.40b	40.50b	54.33b
T3	FYM (5 t/ha)	14.77e	27.27ef	36.00de	51.70h
T4	Vermicompost (2.5 t/ha)	14.70e	26.73f	35.03e	52.87ef
T5	FYM (5 t/ha) + Vermicompost (2.5 t/ha)	15.13d	27.60de	36.33d	52.40g
T6	75% DAP + Vermicompost (2.5 t/ha)	15.57c	28.10d	36.43d	52.60fg
T7	75% DAP + FYM (5 t/ha)	15.60bc	28.20d	37.17d	53.17de
T8	75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	16.27a	33.07a	42.33a	56.73a
T9	50% DAP + Vermicompost (2.5 t/ha)	15.73bc	32.53a	40.80b	53.37cd
T10	50% DAP + FYM (5 t/ha)	15.80bc	29.53c	38.80c	52.40g
T11	50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	15.90b	30.00c	39.13c	53.60c
	CD	0.31	0.82	1.29	0.33
	CV	1.17	1.66	2.009	0.37
	SE.m	0.11	0.28	0.44	0.11

3. Number of leaves per plant

The data on number of leaves per plant is given in Table 3 showed that the number of leaves per plant was significantly influenced with different treatments at all growth stages.

The significantly maximum number of leaves per plant (18.7) was recorded with T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) after 30 days of sowing. Treatment T11 (50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) and T9 (50% DAP + Vermicompost (2.5 t/ha)) is statistically at par but significantly different from other treatments while, treatments T6, T7 and T2 are statistically at par with each other. The number of leaves per plant was found significantly minimum in treatment T1 (control). Maximum number of leaves per plant (60.3 and 141.0) was observed with treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) followed by treatment T11 (57 and 136.7) and T2 (56.7 and 136.7) at 60 and 90 DAS, respectively. However, these were statistically at par with each other while, significantly minimum number of compound leaves per plant (48.0 and 98.66) were recorded with treatment T1 (control) at both the growth stages, respectively.

Table 3: Effect of organic and inorganic treatments combination various Numbers of leaves of chickpea

		Number of Leaves		
Treatment	**Description**	**30DAS**	**60DAS**	**90DAS**
T1	Control (No Nutrient Application)	9.0f	48.0 h	88.7f
T2	DAP (100 kg/ha)	16.0c	56.7bc	136.7b
T3	FYM (5 t/ha)	14.7de	54.7 de	126.3cd
T4	Vermicompost (2.5 t/ha)	14.0e	52.7 g	118.3e
T5	FYM (5 t/ha) + Vermicompost (2.5 t/ha)	15.0d	53.3 fg	124.0d
T6	75% DAP + Vermicompost (2.5 t/ha)	16.0c	54.0 ef	128.3c
T7	75% DAP + FYM (5 t/ha)	16.0c	54.7 de	134.7b
T8	75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	18.7a	60.3a	141.0a
T9	50% DAP + Vermicompost (2.5 t/ha)	17.0b	56.7 bc	135.0b
T10	50% DAP + FYM (5 t/ha)	15.0d	55.7 cd	136.0b
T11	50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	17.0b	57.0b	136.7b
	CD	0.77	1.02	2.85
	CV	2.99	1.10	1.32
	SE.m	0.26	0.35	0.97

4. Number of Root Nodules per plant: It is obvious from data given in Table 4 that number of nodules per plant was significantly affected by different treatments. The maximum number of nodules (24.30) were significantly recorded with treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) followed by T2 (23.18) at 40 DAS. However, both the treatments were statistically different for number of nodules per plant at 40 DAS. While, significantly minimum number of nodules per plant (6.89) were obtained in treatment T1 (control) at 40 DAS.

5. Number of pods per plant

The data pertaining to the effect of different treatments on number of pods per plant summarized in Table 4 indicated that number of pods per plant was significantly affected by different fertility treatments. The treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) recorded maximum number of pods per plant (33.0).It is significantly different from all other treatment. In the similar lines, Treatment T8 was followed by treatment T2 (DAP (100 kg/ha)) with 31 number of pods per plant and it was also significantly different from other treatment. Treatment T4 and T5was significantly at par with each other treatment whereas significantly minimum number of pods per plant (17) was recorded in treatment T1 (Control).

Table 5: Effect of various organic and inorganic treatments combination on pod per plant

Treatment	**Description**	**Pods per plant**
T1	Control (No Nutrient Application)	17j
T2	DAP (100 kg/ha)	31b
T3	FYM (5 t/ha)	22i
T4	Vermicompost (2.5 t/ha)	23h
T5	FYM (5 t/ha) + Vermicompost (2.5 t/ha)	23h
T6	75% DAP + Vermicompost (2.5 t/ha)	24g
T7	75% DAP + FYM (5 t/ha)	25f
T8	75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	33a
T9	50% DAP + Vermicompost (2.5 t/ha)	27e
T10	50% DAP + FYM (5 t/ha)	29d
T11	50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	30c
	CD	0.91
	CV	2.06
	Sem	0.31

Quality Parameter

Grain yield (Kg per hectare)

It is clearly stated from the data presented in table 5 that the grain yield of chickpea was deviated significantly due to various treatments. The significantly highest grain yield (2799.30 kg/ha) was obtained under the treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha) followed by the treatment T2 (DAP (100 kg/ha)) with 2643.37kg/ha and T11 (2406.73 kg/ha) while, significantly lowest grain yield (742.56 kg/ha) was obtained with treatment T1 (Control).

Table 6: Effect of various organic and inorganic treatments combination on grain yield of chickpea

Treatment	Description	Grain Yield (kg per hectare)
T1	Control (No Nutrient Application)	742.57h
T2	DAP (100 kg/ha)	2643.37b
T3	FYM (5 t/ha)	1200.43g
T4	Vermicompost (2.5 t/ha)	1234.40g
T5	FYM (5 t/ha) + Vermicompost (2.5 t/ha)	1322.47g
T6	75% DAP + Vermicompost (2.5 t/ha)	2146.23d
T7	75% DAP + FYM (5 t/ha)	2034.60de
T8	75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	2799.30a
T9	50% DAP + Vermicompost (2.5 t/ha)	1771.70f
T10	50% DAP + FYM (5 t/ha)	1985.57e
T11	50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	2406.73c
	CD	126.731
	CV	4.034
	Sem	42.95

Test weight

The data presented in Table 6 showed that the test weight of chickpea was significantly affected by different treatments. The highest test weight of chickpea (141.6 g) was recorded under treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha) followed by T2(141.2g) and T11(140.8). Treatment T8, T2and T11 are significantly different from each other whereas, the significantly lowest test weight of chickpea (138.2 g) was observed with treatment T1(Control).

Table 7: Effect of various organic and inorganic treatments combination test weight

Treatment	Description	Test weight (g)
T1	Control (No Nutrient Application)	138.2f
T2	DAP (100 kg/ha)	141.2b
T3	FYM (5 t/ha)	138.3f
T4	Vermicompost (2.5 t/ha)	138.2f
T5	FYM (5 t/ha) + Vermicompost (2.5 t/ha)	139.6e
T6	75% DAP + Vermicompost (2.5 t/ha)	139.8e
T7	75% DAP + FYM (5 t/ha)	139.8e
T8	75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	141.6a
T9	50% DAP + Vermicompost (2.5 t/ha)	140.2d
T10	50% DAP + FYM (5 t/ha)	140.2d
T11	50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)	140.8c
	CD	0.242
	CV	0.102
	Sem	0.082

Summary & Conclusion

The study revealed that the maximum plant population (32.00 and 25.00) was recorded with treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) followed by treatment T2 (DAP (100 kg/ha) with value of 31.67 and 23.67 followed by treatment T11 (50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) having 31.33 and 24.67 at 15 days after sowing and at harvest, respectively. The minimum plant population (27.67 and 16.67) was observed in T1(Control treatment) at both the growth stages. After 30 days after sowing, significantly highest plant height (16.27cm) was observed with treatment T8(75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) followed by T11(50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) and T10(50% DAP + FYM (5 t/ha)) was observed 15.90 cm and 15.80cm respectively. After 60 days after sowing, significantly highest plant height 33.07 cm was observed with treatment T8(75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) was significantly at par with T11(50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) with 32.53 cm plant height. Treatment T2(DAP (100 kg/ha)) is significantly different from all other treatments and 31.40 cm plant height was observed. At 90 DAS the treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) recorded significantly highest plant height (42.33 cm) over other treatments followed by treatment T2 (40.50 cm) and T11 (39.13 cm) however, both the follower treatments were statistically significantly different from with each other. But Treatment T11 is significantly at par with T10 (50% DAP + FYM (5 t/ha)). At harvest, the significantly highest plant height (56.73 cm) was observed with treatment T4 (RDF+ vermicompost) over other treatments followed by treatment T2 (DAP (100 kg/ha)) with plant height 54.33 cm. The significantly maximum number of leaves per plant (18.7) was recorded with T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) after 30 days of sowing. Treatment T11 (50% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) and T9 (50% DAP + Vermicompost
(2.5 t/ha)) is statistically at par but significantly different from other treatments while, treatments T6, T7 and T2 are statistically at par with each other. Maximum number of leaves per plant (60.3 and 141.0) was observed with treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) followed by treatment T11 (57 and 136.7) and T2 (56.7 and 136.7) at 60 and 90 DAS, respectively. The maximum number of nodules (24.30) were significantly recorded with treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) followed by T2 (23.18) at 40 DAS. However, both the treatments were statistically different for number of nodules

per plant at 40 DAS. The treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) recorded maximum number of pods per plant (33.0). It is significantly different from all other treatment. In the similar lines, Treatment T8 was followed by treatment T2 (DAP (100 kg/ha)) with 31 number of pods per plant and it was also significantly different from other treatment. The significantly highest grain yield (2799.30 kg/ha) was obtained under the treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) followed by the treatment T2 (DAP (100 kg/ha)) with 2643.37kg/ha and T11
(2406.73 kg/ha) while, significantly lowest grain yield (742.56 kg/ha) was obtained with treatment T1 (Control). The highest test weight of chickpea (141.6 g) was recorded under treatment T8 (75% DAP + Vermicompost (2.5 t/ha) + FYM (5 t/ha)) followed by T2(141.2g) and T11(140.8). Treatment T8, T2 and T11 are significantly different from each other whereas, the significantly lowest test weight of chickpea (138.2 g) was observed with treatment T1 (Control).

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