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Effect of different nutrient management practices on growth, yield and economics in chickpea

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Abstract
During the *Rabi* season 2020-21, a field experiment was conducted at the Research Farm, Department of Agronomy, G.H. Raisoni University, Chhindwara, Madhya Pradesh, to see how nutrient management affected chikpea growth and yield (*Cicer artietinum* L.). 100 percent Recommended Dose Fertilizer (RDF), 100 percent N through Vermicompost, 100 percent N through Poultry Manures, 50 percent N through RDF + 50 percent N through Vermicompost, 50 percent N through RDF + 50 percent N through Poultry Manures, 50 percent N through Poultry Manures + 50 percent N through Vermicompost, 50 percent N through Poultry Manures + 50 percent N through Vermicompost, 50 percent N through Po The study was set up in a randomised block design with three replications. The experimental results revealed that plant height and dry matter accumulation plant-1, yield attributes (Pods plant^{-1}, dry weight of pods plant^{-1}, seed pod^{-1}, and seed index), maximum grain yield (kg ha^{-1}), straw yield (2784 q ha^{-1}), gross monetary returns (87847 Rs. ha^{-1}), net monetary returns (59542 Rs. ha^{-1}), and benefit cost ratio (3.1) are all growth attributing characters of the chickpea crop.

Keywords: Chickpea, growth, yield, economics and fertilizers

Introduction
Chickpea (*Cicer arietinum* L.), often known as gramme or Bengal gramme, is one of India's most significant Rabi season pulse crops, owing to its economic importance as well as its ability to maintain soil fertility. It is a significant pulse crop, ranking third among pulses. In the green stage, it is high in protein (18-22%), carbohydrate (62%), B-group vitamins, and some minerals like as Ca, Fe, and vitamin C.

It contains 21% protein and 38-59 percent carbs, making it a major source of vegetable protein in the human diet (Gupta, 1989). Chickpea is also credited with the ability to fix atmospheric nitrogen through a symbiotic process, and it is predicted that chickpea has the capability to fix 140 kg N ha-1 throughout a growth season (Rupela and Saxena, 1987). After mineralization of chickpea crop wastes, the fixed N can not only meet the legume's requirements for maximum grain production, but it can also be used by succeeding crops.

Nitrogen is one of the most important nutrients for plants all around the world. It's found in a variety of molecules that are necessary for plant growth, including chlorophyll, nucleotides, alkaloids, enzymes, hormones, and vitamins. Brady (Brady, 2012).

Fertilizer nitrogen has contributed greatly towards improving food production, although even with optimum agronomic methods, the recovery of fertiliser nitrogen barely exceeds 30-60 per cent, because most of the applied nitrogen gets leached and becomes unavailable for plant use.

Therefore applying organic manures may solve this problem. Superiority of organic matter over chemical fertilizer is proven in crop production. Because of the depletion of soil fertility, interest is growing worldwide in using organic manures for crop production Delate and Camberdeth (2004) [2]. Additional, organic matter will improve the physical and chemical property of soil Bouajila and Sanaa (2011) [1].

This research was aimed to compare between organic and inorganic fertilizer in their efficiency to available NPK in to soil and their influence of chickpea yield.

The above technology would increase N use efficiency and thus economize fertilizer doses. The occurrence and activity of soil microbes have their bearing on soil fertility as they help in nutrient mineralization in soil and in turn maintaining soil health.

Materials and Methods

The field experiment was conducted at Research Farm, Department of Agronomy, G.H. Raisoni University, Chhindwara, Madhya Pradesh during *Rabi* season 2019. The soil of the experimental field was red in texture, low in available nitrogen (193.00kg ha^{-1}) medium in available phosphorus (19.89kg ha^{-1}) potassium (475.78kg ha^{-1}) and was alkaline in reaction (pH 7.54). Chickpea variety Vijay was sown @75 kg seed ha^{-1} at spacing of 30 cm between the lines, on 26rd November, 2020 and harvested on 14nd March, 2021. The optimum plant population was maintained by gap filling, the crop was irrigated as per the requirements. According to the treatment of fertilizers were applied at the time of sowing as basal dose. The experiment was laid out in randomized block design with seven treatments and three replications. The gross and net plot size were 5 x 3 m^2 and 3.8 x 1.8 m^2, respectively. The one treatment consisted of Control (without any ferilizer)., one treatment is 100 Nitrogen through and two treatment 100% application of Nitrogen through Vermicompost and poultry manure and three treatment are combination with 50% Nitrogen through RDF.

Treatment details

T_1 : Control
T_2 : 100% Recommended Dose Fertilizer (RDF)
T_3 : 100% N through Vermicompost
T_4 : 100% N through Poultry Manures
T_5 : 50% N through RDF + 50% N through Vermicompost
T_6 : 50% N through RDF + 50% N through Poultry Manures
T_7 : 50% N through Poultry Manures + 50% N through Vermicompost

Result and Discussion

Plant height (cm)

Data in respect of plant height recorded at an interval of 30 days from sowing as influenced by different treatments are presented in Table 1.

Table 1: Effect of organic and inorganic nutrients on plant height at different successive stages

Plant Height (cm)				
Treatment	30 DAS	60 DAS	90 DAS	At harvest
T_1 Control	19.85	37.33	40.00	40.25
T_2 100% Recommended Dose Fertilizer (RDF)	22.48	42.93	43.48	43.67
T_3 100% N through Vermicompost	21.17	39.14	45.99	46.04
T_4 100% N through Poultry Manure	21.46	40.85	47.79	47.84
T_5 50% N through RDF + 50% N through Vermicompost	21.85	41.48	44.25	44.25
T_6 50% N through RDF + 50% N through Poultry Manure	22.22	42.32	45.13	45.13
T_7 50% N through Poultry Manure + 50% N through Vermicompost	21.36	39.65	46.60	46.72
SE(m)	0.32	0.34	0.20	0.20
CD at 5%	0.99	1.06	0.61	0.64

At 90 DAS and at harvest highest plant observed under the application of 100% N through Poultry Manure (47.79 and 47.84 cm, respectively) followed by the application of 50% N through Poultry Manure + 50% N through Vermicompost (46.60 and 46.72 cm, respectively) which is at par with the application of 100% N through Vermicompost (45.99 and 46.04 cm, respectively) and lowest plant height was recorded under control (40.00 and 40.25 cm, respectively)

Increase in plant height might be due to the presence of macro and micro nutrients which help in enhancing photosynthesis, cell division and cell elongation which allow the plant grow faster. Similar results were obtained by

Dry weight plant^{-1}: The data on total dry matter accumulation of plant^{-1} as influenced by different treatments recorded periodically are presented in Table 2. Similar trend of dry matter accumulation plant^{-1} was found at 90 DAS and at harvest. Dry matter was significantly influenced mainly due to application of organic manure maximum dry matter accumulation plant^{-1} with the application of 100% N through Poultry Manure (26.16 and 26.10 g, respectively) followed by the application of 50% N through Poultry Manure + 50% N through Vermicompost (24.72 and 24.69 g, respectively) over the rest of treatments. Minimum dry matter accumulation plant^{-1} was recorded under the control (13.02 and 12.85 g, respectively)

Table 2: Effect of organic and inorganic nutrients on dry weight plant^{-1} at different successive stages

Dry Weight Plant^{-1}				
Treatment	30 DAS	60 DAS	90 DAS	At harvest
T_1 Control	1.05	6.66	13.02	12.85
T_2 100% Recommended Dose Fertilizer (RDF)	2.64	13.07	21.10	20.95
T_3 100% N through Vermicompost	1.44	10.13	23.48	23.44
T_4 100% N through Poultry Manure	1.67	11.09	26.16	26.10
T_5 50% N through RDF + 50% N through Vermicompost	1.67	11.88	21.87	21.78
T_6 50% N through RDF + 50% N through Poultry Manure	2.00	12.76	22.84	22.80
T_7 50% N through Poultry Manure + 50% N through Vermicompost	1.29	10.51	24.72	24.69
SE(m)	0.20	0.30	0.31	0.29
CD at 5%	0.62	0.95	0.91	0.89

Number of branches plant^{-1}

Data in respect of number of branches plant^{-1} recorded at an interval of 30 days from sowing as influenced by different treatments are presented in Table 3.

At 90 DAS and at harvest similar result was recorded, the highest number of branches plant^{-1} observed under the application of 100% N through Poultry Manure (9.3) followed by the application of 50% N through Poultry Manure + 50% N through Vermicompost (8.67) which is at par with the application of 100% N through Vermicompost and 50% N

through RDF + 50% N through Poultry Manure (8.00) and lowest number of branches plant^{-1} was recorded under control (6.3). The Similar findings were also observed by Singh *et al.* (2010) [5], Choudhary *et al.* (2011) [6], Ramawter *et al.* (2013) [3].

Table 3: Effect of organic and inorganic nutrients on branches plant^{-1} at different successive stages

Branches Plant^{-1}				
Treatment	30 DAS	60 DAS	90 DAS	At harvest
T_1 Control	1.33	4.33	6.33	6.33
T_2 100% Recommended Dose Fertilizer (RDF)	2.33	5.33	7.33	7.33
T_3 100% N through Vermicompost	1.67	5.67	8.00	8.00
T_4 100% N through Poultry Manure	1.67	5.67	9.33	9.33
T_5 50% N through RDF + 50% N through Vermicompost	1.67	6.33	7.67	7.67
T_6 50% N through RDF + 50% N through Poultry Manure	2.00	6.33	8.00	8.00
T_7 50% N through Poultry Manure + 50% N through Vermicompost	1.67	5.67	8.67	8.67
SE(m)	0.28	0.36	0.26	0.20
CD at 5%	0.88	1.11	0.80	0.64

Yield attributes

Data on yield attributes *viz*., mean number of pods plant^{-1}, seeds pod^{-1}, test weight and harvest index as influenced by various treatments are shown in the Table 4.

Number of pods plant^{-1}

Highest number of pods plant^{-1} was recorded under the application of 100% N through Poultry Manure (83.67) followed by 50% N through Poultry Manure + 50% N through Vermicompost (78.67) which is at par with 100% N through Vermicompost (76.33) and lowest number of pods plant^{-1} was recorded under control (52.00).

Seeds pod^{-1}

Highest number of seeds pods^{-1} was recorded under the application of 100% N through Poultry Manure (3) followed by 50% N through Poultry Manure + 50% N through Vermicompost (2.33) which is at par with 100% N through Vermicompost (2) and lowest number of seeds pods^{-1} was recorded under control (1.33).

Table 4: Effect of organic and inorganic nutrients on number of pods plant^{-1}, Seeds Pod^{-1}, Test Weight and Harvest Index

Yield Attributes				
Treatment	Pods Plant^{-1}	Seeds Pod^{-1}	Seed index	HI (%)
T_1 Control	52.00	1.33	15.67	37.74
T_2 100% Recommended Dose Fertilizer (RDF)	58.67	1.67	16.18	39.22
T_3 100% N through Vermicompost	76.33	2.00	17.44	39.68
T_4 100% N through Poultry Manure	83.67	3.00	18.54	40.49
T_5 50% N through RDF + 50% N through Vermicompost	71.33	2.00	16.62	39.53
T_6 50% N through RDF + 50% N through Poultry Manure	73.67	2.00	16.92	39.37
T_7 50% N through Poultry Manure + 50% N through Vermicompost	78.67	2.33	17.97	39.22
SE(m)	0.88	0.23	0.18	-
CD at 5%	2.74	0.72	0.55	-

Seed Index (g)

Highest test weight was recorded under the application of 100% N through Poultry Manure (18.54) followed by 50% N through Poultry Manure + 50% N through Vermicompost (17.97) which is at par with 100% N through Vermicompost (17.44) and lowest number of seeds pods^{-1} was recorded under control (15.67).

Harvest Index (%)

Highest harvest index was recorded under the application of 100% N through Poultry Manure (40.49) followed by 50100% N through Vermicompost (39.68) which is at par with 50% N through RDF + 50% N through Vermicompost (39.53) and lowest harvest index was recorded under control (37.74).

Yield studies

The data on biological yield (kg ha^{-1}), Seed yield (kg ha^{-1}) and straw yield (kg ha^{-1}), as influenced by various organic and inorganic nutrient treatments are presented in Table 5.

Biological Yield (kg ha^{-1})

The study of data indicated that the biological yield per hectare was significantly influenced due to different nutrient management treatments. Highest biological yield was recorded under the application of 50% N through Poultry Manure + 50% N through Vermicompost and 100% N through Poultry Manure (4545 & 4545 kg ha^{-1}, Respectively) followed by with the application of 100% N through Vermicompost (4282 kg ha^{-1}) and lowest stover yield was recorded under control (2689 kg ha^{-1}).

Seed Yield (kg ha^{-1})

Yield is a complex phenomenon and one of the major constraints for harnessing the yield potential of chickpea due to the slow growth rate at early stage due to imbalance nutrient availability the cumulative effect is finally reflected in terms of reduced seed yield.

The data pertaining to seed yield are presented in Table 4. The study of data indicated that the seed yield per hectare was significantly influenced due to different nutrient management treatments. Highest seed yield was recorded under the application of 100% N through Poultry Manure (1840 kg ha^{-1}) followed by 50% N through Poultry Manure + 50% N through Vermicompost (1782 kg ha^{-1}) followed by 100% N through Vermicompost (1699 kg ha^{-1}) and lowest seed yield was recorded under control (1015 kg ha^{-1}).

Stover Yield (kg ha^{-1})

The study of data indicated that the stover yield per hectare

was significantly influenced due to different nutrient management treatments. Highest stover yield was recorded under the application of 50% N through Poultry Manure + 50% N through Vermicompost (2763 kg ha^{-1}) which is at par with the application of 100% N through Poultry Manure (2705 kg ha^{-1}) followed by 100% N through Vermicompost (2583 kg ha^{-1}) and lowest stover yield was recorded under control (1297 kg ha^{-1}). These finding corroborates with the results of several other workers Ghanshyam *et al.* (2010) and Singh *et al.* (2008) [4].

Table 5: Effect of organic and inorganic nutrients on Biological yield Kg ha^{-1}, Seeds yield Kg ha^{-1}, and Stover yield Kg ha^{-1}

Yield			
Treatment	**Biological yield Kg ha^{-1}**	**Seeds yield Kg ha^{-1}**	**Stover yield Kg ha^{-1}**
T_1 Control	2689	1015	1297
T_2 100% Recommended Dose Fertilizer (RDF)	3680	1443	2237
T_3 100% N through Vermicompost	4282	1699	2583
T_4 100% N through Poultry Manure	4545	1840	2705
T_5 50% N through RDF + 50% N through Vermicompost	4046	1599	2447
T_6 50% N through RDF + 50% N through Poultry Manure	4199	1653	2546
T_7 50% N through Poultry Manure + 50% N through Vermicompost	4545	1782	2763
SE(m)	44.26	17.34	26.92
CD at 5%	137.89	54.02	83.88

Economic studies

Data in respect to gross monetary returns, net monetary returns and B:C ratio after harvest of the crop as influenced by various treatments are presented in Table 5.

Gross monetary returns (Rs. ha^{-1})

Data in Table 5 revealed that gross monetary returns Rs. ha^{-1} were significantly influenced due to various treatments. The maximum gross monetary returns of 106610 Rs. ha^{-1} was recorded with 100% N through Poultry Manure (T_4) followed by 50% N through Poultry Manure + 50% N through Vermicompost (T_7) 103554 Rs. ha^{-1}. The lowest gross monetary returns of 72029 Rs.ha^{-1} was observed in control (T_1). Similar results were obtained by Kumar (2013), Mallesha (2013), Ali (2014), Murali *et al.*(2014), Gowda *et al.*(2015) and Navaz *et al*. (2017).

Net monetary returns (Rs. ha^{-1})

Data given in Table stated that the NMR recorded from the application of significantly maximum net monetary returns of 80125 Rs. ha^{-1} was recorded with 100% N through Poultry Manure ha^{-1} (T_4) followed by 50% N through Poultry Manure + 50% N through Vermicompost (T_7) 76678 Rs. ha^{-1}. The lowest net monetary returns were recorded in control 48983 Rs. ha^{-1} (T_1).

Benefit: cost ratio

The data presented in Table 5 showed that, benefit: cost ratio was maximum with 100% N through Poultry Manure (T_4) *i.e.* 3.03 followed by followed by 50% N through Poultry Manure + 50% N through Vermicompost (T_7) 2.85.The lowest benefit to cost ratio was recorded with control (T_5) 2.13.

Table 6: Effect of organic and inorganic nutrients on economics of the treatments

Treatment	**Cost of cultivation (Rs. ha^{-1})**	**GMR (Rs. ha^{-1})**	**NMR (Rs. ha^{-1})**	**B:C**
T_1 Control	23046	72029	48983	2.13
T_2 100% Recommended Dose Fertilizer (RDF)	25406	83838	58432	2.30
T_3 100% N through Vermicompost	29785	98629	68844	2.31
T_4 100% N through Poultry Manure	26485	106610	80125	3.03
T_5 50% N through RDF + 50% N through Vermicompost	24785	92857	68072	2.75
T_6 50% N through RDF + 50% N through Poultry Manure	24986	96026	71040	2.84
T_7 50% N through Poultry Manure + 50% N through Vermicompost	26876	103554	76678	2.85

Conclusion

On the basis of the results obtained in this study, it is concluded that the application of 100% N through Poultry Manure treatment gave maximum plant height, highest number of branches per plant, dry weight per plant, maximum dry weight of pod, maximum number of grain per pod, maximum number of pod per plant, maximum seed yield and maximum harvest index, net monetary returns and B:C ratio.

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