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Effect of organic source of nutrient and methods of application of iron on growth and yield of summer greengram

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Abstract
The experiment was conducted in Crop Research Farm in the Department of Agronomy, SHUATS, Prayagraj (U.P.) during summer season of 2022 on greengram crop. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 6.8) with low level of organic carbon (0.332%), available N (225 Kg/ha), P (14.60 kg/ha) and higher level of K (213.50 kg/ha). The treatments consisted of three different organic source of nutrient (Farm yard manure 8t/ha, Poultry manure 2.5 t/ha, Vermicompost 2.5 t/ha) and methods of application of iron (Soil application 20 kg/ha $FeSO_4$, Foliar application 0.5% $FeSO_4$ at 20 DAS, Soil Application 10 kg/ha $FeSO_4$ and Foliar application 0.25%$FeSO_4$ at 20 DAS) and a control. The experiment was laid out in randomized block design with ten treatments and replicated thrice. Results revealed that, Application of Poultry Manure (2.5 t/ha) along with Soil Application (10 kg/ha $FeSO_4$) followed by (0.25% $FeSO_4$) (Foliar Application at 20 DAS)) recorded highest plant height (42.03 cm),number of nodules (12.50), dry matter accumulation (40.41 g/m^2/day number of pods per plant (25.44), seeds per pod (12.50) and test weight (40.41 g) which attributed to higher seed yield (2030 kg/ha) and stover yield (4420 kg/ha).Result also shows, highest gross returns (160741.50 INR/ha), net returns (120346.5 INR/ha) and benefit cost ratio (2.97).

Keywords: Iron, foliar, manure, yield

Introduction
Greengram is an oldest and well known principle pulse crop of Asia (Kokani *et al*., 2014) [7], the crop is originated from India and secondary origin was Central Asia (Vavilov 1951) [17]. Greengram is excellent source of high quality protein, essential amino acids, fatty acid, fiber, minerals and vitamins (Sharma *et al*., 2013) [19].

The repeated use of inorganic fertilizer alone fails to sustain desired yield, impairs soil physical conditions and reduces organic matter contents (Mohammad, 2010) [9] leads to environmental pollution especially due to their continuous use (Bhakiyathu, 2005) [4]. Of late there is a growing interest among the farmers to cultivate crops under organic farming because of the escalating cost of inorganic fertilizers, decreased soil fertility, environmental and health concerns due to pesticide usage and expected premium prices for organically grown crops (Ramesh *et al*. 2005) [12]. Albiach *et al*. (2000) [2] noted that organic fertilizers are not only the source of organic matter and nutrient, but also boost microbial population and improve physical, biological and chemical properties of the soil.

Farmyard manure, Poultry manure, Vermicompost have high levels of nitrogen, phosphorous and potassium and micro Nutrients, Microbial and Enzyme activities and Growth Regulators and continuous and adequate use with proper management can increase soil organic Carbon, soil water retention and transmission and improvement in other physical properties of soil like Bulk Density, resistance and aggregation as well as beneficial effect on growth of variety of plants (Singh *et al*., 2017) [14]. Further, the application of poultry manure, vermicompost, goat manure and FYM for nitrogen might have increased the microbial population leading to mineralization of organically bound N into plant available from. (SR Diwale, 2020) [15].

Iron (Fe) is one of the essential micronutrient that enhances plant growth and reproduction (Welch. 1995) [18]. Also, it is involved in chlorophyll and thylakoid synthesis and chloroplast development. Although, total iron content of soils is much higher than requirement of plant but its bioavailability is limited (Guerinot and Yi, 1994) [5].

Increased availability of iron also helps in absorption of nutrients, which are expected to have efficient photosynthetic mechanism and better equipped for efficient translocation of

photosynthates from source to sink, consequently resulting into higher harvest index (Bera *et al.* 2015) [3]. Bera *et al.* (2015) [3], also reported that foliar sprays of Fe significantly reduced iron deficiency chlorosis.

Materials and Methods

The materials and methods adopted in the research trial entitled, "Effect of organic source of nutrient and methods of application of iron on growth and yield of summer greengram". The experiment was conducted during summer season of 2022. The soil of the experimental field was sandy loam in texture, slightly alkaline reaction (pH 6.8) with low level of organic carbon (0.332%), available N (225 Kg/ha), P (14.60 kg/ha) and higher level of K (213.50 kg/ha). The experiment was conducted in randomized block design (RBD). Each treatment was replicated thrice. Treatments were randomly arranged in each replication and are divided into 9 plots. The particulars of the treatments and treatment combinations are: T_1 FYM (8t/ha) + 20 kg/ha $FeSO_4$, T_2 Poultry Manure (2.5 t/ha) + 20 kg/ha $FeSO_4$, T_3 Vermicompost (2.5 t/ha) + 20 kg/ha $FeSO_4$, T_5 FYM (8 t/ha) +0.5% $FeSO_4$, T_6 Poultry Manure (2.5 t/ha) +0.5% $FeSO_4$, T_7 Vermicompost (2.5 t/ha) +0.5% $FeSO_4$, T_8 FYM(8t/ha) + 10 kg/ha $FeSO_4$ + 0.25% $FeSO_4$, T_8 Poultry Manure (2.5 t/ha) + 10 kg/ha $FeSO_4$+ 0.25% $FeSO_4$, T_9 Vermicompost (2.5 t/ha) + 10 kg/ha $FeSO_4$ + 0.25% $FeSO_4$, Control (20-40-20 kg/ha). The observations were recorded on different growth parameters at harvest viz. plant height(cm), plant dry weight, Number of nodules per plant, number of pods per plant, number of seeds per pod, test weight, grain yield, stover yield and harvest index.

Results and Discussion

Effect of organic source of nutrient and methods of application of iron on plant height of summer greengram:

At 45 DAS, the highest plant height was recorded by treatment 8 (Poultry manure (2.5 t/ha) (Basal)+ Soil Application (10 kg/ha) + 0.25% $FeSO_4$ (Foliar Application)). Whereas, Treatment 2 (Poultry manure (2.5 t/ha) (Basal)+$FeSO_4$ (20 kg/ha) (Basal)), Treatment 3 (Vermicompost (2.5 t/ha) (Basal)+ $FeSO_4$ (20 kg/ha) (Basal)), Treatment 4 (FYM (8t/ha) (Basal)+0.5% $FeSO_4$ (Foliar Application)),Treatment 5 (Poultry manure (2.5 t/ha) (Basal)+ 0.5% $FeSO_4$ (Foliar Application)), Treatment 6 (Vermicompost (2.5 t/ha) (basal)+ 0.5% $FeSO_4$ (Foliar Application)) and Treatment 9 (Vermicompost (2.5 t/ha) (basal)+ Soil Application(10 kg/ha) +0.25% $FeSO_4$ (Foliar Application)) are found to be statistically at par with Treatment 8. The application of Poultry manure might have favoured better root proliferation, more solubility of phosphorous which consequently favoured higher biological nitrogen fixation and uptake of nutrients and availability of all plant nutrients during the crop growth period. This resulted in the higher plant height. (Pathan *et al.* 2022) [10].

Effect of organic source of nutrient and methods of application of iron on number of nodules of summer greengram

At 45 DAS, the result was found significant, and treatment 8 (Poultry manure (2.5 t/ha) (Basal) + Soil Application (10 kg/ha) + 0.25% $FeSO_4$ (Foliar Application)) was recorded to have the highest number of nodules. While Treatment 9 (Vermicompost (2.5 t/ha) (basal)+ Soil Application (10 kg/ha) +0.25% $FeSO_4$ (Foliar Application)) was found to be statistically at par with treatment 8.The increase in number of nodules per plant might be due to direct addition and slow release of nutrients from poultry manure. The more content of phosphorous and its solubility in soil helped in better root proliferation and formation of nodules Pathan *et al*. 2022 [10]. Increase in nodule count might be due to increased infection and rhizobial colonization in rhizosphere because of increased availability of micronutrient Meena *et al.* 2012 [8].

Effect of organic source of nutrient and methods of application of iron on plant dry weight of summer greengram

At 45 DAS, plant dry weight was found significant. However, Treatment 8 (Poultry manure (2.5 t/ha) (Basal)+ Soil Application (10 kg/ha) + 0.25% $FeSO_4$ (Foliar Application)) was found to be the highest. while Treatment 9 (Vermicompost (2.5 t/ha) (basal)+ Soil Application(10 kg/ha) +0.25% $FeSO_4$ (Foliar Application)) had recorded (7.05 g) which was found statistically at par with Treatment 8 (Poultry manure (2.5 t/ha) (Basal)+ Soil Application (10 kg/ha) + 0.25% $FeSO_4$ (Foliar Application)). This may be due to soil and foliar application of $FeSO_4$ along with poultry manure which ultimately increased nutrient concentration in root zone, increased nutrient availability and uptake, increased transplantation of photosynthates from source to sink, hence higher dry matter production. Due to increased metabolic activity by increased supply of nutrients, more accumulation of dry matter in leaves helped the photosynthetic area to remain active for longer period and was responsible for overall growth of plant in terms of dry matter production. Saakshi *et al*. 2020 [13].

Effect of organic source of nutrient and methods of application of iron on crop growth rate of summer greengram

The Crop growth rate at 45-60 DAS was found non-significant. However, the maximum crop growth rate was recorded in Treatment 9(Vermicompost (2.5 t/ha) (basal) + Soil Application (10 kg/ha) + 0.25% $FeSO_4$ (Foliar Application)). It might be due to basal application of poultry manure supplied all essential nutrients, growth hormones and enzymes to plant, which favours rapid cell division and ultimately results into better growth of plant Akash *et al*. 2022 [1]. It might be due to application of iron increased dry weight of root nodules, dry matter accumulation at all stages of greengram growth Yadav *et al*. 2001 [16].

The relative growth rate was recorded as non-significant at all the growth stages.

Effect of organic source of nutrient and methods of application of iron on yield attributes of summer greengram

Yield parameters of the crop experimented was significantly affected by the combined application of organic source of nutrient and method of application of iron. Treatment 8 (Poultry manure (2.5 t/ha) (Basal) + Soil Application (10 kg/ha) + 0.25% $FeSO_4$ (Foliar Application)) was found to consistently record significanty higher number of pods per plant, number of seed per pod and test weight. The micronutrients might have enhancing role in seed setting that resulted in improvement in no. of seeds per pod. Greater mobilization of photosynthesis to the developing seeds by

application of micronutrients might be the reason for increase in seed weight Pochampally *et al*. 2020**.**

Effect of organic source of nutrient and methods of application of iron on yield of summer greengram

The highest grain yield was recorded (2030 kg/ha) in Treatment 8 (Poultry manure (2.5 t/ha) (Basal) + Soil Application (10 kg/ha) + 0.25% $FeSO_4$ (Foliar Application). While Treatment 5 (Poultry manure (2.5 t/ha) (Basal)+ 0.5% $FeSO_4$ (Foliar Application)), Treatment 6 (Vermicompost (2.5 t/ha) (basal)+ 0.5% $FeSO_4$ (Foliar Application)) and Treatment 9 (Vermicompost (2.5 t/ha) (basal)+ Soil Application(10 kg/ha) +0.25% $FeSO_4$ (Foliar Application)) was found to be significantly at par with Treatment 8 (Poultry manure (2.5 t/ha) (Basal)+ Soil Application(10 kg/ha) + 0.25% $FeSO_4$ (Foliar Application)). The minimum seed yield was recorded (1073 kg/ha) by control.

The highest stover yield was recorded (4420 kg/ha) in Treatment 8 (Poultry manure (2.5 t/ha) (Basal) + Soil Application (10 kg/ha) + 0.25% $FeSO_4$ (Foliar Application).While Treatment 5 (Poultry manure (2.5 t/ha) (Basal)+ 0.5% $FeSO_4$ (Foliar Application), Treatment 7 (FYM (8t/ha) (Basal)+Soil Application (10 kg/ha) +0.25% $FeSO_4$ (Foliar Application)) and Treatment 9 (Vermicompost (2.5 t/ha) (basal)+ Soil Application(10 kg/ha) +0.25% $FeSO_4$ (Foliar Application) was found to be significantly at par with Treatment 8 (Poultry manure (2.5 t/ha) (Basal)+ Soil Application (10 kg/ha) + 0.25% $FeSO_4$ (Foliar Application). The minimum stover yield was recorded (2416.67 kg/ha) by control.

According to the data showed, the harvest index was recorded as non-significant.

The beneficial response of poultry manure to yield attributes might also be attributed to the availability of sufficient amounts of easily utilizable from of plant nutrients throughout the growth period and especially at critical growth periods of crop resulting in better uptake, plant vigour and superior yield attributes Pathan *et al.* 2022 [10]. Higher nutrient availability have resulted in higher production of photosynthates and better translocation within plants resulting in better development of sink source ratio of photosynthates. Significantly higher stover yields recorded could be attributed to better plant growth viz., higher plant height and dry matter accumulation as recorded under these treatments Rambuatsaiha *et al.* 2017 [11].

Table 1: Response of organic source of nutrient and methods of application of iron on growth parameters of summer greengram.

S. No.	Treatments combinations			At 45DAS		
		Plant Height (cm)	Number of nodules (No.)	Plant dry weight (g/plant)	Crop growth rate (g/m^2/day)	Relative growth rate (g/g/day)
1.	FYM (8 t/ha) + 20 kg/ha $FeSO_4$	27.30	29.67	5.70	4.49	0.04
2.	Poultry manure (2.5 t/ha) + 20 kg/ha $FeSO_4$	33.63	35.67	6.46	4.74	0.04
3.	Vermicompost (2.5 t/ha) + 20 kg/ha $FeSO_4$	30.97	35.00	6.33	4.44	0.04
4.	FYM (8 t/ha) + 0.5% $FeSO_4$	32.83	31.00	6.03	4.63	0.04
5.	Poultry manure (2.5 t/ha) + 0.5% $FeSO_4$	35.13	37.88	6.72	5.08	0.04
6.	Vermicompost (2.5 t/ha) + 0.5% $FeSO_4$	30.53	37.03	6.31	4.87	0.04
7.	FYM (8 t/ha) + 10 kg/ha $FeSO_4$ + 0.25% $FeSO_4$	28.77	34.11	6.46	4.67	0.04
8.	Poultry manure (2.5 t/ha) + 10 kg/ha $FeSO_4$ + 0.25% $FeSO_4$	35.96	43.55	7.93	4.89	0.03
9.	Vermicompost (2.5 t/ha) + 10 kg/ha $FeSO_4$ + 0.25% $FeSO_4$	34.01	40.22	7.05	5.60	0.04
10.	Control NPK 20-40-20 kg/ha	29.20	26.78	5.39	4.61	0.04
	F-Test	S	S	S	NS	NS
	SEm (±)	1.85	1.38	0.34	0.53	0.01
	CD(p=0.05)	5.50	4.11	1.01	-	-

Table 2: Response of organic source of nutrient and methods of application of iron on yield parameters and yield of summer greengram.

S. No.	Treatments combinations	Yield parameters and yield					
		No. of pods/plant (No.)	No. of seeds/pod (No.)	Test Weight (g)	Seed Yield (kg/ha)	Stover Yield (kg/ha)	Harvest Index (%)
1.	FYM (8 t/ha) + 20 kg/ha $FeSO_4$	19.94	10.50	33.47	1166.67	2716.67	30.11
2.	Poultry manure (2.5 t/ha) + 20 kg/ha $FeSO_4$	21.52	10.94	35.64	1316.67	3066.00	30.04
3.	Vermicompost (2.5 t/ha) + 20 kg/ha $FeSO_4$	21.07	10.82	34.28	1450.00	3050.00	32.87
4.	FYM (8 t/ha) + 0.5% $FeSO_4$	20.69	10.75	35.34	1233.33	3123.33	27.18
5.	Poultry manure (2.5 t/ha) + 0.5% $FeSO_4$	23.68	11.63	37.53	1665.00	3573.33	32.36
6.	Vermicompost (2.5 t/ha) + 0.5% $FeSO_4$	22.27	11.29	36.37	1586.67	3216.67	32.92
7.	FYM (8 t/ha) + 10 kg/ha $FeSO_4$ + 0.25% $FeSO_4$	22.55	10.97	35.71	1483.33	3780.00	30.77
8.	Poultry manure (2.5 t/ha) + 10 kg/ha $FeSO_4$ + 0.25% $FeSO_4$	25.44	12.50	40.41	2030.00	4420.00	31.47
9.	Vermicompost (2.5 t/ha) + 10 kg/ha $FeSO_4$ + 0.25% $FeSO_4$	24.91	11.39	36.59	1693.33	3840.00	31.71
10.	Control NPK 20-40-20 kg/ha	18.22	10.12	32.88	1073.00	2416.67	30.44
	F-Test	S	S	S	S	S	NS
	SEm (±)	0.68	0.36	1.03	242.17	518.33	2.89
	CD(p=0.05)	2.01	1.07	3.07	508.78	1088.97	-

Conclusion

Application of poultry manure at 2.5 t/ha along with 10 kg/ha $FeSO_4$ followed by foliar spray of 0.25% $FeSO_4$ at 20 DAS (Treatment 8) in summer greengram recorded higher grain

yield and benefit cost ratio.
The conclusions drawn are based on one season data only which requires further confirmation for recommendation.

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