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Evaluation of different nutrient management practices on growth and yield of red gram (*Cajanus cajan* L.) under irrigated conditions of Punjab

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Abstract

A field experiment on “Evaluation of different nutrient management practices on growth and yield of red gram (*Cajanus cajan* L.) under irrigated conditions of Punjab” was conducted at Campus for Research and Advanced Studies, during *Kharif* 2021-22. The experiment was conducted in factorial randomized design with 16 treatment combination and three replications. It consists four solid fertilizers in main plot and four different liquid fertilizers in sub plot. The results revealed that both growth and yield (16.44 q ha⁻¹ and 15.18 q ha⁻¹) were significantly higher with the application of solid fertilizer 10 t FYM ha⁻¹ + 5 kg S ha⁻¹ + 2 t VC ha⁻¹ + *Rhizobium* 5 kg ha⁻¹ and liquid fertilizer 2% urea solution + 2% DAP solution + 5% punchgavya solution.

Keywords: Nutrient management, growth, yield, red gram, *Cajanus cajan* L.

Introduction

Red gram (*Cajanus cajan* L.) is a major pulse crop grown in tropical and sub tropical areas throughout the country. It is also known as ‘Tur’, ‘Arhar’, ‘Red gram’ in India. From the total production of the world, 91% of the total is produced in India. Its seed contains 25% protein, 1.7% fat, 3.5% minerals, 1.5% fibre content and 57.6% carbohydrate content (Singh *et al.* 2015)^[1]. Being a leguminous crop, it utilizes atmospheric nitrogen through symbiotic nitrogen fixation with the help of nodule bacteria to meet the nitrogen requirement for crop. Adequate supply of nutrients is the key for improving the food grain production in pulses as well as sustaining the soil health. Organic solid fertilizers such as FYM and vermicompost is slow releasing fertilizer which helps in improving the fertility level of soil by increasing microbial population. It also helps in growth of new shoots and leaves. Poultry manure is enriching in several plant nutrients like nitrogen phosphorus and potassium However, foliar application of organic forms such as punchgavyea (mixture of cow dung, ghee, urine, jagry, and curd) is quite effective in boost immunity, promoting plant growth and induces quality among the seed. Application of inorganic fertilizer in combination of organic manure is basic need to enhance productivity. Some of the solid inorganic fertilizers application such as urea, DAP, SSP plays effective role in growth as well as in yield of red gram. Nitrogen helps in vegetative growth, chlorophyll formation and synthesis of proteins. Phosphorus helps in energy transfer, root growth, and formation of grain and maturity and Potassium is important for ensuring optimal growth and activator of dozens of important enzymes. Response to K application varies with the location. Inorganic liquid fertilizer solution of urea, DAP, that applied directly to the foliage of plant. They help to the direct availability of required nutrients through entry from leaf cuticle and then in cells that plant shows immediate effect of fertilizer application.

Materials and Methods

The present of investigation was carried out during *Kharif* season of the year 2021 at the Campus for Research and Advanced studies, Dhablan G.S.S.D.G.S. Khalsa College, Patiala. The experiment was conducted in Factorial Randomised block design that is replicated three times with different nutrient management practices.

The treatment considered four solid fertilizers (SF₁-100% RDF ha⁻¹, SF₂- 10 t FYM ha⁻¹ + 3t poultry manure ha⁻¹, SF₃- 8 t FYM ha⁻¹ + 5 kg S ha⁻¹ + 2 t vermicompost ha⁻¹, SF₄- 10 t FYM ha⁻¹ + 5 kg S ha⁻¹ + 2 t vermicompost ha⁻¹ + *Rhizobium* 5 kg ha⁻¹) and four liquid fertilizers (LF₁-2% urea solution +1% DAP solution, LF₂-3% urea solution + 2% DAP solution, LF₃-2% urea solution +1% DAP solution +2% punchagavya solution, LF₄ - 2% urea solution + 2% DAP solution + 5% punchagavya solution). From five randomly selected plants the plant height was recorded from ground level to the tip of the main stem. The number of leaves of five randomly plants were counted and average was computed. The plants taken for fresh weight was put for drying for a week and after a week dried weight was taken and computed. Grain yield per plot was recorded after threshing and winnowing the seeds from each net plot area. The seed yield ha⁻¹ was worked out and expressed in q ha⁻¹. The total biological portion from yield of above ground portion from net plot at harvest was recorded after complete sun drying. After harvesting the crop the biological yield and grain yield was recorded then deduct the grain yield from biological yield and got straw yield

Results and Discussion

Among solid fertilizers highest plant height (cm), no. of leaves plant⁻¹ and dry weight plant⁻¹ was found at 30 DAS which was attained with the application of 100% RDF because it readily provides the desired amount of plant nutrients and increase meristematic activity and all other growing activities of plant that raise the height of plant, no. of leaves plant⁻¹ and dry weight plant⁻¹. However, these parameters are maximum at 60, 90 DAS and at harvest with application of 10 t FYM ha⁻¹ + 5 kg S ha⁻¹ + 2 t VC ha⁻¹ + *Rhizobium* 5 kg ha⁻¹ FYM and VC are enrich in several macro and micro nutrients and also act as slow releasing

source of nutrients and have constricted losses that provide nutrients for whole crop period, as sulphur helps in photosynthesis that initiate growth in Application of *Rhizobium* biofertilizer with FYM and VC initiate root growth and more uptakes of nitrogen and other essential nutrients Similar results were taken by Poonia *et al.* (2014)^[2] and Yadav *et al.* (2021)^[3].

The liquid fertilizers have significantly effect on growth parameters. Highest plant height (cm), no. of leaves plant⁻¹ and dry weight plant⁻¹ was attained with application of 2% urea solution + 2% DAP solution + 5% punchagavya. This might be due to that application of urea, DAP and punchagavya as liquid form increase the efficiency and speed of absorption and of plant nutrient that promotes metabolic activities of plant and contributes for growth and development of plant Similar results were taken by Mishra *et al.* 2015^[4].

The highest grain yield (q ha⁻¹), straw yield (q ha⁻¹) and biological yield (q ha⁻¹) among the solid fertilizers was obtained with the application of 10 t FYM ha⁻¹ + 5 kg S ha⁻¹ + 2 t VC ha⁻¹ + *Rhizobium* 5 kg ha⁻¹. The gradual release and steady supply of nutrients throughout the whole growth period of crop which maintained the later on the translocation of photosynthetes to various sink that results to higher grain yield, straw yield and biological yield of plant. Similar results were recorded by Wadile *et al.* 2020^[5].

Among liquid fertilizers maximum grain yield (q ha⁻¹), straw yield (q ha⁻¹) and biological yield (q ha⁻¹) attained with the application of 2% urea solution + 2% DAP solution + 5% punchagavya solution This might be due to the reason that easily absorption and translocation of liquid fertilizer increases the overall growth of plant that helps to increase the grain yield, straw yield of plant. Similar results were found by Priyanka *et al.* 2019^[6].

Table 1: Effect of different nutrient management practices on plant height (cm) of red gram

Treatments	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	At harvest
Solid fertilizers				
SF ₁ -100% RDF ha ⁻¹	46.58	112.67	179.33	217.33
SF ₂ - 10 t FYM ha ⁻¹ + 3t Poultry manure ha ⁻¹	39.08	94.25	163.50	207.25
SF ₃ -8 t FYM ha ⁻¹ + 5 kg S ha ⁻¹ + 2 t VC ha ⁻¹	41.92	102.83	170.58	211.58
SF ₄ -10 t FYM ha ⁻¹ + 5 kg S ha ⁻¹ + 2t VC ha ⁻¹ + <i>Rhizobium</i> 5 kg ha ⁻¹	44.25	118.08	184.75	221.42
SEm ±	1.03	1.91	1.53	1.37
CD 5%	2.88	5.31	4.26	3.81
Liquid fertilizers				
LF ₁ -2% Urea solution +1% DAP solution	39.92	92.08	167.83	206.50
LF ₂ -3% Urea solution + 2% DAP solution	42.50	97.92	171.75	210.08
LF ₃ -2% Urea solution +1% DAP solution +2% Punchagavya solution	44.33	106.17	176.50	215.92
LF ₄ - 2% Urea solution + 2% DAP solution + 5% Punchagavya solution	45.08	113.67	182.08	218.08
Sem ±	1.14	3.19	2.60	2.14
CD 5%	2.55	7.66	5.65	4.41

Table 2: Effect of different nutrient management practices on number of leaves plant⁻¹ of red gram

Treatments	Number of leaves plant ⁻¹			
	30 DAS	60 DAS	90 DAS	At harvest
Solid fertilizers				
SF ₁ -100% RDF ha ⁻¹	32.58	224.58	574.67	589.17
SF ₂ - 10 t FYM ha ⁻¹ + 3t Poultry manure ha ⁻¹	22.00	209.25	556.00	565.92
SF ₃ -8 t FYM ha ⁻¹ + 5 kg S ha ⁻¹ + 2 t VC ha ⁻¹	24.33	215.00	565.08	578.00
SF ₄ -10 t FYM ha ⁻¹ + 5 kg S ha ⁻¹ + 2t VC ha ⁻¹ + <i>Rhizobium</i> 5 kg ha ⁻¹	28.17	231.42	581.50	594.25
SEm±	1.94	3.37	2.74	2.40
CD 5%	5.41	8.36	7.62	6.51
Liquid fertilizers				
LF ₁ -2% Urea solution +1% DAP solution	23.75	203.33	560.67	567.92
LF ₂ -3% Urea solution + 2% DAP solution	24.25	215.08	565.00	579.92
LF ₃ -2% Urea solution +1% DAP solution +2% Punchagavya solution	28.58	221.42	573.83	588.17
LF ₄ - 2% Urea solution + 2% DAP solution + 5% Punchagavya solution	31.50	227.42	577.75	592.33
SEm±	1.95	3.76	3.48	3.05
CD 5%	4.02	7.77	7.19	6.58

Table 4: Effect of different nutrient management practices on dry weight plant⁻¹(g) of red gram

Treatments	Dry weight plant ⁻¹ (g)			
	30 DAS	60 DAS	90 DAS	At harvest
Solid fertilizers				
SF ₁ -100% RDF ha ⁻¹	4.68	22.12	78.17	83.54
SF ₂ - 10 t FYM ha ⁻¹ + 3t Poultry manure ha ⁻¹	2.03	16.40	58.25	69.42
SF ₃ -8 t FYM ha ⁻¹ + 5 kg S ha ⁻¹ + 2 t VC ha ⁻¹	2.63	18.96	65.42	77.17
SF ₄ -10 t FYM ha ⁻¹ + 5 kg S ha ⁻¹ + 2t VC ha ⁻¹ + <i>Rhizobium</i> 5 kg ha ⁻¹	4.08	23.72	85.83	93.07
SEm±	0.23	1.98	1.38	1.47
CD 5%	0.65	4.02	3.83	5.80
Liquid fertilizers				
LF ₁ -2% Urea solution +1% DAP solution	2.64	17.97	63.08	72.83
LF ₂ -3% Urea solution + 2% DAP solution	2.82	19.23	69.17	77.67
LF ₃ -2% Urea solution +1% DAP solution +2% Punchagavya solution	3.78	21.73	75.33	82.19
LF ₄ - 2% Urea solution + 2% DAP solution + 5% Punchagavya solution	4.18	22.30	80.08	89.50
SEm±	0.51	1.28	2.15	3.34
CD 5%	1.03	2.91	4.65	7.55

Table 5: Effect of different nutrient management practices on grain yield, straw yield, biological yield and harvest index of red gram

Treatment	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Biological yield (q ha ⁻¹)
Solid Fertilizers			
SF ₁ -100% RDF ha ⁻¹	14.09	53.73	67.82
SF ₂ - 10 t FYM ha ⁻¹ + 3t Poultry manure ha ⁻¹	9.99	46.10	56.08
SF ₃ -8 t FYM ha ⁻¹ + 5 kg S ha ⁻¹ + 2 t VC ha ⁻¹	11.66	48.14	59.80
SF ₄ -10 t FYM ha ⁻¹ + 5 kg S ha ⁻¹ + 2t VC ha ⁻¹ + <i>Rhizobium</i> 5 kg ha ⁻¹	16.44	56.03	72.47
SEm±	0.55	0.93	0.92
CD 5%	1.54	2.59	2.58
Liquid Fertilizers			
LF ₁ -2% Urea solution +1% DAP solution	11.05	47.63	58.68
LF ₂ -3% Urea solution + 2% DAP solution	12.05	49.19	61.22
LF ₃ -2% Urea solution +1% DAP solution +2% Punchagavya solution	13.90	52.89	66.80
LF ₄ - 2% Urea solution + 2% DAP solution + 5% Punchagavya solution	15.18	54.29	69.47
SEm±	0.67	69.83	1.12
CD 5%	1.38	203.82	2.33

Conclusion

On the basis of results from the experimentation, it can be concluded that among the solid fertilizers 10 t FYM ha⁻¹ + 5 kg S ha⁻¹ + 2t vermicompost ha⁻¹ + *Rhizobium* 5 kg ha⁻¹ application results higher growth and yield where in liquid fertilizers application of 2% Urea solution + 2% DAP solution + 5% Punchagavya solution results higher growth and yield. Moreover, the according to B.C ratio 100% RDF in solid fertilizers and of 2% Urea solution + 2% DAP solution + 5% Punchagavya in liquid produced maximum results.

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