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Effect of Organic Manure and Inorganic Fertilizer on Growth, Yield And Quality of Green Gram (*Vignaradiata L.*)

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Abstract

The study was carried out with the objectives to determine the impact of organic and inorganic fertilizer on growth, yield attributes and quality of green gram, to assess the influence of organic and inorganic fertilizer on soil fertility and to work out the economics and profitability of organic and inorganic fertilizer management practices in green gram.

Replacement of 50% inorganic fertilizer by organic sources increased 0.96-40.6% dry matter than RDF, whereas, 75% inorganic fertilizer replacement harvest 1.65-14.5% lower dry matter. Integration of organic and chemical sources showed 53.9-382.9% and solely organic sources recorded 20.5-146.5% higher crop growth rate as compared to control treatment. Organic sources coupled with 50% inorganic fertilizer showed 0.15-7.75% increment in nodule number compared to RDF treatment. Plots treated with VC 1t ha^{-1} + 50% RDN recorded highest number of pods per plant (25.15), highest pod length (9.80 cm), most seeds per pod (13.05) and greater seed yield (935.0 kg ha^{-1}). VC 1t ha^{-1} + 50% RDN treatment produced 48.2-54.5% and 8.53% higher yield compared to 100% organic and RDF treatment. Higher nutrient and protein content (221.5-262.0 mg g^{-1}) also recorded in integrated treatments. Maximum gross return (₹68021.00) and was recorded in VC 1t ha^{-1} + 50% RDN treatment, whereas, higher benefit–cost ratio (2.45) was recorded in RDF treated plots. Lowest gross return benefit-cost ratio (1.25) was observed in VC @ 1.75t ha^{-1} treated plots.

Economically, it is apparent that organic manuring in green gram is not a profitable venture, owing to high input cost. Use of inorganic fertilizer with recommended dose is profitable.

Key words: Greengram, manuring,vermicompost, yield, economics

1. Introduction

Greengram (*Vigna radiata L.*Wilczek) also known as moong or mung, is the thirdmost important pulse crop in India after gram and redgram (Miachieo *at al.,* 2019). Itbelongstothe“Leguminosae”familyandsubfamily“Papilionaceae”.Greengramisthought to have originated in India and Central Asia. It extends from India to China, Iraq,Japan,Africa,andothercountries.GreengramisprimarilygrowninRajasthan,Maharashtra,AndhraPradesh,Orissa,Gujarat,MadhyaPradesh,Punjab,andUtterPradeshinIndia.

Pulses are significant in India's agricultural economy not only for their worth as human food, but also for animals because of their high protein content. Due to pulses deep roots and great ground cover, pulses are drought tolerant and minimize soil erosion and are known as a "Marvel of Nature" because of these positive qualities (Srikant, 2010). Pulses are cultivated all year round in India due to the diverse agro-climatic conditions. Pulses are produced in large quantities in India, which makes it the world's largest producer. In India, total pulse production is expected to reach 25.58 million tonnes (MT) in 2020-21, adding 2.55 MT from the previous year's 23.03 MT (DES, Ministry of Agriculture, 2022). India produces 25% of the world's pulses, consumes 7% of the world's consumption, and imports 14% of the world's pulses (FAO, 2019).

The green gram seed is high in copper, phosphorus, potassium, magnesium and important vitamins, and contains 20-25% protein, 1.3% fat, 15.4% fibre and 3.7% ash (FAO, 2019). It seeds are high in lysine (4600 mg g-1 N) and tryptophan (60 mg g-1 N) and may be consumed as whole grain or as ‘dal’ in variety of purposes. Mung bean seeds, as compared to other pulses, are more delicious, nutritionally digestible, and non- flatulent (Anjum et al., 2006). Ascorbic acid (vitamin C), riboflavin, and thiamine are all rich in sprouted mung bean seeds (Choudhary, 2010).

The inorganic fertilizers, no doubt, are the important source of nutrients in crops which can meet the nutrient requirement but their imbalance and continuous use causes environmental pollution and deterioration of soil health. Another issue for the farmer is the availability of fertilizer at reasonable rates. Under these circumstances, farmers should not depend on single source of plant nutrients like inorganic fertilizers. A balanced use of inorganic fertilizers, organic manures and bio-fertilizers are required to develop an integrated plant nutrition supply system.

Among organic manures, FYM is rich in organic matter and is a good source of plant nutrients. It helps to buffer soils against rapid chemical changes. FYM can potentially be used as a source of energy for soil microorganisms. Improvement in physical properties of soil, organic carbon and available nitrogen, phosphorus and potassium was found due to long term application of FYM and fertilizer (Babulkar et al., 2000). Application of FYM to crops also avoids its wasteful use for burning purposes.

Vermicompost is a sustainable bio-fertilizer produced from organic wastes by the use of earthworms. Vermicompost is a rich source of primary nutrients N, P, K and micronutrients. The combined use of inorganic fertilizer and organic manure has been shown to be highly promising, not only in terms of crop yield but also in terms of crop production stability (Nambiar and Abrol, 1992).

Integrated management of inorganic fertilizers and organic manure may be an important strategy for sustainable production of crops. This may not only improve the efficiency of inorganic fertilizers along with their minimal use in crop production besides providing stability in crop production with higher crop yield and improved major and minor nutrients availability (Rautaray et al., 2003). So, the greengram yield and quality can be improved by the balanced use of fertilizers and also by managing the organic manures properly.

With the above information in mind a field experiment was conducted at the Faculty of Agriculture and Veterinary Sciences, Mewar University with the objectives to determine the impact of organic manure and inorganic fertilizer on growth, yield attributes, quality, economics and profitability of organic manure and inorganic fertilizer management practices in green gram.

2. Materials and Methods

A field experiment was conducted at the instructional farm of Faculty of Agriculture and Veterinary Sciences, Mewar University Gangrar, Chittorgarh. The climate is subtropical, with high rainfall, high humidity, and a lengthy winter. The year is dominated by a prolonged winter or dry *rabi* season and a protracted rainy season. The average annual rainfall ranges from 800 to 900 mm. During the wet months of June to September, the south-west monsoon accounts for around 80% of total rainfall. The temperature range is extensive. The lowest temperature is 7.1–8.0°C, while the highest temperature is 24.8–32.2°C. The region is often humid and warm, however there is a cold spell from December to February. The agro-ecological situation is increasingly complicated and dynamic as a result of the changing climate. The investigate the “Effect of Organic Manure and Inorganic Fertilizer on Growth, Yield and Quality of Green Gram (Vigna radiate L.)” in the southern regionduring the summer of 2022having ten treatments of vermicompost and FYM with following treatments *viz*., T_1-Control (no fertilization), T_2-Recommended dose of fertilizer (RDF) @ 25:60:40 kg ha^{-1} N, P_2O_5, K_2O, T_3-Farm yard manure (FYM) @4.47t ha^{-1},T_4-Vermicompost (VC) @ 1.75t ha^{-1}, T_5-FYM 2.24t ha^{-1} + VC 0.87t ha^{-1}, T_6-FYM 2.24t ha^{-1}+ 50% RDN,T_7-VC 0.87t ha^{-1}+ 50% RD, T_8-FYM 3.35t ha^{-1} + 25% RDN, T_9-VC 1.31t ha^{-1} + 25% RDN, T_{10}-FYM 1.12t ha^{-1}+ VC 0.44t ha^{-1}+ 50% RDN and replicated by three times.The recommended dose of 20 kg N ha^{-1} and 40 kg P_2O_5 ha^{-1} as rainfed greengram was applied and sown in lines adopting standard package of practice.The soils of the experimental field was loamy sand having low in organic carbon (0.43%), available N (226 kg ha-1), medium in P2O5 (28.0 kg ha-^{1}) and was sufficient in available K (370 kg ha-1), slightly alkaline with pH 8.11 and EC 0.27 d Sm-1.

Table2.1Physico-chemicalpropertiesof soiloftheexperimentalfield

Particulars	Values	Methodemployed
A. PhysicalProperties		
TexturalComposition		
Sand (%)	62.05	InternationalPipettemethod(Piper, 1950)
Silt(%)	20.47	
Clay(%)	17.48	
BulkDensitygm/cc	1.48	Core Sampler method(Piper,1950)
FieldCapacity(%)	37.89	Field sampler method(Piper, 1950)
B. ChemicalProperties		
pH(1:2.5,soil:watersuspension)	5.68	pHmeter (Jackson, 1967)
Organic Carbon(%)	0.89	Walkleyand BlackMethod(1934)
OrganicMatter(%)	1.01	Walkleyand BlackMethod(1934)
AvailableNitrogen(kgha^{-1})	150.53	Alkaline permanganate Method (Subbaiahand Asija, 1956)
AvailablePhosphorus(kgha^{-1})	22.52	Bray&KurtzP_1method (Bray&Kurtz, 1945)
AvailablePotassium(kgha^{-1})	110.85	Neutral normal ammonium acetatemethod (Schollenberger andSimon,1945)

The greengram variety IPM 02-14 (Shreya)was sown on 28/01/2022rows opened at 30 cm (inter row) × 10 cm (intra row). Before sowing seeds in the field, green gram seeds were treated with a *Rhizobium* culture @ 5-7 g/kg of seeds. The treated seed was dropped by hand in furrows done by hand tyne @ 20-25 kg seed ha^{-1} in all rows opened at 30 cm (inter row) × 10 cm (intra row). The sowing depth was kept at 2-3 cm. All other standard cultural practices were followed during the cropping season. The required nutrients were applied through Urea and DAP in which half full dose of of nitrogen and phosphorus was applied at the time of sowing and nitrogen as urea doses were applied as basal and the rest 50% were applied as split dose 30 DAS (days after sowing), vemicompost and FYM applied before sowing at field preparation time. Observation on growth parameters, yield attributes, yield of greengram upon different nitrogen sources and levels was recorded and their significance was tested by the variance ratio and relative economics was calculated as per the prevailing market prices of the inputs and produced during *zayad*season. Statistical analysis was done as per process suggested by Panse and Sukhatme (1985).

3. Results and Discussion

The current study, titled "Effect of Organic Manure and Inorganic Fertilizer on Growth, Yield and Quality of Green Gram (*Vigna radiate* L.)" was performed during the summer season of 2022ondifferentgrowthandyieldattributes,yield,qualityparameters,nutrientcontent and nutrient uptake were statistically analysed and the results were given below in the form of tables and graphs as appropriate. The observed results have beendescribed after the data has been evaluated for their test of significance.

3.1 Growthattributes

3.1.1Plantheight

Successive increment in plant height of green gram was noticed with age of the crop.Plant height influenced significantly at 20, 40, 60 DAS and at harvesting stage with all theorganicandinorganic fertilizertreatments.PlotstreatedwithVC0.87tha^{-1}+50%RDNwere exhibited higher plant height (11.47-48.43 cm) followed by FYM 1.12t ha^{-1} + VC 0.44tha^{-1}+50%RDN(10.55-48.30cm)andFYM2.24tha^{-1}+50%RDN(10.50-48.18cm)treated plots. Sole or combine application of organic fertilizer failed to attain height overinorganic fertilizer.Shorterplants(7.28cm,20.57cm,31.93cmand39.10cmat20,40,60DAS and at harvest respectively) were observed in control (no fertilizer) treatment (Table4.1). Organic fertilizer in combination with 50% RDN produced 0.2-1.69 cm taller plantcompared to plots treated with RDF. Fully organic fertilizer treated plots were recorded2.90-7.67cm taller plantsthancontrolplots. The combination of organic and chemical fertilizers increased plant height than use of inorganic fertilizer alone as RDF (Meena *et al*., 2015; Verma *et al*., 2017).

Table3.1Effectof organic manureandinorganic fertilizeron plantheight ofgreengram

Treatments	Plant height (cm)			
	20 DAS	40 DAS	60 DAS	At harvest
T_1	7.28	20.57	31.93	39.10
T_2	10.48	27.17	40.53	47.67
T_3	10.19	25.13	38.17	45.00
T_4	10.25	25.93	38.72	45.33
T_5	10.39	26.39	39.60	46.07
T_6	10.50	28.17	41.70	48.18
T_7	11.47	28.83	42.22	48.43
T_8	10.39	26.40	39.80	46.37
T_9	10.40	26.77	40.17	47.13
T_{10}	10.55	28.30	42.10	48.30
SEM	0.57	1.11	1.90	1.54
LSD (≤0.05)	1.68	3.31	5.64	4.59
CV%	9.60	7.30	8.30	5.80

SEM: standard error of mean; LSD: least significant difference; CV:coefficient of variation;

4.1.1 Leaf Area Index (LAI)

Table 4.2 indicated that nutrient management treatment had significant effect on LAIwiththeadvancementoftheperiodicalgrowthstages. Organicandinorganic fertilizer significantlyincreasedLAI overcontrol.

Table3.2Effectoforganic manure andinorganic fertilizer onleafareaindexofgreengram

Treatments	Leaf area index			
	20 DAS	40 DAS	60 DAS	At harvest
T_1	0.347	1.57	2.20	1.87
T_2	0.665	2.75	3.48	2.83
T_3	0.622	2.63	3.05	2.72
T_4	0.633	2.67	3.26	2.77
T_5	0.640	2.70	3.30	2.78
T_6	0.669	2.77	3.52	2.84
T_7	0.677	2.87	3.60	2.90
T_8	0.644	2.70	3.38	2.81
T_9	0.661	2.74	3.47	2.82
T_{10}	0.670	2.84	3.56	2.89
SEM	0.06	0.21	0.24	0.16
LSD (≤0.05)	0.17	0.61	0.71	0.47

CV%	16.30	13.60	12.60	10.00

ThemaximumLAIrecordedinVC0.87t ha^{-1} + 50% RDN treated plots and it was at par with all the nutrient managementtreatments at all the growth stages of green gram. Organic sources of nutrients produce 38-84% higher LAI over control, whereas, integration of organic and chemical sources harvest50-95% higher LAI. Control plots were recorded lowest LAI (0.347-2.20) at all the growthstages crops.Highest LAI (3.60) observed in VC 0.87t ha^{-1} + 50% RDN treatment at 60DASamongdifferent crop growthstagesof greengram.Barkha *et al*. (2020) also reported, application of 50% RDF + bio- compost @ 2.5 t ha^{-1} + PSB @ 2.5 l ha^{-1} in summer mungbean performed better as compared to 100% RDF.

3.2 Yieldattributesandyield

3.2.1 Podsperplant

Plots treated with VC 0.87t ha^{-1} + 50% RDN recorded highest number of pods perplant (25.15) which was closely followed by FYM 1.12t ha^{-1} + VC 0.44t ha^{-1} + 50% RDN(25.06), FYM 2.24t ha^{-1} + 50% RDN (24.97) and RDF (21.35) treated plots. Combination oforganic manure with 25% or 50% inorganic fertilizer exhibited higher number of pods perplant (15.77-25.15) compared to 100% organic treatments (15.16-15.56). RDF treated plotsobserved 110.97% higher pods (21.35) per plant than control treatment. Plots received thetreatmentofVC0.87tha^{-1}+50%RDNrecorded148.52%higherpodscomparedtono fertilizer treatment plots and 17.80% higher pods than 100% RDF treatment. Lowest numberofpods(10.12) per plant wasrecorded incontrolplots. (Tyagi *et al*., 2014).

3.2.2 Podlength

The pod length under diverse organic and chemical nutrientsources ranged 6.33 cm to 9.80 cm. Highest pod length (9.80 cm) was recorded in VC 0.87tha^{-1} + 50% RDN treated plots. The lowest pod length (5.33 cm) was recorded under controltreatment. 50% replacement in inorganic fertilizer exhibited 1.39-4.81% higher pod lengthcompared to 100% RDF treatment, whereas 75% replacement produced 18.82-19.47% lowerpod length. Plots with 100% organic treatments recorded 35.08-39.77% higher pod lengththancontrol and20.32-23.0% lowerpod length compared to RDFtreatment(Table 4.3).Increased fertilizer supply in a more synchronized manner at the treatments led to animprovement in pod length and other yield attributes (Patra and Sinha, 2012).

3.2.3 Seedsper pod

The plotstreated with VC 0.87t ha^{-1} + 50% RDN treatments produced the most seeds per pod (13.05).RDF treated plots recorded higher number of seeds (12.51) per pod than 100% organictreatments (9.45-9.54). Combination of organic and chemical sources also produced greaternumberof seeds(9.60-13.05)per plantcompared toorganictreatments(Table 4.3). Similar findings also reported by Meena *et al*., 2013, Yadav *et al*., 2016 and Rekha *et al*., 2018.

3.2.4 Testweight

Testweight(1000seed)wassignificantlyinfluencedby theintegratednutrientmanagement.Highertestweight39.25gwasrecordedinVC0.87tha^{-1}+50%RDN treated plots. Test weight of RDF treated plots were 38.40 g, which was 18.81% higher thancontrol treatment. Combination of organic and chemical treatments recorded test weight of37.00-39.25 g whereas, 100% organic treatments exhibited 36.51-36.95 g of 1000 seedweight(Table 3.3).

Table3.3Effectoforganic manure andinorganic fertilizer onyieldattributesofgreengram

Treatments	Yield attributes			
	Pods per plant	Pod length (cm)	Seeds per pod	Test weight (g)
T_1	10.12	5.33	7.08	32.32
T_2	21.3	9.35	12.51	38.40
T_3	15.16	7.20	9.45	36.51
T_4	15.44	7.33	9.50	36.72
T_5	15.56	7.45	9.54	36.95
T_6	24.97	9.48	12.62	38.73
T_7	25.15	9.80	13.05	39.25
T_8	15.77	7.53	9.60	37.00
T_9	16.22	7.59	10.00	37.37
T_{10}	25.06	9.58	12.71	39.02
SEM	1.59	0.57	0.76	1.17
LSD (≤0.05)	4.72	1.71	2.25	3.48
CV%	14.90	12.30	12.40	11.0

Increasedseedweightoccurredfromthetranslocationandaccumulationofphotosynthatesintheeconomicsinks(patel*etal*.,2003;Sutaria*etal*.,2010).Betterchlorophyll synthesis in leaves, on the other hand may be the reason since organic manurescontain significant amounts of Mg in addition to other minerals, which may have aidedchlorophyllsynthesis(Patraand Sinha, 2012).

3.2.5 Seedyield

Significantly higher seed yield was recorded with combined application of organicand chemical as compared to organic fertilizer alone. When compared to 100% organic andchemical treatments, VC 0.87t ha^{-1} + 50% RDN produced considerably greater seed yield(935.00 kg ha^{-1}) and was determined to be 48.24-54.54% and 8.53% higher respectively. Incomparison to RDF treated plots, 75% inorganic fertilizer substitution yielded 23.92-26.04%lower yield, whereas, 50% replacement yielded 1.11-8.53% greater yield. RDF treated plotshadayield increaseof115.74%over controlplots.

Table 3.4 Effect of organic manure and inorganic fertilizer on yield and harvest index of greengram

Treatments	Seed yield (kg/ha)	Stover yield (kg/ha)	Biological yield (kg ha^{-1})	Harvest index (%)
T_1	399.33	1028.83	1428.16	27.83
T_2	861.51	2255.60	3126.63	27.83
T_3	605.03	1586.19	2191.22	27.58
T_4	625.10	1617.10	2242.20	27.83
T_5	630.73	1657.18	2287.92	27.80
T_6	871.03	2258.57	3120.08	27.70
T_7	935.00	2407.25	3342.25	27.88
T_8	637.13	1662.71	2299.84	27.85
T_9	655.43	1666.57	2322.01	28.15
T_{10}	884.10	2354.70	3238.80	27.31
SEM	68.96	184.22	248.01	0.82
LSD (≤0.05)	204.89	547.33	736.87	NS
CV%	16.80	17.30	16.80	5.10

Channa veer swami (2005) found similar results in peanut, while Rajkhowa*et al.* (2002)reportedsimilarresultsingreengram.Higherseedyieldmaybeattributedduetohigherpodsper plant seedsper podandseedsperplant(Tyagi*et al*., 2014;Patel*et al*.,2020).

3.2.6 Stover yield

The effects of chemical and organic nutrient management on the stover yield were found tobe considerable. The plots treated with VC 0.87t ha^{-1} + 50% RDN treatments producedhigheststoveryield(2407.25kg ha^{-1}).RDF treatedplotsrecordedhigherstoveryield(2255.60 kg ha^{-1}) than 100% organic treatments (1586.19-1657.18 kg ha^{-1}). Combination oforganic and chemical sources also produced greater stover yield (1662.71-2407.25 kg ha^{-1})comparedto organictreatments. Similar findings were reported by Yadav *et al*., 2017 and Sanbharisha *et al*., 2019.

3.2.7 Biologicalyield

VC 0.87t ha^{-1} + 50% RDN produced a higher biological yield (3342.25 kg ha^{-1}) than the100% chemical and organic fertilizer treatments, with yields of 6.90% and 46.08-52.53%,respectively.The control treatmenthad the lowestbiologicalyield(1428.16 kgha^{-1}).soils resulting in enhanced solubility of nutrients and their consequent availability to plants. Rahman *et al*., 2014 also reported better vegetative and reproductive growth with the respective treatments may be thereason of higher biological yield. Organics helps in enhancing the activity of microorganismin

3.2.8 Harvestindex

Harvestindexwasnotincreasedwiththeapplicationofinorganicandorganicsources of nutrients. The maximum harvest index recorded (28.15%) with treatment VC1.31t ha^{-1} + 25% RDN and minimum obtained (27.31%) under FYM 1.12t ha^{-1} + VC 0.44tha^{-1}+50%RDNtreatment.Fully organictreatmentsproducehigherharvestindexascomparedtoRDFandtreatmentscomprisesof75%organic +25%inorganic fertilizers.

3.3 Nutrientconcentration

3.3.1Nitrogencontent inseedandstraw

The analysis of the data in table 4.9 indicated that during the research, organic andchemical nutrient management treatments caused significant variation in the N content inseed. Plots treated with VC 0.87t ha^{-1} + 50% RDN recorded highest N content (4.19%inseed and 2.48% in straw) which was at par withFYM 1.12tha^{-1}+VC 0.44t ha^{-1}+50%RDN(4.12%and 2.42%),FYM2.24t ha^{-1}+ 50% RDN(4.09% and2.39%) and RDF(4.07% and 2.33%) treated plots.

3.3.2 Phosphoruscontent in seedandstraw

Plots treated withVC0.87tha^{-1}+50%RDNrecordedhighestPinseed(0.420%)andstraw(0.236%)whichwas at par with FYM 1.12t ha^{-1} + VC 0.44t ha^{-1} + 50% RDN, FYM 2.24t ha^{-1} + 50% RDNand RDF treated plots. RDF treated plots observed 36.71% and 77.87% higher P content inseed and straw, respectively than control treatment.

Table3.5Effectoforganic manureandinorganic fertilizeronnutrientcontent ofgreengram

Treatments	Nutrient Content (%)					
	Nitrogen		Phosphorus		Potassium	
	Seed	Straw	Seed	Straw	Seed	Straw
T_1	3.00	1.16	0.286	0.122	0.74	0.95
T_2	4.07	2.33	0.391	0.217	1.39	1.23
T_3	3.42	1.58	0.328	0.164	1.10	1.10
T_4	3.47	1.67	0.333	0.167	1.21	1.13
T_5	3.51	1.74	0.337	0.172	1.24	1.16
T_6	4.09	2.39	0.393	0.224	1.41	1.24
T_7	4.19	2.48	0.420	0.236	1.55	1.31
T_8	3.54	1.80	0.377	0.174	1.33	1.17
T_9	3.60	1.86	0.383	0.214	1.34	1.23
T_{10}	4.12	2.42	0.416	0.227	1.44	1.24
SEM	0.12	0.13	0.01	0.01	0.11	0.03
LSD (≤0.05)	0.37	0.38	0.03	0.03	0.34	0.10

CV%	5.80	11.30	5.50	10.90	15.50	4.90

3.3.3 Potassiumcontent in seed and straw

Significantly higher K content was recorded with combined application of organicand chemical as compared to organic fertilizer alone. When compared to 100% organic andchemicaltreatments,RDF recordedconsiderably greaterK inseedandstrawandwasdetermined to be 12.10-26.33% and 6.03-11.82% higher respectively. In comparison to RDFtreated plots, 75% inorganic fertilizer substitution recorded 3.73-5.13% lower K whereas,50% replacement observed 0.81-11.51% greater K content. RDF treated plots had 87.84%(seed)and 29.47% (straw) higherKcontentovercontrolplots.

Application of 50 and 100 % NPK of RDF significantly improved the nitrogen,phosphorus and potassium contents in seed and straw over control. Further, seed proteincontentofgreengramalsoincreasedsignificantlybyusing100%RDFovercontrol.Significant increase N, P and K content due to chemical sources of nutrientsunder the present study are in close agreement with the findings of Borse *et al.* (2002),Ikraam(2002)and Yakadri*et al.*(2004).

3.4 Nutrientuptake

3.4.1 Nitrogenuptake

TheNuptakeunderdiverseorganicandchemicalnutrientsourcesranged23.97 to 98.86 kg ha^{-1}. Highest N uptake (98.86 kg ha^{-1}) was recorded in VC 0.87t ha^{-1} +50% RDN treated plots. The lowest N uptake (23.97 kg ha^{-1}) was recorded under controltreatment.

3.4.2 Phosphorusuptake

Significantly higher P uptake was recorded with combined application of organic andchemical as compared to organic fertilizer alone (Table 4.6). When compared to 100%organic and chemical treatments, RDF showed considerably greater P uptake (8.33 kg ha^{-1})and was determined to be 72.11-73.91% higher. In comparison to RDF treated plots, 75%inorganic fertilizersubstitutionexhibited40.83-41.41%loweruptake,whereas,50%replacementshowed 0.98-11.15%greateruptake of phosphorus. RDF treated plots had271.05%higher p uptakeover controlplots.

Table3.6Effectoforganic manureandinorganic fertilizeronnutrientuptakeofgreengram

Treatments	Nutrient Content (%)		
	Nitrogen	Phosphorus	Potassium
T_1	23.97	2.38	18.76
T_2	88.94	8.33	41.91
T_3	48.98	4.84	30.20
T_4	49.20	4.90	33.40
T_5	51.14	5.03	37.10
T_6	89.81	8.56	42.47
T_7	98.86	9.49	47.87
T_8	52.11	5.13	37.71
T_9	52.63	5.66	39.43
T_{10}	91.07	8.64	42.74
SEM	7.03	0.54	3.30
LSD (≤0.05)	20.87	1.60	9.79
CV%	18.80	14.80	15.40

3.4.3 Potassiumuptake

K uptake was significantly increased with the application of inorganic and organicsources of nutrients (Table 4.10). The maximum K uptake recorded (47.87 kg ha^{-1}) withtreatment VC 0.87t ha^{-1} + 50% RDN and minimum obtained (18.76 kg ha^{-1}) under thecontrol. Fully organic treatments showed lower K uptake (30.20-37.10 kg ha^{-1}) as comparedto RDF (41.91 kg ha^{-1}) and treatments comprises of 75% organic + 25% inorganic fertilizers(37.71-39.43 $kgha^{-1}$). Similar findings were observed in black gram byReddy*et al.* (2000).

3.5 Soilnutrientstatusafterharvest

3.5.1 Availablenitrogen, Phosphorus and Potassium

The data presented in Table 4.11 revealed that significantly higher available nitrogenwas observed withchemical and organic nutrientstreatment as compared to control plot.Soil residual nitrogen increased perceptibly with the application of VC 0.87t ha^{-1} + 50%RDN was higher (172.8 kg/ha) and it was at par with treatments of FYM 1.12t ha^{-1} + VC0.44tha^{-1}+50%RDN,FYM2.24tha^{-1}+50%RDNand100%RDF(164.5,164.0and163.6kg/harespectively).Significantly higher residual P was recorded with combined application of organicand chemical as compared to organic fertilizer alone (Table 4.11). When compared to 100%organic and chemical treatments, RDF showed considerably greater available P (23.92 $kgha^{-1}$) and was determined to be 24.74-41.24% higher. The greatest potassium status was in VC 0.87tha^{-1} + 50% RDN (120.20 kg ha^{-1}) treated plots and it was comparable to all other nutrientmanagementtreatments.

Table 3.7 Effect of organic manure and inorganic fertilizer on available nutrient in soil afterharvest of greengram

Treatments	Available nutrient (kg ha^{-1})		
	Nitrogen	**Phosphorus**	**Potassium**
T_1	107.0	12.32	92.16
T_2	163.6	22.74	116.32
T_3	132.4	16.10	105.57
T_4	134.1	16.53	111.58
T_5	134.6	18.23	112.97
T_6	164.0	23.09	117.17
T_7	172.8	23.92	120.20
T_8	136.1	22.63	114.52
T_9	136.8	22.69	115.97
T_{10}	164.5	23.80	118.27
SEM	8.29	1.04	3.73
LSD (≤0.05)	24.64	3.09	11.08
CV%	9.90	8.90	5.70

Vermicompost includes significant levels of major and micronutrients in the mostappropriate pH range, which may have resulted in their enhanced status in soil followingmungbeanharvest.Rasal*etal.*(2002)alsofoundthatvermicomposthadafavorableimpacton soil characteristics and nitrogen, phosphorus and potassium mineralization.

3.6 Proteincontent

Plots treated with VC 0.87t ha^{-1} + 50% RDN had the highest protein content in seed(262.0 mg g^{-1}), which was at part with FYM 1.12t ha^{-1} + VC 0.44t ha^{-1} + 50% RDN, FYM2.24t ha^{-1} + 50% RDN, and RDF (25:60:40 kg ha^{-1} NPK) treatments. When compared to100%organic treatments,theproteinlevelofRDFtreatedplotswas13.22-15.92%greater.

Table 3.8 Effect of organic manure and inorganic fertilizer on protein contentofgreengram

Treatments	Protein content (mg g^{-1})
T_1	187.70
T_2	254.90
T_3	213.81
T_4	217.30
T_5	219.90
T_6	256.10
T_7	262.00
T_8	221.50
T_9	225.50
T_{10}	257.80
SEM	7.71
LSD (≤0.05)	22.91
CV%	5.80

3.7 Economics

Economic analysis was done on the basis of local minimum support price (MSP) ofthe produce. From the table 4.13, it is found that, VC @ 1.75t ha^{-1} treatment had higher costofcultivation(₹36450.00),becauseof highcostofvermicompost.Highergross return(₹68021.00) recorded in VC 0.87t ha^{-1} + 50% RDN treated plots due to higher yield. On theotherhand,plotstreatedwithFYM2.24tha^{-1}+50%RDNhadhighernetreturn(₹37364.00).Benefit-cost(B:C)ratioof2.45recordedinRDFtreatedplotstoothertreatments. Whereas, in spite of getting higher yield in VC 0.87t ha^{-1} + 50% RDN treatment,the B:C ratio was low due to high cost of cultivation. In the current study, the improved net returns may be explained by enhanced yielddue to the effect of inorganic fertilizer sources. Furthermore, the benefit-cost ratio wasreduced as a result of the use of organic sources (vermicompost) and FYM of the higher costofusingorganicsources.Rajkhowa*etal.*(2003)reportedthatusing100%inorganic fertilizer (N:P_2O_5 @ 15 and 35 kg ha^{-1}) enhanced green gram economics significantly overcontrol.Yakadri*et al.* (2004)and Yadav*et al.*(2006)reported similarfindings.

Table3.9Effectoforganic manureandinorganic fertilizeroneconomics ofgreengram

Treatments	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	Benefit-cost ratio
T_1	20450.00	29052.00	8602.00	1.42
T_2	25557.00	62675.00	37118.00	2.45
T_3	33727.00	44016.00	10289.00	1.31
T_4	36450.00	45476.00	9026.00	1.25
T_5	31450.00	45886.00	14436.00	1.46
T_6	26004.00	63368.00	37364.00	2.44
T_7	31004.00	68021.00	37017.00	2.19
T_8	25227.00	46351.00	21124.00	1.84
T_9	26450.00	47683.00	21233.00	1.80
T10	28504.00	64318.00	35814.00	2.26

4. Conclusion

Plant height influenced significantly at 20, 40, 60 DAS and at harvesting stage withall the organic and inorganic fertilizer treatments. Plots treated with VC 0.87t ha^{-1} + 50%RDNwere exhibited higher plant height (11.47-48.43 cm). Highest LAI(3.60) observed in VC 0.87t ha^{-1} + 50% RDN treatment at 60 DAS among different cropgrowth stages of green gram. Plots received the treatment of RDF showed 15.71-57.81%additional trifoliate leaves per plant as compared to control plots. Replacementof50%inorganic fertilizerbyorganicsourcesincreased0.96-40.66%DMAthanRDF,whereas,75%inorganic fertilizerreplacement produce 1.65-14.59% lower dry matter throughout the growing period. Solelyorganic sources of nutrients produce less quantity of dry matter compared to RDF. HighestDMA m^{-2} (19.20-437.36 g m^{-2}) was recorded in VC 0.87t ha^{-1} + 50% RDN treated plotswhichwas123.79-372.39%highercomparedtocontrolplots.

Combinationoforganicmanurewith25%or50% inorganic fertilizerexhibitedhighernumberofpodsperplant(15.77-25.15)comparedto100%organictreatments(15.16-15.56). Plots with 100% organic treatments recorded 35.08-39.77% higher podlengththancontroland20.32-23.0%lowerpodlengthcomparedtoRDFtreatment.Combination of organic and chemical sources also produced greater number of seeds (9.60-13.05) per plant compared to organic treatments. In comparison to RDF treated plots, 75%inorganic fertilizer substitution yielded 1.79-14.27% lower yield, whereas, 50% replacementyielded 23.92-26.04% greater yield. RDF treated plots had a yield increase of 115.74% overcontrol plots. VC 0.87t ha^{-1} + 50% RDNproduced a higher biological yield (3342.25 kg ha^{-1}) than the 100% chemical and organic fertilizer treatments, with yields of 6.90% and 46.08-52.53%, respectively. The N uptake under diverse organic and chemical nutrient sourcesranged 23.97 to 98.86 kg ha^{-1}. Highest N uptake (98.86 kg ha^{-1}) was recorded in VC 0.87tha^{-1} + 50% RDN treated plots. The lowest N uptake (23.97 kg ha^{-1}) was recorded undercontrol treatment. In comparison to RDF treated plots, 75% inorganic fertilizer substitutionexhibited40.83-41.41%loweruptake,whereas,50%replacementshowed0.98-11.15%greateruptakeofphosphorus.Vermicompostincludessignificantlevelsofmajorandmicronutrients in the most appropriate pH range, which may have resulted in their enhancedstatus in soil following mungbean harvest. Plots treated with VC 0.87t ha^{-1} + 50% RDN hadthe highest protein content in seed (262.0 mg g^{-1}), which was at part with FYM 1.12t ha^{-1} +VC0.44tha^{-1}+50%RDN,FYM2.24tha^{-1}+50%RDN,andRDF(25:60:40kgha^{-1}N:P_2O_5:K_2O) treatments. Our data showed that for seeds harvested from organic treatments,the TPC was, 91.59-95.06% higher compared to the control. The highest TPCconcentrations of 45.0 mg GAE g^{-1} was measured in FYM 2.24t ha^{-1} + VC 0.87t ha^{-1} treatedplots. A higher TFC was found in green gram seeds harvested from FYM 2.24t ha^{-1} + VC0.87t ha^{-1} treated plots, on average, 122.55% higher than in seeds harvested from controlplots. Economic analysis was done on the basis of localminimum support price (MSP) ofthe produce. Higher gross return (₹68021.00) recorded in VC 0.87t ha^{-1} + 50% RDN treatedplots due to higher yield. Benefit-cost (B:C) ratio of 2.45 recorded in RDF treated plots toothertreatments.

Onthe basisoftheexperimentalfindingsthe followingconclusionsmaybe Pureorganic manure failstoproducesignificanteffectongrowth,yieldattributes and yield. Whereas, organic fertilizers accelerate biosynthesis of secondarymetabolites, which induces the acetate shikimate pathway, resulting in the highestproductionofflavonoidsandphenolics.Integrationoforganicnutrientswithinorganic fertilizer significantly affects the growth and yield attributes and producehigheryield.Inorganic fertilizer alone or in combination with organics had an optimistic effect onavailablenitrogen,phosphorusandpotassiumcontentinthesoilafterharvestofgreengram,whichwasappreciablyhigherincomparisontosingle organicssources.Organic manuring in green gram is not a profitable venture, owing to high input cost.Useofinorganic fertilizerwithrecommendeddose iseconomicallyprofitable.

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