International Journal of Agricultural Sciences
Volume 9 | Issue 1| January, 2013 | 275-279

RESEARCH PAPER

Residual effect of organic manures on growth, yield and economics of greengram in maize- sunflower-greengram system

K. TEJESWARA RAO*, A. UPENDRA RAO AND D. SRINIVASULA REDDY
Research Station, Seethampeta, SRIKAKULAM (A.P.) INDIA
(Email : tejascientist@Yahoo.com)

Abstract : Field experiments were conducted for two consecutive years (2003-04 and 2004-2005) at S.V. Agricultural college farm (ANGRAU), Tirupati , Southern plateau and Hills zone of India on red sandy soils consisting Greengram was raised as residual crop during summer in a sequence of maize sown in *Kharif* and sunflower sown in *Rabi* with the imposition of the treatments to the first two crops of the sequence. Six different sources of nitrogen *viz.*, farm yard manure, vermicompost, neem leaf, poultry manure, pig manure and fertilizer to supply recommended dose of nitrogen on equalent nitrogen basis and one absolute control were applied to first two crops in the cropping system. Various parameters of greengram were influenced differently by varied manurial practices tried. However, during both the years of investigation, all the growth and yield attributes, yield (seed as well as haulm), harvest index, gross returns, net returns and benefit-cost ratio of green gram were at their best with the residual effect of poultry manure either with or without the use of *Panchagavya*. The uptake of nitrogen, phosphorus and potassium by greengram crop and protein content of seed was significantly higher with the residual effect of various organic sources either with or without the use of *Panchagavya* than with fertilizer either with or without the use of *Panchagavya*. The highest phosphorus uptake of greengram was recorded with the residual effect of poultry manure either with or without the spray of *Panchagavya*, while the potassium uptake was the highest with vermicompost either with or without the spray of *Panchagavya*. Gross returns, net returns and benefit-cost ratio of greengram were significantly lesser with the residual effect of fertilizer than with any of the organic sources tried. All the growth and yield attributes, yield, nutrient uptake, harvest index, protein content of the seed and economic returns of greengram were at their lowest with the residual effect of non-manuring through any source to either maize or sunflower, which were statistically similar to those with foliar application of *Panchagavya* alone to the preceding two crops.

Key Words : Green gram, Organic manures, Growth, Yield, Nutrient uptake, Economics

View Point Article : Rao, K. Tejeswara, Rao, A. Upendra and Reddy, D. Srinivasula (2013). Residual effect of organic manures on growth, yield and economics of greengram in maize- sunflower-greengram system. *Internat. J. agric. Sci.*, **9**(1): 275-279.

Article History : Received : 29.08.2012**; Revised :** 01.11.2012**; Accepted :** 13.12.2012

INTRODUCTION

Organic farming is not a new concept to Indian farmers, because they have practiced it since times immemorial. Organic farming system relies on crop rotation, crop residues, animal manures, legumes, green manures, off- farm wastes and biological pest control. Yields in organic farming are lower than chemical farming during initial years of practice and it takes a few years to stabilize the yields. However, in the long run, if properly followed ,yield with organic farming would be a greater than those obtained with chemical farming . The gravity of environmental degradation has drawn the attention of the scientists and planners towards finding out ecologically sound, viable and sustainable farm technologies, keeping in view of the needs of the future generations. Most of the Indian soils contain less than 0.5 per cent organic carbon. Unless it is raised to 0.9–1 per cent level, productivity of the soil can not be optimized (Veeresh,2002).Organic farming is known to sustain production and productivity by maintaining better soil fertility and microbial activity (Sunita *et al.*, 2004).In view

*** Author for correspondence**

of the resurgence of interest in alternative agriculture in recent years, organic farming has been considered to be sound and viable option in most of the countries. In light of the above, investigations were taken up for two consecutive years, with the objectives of studying the response of maize- sunflower system to different organic manures and *Panchagavya* on the productivity and quality and to trace out the carry over effects any on succeeding crops. In the present study, greengram crop was raised succeeding to maize- sunflower, without imposing any treatments, with the aim to find out the carry over effect of varied manurial practices adapted to preceding maize and sunflower crops

MATERIALS AND METHODS

Field experiments were conducted for two consecutive years (2003-04 and 2004 - 05) at S. V. Agricultural College farm (ANGRAU), Tirupati, Southern plateau and Hills zone of India on red sandy soils. In these investigations, maize was grown during late *Kharif*, sunflower during late *Rabi* followed by greengram during summer as residual crop during both the years. The experiment was laid out in a Randomized Block Design, replicated thrice and the same lay out was followed during the second year of study. There were fourteen treatments comprising of six different sources of nitrogen *viz.*, farm yard manure ,vermicompost , neem leaf, poultry manure, pig manure and fertilizer to supply recommended dose of nitrogen on equalent nitrogen basis and one treatment of no manuring through any source . All the seven treatments were tried with and without the foliar application of *Panchagavya*, thus, making the total treatments to fourteen. The treatments were imposed to maize, sunflower crops and greengram raised as residual crop without manurial application. LGG-460 was the test cultivars of greengram. *Panchagavya* is a mixture of cow dung (1kg), cow urine (750 ml), cow milk (500 ml), cow curd (500ml) and cow ghee (250ml). In addition to the five products from the indigenous cow, sugarcane juice (750ml), tender coconut water (750ml), pure honey (250ml) and ripe bananas (250g) were also added to accelerate the fermentation process.

Plant height from ground surface to top most growing point was recorded from ten labeled plants of net plots at flowering and expressed in cm. LI-COR model LI-3000 portable leaf area meter with the transparent belt conveyer (Model LI-3050A) utilizing an electrical display was used for measuring leaf area at flowering and leaf area index was calculated by dividing the total leaf area with corresponding land area as per the formula. Five plants were uprooted from the destructive sampling area at harvest and the plants devoid of roots were sun dried and later oven dried at 60^0C to a constant weight, weighed and expressed in kg ha^{-1}. Total number of pods from ten labeled plants in each of the net plot were counted, averaged and expressed as number of pods $plant^{-1}$.The number of seeds pod^{-1} from 20 pods taken at random from each treatment was counted, averaged and expressed as number of seeds pod^{-1}.Five seed samples were drawn from net plot yield of each treatment and weight of thousand seeds of each sample was recorded, averaged and expressed as 1000 seed weight in grams. Total seed yield obtained from two pickings from net plot area was sun dried to 8 per cent moisture, weighed and expressed as kg ha^{-1}. The haulms from each net plot area were sun dried to a constant weight, weighed and expressed in kg ha^{-1}. Harvest index is the ratio of seed weight to the total biological yield and is expressed as percentage. Seed samples were taken from each plot and analysed for total N by microkjeldhal method. The N content of the seed was multiplied with 6.25 to arrive at the crude protein content and expressed

Table A : Biochemical properties of *Panchagavya* stock solution

Property	Composition value	Methodology
Total N (mg kg^{-1})	380	Microkjeldhal – Humphries (1956)
Total P (mg kg^{-1})	258	Triple acid digestion (calorimetry) Jackson (1973)
Total K ((mg kg^{-1})	430	Triple acid digestion (Flame Photometry) Jackson (1973)
Total organic carbon (%)	0.85	Wet digestion Walkley & Black (1934)
Total sugar (µg ml^{-1})	215	Nelson Somogyi's hydrolysis – Somogyi (1952)
Reducing sugars (µg ml^{-1})	88	
Glucose (mg/dl)	7.5	Glucose oxidase – Malick and Singh (1980)
Sodium (mg kg^{-1})	105	Triple acid digestion (Flame Photometry) Jackson (1973)
Calcium (mg kg^{-1})	28	
Yeast (CFU/ml)	38 X 10^4	Saborauds agar medium
Actinomycetes (CFU/Mml)	4 X 10^2	Ken Knight's medium Ken Knight and Muncie (1939)
Lactic acid bacteria (CFU/ml)	26X10^6	MRS agar
Zn (mg kg^{-1})	0.28	DTPA extractant (AAS) Lindsay and Norvell (1978)
Fe (mg kg^{-1})	0.87	
Mn (mg kg^{-1})	0.20	
Cu (mg kg^{-1})	0.17	

in per cent. Phosphorus was estimated by calorimetric method using a Technicon autoanalyser and potassium by flame photometry (Jackson, 1973). The uptake of N, P and K in kg ha^{-1} at harvest was calculated by multiplying the nutritional content with the respective dry matter production at harvest. Economic parameters like gross returns, net returns and rupee returned $rupee^{-1}$ invested were worked out treatment – wise taking prevailing market rates for different inputs and out puts. Relative agronomic effectiveness of the treatments was calculated using the formula given by Sharma *et al*.(2003). Data were analyzed using ANOVA and the significance was tested by Fisher's least significance difference (p= 0.05) by pooling two years data. The biochemical properties of *Panchagavya* stock solution are given in Table A.

RESULTS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Growth yield attributes and yield :

The tallest plants with largest leaf area and highest dry matter accrual, with the highest number of pods $plant^{-1}$and number of seeds pod^{-1} as well as thousand seed weight (Table 1), highest yield (seed as well as haulm), and highest harvest index of greengram were produced with the residual effect of poultry manure either with or without the spray of *Panchagavya* applied to previous crops of maize and sunflower. The next highest stature of all the above parameters was recorded with pig manure with or without *Panchagavya,* which was significantly higher than with the residual effect of neem leaf manure with or without *Panchagavya,* which in turn was statistically superior to the residual effect of vermicompost or farm yard manure with or without *Panchagavya*. Greengram being a legume, it responds to the supply of phosphorus from poultry manure, which was applied to the preceding crops contained high quantity of P, which would have left considerable quantity of P in the soil to be utilized by greengram, which might have triggered the growth resulting in higher yield. Application of recommended dose of fertilizer with or without *Panchagavya* to preceding crops resulted in higher level of all the parameters than with the residual effect of non manuring to previous crops with or without *Panchagavya*. All the above mentioned parameters of greengram were at their lowest with the residual effect of non-manuring to both the preceding crops. The findings are in agreement with that of Gorodonii *et al.* (1994) who reported conspicuous residual effect of organic manures applied to preceeding crops on succeeding greengram. Marginal variations in the residual effects of organic manures applied to preceeding crops on succeeding crop has been reported by Rao (2004).

Protein content and N uptake :

Residual effect of various organic manures either with or without the spray of *Panchagavya* applied to previous crops of maize and sunflower was comparable, in respect of protein content of greengram seed and nitrogen uptake by the crop, which were significantly higher than with the residual effect of application of recommended dose of fertilizer with or without *Panchagavya*, which were statistically superior to those recorded with residual effect of non manuring to previous crops with or without *Panchagavya*, which resulted in the lowest protein content of the seed and nitrogen uptake

Table 1 : Plant height, leaf area index, dry matter production at harvest of greengram as influenced by varied manurial practices and *Panchagavya* spray

Treatments	Plant height at flowering (cm)		LAI at flowering		DMP H (kg ha^{-1})		Number of pods $plant^{-1}$		Number of seeds pod^{-1}		1000 seed weight (g)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
T_1.No manure	22.8	26.4	1.14	1.23	2014	2085	7.0	7.2	5.2	5.5	19.4	21.8
T_2. *Panchagavya*	23.5	27.2	1.22	1.32	2032	2102	7.2	7.5	5.6	5.8	20.8	22.5
T_3.RDF	26.2	33.5	1.45	1.56	2086	2175	12.8	13.0	8.2	9.0	24.2	25.6
T_4.RDF + *Panchagavya*	26.8	34.0	1.47	1.58	2110	2192	13.0	13.1	8.6	9.2	24.6	26.0
T_5.Farm yard manure	29.5	36.8	1.71	1.82	2186	2304	13.8	14.0	9.4	9.8	26.2	27.5
T_6.FYM + *Panchagavya*	30.2	37.2	1.73	1.84	2234	2336	14.0	14.0	9.4	9.8	26.2	27.8
T_7.Vermicompost	30.8	37.5	1.73	1.84	2268	2368	14.2	14.2	9.6	10.0	26.4	28.0
T_8.T_7 + *Panchagavya*	31.5	38.0	1.78	1.86	2332	2382	14.4	14.2	9.6	10.0	26.6	28.0
T_9.Neem leaf manure	34.0	40.8	2.00	2.12	2532	2601	15.2	15.2	10.2	10.6	28.0	29.5
T_{10}.T_9 + *Panchagavya*	34.6	41.4	2.03	2.14	2564	2612	15.4	15.6	10.2	10.6	28.2	29.8
T_{11}.Poultry manure	40.4	47.6	2.51	2.65	2706	2792	17.2	17.6	11.2	12.0	31.3	32.8
T_{12}.T_{11} + *Panchagavya*	41.1	47.9	2.54	2.69	2730	2808	17.3	17.7	11.4	12.1	31.6	33.2
T_{13}.Pig manure	37.2	44.4	2.25	2.38	2620	2685	16.2	16.5	10.6	11.3	29.6	31.2
T_{14}.T_{13} + *Panchagavya*	37.8	44.8	2.28	2.40	2644	2721	16.4	16.7	10.7	11.4	30.0	31.4
S.E.±	0.92	0.85	0.07	0.08	19.0	24.3	0.25	0.28	0.14	0.18	0.42	0.46
C.D. (P = 0.05)	2.4	2.6	0.20	0.23	54	69	0.7	0.8	0.4	0.5	1.2	1.3

by greengram crop (Table 2). The increased nitrogen uptake due to application of organic manures might be due to decreased losses of slowly released N during decomposition.

Phosphorus uptake :

Residual effect of poultry manure either with or without the spray of *Panchagavya* applied to previous crops of maize and sunflower was comparable, in respect of phosphorus uptake of greengram, which was the highest (Table 2). The next highest phosphorus uptake was recorded with pig manure with or without *Panchagavya*, which was significantly higher than with the residual effect of neem leaf manure with or without *Panchagavya*, which in turn was statistically superior to the residual effect of vermicompost or farm yard manure with or without *Panchagavya*. Improvement in inherent application of recommended dose of fertilizer with or without *Panchagavya* to preceding crops resulted in higher phosphorus uptake of greengram than with the residual effect of non-manuring to previous crops with or without *Panchagavya* . The higher uptake of with most of the organic

Table 2 : Yield, harvest index, protein content(%) and N,P ,K uptake at harvest of greengram as influenced by varied manurial practices and *Panchagavya* spray

Treatments	Seed yield (kg/ha)		Haulm yield (kg/ha)		Harvest index		Protein content(%)		N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
T_1-No manure	380	396	954	992	18.87	18.99	14.8	15.2	17.2	17.6	2.74	3.64	9.8	10.6
T_2- *Panchagavya*	392	412	972	1016	19.29	19.60	14.8	15.2	18.6	19.2	2.82	3.82	10.2	11.2
T_3-RDF	442	462	1204	1268	21.19	21.24	16.5	16.6	31.8	33.8	3.68	4.86	13.8	14.6
T_4-RDF + *Panchagavya*	454	476	1225	1294	21.52	21.72	16.5	16.8	32.9	35.6	3.72	4.98	14.2	15.0
T_5-Farm yard manure	502	526	1388	1456	22.96	22.83	20.4	20.5	55.0	54.5	5.22	6.52	16.8	19.2
T_6-FYM + *Panchagavya*	526	542	1415	1485	23.55	23.20	20.4	20.5	57.0	55.9	5.25	6.54	16.8	19.2
T_7-Vermicompost	546	568	1438	1518	24.07	23.99	20.6	20.8	54.4	54.2	5.28	6.58	21.4	23.6
T_8-T_7 + *Panchagavya*	568	584	1482	1532	24.36	24.52	20.6	20.8	56.0	55.0	5.28	6.58	21.8	24.1
T_9-Neem leaf manure	652	672	1586	1648	25.75	25.84	20.6	20.8	54.0	53.6	7.78	7.02	16.5	19.0
T_{10}-T_9 + *Panchagavya*	665	684	1612	1685	25.94	26.19	21.0	21.4	55.2	54.8	7.80	7.08	16.6	19.0
T_{11}-Poultry manure	784	812	1954	2058	28.97	29.08	21.2	21.6	54.2	54.0	8.83	8.02	16.4	18.1
T_{12}-T_{11} + *panchagavya*	792	824	1986	2092	29.01	29.34	21.2	21.8	55.8	54.8	8.90	8.10	16.4	18.6
T_{13}-Pig manure	724	742	1825	1872	27.63	27.64	21.0	21.4	54.6	54.5	8.30	7.52	19.0	21.2
T_{14}-T_{13} + *panchagavya*	732	758	1852	1904	27.69	27.86	21.2	21.6	56.4	55.2	8.32	7.56	19.4	21.6
S.E.±	380	396	954	992	18.87	18.99	14.8	15.2	1.55	1.41	0.17	0.15	0.63	0.67
C.D. (P = 0.05)	392	412	972	1016	19.29	19.60	14.8	15.2	4.4	4.0	0.48	0.42	1.8	1.9

Table 3 : Economics and relative agronomic effectiveness of greengram as influenced by the residual effect of various manurial practices and *Panchagavya* spray to preceding crops of maize and sunflower

Treatments		Gross returns (Rs ha^{-1})		Net returns (Rs ha^{-1})		Benefit-cost ratio		Relative agronomic effectiveness	
		2004	2005	2004	2005	2004	2005	2004	2005
T_1	T_1-No manure	7600	7920	3800	4120	2.00	2.08	0	0
T_2	T_2- *Panchagavya*	7840	8240	4040	4440	2.06	2.17	19	24
T_3	T_3-RDF	8840	9240	5040	5440	2.33	2.43	100	100
T_4	T_4-RDF + *Panchagavya*	9080	9520	5280	5720	2.39	2.51	119	121
T_5	T_5-Farm yard manure	10040	10520	6240	6720	2.64	2.77	197	197
T_6	T_6-FYM + *Panchagavya*	10520	10840	6720	7040	2.77	2.85	235	221
T_7	T_7-Vermicompost	10920	11360	7120	7560	2.87	2.99	268	261
T_8	T_8-T_7 + *Panchagavya*	11360	11680	7560	7880	2.99	3.07	303	285
T_9	T_9-Neem leaf manure	13040	13440	9240	9640	3.43	3.54	439	418
T_{10}	T_{10}-T_9 + *Panchagavya*	13300	13680	9500	9880	3.50	3.60	460	436
T_{11}	T_{11}-Poultry manure	15680	16240	11880	12440	4.13	4.27	652	630
T_{12}	T_{12}-T_{11} + *Panchagavya*	15840	16480	12040	12680	4.17	4.34	665	648
T_{13}	T_{13}-Pig manure	14480	14840	10680	11040	3.81	3.91	555	524
T_{14}	T_{14}-T_{13} + *Panchagavya*	14640	15160	10840	11360	3.85	3.99	568	548
	S.E.±	276.1	283.8	229.6	244.7	0.049	0.053	-	-
	C.D. (P = 0.05)	784	806	652	695	0.14	0.15	-	-

manures may be attributed to solubility action of organic acids produced during the decomposition of organic materials on native and applied phosphorus. This is in conformity with the other workers those also elucidated the solubility action of the organic acids to enable higher nutrient uptake.

Potassium uptake :

Residual effect of vermicompost either with or without the spray of *Panchagavya* applied to previous crops of maize and sunflower was comparable, in respect of potassium uptake of greengram, which was the highest (Table 2). The next higher potassium uptake was recorded with pig manure with or without *Panchagavya*, which was significantly higher than with the residual effect of farm yard manure or neem leaf manure or poultry manure with or without *Panchagavya*, but comparable among them. Application of recommended dose of fertilizer with or without *Panchagavya* to preceding crops resulted in higher potassium uptake than with the residual effect of non-manuring to previous crops with or without *Panchagavya*, The lowest uptake of phosphorus and potassium by greengram crop at different crop growth stages was registered with the residual effect of non-manuring to both the preceding crops. The findings are in corroboration with that of Rao and Murthy (2009).

Economics and relative agronomic effectiveness :

The highest gross and net returns as well as benefit-cost ratio from greengram crop were realized with poultry manure along with *Panchagavya* spray, which were however, comparable with poultry manure alone and significantly higher than with pig manure either with or without *Panchagavya*, which were superior to neem leaf manure with or without *Panchagavya* , which in turn were significantly higher than with vermicompost or farm yard manure with or without the use of *Panchagavya* (Table 3). Supply of nitrogen through fertilizer either with or without *Panchagavya* resulted in significantly lower economic returns than with all the organic sources tried either with or without the use of *panchagavya*, but significantly higher than with no manuring with or without *panchagavya* spray. The lowest gross and net returns as well as benefit-cost ratio from greengram crop were realized with the residual effect of non-manuring to both the preceding crops. Similar results of higher returns obtained with greengram as a result of residual effect of organic manures applied to preceding crop than chemical fertilization has been reported by Rao and Murthy (2009). Relative agronomic effectiveness of the greengram also highest in poultry manure along with *panchagavya* spray followed by poultry manure alone and pig manure along with *panchagavya* spray during both the years.

Application of recommended dose of fertilizer to both the preceding crops could not extend any carry over effect on greengram, as could be noticed from the all the above mentioned parameters of greengram, which were significantly lesser than with any of the five organic manures applied to two preceding crops. All the other four organic manures have resulted in nearly equal performance of greengram, but significantly superior to fertilizer, indicating that fertilizers can not leave behind residual nutrients to be used by the succeeding crop as compared to organic manures. The results of the present investigation are in agreement with those of Gorodonii *et al.* (1999) .

REFERENCES

Gorodonii, M. M., Bogdan, I. K., Bikin, A. B., Karpenko. M. A., Sheremet, O. P., Likhozhan, O. I. and Adamenko, S. M. (1994). The effect of vermicompost on physiological processes and plant productivity. *Fiziologiya - i - Biokhimya - Kulturmykh - Rastenii*, **26**(4): 405-410.

Humphries, E.C. (1956). Mineral components and ash analysis. In: *Modern method of plant analysis*. Spinger - Verlag, Berlin **1**: 468-502.

Jackson, M.L. (1973). Soil chemical analysis. Prentice Hall India Private Limited, NEW DELHI, INDIA, 498 pp.

Ken Knight,G. and Muncie, J.H. (1939). Isolation of phytopathogenic actinomycetes. *Phytopathology,* **29**:1000-1001

Lindsay, W. L. and Norvell, W. A . (1978). Development of DTPA soil test for Zn, Fe, Mn and Cu. *Soil Sci. Soc. American J.,* **42** : 421-428.

Malick, C.P. and Singh, M.B. (1980). *Plant enzymology and histo enzymlogy*. Kalyani Publication.

Rao, A.U. (2004). Studies on integrated nitrogen management and seedling ages in rice-greengram system. Ph.D Thesis, Acharya N.G. Ranga Agricultural University, Hyderabad, A.P. (INDIA).

Rao, A.U. and Murthy, K.M.D. (2009). Residual effect of integrated nitrogen management in rice on succeeding mungbean. *J. Food Legumes*, **20**(2):190-191.

Sharma ,C.M., Seema.O and Bharadwaj, S.K. (2003). Agronomic efficacy of indigenous and exotic rock phosphate in soybean in acid soils. *Indian J. Agron.,* **48** (4):305-308.

Somogyi, M. (1952). Note on sugar determination. *J. Biol. Chem.*, **200**:145-154.

Sunitha ,A., Raja,V., Reddy, R.S. and Rao, B.V. (2004). Soil microbial activity and nutrient dynamics in rice soils as affected by organic farming. Proceedings of symposium on organic farming-prospects and challenges in the millennium. organised by ANGRAU,Hyderabad from 13 -14. May 2004.PP.45-48.

Veeresh, G.K. (2002). Organic farming: ecologically sound and economically sustainable NGO back ground papers Regional Perspective: India 2-6pp

Walkey, A. and Black, C. A. (1934). Estimation of organic carbon by chromic acid titration method. *Soil Sci.*, **37**: 29-38.

*_*_*_*_*_*