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Organic Farming Studies in Greengram

Tejeswara Rao K , Srinivasula Reddy D and Ramana A V
Agricultural Research Station, Seethampeta, Srikakulam , Andhra Pradesh 532 443

ABSTRACT

Investigations entitled "Studies on organic farming in maize- sunflower- greengram cropping system were carried out for two consecutive years (2003-04 and 2004-2005) at S V Agricultural College farm (ANGRAU), Tirupati. In these investigations, greengram was raised as residual crop during summer in both the years of experimentation. 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 equal nitrogen basis and one treatment of no manuring through any source 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*.

Nitrogen uptake by greengram 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*. The uptake of phosphorus and potassium by greengram crop 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*. 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, Neem leaf manure, Organic farming, Panchagavya, Poultry manure, Residual fertility, Vermicompost.

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 . 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). In view 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. Scientific studies are limited to disclose the productivity levels, their stability and profitability that can be achieved through pure organic sources of nutrient supply in comparison with inorganic sources. It is very much essential to develop strong, viable and compatible packages of nutrient management through organic sources for various crops and cropping systems to suit the local conditions. In light of the above, investigations were taken up for two consecutive years, with the objectives of studying the response of greengram to residual fertility of different organic manures, to trace out any residual fertility of the influence of *Panchagavya* on the productivity and quality of greengram, to trace out the carry over effect of organic manures applied to maize and sunflower on the dynamics of soil fertility in the cropping system.

Table 1. 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) Jackso (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)
Calcium (mg kg^{-1})	28	Jackson (1973)
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	

Table 2. Plant height, leaf area index of greengram at harvest as influenced by varied manurial practices and *Panchagavya* spray.

	Treatments	Plant height at harvest(Cm)		Leaf area index at harvest		Drymatter production (kg ha^{-1})	
		2004	2005	2004	2005	2004	2005
T_1	No manure	22.8	26.4	1.14	1.23	2014	2085
T_2	No manure + *panchagavya*	23.5	27.2	1.22	1.32	2032	2102
T_3	Recommended dose of fertilizer	26.2	33.5	1.45	1.56	2086	2175
T_4	Recommended dose of fertilizer + *panchagavya*	26.8	34.0	1.47	1.58	2110	2192
T_5	Farm yard manure	29.5	36.8	1.71	1.82	2186	2304
T_6	Farm yard manure + *panchagavya*	30.2	37.2	1.73	1.84	2234	2336
T_7	Vermicompost	30.8	37.5	1.73	1.84	2268	2368
T_8	Vermicompost + *panchagavya*	31.5	38.0	1.78	1.86	2332	2382
T_9	Neem leaf	34.0	40.8	2.00	2.12	2532	2601
T_{10}	Neem leaf + *panchagavya*	34.6	41.4	2.03	2.14	2564	2612
T_{11}	Poultry manure	40.4	47.6	2.51	2.65	2706	2792
T_{12}	Poultry manure + *panchagavya*	41.1	47.9	2.54	2.69	2730	2808
T_{13}	Pig manure	37.2	44.4	2.25	2.38	2620	2685
T_{14}	Pig manure + *panchagavya*	37.8	44.8	2.28	2.40	2644	2721
	SEm±	0.92	0.85	0.070	0.081	19.0	24.3
	CD (P = 0.05)	2.4	2.6	0.20	0.23	54	69

Table 3. Yield attributes of greengram as influenced by the residual effect of varied manurial practices and *Panchagavya* spray to preceding crops of maize and sunflower

	Treatments	Number of pods plant^{-1}		Number of seeds pod^{-1}		1000 seed weight (g)	
		2004	2005	2004	2005	2004	2005
T_1	No manure	7.0	7.2	5.2	5.5	19.4	21.8
T_2	No manure + *panchagavya*	7.2	7.5	5.6	5.8	20.8	22.5
T_3	Recommended dose of fertilizer	12.8	13.0	8.2	9.0	24.2	25.6
T_4	Recommended dose of fertilizer + *panchagavya*	13.0	13.1	8.6	9.2	24.6	26.0
T_5	Farm yard manure	13.8	14.0	9.4	9.8	26.2	27.5
T_6	Farm yard manure + *panchagavya*	14.0	14.0	9.4	9.8	26.2	27.8
T_7	Vermicompost	14.2	14.2	9.6	10.0	26.4	28.0
T_8	Vermicompost + *panchagavya*	14.4	14.2	9.6	10.0	26.6	28.0
T_9	Neem leaf	15.2	15.2	10.2	10.6	28.0	29.5
T_{10}	Neem leaf + *panchagavya*	15.4	15.6	10.2	10.6	28.2	29.8
T_{11}	Poultry manure	17.2	17.6	11.2	12.0	31.3	32.8
T_{12}	Poultry manure + *panchagavya*	17.3	17.7	11.4	12.1	31.6	33.2
T_{13}	Pig manure	16.2	16.5	10.6	11.3	29.6	31.2
T_{14}	Pig manure + *panchagavya*	16.4	16.7	10.7	11.4	30.0	31.4
	SEm±	0.25	0.28	0.14	0.18	0.42	0.46
	CD (P = 0.05)	0.7	0.8	0.4	0.5	1.2	1.3

MATERIAL AND METHODS

Investigations entitled "Studies on organic farming in maize- sunflower- greengram cropping system were carried out for two consecutive years (2003-04 and 2004-2005) at S V Agricultural College farm, Tirupati. In these investigations, Greengram was grown during *summer* 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 equal nitrogen basis and one treatment of no manuring through any source . All the seven treatments were tried with and without foliar application of *panchagavya, thus* making the total treatments to fourteen. The test cultivar of greengram LGG-460 was used. Panchagavya is a mixture of cow dung (1kg), cow urine (750 ml), cow milk (500 ml), cow curd (500ml) and cow s ghee (250ml). In addition, sugarcane juice (750ml), were significantly higher with the application of any of the five organic manures in combination with foliar application of *panchagavya* than with the use of tender coconut water (750ml), pure honey (250ml) and ripe bananas (250g) were also added to accelerate the fermentation process .All the analysed properties of the indigenous mixture *panchagavya* are of pure organic in origin (Table 1). Plant height from ground surface to top most growing point was recorded from ten labeled plants of net plots at harvest 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 harvest. Leaf area index was calculated by dividing the total leaf area with corresponding land area as per the formula suggested by Watson (1952). 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^{0}C 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

Table 4. Yield (kg ha^{-1}), harvest index (%) and Protein content (%) of greengram as influenced by the residual effect of varied manurial practices and *Panchagavya* spray to preceding crops of maize and sunflower.

Treatments		Seed Yield		Haulm Yield		Harvest Index		Protein Content	
		2004	2005	2004	2005	2004	2005	2004	2005
T_1	No manure	380	396	954	992	18.87	18.99	14.8	15.2
T_2	No manure + *panchagavya*	392	412	972	1016	19.29	19.60	14.8	15.2
T_3	Recommended dose of fertilizer	442	462	1204	1268	21.19	21.24	16.5	16.6
T_4	Recommended dose of fertilizer + *panchagavya*	454	476	1225	1294	21.52	21.72	16.5	16.8
T_5	Farm yard manure	502	526	1388	1456	22.96	22.83	20.4	20.5
T_6	Farm yard manure + *panchagavya*	526	542	1415	1485	23.55	23.20	20.4	20.5
T_7	Vermicompost	546	568	1438	1518	24.07	23.99	20.6	20.8
T_8	Vermicompost + *panchagavya*	568	584	1482	1532	24.36	24.52	20.6	20.8
T_9	Neem leaf	652	672	1586	1648	25.75	25.84	20.6	20.8
T_{10}	Neem leaf + *panchagavya*	665	684	1612	1685	25.94	26.19	21.0	21.4
T_{11}	Poultry manure	784	812	1954	2058	28.97	29.08	21.2	21.6
T_{12}	Poultry manure + *panchagavya*	792	824	1986	2092	29.01	29.34	21.2	21.8
T_{13}	Pig manure	724	742	1825	1872	27.63	27.64	21.0	21.4
T_{14}	Pig manure + *panchagavya*	732	758	1852	1904	27.69	27.86	21.2	21.6
	SEm±	14.8	17.3	33.8	40.1	0.338	0.381	0.28	0.32
	CD (P = 0.05)	42	49	96	114	0.96	1.08	0.8	0.9

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 g. 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 (Dubez and Wells, 1968) to arrive at the crude protein content and expressed in percent.

RESULTS AND DISCUSSION

The tallest plants with largest leaf area and highest dry matter accumulation, with the highest number of pods plant^{-1} and number of seeds pod^{-1} as well as thousand seed weight, 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* (T_{12} and T_{11}) 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* (T_{14} and T_{13}), which was significantly higher than with the residual effect of neem leaf manure with or without *panchagavya* (T_{10} and T_9), which in turn was statistically superior to the residual effect of vermicompost or farm yard manure with or without *panchagavya* (T_8, T_7, T_6 and T_5). Application of recommended dose of fertilizer with or without *panchagavya* (T_4 and T_3) 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* (T_2 and T_1). All the above mentioned parameters of greengram were at their lowest with the residual effect of non-manuring to both the preceding crops (Table 2-5).

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

Table 5. Economics of greengram as influenced by the residual effect of varied 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	
		2004	2005	2004	2005	2004	2005
T_1	No manure	7600	7920	3800	4120	2.00	2.08
T_2	No manure + *panchagavya*	7840	8240	4040	4440	2.06	2.17
T_3	Recommended dose of fertilizer	8840	9240	5040	5440	2.33	2.43
T_4	Recommended dose of fertilizer + *panchagavya*	9080	9520	5280	5720	2.39	2.51
T_5	Farm yard manure	10040	10520	6240	6720	2.64	2.77
T_6	Farm yard manure + *panchagavya*	10520	10840	6720	7040	2.77	2.85
T_7	Vermicompost	10920	11360	7120	7560	2.87	2.99
T_8	Vermicompost + *panchagavya*	11360	11680	7560	7880	2.99	3.07
T_9	Neem leaf	13040	13440	9240	9640	3.43	3.54
T_{10}	Neem leaf + *panchagavya*	13300	13680	9500	9880	3.50	3.60
T_{11}	Poultry manure	15680	16240	11880	12440	4.13	4.27
T_{12}	Poultry manure + *panchagavya*	15840	16480	12040	12680	4.17	4.34
T_{13}	Pig manure	14480	14840	10680	11040	3.81	3.91
T_{14}	Pig manure + *panchagavya*	14640	15160	10840	11360	3.85	3.99
	SEm±	276.1	283.8	229.6	244.7	0.049	0.053
	CD (P = 0.05)	784	806	652	695	0.14	0.15

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 by greengram crop(Table-6)

Residual effect of poultry manure either with or without the spray of *panchagavya* (T_{12} and T_{11}) applied to previous crops of maize and sunflower was comparable, in respect of phosphorus uptake of greengram, which was the highest. The next highest phosphorus uptake was recorded with pig manure with or without *panchagavya* (T_{14} and T_{13}), which was significantly higher than with the residual effect of neem leaf manure with or without *panchagavya* (T_{10} and T_9), which in turn was statistically superior to the residual effect of vermicompost or farm yard manure with or without *panchagavya* (T_8, T_7, T_6 and T_5). Application of recommended dose of fertilizer with or without *panchagavya* (T_4 and T_3) 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* (T_2 and T_1).

Residual effect of vermicompost either with or without the spray of *panchagavya* (T_8 and T_7) applied to previous crops of maize and sunflower was comparable, in respect of potassium uptake of greengram, which was the highest. The next higher potassium uptake was recorded with pig manure with or without *panchagavya* (T_{14} and T_{13}), which was significantly higher than with the residual effect of farm yard manure or neem leaf manure or poultry manure with or without *panchagavya* (T_6, T_{10}, T_{12}, T_5, T_9 and T_{11}), but comparable among them. Application of recommended dose of fertilizer with or without *panchagavya* (T_4 and T_3) to preceding crops resulted in higher potassium uptake than with the residual effect of non manuring to previous crops with or without *panchagavya* (T_2 and T_1). The lowest uptake of phosphorus and potassium by greengram crop at different crop growth stages(Table 6) was registered with the residual effect of non-manuring to both the preceding crops.The highest gross and net returns as well as benefit-cost ratio from greengram crop(Table 5) were realized with poultry manure along with *panchagavya* spray (T_{12}), which

Table 6. Nitrogen, phosphorus and potassium uptake (kg ha^{-1}) of greengram at harvest as influenced by varied manurial practices and *Panchagavya* spray

Treatments		N uptake		P uptake		K uptake	
		2004	2005	2004	2005	2004	2005
T_1	No manure	17.2	17.6	2.74	3.64	9.8	10.6
T_2	No manure + *panchagavya*	18.6	19.2	2.82	3.82	10.2	11.2
T_3	Recommended dose of fertilizer	31.8	33.8	3.68	4.86	13.8	14.6
T_4	Recommended dose of fertilizer + *panchagavya*	32.9	35.6	3.72	4.98	14.2	15.0
T_5	Farm yard manure	55.0	54.5	5.22	6.52	16.8	19.2
T_6	Farm yard manure + *panchagavya*	57.0	55.9	5.25	6.54	16.8	19.2
T_7	Vermicompost	54.4	54.2	5.28	6.58	21.4	23.6
T_8	Vermicompost + *panchagavya*	56.0	55.0	5.28	6.58	21.8	24.1
T_9	Neem leaf	54.0	53.6	7.78	7.02	16.5	19.0
T_{10}	Neem leaf + *panchagavya*	55.2	54.8	7.80	7.08	16.6	19.0
T_{11}	Poultry manure	54.2	54.0	8.83	8.02	16.4	18.1
T_{12}	Poultry manure + *panchagavya*	55.8	54.8	8.90	8.10	16.4	18.6
T_{13}	Pig manure	54.6	54.5	8.30	7.52	19.0	21.2
T_{14}	Pig manure + *panchagavya*	56.4	55.2	8.32	7.56	19.4	21.6
	SEm±	1.55	1.41	0.169	0.148	0.63	0.67
	CD (P = 0.05)	4.4	4.0	0.48	0.42	1.8	1.9

were however, comparable with poultry manure alone (T_{11}) and significantly higher than with pig manure either with or without *panchagavya* (T_{14} and T_{13}), which were superior to neem leaf manure with or without *panchagavya* (T_{10} and T_9), which in turn were significantly higher than with vermicompost or farm yard manure with or without the use of *panchagavya* (T_8, T_7, T_6 and T_5). Supply of nitrogen through fertilizer either with or without *panchagavya* (T_4 and T_3) 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 (T_2 and T_1). The tallest plants with largest leaf area and highest dry matter accrual (Table 2), with the highest number of pods $plant^{-1}$ and number of seeds pod^{-1} as well as thousand seed weight, highest yield (Table 4), highest harvest index, highest protein content of seed (Table 4), highest nutrient uptake (Table 6) and economic returns (Table 5) of greengram were recorded with the residual effect of poultry manure applied to previous crops of maize and sunflower. 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. Greengram being a legume, it responds to the supply of phosphorus and poultry manure, which was applied to the preceding crops contained high quantity of P, which would have left considerable quantity P in the soil to be utilized by greengram, which might have triggered the growth resulting in higher yield, quality and economic returns. 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 Gaudencio *et al.* (1998) and Dash *et al.* (*2000*).

It is customary in India, to include short duration pulse crops in high intensive cropping systems, since they are known to sustain with the residual fertility of soil resulting from heavily manured preceding crops of the cropping system, besides enriching the soil with moderate quantities of nitrogen. In the present study, greengram crop was raised succeeding 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**.** crop realized with the residual effect of non-manuring to both the preceding crops.

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