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RESEARCH ARTICLE

Organic farming studies in sunflower

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SUMMARY

Field experiments were conducted for two consecutive *Rabi* seasons of 2003-04and 2004-05 at Tirupati , Southern plateau and Hills zone of India on red sandy soils with fourteen treatments comprised 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 equalant nitrogen basis and one absolute control were tried with and without the foliar application of *Panchagavya,* . All the growth and yield attributes, yield (seed as well as stalk) harvest index, nitrogen uptake and gross returns as well as net returns of sunflower were at their best with recommended dose of fertilizer either with or without *Panchagavya* spray. The highest oil content of the seed was recorded with neem leaf manure in combination with *Panchagavya*, which was however, comparable with all the other four organic sources tried in combination with *Panchagavya*, but significantly higher than with the fertilizer either with or without the use of *Panchagavya*. The highest phosphorus uptake of sunflower was recorded with 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*. Irrespective of the source of nutrient supply, foliar application of *Panchagavya* resulted in higher nutrient uptake of sunflower than with the use of respective organic manures alone without the use of *Panchagavya*. Among the organic sources tried, the highest net returns and benefit-cost ratio of sunflower were realized with poultry manure in combination with *Panchagavya*.

Key Words : Sunflower, Organic farming, *Panchagavya*, Yield, Nutrient uptake

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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. 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. In light of the above, investigations were taken up for two consecutive years, with the objectives of studying the response of sunflower to different organic manures, to investigate the influence of *Panchagavya* on the productivity and quality of sunflower, to trace out the effect of organic manures applied to sunflower, to work out the dynamics of soil fertility in the cropping system and to suggest the best organic manurial practice for sunflower, based on productivity, economic viability and sustenance of soil fertility.

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MATERIALS AND METHODS

Field experiments were conducted for two consecutive *Rabi* seasons of 2003-04and 2004-05 at S.V. Agricultural college

farm (ANGRAU), Tirupati , Southern plateau and Hills zone of India on red sandy soils with fourteen treatments comprised 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 the foliar application of *Panchagavya*, thus, making the total treatments to fourteen .The experiment was laid out in a Randomized Block Design, replicated thrice and the experiment was carried in the same field during both the years of study with un distrubbed lay out . The test cultivar of sunflower, MSFH-17 was used. *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, sugarcane juice (750ml), tender coconut water (750ml), pure honey (250ml) and ripe bananas (250g) were also added to accelerate the fermentation process. Plant height of sunflower was recorded at 15 days interval up to heading, by measuring from base of the plants to the terminal bud of the ten tagged plants 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 15 days interval till harvest. Leaf area index was calculated by dividing the total leaf area with corresponding land area as per the formula. Five plants from the destructive sampling area were cut to the base, sun dried and then oven dried at 60°C till to a constant weight and expressed as kg ha^{-1}.Diameter of the heads from the labeled plants of each of the net plots was measured, averaged and expressed in cm. Both filled and unfilled seeds from the heads of ten plants were counted and the mean value was expressed as total number of seeds $head^{-1}$.From the total number of seeds $head^{-1}$, filled seeds were separated, counted, averaged and expressed as filled seeds $head^{-1}$.Five composite samples of 1000 seeds each were drawn from net plot produce of each treatment and weights were recorded. The mean value was presented as thousand seed weight in g. Seed obtained from the net plots was thoroughly sun dried to a moisture level of 8 per cent, weighed and expressed in kg ha^{-1}. Stalks obtained from net plots were thoroughly 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. Oil content of sunflower seeds was estimated by using ether extraction procedure in a soxhlet apparatus and also confirmed with NMR spectroscopy (Bruter Minispe P_2O_5 model) against a standard reference sample. Biochemical properties of *Panchagavya* stock solution are given Table A.

RESULTS AND DISCUSSION

The tallest plants with largest leaf area and highest dry matter accrual, with the largest head diameter, highest number of total and filled seeds $head^{-1}$ and highest grain weight, highest yield (seed as well as stalk), highest harvest index of sunflower were produced with recommended dose of fertilizer. With the recommended dose of fertilizer, any crop would perform at its best, because of adequate and balanced nutrient supply to the crop at the right time of requirement. Accordingly, the sunflower crop under comfortable nutrition could produce the growth parameter of the highest stature, which could accrue huge quantity of biomass and partitioned a sizeable quantity of assimilates to the sink. Thus, resulting in better yield structure as exhibited by all the yield attributes

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 and 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)	26 x 10^6	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	

of the largest stature, which could result in the highest yield. The results of present investigation are in accordance with . . . . *et al.* (1999).

The highest oil content in the seed of sunflower was recorded with neem leaf manure, which was comparable with all other organic sources tried (Table 2). For biosynthesis of oil in oilseed crops, sulphur is required in adequate quantities. Organic manures possess large quantities of secondary and micronutrients, besides the major nutrients. Thus the large quantities of sulphur present in organics applied would have manifested in higher oil content in sunflower seed. Similar findings were reported by Somasundaram (2003).

The highest nitrogen uptake of sunflower was registered with recommended dose of fertilizer, while that of phosphorus uptake was highest with poultry manure. The potassium uptake was highest with vermicompost (Table 3). Under recommended level of nitrogen supply, N would be taken up by the crop uninterruptedly, since it was applied in suitable number of splits to match the physiological needs of the crop, resulting greater absorption compared to the organic source of N applied totally as basal. Higher uptake of N by sunflower crop with recommended dose of fertilizer than with organic sources, even on equal nutrient basis was reported by several earlier researchers. The highest P uptake by sunflower crop was recorded with poultry manure and the highest K uptake was associated with vermicompost. This was due to higher levels of P and K in the corresponding organic manures, which happened to be due to the application of all manures and fertilizer on equal N basis. These results are in agreement with those of Raju *et al.* (1991), Bhiday (1994), Ramamurthy and Shivashankar (1997) and Lam *et al.* (1997).

Fertilizer application could just maintain the status of soil organic carbon in the cropping system, with neither improving nor declining at the end of the annual cropping cycle. While it was found gradually built up compared to the pre-experimental level with the application of organic manures. Among the organic sources tried, neem leaf manure, vermicompost and farmyard manure added more organic carbon to the soil compared to pig manure and poultry manure. Slow decomposition of neem leaf , vermicompost and farmyard manure over other manures may probably the reason for the differences in soil organic carbon .Neverthless, organics did build up the organic content as well as nutrients there by indicating the sustenance of soil productivity. Ramesh and Rao (2009) also reported that soil health could be sustained with organic nutrition due to diversification of soil biota.

Available nitrogen status was higher with neem leaf manure followed by poultry manure and vermi compost than with pig manure and farmyard manure (Table 3). Fertilizer application almost maintained the status of available nitrogen , while it was declined with absolute control. The mineralization of organic manures and release pattern of nitrogen into the soil solution differs at large and accordingly and available

Table1: Growth parameters,yield attributes of sunflower as influenced by varied manurial practices and *Panchagavya* spray

	Treatments	Plant height at heading(cm)		Leaf area index at 60 DAS		Dry matter production (kg ha^{-1})		Head diameter (cm)		Total seeds head^{-1}		Filled seeds head^{-1}		1000 seed weight(g)	
		2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
T_1	No manure	64.5	62.4	0.46	0.49	1325	1436	7.3	7.8	153	169	117	135	29.4	31.2
T_2	No manure + *Panchagavya*	78.7	72.5	0.72	0.73	1532	1724	9.5	10.0	186	202	168	182	32.4	33.2
T_3	Recommended dose of fertilizer	134.2	134.5	1.81	1.84	4448	4586	16.0	17.2	396	404	325	347	40.7	41.8
T_4	Recommended dose of fertilizer + *Panchagavya*	135.6	137.4	1.84	1.87	4503	4642	16.3	17.5	403	412	331	352	40.9	42.1
T_5	Farm yard manure	110.2	106.2	1.42	1.42	3752	3868	12.0	13.2	290	288	252	280	37.2	37.0
T_6	Farm yard manure +*Panchagavya*	123.5	122.8	1.62	1.64	4187	4278	14.0	15.2	350	353	294	318	39.2	40.0
T_7	Vermicompost	106.2	102.5	1.40	1.40	3677	3748	12.0	13.0	280	274	248	268	37.0	36.8
T_8	Vermicompost + *Panchagavya*	121.6	120.6	1.60	1.62	4093	4168	13.8	15.0	340	336	284	310	39.0	38.8
T_9	Neem leaf	112.8	110.3	1.43	1.45	3853	3942	12.2	13.4	302	302	262	286	37.5	37.2
T_{10}	Neem leaf + *Panchagavya*	125.8	124.2	1.65	1.66	4252	4364	14.2	15.5	362	368	304	324	39.4	40.2
T_{11}	Poultry manure	111.6	108.6	1.42	1.45	3800	3898	12.2	13.2	296	292	258	282	37.4	37.0
T_{12}	Poultry manure + *Panchagavya*	124.6	123.3	1.65	1.64	4198	4304	14.0	15.5	358	361	298	320	39.2	40.0
T_{13}	Pig manure	108.8	104.8	1.40	1.42	3707	3793	12.0	13.0	284	280	250	275	37.2	36.8
T_{14}	Pig manure – *Panchagavya*	122.8	121.6	1.62	1.62	4142	4234	13.8	15.0	345	348	288	312	39.0	38.8
	S.E.±	2.78	2.89	0.053	0.056	63.7	71.8	0.49	0.53	10.21	11.27	6.69	7.39	0.42	0.49
	C.D. (P = 0.05)	7.9	8.2	0.15	0.16	181	204	1.4	1.5	29	32	19	21	1.2	1.4

Table 2: Yield, harvest index, oil content and economics of sunflower as influenced by varied manurial practices and *Panchagavya* spray

Treatments		Seed yield (kg ha^{-1})		Stalk yield (kg ha^{-1})		Harvest Index (%)		Oil content (%)		Gross returns (Rs ha^{-1})		Net returns (Rs ha^{-1})		Benefit-cost ratio	
		2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
T_1	No manure	442	484	618	754	33.36	33.70	31.3	31.6	7072	7744	2572	3244	1.57	1.72
T_2	No manure + *Panchagavya*	526	594	804	928	34.33	34.45	33.5	33.8	8416	9504	3616	4704	1.75	1.98
T_3	Recommended dose of fertilizer	1669	1729	2225	2284	37.52	37.70	36.2	36.4	26704	27664	20004	20964	3.99	4.13
T_4	Recommended dose of fertilizer + *Panchagavya*	1696	1757	2264	2302	37.66	37.85	36.4	36.5	27136	28112	20136	21112	3.88	4.02
T_5	Farm yard manure	1328	1375	1838	1925	35.39	35.55	38.6	39.0	21248	22000	14396	15148	3.10	3.21
T_6	Farm yard manure + *Panchagavya*	1546	1586	2064	2128	36.92	37.07	40.6	41.2	24736	25376	17584	18224	3.46	3.55
T_7	Vermicompost	1292	1335	1782	1875	35.14	35.62	38.4	38.8	20672	21360	13175	13863	2.76	2.85
T_8	Vermicompost + *Panchagavya*	1504	1538	2005	2092	36.75	36.90	40.6	41.2	24064	24608	16267	16811	3.09	3.16
T_9	Neem leaf	1385	1418	1884	1964	35.95	35.97	38.6	39.0	22160	22688	16060	16588	3.63	3.72
T_{10}	Neem leaf + *Panchagavya*	1578	1624	2108	2162	37.11	37.21	40.9	41.5	25248	25984	18848	19584	3.95	4.06
T_{11}	Poultry manure	1354	1396	1862	1942	35.63	35.81	38.4	38.6	21664	22336	16536	17208	4.22	4.36
T_{12}	Poultry manure + *Panchagavya*	1552	1602	2096	2144	36.97	37.22	40.8	41.5	24832	25632	19404	20204	4.57	4.72
T_{13}	Pig manure	1305	1352	1816	1906	35.20	35.64	38.4	38.8	20880	21632	12810	13562	2.59	2.68
T_{14}	Pig manure +*Panchagavya*	1528	1564	2028	2104	36.89	36.94	40.4	41.0	24448	25024	16078	16654	2.92	2.99
	S.E.±	28.5	33.1	39.4	41.9	0.127	0.138	0.56	0.60	419.7	452.1	276.4	290.1	0.063	0.065
	C.D. (P = 0.05)	81	94	112	119	0.36	0.39	1.6	1.7	1192	1284	785	824	0.18	0.18

Table 3 : Nitrogen, phosphorus and potassium uptake (kg ha^{-1}) of sunflower at harvest and post harvest soil available nitrogen, phosphorus and potassium as influenced by varied manurial practices and *Panchagavya* spray

Treatments		N uptake		P uptake		K uptake		Organic carbon (%)		Nitrogen (kg ha^{-1})		Phosphorus (kg ha^{-1})		Potassium (kg ha^{-1})	
		2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
	Initial	-	-	-	-	-	-	0.23	0.32	135.6	174.4	17.63	26.75	176.5	224.3
T_1	No manure	20.4	21.4	4.75	5.32	31.5	34.2	0.16	0.14	103.5	84.2	12.72	8.23	160.8	132.8
T_2	*panchagavya*	26.5	28.6	4.82	5.38	32.6	34.8	0.16	0.14	103.0	84.0	12.70	8.18	160.2	132.2
T_3	RDF	75.8	78.4	7.80	8.20	47.8	51.6	0.20	0.15	118.5	125.0	25.15	41.40	204.6	216.5
T_4	RDF + *panchagavya*	76.4	78.8	8.10	8.26	48.6	52.5	0.20	0.15	117.4	123.0	24.52	40.44	202.5	214.8
T_5	Farm Yard Manure	64.6	67.2	8.75	9.68	59.6	60.0	0.39	0.45	138.0	173.4	18.54	22.88	210.2	225.6
T_6	FYM + *panchagavya*	70.8	73.5	9.50	9.76	60.4	60.6	0.39	0.45	138.0	172.6	18.28	22.43	208.4	223.8
T_7	Vermicompost	63.2	65.6	9.54	9.82	67.8	68.0	0.40	0.48	144.2	181.8	20.60	27.92	232.5	298.2
T_8	Vermicompost + *panchagavya*	69.4	72.0	9.58	9.90	68.4	68.8	0.40	0.48	143.4	180.6	20.26	27.64	230.8	295.4
T_9	Neem leaf	66.0	68.6	10.76	11.04	58.2	58.4	0.42	0.49	158.2	206.2	22.82	33.63	211.2	237.5
T_{10}	Neem leaf + *panchagavya*	72.2	74.8	10.82	11.16	59.0	59.2	0.42	0.49	157.5	204.8	22.45	33.04	210.6	235.8
T_{11}	Poultry manure	65.2	68.0	13.28	13.96	56.8	57.2	0.30	0.36	148.2	193.9	28.26	48.06	206.8	218.6
T_{12}	Poultry manure + *panchagavya*	71.4	74.2	13.40	14.10	57.4	57.8	0.30	0.36	147.5	193.1	27.84	47.04	205.4	218.2
T_{13}	Pig manure	63.8	66.4	12.02	12.40	63.8	64.0	0.32	0.36	138.6	174.8	24.45	39.16	228.2	293.2
T_{14}	Pig manure + *panchagavya*	70.2	72.8	12.10	12.70	64.6	64.5	0.32	0.36	138.5	174.0	23.88	38.21	226.4	291.4
	SEm±	1.13	1.13	0.394	0.408	1.06	1.13	0.03	0.04	4.17	4.63	0.878	1.019	6.28	6.53
	CD (P = 0.05)	3.2	3.2	1.12	1.16	3.0	3.2	0.09	0.11	11.9	13.2	2.5	2.9	17.9	18.6

nitrogen replenished the soil solution. Buiilt up Soil available phosphorus and available potassium status in the was found compared to the pre-experimental level, with the application of organic manures as well as fertilizer. The build up of soil available phosphorus status with varied manurial practices was in the descending order of poultry manure, pig manure , fertilizer, neem leaf manure, vermicompost and farmyard manure, while the build up of soil available potassium status with varied manurial practices was in the descending order of vermicompost, pig manure, neem leaf manure, farmyard manure, poultry manure and fertilizer. The P and K content of different organic sources tried differed to a large extent and the final balances of P and K were in commensurate to their respective contents of P and K in different organic sources. Higher available nutrient status with organic farming practices might be due to slow decomposition of organic components, the losses of N from these fractions may be minimized, in addition to synergistic effect on P and K transformation, the available nutrient status tend to improve slightly compared to the initial nutrient level. All the four soil fertility parameters were found depleted at the end of two year cropping cycles due to non-manuring to any of the crops in the cropping system *i.e.* absolute control. The results are in line with that of Stockdale *et al.*, 2001), who reported that soil fertility could be sustained with organic nutrition due to tightening the nutrient cycles.

The highest seed yield of sunflower obtained with recommended dose of fertilizer, obviously resulted in higher economic returns. Reasonably higher yield resulting in higher gross returns and relatively cheaper cost of poultry manure has resulted in higher B-C ratio. The outcome from the present investigation corroborates with the findings of Natarajan (2002), Parrot and Marsdon (2002) and Somasundaram (2002).All the five organic manures tried on sunflower crop have resulted in equal performance in terms of yield and economic returns. The results have revealed that sunflower crop could respond to various organic manures in similar way and hence, one can go for the choice of organic sources to sunflower, depending upon the abundant availability locally and cheaper cost. The outcome of the present investigation corroborates with the findings of Murugappan *et al.* (2001), Franki *et al.* (2004) and Latha *et al.* (2002).

Growth parameters, yield attributes, yield, nutrient uptake, oil content of the seed and economic returns were at their lowest with non- manuring of sunflower through any source. It is obvious that modern genotypes of crops would under perform in the absence of adequate nutrient supply, since they are responsive only to the applied nutrients and the same thing happened in the present study. Sunflower crop has flowered and matured at the earliest with no manure, while the flowering and maturity was found most delayed with recommended dose of fertilizer, which took significantly more number of days than with all the organic sources of manuring which were comparable among them. Under adequate nutrition of N and its availability to the crop continuously, the vegetative phase will be extended and it is opposite with non-supply of N, exactly that was what happened in the present study. Widely published research evidence is available to support the same phenomenon in several crops, including sunflower.

Panchagavya was applied as foliar spray to sunflower crops (as per the treatments) at fortnightly intervals starting from 15 DAS to 15 days before harvest. *Panchagavya* was known to contain plant growth stimulants, which can enhance the biological efficiency of crops and the quality of the produce (Pathak and Ram, 2002). It contains macro and micronutrients, besides several groups of beneficial microorganisms (Table 1). The effect of *Panchagavya* on the productivity and quality of the economic produce of maize and sunflower is deduced here under. *Panchagavya* has exerted variable influence on different parameters of the two crops on which it was applied. Oil content of sunflower seed was found improved considerably with foliar application of *panchagavya* in combination with any of the organic manures tried over their individual application. The increase in oil content with the use of *Panchagavya* ranged from 5.2 to 8.0 per cent with different manures. As indicated earlier, *Panchagavya* is known to contain certain plant growth stimulants, which can improve the biological efficiency and quality of certain crops (Pathak and Ram, 2002). Thus, the oil content of sunflower seed might have been improved due to beneficial effect on biosynthesis of oil. These results are in accordance with those of Somasundaram (2003).

It was clearly found from this study that foliar application of *Panchagavya* alone to maize and sunflower crops could not exert any beneficial effect either on the productivity or quality and this was just comparable with non-manuring to the two crops through any source. This amply indicates that foliar application of *Panchagavya* alone to crops can not meet the nutritional requirement of the crops and *Panchagavya* can be used as a supplement or additive, whenever organic sources are applied to the crops. Further, *Panchagavya* acts as a top dressing to supplement the nutrient requirement of crop. Hence, it can be tried out higher levels of organic sources and high carbon contents of soils also.

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