

# Effect of organics on the productivity of groundnut and its residual effects on succeeding safflower under rainfed farming situations

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## Abstract

The results indicated that organic farming with heavy application of farmyard manure (FYM) (75 t/ha) during kharif 2004 produced higher dry pod yield (3510 kg/ha) as compared to inorganic farming involving applications of recommended dose of NPK fertilizers (2970 kg/ha). However, during 2005 and 2006, inorganic fertilizer amended plots produced higher pod yield of groundnut (1660 to 2333 kg/ha) compared to organically amended plots (1597 to 1937 kg/ha). The study indicated that the groundnut showed greater response to the application of organic manures (i.e., organic farming) under low rainfall with dry spell situations occurring at early growth stages. On the contrary, under wet situations (i.e., with good rainfall and good number of rainy days during the entire growth period), groundnut showed greater response to the applications of a recommended dose of NPK fertilizers (i.e., inorganic farming). Organic amendments to a groundnut crop during kharif and no organic manures and fertilizers to safflower during rabi in groundnut-safflower sequence cropping system (double cropping system) produced 13.24 to 22.69 % higher seed yield of safflower over treatment with the inorganic fertilizers to groundnut crop during kharif and no organic manures and fertilizers to safflower during rabi (816 to 1437 kg/ha).

## Key Words

Kharif: Rainy season, Rabi: Post-rainy season, RD: Rainy day/s, FYM: Farmyard manure, DAS: Days after sowing.

## Introduction

Among the different agronomic management practices, use of organics is of prime importance under rainfed farming situations. High yields of groundnut and sustainability in its production can be obtained with better fertility management practices especially with organic farming practices (Nagaraj *et al.* 2001). Organic farming in recent years gaining impetus due to realization of inherent advantages it confers in sustaining crop production under aberrant rainfed farming situations and also maintaining dynamic soil nutrient status and safe environment (Malligawad and Parameshwarappa 2006; Malligawad *et al.* 2007). Use of either farmyard manure (FYM) and vermicompost along with other organic amendments like neem seed cake; and bio-fertilizers and bio-pesticides etc., in rainfed groundnut, found advantageous for sustainable crop production. Groundnut being a legume leaves lot of residual fertility which intern helps succeeding crop under rainfed farming situations. Further, integration and incorporation of organic manures (farmyard manures/vermicompost) in the agricultural system helps to improve soil structure, soil microbial activity and soil moisture conservation and which intern helps to stabilize the production and productivity of the crops (either in single cropping system or in double cropping system) in rainfed farming situations. Safflower, in general, performs better when it succeeds a short duration legumes like mungbean, blackgram and groundnut than cereal crops like sorghum and maize due to favourable moisture regimes and residual fertility. Hence, it offers an excellent opportunity for doubling the existing level of cropping intensity and thereby steps up returns from rainfed farming in many conventional mono-cropped areas. Oilseeds based double cropping system under rainfed farming situations assumed greater importance in increasing oilseed production. Growing of groundnut during kharif and safflower during rabi season in sequence in areas where the rainfall is fairly well distributed from June to October found advantageous under suitable nutrient management practices. Some times the succeeding crop of safflower suffers due to insufficient stored soil moisture and erratic post-rainy season rains. Under such situations conservation of soil moisture during preceding season through the application of organics helps to alleviate the problem. In view of above fore-going points, a field trial on the effect of organics on the productivity of Spanish bunch groundnut during kharif and its residual effects on succeeding safflower in rabi season under rainfed farming situations was carried out at University of Agricultural Sciences, Dharwad, Karnataka (India) during 2004-05 to 2006-07.

## Methods

A field experiment to study the effect of application of organics on the productivity of groundnut (cv. JL-24 a Spanish bunch) and safflower in groundnut-safflower sequence cropping system was conducted in organic deficient Vertisols (Medium black soil) under rainfed farming situations at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka (India) during 2004-05, 2005-06 and 2006-07. The chemical test values of soil were 7.35 pH, 0.13 dS/m EC, 4.30 % CaCO<sub>3</sub>, 0.45 % organic carbon, 252 kg available N/ha, 11.90 kg available P/ha, 297.60 kg available K/ha, 10.95 ppm Fe (DTPA-extractable iron) and 4.45 ppm Zn (DTPA-extractable zinc). The total rainfall received during the crop growth period of groundnut in kharif and safflower in rabi seasons of different years is furnished in Table 1. The experiment consisted of two treatments (T<sub>1</sub>- organic farming and T<sub>2</sub>. Inorganic farming) and both the treatments were imposed for groundnut in kharif season during all the years. *Organic farming (T<sub>1</sub>)* included the application of farmyard manure (FYM) @ 75 t/ha during first year of experiment (kharif 2004) and 10 t/ha in subsequent years (kharif 2005 and kharif 2006) of experiment. The treatment also received vermicompost @ 2 t/ha during all the years. In all the years, the seeds of groundnut were treated with bio-fertilizers such as *rhizobium*, phosphate solubilizing bacteria (*Pseudomonas striata*) and plant growth promoting *rhizobacteria* (PGPR) in all the years. In order to encounter biotic stresses, bio-pesticides such as neem seed cake @ 500 kg/ha (soil application), seed treatment with *Trichoderma harzianum* @ 5 g/kg seed and spraying crop with 5 % neem seed kernel extract were used in groundnut. Another treatment T<sub>2</sub>. *Inorganic farming* involves seed treatment with Captan (3 g/kg seed), application of recommended dose of inorganic fertilizers (25 kg N, 75 kg P<sub>2</sub>O<sub>5</sub> and 25 kg K<sub>2</sub>O/ha) and chemical pesticides to groundnut in all the years. The FYM was applied 21 to 29 days before groundnut sowing and was thoroughly incorporated into the soil. Neem cake and vermicompost in T<sub>1</sub> and inorganic fertilizers in T<sub>2</sub> were applied in the seed rows at the time of sowing. The plot size for each treatment was 50 m × 20 m (100 m<sup>2</sup>). The seeds of JL 24 (a Spanish bunch groundnut cultivar) were hand dibbled at planting geometry of 30 cm × 10 cm. Groundnut plots were kept weed free by integrated weed management practices. The maturity duration of the groundnut crop during kharif 2004, kharif 2005 and kharif 2006 was 107, 106 and 110 days, respectively. At the time of harvest, 60 plants were taken at random in each treatment to record observations on yield components and yield/plant. The crop was uprooted and pods were allowed to sun dry along with haulm for a period one-week. Pods were plucked, dried and cleaned and; dry pod yield/plot was recorded. Safflower as succeeding crop to groundnut was grown without any organic manure and fertilizers application during rabi seasons of 2005-06 and 2006-07 under rainfed situations. Captan treated seeds of safflower was drill sown at a spacing of 70 cm × 20 cm at 21 and 31 days after groundnut harvest during rabi 2005-06 and rabi 2006-07, respectively. A rainfall of 99.0 mm (6 RD) and 27.2 mm (1 RD) was received during the period from harvest of groundnut to sowing of safflower during rabi 2005-06 and rabi 2006-07, respectively. Total rainfall received during the growth period of safflower during different years given in Table 1. The plots of safflower were kept weed free by frequent inter-cultivation. The safflower crop was harvested 137 and 142 days after sowing during rabi 2005-06 and rabi 2006-07, respectively. At harvest, 25 plants were taken at random in each treatment to record observations on yield components and seed weight/plant. The dried plants from each plot and seeds were separated by threshing. Seed yield/plot was recorded. Groundnut-safflower sequence cropping system took 264 and 277 days duration during 2005-06 and 2006-07, respectively.

**Table 1. Rainfall and number of rainy days during different growth periods of groundnut (Kharif 2004, kharif 2005 and kharif 2006) and safflower (Rabi 2005-06 to Rabi 2006-07)**

Groundnut (Kharif season)				Safflower (Rabi season)*		
Crop growth period	2004	2005	2006	Crop growth period	2005-06	2006-07
Maturity duration (Days)	107	106	104	Maturity duration (Days)	137	142
Pre-sowing	33.2 (04)	138.8 (09)	135.6 (08)	Pre-sowing	99.0 (06)	27.2 (01)
Sowing to 30 DAS	11.4 (04)	278.6 (09)	189.2 (17)	Sowing to 30 DAS	0.0 (00)	33.4 (03)
31 to 61 DAS	167.4 (14)	108.6 (14)	170.7 (22)	31 to 61 DAS	0.0 (00)	0.0 (00)
61 to 90 DAS	95.7 (07)	219.7 (14)	73.8 (09)	61 to 90 DAS	0.0 (00)	0.0 (00)
91 to Harvest	143.7 (06)	52.2 (06)	37.2 (04)	91 to 120 DAS	0.0 (00)	0.0 (00)
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<b>Total (Seeding to harvest)</b>	<b>418.2 (28)</b>	<b>659.1 (53)</b>	<b>470.9 (52)</b>	<b>Total (Seeding to harvest)</b>	<b>5.2 (01)</b>	<b>46.2 (04)</b>

## Results

### *Performance of groundnut during kharif season.*

The results indicated that organic farming with heavy application of farmyard manure (FYM) (75 t/ha) during kharif 2004 produced higher dry pod yield (3510 kg/ha) as compared to inorganic farming involving application of recommended dose of NPK fertilizers (2970 kg/ha). During 2004, soon after groundnut establishment, there was dry spell for a period of 38 days (Table 1). The rainfall after the dry spell situation was normal. Groundnut crop in organically amended plot did not show any moisture stress during the period of dry spell due to better moisture holding. Further, sustained availability of soil moisture in organically amended plot was probably related to better conservation of soil moisture from the pre-sowing rainfall. On the contrary, groundnut with addition of inorganic fertilizers showed moderate to severe moisture stress during same initial dry spell period. This was probably due to poor moisture retention in chemically amended plot. However, during 2005 and 2006, groundnut in inorganic fertilizers amended plots produced higher pod yield of groundnut (1660 to 2333 kg/ha) compared to in organically amended plot (1597 to 1937 kg/ha). The groundnut crop did not undergo moisture stress during any of its growth period during 2005 and 2006 as the crop received fairly good amount of rainfall right from sowing to harvest. The amount of rainfall received during the different crop growth periods of groundnut during 2005 and 2006 was high and was fairly well distributed as compared to rainfall during 2004. Fairly higher rainfall with more number of rainy days at different growth stages of groundnut during kharif 2005 and kharif 2006 (Table 1.) might have resulted in greater retention of water in organically amended plots which intern resulted in higher soil moisture content. Higher soil moisture in organically amended plot generally lead to poor aeration and decreased activity of soil microorganisms which intern affects the nutrient availability. It was also observed that, groundnut in organically amended plot showed yellowing symptoms and poor growth. These are the some of reasons why groundnut failed to perform under organically amended plot in high rainfall situations of kharif 2005 and kharif 2006. On the contrary, groundnut performed well in inorganically amended plot probably because of lower moisture content and readily available nutrients from applied fertilizers. Mean of the three years data indicated that both organic farming and inorganic farming produced similar dry pod yield of groundnut (Table 2). The study clearly indicates that the groundnut showed greater response to the application of organic manures (i.e., organic farming) under low rainfall situations with dry spell at the early growth stages. On the contrary, under wet situations (i.e., with good rainfall and good number of rainy days during the entire growth period), groundnut showed greater response to the applications of recommended dose of NPK fertilizers (i.e., in inorganic farming).

**Table 2. Dry pod yield and ancillary characters of groundnut as influenced by different methods of farming during kharif season under rainfed farming situations.**

Characters	Organic farming (T <sub>1</sub> )				Inorganic farming (T <sub>2</sub> )			
	2004	2005	2006	Mean	2004	2005	2006	Mean
Dry pod weight (g/plant)	32.69	12.55	11.90	<b>19.05</b>	28.91	14.20	11.40	<b>18.17</b>
No. of undeveloped pods/plant	2.1	2.8	2.60	<b>2.50</b>	2.1	5.9	2.00	<b>3.33</b>
No. of developed pods/plant	23.0	13.1	10.20	<b>15.43</b>	18.3	12.4	11.80	<b>14.17</b>
Total number of pods/plant	25.1	15.9	12.80	<b>17.93</b>	20.4	18.3	13.80	<b>17.50</b>
100-Dry pod weight (g)	116.28	94.34	107.56	<b>106.06</b>	113.64	101.01	82.61	<b>99.08</b>
Dry pod yield (kg/ha)	3510	1597	1937	<b>2348</b>	2970	1660	2333	<b>2321</b>
Kernel yield (kg/ha)	2863	1166	1471	<b>1833</b>	2345	1174	1804	<b>1774</b>
Dry haulm yield (kg/ha)	3245	2327	2244	<b>2605</b>	2740	2334	4492	<b>3189</b>
Shelling per cent	81.58	73.02	75.95	<b>76.85</b>	78.94	70.74	77.31	<b>75.66</b>
Sound mature kernels (%)	91.90	94.16	97.57	<b>93.88</b>	88.42	95.62	97.41	<b>93.82</b>
100-Kernel weight (g)	50.83	38.73	37.17	<b>42.24</b>	50.76	37.52	42.25	<b>43.51</b>
Harvest index	0.424	0.297	0.352	<b>0.358</b>	0.411	0.294	0.264	<b>0.323</b>

### *Performance of safflower during rabi season*

In groundnut-safflower sequence cropping system, succeeding crop of safflower grown without application of organic manures and fertilizers during rabi season produced higher seed yield in organic farming compared to in inorganic farming. Treatment with organic amendments to groundnut crop during kharif and no organic manures and fertilizers to safflower during rabi produced 13.24 to 22.69 % higher seed yield of safflower over treatment with the inorganic fertilizers to groundnut crop during kharif and no organic manures and fertilizers to safflower during rabi (816 to 1437 kg/ha) (Table 3). Mean of the two years data indicated that organic farming in preceding groundnut crop produced 19.25 % higher seed yield of safflower as compared to inorganic farming. The extent of increase in yield of safflower was more in first year of groundnut-safflower sequence (2005-06) compared to second year of groundnut-safflower sequence (2006-07). During second year of groundnut-safflower sequence (2006-07), the seed yield of safflower tended to decrease. Decrease in seed

yield of safflower during second cycle may be ascribed to lower residual fertility left after the harvest of preceding groundnut. The higher seed yield of safflower grown in organically amended groundnut plot may be ascribed to the higher amount of residual soil moisture. Organic farming through the addition of farmyard manure and vermicompost in groundnut during kharif lead to better conservation of rain water during its growth period and during period from harvest of groundnut to sowing of safflower and which intern might have exerted beneficial influence on the succeeding safflower with respect moisture availability during rabi season. On the contrary, poor conservation of rain water in inorganically amended plot during preceding season due to the absence of organic manures might have lead to the poor availability of soil moisture in addition poor residual soil fertility to safflower during rabi season. Thus, the study clearly indicates that under rainfed farming situations with moderately high rainfall, sustainable yields of groundnut and safflower in groundnut-safflower sequence system can be obtained with organic farming involving application of organic manures and vermicompost.

**Table 3. Seed yield and ancillary characters of safflower as influenced by different methods of farming during succeeding rabi season under rainfed farming situations.**

Characters	Organic farming (T1)*			Inorganic farming (T2)*		
	2005-06	2005-06	Mean	2005-06	2005-06	Mean
No. of capsules/plant	26.7	52.2	<b>39.5</b>	22.0	45.9	<b>34.0</b>
Capsule weight/plant (g)	56.99	19.90	<b>38.45</b>	53.70	17.81	<b>35.75</b>
Seed weight/plant (g)	26.45	9.70	<b>18.08</b>	21.64	8.60	<b>15.12</b>
Seed yield (kg/ha)	1763	924	<b>1344</b>	1437	816	<b>1127</b>

\*-\*.Treatments were imposed for preceding groundnut crop

### Conclusion

The study indicates that the groundnut showed greater response to the application of organic manures (i.e., organic farming) under low rainfall situations with dry spell at the early growth stage. On the contrary, under wet situations (i.e., with good rainfall and good number of rainy days during the entire growth period), groundnut showed greater response to the applications of recommended dose of NPK fertilizers (i.e., in inorganic farming). The study also revealed that under rainfed farming situations with moderately high rainfall, sustainable yields of groundnut and safflower in groundnut-safflower sequence system can be obtained with organic farming involving application of organic manures and vermicompost to preceding groundnut and no organic manures and fertilizers to succeeding safflower crop.

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