Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(3): 324-327
Received: 10-03-2019
Accepted: 12-04-2019

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Effect of incorporation of crop residue on physico-chemical properties and micronutrient status of soil green gram - sunflower sequence

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Abstract
The present investigation was undertaken at Experimental Farm, Annamalai University with eleven treatments and three replications framed under Randomized Block Design in summer season for greengram and split plot design in *Rabi* season for sunflower. The eleven treatments were T_1 Control, T_2 RDF greengram, T_3 incorporation of cotton stalk @ 41 ha^{-1} + 50% N of RDF, T_4 incorporation of cotton stalk @ 41 ha^{-1} + 100 % N of RDF, T_5 incorporation of cotton stalk @ 41 ha^{-1} + 125 % N + 100 % P through RDF, T_6 - incorporation of sunflower straw @ 41 ha^{-1} + 50% N of RDF, T_7 incorporation of sunflower straw @ 4 t ha^{-1} + 100 % N of RDF, T_8 incorporation of sunflower straw @ 4 t ha^{-1} + 125 % N + 100% P of RDF, T_9 incorporation of farm waste (including grasses) @ 4 t ha^{-1} + 50 % N of RDF, T_{10} incorporation of farm waste (including grasses) @4 t ha^{-1} + 100% N of RDF, T_{11} incorporation of farm waste (including grasses) @ 4 t ha^{-1} + 125 % N + 100% P of RDF. The results indicated that various physico-chemical properties of soil such as bulk density, soil reaction, Electrical conductivity were decreased available N,P,K and micronutrient status of soil were increased. It can be stated that incorporation of sunflower straw @ 4 t ha^{-1} + 125 % N + 100% P of RDF to greengram in *kharif* season and 75% RDF to sunflower in *Rabi* season indicating thereby 25 percent saving of fertilizers and not only improved the physico-chemical and micronutrient status of soil..

Keywords: Crop residues, farm waste, greengram, micronutrients, physico-chemical properties, sunflower

Introduction
Long terms studies in many cropping systems have clearly indicated that crop residue and green manure with chemical fertilizer resources of nutrients could sustain high productivity and improves soil health. Crop residues, used as dry fodder for animals and very little is returned back to soil by way of direct incorporation, mulching or through composting. It fact returning wastes to land leads to maintenance of soil health. Burning of crop residues results in atmospheric pollution, loss of plant nutrients and organic matter (Rusmussen *et al.*, 1980) [13]. Such crop residues, if managed properly have great potential to be utilized as source of plant nutrients in achieving sustainable crop productivity.
Increasing demand of food to feed the ever growing population along with rising cost of chemical fertilizers and depleting soil fertility owing to intensive cropping necessitates judicious use of renewable (organic) and non-renewable (inorganic) sources of input energy. There is urgent need is to test easily available alternative sources of energy such as farmyard manure, rice straw, wheat straw etc. for sustainable crop production and soil health as well (Singh *et al.*, 2000) [14]. Recycling of organic residues is becoming an increasingly important aspect of environmentally sound sustainable agriculture (Bellakki and Badanur, 2000) [2]. Increased removal of micronutrients a consequence of adoption of high yielding varieties and intensive cropping together with a shift toward high analysis NPK fertilizers has caused decline in the level of micronutrients in soil below that required for normal productivity of crops (Dangarwala *et al.*, 1974).

Material and Methods
With a view to study the effect of incorporation of cotton stalk, sunflower straw and farm waste on yield of greengram sunflower sequence and physico-chemical properties and micronutrient status of soil field experiment were conducted at Experimental Farm, Annamalai University.

Physico-chemical characteristics of experimental soil
Depth (142 cm), slope (1-3 %), cSand (31.2 %), slit (16.1%) clay (51.2 %), texture (Clay), order (Vertisols), sub group (Typic Haplustert), bulk density (0-15 cm - 1.34 Mg m^{-3}), free lime (5.7 %), pH (8.0-8.1), EC (0.303dSm^{-1}). Organic carbon (4.9 g kg^{-1}), total N (0.044 %), available nitrogen (155.62 kg ha), available phosphorus (10.30 kg ha^{-1}), available potassium (358 kg ha^{-1}), available sulphur (8.06 kg ha^{-1}), available calcium (C. mol (p+) kg^{-1}) 38, available magnesium (C. mol (p+) kg) 6, available zinc 0.6 (ppm) C.L., available iron 4.5 (ppm) C.L. (2.182 ppm), available copper 0.2 (ppm) C.L. (0.56 ppm), available manganese 2.0 (ppm) C.L. 1.02 ppm, available boron (ppm) (0.52 ppm) (0.18 ppm). Treatment details: T_1 - Control (No manure and fertilizer), T_2 - 100 % RDF, T_3 - Incorporation of cotton stalk @ 41 ha ^{1} +RDF @ 50% N, T_4 - Incorporation of cotton stalk @ 4 t ha^{-1} +100 % RDF, T_5 - Incorporation of cotton stalk @ 4 t ha^{-1} +RDF @ 125% N + 100% P, T_6 - Incorporation of sunflower straw @ 4 t ha^{-1} + RDF @ 50% N, T_7 - Incorporation of sunflower straw @ 41 ha^{-1} +100 % RDF, T_8 - Incorporation of sunflower straw @ 4 t ha^{-1} + RDF @ 125% N + 100% P, T_9 - Incorporation of all farm waste (including grasses) @ 4 t ha^{-1} + RDF @ 50% N, T_{10} - Incorporation of all farm waste (including grasses) @ 4 t ha^{-1} + 100 % RDF, T_{11} - Incorporation of all farm waste (including grasses) @ 4 t ha^{-1} + RDF @125% N+ 100% P.
Note: Treatment of decomposition culture was given to all crop residues and incorporated in the field 15 days before sowing of summer greengram.

Size of cotton stalk	:	1 to 2 cm
Sunflower straw	:	1 to 2 cm
Farm waste	:	2 to 3 cm

Composition of organic added (oven dry basis)

Source	N %	P%	K %
Cotton stalk	0.45	0.15	0.65
Sunflower straw	0.95	0.24	0.78
Farm waste	0.30	0.09	0.47

The surface soil samples from each plot before sowing and after harvesting of greengram and sunflower crop were collected and dried in made, ground and sieve through 2 mm sieve. They were stored in labeled polythene bags for subsequent analysis.

Soil Texture: It was determined by Bouyoucos hydrometer method (Piper, 1966). Soil pH was determined in 1:2.5 soil water suspension with Buckman glass electrode pH meter (Jackson, 1967) [8]. EC was determined with the help of direct leading conductivity meter using soil water suspension of 1:2.5 ratio (Jackson, 1967) [8]. Organic carbon was determined by wet digestion method as described by Walkley and Black (Jackson, 1967) [8]. Total nitrogen was determined by Kjeldhal digestion method. Available nitrogen in soil was quantified by using alkaline permagnate (0.32 % K MnO„) method as described by Subhiah and Asija (1956) [15]. Available phosphorus (kg ha^{-1}) was extracted by Olsen's reagent and determined by using calorimetric method. Available potassium (kg ha^{-1}) It was extracted with neutral N ammonium acetate and was measured by flame photometer (Jackson, 1967) [8]. Determination of available micronutrients from soil. Zn, Cu, Fe, Mn, were determined in DTPA extract using VARIAN - SPECTRA A.A. Atomic absorption spectrophotometer (Tandon, 1999) [16]. Available sulphur by turbidimetric method (Jackson, 1967 [8], available calcium and magnesium EDTA method (Jackson, 1967 [8], available boron hot water extraction (Tandon, 1999) [16]. Available molybdenum Grigg's reagent (Tandon, 1999) [16]. Analysis of variance was used for statistical analysis (Panse and Sukhatme, 1971) [12]. The critical difference was worked out at 5 percent level of significance.

Results and Discussion
Effect of incorporation of crop residues on soil
The data regarding bulk density, pH, ECe (Electrical conductivity) and organic carbon of soil as influenced by various treatments are recorded in Table 1. Data indicate that the maximum bulk density was recorded in treatment T_1 (control) (1.28 Mg m^{-1}) without incorporation of crop residue. The minimum bulk density was found in treatment T_8 (1.24 mg^{-3}) incorporation of sunflower straw @ 41 ha^{-1} + RDF @ (125% N +100% P). The data regarding pH of soil was found minimum in treatment T_8 incorporation of sunflower straw @ 4 t ha^{-1} + RDF @ (125% N + 100% P) and minimum in treatment without incorporation of crop residues T, control. The data related to ECe of soil was found maximum in treatment without incorporation of crop residue treatment T_1 (control). Minimum ECe of soil recorded in treatment T_8 incorporation of sunflower straw @ 4 t ha^{-1} + RDF @ (125 % N + 100% P). The organic carbon of soil was found highest in treatment T_8 incorporation ofsunflowerstraw@41 ha^{-1} + RDF @ (125% N + 100% P) and lowest in treatment T, (control) without incorporation of crop residue. Incorporation of crop residues cotton stalk, sunflower straw and farm waste subsequent decomposition added organic matter to soil and thus mass per unit volume of soil reduced resulting in lower bulk density. Decrease in bulk density with the increased organic carbon was reported by Lanjewar *et al.* (1992) [11] and Das *et al.* (2001) [4]

Fertility status of nutrients after harvest of greengram
The availability of nutrients in the soil is the most important factor that determines the uptake of the same by the plant. The possible ways to increase the availability of nutrients in the soil are either by an increase in the dose of fertilizer or by increase in the efficiency of added nutrients in the soil or a combination of both. Integrated use of organic and inorganic improved the fertility status of soil. Increase in the availability of nutrient content in soil with incorporation of crop residue was observed. The nutrient content of the soil was variable as per the treatment. Highest available nutrient recorded in the treatment T_8 due to incorporation of sunflower straw @41 ha^{-1} + RDF @ (125% N + 100 % P) over to all treatment over to control. The availability of nutrient increased with incorporation of crop residue was also observed by Shankaran *et at.* (2002). The lowest available nutrient found in the treatment T_1 (control). The data presented in **Table 2** indicate that the incorporation of crop residue increased the available micro nutrient content of soil than the control. The available micro nutrient content in soil after harvest of greengram varied.

Table 1: Effect of crop residues on physico-chemical properties of soil after harvest of greengram

Treatment	Bulk density (Mg m^{-3})	pH	EC (dSm^{-1})	Org. C (g kg^{-1})	Avail. N (kg ha^{-1})	Avail. P (kg ha^{-1})	Avail. K (kg ha^{-1})	Avail. S (kg ha^{-1})
T_1	1.28	8.01	0.29	4.0	161.08	10.40	358.16	8.15
T_2	1.27	8.07	0.29	4.4	163.03	12.36	360.60	10.32
T_3	1.26	8.04	0.28	4.2	172.44	12.10	358.90	8.91
T_4	1.25	7.99	0.29	4.4	175.44	12.3	359.10	9.74
T_5	1.25	7.97	0.25	4.4	176.50	13.7	363.69	10.27
T_6	1.27	7.97	0.28	4.5	177.93	13.02	367.34	9.50
T_7	1.24	7.99	0.27	4.6	179.59	13.73	371.47	9.97
T_8	1.24	7.95	0.26	4.8	187.53	16.05	379.80	10.55
T_9	1.25	7.97	0.27	4.2	169.80	11.95	357.12	9.05
T_{10}	1.27	7.99	0.28	4.1	170.75	12.05	380.95	9.63
T_{11}	1.26	8.05	0.28	4.2	173.83	13.51	361.90	9.86
SE (m) +	0.015	0.01	0.006	0.006	2.59	0.31	2.16	0.03
CD at 5%	-	-	-	-	7.28	0.89	6.09	0.10

Table 2: Effect of crop residue on micronutrient status of soil after harvest of greengram

Treatments	B (ppm)	Mo (ppm)	Zn (ppm)	Fe (ppm)	Cu (ppm)	Mn (ppm)
T_1	0.51	0.19	0.39	2.45	0.67	1.34
T_2	0.94	0.44	0.45	2.60	0.77	1.43
T_3	0.63	0.25	0.39	2.74	0.76	1.56
T_4	1.02	0.48	0.43	2.75	0.70	1.77
T_5	1.11	0.50	0.45	2.94	0.68	1.48
T_6	0.75	0.32	0.40	2.85	0.75	1.39
T_7	1.10	0.49	0.45	2.96	0.72	1.73
T_8	1.18	0.53	0.46	3.03	0.79	1.79
T_9	0.87	0.39	0.39	2.71	0.75	1.67
T_{10}	0.96	0.45	0.41	2.79	0.72	1.57
T_{11}	0.99	0.47	0.44	2.99	0.75	1.56
SE (m) +	0.03	0.02	0.0003	0.13	0.038	0.12
CD at 5%	0.10	0.06	0.001	0.38	-	-

Treatment T_3 incorporation of sunflower straw @ 4 t ha^{-1} + RDF @ (125 % N + 100 % P) significantly increased the available micro nutrient content in soil followed by treatment T_5 and T_7. The molybdenum content in soil increased with incorporation of crop residue. Similar observation was recorded by Basumatary *et al.,* (2000) [1] and Guled *et al.,* (2002) [6]. The lowest micro nutrient content was in the treatment T_1 (control).

Effect of crop residues and fertilizer doses on physico-chemical properties of soil

Effect of crop residue - The data indicate that the maximum bulk density was recorded in treatment T_1 (control) without incorporation of crop residue and minimum bulk density was found in treatment T_8 incorporation of sunflower straw @ 4 t ha^{-1} + RDF @ (125 % N + 100 % P).

The data regarding the pH and EC of soil was found minimum in treatment T_8 incorporation of sunflower straw @ 4 t ha^{-1} and maximum in treatment without incorporation of crop residue in treatment T_1 (control).

The data further indicated that organic carbon and fertility status of major and secondary nutrient content in soil was significantly influenced with incorporation of crop residue was higher in treatment T_8 - incorporation of sunflower straw @4 t ha^{-1} + RDF @ (125% N + 100% P). with was significantly over other treatment. The lowest organic carbon and fertility status of major and secondary nutrient content in soil was observed in the treatment T_1 - (control).

Effect of crop fertilizer doses - The data indicate that the highest bulk density was recorded in treatment T_1 (control) incorporation of crop residue with fertilizer dose decreased the bulk density of soil recorded in treatment T_8 incorporation of sunflower straw @4 t ha^{-1} + RDF @ 125% N + 100%P.

The data related to pH and EC of soil decreased with incorporation of crop residue with fertilizer doses. Treatment T_8 sunflower straw @ 4 t ha^{-1} + RDF @ (125% N + 100% P) recorded minimum pH of soil.

The data further indicate that available organic carbon and fertility status of major and secondary nutrient. Highest content of available major and secondary nutrient in soil was recorded in F2 -100 % RDF which was significantly superior was observed in F1 - 75 %TDF treatment.

Effect of interaction-The interaction effect between crop residue and fertilizer doses was found to be non-significant with regard to physico-chemical properties of soil. Similar results were reported by Lanjewar *et al.,* (1992) [11], Hundekar *et al.,* (1999), Bharambe *et al.* (2001) [3] and *Das et al.,* (2001) [4].

Conclusion

Effect crop residue and fertilizer doses on fertility status of soil after harvest of sunflower

Effect of crop residue - Results reveal that the status of available of micronutrient in soil was significantly influenced with application of crop residue. The content of Zinc content in soil was significantly influenced with incorporation of crop residue. Zinc content (0.46 ppm), iron (7.11 ppm), manganese (8.10 ppm), copper (1.11ppm), born (0.90 ppm), molybdenum (0.28 ppm), was higher in treatment T_s sunflower straw @ 4 t ha^{-1} + RDF @ (125 % N + 100 % P) which was significantly superior over other treatment. The lowest available zinc (0.39 ppm), iron (3.47 ppm), manganese (4.16 ppm), copper (0.32 ppm), born (0.43 ppm), molybdenum (0.16 ppm) was observed in T_1 treatment (control) without crop residues.

Table 3: Physico-chemical properties of soil after harvest of sunflower

Main factor	Bulk density Mean (Mg m^{-3})	pH Mean	EC (dSm^{-1}) mean	Org. C (g kg 1) mean	Avail. N (kg ha^{-1})	Avail. P (kg ha^{-1})	Avail. K (kg ha^{-1})	Avail. S (kg ha^{-1})
T_1	1.27	8.01	0.29	4.4	165.23	10.71	361.01	8.11
T_2	1.26	7.97	0.28	4.4	168.50	12.56	363.25	8.23
T_3	1.25	8.01	0.26	5.0	175.55	12.86	364.96	8.40
T_4	1.24	7.99	0.26	5.6	176.25	13.06	371.64	8.71
T_5	1.25	7.98	0.26	5.6	176.61	13.59	377.31	8.88

T_6	1.25	7.96	0.27	5.9	180.06	14.27	388.17	9.01
T_7	1.24	7.95	0.26	5.9	181.26	15.75	394.59	9.20
T_8	1.22	7.90	0.25	6.4	187.27	17.37	401.43	10.49
T_9	1.26	7.98	0.27	5.7	171.25	12.69	368.45	8.47
T_{10}	1.26	7.96	0.28	5.6	171.32	12.95	369.90	8.59
T_{11}	1.27	7.96	0.29	5.9	174.22	13.02	374.70	8.79
SE(m)±	0.01	0.004	0.002	0.01	0.507	0.18	1.56	0.013
CD at 5%	-	0.010	0.006	-	1.06	0.54	4.61	0.037
Sub factor (Fertilizer doses)								
75 % RDF	1.26	7.97	0.27	0.54	175.11	13.41	376.40	8.78
100% RDF	1.25	7.96	0.26	0.56	175.34	13.65	375.50	8.84
SE(m) +	0.004	0.002	0.001	0.003	0.143	0.13	0.67	0.006
CD at 5%	-	0.008	0.004	-	0.39	0.37	1.97	0.026
Interaction								
SE(m) ±	0.01	0.009	0.005	0.01	0.475	0.43	2.22	0.022
CD at 5%	-	-	-	-	-	-	-	-

Table 4: Effect of crop residue and fertilizer doses on micronutrients status of soil after harvest of sunflower under various treatments

Main factor	B (ppm)	Mo (ppm)	Zn (ppm)	Fe (ppm)	Cu (ppm)	Mn (ppm)
T_1	0.43	0.16	0.39	3.47	0.32	4.16
T_2	0.46	0.17	0.39	3.79	0.41	4.28
T_3	0.51	0.18	0.40	4.21	0.47	5.19
T_4	0.62	0.21	0.42	5.57	0.63	6.47
T_5	0.70	0.23	0.44	6.06	0.85	7.35
T_6	0.75	0.24	0.44	6.37	0.90	7.69
T_7	0.78	0.25	0.45	6.77	0.98	7.89
T_8	0.90	0.28	0.46	7.11	1.11	8.10
T_9	0.55	0.19	0.41	4.61	0.53	5.71
T_{10}	0.59	0.20	0.42	5.18	0.58	6.27
T_{11}	0.67	0.22	0.43	5.93	0.74	7.16
SE(m) +	0.01	0.01	0.0001	0.01	0.01	0.001
CD at 5%	0.03	0.04	0.0004	0.05	0.03	0.004
Sub factor (Fertilizer doses)						
75 % RDF	0.62	0.21	0.427	5.33	0.683	6.35
100% RDF	0.64	0.22	0.428	5.41	0.693	6.43
SE(m) +	0.005	0.005	0.0001	0.007	0.003	0.001
CD at 5%	0.01	-	0.0002	0.027	0.013	0.003
Interaction						
SE(m) +	0.01	0.19	0.0004	0.02	0.11	0.003
CD at 5%	-	-	-	-	-	-

Effect of fertilizer doses - Effect of fertilizer dose (F1- 75% RDF, F2 - 100 % RDF) on available zinc content in soil was found to be significant. The highest micronutrient content in soil was recorded in F2 -100 % RDF which was significantly superior (0.46 ppm) over F1-75% RDF treatment.

Effect of interaction - The interaction effect between crop residue and fertilizer doses was found to be non-significant with regard to available micronutrient content in soil. Similar observation recorded by Lai and Mathur (1989) [10], Kher (1993) [9] and Basumatary *et al.* (2000) [1].

References

1. Basumatury A, Talukdar MC, Das J. Long term effect of integrated Nutrients supply on DTPA- Extractable micronutrients in an Inceptisol Assam. New Agriculturist. 2000; 11(1, 2):77-79.
2. Bellakki MA, Badanur VR. Residual effects of crop residues in conjunction with organic, inorganic and cellulolytic organisms on chickpea grown on vertisol. J Indian Soc. Soil Sci. 2000; 48(2):393-395.
3. Bharambe PR, Shelke DK, Jadhav GS, Vaishnava VG, Oza SR. Management of salt affected Vertisols with subsurface drainage and crop residue incorporation under soybean wheat cropping system J Indian Soc. Soil Sci. 2001; 49(1):24-29.
4. Das K, Medhi DN, Guha B. Recycling effect of crop residues with chemical fertilizers on physico-chemical properties of soil and rice *(Oryza sativa)* yield Indian J of Agronomy. 2001; 46(4):648-653.
5. Dangarwala WC, Ohu JO, Ekwae El. Effect of zinc nutrition on yield of chickpea under dry condition. Annual report of AICRP on micronutrients (ICAR) Gujrat Agricul. Univ.Anand Campus, Anand, 1994.
6. Guled MB, Gundlur SS, Hiremath KA, Surkod VS, Balanayoundar SR. Influence of different in situ moisture conservation practices on soil properties and yield of sorghum-sunflower-cropping system. Karnataka J Agri. Sci. 2002; 5(3):514-517.
7. Hundekar ST, Badanur VP, Sarangumath PA. Effect of crop residues in combination with fertilizer on soil properties & sorghum yield. Fert. News. 1999; 44(3):59-60.
8. Jackson ML. Soil Chemical Analysis, Prentice Hall India Pvt. Ltd., New Delhi, 1967.
9. Kher, Deepak. Effect of continuous liming, manuring and cropping on DTPA - Extractable Micronutrient in an Alfisol. J Indian Soc. Soil Sci. 1993; 42(2):366-367.
10. Lai, Suresh, Mathus BS. Effect of long-term application of manure and fertilizers on the DTPA extractable micronutrients in acid soil J Indian Soc. Soil Sci. 1989; 37:588-590.
11. Lanjewar MM, Shelke DK, Jadhav SL, Hiwase BJ. Studies on effect of incorporation of rice straw in soil on its properties rice yield and its residual effect on succeeding chickpea. J Soils Crops. 1992; 2(2):52-55.
12. Panse GV, Sukhatme PV. Statistical Techniques for Agricultural Research Workers, ICAR, New Delhi, 1971.
13. Rusmussen PE, Allmaras RR, Rhode CR, Roager NC Jr. Crop residue influence on soil carbon and nitrogen in wheat fallow system. Soil Science Soc. American J. 1980; 44:596-600.
14. Singh AK, Mahapatra BS, Sharma GL. Effect of integrated management of summer legume residue and urea - N on soil fertility and nitrogen nutrition in rice - mustard cropping system. J Farming Systems Research and Development. 2000; 70(12):835-839.
15. Subbiah BV, Asija El. A rapid procedure for estimation of available nitrogen in soil. Current Sci. 1956; 25(8):259-260.
16. Tandon HLS. Method of Analysis of Soil, Plant, Water and Fertilizer. Fertilizer Development, Consultation and Organization, New Delhi, 1999.