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Original Research Article

Farm waste recycling for enhancing productivity, nutrient uptake, soil fertility and economics of groundnut (*Arachis hypogaea*)-wheat (*Triticum aestivum*) crop sequence

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Abstract

A field experiment was conducted to evaluate the effect of farm waste recycling in comparison to chemical fertilizers on productivity, nutrient uptake, soil fertility and economics of groundnut (*Arachis hypogaea* L.)-wheat (*Triticum aestivum* L. emend. Fiori and Paol.) cropping sequence at Junagadh (Gujarat, India) during *kharif* and *rabi* seasons of 2008-09 to 2010-11. The results revealed that application of enriched compost @ 5 t ha^{-1} to groundnut and recommended dose of fertilizer to wheat proved superior in respect of pod and haulm yield of groundnut, grain and straw yield of wheat, nutrient uptake (N, P and K) by groundnut and wheat, soil fertility (organic carbon, available N and P), net returns and B:C ratio over chemical fertilizer to both the crops. Farm waste incorporated in soil did not show direct effect on groundnut, however produced residual effect on wheat by improving soil fertility in comparison to chemical fertilizers.

Keywords: Groundnut, Wheat, Compost, Fertilizer

INTRODUCTION

Groundnut-wheat is well established and the most suitable cropping sequence in South Saurashtra region of Gujarat state. However, there are indications of stagnation or even decline in the productivity of groundnut-wheat cropping system due to decline in soil organic matter, deficiency of secondary and micronutrients and non-availability of cost effective fertilizers. FYM is the most important organic source but its non-availability or high cost necessitates searching of other sources. Farm wastes are potential and cheapest sources of organic matter. Keeping these points in view, the present experiment was carried out to explore the potentiality of farm waste recycling in groundnut-wheat crop sequence.

MATERIALS AND METHODS

A field experiment was conducted at Instructional Farm, Department of Agronomy, Junagadh Agricultural University, Junagadh during *kharif* and *rabi* seasons of 2008-09 to 2010-11. The soil was clayey with pH 7.9 and EC 0.28 dS m^{-1} having 0.68% organic carbon, 236 kg ha^{-1} available N, 23 kg ha^{-1} available P and 270 kg ha^{-1} available K. The experiment was laid out in randomized block design with four replications. The treatments viz., T_1- recommended fertilizer dose (RDF) i.e. 12.5-25-0 kg N-P_2O_5-K_2O ha^{-1}, T_2- FYM @ 20 t ha^{-1}, T_3- compost @ 5 t ha^{-1}, T_4- enriched (super digest) compost @ 5 t ha^{-1}, T_5- soil incorporation of wheat straw @ 5 t ha^{-1}, T_6- burning of wheat straw in field @

Table 1. Effect of different treatments on pod and haulm yield of groundnut.

Treatments	Pod yield (q ha^{-1})				Haulm yield (q ha^{-1})			
	2008	2009	2010	Pooled	2008	2009	2010	Pooled
RDF	11.01	15.72	12.57	13.10	18.63	32.83	20.45	23.97
FYM	11.79	18.32	14.31	14.81	19.64	36.24	21.20	25.69
Compost	11.16	16.70	13.95	13.94	19.34	34.91	20.90	25.05
Enriched compost	12.46	20.52	14.92	15.97	20.39	36.68	21.42	26.16
Wheat straw + RDF	10.38	15.85	13.24	13.16	18.83	33.76	20.01	24.20
Burnt wheat straw + RDF	11.35	16.79	14.14	14.09	19.57	35.21	21.12	25.30
Cotton Stalk + RDF	10.12	14.84	11.83	12.26	18.04	28.33	19.63	22.00
Castor stalk + RDF	10.01	15.68	11.16	12.28	18.08	26.73	19.26	21.36
Pearlmillet stover + RDF	9.67	14.27	11.76	11.90	13.90	29.06	18.59	20.52
CD (P=0.05)	1.51	1.38	1.21	1.74	NS	3.78	1.43	NS

Table 2. Residual effect of different treatments applied to groundnut on grain and straw yield of wheat.

Treatments	Grain yield (q ha^{-1})				Straw yield (q ha^{-1})			
	2008	2009	2010	Pooled	2008	2009	2010	Pooled
RDF	31.57	25.96	24.65	27.39	42.75	34.03	31.57	36.12
FYM	36.90	32.14	29.55	32.86	46.15	48.50	36.12	43.59
Compost	38.44	32.52	30.02	33.66	48.03	46.11	36.32	43.49
Enriched compost	40.83	33.78	33.18	35.93	52.47	49.56	37.39	46.47
Wheat straw + RDF	36.20	31.10	28.82	32.04	45.18	42.05	35.73	40.99
Burnt wheat straw + RDF	35.55	27.84	24.31	29.23	40.60	35.44	32.45	36.16
Cotton Stalk + RDF	34.43	29.40	25.54	29.79	43.52	39.31	33.03	38.62
Castor stalk + RDF	35.90	30.79	28.05	31.58	44.69	41.59	34.80	40.36
Pearlmillet stover + RDF	35.91	29.82	26.20	30.64	44.03	38.20	34.15	38.79
CD (P=0.05)	NS	4.01	1.61	2.97	NS	5.23	2.39	4.65

5 t ha^{-1} + RDF, T_7- compost of cotton stalk @ 5 t ha^{-1} + RDF, T_8- compost of castor stalk @ 5 t ha^{-1} + RDF and T_9- compost of pearlmillet stover @ 5 t ha^{-1} + RDF, were applied to groundnut in rainy (*kharif*) season. In succeeding *rabi* season, wheat was grown in same plots with a fertilizer dose of 120-60-0 kg N-P_2O_5-K_2O ha^{-1}. The groundnut variety 'GG 11' was sown at 75 cm row spacing using 100 kg seeds ha^{-1} and wheat variety 'GW 496' was sown at 22.5 cm row spacing using seed rate of 120 kg ha^{-1}. The gross and net plot sizes were 10.0 m x 6.0 m and 8.0 m x 4.5 m, respectively. The crops were raised with standard package of practices recommended for the region.

RESULTS AND DISCUSSION

Crop yields

An appraisal of data presented in Table 1 shows that different treatments exerted their significant influence on pod yield of groundnut during all the three years and in pooled results. Treatment comprising enriched compost recorded significantly the highest pod yield but remained at par with treatments involving FYM, burning of wheat straw + RDF, compost and RDF in the first year, with FYM, burning of wheat straw + RDF and compost in the third year and with FYM in pooled results. Application of pearlmillet stover, castor stalk, cotton stalk and wheat straw along with RDF did not show additional effect on pod yield of groundnut over

Table 3. Effect of different treatments on nutrient uptake by groundnut.

Treatments	Nitrogen uptake (kg ha^{-1})			Phosphorus uptake (kg ha^{-1})			Potassium uptake (kg ha^{-1})		
	2008	2009	2010	2008	2009	2010	2008	2009	2010
RDF	89.71	84.26	74.86	5.68	4.85	4.91	25.21	24.53	23.60
FYM	94.43	89.72	84.83	6.50	5.59	5.17	27.27	26.15	24.70
Compost	92.92	85.69	77.31	5.93	5.28	5.02	26.44	25.63	24.05
Enriched compost	101.38	95.97	84.72	6.35	5.79	5.49	27.85	26.31	25.76
Wheat straw + RDF	90.56	85.48	74.39	5.51	4.90	5.06	25.26	24.35	23.79
Burnt wheat straw + RDF	93.62	88.03	82.98	5.75	5.58	5.09	26.07	25.07	25.09
Cotton Stalk + RDF	77.99	81.83	71.79	5.34	4.43	4.41	22.68	22.60	22.39
Castor stalk + RDF	85.04	66.40	69.97	5.31	4.77	4.07	22.96	21.35	22.85
Pearlmillet stover + RDF	74.38	63.64	71.80	4.19	3.66	4.36	21.58	22.23	21.19
CD (P=0.05)	15.16	15.60	11.01	1.23	0.76	0.85	4.64	3.16	2.52

Table 4. Residual effect of different treatments applied to groundnut on nutrient uptake by wheat.

Treatments	Nitrogen uptake (kg ha^{-1})			Phosphorus uptake (kg ha^{-1})			Potassium uptake (kg ha^{-1})		
	2008	2009	2010	2008	2009	2010	2008	2009	2010
RDF	85.38	83.14	78.70	12.45	10.65	8.58	73.03	69.72	60.16
FYM	101.28	95.11	86.11	14.55	12.31	10.45	89.05	81.48	73.89
Compost	102.86	97.69	87.72	14.50	12.20	10.23	90.69	83.01	72.17
Enriched compost	104.08	97.73	93.41	14.61	12.74	10.51	91.71	83.61	74.97
Wheat straw + RDF	100.81	95.10	86.10	13.85	11.81	10.05	86.21	81.23	70.09
Burnt wheat straw + RDF	92.22	85.22	76.99	13.06	11.08	8.48	76.96	71.74	61.40
Cotton Stalk + RDF	95.29	87.58	83.44	13.40	11.67	9.28	79.74	75.18	69.43
Castor stalk + RDF	96.94	91.72	86.76	13.46	11.76	9.89	80.15	80.96	70.98
Pearlmillet stover + RDF	97.69	89.58	85.60	13.81	11.51	9.55	81.41	76.86	71.93
CD (P=0.05)	9.39	11.39	10.42	1.23	1.09	1.27	14.02	10.55	6.39

RDF. Despite non-significant influence in first year and pooled results, application of enriched compost resulted in significantly the highest haulm yield in second and third year of experimentation, but it was at par with FYM, burning of wheat straw + RDF, compost and wheat straw + RDF in second year and also with RDF in third year.

Different treatments manifested their residual impact on grain and straw yield of wheat in 2008, 2009 and pooled results (Table 2), wherein enriched compost recorded significantly the highest grain and straw yields. Treatments comprising FYM, compost, wheat straw + RDF, castor stalk + RDF and pearlmillet stover + RDF in 2008 and compost in pooled results were at par with enriched compost in respect of grain yield. Similarly, FYM and compost in 2008 and pooled results and FYM, compost and wheat straw + RDF in 2009 were statistically equivalent to enriched compost in respect of straw yield of wheat. Raj *et al.* (2001) and Rasal *et al.* (2002) reported beneficial effect of phosphocompost on productivity of groundnut-wheat crop sequence.

Nutrient uptake

Various treatments significantly influenced uptake of N, P and K by groundnut (Table 3). Treatments comprising enriched compost, FYM, compost, burning of wheat straw + RDF, wheat straw + RDF and RDF, being mutually at par, removed higher uptake of N, P and K over recycling of crop resid-

Table 5. Effect of different treatments on soil fertility (after 3 years) and economics (average of 3 years).

Treatments	O.C. (%)	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})	Net returns (Rs ha^{-1})			B:C ratio
					Groundnut	Wheat	Total	
RDF	0.62	201.81	21.11	259.80	16422	8579	25001	2.30
FYM	0.73	239.88	26.49	283.30	16955	12782	29736	2.38
Compost	0.71	235.25	26.29	280.84	15054	13337	28390	2.29
Enriched compost	0.72	240.29	26.59	283.39	20415	15075	35490	2.79
Wheat straw + RDF	0.70	233.31	25.12	273.50	15146	12078	27224	2.32
Burnt wheat straw + RDF	0.66	209.28	22.22	272.27	16506	9869	26375	2.27
Cotton Stalk + RDF	0.68	215.12	24.80	272.69	14866	10384	25250	2.31
Castor stalk + RDF	0.69	229.14	25.11	279.52	15300	11724	27024	2.44
Pearlmillet stover + RDF	0.70	226.86	24.52	270.48	14604	10988	25592	2.37
CD (P=0.05)	0.06	30.04	3.48	NS				

ues (pearlmillet, castor and cotton) along with RDF. Enriched compost was found to be superior over other treatments in this respect followed by FYM.

Treatments applied to *kharif* groundnut exerted their residual effect on nutrient uptake by wheat (Table 4). Enriched compost was superior to other treatments in this regard. Treatments involving farm waste either alone or in combination with RDF were at par and recorded significantly higher uptake of N, P and K by wheat over RDF and burning of wheat straw + RDF. Ghosh *et al.* (2001) also reported similar results.

Soil fertility

A perusal of data presented in Table 5 indicates that different treatments significantly influenced the residual status of organic carbon, available N and available P, but not available K status in soil after three years. Recycling of farm waste, applied alone or in combination with RDF, recorded significantly higher values of organic carbon, available N and available P over RDF and burning of wheat straw + RDF. Analogous results were also reported by Rasal *et al.* (2002).

Economics

The data presented in Table 5 shows that application of enriched compost recorded the highest net returns from groundnut and wheat. Other farm waste recycling treatments also recorded higher net returns over RDF. The highest B:C ratio was recorded with enriched compost and the lowest with burning of wheat straw + RDF. Comparable results were also reported by Kathmale *et al.* (2000) and Bhagat (2001).

On the basis of three years field study, it seems quite logical to conclude that application of enriched compost @ 5 t ha^{-1} to groundnut and recommended fertilizer dose to wheat was found to be advantageous in respect of productivity, nutrient uptake, soil fertility and economics.

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