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EFFICACY OF ORGANICS IN CONJUNCTION WITH INORGANICS ON YIELD OF GROUNDNUT UNDER RAINFED AND PROTECTIVE IRRIGATION CONDITIONS IN RAINFED ALFISOLS OF ANDHRA PRADESH

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ABSTRACT

A field experiments were conducted at Agricultural Research Station, Ananthapuramu during 2014 and 2015 *kharif* seasons to compare the yield and yield attributes under organics in conjunction with inorganics in rainfed alfisols with and without protective irrigations during long dry spells. The experiment was laid out in Randomized block design in two separate blocks with same treatments, one block is under purely rainfed and another block was given protective irrigation. The comparison was made among the supply of 100 per cent nitrogen through organics, 100 per cent through inorganics, 50 per cent organic and 50 per cent inorganic and with predominant sheep penning practice in the region under both rainfed and protective irrigated conditions. The results revealed that the crop yields increased from the 2014 to 2015 *kharif* under both the rainfed and protective irrigation conditions. But the magnitude of increase in the yield was more in protective irrigation as compared to the rainfed conditions. The study revealed that the organics in conjunction with inorganics significantly influenced the yield of groundnut under rainfed and protective irrigation conditions in alfisols of Andhra Pradesh. The greater response was observed for the application of organic manures and sheep penning under both rainfed and protective irrigation situations.

KEYWORDS: Organic, inorganic, sheep penning, rainfed, protective irrigation, groundnut yield.

INTRODUCTION

The production and productivity of Groundnut (*Arachis hypogaea L.*) in rainfed alfisols of Andhra Pradesh is low as compared to the national average. The majority of the groundnut area is in the Anantapur and other districts of the rayalaseema region. The low productivity of *kharif* groundnut may be due to cultivation in marginal and sub marginal lands, little or no biomass recycling, low soil organic matter, sub optimal nutrient application, low nutrient use efficiency and multi nutrient deficiencies, coupled with frequent drought. There is a high variability in the onset of monsoon, very low and poor distribution of rainfall during growing season. The agro ecological region is complex, risk prone and under invested. Therefore, there is a need for regionally differentiated nutrient management strategies (Nataraj *et al*., 2016). Coupled with the above reasons, groundnut is an exhaustive crop and removes large amount of macro and micro nutrients from soil. None of the sources of nutrients can meet the total plant nutrient need of crop adequately. Hence integrated use of nutrients from chemical and locally available organic sources is the most efficient way (Solanki *et al.,* 2006). The integrated use of locally available organic sources not only supplies the nutrients but also improves the soil physical properties, enhances the soil fertility status and intern enhances the sustainability of the rainfed production system. Keeping this in view the present study was under taken to evaluate the efficacy of organics in conjunction with inorganics on yield of *kharif* groundnut under rainfed and protective irrigation conditions in alfisols of Andhra Pradesh.

MATERIALS AND METHODS

Field experiments were conducted at Agricultural Research Station, Ananthapuramu during *kharif*, 2014 and 2015 in fixed plots for two consecutive seasons to study the efficacy of organics in conjunction with inorganics on yield of groundnut under rainfed and protective irrigation conditions. The soil type is alfisols and topography of the site is nearly level to gentle (1-3% slope). The experiment was laid out in completely randomized block design with three replications in two separate blocks *viz.,* purely rainfed block and protective

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irrigation block. Both block have eleven same treatments (Table 1 and 2) *viz;* T_1: Control (no organics and inorganics), T_2: Recommended dose of fertiliser (RDF) (20 kg N ha^{-1}: 40 kg P_2O_5 ha^{-1}: 40 kg K_2O ha^{-1}), T_3: 50 % nitrogen through urea + 50 % nitrogen through FYM ,T_4: 100% nitrogen through FYM, T_5: 50% nitrogen through urea + 50% nitrogen through leaf compost, T_6: 100% nitrogen through leaf compost, T_7: 50% nitrogen through urea + 50% nitrogen through sheep manure, T_8: 100% nitrogen through sheep manure,T_9: 100 % nitrogen through sheep penning,T_{10}: 100% nitrogen through enriched groundnut shells and T_{11}: 50% nitrogen through urea + 50 % nitrogen through enriched groundnut shell. Prior to the experiment initial soil analysis (0-30 cm depth) was done in the laboratory using standard soil analytical procedures (Jackson, 1973). Organic manures were applied two weeks before sowing of the crop. Nitrogen, phosphorus and potassium were applied in the form of urea, diammonium phosphate and muriate of potash respectively at the time of sowing. In protective irrigation block, two irrigations were given at 55 and 75 DAS during 2014 and one irrigation at 75 DAS was given at 75 DAS during 2015 with 20 mm depth of water. Post-harvest soil samples were analyzed for different physico-chemical properties. The yield and yield attributes were recorded and compared with rainfed and protective irrigation block and also among the different sources of organics in conjunction with inorganics on yield of groundnut.

RESULTS AND DISCUSSION

Number of filled pods plant^{-1}

During both the years of experimentation the organics in conjunction with inorganics on yield of groundnut under rainfed and protective irrigation conditions in alfisols exerted marked influence on the number of filled pods plant^{-1} in groundnut (Table 1). The pod formation is the complex process and governed by complementary interaction between source and sink. Thus the favorable effect of readily available nutrients with 100 per cent nitrogen through sheep penning is evident with higher dry matter accumulation and effective translocation of photosynthates to the sink which in turn resulted in higher number of filled pods plant^{-1}. Further, application of nutrients through FYM and fertilizers or recommended dose of fertilizers alone under rainfed conditions and leaf compost under protective irrigated condition was attributed to increased size of the source and consequently, the enhanced partitioning of photosynthates towards newly formed sink. The results were in conformity with the findings of Reddy *et al*. (2010).

Number of ill filled pods plant^{-1}

Under both the farming situations during two consecutive years of study, the number of ill filled pods plant^{-1} did not exhibit any significant difference among the treatments except control although the lowest number of ill filled pods plant^{-1} were recorded with 100 per cent nitrogen through sheep penning (Table 1). Control recorded the higher number of ill filled pods plant^{-1}.

Hundred pod weight

The higher hundred pod weight with the sheep penning treatments might be due to adequate supply of nutrients to the crop (Table 2). Further, sheep penning and FYM have also helped in improvement of soil physico chemical properties *viz.,* aggregate stability and soil organic carbon content as well as moisture availability for better growth and development of the plant. Similar findings were also obtained by Kamalakannanan and Ravichandran (2013) and Ola *et al*. (2013).

Hundred kernel weight

During both the years of study, under rainfed condition, the highest kernel weight of groundnut was recorded with supply of 100 per cent nitrogen through sheep penning (Table 2). This might be due to improved soil fertility in terms of soil organic matter, soil biological population there by better availability and uptake of plant nutrients, which might have synergistic effect in maintaining the higher chlorophyll content, favorable enzyme activity and other biological process, enable higher out turn of photosynthates for production of bold seeds. Similar results were reported by Datta *et al.* (2014) and Patil *et al.* (2015). The lowest hundred kernel weight was recorded with control (T_1) due to poor soil fertility status.

Shelling percentage

During both the years of study, the highest shelling percentage in groundnut was recorded with supply of 100 per cent of N through sheep penning (Table 2). This might be attributed to enhanced partition of photosynthates to the developing pods. Moreover, the higher hundred kernel weight with the above treatments might have resulted in higher shelling percentage. More number of bigger sized

Table 1. Number of filled pods and number of ill filled pods plant^{-1} in groundnut as influenced by organic and inorganic sources of nitrogen under rainfed and protective irrigation conditions in rainfed alfisols

Treatments	Rainfed condition				Protective irrigation			
	No. of filled pods plant^{-1}		No. of ill filled pods plant^{-1}		No. of filled pods plant^{-1}		No. of ill filled pods plant^{-1}	
	2014	2015	2014	2015	2014	2015	2014	2015
T_1 : Control (no organics and inorganics)	6.6	9.3	6.0	6.6	10.0	14.5	5.3	6.0
T_2 : Recommended dose of fertiliser (RDF) (20- 40- 40 kg N, P_2O_5 and K_2O ha^{-1})	10.3	15.0	4.3	3.3	16.1	21.8	3.6	2.7
T_3 : 50% nitrogen through urea + 50% nitrogen through FYM	10.0	14.3	4.0	3.6	16.0	22.6	3.3	2.4
T_4 : 100% nitrogen through FYM	9.3	13.3	4.2	3.6	14.2	20.5	3.6	2.9
T_5 : 50% nitrogen through urea + 50% nitrogen through leaf compost	8.6	13.0	4.0	3.8	15.6	21.7	3.3	3.2
T_6 : 100% nitrogen through leaf compost	8.0	11.3	4.4	3.9	11.5	18.6	3.8	3.1
T_7 : 50% nitrogen through urea + 50% nitrogen through sheep manure	8.6	13.0	4.3	3.6	14.0	20.3	3.1	3.0
T_8 : 100% nitrogen through sheep manure	7.6	11.6	4.1	3.7	11.2	18.5	3.3	3.7
T_9 : 100% nitrogen through sheep penning	10.6	15.3	4.0	3.0	16.9	23.1	3.0	2.3
T_{10} : 100% nitrogen through enriched groundnut shells	7.3	11.6	4.2	3.8	11.0	18.1	3.8	3.2
T_{11} : 50% nitrogen through urea + 50% nitrogen through enriched groundnut shells	9.0	12.6	4.3	3.3	13.3	19.6	3.6	3.0
SEm±	0.37	0.44	0.15	0.31	0.48	0.51	0.26	0.33
CD (P=0.05)	1.0	1.3	0.4	0.9	1.4	1.5	0.8	0.9

Table 2. Pod weight, Kernel weight and Shelling Percentage of groundnut as influenced by organic and inorganic sources of nitrogen under rainfed and protective irrigation conditions in rainfed alfisols

Treatments	Rainfed condition						Protective irrigation					
	100 pod weight (g)		100 kernel weight (g)		Shelling percentage		100 pod weight (g)		100 kernel weight (g)		Shelling percentage	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
T_1 : Control (no organics and inorganics)	61.0	69.7	30.7	35.2	63.2	69.9	69.5	72.8	32.4	38.6	66.2	70.5
T_2 : Recommended dose of fertiliser (RDF) (20- 40- 40 kg N, P_2O_5 and K_2O ha^{-1})	66.7	76.6	33.7	39.2	68.3	73.8	74.9	79.1	38.5	41.8	71.2	74.5
T_3 : 50% nitrogen through urea + 50% nitrogen through FYM	66.3	76.3	33.5	38.9	68.1	73.2	74.5	79.9	38.3	41.0	71.9	75.0
T_4 : 100% nitrogen through FYM	64.8	75.3	32.9	37.6	67.5	72.9	73.3	77.8	37.2	40.2	70.6	73.4
T_5 : 50% nitrogen through urea + 50% nitrogen through leaf compost	65.5	75.7	33.1	37.9	67.6	73.1	74.1	78.9	38.1	40.9	70.9	75.4
T_6 : 100% nitrogen through leaf compost	63.1	74.0	31.3	36.3	66.1	70.0	71.2	75.1	35.3	37.8	68.3	70.9
T_7 : 50% nitrogen through urea + 50% nitrogen through sheep manure	64.5	74.8	32.8	37.4	67.2	72.4	72.9	77.5	36.7	40.0	70.1	73.2
T_8 : 100% nitrogen through sheep manure	63.5	74.1	31.5	36.5	66.2	71.2	72.0	76.0	35.5	38.1	69.0	71.4
T_9 : 100% nitrogen through sheep penning	67.3	77.4	34.9	40.1	69.0	74.5	75.1	79.6	39.0	42.5	72.3	75.4
T_{10} : 100% nitrogen through enriched groundnut shells	63.0	72.8	31.1	36.1	66.0	71.0	71.8	75.6	35.0	37.4	67.9	71.1
T_{11} : 50% nitrogen through urea + 50% nitrogen through enriched groundnut shells	64.4	74.6	32.4	37.3	67.1	71.8	72.4	77.1	36.2	39.7	69.8	73.0
SEm ±	0.4	0.48	0.51	0.43	0.41	0.45	0.4	0.51	0.55	0.62	0.52	0.64
CD (P=0.05)	1.2	1.4	1.5	1.3	1.2	1.3	1.1	1.5	1.6	1.8	1.5	1.9

Table 3. Pod and haulm yield (kg ha^{-1}) of groundnut as influenced by organic and inorganic sources of nitrogen under rainfed and protective irrigation conditions in rainfed alfisols

Treatments	Rainfed condition				Protective irrigation			
	Pod yield		Haulm yield		Pod yield		Haulm yield	
	2014	2015	2014	2015	2014	2015	2014	2015
T_1 : Control (no organics and inorganics)	497	807	1018	1746	698	1284	1530	2236
T_2 : Recommended dose of fertiliser (RDF) (20- 40- 40 kg N, P_2O_5 and K_2O ha^{-1})	780	1429	1550	2823	1119	1951	2675	3320
T_3 : 50% nitrogen through urea + 50% nitrogen through FYM	801	1496	1496	2738	1209	1997	2763	3401
T_4 : 100% nitrogen through FYM	739	1290	1437	2530	1070	1768	2507	3097
T_5 : 50% nitrogen through urea + 50% nitrogen through leaf compost	758	1319	1471	2612	1098	1879	2631	3231
T_6 : 100% nitrogen through leaf compost	638	1074	1209	2243	842	1437	2184	2840
T_7 : 50% nitrogen through urea + 50% nitrogen through sheep manure	709	1228	1418	2490	1012	1715	2331	3004
T_8 : 100% nitrogen through sheep manure	671	1104	1260	2302	869	1528	2291	2961
T_9 : 100% nitrogen through sheep penning	842	1530	1696	2944	1280	2013	2807	3441
T_{10} : 100% nitrogen through enriched groundnut shells	611	1020	1187	2198	817	1395	2156	2750
T_{11} : 50% nitrogen through urea + 50% nitrogen through enriched groundnut shells	697	1167	1391	2430	997	1603	2291	2961
SEm ±	22.1	61	69	100.2	66.5	77.9	56.8	85.7
CD (P=0.05)	65	181	205	298	197	231	169	254

pods plant^{-1} might have accommodated larger kernels providing sufficient space for development with balanced and adequate supply of nutrients. Similar observations were made by Datta *et al.* (2014) and Jena (2015).

Pod yield

Pod yield in groundnut was significantly influenced by combinations of organic and inorganic sources of nitrogen. During *kharif,* 2014 and 2015, the highest pod yield (842 and 1530 kg ha^{-1}) of groundnut was recorded with supply of 100 per cent nitrogen through sheep penning (Table 3). Under protective irrigation during *kharif* 2014 and 2015, the same treatment recorded highest pod yield of 1280 and 2013 kg ha^{-1}.

The beneficial effect of sheep penning, FYM in conjunction with fertilizers may be due to the effect of organic matter in improving the physical, chemical and biological environment of the soil conducive for better plant growth and thereby higher pod yield (Reddy *et al.* 2010). The slight increase in pod yield with recommended dose of fertilizes might be due to immediate availability of adequate quantity of NPK required for the crop growth and development (Devi *et al*., 2003). The pod yield being function of yield attributes which was favorably influenced by supply of 50 per cent nitrogen through organics and 50per cent through inorganics which might have led to the reduction of C: N ratio and stimulation of the mineralization process of organic nitrogen that might have intern resulted in greater accumulation of dry matter right from the early stage of the crop growth. The results were agreement with the findings of Patil *et al.* (2015).

Haulm yield

The increased haulm yield was noticed in combination of organics and inorganics and sheep penning treatment (Table 3). The reason may be attributed to the beneficial effect of combined use of organic manure and fertilizers. Where the nutrient availability increased through enhanced microbial activity, conversions from unavailable to available forms and also due to improved physical, chemical and bio-chemical conditions. Similar results of obtaining higher haulm yield with the application organic manures was reported by Patil *et al.* (2015).

When nitrogen was not supplied either through organic or inorganic source, crop has to depend obviously upon soil nitrogen, which is not sufficient to produce even reasonable haulm yields. In the present study, non-supply of nitrogen through any source in control (T_1) resulted in poor performance of the crop which could be noticed by the lowest values of all the growth parameters, yield attributes, nutrient uptake and pod yield. These results are in conformity with the findings of Shankaranarayana *et al.* (2004).

CONCLUSION

Based on the outcome of the investigation, it could be inferred that the efficacy of organic manures, particularly the sheep penning showed greater response and yielded better even under rainfed conditions. On the contrary, under protective irrigation during critical stage of the crop and also during long dry spells organic manures in conjunction with the inorganics given higher yield. This revealed that the organics in conjunction with inorganics significantly influences the yield of groundnut under rainfed and protective irrigation conditions in alfisols of Andhra Pradesh. This also suggested that the conjunction of organic and inorganic sources of nitrogen is necessary for sustainable production of groundnut in low rainfall areas of Andhra Pradesh.

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