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Yield maximisation in groundnut - horse gram cropping sequence in rainfed red soils of Dharmapuri district

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Abstract : Field experiments were conducted in groundnut - horse gram cropping sequence consecutively for two years. Composted coir pith (CCP), Tank silt (TS), Soil test based NPK and micronutrient (MN) mixture increased the yield of groundnut as well as horse gram besides improving the post harvest soil available NPK status. In groundnut the highest mean pod yield of 1875 Kg ha^{-1} (1993-94) and 1860 Kg ha^{-1} (1994-95) were registered by the application of soil test based NPK along with MN mixture @ 12.5 kg ha^{-1} which were 72.9 and 37.0 per cent increase over control. In horse gram the maximum mean gain yield of 993 kg ha^{-1} (1993-94) and 350 kg ha^{-1} (1994-95) were recorded by the combined application of Composted Coir Pith and Tank silt. The inorganic treatments recorded 18 and 30 per cent increase in yield over control during 1993-94 and 1994-95 respectively. Among the interaction of organic and inorganic treatments, application of Composted Coir Pith + Soil test based NPK + MN mixture or Tank silt + soil test based NPK showed its superiority.

Key words : Groundnut - Horse gram sequence, composted coir pith, tank silt, residual crop

Introduction

Groundnut - horse gram sequence is one of the major cropping systems in the dry lands of Dharmapuri District of Tamil Nadu accounting 0.88 lakh hectares (L ha) in groundnut with the production of 1.28 lakh metric tones (LMT) and 0.61 L ha in horse gram with the production of 0.29 LMT (Anon, 1994). The productivity of the above crops is at variance, due to the various soil and climatic factors as it solely depends on monsoon rains. In order to improve the soil and to develop suitable management strategies for yield maximization in the above cropping sequence in rainfed red soils of Dharmapuri district, Tamil Nadu, field experiments were conducted at Regional Research Station, Paiyur during 1993-95 with groundnut cv. TMV-7 and horse gram cv. Paiyur - 1 as test crops.

Materials and methods

The experiments were conducted in loamy sand soil (Typic Ustorthent), which analysed for 156.0, 18.0 and 90.0 kg ha^{-1} available N, P and K respectively. The soil was free from salinity and alkalinity hazards. The groundnut and horse gram were grown from July to November and November to February respectively. Based on the initial soil fertility status, soil test based fertilizer schedule for groundnut was arrived at as 28.8, 5.5 and 4.5 kg N, P_2O_5 and K_2O per hectare. The nutrients were applied in the form of urea, single super phosphate enriched with farmyard manure and muriate of potash. The following were the treatment schedule replicated thrice in split plot design. Organic treatments viz., M_1 - composted coir pith (CCP) @ 5 t ha^{-1}, M_2-tank silt (TS) @ 40 t ha^{-1} and M_3 - CCP + TS. Inorganic treatments included S_1 - control,

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Yield

Table 1. Influence of organic and inorganic treatments on yield of Groundnut under Groundnut - Horse gram sequence.

Table 1. Influence of organic and inorganic treatments on yield of Groundnut under Groundnut - Horse gram sequence.

Treatments	Pods (kg ha^{-1})										Haulms (kg ha^{-1})									
Organic	1993 - 94					1994 - 95					1993 - 94					1994 - 95				
Inorganic →	Control	NPK	MN	NPK + MN	Mean	Control	NPK	MN	NPK + MN	Mean	Control	NPK	MN	NPK + MN	Mean	Control	NPK	MN	NPK + MN	Mean
CCP	965	1711	971	1698	1338	1352	1642	1423	1740	1539	2499	2768	2525	2794	2647	2349	2492	2134	2664	2410
TS1154	1938	1201	1946	1560	1427	1873	1502	1936	1684	2715	3014	2724	3068	2880	2516	3048	2481	2983	2757	
CCP+ TS	1133	1947	1180	1981	1560	1308	1892	1369	1923	1623	2714	3047	2732	3081	2894	2566	3020	2574	3039	2799
Mean	1084	1865	1119	1875	–	1362	1802	1431	1866	-	2643	2943	2661	2981	-	2477	2853	2396	2895	-
	SED	CD (P= 0.05)*				SED	CD (P = 0.05)*				SED	CD (P = 0.05)*				SED	CD (P = 0.05)*			
Organic	26.8	74.3				15.7	44				35.5	98.6				12.8	35.6			
Inorganic	26.1	55				45.6	98				23	48.5				48.5	102.20			
Inorg. at organic	45.3	95.2				80.7	169.7				39.4	N.S				84.2	N.S			
Org. at inorganic	48.5	101.9				71.7	152.9				49.6	N.S				74.1	N.S			

* 5% level of significance

S_2 - soil test based NPK, S_3 - micro nutrient (MN) mixture @ 12.5 kg ha^{-1} and S_4 - NPK + MN. Consecutively in the second year also the above schedule of treatments were imposed in the same plots based on the soil test NPK status of individual plots. The NPK content of CCP was 1.25, 0.04 and 2.0 per cent respectively. Similarly the tank silt used in the experiment contains 123.2 ppm N, 1.1 ppm P and 375 ppm K. Treatment wise yield was recorded at harvest of each crop.

The soil samples were analysed for available NPK at post harvest stage during 1993-94 and 1994-95 to assess the residual fertility status. Analysis of different soil constituents was done by using standard procedures as outlined by Jackson (1973).

Results and Discussion

Groundnut

POD YIELD : The organic and inorganic treatments enhanced the pod yield of groundnut. However, the magnitude of variation was higher in the inorganic treatments as compared to organics (Table 1). The highest mean pod yield of 1875 kg ha^{-1} (1993-94) and 1860 kg ha^{-1} (1994-95) were registered by the application of soil test based NPK along with MN mixture 12.5 kg ha^{-1}. However, the yield levels were on par with the application of soil test based NPK alone and thus inferred that the application of MN mixture had only marginal effects. Among the organic treatments, application of tank silt @ 40 t ha^{-1} either alone or with CCP @ 5 t ha^{-1} recorded the higher pod yield. In the year 1994-95, CCP application enhanced the pod yield considerably over the year 1993-94. Combined application of tank silt with soil

Table 2. Yield of horse gram (residual crop) Under groundnut - horse gram sequence.

Treatments	Grains (kg ha^{-1})										Haulms (kg ha^{-1})									
Organic	1993-94					1994-95					1993-94					1994-95				
Inorganics → Organics ↓	Control	NPK	MN	NPK + MN	Mean	Control	NPK	MN	NPK + MN	Mean	Control	NPK	MN	NPK + MN	Mean	Control	NPK	MN	NPK + MN	Mean
CCP	830	1016	927	1069	961	280	352	286	314	323	927	1155	1000	1337	1105	508	604	433	581	532
TS	864	944	858	955	905	313	390	301	392	349	1054	1237	1100	1279	1168	465	626	470	640	550
CCP+ TS	914	1052	954	1054	993	305	380	315	400	350	1027	1236	1041	1365	1167	418	630	413	656	529
Mean	869	1004	913	1026	–	299	374	301	389	–	1003	1209	1047	1327	–	464	620	439	626	–
	SED	CD (P=0.05)*				SED	CD (P = 0.05)*				SED	CD (P = 0.05)*				SED	CD (P = 0.05)*			
Organic	13.2	36.8				23.33	NS				36.6	NS				25.7	NS			
Inorganic	26.1	26.5				20.9	44.1				39.7	83.5				31.8	66.8			
Inorg. at organic	21.8	45.9				36.3	NS				68.8	NS				55.0	NS			
Org. at inorganic	23.1	48.6				39.1	NS				39.9	NS				54.2	NS			

* 5% level of significance

test based NPK had greater influence on the pod yield and might be due to the improvement in soil physical condition for pod formation.

HAULMS YIELD: Although, the interaction of organic and inorganic treatments could not able to enhance the haulms yield to any significant level, the improvement was observed in both organic and inorganic treatments. Among the organic treatments, application of TS either alone or in combination with CCP recorded the mean haulms yield of 2880 and 2757 kg ha^{-1} during 1993-94 and 1994-95 respectively. Among the inorganic treatments, application of soil test based NPK + MN mixture recorded the highest mean yields of 2981 and 2895 kg ha^{-1} during the first and second years respectively. However, they were on par with the application of soil test based NPK alone which indicated that the application of micronutrients had little influence on the yield of haulms. Higher yield through the addition of TS and CCP might be attributed to more moisture retentive capacity and improved soil physical condition for pod formation (Aruna Rajagopal *et al*., 1995). Increase of groundnut yield due to the application of NPK was also reported by Bhasole *et al*. (1982) which lend support to the present results.

***Horsegram* (RESIDUAL CROP)**

GRAIN YIELD : The yield of residual horse gram (Table 2) revealed that in the year 1994-95 the yield was lower than 1993-94 which may be due to the lower amount of rainfall and less number of rainy days during the growth period (632.7 mm with

Table 3a. Post-harvest soil fertility status under groundnut - horse gram sequence 1993-94

Table 3a. Post-harvest soil fertility status under groundnut - horse gram sequence 1993-94

Treatments	$KMnO_4$ - N (ppm)					Olsen - P (ppm)					NH_4OAc - K (ppm)				
Inorganics → Organics ↓	Control	NPK	MN	NPK + MN	Mean	Control	NPK	MN	NPK + MN	Mean	Control	NPK	MN	NPK + MN	Mean
CCP	74.7	99.7	78.8	96.3	87.4	12.0	13.7	11.8	14.0	12.9	51.0	78.3	52.7	61.6	60.9
TS	70.4	101.0	93.5	101.8	91.7	10.3	17.2	13.2	17.2	14.6	33.7	52.1	40.7	68.4	50.0
CCP+TS	80.5	89.7	80.8	93.6	86.1	18.0	20.3	18.3	20.5	19.3	43.3	62.3	52.3	69.0	56.9
Mean	76.2	96.8	84.4	97.3	-	13.4	17.1	14.4	17.2	-	44.3	64.5	48.6	66.3	-
	SED	CD (P = 0.05)*				SED	CD (P = 0.05)*				SED	CD (P = 0.05)*			
Organic	3.3	NS				0.4	1.1				6.7	NS			
Inorganic	5.3	11.0				0.3	0.6				5.6	11.8			
Inorg. at organic	9.1	NS				0.5	1.1				9.7	NS			
Org. at inorganic	8.5	NS				0.6	1.4				10.8	NS			

* 5% level of significance

34 rainy days during 1993-94 and 291.8 mm with 21 rainy days during 1994-95). Among the organic treatments, application of CCP alone or with TS recorded comparable yield. The maximum mean grain yield of 993 kg ha^{-1} (1993-94) and 350 kg ha^{-1} (1994-95) were recorded by the combined application of CCP + TS. Among the inorganic treatments, the highest yield was obtained by the application of soil test based NPK + MN mixture and was comparable to soil test based NPK alone. Among the interaction of organic and inorganic treatments, application of CCP + soil test based NPK + MN mixture or TS + soil test based NPK showed its superiority over rest of the treatments. Application of CCP and TS might have played a favourable role in holding nutrients, which might have contributed to the subsequent residual crops, besides, continuous mineralisation of CCP.

HAULMS YIELD : The magnitude of variation in the haulms yield in the different organic and inorganic treatments, was not to that extent of grain yield. Though there was numerical variation in the haulms yield, the effect was not spectacular due to the organic and their interaction with inorganic nutrients. However, application of soil test based NPK and their combination with MN increased the haulms yield over control. Yield enhancement in horse gram through CCP application was also reported by Prabakaran and Ramasamy (1995), which lend support to the present findings.

Post harvest soil fertility status

The post harvest residual soil NPK status (Table 3a & 3b) was greatly varied by the different organic and inorganic treatments. However, the influence was spectacular in the inorganic treatments as compared to organics.

Table 3b. Post-harvest soil fertility status under groundnut - horse gram sequence 1994-95

Treatments	$KMnO_4$ - N (ppm)					Olsen - P (ppm)					NH_4OAc - K (ppm)				
Inorganics → Organics ↓	Control	NPK	MN	NPK + MN	Mean	Control	NPK	MN	NPK + MN	Mean	Control	NPK	MN	NPK + MN	Mean
CCP	83.1 (11.2)	109.3 (9.6)	87.8 (11.4)	113.2 (17.5)	98.35 (12.5)	13.7 (14.2)	14.5 (5.8)	13.2 (11.9)	14.2 (1.4)	14 (8.5)	61.3 (20.2)	85.3 (8.9)	62 (17.6)	91.9 (49.2)	75.13 (23.3)
TS	99.7 (41.6)	116.2 (15.0)	103 (10.2)	119.3 (17.1)	109.5 (19.4)	11.7 (13.6)	17.8 (3.5)	13.2 (0.0)	18.2 (5.8)	15.2 (4.8)	54.7 (40.6)	59.9 (14.9)	50.3 (23.6)	78.1 14.2)	60.8 (21.6)
CCP+ TS	86.7 (7.7)	98.3 (9.6)	89.4 (15.6)	102.2 (9.2)	94.2 (9.4)	18.8 (4.4)	20.8 (2.5)	19 (3.8)	21.3 (3.9)	20 (3.6)	55.2 (27.5)	74.6 (18.6)	63 (20.9)	81 (17.4)	68.5 (20.4)
Mean	89.8 (19.4)	107.9 (11.5)	93.4 (10.7)	111.6 (14.7)	–	17.7 (32.1)	17.7 (3.5)	15.1 (4.9)	18 (4.7)	—	57.1 (28.9)	73.3 (13.6)	58.4 (20.4)	83.7 (26.2)	–
	SED	CD (P = 0.05)*				SED	CD (P = 0.05)*				SED	CD (P = 0.05)*			
Organic	3.4	9.3				0.5	1.3				2.4	6.7			
Inorganic	3.3	6.9				1	N.S				5.8	12.2			
Inorg. at organic	6.7	NS				0.5	1.1				9.8	NS			
Org. at inorganic	7.3	NS				0.7	1.6				10.5	NS			

* 5% level of significance Values given in parentheses are percent increase over 1993-94-post harvest soil nutrients level.

Application of soil test based NPK alone or in combination with MN showed comparable values of NPK. Among the different organics, application of TS improved the N status while CCP + TS enhanced the P whereas K status was influenced by the CCP. Increase in available N might be due to the direct addition of N through inorganic fertilizers to the available pool as reported by Bellakki and Badanur (1997). The additions of organic materials also form a cover on sesquioxide and thus reduce the P fixing capacity of the soil (Bellakki and Badanur, 1997). Increase in available K might be attributed to the direct effect of K to the available pool of soil besides the release of K due to the interaction of CCP with clay. These results are in line with the findings of Bhardwaj and Omanuar (1994). Legumes are reported to solubilise more P which might leave the soil richer in plant nutrients (Singh and Sahu, 1981).

Among the interaction of organic and inorganic treatments, application of Composted Coir Pith @5 t ha^{-1} + soil test based NPK + Micronutrient mixture @ 12.5 kg ha^{-1} or Tank Silt @ 40 t ha^{-1} + soil test based NPK showed its superiority over rest of the treatments in increasing the yield of main and residual crops besides improving the post harvest soil fertility.

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References

Anonymous, (1994). Agro Stat. Directorate of Agriculture. Madras - 5.

Aruna Rajagopal, Asokaraja, N and Velu, G. (1995). Impact of irrigation management practices and soil amendments in groundnut. **Madras Agric. J.**, 82: 341-344.

Bellakki, M.A and Badanur, V.P. (1997). Long-term effect of integrated nutrient management on properties of Vertisol under dry land agriculture. **J. Indian Soc., Soil Sci**. 45: 438-442.

Bhardwaj, V. and Omanuar, P.K. (1994). Long-term effects of Continuous rotational cropping and fertilization on crop yields and Soil properties - II Effects on EC, pH, organic matter and available nutrients of soil. **J. Indian Soc. Soil Sci.** 42: 387.

Bhasole, R.J. Jadav, S.N. and Wagh, V.B. (1982). Response of groundnut var M-13 to NPK during *kharif* season under konkan climate condition. **Madras Agric. J**. 69: 457-460.

Jackson, M.L, (1973). Soil Chemical Analysis. Prentice Hall of India PVT. Ltd, New Delhi.

Prabakaran, J and Ramasamy, A. (1995). Response of Col Horse gram to soil amendments and *Rhizobium*. **Madras Agric. J**. 82: 394-395.

Singh, B.G., and Sahu, M.P. (1981). Fertilizers use in groundnut based cropping system in different agro climatic zones. Fert. News. September : 51- 55.

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