

Integrated nutrient management in groundnut (*Arachis hypogaea*)-wheat (*Triticum aestivum*) cropping system on vertisols of western Maharashtra plains zone

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ABSTRACT

A field experiment on integrated nutrient management in groundnut (*Arachis hypogaea* L.) var. 'Phule Pragati'-wheat (*Triticum aestivum* L. emend. Fiori. & Paol.) var. 'HD 2189' cropping system revealed that maximum and significantly higher (57% higher over control) pod yield of rainy season (*kharif*) groundnut (2,751 kg/ha) and winter wheat yield under control (2,232 kg/ha) as well as recommended dose of fertilizer (5,415 kg/ha) were recorded due to application of 2.5 tonnes farmyard manure (FYM) + 75% recommended fertilizer to *kharif* groundnut. Application of recommended fertilizer dose to wheat crop recorded 5,100 kg/ha grain yield compared with the control giving only 1,924 kg/ha. Significantly higher groundnut-equivalent yield (5,947 kg/ha), net returns (Rs 55,611/ha) and benefit : cost (B : C) ratio (4.54) of the groundnut-wheat cropping system were also observed due to application of 2.5 tonnes FYM + 75% recommended fertilizer to *kharif* groundnut and full recommended fertilizer to wheat crop, closely followed by application of 10 tonnes wheat straw (crop residue) + 50% recommended dose of fertilizer (RDF) to *kharif* groundnut. These treatments are helpful in building up soil fertility too.

Key words : Vertisols, Groundnut-wheat cropping system. Productivity, Integrated nutrient supply

Generally fertilizer dose is recommended on the basis of individual crop response, as the determination of the fertilizer dose for cropping system is complex due to factors like soil, nutrient fixation and residual effects. To encourage rational use of fertilizer, it is essential that the cultivators

are made aware of the profitability of fertilizer application under sequence cropping. The importance of growing legumes for sustaining and improving soil fertility has been known since long. The wheat productivity increased due to preceding legume crop (More and Bagade, 1982; Jadhav and

Koregave, 1988). Groundnut-wheat is one of the cropping systems that is gaining popularity under intensive cultivation on vertisols. Information on nutrient requirement for this intensive cropping system is limited, particularly when nutrients are supplied through partly organic and partly inorganic sources. Sustainability of higher yields could be achieved through integrated nutrient management (Singh *et al.*, 1990). Therefore the present experiment on integrated nutrient management in groundnut-wheat crop sequence was conducted.

MATERIALS AND METHODS

The field experiment was conducted during the rainy (*kharif*) and winter (*rabi*) seasons of 1994-95 to 1996-97 at Agricultural Research Station, K. Digraj, Sangli. The annual precipitation received during 1994, 1995 and 1996 was 617.9, 381.8 and 490.0 mm respectively. The experiment was laid out in randomized block design with 3 replications. Three cycles of the system were completed in fixed plots. Soil of the experimental site was medium deep black vertisols, analysing medium in organic carbon (0.57 %), low in available N (252 kg/ha) and available P_2O_5 (9.82 kg/ha), and high in available K_2O (387 kg/ha), with pH 8.7 and electrical conductivity [EC] 0.44 mmhos/cm. In all, 8 fertilizer treatments were applied to the *kharif* groundnut, viz. control (no fertilizer) [T₁]; farmers' practice [FP] (10 kg N + 20 kg P_2O_5 /ha [T₂]; FP + *Rhizobium* [T₃]; FP + *Rhizobium* + phosphorus-solubilizing microorganisms [PSM] [T₄]; recommended dose of fertilizer (RDF) (20 kg N + 40 kg P_2O_5 /ha [T₅]; 5 t FYM + 50% RDF [T₆];

2.5 t FYM + 75% RDF [T₇]; and 10 t crop residue (wheat straw) + 50% RDF [T₈]. For *rabi* wheat two fertilizer treatments, viz. control (no fertilizer) and RDF (120 kg N + 60 kg P_2O_5 + 60 K_2O) were superimposed over *kharif* groundnut treatments. Nitrogen, phosphorus and potassium were applied through urea, single superphosphate and muriate of potash respectively. The full dose of fertilizer to *kharif* groundnut was applied at the time of sowing and for the *rabi* wheat half dose of nitrogen and full dose of phosphorus and potash were applied at the time of sowing and the remaining half dose of nitrogen was applied 30 days after sowing. Groundnut (var 'JL 24' and wheat (var. 'HD 2189') were sown. All other recommended agronomic practices were followed to raise groundnut and wheat crops.

RESULTS AND DISCUSSION

Yield of groundnut

Results (Table 1) revealed that during all the 3 years as well as in the pooled data, mean maximum and significantly higher dry pod (2,751 kg/ha) and haulm yields (5,119 kg/ha) of *kharif* groundnut were observed due to application of 2.5 tonnes FYM + 75% recommended dose of fertilizer, which is 57% higher than of control and 31% higher than of farmers' practice. However, this treatment was closely followed by application of 10 t wheat straw + 50% recommended fertilizer dose. Giri (1993) reported that groundnut crop gives response up to 12.5 kg N and 21.5 kg P_2O_5 /ha. Under medium fertility status of the soil (treatments T₂ to T₄, when the treatments of farmers' practice was supplemented with

Rhizobium and phosphorus-solubilizing micro-organisms (T_4) significant increase in dry-pod yield was observed during the first year. Though there was no significant difference in the dry-pod yield during the

succeeding years, there was increase in the mean yield by 171 kg/ha.

Yield of wheat

Application of recommended dose of fertilizers wheat crop recorded 5,100 kg/ha

Table 1. Effect of fertilizer treatments on yield (kg/ha) of groundnut

Treatment	1994		1995		1996		Mean	
	Pod	Haulm	Pod	Haulm	Pod	Haulm	Pod	Haulm
T_1 : Control	1,683	2,921	1,799	3,905	1,788	3,172	1,757	3,333
T_2 : FP	2,032	3,659	2,140	4,468	2,109	5,741	2,094	3,956
T_3 : T_2 + <i>Rhizobium</i>	2,238	3,984	2,236	4,741	2,127	3,767	2,200	4,164
T_4 : T_3 + PSM	2,286	3,937	2,349	4,847	2,161	3,831	2,265	4,205
T_5 : RDF (25:50)	2,619	4,587	3,034	5,442	2,437	4,323	2,697	4,784
T_6 : 5 t FYM + 50% RDF	2,643	4,683	3,019	6,024	2,458	4,339	2,707	5,015
T_7 : 2.5 t FYM + 75% RDF	2,683	4,849	3,058	6,053	2,513	4,455	2,751	5,119
T_8 : 10 t CR + 50% RDF	2,579	4,817	2,974	5,878	2,609	4,629	2,720	5,180
Mean	2,346	4,174	2,576	5,170	2,275	4,032	2,399	4,470
CD (P = 0.05)	126	270	414	1,051	359	628	233	332

Table 2. Effect of fertilizer treatments on yield of wheat (kg/ha)

Treatment	1994-95		1995-96		1996-97		Mean	
	Control	RDF	Control	RDF	Control	RDF	Control	RDF
T_1 : Control	1,224	4,616	1,213	4,589	1,749	4,973	1,233	4,639
T_2 : Farmer's practice	1,404	4,973	1,433	4,675	2,373	5,399	1,462	4,817
T_3 : T_2 + <i>Rhizobium</i>	1,484	4,944	1,535	4,793	2,435	5,460	1,561	4,900
T_4 : T_3 + PSM	1,696	4,831	1,551	4,788	2,482	5,473	1,598	4,876
T_5 : RDF (25:50)	1,777	4,965	1,997	4,874	2,377	5,837	1,988	5,003
T_6 : 5 t FYM + 50% RDF	1,737	5,073	2,142	5,142	2,373	5,722	2,108	5,196
T_7 : 2.5 t FYM + 75% RDF	1,908	5,335	2,260	5,352	2,483	5,926	2,232	5,415
T_8 : 10 t CR + 50% RDF	2,005	5,150	2,195	5,083	1,982	5,480	2,168	5,142
Mean	1,700	4,853	1,790	4,912	2,282	5,534	1,924	5,100
CD (P = 0.05)	441	NS	152	298	NS	NS	95	165

grain yield, which is 165% higher than of the control (1,924 kg/ha). Giri (1993) reported that direct application of N up to 100 kg/ha increased the growth attributes and yield of wheat. Wheat yield under control as well under recommended dose of fertilizer was also influenced significantly by fertilizer treatments to *kharif* groundnut. Application of 2.5 tonnes FYM + 75% recommended fertilizer recorded maximum and significantly higher mean grain yield of wheat (2,232 kg/ha and 5,416 kg/ha). This was 16.48 and 81.16 % higher than the control and recommended fertilizer treatments to wheat respectively. This was closely followed by the application of 10 t wheat straw + 50% recommended fertilizer (Table

2). Under low-fertility status of the soil (no fertilizer to wheat crop treatments T₂ to T₄ the treatment F P + *Rhizobium* + PSM (T₄) to *kharif* groundnut gave significant increase in the wheat yield.

Economics of cropping system

The effects of fertilizer treatments on the economics of groundnut-wheat cropping system (Table 3) revealed that significantly higher groundnut-equivalent yield (5,947 kg/ha), net returns (Rs 55,611/ha) and benefit : cost ratio (4.54) of the groundnut-wheat cropping system were observed due to application of 2.5 tonnes FYM + 75% recommended fertilizer to *kharif* groundnut and full dose of recommended fertilizer to

Table 3. Effect of fertilizer treatments on economics of groundnut-wheat cropping system (Mean of data 3 years)

Treatment	Groundnut equivalent		Net returns		Benefit : cost ratio	
	Control	RDF	Control	RDF	Control	RDF
T ₁ : Control	2,732	4,397	19,953	37,957	2.55	3.56
T ₂ : Farmers' practice	3,347	4,987	26,897	44,581	3.02	3.92
T ₃ : T ₂ + <i>Rhizobium</i>	3,456	5,080	28,163	45,651	3.12	3.99
T ₄ : T ₃ + PSM	3,570	5,131	29,480	46,207	3.21	4.01
T ₅ : RDF (25:50)	4,121	5,708	35,750	52,810	3.62	4.37
T ₆ : 5t FYM+50% RDF	4,167	5,781	36,196	53,580	3.63	4.40
T ₇ : 2.5 t FYM + 75% RDF	4,286	5,947	37,698	55,611	3.75	4.54
T ₈ : 10 t CR + 50% RDF	4,176	5,765	36,583	53,644	3.71	4.46
Mean	3,732	5,349	31,340	48,753	3.33	4.16
CD (5%)	424	281			0.39	0.24
CV (%)	5.12	4.34			6.76	3.22

Market rates : Groundnut pods (Rs 12/kg), dry haulm (Rs 1/kg), wheat grain (Rs 6/kg), wheat straw (Re 0.30/kg)

Cost of inputs : *Rhizobium* (Rs 30/kg), PSM (Rs 70/kg), FYM (Rs 50/kg), wheat straw (Re 0.30/kg)

wheat crop, closely followed by application of 10 t wheat straw (crop residue) + 50% recommended fertilizer to *kharif* groundnut and full dose of recommended fertilizer to wheat crop. These treatments also helped build the soil fertility. Deshpande and Jadhav (1996) also reported that groundnut-wheat crop sequence was most remunerative and gave the highest B : C ratio too.

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