



Integrated nutrient management in groundnut (*Arachis hypogaea* L.)-maize (*Zea mays*) cropping system

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Abstract : A field experiment was conducted to assess the fertilizer requirement of groundnut (*Arachis hypogaea* L.) - maize (*Zea mays*) cropping system on *Vertisol* of western Maharashtra plain zone. Dry pod and haulm yield of the summer groundnut were increased significantly due to the integrated nutrient management treatments. Maximum and significantly higher dry pod (36.34 q ha⁻¹) and haulm (51.07 q ha⁻¹) yield were recorded due to the application of 75 % RDF + 25 % N through FYM + *Rhizobium* + PSB. Application of 75 % RDF + 25 % N through FYM + *Rhizobium* + PSB to preceded groundnut and 75 % RDF + 25 % N through FYM + *Azobacter* + PSB to succeeding maize recorded maximum maize seed yield (36.23 and 40.30 q ha⁻¹) and stover yield (50.99 and 54.96 q ha⁻¹), respectively. However, application of 75 % RDF + 25 % N through FYM + *Rhizobium* + PSB to preceded groundnut and 75 % RDF + 25 % N through FYM + *Azobacter* + PSB to succeeding maize recorded maximum groundnut equivalent yield (51.70 and 51.55 q ha⁻¹), respectively.

Key Words : Groundnut-maize cropping system, Integrated nutrient management, Organic manure

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INTRODUCTION

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 profitability of fertilizer application under sequence cropping. The importance of growing legumes for sustaining and improving soil fertility has been known since long. The maize productivity increased due to preceding legume crop (Morey and Bagade, 1982, Jadhav and Koregave, 1988). Groundnut-maize is one of the cropping systems that is gaining productivity 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 yield could be

achieved through integrated nutrient management (Singh *et al.*, 1990). Therefore, the present experiment on integrated nutrient management in groundnut-maize crop sequence was conducted.

MATERIAL AND METHODS

The field experiment was conducted during the summer and rainy (*Kharif*) season of 2009 and 2010 at Central Campus, Mahatma Phule Krishi Vidyapeeth, Rahuri. The annual precipitation received during 2009 and 2010 was 529.4 and 729.5 mm, respectively. The experiment was laid in Randomized Block Design and strip plot design with four replications. Two cycles of the system were completed in fixed plots. Soil of the experimental field was sandy clay loam in texture. Low in available N (238 kg ha⁻¹), medium in available P₂O₅ (24 kg ha⁻¹) high in available K₂O (358 kg ha⁻¹) and medium in organic carbon (0.42 %) with pH 8.2 and

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electrical conductivity (EC) 0.30 mmhos cm⁻¹. In all five fertilizer levels were applied to the the summer groundnut viz., F₁= 100 % RDF (25 : 50 :00 NPK kg ha⁻¹), F₂= 75 % RDF + 25 % N through FYM + *Rhizobium* + PSB; F₃= 50 % RDF + 50 % N through FYM + *Rhizobium* + PSB; F₄= 25 % RDF + 75 % N through FYM + *Rhizobium* + PSB; and F₅= 100 % N through organic manure (50 % N through FYM + 25 % N through vermicompost + 25 % N through neem cake + *Rhizobium* + PSB). For *Kharif* maize six fertilizer levels viz., M₁= 100 % RDF (120 : 60 : 60 NPK kg ha⁻¹), M₂= 75 % RDF + 25 % N through FYM + *Azobacter* + PSB; M₃= 50 % RDF + 50 % N through FYM + *Azobacter* + PSB; M₄= 25 % RDF + 75 % N through FYM + *Azobacter* + PSB; M₅= 100 % N through organic manure (50 % N through FYM + 25 % N through vermicompost + 25 % N through neem cake +

Azobacter + PSB) and M₆= control were superimposed over summer groundnut treatments. Nitrogen, phosphorus and potassium were applied through urea, single super phosphate and muriate of potash, respectively. The full dose of fertilizer to summer groundnut was applied at the time of sowing and for the *Kharif* maize half dose of nitrogen and full dose of phosphorus and potash was applied at the time of sowing and the remaining half dose of nitrogen was applied 30 DAS after sowing. Groundnut (var. TAG-24) and maize (var. Affrican Tall) were sown. All other recommended agronomic practices were followed to raise groundnut and maize crop.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under

Table 1 : Dry pod and dry haulm yield of groundnut as influenced by different integrated nutrient management treatment

Treatments	Dry pod yield (qha ⁻¹)			Dry haulm yield (qha ⁻¹)		
	2009	2010	Pooled mean	2009	2010	Pooled mean
Fertilizer to groundnut						
F ₁ = 100 % RDF (25:50:00 NPK (kgha ⁻¹))	33.94	36.16	35.05	49.45	50.12	49.78
F ₂ = 75 % RDF + 25 % N through FYM + <i>Rhiz.</i> + PSB	35.46	37.23	36.34	50.97	51.18	51.07
F ₃ = 50 % RDF + 50 % N through FYM + <i>Rhiz.</i> + PSB	34.56	36.47	35.52	50.06	50.62	50.34
F ₄ =25 % RDF + 75 % N through FYM + <i>Rhiz.</i> + PSB	32.14	34.26	33.20	47.67	48.32	47.99
F ₅ = 100 % N through organic manure	31.22	33.28	32.25	46.72	47.27	47.00
S.E. +	0.40	0.32	0.27	0.46	0.41	0.32
C.D. (P=0.05)	1.24	1.00	0.82	1.39	1.25	0.96

*100 % N through organic manure (50% N through 0.33FYM + 25 % N through vermicompost + 25 % N through neemcake + *Rhiz.* + PSB)

Table 2 : Seed yield, stover yield and groundnut equivalent yield of maize as influenced by integrated nutrient management treatments

Treatments	Seed yield (qha ⁻¹)			Stover yield (qha ⁻¹)			Groundnut equivalent yield (qha ⁻¹)		
	2009	2010	Pooled mean	2009	2010	Pooled mean	2009	2010	Pooled mean
Fertilizer to groundnut									
F ₁ = 100 % RDF (25:50:00 NPK kgha ⁻¹)	35.00	35.90	35.45	48.28	51.78	50.03	48.15	51.99	50.07
F ₂ = 75 % RDF + 25 % N through FYM + <i>Rhiz.</i> + PSB	35.78	36.68	36.23	49.05	52.93	50.99	49.99	53.41	51.70
F ₃ = 50 % RDF + 50 % N through FYM + <i>Rhiz.</i> + PSB	34.00	34.90	34.45	47.28	51.31	49.30	48.36	51.86	50.11
F ₄ =25 % RDF + 75 % N through FYM + <i>Rhiz.</i> + PSB	32.68	33.60	33.14	45.98	50.01	48.00	45.41	49.07	47.24
F ₅ = 100 % N through organic manure	31.30	32.10	31.70	44.58	48.61	46.60	43.93	47.43	45.68
S.E. ±	0.22	0.13	0.14	0.12	0.15	0.09	0.36	0.33	0.26
C.D. (P=0.05)	0.68	0.41	0.44	0.39	0.48	0.28	1.11	1.03	0.68
Fertilizer to maize									
M ₁ = 100 % RDF (25:50:00 NPK kgha ⁻¹)	38.56	40.52	39.54	54.04	54.04	54.04	49.12	53.35	51.23
M ₂ = 75 % RDF + 25 % N through FYM + <i>Rhiz.</i> + PSB	39.36	41.24	40.30	54.76	55.16	54.96	49.45	53.67	51.55
M ₃ = 50 % RDF + 50 % N through FYM + <i>Rhiz.</i> + PSB	36.96	38.14	37.55	50.76	53.86	52.31	48.47	52.30	50.35
M ₄ =25 % RDF + 75 % N through FYM + <i>Rhiz.</i> + PSB	34.96	35.34	35.15	48.96	53.84	51.40	47.66	51.06	49.36
M ₅ = 100 % N through organic manure	34.76	34.54	34.65	45.62	53.34	49.48	47.58	50.66	49.14
M ₆ = Control	17.92	18.04	17.98	28.08	35.36	31.72	40.74	43.43	42.08
S.E. ±	0.49	1.05	0.55	0.50	0.43	0.28	0.19	0.46	0.24
C.D. (P=0.05)	1.49	3.16	1.68	1.52	1.30	0.84	0.57	1.39	0.73
Interaction									
F x M	NS	NS	NS	NS	NS	NS	NS	NS	NS
M x F	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS=Non-significant

following heads :

Performance of summer groundnut :

Results (Table 1) revealed that, 2 years as well as in the pooled data, mean maximum and significantly higher dry pod (36.34 q ha⁻¹) and haulm yield (51.07q ha⁻¹) of summer groundnut was observed due to application of 75 % RDF + 25 % N through FYM + *Rhizobium* + PSB, which is 12.68 and 8.65 % higher than of 100 % N through organic manure (50 % N through FYM + 25 % N through vermicompost + 25 % N through neem cake + *Azobacter* + PSB), respectively. However, this treatment was closely followed by application of 50 % RDF + 50 % N through FYM + *Azobacter* + PSB and 100 % RDF through inorganic. The ¾ dose of application 75 % RDF through inorganic might have supplied readily available source of nitrogen, phosphorus and potassium in early growth stage while the ¼ dose of application 25 % N through FYM along with biofertilizer might have acted as supplementary nitrogen source in latter

stage of crop growth. It might have helped in making available nutrient supply throughout the growth of crop as per requirement and improved symbiotic nitrogen fixation in groundnut (Rayer, 1984).

Performance of Kharif maize:

Effect of preceding crop:

Application of 75 % RDF + 25 % N through FYM + *Rhizobium* + PSB to preceding groundnut crop recorded significantly higher seed yield (36.23 q ha⁻¹) and stover yield (50.99 q ha⁻¹) which is 14.29 % and 9.42 %, respectively higher than 100 % N through organic manure (31.70 and 46.60 q ha⁻¹). However, this treatment was closely followed by the application of 100 % RDF through inorganic fertilizer. Giri (1993) reported that groundnut crop gives response upto 12.5 kg N and 21.5 kg P₂O₅ ha⁻¹.

Effect of succeeding maize:

Application of 75 % RDF + 25 % N through FYM +

Table 3 : Gross monetary returns, cost of cultivation, net monetary returns and B : C ratio as influenced by different treatments in Groundnut-maize cropping sequence

Treatments	Gross monetary returns (Rs ha ⁻¹)			Cost of cultivation (Rs ha ⁻¹)			Net monetary returns (Rs ha ⁻¹)			B:C ratio		
	2009	2010	Pooled mean	2009	2010	Pooled mean	2009	2010	Pooled mean	2009	2010	Pooled mean
Fertilizer to groundnut												
F ₁ 100 % RDF (25:50:00 NPK kg ha ⁻¹)	159948	182983	171466	54679	59132	56905	105269	123850	114560	2.93	3.09	3.01
F ₂ 75 % RDF+ 25 % N through FYM + <i>Rhizobium</i> + PSB	165952	187846	176899	56754	61842	59319	109156	126003	117580	2.92	3.04	2.98
F ₃ 50 % RDF+ 50 % N through FYM + <i>Rhizobium</i> + PSB	160576	182478	171527	57687	63534	60610	102889	118943	110917	2.78	2.87	2.83
F ₄ 25 % RDF+ 75 % N through FYM + <i>Rhizobium</i> + PSB	150922	172818	161870	58245	64796	61520	96677	108022	100350	2.55	2.66	2.63
F ₅ 100 % N through organic manure	146029	167082	156556	64293	70427	67359	81736	96655	89196	2.27	2.37	2.32
S.E. ±	1157	1149	768	.....	.....	.....	832	792	595	0.011	0.021	0.014
C.D. (P=0.05)	3568	3544	2367	.....	.....	.....	2566	2443	1835	0.033	0.063	0.042
Fertilizer to maize												
M ₁ 100 % RDF (120:60:60 NPK kg ha ⁻¹)	163494	187714	175605	57021	62033	59526	106473	125682	116078	2.87	3.03	2.96
M ₂ 75 % RDF+ 25 % N through FYM + <i>Azobacter</i> + PSB	164591	188884	176738	58167	63698	60932	106425	125186	115806	2.83	2.98	2.91
M ₃ 50 % RDF+ 50 % N through FYM + <i>Azobacter</i> + PSB	161151	184130	172641	58885	64854	61868	102266	119276	110772	2.74	2.85	2.79
M ₄ 25 % RDF+ 75 % N through FYM + <i>Azobacter</i> + PSB	158407	179929	169169	59656	66049	62852	98751	113879	106317	2.66	2.73	2.70
M ₅ 100 % N through organic manure	157880	178689	168285	64970	70842	67905	92910	107846	100379	2.43	2.53	2.48
M ₆ Control	134585	152500	143543	51341	56201	53770	83244	96299	89772	2.62	2.71	2.66
S.E. ±	684	1587	816	.....	.....	.....	313	625	293	0.010	0.010	0.008
C.D. (P=0.05)	1969	4780	2458	.....	.....	.....	944	1885	883	0.030	0.030	0.024
Interaction												
F x M	NS	NS	NS	.....	.....	.....	Sig	Sig	Sig	Sig	Sig	Sig
M x F	NS	NS	NS	.....	.....	.....	Sig	Sig	Sig	Sig	Sig	Sig
General mean	156685	178641	167663	58340	63946	61143	98347	114694	106520	2.70	2.81	2.76

F₅ and M₅ : Organic manure source (50% N through FYM + 25% N through vermicompost + 25% N through Neem cake + biofertilizers)

Azo. + PSB to succeeding maize crop recorded significantly maximum maize seed yield (40.30 q ha⁻¹) and stover yield (54.96 q ha⁻¹) which is 124.13 % and 73.26 % higher than the control (17.98 and 31.72 q ha⁻¹). However, this treatment was at par with 50 % RDF + 50 % N through FYM + *Azo.* + PSB. This increase in yield might be due to the early scence observed in combine use of FYM and chemical fertilizers. Oranic matter improves the soil structure, reduces soil crustin and also serves energy forsoil microflora utilization of exhaustible atmospheric nitrogen through biological nitrogen fixation can help a great deal in maintaining soil productivity (Hankare *et al.*, 2005).

Performance of groundnut equivalent yield:

Effect of preceding crop:

Application of 75 % RDF + 25 % N through FYM + *Rhiz.* + PSB to preceding groundnut crop recorded significantly maximum groundnut equivalent yield (51.70 q ha⁻¹) than rest of treatments, which is 13.17 % higher than 100 % N through organic manure (45.68 q ha⁻¹).

Effect of succeeding maize:

Application of 75 % RDF + 25 % N through FYM + *Azo.* + PSB to succeeding maize crop recorded significantly maximum groundnut equivalent yield (51.55 q ha⁻¹) which is 22.50 % higher than the control (42.08 qha⁻¹). However, this treatment was at par with 100 % RDF through inorganic fertilizer.

Economics of cropping system

Effect of preceding groundnut:

Application of 75 % RDF + 25 % N through FYM +

Rhiz. + PSB to recorded significantly higher gross monetary returns (Rs. 176899 ha⁻¹), net returns (Rs. 117580 ha⁻¹). However, the benefit : cost ratio (3.01) was recorded maximum in 100 % RDF through inorganic fertilizer treatment.

Effect of succeeding maize crop:

Application of 75 % RDF + 25 % N through FYM + *Azo.* + PSB recorded significantly higher gross monetary returns (Rs. 176738 ha⁻¹), net returns (Rs. 115806 ha⁻¹) and this treatment was at par with 100 % RDF through inorganic fertilizer. However, the benefit : cost ratio (2.96) was observed maximum in 100 % RDF through inorganic fertilizer treatment. This might be due to decrease in production cost and increase in sellein rate of produce. Jadhve and Koregave (1988).

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