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RESEARCH ARTICLE

SITE-SPECIFIC NUTRIENT MANAGEMENT (SSNM) IN GROUNDNUT-SUNFLOWER CROPPING SYSTEM

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ABSTRACT

A field experiment was conducted during the *kharifand rabi* season 2011 at UAS, Bangalore to examine SSNM effect on growth, yield and nutrient uptake of the sunflower cropping system. Application of soil test value based NPK along with limiting micronutrient, boron and FYM (5t/ha) along with *Trichodermavidride* (T6) has recorded significantly higher seed yield (2367kg/ha) and oil yield (970kg/ha) as well as a higher growth and yield parameters viz. plant height (154.8 cm/ plant), stem girth (1.95cm), head diameter (13.55 cm) and 100 seed weight (4.88g) as compared to the control.The results also revealed that a higher economic returns were obtained with respect to cost of cultivation in T6 when SSNM was practiced in groundnut- sunflower cropping system.

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INTRODUCTION

Sunflower (*Helianthes annus L.*) is one of the important oilseed crops of the world and ranks third in production next to groundnut and soybean and its oil is generally considered as a"premium oil" because of its light colour and high level of unsaturated fatty acids and have high value in the market. On the other hand groundnut (*Arachis hypogaea L.*) is an important food legume and oilseed of the world and is a major *kharif* crop of India. Oilseed based cropping systems have high nutrient demands and require integrated nutrient management. The response of annual oilseeds crops to major, secondary and micronutrients is significant, emphasizing the need for ensuring adequate nutrient supply to oilseeds (Hedge and Sudhakara Babu, 2002). SSNM is a "repackaging" of strategies which includes site and season specific knowledge of crop nutrients requirements and indigenous nutrient supplies and are required to increase productivity, yields and nutrient use efficiency in different cropping systems. SSNM improved the seed and oil yields of sunflower and increased the profitability with conservation of soil fertility in sunflower- groundnut cropping system in alfisols (Reddy *et al.,* 2007).

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MATERIALS AND METHODS

An experiment to study the effect of site specific nutrient management in groundnut- sunflower cropping system was carried out at ZARS, Dept. of Agronomy, University of Agricultural Sciences, Bangalore during the *kharif* and *rabi* seasons of the year 2011. The experiment was laid out in a Randomized Block Design. For the *kharif* based groundnut, treatment consisting of only RDF (recommended dosage of fertilizer) was used while for the sunflower crop there were six treatments with three replications. The six treatments comprised of combinations:

T_1- Control (No manure or fertilizer)
T_2 - 100% Recommended NPK (as per package of practices for state or agro-ecoregion)
T_3- 150% of Recommended NPK
T_4- 100% Recommended NPK + 5t FYM/ha + Crop residue incorporation with *Trichodermaviride*
T_5- Site specific (soil test based) target yield NPK + Limiting micronutrient (B)
T_6- Site specific (soil test based) target yield NPK + Limiting micronutrient (B)+ 5t FYM/ha + Crop residue incorporation with *Trichodermaviride*

Sowing of groundnut seeds was done on August 2011 with a spacing of 30cm x 15 cm at the rate of 2 seeds per hill. In case

of sunflower crop, two seeds per hill were hand dibbled at 4cm depth in 60 cm spaced furrows maintaining 30 cm between hills. The sources of fertilizers were Urea, DAP and MOP which were applied at a recommended dosage of 25:75:38 kg NPK per ha in groundnut and 62.5:75:62.5 kg NPK per ha in case of sunflower. In sunflower, the fertilizers except for N were applied as basal dose. 50% of N applied as basal dose and remaining 50% N applied at the time of earthing up. Farmyard manure @ 5t/ha, crop residue incorporated with *Trichodermaviride* and different concentrations of recommended dose of NPK were applied. The growth and yield parameters were estimated in field conditions by randomly selection of ten plants from each plot.

RESULTS AND DISCUSSION

The various observations recorded on crop *viz.*growth and yield parameters for sunflower cropping as well as nutrient uptake as influenced by various treatments are presented and discussed hereunder

Growth parameters of sunflower

Site specific nutrient management influenced leaf area, leaf area index and total dry matter at 30, 60 and 90 days after sowing (Table 1). At 60 DAS, all the three parameters were highest compared to 30 and 90 DAS. In case of leaf area and LAI, 100% of RDF,T_2 gave highest leaf area (7695.5 cm2/plant) and LAI(4.275cm^2/plant), followed by T_3(7500 cm^2/plant) for leaf area and (4.166 cm^2/plant) for LAI and the lowest was observed in control T_1, (3821.8cm^2/plant) and (2.123cm^2/plant) for leaf area and LAI respectively. Similar results of increased leaf area index at 60 DAS due to the application of 60:79.2:50.4 NPK per hectare has been reported earlier by Vasudevan *et al.* (1997). SSNM influenced dry matter at 60 DAS as highest TDM was observed in T_4(214 g/plant) where 100 % RDF along with FYM and *Trichodermaviride* was applied. This value was on par with T_2 (203.8g/plant) where 100% RDF was applied while lowest was found in T_1(99g/plant). Days to 50 percent flowering, plant height and stem girth for sunflower crop are influenced by site specific nutrient management (Table 2). *No* significant variations observed in different treatments for days to 50 percent flowering but a significantly higher days to flowering (75 days) found when no manures or fertilizers are applied. The tallest plant height (157.4 cm) was recorded inT_2, which was significantly superior to all other treatments including control (T_1). A similar result was obtained by Patel and Thakur (2003) who reported that phosphorus application at the rate of 80 kg P_2O_5/ha significantly increased plant height. Plants receiving 100 % RDF and FYM along with Trichodermaviride registered a higher stem girth (2.03 cm) in case of T_4 and this was found at par with T_5 (2.03cm) where soil test values based NPK was applied along with limiting micronutrient boron, however lowest was observed in control.

Yield and yield parameters

Yield attributes and yield of sunflower crop with respect to head diameter, test weight, seed yield, oil yield and harvest index are affected by site specific nutrient treatments (Table 3). The perusal of data revealed that highest head diameter (13.90 cm) was noticed in T_3 (150 % RDF) which was significantly superior to all other treatments including control, T_1. This was in accordance with Malik *et al*. (2004) who reported that increasing levels of NPK increase yield and yield parameters of sunflower. A higher test weight was recorded in T_2 (4.89 g) where 100 % RDF was applied and it was followed by T_6 (4.*88g)* and T_5 (4.60g). Three treatments showed promising results in accordance with seed yield and oil yield. The treatment with soil test based target yield NPK along with 5t FYM/ha and *Trichodermaviride* showed highest seed yield (2367 kg/ha) and oil yield (970 kg/ha) in T_6 which was followed by T_3(2315 kg/ha) for seed yield and (955 kg/ha) for oil yield,where 150% RDF was the treatment and T_5 (site specific target yield NPK with B) with 2270 kg/ha seed yield and 921.3 kg/ha oil yield while treatment with no manures or fertilizer (T_1) recorded lowest value for both parameters. A similar conclusion was given by Nandhagopal *et al.* (2003) who reported that application of 100% N + 100 % SSP as enriched FYM in conjunction with *azospirillum*and *phosphobacteria*inoculation produced the highest grain yield, stalk yield and oil content. Integrated nutrient use of both organic manures and inorganic fertilizers simultaneously is probably the most effective method to maintain healthy sustainable soil system while increasing crop productivity (Janssen, 1993). Site specific target yield NPK with B recorded a significantly higher harvest index in T_5 (0.275) compared to other treatments. However, treatment with 100% RDF (T_2) recorded lowest (0.183). Sofi *et al.* (2004) revealed that increased dose of nitrogen and sulphur (120 and 60 kg/ha, respectively) were equally and synergistically effective to enhance seed yield, test weight and harvest index of sunflower.

Nutrient uptake parameters

Nutrient uptake *viz.,* N, P, K, S, B and Zn uptake by the sunflower crop is influenced by the site specific nutrient management approach in the groundnut- sunflower cropping system (Table 4 and 5). Nuptake (103 kg/ha) and K uptake (116 kg/ha) were found to be highest in T_6. For K uptake, application of soil test target yield NPK along with limiting micronutrient B in T_5 (116 kg/ha) was at par with T_6 while for N uptake, T_5 (102kg/ha) andT_3 (101 kg/ha) was found to be at par with T_6.

However lowest was in control, T_1 (93kg/ha) for N and (97 kg/ha) for K uptake. Kademani *et al.* (2003) in vertisols of Karnataka also gave a similar report that the available N, P, K and S in soil at harvest of sunflower was highest with application of vermicompost @ 2 t per ha followed by FYM @ 5 t per ha. Significantly higher P uptake by sunflower was noticed in T_3 (26 kg/ha) which was on par with T_6 (25.9 kg/ha), T_5 (25.5 kg/ha) and T_4 (25.5 kg/ha). A similar report was given by Chitdeshwari *et al*. (2007) who reported that increasing levels of the respective nutrients (34:64:108 kg NPK ha^{-1}) increased the nutrient content in the crop and its uptake. Significantly higher S uptake was observed in T_6 (12.8 kg/ha) as compared to all other treatments followed by T_5 which recorded a value of 12.5 kg/ha. 100 % RDF and soil test based target yield NPK with B showed promising results as highest value was observed in T_2 and T_5 (326 g/ha) for B uptake by sunflower crop and this was found to be on par with T_4 (321g/ha) and T_3(320 g/ha) and lowest was recorded in T_1(262g/ha) with no manures and fertilizers. From the data for Zn uptake, a higher value was observed in the treatment where soil test based target yield NPK along with B was applied in T_5 (658 g/ha) followed by T_4(656 g/ha) and T_6 (632 g/ha) respectively and lowest was observed in control, T_1 (515g/ha).

Table 1. Leaf area (cm^2/plant), Leaf Area Index and dry matter accumulation in *rabi*sunflower as influenced by Site Specific Nutrient Management approach

Rabi Sunflower Treatments	Leaf Area (cm^2/plant)			LAI			Total Dry matter accumulation (g/plant)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1 : Control	850.8	3821.8	1607.0	0.472	2.123	0.892	8.35	99.00	61.25
T_2 : 100% Recommended NPK	1299.8	7695.5	2298.8	0.722	4.275	1.277	10.38	203.8	110.5
T_3 : 150% of T_2	1311.5	7500.0	2460.0	0.728	4.166	1.366	10.65	174.0	123.3
T_4 : T_2 + FYM + Cropresidueincorporation with *Trichodermaviride*	1478.5	6493.0	2899.3	0.821	3.607	1.611	10.58	214.0	149.8
T_5 : Site specific (soil test based) target yield NPK + B	1267.0	6305.8	3578.8	0.704	3.503	1.988	11.03	201.5	168.0
T_6 : T_5 + FYM + Cropresidueincorporation with *Trichodermaviride*	1239.5	6543.8	2818.3	0.689	3.635	1.566	12.38	199.50	155.8
SEm±	78.47	284.19	111.1	0.044	0.158	0.062	0.662	3.629	3.34
CD (P=05)	236.5	856.5	334.8	0.132	0.476	0.186	1.99	10.94	10.06
CV (%)	12.64	8.89	8.51	12.66	8.89	8.52	12.53	4.11	4.99

Table 2. Growth parameters of*rabi* sunflower (KBSH-53) as influenced bySite Specific Nutrient Management for Sunflower based Cropping System

Rabi Sunflower Treatments	Days to 50% flowering	Plant Height (cm)	Stem Girth (cm)
T_1 : Control	75	129.6	1.50
T_2 : 100% Recommended NPK	73	157.4	1.97
T_3 : 150% of T_2	73	156.6	2.01
T_4 : T_2 + FYM + Cropresidueincorporation with *Trichodermaviride*	73	156.0	2.03
T_5 : Site specific (soil test based) target yield NPK+ B	73	154.7	2.03
T_6 : T_5 + FYM + Cropresidueincorporation with *Trichodermaviride*	73	154.8	1.95
SEm±	0.48	4.16	0.10
CD (P=05)	1.45	12.54	0.30
CV%	1.31	5.49	10.86

Table 3. Yield parameters of *rabi*sunflower (KBSH-53) due toSite Specific Nutrient Management for Sunflower based Cropping System

Rabi Sunflower Treatments	Head Diameter (cm)	100 seed weight (g)	Seed yield (kg/ha)	Oil yield	HI
T_1 : Control	11.45	4.08	861	351.8	0.205
T_2 : 100% Recommended NPK	12.85	4.89	1903	786.3	0.183
T_3 : 150% of T_2	13.90	4.42	2315	954.8	0.268
T_4 : T_2 + FYM + Cropresidueincorporation with *Trichodermaviride*	13.00	4.48	2210	907.3	0.210
T_5 : Site specific (soil test based) target yield NPK + B	13.15	4.60	2270	921.3	0.275
T_6 : T_5 + FYM + Cropresidueincorporation with *Trichodermaviride*	13.55	4.88	2367	970.0	0.230
SEm±	0.55	0.29	105.5	42.79	0.011
CD (P=05)	1.66	NS	318	128.9	0.033
CV%	8.49	12.73	10.62	10.50	9.22

Table 4. N, P and K uptake by *rabi*sunflower as influenced by Site Specific Nutrient Management approach (n=3)

Rabi Sunflower Treatments	S Uptake (kg/ha)			B Uptake (g/ha)			Zn Uptake (g/ha)		
	Stalk	Seed	Total	Stalk	Seed	Total	Stalk	Seed	Total
T_1 : Control	4.6	5.3	9.9	122	140	262	189	326	515
T_2 : 100% Recommended NPK	5.8	5.9	11.7	162	164	326	280	305	585
T_3 : 150% of T_2	5.6	6.1	11.7	158	162	320	219	369	588
T_4 : T_2 + FYM + Cropresidueincorporation with *Trichodermaviride*	4.9	6.2	11.1	163	158	321	278	378	656
T_5 : Site specific (soil test based) target yield NPK + B	6.0	6.5	12.5	170	156	326	300	358	658
T_6 : T_5 + FYM + Cropresidueincorporation with *Trichodermaviride*	6.1	6.7	12.8	149	148	297	302	330	632
SEm±	0.457	0.368	0.537	3.364	4.859	4.664	11.247	9.202	18.19
CD (P=05)	NS	NS	1.618	10.13	14.64	14.05	33.89	27.73	54.81
CV (%)	14.35	10.46	8.00	3.78	5.44	2.62	7.46	4.63	5.20

Table 5. S, B and Zn uptake by *rabi*sunflower as influenced by Site Specific Nutrient Management approach (n=3)

Rabi Sunflower Treatment	System gross returns (Rs /ha)	System cost of cultivation (Rs /ha)	Net returns (Rs /ha)	B:C Ratio
T_1 : Control	92070	49821	42249	1.85
T_2 : 100% Recommended NPK	126810	53442	73368	2.37
T_3 : 150% of T_2	142770	55253	87517	2.58
T_4 : T_2 + FYM + Cropresidueincorporation with *Trichodermaviride*	137100	56642	80458	2.42
T_5 : Site specific (soil test based) target yield NPK + B	138210	54358	83852	2.54
T_6 : T_5 + FYM + Cropresidueincorporation with *Trichodermaviride*	141300	57558	83742	2.45

Table 6. Groundnut–sunflower system economics as influenced by Site Specific Nutrient Management

Rabi Sunflower Treatments	N uptake (kg/ha)			P uptake (kg/ha)			K uptake (kg/ha)		
	Stalk	Seed	Total	Stalk	Seed	Total	Stalk	Seed	Total
T_1 : Control	31	62	93	10.1	11.2	21.3	79	18	97
T_2 : 100% Recommended NPK	33	63	96	12.2	12.8	25.0	84	20	104
T_3 : 150% of T_2	35	66	101	13.0	13.0	26.0	87	22	109
T_4 : T_2 + FYM + Cropresidueincorporation with *Trichodermaviride*	33	64	97	12.6	12.9	25.5	90	20	110
T_5 : Site specific (soil test based) target yield NPK + B	34	68	102	12.8	12.7	25.5	95	21	116
T_6 : T_5 + FYM + Cropresidueincorporation with *Trichodermaviride*	36	67	103	12.9	13.0	25.9	94	22	116
SEm±	1.73	1.661	2.396	0.777	0.649	0.858	3.036	1.244	3.04
CD (P=05)	NS	NS	NS	NS	NS	2.58	9.14	NS	9.16
CV (%)	8.91	4.43	4.21	10.95	8.93	5.97	5.97	10.41	4.85

Groundnut-sunflower system economics

Economics of sunflower *viz.,* system gross returns, system cost of cultivation, net returns, benefit cost ratio of sunflower cultivation is influenced by Site Specific Nutrient Management approach (Table 6). 150 % RDF (T_3) recorded a higher gross returns of Rs 142770/ha and net returns ofRs 87517/ha compared to other treatments like T_6 (soil test value based target yield NPK and 5t FYM/ha along with *Trichodermaviride*) with a gross returns of Rs 141300/ha and net returns of Rs 83742/ha, T_5 where soil test value based target yield NPK with a limiting micronutrient B gave Rs 138210/ha as gross returns andRs 83852/ha as net returns, T_4 (100 % RDF with 5t FYM/ha and *Trichodermaviride*) which recorded a gross returns of Rs 137100/ha and net returns of Rs 80458/ha. However, lowest gross returns as well as net returns of the groundnut- sunflower system was observed in T_1, Rs 92070/ha and Rs 42249/ha respectively. Ankineedu *et al*. (1983) reported that intercropping of groundnut + sunflower (6:2) with fertilizers to both crop recommended togroundnut gave higher net returns (Rs.1077 per ha) at Akola. T_6 (soil test value based target yield NPK along with 5t FYM /ha and *Trichodermaviride*) recorded a higher cost of cultivation of Rs 57558/ha which was found to be on par with T_4 Rs 56642/ha where 100 % RDF with 5t FYM/ha and *Trichodermaviride* was applied and this value was followed by T_3 (Rs 55253/ha) and T_5 (Rs 54358/ha) and lowest was found in control, T_1(Rs 49821/ha). The highest benefit cost ratio was obtained where 150 % RDF was applied as the treatment in T_3 (2.58) followed by T_5 (soil test value based target yield NPK with limiting micronutrient and T_6 (soil test value based target yield NPK in addition with 5t FYM/ha and *Trichodermviride*) which recorded a benefit cost ratio of 2.54 and 2.45 respectively. The lowest benefit cost ratio was however recorded in control, T1 (1.85).

Growth and yield attributes of groundnut

Growth and yield parameters of groundnut showed non-significant trend with RDF and due to lowerincidence of pests and diseases during crop growth stages it resulted in a good groundnut pod yield.

Conclusion

Among the different treatments, application of site specific (soil test based) target yield NPK with the addition of a limiting micronutrient boron and along with FYM and *Trichodermaviride* could be practicable to obtain optimum production and productivity in groundnut- sunflower based cropping system.

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