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Nutrient Management through Organic Sources in Soybean-Wheat Cropping Sequence under Irrigated Condition

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ABSTRACT

Field experiments were conducted during kharif and rabi for two consecutive years (2010-11 and 2011-12) to evaluate the direct and residual effect of various organic manures and crop residues alone and along with jeevamrut on productivity and economics of soybean – wheat cropping system. Three organic manures (FYM, vermicompost and compost) alone and along with jeevamrut, three crop residues (cotton, wheat and soybean) @ 5 ton ha^{-1}along with jeevamrut were applied/incorporated in soil one month before sowing to both soybean and wheat crop. Only nitrogen level was balanced through manures and no phosphorus and potash were applied, jeevamrut was applied @ 500 l ha $^{-1}$at 30 and 45 DAS. The pooled results of two years revealed that significantly higher soybean grain equivalent yield (33.48 q ha $^{-1}$), production efficiency of system (19.41 kg day $^{-1}$ha $^{-1}$) and maximum B:C ratio (2.21) were recorded with 100 % RDN through vermicompost + jeevamrut (T_6) followed by 100 % RDN through vermicompost (T_3).

Key words: *Farm yard manure, Vermicompost, Compost, Jeevamrut, Soybean- Wheat system, Productivity, Profitability*

INTRODUCTION

Soybean –Wheat is the predominant cropping system in deep vertisols of central India. In Maharashtra, there is growing awareness in farmers to cultivate crops under organic farming system because of ill effects of inorganic fertilizers. Organic manures and crop residues are good source of nutrients and are important components in the stability of organic agriculture. Now a day's farmers prefer mechanical harvesting of crop, such mechanical harvesting provides a sizable quantity of crop residues which can be easily recycled for nutrient supply. The long term experiments have shown the results that productivity and soil fertility status was improved with supply of N through FYM, vermicompost, compost and crop residues as compared to only inorganic fertilizers.

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Nitrogen is the element to be first thrust in sense of organic farming, hence the use of organic inputs like FYM, vermicompost, compost, crop residues and Jeevamrut etc. are very well known for supplying the N in major quantity and also improve physical, chemical and biological properties of the soil and also improve productivity of crops on sustainable basis[8]. Therefore present investigation was carried out.

MATERIALS ANDMETHODS

The field experiment were conducted during *kharif* and *rabi* season for two consecutive years (2010-11 and 2011-12) at Agronomy Department Research Farm of Akola (Maharashtra). The soil of the experimental field was clayey in texture, low in organic carbon (0.40 %), available N (204 kg ha^{-1}), available P (17 kg ha^{-1}), marginally high in available potassium (328 kg ha^{-1}) and slightly alkaline in reaction (pH 7.8). The treatments having different organic nutrient sources were tested in randomized block design replicated thrice. The same set of treatments were applied to both *kharif* and *rabi* crops , the treatments applied are based on nitrogen equivalent basis i.e. recommended nitrogen dose of soybean (30 kg N ha^{-1}) and wheat (80 kg N ha^{-1}) of both the crops was applied through organic sources only. The treatments consisted of in situ incorporation of (T_1) control, (T_2) 100% RDN through FYM,(T_3) 100% RDN through vermicompost,(T_4) 100% RDN through compost, (T_5) 100% RDN through FYM + jeevamrut, (T_6) 100% RDN through vermicompost + jeevamrut, (T_7) 100% RDN through compost + jeevamrut,(T_8) Cotton residue @ 5 ton ha^{-1}+ jeevamrut, (T_9) Wheat residue @ 5 ton ha^{-1}+ jeevamrut and (T_{10}) Soybean residue @ 5 ton ha^{-1}+ jeevamrut. Application of organic manures and crop residues were applied and incorporated in experimental plot one month before sowing and application of jeevamrut was done @ 500 l ha^{-1} at 30 and 45 DAS.

RESULTS AND DISCUSSION

Productivity of soybean: Yield attribute and yield (Table-1)

The nutrient management treatments comprising application of 100 per cent N through vermicompost + Jeevamrut and application of 100 per cent N through vermicompost to soybean, produced significantly higher number of pods, weight of pods, number of grains and weight of grains per plant during respective years, 2010-11 and 2011-12, whereas 100 grain weight remained unaffected by any of the nutrient management treatments during both the years. The liquid organic fertilizer (*Jeevamrut*) along with organic manure might have helped in timely release of nutrients as per requirement of the plant at different stages of crop growth. This might have also helped in faster degradation and release of nutrients resulting in its better availability throughout the crop growth mediated by biological process through increased microbial and soil enzyme activity[10]. Application of 100 per cent N through vermicompost + Jeevamrut produced soybean grain yield (17.77 q ha^{-1}) which was comparable to application of 100 per cent N through vermicompost (16.92 q ha^{-1}). The per cent increase in soybean grain yield due to application Jeevamrut in addition to FYM, vermicompost and compost was 16.71, 5.02 and 10.64 per cent over sole application of those organic manures. Similarly, straw and biological yield were also significantly higher with these treatments. Harvest index of soybean was not influenced with the various nutrient management treatments during any year of experimentation.

The enhancement in grain yield of soybean could be attributed to cumulative effect of better growth, more dry matter accumulation with better partitioning of photosynthates towards sink, and eventually more number of pods, pod weight and grain yield per plant, ultimately resulting in increased grain yield[9,4].

Dry matter accumulation (Table-2)

Application of 100 per cent N through vermicompost + Jeevamrut (T_6), being at par with application of 100 per cent N through vermicompost (T_3) was significantly superior over all other treatments in respect of dry matter accumulation in grain during both the seasons.

The stem dry matter accumulation was more with application of 100 per cent N through vermicompost + Jeevamrut (T_6). However, it was on par with treatment T_3, T_5 and T_7 during 2010-11 but during 2011-12, treatment T_6 and T_3 being at par, was significantly superior over all other treatments in respect of production of stem dry matter.

The dry matter accumulation in stover was more with application of 100 per cent N through vermicompost + Jeevamrut and it was on par with treatment T_3, T_5 and T_7 during 2010-11. During 2011-12, treatment T_6 and T_3 being at par with each other, was significantly superior over all other treatments in respect of dry matter accumulation in stover.

Quality parameters (Table-3)

The quality parameters such as protein and oil content did not differ significantly due to various treatments during both the years. However, their per hectare yield were higher with application of 100 per cent N through vermicompost + Jeevamrut and application of 100 per cent N through vermicompost during first and second year. Nitrogen is main constituent of amino acid biosynthesis and helps in formation of protein. N which also helps in the efficient absorption and utilization of other required plant nutrients like phosphorus and sulphur, which is very essential for energy transformation process and it might have increased the oil content[2].

Yield attributes *viz*. length of spike, number of grains per spike, grain weight per spike and grain weight per plant were significantly more with the application of 100 per cent N through vermicompost + Jeevamrut and application of 100 per cent N through vermicompost which were at par with each other (Table-4). However, test weight of wheat was not influenced by nutrient management practices during both the years. Combined application of vermicompost and Jeevamrut was found effective and might have resulted in vigorous root development, better N fixation and growth and development of plant leading to higher photosynthetic activity and translocation of photosynthates to the sink, which might have resulted in better development of yield attributes and finally in higher grain yield per plant[3].

Dry matter accumulation (Table-5)

Application of 100 per cent N through vermicompost + Jeevamrut (T_6), being at par with application of 100 per cent N through vermicompost (T_3) was found significantly superior over all other treatments in respect of dry matter accumulation in grain, stem and husk, during both the seasons. Application of 100 per cent N through vermicompost (T_3) was at par with application of 100 per cent N through FYM + Jeevamrut (T_5) and compost + Jeevamrut (T_7), during both the seasons.

The leaf dry matter accumulation was significantly more with application of 100 per cent N through vermicompost + Jeevamrut (T_6) but it was found at par with treatment T_3, during both the seasons. Application of 100 per cent N through vermicompost (T_3) was at par with the treatment T_5, T_7, T_2 and T_4 during 2010-11 and with treatment T_5 and T_7 during 2011-12 in respect of dry matter accumulation by leaves.

Yield and quality parameters (Table-6)

The seed yield of wheat was significantly improved due to application of 100 per cent N through vermicompost + Jeevamrut (26.20 q ha^{-1}) which was comparable to yield obtained with application of 100 per cent N through vermicompost (25.30 q ha^{-1}), during both the years of investigation. The straw and biological yield of wheat was also higher under these treatments. The increase in wheat yield due to application of Jeevamrut was 3.39, 3.56 and 3.04 per cent over sole application of FYM, vermicompost and compost. This could be owing to higher availability of nutrients because of proliferous root system, resulting in adequate nutrients and water uptake by crop and better transpiration efficiency. This might have led to higher photosynthetic efficiency, which might have favorably affected the yield contributing parameters and consequently higher grain, straw and biological yield[3,12].

The protein content in wheat seed was not influenced by various nutrient management treatments, however, protein production was higher in application of 100 per cent N through vermicompost + Jeevamrut and application of 100 per cent N through vermicompost during both the seasons. Nitrogen is main constituent of amino acid biosynthesis and helps in the formation of protein by serving as a starting material for the biosynthesis of amino acids[7].

Cropping system

Soybean equivalent yield and Production efficiency

Soybean equivalent yield of the cropping system was significantly influenced with the application of 100 per cent N through vermicompost + Jeevamrut; however, it was comparable to application of 100 per cent N through vermicompost during the period of investigation.

Nutrient management also improved the production efficiency (kg day^{-1} ha^{-1}) of the system and higher production efficiency was noticed with 100 per cent N through vermicompost + Jeevamrut followed by application of 100 per cent N through vermicompost. The higher soybean equivalent yield and production efficiency might be attributed to proper utilization of nutrients due to its sustained availability which resulted in better crop growth and ultimately higher grain yield. These findings are in close conformity with those reported by Tomar *et al.*[13], Kumpawat[5] and Singh *et al.*[11].

Economics and Economic efficiency (Table-7)

The gross monetary returns and net monetary returns of the system were maximum with 100 per cent N through vermicompost + Jeevamrut and application of 100 per cent N through vermicompost during the period of investigation. However, these treatments did not show significant difference with application of 100 per cent N through FYM + Jeevamrut and application of 100 per cent N through FYM during both the years. Highest B:C ratio was registered in the treatment receiving 100 per cent N through FYM + Jeevamrut.

Highest economic efficiency (Rs. day^{-1} ha^{-1}) was noticed in the treatment receiving 100 per cent N through vermicompost + Jeevamrut followed by application of 100 per cent N through vermicompost during 2010-11. However, it was comparable to application of 100 per cent N through FYM + Jeevamrut and application of 100 per cent N through FYM during 2011-12[6,1].

Table 1: Various yield attributes of soybean as influenced by different treatments during 2010-11 and 11-12

Treatments	2010-11					2011-12				
	No. of pods plant^{-1}	Weight of pods plant^{-1} (g)	No. of seeds plant^{-1}	Weight of seeds plant^{-1} (g)	100 seed weight (g)	No. of pods plant^{-1}	Weight of pods plant^{-1} (g)	No. of seeds plant^{-1}	Weight of seeds plant^{-1} (g)	100 seed weight (g)
T_1	15.10	4.03	41.77	3.82	8.27	13.68	3.60	31.73	3.52	8.20
T_2	26.53	7.00	65.81	6.44	9.17	22.09	6.26	59.95	5.42	9.11
T_3	35.57	9.61	84.02	8.48	9.47	30.48	8.83	78.77	7.35	9.42
T_4	24.98	6.49	62.50	6.07	9.13	20.80	5.81	58.76	5.06	9.10
T_5	30.75	8.17	75.16	7.33	9.30	27.40	7.83	72.07	6.66	9.23
T_6	37.29	10.21	89.66	8.90	9.57	34.04	9.88	86.96	7.96	9.53
T_7	28.42	7.52	69.66	6.83	9.27	23.83	7.02	63.52	5.84	9.20
T_8	19.05	4.77	51.20	4.67	8.57	16.46	4.53	49.03	4.14	8.53
T_9	21.68	5.37	56.65	5.11	8.63	19.08	5.13	54.96	4.88	8.60
T_{10}	24.37	6.17	62.45	5.74	8.70	19.93	5.70	56.15	4.99	8.67
SE (m)$\pm$	1.87	0.48	3.40	0.32	0.33	1.65	0.45	3.49	0.21	0.35
CD(P=0.05)	5.56	1.42	10.10	0.94	NS	4.89	1.34	10.38	0.62	NS
GM	26.37	6.93	65.88	6.33	9.00	22.78	6.46	61.19	5.58	8.95

Table 2: Mean dry matter accumulation in stem, seed and stover at harvest (g), grain and stover yield ($q\ ha^{-1}$) of soybean as influenced by different treatments during 2010-11 and 2011-12

Treatments	Mean dry matter accumulation(g)						Grain yield($q\ ha^{-1}$)			Stover yield($q\ ha^{-1}$)		
	2010-11			2011-12								
	Stem	Seed	Stover	Stem	Seed	Stover	2010-11	2011-12	Pooled	2010-11	2011-12	Pooled
T_1	2.96	2.84	1.09	3.72	2.50	1.37	8.85	8.04	8.44	11.60	11.09	11.34
T_2	5.44	5.58	1.67	4.75	4.40	1.65	13.80	12.45	13.13	21.32	19.10	20.21
T_3	5.86	7.67	1.99	6.19	6.59	2.25	17.16	16.69	16.92	26.78	25.93	26.36
T_4	5.43	5.20	1.63	4.39	4.18	1.52	13.34	12.02	12.68	20.56	18.40	19.48
T_5	5.87	6.45	1.76	5.19	5.67	1.89	15.12	14.53	14.82	23.40	22.38	22.89
T_6	6.67	8.07	2.13	6.37	7.16	2.51	18.08	17.46	17.77	28.47	27.35	27.91
T_7	5.84	5.96	1.74	4.87	4.75	1.68	14.30	13.75	14.03	22.09	21.06	21.57
T_8	3.71	3.47	1.23	2.78	3.09	0.98	10.24	9.52	9.88	15.53	14.35	14.94
T_9	4.29	4.04	1.47	3.63	3.89	1.38	11.14	10.32	10.73	16.95	15.63	16.29
T_{10}	4.43	4.70	1.54	3.98	4.12	1.40	12.14	11.18	11.66	18.64	16.86	17.75
SE (m)±	0.41	0.40	0.13	0.31	0.30	0.11	0.85	0.82	0.54	1.39	1.20	0.82
CD(P=0.05)	1.22	1.19	0.39	0.93	0.90	0.32	2.54	2.43	1.60	4.12	3.56	2.45
GM	5.05	5.40	1.63	4.59	4.63	1.66	13.43	12.60	13.01	20.53	19.21	19.87

Table 3: Harvest index, protein and oil yield ($kg\ ha^{-1}$) of soybean as influenced by different treatments during 2010-11 and 2011-12

Treatments	2010-11			2011-12		
	Harvest index (%)	Protein Yield ($kg\ ha^{-1}$)	Oil yield ($kg\ ha^{-1}$)	Harvest index (%)	Protein Yield ($kg\ ha^{-1}$)	Oil yield ($kg\ ha^{-1}$)
T_1	42.27	311.52	136.99	42.02	284.94	125.10
T_2	39.31	534.58	240.67	39.45	485.58	230.42
T_3	39.06	666.16	307.17	39.14	655.37	299.07
T_4	39.36	512.42	230.28	39.52	466.63	208.70
T_5	39.27	586.79	281.52	39.37	569.95	271.57
T_6	38.85	707.01	338.30	38.97	693.73	328.08
T_7	39.32	551.92	264.12	39.47	535.15	241.62
T_8	39.73	368.34	160.59	39.88	343.94	149.96
T_9	39.66	405.91	180.85	39.78	377.53	165.88
T_{10}	39.44	453.34	197.74	39.82	419.63	184.78
SE (m)±	0.23	39.59	19.81	0.18	36.54	18.12
CD(P=0.05)	NS	97.61	48.85	NS	91.54	45.84
GM	39.72	509.79	233.79	39.74	483.24	220.52

Productivity of wheat: Yield attributes

Table 4: Various yield attributes of wheat as influenced by different treatments during 2010-11 and 11-12

Treatments	2010-11					2011-12				
	Length of spike (cm)	No. of grains $spike^{-1}$	Grain $wt.spike^{-1}$ (g)	Grain $wt.plant^{-1}$ (g)	1000 grain wt.(g)	Length of spike (cm)	No. of grains $spike^{-1}$	Grain $wt.spike^{-1}$ (g)	Grain $wt.plant^{-1}$ (g)	1000 grain wt.(g)
T_1	3.76	15.27	0.58	0.99	33.37	3.69	14.77	0.53	0.88	32.87
T_2	6.29	27.72	1.67	2.73	41.03	5.94	25.07	1.53	2.34	40.48
T_3	7.19	34.75	1.99	4.05	42.04	6.82	31.58	1.88	3.85	41.64
T_4	6.22	26.43	1.61	2.67	40.96	5.83	22.76	1.49	2.29	40.30
T_5	6.86	32.96	1.91	3.65	41.62	6.44	30.33	1.85	3.44	40.92
T_6	7.68	37.98	2.23	4.53	42.11	7.32	36.26	2.13	4.28	41.74
T_7	6.78	31.53	1.86	3.57	41.26	6.36	29.47	1.79	3.42	40.42
T_8	4.08	16.77	0.81	1.19	37.65	3.79	15.85	0.73	1.02	35.57
T_9	4.57	19.52	0.89	1.23	39.79	4.37	17.84	0.81	1.10	38.96
T_{10}	4.94	21.00	1.00	1.58	40.04	4.56	19.71	0.85	1.33	39.26
SE (m)±	0.27	1.65	0.09	0.17	1.88	0.29	1.52	0.09	0.14	1.81
CD(P=0.05)	0.81	4.91	0.28	0.49	NS	0.86	4.51	0.27	0.43	NS
GM	5.84	26.39	1.45	2.62	39.99	5.51	24.36	1.36	2.39	39.22

Table 5: Mean dry matter accumulation in leaves, stem, grain and husk (g),grain and straw yield (q ha^{-1}) at harvestof wheat as influenced by different treatments during 2010-11 and 2011-12

Treatments	Mean dry matter accumulation (g)							
	2010-11				2011-12			
	Leaves	Stem	Grain	Husk	Leaves	Stem	Grain	Husk
T_1	0.75	1.61	0.90	0.87	0.73	1.55	0.84	0.84
T_2	1.45	3.25	2.75	1.82	1.32	2.95	2.36	1.64
T_3	1.59	3.71	4.03	2.13	1.51	3.53	3.85	2.02
T_4	1.42	3.20	2.75	1.72	1.30	2.90	2.28	1.60
T_5	1.48	3.45	3.63	1.97	1.42	3.29	3.48	1.87
T_6	1.74	4.10	4.60	2.36	1.64	3.85	4.34	2.21
T_7	1.45	3.38	3.53	1.91	1.40	3.24	3.45	1.82
T_8	0.82	1.78	1.16	0.98	0.76	1.65	0.98	0.89
T_9	1.04	2.23	1.23	1.21	1.00	2.14	1.13	1.15
T_{10}	1.14	2.48	1.60	1.29	1.06	2.28	1.34	1.23
SE (m)$\pm$	0.06	0.14	0.17	0.08	0.05	0.13	0.14	0.07
CD(P=0.05)	0.19	0.40	0.50	0.25	0.16	0.39	0.41	0.21
GM	1.29	2.92	2.62	1.63	1.21	2.74	2.40	1.53

Table 6: Yield, harvest index and protein (kg ha^{-1}) of wheat as influenced by different treatments during 2010-11 and 2011-12

Treatments	Grain yield (q ha^{-1})			Straw yield (q ha^{-1})			Harvest index (%)		Protein Yield (kg ha^{-1})	
	2010-11	2011-12	Pooled	2010-11	2011-12	Pooled	2010-11	2011-12	2010-11	2011-12
T_1	11.09	10.24	10.68	16.17	15.35	15.76	40.68	40.00	107.24	100.59
T_2	22.23	20.78	21.51	34.25	31.81	33.03	39.36	39.52	243.24	230.47
T_3	26.01	24.59	25.30	40.53	38.10	39.32	39.11	39.23	288.72	281.78
T_4	21.85	20.21	21.03	33.60	30.86	32.23	39.41	39.57	238.98	221.12
T_5	23.00	21.48	22.24	35.54	33.02	34.28	39.29	39.43	262.82	248.24
T_6	26.97	25.42	26.20	42.25	39.63	40.94	38.95	39.07	310.86	297.35
T_7	22.53	20.81	21.67	34.79	31.88	33.33	39.33	39.50	257.38	238.32
T_8	13.04	12.28	12.66	19.70	18.47	19.08	39.76	39.92	130.85	121.44
T_9	14.30	13.69	14.00	21.66	20.66	21.16	39.70	39.83	142.81	136.45
T_{10}	15.70	15.01	15.36	24.03	22.81	23.42	39.53	39.68	162.32	156.67
SE (m)$\pm$	1.26	1.07	0.49	1.89	1.63	0.80	0.24	0.19	16.83	14.63
CD(P=0.05)	3.76	3.18	1.47	5.63	4.84	2.37	NS	NS	50.00	43.47
GM	19.67	18.45	19.06	30.25	28.26	29.26	39.51	39.57	214.52	203.24

Table 7: Gross monetary returns, net monetary returns (Rs. ha^{-1}), B:C ratio,soybean grain equivalent yield(q ha^{-1}), production efficiency (kg day^{-1}ha^{-1}) and economic efficiency (Rs day^{-1} ha^{-1}) of soybean-wheat cropping sequence as influenced by different treatments during 2010-11 and 11-12

Treatments	Gross monetary returns (Rs ha^{-1})		Net monetary returns (Rs ha^{-1})		B:C		Soybean grain equivalent yield (q ha^{-1})		Production efficiency of system (kg day^{-1} ha^{-1})		Economic efficiency of system (Rs day^{-1} ha^{-1})	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
T_1	56893	52668	27037	22812	1.90	1.76	15.50	14.45	8.59	8.27	116.54	103.22
T_2	101690	92789	58041	49140	2.32	2.13	27.14	24.92	15.53	15.04	250.18	222.35
T_3	121973	117049	67920	62995	2.26	2.17	32.76	31.44	18.60	18.68	292.76	285.05
T_4	98454	89848	49305	40699	2.21	2.02	26.45	24.15	15.17	14.58	212.52	184.16
T_5	107625	102041	61736	56152	2.35	2.22	28.91	27.42	16.43	16.30	266.10	254.08
T_6	127598	121796	71305	65502	2.27	2.16	34.26	32.71	19.42	19.40	307.35	296.39
T_7	102885	97555	51496	46166	2.00	1.90	27.82	26.24	15.87	15.63	221.96	208.89
T_8	67175	62789	32119	27733	1.92	1.79	18.06	16.89	10.03	9.86	138.45	125.49
T_9	73354	68928	35298	30872	1.93	1.81	19.72	18.53	10.97	10.86	152.14	139.69
T_{10}	80223	75075	39667	34519	1.98	1.85	21.56	20.19	12.00	11.85	170.98	156.19
SE (d)	3211	4337	3211	4337	--	--	0.86	1.17	0.51	0.68	13.84	19.62
CD (P= 0.05)	9538	12883	9538	12883	--	--	2.57	3.47	1.51	2.03	41.11	58.30
GM	93787	88054	49392	43659	2.11	1.98	25.22	23.69	14.26	14.05	212.90	197.55

REFERENCES

1. Chitale, S., Alok ,T., Sandeep, B., Rama Mohan, S., Tomar, H. S. and Urkurkar, J. S., Performance of soybean based cropping sequence under organic, inorganic and integrated nutrient supply system in vertisols. *Indian J. Agron*., **58(2)**: 163-167 (2013).
2. Deotale, R.D., Vandana, B.K. and Banginwar, A.D., Effect of foliar sprays of cow urine and NAA on morpho physiological, chemical, biochemical parameters and yield of soybean (Glycine max L.). *J. Soils and Crops*, **21(2)**: 332-337 (2011).
3. Ghanshyam, Rakesh, K. and Jat, R. K., Productivity and Soil fertility as affected by organic manures and inorganic fertilizer in greengram – wheat system. *Indian J. Agron.,* **55(1)**: 16-21 (2010).
4. Jeevan Rao, K. and Rama Laxshmi, S., Yield and nutrient uptake of soybean as influenced by different levels of urban and agricultural waste compost. *J. Soil and Crops*, **19(1)**: 1-7 (2009).
5. Kumpawat, B.S., Production potential and economics of different crop sequences. *Indian J. Agron*., **46(3)**: 421-429 (2001).
6. Narkhede, W.N., Deshmukh, M.S., Bhale, V.M., Gill, M.S., Gadade, G.D. and More, S.S., Diversification of cropping system under assured irrigated conditions in Central plateau zone of Maharashtra. *Indian J. Agron.,* **56(2)**: 104-108 (2011).
7. Mane, S.S., Dhumale, D.B. and Kanawade, D.G. Productivity and quality parameters of wheat as influenced by organic and inorganic fertilization. *PKV Res. J*., **33(2)**: 272-274 (2009).
8. Mishra, A., Kumar, N., Chandra, R. and Singh, S.K., Effect of enriched compost in combination with fertilizers on nodulation, growth and yield of soybean. *Soybean-Research*, **3:** 63-67 (2005).
9. Reddy, R.U., Reddy, S.N. and Reddy, M.S., Yield, yield attributes and oil content of soybean as influenced by INM in soybean-maize cropping system. *Inter. J. Agric. Sci.*, **5(1)**: 15-17 (2009).
10. Shinde, V.S., Sankpal, V.Y., Jawale, S.J., Shaikh, A.A., Dalavi, N.D. and Jadhav, M.B., Effect of integrated nutrient management on yield attributes and quality of soybean. *J. Maharashtra Agric. Univ.*, **34(1)**: 107-108 (2009).
11. Singh, P.K., Kushwah, V.S. and Lal, S.S., Integrated nutrient management in black gram-potato-wheat sequence. *Potato J.*, **38(2)**: 170-175 (2011a).
12. Singh, V.Y., Dhar, D.W. and Agrawal, B., Influence of organic nutrient management on basmati rice-wheat-greengram cropping system. *Indian J. Agron.,* **56(3)**: 169-175 (2011b).
13. Tomar, R.K.S., Namdeo, K.N. and Raghu, J.S., Productivity and economics of double cropping with pulses and oilseeds against the base crop wheat. *Indian J. Agron.,* **41(2)**: 205-208 (1996).