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Effect of tillage practices and nutrient levels on economic, uptake and available nutrient in soybean based cropping systems

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Abstract
The field investigation was undertaken during *kharif* and *rabi* season of 2014-15 and 2015-16 on clayey soil at the farm of AICRP on Integrated Farming Systems, VNMKV, Parbhani. Treatment consists of twelve treatment combinations comprising two tillage practices (minimum tillage, conventional tillage) and two cropping systems (soybean-*rabi* sorghum,soybean-wheat) in main plot, three levels of nutrients (75, 100 and 125 per cent RDF) in sub plot for soybean in *kharif* and after that for *rabi* sorghum and wheat in *rabi* season were assigned in a split-split plot design. The gross and net monetary returns, B:C ratio and economic efficiency were also found to be higher with practice of conventional tillage and 125 per cent RDF to soybean, *rabi* sorghum and wheat. Soybean-wheat cropping systems noted higher gross and net monetary returns, B:C ratio and economic efficiency. Also the nutrient uptake by crops was significantly higher in conventional tillage and application 125 per cent RDF treatments. Available nutrient status of the soil after harvest of crop was significantly higher in minimum tillage treatments.

Keywords: Conventional tillage, minimum tillage, nutrient levels, rabi sorghum, soybean, wheat, yield etc.

Introduction
Soybean-wheat and soybean-*rabi* sorghum are the most dominant cropping systems on the Vertisols of Central India. Cultivation of soybean in rainy season (June to October) has witnessed a phenomenal growth in the last two decades in the region while wheat or *rabi* sorghum in winter season (November to April) has a considerable potential due to congenial climate. Besides including a legume (soybean) in sequence with a cereal crop (wheat or *rabi* sorghum) may prove beneficial for long term productivity and sustainability of the system. Rotation of soybean and wheat is practiced on 4.5 million ha on the Vertisols of Central India but the mean yields are only 0.9 t and 1.7 t ha^{-1}, respectively due to limited knowledge of resource conservation technologies.

Tillage is the most important input, constituting about 25-30 per cent of energy requirement for crop production. In view of the continued energy crisis, there is a need for exploring the possibilities of reducing the tillage requirements for various crops and assessing their residual impact on the succeeding crops when grown in the system. In soybean-based cropping system, the productivity of succeeding *rabi* crops was considerably influenced by tillage across the country. There is ample scope for reducing the tillage operations in various *rabi* and *kharif* crops without significant reduction in their yields and without any adverse impact on succeeding crops in various systems at different locations, leading to energy saving in tillage practices in various cropping systems.

Nutrient management is the maintenance of soil fertility and of plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of the benefits from all possible resources. This approach of nutrient management aims at sufficient and efficient use of all the major sources of plant nutrients. So as to get maximum economic yield without any deleterious effect on physio-chemical and biological properties of the soil. Further to safeguard the environment from degradation and to maintain the purity of air, water and food. There should be careful usage of chemical fertilizers on sound scientific lines and alternatively ecological agriculture could be contemplated wherever there is shortage of chemical fertilizer and other sources of nutrients.

Research work on soybean based cropping system is lacking in Marathwada region. This project was designed to develop a feasible and economically viable soybean based cropping system by using Resource Conservation Technologies (RCTs) that could benefit the farmers as well as researchers in this locality. Therefore keeping these facts in view, the present studies

were planned to investigate the idea about soybean based cropping system for the area. The findings of these studies will result in increased production in terms of economic yield, proper distribution of farm labour and irrigation water and bio nitrogen status in soil, which will ultimately improve the living standards of the farmers of the area.

Materials and Methods

The experiments were conducted at experimental farms of AICRP on Integrated farming systems, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (MS), during *kharif* and *rabi* season of 2014-15 and 2015-16. The topography of the experimental field was fairly uniform and levelled.The soil of the experimental plot was clayey in texture and slightly alkaline in reaction having low in organic carbon (0.62), available nitrogen (134.77) and phosphorus (13.26), but marginally high in available potassium (503.25). The climate of Parbhani is semi-arid and characterized by three distinct seasons *viz.,* summer being hot and dry during March to May, warm and humid monsoon in June to October and winter with mild cold from November to February. Most of the rainfall received from south-west monsoon during June to October with mean annual normal precipitation of 964 mm received in 66.84 rainy days.

Treatment consists of twelve treatment combinations comprising two tillage practices minimum tillage (*kharif*- 1 moghda + 1harrowing, *rabi*- 2 harrowing) and conventional tillage (*kharif*- 1 ploughing + 1 moghda + 1 harrowing, *rabi*- 1 moghda + 2 harrowing) and two soybean-based cropping systems (soybean-*rabi* sorghum, soybean-wheat) in main plot, three nutrient levels (75,100,125 per cent RDF) in sub plot for soybean in *kharif* season and *rabi* sorghum, wheat in *rabi* season. The treatments were assigned in a split-split plot design with three replication. Certified seed for each crop under experimentation was used. Sowing was undertaken after receipt of sufficient rains during *kharif* season by drilling method. The distance between two rows was kept 45 cm while intra row distance was 5 cm for soybean crop in *kharif*. The seed rate used for soybean c.v. MAUS-71 was 62.5 kg ha^{-1}. During *rabi* season the seed rate used for *rabi* sorghum c.v. SPV-1595 10 kg ha^{-1}. The distance in between two rows was 45 cm and in between two plants was 15 cm and in case of wheat the seed rate used wheat c.v. NAIW-301 100 kg ha^{-1}. The distance in between two rows was 22.5 cm.

The recommended dose of fertilizer (RDF) used for soybean was 30: 60: 30 kg N, P_2O_5 and K_2O ha^{-1} respectively. Full dose of N, P_2O_5 and K_2O was applied at the time of sowing as basal dose to soybean crop. In *rabi* season also the *rabi* sorghum and wheat crop received fertilizer dose as per the treatments. The recommended dose of fertilizer for the *rabi* sorghum was 80:40:40 kg N, P_2O_5 and K_2O ha^{-1} and for wheat crop 100:50:50 kg N, P_2O_5 and K_2O ha^{-1} respectively. Half dose of N and full dose of P_2O_5 and K_2O was applied at the time of sowing and remaining half dose of N was applied at 45 days after sowing for both crops. The source of nutrients was urea, single super phosphate and murate of potash and ferrous sulphate.

Soybean is grown as *rainfed* crop therefore it does not require any irrigation but in case of dry spell one or two life saving irrigation were given as protective irrigation. In *rabi* season three irrigations were given to *rabi* sorghum at vegetative growth, flowering and grain filling stage and five irrigation was given to wheat at CRI, tillering, late jointing stage, flowering and dough stage as per the necessity during the total period of investigation during both the years. Five plants from each net plot were selected randomly to represent the population in each net plot and labelled for recording growth observations. Various observations were recorded on these plants periodically after 30 days of sowing at an interval of 15 days for soybean and wheat and at an interval of 30 days for rabi sorghum crop till maturity of the crops, respectively. Observations on yield components were recorded after harvest of crop.

Economic efficiency was calculated by dividing the net monetary return of cropping systems with duration of cropping systems (days) and expressed ` day^{-1} (Prashad *et al.*, 2013).

$$\text{Economic efficiency (\%)} = \frac{\text{Net monetary return}}{\text{Cropping period}}$$

Plants used for dry matter study at harvest were utilized for estimation of nitrogen, phosphorus and potassium content. These plants were ground and N, P and K in straw and seed were estimated by the methods suggested by Jackson (1967) as given below. The total nutrient uptake in kg ha^{-1} was calculated by using formula.

$$\text{Uptake of nutrient (kg ha}^{-1}\text{)} = \frac{\text{Yield (kg ha}^{-1}\text{) x Nutrient content}}{100}$$

Result and Discussion

Gross, Net monetary and B: C ratio

Under tillage practices, conventional tillage recorded higher gross, net return, benefit:cost ratio than minimum tillage during both the years of experimentation and pooled study, which might be probably due to higher yield of different crops in conventional tillage as compare to minimum tillage. Even the cost of cultivation was higher in conventional tillage but higher gross returns compensated the high cost of cultivation and resulted in higher net returns and B: C ratio. Among the cropping systems soybean-wheat cropping systems obtained higher gross monetary returns, net monetary returns and benefit:cost ratio over soybean-*rabi* sorghum cropping systems in both years experiment and pooled analysis Similar results reported by Mishra *et al.,* (2009) and Billore *et al.,* (2013).

Between nutrients levels, application of 125 per cent RDF levels obtained higher gross and net monetary returns followed by 100 per cent RDF during both the years of experimentation and in pooled results. Similar trend found in benefit:cost ratio. These findings are in close conformity with those reported by Singh *et al.,* (2006), Arya *et al.,* (2005).

Economic efficiency

Practice of conventional tillage in soybean crop followed by conventional tillage to *rabi* sorghum and wheat recorded higher economic efficiency of cropping system i.e. 158,129 and 141 Rs. $ha^{-1}day^{-1}$during 2014-15, 2015-16 and pooled results, respectively, which was significantly higher than minimum tillage (T_1) in both year and pooled study.

Soybean-wheat noted significantly more economic efficiency than soybean-*rabi* sorghum cropping systems in both years and pooled analysis. In case of nutrient levels, economic efficiency was significantly higher (175, 141 and 158 Rs.$ha^{-1}day^{-1}$during 2014-15, 2015-16 and pooled study, respectively) under the treatments receiving 125 per cent RDF over the treatment of 75 per cent RDF and 100 per cent RDF

during both the years of investigation and in pooled results. The application of 75 per cent RDF recorded significantly the lowest production efficiency than 125 per cent RDF and 100 per cent RDF during both the years of investigation and pooled study.

Nutrient uptake

Nutrient uptake by soybean

The nutrient *viz*., N, P and K uptake was enhanced due to both tillage treatments in soybean. The higher values of nutrient (N, P and K) uptake were found under the treatments of conventional tillage over minimum tillage during the both the years of investigation. The higher values of uptake of nutrients were a result of higher grain yield. Beneficial effect of conventional tillage might be due to sustained availability of nutrients and their efficient translocation to the economic sink. Similar result reported by Arya *et al*., (2005).

The soybean based cropping systems had no significant influence on nutrient uptake study in both years. The total uptake of N, P and K by soybean was highest due to application of 125 per cent RDF levels during both the years of experimentation. It may be due to fact that balanced and optimum application of NPK resulted in increased concentration of NPK in soil solution which ultimately increased the uptake and direct contribution towards the available pool at harvest. Similar findings were reported earlier by Arbad *et al*., (2011) and Chaturvedi *et al.,* (2010).

Nutrient uptake by *rabi* sorghum

Considerable increase in N, P and K uptake was attributed to higher seed and fodder yields. The total N, P and K uptake was highest due to application of conventional tillage with 125 per cent RDF application. The adequate supply of nutrient favoured the better vegetative growth and increased the yield of *rabi* sorghum reflecting in enhancement in nutrient content in seed and straw of *rabi* sorghum and their higher uptake.

Nutrient uptake by wheat

Noteworthy increase in N, P and K uptake was attributed to higher seed and straw yields. The total N, P and K uptake was highest due to application of conventional tillage with 125 per cent RDF application. Higher N, P, and K uptake by wheat under conventional tillage due to favourable soil environment and crop growth reported by Sharma *et al.* 2010.

Total systems uptake

System uptake (N, P, and K) was recorded significantly higher under conventional tillage during both years of cropping. Increased availability of nitrate nitrogen under conventional tillage resulted in better growth and development and ultimately higher grain yield. Similar findings reported by Chitale *et al.,* (2007) and Jain *et al.,* (2007).Soybean-wheat cropping systems recorded higher nutrient uptake over the soybean-*rabi* sorghum cropping systems during both years.

Application of 125 per cent RDF recorded significantly higher total N, P, K uptake over 100 per cent RDF and 75 per cent RDF. This might be due to availability of more nutrients over entire period of crop growth resulted in nutrient build up and uptake. Similar findings reported by Singh *et al.,* (2006) and Tanwar *et al.,* (2003)

Available nutrient

Available nutrient after harvest of soybean

Available nutrient (N, P and K) status in the soil after soybean harvest was improved due to both tillage practices in soybean during the period of experimentation. Available N, P and K soil after harvest of soybean was higher under minimum tillage followed by conventional tillage. The soybean based cropping systems had no significant influence on available nitrogen, phosphorus and potassium content study in both years. Available nitrogen, phosphorus and potassium content in soil after harvest of soybean due to different fertilizer levels applied to soybean the improvement in the available nutrient content of soil after soybean harvest was higher with the application of 125 per cent RDF.

Available nutrient after harvest of *rabi* sorghum

The nutrient studies of soil after harvest of *rabi* sorghum crop was found to be improved with the tillage practices and nutrient levels applied in *rabi* sorghum and preceding soybean crop. Practice of minimum tillage with 125 per cent RDF application recorded higher nutrient status of soil after the harvest of *rabi* sorghum crop. The increase in available N, P and K might be due to plenty supply of nutrient to *rabi* sorghum and soybean in *kharif*.

Available nutrient after harvest of wheat

The nutrient studies of soil after harvest of wheat crop was found to be improved with the tillage practices and nutrient levels applied in wheat and preceding soybean crop. Practice of minimum tillage with 125 per cent RDF application recorded higher nutrient status (N, P and K) of soil after the harvest of wheat crop. Similar result reported by Vyas *et al.,* (2013). In case of higher nutrient levels increase in available N, P and K might be due to adequate supply of nutrient to wheat and soybean in *kharif*. Similar results also reported by Sharma *et al.,* (2014).

Table 1: GMR (Rs. ha^{-1}), NMR (Rs. ha^{-1}) and B:C ratio as influenced by different treatments during 2014-15 and 2015-2016

Treatments	Gross monetary return (Rs. ha^{-1})			Net monetary return (Rs. ha^{-1})			B:C ratio	
	2014-15	2015-16	Pooled	2014-15	2015-16	Pooled	2014-15	2015-16
Tillage								
T_1: Minimum tillage	103570	90094	96832	52236	38732	45484	2.01	175
T_2: Conventional tillage	111964	102124	107040	57542	47474	52508	2.05	1.87
S.E. (m) ±	2042.89	1890.59	1966.70	1071.59	875.29	973.45	---	---
C.D. at 5%	7069.57	6542.53	6795.10	3708.34	3029.02	3363.80	---	---
Cropping system								
C_1:Soybean-*Rab*i sorghum	102743	90428	96585	51923	39491	45707	2.02	1.77
C_2:Soybean-Wheat	112791	101790	107290	57854	46715	52284	2.05	1.85
S.E. (m) ±	2042.89	1890.59	1966.70	1071.59	875.29	2331.70	---	---
C.D. at 5%	7069.57	6542.53	6795.10	3708.54	3029.02		---	---
Nutrient levels								

N_1: 75 % RDF	94316	82932	88624	43530	32063	37796	1.85	1.63
N_2: 100 % RDF	110130	98488	104310	57278	45503	51390	2.08	1.86
N_3: 125 % RDF	118854	106907	112880	63858	51744	57801	2.16	1.94
S.E. (m) ±	3853.87	3379.49	3616.70	1899.04	1398.54	1545.10	---	---
C.D. at 5%	11554.43	10132.16	10819.00	5693.57	4193.00	4932.10	---	---
Interaction								
T X C								
S.E. (m) ±	2889.08	2673.69	2781.40	1515.46	1237.85	1376.60		
C.D. at 5%	NS	NS	NS	NS	NS	NS		
T X N								
S.E. (m) ±	5450.20	4779.32	5114.80	2685.64	1977.83	2331.70		
C.D. at 5%	NS	NS	NS	NS	NS	NS		
C X N								
S.E. (m) ±	5450.20	4779.32	5114.80	2685.64	1977.83	2331.70		
C.D. at 5%	NS	NS	NS	NS	NS	NS		
T X C X N								
S.E. (m) ±	7707.75	6758.98	7233.40	3798.07	2797.07	3297.60		
C.D. at 5%	NS	NS	NS	NS	NS	NS		
General mean	107767	96109	101937	54889	43103	48996	2.03	1.81

Table 2: Economic efficiency (Rs. $ha^{-1}day^{-1}$) as influenced by different treatments during 2014-15 and 2015-16

Treatments	**Economic efficiency (Rs. $ha^{-1}day^{-1}$)**		
	2014-15	**2015-16**	**Pooled**
Tillage			
T_1: Minimum tillage	143	106	127
T_2: Conventional tillage	158	129	141
S.E. (m) ±	2.43	1.89	2.16
C.D. at 5%	8.43	6.52	7.56
Cropping system			
C_1:Soybean-*Rab*i sorghum	142	108	128
C_2:Soybean-Wheat	158	128	145
S.E. (m) ±	2.43	1.89	2.16
C.D. at 5%	8.43	6.52	7.56
Nutrient levels			
N_1: 75 % RDF	119	88	103
N_2: 100 % RDF	157	125	141
N_3: 125 % RDF	175	141	158
S.E. (m) ±	4.62	3.74	4.08
C.D. at 5%	13.86	11.21	12.24
Interaction			
T X C			
S.E. (m) ±	3.44	2.67	3.12
C.D. at 5%	NS	NS	NS
T X N			
S.E. (m) ±	6.54	5.29	5.78
C.D. at 5%	NS	NS	NS
C X N			
S.E. (m) ±	6.54	5.29	5.78
C.D. at 5%	NS	NS	NS
T X C X N			
S.E. (m) ±	9.25	7.48	7.94
C.D. at 5%	NS	NS	NS
General mean	150	118	135

Table 3: Uptake of nitrogen, phosphorus and potassium (kg ha^{-1}) in soybean as influenced by different treatments during 2014-15 and 2015-16

Treatments	**2014-15**			**2015-16**		
	N	**P**	**K**	**N**	**P**	**K**
Tillage						
T_1: Minimum tillage	107.20	15.16	43.58	90.01	12.79	37.51
T_2:Conventional tillage	122.25	20.00	50.39	109.65	17.93	45.17
S.E. (m) ±	2.22	0.39	1.04	1.93	0.32	0.84
C.D. at 5%	7.69	1.34	3.59	6.69	1.12	2.92
Cropping system						
C_1:Soybean-*Rab*i sorghum	112.91	17.05	46.23	97.58	14.93	40.55
C_2:Soybean-Wheat	116.54	18.11	47.75	102.08	15.79	42.13
S.E. (m) ±	2.22	0.39	1.04	1.93	0.32	0.84
C.D. at 5%	NS	NS	NS	NS	NS	NS

Nutrient levels						
N_1: 75 % RDF	92.81	12.66	38.32	79.70	10.75	33.30
N_2: 100 % RDF	114.81	17.47	46.97	100.81	15.31	41.28
N_3: 125 % RDF	136.56	22.61	55.67	118.98	20.03	49.44
S.E. (m) ±	3.81	0.68	1.70	3.63	0.59	1.54
C.D. at 5%	11.42	2.04	5.10	10.87	1.78	4.62
Interaction						
T X C						
S.E. (m) ±	3.14	0.55	1.47	2.73	0.46	1.19
C.D. at 5%	NS	NS	NS	NS	NS	NS
T X N						
S.E. (m) ±	5.39	0.96	2.40	5.13	0.84	2.18
C.D. at 5%	NS	NS	NS	NS	NS	NS
C X N						
S.E. (m) ±	5.39	0.96	2.40	5.13	0.84	2.18
C.D. at 5%	NS	NS	NS	NS	NS	NS
T X C X N						
S.E. (m) ±	7.62	1.36	3.40	7.25	1.19	3.08
C.D. at 5%	NS	NS	NS	NS	NS	NS
General mean	114.73	17.58	46.99	99.83	15.36	41.34

Table 4: Uptake of N, P and K (kg ha^{-1}) *rabi* sorghum as influenced by different treatments during 2014-15 and 2015-16

Treatments	**2014-15**			**2015-16**		
	N	**P**	**K**	**N**	**P**	**K**
T_1 : Minimum tillage with 75 % RDF	45.38	15.44	31.41	38.95	12.72	26.62
T_2 : Minimum tillage with 100 % RDF	56.45	19.76	37.98	47.64	15.91	31.66
T_3 : Minimum tillage with 125% RDF	64.82	23.23	42.99	58.78	20.25	38.52
T_4: Conventional tillage with 75 % RDF	51.05	18.70	35.64	43.16	14.89	29.78
T_5: Conventional tillage with 100 % RDF	64.44	24.77	45.84	58.57	21.38	41.32
T_6: Conventional tillage with 125% RDF	71.26	28.06	50.03	64.00	24.30	44.40
General mean	58.90	21.66	40.65	51.85	18.24	35.38

Table 5: Uptake of nitrogen, phosphorus and potassium (kg ha^{-1}) in wheat as influenced by different treatments during 2014-15 and 2015-16

Treatments	**2014-15**			**2015-16**		
	N	**P**	**K**	**N**	**P**	**K**
T_1 : Minimum tillage with 75 % RDF	53.86	10.73	70.45	47.84	9.09	68.74
T_2 : Minimum tillage with 100 % RDF	67.87	14.90	82.01	59.21	12.38	78.46
T_3 : Minimum tillage with 125% RDF	77.01	15.38	89.39	69.15	13.27	85.65
T_4: Conventional tillage with 75 % RDF	60.27	12.00	75.18	54.15	10.24	74.72
T_5: Conventional tillage with 100 % RDF	76.95	16.32	90.63	70.68	14.59	90.31
T_6: Conventional tillage with 125% RDF	86.68	21.36	98.09	79.25	18.90	96.46
General mean	70.44	15.12	84.29	63.38	13.08	82.39

Table 6: Available nitrogen, phosphorus and potassium content (kg ha^{-1}) of soil after harvest of soybean as influenced by different treatments during 2014-15 and 2015-16

Treatments	**2014-15**			**2015-16**		
	N	**P**	**K**	**N**	**P**	**K**
Tillage						
T_1: Minimum tillage	161.38	18.83	570.11	157.04	17.40	558.44
T_2: Conventional tillage	152.96	17.01	553.52	143.32	15.60	541.69
S.E. (m) ±	1.70	0.19	4.54	1.68	0.17	4.26
C.D. at 5%	5.89	0.63	15.71	5.80	0.58	14.74
Cropping system						
C_1:Soybean-*Rab*i sorghum	155.49	17.79	557.44	150.07	16.42	545.78
C_2:Soybean-Wheat	158.85	18.05	566.19	153.29	16.58	554.34
S.E. (m) ±	1.70	0.19	4.54	1.68	0.17	4.26
C.D. at 5%	NS	NS	NS	NS	NS	NS
Nutrient levels						
N_1: 75 % RDF	147.73	16.21	531.92	143.02	15.02	523.38
N_2: 100 % RDF	158.51	18.36	569.57	152.88	16.82	559.28
N_3: 125 % RDF	165.26	19.24	583.95	159.14	17.66	567.23
S.E. (m) ±	2.66	0.30	9.23	2.29	0.29	8.77
C.D. at 5%	7.97	0.90	27.67	6.87	0.86	26.28
Interaction						
T X C						
S.E. (m) ±	2.41	0.27	6.42	2.37	0.24	6.02
C.D. at 5%	NS	NS	NS	NS	NS	NS

T X N						
S.E. (m) ±	3.76	0.43	13.05	3.24	0.41	12.40
C.D. at 5%	NS	NS	NS	NS	NS	NS
C X N						
S.E. (m) ±	3.76	0.43	13.05	3.24	0.41	12.40
C.D. at 5%	NS	NS	NS	NS	NS	NS
T X C X N						
S.E. (m) ±	5.32	0.60	18.46	4.58	0.58	17.53
C.D. at 5%	NS	NS	NS	NS	NS	NS
General mean	157.17	17.92	561.81	151.68	16.50	550.06

Table 7: Available nitrogen, phosphorus and potassium content (kg ha^{-1}) of soil after harvest of *rabi* sorghum as influenced by different treatments during 2014-15 and 2015-16

Treatments	2014-15			2015-16		
	N	P	K	N	P	K
T_1 : Minimum tillage with 75 % RDF	165.01	16.41	547.69	161.60	15.41	534.69
T_2 : Minimum tillage with 100 % RDF	171.68	18.12	574.58	169.01	16.78	565.58
T_3 : Minimum tillage with 125% RDF	184.44	21.64	596.79	180.59	19.98	589.45
T_4: Conventional tillage with 75 % RDF	159.82	15.08	531.17	154.48	13.75	519.17
T_5: Conventional tillage with 100 % RDF	168.24	18.01	570.59	164.91	16.34	561.59
T_6: Conventional tillage with 125% RDF	179.90	18.18	586.69	176.86	17.89	577.69
General mean	171.51	17.91	567.92	168.24	16.69	558.03

Table 8: Available nitrogen, phosphorus and potassium content (kg ha^{-1}) of soil after harvest of wheat as influenced by different treatments during 2014-15 and 2015-16.

Treatments	2014-15			2015-16		
	N	P	K	N	P	K
T_1 : Minimum tillage with 75 % RDF	157.08	16.38	545.88	145.46	15.38	531.42
T_2 : Minimum tillage with 100 % RDF	168.16	17.91	573.84	160.98	16.57	561.73
T_3 : Minimum tillage with 125% RDF	184.91	20.56	597.78	176.65	19.90	586.18
T_4: Conventional tillage with 75 % RDF	147.32	15.69	519.14	141.33	15.06	509.83
T_5: Conventional tillage with 100 % RDF	161.48	17.24	559.61	154.75	16.57	552.37
T_6: Conventional tillage with 125% RDF	172.65	18.78	586.92	164.42	17.78	580.55
General mean	165.27	17.76	563.86	157.26	16.88	553.68

Reference

1. Arbad BK, Ismail S. Effect of integrated nutrient management on soybean (*Glycine max*)-safflower (*Carthamus tinctorius*) cropping system. Indian J Agron. 2011; 56(4): 340-345.
2. Arya RL, Kumar L, Singh KK and B.L. Kushwaha. Effect of fertilizers and tillage management in rice (*Oryza sativa*) chickpea (*Cicer arietinum*) cropping system under varying irrigation schedules. Indian J Agron. 2005; 50(4):256-259.
3. Billore SD, Ramesh A, Joshi OP, Vyas AK. Productivity, sustainability and stability of soybean based cropping systems under different tillage systems. *Soybean Res.* 2013; 11(1):43-57.
4. Chaturvedi S, Chandel AS, Dhyani VC, Singh AP. Productivity, profitability and quality of soybean (*Glycine max*) and residual soil fertility as influenced by integrated, 2010.
5. Chitale S, Pandey N, Urkurkar JS. Effect of planting method, tillage and weed management on productivity and physiochemical properties of rice-wheat cropping system. Indian J Agron. 2007; 52(4):283-288.
6. Jackson ML. Soil chemical analysis. Prentice Hall of India Private Ltd. New Delhi, 1967, 498.
7. Jain N, Mishra JS, Kewat ML, Jain V. Effect of tillage and herbicides on grain yield and nutrient uptake by wheat (*Triticum aestivum*) and weeds. Indian J Agron. 2007; 52(2):131-134.
8. Mishra JS, Singh VP. Weed dynamics and productivity of soybean (*Glycine max*)-based cropping systems as influenced by tillage and weed management. *Indian J of Agron.* 2009; 54(1):29-35.
9. Prasad D, Yadava MS, Singh CS. Diversification of rice (*Oryza sativa*)-based cropping systems for higher productivity and resource-use efficiency under irrigated ecosystem of Jharkhand. Indian J Agron. 2013; 58(3):264-270.
10. Sharma AR, Singh R, Dhyani SK, Dube RK. Tillage and legume mulching effect on moisture conservation and productivity of *rainfed* maize (*Zea mays*)-wheat (*Triticum aestivum*) cropping system. Indian J Agron. 2010; 55(4):245-252.
11. Sharma SK, Jain NK. Nutrient management in wheat (*Triticum aestivum*)-based cropping system in sub-humid southern zone of Rajasthan. Indian J Agron. 2014; 59(1):26-33.
12. Singh P, Nepalia V, Tomar SS. Effect of weed control and nutrient management on soybean (*Glycine max*) productivity. Indian J Agron. 2006b; 51(4):314-317.
13. Tanwar SPS, Shaktawat MS. Influence of phosphorus sources, levels and solublilizers on yield, quality and nutrient uptake of soybean (*Glycine max)*-wheat (*Triticum aestivum*) cropping system in southern Rajasthan. Indian J Agron. 2003; 73(1):3-7.
14. Tanwar SPS, Shaktawat MS. Influence of phosphorus sources, levels and solublilizers on yield, quality and nutrient uptake of soybean (*Glycine max)*-wheat (*Triticum aestivum*) cropping system in southern Rajasthan. Indian J Agron. 2003; 73(1):3-7.