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Effect of tillage and target yield approach on growth, yield and yield attributes and economics of maize – wheat cropping system

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Abstract

A field experiment was conducted during *kharif* and *rabi* seasons of 2013-14 and 2014-15 at Agricultural Research Station, Bheemaranagudi to study the effect of tillage and target yield approach on growth, yield and yield attributes and economics of maize – wheat cropping system. The results indicated that the growth and yield parameters of maize and wheat at harvest did not influence due to tillage practices. All these yield parameters were relatively higher in zero tillage with mulch @ 5 t ha⁻¹ when compared to conventional tillage. Grain and stover yield of maize did not differ significantly due to different tillage management practices. But, zero tillage with mulch @ 5 t ha⁻¹ produced relatively higher yield (65.9 q ha⁻¹) than the zero tillage (64.3 q ha⁻¹) followed by conventional tillage (55.8 q ha⁻¹). Further, due to nutrient management strategies, the growth and yield parameters of maize differed significantly. Target yield of 10 t ha⁻¹ exhibited significantly higher growth and yield attributes at harvest when compared to other treatments except targeted yield of 8 t ha⁻¹ and 150% RDF. The lowest values of these attributes were recorded in farmer's practice of nutrient management followed by RDF. The grain yield and stover yield (69.9 q ha⁻¹ and 89.5 q ha⁻¹, respectively) of maize was significantly higher with targeted yield of 10 t ha⁻¹ followed by targeted yield of 8 t ha⁻¹ and 150% RDF. The lowest grain and stover yield (53.6 q ha⁻¹ and 74.3 q ha⁻¹, respectively) was recorded in farmers practice followed by RDF. Non significant differences for grain and stover yield of maize were recorded due to interaction of tillage and target yield approach. The growth and yield and yield parameters of wheat did not differ due to tillage practices and target yield approaches followed for maize. Maize equivalent yield of wheat and system productivity were followed same trend as that of maize yield. Among different tillage practices, zero tillage (Rs. 78,181 ha⁻¹ and 2.19) and zero tillage with mulch @ 5 t ha⁻¹ (Rs. 80,272 ha⁻¹ and 2.18) were recorded maximum net returns and higher BC ratio respectively. Similarly among different target yield approaches, the target yield of 10 t ha⁻¹ (Rs. 85,105 and 2.18) followed by targeted yield of 8 t ha⁻¹ (Rs. 80,565 and 2.17) were recorded maximum net returns and higher BC ratio respectively as compare to other treatments.

Keywords: Tillage, crop residue, mulch, target yield, maize equivalent yield, system productivity

Introduction

The productivity of cropping system is a function of soil type, climate, tillage practices and nutrient availability which are dynamic and highly variable. To achieve the higher productivity nutrient management holds the key role. Optimum use of existing resources like residues on surface and application of FYM and timely applications of soil test based optimum rates of nutrients etc, are pivotal in achieving food security.

In present scenario of agriculture in the world as well as in the country, the rising cost of cultivation and in availability of inputs in agriculture are now redefining the farming practices and hence increased attention is paid towards the deployment of conservation agriculture practices. Conservation agriculture maintains permanent and semi permanent soil cover with residues to conserve, improve and make more efficient use of natural resources such as soil, water and biological resources. There are many options to achieve efficient utilization of resources by following the practices of green manuring, brown manuring, conservation agriculture, crop nutrition through target yield approach etc.

There are some indications of stagnation or even decline in the productivity of the cropping system due to decreased soil organic matter, over exploitation of nutrients reserve, loss of

nutrients and non availability of cost effective fertilizer. Further, the application of inorganic fertilizers even in balanced form may not sustain soil fertility and productivity under continuous cropping. Zero tillage with crop residues management is capable of increasing the soil health and quality by improving soil properties, minimizing soil erosion, soil water evaporation and conserving soil moisture which has been well documented. Hence, reduced tillage practices have been widely used in the last decade as an attractive alternative over conventional tillage practice because of their potential to reduce production or operating costs and benefit for the environment and can save considerable time with seed bed preparation compared with conventional tillage practices.

Site specific nutrient management (SSNM) is one tool employed to apply nutrients at right rate, right source, right time with right method based on the soil test value for getting higher yields and to save nutrients. Among the several technologies for nutrient management, the site specific nutrient management is seen as one of the main objectives in present scenario of agriculture. It is one of the techniques most relevant to Indian Farming community. Farming has to be treated as another business during these days and we must try to maximize the resource available to us in the most efficient manner possible. Due to the importance of plant nutrition and its influence on crop yield and quality, it is expected that SSNM would improve the economic and environmental outcome of crop production. It is an approach for need based feeding of the crops with nutrients (Dhillon *et al.* 2006) [4]. The approach further aims at increasing farmers profit by achieving the goal of maximum crop yields. Further under irrigated condition, there is an opportunity to take two crops in a year following maize-wheat and maize-chickpea cropping systems in order to get efficient utilization of existing available resources. Such kind of cropping system needs full season nutrient requirement through nutrient supply system on sustainable manner. There are many options that are available to fulfill the requirement of nutrients regularly in cropping system while keeping the productivity of land sustainable.

Therefore, an investigation was undertaken to know the effect of tillage and target yield approach on growth, yield and yield attributes and economics of maize – wheat cropping system.

Material and methods

A field experiment on performance of maize based cropping system in different nutrient management through target yield approach under varying tillage and residue management practices was conducted in maize - wheat cropping system during *kharif* and *rabi* seasons of 2013-14 and 2014-15 at Agricultural Research Station, Bheemaranagudi, University of Agricultural Sciences, Raichur, Karnataka. The nutrient management through targeted yield approach under varying tillage and residue management practices was followed for maize during *kharif* and its residual effect was tested on succeeding wheat during *rabi* season. The soil of the experimental site was medium deep black soil with 7.90 pH. The soil was low in available nitrogen (207 kg ha⁻¹), high in available phosphorus (52.3 kg ha⁻¹) and high in available potassium (344 kg ha⁻¹). The organic carbon content of the soil was low (0.49 %). The Agricultural Research Station represents the UKP command where in rice - rice, chilli and cotton are the predominant crops. The rainfall during cropping seasons in the year 2013 - 14 and 2014 - 15 received 759 mm and 646 mm respectively. The experiment was laid out in split plot design consists of three main plots *viz.*,

conventional tillage, zero tillage and zero tillage with mulch @ 5 t ha⁻¹ and six sub plots *viz.*, target yield (6 t ha⁻¹), target yield (8 t ha⁻¹), target yield (10 t ha⁻¹), RDF, 150% RDF and farmers practice in three replications. The hybrid 900M was used for maize and the variety DWR 198 was used for wheat. The fertilizers were applied as per treatments for maize. For wheat, the fertilizers were applied as per the recommendation. Pre emergent herbicide pendimethalin 30 EC @ 2.5 kg ha⁻¹ was used to control weeds in initial stage in maize as well as in wheat. Post emergent herbicide 2, 4 - D 80 % @ 1.25 kg ha⁻¹ was used for suppressing the weed growth in maize and wheat at 25 DAS. Other agronomic practices were followed commonly in all the treatments as per the recommendations.

Results and Discussion

Effect of crop residue and tillage management practices on growth and yield of maize

The data revealed that the grain yield and stover yield of maize did not differ due to different tillage practice. However the numerically higher grain yield (65.9 q ha⁻¹) and stover yield of maize (88.3 q ha⁻¹) were noticed with zero tillage with mulch @ 5 t ha⁻¹ followed by zero tillage (64.3 q ha⁻¹ and 84.2 q ha⁻¹ respectively). Numerically the lowest grain yield and stover yield were recorded in conventional tillage (55.8 q ha⁻¹ and 76.2 q ha⁻¹ respectively). The higher value of grain yield could be attributed to relatively higher cob length (14.92 cm), cob girth (12.87 cm), number of grains per cob (426.71), grain weight per plant (184.91 g) and test weight (24.58 g). The lowest cob length (12.71 cm), cob girth (10.99 cm), grain weight per plant (169.88 g) and test weight (22.70 g) were recorded in conventional tillage. These results are in accordance with those obtained by Prashanth and Patil (2013) [7], Singh *et al.* (2013) [9], Bahar (2013) [2] and Yaseen *et al.* (2014) [10]. The differences in yield parameters due to different tillage practices can be attributed to plant height, leaf area, leaf area index and total dry matter production. However, zero tillage with mulch @ 5 t ha⁻¹ recorded relatively higher total dry matter production (379.72 g plant⁻¹), leaf area, leaf area index and plant height compared to conventional tillage and zero tillage. Further, the same treatment recorded higher dry matter production closely followed by zero tillage (335.49 g plant⁻¹) when compared to conventional tillage which recorded lower dry matter production (319.86 g plant⁻¹). The increase in plant height, leaf area and leaf area index could be due to profuse growth of plants enhanced by balanced application of nutrients. The increase in the plant height might be due to luxuriant growth and development of the crop which resulted from favourable conditions created by zero tillage or/with mulch. Further this treatment was found to be better in recording higher stover yield and harvest index.

Effect of nutrient management practices (target yield approach) on growth and yield of maize

In the present study, the effect of nutrient application through targeted yield approach exerted significant influence on the grain yield of maize. The highest grain yield of maize was obtained with target yield of 10 t ha⁻¹ (69.90 q ha⁻¹) followed by target yield of 8 t ha⁻¹ (65.8 q ha⁻¹) and by 150% RDF (64.0 q ha⁻¹). The significantly lower grain yield was observed in farmers' practice (53.6 q ha⁻¹) followed by RDF (56.2 q ha⁻¹). Significantly higher stover yield was recorded in target yield of 10 t ha⁻¹ (89.5 q ha⁻¹) followed target yield of 8 t ha⁻¹ (86.7 q ha⁻¹) and 150% RDF (85.7 q ha⁻¹). The lower stover yield was recorded in farmers' practice (74.3 q ha⁻¹) followed by

RDF (78.3 q ha⁻¹). The increase in grain yield of maize in target yield of 10 t ha⁻¹ and target yield of 8 t ha⁻¹ was 30.41 and 22.76 per cent respectively over farmers' practice and 24.38 and 17.1 per cent respectively over RDF. Higher grain yield of maize could be attributed due to higher cob length, cob girth, number of grains per plant (462.30), grain weight per plant (188.77 g) and test weight (25.14 g) due to balanced supply of nutrients which enhanced luxuriant growth and development of crop. These results corroborated with the findings of Paramasivan *et al* (2012) [8] and Ashok Biradar and Jayadeva (2013) [1]. Markedly lesser cob length, cob girth, number of grains per plant (313.26), grain weight per plant (163.80 g) and test weight (21.76 g) were recorded in farmers' practice followed by RDF. This could be attributed to less quantity of total nutrients supplied under these treatments resulting in the reduction of growth and yield parameters. The differences in yield parameters due to different target yield approach can be attributed to plant height, leaf area, leaf area index and dry matter production. In the present study, significantly higher plant height, leaf area, leaf area index and total dry matter production were recorded with target yield of 10 t ha⁻¹ followed by target yield of 8 t ha⁻¹. Significantly lower plant height, leaf area, leaf area index and total dry matter production were recorded in farmers' practice followed by RDF. The higher values of these parameters could be attributed to luxuriant growth of the crop.

Non-significant differences for grain and straw yields of maize were noticed due to interaction of tillage and nutrient management through target yield approaches.

Effect of crop residue, tillage practices and target yield approach on succeeding wheat

The differences in growth and yield contributing attributes of wheat due to target yield approach followed for maize did not differ due to target yield approaches. However, higher values of these growth and yield parameters were registered in the plot which received nutrients for target yield of 10 t ha⁻¹ compared to other treatments. The increase in these growth and yield parameters might be attributed to luxuriant growth and development of crop under residual effect of nutrients applied through target yield in preceding maize. Zero tillage with mulch @ 5 t ha⁻¹ was found to increase the grain yield of wheat by 6.95 and 3.83 per cent over conventional tillage. Thus, the same treatment produced relatively higher straw yield and harvest index. The findings of and Gangawar *et al.* (2004) [5] also fell in line with the findings of Jat *et al.* (2010) [6]. They observed that the residual effect of *Sesbania* green manuring + wheat straw and *Sesbania* green manuring alone used in preceding maize affected significantly the growth and yield of succeeding wheat. Interaction effect due to tillage and target yield approach did not influence succeeding wheat crop.

Economics of tillage and nutrient management practices in maize – wheat cropping system

Maize equivalent yield

Maize equivalent yield was influenced due to different tillage practices. However, higher maize equivalent yield (23.0 q ha⁻¹)

was recorded with zero tillage with mulch @ 5 t ha⁻¹. The lower maize equivalent yield (21.5 q ha⁻¹) was recorded with conventional tillage. The different target yield approaches differed significantly. Target yield of 10 t ha⁻¹ recorded significantly higher maize equivalent yield (24.6 q ha⁻¹). The lowest maize equivalent yield (18.3 q ha⁻¹) was recorded in conventional tillage followed by RDF which recorded maize equivalent yield of 20.6 q ha⁻¹. The interaction effect due to tillage practices as well as target yield approaches did not differ.

System productivity

System productivity of maize – wheat cropping system differed significantly due to different tillage practices. Zero tillage with mulch @ 5 t ha⁻¹ recorded significantly higher system productivity (88.9 q ha⁻¹) followed by zero tillage. The lowest system productivity (77.3 q ha⁻¹) was registered with conventional tillage. Similar findings were reported by many research workers which conclusively proved that zero tillage with or without mulch is more productive (Bhattacharyya *et al.*, 2008) [3]. The different target yield approaches differed significantly for system productivity. Target yield of 10 t ha⁻¹ recorded significantly higher system productivity (94.5 q ha⁻¹). Significantly the lowest system productivity (71.9 q ha⁻¹) was recorded in conventional tillage followed by RDF which recorded system productivity of 76.8 q ha⁻¹. The interaction effect due to tillage practices as well as target yield approaches did not differ significantly.

Economics of maize - wheat

The data indicated that the gross returns, net returns and B:C differed significantly due to tillage practices. Zero tillage with mulch @ 5 t ha⁻¹ followed by zero tillage recorded significantly higher gross returns (Rs. 1,17,086 ha⁻¹) compared to conventional tillage (Rs. 1,01,826 ha⁻¹). Significantly higher net returns (Rs. 80,272 ha⁻¹) was recorded in zero tillage with mulch @ 5 t ha⁻¹ compared to conventional tillage (Rs.62,112 ha⁻¹). Further, this treatment remained on par with zero tillage. The B:C ratio was also higher (2.19) with zero tillage and zero tillage with mulch @ 5 t ha⁻¹ (2.18) than in conventional tillage (1.55). The slight variation in B:C ratio might be due to cost of mulch. Various research workers have conclusively proved that zero tillage with or without mulch is economical (Jat *et al.*, 2010 [6]; Paramasivan *et al.*, 2012 [8] and Prashanth and Patil, 2013) [7]. The different target yield approaches differed significantly for gross returns, net returns and B:C. The target yield of 10 t ha⁻¹ recorded significantly higher gross return (Rs.1,24,435 ha⁻¹), net returns (Rs. 85,105 ha⁻¹) and B:C ratio (2.18) followed by target yield of 8 t ha⁻¹. The lowest gross returns (Rs.94,714 ha⁻¹) and net returns (Rs. 61,119 ha⁻¹) was noticed with farmers' practice followed by RDF. Significantly lowest B:C ratio was recorded with RDF (1.72) followed by 150% RDF (1.84) and these treatments were found to be on par with farmers' practice (1.85). The lowest B:C ratio could be attributed to cost of fertilizers and their yield levels. The interaction effect due to tillage practices as well as target yield approaches did not differ significantly.

Table 1: Growth parameters of maize and wheat at harvest as influenced by different tillage practices and target yield approaches in maize - wheat cropping system (Mean of two years)

Treatment	Maize				Wheat			
	Plant height (cm)	Leaf area (dm ²)	LAI	Total dry matter production (g plant ⁻¹)	Plant height (cm)	Leaf area (dm ²)	LAI	Total dry matter production (g plant ⁻¹)
Main plots (M)								
M ₁ - Conventional tillage	176.40	40.89	2.27	319.86	64.43	12.45	0.83	118.70
M ₂ - Zero tillage	191.10	44.09	2.45	335.49	65.71	12.74	0.85	129.54
M ₃ - Zero tillage with mulch @ 5 t/ha	195.60	48.99	2.72	379.72	67.03	13.29	0.89	137.75
S. Em ±	6.86	3.01	0.17	21.40	1.49	0.61	0.04	6.80
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Sub plots (S)								
S ₁ - Targeted yield (6 t/ha)	187.10	44.17	2.45	331.47	64.91	12.46	0.83	126.88
S ₂ - Targeted yield (8 t/ha)	193.60	47.64	2.65	374.33	66.79	13.29	0.89	132.08
S ₃ - Targeted yield (10 t/ha)	197.40	50.23	2.79	398.94	69.86	14.56	0.97	136.81
S ₄ - RDF	183.80	42.21	2.35	317.60	64.41	12.03	0.80	125.83
S ₅ - 150% RDF	189.50	46.26	2.57	352.98	66.33	12.67	0.84	127.87
S ₆ - Farmer's practice	174.90	37.41	2.08	294.83	62.05	11.93	0.80	122.51
S. Em±	4.36	2.53	0.14	17.89	2.80	0.94	0.06	5.97
C.D. (0.05)	12.66	7.35	0.40	51.91	NS	NS	NS	NS
Interaction (M x S)								
S. Em±	9.50	5.01	0.28	31.22	3.66	1.49	0.01	11.21
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 2: Yield parameters of maize and wheat at harvest as influenced by different tillage practices and target yield approaches in maize - wheat cropping system (Mean of two years)

Treatment	Maize					Wheat			
	Cob length (cm)	Cob girth (cm)	Number of grains per cob	Grain weight (g plant ⁻¹)	Test weight (g)	Number of effective tillers	Number of grains per spike	Grain weight per spike (g)	Test weight (g)
Main plots (M)									
M ₁ - Conventional tillage	12.71	10.99	348.44	169.88	22.70	193.61	27.22	1.50	34.70
M ₂ - Zero tillage	14.32	12.51	406.15	179.70	23.89	196.59	28.20	1.57	35.76
M ₃ - Zero tillage with mulch @ 5 t/ha	14.92	12.87	426.71	184.91	24.58	198.88	30.39	1.66	37.53
S. Em ±	0.76	0.67	27.90	5.30	0.67	8.27	1.13	0.05	1.02
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sub plots (S)									
S ₁ - Targeted yield (6 t/ha)	14.09	12.08	402.19	178.49	23.75	193.77	28.00	1.53	35.62
S ₂ - Targeted yield (8 t/ha)	15.04	13.22	431.80	186.20	24.83	199.26	29.70	1.75	38.94
S ₃ - Targeted yield (10 t/ha)	15.65	13.91	462.30	188.77	25.14	205.68	32.27	1.91	39.27
S ₄ - RDF	12.57	10.60	333.73	169.82	22.58	193.22	27.16	1.42	33.16
S ₅ - 150% RDF	14.47	12.79	419.33	181.87	24.29	196.06	28.45	1.60	37.48
S ₆ - Farmer's practice	12.07	10.15	313.26	163.80	21.76	190.17	25.84	1.25	31.52
S. Em±	0.70	0.70	29.19	5.44	0.72	6.09	1.52	0.18	2.22
C.D. (0.05)	2.06	2.03	84.71	15.78	2.08	NS	NS	NS	NS
Interaction (M x S)									
S. Em±	1.23	1.23	51.55	9.52	1.26	12.69	1.35	0.12	2.49
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS – Non significant

Table 3: Grain yield, stover yield and harvest index of maize and grain yield, straw yield and harvest index of wheat as influenced by different tillage practices and target yield approaches in maize - wheat cropping system (Mean of two years)

Treatment	Maize			Wheat			Maize equivalent yield of wheat (q ha ⁻¹)	System productivity (q ha ⁻¹)
	Grain yield of maize (q ha ⁻¹)	Stover yield (q ha ⁻¹)	Harvest Index	Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	Harvest Index		
Main plots (M)								
M ₁ - Conventional tillage	55.8	76.5	0.42	18.99	25.20	0.44	21.5	77.3
M ₂ - Zero tillage	64.3	84.2	0.43	19.56	25.94	0.44	22.1	86.5
M ₃ - Zero tillage with mulch @ 5 t/ha	65.9	88.3	0.43	20.32	26.85	0.43	23.0	88.9
S. Em ±	3.60	4.21	0.01	0.57	0.89	0.001	1.19	1.46
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	5.99

Sub plots (S)								
S ₁ - Targeted yield (6 t / ha)	62.7	83.5	0.43	20.20	26.47	0.44	22.9	85.5
S ₂ - Targeted yield (8 t / ha)	65.8	86.7	0.43	20.91	27.84	0.43	23.7	89.5
S ₃ - Targeted yield (10 t / ha)	69.9	89.5	0.44	21.72	29.47	0.43	24.6	94.5
S ₄ - RDF	56.2	78.3	0.42	18.23	24.63	0.43	20.6	76.8
S ₅ - 150% RDF	64.0	85.7	0.43	20.49	26.70	0.44	23.2	87.2
S ₆ - Farmer's practice	53.6	74.3	0.42	16.17	20.86	0.44	18.3	71.9
S. Em±	3.1	2.9	0.005	0.95	1.19	0.003	0.97	3.04
C.D. (0.05)	9.1	9.0	0.016	NS	NS	NS	2.80	8.82
Interaction (M x S)								
S. Em±	5.6	5.5	0.01	1.39	2.08	0.002	1.94	3.58
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS

NS – Non significant

Table 4: Economics of maize - wheat cropping system as influenced by different tillage and target yield approaches in maize - wheat cropping system

Treatment	Cost of cultivation of maize – wheat system (Rs. ha ⁻¹)			Gross returns (Rs. ha ⁻¹)			Net returns (Rs ha ⁻¹)			B C ratio		
	2013-14	2014-15	Pooled	2013-14	2014-15	Pooled	2013	2014	Pooled	2013	2014	Pooled
Main plots (M)												
M ₁	39078	40350	39714	109591	94061	101826	70514	53711	62112	1.80	1.32	1.55
M ₂	35578	35850	35714	121022	106768	113895	85445	70918	78181	2.41	1.98	2.19
M ₃	36578	37050	36714	124244	109927	117086	87667	72877	80272	2.40	1.97	2.18
S. Em ±	-	-	-	2792	2213	1920	2792	2213	1920	0.08	0.06	0.06
C.D. (0.05)	-	-	-	11260	8921	7744	11261	8921	7745	0.32	0.25	0.24
Sub plots (S)												
S ₁	35844	36544	36161	119773	105559	112666	83929	69015	76472	2.35	1.90	2.13
S ₂	36936	37598	37234	125656	110008	117832	88720	72410	80565	2.41	1.94	2.17
S ₃	38892	39767	39296	131215	117654	124435	92323	77887	85105	2.38	1.97	2.18
S ₄	37238	37716	37444	108819	93478	101149	71581	55762	63672	1.94	1.50	1.72
S ₅	40188	41054	40588	122554	107084	114819	82366	66030	74198	2.06	1.62	1.84
S ₆	33368	33821	33561	101699	87729	94714	68331	53908	61119	2.07	1.62	1.85
S. Em±	-	-	-	4163	5268	4006	4163	5268	4006	0.11	0.14	0.11
C.D. (0.05)	-	-	-	12081	15289	11626	12081	15289	11626	0.33	NS	0.32
Interaction (M x S)												
S. Em±	-	-	-	6841	5420	4705	6841	5420	4705	0.19	0.15	0.14
C.D. (0.05)	-	-	-	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS – Non significant

Rate: Maize – Rs 1325/ q (2013-14) and Rs. 1310/q (2014-15), Wheat – Rs.1550/q (2013-14) and Rs. 1450/q (2014-15)

Main plots: M₁ - Conventional tillage, M₂ - Zero tillage, M₃ - Zero tillage with mulch @ 5 t / haSub plots: S₁ - Targeted yield (6 t / ha), S₂ - Targeted yield (8 t / ha), S₃ - Targeted yield (10 t / ha), S₄ - RDF, S₅ - 150% RDF, S₆ - Farmer's practice

Conclusion

Zero tillage with mulch @ 5 t ha⁻¹ followed by zero tillage alone produced relatively higher yields compare to conventional tillage. Further, target yield of 10 t ha⁻¹ followed by target yield of 8 t ha⁻¹ exhibited significantly higher yield. Thus, application of nutrients through targeted yield approach is more useful and profitable since benefit cost ratio is higher compared to application of farmers practice and 100 per cent RDF + FYM @ 10 t ha⁻¹. Application of nutrients through targeted yield approach in combination with organic source is more useful sustaining the productivity of cropping system.

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