



## Conservation agriculture-impact on the productivity and economy of various cropping systems of Central India

Tiwari, A., Rawat, A. ✉, Agrawal, K. K., Nayak, S.

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### Abstract

Present field research work of different resource conservation practices on cropping systems was studied in both the season i.e. Kharif and Rabi season during 2010- 2012 at Research Farm, J.N. Krishi Vishwa Vidyalaya, Jabalpur (M.P). Research Farm of Kymore plateau and Satpura hill region of Madhya Pradesh which is located at Central India. Results received from the experiment indicated that the Conventional tillage has demonstrated its supremacy over limited tillage with more total production in terms of rice equivalent yield (REY) and economic point of view. The mulch application significantly promotes the production of the tillage system without the mulch, but no mulch has a higher Net Monetary Return (NMR) than the applied mulch. The application of recommended dose of fertilizers, in which 25% Nitrogen supplied through organic sources resulted in greater total production in term of REY of cropping system of the area than the recommended dose of fertilizers alone, but economically greater Net Monetary Returns was observed in 100% recommended dose of fertilizers. The existing cropping system Rice-Berseem purely not only gave higher total production in term of REY, but the most selective choice for the conservation of resource in the Kymore plateau region, and fetched the maximum NMR and B:C ratio.

**Key words:** *Conservation, Mulch, Cropping System, Tillage, REY*

### Introduction

India is an agricultural nation where a great deal of farmland is used for agricultural purposes and various crops are cultivated as per variable agro-ecological regions.. It is calculable that concerning 500-550 Mt of crop residue area unit created per annum within the country, and these crop residues area unit of tremendous price to the farmers. However, an oversized portion of the residue is burnt on-farm primarily to create the sphere prepared for the sowing of the succeeding crop. To manage residues in a very productive and profitable approach, Conservation Agriculture (CA) promotes smart prospects. With the adoption of conservation agriculture, these residues may be accustomed to improve soil health, increase crop productivity, scale back pollution, and enhance the property and resilience of agriculture. The resource Conservation technology (RCTs) caused minimum soil disturbance with higher soil cover through crop residues or, different cover crops and crop rotations for inbound higher productivity. Continuous

cropping and removal of crop residues results in poor soil quality has crystal rectifier to land degradation. Several analysis works on production systems beneath varied agro-ecological zones of Asia have shown potential advantages of CA-based crop management technologies on resource conservation, use-efficiency of external inputs, yield enhancement, soil health improvement, and adaptation to changing climates, soil carbon increase could provide a legacy for soil health improvement (Gupta *et al.*, 2003; Malik *et al.*, 2005; Gupta and Seth, 2007; Gupta and Sayre, 2007; Gupta *et al.*, 2010; Jat *et al.*, 2010; Lu *et al.*, 2020). In order to explore the prospects within the face of major constraints for the adoption of conservation agriculture, strategic long-run analysis during this region is required.

### Materials and Methods

During the 2010-11 and 2011-12 *Kharif* and *Rabi* seasons, the current field experiments were conducted at, J.N. Krishi Vishwa Vidyalaya, Jabalpur (M.P) Research Farm, and experimental field's soil consist of 46.45, 23.45, and 30.30 percent, the relative proportion of sand, silt and

### Author's Address

Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, M P, India  
E-mail: [anayrawat@gmail.com](mailto:anayrawat@gmail.com)



clay particles, respectively. It was neutral in response (pH7.32), normal in Electrical Conductivity (0.43dS/m, medium in Organic matter content (0.68%) and medium in the available nitrogen content (250.0 kg/ha), available phosphorus content (15.20 kg/ha) and available potassium content (300.0 kg/ha). The bulk density and porosity of the soil at 0-15 and 15.30 cm depths were 1.38 and 1.50mg/m<sup>3</sup>, and 47.92 and 43.40%, respectively. A factorial split-plot design of three replications was selected for the research. Two tillage operations viz., minimal and conventional tillage, and four cropping systems viz., rice-wheat, rice-berseem, maize-wheat, and sorghum-wheat were laid out as main treatments. The main plots were divided into four sub-plots consisting of two mulches (without mulch and with mulch) and two degrees of fertility (100% standard dose of fertilizers and 100% standard dose of fertilizers in which 25% nitrogen through organic source).

## Results and Discussion

### The response of different treatments on productivity i.e. REY (rice equivalent yield q/ha/year)

As per data given in table 1, the grain yield of *Kharif* and *Rabi crops* throughout each year of the investigation was considerably suffering from the tillage method. In terms of rice equivalent yields (99.22 and 101.97 q/ha/year), traditional tillage was slightly more successful than minimum tillage (95.48 and 98.44 q/ha/year) during the both years. Based on the two-year mean results, traditional tillage from the total output point of view proved to be significantly superior to minimum tillage. As per the comparison of minimal tillage with conventional tillage, it is very clear that conventional tillage produced significantly higher REYs (101.97 q/ha/year). When the treatments were compared with that of no mulch application, the grain yield was significantly higher during *Kharif* and *Rabi*, and this trend was reflected in terms of total output. It is also clear from the data that REY (98.85, 102.14 q/ha/year) received during both years was significantly greater at F<sub>2</sub> (100% standard dose of fertilizers + 25% Nitrogen supplied through organic), as compared to the application of 100% standard dose of fertilizers only (95.85, 98.27 q/ha). Rice equivalent

yields (REYs) were calculated under numerous treatments to judge the general productivity of various cropping systems of the targeted area. The REYs differed considerably based on the two years of data due to various cropping systems. The rice-wheat cropping system produced significantly higher REYs (114.48 q/ha/year) as compared to the system of rice-berseem (106.16 q/ha), which was also extensively superior to the maize-wheat, sorghum-wheat (106.16, 90.55, and 89.63 q/ha/year) systems. Mulching application achieved a substantial utmost (100.80 q/ha/year) and 100 percent recommended dose of fertilizers in which 25 percent N by organic application compared to mulch and fertility levels.

### Production efficiency

Production potency refers to the output per day of the complete cropping system below a particular treatment package. Output depends, therefore, on the quantity of total production as well as the length of the total period of cultivation under the specific treatment. Based on two-year results, traditional tillage was significantly higher than minimum tillage in terms of production efficiency (40.25 kg/ha/day). With the rice-wheat cropping method (44.39 kg/ha/day), which was reduced to 41.15, 37.75, 34.81 kg/ha/day due to maize-wheat, sorghum-wheat, and rice-berseem cropping systems, the highest production performance was obtained with Mulch treatment showed substantially higher production efficiency (39.98 kg/ha/day) than no mulch. Use of 100% recommended dose of fertilisers with 25% nitrogen from organic sources has higher production efficiency over 100% use of recommended dose of chemical fertilizers. The interaction between cropping systems and fertility levels indicates that in the rice-wheat cropping system with 100 percent standard dose of fertilizers, in which 25 percent nitrogen supplied through organic sources, the highest production efficiency was reported and the rice-berseem cropping system with 100 percent recommended dose of fertilizers had minimum production efficiency. These results are in near agreement with the results of Rathod *et al.* (2006), and Singh and Rai (2007).

### Effect on economic viability

#### Net monetary returns(NMR)

Under a specific treatment, net financial returns (NMR) per unit space are actual financial gains as a



**Table 1.**Effect of different treatments on Total production i.e. Rice equivalent yield (q/ha/year), Production efficiency (kg/ha/day), Net monetary returns (Rs/ha) and B:C ratio

	Total production in terms of rice equivalent yield (q/ha/year)		Production efficiency (kg/ha/day)		Net monetary returns (Rs/ha)		B:C ratio	
	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12	2010-11	2011-12
Main plot								
Tillage								
T <sub>1</sub> (minimum tillage)	95.48	98.44	37.87	38.85	65324	68304	2.19	2.25
T <sub>2</sub> (conventional tillage)	99.22	101.97	39.13	40.45	65760	69331	2.13	2.19
SEm±	0.51	0.17	0.07	0.15	266	215	0.00	0.00
CD at 5%	1.60	0.55	0.22	0.48	NS	679	0.01	0.01
Cropping systems								
CrSy <sub>1</sub> (rice-wheat)	103.73	106.16	34.01	34.81	84147	85889	2.48	2.50
CrSy <sub>2</sub> (rice-berseem)	113.09	114.48	44.34	44.89	67125	70179	2.07	2.12
CrSy <sub>3</sub> (maize-wheat)	85.63	90.55	39.43	41.15	55089	60067	2.04	2.13
CrSy <sub>4</sub> (sorghum-wheat)	86.95	89.63	36.22	37.75	55805	59135	2.05	2.12
SEm±	0.72	0.25	0.10	0.22	376	304	0.01	0.01
CD at 5%	2.26	0.77	0.31	0.68	1187	960	0.02	0.02
Subplot								
Mulch								
M <sub>0</sub> (No mulch)	97.03	99.60	38.25	39.31	65736	69064	2.18	2.24
M <sub>1</sub> (with mulch)	97.67	100.80	38.75	39.98	65348	68571	2.14	2.19
SEm±	0.51	0.22	0.08	0.16	298	273	0.00	0.00
CD at 5%	NS	0.63	0.22	0.47	NS	785	0.01	0.01
Fertility levels								
F <sub>1</sub> (100% RDF)	95.85	98.27	38.02	38.98	66889	69223	2.24	2.29
F <sub>2</sub> (100% RDF + 25% N from organic sources)	98.85	102.14	38.97	40.31	64195	68412	2.08	2.15
SEm±	0.51	0.22	0.08	0.16	298	273	0.00	0.00
CD at 5%	1.45	0.63	0.22	0.47	855	785	0.01	0.01

result of that they are determined by subtracting the value of cultivation from the gross financial returns of identical treatment. The net monetary returns from traditional tillage over minimum tillage (Rs 69331/ha) were higher based on the two years results. More NMRs (Rs 85889/ha) than other crops were given by the adoption of the rice-wheat cropping system. It was further noted that mulching was advantageous in contrast to no mulch. This was largely due to higher mulching prices. Among the different fertility levels, higher NMRs (Rs 69223/ha) were obtained below the 100%

prescribed fertilizer dose, primarily due to the high cultivation costs associated with the inclusion of organic manure in the other procedure.

Thus, conventional tillage, rice-wheat cropping system, no mulch application, and 100% recommended dose of fertilizers gave higher NMRs over remaining treatments. These results conform with the findings of many scientists in India (Jain *et al.*, 2007, Narayan and Lal, 2009).

#### **Benefit-cost ratio**

The effectiveness of the treatments reflects the benefit-cost ratio. It is said that the B:C ratio of a



specific treatment is an actual monetary benefit over each rupee investment. The trend for every B:C ratio treatment is approximately identical to the trend for NMRs. Unlike traditional tillage, minimal tillage had the maximum B:C ratio (2.25). For cropping systems, the B:C ratio for the rice-wheat cropping system was higher than (2.50) for other cropping systems. Almost similar B:C ratio was recorded in other cropping systems and an increased B:C ratio (2.24) was obtained with no mulch application. Application of 100% standard dose of fertilizers gave greater B:C ratio as compared to 100% recommended dose of fertilizers

in which 25% N supplied through organic sources. Thus, the B:C ratio obtained was in accordance to cost of cultivation and benefit derived from it.

## Conclusion

It can be concluded from the above research that traditional tillage and mulch, 100 percent recommended dose of fertilizers in which 25 percent nitrogen through organic and rice-wheat cropping systems have been one of the best available options for resource conservation in the agro-climate zone of Central India.

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