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## Effect of tillage and crop residue management practices on yield and economics of wheat (*Triticum aestivum* L.) under conservation agriculture

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**Abstract**

A field experiment was conducted at Experiment farm of Agronomy Department, Vasantnao Naik Marathwada Krishi Vidyapeeth, Parbhani, during season *rabi*-2019, to study the effect of tillage and crop residue management practices on yield and economics of wheat (*Triticum aestivum* L.) under conservation agriculture. The experimental plot was laid out in split plot design of fifteen treatment combinations replicated thrice. Where in main plot consist of three tillage practices *viz.*, Zero tillage (T<sub>1</sub>), Reduced tillage (T<sub>2</sub>) and Conventional tillage (T<sub>3</sub>) and sub plot to five crop residue management practices *viz.*, crop residue @ 2.5t/ha (R<sub>1</sub>), crop residue @ 5t/ha (R<sub>2</sub>), crop residue @ 2.5t/ha + consortia @ 5kg/ha (R<sub>3</sub>), crop residue @ 5t/ha + consortia @ 5kg/ha (R<sub>4</sub>) and without crop residue (R<sub>5</sub>). The study of experiment showed that reduced tillage and crop residue application @ 5t/ha + consortia @ 5kg/ha was found significantly higher grain yield. Gross returns, net returns and B:C ratio were recorded highest with reduced tillage and crop residue application @ 5t/ha + consortia @ 5kg/ha. Each increment of tillage and crop residue application correspondingly improved yield as well as gross returns, net returns and B:C ratio of wheat.

**Keywords:** Conservation agriculture, tillage practices, crop residue management, yield and economics

**Introduction**

Wheat (*Triticum aestivum* L.) is the most important cereal crop next to the rice. Its crop belongs to family Gramineae (Poaceae) and sub family Pooideae widely cultivated for its seed, a cereal grain. Being winter crop. Which is a world wide staple food about 2.5 billion people around 36 per cent of the world population. In India wheat is most important food after rice in term of both area and production which contributes 12% of the world wheat pool. In India during 2017-18 area under wheat cultivation was 309.60 Lakh hectare with annual production of 98.38 Lakh Tons with an average productivity 31.72 q/ha. Maharashtra it occupies as area of 12.72 Lakh hectare with production of 22.14 Lakh tons and average productivity is 17.40 q/ha. (Ministry of Agriculture, New Delhi, Economics Times, Fourth Estimates 2017-18).

The productivity of wheat depends on the used proper inputs, appropriate production technology and by encouraging the appropriate tillage practices. Conservation agriculture maintains a permanent or semi-permanent organic soil cover. This can be a growing crop or dead mulch. Its function is to protect the soil physically from sun, rain and wind and to feed soil biota. The soil micro-organisms and soil fauna take over the tillage function and soil nutrient balancing. Mechanical tillage disturbs this process. Therefore, zero or minimum tillage and direct seeding are important elements of CA (FAO website). The technologies of CA provide opportunities to reduce the cost of production, save water and nutrients, increase yields, increase crop diversification, improve efficient use of resources, and benefit the environment (Bhadu *et al.*, 2018) [2]. Adoption these practices permits the management of soil for crop production without excessively disturbing soil.

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tillage function and soil nutrient balancing. Mechanical tillage disturbs this process. Therefore, zero or minimum tillage and direct seeding are important elements of CA. A varied crop rotation is also important to avoid disease and pest problems (FAO website).

Reduced or minimum tillage deals with the reduction of total number of tillage operations required for sowing of a particular crop. Zero tillage deals with the manipulation of soil in narrow strip where seeds are placed. All these practices leave at least 30% stubbles on soil as mulch or add these into soil as source of organic matter (Khan *et al.*, 2017). Zero tillage seeding offers the benefits of retaining surface residues and reduces soil-water losses. With zero-tillage technology, farmers can harvest higher yields and production cost is reduced up to 10% with also improves soil condition and its fertility status (Ghosh *et al.*, 2010) [7]. Conservation agriculture offers an opportunity for arresting and reversing the downward spiral of resource degradation, decreasing cultivation costs and making agriculture more resource use efficient, competitive and sustainable. Keeping this background in view, an attempt was made to study the effect of tillage and crop residue management practices on yield and economics of wheat (*Triticum aestivum* L.) under conservation agriculture.

### Material and Method

A field experiment was conducted at Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, during season *rabi*-2019. The soil of experimental field was deep black, clay in texture, medium in organic carbon, low in available nitrogen (178.00 kg ha<sup>-1</sup>), phosphorus (12.15 kg ha<sup>-1</sup>) and high in potash (488 kg ha<sup>-1</sup>) and pH was 7.80. The field experiment set up in a split plot design with three replications consisting of fifteen treatment combinations. Where the main factor was tillage practices with three tillage treatments consisted of zero tillage (T<sub>1</sub>), reduced tillage (T<sub>2</sub>) and conventional tillage (T<sub>3</sub>). while the subplot treatments were five crop residue management practices, consist of crop residue @ 2.5t/ha (R<sub>1</sub>), crop residue @ 5t/ha (R<sub>2</sub>), crop residue @ 2.5t/ha + consortia @ 5kg/ha (R<sub>3</sub>), crop residue @ 5t/ha + consortia @ 5kg/ha (R<sub>4</sub>) and control (without crop residue) (R<sub>5</sub>). Under zero tillage direct sowing of seed without tilling the land with the help of tractor driven specially designed zero-till-see-drill. In reduced tillage sowing operation was done with BBF planter. The conventional tillage consisted of one deep ploughing, followed by two passes of cultivator with planking in the last pass, after this sowing of seeds was done with tractor driven normal seed drill. Crop residue management practices, in this treatment was done by using chopped soybean crop residues. It was applied 20 DAS and treatments consisting an application of decomposing microbial consortia was applied as spraying after sown crop as surface mulch.

Five plants in each treatment in the net plot area were selected at random and tagged for biometric observations. The economics of treatments were calculated using existing market prices. The input and output costs were compared treatment wise and different parameters, *viz.*, net returns and the B: C ratio were calculated. Data were statistically analyzed as suggested by Panse and Sukhatme (1967) [11].

### Result and Discussion

#### Effect of tillage on yield and economics of wheat

The grain yield were significantly influenced by different tillage practices. The treatment reduced tillage obtained

significantly higher grain yield (2207 kg ha<sup>-1</sup>) was found with reduced tillage which was at par with conventional tillage (T<sub>3</sub>) (2032 kg ha<sup>-1</sup>) and lowest yield was found in zero tillage (T<sub>1</sub>) (1775 kg ha<sup>-1</sup>). This might be due to more favoured overall growth and yield attributing characters due to favourable seed bed, better aeration, scope for more space, light interception, benefit of more conserved moisture in furrows and its support at critical growth stages like tillering, panicle initiation and development. This resulted in higher values of yield attributing characters and which in turn resulted in higher yields of wheat crop. Similar results were reported by Ozpinar S. (2004) [12] and Singh *et al.*, (2020) [16].

However, highest gross return (42501 Rs ha<sup>-1</sup>), net returns (21839 Rs ha<sup>-1</sup>) and benefit cost ratio (2.05) were recorded with reduced tillage among all tillage practices. Lower gross return (34174 Rs ha<sup>-1</sup>), net returns (15012 Rs ha<sup>-1</sup>) and benefit cost ratio (1.77) was observed with zero tillage practices. Increase in gross returns, net returns and benefit cost ratio due to higher crop production with reduced tillage (T<sub>2</sub>), irrespective of greater cost of cultivation value. Similar results were reported by Ozpinar (2004) [12], Singh *et al.*, (2013) [15] and Shivnath (2016) [14]. Conventional tillage resulted highest cost of cultivation (24777 Rs ha<sup>-1</sup>), while zero tillage and reduced tillage resulted in least cost of cultivation (19162 Rs ha<sup>-1</sup> and 20662 Rs ha<sup>-1</sup>) This might be due in conventional tillage consists more number of operation which are necessary and that charges high rates for tillage operation, which reflect into high cost of cultivation in conventional tillage than zero and reduced tillage.

#### Effect of crop residue application on yield and economics of wheat

The grain yield were significantly influenced by different crop residue management practise. The treatment application of crop residue @ 5 t/ha + consortia @ 5 kg/ha (R<sub>4</sub>) obtained significantly higher grain yield (2303 kg ha<sup>-1</sup>) was found with application of crop residue @ 5 t/ha + consortia @ 5 kg/ha (R<sub>4</sub>) over the rest of treatments and lowest yield was found with control (R<sub>5</sub>). This increase in yields might be due to improvement in yield attributes with application of crop residue @ 5 t ha<sup>-1</sup> + consortia @ 5 kg ha<sup>-1</sup> in addition to its multiple roles in favoured overall growth and yield attributing characters due to favorable seed bed, better aeration, scope for more space, light interception, higher microbial activity benefit of more conserved moisture in crop residues treatments. This ultimately resulted in higher values of yield attributing characters and which in turn resulted in higher yields of wheat crop. This result correlate with earlier work conducted by Ram *et al.*, (2010) [13], Dhar *et al.*, (2014) [4, 5] and Kumar and Singh (2018) [9].

However, highest gross return (44350 Rs ha<sup>-1</sup>), net returns (21927 Rs ha<sup>-1</sup>) and benefit cost ratio (1.99) were recorded with reduced tillage among all tillage practices. Lower gross return (31020 Rs ha<sup>-1</sup>), net returns (10746 Rs ha<sup>-1</sup>) and benefit cost ratio (1.53) was observed with zero tillage practices. This might be due to favoured early growth and conservation of moisture in treatment over the rest of treatments and which penultimately resulted in higher yield and thus ultimately gave higher GMR, NMR and B: C ratio.

#### Interaction effect

The interaction effect of all the treatment combination *i.e.* tillage and crop residue management was found non significant.

**Table 1:** Grain yield (kg ha<sup>-1</sup>, cost of cultivation (Rs ha<sup>-1</sup>) gross monetary returns (Rs ha<sup>-1</sup>), net monetary returns (Rs ha<sup>-1</sup>) and B:C ratio as influenced by various treatments.

Treatments	Grain yield (kg ha <sup>-1</sup> )	Cost of cultivation (Rs ha <sup>-1</sup> )	Gross monetary returns (Rs ha <sup>-1</sup> )	Net monetary returns (Rs ha <sup>-1</sup> )	B:C ratio
<b>Tillage practices (T)</b>					
T <sub>1</sub> -Zero tillage	1775	19162	34174	15012	1.77
T <sub>2</sub> - Reduced tillage	2207	20662	42501	21839	2.05
T <sub>3</sub> -Conventional tillage	2032	24777	39130	14352	1.58
S.E. ±	82	-	1591	1591	-
C.D. at 5%	248	-	4775	4775	-
<b>Residue management (R)</b>					
R <sub>1</sub> - crop residue @ 2.5t/ha	1877	21273	36132	14858	1.71
R <sub>2</sub> - crop residue @ 5t/ha	2235	22273	43042	20768	1.96
R <sub>3</sub> - crop residue @ 2.5t/ha + consortia @ 5kg/ha	1998	21423	38464	17040	1.81
R <sub>4</sub> - crop residue @ 5t/ha + consortia @ 5kg/ha	2303	22423	44350	21927	1.99
R <sub>5</sub> - without crop residue (control)	1611	20273	31020	10746	1.53
S.E. ±	69	-	1308	1308	-
C.D. at 5%	2031	-	3925	3925	-
<b>Interaction (T × R)</b>					
S.E. ±	120	-	2329	2329	-
C.D. at 5%	NS	-	NS	NS	-
G. mean	2005	21533	38602	17068	1.80

### Conclusion

All tillage and crop residue management practices showed significant influence on wheat crop. The results revealed that among different tillage and crop residue management practices, the reduced tillage recorded significantly higher grain yield, GMR, NMR and B: C ratio followed by conventional tillage and lowest in zero tillage. Application of crop residue @ 5t/ha + consortia @ 5kg/ha recorded significantly higher grain yield, GMR, NMR and B: C ratio over rest of the treatments.

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