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## Tillage and crop residue management practices effect on soil physical properties under conservation agriculture in wheat

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**Abstract**

A field experiment was conducted during season *rabi*-2019, at Department of Agronomy, Vasandra Naik Marathwada Krishi Vidyapeeth, Parbhani, during season, to study the effect of tillage and crop residue management practices on soil physical properties under conservation agriculture in wheat. 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 @ 2.5 t/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>). Proper tillage and crop residue application management can conserve more soil moisture and improve bulk density of soil was noted. The study of experiment revealed that reduced tillage and crop residue application @ 5t/ha + consortia @ 5kg/ha was found highest soil moisture content over the rest of treatments. In case of bulk density, the maximum improvement in soil bulk density was recorded with conventional tillage (1.20 Mg m<sup>-3</sup>) and crop residue application @ 5t/ha + consortia @ 5kg/ha (1.23 Mg m<sup>-3</sup>).

**Keywords:** Tillage practices, crop residue management practices, soil moisture and bulk density

**1. 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. 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.

Tillage refers to the physical disturbance of soil. In tillage system soil is manipulated with tools and implements for to creates favorable soil environment for better crop establishment. The conventional tillage refers to the intensive tillage with multiple passes of tillage equipment to accomplish land preparation for seed sowing. Conventional tillage practices lead to change in soil structure by modifying soil bulk density and soil moisture content. 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) [5]. Deep tillage breaks up high-density soil layer, improves water infiltration and movement in the soil, enhances root growth and development and increases crop production potential (Bennie & Botha, 1986) [1]. Chaudhary *et al.*, (1992) [2] compared conventional tillage system to zero tillage and concluded that higher moisture retention and 13% more income was obtained in case of zero tillage. But minimum tillage could not compensate the adverse effects of fine texture, very low organic matter and an overall initial weak structure of soil.

Zero tillage and Reduced or minimum tillage have become, in recent years, tillage systems for soil conservation. Their insertion in agricultural practice reduces soil degradation phenomena, avoids the implementation of an intensive management and reduces production costs. Implementing the zero tillage and reduced or minimum tillage systems are perceived as having effects on soil compaction, namely a higher soil moisture than in the conventional tillage with effects on soil moisture and temperature.

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Moisture conservation in soil as increase on soil profile depends or is influenced by the amount and intensity of rainfall, water and soil temperature, slope and land form, by hydro-physical properties, soil texture and compaction. All these soil qualities are closely interdependent and influenced by the tillage system. Soil tillage system and its intensity are modified by direct and indirect actions of soil moisture and bulk density (Moraru & Rusu, 2012)<sup>[6]</sup>.

Crop residue are the part of the plant left in field after the crops have been harvested and threshed or left after pasture are grazed. In corporation of crop residue into soil or retention on the surface through the adaptation conservation agriculture practice has positive influence on physical, chemical, biological properties of soil. These practices reduce the bulk density and increases the hydraulic conductivity of soil by improving the soil structure. Retention of crop residue on the soil surface reduced surface runoff and enhances infiltration. Crop residues retained on the soil surface conserve soil and water and increase the subsequent crop yield. Crop residue and tillage affecting the soil environment directly or indirectly. Adoption of proper crop residue management practices lead to improve soil quality and increase the production with the minimum adverse effect on environment.

The recycling of crop residues has the benefit of converting the surplus farm waste into valuable products for gathering nutrient supplies of crops. It also maintains the soil physical and chemical condition and increase the overall ecological balance of the crop production system (CTIC, 2004). With the utilization of the micro-organism viz. *Trichoderma* sp., the crop residues like cane trash, paddy trash, wheat trash and press mud cake can be recycled into good quality compost not only in pit level but in situ also, which will improve organic matter along with macro, micronutrients, physio-chemical and biological conditions of soil apart from saving the environment being polluted due to trash burning and would maintain the sustainability of crop production.

The present investigation was planned to determine the effect of different tillage systems in combination with crop residue management on soil physical properties of wheat under conservation agriculture.

## 2. Material and Method

A field experiment was conducted during season *rabi*-2019, at Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. 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 wheat crop variety Trimbak (NIAW-301) was sown at a spacing of 22.5 cm on 18<sup>th</sup> November, 2019 and harvested on 5<sup>th</sup> March, 2020. 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 (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.

For the determination of moisture percentage, soil samples were taken from a depth of 0-15 cm with the help of screw auger. Then soil moisture percentage was determined from these samples by gravimetric method. The values of soil moisture percentage were used for computing soil bulk density from a depth of 0-15 cm.

## 3. Result and Discussion

### 3.1 Soil moisture content (%)

The amount of moisture the soil retains under a given condition is closely related to porosity and size of voids as well as properties of the soil particles. The soil moisture is modified by using different tillage and crop residue management practices through particle to particle contact and porosity of soil. The root growth and its proliferation are directly related to water availability in soil profile. Thus, soil moisture can greatly impact nutrient transformation, its release from organic forms, its uptake by roots and subsequent translocation and utilization by plant. Therefore, it is important to quantify the changes in soil moisture content as influenced by various tillage crop residue management practices. It is well known that degree of tillage and crop residue management practices highly influences the soil moisture content, even though the soil having same physical properties.

#### 3.1.1 Effect of tillage practices

Tillage practices influenced the mean moisture content in wheat as presented in Table 1. Consistency higher soil moisture content in per cent was observed with reduced tillage (T<sub>2</sub>) followed by treatment zero tillage (T<sub>1</sub>) and lowest moisture observed in conventional tillage (T<sub>3</sub>). This might be due maximum conservation of soil moisture with treatment reduced tillage consisting broad bed furrow prove its superiority by keeping the rhizosphere with adequate amount water content. Greater sub soil compaction with treatment zero tillage (T<sub>1</sub>) might have resulted in formation of lesser number of pore spaces, thus reflecting in reduced soil moisture content.

#### 3.1.2 Effect of crop residue practices

Crop residue practices had profound effect on soil moisture content (%). Treatments application of crop residue @ 5t/ha + consortia @ 5 kg/ha (R<sub>4</sub>) crop residue @ 5t/ha (R<sub>2</sub>) registered highest soil moisture content as compared to remaining crop residue management practices. Adequate amount of residue application with treatments application of crop residue @ 5t/ha + consortia @ 5 kg/ha (R<sub>4</sub>) and crop residue @ 5t/ha (R<sub>2</sub>) assured complete ground cover, thus restricted the moisture loss through evaporation from the crop land. Whereas in remaining treatments, due to inadequate ground cover, accelerate the evaporation process might have reflected in lower soil moisture conservation.

### 3.2 Soil bulk density (Mg m<sup>-3</sup>)

The observations recorded for quantifying the bulk density from the depth of 0-15 cm are presented in Table 2. It is obvious from the values of general mean that, the values of bulk density were increases from sowing to harvest.

### 3.2.1 Effect of tillage practices

Tillage practices had profound effect on bulk density. The value of bulk density at various growth stages of crop decreased with increase in the soil manipulation and number of tillage operation. At time of sowing after application of various tillage practices, maximum improvement in soil bulk density ( $1.20 \text{ Mg m}^{-3}$ ) was recorded with conventional tillage system. Whereas, soil compaction increased with zero and reduced tillage. At time of harvesting, the practice of zero tillage ( $T_1$ ) recorded highest bulk density ( $1.32 \text{ Mg m}^{-3}$ ). Whereas, lowest bulk density was observed in conventional tillage ( $T_3$ ) ( $1.23 \text{ Mg m}^{-3}$ ) which was followed by reduced tillage ( $T_2$ ) ( $1.27 \text{ Mg m}^{-3}$ ). This might be due to tillage operations in conventional tillage ( $T_3$ ) resulted in increased porosity thus reflecting in reduced soil bulk density. These

results are conformation with the results of Gangwar *et al.*, (2004)<sup>[4]</sup> and Singh *et al.*, (2011)<sup>[7]</sup>.

### 3.2.2 Effect of crop residue practices

The bulk density of soil as influenced by different residue management practices. As the crop residue was applied at 20 DAS, data regarding bulk density of soil was found inconsistent at initial stage. At time of harvesting, significant improvement in the values of bulk density was noticed with treatment crop residue @ 5 t/ha + consortia 5 kg/ha ( $R_4$ ) i.e.,  $1.23 \text{ Mg m}^{-3}$  which was followed by treatment crop residue @ 5 t/ha ( $R_2$ ) i.e.,  $1.24 \text{ Mg m}^{-3}$  and lowest improvement in the bulk density was noticed with treatments control ( $R_5$ ) i.e.,  $1.32 \text{ Mg m}^{-3}$ . Which may be due to proportionate addition of crop residues, there by the treatments receiving greater amount of crop residues possess lesser soil compaction.

**Table 1:** Mean soil moisture content (%) at 0-15 cm depth influenced by various tillage practices and crop residue management treatments in wheat

Treatments	At sowing	20 DAS	40 DAS	60 DAS	80 DAS	At harvest
<b>Tillage practices (T)</b>						
T <sub>1</sub> -Zero tillage	28.17	21.18	23.85	22.71	18.71	14.22
T <sub>2</sub> - Reduced tillage	27.54	23.45	27.89	25.82	21.77	17.61
T <sub>3</sub> -Conventional tillage	26.87	20.56	22.15	20.79	17.34	13.26
<b>Residue management (R)</b>						
R <sub>1</sub> -crop residue @ 2.5t/ha	27.47	20.5	23.55	22.56	18.17	14.29
R <sub>2</sub> - crop residue @ 5t/ha	28.7	22.47	26.82	25.42	21.07	16.04
R <sub>3</sub> - crop residue @ 2.5t/ha + consortia @ 5kg/ha	27.56	21.6	24.67	23.22	18.92	15.89
R <sub>4</sub> - crop residue @ 5t/ha + consortia @ 5kg/ha	28.54	22.8	27.62	26.12	22.6	17.17
R <sub>5</sub> - without crop residue (control)	27.23	20.25	20.45	18.49	16.13	12.11
G. mean	27.76	21.60	24.62	23.14	19.33	15.07

**Table 2:** Bulk density ( $\text{Mg m}^{-3}$ ) at 0-15 cm depth as influenced by various tillage practices and crop residue management treatments in wheat

Treatments	Initial	At harvest
<b>Tillage practices (T)</b>		
T <sub>1</sub> -Zero tillage	1.30	1.32
T <sub>2</sub> - Reduced tillage	1.25	1.27
T <sub>3</sub> - Conventional tillage	1.20	1.23
<b>Residue management (R)</b>		
R <sub>1</sub> - crop residue @ 2.5t/ha	1.26	1.28
R <sub>2</sub> - crop residue @ 5t/ha	1.20	1.24
R <sub>3</sub> - crop residue @ 2.5t/ha + consortia @ 5kg/ha	1.25	1.27
R <sub>4</sub> - crop residue @ 5t/ha + consortia @ 5kg/ha	1.22	1.23
R <sub>5</sub> - without crop residue (control)	1.30	1.33
G. mean	1.25	1.27

## 4. Conclusion

Our result of experiment revealed that proper tillage and crop residue application management can conserve more soil moisture and improve bulk density of soil for better growth of wheat in vertisol soil. Hence, using reduced tillage practice along with application of crop residue application @ 5t/ha + consortia @ 5kg/ha observed conserve more soil moisture content over the rest of treatments. In respect of bulk density, the maximum improvement in soil bulk density was recorded with conventional tillage ( $1.20 \text{ Mg m}^{-3}$ ) and crop residue application @ 5t/ha + consortia @ 5kg/ha ( $1.23 \text{ Mg m}^{-3}$ ) than others treatments.

## 5. References

- Bennie TP, Botha FJP. Effect of deep tillage and controlled traffic on root growth, water use efficiency and yield of irrigated maize and wheat. *Soil and Tillage Res* 1986;7:85-95.
- Chaudhary AD, Javed M, Rana MA, Sarwar A, Zaman Q. Comparative performance of direct drilling and conventional tillage practices under rice-wheat rotation system. *Pakistan J Agri. Sci* 1992;29:5-8.
- CTIC National Crop Residue Management Survey: (2002) Results. Conservation Technology Information Center, West Lafayette, IN 2004. Available at: <http://www.ctic.purdue.edu/CTIC/CRM.htm> l.
- Gangwar K, Singh K, Sharma S. Effect of tillage on growth, yield and nutrient uptake in wheat after rice in the Indo-Gangetic Plains of India. *The Journal of Agricultural Science* 2004;142(4):453-459.
- Khan HZ, Shabir MA, Akbar N, Iqbal A, Shahid M, Shakoor A *et al.* Effect of different tillage techniques on productivity of wheat (*Triticum aestivum* L.). *J Agric Basic Sci* 2017;2(1):44-49.
- Moraru PI, Rusu T. Effect of tillage systems on soil moisture, soil temperature, soil respiration and production of wheat, maize and soybean crops. *Journal of Food, Agriculture & Environment* 2012;10(2 Part 1):445-448.

7. Singh V, Srivastava A, Singh RK, Savita US. Effect of tillage practices and residue management on soil quality and crop yield under maize (*Zea mays*)-Based cropping system in Mollisol. Indian Journal of Agricultural Sciences 2011;81(11):1019.