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Effect of tillage and crop residue management practices on soil moisture and bulk density of soil under conservation agriculture

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Abstract
The field experiment was conducted during *Kharif* season 2019 at Experiment farm of Agronomy Department, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, to study the effect of tillage and crop residue management practices on soil moisture and bulk density of soil under conservation agriculture. The experiment was laid out in a split plot design with the combinations of three tillage practices in main plots and five crop residue management practices in sub plots with three replications on fixed site. Results indicated that the reduced tillage and crop residue application @ 5t/ha + consortia @ 5kg/ha was found highest soil moisture over the rest of treatments. In case of bulk density treatment conventional tillage and crop residue application @ 5t/ha + consortia @ 5kg/ha recorded significant improvement in bulk density of soil.

Keywords: Conservation agriculture, tillage practices, crop residue management, soil moisture, bulk density

Introduction

Soybean is basically a pulse crop but is gaining importance as an oilseed crop too and is the world's first ranking crop as a source of vegetable oil and in India too. Among the edible oilseeds, soybean *[Glycine max* (L.) Merrill.] is the leading oilseed crop in the world. Soybean is of paramount important in human and animal nutrition, because it is a major source of edible vegetable oil and high protein feed as well as food in the world. It is an excellent health food and contains about 40 per cent quality protein, 23 per cent carbohydrates and 2 per cent cholesterol free oil. Soybean protein is rich in valuable amino acid viz., lysine (5%) which is deficient in most of the cereals. Soybean is the cheapest source of proteins and it is called "Poor man's meat". (Dixit *et al*., 2011) [2].

Today, in the country, the area under conservation tillage has increased to more than 2 million ha. However, there has been little corresponding change in the application rates and management of nutrients, especially phosphorus. Conservation tillage or zero tillage may have positive, negative or no effect on grain yield of crops depending on soil, crop, cropping system and climatic conditions. Therefore, site-specific suitability of various crops and cropping systems for conservation agriculture needs extensive investigations. (Pradhan *et al.,* 2011) [7].

Crop residues are those parts of the plants left in the field after the harvestable parts of the crops (grain, tubers, roots, etc.) have been removed. Crop residues at times have been regarded as waste materials that require disposal, but it has become increasingly realized that they are important natural resources and not wastes. The recycling of crop residues has the advantage of converting the surplus farm waste into useful products for meeting nutrient requirements of crops. It also maintains the soil physical and chemical condition and improves the overall ecological balance of the crop production system. (CTIC, 2004) [1].

Among the all legumes, soybean is most sensitive to soil moisture. Due to reduced soil moisture availability soybean crops suffers from water stress and yield of crop reduced. The decrease in yield of soybean can be reduced if proper amount of water is stored in soil. By adopting various soil moisture conservation practices water availability and proper utilization of water by crop can be increased up to greater extent (Patil *et al*. 2010) [6]. So adoption of the various tillage and crop residue management practices helps in reducing water loss from soil. Keeping in view all the above point, the field experiment was executed to investigate the interventions of tillage and crop residue management practices on soil moisture and bulk density of soil under conservation agriculture.

Material and Method

Experimental site and soil

An experiment was laid out at the farm of the Department of Agronomy, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (MS) during *Kharif* seasons of 2019. The soil of experimental field was medium deep black, clay in texture, well drained, low in available nitrogen (179.00 kg ha^{-1}), medium in available phosphorus (12.50 kg ha^{-1}), high in potash (478 kg ha^{-1}), organic carbon (0.58%) and slightly alkaline in reaction (pH 7.90). The topography of the experiment field was fairly uniform and leveled. The total rainfall during the study period was 949.6 mm.

Layout and experiment design

The field layout was done in Split plot design with three replications in a fixed lay out. The treatments were consisting of three tillage methods as main plot treatments and five crop residue management practices as sub plot treatments. The main plot treatments consisted of 3 tillage practices *viz*., zero tillage (T_1), reduced tillage (T_2) and conventional tillage (T_3) while the subplot treatments were five crop residue management practices *viz*., crop residue @ 2.5 t/ha (R_1), crop residue @ 5 t/ha(R_2), crop residue @ 2.5t/ha + consortia @ 5 kg/ha (R_3), crop residue @ 5 t/ha + consortia @ 5kg/ha (R_4) and without crop residue i.e. control (R_5).

Field management practices

Soybean variety (MAUS-162) was sown on 5th july, 2019 in various tillage practices with recommended seed rate at a row spacing of 45 cm. Seeds were inoculated with *Rhizobium* culture (*Bradyrhizobium japonicum*) and PSB. The N, P and K were given in the form of urea, single super phosphate and muriate of potash at the time of sowing. In zero tillage the crop was sown without any tillage operation with zero-till-seed-drill without disturbance of soil, by just opening a narrow furrow, putting the seeds into furrow and covering the seeds in one operation. In reduced tillage sowing operation was done with tractor drawn BBF planter. The bed making (180 cm), furrow opening (15 cm) and planting (placement of seed) at 45×5 cm was done in one operation at a time with BBF planter. While in conventional tillage, the plots were ploughed 1 time followed by 2 harrowing, intercultural and sowing was done with seed drill. The crop residue management treatments were applied to the soybean crop at 25 DAS and immediately consortia (a microbial decomposer) spraying was done in treatments crop residue @ 2.5t/ha + consortia @ 5kg/ha (R_3) and crop residue @ 5t/ha + consortia @ 5 kg/ha (R_4). Other crop management practices were performed as per recommended package of practices.

Results and Discussion

The results as well as discussions of the various tillage and crop residue management practices have been presented under following heads:

Soil moisture content (%)

It is well known that degree of tillage operations highly influence the soil moisture content, even though the soil having same physical properties. Moreover, tillage implements can also affect soil denseness resulting in the rate of movement of water at soil air interface; and subsequently within soil. Data on soil moisture content on the basis of percentage and depth (cm) under depth of soil 0-15cm is furnished in Table 1.

Effect of tillage practices

Tillage practice significantly influenced the mean moisture content. Remarkable improvement in conserving rainfall was noted with reduced tillage (T_2) consisting of BBF planter. Reduced tillage (T_2) recorded highest mean moisture content followed by treatment zero tillage (T_1), whereas conventional tillage (T_3) recorded lowest moisture at the all the crop growth intervals. This might be due to adequate conservation of rain water in broad bed as compare to the flat beds.

Effect of crop residue management practices

Crop residue practices had profound effect on soil moisture content (%). Treatment application of crop residue @ 5 t ha^{-1} + consortia @ 5 kg ha^{-1} (R_4) recorded highest soil moisture content as compared to other crop residue management practices and it was followed by crop residue @ 5 t ha^{-1} (R_2), crop residue @ 2.5 t ha^{-1} + consortia @ 5 kg ha^{-1} (R_3), crop residue @ 2.5 t ha^{-1} (R_1), and lowest was recorded in control (R_5). Adequate amount of residue application with crop residue @ 5 t ha^{-1} + consortia @ 5 kg ha^{-1} (R_4) and crop residue @5 t ha^{-1} (R_2) assured complete ground cover, thus restricted the moisture loss through evaporation from the crop land and maintains soil temperature. These findings are in close agreement with the findings of Patil *et al*. (2010) [6] where they observed that, moisture content in soil from 0-30 cm depth was found higher in mulched plots as compared to no mulch plots at all growth stages of crop up to the harvest of crop. This might be due to reduced soil temperature due to mulching, which prevents the evaporation of water from soil. These results are also in agreement with Khurshid *et al*. (2006) [5].

Table 1: Mean soil moisture content (%) at the depth of 0-15 cm as influenced by various tillage and crop residue management practices

Treatments	At sowing	Days after sowing						At harvest
		15	30	45	60	75	90	
Tillage (T)								
T_1-Zero tillage	20.28	21.37	27.21	18.69	21.08	28.73	25.13	19.34
T_2-Reduced tillage	21.24	22.26	29.32	20.83	23.89	31.86	26.94	20.53
T_3-Conventional tillage	19.23	20.63	26.82	18.17	20.82	28.63	24.46	18.13
Crop residue management (R)								
R_1-Crop residue @ 2.5 t ha^{-1}	19.68	21.85	27.20	18.89	21.32	29.42	25.23	18.90
R_2-Crop residue @ 5 t ha^{-1}	20.84	21.86	28.24	19.26	23.07	30.89	26.33	19.86
R_3-Crop residue @ 2.5 t ha^{-1} + consortia 5kg ha^{-1}	20.48	20.95	28.26	19.17	22.08	29.46	25.41	19.27
R_4-Crop residue @ 5 t ha^{-1} + consortia 5kg ha^{-1}	20.18	21.23	27.89	20.82	23.37	30.91	26.56	20.75
R_5-Control	20.07	21.21	27.35	18.02	19.81	28.02	24.02	17.87
GM	20.25	21.42	27.78	19.23	21.93	29.74	25.51	19.33

Bulk density (Mg m^{-3}) of soil

Vertisols are mostly compressible soil having the tendency to swell and shrink depending upon the moisture status. Both, soil texture and moisture are believed to have largest influence in determining the degree of compaction. Soil texture, especially its mean weight diameter value affects the amount of macropore space in the soil and ultimately the soil strength. Soils with a broad distribution of particle size are consider the most compactable although fine textured soil have been found to be compact to relatively high densities.

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.

Effect of tillage practices

The data pertaining to bulk density at 0-15 cm soil depth were recorded at sowing and harvesting i.e. at initial and final stage of crop growth. At sowing significant improvement in values of bulk density was noticed with conventional tillage (T_3) where its value was 1.20 Mg m^{-3} which was followed by treatment reduced tillage (1.25 Mg m^{-3}). Significantly lowest improvement in the values of bulk density was noticed with practices zero tillage (T_2) its value was 1.29 Mg m^{-3}, respectively. It was evident from the above result that the values of bulk density at various growth stages of crop decreased with increase in the soil manipulation and number of tillage operation. At the time of harvesting the treatment conventional tillage (T_3) (1.21 Mg m^{-3}) recorded significant improvement in bulk density than other tillage practices. This might be due to increase in soil manipulation and number of tillage operation carried in conventional tillage. The effect of tillage practices on soil bulk density is in line with the reports of Rashidi and Keshavrzpour (2007) [8], Gal *et al*. (2007) [3] and Kahlon (2014) [4].

Effect of crop residue management practices

It is clearly indicated from data that the crop residue management practices had a significant effect on bulk density of soil at harvest. As the crop residue was applied at 30 DAS, data regarding bulk density of soil was found inconsistent at initial stage. At harvesting significant improvement in the values of bulk density was noticed with treatment crop residue @ 5 t ha^{-1} + consortia 5 kg ha^{-1} (R_4) its value was 1.24 Mg m^{-3} which was followed by treatment crop residue @ 5 t ha^{-1} (1.25 Mg m^{-3}) and significantly lowest improvement in the values of bulk density was noticed with practices control (R_5) its value was 1.28 Mg m^{-3}. These results are in agreement with Khurshid *et al*., (2006) [5].

Table 2: Bulk density (Mg m^{-3}) of soil at the depth of 0-15 cm as influenced by various tillage and crop residue management practices

Treatments	Initial	Final
Tillage (T)		
T_1-Zero tillage	1.29	1.32
T_2-Reduced tillage	1.25	1.27
T_3-Conventional tillage	1.20	1.21
Crop residue management (R)		
R_1-Crop residue @ 2.5 tonne ha^{-1}	1.25	1.27
R_2-Crop residue @ 5 tonne ha^{-1}	1.24	1.25
R_3-Crop residue @2.5 tonne ha^{-1} + consortia 5 kg ha^{-1}	1.25	1.27
R_4-Crop residue @ 5 tonne/ha + consortia 5kg ha^{-1}	1.23	1.24
R_5-Control	1.25	1.28
GM	1.24	1.26

Conclusions

This experiment illustrated that soil physical properties such as soil moisture and bulk density were influenced by various tillage and crop residue management practices. Result of experiment revealed that proper tillage and crop residue management practices can conserve more soil moisture and improve bulk density of soil for better growth of soybean in vertisol soil.

References

1. CTIC, National Crop Residue Management Survey: 2002 Results. Conservation Technology Information Center, West Lafayette, IN. Available at; 2004. http://www.ctic.purdue.edu/CTIC/CRM.htm l.
2. Dixit, Daksha, Dharati M Kubavat, Sureshbhai P Rathod, Mital M Patel, Tulsibhai. A study of variations in the origin of profunda femoris artery and its circumflex branches. Int. J Biol. Med. Res. 2011;2(4):1084-1089.
3. Gal A, Vyn TJ, Micheli E, Kladivko EJ, McFee WW. Soil carbon and nitrogen accumulation with long-term no till versus mouldboard ploughing overestimated with tilled zone sampling depths. Soil and Tillage Research. 2007;96:42-51.
4. Kahlon MS. Soil physical characteristics and crop productivity as affected by tillage in rice-wheat system. Journal of Agricultural Science. 2014;6(12):107.
5. Khurshid KASHIF, Iqbal M, Arif MS, Nawaz A. Effect of tillage and mulch on soil physical properties and growth of maize. International Journal of Agriculture and Biology. 2006;8(5):593-596.
6. Patil BHARATI, Pongde SM, Suryapujary SM, Chorey AB. Effect of mulching and land configuration on moisture use, moisture use efficiency and yield of soybean (*Glycinemax* L.). Asian Sci. 2010;5(1):1-4.
7. Pradhan PR, Pandey RN, Behera UK, Swarup A, Datta SC, Dwivedi BS. Tillage and crop residue management practices on crop productivity, phosphorus uptake and forms in wheat (*Triticum aestivum*)-based cropping systems. Indian Journal of Agricultural Sciences. 2011;81(12):1168.
8. Rashidi M, Keshavarzpour F. Effect of different tillage methods on grain yield and yield components of maize (*Zea mays* L.). Int. J Agric. Biol. 2007;9(2):274-277.