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Effect of deep tillage practices under the recommended dose of fertilizer growth and yield of wheat (*Triticum aestivum* L.) Cv. PBW 502

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Abstract
A field experiment was conducted during *Rabi* season (November-April) 2018-2019 at the research farm with the objective to evaluate the effect of deep tillage on the physical properties of growth and yield of wheat. The experiment was laid out in Randomized Block Design with three replications during *Rabi* season 2018-2019. The treatment consisted of four levels of tillage practices T_1 (12 cm depth of tillage) T_2 (22 cm depth of tillage) T_3 (32 cm depth of tillage) and T_4 (42 cm depth of tillage). The results indicated that deep tillage has a significant effect on Tillage depth influences the soil water plant ecosystem, thereby affecting crop yield. Through the effect of deep tillage was not significant on the growth but the grain yield of wheat significantly increases from 35.00 q ha^{-1} in T_1 (12 cm depth of tillage) to 43.89 q ha^{-1} in T_4 (42 cm depth of tillage).

Keywords: Wheat, deep tillage, growth and yield

Introduction
Wheat (*Triticum aestivum* L.) is an important cereal crop of Indo-Gangetic plains of India in general and Punjab, in particular. In India, it is cultivated over an area of 28.15 million ha with an annual production of 77.63 million tones and average yield of 2708 kg ha^{-1}. In Punjab, wheat is cultivated on an area of 3.48 million ha with an annual production of 157.2 million tones having an average productivity of 4507 kg ha^{-1}. Wheat (*Triticum aestivum* L.) belongs to family Poaceae and is very important crop as it contributes major portion of staple food for the world's population. Soil physical properties are affected by various tillage practices and soil compaction increases the shear strength of soil. Compaction of soil increases dry bulk density reduces pore space volume and requires higher tillage energy and impedes root growth. A reduction in pore space hinders water and air movement in the soil, reduces the water holding capacity and restricts root penetration in the soil Sabir *et al*., (1990), Osunbitan *et al*., (2005) [9]. Soil physical conditions detrimental to root proliferation in subsoil are generally related to tillage pans that develop below tilled layer Akhtar *et al*., (2005) [1]. Soil physical properties are affected by various tillage practices Singh and Panesar, (1991), Busscher and Bauer, (2004) [10]. Excessive soil manipulation by tillage implements is however detrimental to soil structure with serious consequences on the emergence and yield of crop**.** The specific objective of research work was to study the effect of different tillage implements on soil physical properties, mechanical properties, emergence of seed and crop yield.

Materials and methods
The present study entitled "Effect of deep tillage practices under the recommended dose of fertilizer on growth and yield of Wheat (*Triticum aestivum* L.)" Cv. PBW 502. will be carried out during the *Rabi* season 2018-2019 and will comprised of a field experiment which will be laid out at crop research farm of Department of Soil Science & Agricultural Chemistry, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, 211 007 (U.P.) India which is located at 25°. 27^1N latitude, 81°.56^1 E longitude and 98 m above the mean sea level. The detail of the experimental site, soil and climate is described in this chapter together with the experimental design, layout plan, cultural practice and techniques employed for the parameters. The area of Prayagraj district comes under subtropical belt in the South East Uttar Pradesh, which experience extremely hot summer and fairly winter. The maximum temperature of the location reaches up to 46 ºC-48 ºC and seldom

falls as 40 ºC-50 ºC. The relative humidity ranged between 20 to 94 percent. The average rainfall in this area is around 1100 mm annually. It comes under subtropical climate receiving the mean annual rainfall of about 1100 mm, major rainfall from July to end of September. The minimum temperature during the crop season was to be 25.01 ºC and the maximum is to be 41.94 ºC. The minimum humidity was 42.70% and maximum was to be 93.37%.

Experimental site

The field experiment will be carried out during the *Rabi* season 2018-2019 at the Research farm of Department of soil science Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (U.P.) located at 25.57' N latitude 81.57' E longitude and 98 m above mean sea level.

Soil analysis

Soil sample were taken from 0-15 cm randomly prior to tillage operations, air dried and passed through 2 mm sieve and the size of sample was reduced by conning quartering. Then the composite soil sample was taken for mechanical, physical and chemical analysis.

Design and treatment

The experiment was laid out in Randomized Block Design. The treatments have been replicated three times. The different treatments were employed randomly in each replication. The details of the treatments are given as under.

Details of treatments

Treatments	Depth of tillage (cm)
T_1	0-12
T_2	12-22
T_3	22-32
T_4	32-42

Recommended Dose of Fertilizer (NPK) for wheat

S. No.	Source of fertilizers	RDF
1.	Nitrogen	N at 120 kg ha^{-1}
2.	phosphorus	P_2O_5 at 60 kg ha^{-1}
3.	Potassium	K_2O at 40 kg ha^{-1}

Result and discussion

1. Plant Height

The plant height was recorded at 30, 60, 90, 120 DAS and results of the data recorded and analyzed are depicted in the Table 1. The result of the data shows that the plant height were not significantly influenced by tillage practices among all the treatments at 30,60,90 and 120 DAS. The maximum plant height (cm) at 30, 60, 90 and 120 DAS was recorded in T_4 (42 cm depth tillage) which was 18.25, 56.74, 97.36, 97.36 cm respectively. The minimum plant height (cm) at 30, 60, 90 and 120 DAS was found in T_1 (12 cm depth of tillage) which was 17.62, 54.25, 94.38 and 94.38 cm respectively. Tillage brings about a suitable tilth which results into desirable physical conditions required for better plant growth. This may be due to deep plowing which provides favorable conditions for plant growth. Similar results were reported by Javadi *et al.,* (2009).

2. Number of tillers per plant

The number tillers per plant was recorded at 30, 60, 90 and 120 days after sowing and results of the data recorded and analyzed are depicted in Table 1. The result of the data shows that the number of tillers per plant increases gradually as the depth of tillage increases among all treatments at 60, 90, and 120 DAS the number tillers per plant was found to be significant among all treatments at 60, 90, 120 DAS except at 30 DAS. The maximum number tillers per plant at 30, 60, 90 and 120 DAS was recorded in T_4 (42 cm depth of tillage) which was 4.33, 7.66, 7.66 and 7.66 respectively. The minimum number of tillers per plant at 30, 60, 90 and 120 DAS was found in T_1 (12 cm depth of tillage) which was 2.66, 5.66, 6.33 and 6.33 respectively. The favorable soil condition in tillage treatment with optimum bulk density facilitated proper aeration, nutrient uptake and root development which in turn contributed towards vigorous growth of plant Yadav *et al.,* (2011) [13]. This may be due to deep tillage and better pulverization of soil. Similar findings reported in Amin *et al.,* (2013) [2].

3. Spike length (cm)

The spike length was recorded at maturity stage *i.e.* 120 DAS and the results of the data recorded and analyzed are depicted in Table 2.The result the data shows that the spike length was not significantly influenced as the depth of tillage increases among all treatments at 120 DAS. The maximum spike length (cm) was recorded in T_4 (42 cm depth of tillage) which was 9.5 cm. the minimum spike length (cm) was recorded in T_1 (12 cm depth of tillage) which was 8.66 cm. Spike length is a key factor contributing towards the yield of wheat. Higher the length of the spike higher would be the grains production per spike leading to higher yield. Positive physiological and metabolic activities of wheat were probably influenced by tillage operation. The results are in agreements with Singh *et al.,* (2007) [11].

4. Dry matter weight (g)

The dry matter weight was recorded at maturity *i.e.* 120 day after sowing and the results of the recorded and analyzed are depicted in Table 2. The of the data shows that then dry matter weight per plant was not significantly influenced by tillage practices among all the treatments. The maximum dry weight per plant (g) was recorded in T_4 (42 cm depth of tillage) which was 14.08 g. The minimum dry weight per plant (g) was found in T_1 (12 cm depth of tillage) which was 13.55 g. The potential of a crop to accumulate dry matter in its vegetative parts and it is due to the combined effects of all growth parameters like tillers per plant height. Similar results were reported by Islam *et al.,* (2011) [6].

5. Number of grains per spike

The number of grains per spike was recorded at harvest stage and results of the data recorded and analyzed are depicted in Table 2.The result of the data shows that the number of grains per spike was not significantly influenced as the depth of tillage increases among the treatments. The maximum number of grains per spike was recorded in T_4 (42 cm depth of tillage) which was 40.24 g. The minimum number of grains per spike was founded in T1 (12 cm depth of tillage) which was 43.5 g. The number of grains per spike is one of the most crucial yield determining component and has directly related to grain yield of wheat. These results are in line with findings of Gupta (2002) [5], Camara *et al.,* (2004) [4] who performed experiment to check effect of tillage on wheat and concluded that tillage might have influenced the number of grains per spike.

6. Grain yield (q ha^{-1})

The Grain yield was recorded at harvest and results of the data recorded analyzed are depicted in Table 2. The effects of

tillage depths on grain yield of wheat were found significant and varied among the treatments. The highest yield was found in T_4 (42 cm depth of tillage) which was 44.29q ha^{-1} and the lowest yield were obtained in T_1 (12 cm depth of tillage) which was 36.48 q ha^{-1}. Higher tillage depth favorably influenced the soil water plant ecosystem, there by improved crop yields Ardell *et al*., (2000); Ranjan *et al*., (2006) [8]; Jabro *et al*., (2010) [7] which is in agreement with the present findings.

7. Test weight 1000 grains (g)

The results of the data recorded and analyzed for 1000 grains weight are depicted in Table 2. The test weight was significantly found to be influenced by the different depth of tillage and varied among the treatments. The results show that the 1000 grains weight increases. The maximum 1000 grains weight (g) was found in (42 cm depth of tillage) which was 41.72 g and the minimum 1000 grains weight (g) were obtained in T_1 (12 cm depth of tillage) which was 39.12 g. This might be due to exposure of roots to absorb more moisture and nutrients in deep tillage practices. As a result, wheat at grain filling stage does not suffer from water shortage. These results are similar to the findings reported by Weiqiang *et al.,* (2004) [12].

Table 1: Effect of deep tillage practices on plant height (cm), No. of tillers $plant^{-1}$ at 30, 60, 90 and 120 (DAS)

	Plant Height (cm)				Number of tillers per plant			
Treatments	**30 (DAS)**	**60 (DAS)**	**90 (DAS)**	**120 (DAS)**	**30 (DAS)**	**60 (DAS)**	**90 (DAS)**	**120 (DAS)**
T_1	17.6	54.25	94.38	94.38	2.66	5.66	6.33	6.33
T_2	17.73	54.65	95.76	95.76	3.66	6.33	6.66	6.66
T_3	17.74	56.78	96.46	96.46	4	6.66	7	7
T_4	18.25	56.78	97.36	97.36	4.33	7.66	7.66	7.66
F-test	S	S	S	S	NS	NS	NS	NS
S.Em.	0.066	0.058	0.146	0.146	-	-	-	-
C.D. at 5%	0.234	0.205	0.514	0.514	-	-	-	-

Table 2: Effect of deep tillage practices on spike length, Dry matter (WT), No. of grains $spike^{-1}$, Grain yield, Test weight of 1000 grains at maturity (120 DAS)

Treatments	Spike length (120 DAS)	Dry matter weight (g)	Number of grains per spike	Grain yield (q ha^{-1})	Test weight 1000 grains (g)
T_1	8.666667	13.55	40.24333	36.48667	39.12667
T_2	9.166667	13.86667	41.84333	38.02	40.50333
T_3	8.7	13.78333	41.24333	43.23	41.08667
T_4	9.4	14.08333	43.5	44.29667	41.72333
F-test	S	NS	S	S	S
S.Em.	0.129	-	0.172	0.352	0.159
C.D. at 5%	0.457	-	0.608	1.243	0.569

Conclusion

Deep tillage posses many advantages for farmers. It breaks up high density soil Layers, improves the physical condition of the soil, deep tillage in clay soils often benefits both the crop roots and drainage of the soil and thus may overcome both moisture deficit problems during the dry season and problems of excessive moisture during the rainy season, it enhances the nutrient availability. It make the plants to explore the entire soil volume for water and nutrients, it improves water infiltration and movement in the soil it increases the water use efficiency, it enhances the root growth and development, it alters population of weed seed bank, it brings down the past and pathogen incidence and it increases crop yields.

It was concluded from the study that deep tillage have improved the soil physical environment, made the soil softer indicated by increased the moisture retentive capacity of soil and ultimately favored increased yield of wheat and brought maximum net profit. However, on the basis of one season experimental results, recommendation cannot be made; hence further researches on this aspect need to be done for recommendations to the farmers.

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