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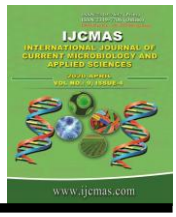

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Effect of Tillage and Weed Management Practices on Soil Physico-Chemical Characteristics and Wheat Economics

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A B S T R A C T

Tillage and weed management practices affect physico-chemical characteristics of soils. Therefore, a field study was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, during *rabi*season 2017-18 with two tillage practices i.e., conventional tillage (CT), Zero tillage (ZT) and three weed management practices i.e., Clodinafop+ Metsulfuron (60+4 g ha^{-1}) RM, Clodinafop+ Metsulfuron (60+4 g ha^{-1}) RM *fb* 1 hand weeding and One hand weeding (45DAS). Effect of these treatments was observed on soil pH, electrical conductivity (EC), bulk density, soil organic carbon content (SOC), and Av. N, P, K and Zn. Among tillage practices, the mean highest SOC was found under ZT+R (3.7 g kg^{-1}) followed by ZT (3.5 g kg^{-1}) and lowest under CT (3.3 g kg^{-1}) for soil and weed management was found under Clodinafop + metsulfuron @ 60+4 g ha^{-1} (30 DAS) *fb* 1 hand weeding (45 DAS) 3.6 (g kg^{-1}) followed by Clodinafop+ metsulfuron@ 60 +4 g ha^{-1} (30 DAS) 3.6 (g kg^{-1}) Mean highest Av. N, P, K and Zn (kg ha^{-1}) was observed under ZT+R (170.33), (16.64) , (282.24) and (7.02) and the lowest under CT 149.67(kg ha^{-1}), (14.62) (kg ha^{-1}), (248.00) (kg ha^{-1}) and (6.17) ppm for soil and weed management was found under Clodinafop + metsulfuron @ 60+4 g ha^{-1} (30 DAS) *fb* 1 hand weeding (45 DAS) 162.60 (kg ha^{-1}), 15.89 (kg ha^{-1}), 269.43 (kg ha^{-1}) and 6.70ppm. Effect of tillage and weed management practices on soil pH, EC and bulk density was not significant in the soils.

Introduction

Wheat (*Triticum aestivum* L.) is a staple food of the world and belongs to family Poaceae (Gramineae). It is a C3 plant primarily grown in temperate regions and also at higher altitude under tropical climatic areas in winter season. Wheat is the single most important cereal crop that has been considered as integral component of the food security system of the several nations. It has been described as the 'King of cereals' because of the acreage and high productivity which also occupies a prominent position in the international food grain trade.

Tillage has been part of most agricultural systems throughout history because it achieves many agronomic objectives (e.g., seed bed preparation, soil conditioning, weed suppression and residue management). But, the excessive tillage practices adversely affect soil health, crop productivity and environment quality by affecting soil structure, soil carbon loss and emission of greenhouse gases (*Beare et al.,* 1994).

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It has been described as the 'King of cereals' because of the acreage and high productivity which also occupies a prominent position in the international food grain trade. Wheat provide nearly 55% of the carbohydrate and 20% of food calories which is consumed by two billion people (36% of the world population) as staple food. Canada, Australia, Pakistan, Turkey, UK, Argentina, Iran and Italy. These countries contribute about 74.82% of the total world wheat production. Modified tillage and crop establishment practices are being advocated for improving resource use efficiency and crop productivity in diversified cropping system. Technologies such as zero tillage, conservation tillage and residue management have been fallowed in different crop for conserving resources improving yield and soil health.

Wheat (*Triticum aestivum L emend. Fiori & faol) is the most important crop* globally and has received the highest attention for development and promotion of such technologies. In India it is grown on 26 million hectare largely under irrigated conditions following intensive tillage operations.

Zero tillage allow early sowing of wheat reduces the cost of the production. In zero tillage, the crop are shown with minimum disturbance of soil by placing the seed in narrow slit 3-4 cm wide and 4-7 cm deep without land preparation, this optimizes tillage operation, saves water, reduce lodging and ensures better fertilizer use. The weed are major constraints in the adoption of zero tillage technology in Wheat. Although zero tillage reduce the infestation of *Phalarisminor,* it aggravates the problem of broad leaved weed (*Monsef et al.,* 2016). Effective weed control is important not only to check the yield losses due to weed but also to reduce the nutrient losses.

Optimizing tillage, crop establishment and weed management practices through is essential for improving resource use efficiency and improving soil health. Integrated weed management practices (herbicide + hand weeding) control effective weed in wheat and improve the soil health by entering sun light aeration and enhancing micro flora in soil.

Materials and Methods

The study was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, during *rabi*season 2017-18 and the geographical location of Ayodhya district lies between latitude 42.470 and 25.560 North and longitudes 18.120 and 83.980 East and at an altitude of 113 meters in the Gangatic alluvium of Eastern Uttar Pradesh. The experiment involved Tillage and residue management (Main plot) five treatment M1 CT (Transplanted), M2 CT (Transplanted), M3 CT (Direct seeded), M4 ZT (Direct seeded) M5 ZT (Direct seeded)+R and three Weed management (Sub plot) W1 Clodinafop+ Metsulfuron (60+4 g ha^{-1}) RM W2 Clodinafop+ Metsulfuron (60+4 g ha^{-1}) RM *fb* 1 hand weeding W3 One hand weeding (45DAS) Plots were 11 m long and 3 m wide.

The weekly mean minimum and maximum temperatures during the crop season were ranged from 4.7 to 17 0C and 13.80C to 35.200C, total rainfall received was 00.00 mm during the entire crop season Relative humidity, and sunshine hours were found to varied from 54.4 to 85.6 per cent, and 0.50 to 7.1 hours, respectively. That weekly mean minimum and maximum temperatures during the crop season were ranged from 4.7 to 17 0C and 13.80C to 35.200C, total rainfall received was 00.00 mm during the entire crop season Relative humidity, and sunshine hours were found to Varied from 54.4 to 85.6 per cent, and 0.50 to 7.1 hours, respectively. Soil pH was determined (1:2 soil: water suspension) using a pH meter fitted with a calomel glass electrode (Model Elico LI 127). EC of 1:2 soil: water supernatant (kept overnight) was estimated using a solubridge (model Systronic Conductivity Meter 304). Oxidizable soil organic carbon was estimated using (Walkley and Black 1934) rapid titration method, using a diphenyl amine indicator. Alkaline $KMnO_4$ (potassium permanganate) method as described by *Subbiah* and *Asija* (1956) was used to determine available nitrogen in soil samples. Available phosphorus was determined by extracting the soil samples with 0.5 M $NaHCO_3$, pH 8.5 (*Olsen et al.,* 1954) and measuring the P content in the extract by colorimetric method using a spectrophotometer at 760 nm wavelength using ascorbic acid method.

Available potassium content in soil was estimated by extraction of soil with neutral 1N NH4OAc solution of potassium in the extract was determined using flame photometer as described by *Page et al.,* (1982). Normal sodium acetate (NaOAc) (pH 8.2) was used to determine the CEC of the soils following the procedure of Bache (1976).

Results and Discussion

Available nutrients N, P, K and Zn (kg ha-1)

The result is indicated that the tillage and weed management practices cause significant effect on available nitrogen, phosphorus, potassium and zinc content. Maximum available N (170.33 kg ha^{-1}), P (16.64 kg ha^{-1}), K (282.4 kg ha $^{-1}$) and Zn (7.02 ppm) were observed Under M5 (ZT+R) treatment where zero tillage + residue were applied in the experimental field.

All the growth, yield attributes and grain and straw yield as affected with the adaptation of various tillage system weed control measures, maximum nutrient contents were recorded under T5 (ZT-ZT) treatments this was mainly due to better soil health (addition of organic matter into soil and Corban sequestration). Maximum uptake of nutrients (N P & K) was observed under conventional tillage system.

It was mainly due to Increase in grain and straw yield of wheat under CT-CT treatment, conventional tillage manage the good cultivation technique, environmental condition into soil. The above finding was also related with the Neugsehwandtner *et al.*, (2014) and Kumar *et al.*, (2017) Weed control management did not any significant effect on content the nutrients (N P & K) while with nutrients uptake were affected significantly, maximum content and uptake of nutrients were observed with W2 treatment where redimix herbicide +one hand weeding applied. This was mainly due to effective herbicide and inter culture operation. They provide better environment condition for absorption of nutrients, herbicide check the weed intensity and inter culture operation enhance the appearance of aeration and sun light into soil. The results are agreement with the Gangwar *et al.*, (2004), Neugsenwandtner (2014), Martineg *et al.*, (2016) (Table 1).

Soil health (Physico-chemical properties of soil after harvesting the wheat)

Data regarding Physico-chemical properties of soil after harvesting the wheat crop have been presented in table 1. Better improvement in soil health was observed with M5 (ZT+R) treatment where zero tillage + residue were applied in the experimental field. Maximum organic Corban (3.7g kg^{-1}) were observed Under M5 (ZT+R) treatment. While bulk density (1.50 mg m-3), pH (8.00) and EC (0.21 dSm-1) was recorded minimum with this treatment (M5) (ZT+R) as compared to the rest of the treatment. Weed management practices did not found significantly on the soil health (Physico-chemical properties of soil) slightly improvement was recorded with the W2 (redimix herbicide + one hand weeding) treatment silt loam texture was recorded in all the treatments.

Table.1 Available nutrients N, P, K and Zn (kg ha^{-1})

Treatments	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	Zn (ppm)
Tillage system				
M_1 (CT)	149.67	14.62	248.00	**6.17**
M_2 (ZT)	161.33	15.76	267.33	**6.65**
M_3 (CT)	155.67	15.21	257.94	**6.41**
M_4 (ZT+R)	166.33	16.25	275.61	**6.85**
M_5 (ZT+R)	170.33	16.64	282.24	**7.02**
SEm±	1.88	0.19	3.12	**0.08**
CD at 5%	6.59	0.67	10.92	**0.28**
Weed management				
W_1Clodinafop+metsulfuron @ 60 +4 g ha^{-1} (30DAS)	160.60	15.69	266.11	**6.62**
W_2-Clodinafop + metsulfuron @60+4 g ha^{-1} (30 DAS) *fb* 1 hand weeding (45 DAS)	162.60	15.89	269.43	**6.70**
W_3- 1 hand weeding (45 DAS)	158.80	15.51	263.13	**6.54**
SEm±	1.63	0.16	2.71	**0.07**
CD at 5%	**4.72**	**0.48**	**7.82**	**0.20**

Table.2 Effect of tillage and weed management practices on bulk density and texture classes after harvesting of wheat

Treatments	Bulk density (mg m^{-3})	Texture Classes
Tillage system		
M_1 (CT)	1.54	**Silt loam**
M_2 (ZT)	1.51	**Silt loam**
M_3 (CT)	1.54	**Silt loam**
M_4 (ZT+R)	1.57	**Silt loam**
M_5 (ZT+R)	1.59	**Silt loam**
SEm±	0.019	**Silt loam**
CD at 5%	NS	**Silt loam**
Weed management		
W_1- Clodinafop+ metsulfuron@ 60 +4 g ha^{-1} (30 AS)	1.52	**Silt loam**
W_2-Clodinafop + metsulfuron @ 60+4 g ha^{-1} (30 DAS) *fb*1 hand weeding (45 DAS)	1.51	**Silt loam**
W_3- 1 hand weeding (45 DAS)	1.51	**Silt loam**
SEm±	0.016	**-**
CD at 5%	**NS**	**-**

Table.3 Effect of tillage and weed management practices on pH, EC and organic carbon after harvesting of wheat

Treatments	pH (1:2.5)	EC (dSm^{-1})	O C (g kg^{-1})
Tillage system			
M_1 (CT)	8.16	0.23	**3.3**
M_2 (ZT)	8.13	0.23	**3.5**
M_3 (CT)	8.16	0.23	**3.4**
M_4 (ZT+R)	8.10	0.22	**3.7**
M_5 (ZT+R)	8.00	0.21	**3.7**
SEm±	0.11	0.09	**0.03**
CD at 5%	NS	NS	**NS**
Weed management			
W_1- Clodinafop+ metsulfuron@ 60 +4 g ha^{-1} (30 DAS)	8.14	0.23	**3.5**
W_2-Clodinafop + metsulfuron @ 60+4 g ha^{-1} (30 DAS) *fb* 1 hand weeding (45 DAS)	8.12	0.21	**3.6**
W_3- 1 hand weeding (45 DAS)	8.17	0.22	**3.5**
SEm±	0.09	0.09	**0.02**
CD at 5%	**NS**	**NS**	**NS**

Table.4 Effect of tillage and weed management practices on economics of wheat

Treatment combination	Total cost of cultivation (₹ ha^{-1})	Gross income (₹ ha^{-1})	Net return (₹ ha^{-1})	B-C ratio
T1W1	35202	101499	66297	**1.88**
T1W2	38682	106058	67376	**1.74**
T1W3	36722	97330	60608	**1.65**
T2W1	31902	75546	43644	**1.37**
T2W2	35382	79190	43808	**1.24**
T2W3	33422	71020	37598	**1.12**
T3W1	35202	96819	61617	**1.75**
T3W2	38682	98859	60177	**1.56**
T3W3	36722	94762	58040	**1.58**
T4W1	31902	82092	50190	**1.57**
T4W2	35382	86608	51226	**1.45**
T4W3	33422	77716	44294	**1.33**
T5W1	31902	87795	55893	**1.75**
T5W2	35382	92204	56822	**1.61**
T5W3	**33422**	**84470**	**51048**	**1.53**

Tillage system affected the Physico-Chemical properties of soil basically after harvesting the wheat crop but effect was non-significant on bulk density, soil texture, pH, EC and organic Corban while availability was slightly significant on nutrients. Maximum improvement in soil health were observed under M5 (ZT+ZT) followed by M4 (ZT+R), M2 (ZT), M3 (CT) and M1 (CT) treatments respectively. This was mainly due to changing of soil health in soil profile. Tillage intensities being continuous applied for five year, organic Corban-sequestration accumulated system in soil under zero tillage system. Soil fertility slightly influenced /improved in soil profile where the long term zero tillage practices had been maintained. Similar result were also reported by diek (1982), six *et al.*, (1999), Kumar *et al.*, (2016) and 2017, respectively.

Among the weed control management comparative effect of redimix herbicide + one hand weeding treatment was observed as compared to rest of the treatments. Slightly improvement in soil health was recorded under W2 treatment. Clodinofop+ metsulfuron+ one hand weeding check the weed density and promote aeration and pulverization in soil, it involves a bit of rhizosphere soil mixing and this can contributes to enhance microbial activities. The above finding were also agreement with the Dick *et al.*, (1982) six *et al.*, (1999), Kumar *et al.*, 2016 and 2017(Table 2 and 3).

Effect on economics

The maximum net return of Rs. (67376) was obtained with M1W2 (CT, clodinofop + metsulfuron 60+4 g ha^{-1}) treatment combination while B:C ratio was with M1W1(CT, clodinofop + metsulfuron @ 60+4 g ha^{-1} fb one hand weeding (1.88). Least total cost of cultivation was observed Rs. (31902) with M5W1 (ZT+R clodinafop +metsulfuron 60+4 g ha^{-1}) treatment. Conventional tillage system was not found economically superior than zero tillage it was due high labour and field preparation cost Conventional tillage system gave better net return per rupee investment, this was mainly due to higher grain and straw yield to greater extent as compared to zero tillage

system. The results are agreements with- Dick *et al.*, (1982, Gangwar *et al.*, (2004), Verma and Srivastav (1989), Mishra and Singh (2012), Gopinath *et al.*, (2007, Neugsehwandtner *et al.*, (2014) (Table 4).

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