Indian Journal of Weed Science **48**(2): 220–221, 2016
DOI: 10.5958/0974-8164.2016.00054.X

Short communication

Effect of tillage and herbicides on rhizospheric soil health in wheat

Raj Kumar*, R.S. Singh, Jai dev and B.K. Verma
Department of Agronomy, Narendra Dev University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh 224 229

Received: 5 April 2016; Revised: 8 June 2016

Key words: Free-living nitrogen fixing bacteria, Phosphate solubilising bacteria, Soil biomass carbon, Soil respiration, Percent root colonization, Phosphate solubilising bacteria

Adoption of intensive cropping systems has resulted in a long-scale use of agro chemicals. Weeds as one of the groups of pest are the major biological constraint, and lack of suitable eco-friendly weed control alternatives has led to increase in reliance on herbicides in many crops. Generally herbicides are not harmful when applied at recommended rates (Selvamani and Sankaran 1993) but some herbicides may affect non-target organisms including microorganisms (Shukla 1997). These effects on non target organisms may reduce the performance of important and critical soil functions such as organic matter decomposition, nitrogen fixation and phosphate solubilisation which support the soil health, plant growth and in turn crop productivity. Therefore, knowledge about effects of long-term application of herbicide on soil microbes is highly essential. Hence, present investigation to study the long-term effect of different tillage systems and application of herbicides for rice-wheat cropping systems in wheat crop was carried out to find effect on physic-chemical and microbial properties in the rhizosphere soil.

Field experiment was conducted during 2012-13 in rice-wheat cropping system at Narendra Dev University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh. The main plot treatments included tillage system, *viz*. Zero- zero tillage (Z-Z tillage), zero-conventional tillage (Z-C tillage), conventional-zero tillage (C-Z tillage), conventional-conventional tillage (C-C tillage) while the sub-plot treatments included weed management measures such as hand weeding at 35 and 55 DAS, isoproturon 1.0 kg/ha + 2,4-D + 1 HW (45 DAS) and weedy check. Rhizospheric soils were collected randomly from the top layers of the soil depth (0-15 cm) from each plot at 50 DAS and at harvest for rhizospheric soil health studies from experimental field during *Rabi* season 2012 using standard methods.

***Corresponding author:** rkpnduat@gmail.com

Effect of tillage system

Establishment methods had no significant effect on physico-chemical and microbial properties at 50 DAS, and at harvest stages. Among various tillage systems, slight improvement in physico-chemical and microbial properties was observed under zero tillage as compared to conventional tillage. This was mainly due to slight improvement in organic carbon percentage.

At 50 DAS, maximum free-living 'N' fixing bacteria (FLNFB), phosphate solubilizing bacteria (PSB), soil biomass carbon (SBC), soil respiration and enzyme activities (acid –P, alkaline-P and dehydrogenase) was recorded in Z-Z tillage (11.72 c.f.u. x 10^4/g, 11.50 c.f.u. x 10^4/g, 112.75 µg, 93.21 µgp- NP/h/g and 15.12 µg TPF/h/g). Similar trend were also recorded at harvest (Table 1). Maximum beneficial micro organisms were recorded at harvest stage. It may be due to improvement in physico-chemical and biological properties of soil.

Effect of weed control measures

Weed control measures did not affect soil properties. However, significant variations were observed in microbial properties between two hand weeding and herbicides (isoproturon 1.0 kg/ha + 2, 4-D + 1 HW). This was mainly due to herbicide effect. Maximum microbial properties *i.e*. FLNFB (12.50 cfu × 10^4), PSM (11.55 cfu × 10^4), SBC (113.11 µg), SR (60 mg per 100 soil/d), PRC (14), Acid-P (94.11 µgp-NP/h/g), alkaline-P (164.20 µgp-NP/h/g) and DHA (18.52 µg) was observed in two hand weeding. Among various weed control measures, maximum microbial population was recorded in hand weeding and minimum in herbicide treated plots. Hand weeding always promotes aeration in soil, it involves a bit of rhizosphere soil mixing and this can contributes to enhanced microbial activities. While Bhale *et al.*(2012) reported that hand weeding allows pulverization of soil and better soil aeration which ultimately increase the microbial population in the soil.

Table 1. Effect of establishment methods and weed management practices on soil microbial properties of rhizospheric soil of wheat

Treatment	50 DAS								At harvest						
	FLNFB	PSM	SBC	SR	PRC	Acid P	Alkaline P	DHA	FLNFB	PSM	SBC	SR	Acid P	Alkaline P	DHA
Tillage system															
Z-Z	11.7	11.5	112	0.55	13.0	93.2	158	15.1	17.5	13.9	104	0.48	90.0	153	15.5
Z-C	11.5	10.9	112	0.54	11.5	92.7	157	15.1	15.8	13.7	102	0.45	80.5	154	14.9
C-Z	10.4	10.0	111	0.52	11.3	92.2	162	15.0	15.7	12.2	100	0.45	85.7	155	14.0
C-C	10.5	10.5	111	0.54	12.0	91.0	161	14.5	15.1	13.5	100	0.48	88.0	157	14.7
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Weed control															
HW at 35 and 55 DAS	12.5	11.5	113	0.60	14.0	94.1	164	18.5	15.1	14.0	110	0.62	92.2	160	16.0
Isoproturon 1.0kg/ha + 2,4-D + 1 HW (45 DAS)	10.1	9.2	103	0.57	10.5	87.2	152	12.1	13.0	12.2	107	0.58	90.1	157	12.5
Weedy check	10.2	10.0	105	0.53	10.1	89.5	155	13.0	13.2	12.3	106	0.51	90.3	152	10.1
LSD (P=0.05)	1.20	1.25	6.50	0.14	2.20	3.50	6.50	1.27	NS	NS	NS	0.15	NS	5.90	1.37

PSM- P-solubilizing microorganism (c.f.u. x 10^4/g); Acid P -Acid -phosphate activity (µgp-NP/h/g); Alkaline P -Alkaline -phosphate activity (µgp-NP/h/g); SBC –Soilbiomasscarbon (µg); DHA - De-hydrogenase activity (µg TPF/h/g); SR - Soil respiration (mg CO_2 per 100 soil/d); PRC - Percent root colonization

Further results revealed that isoproturon + 2,4-D applied in wheat under rice-wheat cropping system did not leave any residual harmful effect on physico-chemical and microbial properties of the soil.

It was concluded that various tillage system and weed control measures in wheat crop did not leave any harmful residual effect on physico-chemical and microbial properties of the soil.

SUMMARY

Four tillage systems *viz.* (i) zero–zero tillage (ii) zero-conventional tillage (iii) conventional-zero tillage (iv) conventional–conventional tillage systems were evaluated on the survival and growth of free living nitrogen fixing bacteria, total phosphate solubilising bacteria, soil biomass carbon, soil respiration, per cent root colonization and enzymic activities in rhizospheric soil. Among weed control measures, comparative effects of hand weeding and recommended herbicides (isoproturon at 1.0 kg/ha + 2,4-D + 1 HW (45 DAS) were tested along with weedy check. The results revealed that tillage systems did not influence microbial soil health. The maximum growth of different micro organisms was observed in zero tillage system, whereas minimum was in conventional tillage system. There were no adverse effects of recommended herbicide use on soil microbial health. Application of isoproturon + 2,4-D had no adverse effect on rhizosphreric soil health of wheat crop.

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