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Short communication

Tillage practices effects on winter crops weeds density and growth under rice based cropping system

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Rice-based cropping systems are most predominant in India. Out of 139.9 million hectare (Mha) net cropped area, about 53% is rainfed and it produces almost 45% of food grains, 75-85% of pulses and oilseeds and significant amount of important industrial crops. Weeds are considered as one of the major limiting factors for efficient crop production in rainfed areas. Changes in tillage practices can cause shifts in weed species and densities. However, very little attention was given to understand effect of tillage practices on weed populations, as such information could be used to reduce populations of troublesome weed species (Peachey *et al*. 2006). So far much emphasis has been given on studying crop yields, weed emergence pattern and seed bank dynamics comparing zero tillage (ZT) and other conservation tillage practices with conventional tillage (CT) in rice based cropping systems across the world. However, meager efforts have been made on managing weed problem and improving yields by imposing diverse crops and designed tillage sequences within a cropping system. The present study was undertaken with the aim to understand effects of tillage practices on weed population in winter (*Rabi*) crops under rainfed rice based cropping system of Chhattisgarh.

A field experiment involving 4 tillage practices and 6 different *Rabi* crops was undertaken at Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) during *Rabi* winter season of 2014-15. Geographically, Raipur is situated in the centre of Chhattisgarh and lies between 210 16' N latitude and 810 36' E longitudes with an altitude of 298 m above the mean sea level (msl). The climatic condition of Raipur is sub-humid to semi-arid and receives average annual rainfall of 1325 mm. Soil sampling from the experiment field were taken with the help of a tube auger from 10 different points of the plots before starting of field experiment and were subsequently processed for further analysis for soil quality parameters. The analyzed soil indicated sandy loam texture and had pH (6.6), bulk density (1.48 g/cm^3), organic carbon (0.72%) and available NPK (219.14, 16.70 and 322 kg/ha, respectively).

The experiment was laid out in strip plot design with three replications. The treatment consisted of four tillage practices *viz.* zero tillage (ZT) direct-drilling of seeds and fertilizers at 2nd days after harvesting (DAH) of rice, minimum tillage (MT) and line sowing of seeds and fertilizers at 3rd DAH of rice, MT and line sowing of seeds and fertilizers at 6th DAH of rice, farmer practice-broadcasting seeds and fertilizer at 12th DAH of rice in horizontal strips and six *Rabi* crops *viz.* buckwheat, chickpea, lathyrus, safflower, linseed and toria in vertical strips. The varieties of crops namely *Fagopyrum esculentum* (buckwheat), *Cicer aeritinum* (chickpea), *Lathyrus sativus* (lathyrus), *Carthamus tinctorius* (safflower), *Linum usitatissimum* (linseed) and toria were *JG-14*, *Prateek*, *Bhima*, *RLC-92* and *Indira Toria–1*, respectively. The sowing of crops such as buckwheat, chickpea, *Lathyrus*, safflower, linseed and *Toria* was done on 31st October, 1st, 4th and 10th November 2014, respectively. All recommended package of practices of each crop were adopted during study period. During crop growth period, the maximum temperature varied between 25 ^{0}C to 37.3 ^{0}C with bright sunshine hours of 3 to 9.8 per day while**,** the minimum temperature ranged between 8 ^{0}C to 21.5 ^{0}C. The maximum and minimum relative humidity during the crop period was recorded 94 and 22%, respectively. A total of 11.7 mm rainfall was also received during the crop period. Weed parameters were recorded at 30, 60, 90 days after sowing (DAS) and at harvest. Weed growth, density and biomass were recorded with the help of one m^2 quadrate and oven drying, recorded data were subjected to square root transformation *i.e.* $\sqrt{x+0.5}$

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The data obtained from various characters under study were analyzed by the method of analysis of variance as described by Gomez and Gomez (1984).

Effect on weed density and biomass

Tillage practices and crops showed significant influence on weed density at almost all the growth stages (**Table 1**). Significantly lowest weed density (41.8, 48.8, 52.5 and 49.3 at 30, 60, 90 DAS and at harvest, respectively) was recorded with ZT direct drilling of seeds and fertilizers at 2nd days after harvesting (DAH) of rice. However, highest weed density (246.7, 216.2, 191.4 and 157.2 at 30, 60, 90 DAS and at harvest, respectively) was recorded under minimum tillage (MT) and line sowing of seeds and fertilizers at 3rd DAH of rice. Sangwan *et al.* (2008) also observed higher weed emergence and density under conventional method of sowing than ZT. *Rabi* crops also significantly influenced weed density at all the growth stages except 30 DAS. Lowest weed density among the tested crops was observed under safflower (119.75, 99.23 and 73 at 60, 90 DAS and at harvest, respectively), which was at par with *Lathyrus*. Highest weed density was recorded with buckwheat (141, 144.4 and 133.3 at 60, 90 DAS and at harvest, respectively). It was also observed that maximum numbers of recorded weed species were annuals.

Tillage practices and *Rabi* crops showed significant influence on weed biomass at all the growth stages **(Table 2)**. Among the tillage practices, significantly lowest weed biomass (1.36, 3.93, 8.92 and 11.12 g/m^2 at 30, 60, 90 and harvest stage, respectively) was recorded under ZT direct-drilling of seeds and fertilizers at 2nd DAH of rice. Whereas, highest weed biomass, *viz.* 9.23, 16.6, 33.5 and 37 g/m^2 at 30, 60, 90 and harvest stage, respectively was recorded under MT and line sowing of seeds at 3rd DAH of rice. The highest weed biomass recorded under MT and line sowing of seeds at 3rd DAH of rice was due to presence of higher weed population. In contrary to our observations, Monsefi *et al.* (2014) observed higher weed biomass in ZT than conventional tillage (CT) system. Similar to tillage practices, crops also significantly influenced weed biomass across the growth stages. Significantly lowest biomass was observed with safflower (4.8, 8.52, 20.33 and 23.88 g/m^2 at 30, 60, 90 and harvest stage, respectively), which was at par with linseed and *Toria* at 30 DAS, *Lathyrus* and *Toria* at 90 DAS and *Lathyrus*, chickpea and Toria at harvest stage.

Weed growth rate (g/day/m^2)

The weed growth increased in significant proportion up to 90 DAS and thereafter decreased (**Table 2**). Among the tillage practices, significantly highest weed growth rate (0.048, 0.083 and 0.09 g/day/m^2 at 60, 90 DAS and at harvest, respectively) was noted under MT and line sowing of seeds at 3rd DAH of rice. While, lowest weed growth rate (0.037, 0.050 and 0.05 g/day/m^2 at 60, 90 DAS and at harvest, respectively) was observed under ZT direct drilling of seeds and fertilizers at 2nd DAH of rice. These results were corroborated with the findings of Malik *et al.* (2000). With respect to *Rabi* crops, highest weed growth rate was recorded under toria throughout crop growth period and lowest weed growth rate was recorded in lathyrus (0.032g/day/m^2) at 60 DAS and safflower (0.064 and 0.005 g/day/m^2) at 90 DAS and at harvest stage, respectively.

Table 1. Effect of tillage practices and *Rabi* crops on weed density in rainfed rice based cropping system of Chhattisgarh

Treatment	Weed density (no. of weed/m^2)			
	30 DAS	60 DAS	90 DAS	At harvest
Tillage practice				
ZT direct drilling of seeds and fertilizers at 2nd days after harvesting (DAH) of rice,	6.51 (41)	7.02 (49)	7.28 (52)	7.06 (49)
MT and line sowing of seeds and fertilizers at 3rd DAH of rice	15.72 (247)	14.72 (216)	13.85 (191)	12.56 (157)
MT and line sowing of seeds and fertilizers at 6th DAH of rice	13.84 (191)	12.66 (160)	12.75 (162)	11.78 (138)
Farmer practice-broadcasting seeds and fertilizers at 12th DAH of rice	10.70 (114)	9.97 (99)	10.43 (108)	10.38 (107)
LSD (p=0.05)	4.98	4.12	4.42	4.23
Rabi crop				
Fagopyrum esculentum	12.38 (152)	11.90 (141)	12.04 (144)	11.57 (133)
Cicer aeritinum	12.37 (152)	11.46 (131)	11.48 (131)	11.4 (129)
Lathyrus sativus	12 (143)	11.76 (124)	10.43 (108)	9.04 (81)
Carthamus tinctorius	11.98 (143)	10.97 (119)	9.99 (99)	8.57 (73)
Linum usitatissimum	12.06 (145)	11.45(130)	11.88 (141)	10.97 (119)
Brassica campestris	12.41 (153)	11.82 (139)	12.18 (148)	11.92 (141)
LSD (p=0.05)	NS	9.99	9.10	7.85

*Square root transformed values ($\sqrt{x+0.5}$), original values are in parentheses

Table 2. Effect of tillage practices and *Rabi* crops on weed biomass and growth rate in rainfed rice based cropping systems of Chhattisgarh

Treatment	Weed biomass (g/m^2)				Weed growth rate (g/day/m^2)		
	30 DAS	60 DAS	90 DAS	At harvest	60 DAS	90 DAS	At harvest
Tillage practice							
ZT direct drilling of seeds and fertilizers at 2nd days after harvesting (DAH) of rice	1.36 (1.36)	2.10 (3.93)	3.07 (8.92)	3.41 (11.12)	0.037	0.050	0.0055
MT and line sowing of seeds and fertilizers at 3rd DAH of rice	3.12 (9.23)	4.13 (16.58)	5.83 (33.48)	6.12 (37)	0.048	0.083	0.0090
MT and line sowing of seeds and fertilizers at 6th DAH of rice	2.57 (6.12)	3.45 (11.4)	5.42 (28.93)	5.8 (33.15)	0.039	0.078	0.0084
Farmer practice-broadcasting seeds and fertilizers at 12th DAH of rice	2.16 (4.17)	2.77 (7.18)	3.96 (15.19)	4.45 (19.31)	0.037	0.056	0.0060
LSD (P=0.05)	0.18	0.33	0.70	0.84	NS	0.008	0.0016
Rabi crop							
Fagopyrum esculentum	2.48 (5.67)	3.38 (10.94)	4.88 (23.34)	5.21 (26.65)	0.042	0.068	0.0063
Cicer aeritinum	2.49 (5.7)	3.33 (10.6)	4.74 (21.98)	5.13 (25.82)	0.040	0.067	0.0079
Lathyrus sativus	2.46 (5.54)	3.13 (9.27)	4.6 (20.65)	4.97 (24.17)	0.032	0.067	0.0076
Carthamus tinctorius	2.30 (4.8)	3 (8.52)	4.56 (20.33)	4.94 (23.88)	0.039	0.064	0.0050
Linum usitatissimum	2.31 (4.84)	3.2 (9.71)	4.72 (21.78)	5.01 (24.61)	0.042	0.065	0.0080
Brassica campestris	2.30 (4.77)	3.18 (9.61)	4.71 (21.7)	5.12 (25.75)	0.046	0.069	0.0086
LSD (p=0.05)	0.39	0.71	1.63	1.87	0.013	0.007	0.0018

*Square root transformed values ($\sqrt{x+0.5}$), original values are in parentheses; DAS - Days after sowing

SUMMARY

This study was conducted with the aim to understand the effects of tillage practices and *Rabi* crops on weeds in rainfed rice based cropping system of Chhattisgarh. Significantly lowest weed density, biomass and weed growth rate across all the growth stages under ZT direct drilling of seeds and fertilizers at 2nd days after harvesting (DAH) of rice as compare to other tillage practices. Among the *Rabi* crops, significantly lowest weed density, biomass and weed growth rate at all the growth stages except 30 DAS were observed with safflower crop. The combination of ZT direct drilling of seeds and fertilizers at 2nd DAH of rice and safflower can be used for better management of weeds in rainfed rice based cropping system.

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