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Effect of varying tillage and sowing methods on weed dynamics under rice-wheat cropping system in Kymore plateau and Satpura hill zone of Madhya Pradesh

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ABSTRACT

Field experiments carried out in rice–wheat cropping system revealed that 29 weeds infested the rice crop and out of them 10 and 2 weed species were absent on 30th day and maturity stages, respectively. Total weed intensity was 116 weeds/m^2 at 15-30 day stage of rice, which was double (201 weeds/m^2) at maturity stage. Direct seeded rice had significantly higher weed intensity (143 and 226 weeds/m^2 at 30DAS and maturity stages, respectively) with the highest weed biomass of 5.55 q/ha at maturity stage than all other 3 tillage and sowing methods. Wheat crop was infested with 17 weed species out of which two species were absent at 30 DAS and maturity stages. The zero till wheat had significantly higher weed intensity (121 and 81 weeds/m^2 at 30 DAS and maturity stages, respectively) than other three tillage and sowing methods. The former had also significantly higher weed biomass than latter. The weed intensity was higher (95 weeds/m^2) at 30 DAS than that at maturity (59/m^2).

Key words - Cropping system, Weed biomass, Weed dynamics, Weed intensity

Rice–wheat cropping system is predominant under irrigated production system of north and central India, which covers about 10.5 mha in the country, particularly in Indo-Gangetic plains (Yadav *et al.* 1998). It is also prevalent in north, central and eastern parts of Madhya Pradesh even under rainfed production system because of good rainfall (1200-1500 mm). Both crop components under this cropping system are fertility exhaustive and need more labour, time, energy, cost and agro-inputs for their successful cultivation due to their high production potential. Serious weed infestation is major problem associated with this cropping system. The floristic composition of weeds in rice-wheat cropping system varies according to agro-climatic conditions and also depends on the tillage and sowing methods, cultural practices, irrigation and rainfall pattern *etc.* The information on weed dynamics has much concern for planning efficient weed management. Hence, efforts have been made in the present investigation to evaluate the weed dynamics of rice –wheat cropping system under varying tillage and sowing methods of both component crops.

MATERIALS AND METHODS

Field experiments were conducted at Krishi Nagar Research Farm, J.N. Krishi Vishwa Vidayalya, Jabalpur, (M.P.) during three consecutive years (2004-05 to 2006-07). The soil of the experimental field was sandy loam in texture and neutral in reaction (7.4 pH) with low in OC content (0.68%) and low in available N (210 Kg/ha) as well as P (9.6 Kg/ha) and medium in available K (308 Kg/ha) contents.

Sixteen treatments consisted of 4 tillage and sowing methods for both crop components under rice-wheat system were tested in a strip plot design with 3 replications. Tillage and sowing methods were P_1- direct drilled in dry field, P_2-direct seeding of sprouted rice seeds through drum seeder in puddle field, P_3 -manual transplanting and P_4-transplanting by self propelled transplanter (SPT) for rice cv. Kranti and T_1-conventional tillage and sowing, T_2-zero till sowing, T_3 -strip till sowing and T-bed planting for wheat cv. GW-273. A uniform dose of fertilizers ((120kg N+ 60kg P_2O_5+40 kg K_2O/ha)) was applied to both components crops along with other agronomic practices as per state recommendations.

Sowing of rice was done on the same day in case of all sowing methods *viz.*. direct seeding of rice (DSR) in dry field before onset monsoon under (P_1), sowing in nursery to get seedlings for transplanting (P_3 and P_4) and soaking of seeds to obtain sprouted seeds under (P_2). Sowing of wheat was done by different methods immediately after harvesting of preceding rice grown under

different tillage and sowing methods. The observations on weeds intensity were recorded at 30 DAS/DAT and maturity stages of both crops by using a quadrate (0.5 m^2) at 4 places in each plot and then species wise total intensity of weeds/m^2 were determined. The weed biomass also recorded at maturity stage of both crops.

RESULTS AND DISCUSSION

Floristic composition of weeds

Based on the data for 3 years, the species wise weed composition varied due to different tillage and sowing methods in both crop components under rice- wheat system due to the variations in crop stand establishment (Table 1). In all 29 weed species had shown their presence in rice with some minor weeds. The weeds infesting rice at 30 day growth stage were *Echinochloa colona* + *E. crusgalli* (30.8%), *Cyperus iria* (16.3%), *C.rotundus* (2.37%),*Scirpus latiflorus* (1.5%), *Eleusine indica* (0.64%), *Panicum repens* (2.3%), *Paspalum sanguinale* (10.1%), *Eclipta alba* (3.6%), *Ammannia baccifera* (9.0%), *Commelina communis* (3.87%), *Trianthema monogyna* (3.87%), *Digitaria ciliaris* (4.74%), *Alternanthera philoxeroides* +*A. sessilis* (7.9%) and *Ludwigia palustris* (2.5%) along with other minor weeds (4.31%). It was remarkable that *Elusine indica* was present only with DSR, at this stage, while *Scripus latriflorus, Alternanthera philoxeroides*, *Monochoria vaginalis* and *Marselia qudrifoliata* were absent with DSR. The intensity of *Scirpus latiflorus* (3.5%), *C.rotundus* (3.5%), *Eleusine indica* (0.74%), *Panicum repens (*4.8%), *Paspalum sanguinale* (12.2%), *Eclipta alba* (3.7%), *Digitaria adscendens* (4.90%), *Alternanthera philoxiorides* +*Alternanthera sessilis* (9.2%), *Ludwigia palustris* (3.0%), and other minor (10.5%), weeds increased at maturity stage of rice, while remaining weeds showed declining trend in their intensity. It was further noticed that some new weeds *viz. Cyperus defformis* (11.6%), *Fimbristylis miliacea* (6.4%),*Sahima nervosum* (3.4%), *Caesulia axillaries* (3.7%), *Monochoria vaginalis* (3.7%), *Cyanotis axillaries* (1.8%) and *Marselia qudrifoliata* (0.7%) had shown their severe infestation after 30 DAS/DAT stage of rice.

Total 17 weeds infested the succeeding wheat grown after harvest of rice with few other minor weeds. The common weeds infesting wheat at 30 DAS were *Phalaris minor* (6.8%), *Medicago* Spp. (34.0%), *Trifolium flagiferum* (5.7%), *Chenopodium album* (12.3%), *Melilotus indica* + *Melilotus alba* (4.1%), *Fumaria parviflora* (6.28%), *Spergula arvensis*(7.3%), *Anagallis arvensis* (5.49%), *Vicia sativa* (3.92%), *Lathyrus aphaca,*(1.0%), *Cyperus rotundus*(6.2%), *Cichorium intybus* (1.0%) and *Oldenlandia dichotoma* (3.9%) along with other minor weeds (3.66%). *P.minor, L.aphaca and Cichorium intybus,* disappeared after 30 DAS because of recommended weed control treatment. The intensity of almost all weeds declined considerably at maturity over their intensity at 30 DAS due to the effect of weed control practices performed in the crop, but intensity of *C.rotundus* (10.1%) and *Oldenlandia dichotoma* (8.01%) showed rising trend. New weeds *viz., Rumex dentatus* (8.34%) and *Portulaca oleracea* (7.1%) had shown their presence in wheat at maturity stage.

Weed intensity

In rice, total weed intensity was 143,114,104 and 103 weeds/m^2 with direct seeding in dry fields (P_1), direct seeding of sprouted seeds in puddled field by drum seeder (P_2), manual transplanting (P_3) and mechanical transplanting (P_4), respectively at 30 DAS/DAT, which increased to 226, 204,189, 188 weeds/m^2, respectively at maturity (Table 2). The DSR had significantly higher weed density at both growth stages than rest 3 tillage and sowing methods of rice which were on par with each other in this regard (Sharma *et al*. 2006).

In wheat, the weed intensity was 90,121,82 and 89 weeds/m^2 with conventional till sowing (T_1), zero-till sowing (T_2), strip-till sowing (T_3), and bed planting (T_4), respectively at 30 DAS and, which decreased 56,81,45 and 55 weeds/m^2, respectively at maturity mainly due to following the recommend weed control measures under all tillage and sowing methods. The zero till sown wheat had significantly higher weed intensity than rest 3 tillage and sowing methods of wheat at both growth stages. The variations in weed infestation among the latter 3 tillage and sowing methods were not significant.

Weed biomass

The total weed biomass at maturity stage significantly varied with tillage and sowing methods in rice and wheat grown in a sequence. The DSR had significantly produced higher weed biomass (5.55 q/ha) than rest 3 tillage and sowing methods of rice producing comparable weed biomass ranging from 4.79 to 5.08 q/ha. Weed intensity had strong positive association with weed biomass (Singh *et al.* 2006), hence the DSR, produced maximum weed biomass among all tillage and sowing methods of rice. The zero till sown wheat produced maximum weed biomass (4.49 q/ha), among all tillage and sowing methods at maturity, which was significantly higher than rest 3 tillage and sowing methods having comparable weed biomass ranging from 3.26 to 3.65 q/ha mainly due to higher weed intensity. Similar results have also been reported by other workers (Jain *et al.* 2006).

Table 1. Effect of different tillage and sowing methods on weed species wise density (no./m^2) at 30 DAS and harvest in rice-wheat cropping system (mean data of 2004-05 to 06-07)

Weed	Tillage and sowing methods in rice				Mean	Weed	Tillage and sowing methods in wheat			
	P_1	P_2	P_3	P_4			T_1	T_2	T_3	T_4
Echinochloa colona	27 (16)	18 (12)	17 (12)	17 (12)	19.75 (13)	*Phalaris minor*	6 (-)	10 (-)	5 (-)	5 (-
Echinochloa crusgalli	20 (10)	16 (6)	14 (6)	14 (6)	16 (7)	*Medicago spp.*	28 (20)	40 (23)	28 (20)	34 (20
Cyperus iria	28 (12)	16 (8)	16 (6)	16 (6)	19 (8)	*Trifolium flagiferum*	6 (1)	6 (1)	5 (1)	5 (1
Cyperus defformis	- (32)	- (22)	- (20)	- (20)	- (24)	*Chenopodium album*	10 (4)	18 (4)	10 (2)	10 (2
Scirpus latiflorus	-	3 (10)	2 (9)	2 (9)	1.75 (7)	*Melilotus spp.*	4 (1)	5 (3)	4 (1)	3 (1
Cyperus rotundus	2 (10)	3 (8)	3 (5)	3 (5)	2.8 (7)	*Rumex dentatus*	- (5)	- (7)	- (3)	- (5
Eleusine indica	3 (6)	-	-	-	0.7 (1.5)	*Fumaria parviflora*	5 (2)	8 (10)	5 (2)	6 (2
Panicum repens	5 (15)	2 (8)	2 (8)	2 (8)	2.75 (9.75)	*Spergula arvensis*	7 (2)	8 (2)	5 (1)	8 (1
Paspalum sanguinale	10 (12)	14 (14)	12 (17)	11 (16)	11.75 (14.75)	*Anagallis arvensis*	5 (3)	5 (3)	5 (2)	6 (2
Sehima nervosum	- (12)	- (6)	- (5)	- (5)	- (7)	*Vicia sativa*	5 (1)	3 (1)	5 (2)	2 (2
Caesulia axillaris	- (8)	- (8)	- (7)	- (7)	- (7.5)	*Lathyrus aphaca*	1 -	1 -	1 -	1
Eclipta alba	5 (10)	4 (8)	4 (6)	4 (6)	4.25 (7.5)	*Cyperus rotundus*	6 (4)	8 (12)	3 (4)	6 (4
Monochoria vaginalis	-	- 10	- 10	- 10	- (7.5)	*Cichorium intybus*	1 (-)	1 (-)	1 (-)	1 (-
Ammannia baccifera	12 (3)	10 (2)	10 (2)	10 (2)	10.5 (2.25)	*Oldenlandia dichotoma*	4 (5)	4 (5)	3 (4)	4 (5
Cyanotis axillaris	- 3	- (4)	- (4)	- (4)	- (3.75)	*Portulaca oleracea*	- (5)	- (5)	- (2)	- (5
Commelina communis	-	6 (4)	6 (3)	6 (3)	4.5 (2.5)	Other minor weeds	4 (6)	4 (6)	2 (2)	4 (6
Marselia quadrifoliata	-	-	- (3)	- (3)	- (1.5)	TOTAL	90 (56)	121 (81)	82 (45)	89 (55
Trianthema monogyna	6 (3)	4 (2)	4 (2)	4 (2)	1.5 (2.25)					
Digitaria ciliris	9 (15)	5 (10)	4 (10)	4 (10)	5.5 (8.75)					
Alternathera philoxeroides	- (2)	5 (12)	4 (12)	4 (12)	3.75 (9.5)					
Alternanthera sessilis	3 (10)	2 (10)	2 (8)	2 (8)	2.25 (9)					
Fimbristylis miliacea	- (18)	- (12)	- (11)	- (11)	- 13					
Ludwigia palustris	6 10	2 (6)	2 (5)	2 (4)	3 (6.25)					
Other minor weeds	8 (30)	4 (20)	4 (18)	4 (17)	5 (21.25)					
Total	143 (226)	114 (204)	104 (189)	103 (188)	116 (201)					

Figures with and with out parenthesis belong to 30 day and maturity stages, respectively P_1- DSR, P_2-Drum seeded rice, P_3- manual transplanting, and P_4-mechanical transplanting manual T_1-conventional till sowing, T_2-zero-till sowing, T_3-strip-till sowing and T_4-bed planting

Table 2. Effect of different tillage and sowing methods on mean total wheat population and dry weight of weeds rice- wheat cropping system (2004-05 to 2006-07)

Tillage and sowing methods	Weed population /m^2		Weed dry weight (q/ha) at maturity
	at 30 DAS/DAT	at maturity	
Rice			
Direct drilling in dry field	143	216	5.55
Direct seeding of sprouted seeds in puddled field	114	193	5.08
Manual transplanting	104	189	4.83
Mechanical transplanting	103	188	4.79
LSD (P=0.05)	10	24	0.09
Wheat			
Conventional till sowing	89	56	3 .55
Zero till sowing	121	81	4.45
Strip till sowing	56	45	3.25
Bed planting	85	55	3.58
LSD (P=0.05)	10	12	0.09

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