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Effect of integrated weed management on weed dynamics and nutrient uptake by weeds in rice crop

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Abstract
A field experiment was conducted in rice during *kharif* season of 2013 on sandy loam soil at Crop Research Centre, Chirauri of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.).The experiment was conducted in R.B.D with three replications comprising twelve treatments of weed management (weedy check, weed free Pretilachlor, Pretilachlor+1Handweeding, Pyrazosulfuron+Almix, Azimsulfuron, Orthosulfuron, Pyrazosulfuron, Bispyribac-Na, Butachlor, Fenoxaprop ethyl, Almix. The soil of experimental field was sandy loam in texture, low in organic carbon and available nitrogen, medium in available phosphorus and available potassium with near to neutral in reaction. The results indicated that herbicide combination methods of weed control significantly reduced the weed population and dry weight effectively over weedy check. The minimum weed index and maximum weed control efficiency were recorded with the application of Pretilachlor+1Hand weeding than other treatments. The nitrogen, phosphorus and potash uptake by weeds reduced significantly by the application of Pretilachlor+1Hand weeding than other chemical treatments.

Keywords: Integrated weed management, weed dynamics, rice

Introduction
Cereals play major role in our food economy and are the most important part of diet throughout the world. Amongst cereals, rice is one of the most important cereal crops and staple food of India and world, occupying globally about 155.6 million ha area with the production of 470.2 million tonnes It accounts for about 45% of total food grain production and 55% of cereals production in the country, contributes about 20- 25% of the agricultural GDP. Rice is primarily a high energy food and is a good source of amino acids and fat contents. It is cultivated on an area of 42.75 million hectare area which is maximum among all rice growing countries having annual production about 105.24 million tonnes and productivity of 2.46 tonnesha^{-1}.It accounts for about 40.92% of total food grain production and 44.07% of cereal production in the country (Anonymous, 2013-14) [1]. Uttar Pradesh is the largest rice growing state, cultivated over an area of about 58.6 lakh hectares with a production of 144.1 lakh tonnes and the productivity of 2460 kg ha^{-1} (Anonymous, 2013-14) [1].
Transplanted rice is mainly infested by grasses some sedges and broad-leaved weeds. Moreover, recommended pre-emergence, post-emergence herbicides are effective against grasses, sedges and broad-leaved weeds. Additionally, continuous use of the same herbicide may lead to change in weed flora and their intensity with respect to time and may also result in evolution of resistance in some weed species. Recently, Penoxsulam is emerged as a new acetolactate synthase (ALS) inhibitor herbicide for post-emergence control of annual grasses, sedges and broadleaf weeds in rice culture (Jabusch and Tjeerdema, 2005) [5]. Bispyribac-sodium, a pyrimidinyl carboxy herbicide, is also effective to control many annual and perennial grasses, sedges and broad-leaved weeds in rice fields (Schmidt *et al*., 1999; Yun *et al*., 2005) [7, 11]. Bispyribac-sodium applied mid-to late-post-emergence at 20 to 23gm/ha has been reported to control barnyardgrass 98%; however when applied late post-emergence to three- tiller barnyard grass, the control was reduced to 70% (Williams, 1999) [9]. Bensulfuron-methyl was studied for controlling sedges and non-grassy weeds in transplanted rice (*Oryza sativa*) and Tank-mix application of Bensulfuron-methyl + Pretilachlor (50+500 g/ha) was found to be the most effective herbicide treatments with weed control efficiency 95% and produced 5.72 tonnes/ha yield (Saha, 2009) [6]. Keeping these points in view, the present investigation was carried out to find the efficacy of weed control treatments on weed growth, weed control efficiency and nutrient uptake by weeds.

Methodology
The experiment was conducted during *kharif* season 2013 at the Crop Research Centre, Chirori, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.),

to assess the effect of weed control treatments on weeds growth, weed control efficiency and nutrient uptake by weeds in transplanted rice. The experiment was conducted in R.B.D with three replications keeping twelve treatments of weed management (Weed free, Weedy check, Pretilachlor, Pretilachlor+1Hand Weeding, Pyrazosulfuron+Almix, Azimsulfuron, Orthosulfuron, Pyrazosulfuron, Bispyribac-Na, Butachlor, Fenoxaprop ethyl and T_{12}Almix. The soil of experimental field was sandy loam in texture, low in organic carbon and available nitrogen, medium in available phosphorus and available potassium with near to neutral in reaction. The seedling of rice variety Pusa Sugandha-5 was raised in nursery by Wet bed method. The 25 days old seedlings were transplanted in the field. The crop was fertilized with 120:60:40:25 kg N, P, K and Zn per hectare. The crop was raised as per recommended practices except weed management practices which were followed as per treatments.

Results and Discussion

The predominant weed species in experimental field were *Echinochloa colonum, Echinochloa crusgalli, Ischaemum rugosum, Eleusine indica, Dactyloctenium aegyptium, Cynodon dactylon, Commelina benghalensis, Phyllanthus niruri, Cyperus iria, Cyperus rotundus, Eclipta alba* (Table-1) at different crop growth stages. The highest total weed count at 60 DAT was 276 m^{-2} (Table-2) under weedy check. In general, the total weeds tend to increase up to 60 DAT and decline, thereafter. Such trend might be attributed to the fact that during initial stage the requirement of crop plants remaining low, allowing the new weeds to emerge and grow vigorously, whereas during later phase there may be exclusion of weeds owing to shading effect.

The different chemicals T_3 (Pretilachlor), T_4 (Pretilachlor+1HW), T_5 (Pyrazosulfuron+Almix), T_6 (Azimsulfuron), T_7 (Orthosulfuron), T_8 (Pyrazosulfuron), T_9 (Bispyribac-Na), T_{10} (Butachlor), T_{11} (Fenoxaprop ethyl) and T_{12} (Almix) control the weeds effectively as compared to unweeded check. Significantly the lowest weed population and total dry weight (Table-2) recorded under weed free treatment because weed free treatment was kept free of weeds by hand weeding. Highest weed population and dry weight were recorded in unweeded check (T_1) plots due to unchecked growth of weeds which compete for all the resources up to maturity with crop. T_4 (Pretilachlor+1HW) proved to be the best treatment among the different herbicides/combinations. Similar findings were also reported by Chopra and Chopra (2003) [2], Yadav *et al*. (2008) [10] and Sunil *et al.* (2011) [8].

The minimum weed index and highest weed control efficiency (84.41%) among the chemicals was found with the application of T_4 (Pretilachlor+1HW) followed by T_3 (Pretilachlor) (80.99%). Similar observations were also recorded by Saha (2009) [6].

The uptake of nitrogen, phosphorus and potassium by weeds is a product of their nitrogen, phosphorus and potassium contents with respect to dry matter yield of weeds. The lowest uptake of nitrogen, phosphorus and potassium by weeds were recorded (T_4) Pretilachlor +1hand weeding treatment as compared to other chemical treatments. The data presented in Table-3 reveals that the highest nitrogen, phosphorus and potash uptake (96.29, 14.62 and 118.22 kg ha^{-1}, respectively) by weeds was recorded in weedy treatment. Among the herbicides, (T_4) Pretilachlor+hand weeding treatment showed lowest nitrogen, phosphorus and potash uptake (22.09, 4.27 and 24.07 kg ha^{-1}, respectively) as compared to other herbicidal treatments. The similar findings were also reported by Dhiman and Singh (2005) [4].

Findings of the present study suggest that the combined application of Pretilachlor+1Hand Weeding treatment proved to be better than all other herbicides/combinations in transplanted rice due to its broad spectrum nature, reduced weed population and weed dry weight, higher weed control efficiency and lowest nutrient loss by weeds. Thus, the application of Pretilachlor+1Hand Weeding can be adopted for controlling the weeds in transplanted rice.

Table 1: Common weeds associated with rice crop

English name	Family	Botanical name
Grasses		
Swank, jungle rice	Poaceae	*Echinochloa colonum*
Barnyard grass	Poaceae	*Echinochloa crusgalli*
Wrinkle grass	Poaceae	*Ischaemum rugosum*
Goos grass	Poaceae	*Eleusine indica*
Crowfoot grass	Poaceae	*Dactyloctenium aegyptium*
Bermuda grass	Poaceae	*Cyondon dactylon*
Broad leaf weeds		
Day flower	Commelinaceae	*Commelina benghalensis*
Phyllanthus	Phyllanthaceae	*Phyllanthus niruri*
False daisy	Asteraceae	*Eclipta alba*
Caesulia	---------	*Caesulia axillaris*
Sedges		
Yellow nut sedges	Cyperaceae	*Cyperus iria*
Purple nut sedges	Cyperaceae	*Cyprus rotundus*

Table 2: Weed population and dry weight as influenced by integrated weed management in rice crop.

Treatments	Weed population (m^{-2})			Weed dry weight (g m^{-2})		
	30 DAT	60 DAT	At Harvest	30 DAT	60 DAT	At Harvest
T_1 (Weedy check)	15.25(231.83)	16.64(276.15)	16.14(259.65)	7.55(56.00)	9.72(93.60)	11.40(128.9)
T_2 (Weed-Free)	1.00 (0.00)	1.00(0.00)	1.00(0.00)	1.00(0.00)	1.00(0.00)	1.00(0.00)
T_3 (Pretilachlor)	4.60(20.19)	6.08(35.96)	5.94(34.29)	3.26(9.64)	4.35(17.98)	5.05(24.51)
T_4 (Pretilachlor+1HW)	3.68(12.58)	5.37(27.89)	5.46(28.79)	2.86(7.21)	4.00(15.06)	4.59(20.11)
T_5 (Pyrazosulfuron+Almix)	5.39(28.07)	6.62(42.85)	6.25(38.13)	3.28(9.77)	4.64(20.61)	5.18(25.90)
T_6 (Azimsulfuron)	6.22(37.74)	7.46(54.67)	7.32(52.73)	3.60(12.00)	4.98(23.93)	5.74(32.00)

T_7 (Orthosulfuron)	6.85(45.99)	8.05(63.75)	7.74(58.90)	4.14(16.20)	5.44(28.65)	6.01(35.20)
T_8 (Pyrazosulfuron)	7.33(52.80)	8.58(72.68)	8.51(71.57)	4.48(19.06)	5.85(33.33)	6.39(39.84)
T_9 (Bispyribac-Na)	7.74(58.91)	8.88(77.96)	8.75(75.51)	4.57(19.96)	5.79(32.66)	6.40(40.05)
T_{10} (Butachlor)	8.20(66.34)	9.33(86.15)	9.07(81.86)	4.78(21.93)	6.01(35.54)	6.59(42.53)
T_{11} (Fenoxaprop ethyl)	8.57(72.51)	9.77(94.91)	9.40(87.37)	4.76(21.75)	6.20(37.57)	6.61(42.75)
T_{12} (Almix)	9.05(81.00)	9.98(98.64)	9.78(94.59)	4.96(23.60)	6.60(42.58)	6.81(45.50)
SEm±	0.06	0.05	0.05	0.01	0.06	0.03
CD(P=0.05)	0.18	0.17	0.16	0.04	0.17	0.09

DAT-Days after Transplanting.
Original values given within the parenthesis.

Table 3: Weed index and weed control efficiency and nutrient uptake by weeds as influenced by integrated weed management in rice crop.

Treatments	Weed Index	Weed control efficiency	Nutrient uptake (kg ha^{-1})		
			N	P	K
T_1 (Weedy check)	42.75	0.00	9.86(96.29)	3.95(14.62)	10.91(118.22)
T_2 (Weed-Free)	0.00	100.00	1.00(0.00)	1.00(0.00)	1.00(0.00)
T_3 (Pretilachlor)	8.20	80.99	4.96(23.65)	2.37(4.64)	5.17(25.66)
T_4 (Pretilachlor+1HW)	2.76	84.41	4.80(22.09)	2.30(4.27)	5.00(24.07)
T_5 (Pyrazosulfuron+Almix)	5.54	79.92	5.15(25.52)	2.48(5.17)	5.33(27.39)
T_6 (Azimsulfuron)	12.55	75.19	5.63(30.67)	2.65(6.06)	5.87(33.51)
T_7 (Orthosulfuron)	17.54	72.71	5.83(33.05)	2.70(6.32)	6.12(36.52)
T_8 (Pyrazosulfuron)	18.47	69.11	6.16(37.00)	2.85(7.15)	6.44(40.54)
T_9 (Bispyribac-Na)	19.68	68.95	6.08(36.00)	2.79(6.79)	6.43(40.36)
T_{10} (Butachlor)	23.13	67.02	6.22(37.77)	3.71(6.35)	6.55(41.95)
T_{11} (Fenoxaprop ethyl)	23.26	66.85	6.11(36.30)	3.72(6.40)	6.47(40.97)
T_{12} (Almix)	28.45	64.72	6.25(38.04)	3.71(6.35)	6.71((44.05)
SEm±	1.04	0.30	0.04	0.03	0.05
CD(P=0.05)	3.08	0.88	0.13	0.10	0.16

Original values given within the parenthesis

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