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Response of integrated weed management on growth and yield of rice crop in western U.P.

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Abstract

The experiment was carried out during kharif season 2013 at the Crop Research Center, Chirori of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.). 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 25 days old seedling of rice variety Pusa Sugandha-5 was transplanted at a spacing of 20 x 10 cm. 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 and Eclipta alba at different crop growth stages. The highest plant height, dry matter accumulation, yield attributes and yields were recorded with (T_2) weed free treatment which remained at par with (T_4) Pretilachlor + Hand weeding treatment. Thus combined application of Pretilachlor+1Hand weeding treatment proved superiority than all other herbicides/combinations in transplanted rice due to its broad spectrum nature, giving higher yields, reduced weed population, providing maximum net return and also the B: C ratio.

Key words: Integrated, weed management, Rice.

Introduction

Rice is most prominent crop of India and is the staple food of the people of the eastern and southern parts of the country. Transplanting after puddling (A process where soil is compacted to reduce water seepage) has been a major traditional method of rice establishment. Cereals play major role in our food economy and are the most important part of diet throughout the world. Amongst cereals, rice *(Oryza sativa* L.) is the most important and extensively grown in tropical and subtropical regions of the world, is staple food for more than 60 per cent of the world population. Rice plays unique role in providing calories to the majority of Asian and Latin American countries. It is grown in about 112 countries in the world, covering every continent and is consumed by 2500 million people in developing countries**.** Among cereals, rice is the major source of calories for about 40% of the world population and every third person on earth eats rice every day in one form or other**.**

In India, occupies a pivotal place in Indian agriculture and it contributes to 15% of annual GDP and provides 43% calorie requirement for more than 70% of Indians. Rice is primarily a high energy food and is a good source of amino acids and fat contents. In India, 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 tonnes ha^{-1}. It accounts for about 40.92% of total food grain production and 44.07% of cereal production in the country (Anonymous, 2013-14). Rice is generally grown by transplanting in puddled soils, because the condition for higher productivity is more conducive in transplanted rice. But, there is need to increase rice production by about 3% every year over the next decade to feed the increasing population of the country.

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. In general, approximately 40-45% rice yield is reduced due to weed infestation. Therefore, the present study is planned on Integrated weed management in rice in western Uttar Pradesh.

Research methodology

The experiment was carried out during *kharif* season 2013 at the Crop Research Center, Chirori of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.) at a latitude of 28^0 402 North and longitude of 76^0 422 East and at an altitude of 237 meter above mean sea level. Meerut lies in the heart of Western Uttar Pradesh and has sub-tropical climate. 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 uprooted and transplanted in the field at a spacing of 20 x 10 cm. Rest of the practices were followed as per recommendation except weed management which was applied as per treatments.

Results and discussion

The major weed species infested the crop were *Echinochloa colonum, Echinochloa crusgalli, Ischaemum rugosum, Eleusine indica, Dactyloctenium aegyptium,Cynodon dactylon, Commelina benghalensis, Phyllanthus niruri, Cyperus iria, Cyperus rotundus, Eclipta alba* at different crop growth stages. The highest total weed count at 60 DAT was 276 m^{-2} under weedy check (Table 1). 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 herbicide treatments control the weeds effectively as compared to unweeded check. Significantly the lowest weed population and total dry weight (Table 1) recorded under weed free treatment because weed-free treatment was kept free of weeds by hand weeding. The maximum 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) treatment proved to be the best treatment among the different herbicides. Similar findings were also reported by Sunil *et al.* (2011).

The highest plant height and dry matter accumulation (Table 2) were recorded with application of (T_2) weed free treatment which remained at par with (T_4) Pretilachlor + Hand weeding. Over all lowest plant height and dry matter accumulation was recorded in weedy plots at all the stages. This may be due to less density and lower dry weight of weeds in (T_4) Pretilachlor + Hand weeding applied plots, which resulted in less crop-weed competition and gave more plant height and dry matter accumulation. Similar findings were also reported by Lakshmi and Ramana (2008).

Panicle length, filled grains panicle^{-1}, unfilled grains panicle^{-1} and 1000-grains weight (Table 2) differed significantly due to integrated weed management practices. The number of grains per panicle were also boost up significantly when the crop was treated with (T_4) Pretilachlor + Hand weeding as

Table 1: Weed population (m^{-2}) and weed dry weight in rice crop as influenced by various integrated weed management treatments

Treatments	Weed population			Weed dry weight		
	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 with in the paranthesis.

Table 2: Growth and yield attributes of rice crop as influenced by various integrated weed management treatments at harvest stage

Treatments	Plant height (cm)	No. of tillers (m^{-2})	Dry matter accumulation (g m^{-2})	Panicle length (cm)	Filled grain panicle^{-1}	Unfilled grain panicle^{-1}	1000 grain weight (g)
T_1 (Weedy check)	90.20	197.08	958.66	22.90	115.89	35.95	22.90
T_2 (Weed-Free)	132.79	295.89	1297.80	27.99	140.79	14.80	24.95
T_3 (Pretilachlor)	122.49	285.35	1247.22	26.89	135.84	17.37	24.60
T_4 (Pretilachlor+1HW)	130.20	293.70	1288.47	27.94	140.00	15.19	24.90
T_5 (Pyrazosulfuron+Almix)	123.91	289.33	1260.56	27.09	138.90	17.47	24.79
T_6 (Azimsulfuron)	118.62	276.09	1235.12	26.09	135.00	18.09	24.10
T_7 (Orthosulfuron)	117.38	265.91	1230.42	26.00	133.94	22.50	23.99
T_8 (Pyrazosulfuron)	114.25	259.41	1225.13	25.95	133.79	22.83	23.90
T_9 (Bispyribac-Na)	113.38	251.68	1223.14	25.90	133.50	23.20	23.90
T_{10} (Butachlor)	107.34	248.37	1200.53	25.70	128.90	23.53	23.70
T_{11} (Fenoxaprop ethyl)	102.70	225.67	1165.14	25.00	125.50	25.10	23.30
T_{12} (Almix)	100.70	215.17	1161.14	24.00	122.90	26.89	22.99
SEm±	1.87	1.04	4.38	0.18	0.93	0.27	0.82
CD(P=0.05)	5.52	3.07	12.92	0.54	2.74	0.79	0.24

compared to rest of the treatments due to reduced crop-weed competition and better sink capacity. Increase in the sink capacity of crop was expressed in terms of filled grains, panicle length and 1000-grains weight. The yield attributes are decided by genetic makeup of the crop and variety, but the agronomic manipulation also affects them to a great extent. The reproductive growth depends on vegetative growth of plant. Better vegetative growth increases the photosynthetic area and supply of photosynthates towards sink which decided the yield attributes and ultimately the yield.

The higher values of yield attributes may probably due to increased synthesis and translocation of metabolites for the panicle development and grains formation. Besides, thousand grains weight was also increased due to high mobilization of photosynthates from source to sink which is essential for protein synthesis and carbon assimilation. Similar findings were also reported by Saini and Angiras (2002) and Kathirvelan and Vajyapuri (2004).

The final yield of the crop is the cumulative effect of yield attributes and the factors which directly or indirectly influenced them. A crop can performed best only when the display of foliage on the ground surface is in such a manner that utilizes maximum natural resources. In present study, the crop yield was significantly influenced by the different weed management practices. The maximum grain, straw and biological yield (Table 3) were observed in weed free plots which remains at par with (T_4) Pretilachlor + Hand weeding treatment. The maximum grain, straw and biological yield ha^{-1} in weed free and (T_4) Pretilachlor + Hand weeding treated plots were mainly due to the increased values of all the yield attributes. Such effects of weed management practices on attributes have also been reported by Dubey *et al.* (2005).

Harvest index is the ratio of grain and biological yield. From the Table 3 it is clear that harvest index of rice crop was significantly influenced by various herbicidal treatments. The highest harvest index (42.40%) was recorded in (T_2) weed free plots followed by (T_4) Pretilachlor+hand weeding treatment (42.04%). This significant increase in harvest index of rice over (T_1) weedy check was due to reduced crop-weed competition, better sink development and more ability of the plant to convert the dry matter into grain yield brought by controlling the weeds.

The uptake of nitrogen, phosphorus and potassium in grains and straw is a product of their nitrogen, phosphorus and potassium contents with respect to dry matter yield. Higher content and uptake of nitrogen, phosphorus and potassium (Table 3) were recorded (T_2) weed free and (T_4) Pretilachlor+hand weeding treatment as compared to all other treatments. This might be due to (i) increased supply of most essential nutrients directly to the crop (ii) indirectly through checking the loss of nutrients by weeds, and (iii) increasing the nutrient use efficiency.

In weed management practices highest cost of cultivation (37752 Rs ha^{-1}) was recorded under (T_2) weed free plots due to higher labour cost, followed by (T_4) Pretilachlor fb Hand weeding (32187 Rs ha^{-1}) due to higher market price of the herbicide and cost of hand weeding (Table 4), so cost of cultivation is higher than other treatments. On the other hand the lowest cost (28752 Rs ha^{-1}) of cultivation was observed in

Table 3: Yield and nutrient uptake by rice crop as influenced by various integrated weed management treatments

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Biological yield (q/ha)	Harvest index (%)	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})
T_1 (Weedy check)	32.00	59.90	91.90	34.84	65.40	16.76	87.81
T_2 (Weed-Free)	56.00	76.00	132.00	42.40	132.52	41.11	148.23
T_3 (Pretilachlor)	51.33	71.00	122.33	41.96	116.22	33.29	128.88
T_4 (Pretilachlor+1HW)	54.40	75.00	129.40	42.04	128.40	38.35	143.04
T_5 (Pyrazosulfuron+Almix)	52.89	72.99	125.89	42,00	120.32	34.26	133.81
T_6 (Azimsulfuron)	48.89	69.90	118.80	41.15	108.94	30.94	123.86
T_7 (Orthosulfuron)	46.09	67.95	114.05	40.42	102.28	29.05	119.46
T_8 (Pyrazosulfuron)	45.66	67.59	113.26	40.30	97.28	28.13	117.47
T_9 (Bispyribac-Na)	44.89	64.95	109.84	40.87	95.17	26.98	112.00
T_{10} (Butachlor)	42.99	64.90	107.89	39.88	90.12	25.59	110.17
T_{11} (Fenoxaprop ethyl)	42.89	61.00	103.89	41.29	87.41	24.59	102.78
T_{12} (Almix)	39.99	60.90	100.89	39.65	81.71	22.57	101.77
SEm±	0.68	0.75	1.01	0.42	1.77	0.42	2.29
CD(P=0.05)	2.00	2.23	3.00	1.25	5.25	1.26	6.77

Table 4: Economics of rice crop as influenced by various integrated weed management treatments.

Treatments	Cost of cultivation	Gross return (Rs/ha^{-1})	Net Return (Rs/ha^{-1})	Benefit: cost ratio
T_1 (Weedy check)	28752	85794	57042	1.98
T_2 (Weed-Free)	37752	145808	108056	2.86
T_3 (Pretilachlor)	29787	133842	104055	3.49
T_4 (Pretilachlor+1HW)	32187	141819	109632	3.40
T_5 (Pyrazosulfuron+Almix)	30407	137902	107495	3.53
T_6 (Azimsulfuron)	29862	127838	97976	3.28
T_7 (Orthosulfuron)	29962	120825	90863	3.03
T_8 (Pyrazosulfuron)	30332	119740	89408	2.94
T_9 (Bispyribac-Na)	30612	117495	86883	2.83
T_{10} (Butachlor)	29712	112927	83215	2.80
T_{11} (Fenoxaprop ethyl)	30037	112102	82065	2.73
T_{12} (Almix)	29187	105127	75940	2.60

weedy check treatment. However, the highest gross return (145808 Rs ha^{-1}) was recorded in (T_2) weed free treatment and higher net return (109632 Rs ha^{-1}) was obtained in (T_4) Pretilachlor + hand weeding. Similar results were also reported by Dhiman and Singh (2005). Among the weed management practices highest value of B: C ratio (3.53) was recorded under T_5 (Pyrazosulfuron+Almix) due to lower cost of cultivation under this treatment.

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