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Influence of various doses of Herbicides on weed flora population, yield attributes and yield of Transplanted Rice (*Oryza sativa*)

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Abstract - **An experiment was undertaken to study the response of different doses of herbicides on weed flora population, yield attributes and yield of transplanted rice. The investigation was carried out at Students' Farm of College of Agriculture, Chaudhary Charan Singh Haryana Agricultural University; Kaul (Kaithal). The experiment laid out in randomized block design replicated three times during the *kharif* season of 2008 consisting 15 treatments combinations *viz*., T_1- 25 g/ha dose of Bispyribac sodium 10 SC at 20 DAT; T_2- 25 g/ha dose of Bispyribac sodium 10 SC at 25 DAT; T_3- 30 g/ha dose of Bispyribac sodium 10 SC at 20 DAT; T_4- 30 g/ha dose of Bispyribac sodium 10 SC at 25 DAT; T_5- 30 g/ha dose of Azimsulfuron 50 DF at 20 DAT; T_6- 30 g/ha dose of Azimsulfuron 50 DF at 25 DAT; T_7- 40 g/ha dose of Azimsulfuron 50 DF at 20 DAT; T_8- 40 g/ha dose of Azimsulfuron 50 DF at 25 DAT; T_9- 750 g/ha dose of Pretilachlor 50 EC at 3 DAT; T_{10}- 1500 g/ha dose of Butachlor 50 EC at 3 DAT; T_{11}- 100 g/ha dose of Oxadiargyl 80 WP (Top Star) at 3 DAT; T_{12}- 20 g/ha dose of Pyrazosulfuron 10 WP at 3 DAT; T_{13}- 56.25 g/ha dose of Fenoxaprop-p-ethyl 9 EC (Whip Super) at 25 DAT; T_{14}- Weed Check; T_{15}- Weed Free. Findings of the experiment revealed that among POE treatments, T_3 recorded significantly lowest grassy weed population i.e. 3.1, 3.5 and 3.2/m^2 at 40, 60 and 80 days after transplanting respectively, in comparison to rest of the other treatments except treatment T_1 (3.2, 4.4 and 3.9/m^2 respectively) to which it is statically at par. Among POE treatments, highest broad leaf weed control was observed in treatment T_7 *i.e.* 3.4, 4.0 and 3.5/m^2 at 40, 60 and 80 days after transplanting respectively, which was statistically at par with treatments T_1, T_3, T_5 and T_8. Performance of Bispyribac sodium @ 30g/ha at 20 DAT in controlling grassy weed and Azimsulfuron @ 30 g/ha at 20 DAT and Azimsulfuron 40 g/ha at 20 DAT in controlling broad leaf weeds at 40, 60 and 80 days after transplanting which were statically at par with Pretilachlor @ 750 g/ha at 3 DAT (PRE) which was best among all treatments except weed free in terms of highest effective tillers/m^2, highest filled grains/panicle, lowest unfilled grains/panicle, boldest grain and productivity of rice crop. So using Pretilachlor (PRE) @ 750 g/ha at 3 DAT and Bispyribac sodium (POE) @ 30 g/ha at 20 DAT are the best options in transplanted rice in terms of weed control as well as productivity of rice.**

Keywords- **Rice, Weed, POE, Bispyribac sodium, Herbicide.**

I. INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crops of India and is a staple food of more than 65 % of population. Its accounts for about 17.28% of total food grain production and 18.49% of total cereals production in the country, contributing 20- 25% of the agricultural GDP [5]. In India, rice crop occupies an area of about 43.50 million hectares with total production of 104.41 million tones and productivity 2400 kg/ha during 2015-16 [1]. In Haryana, rice is cultivated over an area of 1.35 million hectares with a production of 4.15 million tonnes and productivity 3061 kg/ha during 2015-16 [1]. Weeds are widely regarded as pests of great agricultural menace as they pose serious problems by causing serve competition with crop plants for nutrients, moisture, solar energy and space. Thus, bring heavy reductions in growth and yield of crop plants. Hand pulling of weeds is time consuming, cumbersome and costly alternative**.** In India, the extent of yield reduction in transplanted rice due to weeds alone has been reported to be from 10 to 70 % [4]. The loss of yield occurs from 25-30% due to unchecked weeds growth [6]. Transplanted rice faces 31% grain yield reduction due to uncontrolled weeds [4]. Appropriate control of weeds is thus an important operation influencing rice production. Transplanted rice is mainly infested by barnyard grass besides some sedges and broad-leaved weeds. Moreover recommended herbicides are effective against grasses only when used as pre-emergence and if there is availability of water at least for 48 hours after treatment. With the continuous use of these herbicides, particularly Anilofos, problem of sedges and broadleaf weeds

is increasing every year. So, due to increasing problem of sedges and lack of availability of water after transplanting there is an urgent need to have an early post-emergence herbicide, which can provide effective control of complex weed flora. 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 developing of resistance in some weed species. Recently, some herbicides like Bispyribac sodium and Azimsulfuron are reported to be effective for weed control in transplanted rice. Keeping these points in view, the present investigation was carried out to study the effect of post-emergence (POE) herbicides on weed control, its significance in relation to pre-emergence (PRE) herbicides and productivity in transplanted rice.

II. MATERIALS AND METHODS

The present study was undertaken to study the response of different doses of herbicides on Weed Control Efficiency, growth and productivity of Transplanted Rice. The investigation was carried out at Students' Farm of College of Agriculture, Chaudhary Charan Singh Haryana Agricultural University; Kaul (Kaithal) situated at 30 km from the holy city of Kurukshetra at latitude of 29°51′ North and longitude of 76°41′ East at an elevation of 241 meters above mean sea level. The experiment laid out in randomized block design replicated three times during the *kharif* season of 2008 consisting 15 treatments combinations viz., T_1- 25 g/ha dose of Bispyribac sodium 10 SC at 20 DAT; T_2- 25 g/ha dose of Bispyribac sodium 10 SC at 25 DAT; T_3- 30 g/ha dose of Bispyribac sodium 10 SC at 20 DAT; T_4- 30 g/ha dose of Bispyribac sodium 10 SC at 25 DAT; T_5- 30 g/ha dose of Azimsulfuron 50 DF at 20 DAT; T_6- 30 g/ha dose of Azimsulfuron 50 DF at 25 DAT; T_7- 40 g/ha dose of Azimsulfuron 50 DF at 20 DAT; T_8- 40 g/ha dose of Azimsulfuron 50 DF at 25 DAT; T_9- 750 g/ha dose of Pretilachlor 50 EC at 3 DAT; T_{10}- 1500 g/ha dose of Butachlor 50 EC at 3 DAT; T_{11}- 100 g/ha dose of Oxadiargyl 80 WP (Top Star) at 3 DAT; T_{12}- 20 g/ha dose of Pyrazosulfuron 10 WP at 3 DAT; T_{13}- 56.25 g/ha dose of Fenoxaprop-p-ethyl 9 EC (Whip Super) at 25 DAT; T_{14}- Weed Check; T_{15}- Weed Free. It is located in the heart of the rice growing region 'Rice Bowl' of the Haryana state. The soil of the experimental field was clay loam in texture and slightly alkaline in reaction. The soil was low in organic carbon (0.32%), low in available nitrogen (161 kg/ha) and medium in available phosphorus (16 kg/ha) and high in available potassium (330 kg/ha). After preparation of the field 30 days old seedlings were transplanted on 3rd July, 2008 manually at a spacing of 20 x 15 cm with two seedlings per hill. The Rice variety used was HKR-47. Recommended package and practices were followed for rest of the other operations. The crop was harvested at full physiological maturity stage on 18th October, 2008.

Weed population (grassy and broad leaf) from experimental plots was recorded at 40, 60 and 80 days after transplanting with the help of quadrate of size 50 x 50 cm thrown randomly at two places. The weed number so counted was converted into number per square meter. Shoots bearing panicles at the time of harvesting were recorded by using a quadrate of one square meter from three places in each plot at 40, 60 and 80 DAT and average of three places was taken for analysis. Ten panicles were selected randomly from each plot and number of filled and unfilled grains per ten panicles were counted and average number of grains per panicles was worked out. One thousand filled grains from the produce of the net plots were counted and their weight was recorded in grams.

Border rows all around the experimental plots were harvested first and thereafter the net area was harvested separately. Produce of net plots was threshed and grains thus obtained were winnowed, cleaned and weighed. The yield recorded in kg/plot was standardized to 14% moisture and then weight was converted into kg/ha. Dry weight of straw collected from net plot was recorded after sun drying for 5-6 days and expressed in kg/ha.

III. RESULTS AND DISCUSSION

Growth and development is a physiological phenomenon of plant life. The rate and amount of growth has a very considerable effect on ultimate yield of plant which is affected by biotic and abiotic factors. Weed infestation is one of the major biotic constraints in transplanted rice production. So reducing the weed population and eliminating the crop-weed competition results in better crop growth and yield. *Echinochloa colona* and *Echinochloa crusgalli* were the dominant weeds and constituted 21.3 % and 17.1 % of the total weed population respectively and among the broad leaved weeds *Ammania baccifera* and *Ludwigia parviflora* occupied 11.4 and 7.8 % respectively in the weedy check plot.

A. Effect of Different Doses of Herbicides on Weed Flora Population

The data in respect of weed population of grassy and broad leaf weeds have been tabulated in Table I. The number of grassy weeds increased upto 60 DAT in pre-emergence herbicide treatments and weedy check. Application of post-emergence herbicides had a decrease in grassy weed population at 40 DAT and then an increase upto 60 DAT and decreasing trend was noticed afterwards. Grassy weed population was significantly lowest in weed free treatment at all stages of observation in comparison to all other

treatments. Among POE treatments, T_3 recorded significantly lowest grassy weed population i.e. 3.1, 3.5 and 3.2/m^2 at 40, 60 and 80 days after transplanting respectively, in comparison to rest of the other treatments except treatment T_1 (3.2, 4.4 and 3.9/m^2 respectively) to which it is statically at par. Pre-emergence herbicides were statistically similar at 20 DAT except Oxadiargyl. Application of Pretilachlor 750 g/ha (3 DAT), Butachlor 1500 g/ha (3 DAT), Bispyribac sodium 25 and 30 g/ha (20 DAT) and Pyrazosulfuron 20 g/ha (3 DAT) brought about similar significant reduction in number of grassy weeds at 40, 60 and 80 DAT. Azimsulfuron at all doses and stages did not provide good control of grassy weeds than other herbicides but was significantly better than weedy check. Similarly Walia *et al.* [7] found significantly lower weed population and dry weight of grassy weeds with the pre-emergence application of Pendimethalin 0.75 kg/ha fb post-emergence application of Bispyribac 25 g/ha. Post-emergence application of Azimsulfuron/2, 4-D was found to be less effective as grass weed population especially *Echinochloa crusgalli* and *Panicum crusgalli* was higher.

Table I. Effect of different doses of herbicides on Grassy weeds and Broad leaf weeds population in transplanted rice

Treatments	Grassy weeds (No./m2)			Broad leaf weeds (No./m2)		
	40 DAT	60 DAT	80 DAT	40 DAT	60 DAT	80 DAT
T_1	3.2 (10)	4.4 (19)	3.9 (15)	4.5 (20)	4.2 (27)	4.5 (20)
T_2	4.3 (18)	5.1 (25)	4.7 (22)	5.3 (28)	5.8 (34)	5.6 (31)
T_3	3.1 (8)	3.5 (12)	3.2 (10)	4.3 (18)	5.0 (25)	4.3 (18)
T_4	4.2 (17)	4.8 (23)	4.4 (19)	5.1 (25)	5.7 (32)	5.5 (30)
T_5	4.8 (23)	6.7 (45)	6.4 (41)	3.7 (13)	4.4 (19)	3.8 (14)
T_6	6.3 (39)	8.1 (65)	7.5 (56)	4.5 (20)	5.3 (28)	4.8 (23)
T_7	4.6 (21)	6.6 (43)	6.3 (39)	3.4 (11)	4.0 (16)	3.5 (12)
T_8	5.8 (33)	7.4 (55)	6.9 (48)	4.3 (18)	5.0 (28)	4.4 (19)
T_9	3.1 (9)	3.5 (12)	3.2 (10)	3.2 (10)	3.9 (15)	3.2 (10)
T_{10}	3.4 (11)	3.8 (14)	3.5 (12)	3.7 (15)	4.7 (22)	3.9 (15)
T_{11}	5.8 (33)	7.4 (55)	7.0 (49)	4.9 (24)	6.3 (40)	5.7 (32)
T_{12}	3.2 (10)	4.0 (16)	3.7 (13)	4.2 (16)	4.5 (20)	4.1 (17)
T_{13}	4.3 (18)	5.9 (35)	5.5 (30)	5.8 (33)	7.0 (49)	6.6 (43)
T_{14}	12.7 (160)	13.0 (170)	12.7 (160)	10.3 (105)	9.8 (95)	9.2 (85)
T_{15}	0.7 (0)	0.7 (0)	0.7 (0)	0.7 (0)	0.7 (0)	0.7 (0)
CD (P=0.05)	**1.1**	**1**	**1**	**0.9**	**1.1**	**1.1**

Values are square root $\sqrt{x} + 0.5$ transformed and actual values are given in parenthesis; DAT: Days after transplanting

Table II: Effect of different doses of herbicides on yield attributes and productivity of transplanted rice

Treatments	Effective tillers/m^2 at harvest	Filled grains/ panicle	Unfilled grains/ panicle	1000- grains weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1	310	157	14	24.8	6404	7735
T_2	297	152	16	24.6	6298	7555
T_3	324	162	12	24.9	6552	7863
T_4	301	153	15	24.7	6336	7606
T_5	283	146	18	24.7	6156	7384
T_6	260	133	24	24.4	5696	6838
T_7	288	149	17	24.7	6204	7442
T_8	280	145	19	24.6	6090	7317
T_9	329	164	10	24.9	6605	7923
T_{10}	322	162	13	24.9	6543	7852
T_{11}	270	138	22	24.4	5875	7045

T_{12}	315	160	13	24.8	6384	7782
T_{13}	275	142	21	24.5	6025	7204
T_{14}	220	120	30	23.8	4046	5257
T_{15}	330	165	10	25	6648	7974
CD (P=0.05)	**28**	**8**	**4**	**0.5**	**272**	**346**

Values are square root √x + 0.5 transformed and actual values are given in parenthesis; DAT: Days after transplanting

The data on population of broad-leaf weeds at various stages of observation revealed that number of broad-leaf weeds increased from 20 to 60 DAT where pre-emergence herbicides were applied and its density decreased afterwards. Pre-emergence herbicides Pretilachlor 750 g/ha (3 DAT), Butachlor 1500 g/ha (3 DAT) and Pyrazosulfuron 20 g/ha (3 DAT) were statistically similar but better than Oxadiargyl at 20 DAT. Azimsulfuron 30 and 40 g/ha (20 DAT) and Pyrazosulfuron 20 g/ha (3 DAT) were statistically similar to Pretilachlor and Butachlor to control the broad leaved weeds at 40, 60 and 80 DAT. Among POE treatments, highest broad leaf weed control was observed in treatment T_7 i.e. 3.4, 4.0 and 3.5/m^2 at 40, 60 and 80 days after transplanting respectively, which is statistically at par with treatments T_1, T_3, T_5 and T_8. Yadav *et al.* [8] also reported that weed population and dry weight of broad leaf weeds under all the treatments of Azimsulfuron was at par with Pretilachlor.

B. Effect of Different Doses of Herbicides on Yield Attributes and Yield of Transplanted Rice

Growth, development and yield contributing characters ultimately determine the yield of a crop. The yield attributes or the sink capacity of a crop is determined by the vegetative growth throughout the life cycle of the plant. Vigorous growth of a crop is associated with higher sink capacity. Weeds reduce crop growth and ultimately the yield through competition for nutrients, space, moisture and light as a result of their better adaptation to adverse environmental conditions as compared to crop plants. The control of weeds at critical stages of crop-weed competition turn the growth factor in favour of crop plants. Better use of growth factors by rice plant in the plots receiving weed control treatments due to less crop-weed competition was reflected on yield attributing characteristics viz., effective tillers/m^2, filled grains, 1000-grains weight. This may be due to lower weed density, which resulted in less competition.

Data shown in Table II revealed that the number of effective tillers/m^2 was influenced significantly by weed control treatments. Weed free treatment resulted in significantly highest number (330/m^2) of effective tillers/m^2 though at par with treatments T_1 (310//m^2), T_3 (324/m^2), T_9 (329/m^2), T_{10} (322/m^2) and T_{12} (315/m^2). Number of filled grains/panicle was also significantly affected by different treatments under study. The number of filled grains per panicle was highest (165/ panicle) in weed free treatment and these remained at par with treatments T_1, T_3, T_{10} and T_{12}. Lowest number (120/panicle) of filled grains was observed in weedy check. Number of unfilled grain was lower (10/ panicle) in weed free treatment and highest (30/panicle) in weedy check. Pretilachlor 750 g/ha (3 DAT), Butachlor 1500 g/ha (3 DAT), Bispyribac sodium 25 and 30 g/ha (20 DAT) and Pyrazosulfuron 20 g/ha (3 DAT) statistically at par with weed free treatment in reducing unfilled grains per panicle. Boldest grains (25g/1000-grains) were observed in weed free treatment and lighter (23.8g/1000-grains) in weedy check. All treatments had significantly higher 1000-grain weight than weedy check but remained statistically alike among themselves.

The grain yield was significantly higher with use of different weed control treatments over unweeded control. The highest grain yield and straw yield was obtained with weed free treatment (6648 and 7974 kg/ha) followed by Pretilachlor 750 g/ha (3 DAT) and minimum with weedy check. Application of Bispyribac sodium 25 and 30 g/ha (20 DAT), Butachlor 1500 g/ha (3 DAT) and Pyrazosulfuron 20 g/ha (3 DAT) had statistically similar grain yield to weed free treatment. Kathirvelan and Vaiyapuri [2] also reported that hand weeding (20 and 40 DAT) gave higher grain and straw yield. Dubey *et al.* [3] also reported maximum number of panicles/m^2 and grain yield of rice under weed-free treatment. Walia *et al.* [7] obtained significantly higher grain yield with pre-emergence application of Pendimethalin 0.75 kg/ha *fb* Bispyribac 25 g/ha in dry seeded rice.

IV. CONCLUSIONS

From the findings it is concluded that Bispyribac sodium treatments (T_1, T_3 and T_4) were statically at par with PRE treatment Pretilachlor 750 g/ha at 3 DAT (T_9). Treatments T_9 is the best treatment among all treatments except treatment T_{15} (weed free) in terms of highest number of effective tillers/m^2 production (329), filled grains/panicle (164), lowest unfilled grains/ panicle (10) and productivity of rice crop. So using Pretilachlor (PRE) @ 750 g/ha at 3 DAT and Bispyribac sodium (POE) @ 30 g/ha at 20 DAT are the best options in transplanted rice in terms of weed control as well as productivity of rice.

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