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Effect of Different Doses of Herbicides on Weed Control Efficiency, Growth and Productivity of Transplanted Rice (*Oryza sativa*)

Naresh Kumar[1*], Dharam Pal Nandal[2], Amit Kumar[1] and Mukesh Kumar[1]

[1]Department of Agronomy, CCS, Haryana Agricultural University Hisar-125 004, India

[2]Director, Directorate of Student Welfare, CCS, Haryana Agricultural University Hisar-125 004, India

*Corresponding Author E-mail: naresh.jindra@gmail.com

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ABSTRACT

An experiment was undertaken to study the response of different doses of herbicides on weed control efficiency, growth parameters 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 latitude of 29°51' North and longitude of 76°41' East at an elevation of 241 meters above mean sea level. The experiment was 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 9EC (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 total weed density at 60 DAT (7.2/m^2) and 80 DAT (6.2/m^2), lowest dry matter accumulation by weeds at harvest (6.5 g/m^2) in comparison to rest of the other treatments except treatment T_1 (7.8/m^2, 7.1/m^2 and 7.7 g/m^2 respectively) to which it was statistically at par. Highest weed control efficiency was observed in treatment T_3 (87.2%) among POE treatments and in treatment T_9 (89%) among PRE treatments. Performance of treatments T_1, T_3 and T_4 were statistically at par with PRE treatment T_9 which is best among all treatments except treatment T_{15} (weed free) in terms of highest number of tillers production, dry matter accumulation by crop plants and productivity of rice crop. So using Bispyribac sodium (POE) 25 g/ha at 20 DAT or 30 g/ha at 20 DAT are the alternate options in transplanted rice in terms of weed control as well as productivity of rice.

Key words: *Rice, Weed, POE, Bispyribac sodium, Herbicide*

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INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crop of India and is a staple food of more than 65 % of its 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 (Singh, 2001). In India, rice crop occupies an area of about 43.50 million hectares with total production of 104.41 million tonnes and productivity 2400 kg/ha during 2015-16[1]. In Haryana, rice is cultivated over an area of 1354 thousand hectares with a production of 4145 thousand tonnes and productivity 3061 kg/ha during 2015-16[2]. 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[7]. 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 (*Echinochloa crusgalli*) 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.

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^{o}51′ North and longitude of 76^{o}41′ East at an elevation of 241 meters above mean sea level. The experiment was 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 9EC (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 3 July 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. Total weed density from experimental plots was recorded 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. Weeds lying within quadrate area in each plot were cut from the ground level. The samples were first sun-dried and then dried in oven at 70°C for about 72 hours. Subsequently, samples were weighed and dry matter accumulation (g/m2) of weeds was recorded. %weed control was recorded visually. Weed control efficiency (WCE) at the time of last observation stage was worked out as per formula given below[3].

$$\text{Weed control efficiency} = \frac{Wc - Wt}{Wc} \times 100$$

Where,

Wc = weed dry weight in control plots.

Wt = weed dry weight in treated plots.

The height of the longest tiller was measured from five tagged plants from the base of the plant to the highest terminal point and average of these was taken to compute mean plant height. Number of tillers was recorded by using a quadrate of one square meter from three places in each and average of three places was taken for analysis. Plants from the randomly selected places using a quadrate of one square meter in each plot were cut close to the ground to record dry matter accumulation. Samples were first dried in sun and then oven dried at 70° C till constant weight was achieved. After drying, the samples were weighed for recording dry weight. 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.

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.

Effect of different doses of Herbicides on weed control

The data in respect of total weed density, drymatter accumulation by weeds and weed control efficiency have been tabulated in Table1. Weed control treatments [weed free (T_{15}), Pretilachlor 750 g/ha at 3 DAT (T_9), Bispyribac sodium 25 and 30 g/ha at 20 DAT (T_1 and T_3), Butachlor 1500 g/ha at 3 DAT (T_{10}), Pyrazosulfuron 20 g/ha at 3 DAT (T_{12})] effectively controlled the weeds with significant difference compared to weeded check (T_{14}). Significantly lowest weedy population and total dry weight were recorded under weed free treatment obviously. Treatments T_1 and T_3 proved to be the best treatment among the post-emergence

herbicides treatments with the weed control efficiency of 87.17% and 82.06% respectively. Late application of Bispyribac sodium 25 and 30 g/ha at 25 DAT resulted in decreased in weed control efficiency. Treatment T_{15} having maximum weed control efficiency followed by T_9 (89%), T_3 (87.2%), T_{10} (85.3%), T_{12} (82.6%) and T_1 (82.1%). Walia[8] also reported the significantly less dry weight and population of weeds in dry seeded rice with post-emergence application of Bispyribac 40 g/ha and Azimsulfuron 30 g/ha as compared to unweeded treatment at 75 DAS. The studies reveals that total population of weeds increased upto 60 DAT in weedy check and herbicidal treatments applied at 3 DAT (PRE). There was decrease in total weed population at 40 DAT after application of post-emergence herbicides and then an increase upto 60 DAT and it showed a decreasing trend afterwards. Total weed population was lowest in weed free treatment at all stages of observations. Among PRE herbicides, Pretilachlor 750 g/ha, Butachlor 1500 g/ha and Pyrazosulfuron 20 g/ha (3 DAT) proved significantly better than Oxadiargyl but statistically at par with Pyrazosulfuron in reducing the weed density at 20, 40, 60 and 80 DAT. Bispyribac sodium 25 and 30 g/ha applied at 20 DAT also resulted in significant reduction of weed population at 40, 60 and 80 DAT and remained statistically similar to Pretilachlor and Butachlor. Bispyribac sodium 25 and 30 g/ha applied at 25 DAT, Azimsulfuron 40 g/ha applied at 20 DAT were the next good herbicides.

Effect of Different Doses of Herbicides on growth and yield of rice

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 plant growth characters viz., plant height, number of tillers and crop dry matter accumulation. This may be due to lower dry weight of weeds, which resulted in less competition. Significantly taller plants were noticed in treatments T_1, T_3, T_9, T_{10}, T_{12} and T_{15} than weedy check. Among POE treatments T_3 recoded significantly highest plants height over rest of the other treatments except T_1 to which it was statistically at par. This may be due to lower dry weight of weeds, which resulted in less competition. Significantly higher number of tillers was recorded in plots kept weed free, which remained statistically at par with 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). The dry matter accumulation was significantly influenced by various treatments at all the stages of observation. The weed free treatment produced highest dry matter and weedy check treatment the lowest at all stages. Pretilachlor (750 g/ha), Butachlor (1500 g/ha), Bispyribac sodium (25 and 30 g/ha applied at 20 DAT) and Pyrazosulfuron (20 g/ha) proved statistically at par with weed free treatment at 40, 60, 80 DAT and at harvest. Singh[6] also showed significant decrease in plant height, number of tillers and ultimately crop dry matter production due to unchecked weed growth in rice. 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.

Table 1: Effect of different doses of herbicides on weed control in transplanted rice

Treatments	Total weed density/m^2				Dry matter accumulation by weed (g/m2) at harvest	WCE (%)
	20 DAT	40 DAT	60 DAT	80 DAT		
T_1	11.8 (140)	6.6 (43)	7.8 (62)	7.1 (50)	7.7 (59.3)	82.1
T_2	12.1 (146)	7.9 (62)	9.4 (88)	8.9 (79)	9.0 (81.8)	75.3
T_3	12.0 (143)	6.0 (36)	7.2 (51)	6.2 (38)	6.5 (42.4)	87.2
T_4	11.9 (142)	7.6 (57)	9.0 (82)	8.5 (73)	8.8 (78.3)	76.3
T_5	12.2 (149)	7.4 (56)	10.0 (101)	9.2 (85)	10.3 (105.8)	68
T_6	12.1 (147)	9.2 (84)	11.5 (133)	10.6 (113)	12.3 (150.7)	54.4
T_7	11.9 (143)	7.2 (52)	9.7 (95)	8.9 (79)	9.4 (88.7)	73.2
T_8	12.2 (149)	8.5 (73)	10.9 (119)	9.9 (99)	10.6 (113.5)	65.7
T_9	3.5 (12)	5.2 (27)	6.2 (38)	5.4 (29)	6.0 (36.4)	89
T_{10}	4.3 (18)	6.2 (38)	7.3 (53)	6.3 (40)	6.9 (48.5)	85.3
T_{11}	7.2 (52)	8.9 (79)	11.2 (125)	10.3 (105)	11.5 (131.8)	60.1
T_{12}	4.8 (23)	6.2 (39)	7.6 (58)	6.9 (48)	7.6 (57.5)	82.6
T_{13}	12.0 (144)	8.6 (75)	10.8 (117)	10.0 (101)	11.2 (125.0)	62.2
T_{14}	12.8 (165)	18.7 (350)	18.8 (352)	17.5 (307)	18.2 (330.5)	-
T_{15}	0.7 (0)	0.7 (0)	0.7 (0)	0.7 (0)	0.7 (0)	100
CD (P=0.05)	1.7	1.6	1.7	1.7	1.7	-

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

Table 2: Effect of different doses of herbicides on growth parameters and productivity of rice

Treatments	Plant height (cm) at harvest	Number of tillers /m2 at 80 DAT	Dry matter accumulation by crop at harvest (g/m^2)	Grain yield (kg/ha)	Straw yield (kg/ha)
T_1	108.6	332	1200	6404	7735
T_2	106	310	1167	6298	7555
T_3	109.5	340	1265	6552	7863
T_4	106.5	315	1182	6336	7606
T_5	105.3	302	1106	6156	7384
T_6	101.2	274	970	5696	6838
T_7	105.6	306	1134	6204	7442
T_8	103.5	296	1091	6090	7317
T_9	109.7	342	1283	6605	7923
T_{10}	108.9	336	1258	6543	7852
T_{11}	102.5	284	1005	5875	7045
T_{12}	108.6	336	1232	6384	7782
T_{13}	103.2	290	1058	6025	7204
T_{14}	95.9	232	851	4046	5257
T_{15}	111.1	346	1298	6648	7974
CD (P=0.05)	2.5	28	102	272	346

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

CONCLUSIONS

From the findings it is concluded that Bispyribac sodium treatments (T_1,T_3 and T_4) were statistically 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 tillers production, dry matter accumulation by crop plants and productivity of rice crop. So using Bispyribac

sodium (POE) 25 g/ha at 20 DAT or 30 g/ha at 20 DAT are the alternate options in transplanted rice in terms of weed control as well as productivity of rice.

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