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Research Article

Effect of pre-mix pendimethalin + pyrazosulfuron on grain yield and yield attributes of rice (*Oryza sativa* L.)

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Abstract

The experiment was carried out at Research Farm in Department of Agronomy, Punjab Agricultural University, Ludhiana to work out effective weed management strategy in transplanted rice. Nine treatments viz. pendimethalin + pyrazosulfuronat 675 + 15 g, 900 + 20 g, 1125 + 25 g, pendimethalin at 1500 g, pyrazosulfuronat 15 g, pyrazosulfuronat 20 g, metsulfuron + chlorimuronat 4 g ha^{-1}, hand weeding and weedy check replicated thrice laid out in randomized complete block design (RCBD). The results revealed that pendimethalin + pyrazosulfuron at 1125 + 25 g ha^{-1}, provided effective weed control (73.8-86.2% weed control efficiency) over other treatments. During 2015, pendimethalin + pyrazosulfuron at 1125 + 25 g ha^{-1} was found profitable with higher rice grain yield (6.65 t ha^{-1}) and cost benefit ratio (1:2.25). Pendimethalin + pyrazosulfuronatat 900 + 20 g ha^{-1}, was found profitable with higher rice grain yield (7.35 t ha^{-1}) and cost benefit ratio (1:2.50) and was statistically at par with pendimethalin + pyrazosulfuron at 1125 + 25 g ha^{-1} for weed control during 2016.

Keywords: Herbicide, weed density, weed control efficiency, yield, yield attributes

1. Introduction

Rice (*Oryza sativa*L.) is an important food crop feeding more than 60 per-cent of population in India. In India, area under rice is 43.86 m ha with a production of almost 104.80 m ton and productivity being 2390 Kg ha^{-1} (FAO, 2017). Rice production in India has increased during the last 61 years by nearly 400% from 1950 to 2015. Major share of rice production is in *kharif* season. Rice is grown well in hot and moist climate. It requires an optimum temperature range of 16°C – 27°C and rainfall of 100 to 200 cm**.** Rice can be grown in all type of soils like light to heavy soil, except very sandy but clay soil is the best for rice cultivation (Mahajan *et al*., 2009). Introduction of high yielding varieties, responsive to good fertilizer management coupled by improved package of practices for various regions has led to increase in productivity of rice. India ranked first in area and second in production and ranks 51st in productivity, has to produce 135-145 million tonnes of rice by 2020 to feed 350 million people (Prakash *et al*., 2008). So, there is a large scope for increase in productivity.

Weeds are one of the major constraints for getting optimum rice production because of their ability to compete for space, moisture, sunlight and nutrients. Uncontrolled growth of weeds in paddy reduced the grain yield by 75.8, 70.6 and 62.6 percent in dry seeded rice, wet seeded rice and transplanted rice, respectively (Singh *et al.,* 2005). The diverse weed population under transplanted paddy conditions (grasses, sedges and broad-leaved weeds) can cause yield reduction up to 76 percent (Mishra *et al*., 2007). About 60 percent of the weeds emerge during 7–30 days after transplanting and strongly compete with rice (Saha and Rao, 2010).

Herbicides are commonly used method for the control of weeds. Further sulfonylurea herbicides are widely used in India in number of crops like wheat and rice. Several pre-emergence herbicides like butachlor, propanil, oxyfluorfen, pendimethalin etc. have been tried to control weeds in direct seeded and transplanted paddy (Sheeja *et al*., 2013). Farmers generally apply herbicides by mixing them in sand for easy operation and prefer to use either single application of pre or post herbicides, which fails to control diverse weed flora observed in direct seeded rice and transplanted

rice (Chauhan, 2012; Chauhan and Opena, 2012). However, it is important to use a broad-spectrum herbicide including pre and post herbicides for season long effective weed control and to avoid shift towards problematic weed species (Chauhan, 2012; Yadav *et al.*, 2009) or evolution of herbicide resistant weed biotypes. Herbicide combinations chosen judiciouslygives effective weed control than single herbicide application (Khaliq *et al.*, 2012). Keeping in view the above ideas, an experiment was carried out to study the effect of different herbicide combinations on grain yield and economics of transplanted rice.

2. Material and methods

The experiment was carried out at Research Farmin the Department of Agronomy, Punjab Agricultural University, Ludhiana during *Kharif* 2015 and 2016. The research farm is situated at 30° 54' N latitude and 75° 48' E longitude and at the height of 247 meters above the mean sea level. It is characterized by sub-tropical and semi-arid type of climate with hot and dry summer (April to June), hot and humid climate (July to September) and cold winter (November to January). The maximum and minimum temperatures show considerable variations during both summer and winter seasons. Maximum temperature goes above 47°C during summer, while temperature below 4°C accompanied by frosty spells is quite common during the winter months of December and January. The temperature remains mild in the month of February and March. The average annual rainfall at Ludhiana is 500-750 mm, most of which is received during the rainy season from July to September. The soil of the experiment field was loamy sand, having pH (7.2 and 7.1), EC (0.32 and 0.30 dS m^{-1}), OC (0.31 and 0.32%), available N (196.0 and 197.5 Kg ha^{-1}), available P (18.8 and 20.5 Kg ha^{-1}) and available K (213.2 and 216 Kg ha^{-1}), respectively during both years of experimentation. The experiment with treatments namely, pendimethalin 30% EC + pyrazosulfuron 10% WP at 675 + 15 g, 900 + 20 g, 1125 + 25 g a.i ha^{-1}, pendimethalin 30% EC at 1500 g a.i. ha^{-1}, pyrazosulfuron 10%WP at 15 g a.i. ha^{-1}, pyrazosulfuron 10% WP at 20 g a.i. ha^{-1}, metsulfuron 10% + chlorimuron 10% WP at 4 g a.i ha^{-1}, hand weeding and weedy check in randomized complete block design (RCBD) with three replications was conducted. Herbicides were applied as pre-emergence i.e. 0-3 days after transplanting as sand-mix. The application of herbicides was done as per treatment in standing water. Hand weeding was done twice at 15 and 30 DAT. Rice variety PR 121 was transplanted on 09-07-2015 and 22-6-2016, respectively. Recommended dose of fertilizer N, P_2O_5 and K_2O at 125, 30, 30 Kg ha^{-1}, respectively was applied to the crop during the crop season. The source of fertilizers used was urea, single super phosphate and muriate of potash. Full dose of P and K and one third dose of nitrogen wasapplied at the last puddling and remaining dose of nitrogen in two equal splits after three weeks and six weeks after transplanting. Weed count and weed dry matter was recorded at 45 and 75 days after treatment (DAT). The numbers of weed species were recorded in a quadrat of 1 m × 1 m in three random spots per plot and average was expressed in number m^{-2}. Whereas, for weed dry matter, weeds were categorized as broadleaved, grasses and sedge weeds and then dry matter of weeds was weighed and expressed in gm^{-2}.The post emergence herbicide was applied with knapsack sprayer fitted with flan nozzle after draining the water from the field. Weed control efficiency were calculated at 45 and 75 days after treatment application as per formula given below:

$$\text{Weed control efficiency} = \frac{\text{WDC-WDT}}{\text{WDC}} \times 100$$

Where, WDC = Weed dry matter in untreated plot (gm^{-2})

WDT = Weed dry matter in treated plot (gm^{-2})

The data collected were subjected to analysis using analysis of variance (ANOVA) for the randomized block design to test the significance statistical methods using SAS software.The attributes having significant correlation have been chosen for regression analysis.

3. Results and discussion

The experiment field was infested with diverse flora of grass weeds mainly *Echinochloa* spp. (*E. colona* and *E. crus-galli*), broad leaf weeds *viz., Ammania baccifera, Eclipta alba, others (Caesulia axillaris, Sphenoclea zeylanica, Alternanthera sessilis*) and sedges *Cyperus* spp. (*C. difformis* and *C. iria*).

3.1 Weed density

Pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1} recorded lowest weed density of *Echinochloa* spp. at 45 DAT and recorded as the best treatment among the herbicide treatments, for the control of grass weeds. Weedy check, where no herbicide was applied recorded more density of *Echinochloa* spp. with 8 plants per m^2 in 2015 and 11 per m^2 in 2016. Similar trend was observed for the control of broad leaf weeds where pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1} was applied. Significant reduction in population of broad leaf weeds (*Ammania baccifera, Eclipta alba* and others) was recorded during both the years of experimentation. More broad leaved weeds were recorded in weedy check. Sedges (*Cyperus*

Table 1: Effect of different treatments on weed no. per m^2 at 45 days after transplanting in transplanted rice.

Treatments	Dose (g ha^{-1})	Weed density (No. m^{-2})									
		Grass weed		Broadleaved weeds				*Others weeds*		Sedges	
		Echinochloa spp.		*A. baccifera*		*E. alba*				*Cyperus* spp.	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Pendimethalin + pyrazosulfuron	675 + 15	1.37 (1)*	2.36 (5)	2.23 (4)	2.63 (6)	1.82 (2)	1.79 (2)	2.08 (3)	1.79 (2)	1.95 (3)	1.87 (4)
Pendimethalin + pyrazosulfuron	900 + 20	1.28 (0.7)	1.49 (1)	1.53 (2)	1.41 (1)	1.13 (0.3)	1.38 (1.0)	1.14 (0.3)	1.14 (0.3)	1.37 (1)	1.41 (1)
Pendimethalin + pyrazosulfuron	1125 + 25	1.07 (0.2)	1.24 (0.7)	1.14 (0.3)	1.00 (0)	1.07 (0.2)	1.14 (0.3)	1.00 (0.0)	1.00 (0)	1.14 (0.3)	1.00 (0)
Pendimethalin	1500	1.21 (0.5)	1.24 (0.7)	2.55 (6)	2.88 (7)	1.56 (2)	2.23 (4)	1.95 (3)	1.99 (3)	1.95 (3)	2.73 (7)
Pyrazosulfuron	15	1.95 (3)	3.39 (11)	1.95 (3)	3.63 (12)	2.08 (3)	2.63 (6)	2.23 (4)	1.99 (3)	1.37 (1)	1.53 (2)
Pyrazosulfuron	20	1.82 (2)	2.49 (5)	2.73 (7)	2.75 (7)	1.72 (2)	2.29 (4)	1.95 (3)	1.99 (3)	1.00 (0.0)	1.37 (1)
Metsulfuron + chlorimuron	4	3.08 (9)	3.29 (10)	1.19 (0.5)	1.24 (0.7)	1.14 (0.3)	1.00 (0)	1.56 (2)	1.79 (2)	1.82 (2)	2.34 (5)
Hand weedings (Two)	-	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)
Weedy check	-	2.99 (8)	3.48 (11)	2.38 (5)	3.60 (12)	2.86 (7)	2.44 (5)	2.99 (8)	2.15 (4)	2.77 (7)	3.68 (13)
CD at 5%	-	0.42	0.71	0.38	0.63	0.41	0.48	0.42	0.42	0.47	0.67

*Figures within parenthesis are original values. Data is subjected to square root transformation

spp.) were effectively controlled by pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1} (Table 1). Pendimethalin + pyrazosulfuronat 900 + 20 g ha^{-1} showed similar results with 1125 + 25 g ha^{-1} in providing control of grasses, broad leaved weeds and sedges. Pyrazosulfuron at 20 g ha^{-1} was more effective than 15 g ha^{-1} for the control of sedges as compared to grasses and broad leaf weeds. Metsulfuron + chlorimuron at 4 g ha^{-1} provided effective control of broad leaf weeds.

At 75 DAT, pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1} continued to show the best results by reducing weed density of grasses, broad leaf weeds and sedges. Lowest density of *Echinochloa* spp., broad leaf weeds, *Ammania baccifera*, *Eclipta alb*a and others and sedges (*Cyperus* spp.) were recorded. However higher weed density *viz.,* grasses, broad leaved weeds and sedges wasrecorded in weedy check during both the years (Table 2). Pendimethalin + pyrazosulfuronat 900 + 20 g ha^{-1} was at par with 1125 + 25 g ha^{-1} for the control of diverse weed flora in rice. Singh *et al.* (2005) also observed the similar results when combination of pendimethalin + pyrazosulfuronwas applied which resulted in effective control of mixed weed flora in rice field, may be due to pendimethalin which was effective in controlling annual grasses and certain broad leaved weeds and pyrazosulfuron gave effective control against sedges, so provided over all control of weed flora.

3.2 Weed dry weight and weed control efficiency (WCE)

In hand weeding treatment there was no weed population recorded so weed dry weight was also recorded zero (0) and weed control efficiency was the highest among all the treatments i.e. 100% at 45 and 75 DAT during both years. Among the herbicidal treatments at 45 DAT, the results were at par in pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1} and with hand weeding by controlling mixed weed flora effectively and recorded lowest weed dry weights of grasses, broad leaved weeds and sedges (14, 3, 3g m^{-2} in 2015, and 5, 2, 2 g m^{-2} in 2016, respectively), total weed dry weight was also recorded lowest 20 g m^{-2} during 2015 and 9 g m^{-2} with pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1}. Weed check recorded the highest weed dry weight of grasses, broad leaved weeds and sedges (49, 18, 17g m^{-2} in 2015 and 22, 19, 24 g m^{-2}in 2016) and total dry weight of 84 g m^{-2} and 65 g m^{-2} in 2015 and 2016 respectively. Highest weed control efficiency among the herbicidal treatments was recorded 76.2% and 86.2% during 2015 and 2016, respectively with pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1}.

At 75 DAT, similar result trend was observed for weed dry weight. Lowest weed dry weight was recorded with pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1} and highest weed dry weight was recorded with weedy check treatment. Lowest weed dry weight (20, 8, 7 g m^{-2} of grasses, broad leaved weeds and sedges in 2015 and 24, 4, 10 g m^{-2} of grasses, broad leaved weeds and sedges in 2016, respectively) with total dry weight of all weed mixed flora 35 g m^{-2} in 2015 and 38 g m^{-2} in 2016 and also recorded highest weed control efficiency of 71.5% in 2015 and 71.4% in 2016 among all herbicide treatments. However, highest weed dry weight of grasses, broad leaved weeds and

Table 2: Effect of different treatments on weed density at 75 days after transplanting in transplanted rice.

Treatment	Dose (g ha^{-1})	Weed density (No. m^{-2})									
		Grass		Broadleaved weeds				Other		Sedges	
		Echinochloa spp.		*A. baccifera*		*E. alba*				*Cyperusspp*	
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Pendimethalin + pyrazosulfuron	675 + 15	1.87 (3)*	2.92 (8)	3.16 (9)	3.99 (15)	3.39 (11)	3.29 (10)	2.73 (7)	1.99 (4)	3.14 (9)	3.26 (10)
Pendimethalin + pyrazosulfuron	900 + 20	1.14 (0.3)	1.79 (2)	2.57 (6)	2.64 (7)	2.36 (5)	1.99 (4)	2.15 (4)	1.41 (1)	2.64 (6)	1.75 (3)
Pendimethalin + pyrazosulfuron	1125 + 25	1.14 (0.3)	1.39 (1)	2.15 (4)	1.73 (2)	1.72 (2)	1.79 (3)	1.72 (2)	1.41 (1)	2.15 (4)	1.67 (3)
Pendimethalin	1500	1.32 (0.8)	2.99 (8)	3.07 (9)	4.35 (18)	3.15 (9)	4.61 (20)	2.23 (4)	1.75 (3)	3.08 (9)	3.31 (10)
Pyrazosulfuron	15	2.68 (6)	4.61 (20)	3.12 (9)	3.95 (15)	3.10 (9)	4.13 (16)	2.36 (5)	2.34 (5)	2.36 (5)	3.31 (10)
Pyrazosulfuron	20	2.04 (3)	3.78 (13)	2.78 (7)	3.77 (13)	2.48 (5)	4.03 (15)	2.15 (4)	1.99 (4)	1.53 (2)	2.32 (5)
Metsulfuron + chlorimuron	4	4.54 (20)	5.35 (28)	2.15 (4)	1.38 (1)	2.36 (5)	1.00 (0.0)	2.15 (4)	1.73 (2)	1.19 (0.5)	1.14 (0.3)
Hand weedings (Two)	-	1.82 (2)	1.14 (0.3)	2.03 (3)	1.38 (1)	1.99 (3)	1.24 (0.7)	1.56 (2)	1.41 (1)	2.22 (4)	1.24 (0.7)
Weedy check	-	4.58 (20)	5.09 (25)	3.62 (12)	4.27 (17)	3.67 (13)	3.59 (12)	3.62 (12)	2.88 (7)	3.12 (9)	5.13 (25)
CD at 5%	-	0.63	0.52	0.61	1.06	0.62	0.84	0.55	0.53	0.58	0.92

*Figures within parenthesis are original values. Data is subjected to square root transformation

sedges (55, 22, 46 g m^{-2} in 2015 and 58, 22, 53g m^{-2} in 2016, respectively) was recorded with weedy check with highest total weed biomass of 123 in 2015 and 113 in 2016. These results are in confirmation with the findings of Kaur and Singh (2015) and Singh *et al.* (2008) also recorded effective control of grasses, broad leaved weeds and sedges with combination of pendimethalin + pyrazosulfuron. Pendimethalin pre-emergence application help in managing BLWs and show no effect on rice and pyrazosulfuron manage to control grasses and sedges at critical crop-weed competition period of rice and hence result in higher crop yields and low the pressure of weed competition (Ghosh *et al.,* 2018).

3.3 Yield attributes and grain yield of rice

No significant difference in plant height and panicle length was recorded. Different weed control treatments had significant effect on the grain yield of rice. Highest grain yield of rice was obtained with pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1} (6.65 t ha^{-1}) which was at par with hand weeding (6.59 t ha^{-1}) and pendimethalin + pyrazosulfuronat 900 +

Table 3: Effect of different treatments on weed dry weight (g m^{-2}) and weed control efficiency at 45 days after transplanting in transplanted rice.

Treatments	Dose (g ha^{-1})	Weed dry weight (g m^{-2})						Total weed dry weight (g m^{-2})		WCE (%)	
		Grass		Broad leaved weeds		Sedges					
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Pendimethalin + pyrazosulfuron	675 + 15	5.15 (25)*	3.15 (9)	3.19 (8)	2.94 (8)	3.17 (8)	2.61 (6)	6.71 (41)	4.90 (23)	51.2	64.6
Pendimethalin + pyrazosulfuron	900 + 20	4.00 (15)	2.65 (6)	2.24 (4)	2.03 (4)	2.06 (3)	1.75 (2)	4.80 (22)	3.61 (12)	73.8	81.5
Pendimethalin + pyrazosulfuron	1125 + 25	3.92 (14)	2.44 (5)	1.66 (3)	1.62 (2)	2.06 (3)	1.75 (2)	4.53 (20)	3.17 (9)	76.2	86.2
Pendimethalin	1500	5.05 (25)	4.20 (17)	3.27 (10)	3.85 (14)	3.55 (11)	3.86 (14)	6.86 (46)	6.73 (45)	45.2	30.8
Pyrazosulfuron	15	5.61 (27)	4.44 (19)	2.81 (7.0)	3.54 (12)	2.55 (6)	2.20 (4)	6.36 (40)	5.94 (35)	52.4	46.2
Pyrazosulfuron	20	5.28 (27)	4.01 (15)	2.22 (6)	3.28 (10)	2.45 (7)	1.58 (2)	6.37 (40)	5.24 (27)	52.4	58.5
Metsulfuron + chlorimuron	4	6.79 (44)	4.71 (21)	1.80 (3)	1.14 (0.3)	2.10 (4)	1.00 (0)	7.21 (51)	4.75 (21)	39.3	67.7
Hand weedings (Two)	-	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	1.00 (0)	100	100
Weedy check	-	7.07 (49)	4.79 (22)	4.25 (18)	4.38 (19)	4.25 (17)	4.95 (24)	9.18 (84)	8.08 (65)	-	-
CD at 5%	-	0.58	0.53	0.79	0.98	0.5	0.71	0.75	0.86	-	-

*Figures within parenthesis are original values. Data is subjected to square root transformation

Table 4: Effect of different treatments on weed dry weight and weed control efficiency at 75 DAT in transplanting rice.

Treatments	Dose (g ha^{-1})	Weed dry weight (g m^{-2})						Total weed dry weight (g m^{-2})		WCE (%)	
		Grass		Broad leaved weeds		Sedges					
		2015	2016	2015	2016	2015	2016	2015	2016	2015	2016
Pendimethalin + pyrazosulfuron	675 + 15	6.91 (47)*	5.74 (32)	3.74 (13)	3.32 (10)	4.51 (19)	4.36 (18)	8.96 (79)	7.81 (60)	35.8	54.9
Pendimethalin + pyrazosulfuron	900 + 20	4.80 (22)	5.20 (26)	3.15 (9)	2.65 (6)	3.16 (9)	3.78 (13)	6.40 (40)	6.78 (45)	67.5	66.2
Pendimethalin + pyrazosulfuron	1125 + 25	4.54 (20)	5.00 (24)	2.94 (8)	2.10 (4)	2.87 (7)	3.31 (10)	5.97 (35)	6.24 (38)	71.5	71.4
Pendimethalin	1500	6.02 (35)	6.08 (36)	3.43 (11)	4.50 (19)	4.22 (17)	4.65 (21)	8.0 (63)	8.78 (76)	48.8	42.9
Pyrazosulfuron	15	6.86 (46)	7.45 (55)	4.93 (23)	3.99 (15)	2.61 (6)	3.64 (12)	8.75 (75)	9.10 (82)	39	38.3
Pyrazosulfuron	20	6.33 (39)	6.66 (43)	4.74 (22)	3.64 (12)	3.36 (10)	3.58 (12)	8.49 (71)	8.29 (67)	42.3	49.6
Metsulfuron + chlorimuron	4	7.52 (56)	7.43 (54)	2.87 (7)	2.99 (8)	2.46 (5)	3.11 (9)	8.30 (68)	8.48 (71)	44.7	46.6
Hand weedings (Two)	-	2.49 (5)	2.20 (4)	2.70 (6)	2.23 (4)	2.40 (5)	1.48 (2)	4.17 (16)	3.26 (10)	87	92.5
Weedy check	-	7.43 (55)	7.64 (58)	4.72 (22)	4.80 (22)	6.84 (46)	7.35 (53)	11.08 (123)	11.55 (133)	-	-
CD at 5%	-	0.76	0.69	0.59	0.72	0.5	0.65	0.68	0.73	-	-

*Figures within parenthesis are original values. Data is subjected to square root transformation

20 g ha^{-1} (6.55 t ha^{-1}) and was significantly superior to rest of the treatments during 2015. However, in 2016, highest grain yield of rice (7.35 t ha^{-1}) was recorded in pendimethalin + pyrazosulfuronat 900 + 20 g ha^{-1} and hand weeding treatment i.e. 7.35 t ha^{-1} and was at par with pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1} with 7.31 t ha^{-1} and superior to all other treatments.. Lower weed biomass as well as higher grain yield in paddy was recorded in cyhalofop + chlorimuron + metsulfuron followed by fenoxaprop + chlorimuron + metsulfuron (Menon *et al.*, 2014).

3.4 Economics

Among the herbicidal treatments, maximum B:C ratio of 2.25 was recorded with pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1} followed by

Table 5: Effect of different treatments on yield attributes and yield and benefit cost ratio in transplanting rice.

Treatments	Dose (g ha^{-1})	Plant height (cm)		Panicle length (cm)		Grain yield (t ha^{-1})		B:C	
		2015	2016	2015	2016	2015	2016	2015	2016
Pendimethalin + pyrazosulfuron	675 + 15	70.60	68.47	24.0	22.7	5.88	6.99	1:2.02	1:2.40
Pendimethalin + pyrazosulfuron	900 + 20	73.20	69.93	24.7	22.9	6.55	7.35	1:2.24	1:2.50
Pendimethalin + pyrazosulfuron	1125 + 25	74.73	71.20	25.0	22.9	6.65	7.31	1:2.25	1:2.47
Pendimethalin	1500	69.53	69.93	24.3	22.7	5.88	6.88	1:1.96	1:2.29
Pyrazosulfuron	15	70.26	68.73	24.6	22.7	5.70	6.77	1:1.99	1:2.35
Pyrazosulfuron	20	71.40	69.27	24.7	22.6	5.75	6.73	1:2.00	1:2.33
Metsulfuron + chlorimuron	4	71.60	70.67	24.5	22.6	5.33	6.50	1:1.86	1:2.26
Hand weedings (Two)	-	76.73	70.33	25.3	22.9	6.59	7.35	1:1.80	1:2.02
Weedy check	-	74.07	67.07	23.9	22.5	5.15	5.14	1:1.82	1:1.81
CD at 5%	-	NS	NS	NS	NS	0.59	0.28	-	-

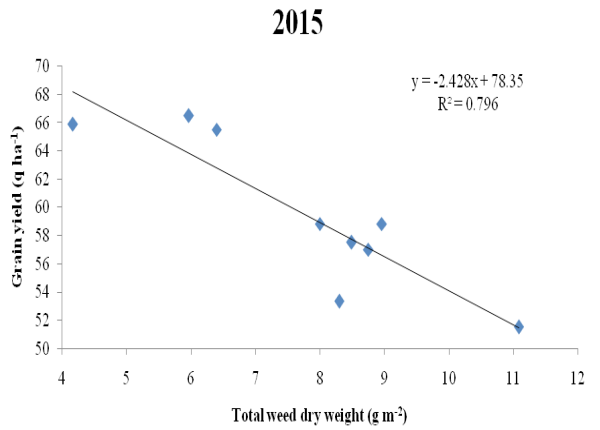

Fig. 1: Relationship between grain yield and total weed dry weight during 2015

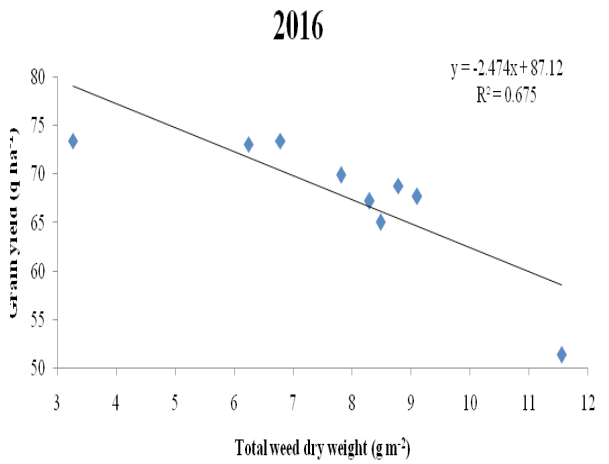

Fig. 2: Relationship between grain yield and total weed dry weight during 2016

lower doseat 900 + 20 g ha^{-1} during 2015 and B:C ratio of 2.50 was recorded with pendimethalin + pyrazosulfuronat 900 + 20 g ha^{-1} and followed by pendimethalin + pyrazosulfuronat 1125 + 25 g ha^{-1} during 2016 (Table 5). This may be due to the fact that both the treatments had shown effective control on weed flora and helped in attaining higher grain yield as compared to other treatments. Hand weedings significantly improved the grain yield but the profit margin gets reduced due to higher wages of human labour incurred.

3.5 Correlation and regression

Correlation between grain yield and total weed dry weight was found to be negative as there was decrease in grain yield with increase in weight of total weed dry weight. Similarly, the coefficient of determination (r^2) indicated that there was 79.7% and 67.5% variability in grain yield during 2015 (Fig. 1) and 2016 (Fig. 2), respectively which was due to its association with total weed dry weight. Regression coefficient suggested that with the increase in total weed dry weight by 1 g m^{-2} there was decrease in grain yield by 2.43 q ha^{-1} in 2015 and 2.47 q ha^{-1} in 2016.

Mixed weed flora dominated in rice crop namely*Echinochloa* spp., *Ammania baccifera*, *Eclipta alba*, and *Cyperus* spp. (*C. difformis* and *C. iria*) if not controlled properly reduced the grain yield of rice. The two year study indicated that herbicide premix of pendimethalin + pyrazosulfuronat 900 + 20 to 1125 + 25 g ha^{-1} was found to be effective for reducing weed infestation and achieving better yields of transplanted rice.

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