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"Effect of Weed Management Practices on Weed Dynamics, Yield and Economics of Transplanted Rice"

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ABSTRACT: *A field experiment was conducted at the Agronomy Farm, College of Agriculture, Nagpur during* kharif *season of 2011-2012. The soil was low in available nitrogen, moderately low in phosphorus and high in available potash. The experiment was laid out in Randomized block design with six treatments and four replications. The lowest dry matter of weeds and highest weed control efficiency was recorded with two hoeing and two weeding at 20 and 40 DAT. The highest grain yield and straw yield was obtained under treatment two hoeing and two weeding at 20 and 40 DAT. Maximum gross monetary return, net monetary return and benefit:cost ratio was obtained under treatment of two hoeing and two weeding at 20 and 40 DAT (T_2) and it was similar with ethoxysulfuron with 12.5 g ha^{-1} at 3-4 DAT.*

Key words: *Dynamics, Economic, Rice, Weed, Yield.*

INTRODUCTION

Rice is one of the most important staple food grain crop of the world. Total area under rice in India is 43.81 million hectares with annual production of 100.50 million tonnes and productivity was 3.0 tonnes ha^{-1}(Anonymous,2010).Though production is large, but per hectare yield is very poor as compared to other rice growing countries like Japan(6.4 tonnes ha^{-1}) China (6.0 tonnes ha^{-1}) and USA(7.5 tonnes ha^{-1}). The average yield of rice in India 29.29 q ha^{-1} (Anonymous, 2010).

It is grown practically in all states of India but major states are West Bengal, U.P., Bihar, Orissa, M.P., A.P. and Tamil Nadu with 80% area and 76% production. Maharashtra state during 2008-09 had about 14.88 lakh hectare area under rice with total output of 20.98 lakh t. However, the average productivity of Maharashtra is low (1.76 t ha^{-1}) as compared to other rice growing states like Tamil Nadu (3.4 t ha^{-1}), Punjab (3.2 t ha^{-1}) Andhra Pradesh (2.8 t ha^{-1}), Karnataka (2.5 t ha^{-1}), Haryana (2.3 t ha^{-1}) and West Bengal (2.2 t ha^{-1}). The average productivity of Vidarbha region is 1.47 t ha^{-1} which is too low.

Weed management is very critical factor for successful rice production, because the soil condition favours simultaneous germination of weed seeds along with rice seeds. So it is difficult to control weeds by hand weeding in the early stage of crop growth in transplanted rice. The farmer has to be more careful in weed control to explicit high yield potential of variety. Now a day the chemical control method is becoming popular among the rice belt farmers because it is the most efficient in reducing weed competition with minimum labour cost (Baloch, 1994, Awan, 1988). Manual weeding becomes difficult because of possible damage to rice plants, problem in differentiating grassy weeds, labour scarcity, time consumed and relatively less effectiveness. Herbicides are considered to be an alternative supplement to hand weeding. Rice grain production in India suffers a yearly loss of 15 MT due to weed competition (Kathirean, 2002). Though herbicide use in India is low, it is more popular in rice (Morallo and Rajesus, 1983). Near about 54% herbicidal use in India is made towards rice.

The use of herbicide is potentially one of the most labour saving innovation and sustainable in terms of enhance productivity in modern rice cultivation. Several pre-emergence herbicides including Butachlor, Thiobencarb, Pendimethalin, oxyfluorfen and Nitrofen alone or supplemented with hand weeding, have provide a fair degree of weed control. But use of same group of herbicide having the same mode of action over a period of time on a same piece of land leads to imbalance in terms of weeds shift, environmental pollution and development of resistance in weeds.

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In herbicidal control there is no automatic signal to stop a farmer who may be applying the chemical inaccurately till he sees the results in the crop sprayed. It requires considerable skill. In some cases there is herbicide residue effect on succeeding crop observed. Therefore, the use of newer herbicide is essential in controlling weed population. The new and promising herbicide like ethoxysulfuron for early post-emergence application with suitable dose need to be determined to keep the land free during critical period of crop growth.

MATERIALS AND METHODS

The present investigation was carried out on the experimental field no. 11 of the farm of Agronomy Section, College of Agriculture, Nagpur during the *kharif* season of 2011-2012. The soil of experimental plot was silt clay in texture having slightly alkaline nature pH (7.8).As regards to fertility status, it was low in available nitrogen, moderate in available phosphorus, fairly rich in available potassium and moderate in organic carbon content. Nagpur is situated at elevation of 321 meter above mean sea level and at latitude 21^0 10′ North and longitude at 79^0 19′East, having tropical climate with assured but variable rainfall in *kharif* season associated with severe hot summer. Weekly and monthly meteorological data in respect of rainfall, humidity, minimum and maximum temperature and rainy days of *kharif* and *rabi*, 2010-2011 recorded at meteorological observatory, College of Agriculture, Nagpur.

The experiment was laid out in Randomized Block Design with four replication and six treatments which include application of herbicide with weeding and hoeing.

Detail of experimental treatment as T_1 Check(unweeded) ,T_2 Two hoeing and two weeding at 20 and 40 DAT, T_3 Ethoxysulfuron 10 g ha^{-1} at 3-4 DAT, T_4 Ethoxysulfuron 12.5 g ha^{-1} at 3-4 DAT ,T_5 Ethoxysulfuron 15 g ha^{-1} at 3-4 DAT, T_6 Ethoxysulfuron 17.5 g ha^{-1} at 3-4 DAT

(DAT : Days After Tranplanting **)** The seeds were sown in nursery bed on 26th June 2010. The seed beds were irrigated whenever necessary. The nursery was kept weed free. The necessary plant protection measures were taken in the nursery.The experimental field was ploughed twice, puddled and then leveled by planker. The layout was prepared after puddling and leveling. Transplanting was done on 27thJuly 2010.The paddy crop was fertilized with recommended dose of 100:50:50 kg NPK ha^{-1}.Nitrogen was applied through urea in three split doses i.e at the time of puddling, tillering and panicle initiation stage, phosphorus applied at the time of puddling through single super phosphate and potassium was applied through muriate of potash at puddling.

Ethoxysulfuron is the commercial product used as herbicide in experiment Herbicide was mixed with two liters of water and then sprayed uniformly. Ethoxysulfuron is mainly taken up by the leaves and is translocated within the plant. After inhibition of plant growth, chlorotic patches develop and spread at first acropetally, and then basipetally. The action of the product reaches its conclusion about 3-4 weeks after application with the death of the whole plant. Ethoxysulfuron acts by inhibition of the acetoloctate synthesis.

Economics of the treatment was worked out in terms of cost of cultivation, gross monetary return, net monetary return and benefit: cost ratio was calculated.The grain and straw yield of paddy was converted in money value i.e. Rs. ha^{-1} at the rate recommended by price fixing committee, PDKV, Akola for the year 2010-2011.Price of grain was taken as.1500 q^{-1} and straw as Rs.20 q^{-1}Net monetary return was calculated by substracting the cost of cultivation from gross monetary return treatment wise.The benefit Cost ratio was worked out by dividing gross monetary return (Rs.ha^{-1}) with total cost of cultivation (Rs.ha^{-1}).

RESULTS AND DISCUSSION

Data pertaining to mean monocot weed population as influenced by different treatments are presented in Table 1′. the herbicidal treatments recorded less weed population than unweeded check. Two hoeing and two weeding at 20 and 40 DAT (T_2) was at par with treatment ethoxysulfuron at 15 g ha^{-1} at 3-4 DAT (T_5), ethoxysulfuron at 12.5 g ha^{-1} at 3-4 DAT (T_4) and ethoxysulfuron at 17.5 g ha^{-1} at 3-4 DAT (T_6). Monocot weed population was reduced significantly due to different weed control treatments at all growth stages the lowest density of monocot weed was recorded with two hoeings and two weedings at 20 and 40 DAT (T_2). These results are in agreement with those reported by Subramanyam *et al.* (2003), Pillai *et al.* (1976), Bhagat *et al.* (1977).

Data pertaining mean dicot weed population as influenced by different treatments are presented in Table 1. Cultural treatment two hoeing and two weeding at 20 and 40 DAT (T_2) were found significantly effective in reducing dicot weed population. Among the chemical treatment ethoxysulfuron 15 g ha^{-1} at 3-4 DAT (T_5), ethoxysulfuron 12.5 g ha^{-1} at 3-4 DAT (T_4)

Table 1
Weed dynamics Yield and Economics of transplanted rice as influenced by different weed management practices

Treatments	*Monocot weed population*	*Dicot weed population*	*Total weed population*	*Total weed dry matter (g)*	*Weed index (%)*	*Weed control efficiency (%)*	*Straw Yield*	*Grain yield ($q\ ha^{-1}$)*
T_1- Check(unweeded)	5.11 (25.65)	4.96(24.18)	7.09(49.83)	17.6	44.58	82.52	38.50	23.80
T_2- Two hoeings and two weedings at 20 and 40 DAT	2.75(7.10)	2.37(5.15)	3.57(12.25)	3.71	–	52.52	57.95	42.95
T_3- Ethoxysulfuron 10 g ha^{-1} at 3-4DAT	4.22(17.35)	3.33(10.65)	5.33(28.00)	9.40	27.12	82.81	44.00	31.30
T_4- Ethoxysulfuron 12.5 g ha^{-1} at 3- 4 DAT	3.10(9.10)	2.52(5.85)	3.93(14.95)	3.62	11.43	82.06	52.56	38.04
T_5- Ethoxysulfuron 15 g ha^{-1} at 3-4 DAT	3.20(9.75)	2.44(5.45)	3.96(15.20)	3.67	11.05	72.64	52.70	38.20
T_6- Ethoxysulfuron 17.5 g ha^{-1} at 3-4DAT	3.39(11.00)	2.50(5.75)	4.15(16.75)	5.50	15.48	62.09	50.36	36.30
SE (m) ±	0.24	0.15	0.24	0.59	–	–	0.28	0.42
CD at 5%	0.68	0.46	0.71	1.79	–	–	0.83	1.25
GM	3.62	3.02	4.67	7.28	18.27	49.15	34.89	

* Transformed values $\sqrt{x+0.5}$
Figure in parentheses are the original values.

Table 2
Economic studies as influenced by different treatments

Treatments	*Cost of cultivation (Rs. ha^{-1})*	*Gross monetary returns (Rs. ha^{-1})*	*Net monetary returns (Rs. ha^{-1})*	*B : C ratio*
T_1-Check(unweeded)	25980	36470	10490	1.43
T_2- Two hoeings and two weedings at 20 and 40 DAT	28060	65584	37524	2.33
T_3- Ethoxysulfuron 10 g ha^{-1} at 3-4 DAT	26276	47830	21554	1.82
T_4- Ethoxysulfuron 12.5 g ha^{-1} at 3- 4 DAT	26290	58111	31821	2.21
T_5- Ethoxysulfuron 15 g ha^{-1} at 3-4 DAT	26304	58354	32050	2.21
T_6- Ethoxysulfuron 17.5 g ha^{-1} at 3-4 DAT	26318	55457	29139	2.10
SE (m) ±	–	2475	2311	–
CD at 5%	–	7473	6713	–
GM	–	53330	26813	–

and ethoxysulfuron 17.5 g ha^{-1} at 3-4 DAT (T_6) was statistically superior in reducing dicot weed population. However these treatments found to be at par with two hoeing and two weeding at 20 and 40 DAT (T_2).

The data pertaining to mean total weed population as influenced by different treatments are presented in Table 1.The treatment of two hoeing and two weeding at 20 and 40 DAT (T_2) significantly reduced weed population over other treatments except ethoxysulfuron 15 g ha^{-1} at 3-4 DAT (T_5), ethoxysulfuron 12.5 g ha^{-1} at 3-4 DAT (T_4) and ethoxysulfuron 17.5 g ha^{-1} at 3-4 DAT (T_6).These treatment were at par with two hoeing and two weeding at 20 and 40 DAT (T_2).

Data relating to mean weed dry matter as influenced by different treatments are presented in Table 1. The treatment of unweeded check (T_1) recorded highest weed dry matter and was inferior. Two hoeing and two weeding at 20 and 40 DAT (T_2) significantly superior over rest of the treatments i.e. 1 and 3 and was at par with treatment ethoxysulfuron at 15 g ha^{-1} at 3-4 DAT (T_5) and ethoxysulfuron at 12.5 g ha^{-1} at 3-4 DAT (T_4) and ethoxysulfuron at 17.5 g ha^{-1} at 3-4 DAT (T_6). It is evident from the analysis of data that all the weed control measures brought significant reduction in weed dry matter as compared to unweeded check. Reduction in weed dry matter is due to reduction in weed population. Highest reduction in weed dry matter was found in two hoeing and two weeding at 20 and 40 DAT and next in ethoxysulfuron 12.5 g ha^{-1} at 3-4 DAT (T_5). These findings were correlated with results of Awan *et al.* (2004), Puniya *et al.,* (2007), and Subramanyam *et al.* (2007).

Data pertaining to weed index value as influenced by different treatments are presented in Table 1.Weed index was computed as the yield reduction comparative to highest yielding treatment. Treatment unweeded check (T_1) was recorded maximum weed index value (44.58) so was inferior. Application of ethoxysulfuron 15 g ha^{-1} at 3-4 DAT (T_5) recorded lowest weed index value due to effective control of weed followed by ethoxysulfuron 12.5 g ha^{-1} at 3-4 DAT (T_4). Similar results also reported by Singh and Singh (1994) and Bali *et al.* (2004).

The data pertaining to weed control efficiency as influenced by different treatments are presented in Table 1. WCE was higher by two hoeing and two weeding at 20 and 40 DAT (T_2) and also in ethoxysulfuron 12.5 g ha^{-1} at 3-4 DAT (T_4). These results are in agreement with those reported by Singh *et al.* (1992), Bali *et al.,* (2004), and Ram Mangat *et al.* (2004).

Data pertaining to straw yield per hectare as influenced by different treatments are presented in Table 1. Treatment with two hoeing and two weeding at 20 and 40 DAT (T_2) was significantly superior over rest of the treatments. Among herbicidal treatments ethoxysulfuron 15 g ha^{-1} at 3-4 DAT (T_5) produced significantly more straw yield and was at par with ethoxysulfuron 12.5 g ha^{-1} at 3-4 DAT (T_4). Unweeded check (T_1) recorded lowest straw yield (38.50 q ha^{-1}).The mean straw yield was recorded 49.15 q ha^{-1}. Increase in straw yield of paddy might be due to luxurious growth and less crop weed competition in the weed free, treatment having two hoeing and two weeding at 20 and 40 DAT and ethoxysulfuron 15 g ha^{-1} at 3-4 DAT. Similar results are also recorded by Subramanyam *et al.,* (2003) Ramana *et al.,* (2007) and Singh *et al.,* (2006).

Relevant data on grain yield per hectare as affected by different treatments are presented in Table 1. Data indicated that two hoeing and two weeding at 20 and 40 DAT (T_2) recorded significantly highest grain yield (42.95 q ha^{-1}) over rest of the treatments. In herbicide application, treatment ethoxysulfuron 15 g ha^{-1} at 3-4 DAT (T_5) produced significantly higher grain yield but gives statistically similar yield with ethoxysulfuron 12.5 g ha^{-1} at 3-4 DAT (T_4). Lowest grain yield of 23.80 q ha^{-1} was recorded in unweeded control (T_1) among the various treatments. Mean grain yield of paddy was recorded as 34.89 q ha^{-1}. Similar results are also recorded by Subramanyan *et al.,* (2003) Ramana *et al.,* (2007) and Singh *et al.*, (2006).

Data regarding the gross monetary return, net monetary returns and benefit cost ratio influenced by different treatments are presented in Table 2. The highest gross and net monetary return was recorded in two hoeings and two weedings at 20 and 40 DAT (T_2) and it was at par with ethoxysulfuron 15 g ha^{-1} at 3-4 DAT (T_5) and ethoxysulfuron 12.5 g ha^{-1} at 3-4 DAT (T_4).Highest B: C ratio was recorded in two hoeing and two weeding at 20 and 40 DAT (2.33) followed by ethoxysulfuron 15 g ha^{-1} at 3-4 DAT(2.21), ethoxysulfuron 12.5 g ha^{-1} at 3-4 DAT(2.21) and ethoxysulfuron 17.5 g ha^{-1} at 3-4 DAT(2.10). These result in accordance with the result of Singh and Rahman (1992), Ramana *et al.,* (2007).

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