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Weed management effects on weed control efficiency, yield and economics of transplanted rice in *Typic Ustochrept* soil of Uttar Pradesh

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Abstract
A field experiment entitled "Weed management effects on weed control efficiency, yield and economics of transplanted rice was conducted during *Kharif* 2016 at Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, U. P. (India) to find out the impact of different herbicides on weed flora,yield and economics of transplanted Rice *(Oryza sativa* L.). Among weed management practices sole application of Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE), Pyrazosulfuron (150 g a.i ha^{-1}PE), Butachlor (1.5 kg a.i ha^{-1}) obtained selectivity towards broad leave weeds, whereas Oxidiargyl (100 g a.i ha^{-1} PE), Anilophos fb Bispyribac Sodium (400 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE), Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1}POE) performed selectivity towards narrow leave weeds, respectively. Similarly, Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1}PE fb 30 g a.i ha^{-1} POE) recorded selectivity towards narrow leave weeds. Among weed management practices, this research finding indicates that the application of Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1}PE fb 25g a.i ha^{-1} POE) proved to be the most effective in minimizing the total weed density (5.0,6.26 and 6.10 m^{-2}), biomass of weed and enhancing the weed control efficiency (74.96 %),grain yield (46.20),net return(47902) and benefit ratio (2.27) which have the potential of being used as best combination of herbicides. Effective weed control practices could be used for the better production of transplanted rice in *Typic Ustochrept* soil of Uttar Pradesh.

Keywords: weeds density; weed control efficiency; Pyrazosulfuron; profitability, bispyribac sodium

Introduction
Rice is generally cultivated by transplanting in puddle soil, because of better growing condition to achieve higher productivity under transplanted rice. Irrespective of the method of rice establishment, weeds are major problem for rice production as these competes with crop for resources that ultimately affects the product quality. In India, the extent of yield reduction in transplanted rice due to weeds alone has been reported to be from 10 to 70 % (Rajkhowa *et al.,* 2006) [3]. India's rice demand is estimated to rise to 122 million tons in 2020, which is equivalent to an overall increase of 22% in the next 10 years. But, the current evidence shows declining factor productivity and a plateau in rice yields due to weed infestation fatigued natural resources, declining water table, increasing labour scarcity and energy shortage, escalating fuel prices, and changing climatic conditions. Therefore, yield gains have to be achieved by using proper weed management. Heavy weed infestation is one of the major constraints in transplanted rice causing severe yield losses. Weeds emerge simultaneously with germination rice seedling resulting in severe competition for nutrient, light, and space. Intensity of competition increased when one of the resources (nutrient, light, moisture and space) fall short of total requirement of rice-wee, weeds by virtue of their high adoptability and faster growth dominate the crop habitat reduce the yield potential. The degree of rice-weed competition depends on crop factor i.e. cultivar, crop density, crop age, plant spacing etc.
Effective weed control in transplanted rice is one of the major limitations hindering its wide spread cultivation. Manual removal of weeds is labor intensive tedious, back–breaking and does not ensure weed removal at critical stage of crop weed competition bring heavy reduction in growth and yield of the crop. Hand pulling (hand weeding) of weeds is time consuming, cumbersome and costly alternative. Hence for transplanted rice, the chemical method of weed management is best suited as take care of weeds right from beginning of crop growth and is cost effective. Therefore a new herbicide may be more effective for this purpose.

Among all the herbicides for control of *Echinochloa crusgalli*, bispyribac sodium 25 g a.i ha^{-1} was the best while Azimsulfuron 30 g a.i. /ha was quite good against sedges **(**Yadav *et al*., 2011**)** [13]. Water management is an important component of any weed control program, whether any herbicide is used or not. Herbicides which give excellent control when applied into water may perform poorly in the absence of standing water **(**Kumar *et al*., 2009**)** [11]. Integrated use of herbicide Azimsulfuron or Pyrazosulfuron-ethyl with hand weeding at 40 DAT or Butachlor and Anilophos along with closer planting was effective for reducing weed Population and dry weight **(**Gogoi *et al*., 2005**)** [2]. The herbicide pyrazosulfuron-ethyl has both foliar and soil activity (Rajkhowa *et al.*, 2006**)** [3]. It is generally recommended as a pre emergence herbicide in transplanted rice (Angiras and Kumar 2005**)** [1]. Bispyribac-sodium is a post emergence herbicide, used as broad spectrum weed control of grasses, broad leaves and annual sedges, with excellent control of *Echinochloa species*. Reduction in weed density due to application of bispyribac-sodium at 15 and 25 DAT in transplanted rice were reported by Yadav *et al*., (2009) [12]. Herbicides with differential selectivity can be applied sequentially, but it results in enhancing the cost. Therefore, mixing two different herbicides and applying them simultaneously widens the spectrum of weed-control, saves time and application cost.

Materials and Methods

Experimental location, climate and soil characteristics

Meerut has a semi-arid and sub-tropical climate characterized by hot summers and severe cold winters. The mean maximum temperature was noticed in June, which is the hottest month of the year, ranges from 40º to 45ºC. The mean annual rainfall is about 850 mm, of which nearly 80 per cent is received in the monsoon period from July to September and the remaining in the period between Octobers to May. Mean relative humidity attains the maximum value (70 to 77% or even more) during the monsoon season and the minimum (30 to 45%) during the summer months.

Experimental details

The study was undertaken at Crop Research Centre of Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut during *Kharif* season 2016. The experiment was conducted in randomized block design with three replications comprising twelve weed management treatments [T_1-Weedy check, T_2- two hand weeding,T_3- Butachlor (1.5 kg a.i ha^{-1}) fb One hand weeding, T_4-Pyrazosulfuron (150 g a.i ha^{-1}PE), T_5-Azimsulfuron (30 g a.i ha^{-1}POE), T_6-Oxidiargyl (100 g a.i ha^{-1}PE) fb one hand weeding, T_7-Anilophos fb Bispyribac Sodium (400 g a.i ha^{-1}PE fb 25g a.i ha^{-1}POE),T_8-Pyrazosulfuron (150 g a.i ha^{-1}) fb one hand weeding, T_9-Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE), T_{10}-Anilophos fb Azimsulfuron (400 g a.i ha^{-1} PE fb 30 g a.i ha^{-1} POE),T_{11}- Azimsulfuron (30 g a.i ha^{-1}) fb one hand weeding and T_{12}-Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1}PE fb 30 g a.i ha^{-1}POE)] were used for the experimentation. The soil of the experimental field was sandy loam soil, low in organic carbon and available N, medium available P and K and slighty alkaline in reaction. Rice cv. Pusa basmati 1 was transplanted on second fortnight of July, 2016 at 20 cm ×10 cm spacing. Recommended package and practices were followed for the cultivation of rice except weed management and harvested in second fortnight of October, 2016. The herbicides were applied as per treatment details.The required quantity of herbicide were applied with manually operated knapsack sprayer fitted with flat-fan nozzle using a spray volume of 500 l of water / ha.

Observations recorded

The number of individual weed present in the field was recorded at 30, 60 and 90 DAT. Grasses, broad leaved weeds and sedge weeds present within three randomly selected 0.5 m x 0.5 m quadrate in each net plot area were counted separately, converted it to number of weeds m^{-2} before subjecting to statistical analysis. Data on weed density and biomass were subjected to square-root transformation. Weed control efficiency was calculated based on the weed biomass respectively. The WCE efficiency was calculated as:$W.C.E\,(\%) =$

$$\frac{Weed\ dry\ matter\ in\ weedy\ check - weed\ dry\ matter\ in\ treated\ plot}{Weed\ dry\ matter\ in\ weedy\ check} X\ 100$$

Statistical analysis

The data obtained from study were analyzed statistically using the F–test, as per the procedure given by Gomez and Gomez (1984). LSD values at p = 0.05 were used to determine the significance of difference between treatment means.

Results

Weed flora

The crop was infested withNarrow leaved, broad leaved and other weeds (Table 1). The most dominant weed species found in the field were *Echnochloa colonum, Echnochloa crusgalli, Dactyloctenium aegyptium,Commelina benghalensis, Phyllanthus niruri, Cyprus iria, Cyprus rotundus* etc**.**

Table 1: Common weeds associated with rice crop during the experimentation

Weed name	Family	Botanical name
Narrow leave weeds		
Swank, jungle rice	Poaceae	*Echinochloa colona*
Barnyard grass	Poaceae	*Echinochloa crucially*
Crowfoot grass	Poaceae	*Dactyloctenium aegyptium*
Broad leave weed		
Day flower	Commelinaceae	*Commelina benghalensis*
Phyllanthus	Phyllanthaceae	*Phyllanthus niruri*
Pink nod flower	Asteraceae	*Caesulia axillaris*
Other weed		
Yellow nut sedges	Cyperaceae	*Cyprus iria*
Purple nut sedges	Cyperaceae	*Cyprus rotundus*

Total weeds density (m^{-2})

Density of total weeds was affected significantly by various treatments involving weed management practices (Figure 1). Among weed control treatments significantly highest total weed density at 30, 60 and 90 DAT (16.63, 17.33 and 16.39 m^{-2}, respectively) was found under weedy check treatment. The lowest weed density (5.0 m^{-2}) was recorded in Pyrazosulfuron fb Bispyribac Sodium at 30 DAT. At 60 and 90 DAT significantly lower weed density (6.19 and 5.86 m^{-2}) observed with two hand weeding. Among the different herbicidal treatments lowest density of total weeds was found with the application of Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) and found at par with Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1} PE fb 30 g a.i ha^{-1} POE) and Anilophos fb Bispyribac Sodium (400 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE).

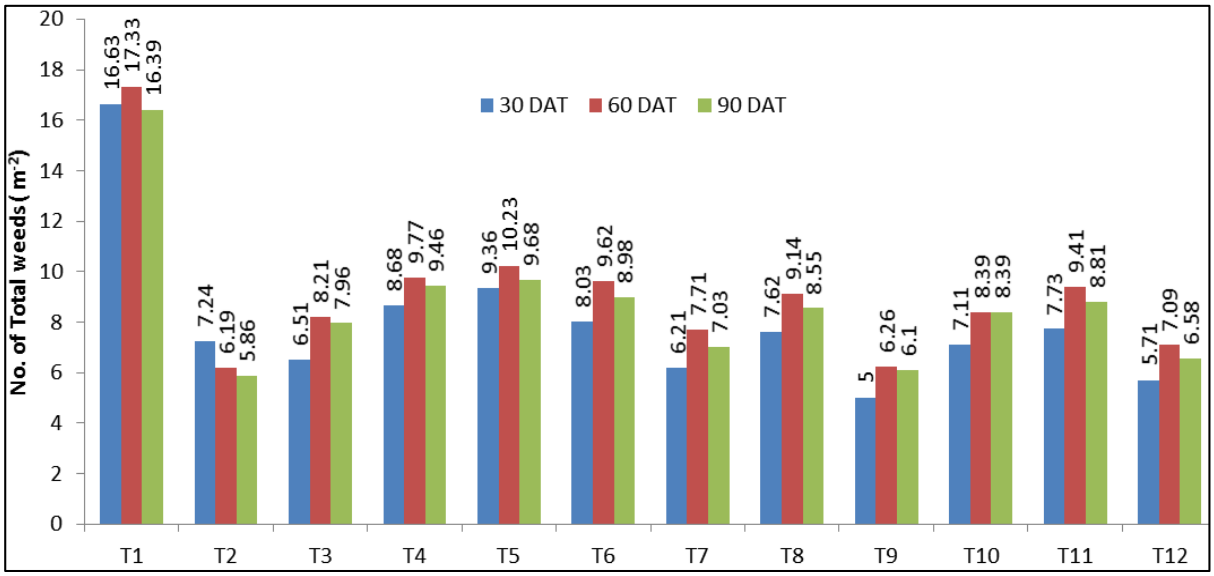

Fig 1: Effect of weed management treatment on total weeds (m^{-2}) in rice at different stages

Narrow weed density (m^{-2})

Among different weed control treatment, significantly the highest narrow leaf weed density at 30, 60 & 90 DAT (11.0, 11.22 & 9.71 m^{-2}, respectively) was found under weedy check treatment (Table 2). Among the herbicide at 30 and 60 DAT, lowest density of different narrow leaved weeds (2.86 and 4.37 m^{-2}) found under Pyrazosulfuron fb Bispyribac Sodium which was found identical with Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1} PE fb 30 g a.i ha^{-1} POE 3.32 & 4.93 m^{-2}. The lowest weed density at 90 DAT of narrow leave weeds (4.27 m^{-2}) was recorded in Pyrazosulfuron fb Bispyribac Sodium and found at par with Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1} PE fb 30 g a.i ha^{-1}) and Anilophos fb Bispyribac Sodium (400 g a.i ha^{-1} PE fb25g a.i ha^{-1} POE).

Table 2: Performance of weed management practices on total narrow leave weed (m^{-2}) atvarious days after transplanted of rice crop

Treatments		Total no. of narrow leave weed (m^{-2})		
		30 DAT	60 DAT	90 DAT
T_1	Weedy check	11.00 (120.2)	11.22 (125.0)	9.71 (93.5)
T_2	Two hand weeding	4.45 (19.2)	4.37 (18.3)	4.02 (15.3)
T_3	Butachlorfb One hand weeding	4.12 (16.5)	6.03 (35.6)	5.74 (32.1)
T_4	Pyrazosulfuron	5.75 (32.5)	6.79 (45.5)	6.29 (38.8)
T_5	Azimsulfuron	6.06 (36.0)	7.21 (51.2)	6.81 (45.5)
T_6	Oxidiargyl one hand weeding	5.38 (28.3)	6.67 (43.7)	6.24 (38.1)
T_7	Anilophos fb Bispyribac Sodium	3.78 (13.5)	5.41 (28.5)	4.69 (21.1)
T_8	Pyrazosulfuron one hand weeding	4.91 (23.5)	6.48 (41.2)	6.00 (35.1)
T_9	Pyrazosulfuron fb Bispyribac Sodium	2.86 (7.2)	4.37 (18.3)	4.27 (17.3)
T_{10}	Anilophos fb Azimsulfuron	4.37 (18.5)	5.86 (33.6)	5.70 (31.7)
T_{11}	Azimsulfuronfb one hand weeding	5.12 (25.5)	6.56 (42.2)	6.17 (37.2)
T_{12}	Pyrazosulfuron fb Azimsulfuron	3.32 (10.4)	4.93 (23.5)	4.60 (20.2)
	CD (P= 0.05)	1.17	0.86	0.63

Broad leave weed density (m^{-2})

The *Commelina benghalensis, Phyllanthus niruri* and *Caesulia axillaris* were major broad leave weeds found in the rice field. Among the different treatment the weed highest density of broad leave weeds (8.24, 9.17 & 8.77 m^{-2}) was observed in weedy check treatment at 30, 60 & 90 DAT respectively (Figure. 2). At 30 DAT, lowest density of broad leave weeds (3.17 m^{-2}) found under Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25 g a.i ha^{-1} POE) and was at par with Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1} PE fb 30 g a.i ha^{-1} POE). At 60 and 90 DAT, lowest density of broad leave weedsfound in Pyrazosulfuron fb Bispyribac Sodium followed by Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1} PE fb 30 g a.i ha^{-1} POE) and Anilophos fb Bispyribac Sodium (400 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) treatment.

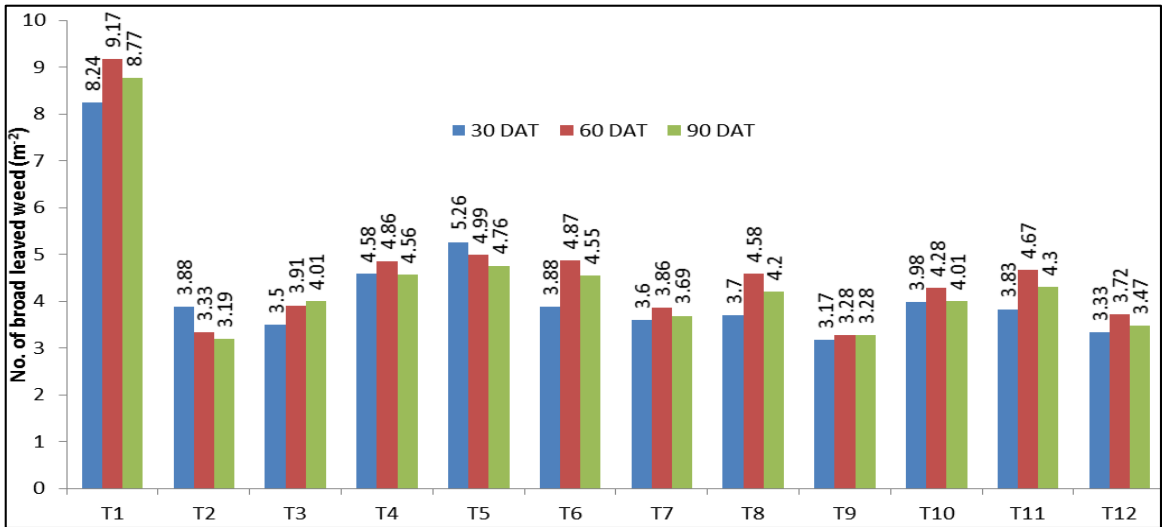

Fig 2: Weed management practices on total broad leaved weed population (m-2) at different stages in rice crop

Others density (m^{-2})

Highest density (9.47, 9.62 & 9.81 m^{-2}) of sedges was observed in weedy check treatment at 30, 60 & 90 DAT, respectively (Table 3). Among the herbicidal treatments, lowest density of sedges at 30 DAT (3.16 m^{-2}) was found under Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1}PEfb 25ga.i ha^{-1} POE). At 60 and 90 DAT lowest density of sedges (3.43 & 3.33 m^{-2}) found in Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) and found identical with Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1} PE fb 30 g a.i ha^{-1} POE) and Anilophos fb Bispyribac Sodium (400 g a.i ha^{-1}PE fb 25g *a.i* ha^{-1} *POE).*

Weed dry weight and weed control efficiency (WCE)

Weed dry weight was affected significantly by various treatments involving weed management practices (Figure 3). Among weed control treatments significantly highest weed dry weight (7.69, 11.56, & 12.96 g m^{-2}) at 30, 60 and 90 DAT was found in weedy check, respectively. While the lowest dry weight (3.37, 4.85 and 5.83 g m^{-2}) was recorded in two hand weeding treatment. Among different herbicides, lowest weed dry weight was found under Pyrazosulfuron fb Bispyribac Sodium followed by Pyrazosulfuron fb Azimsulfuron and Anilophos fb Bispyribac Sodium treatments at 30, 60 and 90 DAT. Among the different weed management treatments, highest weed control efficiency (WCE) was observed under two hand weeding followed by Pyrazosulfuron fb Bispyribac Sodium, Pyrazosulfuron fb Azimsulfuron and Anilophos fb Bispyribac Sodium treatments at 90 DAT.

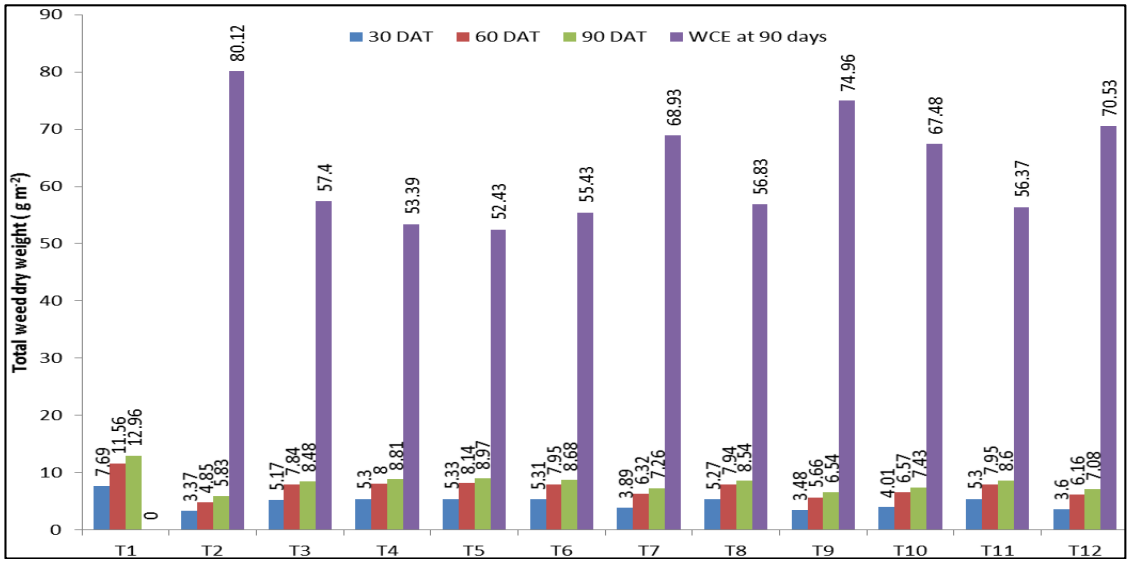

Fig 3: Effect of weed management treatment on total weed dry weight (g m-2) at various transplanting time and weed control efficiency at 90 Days stage in rice crop

Yield

Grain yield was affected significantly by various treatments involving weed management practices (Table 4). The highest grain yield (47.88 q ha^{-1}) was found in two hands weeding and significantly higher to rest of the treatments. Among the herbicidal treatments, the highest grain (46.20 q ha^{-1}) and straw yield (70.30 q ha^{-1}) was recorded with the application of Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) and was at par with Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1} PE fb 30 g a.i ha^{-1} POE). Grain yield was increased to the tune of 37.66% with the application of Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) over weedy check treatment and the straw yield was increased to the tune of 33.14 % with the application of Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) over weedy check treatment.

Economics

Higher cost of cultivation was reported under different weed management treatment in comparison to weedy check. Treatment T_2 (two hand weeding) was recorded highest cost of cultivation Rs41236 (Table 4). However, two hand weeding registered lower monetary returns than the combination of herbicide mixture because higher cost incurred on manual weeding to keep the crop-weed free during crop period. Among different herbicidal treatments, T_8Pyrazosulfuronfb one hand weeding was found higher cost of cultivation Rs39936followed by T_{11}Oxidiargylfb one hand weeding Rs39206, respectively. Gross return was found highest underT_2two hand weeding treatment. However, highest net return and benefit to cost ration was found highest under treatment T_9Pyrazosulfuron fb Bispyribac Sodium treatment.

Discussion

The different chemical controls the weeds effectively as compared to weedy check. Significantly the lowest total weed population, density of narrow, broad and other and total dry weight recorded under two hand weeding treatment because two hand weeding treatment was kept of weeds free by hand weeding (Table 2,3, 4 & 5). Highest total weed density and dry weight were recorded in weedy check plots due to un checked growth of weeds which compete for all the resources up to maturity with crop. Among the herbicides Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) found the best and was at par with Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1} PE fb 30 g a.i ha^{-1} POE) to control weeds. Lowed weed density and dry weight due to application of different herbicide was also reported by Khaliq *et al.* (2013) [6]. Among the herbicides at 90 DAT the highest weed control efficiency (74.96%) was observed in Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) which was found at par with Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1} PE fb 30 g a.i ha^{-1} POE) (70.53%). The Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) showed highest WCE among herbicidal treatments, owing to better control of grasses, sedges and broad leaf weeds by these herbicides. These results are corroborated with that reported by Rao (2005) [10], and further supported by the work of Nayak *et al*. (2014) [9], who obtained a variable weed control in rice field with the use of different herbicides.

The final yield of the crop is the cumulative effect of yield attributes and the factor which directly effect and or indirectly influenced them. A crop can performed best only when the display of foliage on the ground surface was in such a manner that utilizes maximum natural resources. In our study, grain and straw yield was significantly influenced by the different weed management practices (Table 7). Treatment two hand weeding was superior in relation to grain and straw yield followed by Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) plots. Among the herbicide Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE) was superior in grain yield ha^{-1} and 37.66 % higher grain yield over weedy check. This was might be due to the higher crop growth of rice in terms of foliage, large amount of photosynthesis, which act as source and helped in developing yield attributes due to low crop weed competition and finally the higher grain yield. Application of post emergence herbicide resulted in the highest grain yield (Bhowmick and Ghosh, 2006**)** [2]. The minimum grain yield was obtained from un-weeded control due to no control measure was adopted in this plot. Finding of present investigation are in agreement with finding of Narwal (2002) [8].

In weed management practices the highest cost of cultivation (41236 Rs ha^{-1}) was recorded under two hand weeding plot due to higher labor charge and lowest cost of cultivation (36136 Rs ha^{-1}) was observed in weedy check treatment (Table 7).Hossain (2015) also reported similar results. The highest gross return (88338.6 Rs.ha^{-1}) was recorded in two hand weeding treatment was found statistically at par with the application of Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE). Singh *et al.* (2015) also reported similar results. This might be due to its ability to control only a portion of the weeds population at the earlier growth stage, this result agreed with the findings of (Mirza Hasanuzzaman *et al*., 2009). The highest net return (47902 Rs ha^{-1}) was obtained under the treatment Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE). The highest value of B: C Ratio (2.27) was recorded in the treatment of Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1} PE fb 25g a.i ha^{-1} POE). Higher net returns and B: C ration under chemical weed management. This agreed with the work of by Kabdal *et al.* (2014) [5], which showed that herbicides, when used in rice suppressed weed growth and increased the yield of rice

Table 3: Effect of weed management treatment on total other weeds in rice at different stages

Treatments		Density of other (m^{-2})		
		30 DAT	**60 DAT**	**90 DAT**
T_1	Weedy check	9.47 (88.9)	9.62 (91.7)	9.81 (89.9)
T_2	Two hand weeding	4.34 (18.2)	3.33 (10.1)	3.30 (9.9)
T_3	Butachlorfb One hand weeding	3.89 (14.3)	4.16 (16.7)	3.98 (15.2)
T_4	Pyrazosulfuron	4.87 (22.9)	5.17 (26.1)	4.87 (23.1)
T_5	Azimsulfuron	4.99 (24.0)	5.41 (28.5)	5.12 (25.5)
T_6	Oxidiargyl fb one hand weeding	4.68 (21.1)	5.08 (25.1)	4.78 (22.1)
T_7	Anilophos fb Bispyribac Sodium	3.61 (12.2)	4.10 (16.0)	3.99 (15.1)
T_8	Pyrazosul fu ronfb one hand weeding	4.35 (18.1)	4.75 (21.9)	4.64 (20.9)
T_9	Pyrazosulfuron fb Bispyribac Sodium	3.16 (9.0)	3.43 (11.0)	3.33 (10.1)
T_{10}	Anilophos fb Azimsulfuron	4.22 (17.0)	4.47 (19.2)	4.08 (15.9)
T_{11}	Azimsulfuronfb one hand weeding	4.58 (20.1)	5.06 (24.8)	4.77 (21.9)
T_{12}	Pyrazosulfuron fb Azimsulfuron	3.43 (11.0)	3.84 (14.0)	3.71 (13.0)
	CD (P= 0.05)	0.85	0.93	0.90

Original values in parenthesis. Values are square root $\sqrt{(X + 1.0)}$

Table 4: Effect of weed management practices on yield and economics of rice crop

Treatments		Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	Benefit: cost ratio
T_1	Weedy check	28.80	47.00	36136	54086	17950	1.49
T_2	Two hand weeding	47.88	71.82	41236	88338	47102	2.14
T_3	Butachlorfb One hand weeding	40.24	63.66	39701	75067	35366	1.89
T_4	Pyrazosulfuron	38.10	60.9	37046	71232	34186	1.92
T_5	Azimsulfuron	36.12	58.88	36656	67816	31160	1.85
T_6	Oxidiargyl fb one hand weeding	39.76	63.24	39737	74257	34520	1.86
T_7	Anilophos fb Bispyribac Sodium	43.44	67.16	37177	80646	43469	2.16
T_8	Pyrazosul furonfb one hand weeding	41.47	64.83	39936	77168	37232	1.93
T_9	Pyrazosulfuron fb Bispyribac Sodium	46.20	70.30	37587	85489	47902	2.27
T_{10}	Anilophos fb Azimsulfuron	42.10	65.75	37156	78324	41168	2.10
T_{11}	Azimsulfuronfb one hand weeding	40.53	63.47	39206	75446	36240	1.92
T_{12}	Pyrazosulfuron fb Azimsulfuron	45.77	70.23	37566	84439	46873	2.24
	CD (P= 0.05)	1.13	3.59	509	3425	2915	0.04

Conclusion

From data presented it might reasonably be argued that Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1}PE fb 25g a.i ha^{-1}POE) was at par with Pyrazosulfuron fb Azimsulfuron (150 g a.i ha^{-1}PE fb 30 g a.i ha^{-1}POE) in terms of controlling diverse weed population. It successfully controlled the complex weed flora in transplanted rice in *Typic Ustochrept* soil of Uttar Pradesh. Chemical herbicide applied as pre and post emergence Pyrazosulfuron fb Bispyribac Sodium (150 g a.i ha^{-1}PE fb 25g a.i ha^{-1}POE) was the most remunerative and effective herbicide combination for controlling the complex weed flora and enhancing the productivity of transplanted rice. Manual weeding is not at all cost-effective and therefore, weed management by applying the aforementioned herbicide combinations in rotation may be practiced to run the transplanted rice systemas a profitable business venture. Results so far indicated that herbicide application offered higher weed control efficiency as well as higher rice yield as observed in different herbicide combinations. However, since herbicide application has been increasing rapidly in the country, impacts of repeated as well as longer term application of herbicides in transplanted rice on soil health parameters raise concern as well as deserve attention for further research before reaching any precise conclusion.

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