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Sunita Kumari
Krishi Vigyan Kendra, Vaishali,
Bihar, India

Devendra Kumar
Krishi Vigyan Kendra, Vaishali,
Bihar, India

Narendra Kumar Mehta
Krishi Vigyan Kendra, Vaishali,
Bihar, India

Veena Shahi
Krishi Vigyan Kendra, Vaishali,
Bihar, India

Effect of weed management practices on weed control efficiency, productivity and economics of transplanted rice (*Oryza sativa*)

Sunita Kumari, Devendra Kumar, Narendra Kumar Mehta and Veena Shahi

Abstract

An OFT (on farm trial) was conducted on KVK, Vaishali, Dr. RPCAU, Pusa, Samstipur in two consecutive kharif seasons of years 2015 and 2016 on selected five farmers' field with 6 treatments to find out the effect of different weed management practices to control complex weed flora in rice (*Oryza sativa* L) crop. Mean data of two years experimentation indicated that the application of various weed management practices significantly increased yield attributes viz. no. of panicles/ square meter, no. of grains/ panicle and 1000- grain weight. Yield and monetary income of rice crop were significantly influenced by application of weed management practices. Among all treatments, application of bispyribac- sodium @ 25 g ai/ha resulted in higher no. of panicles/ square meter (221.0), the maximum grain yield (4.05 t/ha), net return (40812 Rs/ha) and B:C ratio (1.58) which was superior to rest of the treatments. The highest weed control efficiency was recorded with bispyribac- sodium closely followed by two hand weeding (20 & 40 DAT). Two year study indicates that the application of bispyribac-sodium 25 g ai/ha was the best for higher yield and net returns from rice.

Keywords: B: C ratio, herbicides, net return, weed control efficiency, yield

Introduction

India is the world's second largest producer of rice after China accounting for 20 % of world rice production (Singh *et al.*, 2012) [6]. Rice is the staple food of the people of the eastern and southern parts of the country. It is cultivated in an area of 43.9 million ha, with a production of 106.5 million tonnes and an average productivity of 2.4 t/ ha during 2013 – 14 (Economic Survey 2014 – 15). In Bihar, it is the most widely cultivated cereal crop during rainy season. Weeds are a major impediment to rice production through their ability to compete for resources and their impact on product quality. Weeds are responsible for heavy rice yield losses, to the extent of complete crop loss under extreme conditions. Uncontrolled weeds cause up to 80 % reduction in grain yield and sometimes result in complete failure of crop (Pandey *et al.*, 2000; Gopinath and Kundu, 2008) [5, 3]. Proper weed management technology can result in an addition to rice production. Thus weed management would continue to play a key role to meet the growing food demands of increasing population in India.

Manual weeding with 'Khurpi' is a common practice in Vaishali district of Bihar. Therefore, the major challenge for farmers is effective weed management, as failure to eliminate weeds may result in low or no yield. Manual removal of weeds is labour intensive, tedious and does not ensure weed removal at critical stage of crop – weed competition due to non-availability of labour, and sometimes bad weather condition which does not allow labours to move in the field. Herbicides are more effective in controlling the weeds besides reducing the total energy requirement for rice cultivation. Hence, present investigation was conducted at selected farmer's field to evaluate the effect of different weed management practices over traditional farmers' practice.

Materials and methods

Five farmers were randomly selected for on farm trial on transplanted rice in Vaishali district of Bihar during the *kharif* season of 2015 and 2016. All the farmers selected for on farm trial were small farmers. Soil samples were collected from selected farmer's field and were analyzed separately. The soil was sandy loam to loam, young alluvial calcareous in nature with mean pH 8.16, mean EC 0.11, low in available N (mean value 177.01 kg/ha), medium in P (mean value 13.80 kg/ha) & K (mean value 137.28kg/ha) and low in organic carbon mean value 0.47 %. The experiment comprised 6 treatments viz. weedy check, farmers' practice (one hand weeding at 25 DAT), Two hand weeding (at 20 and 40 DAT),

Correspondence
Sunita Kumari
Krishi Vigyan Kendra, Vaishali,
Bihar, India

Butachlor @ 1.5 kg ai/ha (at 3 DAT), Pretilachlor @ 750 g ai/ha (at 3 DAT) and Bispyribac -Sodium @ 25 g ai/ha (at 15 DAT), were laid out in randomized block design at each farmer's field. Rice (var. - Sahbhagidhan) was sown by using seed rate of 30 kg/ha on 20 June and 25 June in 2015 and 2016 respectively. Twenty five days old seedlings of rice was transplanted using 2 seedlings per hill at 20 cm x 10 cm spacing. All the herbicides were applied with manually operated knap – sack sprayer fitted with a flat – fan nozzle using a spray volume of 500 L water/ha by keeping a thin film of water in the field. The crop was fertilized with recommended doses of fertilizers viz. 80: 40: 20 kg N, P₂O₅, K₂O /ha. Half dose of N and full P₂O₅ and K₂O were applied as basal before seedling transplanting and balance N were top – dressed in 2 equal splits – one fourth at active tillering (30-35 DAT) and the remaining one – fourth at panicle – initiation (60 -65 DAT) stage of the crop. Data on dry weight of weeds were recorded by cutting at ground level, washed with tap water, sun dried first followed oven drying at 65 degree centigrade for 48 hours and then weighed. Weed control efficiency was calculated using weed dry weight data at 60 DAS which was maximum during weed growth period irrespective of treatments. Yield and its attributes were recorded during the course of investigation. All the data were subjected to analysis of variance (ANOVA) as per the standard procedures and comparison of treatment means was made by critical difference (CD) at 5 % probability. Economics were computed using the prevailing market price of inputs and outputs.

Results and discussion

Effect on weeds

The major weed flora observed in the experimental field included *Echinochloa crus-galli*, *E. colona*, *Cyperus rotundus*, *C. iria* and *Eclipta alba*. Application of bispyribac- sodium

significantly reduced the dry weight of weeds compared to other treatments, but was at par with two hand weeding. However all the treatments were more effective over weedy check in this respect (table 2). The maximum weed control efficiency (WCE) was recorded under application of bispyribac sodium. This is due to less number of weeds germinated under this treatment resulting in minimum biomass production. Similar results have been reported by Bahar and Singh (2004) [1].

Yield and yield attributes

All the weed management treatments resulted in significant increase in number of panicles/square meter, panicle length, no. of grains/panicle and 1000- grain weight compared to weedy check. The highest yield attributes viz. no. of panicles/ square meter, panicle length, grains/ panicle and 1000- grain weight were recorded with bispyribac sodium due to lowest weed – crop competition during the crop growth (table 2). Bispyribac-sodium being at par with pretilachlor and two hand weeding recorded significantly higher no. of panicles/ square meter, no. of grains/ panicle and 1000- grain weight compared with all other treatments. In case of panicle length, bispyribac-sodium being at par with pretilachlor and butachlor also registered significantly higher value compared to other treatments. Weed management treatments showed significantly higher grain and straw yield over the weedy check. Application of bispyribac-sodium as post emergence produced significantly higher grain and straw yield over the other weed management treatments except pretilachlor and two hand weeding (table 3). The lowest grain yield (2.2 t/ha) was recorded with weedy check, while the highest (40.50 t/ha) was obtained with bispyribac- sodium and similar trend was found in case of straw yield. All treatments non-significantly influenced the harvest index of rice. These results corroborate with the findings of Nath *et al.* (2014) [4].

Table 1: Chemical characteristics and macronutrients status of farmers soils.

Soil Property	Minimum	Maximum	Mean	S.D
pH(1:2 soil: water)	7.80	8.42	8.16	0.07
EC(dS / m)	0.05	0.16	0.11	0.02
Organic carbon (%)	0.41	0.54	0.47	0.03
Nitrogen	163.37	190.66	177.01	7.35
Phosphorus	11.90	15.69	13.80	0.64
Potash	121.15	153.40	137.28	7.98

Table 2: Weed dry matter, weed control efficiency, and yield attributes of rice as influenced by different weed management practices (mean data of two years)

Treatments	Dry weight of weeds at 60 DAT(kg/ha)	Weed control efficiency (%)	No. of panicles/m ²	Panicle length (cm)	No. of grains / panicles	1000grain weight(g)
Weedy check	348.6	-	98.6	15.6	93.5	22.98
Farmers practice	168.7	51.6	170.5	18.5	103.4	23.46
Two hand weeding(20&40 DAT)	96.9	72.2	208.2	21.9	136.0	24.08
Butachlor (1.5kg/ha at 3 DAT)	124.1	64.4	192.4	22.2	119.2	23.82
Pretilachlor (750g/ha at 3 DAT)	105.7	69.7	201.5	23.1	131.50	24.02
Bispyribac- sodium (25g/ha at 15 DAT)	92.7	73.4	221.0	24.16	140.10	24.14
SEm±	9.58	-	9.07	0.69	6.56	0.11
CD(P=0.05)	29.7	-	26.4	1.98	19.4	0.31

Table 3: Yield and economics of Rice as influence by different weed management practices (mean data of two years)

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Cost of cultivation (₹/ha)	Net Return(₹/ha)	B:C ratio
Weedy check	22.20	35.16	38.70	23200	13616	0.58
Farmers practice	30.60	46.96	39.45	25325	25271	0.99
Two hand weeding(20&40 DAT)	37.25	57.32	39.39	27575	34032	1.23
Butachlor (1.5kg/ha at 3 DAT)	35.00	52.78	39.87	24650	33128	1.34
Pretilachlor (750g/ha at 3 DAT)	38.40	57.40	40.08	25100	38240	1.52
Bispyribac- sodium (25g/ha at 15 DAT)	40.50	59.37	40.55	25875	40812	1.58
SEm±	1.29	1.68	0.69	-	-	-
CD(P=0.05)	3.75	4.91	NS	-	-	-

Economics

The cost of cultivation was lower in all the treatments involving herbicide use compared to two hand weeding (table 3). The cost of cultivation was highest (27575 Rs/ha) with two hand weeding (20 & 40 DAT) closely followed by bispyribac- sodium. Owing to higher yield and low cost of herbicides and labour requirement, bispyribac- sodium gave highest net return (40812 Rs/ha) closely followed by pretilachlor. All the three treatments involving herbicide use recorded higher B:C ratio compared to other treatments. Bispyribac –sodium being at par with pretilachlor fetched significantly higher net return and B:C ratio compared to other treatments.

On the basis of above findings, it may be concluded that application of bispyribac-sodium (25 g/ha) at 15 DAT reduced population of weed flora and maximized grain yield & economical return significantly.

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