Indian Journal of Agronomy **58** (4): 465–468 (December 2013)

Research Paper

Effect of weed-control measures on yield, weed control, economics and energetics of rice *(Oryza sativa)*-wheat (*Triticum aestivum*) cropping system

R.B. TIWARI[1], T.D. PANDEY[2], GEET SHARMA[3] AND N.K. CHAURE[4]

TCB College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Bilaspur, Chhattisgarh 495 001

Received : January 2013; Revised accepted : October 2013

ABSTRACT

An experiment was conducted during 2010–11 and 2011–12 at Bilaspur, Chhattisgarh, to assess the effect of weed-control measures on grain yield, weed control efficiency (WCE) and economics of rice (*Oryza sativa* L.)-wheat [*Triticum aestivum* (L.) emend. Fiori & Paol.] cropping system. Application of pyrazosalfuron @ 0.02 kg/ha as pre-emergence + fenoxoprop-p-ethyl @ 0.06 kg/ha (25 days after sowing) as post-emergence resulted in significantly higher grain yield (5.7 t/ha), weed-control efficiency (76.3%) and net returns (₹41,800/ha) over other weed-management practices adopted in rice. In case of wheat, the highest grain yield (5.5 t/ha), net returns (₹36,200/ha) and weed-control efficiency (89.6%) was obtained with the application of sulfosulfuron @ 0.025 kg/ha (25 days after sowing) as post-emergence. The highest energy productivity (0.426 kg/MJ) was observed due to application of pyrazosulfuron as pre-emergence and fenoxoprop as post emergence in rice, while in case of wheat the highest energy productivity (0.490 kg/MJ) was recorded with application of sulfosulfuron applied as post emergence over the other weed-management treatments.

Key words: Crop protection, Cropping system, Energetics, Energy productivity, Rice weed flora, Weed control, Wheat

Rice–wheat is the most important cropping sequence in India (Prasad, 2005). With the increase in area under irrigation in Chhattisgarh, the area under rice–wheat cropping system is also increasing gradually. However, the productivity of rice and wheat crop is very low compared to other rice–wheat growing states in the country. The area under direct-seeded rice is around 70% in Chhattisgarh, which is severely affected due to high weed infestation and ultimately reduces the yield by 25–70%. In general, hand-weeding and pre-emergence application of herbicides in rice crop is in practice to control the weeds, which are not responsive as per expectation due to weather and application problems. Thus the post-emergence application of herbicide may be helpful to control broad spectrum weeds. Some new formulations have been evaluated, which are suitable to apply as post-emergence. Similarly, in wheat crop application of 2, 4-D as post-emergence is common, but application of 2, 4-D is unable to control narrow leaved weeds and sedges. Thus, new formulation of herbicides as post-emergence and in combination with pre-emergence have been tried to control weeds in rice and wheat. The use of energy resources have increased remarkably, thus energy aspect need to be analyzed for appropriate weed-control measure. The energy-agriculture relationship is becoming more important with the intensification of the cropping systems and its management practices. In present study, an attempt was made to assess the effect of weed control measures on yield, weed-control and economics of rice–wheat cropping system.

MATERIALS AND METHODS

A field experiment was conducted during 2010–11 and 2011–12 at research farm of TCB College of Agriculture and Research Station, Bilaspur, Chhattisgarh. The soil was clay loam, with pH 7.2, low in organic carbon (0.48%) and available nitrogen (216 kg/ha) and medium in available phosphorus (20.5 kg/ha) and available potash (378 kg/ha). The experiment was laid out in randomized block design with 3 replications. Weed-control treatments during the rainy season (*kharif*) in rice consisted of weedy check, hand-weeding at 20 and 40 days after sowing (DAS), butachlor as pre-emergence at 1.0 kg/ha + fenoxoprop-p-ethyl as post-emergence at 0.06 kg/ha, pyrazosulfuron as pre-emergence at 0.02 kg/ha + fenoxoprop-p-ethyl as post-emergence at 0.06 kg/ha, oxadiarzil as pre-emergence at

[1]**Corresponding author Email:** rbt1961@rediffmail.com
[1,2]Professor, [3]Scientist, Agronomy, [4]Principal Scientist, Statistics IGKV, TCB College of Agriculture, Bilaspur, Chhattisgarh 495 001

0.075 kg/ha + fenoxoprop-p-ethyl as post-emergence at 0.06 kg/ha, fenoxoprop-p-ethyl at 0.06 kg/ha + metsulfuron methyl + chlorimuron (almix) at 0.020 kg/ha (tank mixture) as post-emergence (25 DAS), and ethoxysulfuron @ 0.015 kg/ha + fenoxoprop-p-ethyl at 0.06 (mixed) as post-emergence application. While during the winter season (*rabi*) in wheat crop, weed-control treatments were weedy check, hand weeding at 20 DAS, isoproturon as post-emergence @1.0 kg/ha, sulfosforon at 0.025 kg/ha as post-emergence, 2,4–D at 0.5 kg/ha + metsulfuron methyl as post-emergence, iodosulfuron at 0.025 kg/ha as post-emergence, and fenoxoprop-p-ethyl at 0.06 kg/ha as post-emergence. A common dose of fertilizer at 100:60:40 kg N:P:K/ha was supplied in rice and wheat crop during *kharif* and *rabi* season respectively. The rice 'MTU 1010' and wheat 'GW 322' were sown on 28 June and 25 November, respectively, during both the years. The total energy utilized by crop for production and energy productivity was calculated as per procedure described by Devasenapathi *et al.* (2009).

RESULTS AND DISCUSION

Weed flora

The major weed flora observed in the experimental field included *Echinochloa crus-galli, E. colona, Cyperus rotundus, Commelina benghalensis, Monochoria vaginalis, Ludvigia perenis, Ischaemum rugosum, Digitaria sanguinalis* and *Marselia quadrifolia* in rice crop. However, in wheat crop weed species were *Phalaris minor, Chenopodium album, Anagalis arvensis, Medicago denticulata, Physalis minima, Vicia sativa* and *Melilotus alba* in experimental area.

Effect on weeds

Different weed-control measures significantly influenced the weed biomass, weed-control efficiency, grain yield and net profit in rice and wheat crop. In rice crop, application of pyrazosulfuron as pre-emergence + fenoxoprop as post-emergence; fenoxoprop mixed with metsulfuron + chlorimuron as post-emergence and fenoxoprop mixed with ethoxy sulfuron as post-emergence significantly reduced the dry weight of weeds compared with other treatments, but were at par with hand weeding twice. While in wheat crop application of sulfoslfuron as post-emergence reduced weed dry weight significantly compared with the control but was at par to other weed-control treatments and thus ultimately enhanced weed-control efficiency.

Effect on grain yield and economics

All the weed-control measures significantly influenced the yield of rice as compared to un-weeded check. Application of pyrazosulfuron as pre-emergence + fenoxoprop as post-emergence produced significantly higher grain yield over the other weed-management practices. However, differences with respect to grain yield of rice, hand-weeding, fenoxoprop mixed with metsulfuron + chlorimuron as post- emergence and fenoxoprop mixed with ethoxy sulfuron as post-emergence were non-significant. However, the highest net profit was fetched with the application of pyrazosulfuron as pre-emergence + fenoxoprop as post-emergence, followed by fenoxoprop mixed with metsulfuron + chlorimuron as post-emergence; fenoxoprop mixed with ethoxy sulfuron as post-emergence, hand-weeding twice, butachlor as pre-emergence + fenoxoprop as post-emergence, oxadarzil as pre-emer-

Table 1. Weed dry matter, weed-control efficiency, grain yield, total energy, energy productivity and net profit of direct seeded rice as influenced by weed control methods (pooled data 2 years)

Treatment	Dry weight of weeds (kg/ha)	Weed-control efficiency (%)	Grain yield (t/ha)	Total energy ($\times 10^3$MJ/ha)	Energy productivity (kg/MJ)	Net returns ($\times 10^3$₹/ha)
Weedy check	359.6	-	1.6	13.23	0.126	3.8
Hand-weeding at 20 and 40 DAS	96.8	73.0	5.5	14.60	0.377	37.8
Butachlor pre-emergence + fenoxoprop post-emergence	107.5	70.3	5.2	13.59	0.379	36.4
Pyrazosulfuran pre-emergence + fenoxoprop post-emergence	85.2	76.3	5.7	13.37	0.426	41.8
Oxadarzil pre-emergence + fenoxoprop post-emergence	123.8	65.5	4.7	13.37	0.356	32.2
Fenoxoprop + metsulfuron methyl + chlorimuron as post-emergence (Tank mixed)	91.3	74.6	5.5	13.35	0.410	38.5
Ethoxysulfuron + fenoxoprop post-emergence (tank mixed)	95.2	73.5	5.3	13.36	0.397	38.3
SEm±	4.78	-	1.04	-	-	0.72
CD (P=0.05)	14.6	-	3.2	-	-	2.2

HW, Hand-weeding; DAS, Days after sowing

Table 2. Weed dry matter, weed control efficiency, grain yield, energy utilization and energy productivity and net profit of wheat as influenced by weed control methods (pooled data 2 years)

Treatment	Dry weight of weeds (kg/ha)	Weed-control efficiency (%)	Grain yield (t/ha)	Total energy ($\times 10^3$MJ/ha)	Energy productivity (kg/MJ)	Net returns ($\times 10^3$₹/ha)
Weedy check	194.1	-	2.9	12.6	0.242	12.9
Hand-weeding at 20 DAS	22.2	88.5	5.0	13.6	0.372	30.1
Isoproturon post-emergence	25.8	86.6	4.8	12.7	0.390	30.7
Sulfosulfuron post-emergence	20.0	89.7	5.5	12.6	0.490	36.2
2, 4-D + Metsulfuron methyl post-emergence (tank mixed)	25.7	86.7	5.4	12.7	0.426	35.2
Iodosulfuron post-emergence	27.9	85.6	5.2	12.6	0.419	33.5
Fenoxa prop post-emergence	20.5	89.4	5.4	12.7	0.429	35.8
SEm±	2.81	-	2.37	-	-	0.45
CD (P=0.05)	8.6	-	7.1	-	-	1.39

HW, Hand-weeding; DAS, Days after sowing

gence fenoxoprop as post-emergence and unweeded control during both the years. The mean grain yield of rice crop was increased when pyrazosulfuron applied as pre-emergence + fenoxoprop as post-emergence to the tune of 256.2, 3.6, 9.6, 21.2, 3.6 and 7.5% and mean net profit was increased at 1,000, 10.5, 14.8, 29.8, 8.5, and 8.4%, respectively, over weedy check, hand-weeding at 20 and 40 DAS, butachlor as pre-emergence + fenoxoprop as post-emergence, oxadarzil as pre-emergence + fenoxoprop as post-emergence, fenoxoprop + metsulfuron methyl + chlorimuron as post-emergence (mixed), ethoxy sulfuron + fenoxoprop as post-emergence (mixed). The increase in grain yield might be owing to reduced weed density, weed dry weight and better weed control efficiency. Our results confirm findings of Gopinath and Kundu (2008), Kumar *et al.* (2010), Singh *et al.* (2008) and Gopinath *et al.* (2012). The highest grain yield and net profit were obtained in pyrazosulfuron as pre-emergence and fenoxoprop as post-emergence (Table 1), followed by fenoxoprop + metsulfuron + chlorimuron as post-emergence, which was significantly superior to other weed-control treatments. However, the differences for grain yield and net profit between hand-weeding and fenoxoprop + metsulfuron + chlorimuron were non-significant. These findings might be due to the effect of treatments on weed dry weight and weed-control efficiency and ultimately higher yield. In case of wheat crop, weed-control methods also influenced yield and other parameters significantly (Table 2). Weed-control treatments showed significantly higher grain yield over the control. However, difference among the weed control measures were not significant. The highest grain yield and net profit were fetched with treatment sulfosulfuron applied as post-emergence. The mean grain yield of wheat crop was increased due to treatment sulfosulfuron to the tune of 89.6, 10.0, 14.5, 1.8, 5.7 and 1.8% and mean net profit was also increased at 180, 20.2, 17.9, 2.8, 8.6 and 11.0%, respectively, over weedy check, hand-weeding at 20 DAS, isoproturon as post-emergence, 2, 4-D + metsulfuron methyl, iodosulfuron as post-emergence, fenoxa prop as post-emergence. These results might be because of difference in weed dry weight obtained due to weed-control treatments, which resulted in reduced crop weed competition for space, solar radiation interceptions, moisture and nutrient uptake.

Energy-utilization pattern

Among weed-management treatments, hand-weeding twice in rice crop and ones in wheat crop were found to be more energy consuming 14,602 MJ/ha and 13,569 MJ/ha, respectively over other treatments because it consumed higher number of labourer's for weeding (Tables 2, 3). The highest energy productivity (MJ/ha) was observed with pyrazosulfuron as pre-emergence and fenoxoprop as post-emergence with in rice crop, while in case of wheat crop the highest energy productivity was recorded with sulfosulfuron applied as post-emergence over other weed-management treatments. This result might be because of better weed control, higher crop yield and low energy consumption due to treatment.

Based on the study, application of pyrazosulfuron @ 20 g/ha as pre-emergence + fenoxoprop-p-ethyl@60 g/ha at 25 DAS in rice and application of sulfosulfuron @ 25 g/ha at 25 DAS in wheat found most effective, productive and profitable.

REFERENCES

Devasenapathi, P., Kumar, G. Senthil and Shanmugham, P.M. 2009.

Energy management in crop production. *Indian Journal of Agronomy* **54**(1): 80–90.

Gopinath, K.A., Mina, B.L., Singh, K.P. and Natraja, K.C. 2012. Integrated weed management in direct seeded rice. *Indian Journal of Agronomy* **53**(3): 245–49.

Gopinath, K.A. and Kundu, S. 2008. Evaluation of metsulfuron-methyl + chlorimuron-ethyl for weed control in direct seeded rice. *Indian Journal of Agricultural Sciences* **78**(5): 466–69.

Kumar, N., Mina, B.L., Singh, K.P., Chandra, S., Kumar, M. and Shrivastav, A.K. 2010. Weed control for yield and profit maximization in wheat in Indian Himalaya. *Indian Journal of Agronomy* **55**(2): 119–22.

Prasad, R. 2005. Rice–wheat cropping systems. *Advances in Agronomy* **86**: 255–69.

Singh, C.V., Ghosh, B.C., Mitra, B.N. and Singh, R.K. 2008. Influence of nitrogen and weed management on the productivity of upland rice. *Journal of Plant Nutrition and Soil Science* **171**(3): 466–70.