Indian Journal of Weed Science **47**(1): 28–30, 2015

Management of mixed weed flora in barley with tank-mix application of isoproturon with metsulfuron and 2,4-D

S.C. Negi and Pankaj Chopra

Department of Agronomy, Forages and Grassland Management, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh 176 062

Received: 30 January 2015; Revised: 01 March 2015

ABSTRACT

A field experiment was conducted with eight treatments comprising individual application of isoproturon 0.75 and 1.00 kg/ha and tank mix application of isoproturon 0.75 and 1.00 kg/ha with metsulfuron 0.004 kg/ha each and isoproturon 1.00 and 1.25 kg/ha with 2,4-D 0.50 kg/ha each including hand weeding twice and a weedy check. All herbicidal treatments resulted in significant reduction of count and dry matter of total weeds, thereby giving significantly higher grain yield of barley over weedy check. Application of isoproturon + metsulfuron 1.00 + 0.004 kg/ha and isoproturon + 2,4-D 1.25 + 0.5 kg/ha was statistically similar to hand weeding twice with significant reduction of weed count and dry matter resulting in higher weed control efficiency. Tank mix application of all combinations gave significantly higher grain yield of barley. However, isoproturon + metsulfuron 1.00 + 0.004 kg/ha recorded similar higher grain yield of 1.72 t/ha as comparable to hand weeding twice (1.72 kg/ha), which was 8.6 to 27.3 % higher over remaining herbicide treatments. Highest net returns due to weed control and marginal benefit cost ratio of Rs 4661/ha and 2.32, respectively was obtained with isoproturon + metsulfuron 1.00 + 0.004 kg/ha followed by isoproturon + metsulfuron 0.75 + 0.004 kg/ha with corresponding values of Rs 3560/ha and 1.86.

Key words: 2,4-D, Barley, Economics, Isoproturon, Metsulfuron, Tank mix, Weed indices, Yield

Barley (*Hordeum vulgare* L.), an important crop of temperate regions of Himachal Pradesh is grown in an area of 21.24 thousand hectares with a production of 22.94 thousand metric tonnes (Anonymous 2012-13). It is mainly grown for feed, fodder purposes and for the preparation of local tribal beverage. Reasons for low productivity of barley in the region include use of low yielding varieties, cultivation under low fertility and non irrigated conditions and losses caused by weeds and diseases. The yield reduction in barley depends upon type and density of associated weed flora (Walia and Brar 2001). Among weeds, *Phalaris minor* and *Avena ludoviciana* are the most serious problems in barley (Singh *et al*. 1995). Due to strong competitiveness, these weeds can cause yield reduction in the range of 15 to 50% (Morishta and Thill 1988). Similarly, *Chenopodium album*, *Lepidium sativa, Anagallis arvensis* are other broad-leaved weeds, which also compete with crop causing yield reduction up to 25%. El Bawab and Kholousy (2003) reported that controlling weeds by herbicide treatments increased grain yield by about 40.3 and 13.6% when compared to unweeded and hand weeding treatments, respectively. Though under conditions of Himachal Pradesh, isoproturon and 2,4-D have been recommended to control complex weed flora, 2,4-D fails to control certain broad-leaf weeds like *Rumex dentatus, Malva parviflora, Lathyrus aphaca* and *Fumaria parviflora* effectively. Hence, other broad-leaf herbicides *i.e*. metsulfuron-methyl with isoproturon was evaluated against complex weed flora in barley.

***Corresponding author:** drscnegi@yahoo.in

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* 2006-07 and 2007-08 at Experimental Farm of Rice and Wheat Research Centre, Malan, CSK Himachal Pradesh Krishi Vishvavidyalaya Palampur. The experiment was conducted on silty clay loam soil having pH 5.9 with medium total available nitrogen, phosphorus and potassium. The experiment was laid out in randomized block design with eight treatments comprising individual application of isoproturon 0.75 and 1.00 kg/ha and tank mix application of isoproturon 0.75 and 1.00 kg/ha with metsulfuron 0.004 kg/ha each and isoproturon 1.00 and 1.25 kg/ha with 2,4-D 0.5 kg/ha each including hand weeding twice and weedy check. Crop was raised with recommended package of practices except treatments. The individual herbicides were first dissolved individually in the container, then these

were mixed in the sprayer tank for tank mix application of two herbicides. All herbicide treatments were applied at 2-3 leaf stage of weeds. A knapsack sprayer fitted with flat fan nozzle using 750 litres of water per hectare was used for spraying the herbicide. Weed population was taken by quadrate method and dry weight was done as per standard method. Data on total weed count was subjected to "x+1 square root transformation to normalize the distribution. The grain yield of barley was recorded at harvest from the net plot area. Economics of the treatments was computed based on prevalent market prices. The price of barley grain mixture was ` 8.60/ kg. The various impact assessment indices namely weed control efficiency (WCE), weed index (WI), herbicide efficiency index (HEI) and weed management index (WMI) were calculated as per standard formulae.

RESULTS AND DISCUSSION

Barley crop was infested with both grassy and broad-leaved weeds. However, grassy weeds were predominant. The major weeds present in experimental site were *Phalaris minor, Avena ludoviciana, Lolium temulentum, Poa annua, Vicia sativa, Anagallis arvensis* and *Coronopus didymus.*

Effect on weeds

Different weed control treatments except isoproturon 0.75 kg/ha brought about significant variation in total weed count. In hand weeding treatment, significantly lower total weed count and dry matter accumulation was recorded. Among herbicides, isoproturon + metsulfuron 1.00 + 0.004 kg/ha and isoporturon+2,4-D 1.25 + 0.5 kg/ha were statistically similar to each other and they reduced total weed density effectively and equally comparable to two hand weedings. (Table 1). Yadev *et al.* (2006) also proved the superiority of metsulfuron + isoproturon 0.004 +0.75 or 0.004 + 1.00 kg/ha in reducing weed density in wheat.

All weed control treatments were significantly superior over weedy check in reducing dry matter accumulation of total weeds. Hand weeding twice, isoproturon + metsulfuron 1.00 +0.004 kg/ha and isoproturon + 2,4-D 1.25 + 0.5 kg/ha were at par to each other but significantly superior over rest of the treatments. This was reflected in higher weed control efficacy (WCE) values of 89.0, 75.3 and 71.5% achieved by these respective treatments. Efficacy to control weeds by remaining weed control treatments ranged from 69.1 to 63.3% (Table 1).

Effect on crop

The pooled data (Table 1) revealed that all weed control treatments were significantly superior over weedy check in enhancing grain yield of barley. Weeds when allowed to grow throughout crop season caused 45.1% reduction in grain yield. Almost similar significantly higher yield was obtained from isoproturon + metsulfuron 1.00 + 0.004 kg/ha and handweeding. However, all weed control treatments of tank mix application of isoproturon with metsulfuron or 2,4-D were comparable to these in influencing grain yield.

The increase in grain yield of barley due to application of isoproturon + metsulfuron 1.00 + 0.004 kg/ha and hand weeding twice ranged from 8.7 to 27.3% over rest of the herbicidal treatments and 82.0% over weedy check. These results were similar to the findings of Ram and Singh (2009). Higher grain yield of wheat with isoproturon + metsulfuron 1.00 + 0.004 kg/ha was also reported by Singh and Singh (2002). Superiority of isoproturon and 2,4-D was also proved by Bharat and Kachroo (2007) in wheat.

Impact assessment

Grain yield was negatively associated with weed count (r= -0.949) and weed biomass (r= -0.954). HEI, which indicates weed killing potential, was highest (7.46) under hand weeding twice. Among herbicides, isoproturon + metsulfuron 1.00 + 0.004 kg/ha proved to be superior in recording highest HEI value of 3.32 followed by isoproturon+2,4-D 1.25 + 0.5 kg/ha. Efficacy of herbicide was lowest in isoproturon 0.75 kg/ha. Isoproturon + metsulfuron 1.00 + 0.004 kg/ha had the highest WMI of 1.09 followed by isoproturon + metsulfuron 750 + 0.004 kg/ha (0.98), while weedy check had lowest weed management index (WMI) followed by isoproturon 0.75 and 1.00 kg/ha (Table 1).

Economic impact

All chemical control treatments were economicaly viable over hand weeding twice and weedy check. Manual weed control was costly in comparison to herbicides. Because of higher grain yield, isoproturon + metsulfuron 1.00 + 0.004 kg/ha gave the highest gross returns of ` 14,801 and 6,674/ha, respectively, due to weed control which was closely followed by hand weeding twice with corresponding values of ` 14,783 and 6656/ha. Lowest values (` 11,619 and 3,492/ha) for these respective parameters were obtained with isoproturon 0.75 kg/ha. However, due to lower weed control cost, all herbicide treatments were superior to

Table 1. Effect of different treatments on total weed count, weed dry weight, yield of barley and impact indices (on the basis of pooled data of two years)

Treatment	Weed count (no./m^2)	Weed dry matter (g/m^2)	Grain yield (t/ha)	Weed index (%)	Weed control efficiency (%)	HEI	WMI
Isoproturon 0.75 kg/ha	10.20 (103.6)	6.03 (35.9)	1.35	21.50	63.25	1.17	0.68
Isoproturon 1.0 kg/ha	8.82 (77.3)	5.78 (32.9)	1.47	14.47	66.32	1.66	0.84
Isoproturon 0.75 kg/ha + metsulfuron 4 g/ha	8.47 (71.3)	5.54 (30.2)	1.58	8.08	69.08	2.18	0.98
Isoproturon 1.0 kg/ha + metsulfuron 4 g/ha	7.63 (57.8)	4.97 (24.2)	1.72	0.00	75.25	3.32	1.09
Isoproturon 1.0 kg/ha + 2,4-D 0.5 kg/ha	8.48 (71.5)	5.83 (33.5)	1.54	10.28	65.69	1.85	0.96
Isoproturon 1.25 kg/ha + 2,4-D 0.5 kg/ha	7.76 (59.8)	5.32 (27.8)	1.58	8.02	71.53	2.37	0.94
Hand weeding twice	3.06(8.87)	3.35 (10.7)	1.72	0.12	89.03	7.46	0.92
Weedy check	14.09 (197.9)	9.90 (97.6)	0.94	45.09	0.00	0.00	0.00
LSD (P=0.05)	4.83	2.19	0.24				

Values in parentheses are means of original values, Herbicide Efficiency Index (HEI) and Weed Management Index (WMI)

Table 2. Effect of treatments on economics

Treatment	Cost of weed control (x10^3 `/ha)	Gross returns (x10^3 `/ha)	GR_{WC} (x10^3 `/ha)	NR_{WC} (x10^3 `/ha)	MBCR
Isoproturon 0.75 kg/ha	1.58	11.62	3.49	1.91	1.21
Isoproturon 1.0 kg/ha	1.67	12.66	4.53	2.86	1.71
Isoproturon 0.75 kg/ha + metsulfuron 4 g/ha	1.92	13.60	5.48	3.56	1.86
Isoproturon 1.0 kg/ha + metsulfuron 4g/ha	2.01	14.80	6.67	4.66	2.32
Isoproturon 1.0 kg/ha + 2,4-D 0.5 kg/ha	1.84	13.28	5.15	3.31	1.80
Isoproturon 1.25 kg/ha+ 2,4-D 0.5 kg/ha	2.00	13.61	5.49	3.49	1.74
Hand weeding twice	6.40	14.78	6.66	0.26	0.04
Weedy check	0	8.13	0	0	-

GR_{WC} = Gross returns due to weed control, NR_{WC}= Net returns due to weed control, MBCR=Marginal benefit cost ratio

hand weeding twice in influencing net returns and B:C ratio (Table 2). Efficient weed control with isoproturon + metsulfuron 1.00 + 0.004 kg/ha resulted in highest net returns of ` 4,661/ha with B:C ratio of 2.32 and was followed by isoproturon + metsulfuron 0.75 + 0.004 kg/ha (Table 2). These results were in direct conformity with Ram and Singh (2009).

REFERENCES

Anonymous. 2012-13. *Statistical Outline of Himachal Pradesh*. Department of Economics and Statistics, Himachal Pradesh, Shimla.

Bharat R and Kachroo D. 2007. Effect of different herbicides on mixed weed flora, yield and economics of wheat (*Triticum aestivum*) under irrigated conditions of Jammu. *Indian Journal of Agricultural Sciences* **77**(6): 383-386.

El Bawab AMO and Kholousy AO. 2003. Effect of seeding rate and method of weed control on the productivity of Giza 2000, a promising barley line, under new lands condition. *Egyptian Journal of Agricultural Research* **81**(3): 1085 - 1098.

Morishta DW and Thill DL. 1988. Factors of wild oat (*Avena fatua*) interference on spring barley (*Hordeum vulgare)* growth and yield. *Weed Science* **36**: 37-42.

Ram H and Singh A. 2009. Studies on efficacy of tank mix herbicides for the control of weeds in irrigated barley (*Hordeum vulgare* L.). *Indian Journal of Weed Science* **41** (3&4): 167-171.

Singh G and Singh M. 2002. Bio-efficacy of metsulfuron-methyl in combination with isoproturon for control of grassy and non-grassy weeds in wheat. *Indian Journal of Weed Science* **34**(1/2): 9-12.

Singh S, Malik RK, Balyan RS and Singh S. 1995. Distribution of weed flora of wheat in Haryana. *Indian Journal of Weed Science* **27**: 114-121.

Walia US and Brar LS. 2001. Competitive ability of wild oats (*Avena ludoviciana* Dur.) and broad-leaf weeds in relation to crop density and nitrogen levels. *Indian Journal of Weed Science* **33**: 120-123.

Yadav A, Malik RK and Hasija RC. 2006. Efficacy of metsulfuron and isoproturon alone and in combination against complex flora of weeds in wheat. *Annals of Biology* **22**(2): 153-159.