



## Weed management in sugarcane ratoon crop

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### ABSTRACT

A field experiment was conducted on ratoon crop of sugarcane to develop suitable weed management practices during spring seasons of 2008-09, 2009-10 and 2010-11 at Sugarcane Experimental Area, (Ladhowal), Punjab Agricultural University, Ludhiana. A total of fourteen treatments including weedy check was tested in randomized block design with three replication. Herbicidal treatments were applied to ratoon crop immediately after harvesting of plant crop in the 1<sup>st</sup> week of February every year under moist conditions. The highest weed dry weight of 182.7 g/m<sup>2</sup> was recorded in weedy check. All the weed control treatments recorded significantly less weed dry weight as compared to the weedy check. The highest pooled cane yield of 74.3 t/ha was obtained with pre-emergence application of metribuzin 1.4 kg/ha fb 2,4-D 1.6 kg/ha at 45 days after ratoon initiation (DARI). The weed dry weight was significantly reduced to less than one third (54.3 g/m<sup>2</sup>) with pre-emergence application of metribuzin 1.4 kg/ha fb 2,4-D 1.6 kg/ha at 45 DARI compared to weedy check. Atrazine applied as pre-emergence at 2 kg/ha fb 2,4-D 1.0 kg/ha at 45 DARI proved equally effective as pre-emergence metribuzin 1.4 kg/ha fb 2,4-D 1.6 kg/ha at 45 DARI. In sugarcane ratoon crop, pre-emergence application of metribuzin 1.4 kg/ha fb 2,4-D 1.6 kg/ha at 45 DARI or atrazine 2 kg/ha fb 2,4-D 1.0 kg at 45 DARI gave net returns of ` 84,820/- and ` 84,497/- which was 61.7% and 61.1% higher over control, respectively.

**Key words:** Cane yield, Economics, Growth, Ratoon, Sugarcane, Weed density, Weed Management

Weeds infestation in sugarcane ratoon crop is entirely different and is a specific problem when compared with any other crop. In sugarcane, weeds have been estimated to cause yield losses from 10% to total crop failure depending upon composition, diversity of weeds and duration of competition (Mehra *et al.* 1990, Srivasatva and Chauhan 2002). This fact can be understood by specific reasons like establishment of weeds in plant crop as eradication of weeds from plant crop is not possible at affordable cost, wider row spacing (60-120 cm), slow initial growth (90-120 days), heavy fertilization and frequent irrigations. All these factors are responsible for weed infestation which in turn offers a great competition for crop growth in terms of space and inputs.

The efficiency of some of the recommended herbicides for weed control is for a lesser duration (may be between 7-8 weeks after application) which are not able to control weeds up to canopy formation stage. This has made to supplement the herbicides with either hand weeding or application of post-emergence herbicide, which is adding of another cost to crop production. If not controlled timely, the weeds at later stages become almost impossible to control either through chemical or mechanical methods resulting

poor crop growth and losses in cane yield. To realize the main advantage of ratoon ability of sugarcane, timely weed management is one of the most important factor otherwise there are chances of great loss to farmers from ratoon crop in terms of time and money. Since the work done on weed management in ratoon crop is very limited, the experiment was conducted to find out the efficacy of different herbicides on weeds associated with ratoon crop of sugarcane.

### MATERIALS AND METHODS

The experiment was conducted on sugarcane ratoon crop during spring season of 2008-09, 2009-10 and 2010-11 on sandy loam soil at Sugarcane Experimental Area, (Ladhowal), Punjab Agricultural University, Ludhiana to study the effect of different weed control treatments on sugarcane ratoon crop. The plant crop was raised using recommended package and practices of Punjab. The weeds in plant crop were managed through manual weeding. The experiment comprised of fourteen treatments (Table 1) were tested in a randomized block design with three replications. Treatment atrazine 1 kg/ha as PE fb 2,4-D 1.6 kg/ha at 45 DARI, metribuzin 1.4 kg /ha PE fb 2,4-D 1.6 kg/ha at 45 DARI and diuron 1.6 kg/ha fb 2,4-D 1.6 kg /ha at 45 DARI were recommended practices in plant crop under Punjab conditions. Sugarcane variety 'CoJ

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88' was planted in spring seasons of 2008-09, 2009-10 and 2010-11. Ratooning was initiated in the first week of February in subsequent year, respectively in three years of experimentation. All the treatments except trash mulching in alternative rows *fb* 1 hoeing at 1<sup>st</sup> and 6<sup>th</sup> WARI and trash mulching between all rows were applied after giving irrigation immediately after harvesting of plant crop. Data on weed count and dry matter accumulation were recorded from two places in each plot by using a quadrat of 45 x 45 cm<sup>2</sup>. Ratoon crop was harvested in the end of December during all the three years. For quality parameters, *i.e.* Pol % juice and CCS %, a representative sample of 10 stalks from each plot were crushed with vertical three roller laboratory cane crusher to extract the juice. The juice was analyzed by standard method as described by Chen (1985). Commercial cane sugar (CCS %) was calculated using winter's formula (Chen 1985). Other agronomic practices to raise the ratoon crop were followed as per the standard recommendations.

## RESULTS AND DISCUSSION

The mean data of three years study (2008-09, 2009-10 and 2010-11) on various aspects of sugarcane ratoon crop are given in Table 1, 2 and 3.

### Effect on weed density

Population and dry weight of weeds reduced significantly under all the weed control treatments compared with the weedy check (Table 1). The decrease in weed population ranged from 83.6% with three hoeings to 35.8% with the application of glyphosate 0.4 kg/ha as directed spray at 3 weeks stage. The reduction in weed dry weight also followed the similar trend. The highest reduction of 74.3% in dry weight

was observed in three hoeings while the lowest reduction of 35.3% was observed with glyphosate 0.4 kg/ha as directed spray at 3 weeks stage. Among different herbicidal treatments (Table 1), pre-emergence application of metribuzin 1.4 kg/ha *fb* 2,4-D 1.6 kg/ha at 45 days after ratoon initiation (DARI) was found most effective by recording the lowest weed population and dry weight thus showed highest weed control efficiency (WCE). Comparing with weedy check, this treatment showed reduction to the extent of 80.1 and 70.3% in population and dry weight of weeds, respectively, although being statistically at par with pre-emergence application of atrazine 2.0 kg/ha and metribuzin 1.0 kg/ha both followed either by 2,4-D 1.0 kg/ha or by one hoeing at 45 DARI but significantly better than all the herbicidal treatments and the treatment where trash mulch was applied. Suyal and Saini (1987) and Singh *et al.* (2001) also reported the effectiveness of metribuzin in controlling weeds of sugarcane. It has also been observed that pre-emergence application of atrazine 1.0 kg/ha or diuron 1.6 kg/ha *fb* 2,4-D 1.6 kg/ha at 45 DARI which is otherwise a recommendation for the plant crop of sugarcane did not found much effective in controlling weeds in ratoon crop as the weeds get sufficient time to prove their vigour and competitiveness after the plant crop was harvested and left for ratoon.

### Effect on growth and yield

All the weed control treatments significantly increased the number of tillers as compared to weedy check (Table 2). Pre-emergence (PE) application of metribuzin 1.4 kg/ha *fb* 2,4-D 1.6 kg/ha at 45 DARI recorded maximum increase of 66.7% in number of tillers over weedy check and proved significantly bet-

**Table 1. Effect of different weed control treatments on weed population and weed dry weight**

Treatment	Weed count/m <sup>2</sup>	Weed dry weight (g/m <sup>2</sup> )	WCE (%)
Three hoeing at 1 <sup>st</sup> , 4 <sup>th</sup> & 7 <sup>th</sup> WARI	31.3	47.0	74.3
Atrazine 2 kg/ha as PE <i>fb</i> 2,4-D 1 kg/ha at 45 DARI	52.3	62.0	66.1
Atrazine 2 kg/ha as PE <i>fb</i> 1 hoeing at 45 DARI	45.0	59.3	67.5
Atrazine 1 kg/ha as PE <i>fb</i> 2,4-D 1.6 kg/ha at 45 DARI	100.0	110.0	39.8
Metribuzin 1.4 kg/ha PE <i>fb</i> 2,4-D 1.6 kg/ha at 45 DARI	38.0	54.3	70.3
Metribuzin 1 kg/ha as PE <i>fb</i> 2,4-D 1 kg/ha at 45 DARI	49.0	60.3	67.0
Metribuzin 1 kg/ha as PE <i>fb</i> 1 hoeing at 45 DARI	42.7	55.3	69.7
Glyphosate 0.4 kg/ha at 3 weeks stage as directed spray	122.6	118.3	35.2
Glyphosate 0.4 kg/ha at 3 weeks <i>fb</i> 1 hoeing at 60 DARI	105.3	96.7	47.1
Trash mulching in alt rows <i>fb</i> 1 hoeing at 1 <sup>st</sup> & 6 <sup>th</sup> WARI	97.0	87.6	52.1
Trash mulching between all rows	102.3	91.3	50.0
Diuron 1.6 kg/ha <i>fb</i> 2,4-D 1.6 kg/ha at 45 DARI	81.3	90.4	50.5
Diuron 1.6 kg/ha <i>fb</i> 1 hoeing at 45 DARI	73.3	82.3	55.0
Weedy check (no. hoeing and no herbicide application)	191.0	182.7	-
LSD (P=0.05)	11.6	10.5	-

DARI- Days after ratoon initiation; WARI - Week after ratoon initiation

**Table 2. Effect of different treatments on growth, yield and quality of sugarcane ratoon crop**

Treatment	Tiller count (x10 <sup>3</sup> /ha)	NMC (x10 <sup>3</sup> /ha)	Cane yield (t/ha)	PoL (%)	CCS (%)
Three hoeing at 1 <sup>st</sup> , 4 <sup>th</sup> & 7 <sup>th</sup> WARI	183.7	95.3	73.3	18.9	13.1
Atrazine 2 kg/ha as PE <i>fb</i> 2,4-D 1.0 kg/ha at 45 DARI	178.3	97.0	72.0	19.0	13.1
Atrazine 2 kg/ha as PE <i>fb</i> 1 hoeing at 45 DARI	180.3	92.3	71.3	18.8	13.0
Atrazine 1 kg/ha as PE <i>fb</i> 2,4-D 1.6 kg/ha at 45 DARI	164.3	74.0	57.6	18.9	13.1
Metribuzin 1.4 kg/ha PE <i>fb</i> 2,4-D 1.6 kg/ha at 45 DARI	205.0	105.0	74.3	18.7	13.0
Metribuzin 1 kg/ha as PE <i>fb</i> 2,4-D 1.0 kg/ha at 45 DARI	171.0	88.3	69.7	18.9	13.1
Metribuzin 1 kg/ha as PE <i>fb</i> 1 hoeing at 45 DARI	171.0	88.7	72.0	18.7	13.0
Glyphosate 0.4 kg/ha at 3 weeks stage as directed spray	147.0	72.3	54.7	18.8	13.1
Glyphosate 0.4 kg/ha at 3 weeks <i>fb</i> 1 hoeing at 60 DARI	151.7	79.0	62.0	19.1	13.3
Trash mulching in alt rows <i>fb</i> 1 hoeing at 1 <sup>st</sup> & 6 <sup>th</sup> WARI	156.7	81.7	64.7	18.4	12.8
Trash mulching between all rows	161.0	82.3	66.3	19.0	13.2
Diuron 1.6 kg/ha <i>fb</i> 2,4-D 1.6 kg/ha at 45 DARI	162.3	80.0	63.0	19.1	13.2
Diuron 1.6 kg/ha <i>fb</i> 1 hoeing at 45 DARI	166.3	82.3	66.6	19.0	13.3
Weedy check (no. hoeing and no herbicide application)	123.0	69.0	53.3	18.6	12.8
LSD (P=0.05)	14.4	8.7	7.6	NS	NS

**Table 3. Economics of different weed control treatments in sugarcane ratoon**

Treatment	Gross returns (10 <sup>3</sup> /ha)	Expenditure (10 <sup>3</sup> /ha)	Net returns (10 <sup>3</sup> /ha)
Three hoeing at 1 <sup>st</sup> , 4 <sup>th</sup> and 7 <sup>th</sup> WARI	132.09	54.47	77.62
Atrazine 2 kg/ha as PE <i>fb</i> 2,4-D 1.0 kg/ha at 45 DARI	130.00	45.51	84.50
Atrazine 2 kg/ha as PE <i>fb</i> 1 hoeing at 45 DARI	129.09	48.67	80.41
Atrazine 1 kg/ha as PE <i>fb</i> 2,4-D 1.6 kg/ha at 45 DARI	105.95	45.05	60.89
Metribuzin 1.4 kg/ha PE <i>fb</i> 2,4-D 1.6 kg/ha at 45 DARI	133.23	48.41	84.82
Metribuzin 1 kg/ha as PE <i>fb</i> 2,4-D 1 kg/ha at 45 DARI	124.77	47.09	77.69
Metribuzin 1 kg/ha as PE <i>fb</i> 1 hoeing at 45 DARI	128.69	50.25	78.43
Glyphosate 0.4 kg/ha at 3 weeks stage as directed spray	98.32	44.05	54.27
Glyphosate 0.4 kg/ha at 3 weeks <i>fb</i> 1 hoeing at 60 DARI	111.95	47.65	64.29
Trash mulching in alt rows <i>fb</i> 1 hoeing at 1 <sup>st</sup> & 6 <sup>th</sup> WARI	116.36	48.77	67.59
Trash mulching between all rows	119.16	46.67	72.49
Diuron 1.6 kg/ha <i>fb</i> 2,4-D 1.6 kg/ha at 45 DARI	113.06	45.11	67.94
Diuron 1.6 kg/ha <i>fb</i> 1 hoeing at 45 DARI	120.00	48.09	71.91
Weedy check (no. hoeing and no herbicide application)	96.11	43.67	52.44

ter than all other treatments. This treatment also recorded 11.6% increase in tiller numbers over the treatment given three hoeing at 1<sup>st</sup>, 4<sup>th</sup> and 7<sup>th</sup> week after ratoon initiation (WARI) thus exhibiting better control of weeds through use of chemicals rather than performing manual operations (Table 2). The increase in tillers with different weed control treatments except where glyphosate 0.4 kg/ha at 3 weeks stage as directed spray and atrazine 1.0 kg/ha as PE *fb* 2,4-D 1.6 kg/ha at 45 DARI, also led to significant increase in number of millable canes and cane yield over weedy check. Application of metribuzin 1.4 kg/ha PE *fb* 2,4-D 1.6 kg/ha at 45 DARI was found most effective and recorded 52 % increase in the number of millable cane over weedy check. It was followed by pre-emergence application of atrazine 2 kg/ha *fb* 2,4-D 1 kg/ha at 45

DARI and three hoeing at 1<sup>st</sup>, 4<sup>th</sup> and 7<sup>th</sup> WARI. Weed control with metribuzin applied at 1.4 kg/ha as PE *fb* 2,4-D 1.6 kg/ha at 45 DARI also recorded significant increase of 10.2% in number of millable canes over three hoeing given at 1<sup>st</sup>, 4<sup>th</sup> and 7<sup>th</sup> WARI but was at par with the pre-emergence application of atrazine 2 kg/ha *fb* either 2,4-D 1.0 kg/ha or one hoeing at 45 DARI.

All the weed control treatments except where glyphosate 0.4 kg/ha at 3 weeks stage as directed spray and atrazine 1.0 kg/ha as PE *fb* 2,4-D 1.6 kg/ha at 45 DARI yielded significantly higher than the unweeded control. The highest cane yield of 74.3 t/ha was obtained with pre-emergence application of metribuzin 1.4 kg/ha *fb* 2,4-D 1.6 kg/ha at 45 DARI, which was

significantly better than the treatments where weed control was performed using glyphosate 0.4 kg/ha, diuron at 1.6 kg/ha, atrazine 1.0 kg /ha and trash mulching either in all or in alternate rows. Bains *et al* (1980) and Nadagonder and Lokshwar (1981) have also reported superiority of metribuzin over other herbicides for controlling weeds in sugarcane. Pratap (2013) concluded that application of metribuzin at 0.88 kg/ha at 3 DAR followed by one hand weeding at 45 DAR followed by 2,4-D at 0.75 kg/ha at 2-4-D leaf stage of broad-leaved weeds of ratoon crop was found most effective for controlling the weeds of sugarcane ratoon crop. The treatments where metribuzin were applied either 1.4 kg /ha or 1.0 kg/ha followed by one hoeing or 2,4-D at 45 DARI and where atrazine 2.0 kg/ha as PE *fb* either 2,4-D 1.0 kg/ha or one hoeing at 45 DARI along with the treatment given three hoeings were statistically at par to each other. Effective control of weeds might have reduced their competition with the crop for different resources like nutrients, moisture and sunlight and led to enhanced tillering, formation of millable canes and cane yield. Treatments where atrazine 1.0 kg/ha or glyphosate 0.4 kg/ha or trash mulch or diuron 1.6 kg/ha were applied, recorded significantly lower cane yield when compared with the treatment of three hoeing. The reduction in cane yield under these treatments was due to their low weed control efficiency. The different weed management practices could not affect the cane quality significantly in terms of Pol % and CCS %. This may be due to the fact that juice quality is the inherent ability of genotype.

### Economics

All the weed control treatments registered higher net returns than the weedy check (Table 3). Pre-emergence application of metribuzin 1.4 kg/ha *fb* 2,4-D 1.6

kg/ha at 45 DARI or atrazine 2 kg/ha *fb* 2,4-D 1.0 kg at 45 DARI gave net returns of ` 84,820 and 84,497/ha, respectively which was 61.7 and 61.1% higher over weedy check. Applying metribuzin 1.4 kg/ha as pre-emergence *fb* 2,4-D 1.6 kg/ha and atrazine 2 kg/ha *fb* 2,4-D 1.0 kg/ha also recorded 9.3 and 8.9% higher net returns, respectively over crop given 3 hoeing at 1<sup>st</sup>, 4<sup>th</sup> and 7<sup>th</sup> week after ratoon initiation. In spite of recoding the highest weed control efficiency and providing good cane yield, the treatment of three hoeings at 1<sup>st</sup>, 4<sup>th</sup> and 7<sup>th</sup> week after ratoon initiation could not found economical because of higher expenditure incurred on engaging labourers.

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