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Original Research Article

Compatibility Studies on Phytotoxic Effect and Economics by Use of Halosulfuron Methyl with Other Herbicides to Control the *C. rotundus* and Other Associated Weeds in Autumn Planted Sugarcane (*Saccharum officinarum* L.)

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A B S T R A C T

The present investigation was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad, Uttar Pradesh during autumn season of 2010-11. Sugarcane (Var Co 91269) was planted on 13, Nov., 2010 and harvested on 15, Nov. 2011. The experiment was laid out in RBD with three replications. The eight weed control treatments *viz.* post emergence application of halosulfuron (75% WG) 67.5 g ai ha^{-1} (90g ha^{-1}) tank mixed combination with other herbicides like 2,4-D-EE (1.51 kg ha^{-1}), 2,4-D amine salt (2.17 kg ha^{-1}), 2,4-D Na salt (2 kg ha^{-1}), metribuzine (525g ha^{-1}), atrazine (1.25 kg ha^{-1}), MSM (4g ha^{-1}), ethoxysulfuron (15g ha^{-1}) and weedy check were included in the experiment. Fertilizer nutrients and other operations were applied as per the recommendation of cane crop. No phytotoxicity symptoms were observed due to different weed control treatments on the sugarcane crop. The observations were recorded on crop during the experimentation. Halo + atrazine proved significantly superior with respect to economics of autumn planted sugar cane. The maximum values of net return (Rs. 179164 ha^{-1}) and highest value of B-C ratio of Rs 3.60 were recorded with Halo + atrazine (67.5 g + 1.25 kg) treatment combinations. Thus, it may be concluded that for achieving the maximum net profit in autumn planted sugarcane through Halo + atrazine may be adopted with better option under weedy check treatments.

Keywords

Sugarcane, herbicides, weed, Phytotoxic effect, Economics

Introduction

Sugarcane is an important commercial cash crop in India contributes nearly 7.5 per cent of the gross value of agricultural production in the country. About 50 million farmers depend on sugarcane cultivation for their livelihood and equal number of agricultural labourers earns their living by working in sugarcane farms. Sugarcane is the primary raw material for all major sweeteners produced in the country. In India sugarcane is planted in spring (February- March), autumn (September- October) and adsali planting (July -August). Sugar industry is the largest agro-based processing industry next only to textile in India. Molasses is an important by-product of sugar industry. It is used for production of alcohol by the distillaries. The *gur* and *khandsari* are an

alternative sweetening agents prepared from sugarcane. Sugarcane is bound to play a greater role in the Indian economy in the years to come by offering a stable income to the farmers by way of increasing cane price and by providing employment to rural masses. To meet the sugar requirement of increasing population in future, it is essential that sugarcane production has to be stepped up. Since, Vashishtha *et al., (2000)*, there is no scope at present to bring additional land under sugarcane; the targets have to be achieved only through increased productivity.

There are a number of causes responsible for low yield of sugarcane and cane recovery, among them weeds play a very important role to decline the yields and quality of sugarcane. Different weed control methods are being used by the farmers predominantly the manual weeding. But due to unavailability of manual labour in and cost involved, there is a need to find out effective herbicide to control the weeds in sugarcane.

Though a number of herbicides have been tried to control the weeds in sugarcane field and in general gave a satisfactory control but *Cyperus rotundus* is not controlled very effectively by using any weed control method even by using herbicide.

Up to a certain extent 2, 4-D has been found effective to control the *Cyperus spp.*, but only foliage is dried and after wards again regrowth has been observed. For solving this problem a new herbicide molecule (*Halosulfuron methyl*) has been developed and reported to control the *Cyperus spp.* as applied at 2-3 leaf stage. In addition to *Cyperus rotundus*, some other narrow and broad leaf weeds (BLW) cause the infestation in sugarcane. In this regard, to control the wide range of weed species, there is a need to use some other herbicides along with Halosulfuron methyl but there is a need to study their compatibility.

At present sugarcane is being cultivated throughout the country except in certain hilly tracts in Kashmir, Hamanchal Pradesh etc. In North India, the average yield of Sugarcane per unit land area is very low as compared to other part of the country mainly due to its planting in spring/late spring season. Autumn planting of Sugarcane has been introduced as one of the agronomic practices for increasing its yield and juice quality in place of normal spring planting and dedicated efforts are being taken to popularize the cultivation of autumn Sugarcane in North India.

Materials and Methods

The present investigation was conducted with entitled "Compatibility studies on phytotoxic effect and economics by use of halosulfuron methyl with other herbicides to control the *C. rotundus* and other associated weeds in autumn planted sugarcane (*Saccharum officinarum* L.)" Var. Co 91269, at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad, Uttar Pradesh during autumn season of 2010-11. Sugarcane was planted on 13, Nov., 2010 and harvested on 15, Nov. 2011. The experiment was laid out in RBD with three replications.

The eight weed control treatments *viz.* post emergence application of halosulfuron 67.5 g ai ha^{-1} (90g ha^{-1}) tank mixed combination with other herbicides like 2,4-D-EE (1.51 kg ha^{-1}), 2,4-D amine salt (2.17 kg ha^{-1}), 2,4-D Na salt (2 kg ha^{-1}), metribuzine (525g ha^{-1}), atrazine (1.25 kg ha^{-1}), MSM (4g ha^{-1}), ethoxysulfuron (15g ha^{-1}) and weedy check were included in the experiment. The soil of the experimental field was sandy loam, pH

7.90, organic carbon (0.30), available N (204.50 kg), available P (19.20 kg) and available K (305.85 kg). Fertilizer nutrients and other operations were applied as per the recommendation of cane crop.

Statistical analysis with the procedure for randomized plot design as suggested by Gomez and Gomez (1984). The phytotoxic effect on sugarcane data were recorded at given time interval with respect to different bio indicators using the 0-10 point scale during the investigation. The observations were recorded on weeds and on crop during the experimentation. Cane setts were taken from the healthy crop. The canes were cut into three budded sett pieces.

The selected sett pieces were dipped into 0.25% areton solution for 10 minutes prior to planting to protect the cane setts from fungal infection if any. The furrows of 15 cm depth were opened at 75 cm apart with the help of tractor drawn ridger. Treated setts were planted in furrows at the rate of four setts per meter furrow length. Furrows were covered immediately with loose soil with the help of spade and finally field was planked to maintained the better contact of soil with setts. The sugar cane crop was harvested at complete maturity as judged by hand refractometer. There after the net plots were harvested for data recording.

Results and Discussion

Data pertaining to phytoxic effect on sugarcane have been presented in Table-2 and 3. The data were recorded at given time interval with respect to different bio indicators using the 0-10 point scale during the investigation. No phytotoxicity symptoms were observed due to different weed control treatments on the sugarcane crop. The results also supported by Kathiresan *et al.,* (2004).

Table.1 Phytotoxic symptom scoring and rating on crop

Crop injury symptoms	Rating	Effect
No injury, normal	0	None
Slight stunting injury or discoloration	1	Slight
Some stand loss, stunting/ discoloration	2	Slight
Injury more pronounced but not persistent	3	Slight
Moderate injury, recovery possible	4	Moderate
Injury more persistent, recovery doubtful	5	Moderate
More severe injury, no recovery possible	6	Moderate
Severe injury, stand loss	7	Severe
Almost destroyed few plants surviving	8	Severe
Very few plants alive	9	Severe
Complete destruction	10	complete

Table.2 Visual observations on phytotoxicity doses of Halosulfuron methyl 75% WG (score 0-10)

Treatment		Domes (g/ha)		Crop discolouration on DAHA						Chlorosis on DAHA						Stunting on DAHA					
		a.i.	Formulation	1	3	5	7	10	15	1	3	5	7	10	15	1	3	5	7	10	15
T_1	Halosulfuron methyl + 2, 4-D EE	67.5g + 1.51	90g + 3.91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_2	Halosulfuron methyl + 2, 4-D amine salt	67.5g + 2.17	90g + 3.751	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_3	Halosulfuron methyl + 2, 4-D Na salt	67.5g + 2.0 kg	90g + 2.5 kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_4	Halosulfuron methyl + Metribuzin	67.5g 525g	90g + 750g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_5	Halosulfuron methyl + Atrazine	67.5g + 1.25kg	90 + 2.5kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_6	Halosulfuron methyl + M.S.M.	67.5g + 4g	90g+2.5g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_7	Halosulfuron methyl + Ethoxysulfuran	65.7 + 15g	90g +125g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_8	Weedy check			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table.3 Visual observations on phytotoxicity doses of Halosulfuron methyl 75% WG (score 0-10)

Treatment		Domes (g/ha)		Wilting on DAHA						Deformation on DAHA						Vein clearing DAHA					
		a.i.	Formulation	1	3	5	7	10	15	1	3	5	7	10	15	1	3	5	7	10	15
T_1	Halosulfuron methyl + 2, 4-D EE	67.5g + 1.51	90g + 3.91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_2	Halosulfuron methyl + 2, 4-D amine salt	67.5g + 2.17	90g + 3.751	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_3	Halosulfuron methyl + 2, 4-D Na salt	67.5g + 2.0 kg	90g + 2.5 kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_4	Halosulfuron methyl + Metribuzin	67.5g 525g	90g + 750g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_5	Halosulfuron methyl + Atrazine	67.5g + 1.25kg	90 + 2.5kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_6	Halosulfuron methyl + M.S.M.	67.5g + 4g	90g+2.5g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_7	Halosulfuron methyl + Ethoxysulfuran	65.7 + 15g	90g +125g	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T_8	Weedy check			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table.4 Economics of different treatments of autumn planted sugarcane

Treatments		Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio (Rs re^{-1} invested)
T_1	Halo. + 2, 4-D EE	50111	154240	104125	2.07
T_2	Halo. + 2, 4-D amine salt	50097	166107	106010	2.31
T_3	Halo. + 2, 4-D Na salt	49510	184892	135382	2.73
T_4	Halo. + Metribuzin	50120	215992	165872	3.30
T_5	Halo. + Atrazine	49695	228859	179164	3.60
T_6	Halo. + M.S.M.	49004	221081	172077	3.51
T_7	Halo. + Ethoxysulfuran	49395	188729	139334	2.82
T_8	Weedy check	46870	134150	87280	1.86

Analysis of economic factors like cost of cultivation, gross income, net profit and benefit cost ratio are important to evaluate the effect of the treatments from practical point of view to the farming community as well as to the planners (Table-4). In general, the farmers are mainly interested to earn more profit unit^{-1} area, time and investment, whereas planners policies are mainly concentrated for high productivity from the crops. Henceforth, economic analysis of the treatments gave truthful information to both growers as well as planners. The economic analysis have been discussed here by considering cost of inputs used and value of the produce obtained as per prevailing rates in the locality on ha^{-1} area basis it's also studied by Prem, Kumar *(2011).* The maximum cost of Rs. 50115 ha^{-1} was incurred as cost of cultivation in Halo + 2,4-D ethyl ester treatment. It might be due to more cost of herbicides and labour charges. The minimum cost of cultivation Rs. 46870 ha^{-1} was recorded in weedy check treatment.

The maximum gross return of Rs. 228859 ha^{-1} was obtained under Halo + atrazine treatment. It might be due to higher yield of sugarcane and green fodder. The minimum gross return of Rs. 134150 ha^{-1} was recorded under without use of weed control treatment due to poor yield of sugarcane suggested by Tomar *et al., (2003).* Maximum net return of Rs. 179164 ha^{-1} was recorded under halo + atrazine treatment while the minimum net return of Rs. 87280 ha^{-1} with no weed control treatment. It might be due to low yield of sugarcane and green fodder. The highest benefit-cost ratio (Rs Re^{-1} invested) of Rs. 3.60 was obtained with the application of Halo + atrazine treatment. The minimum B-C ratio of Rs. 1.86 was obtained under weedy check. Among of 2,4-D formulations, high B-C ratio was obtained of Rs 2.73 with the application of Halo + 2,4-D Na salt.

It can be concluded that no phytotoxic symptoms were observed on sugarcane due to different herbicide combinations applied and in case of economics it can be concluded that Halo + atrazine (67.5g+ 1.25 kg ha^{-1}) proved very effective for net return and B-C ratio. However, for giving the recommendation further confirmation is required.

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