Bangladesh J. Sugarcane 3 : 45-50

Evaluation of herbicides for weed control in sugarcane

O.O.Oworu
Sugarcane Improvement Programme,
National Cereals Research Institute
P.M.B. 5042
Moor Plantation, Ibadan
Nigeria.

ABSTRACT

Six herbicides were evaluate for their effectiveness in controlling weeds in plant and ratoon crops at Moor Plantation, Ibadan. Simazine applied to the soil four days after seeding at the rate of 6 kg. ai/ha gave the best results and increased tonnage.

Asulam applied post emergent of weeds at 4.5 and 6.0 kg ai/ha caused slight initial toxicity, but the injury sustained did not significantly affect crops yield. Ioxinil at 3.5 and 6.0 kg ai/ha, atrazine at 3.5, 4.5 and 6.0 kg ai/ha and ametryn applied at 3.5, 4.5 and 6.0 kg ai/ha did not increase yield significantly over the untreated plots. Treatments had no significant effect on juice quality as measured by refractometer solid.

INTRODUCTION

Heavy weed infestation, especially before close-in among other factors is a major cause of low tonnage in sugarcane. Weeds in sugarcane consist of both annuals (Broad leaf, sedge and grass) and perennials such as purple nutsedge (*Cyperus rotundus L.*) In general, grasses are more important as weeds than broad leaved species. Chemical weed control remains one of the primary and probably the only practical approach to removing weed competition (Hilton and Osgood, 1972). The objective should be the control of the broadest spectrum of weeds with the fewest herbicides before close-in (Goberdhan, 1971).

Furthermore, information on chemical weed control in sugarcane under Nigerian conditions is very scanty except for routine chemical weed control reported by Ogboh (1973).

The purpose of this study was to evaluate the performance of six herbicides for weed control in sugarcane.

MATERIALS AND METHODS

The plant crop (cv. CO. 1001) was planted on the 4th of May, 1979 on two soil series (Smyth and Montogomery 1962)(pH 6.3, total N O. 10%, organic matter content 1.47%, and cation exchange capacity 3.11m Eq/100g soil) on the experimental

plots of NCRI at Moor Plantation, Ibadan. The herbicides used were : ametryn, atrazine, ioxynil, asulam, simazine and candex. Their chemical names and formulations are given in Table 1. Three rates (3.5, 4.5 and 6.0 kg ai/ha) of each herbicides were compared

Table 1 : Common, chemical names and formulation, concentrations of chemicals evaluated.

NAME		Formulation concentration
Common	Chemical	
Ametryn	2-ethylamino-6-isopropylamino-2-methylthio-1,3,5-triazine	72.% W.P*
Atrazine	2-chloro-4-ethylamino-6-isopropylamino-1,3,5-triazine	80% W.P
Ioxynil	4-hydroxy-3,5-di-iodobenzonitrile	200g/litre E.C
Asulam	Methyl (4-aminobenzen-sulphonyl) carbamate	400g/litre E.C.±
Simazine	2-chloro-4,6-bisethylamino-1,3,5-triazine	80 W.P.
Asulam+Atrazine (Candex)	Methyl (4-aminobenzen -esylphonyl) carbamate+ 2-chloro-6-ethylamino-2-isopropylamino-1,3,5-triazine	70 W.P.

* W.P. - Wettablepowder. ±E.C - Emulsifiable concentrate.

with hand weeded and unweeded plots in a randomized block design with three replicates. The plot size was 6 x 3m^2. The herbicides were applied by hand operated knapsack sprayers.

In the plant crop, land was prepared with one ploughing and two rotavations. Simazine, atrazine, candex and ametryn were applied to the soil 4 days after seeding while ioxynil and asulam were applied 21 days after seeding when the weeds were about 20 cm in height.

Ten cane seed setts were planted in rows spaced 1.5 cm apart. Fertilizers were applied as basal dressings in the form of ammonium sulphate, single superphosphate and muriate of potash at the rate of 125, 56 and 56 kg/ha respectively.

Using the rating scale (5-plant killed; 1-no toxicity) for herbicide toxicity, the symptoms of phototoxicity to the crop were visually scored thirty days after planting, while weed control were scored visually at fortnightly intervals before close-in using the rating scale (9-no control; 1-excellent control).

The dry weights of weeds per plot were determined from three randomly thrown 1m^2 quadrant samples at 30, 60 and 100 days after application and expressed in g/m^2. Yield data were collected at harvest twelve months after planting and refractometer solids (total solids in expressed juice sap) determined with the aid of a hand refractometer.

All the herbicides except ioxynil and asulam were applied on the ratoon crop on 8th June 1980 four days after the removal of the plant crop and weeds. Ioxynil and asulam were applied 21 days after harvest when the regrowth of weeds were about 20cm in height. All the other operations were the same as in the plant crop except for fertilizers which were placed alongside the ratoon stubbles.

RESULTS AND DISCUSSION

The common weeds on the experimental plots are shown in table 2. The major ones included *Cynodon plectostachyus, Paspalum scrobiculatum, Cenchrus ciliaris, Mimosa pudica and Centrosema plumieri.*

In the plant crop, simazine gave the best control. At 4.5 and 6.0 kg ai/ha, it gave the best performance in terms of weed control and yield with no visible damage to the crop. The highest yield (90.3 ton/ha) was obtained when 6.0 kg ai/ha was applied 4 days after seeding (Table 3) and followed by 4.5 kg ai/ha of simazine. These were not however, significantly greater than yields obtained with candex applied at 3.5 and 4.5 kg ai/ha or with asulam applied at 3.5, 4.5 and 6.0 kg ai/ha 21 days after planting or with the hand weeding treatment.

Table 2 : Weed species commonly found on experimental plots at Moor Plantation.

WEED	FAMILY
Calopogonium mucunioides Desv.	Papilionaceae
Cenchrus ciliaris. Linn.	Gramineae
Centrosema plumieri (Turp) Benth.	Papilionaceae
Cleome ciliata. Schum & Thorm.	Capparidaceae
Commelina nodiflora. Linn.	Commelinaceae
Cynodon plectostachyus. Linn.	Gramineae
Digitaria horizontalis. Willd.	Gramineae
Elentheranthra ruderalis. Schum. Bip.	Compositae
Eupatorum odoratum. Linn.	Compositae
Euphorbia heterophylla. Linn.	Euphorbiceae
Indigofera hirsuta. Linn.	Papilionaceae
Ipomea hederifolia. Linn.	Convolvulaceae
Mariscus flabelliformis. H.B & K.	Cyperaceae
Mimosa pudica. Linn.	Mimosa
Paspalum scrobiculatum. Linn.	Gramineae
Sida acuta. Burn. f.	Malvaceae
Spigelia anthelmina Linn.	Loganiaceae
Talinum triagulare. (Jacq) Willd.	Portulacaceae
Tridax procumbens. Linn.	Compositae

Asulam and ioxynil applied at 6.0 kg ai/ha caused initial toxicity to the plant which resulted in the yellowing of the young leaves 5-10 days after spraying, but the canes apparently outgrew the effects. All plots treated with simazine, candex and asulam at 3.5, 4.5 and 6.0 kg ai/ha respectively gave yields which were significantly higher than the untreated control plots.

The weed weights of the treatments ranged from 367.7g/m^2 for the hand weeded plots to 2060g/m^2 for the unweeded control (Table 3). The weed weight for plots treated with simazine at 4.5 and 6.0 kg ai/ha were 4094g/m^2 and 381.8g/m^2 respectively, and were not significantly different from the hand weeded plots. The tiller numbers ranged from 123 for plants treated with 6.0 kg ai/ha of simazine to 28 for the untreated control. No significant difference were obtained among the treatments in terms of refractometer solids.

Table 3 : Effects of herbicides on toxicity and weed control ratings, weed weight, tillering, yield and refractometer solids in a plant crop.

Herbicide Treatment	Application		Toxicity* rating 30 DAA	Weed* control rating	Weed wt. g/m²	No. of Tillers/ plot 50 DAA	TCH	RS.
	Rate (kg.a.i./ ha)	Time (DAP)						
Simazine	6.0	4	1	2	381.8c	123 ab**	90.3a	16.9
Candex	3.5	4	1	3	622.2bc	109 ab	60.6abcd	17.0
Actril	4.5	21	2	5	828.3bc	108 abc	46.5cdef	17.3
Hand weeding	twice	40,97	1	2	367.7c	102 abcd	70.6abcd	17.0
Candex	4.5	4	1	3	440.4c	100 abcde	59.8abcde	17.4
Asulox	3.5	21	1	4	778.9bc	97 abcdef	72.2abc	15.1
Asulox	4.5	21	1	4	999.8bc	87 bcdefg	73.4abc	16.8
Actril	6.0	21	2	3	733.9bc	78 cdefgh	47.7cdef	17.6
Candex	6.0	4	1	3	440.6c	74 defgh	52.8bcde	16.4
Asulox	6.0	21	2	4	1002.4bc	72 defgh	66.6abcd	16.8
Simazine	4.5	4	1	2	409.4bc	72 defgh	86.8ab	16.8
Atrazine	3.5	4	1	3	750.9bc	71 efgh	43.2cdef	18.6
Simazine	3.5	4	1	3	664.8bc	71 efgh	65.3abcd	17.6
Atrazine	6.0	4	1	5	686.5bc	65 gh	30.1f	14.8
Ametryn	3.5	4	1	5	769.6bc	62 gh	22.8 ef	17.6
Ametryn	6.0	4	1	3	875.9bc	56 h	49.9cdef	18.2
Actril	3.5	21	1	5	1437.1ab	54 h	23.8ef	16.4
Ametryn	4.5	4	1	4	724.8bc	49 h	34.5def	17.9
Atrazine	4.5	4	1	4	866.7bc	44 h	27.7ef	18.1
No weeding	—	—	—	9	2038.7a	28 i	19.0f	16.1
								NS

DAA - days after application. DAP - days after planting. TCH - tonnes cane/ha. RS - Refractometer solids. *Toxocity rating : 1-no toxicity : 2-slight toxicity ; 3-moderate toxocity ; 4-severe toxicity ; 5-plant killed ; *Weed control rating: 1-excellent ; 2-3 good ; 4-5 fair ; 6-8 poor ; 9-no control. **Statistical significance at 5% level. Means followed by a common letter are not significantly different at 5% level (Duncan Multiple Range Test).

The application of simazine at 4.5 and 6.0 kg ai/ha to the ratoon crop gave the highest yield (80.6 and 89.6 tonnes/ha respectively). The weed weights ranged from 32.2g/m² in plots treated with 6.0 kg ai/ha of simazine to 1064.2g/m² in the untreated control (Table 4). There were no significant differences in weed weights among plots treated with simazine (6.0 kg ai/ha), atrazine (3.5 and 6.0 kg ai/ha) candex (3.5 kg ai/ha) simazine (3.5 kg ai/ha) and the hand weeded plots. The simazine plots were virtually weed-free just before close in except for some grasses such as the giant star grass (*Cynodon plectostachyus*). The ratoon crop was generally less weedy than the plant crop. Tillers were most numerous (144) on plots treated with simazine (6.0 kg ai/ha) while the fewest (35) were on unweeded plots (Table 4). Refractometer solids did not differ significantly between the treatments.

Simazine (6.0 kg ai/ha) in both plant and ratoon crops gave the bess weed control and yield, without any visible injury to the young cane plants. Further work with this materials particularly its persistence in the soil is obviously desirable. It seems likely that its lower solubility and consequently greater persistence in the soil may account for its better performance than ametryn and atrazine, which are also triazine compounds.

Table 4 : Effects of herbicides on toxicity and weed control ratings, weed weight, tillering, yield and refractometre solids in a ratoon crop.

Herbicide Treatment	Application		Toxicity† rating 30 DAA	Weed* control rating	Weed wt. g/m²	No. of Tillers/ plot 50 DAA	TCH	RS.
	Rate (kg.a.i./ ha)	Time (DAP)						
Simazine	6.0	4	1	2	32.2f**	144a	89.6a	21.8
Candex	3.5	4	1	3	331.1cdef	142a	59.6c	15.8
Actril	4.5	21	1	4	480.0bc	134a	43.5de	17.7
Hand weeding	twice	40,85	1	2	313.3cdef	111ab	64.6c	17.9
Candex	4.5	4	1	3	371.1cde	93abc	56.5cd	15.2
Asulox	3.5	21	2	3	438.3bcd	134a	69.0bc	17.9
Asulox	4.5	21	2	3	524.4bc	141a	67.9c	18.0
Actril	6.0	21	2	3	502.2bc	114ab	42.8e	17.9
Candex	6.0	4	1	4	431.6bcd	131a	50.9d	15.8
Asulox	6.0	21	2	3	426.7bcd	144a	65.9c	17.7
Simazine	4.5	4	1	2	64.7ef	114ab	80.6ab	18.7
Atrazine	3.5	4	1	3	333.3cdef	120ab	42.8e	19.8
Simazine	3.5	4	1	3	120.9def	122ab	60.5c	17.8
Atrazine	6.0	4	1	5	332.0cdef	140a	32.6e	19.9
Ametryn	3.5	4	1	5	451.1bcd	116ab	20.5f	20.2
Ametryn	6.0	4	1	4	522.2bc	130a	46.8f	19.7
Actril	3.5	21	2	5	728.9b	55bc	22.9f	20.8
Ametryn	4.5	4	1	5	444.4bcd	96abc	31.4ef	20.1
Atrazine	4.5	4	1	4	453.3bcd	103abc	28.2f	18.1
No weeding	—	—	—	8	1064.2a	35c	18.9f	17.9
								NS

DAA - Days after application. DAP - Days after planting. TCH - Tonnes cane/ha. RS - Refractometer solids. †Toxicity rating : 1-no toxicity ; 2-slight toxicity ; 3-moderate toxicity ; 4-severe toxicity ; 5-plant killed ;

On the other hand, ioxynil and asulam, which are translocated compounds without any residual activity and little or no persistence in the soil permitted greater amounts of weeds and greater competition. This may explain the reduced yield when compared with the simazine treatments. However, the differences in yield were found not to be statistically significant in the plant crop.

The two hand weedings in the plant and ratoon crops may be insufficient resulting in more weeds during the intervals between the first and second weedings. This may lead to competition and may probably account for the reduction in yield between the hand weeded, simazine and asulam plots. The first weeding was carried out 19 days after germination in the plant and ratoon crops when the plots were still fairly weed free. This appeared to be adequate before the second hand weeding at about close-in. However, the weed competition between the intervals was not enough to cause any significant difference in yield between the hand weeded plots and some herbicide treated plots. There is need, therefore, to investigate the number of hand weeding operations necessar throughout the growth cycle of the crop.

Weed competition was also reflected in tiller number as the large quantity of weeds was associated with lower tiller number and consequently lower yield. Weeds were generally more in the plant crop than in the ratoon because weed seed germination was stimulated by ploughing and harrowing (Ogboh, 1973). In addition, herbicides with

greater persistence, such as simazine, apparently caused greater reduction in weeds because of repeated application on the same plots in the ratoon crop leading to some accumulation in the soil.

The economic and practical effects of the herbicides which could be used as an index of effectiveness (Macqueen and Parker, 1975) are shown in table 5. Thus, it cost about 40k to produce a ton of sugarcane when simazine was applied at the rate of 6.0 kg ai/ha in the plant and ratoon crops compared to 94k and 1.03k/ton of sugarcane when two hand weeding were employed in both plant and ratoon crops.

Table 5 : Effect of herbicide applications and farm operations on the yield and cost/ton of sugarcane

Treatment 6 kg ai/ha	Tonnes cane/ha		Cost of herbicide N/kg		Cost of production cane N/ton	
	P	R	P	R	P	R
Hand weeding	70.6	64.6	3.33**	3.33	0.94	1.03
Atrazine	30.1	32.6	5.06	5.06	1.26	1.16
Simazine	90.3	89.6	4.85	4.85	0.40	0.41
Ametryn	49.9	46.8	6.46	6.46	0.97	1.03

**It takes 10 man day twice to weed an hectare at 3.33k per day.
P - Plant crop. R - Ratoon crop. * - Nigerian currency. One naira is equivalent to 100 kobo or 1 dollar and 50 cents (American currency).

ACKNOWLEDGEMENT

I am grateful to the Director, National Cereals Research Institute, Ibadan for permission to publish this paper. Thanks are due to Dr. N. J. Usoroh of the NIHORT, Ibadan Dr. B.A Olunuga and Dr. S. U. Remison of NCRI, Ibadan for their suggestions in the preparation of the manuscript.

I wish to express gratitude to Mr. Korede of the Herbarium, NCRI, Ibadan for the identification and classification of various weeds.

REFERENCES

Goberdhan, L.C. 1971. Weed Survey. Annual Report Caroni Research Station, Trinidad, P. 32-37.

Hilton, H.W. and Osgood R. V., 1972. Chemical weed control for Hawaiian Plantations. Proc. ISSCT. 14 : 1175-1184.

Macqueen, C.M. and Parker, R.M., 1975. New ways of controlling weeds in sugarcane using Paraquat. *World crops.*. **27** (4) : 160-162.

Ogboh W. C. 1973. Routine chemical weed control at Bacita. Proc. 3rd Nigerian weed Sci. Group Meeting, P. 28-32.

Smyth, A.J. and Montogomery, R.F., 1962. Soils and Land use in Central South Western Nigeria, Ibadan, Government Press.