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Herbicidal Activity of Chlorimuron-ethyl (107 g/kg) Associated with Metribuzin (643 g/kg) on Sugar Cane Weeds and Its Effects on Soil Agrochemical Properties, in Burkina Faso

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Abstract: The efficiency and selectivity of chlorimuron-ethyl (107 g/kg) associated with metribuzin (643 g/kg), against weeds which causes big damages to sugar cane, have been studied on the sugar cane field of Beregadougou. The experimental design was a Latin rectangle with eight treatments in four replications including an untreated control, manual weeding, a control product (Trifloxysulfuron-sdium 1.85% + Ametryn 73.15%) and five rates of chlorimuron-ethyl associated with metribuzin. Weeds counting and weighing their dry biomass have been done using 0.25 m² quadrants to determine their biological efficiencies. The soil nitrogen nitrate and assimilable phosphorus contents were evaluated on a spectrophotometer, those of available potassium on a flame photometer. The biological efficiency coefficients of this herbicide, varied from 12.41% to 100%, according to their dry biomass. High rates, phytotoxics, showed the best coefficients. At the sugar cane complete maturation, the higher rates of imposter led to an accumulation of nitrogen nitrate content and lower available phosphorus and potassium contents, compared to the untreated control. The rate of 1.20 kg/ha became the dose to apply against weeds and less toxic to the soil.

Key words: Chlorimuron-ethyl, metribuzin, weeds, agrochemical properties, sugar cane.

1. Introduction

World sugar production is booming. It follows the increase of consumer needs from which more than two-thirds coming from food industry. Sugar cane is mainly used for its extraction. With an annual production which exceeds 1.7 billion tons, sugar canes are the first plants cultivated in the world with nearly 23% of the total mass produced in agriculture. The big three countries producers are Brazil, India and the European Union which produce for nearly half of this production [1]. In addition to sugar cane, sugar beet is also used as raw material. But sugarcane distanced beet accounting for three quarters of world sugar production. Sugar is an important nutritional value. Indeed, 100 g of sugar providing about 400 kcal. Moreover, sucrose and white sugar contains a few grams of water, calcium (85 mg/100 g) and iron (3.4 mg/100 g) [2]. In Burkina Faso, the SN-SOSUCO (New Sugar Company of Comoe) is the structure since 1974 which produce and market sugar cane.

The sugar cane production as other crops faces many contrains. Among others, the losses came from damage caused by pests (insects, rodents), diseases and weeds. To reduce these losses, the company is implementing various strategies against pests. For the specific case of weeds, three main methods are used: manual weeding, mechanical weeding and chemical control. However, the manual weeding requires much more time and intensive labor, which is not always available especially with the emergence of new sectors such as gold mining.

According to the mechanical weeding, its secondary effects on the soil physical properties, and the fact that it is not feasible in any time of the culture, limit its use.

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At the opposite, chemical weeds control, which requires less time and labor in the short term, found to be an effective way to fight against weeds. However, their environmental effects have not been studied always. The risk assessment of some pesticide on sugar cane has been reported by Ouedraogo [3]. This is why, in this context, for the first time, this presents study focuses on the biological effectiveness of IMPOSTER 750 WP (chlorimuron-ethyl 107 g/kg + metribuzin 643 g/kg) on sugarcane weeds and its effects on soil agrochemical properties.

2. Material and Methods

2.1 Material

The experimentation has been done on SN-SOSUCO factory's plantation, at Beregadougou, on ferriginous soil which at 0-20 cm depth, is characterized by pH 5.2, nitrogen (0.60%), carbon (0.81%), organic matter (1.40%), available phosphorus (0.08%), calcium (1.35 meq/100 g soil), magnesium (0.10 meq/100 g soil), potassium (0.16 meq/100g of soil), sodium (0.01 meq/100 g soil) and suffers (1.16 meq/100g of soil). The plant material was sugar cane (*Saccharum officinarum* L.) variety CO 997, very sensitive to weeds. Cultivation technics consisted of a plowing by a tractor followed by harrowing. The cuttings were planted in line continuously. A mineral fertilizer NPK (160-80-180 kg/ha) was applied. Water supplies have been made, if necessary, by irrigation. Weeding the plots, have been done according to the protocol. The experimental design was a Latin rectangle completely randomized of 8 treatments in 4 repetitions. The different treatments were: untreated control, manual weeding, KRISMAT 3.00 kg/ha, (Chloromuron-ethyl 107 g/kg + Metribuzine 643 g/kg) 0.60 kg/ha = IMPOSTER 0.60 kg/ha, IMPOSTER 1.20 kg/ha, IMPOSTER 2.00 kg/ha, IMPOSTER 2.40 kg/ha and IMPOSTER 3.60 kg/ha. The size of the elementary plot was 11.11 m × 9 m = 99.99 m² that of a useful plot of 10.11 m × 7.50 m = 75.82 m². The inter plot was 1.50 m between the blocks and 2.50 m between treatments.

2.2 Methods

After herbicides' application, the phyto-toxicity of the different herbicides has been evaluated using a visual rating scale method of the European bioassay commission graduated from 0 to 10. Weeds counting have been done on plots at 9th, 16th, 32th, 60th, 50th, 96th and 120th day after herbicides application (DAA). These consisted of counting and pulling weeds, using a square of 0.25 m² placed on four strains at regular intervals along the diagonal in each useful plot. The herbicides biological efficiencies in these observation periods were calculated using the Eq. (1) [4]:

$$C = 100 - \frac{Bi \times 100}{Bx} \quad (1)$$

Where,

C: Biological efficiency (%);

Bi: Number of weeds per square meter or weight of the dry biomass (g/m²) of herbicide on the 1st or 2nd , 3rd counting;

Bx: Number of weeds per square meter or weight of the dry biomass (g/m²) of the untreated control on 1st or 2nd , 3rd counting.

The weeds dry biomass accumulation during the various observations was evaluated by the weighing method [5]. The weeds were identified at the 98th day after treatment using the identification key [6-9]. At the 120th day after application, the number of processible canes was counted on the two central lines of the useful plot. At the maturity, sugar canes were cut and weighed and evaluated on Tone/ha. Saccharose and extractable sugar were evaluated, using a universal polarimeter and a refractometer. Soil samples were taken at the depth of 0-20 cm, from each plot of two blocks, before herbicides application, 16 days and 120 days after, during sugar cane maturity. The nitrogen nitrate contents of the soil were evaluated by atomic absorption spectrophotometer [10]. Those of assimilable phosphorus were evaluated by the method of Bray 1 and available potassium on a flame photometer [11]. An analysis of variance of data was computed and means separations carried out using

Newman-keuls test at 5% level using STAT-ITCF software [12]. The correlations between the studied factors were computed, using ORIGIN 3.0 software.

3. Results

3.1 Selectivity of Different Rates of IMPOSTER WP 750 on Sugar Cane

A visual evaluation of the phytotoxicity, based on E.B.C rating scale was made during the observation periods. At the sixteenth day, sugar cane at IMPOSTER 2.40 kg/ha and 3.60 kg/ha showed some signs of phytotoxicity. Indeed, many discolorations leaves of cane plants have been observed on plots having received these treatments. According to the E.B.C rating scale, this description is equivalent to a strong phytotoxicity and then takes the value 4. For the rest of the treatments, the sugarcane plants showed a normal appearance.

3.2 Effect of Different Rates of IMPOSTER 750 WP on Weeds Dry Biomass Dynamic Accumulation

Evaluated by using the weighing method [5], the dynamics of the accumulation of weeds dry biomass showed growth until 120th day after application (Table 1).

At 9th day after herbicides application, the average affects of herbicides (1 g/m²) is a significant reduction of 25.37% in comparasion with the manual weeding. Between the different rates of IMPOSTER, there is no significant difference. The same trend is observated at 16th day after application.

At 32th day, the average affect of herbicides (1.52 g/m²) is a reduction of weeds dry biomass of 42.42% in comparasion with untreated control. Among herbicides, the lowers dry biomass are on IMPOSTER 2.40 kg/ha and 3.6 kg/ha which are not different with manual weeding and control herbicide which is KRISMAT 3.00 kg/ha.

At 60th day after herbicides application, their average affect (3.18 g/m²) have helped to mitigate the accumulation of dry biomass weed for 52.95% in comparasion with the untreated control and for 26.05% in comparison with the manual weeding. Between KRISMAT 3.00 kg/ha and IMPOSTER at the rates of 2.00 kg/ha to 3.60 kg/ha, there is no significant difference.

They allowed a reduction of 2.32 times to 2.58 times weeds in comparasion with controls and from 1.47 times to 1.64 times in comparison with manual weeding. The best reduction is obtained on the plots treated with the highest rate of IMPOSTER 750 WP for 67.80%.

The average effect of herbicides (4.12 g/m²) at 96th day is a reduction of approximately 1.91 times the weeds dry biomass in comparison with the untreated control and an increase of 1.94 times in comparison with manual weeding. The lower reduction is situated at IMPOSTER 2.00 kg/ha which is not different statically with manual weeding. IMPOSTER 1.20 kg/ha which is not different to KRISMAT 3 kg/ha, gives a reduction of 43.07% in comparison with untreated control.

At the 120th day after application, the average effect (4.23 g/m²) is a reduction of 71.45% weeds dry biomass in comparison with the untreated control. The lowest rate is situated on IMPOSTER 2.00 kg/ha but there is no significant difference between IMPOSTER 1.20 kg/ha and KRISMAT 3.00 kg/ha.

So, during all these periods of observations, the highest rates of IMPOSTER gave the highest reduction of the weeds dry biomass.

3.3 Biological Efficiency of IMPOSTER 750 WP Different Rates, According to Weeds Dry Biomass

The biological efficiency of the different rates of IMPOSTER 750 WP was evaluated by VILITSKY formula and it ranged 12.41% and 100% (Table 2). Those with manual weeding ranged between 63.52% and 100%. The biological efficiency of KRISMAT 3.00 kg/ha varied from 61.49% to 99.67%. The best reductions are on the highest rates of IMPOSTER and it varied from 56.79% to 100%.

Table 1 Affects of IMPOSTER 750 WP different doses on sugar cane weeds dry biomass accumulation.

Treatments	Day After Application (DAA)											
	9		16		32		60		96		120	
	Original data	After $\sqrt{x+1}$	Original data .	After $\sqrt{x+1}$	Original data	After $\sqrt{x+1}$	Original data .	After $\sqrt{x+1}$	Original data	After $\sqrt{x+1}$	Original data	After $\sqrt{x+1}$
Untreated control	0.00	1.00b	0.00	1.00b	6.20	2.64 a	49.60	6.77 a	65.48	7.87 a	219.25	14.82a
Manual weeding	2.79	1.34 a	1.34	1.34 a	0.00	1.00 d	18.09	4.30 b	3.66	2.12 f	13.55	3.80 c
Krismat 75 WG 3.00 kg/ha	0.00	1.00b	0.00	1.00 b	0.02	1.01 d	9.53	2.92 de	25.21	3.87 cd	16.93	4.22 c
Imposter 750 WP 0.60 kg/ha	0.00	1.00b	0.00	1.00 b	5.43	2.10 b	37.21	5.31 b	40.50	5.65 b	24.32	5.03 b
Imposter 750 WP 1.20 kg/ha	0.00	1.00b	0.00	1.00 b	0.81	1.27 cd	15.72	3.20 d	29.65	4.48 c	15.36	4.03 c
Imposter 750 WP 2.00 kg/ha	0.00	1.00b	0.00	1.00 b	0.22	1.53 c	8.81	2.88 de	6.63	2.76 ef	7.53	2.91 d
Imposter 750 WP 2.40 kg/ha	0.00	1.00b	0.00	1.00 b	0.54	1.20 d	8.10	2.62 de	28.29	4.56 c	29.96	5.55 b
Imposter 750 WP 3.60 kg/ha	0.00	1.00b	0.00	1.00 b	0.00	1.00 d	5.28	2.18 de	11.93	3.40 de	12.17	3.62 c
Mean		1.16		1.04		1.47		3.77		4.34		5.50
CV (%)		16.90		8.00		12.50		10.09		10.80		6.8
ETR (ddl = 21)		0.20		0.08		0.18		0.41		0.47		0.38
ETM ($S\bar{X}$)		0.10		0.05		0.90		0.20		0.23		0.19

Table 2 Biological efficiency of IMPOSTER 750 WP doses according to the weeds dry biomass (%).

Treatments	Day After Application (DAA)					
	9	16	32	60	96	120
Untreated control	-	-	-	-	-	-
Manual weeding	-	-	100.00	63.52	94.41	93.81
Krismat 75 WG 3.00 kg/ha	-	-	99.67	80.78	61.49	92.21
Imposter 750 WP 0.60 kg/ha	-	-	12.41	24.97	38.15	88.90
Imposter 750 WP 1.20 kg/ha	-	-	86.93	68.30	54.71	92.99
Imposter 750 WP 2.00 kg/ha	-	-	96.45	82.23	89.56	96.55
Imposter 750 WP 2.40 kg/ha	-	-	91.29	83.66	56.79	86.33
Imposter 750 WP 3.60 kg/ha	-	-	100.00	89.35	81.78	94.44

3.4 Effects of IMPOSTER 750 WP Different Rates on Sugar Cane Weeds Flora

The manual weeding and herbicides have influenced the sugar cane weed flora (Table 3). The experimental plots were mainly grassed by *Agerathum conyzoïde*, *Dioscorea bulbifera*, *Ridens pilosa*, *Commelina bengalensis* and *Mitracarpus villosus*. The highers rates of IMPOSTER reduced the weeds more than 50%. But *Dioscorea bulbifera* was resistant to the different rates of this herbicide and to the control herbicide which is KRISMAT 75 WP.

3.5 Effects of IMPOSTER WP 750 Different Rates on Soil Nitrate Nitrogen Content

According to the nitrate nitrogen, its dynamics was characterized by a reduction during the flowering stage and an increase at the sugar cane maturity (Table 4).

Before herbicides application, the soil nitrate nitrogen average content in herbicides plots (5.29 ppm), is an increase of 41.44% compared to the untreated control and of 25.95% in comparsion with manual weeding plot.

At the flowering stage, the average effect of herbicides (2.70 ppm) is a reduction of 3.57% compared to the untreated control. Besides, IMPOSTER 2.00 kg/ha which led to a significant surplus of 12.50% compared to the untreated control, there is no significant differences between the different rates of IMPOSTER and the untreated control, manual weeding.

At the full maturity of sugar cane, the average effect of herbicides (3.89 ppm) is a reduction of 7.38% compared to the untreated control and an incre of 19.33% compared to manual weeding. KRISMAT 3.00 kg/ha, IMPOSTER 2.00 kg/ha and IMPOSTER 3.60 kg/ha are not different with the untreated control. The manual weeding, IMPOSTER 0.60 kg/ha and IMPOSTER 1.20 kg/ha have the lowest content of nitrate nitrogen in the soil.

Overall, nitrate levels in herbicides exhibit decreases in maturation stage compared to the period before application.

3.6 Effects of IMPOSTER WP 750 Different Rates on Soil Available Phosphorus Content

The dynamic of available phosphorus content in the soil is characterized by a decrease from the period before pesticides application to the sugar cane maturity (Table 4). The average effect of herbicides (24.63 ppm) is a slight decrease of 11.78% compared to the untreated control during the period before herbicides application.

At the flowering stage, the average effect of herbicides (22.28 ppm) on available phosphorus, is a decrease of 90.20% compared to the untreated control. KRISMAT 3.00 kg/ha, IMPOSTER 2.00 kg/ha and IMPOSTER 2.40 kg/ha have led lower content from 49.89% to 70.60% in comparasion with the untreated control. The others treatments do not differ from the untreated control.

Table 3 Affects of IMPOSTER 750 WP different doses on weeds flora after 120th day herbicides application.

Genus especies	Family	Untreated control	Manual weeding	KRISMAT 75 WG 3.0 kg/ha	IMPOSTER 750 WP 0.6 kg/ha	IMPOSTER 750 WP 1.2 kg/ha	IMPOSTER 750 WP 2.0 kg/ha	IMPOSTER 750 WP 2.4 kg/ha	IMPOSTER 750 WP 3.6 kg/ha
Agerathum conyzoïde	Asteraceae	22	4	1	12	3	-	-	-
Bidens pilosa	Asteraceae	21	19	-	1	4	3	-	-
Celosia laxa	Amaranthaceae	1	19	1	14	4	-	-	-
Cienferta digitata	Laminariaceae	1	-	-	-	-	-	-	-
Commelina bengalensis	Combretaceae	14	6	1	-	1	-	-	-
Cucumus melo	Convolvulaceae	2	-	-	-	-	-	-	-
Cyperus sp.	Cyperaceae	1	-	-	-	-	-	-	-
Dioscorea bulbifera	Dioscoreaceae	7	8	33	16	19	14	20	23
Dioscorea dumetorum	Dioscoreaceae	-	-	-	-	1	-	-	-
Euphorbia hirta	Euphorbiaceae	-	1	-	-	-	-	-	-
Mitracarpus villosus	Rubiaceae	11	-	7	1	7	3	-	-
Oldenlandia corymbosa	Rubiaceae	1	-	1	2	-	-	-	-
Rottboelia exaltata	Poaceae	2	1	-	-	1	-	2	-
Vernonia cinerea L.	Asteraceae	-	1	-	-	-	1	-	-
Mean		20.75	16	11	12.5	5.25	5.75	5.5	5.75

Table 4 Affects of IMPOSTER 750WG different doses on nitrate nitrogen, available phosphorous and potassium contents.

Treatments	$N\text{-}NO_3$ (ppm)			P_2O_5 (ppm)			K_2O (ppm)		
	Before application	Flowering stage	Maturity stage	Before application	Flowering stage	Maturity stage	Before application	Flowering stage	Maturity stage
Untreated control	3.74 c	2.80 ab	4.20 a	27.92 ab	24.49 b	13.50 a	37.92 c	29.36 c	55.00 b
Manual weeding	4.20 c	2.33 b	3.26 bc	27.06 ab	19.95 b	11.00 bc	28.08 d	26.73 c	29.00 c
Krismat 3.0kg/ha	7.94 a	2.68 ab	4.20 a	24.39 bc	10.68 c	11.50 abc	25.10 d	49.80 b	33.50 c
Imposter 0.6 kg/ha	3,.74 c	2.57 b	2.80 c	27.75 ab	21.19 b	10.00 c	63.04 a	33.02 c	43.50 bc
Imposter 1.2 kg/ha	4.63 c	3.15 a	3.26 bc	24.39 bc	58.69 a	9.50 c	45.31 bc	28.83 c	32.00 c
Imposter 2.0 kg/ha	4.20 c	2.68 ab	4.66 a	31.55 a	7.20 c	10.0 c	47.28 b	45.61 b	31.50 c
Imposter 2.4 kg/ha	4.20 c	2.45 b	3.97 ab	21.03 cd	12.27 c	10.00 c	58.12 a	58.19 a	81.00 a
Imposter 3.6 kg/ha	7.00 b	2.68a b	4.43 a	18.64 d	23.64 b	13.00 ab	40.88 bc	43.51 b	34.50 c
Moyenne	4.95	2.68	3.85	25.34	22.26	11.06	43.22	39.38	42.50
CV (%)	5.90	5.20	6.40	6.60	7.80	6.30	6.00	5.70	13.30
ETR (ddl = 6)	0.29	1.14	0.24	1.67	1.73	0.70	2.59	2.25	5.65
ETM ($S\bar{X}$)	0.15	0.57	0.12	1.18	1.22	0.35	1.83	1.41	2.83

At the sugar cane maturity, the average effect of herbicides (10.67 ppm) is a decrease of 20.96% available phosphorus content compared to the untreated control. Only KRIMAT 3.00 kg/ha and IMPOSTER 3.60 kg/ha showed equivalent content to the untreated control. Other treatments displayed significant decreases 18.52% to 29.63% compared to the untreated control. The available phosphorus content in all the treatments became twice lower than the period before herbicides applications.

3.7 Effects of IMPOSTER WP 750 Different Rates on Soil Available Potassium Content

Before herbicides application, the average available potassium content on the plots is treated (46.62 ppm), which has an increase of 22.94% compared to the untreated control. Only plots to be treated by IMPOSTER 1.20 kg/ha and IMPOSTER 3.60 kg/ha do not differ from the untreated control.

At the flowering stage, the average effect of herbicides (38.16 ppm) has an increase in the potassium content available 29.97% compared to the untreated control and virtually the double of manual weeding. Between the herbicides, only the low rate of IMPOSTER (0.60 kg/ha) and IMPOSTER (1.20 kg/ha) do not differ from the untreated control and manual weeding. The higher rates of IMPOSTER led to an increase of 48.19% to 98.19% compared to the untreated control.

At the sugar cane maturation, the average effect of herbicides (42.67 ppm) is a reduction in the available potassium content of 22.41% compared to the untreated control and an increase of 47.14% compared to the manual weeding. Beside IMPOSTER 2.40 kg/ha which led to an increase of 47.27%, the other treatments led to a significant decreases compared to the untreated control but are equivalent to manual weeding.

3.8 Influence of Different Doses of IMPOSTER 750 WP on Yield Components and Sugarcane Yield

At the criteria of machining canes, the average effect of hebicides (781.17 canes/useful plot) is an increase of 26.05% in comparison of untreated control. Between the herbicides there is no significant difference. But they allowed an increase of 27.63% to 29.08% in comparison with untreated control.

The average effect of herbicides (84.42 t/ha) is an increase of 19.94% cane yield in comparison with untreated control. Between herbicides, only the high dose of imposter (3.60 kg/ha) does not differ significantly from the control product which is the Krismat. Both herbicides provide an increase of 22.52% and 31.34% compared to the untreated control, respectively.

Between the doses of imposter 0.60 kg/ha and imposter 2.40 kg/ha, there is no significant difference. They provide an increase of 13.34% and of 20.12% compared to the untreated control. The proposed rate (1.20 kg/ha) ensures a surplus of 14.18% compared to the untreated control. At the criteria of extractable sugar, the average effect of herbicides (14.10 t/ha) is an increase of 57.01% compared to the untreated control. Between herbicides, there is no significant difference. At the criteria of sucrose content, there's no significant difference between the objects.

4. Discussion

The different rates of herbicides and manual weeding affected the weeds population density as shown by the correlations between the yield and the factors stadied at 120th day after herbicides application. Between the weeds dry biomass and the yield the correlation is expressed by the following mathematical formula $Y = -0.07X + 86.05$ with $Sd = 4.31$ ($p = 0.019$) (Fig. 1). This correlation is expressed by the following equation $Y = 0.09X + 17.39$ with $Sd = 4.38$ ($p = 0.02$) (Fig. 2). The changes occurred on sugar cane weeds are not only by the ways the herbicides act but also by their rates, persistance of action and spectrum of activity.

IMPOSTER 750 WP is an herbicide which is composed by two active ingrediens (chloromuron-Ethyl and Metribuzin) for pre emergence using against

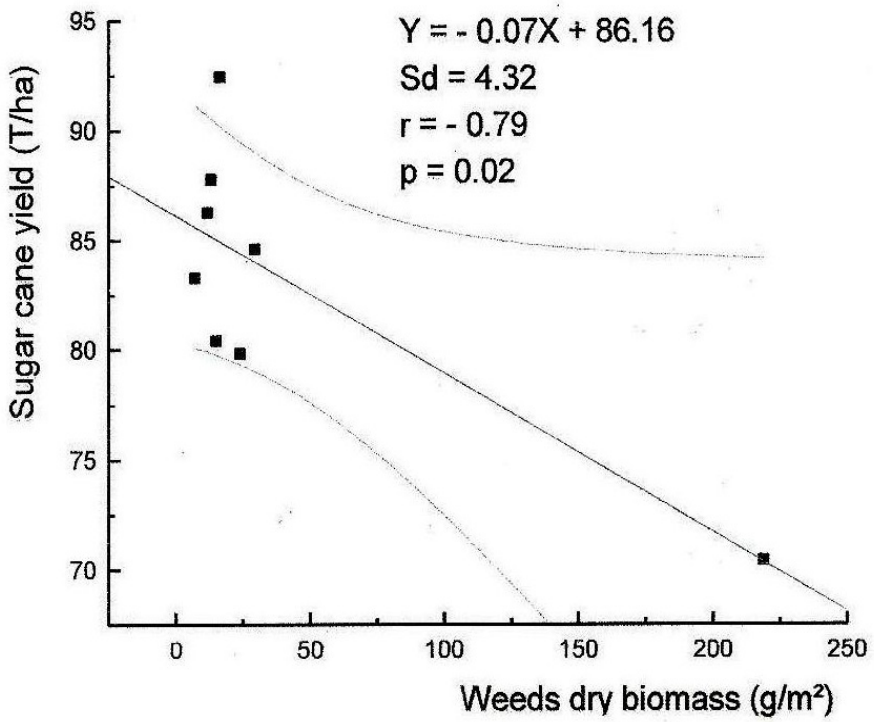

Fig. 1 Correlation between weeds dry biomass at 120th day after herbicides application and sugar cane yield.

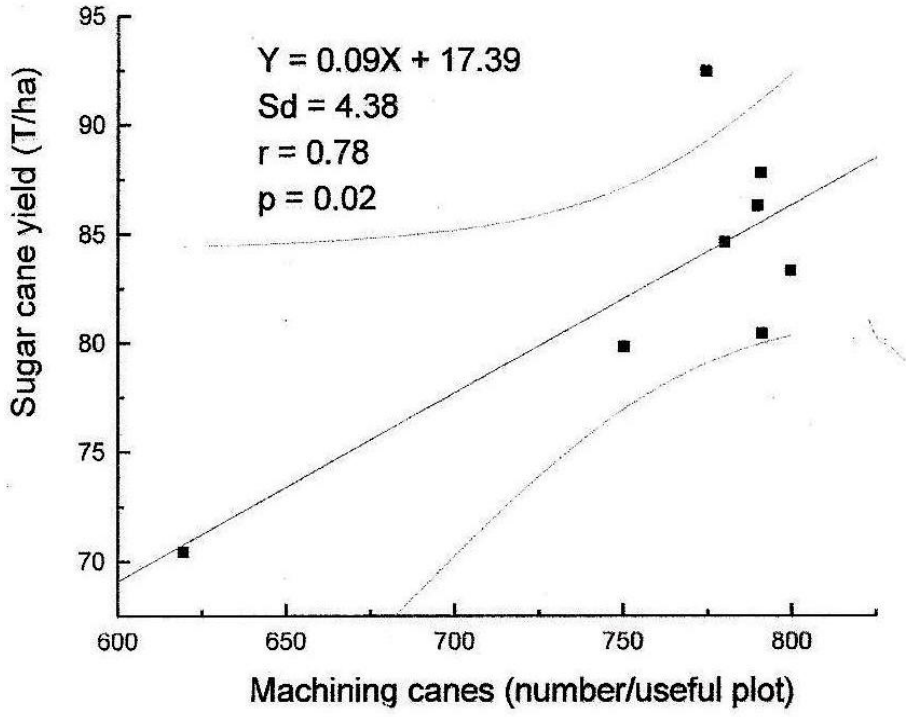

Fig. 2 Correlation between machining canes at 120th day after herbicides application and sugar cane yield.

cyperaceae and other dicothyledons on sugar cane production. The molecules from this chemical family have a large spectrum of weeds control at low doses, a good selectivity on crops, low acute and chronic toxicity and with a good biological efficiency [13, 14]. They have been recognized for their inhibit activity of acetolactate synthetase (ALS), an enzyme implicated in the amin acids biosynthasis. Metribuzin from the family of triazine inhibit the photo synthesis activity on a site which is situated between the photo system II and the plastoquinose of weeds. Metribuzin has a good herbicide activity against dicotyledons. This is why a big reduction of weeds on the plots treated by IMPOSTER 750 WP has been obtained. During the first two months IMPOSTER 750 WP and KRISMAT 75 WG had similar efficiency. But after the 3rd month, there were a clear difference between them, showing that IMPOSTER 750 WP had a long persistance of action. Weeds which seem to be resistant to Metribuzine have been reduced by Chloromuron-ethyl which inhibited the development of weeds [15]. Only *Discorea bulbifera* showed a resistance to then different rates of IMPOSTER 750 WP. *Diocorea bulbifera* has a severe nocivity to the sugar cane.

According to the effects of the different doses of IMPOSTER 750 WP to soil agrochemicals properties, the herbicides application didn't disturb the dynamic of nitrate nitrogen, available phosphorus and potassium contents in the soil. The contents of these minerals elements are the products of soil microorganism activities [16, 17] and depend on their absorption by sugar cane and weeds. This is why, during the flowering stage, a big reduction of nitrate nitrogen content in comparison with the period before herbicides application has been obtained. The absorption is more intensive at the rates of IMPOSTER 750 WP, like imposter 1.20 kg/ha because of the important reduction of weeds. The increase of these contents particular on IMPOSTER 2.00 kg/ha, IMPOSTER 2.40 kg/ha, IMPOSTER 3.60 kg/ha in comparison with the lowest rates is due to the fact that in the maturity, sugar cane doesn't use its needs from the soil for glucides synthesis but from the sugar cane biomass produced after the flowering stage. It gives the same trend according to the effect of IMPOSTER 750 WP on available potassium content in the soil (Table 5). A deep reduction of soil potassium content during the flowering stage and an increase at the sugar cane maturity has been obtained. Gaucher [18] showed that sugar cane needs a lot of potassium in his biomass to ensure glucides synthesis. A reduction of available phosphorus content happened from the period before herbicide application to the maturity. This reduction is determined by its use in part by weeds were they are important and in another part by sugar cane depending on the biological efficiencies of herbicides. During this experimentation, these contents are not lower than those of the manual weeding. As mentioned above, these contents in the soil are in relationship with soil microorganisms particularly ammonyfiying bacteria, nitrifying bacteria, fungies, cellulolytic bacteria and phosphorising bacteria.

Teng and Tao [16] mentioned that bacteria and fungi growth were stimulated and actinomycetes growth was inhibited by chlorimuron-ethyl, came in the conclusion that, according to the risk assessment, chorimuron-ethyl should belong to non poisonous pesticide.

The phytotoxicity cases during the first month were short. The same cases have been observed by Bouhache [19] on wheat caused by Metribuzin and where leaves became yellow. Bertholet [20] showed that Metribuzin which has been applied in a high dose, destroyed *Vicia faba* L.. Nematalla [21] mentioned that Metribuzin and Chlorimuron-ethyl in lower measure created some difficulties in nitrogen ammoniac assimilation and at the end led to a reduction of protein synthesis in wheat and corn. In this experimentation, this phytotoxicity has been stopped after one month. The resistance of sugar cane could be explained by physiological and bio-chemical

Table 5 Effects of IMPOSTER 750WG different doses on sugar cane yield.

Treatments	Machining canes (number/useful plot)	Yield (T/ha)	% to untreated control	Quantity of extractible sugar (T/ha)	Sucrose content (%)
Untreated control	619.75 b	70.39 d	-	8.98 b	12.76 a
Manual weeding	791.00 a	87.72 b	124.62	11.44 ab	13.10 a
Krismat 75 WG 3.00 kg/ha	774.75 a	92.38 a	131.24	11.88 a	12.84 a
Imposter 750 WP 0.60 kg/ha	750.50 a	79.78 c	113.34	10.04 ab	13.22 a
Imposter 750 WP 1.20 kg/ha	791.50 a	80.37 c	114.18	10.30 ab	12.60 a
Imposter 750 WP 2.00 kg/ha	800.00 a	83.24 bc	119.68	11.04 ab	12.96 a
Imposter 750 WP 2.40 kg/ha	780.25 a	84.55 bc	120.12	11.16 ab	13.27 a
Imposter 750 WP 3.60 kg/ha	790.00 a	86.24 ab	122.52	11.10 ab	12.83 a
Moyenne	768.22		83.08	10.74	12.94
CV (%)	7.30		3.40	10.60	4.90
ETR (ddl = 21)	55.88		2.81	1.14	0.63
ETM ($S\bar{X}$)	27.94		1.41	0.57	0.32

proccess. Calderon [22] mentioned that herbicides from the family of triazin as Metribuzin were degradated by some hydroxylation and N-alkylation reactions. Hugh [23] showed that with a quick metabolism, soja bean was able to eliminate chlorimuron-ethyl. It supposed that the reduction of the phytotoxicity in this experimentation is due to some enzymes in sugar cane. All these factors led to an increase of sugar cane yield at the higher doses of chloromuron-ethyl associated with Metribuzin.

5. Conclusions

Chlorimuron-ethyl (107 g/kg) associated with Metribuzin (643 g/kg) has an herbicidal activity against sugar cane weeds particularly against gramineae, dicotyledons and *Cyperus* sp. at the highest rates. When applied from the doses of 2.00 kg/ha to 3.6 kg/ha, this combination led to a short time phytotoxicity. The biological efficiency of chlorimuron-ethyl associated with Metribuzin at the dose of 1.20 kg/ha (Imposter 1.20 kg/ha) varied from 54.71% to 92.99%. Those from the highest doses (2.00-3.60 kg/ha) varied from 56.79% to 100%. Only *Discorea bulbifera* showed a resistance to the different rates of Chlorimuron-ethyl associated with Metribuzin. This association didn't lead to a reduction of nitrate nitrogen, available phosphorus and potassium contents in comparison with manual weeding at the full maturity of sugar cane. So, chlrorimuron-ethyl associated to metribuzin belongs to a non-poisonous chemical. These factors led to an increase of sugar cane yields at the different doses of Imposter 750 WP. Because of this short phyto-toxicity from the rates of 2.00 kg/ha to 3.60 kg/ha, it became better to apply chlorimuron-ethyl associated with metribuzin at the rate of 1.20 kg/ha which gives a yield increase of 14.18% in comparison with the untreated control.

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