Herbicidal Activity of Imazapic (262.5 G / L) Associated With Imazapyr (87.5 G / L) on Sugar Cane Weeds and Its Effects on Soil Agrochemical Properties, in Burkina Faso.

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Abstract— ***Merremia tridentata, Corchorus olitorus, Euphorbia heterophylla*** *are weeds which cause significant damage to sugar cane. To remedy this, while saving the environment, a study of the biological efficacy of imazapic 262.65 g / l associated with Imazapyr 87,5g / l (CMT 505) and its secondary effects on soil agrochemical properties was done at Bérégadougou, in Burkina Faso. The biological efficacy of herbicides was evaluated by counting and weighing the dry biomass of weeds using a sampling square of 0.25 m² placed on four tufts diagonally on the 4 lines of the useful plot. 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 CMT 0.6l / ha varied from 80.96% to 100%. Those of CMT highest doses , phyto-toxic varied from 48.12% to 100%. The nitrogen nitrate, assimilable phosphorous soil contents in herbicides treatments were not different from those of manual weeding. The dose of CMT 0.6l / ha led to a reduction of 32.20% potassium available content compared to manual weeding at the end of tillering. All these factors have allowed CMT, applied at the rate of 0.6l / ha, a surplus of 11.03% cane yield, of 14.74% extractable sugar compared to the untreated control and equivalent to manual weeding. CMT 505 does not interfere, at studied doses, the dynamic evolution of soil agrochemical properties.*

Keywords*— *Imazapic, Imazapyr, weeds, agrochemical properties, Burkina Faso.

I. INTRODUCTION

Sugar production in the world is expanding. Indeed, it follows the increase of the consumption needs, including more than two-thirds come from food industry. With an annual volume production which exceeds 1.7 billion tons, sugar cane are the first plants cultivated worldwide and account for almost 23% (COURTEAU, 2005) of the total mass produced in agriculture.

In Burkina Faso, sugarcane occupies an important place in the agriculture of the country. It remains the flagship of agriculture in the Cascades region where it is produced and processed by New Sugar Company of Comoé (SN-SOSUCO). This company creates enormous job since 1974 and participates in the country's economic development. Before its privatization, it was the second largest provider of employment after the state (Wikipedia, 2014).

The production of sugarcane is facing many problems, the presence of weeds. Weeds present in the plots compete with crops both in terms of access to water, light and nutrients needed for growth. They are often the residence of pests (insects and rodents) as well as disease-carrying organisms. These weeds are causing enormous damage and help to reduce crop yields. Indeed, ZAHAREINKO (1990) estimated that 25-50% yield losses caused by weeds in developing countries. The fight against weeds is a key step for successful agriculture.

Fighting measures such as preventive control, biological control (COLONG *and al*., 2010) and curative control are taken to solve the problem of weeds. Studies have shown that among these methods, chemical control is still in the short term a promising alternative to reduce the impact of weeds on crops. Besides being economical, the use of herbicides is an effective means of struggle against weeds and allows saving time and solving the labor problem. These chemicals used shall, however, to be non-toxic to useful plants and soil microorganisms and without secondary effect on agrochemical soil properties. But mostly, herbicides have not always been eco-toxicological tests on tropical soils before their approval. On the other hand, sugar cane is very sensitive plant to fertilization for its development (MUCHKOVEJ and NEWMAN., 2004). Therefore, it was considered appropriate to study not only the biological effectiveness of the CMT 505 (imazapic 262.5 g / l, + imazapyr 87.5 g / l) on weeds of sugar cane but also his effects on agrochemical soil properties.

II. MATERIALS AND METHODS

2.1. Materials

The test was implanted Beregadougou on a sandy loam soil, the agrochemical map is as follows: water pH = 4.2 Nitrogen (%) = 0.60 Carbon (%) 0.81 organic matter (%) = 1.4 P205 assimilable Ca = 0.08 (meq / 100g) = 1.35 Mg (meq / 100g) = 0.1K (meq / 100g) Na = 0.16 (meq / 100g) = 0, 01 S (meq / 100g) = 1.62. The plant material used was sugar cane variety CO997de species saccharum officinarum. The cultivation technique was to first do a plowing with a tractor followed by a sillonnage. Then the cuttings are flat patterns in furrows and covered with fine soil. The mineral fertilizer was given at doses of 140 kg of nitrogen, 52 kg phosphorus, 145 kg of potassium followed by a fractional addition of 350 kg of urea, 242 kg of potassium chloride and 116 kg of triple super phosphate (TSP). The water needs were met by an irrigation system and rainwater. The maintenance work on the parcels concerned mainly irrigation and weeding according to the protocol. The experimental design was a randomized Fisher block of seven (07) in four treatments (04) repetitions: Untreated, manual weeding, LUMAX 4l / ha, CMT 0.3 l / ha, CMT 0.6 l / ha CMT 1l / ha, CMT 0.5l / ha + acetochlor. 0.4 l / ha. The size of the elemental plot was 11.11 x 9m = 99.99 m^2. That of the useful plot was 10.11 m X 7.50 m = 75.82 m^2.

2.2. Methods

After herbicides application, their phytotoxicity on sugarcane was appreciated, at the different periods of observations, by the visual rating scale of the European Union Bioassays Commission (C.E.B.) numbered from 0 to10. The biological efficiency of different treatments was studied using the method of counting, and, weighing the weeds dry biomass (LIKOV., 1985) using a 0,25m2 quadrant at regular intervals in diagonal, in the same way, in each useful plot on the 7th, 14th, 47th, 64th, 94th and 175ème days after application (DAA) herbicides. The biological efficacy coefficients of herbicides in these observation periods were calculated using the formula (VILITSKY, 1989) as follows:

$$C = 100 - \frac{Bi \times 100}{Bx}$$

Where

C= coefficient of efficiency.

Bi = number of weeds per m² or weight of the dry biomass (g / m²) treatment on the 1st or 2nd or 3rd ... counting.

Bx = number of weeds per m² or weight of the dry biomass (g / m²) of the untreated control on the 1st or 2nd or 3rd ... counting.

The weeds flora analysis was done using identification keys of BERHAUT (1967), AKOBUNDU, (1989), Terry (1989), JOHNSON (1997) keys.

For the study of agrochemical soil properties, soil samples were collected at 0-20 cm soil depth, near the root system of cane plants, in the useful plots of two blocks, before applying the herbicide, at the 65^{th} and 120^{th} day after herbicides application. The nitrate nitrogen extraction from the soil have been done by spectrocalorimeter according to the method of GREWELING and PEECH (1960), available phosphorus determination according to the method of BRAY 1 (1945) and available potassium by flame photometer. At the 175^{th} day after herbicides application, the number of machining rods has been counted per useful plot. During the harvest, the canes were cut and the yield estimated in Tone / ha. The contents of extractable sugar and sucrose were determined using a Refractometer RFM 340 and a universal polarimeter.

An analysis of variance of data (DOSPIEHOV, 1985), was computed and means seperations were done using Newman-Keuls test at 5% level using STAT -ITCF software. The correlations between the factors studied were computed, using ORIGIN 3.0 software.

III. RESULTS

3.1. CMT 505 Phyto-toxicity

Observations following, the application of CMT 505 different rates, revealed, stunting of plants on all plots treated with CMT 505 without burns on leaves. On the basis of C.E.B visual notation, they took a phytotoxicity note 5. .No Case of phytotoxicity was observed on the other objects. Three months after herbicides application, canes plants became normal, green, on the lowest doses of CMT 505. In the opposite, on the others plots with highests doses of CMT 505, the stunted cane plants, remained until the 120th day.

3.2. Effects of different doses of the CMT 505 on the accumulation of sugar cane weeds dry biomass.

Until the 7th and 14th day after herbicides application, no weed was found on the plots. At the 29th day after herbicide application, the average effect of herbicides (1 g / m²) is a reduction of 24.81% weight of weeds dry biomass compared to the untreated control. The different doses of CMT 505 and Lumax are equally effective with a reduction of 24.8% compared to the untreated control (table 1).

TABLE I: EFFECTS OF CMT 505 DIFFERENTS RATES ON THE ACCUMULATION OF SUGAR CANE WEEDS DRY BIOMASS (g/m²).

Treatment	Périodes of observations (DAA=Day After Application)													
	7		14		29		47		64		94		175	
	With out trans	**After** $\sqrt{X+1}$	With out trans	**Afte r** $\sqrt{X+1}$	With out trans	**After** $\sqrt{X+1}$	With out trans	**After** $\sqrt{X+1}$	With out trans	**After** $\sqrt{X+1}$	With out trans.	**After** $\sqrt{X+1}$	With out trans.	**After** $\sqrt{X+1}$
Untreated control	0,00	**1,00**	0,00	**1,00**	0,85	**1,33 b**	11,98	**3,40 a**	20,52	**3,95 a**	58,16	**7,34 a**	82,41	**8,74a**
Manual weeding	0,00	**1,00**	0,00	**1,00**	2,79	**1,74 a**	0,38	**1,14 c**	0,44	**1,18 c**	13,66	**3,25 c**	2,71	**1,78 d**
Lumax 4l /ha	0,00	**1,00**	0,00	**1,00**	0,00	**1,00 c**	15,43	**3,00 a**	3,23	**1,68 b**	0,00	**1,00 d**	6,08	**2,01 d**
CMT 0,3l /ha	0,00	**1,00**	0,00	**1,00**	0,00	**1,00 c**	15,43	**1,75 b**	1,44	**1,40 bc**	8,62	**2,60 c**	71,52	**5,61 b**
CMT 0,6 l/ha	0,00	**1,00**	0,00	**1,00**	0,00	**1,00 c**	3,76	**1,38 b**	0,00	**1,00 c**	0,00	**1,00 d**	15,69	**3,77 c**
CMT0,5l/ha +Ac etoclore 0,4L/ha	0,00	**1,00**	0,00	**1,00**	0,00	**1,00 c**	1,59	**1,00 c**	0,00	**1,00 c**	0,00	**1,00 d**	1,85	**1,52 d**
CMT 1l/ha	0,00	**1,00**	0,00	**1,00**	0,00	**1,00 c**	0,00	**1,00 c**	0,00	**1,00 c**	0,00	**1,00 d**	2,24	**1,62 d**
Moyenne		-		-		**1,15**		**1,85**		**1,60**		**2,92**		**3,57**
CV(%)		-		-		**9,70**		**16,80**		**15,80**		**11,60**		**13,70**
ETR (ddl=18)		-	-			**0,11**		**0,30**		**0,25**		**0,34**		**0,49**
ETM(S$\bar{X}$)		-		-		**0,05**		**0,15**		**0,12**		**0,17**		**0,24**

(Means following by the same letter within the column are not significantly different at 5% level of probability using NEWMAN – KEULS test).

At the 47th day after herbicides application, the average effect of herbicides (1.63 g / m²) represents a reduction of 52.18% the weight of weeds dry biomass in comparison with the untreated control.From all doses of CMT 505, the high dose (CMT 1 l / ha) and the CMT 0.5l / ha acetochlor + 0,4l / ha are most effective with a reduction of 70.59% followed by manual weeding with a reduction of 66.47%. The lower dose (CMT 0.3 l / ha) and the average dose (CMT 0.6l / ha) were not statistically different.CMT 0.6l/ha led to a reduction of 59.41%.

At the 64th dayr after application, the average effect of herbicides (1.22 g / m^2) is a reduction of 69.22% the weight of weeds dry biomass compared to the untreated control. CMT 0.3l/ha,CMT 0.6 l / ha, CMT 1 l / ha and CMT 0.5l / ha acetochlor +

0,4l / ha are equally effective with a reduction of 64.56% to 74.68% compared to the untreated control. There are not different bto manual weeding.

At the 94th dayr after treatment, the average effect of herbicides (1.32 g / m^2) is a reduction of 82.02% the weight of weeds dry biomass compared to the untreated control. CMT 0.6 l / ha, CMT 1 l / ha and CMT 0.5 l / ha + ACE 0.4 l / ha do not differ significantly between them and with Lumax 4l/ha. It is the same between CMT 0.3 l / ha and manual weeding.

At the 175^{th} day after application, the average effect of herbicides is 2,58g / m² with a reduction of 70,48% of the weight of weeds dry biomass compared to the untreated control. Among the different herbicides CMT 0.5l / ha + ACE 0,4l / ha, CMT 1 l / ha, manual weeding and LUMAX 4l/ha have the same level of efficiency. The CMT 0.6l / ha led a reduction of 56.86% compared to the untreated control.

3.3. Biological efficiency of CMT 505 different rates according to weeds dry biomass.

The biological efficiencies were evalauted by VILITSKY formula. The one of the manual weeding ranged from -228.23% to 100% during the observation periods, with an average of 19, 89% (Table 2).

The biological efficiency of LUMAX 4 l / ha ranged from -28.79% to 100% during the observation periods with an average of 57.95%. The same trend is observed at the CMT applied at 0.3 l / ha whose efficacy rates ranged from 13.21% to 100% during the observertion periods with an average of 79.99%.

For the CMT applied at 0.6 l / ha, the biological efficiencies ranged from 80.96% to 100% with an average of 95.38%.

The biological efficiency of CMT applied at 1 l / ha ranged from 97.28% to100% with an average of 99.61%. The biological efficiency of CMT 0.5 l / ha associated with Acetochlor 0.4 l / ha, ranged from 48.62% to 100% with an average of 92.34%.

During these observation periods, the best coefficients are obtained with manual weeding, CMT 1 l / ha, the CMT 0.6l / ha, CMT 0.5 l / ha + ACETOCHLOR 0.4 l / ha, the control product (LUMAX 4l/ha) and finally CMT 0.3 l / ha. Between the herbicides, CMT 1 l / ha has more influence on the dynamics of weeds dry biomass.

TABLE II
BIOLOGICAL EFFICIENCY OF CMT 505 DOSES ACCORDING TO THE WEEDS DRY BIOMASS (%).

	Day After Application (DAA)						
Treatments	**7**	**14**	**29**	**47**	**64**	**94**	**175**
Untreated control	-	-	-	-	-	-	-
Manual weeding	-	-	-228,23	96,82	97,85	76,10	96,71
LUMAX 4 l/ha	-	-	100,00	-28,79	84,25	100	92,63
CMT 0,3 l/ha	-	-	100,00	68,61	92,98	85,17	13,21
CMT 0,6 l/ha	-	-	100,00	86,72	100	100	80,96
CMT 0,5 l/ha+ Acetochlore 0,4l/ha	-	-	100,00	100	100	48,62	97,76
CMT 1 l/ha	-	-	100,00	100	100	100	97,28

N.B the (-) symbol indicates an increase in weeds dry biomass

3.4. Effects of different doses of CMT on the weed flora of sugarcane

At 175th DAA, *Merrenia tridentata* are the most important weeds species of the experimental plot followed by *Corchorus olitoris* and *Ipomoea triloba* (Table 3).

On these plots *Ipomoea triloba* encountered (21.42%), *Corchorus olitorus* (21.42%) and *Merremia tridentata* (28.57%).

On the plots of the manual weeding, Cyperaceae were more important (30%) followed by Portulaceae (20%) compared to other weeds.

On the plot treated with CMT 0.6L / ha, *Ipomoea triloba* (36.36%) is more resistant to this dose than other weeds.

Overall, CMT 1,0 l / ha and CMT 0.5l / ha + acetochlor 0,4l / ha have reduced ensuring importatnt weeds genus and species in comparison with untreated control.

TABLE III
EFFECTS OF DIFFERENTS RATES OF CMT 505 ON SUGAR CANE WEEDS FLORA AT 175TH DAA (plants/m²).

Genus	*species*	Family	Untreated control	Manual weeding	Lumax4 L/ha	CMT0.3 L/ha	CMT0.6 L/ha	CMT 1L/ha	CMT0.5L/ ha + ACE0.4l/ha
Ageratum	conyzoides	Asteraceae	0	1	0	0	0	0	0
Schrankia	leptocupa	Mimosaceae	0	0	0	1	0	0	0
0ldenlandia	herbaceae	Rubiaceae	0	1	0	1	1	1	0
Ipomea	Sp.	Convolvulaceae	0	0	0	0	1	0	0
Ipomea	triloba	Convolvulaceae	0	0	0	0	4	0	1
Euphorbia	heterophylla	Euphorbiaceae	3	1	0	0	0	0	0
Kyllinga	squamulata	Cyperaceae	0	1	0	0	0	0	0
Celosia	laxa	Amaranthaceae	0	0	0	0	1	0	0
Corchorus	olitorus	Sterculiaceae	3	0	0	0	0	1	0
Desmodium	scorpiorus	Fabaceae	1	0	0	0	0	0	0
Digitaria	horizontalis	Poaceae	0	0	0	0	0	1	0
Merremia	tridentata	Convolvulaceae	4	0	1	4	2	1	0
Sida	linifolia	Malvaceae	1	0	0	2	0	0	0
Phyllanthus	amarus	Euphorbiaceae	0	0	0	0	0	1	0
Portulaca	oleraceae	Portulaceae	0	2	0	0	1	0	1
Rottboellia	exaltata	Gramineae	0	0	0	0	0	0	0
Vernomia	cinerea	Asteraceae	0	1	0	0	0	0	0
Dioscorea	bulbifera	Dioscoreacea	1	0	0	0	0	0	0
Cyperus	sp.	Cyperaceae	0	3	0	0	0	0	0
Total			**13**	**10**	**1**	**8**	**10**	**5**	**2**

3.5. Effects of CMT 505 differents doses on the dynamic of soil nitrate nitrogen content.

Before herbicides application, the average content of nitrate nitrogen in the plots to treat with herbicides (6, 02 mg/kg) is a reduction of 4, 44% in comparison with untreated plot. As attested by the variance analysis, there is no significant difference between the others treatments and the untreated control plot except the manual weeding which is characterized by a decrease of nitrate nitrogen content of 63.49% compared to the untreated control (table 4).

At the 64th day after herbicides application, the average effect of treated plots (12.15 mg/kg) is an increase of 333.93% nitrate nitrogen content in comparison with the untreated control. Lumax 4l / ha, CMT 1 l / ha and manual weeding led respectively an increase of 3.4 times, 13.31 times and 3.5 times the nitrate content of the untreated control. Between CMT 0.5 l / ha + Acetochore 0.4 l / ha and CMT 0.6 l / ha there is no significant difference but they differt from the CMT 0.3 l / ha, the manual weeding and Lumax 4l/ha.

At the 120th day after herbicides application, the average effect of herbicides (3.06 mg / kg) is an increase of 5.09% nitrate nitrogen content in comparison with the untreated control. Generally nitrate levels decreased in all plots, and there are no differences between them. These levels of soil nitrate nitrogen decreased at the end of sugar cane tillering in comparison with the begenning periods.

3.6. Effects of different doses of CMT 505 on the dynamics of soil available phosphorus content.

Before applying herbicides, the average content of soil available phosphotus in the plots to treat by herbicides (14, 93 mg/kg) is a week increase of 8, 54% in comparison with the untreated control. The plot to be treat with CMT 0.5 l / ha + ACE 0.4 l / ha had the smallest available phosphorus content (a reduction of 35.5% compared to the untreated control (table 4).

At the 64th day after herbicides application, the average effect of the plots treated with herbicides (7, 24 mg/kg) is an increase of 3, 25 times the one of the untreated control. Between CMT rates, the lower available phosphorus content are situated on CMT 0,6l/ha and CMT 1, 0 l/ha. The lower phosphorus content is obtained on the plot treated with LUMAX 4l/ha.

At the 120th day after treatment, the average effect of herbicides (12.98 mg / kg) is an increase of 5.19% available phosphorus content in comparison with the untreated control. The lower levels are located on Lumax 4l / ha, and CMT 0.5l / ha + Acetochlor 0,4l / ha which are not differnet with manual weeding and untreated control.

Compared to the levels before herbicide application, the available phosphorus content decreased to 64th day and increased at the 120th day after application.

Effects of CMT 505 different doses on the dynamics of soil available potassium content .

Before herbicide application, the plots to be treat with CMT1 l / ha, CMT 0.3 l / ha, had respectively 1.4 times and 1.35 times more soil available potassium content than the untreated control. CMT 0.6 l / ha had a very small amount of potassium (a reduction of 50.59% compared to the untreated control).

The 64th day after herbicides application is a decrease of available potassium content in all plots. But the average effect of herbicides (71.50 mg / kg) is an increase of 6.76% compared to the untreated control. The highest concentrations are located on CMT 0.3l / ha and CMT 0.5l / ha acetochlor + 0,4l / ha which are not mathematically different. The available potassium contents to the other treatments are not different with the untreated control.

The same trend of decline from the previous period continued until the 120th day at the end of tillering. The average effect of herbicides (53.94 mg / kg) is an increase of 37.18% compared to the untreated control. The lower grade is at CMT 0.6l / ha, which is indistinguishable from the CMT 0.3 l / ha, the Lumax 4l / ha and untreated control. The highest content is located at CMT 1l / ha whichgave a surplus of 91.96% compared to the untreated control and 35,85% compared to the manual weeding.

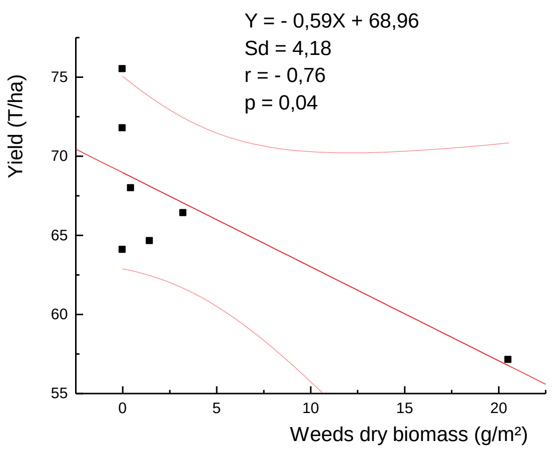

FIG 1: CORRELATION BETWEEN THE WEEDS DRY BIOMASS AT 64TH DAY AFTER HERBICIDES APPLICATION AND SUGAR CANE YIELD.

TABLE IV
EFFECTS OF CMT 505 DIFFÉRENTES DOSES ON SOIL NITRATE NITROGEN, AVAILABLE PHOSPHOROUS AND POTASSIUM CONTENTS.

Treatments	N-NO3 (mg/kg)			P2O5 (mg/kg)			K2O (mg/kg)		
	Before application	64^{th} DAA	120^{th} DAA	Before application	64^{th} DAA	120^{th} DAA	Before application	64th DAA	120th DAA
Untreated control	6,30 a	2,80 d	2,91 a	13,63 ab	2,23 f	12,34 bcd	112,63 d	66,97 bc	39,32 d
Manual weeding	2,80 b	9,80 b	3,27 a	12,16 b	3,07 d	9,43 d	113,36 a	88,17 b	55,56 bc
LUMAX 4l/ha	4,90 a	8,79 b	2,92 a	14,51 ab	2,65 e	11,10 cd	78,31 e	52,70 c	49,81 bcd
CMT 0,3 l/ha	6,30 a	2,80 d	3,15 a	14,65 ab	12,13 a	13,56 abc	152,18 b	106,87 a	44,56 cd
CMT 0,6l /ha	7,01 a	6,30 c	3,15 a	18,19 a	6,86 c	15,08 ab	55,65 f	71,41 b	37,67 d
CMT0,5l/ha+ Acetochlore 4l/ha	7,01 a	5,60 c	2,92 a	8,78 c	8,01 b	9,03 d	140,34 c	115,24 a	62,19 b
CMT 1,0 l/ha	4,90 a	37,27 a	3,15a	18,52 a	6,53 c	16,12 a	157,96 b	81,26 b	75,48 a
Mean	5,50	10,48	3,07	14,32	10,67	12,39	43,22	39,38	42,50
CV (%)	10,40	8,00	6,70	9,80	8,81	7,90	6,00	5,70	13,30
ETR (ddl=6)	0,57	0,84	0,21	1,40	0,94	0,98	2,59	2,25	5,65
ETM ($S\bar{X}$)	0,40	0,59	0,15	0,99	0,66	0,69	1,83	1,59	3,99

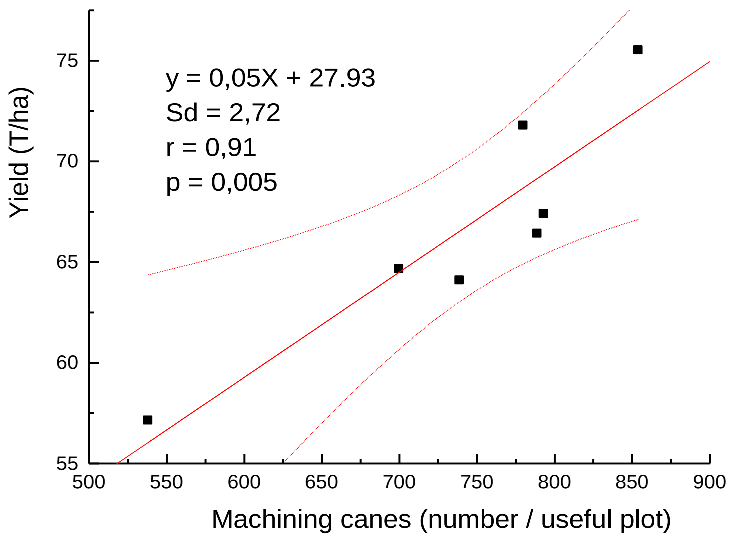

FIG 2: CORRELATION BETWEEN MACHINING CANES AT 175TH DAY AFTER HERBICIDES APPLICATION AND SUGAR CANE YIELD.

Effects of CMT on sugar cane yield components and sugar cane yield.

At the criteria of machining rods, the average effect of herbicides (643.71 canes / useful plot) is an increase of 19.59% compared to the untreated control. The different doses of CMT, which are not differ between them, led to an increase of 30.05% to 58.71% compared to the untreated control. They don't differ with the manual weeding and Lumax 4l / ha.

At the yield criteria, the average effect of herbicides (68,47 t / ha) is an increase of 19,47% compared to the untreated control. Between the differents rates of CMT 505, only CMT 0.6l / ha and CMT 0,5l/ha+Acetochlor 0,4l/ha which are not different between them have led to a

a surplus of 25,63% and 32,18% respectively compared to the untreated control.

TABLE V
EFFECTS OF DIFFÉRENTES RATES OF CMT 505 ON SUGAR CANE YIELD COMPONENTS AND SUGAR CANE YIELD.

Treatment	**Machining canes (number / useful / plot)**	**Yield (T/ha)**	**% to untreated control**	**Extractible sugar (T/ha)**	**Sucrose content (%)**
Untreated control	538,25 b	57,12 c	-	6,69 c	12,95 a
Manual weeding	793,25 a	67,38 b	117,96	8,60 a	12,63 a
Lumax 4,00l/ha	789,00 a	66,40 b	116,25	7,68 b	12,98 a
CMT 0,30l/ha	700,00 a	64,63 b	113,15	7,53 b	12,96 a
CMT 0,60 l/ha	780,00 a	71,76 a	125,63	8,64 a	13,25 a
CMT 0,5l/ha+Acetochlor 0,4l/ha	854,25 a	75,50 a	132,18	8,09 ab	13,32 a
CMT 1,00l/ha	739,00 a	64,08 b	112,18	7,62 b	13,21 a
Mean	741,96	66,69		7,84	13,04
CV (%)	12,60	4,30		4,60	4,60
ETR (ddl= 18)	93,49	2,86		0,36	0,60
ETM ($S\bar{x}$)	46,75	1,43		0,18	0,30

At the amount of extractable sugar test, the average effect of herbicide (7,91 t / ha) is an increase of 18,24% compared to the untreated control. Between herbicides only CMT 0.6 l / ha, which is not different mathematically with manual weeding shows a net surplus of 29, 15% compared to the untreated control. At the criteria of sucrose content, there is no significant difference between the studied objects.

IV. DISCUSSION

Herbicide CMT 505 is composed of two active ingredians (imazapic and imazapyr) forming parts of the imidazolinone family controlling a wide range of grass and broadleaf weeds. Imazapic is a moderately selective and persistent molecule in the soil 7 to 150 days while imazapyr is a non-selective molecule with a persistence of 14 days 17mois (ACTA., 2009). These herbicides when applied on the plot, inhibit acetolactate synthase (ALS) production, an enzyme responsible for formation amino acids formation, essential for protein synthesis in the plant and disrupting the growth of the plant cell and the temporary yellowing host plants over a period of 30 days (ACTA, 2011; Koch *and al*., 2010).

Some case of phytotoxicity, characterized by stunting, have been observed on plots treated by CMT 1, 0 l / ha and CMT 0,5 l / ha + acetochlor 0.4 l / ha. This could be explained either by a nutritional disorder or by the fact that our land is sandy type, irrigation water has concentrated the product in the furrows, causing yellowing and stunting of plants. These results corroborate those of DAVID *and al* (2001) who claimed that a combined treatment of the two molecules on sandy soil and irrigated the two days after treatment was causing cases of phytotoxicity, after a product concentration in the planting furrow . According to the same authors, this phytotoxicity was absorbed once the ducts become hot again and more. Studies by SANTOS *and al* (2013) on the use of imazapic and imazapyr products also revealed a case of phytotoxicity on plants of *Oryzya sativa* at the doses of 0.5 l / ha and 1 l / ha for a period of 20 and 30 days. Similar behavior has also been observed in maize caused by yellowing and reduction of around 35%, 77%, 90% and 100% of the height of the plant (BULCHWALTER *and al*., 1996). The cane recovery is related to the presence of enzymes degrading toxic metabolites of CMT 505. Therefore, three months later, the sugarcane plants were able to resist to this phyto-toxicity during this experimentation.

The present study shows like the one conducted by ULBRICH *and al*. (2005) that the persistence of this molecule goes beyond 4 months. The negative impact of weeds on the cane is premature as shown by the mathematical relationship between the dry biomass of weeds at the 64th day after herbicide application and the sugar cane yield (Figure 1). It is expressed by the following equation: Y = - 0,59X + 68, 96 with a correlation coefficient r = - 0, 76; Sd = 4, 18 (P = 0, 04). The one between the machinig rods and sugar cane yield is expressed by the following regression equation: Y = 0, 005X + 27, 93 with Sd = 2, 72 and r = 0, 91 (p = 0,005 (figure 2).

At the 175th day, no weed was identified on the plot treated with the control product that is LUMAX. This is also because LUMAX consists of three active ingredians of different chemical families and different spectrum activities exerting synergy on the weeds. Metolachlor, of the acetanilids chemical family, acts as inhibitor of germination by its rapid penetration to the hypocotyl and by its action on the stalks. Thus, it is active against many grasses including *Panicum*, *Digitaria* and a number of broadleaf weeds. Terbuthylazine of the chemical family of triazines acts by root absorption on many broadleaf weeds and perennials grasses. Like any triazine, it has a long persistence of action (ACTA 1991). Mesotrione belongs to the chemical family of benzoylcyclohexanediones. According SUTTON *and al* (2002), it can control weeds which could be resistant to triazines or to acetolactate synthesis inhibitors such as *Amaranthu*s spp. species. This may explain why no weed is identified on the plot treated with LUMAX. The combination of these three active ingredians had a negative influence on sedges and broadleaf weeds.

At the 175th day after herbicides application, the highest dose of CMT and CMT 0,5l/ha associated with Acetochlor allowed significantly to reduce weeds. Acetochlor is a herbicide of chloroacetamides family, acetamids whicht inhibits the synthesis of waxes, suberin and gibberellins. It blocks the emergence and the growth weeds and its lead to their destruction. Its persistence of action is about three months (ACTA 2006). Between the different rates of CMT 505, the higher rate reduces significantly sedges and broadleaf weeds.

Sugar cane plants require for their development and growth some nutrients as nitrogen essentially, phosphorus and potassium. The declines of nitrate nitrogen contents on manual weeding, LUMAX 4l / ha, are due to the absorption of these chemicals by the cane but also by weeds. In the opposite, those observed at CMT 0.6 l / ha and CMT 0.5 l / ha + ACE 0,4l / ha are probably due to the absorption by sugar cane by the fact that it has been obtained 100% of biological efficiency at this time in these treatments (Table 2). Declining levels of nitrate nitrogen in the 120th after application except to the untreated control and CMT 0.3 l / ha, is explained by the significant absorption of this element for the development and growth of sugarcane and the low presence of weeds in the other treatments.

According to the content of assimilable phosphorus in the soil, the decreasing at the 64th day followed by an increase on the 120th day, could be explained either by the fact that at the 64th day, the plant absorbed the phosphorus content for the development of tillering. In the opposite at the 120th day, this increase is due to the fertilization by phosphate fertilizer made in this period. This dynamic, non characteristic of the assimilable phosphorus content in the soil, is due to the fact that phosphorus is present in tropical soils, linked to ferrous ions and aluminas.

The potassium content is characterized by a decline during the first days after treatment, the 64th day and the 120th in all plots. The canes plants are indeed producing sugar. For optimum production, the plants need enough potassium in their leaves to ensure the synthesis of carbohydrates, their migration and accumulation in storage organs (GAUCHER, 1968). Increasing potassium in the other objects is due to poor absorption or malfunction of the plant due to the negative effects of weeds. However, this absorption is most important on CMT 0.6 l / ha compared to the period before the herbicides application.

All these factors including the phyto-toxicity to CMT 1,0 l / ha allowed the plots treated with CMT 0.5l / ha + Acetochlor 0.4 l / ha and CMT 0.6l / ha to obtain higher yields and surplus of extractable sugar

V. CONCLUSION

Weeds are a major constraint on sugar cane production. *Merremia tridentata*, *Corchorus olitorus*, *Euphorbia heterophylla* and the cyperaceae constituted the most important weeds. The synergistic action of imazapic and imazapyr which constitutes CMT 505, at higher doses, led to a phytotoxicity on the target plant. The average dose (CMT 0.6l / ha) and the highest dose (CMT 1l / ha) were very effective against sedges, grasses and broadleaf weeds. These rates did not inhibit the dynamic behavior of nitrate nitrogen, assimilable phosphorous and potassium available soil contents. Furthermore CMT 0,6 l / ha led to a surplus of machining rods, CMT 0.6l / ha and CMT 0,5l/ha+Acetochlor 0,4l/ha which are not different between them have led a yield surplus of 25,63% and a surplus of 32,18% extractable sugar respectively compared to the untreated control.. Imazapic 262.5 g / l associated Imazapyr 87.5 g / l (CMT 505) can be proposed for approval by the Sahel Pesticides Committee (CSP) to be applied at 0,6l/ha.

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