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Efficacy of some Integrated Weed Control Treatments on Sugarcane Ratoon Productivity

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ABSTRACT

Two field experiments were carried out at Shandaweel Agricultural Research Station (latitude of 26 33° N and longitude of 31 41°E), Sohag Governorate, Egypt in 2018/2019 and 2019/2020 seasons to study efficacy of some integrated weed control treatments (removing or burning cane trash; hoeing and Ready Peck, Clomdi, Lumax, Garlone herbicides) on yield and quality of sugarcane 1st ratoon of G.2003-47 variety (Giza-3). A randomized complete block design in a split-plot arrangement with three replications was used. The results showed that the removal of plant cane trash out of the field resulted in significant increases in millable cane height, number of millable canes, cane and sugar yields/fed of the 1st cane ratoon crop. However, cane trash treatments had insignificant effect on weed traits, millable cane diameter and juice quality. The applied herbicides and hoeing (twice) negatively and significantly affected fresh, dry weight of both grassy and broad-leaved weeds and their total weight, compared to un-weeded plots. The applied herbicides and hoeing appreciably increased millable cane height, number of millable canes, sucrose%, sugar recovery%, cane and sugar yields. Hoeing was the most effective in weed eradication, resulting in higher sugarcane traits, compared with the other treatments. The effects of interactions among the studied factors on sugarcane and/or weed traits were discussed. Under conditions of the present study, the removal of trash of the plant cane crop out of the field, with hand hoeing twice can be concluded to attain the highest cane and sugar yields of 1st ratoon cane crop.

Keywords: cane trash, weeds, herbicides, hand hoeing, sugarcane.

INTRODUCTION

A considerable amount of cane residue represented in dry leaves (trash) are left in the field after sugarcane harvesting. The disposal of this residue out of the field is an important practice to ensure an appropriate condition for cane ratoon emergence. Crop trash burning is an inexpensive and effective method to remove excessive residue to facilitate the following agricultural practices and to control pests and weeds. However, burning crop trash, generally practiced by cane growers, has become a major environmental problem that causes serious health risks resulted from smoke causing significant air pollution. Moreover, burning of sugarcane trash has profound negative impacts where, it destroys the soil organic matter, exposes the soil to erosion and harms microorganisms.

Nowadays, environmental organizations are calling for not to burn agricultural waste to reduce environmental pollution and benefit from it by recycling in other industrial purposes (Liu, *et al.* 2010). Malhi and Kutcher (2007) observed considerable nutrient losses (C, P, N, and others) by volatilization owing to the burning crop residues in the field. Aquino, *et al.* (2018) cleared that harvesting system that does not include burning residue resulted in increased cane and sugar production, while, the field cane harvest burning system reduced sugarcane production compared to other treatments. Ball-Coelho, *et al.* (1993) examined that effect of burning crop residues on sugarcane yield and C, N, and P cycles. They found that harvestable cane yield of the 1st ratoon crop was greater without burning the trash.

Generally, the increase in weed growth by one kilogram corresponds to a reduction in one kilogram of crop due to the competition with crop plants for growth factors as water, solar radiation and nutrients. Hence, weed control in sugarcane field in the early stage becomes of a paramount importance to decease their population density and growth, duration of weed infestation as well as their competing ability with crop plants. In this respect, Singh and Menhi (2008) found that plots receiving manual hoeing at 20, 40 and 60 days after planting (DAP) resulted in minimum weed density (58.3/m^2) as well as weed dry matter (15.1 g/m^2) and thus proved highly effective. The highest weed control efficiency at 60, 90 and 120 DAP worked out to be 42.6, 58.5 and 67.8%, respectively under this treatment. El-Shafai, *et al.* (2010) showed that practicing hand hoeing three times at 25, 45 and 65 DAP to get rid of weeds associated to sugarcane plants resulted in a reduction in weed weight/m^2 as well as highest values of the studied traits, while the un-weeded plots gave the lowest ones. Fakkar, *et al.* (2009) observed that using of hand hoeing three times significantly reduced weed weight, which positively reflected in getting the highest values of stalk height, diameter, brix, sucrose and sugar recovery percentages as well as millable canes, cane and sugar yields, as compared to the un-weeded treatment. Galal, *et al.* (2015) stated that hand hoeing twice at 30 and 60 DAP reduced the dry weight of the annual broad-leaved weed

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called Morning-glory (*ipomeae spp*.) associated to cane plants and gave the highest values of stalk height and diameter, brix, sucrose and sugar recovery percentages as well as number of millable canes, cane and sugar yields. Fakkar, *et al.* (2017) showed that the most effective treatment in eliminating both grassy and broadleaved weeds was hand hoeing three times and led to increases in stalk height, number of millable canes, cane and sugar yields/fed. Jogi, *et al.* (2019) disclosed that hand hoeing three times resulted in 94.27 m^{-2} weed density, 39.33% weed reduction, 192.00 cm cane length, 2.05 cm cane diameter, 6.13 tillers $stool^{-1}$, 14.45 kg weight of 10 canes, 58.13 t ha^{-1} cane yield, 20.33% brix and 10.17% sugar recovery. Meanwhile, the un weeded plots (check treatment) produced 155.45 m^{-2} weed density, 0.00% weed reduction, 161.67 cm cane length, 1.73 cm cane girth, 2.98 tillers stool-1, 6.68 kg weight of 10 canes, 27.22 t ha^{-1} cane yield, 18.94% brix and 9.47% sugar recovery.

As for the use of herbicides to eliminate weeds accompanying sugarcane, Mobarak *et al.* (2019) found that treatment sugarcane by (Garlone + Ready Peck herbicides) post-planting and/or Ready Peck herbicide pre-emergence alone reduced weed weight of total annual weeds and gave the best value for height, diameter, weight of millable cane and juice quality as well as cane and sugar yields/fed compared with un-weeded check.

Likewise, Mohamed and Marzouk (2019) reported that all the tested herbicides and hand hoeing significantly had high weed control efficiency, which resulted in the highest increase in sugarcane growth, yield and quality of over untreated control. Among the tested herbicidal treatments, Lumax, Garlon and Starane showed maximum herbicidal activity against broad-leaved weeds.

The objective of this work was to find out the most effective combination among the tested weed control treatments to avoid the negative impact of weeds accompanying sugarcane to get the highest cane and sugar yield/fed of cane ratoon crop.

MATERIALS AND METHODS

Two field experiments were carried out at Shandaweel Agricultural Research Station (latitude of 26 33° N, longitude of 31 41°E and altitude of 69 m), Sohag Governorate, in 2018/19 and 2019/20 seasons to study efficacy of some integrated weed control treatments including using cane trash, hoeing and herbicides on yield and quality of sugarcane 1st ratoons of the promising variety G.2003-47 (Giza 3). A randomized complete block design in a split-plot arrangement with three replications was used.

After harvesting of the plant cane in the 1st week of March in both seasons, twelve treatments represent the following combinations were tried:

*** Two cane trash treatments:**

1. Burned trash: trach (dry leaves) was distributed over soil surface of each experimental plot and burned.
2. without trash: after harvesting of sugarcane, trash was collected out of the field.

*** Six weed control treatments including the following:**

1. Diuron (Ready Peck 80% WG) was applied as post-emergence of cane ratoon initiation and before irrigation, at the rate of 2.75 kg/fed.
2. Clomazone (Clomdi 48% EC) was used as post-emergence of cane ratoon initiation and before irrigation, at the rate of 750 cm^3/fed.
3. Mesotrione (Lumax 15% SC) was applied 15 days as post-emergence of cane ratoon initiation and before irrigation, at the rate of 1.7 l/fed.
4. Triclopyr (Garlone 90% EC) was sprayed 15 days as post-emergence of cane ratoon initiation and before irrigation, at the rate of 400 cm^3/fed.
5. Hand hoeing twice at 15 and 45 days after ratoon initiation.
6. Un-weeded (control).

Trash treatments were allocated in the main plots, whereas hoeing and herbicide weeds control treatments were randomly distributed in the sub plots.

The trade, common and chemical names of the used herbicides are presented in Table 1.

Table 1. Trade, common and chemical names of the used herbicides

Trade name	Common name	Chemical name
Ready Peck 80% WG	Diuron	Diuron {3-(3.4-dichlorophenyl)-1.1-dimethylurea) ……80%
Clomdi 48% EC	Clomazone	2-[(2-chlorophenyl)methyl]-4,4-dimethyl-3-isoxazolidinone
Lumax 15% SC	Mesotrione	[4-(methanesulfonyl)-2-nitrobenzoyl] Cyclohexane-1, 3-dione
Garlone 90 % EC	Triclopyr	[3,5,6 trichloro-2-pyridyloxy acetic acid]

Spraying of herbicides was done using CP3 knapsack sprayers fitted with AN 2.5 nozzles at 20-bar pressure in 200 liters of water/fed.

Sub-plot area was 21 m^2, including 6 rows of 3.5 m in length and 1 m apart. Mechanical and chemical properties of the upper 30 cm of the experimental soil showed that, soil texture was sandy loam, which contained (54.01 and 56.34 % sand), (25.34 and 28.44 % silt), (20.66 and 15.22 % clay); (33.0 and 24.0 ppm N), (11.4 and 11.7 ppm P) and (186 and 210 ppm K) with pH of (7.5 and 7.6) in the 1st and 2nd season, respectively.

Phosphorus fertilizer was added at 30 kg P_2O_5/fed as calcium super phosphate (15% P_2O_5) after the disposal of cane trash and before irrigation. Nitrogen fertilizer was applied to the 1st ratoon crop at 230 kg N/fed as urea (46% N) in two equal doses; the 1st was given 15 days after ratoon initiation, *i.e.* after the 1st hand hoeing, whereas, the 2nd N-one was applied after 30 days later, *i.e.* after the 2nd hand hoeing. Potassium fertilizer was added once with the 2nd N-dose at 24 kg K_2O/fed as potassium sulfate (48% K_2O). The other agronomic practices were done as recommended by the Sugar Crops Research Institute.

The recorded data:

I. Weed traits:

Weeds in one m^2 of each sub-plot were pulled out after 75 days after ratoon initiation, separated into broad and grassy-leaved weeds (Table, 2) and dried for seven days in the oven at 70 C° to a constant weight to record the following items:

1. Fresh weight of broad leaf weeds/m^2 (g).
2. Fresh weight of grassy leaf weeds/m^2 (g).

3. Total fresh weeds/m^2 (g).
4. Dry weight of broad leaf weeds/m^2 (g).
5. Dry weight of grassy weeds/m^2 (g).
6. Total dray weeds/m^2 (g/m^2).

Table 2. Scientific name, English name and Family for weeds accompanied sugarcane in the experimental site during 2018/19 and 2019/20 seasons

Weed type	Scientific name	English name	Family
Grassy weeds	*Echinocholac olonum* L.	Jungle rice	Poaceae
Broad -leaved	*Amaranthus hybridus* L.	Pig weed	Amaranthaceae
	Corchorus olitorius L.	Malta jute	Tilaceae
	Datura stramomium L.	Jimsonweed	Solancaceae
	Euphorbia peplus L.	Leafy spurge	Euphorbiaceae
	Portulaca oleracea L.	Common puslane	Protulaceceae
	Xanthium spinosum L.	Cocklebar	Asteraceae

II. Sugarcane traits:

The following data were recorded at harvest:

1. Millable cane height (cm).
2. Millable cane diameter (cm).
3. Number of millable canes/plot was counted and converted into thousands/fed.

A sample of 20 millable canes represent each treatment was taken at random, cleaned and crushed to extract the juice, which was analyzed to determine the following quality traits:

1. Brix% (total soluble solids) was determined using "Brix Hydrometer" according to the method described by "The Chemical Control Lab" of Sugar and Integrated Industries Company (Anonymous, 1981).
2. Sucrose% was determined using "Sacharemeter" according to A.O.A.C. (2005).
3. Sugar recovery% was calculated according to Yadav and Sharma (1980) as follows:

Sugar recovery % = [sucrose % - 0.4 (brix % - sucrose %) × 0.73].

Where:

The harvested sugarcanes of the middle three rows of each sub-plot were cut, topped, cleaned up from trash and weighed and counted to estimate the following traits:

1. Cane yield/fed (ton/fed), which was determined from the fresh weight (kg) of millable canes of each sub-plot, which was converted into tons/fed.
2. Sugar yield/fed (ton/fed), which was estimated according to the following equation:

Sugar yield/fed (ton/fed), = cane yield/fed (ton/fed), x sugar recovery%100.

Statistical analysis:

The collected data were statistically analyzed according to Gomez and Gomez (1984) using the computer "MSTAT-c" statistical analysis package described by Freed, *et al*. (1989). The least significant differences (LSD) at 0.05 level of probability were calculated to compare the differences among means of treatments.

RESULTS AND DISCUSSION

I. Fresh and dry weight of weeds:

Data in Table 3 showed that the disposal of cane trash post-harvesting of the plant cane crop by burning or removing it out of the field had no significant effect on the studied traits of weeds accompanying sugarcane, in both seasons.

Table 3. Efficacy of some integrated weed control treatments using cane trash, hoeing and herbicides on fresh and dry weight of weeds (g/m^2) at 75 days after ratoon initiation in 2018/2019 and 2019/2020 seasons

Treatments		Fresh wt. of broad-leaved weeds		Fresh wt. of grassy-leaved weeds		Total fresh wt. of weeds		Dry wt. of broad-leaved weeds		Dry wt. of grassy-leaved weeds		Total dray wt. of weeds	
		2018 /2019	2019 /2020	2018 /2019	2019 /2020	2018 /2019	2019 /2020	2018 /2019	2019 /2020	2018 /2019	2019 /2020	2018 /2019	2019 /2020
Cane trash treatments (A)													
Burned trash		232.6	244.9	64.2	63.7	296.8	308.7	62.1	72.5	24.9	21.8	86.9	92.6
Without trash		257.7	249.7	71.2	63.7	327.2	313.4	77.1	75.3	28.5	22.1	105.6	97.4
F-test		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Herbicides and hoeing treatments (B)													
Ready Peck 80% WG		100.8	110.7	24.3	31.2	125.2	141.3	25.7	31.0	10.8	11.2	36.5	42.2
Clomdi 48% EC		87.8	87.3	19.5	24.0	107.3	111.5	25.7	26.8	8.8	8.7	34.5	35.5
Lumax 15% SC		59.8	59.0	16.7	20.0	71.5	79.0	17.2	18.5	8.5	7.5	25.7	26.0
Garlone 90 % EC		46.8	42.3	15.8	14.5	62.7	56.8	15.3	13.7	7.0	5.3	22.3	19.0
Hand hoeing		32.5	30.0	10.3	10.7	42.8	40.7	11.0	11.2	5.5	4.5	16.5	15.7
Un-weeded		1142.8	1154.8	319.7	282.0	1462.5	1436.8	322.5	342.2	119.5	94.5	442.0	431.7
LSD at 0.5 level		149.3	61.8	37.0	16.5	180.8	59.5	32.4	24.6	15.4	5.3	45.5	29.5
Interaction (A x B)													
	Ready peck	92.3	103.0	25.7	28.3	118.0	131.3	22.7	28.3	11.3	9.0	34.0	37.3
	Clomdi	91.0	83.3	18.7	22.7	109.6	106.3	26.7	27.3	9.0	8.0	35.7	35.3
Burned	Lumax	64.7	62.3	16.7	22.3	81.3	84.7	18.7	19.3	9.0	8.3	27.7	27.7
trash	Garlone	48.3	44.3	16.7	16.3	65.0	60.7	16.7	14.3	7.7	5.7	24.3	20.0
	Hand hoeing	32.3	30.0	9.7	10.7	42.0	40.7	11.3	10.7	6.0	5.0	17.3	15.7
	Un-weeded	1066.7	1146.3	298.0	282.0	1364.7	1428.3	276.3	335.0	106.3	94.7	382.7	419.7
	Ready peck	109.3	117.3	23.0	34.0	132.3	151.3	28.7	33.7	10.3	13.3	39.0	47.0
	Clomdi	84.7	91.3	20.3	25.3	105.0	116.6	24.7	26.3	8.7	9.33	33.0	35.7
Without	Lumax	55.0	55.7	16.7	17.7	61.7	73.33	15.7	17.7	8.0	6.7	23.7	24.3
trash	Garlone	45.3	40.3	15.0	12.7	60.3	53.0	14.0	13.0	6.3	5.0	20.3	18.0
	Hand hoeing	32.7	30.0	11.0	10.7	43.6	40.7	10.7	11.7	5.0	4.0	15.7	15.7
	Un-weeded	1219.0	1163.3	341.3	282.0	1560.3	1445.3	368.7	349.3	132.7	94.3	501.3	443.7
LSD at 0.5 level		211.2	87.4	52.3	23.3	255.7	84.1	45.9	34.8	NS	7.5	NS	41.7

NS: insignificant differences.

The results manifested that controlling weeds using herbicides and hoeing affected significantly on the fresh and dray weight of broad-leaved, grassy leaved weeds and total weeds in both seasons. Practicing hand hoeing twice resulted in the lowest values previously mentioned weed traits, without significant variance mostly with the tested herbicides, except for Ready Peck concerning the total weed fresh weight and fresh weight of broad-leaved weeds, in the 2nd season. These results showed the effectiveness of hand hoeing in eliminating both broad and grassy-leaved weeds. The highest values of weed traits were recorded in the un-weeded plots. These results are in agreement with that mentioned by Fakkar, *et al.* (2009). These results are also in harmony with those reported by El-Shafai, *et al.* (2010), Galal, *et al.* (2015), Fakkar, *et al.* (2017) and Jogi, *et al.* (2019).

Data in Table 3 showed that the interaction between cane trash and weed control treatments had a significant effect on fresh and dry weight of broad-leaves, grassy leaves and total weeds in both seasons, except dry weight of grassy and total dry weight of weeds, in the 1st one. It was observed that the lowest values of fresh and dry weight of weeds/m^2 were obtained when cane trash was burned combined with hand hoeing twice.

II. Sugarcane growth traits:

The results in Table 4 showed that getting rid of the plant cane trash after harvest out of the field led to significant increase in millable cane height and number of millable canes/fed in both seasons compared to burned trash in plots. However, millable cane diameter was insignificantly influenced by trash treatments. These results were explained by Malhi and Kutcher (2007) and Hardk (2017), who found several negative effects of residue burning including, loss of plant essential nutrients from the field, loss of organic carbon, which leads to decreases in soil organic matter. These results are in agreement with those obtained by Ball-Coelho, *et al.* (1993) and Aquino, *et al.* (2018).

The results pointed that millable cane height, diameter and number of millable canes was significantly affected by the used weed control treatments (herbicides and hoeing) in both seasons (Table 4). The highest values of millable cane height, diameter and their number/fed were obtained by practicing hand hoeing twice to get rid of the associated weeds with sugarcane, probably due to the reduction in weed population, growth and hence their competition with cane plants on the growth factors as solar radiation, water and nutrients. On the contrary, the lowest values of sugarcane traits were recorded in the un-weeded plots due to the severe competition of weeds with sugarcane plants. These results are in agreement with those found by Fakkar, *et al.* (2009), El-Shafai, *et al.* (2010), Galal, *et al.* (2015) Fakkar, *et al.* (2017) and Jogi, *et al.* (2019).

The interaction between cane trash and the other weed control treatments had a significant effect on millable cane height and number of millable canes. However, millable cane diameter was not affected by the interaction, in both seasons. The highest value of cane height and number of millable canes/fed were obtained when cane trash remains after harvest was removed out of the field, with getting rid of weeds by hand hoeing twice. Moreover, insignificant variance was observed in cane height in case of using Lumax and/or Garlone to eliminate weeds, without trash, in the 1st season. In the 2nd one, insignificant variance was recorded in cane height, when weeds were eradicated using hand hoeing or Lumax, Garlone and Clomdi herbides, without trash. In addition, insignificant difference in millable canes number/fed was noticed, when any of the tested herbicides were used, without cane trash, in the 1st season. In the 2nd one, insignificant variance in this trait was detected in case of using Garlone or Lumax for controlling weeds. Likewise, no difference was found in the same trait between Ready Peck and Clomdi herbicides.

Table 4. Efficacy of some integrated weed control treatments using cane trash, hoeing and herbicides on growth traits of sugarcane in 2018/2019 and 2019/2020 seasons

Treatments		Millable cane height (cm)		Millable cane diameter (cm)		Number of millable canes (1000/fed)	
		2018/2019	2018/2020	2018/2019	2018/2020	2018/2019	2018/2020
Cane trash tratments (A)							
Burned trash		277.9	280.6	2.37	2.37	41.50	41.80
Without trash		280.9	287.2	2.38	2.39	41.70	42.16
F-test		*	*	NS	NS	*	*
Herbicides and hoeing treatments (B)							
Ready Peck 80% WG		286.8	291.7	2.41	2.41	43.72	44.15
Clomdi 48% EC		290.0	293.2	2.45	2.46	44.08	44.18
Lumax 15% SC		294.0	296.5	2.39	2.40	44.18	44.50
Garlone 90 % EC		292.3	295.8	2.41	2.43	44.16	44.62
Hand hoeing		300.0	299.3	2.48	2.49	44.61	45.00
Un-weeded		213.2	226.7	2.11	2.11	28.87	29.41
LSD at 0.5 level		3.51	2.46	0.04	0.04	0.19	0.01
Interaction (A x B)							
	Ready Peck	285.0	286.7	2.41	2.40	43.30	43.81
	Clomdi	287.3	287.3	2.45	2.45	43.81	43.85
Burned	Lumax	290.7	292.7	2.39	2.40	43.97	44.17
Trash	Garlone	288.7	289.3	2.38	2.39	43.97	44.34
	Hand hoeing	297.7	296.3	2.48	2.47	44.27	44.64
	Un-weeded	218.0	231.0	2.13	2.13	29.67	29.97
	Ready Peck	288.7	296.7	2.41	2.42	44.14	44.50
	Clomdi	292.7	299.0	2.45	2.47	44.34	44.50
Without	Lumax	297.3	300.3	2.39	2.41	44.38	44.82
trash	Garlone	296.0	302.3	2.45	2.47	44.35	44.90
	Hand hoeing	302.3	302.3	2.49	2.50	44.94	45.36
	Un-weeded	208.3	222.3	2.08	2.08	28.06	28.85
LSD at 0.5 level		4.96	3.48	NS	NS	0.25	0.14

***: significant and NS: insignificant differences.**

III. Juice quality traits:

The results in Table 5 indicated that removing cane trash remained after harvest out of the field or burning it in plots had no significant effect on brix, sucrose and sugar recovery percentages in both seasons.

The results in the same table revealed that the applied herbicides and hoeing treatments had significant effects on brix, sucrose and sugar recovery percentages in both seasons. It was found that practicing hand hoeing twice was the most effective treatment in eradicating weeds accompanied to sugarcane, which resulted in getting the highest values of the three traits. These results are can be attributed to better growth conditions free of weed competition with cane plants, which was positively reflected on more photosynthesis and sugar accumulation in stalks. On the contrary, the lowest values of the studied quality traits were recorded by cane plants suffered from being grown among severe competition with weeds left to grow without any control. These results are in line with those stated by Fakkar, *et al.* (2009), El-Shafai, *et al.* (2010), Galal, *et al.* (2015) Fakkar, *et al.* (2017) and Jogi, *et al.* (2019). Meanwhile, insignificant differences were found between Ready Peck and Clomdi herbicides in brix, sucrose and sugar recovery percentages in the 1st season. Moreover, the difference between Lumax and Garlone herbicides in their influence on these juice quality traits, in both seasons.

Table 5. Efficacy of some integrated weed control treatments using cane trash, hoeing and herbicides on quality traits of sugarcane in 2018/2019 and 2019/2020 seasons

Treatments		Brix%		Sucrose%		Sugar recovery%	
		2018/2019	2018/2020	2018/2019	2018/2020	2018/2019	2018/2020
Cane trash treatments (A)							
Burned trash		22.12	21.92	18.73	18.48	12.85	12.62
Without trash		22.23	22.12	18.79	18.64	12.86	12.72
F-test		NS	NS	NS	NS	NS	NS
Herbicides and hoeing treatments (B)							
Ready Peck 80% WG		22.23	22.06	18.82	18.59	12.90	12.69
Clomdi 48% EC		22.36	22.24	18.94	18.76	13.00	12.81
Lumax 15% SC		22.74	22.45	19.20	18.91	13.14	12.90
Garlone 90 % EC		22.78	22.51	19.24	18.97	13.16	12.95
Hand hoeing		23.11	22.87	19.58	19.25	13.43	13.13
Un-weeded		19.81	20.01	16.77	16.88	11.50	11.54
LSD at 0.5 level		0.24	0.15	0.20	0.20	0.15	0.06
Interaction (A x B)							
Burned trash	Ready Peck	22.15	22.01	18.78	18.54	12.90	12.65
	Clomdi	22.24	22.17	18.89	18.70	13.00	12.78
	Lumax	22.75	22.34	19.22	18.83	13.15	12.85
	Garlone	22.78	22.29	19.23	18.79	13.15	12.82
	Hand hoeing	23.14	22.82	19.59	19.20	13.44	13.09
	Un-weeded	19.65	19.89	16.66	16.85	11.43	11.56
Without trash	Ready Peck	22.31	22.10	18.85	18.64	12.91	12.73
	Clomdi	22.49	22.31	18.99	18.81	13.00	12.84
	Lumax	22.72	22.55	19.19	18.99	13.13	12.95
	Garlone	22.79	22.73	19.25	19.16	13.17	13.08
	Hand hoeing	23.01	22.92	19.56	19.31	13.42	13.17
	Un-weeded	19.96	20.12	16.88	16.92	11.57	11.53
LSD at 0.5 level		0.33	0.35	0.29	0.28	0.21	0.19

Brix, sucrose and sugar recovery percentages were significantly affected by the interaction between the studied weed control treatments in both seasons. It was observed that practicing hand hoeing twice had the most distinguished role in getting rid of weeds, whether cane trash burned and/or removed out of the field, resulting in the highest brix, sucrose and sugar recovery percentages. However, insignificant variance in brix % was recorded among hand hoeing and each of Garlone or Lumax herbicide (in the 1st season) and between hand hoeing and Garlone (in the 2nd one), when the field was cleaned from cane trash. Similarly, no appreciable difference in sucrose % was detected in case of using hand hoeing, Garlone or Lumax (in the 2nd season) without cane trash. Meantime, sugar recovery % was not significantly differed in case of using hand hoeing or Garole to eliminate the presence of weeds in the absence of cane trash, in the 2nd season.

IV. Sugarcane yields

1. Millable cane yield/fed:

Data in Table 6 showed that millable cane yield/fed was significantly affected by cane trash treatments after harvest in both seasons. The results pointed out that clearance of plant cane trash out of the field after harvest increased cane yield of the 1st ratoon crop by 1.08 and 0.53 ton/fed, compared to that obtained by burning cane trash, in the 1st and 2nd season, respectively. These results can be attributed to the increase in the height and number of millable canes/fed (Table 4) gained by cleaning the field from cane trash after harvest, instead of burning it, which cause the loss of loss of plant essential nutrients from the field as P and N, loss of organic carbon and the decrease in soil organic matter (Malhi and Kutcher, 2007; Hardk, 2017) These results are in agreement with those obtained by Ball-Coelho, *et al.* (1993) and Aquino, *et al.* (2018).

The results pointed to a significant response of millable cane yield/fed due to the applied weed control treatments (herbicides and hoeing) in both seasons. Using hand hoeing twice to eradicate weeds resulted in increases in millable cane yield amounted to 29.30 and 28.01 tons/fed in the 1st and 2nd season, respectively, compared with un-weeding. These results manifested the importance of hand hoeing as an effective means in getting rid of weeds compete with sugarcane plants. Controlling weeds with Ready Peck, Clomdi, Lumax and Garlone herbicides

increased millable cane yield by 26.17, 26.72, 27.30 and 27.31 tons/fed, in the 1st season, corresponding to 25.44, 25.49, 26.30 and 26.77 tons/fed, in the 2nd one, successively, compared with the un-weeded plots. These results are in line with those given by Fakkar, *et al.* (2009), El-Shafai, *et al.* (2010), Galal, *et al.* (2015) Fakkar, *et al.* (2017) and Jogi, *et al.* (2019). However, insignificant difference was found in cane yield/fed in case of using Lumax and/or Garlone herbicides to control weeds, in the 1st season. Similarly, applying Ready Peck and Clomdi had insignificant effect on this trait, in the 2nd one.

Millable cane yield/fed was significantly influenced by the interaction between the studied factors in both seasons. The highest value of millable cane yield/fed of the 1st ratoon crop was obtained when cane trash was removed out of the field after harvest, in combination with hand hoeing twice to eliminate weeds in both seasons. Insignificant difference was noticed between Lumax and Garlone in their effect on cane yield/fed, whether cane trash was burned or collected out of the field, in the 1st season. Insignificant variance in cane yield/fed was found between Ready Peck and Clomdi without trash, in both seasons. The same finding was noticed in the 2nd season with burned cane trash.

Table 6. Efficacy of some integrated weed control treatments using cane trash, hoeing and herbicides on sugarcane yields in 2018/2019 and 2019/2020 seasons

Treatments		Millable cane yield/fed (ton)		Sugar yield/fed (ton)	
		2018/2019	2018/2020	2018/2019	2018/2020
Cane trash traetments (A)					
Burned trash		49.67	50.41	6.44	6.41
Without trash		50.75	50.94	6.59	6.53
F-test		*	*	*	*
Herbicides and hoeing treatments (B)					
Ready Peck 80% WG		53.58	54.10	6.91	6.86
Clomdi 48% EC		54.13	54.15	7.04	6.94
Lumax 15% SC		54.71	54.96	7.19	7.09
Garlone 90 % EC		54.72	55.43	7.20	7.18
Hand hoeing		56.71	56.74	7.62	7.45
Un-weeded		27.41	28.66	3.15	3.31
LSD at 0.5 level		0.30	0.11	0.06	0.08
Interaction (A x B)					
Burned trash	Ready Peck	52.73	53.43	6.80	6.76
	Clomdi	53.43	53.50	6.95	6.84
	Lumax	54.01	54.44	7.10	7.00
	Garlone	54.05	55.17	7.11	7.08
	Hand hoeing	55.97	56.28	7.52	7.37
	Un-weeded	27.84	29.62	3.18	3.42
Without trash	Ready Peck	54.43	54.76	7.03	6.97
	Clomdi	54.83	54.79	7.13	7.04
	Lumax	55.41	55.48	7.27	7.18
	Garlone	55.39	55.68	7.29	7.28
	Hand hoeing	57.45	57.21	7.71	7.54
	Un-weeded	26.99	27.70	3.12	3.19
LSD at 0.5 level		0.42	0.15	0.08	0.11

***: significant**

2. Sugar yield/fed:

Data in Table 6 indicated that sugar yield/fed was significantly influenced by cane trash treatments in the both seasons. Removing cane trash out of the field after harvest increased sugar yield by 0.15 and 0.12 ton/fed, compared to burning it, in the 1st and 2nd season, successively. The increase in sugar yield/fed is probably due to the increase of number of millable canes and cane yield/fed (Tables 4 and 6, respectively). These results are in agreement with those reported by Ball-Coelho, *et al.* (1993) and Aquino, *et al.* (2018).

The results exhibited a significant effect on sugar yield due to the used weed control treatments in both seasons. Using hand hoeing proved high efficacy in weed eradication to a large extent and resulted in getting increase in sugar yield amounted to 4.46 and 4.14 tons/fed, in the 1st and 2nd season, respectively, compared to the check (un-weeded). Controlling weeds by Ready Peck, Clomdi, Lumax and Garlone herbicides, increased sugar yield by 3.76, 3.88, 4.04 and 4.05 tons/fed, in the 1st season, corresponding to 3.55, 3.63, 3.78 and 3.87 tons/fed, in the 2nd one, successively, compared with the un-weeded plots. These results are in agreement with those found by Fakkar, *et al.* (2009), El-Shafai, *et al.* (2010), Galal, *et al.* (2015) Fakkar, *et al.* (2017) and Jogi, *et al.* (2019). However, insignificant differences were found in this trait in case of applying Lumax and/or Garlone herbicides, in the 1st season.

Sugar yield was significantly affected by the interaction between the used cane trash treatments (burned or removed) and the other weed control treatments (herbicides and hoeing) in both seasons. It was found that the clearance of cane trash out of the field followed by two hand hoeings was the best combination to get rid of weeds and to produce the highest sugar yield/fed from the 1st ratoon cane crop. Meanwhile, there was no appreciable variance in sugar yield/fed in case of applying Lumax or Garlone herbicides in the presence of burned trash or its absence out of plots, in both seasons.

Under conditions of the present study, the removal of trash of the plant cane crop out of the field, in combination with practicing hand hoeing twice can be concluded to attain the highest cane and sugar yields of 1st ratoon cane crop.

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"فاعلية بعض معاملات المكافحة المتكاملة للحشائش على إنتاجية القصب الخلفة"

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أجريت تجربتان حقليتان بمحطة البحوث الزراعية بشندويل (دائرة عرض 26.33° شمالاً ، خط الطول 31.41° شرقاً وإرتفاع 69 م عن سطح البحر) بمحافظة سوهاج فى موسمى 2019/2018 و 2020/2019 لدراسة فاعلية بعض معاملات المكافحة المتكاملة للحشائش تضمنت إستخدام قش القصب (الأوراق الجافة) والعزيق اليدوى وبعض مبيدات الحشائش على إنتاجية وجودة القصب الخلفة للصنف جيزة 2003-47 (المُسمّى تجارياً جيزة-3). نُفِّذَت التجربة فى تصميم القطاعات كاملة العشوائية بنظام القطع المنشقة مرة واحدة فى ثلاث مكررات ، حيث وضعت معاملات قش القصب بعد الحصاد (قش محروق وبدون قش) فى القطع الرئيسية ، بينما وزعت المعاملات الأخرى لمكافحة الحشائش (مبيدات ريدى بيك ، كلومدى ، لوماكس و جارلون ، والعزيق اليدوى ، وبدون إزالة للحشائش كمقارنة) عشوائياً فى القطع الشقية ، فى كلا الموسمين . أوضحت النتائج أن إزالة قش القصب بعد الحصاد خارج الحقل أدت لزيادة معنوية فى إرتفاع العود وعدد العيدان القابلة للعصير/فدان وحاصلى العيدان والسكر/فدان لمحصول قصب الخلفة - فى حين أن حرق قش القصب بعد حصاده أو إزالته خارج الحقل لم يؤثر معنوياً على صفات الحشائش المدروسة وكذلك قطر عود القصب وصفات جودة العصير فى كلا الموسمين. أظهرت معاملات مكافحة الحشائش المُستخدمة (المبيدات والعزيق) تأثيراً معنوياً على كل الصفات المدروسة للحشائش والقصب ، وأدى إجراء العزيق اليدوى مرتين إلى إنخفاض الوزن الطازج والجاف للحشائش عريضة وضيقة الأوراق والحشائش الكلية ، ونتج عن ذلك الحصول على أعلى قيم لطول وقطر العود وعدد العيدان القابلة للعصير للفدان ، بالإضافة إلى البركس% والسكروز% وناتج السكر% وحاصلى العيدان والسكر للفدان فى كلا الموسمين. يمكن التوصية بإزالة قش القصب الغرس خارج الحقل بعد حصاده ، وإجراء العزيق اليدوى مرتين للتخلص من الحشائش للحصول على أعلى حاصل من عيدان القصب والسكر للفدان من القصب الخلفة.