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Efficacy and Selectivity of S-Metolachlor for Weed Control in Sugar Beet (*Beta vulgaris*L.), Gezira State, Sudan

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Abstract

Sugar Beet (*Beta vulgaris* L.) is considered as the second most important crop in the world after sugar cane in sugar production. Weed competition is considered one of the major constrains to achieve maximum sugar beet yield. The objective of this study was to evaluate the efficacy and selectivity of the herbicide S-metolachlor for weed control and their effect on sugar beet growth and yield. A field experiment was conducted during 2017/18 winter season at the experimental farm, Faculty of agricultural Sciences Gezira University, Sudan. The herbicide S-metolachlor (Dual Gold 96% EC) at two rates (1.92 and 2.4 kg a.i./ha) was applied as per-sowing, two weeks before planting and irrigated immediately after application. Hand weeded and un-wedded treatments were added as controls. The treatments were arranged in a randomized complete block design in 4 replicates. Data were subjected to analysis of variance (ANOVA) procedure ($P \leq 0.05$). Significant means were separated using Duncan's Multiple Range test (DMRT). The herbicide treatments S-metolachlor at the rate of 1.92 and 2.4 kg a.i./ha exhibited slight phytotoxicity on sugar beet plant. S-metolachlor at the two rates tested gave 77-79.5% grass weed control and 52-53% broadleaved weed control. The herbicide treatments significantly increased the root length, root diameter and root weight of sugar beet as compared to un-weeded check. S-metolachlor at the two rates tested gave significantly high root weight compared to un-weeded check. The herbicide treatments increased the gross sugar yield. S-metolachlor at 1.92 and 2.4 kg a.i./ha gave significantly high gross sugar yield (0.95 – 1.22 ton/ha) compared to 0.15 kg/ha gross sugar yield of the un-weeded control. It could be concluded that S-metolachlor at 1.92 kg a.i./ha could be used for weed control in sugar beet to be applied and immediately irrigated two weeks before sowing of sugar beet. Further studies are needed to confirm their safety and inclusion in a management program.

Keywords: *Beta vulgaris*, Efficacy, S-metolachlor, Selectivity, Sugar Beet, Weed Control.

Introduction

Sugar beet (*Beta vulgaris* L.), belongs to the family Chenopodiaceae, is considered as one of the promising sugar crops in Sudan. It is the second crop after sugarcane for sugar production. It can be grown in irrigated schemes of the Sudan. Sugar beet plants are characterized by their slow rate of growth during the early stages from emergence to thinning time. The presence of weeds during the entire growing season decreased sugar beet root yield by 61.2%-92.9% (Salehi *et al*, 2006). Sugar beet is weak in competing with emerging weeds until it has at least 8 true leaves (May, 2001). Competition between sugar beet and annual weeds could be responsible for sugar yield reductions of 25-100% (Poorazar and Ghadiri, 2001).Weeds are known to cause crop yield losses, reduce harvesting efficiency, reduce quality of the harvest product and perhaps harbor insects and diseases that may harm the crop. Yield losses due to are of the greatest concern and have been predicted using early season assessments of the weed population such as weed seedling density, relative time of emergence, weed pressure, and relative leaf area (Schwizer and May, 1993; Dieleman and Mortensen, 1998).

Approximately, 70% of weed species in sugar beet fields are mainly broadleaf annual such as redroot pigweed (*Amaranthus retroflexus* L.) (Weaver and Williams, 1980; Schwizer and May, 1993; Heidari *et al*., 2007). Weeds such as redroot pigweed and fat-hen (*Chenopodium album* L.) can be taller than the crop canopy. Weeds that emerge 8 weeks after sowing, and particularly after the sugar beet plants have eight or more leaves, are less likely to affect yield (Scott *et al.*, 1979).

Weed control is an essential component of productive agriculture. Herbicides are the primary tool to manage weeds. The range of weed species controlled by each herbicide is also limited (Lajos and Lajos, 2000). For high efficacy of chemical method, the timing of application is very important. Weeds should be at cotyledon stage to ensure successful weed control (Dale and Renner, 2005; Dale *et al.*, 2005). The most popular active herbicides applied so far for weed control in sugar beet are phenmedipham, metamitron, ethofumesate, desmedipham, triflusulfuron-methyl, lenacil, clopyralidand chloredazone (May, 2001; Wilson *et al*., 2005; Deveikyte and Seibutis, 2006). Triflusulfuron-methyl is selective for the control of annul and perennial broad-leaved weeds and grasses in sugar beet when applied at low rates. Chloredazone is used extensively for broad-leaved weed control in sugar beet. Field observations indicated that weed emergence commenced 30 days after the application of a reduced dose of 1.3 kg ha^{-1}Chloredazone (Majidi *et al*., 2011).

Since sugar beet, is a temperate crop, grown in warm climate of the Sudan, and is a slow growing crop is vulnerable to severe weed competition. It is also sown in widely spaced rows of 80cm distance providing a large surface area for weeds to germinate and grow. When sugar beets are cultivated without any weed control measure, sugar yield losses can reach up to 95% (Petersen, 2003).The highest cost of hand weeding and their damaging effect on sugar beet plants showed that using herbicides is more economic practice. The chemicals so far applied on sugar beet are not satisfactory with the exception of roundup. Moreover, most tested herbicides for weed control in sugar beet in Sudan were phytotoxic to the crop. Therefore, there in a need to look for optimum time of application of herbicides which are efficient in control of weed and safe to the crop. Therefore, this research was designed to study efficacy and selectivity of S-metolachlor for weed control in sugar beet (*Beta vulgaris* L.), Gezira State, Sudan.

Materials and Methods

Experimental site

A field experiment was conducted in the season 2017/18 at the Experimental Farm of the Faculty of Agricultural Sciences, University of Gezira, Wad Medani, Sudan. Latitude 14° 06´N, longitude 33° 38´E and altitude 407 masl. The area is characterized by hot-semi arid climate. The soil of the experimental site is typical haplusten, line semctitic, isophyperthemic with PH 9.5-8.5 (Adam personal communication).

Field methods

Land preparation was done by disc ploughing, harrowing and leveling, in October 20, 2017. Furrows were opened at 80 cm apart. The experiment was laid out in a randomized complete block design with 6 treatments and 4 replicates. The experimental plots consisted of 5 rows, each 5 m long. The herbicide S-metolachlor (Pendico50% EC) at two rates; 1.92 and 2.4 kg a.i./ha was tested as pre-sowing treatments. The Un-weeded (U) and Hand-weeded (H) treatments were also included. Hand weeding was done manually whereby emerging weeds removed by hand biweekly. The herbicides were applied in October 20, 2017 using a knapsack sprayer calibrated to deliver 357.1 l/ha. Irrigation was given immediately after herbicides application. Sugar beet seeds, variety Linard, were planted two weeks after irrigation. The seeds were sown manually by placing 2-3 seeds/hole in 15 cm spacing. Irrigation was then given biweekly. Urea fertilizer at the rate of 119.1 kg/ ha was applied 30 days after planting. Thinning was done in 15 days after planting to one plant per hole.

Data collection

Seedling emergence and phytotoxicity parameters

Seedling emergence %

The number of emerged sugar beet seedlings was counted in the three middle rows, two week after planting. Then, the seedling emergence percent was calculated by the following formula :

$$Seedling\ emergence\ \% = \frac{Number\ of\ emmeged\ seedlings}{Total\ number\ of\ sown\ seeds\ in\ the\ H\ control} \times 100$$

Phytotoxicity

The injury due to herbicide treatments described as phytotoxicity was estimated visually at 4 and 8 weeks after emergence. The phytotoxicity effect was described using the visual rating scale 0-5. Where; 0 = healthy plant, 1 - 2 = slight phytotoxicity, 3 - 4 = moderate phytotoxicity and 5 = high phytotoxicity or dead plant.

Weed parameters

Weed count %

The effects of herbicides treatments on weeds; annual grasses, annual broadleaf and total weed control % were assessed by counting total and individual weed species in 1 m² (125×80cm) at 4 and 8 week after sowing (WAS). The percent weed control was calculated according to the flowing formula: $Weed\ count\ \% = \frac{Wx-Wy}{Wx} \times 100$

Where; Wx = number of individual weeds in the un-weeded control and Wy = number of individual weeds in the treatment.

Weed ground cover

The percentage weed ground cover was estimated visually. Each plot was assigned as ground cover percentage.

Crop parameters

Sugar beet was harvested 5 months after planting to assess the sugar beet growth and yield characteristics. The yield included the quantity and quality characteristics.

Sugar beet growth characteristics

To assess sugar beet growth characteristics, 10 plants were harvested randomly from each plot. The number of leaves/plant was counted and root length and root diameter were measured using verinier. Then, the leaf fresh weight in g/plant and root weight in g/plant were determined.

Sugar beet yield characteristics

The yield quantity was determined by measuring the top yield (ton/ha), root yield (ton/ha) and gross sugar yield (kg/ha). While the yield quality was determined (at Al Gunied Sugar Factory, Gezira State, Sudan) by measuring the following parameters:

Total Soluble Solids (T.S.S) % (Brix %): It was determined using hand Briximeter device.

Sucrose %: It was determined using the Standard Densimetric Device.

Purity %: It was calculated using the following formula:

$$Purity\ \% = \frac{Sucrose\ \%}{T.S.S.\ \%} \times 100\%$$

Gross sugar yield (kg / ha): It was then calculated using the following formula:

$$Gross\ sugar\ yield\ (kg\ /\ ha) = root\ yield\ (kg/ha) \times sucrose\ \%$$

Data analysis

Collected data were subjected to analysis of variance (ANOVA) procedure (P $\leq$ 0.05). Significant means were separated using Duncan's Multiple Range test (DMRT). The statistical analysis was done using the Software MSTAT.

Results

Effect of the herbicide on seedling emergence and phytotoxicity

Effect of the herbicide on seedling emergence

The results showed that the herbicide S-metolachlor at rate of 1.92 kg a.i./ha and 2.4 kg a.i./ha gave high seedling emergence in sugar beet crop and the seedling emergence was 92.5 % and 87.3 %, respectively (Table 1). S-metolachlor at rate of 1.92 kg a.i./ha significantly (P $\leq$ 0.05) gave high seedling emergence compared to hand-weeded control (100%), while S-metolachlor at rate of 2.40 kg a.i./ha significantly reduced the seedling emergence compared to the hand-weeded control. However, there was no significant difference in the seedling emergence between the two rates of the herbicide.

Effect of the herbicide on phytotoxicity

The results showed that S-metolachlor at the two rates tested, 1.92 kg a.i./ha and 2.4 kg a.i./ha, gave slight phytotoxicity (scale 1) in sugar beet plants (Table 1).

Effect of the herbicide on weed control

Effect of the herbicide on grasses weeds control

The results showed that S-metolachlor at the two rates tested significantly (P $\leq$ 0.05) reduced grass weeds infestation as compared to un-weeded check (Table 2). The herbicide at 1.92 kg a.i./ha and 2.40 kg a.i./ha gave 77.0% and 79.5% grass weed control, respectively. There were no significant differences between the two herbicide rates. The grass weed controlled include; *Sorghums sudanensis*, *Echinochloa colon*, *Brachiaria eruciformis*, and *Eragrostis megatachya*.

Effect of the herbicide on broadleaf weeds control

The results showed that S-metolachlor at the two rates tested significantly (P $\leq$ 0.05) reduced broadleaf weeds infestation as compared to un-weeded check (Table 2). S-metolachlor at 1.92 kg a.i./ha and 2.40 kg a.i./ha gave 52.0% and 53.0% % broadleaf weed control, respectively. There were no significant differences between the two herbicide treatments. The broadleaf weeds controlled include; *Ipomoea cordofana,* *Digera muricata, Sonchus cornutus* and *Amarthus yiridis*.

Effect of the herbicide on total weeds control

The results showed that S-metolachlor at the two rates tested significantly (P ≤ 0.05) reduced total weed infestation as compared to un-weeded check (Table 2). S-metolachlor at 1.92 kg a.i./ha and 2.40 kg a.i./ha gave 64.5% and 66.3% total weed control, respectively. There were no significant differences between the two herbicide treatments. The total weeds controlled include; *Ipomoea cordofana*, *Digera muricata*, *Sonchus cornutus*, *Amarthus yiridis*, *Sorghum sudanens*, *Cynodon dactylon*, *Echinochloa colon*, *Brachiaria eruciformis* and *Eragrostis megatachya*.

Effect of the herbicide on weed ground coverage %

The results showed that S-metolachlor at the two rates tested significantly (P ≤ 0.05) reduced weed ground coverage as compared to un-weeded check (Table 2). S-metolachlor at 1.92 kg a.i./ha and 2.40 kg a.i./ha gave 35.5% and 33.8% weed ground coverage, respectively**.** There were no significant differences between the two herbicide treatments**.**

Effect of the herbicide on sugar beet crop

Effect of the herbicide on sugar beet growth

Effect of the herbicide on number of leaves

Weed competition significantly reduced the number of leaves in the sugar beet by 58.5% compared to the weed free control (Table 3). The high number of leaves/plant (26.27) was obtained from the application of S-metolachlor at 1.92 kg a.i./ha and the low number of leaves/plant (24.58) of sugar beet were obtained from the application of S-metolachlor at 2.40 kg a.i./ha. Both were significantly higher than that of the un-weeded control (12 leaves/plant). There were significant differences between the two herbicide treatments.

Effect of the herbicide on root length

The results revealed that the herbicide at the two rates tested significantly (P ≤ 0.05) increased sugar beet root length compared to the un-weeded control (Table 3). The high root length (35.2 cm) in the herbicides treatments was obtained from the application of S-metolachlor at 1.92 kg a.i./ha and the low root length (34.5 cm) of sugar beet were obtained from the application of S-metolachlor at 2.40 kg a.i./ha, compared to the un-weeded control (15 cm). Unrestricted weed growth significantly increased sugar beet root length by 60%.

Effect of the herbicide on root diameter

Sugar beet root diameter was significantly (P ≤ 0.05) reduced by 75% in the un-weeded control treatment compared to the hand weeded control (Table 3). The large root diameter (8.7 cm) was obtained from the application of S-metolachlor at 1.92 kg a.i./ha and the small root diameter (7.7 cm) of sugar beet were obtained from the application of S-metolachlor at 2.40 kg a.i./ha and both were significantly higher than that obtained in the un-weeded control (2.6 cm).

Effect of the herbicide on leaf fresh weight

Unrestricted weed competition reduced leaf fresh weight by 93% compared to the hand-weeded control (Table 3). The result showed that the high leaf fresh weight (0.149 g/plant) was obtained from the application of S-metolachlor at 1.92 kg a.i./ha and the low leaf fresh weight (0.143 g/leaf) of sugar beet was obtained from the application of S-metolachlor at 2.40 kg a.i./ha. Both were significantly higher than the un-weeded control (0.015 g/leaf) and there were significant differences between them.

Effect of the herbicide on root fresh weight

Sugar beet root growth was significantly (P ≤ 0.05) reduced by 93% in the un-weeded control compared with the weeded control (Table 3). In general, herbicide treatments significantly increased sugar beet root yield compared to un-weeded. The high root weight of 0.700 g / plant was obtained from the application of S-metolachlor at 1.92 kg a.i./ha and the low root weight 0.602 g / plant was obtained from the application of S-metolachlor at 2.40 kg a.i./ha, both were significantly higher than of un-weeded control 0.(0.061g) and comparable to hand weeded treatment (0.808 g / plant).

Effect of the herbicide on sugar beet yield

Effect of the herbicide on the yield quantity

Top yield (ton/ha)

Top yield of the un-weeded control was significantly (P ≤ 0.05) decreased by 83% compared to the hand weeded control (Table 4). The high top yield (1.21 ton/ha) was obtained from the application of S-metolachlor at 1.92 kg a.i./ha and the low top yield (0.95 ton./ha) of sugar beet was obtained from the application of S-metolachlor at 2.40 kg a.i./ha. Both were significantly higher than that of un-weeded control (0.49 ton/ha).

Root yield (ton/ ha)

Unrestricted weed competition reduced root yield of the un-weeded control by 90% compared to the weeded control (Table 4). The result also showed that the high root yield (7.0 ton/ha) was obtained from the application of S-metolachlor at 1.92 kg a.i./ha and low root yield (6.00 ton./ha) of sugar beet root yield were obtained from the application of S-metolachlor at 2.40 kg a.i./ha, both were significantly (P ≤ 0.05) higher than that of the un-weeded control (1.57 ton/ha) and comparable to hand weeded treatment (8.00 ton/ha).

Gross sugar yield (kg/ ha)

The result showed that the high gross sugar yield (1.21 kg /ha) was obtained from the application by S-metolachlor at 1.92 kg a.i./ha and the low gross sugar yield (0.95 kg/ha) was obtained from the application of S-metolachlor at 2.40 kg a.i/ha (Table 4). Both were significantly higher than that un-weeded control (0.150 kg /ha) and comparable to hand weeded treatment (1.43 kg/ha).

Effect of the herbicide on the yield quality

Sucrose %

The result revealed that the herbicide treatments significantly (P ≤ 0.05) reduced sugar beet sucrose % as compared to hand-weeded (Table 5). However, S-metolachlor at 1.92-2.40 kg a.i./ha gave significantly high sucrose % as compared to un-weeded check. With the highest sucrose % in response to S-metolachlor at 1.92 kg a.i./ha.

Total soluble solids (T.S.S. %)

The total soluble solids (T.S.S. %) increased significantly (P ≤ 0.05) in response to herbicide application compared to un-weeded control (Table 5). S-metolachlor at the two rates tested (1.92–2.40 kg a.i./ha) gave 17.8-18.0% in comparison with un-weeded control (9.5%). There were significant differences between the two herbicide treatments.

Purity %

The purity% increased significantly (P ≤ 0.05) in response to herbicide application (Table 5). S-metolachlor at the two rats tested (1.92 – 2.40 kg a.i./ha) gave 89.5-96.4% and they were significantly different as compared with un-weeded control (47.4%). However, there were no significant differences between the two herbicide treatments compared to hand weeded control.

Discussions

In general, the results obtained in this study showed that weed infestation for the whole season in sugar beet caused significant reduction in growth and yield of sugar beet crop compared to hand-weeded control. These findings agreed with Poorazar and Ghadiri, (2001) who reported that competition between sugar beet and annual weeds could be responsible for sugar yield reductions of 25-100%.

The herbicide S-metolachlor at 1.92 - 2.4 kg a.i./ha gave high seedling emergence (87 – 93%) in sugar beet crop, although they were slightly phytotoxic the plants. S-metolachlor was reported to injure sugar beet plant. Bollman and Sprague, (2007) tested the tolerance of 12 varieties of sugar beet to herbicides. They reported that the pre-emergence application of S-metolachlor reduced sugar beet density when rain fall occurred within 7 days of the pre-emergence application. Most tested herbicides for weed control in sugar beet in Sudan were phytotoxic to the crop. To minimize the phytotoxicity the tested herbicides in this study were applied pre-sowing and the plots were irrigated twice before planting sugar beet. Therefore, the herbicide S-metolachlor at 1.92 and 2.4 kg a.i./ha applied pre-sowing were slightly phytotoxic on sugar beet plant. This could be attributed to dilution caused by leaching of the herbicide from the soil surface. Elżbieta Wołejko, (2017) reported that the dissipation of S-metolachlor in the alkaline soil was the slowest between the 2 nd and 7 th days, while that in the acidic soil was between the 5 th and 11 th days, and the dissipation of herbicide was approx. from 3 to 11% and from 1 to 12%, respectively.

The results showed that S-metolachlor at the two rates tested significantly reduced grass weeds (84%), broadleaf weeds (53 %), total weeds control (66%) and weed ground coverage (36%) as compared to un- weeded check. S-metolachlor as Dual Gold was recommended as pre emergence treatment for weed control in sugar beet at the rate of 2-2.5 kg /ha in Pakistan (PARC). S-metolachlor is a chloroacetamide herbicide that controls a broad spectrum of grass and broad-leaf weeds. This herbicide is applied pre-emergence to red beet and weeds and kills weeds as they germinate, making it a useful tool for the control of weeds during the critical period of red beet. S-metolachlor provides control of several species, including redroot pigweed and green foxtail (Senseman, 2007). S-metolachlor is a selective herbicide, absorbed predominantly by the hypocotyls and shoots and inhibits germination. S-metolachlor is used to control of annual grasses such as *Echinochloa*, *Digitaria*, *Setaria*, *Brachiaria*, *Panicum*, and *Cyperus* and some broad-leaved weeds such as *Amaranthus*, *Capsella* and *Portulaca* in maize, sorghum, cotton, sugar beet, fodder beet, sugar cane, potatoes, soya beans, peanuts, sunflowers, various vegetables and pulse crops. It is applied as a pre-plant incorporated, pre-emergence or early post-emergence, at 0.8-1.6 kg/ha. It is often used in combination with broad-leaved herbicides, to extend spectrum of activity (Heydens, *et al*., 2010).

The result showed that high sugar beet growth and yield was obtained from the application of S-metolachlor at 1.92 kg a.i./ha and the low growth and yield was obtained from the application of S-metolachlor at 2.40 kg a.i./ha. They were significantly higher than that un-weeded control and often and comparable to hand weeded treatment. The high top yield (1.48 ton/ha), root yield (7.0 ton/ha) and gross sugar yield (1.21 kg /ha) and was obtained from the application of S-metolachlor at 1.92 kg a.i./ha. It was significantly higher than that of the un-weeded control and comparable to hand weeded treatment. These results were in agreement of that reported by Maher, (2013) who found that the highest root diameter was obtained when sugar beet was weed free the whole season and the lowest root diameter was obtained from weed infestation for whole season. This could be due to the effect of herbicide treatment in controlling weeds and thus reducing the competitive effects of weeds on sugar beet growth and yield. In general, there were no significant differences in efficacy and selectivity between the two herbicide rates.

Conclusion

The results showed that the S-metolachlor at 1.92 and 2.4 kg a.i./ha was relatively safe as it causes slight phytotoxicity to sugar beet when applied two weeks before crop sowing. It was considerably controlled grassy weeds in sugar beet and hence the sugar beet yield was increased compared to the un-weeded control. Therefore, It possible to use S-metolachlor effectively, selectivity and safely to minimize weed infestation in sugar beet two week before sowing the crop where the crop.

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Table 1. Effect of the herbicide on seedling emergence and phytotoxicity of sugar beet crop

Treatments	Seedling emergence %	Phytotoxicity scale (0-5)
S-metolachlor at 1.92 kg a.i/ha	92.50 ab	1.00
S-metolachlor at 2.40 kg a.i/ha	87.25 b	1.00
Hand weeded control	100.0 a	0.00
Un-weeded control	100.0a	0.00
SE±	0.87	
CV%	10.94%	

* Where; 0 = healthy plant, 1 - 2 = slight phytotoxicity, 3 - 4 = moderate phytotoxicity and 5 = high phytotoxicity or dead plant

** Means in the same column followed by the same letter(s) are not significantly (P ≤ 0.05) different according by Duncan's Multiple Range test.

Table 2. Effect of the herbicide on control percentage of annual grasses, annual broadleaf, total weed control and weeds ground cover

Treatments	Control %			Weeds coverage %
	Grass weeds	Broad leaved weeds	Total weeds	
S-metolachlor at 1.92 kg a.i/ha	77.00 b	52.00 b	64.50 b	35.50 b
S-metolachlor at 2.40 kg a.i/ha	79.50 b	53.00 b	66.25 b	33.75 b
Hand weeded control	100.0 a	100.0 a	100.0 a	0.00 c
Un-weeded control	0.00 c	0.00 c	0.00 c	100.0 a
SE±	1.09	4.47	1.68	0.76
CV%	3.10 %	9.25 %	5.44 %	4.01 %

* Means in the same column followed by the same letter(s) are not significantly (P ≤ 0.05) different according by Duncan's Multiple Range test.

Table 3. Effect of the herbicide on some growth characteristics of sugar beet

Treatments	Number of leaves	Root length (cm)	Root diameter (cm)	Leaf fresh weight (g)	Root fresh weight (g)
S-metolachlor at 1.92 kg a.i/ha	26.27 b	35.20 b	8.72 b	0.149 b	0.700 ab
S-metolachlor at 2.40 kg a.i/ha	24.58 c	34.53 b	7.65 c	0.143 b	0.602 abc
Hand weeded control	28.90 a	37.83 a	10.48 a	0.213 a	0.808 a
Un-weeded control	12.00 d	15.00 c	2.625 d	0.015 c	0.061 d
SE±	0.35	0.29	0.19	0.01	0.02
CV%	3.03%	3.49%	5.23%	9.65%	9.00%

* Means in the same column followed by the same letter(s) are not significantly ($P \leq 0.05$) different according by Duncan's Multiple Range test.

Table 4. Effect of the herbicide on sugar beet

Treatments	Top yield (ton/ha)	Root yield (ton/ha)	Gross sugar yield (kg/ha)
S-metolachlor at 1.92 kg a.i/ha	1.48 b	7.00 a	1.21 ab
S-metolachlor at 2.40 kg a.i/ha	1.42 b	6.00 ab	0.95 abc
Hand weeded control	2.01 a	8.00 a	1.43 a
Un-weeded control	0.49 c	1.57 c	0.150 d
SE±	0.06	0.24	0.04
CV%	8.65 %	9.30 %	%9.67

* Means in the same column followed by the same letter(s) are not significantly ($P \leq 0.05$) different according by Duncan's Multiple Range test.

Table 5. Effect of the herbicide on the yield quality of sugar beet quality

Treatments	Sucrose % (Pol)	T.S.S % (Brix)	Purity %
S-metolachlor at 1.92 kg a.i/ha	17.38 b	18.00 b	96.36 a
S-metolachlor at 2.40 kg a.i/ha	15.88 c	17.75 c	89.46 ab
Hand weeded control	18.50 a	19.00 a	97.25 a
Un-weeded control	4.50 d	9.50 d	47.36 c
SE±	0.45	1.13	2.33
CV%	6.11 %	13.92 %	5.77 %

* Means in the same column followed by the same letter(s) are not significantly different according by Duncan's Multiple Range test.

فعالية واختيارية مبيد S–ميتولاكلور لمكافحة الأعشاب في بنجر السكر، ولاية الجزيرة، السودان

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المستخلص

يعتبر بنجر السكر (*Beta vulgaris* L.) ثاني أهم محصول في العالم بعد قصب السكر في إنتاج السكر. تعتبر منافسة الاعشاب واحدة من العقبات الرئيسية في منع تحقيق الحد الأقصى من انتاج بنجر السكر. صممت هذه الدراسة بهدف تقييم فعالية واختيارية مبيدي الأعشاب بنديميثالين، في مكافحة الاعشاب والتأثير على الانتاجية في محصول بنجرالسكر. اجريت تجربة حقلية خلال موسم الشتاء 18/2017 في المزرعة التجريبية بجامعة الجزيرة، السودان. استخدمت مبيدات الأعشاب – Sميتولاكلور بمعدل تطبيق 1.92 و2.4 كجم مادة فعالة / هكتار. تم تطبيق هذا المبيد وريه قبل الزراعة باسبوعين كمعاملة قبل الزراعة. اضيفت معاملة الازالة اليدوية للاعشاب وبدون ازالة للأعشاب كشاهد. صممت التجربة بنظام القطاعات العشوائية الكاملة باربعة مكررات. أخضعت البيانات لتحليل التباين (ANOVA) ($P \leq 0.05$). تم فصل المتوسطات المعنوية باستخدام اختبار دنكن متعدد المدى. أوضحت النتائج ان جرعتي مبيد الاعشاب بنديميثالين ذات اثر سام ضعيف علي نباتات بنجر السكر. كما ثبت فعاليتها في مكافحة الاعشاب وقد أعطى مبيد S–ميتولاكلور بجرعتيه نسبة مكافحة77– 79% للاعشاب النجيلية و52– 5% لعريضة الاوراق على التوالي. أدت المعاملة بمبيدات الاعشاب المستخدمة الي زيادة معنوية في طول الجذر وقطره ووزنه مقارنة بالشاهد الذي تركت فيه الأعشاب طول موسم النمو. كما أعطت المعاملة بمبيد S–ميتولاكلور بالجرعتين المستخدمتين زيادة معنوية في وزن جذر بنجر السكر مقارنة بالمعاملات الأخرى. كما نتج عن المعاملة بمبيد الأعشاب زيادة كبيرة في اجمالي انتاج السكر، وباستخدام مبيد S–ميتولاكلور بمعدل 1.92 و 2.4 كجم مادة فعالة / للهكتار كانت الزيادة في اجمالي انتاج السكر معنوية مقارنة بالمعاملات الاخري حيث تراوحت الانتاجية الاجمالية ما بين 0.95–1.22 كجم/هكتار. بينما كانت الانتاجية الاجمالية 0.15 كجم/هكتار في الشاهد غير المعامل. يستنتج أنه يمكن استخدام مبيد S–ميتولاكلور بمعدل 1.92 كجم مادة فعالة / للهكتار لمكافحة الأعشاب في بنجر السكر، على أن يتم تطبيق المبيد والري قبل اسبوعين من مواعيد زراعة بنجر السكر. الا أن هناك حاجه ملحه لاجراء مزيد من التجارب لضمان سلامة المحصول والتاكد من خلو المنتج من متبقيات المبيد.