U. of K. J. Agric. Sci. 19(1), 64-77, 2011

Efficacy of Some Herbicides on Growth, Tuber Production and Viability of Purple Nut-sedge (*Cyperus rotundus* L.)*

Mohamed Abdel Halim Mohamed, Eltom E. Ali[1] and Salah E. Elamin[1]

Sugarcane Research Center-Guneid, Sudan

Abstract: An experiment was conducted at the Sugarcane Research Center, Guneid, during 2004/05 and 2005/06 seasons to evaluate the efficacy of some foliar herbicides on the growth of purple nutsedge (*Cyperus rotundus* L.) and to assess the effect of the treatments on the production and viability of tubers. The products tested were Krismat 75 WG (Trifloxysulfuron-sodium+ametryn) at three rates (1.79, 2.38 and 2.98 kg product ha^{-1}) and Envoke 75 WG (Trifloxysulfuron-sodium) at three rates (0.025, 0.030 and 0.035 kg product ha^{-1}). Ametryn (Gesapax 50 FW) + Atrazine (Gesaprim 50 FW) were used at the recommended rates (3.81 L + 3.81 L product/ha), as a control. The results showed that statistically significant control of purple nut-edge was attained by all chemical treatments compared with the untreated check. Envoke 75 WG at 0.035 kg product/ha and the standard mixture of Gesapax + Gesaprim at its recommended rate significantly (P=0.05) reduced the number of purple nut-sedge compared with the untreated check. Gesapax + Gesaprim gave the lowest number of green leaves per plant. Envoke 75 WG and Krismat 75 WG showed consistent reductions in tuber production and sprouting. Therefore, their successive application may lead to persistence and continuous reduction in the population density of purple nut-sedge in the fields of sugarcane.

Key words: Herbicide efficacy; nut-sedge; tuber production; tuber viability

---

* Part of M.Sc. (Agric.) thesis by the first author, the University of Khartoum, Faculty of Agriculture, Shambat, Sudan

[1] Faculty of Agriculture, University of Khartoum, Sudan

INTRODUCTION

Purple nut-sedge (*Cyperus rotundus* L.) causes severe losses in sugarcane yields and sugar content in many countries (Holm *et al*. 1977; Arevalo and Bacchi 1980; Durigan *et al*. 2005). It is also classified as one of the world's worst, most troublesome and persistent weeds in rotational and perennial crops and in grasslands. The outstanding characteristic of the purple nut-sedge is its prolific production of underground tubers that can remain dormant and carry the plant through the most extreme conditions of heat, drought, flooding or lack of aeration (Holm *et al.* 1977). Wilson (1955) found that over 95% of the tubers lie in the top 30 cm of soil. Misra (1970) and Holm *et al*. (1977) concluded that the separation of tubers from a chain removes apical dominance, and this has important implications on tillage operations that tear the plant apart so that single tubers are distributed through the plough layer. Shading of this weed without crop interference greatly reduces the number and size of tubers produced (Wills 1975; Jordan-Molero and Stoller 1978; Patterson 1982).

Purple nut-sedge strongly competes with sugarcane and other crops particularly in the early stages of growth, but at late stages crop canopy suppresses the development of aerial parts (Anon. 2003). Increase in density (shoot m^{-1}) of purple nut-sedge was reported to reduce yield of sugarcane in Brazil (Durigan *et al.* 2005). It was suggested that yield reduction is largely due to competition for moisture at stooling time so that only fewer canes are produced.

The tubers make the weed difficult to control, and systemic herbicides may give effective control. Kranz *et al*. (1977) found that many herbicides were effective in killing the aerial parts of *C. rotundus* but had only limited success on the subterranean parts. This may be attributed to rapid regeneration, since the tubers contain large amounts of carbohydrates for resumption of growth of the above ground parts (Elias 1983). Wills and Briscoe (1970) speculated that herbicides applied to the leaf surface must enter through the waxy upper surface, the stomata or thinly cutinized cells of the lower surface. Also, Ubatsch (2000) indicated that to be effective, the herbicide must be translocated throughout the rhizome and tuber network of the plant. Krismat was reported to be

effective in controlling the purple nut-sedge (Soares 1999; Maurer 2001). Durigan *et al*. (2004) in Brazil reported that Trifloxysulfuron–sodium + ametryn (1.0 and 1.5 kg ha^{-1}) reduces the percentage of viable tubers by 50%. Griffin (2004) indicated that Envoke suppresses the growth of purple nut-sedge.

The objective of this study was to evaluate the efficacy of two new products, Krismat 75 WG (Trifloxysulfuron-sodium+ametryne) and Envoke 75 WG (Trifloxysulfuron-sodium), and the standard sugarcane herbicide (Gesapax + Gesaprim) for the control of purple nut-sedge and to assess the effect of the treatments used on the number and viability of tubers.

MATERIALS AND METHODS

A field experiment was conducted in September and January of 2004/05 and 2005/06 seasons at the Sugarcane Research Center, Guneid (Lat. 15^{o}N, long. 33^{o}E). The soil is heavy clay and alkaline in reaction with a pH of 8.5 and low in nitrogen, available P and organic matter. The climate is tropical to semi-arid with low relative humidity. The experiment was conducted to evaluate the efficacy of two new foliar herbicide for the control of purple nut-sedge (*C. rotundus*) in sugarcane.

The experimental area was a fallow for the previous two years and was prepared according to the standard methods adopted for the commercial sugarcane production. It was deep ploughed to a depth of 50 cm. A second deep ploughing (30 cm) was applied a month later and then disc-harrowed, leveled and ridged at 1.5 m spacing. The plot size was 4 furrows of 10 m length.

The treatments were arranged in a randomized complete block design with three replicates. Three-eyed cane setts, taken from a ten month old field grown cane, variety Co 6806, were planted over-lapped in the furrows; 160 setts were planted in each plot. Tubers of purple nut-sedge (*C. rotundus*) were collected from an infested sugarcane commercial field at Guneid and planted in the furrows around the cane setts at a rate of 10 tubers m^{-1} (i.e. 400 tubers $plot^{-1}$). Dursban 48EC was applied at the rate of 3.0 L ha^{-1} for termite control. The setts and tubers were lightly covered

with soil and irrigated immediately. Subsequent irrigations were applied at ten day intervals or were adjusted as required.
The treatments were as follows:

1. Un-weeded (check)
2. Hand-weeded (check)
3. Gesapax+Gesaprim (control) 3.81 L + 3.81 L ha^{-1} Gx + Gm
4. Krismat 75 WG, 1.79 kg ha^{-1} + Agral 90, 0.25% v/v Kr 1.79
5. Krismat 75 WG, 2.38 kg ha^{-1} + Agral 90, 0.25% v/v Kr 2.38
6. Krismat 75 WG, 2.98 kg ha^{-1} + Agral 90, 0.25% v/v Kr 2.98
7. Envoke 75 WG, 0.025 kg ha^{-1} + Agral 90, 0.25% v/v Envoke 0.025
8. Envoke 75 WG, 0.030 kg ha^{-1} + Agral 90, 0.25% v/v Envoke 0.030
9. Envoke 75 WG, 0.035 kg ha^{-1} + Agral 90, 0.25% v/v Envoke 0.035

A knapsack sprayer with a capacity of 16 litres was used for the herbicides application. All herbicide treatments were applied 5 weeks after the first irrigation in season 2004/05 and 8 weeks after the first irrigation in season 2005/06, when sugarcane seedlings and weeds were 60-70 cm and 15-20 cm, respectively. Both the un-weeded and herbicide treated plots received two hand-weedings per month at two-week intervals until full cane canopy was reached; in these plots, all weed species except purple nut-sedge were removed. In the hand-weeded plots (check), all weeds including purple nut-sedge were weeded till full cane canopy, and in the un-weeded control unrestricted weed growth was maintained till harvest at cane age of 14 months. Urea fertilizer was applied at a rate of 476 kg ha^{-1} as practiced.

Data collection
Plant height was measured from the soil level to the tip of the longest leaf (cm), taking an average of four plants/ plot at 2, 6 and 8 weeks after herbicides application for both seasons (2004/05 and 2005/06). The number of purple nut-sedge plants/m^2 was determined from the average of

four readings/ plot using a 1 m^2 quadrate. The number of green leaves per plant was determined by taking the average number of green leaves from four plants per plot.

Tuber production and viability assessment: After cane harvesting, two soil samples were taken from two pits measuring 25 cm diameter x 30 cm depth, dug in the two middle rows. The soil samples were sieved to extract the tubers which were then counted, washed and dried under partial shade. The tubers were sown in sand in plastic pots and irrigated as required for 30 days. Thereafter, sprouting tubers were counted and their percentage was calculated.

RESULTS AND DISCUSSION

Effects of treatments on plant height: The effect of weed control methods on the height of purple nut-sedge during the two seasons is shown in Table 1. The highest weed suppression in the first season (2004/05) was exhibited by Krismat 2.38 kg at 6 weeks after application (WAA); and the least effect on the weed height was shown by Gesapax + Gesaprim at 2 WAA. In the second season (2005/06), the effect of treatments on plant height was statistically significant at 2, 6 and 8 WAA. Hand weeding resulted in maximum weed suppression. At 2 WAA, Envoke at 0.030 kg/ha was the second best treatment. At 6 WAA, the best control was given by Krismat at its highest rate (2.98 kg /ha) and at its medium rate (2.38 kg /ha). Trifloxysulfuron-sodium + ametryne (Krismat) and Trifloxysulfuron-sodium (Envoke) showed the lowest purple nut-sedge height compared with the standard sugarcane herbicide (Gesapax + Gesaprim). These results are in line with Soares (1999) finding that Gesapax did not control purple nut-sedge, while Krismat gave very good control of the weed.

Effects of treatments on number of weeds/m^2: In the first season, the differences between chemical treatments in number of the purple nut-sedge plants/m^2 were not significant (Table 2). However, the number of plants per metre square was significantly lower in the chemical treatments than in the untreated check at all counts except the herbicides Krismat and Envoke at their high rates at 2 WAA. In the second season,

there was no effect regarding the number of nut-sedge plants/m^2 at 2 WAA. When *C. rotundus* was left uncontrolled, the number of plants per square metre was significantly higher than in any other treatment at 6 and 8 WAA, except for the lower rates of Krismat and Envoke at 6 WAA (Table 2). Envoke at 0.030 kg product/ha and Gesapax + Gesaprim were the best in reducing the number of purple nut-sedge in the two seasons. These results are in line with those of Griffin (2004) who reported that Envoke can suppress the growth of purple nut-sedge.

Effects on number of green leaves: In the first season, no significant differences in nut-sedge green leaves were detected between herbicide treatments and the un-weeded control except at 2 WAA (Table 3). At this stage, Krismat, at all rates, and the control (Gesapax + Gesaprim) significantly reduced the number of green leaves compared with the un-weeded control. However, Gesapax + Gesaprim and Krismat at 2.98 kg product ha^{-1} gave significantly the lowest number of green leaves at 2 WAA compared with Envoke at all rates and the weedy check.

In the second season, Krismat (2.98 kg /ha) and Gesapax + Gesaprim reduced the number of green leaves per plant significantly in comparison with the other herbicide treatments and the un-weeded control at 2 WAA. At 8 WAA, Gesapax + Gesaprim and Envoke (0.035 kg /ha) gave the lowest number of green leaves, which was significantly lower than the un-weeded control (Table 3).

Effects on tuber production: All herbicide treatments reduced tubers production in comparison with the untreated control in both seasons (Fig.1). Envoke at the medium and high rates produced the lowest number of tubers in both seasons, followed by Krismat and Gesapax + Gesaprim. Compared with the control, the chemical treatments clearly affected the number of tubers. In the second season, regardless of the rate, Envoke was the first and Krismat the second followed by Gesapax + Gesaprim (Fig.1 b).

Effects on tuber sprouting: Sprouting rate of tubers, collected in the first season, differed considerably (Fig.1 a). The untreated plots gave the highest percentage of tuber sprouting, followed by Gesapax + Gesaprim, and the lowest tuber sprouting was achieved in plots treated with Envoke at the medium rate. In the second season, the untreated plots displayed the maximum tuber sprouting followed by Gesapax + Gesaprim, and the lowest sprouting was recorded from plots treated with Envoke at the highest rate (Fig.1 b).

In both seasons, Gesapax + Gesaprim ranked next to the untreated plots and resulted in the highest tuber sprouting. Envoke and Krismat, at their different rates, performed similarly in both seasons and resulted in the lowest tuber sprouting. These results confirm the findings by Maurer (2001) who reported that three successive annual applications of Krismat significantly reduced purple nut-sedge tuber production and sprouting.

CONCLUSIONS

Based on the findings of this study, the following conclusions can be drawn.

1. Purple nut-sedge height is suppressed by the herbicide used. Krismat and Envoke are superior to the standard herbicide (Gesapax + Gesaprim) in this regard.
2. The standard herbicide treatment (Gesapax + Gesaprim) reduces the number of green leaves of the sedge as compared with most of the other chemical treatments and the un-weeded control.
3. The herbicides Envoke and Krismat are effective in the control of the purple nut-sedge tubers; however, they should be tested for three successive years to verify their efficacy on purple nut-sedge tubers (production and sprouting).

Table 1. Effect of herbicides on *C. rotundus* height (cm) (2004/05 and 2005/06 seasons)

Treatment	Season 2004/05			Season 2005/06		
	Weeks after application			Weeks after application		
	2	6	8	2	6	8
Un-weeded control	22.710a	21.383a	23.208ab	16.723a	22.447a	28.447a
Hand-weeded control	00.000b	00.000c	00.000c	00.000c	00.000c	00.000b
Gx + Gm 3.81L+3.81L	26.333a	21.927a	23.625a	16.997a	17.220ab	23.890a
Krismat 1.79 kg	23.753a	17.740ab	22.375ab	12.333ab	16.887ab	17.443a
Krismat 2.38 kg	24.047a	14.560b	16.042b	13.220ab	15.557b	19.890a
Krismat 2.98 kg	22.877a	16.920ab	17.292ab	13.557ab	13.997b	24.447a
Envoke 0.025 kg	22.170a	19.157ab	19.875ab	13.890ab	19.223ab	18.557a
Envoke 0.030 kg	22.877a	17.360ab	22.042ab	11.443b	17.110ab	25.220a
Envoke 0.035 kg	25.547a	20.380a	21.083a	12.000ab	22.333a	17.777a

Figures in a column followed by the same letter(s) are not significantly different at P=0.05, according to the Duncan's Multiple Range Test**.**

Table 2. . Effect of herbicides on *C. rotundus* population density (number of plants/ m^2) (2004/05 and 2005/06 seasons)

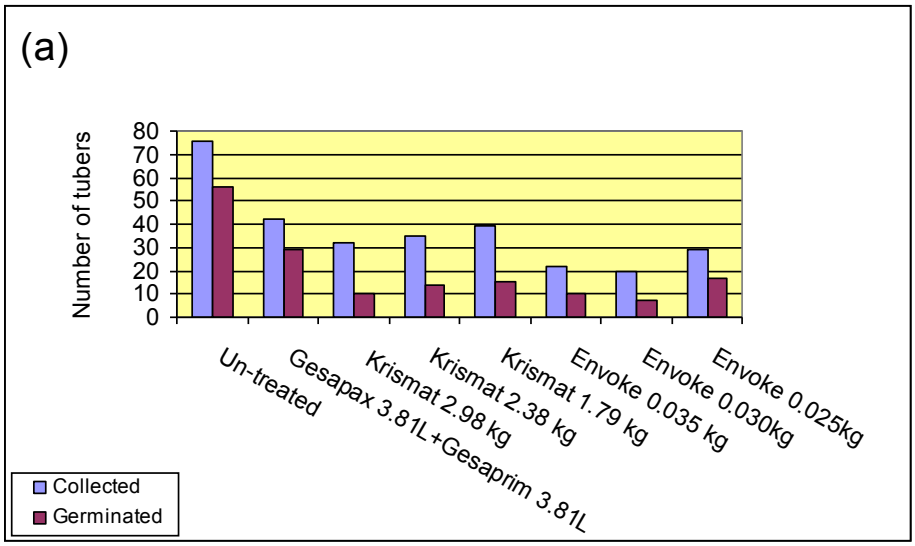
Treatment	Season 2004/05			Season 2005/06		
	Weeks after application			Weeks after application		
	2	6	8	2	6	8
Un-weeded control	20.8333a	33.8333a	35.333a	20.500a	34.000a	43.417a
Hand-weeded control	00.000c	00.000c	00.000c	00.000b	00.000c	00.000c
Gx + Gm 3.81L+3.81L	13.8333b	14.667b	13.583b	14.167a	18.083b	18.333b
Krismat 1.79 kg	14.083b	18.917b	20.167b	21.000a	24.167ab	24.750b
Krismat 2.38 kg	13.750b	15.167b	13.500b	20.000a	21.000b	24.333b
Krismat 2.98 kg	16.500ab	15.167b	14.167b	18.333a	18.167b	22.000b
Envoke 0.025 kg	14.250b	16.833b	17.000b	23.00a	28.417ab	31.083b
Envoke 0.030 kg	12.583b	13.667b	13.500b	18.917a	18.583b	20.083b
Envoke 0.035 kg	15.833ab	16.667b	20.167b	21.083a	17.500b	28.750b

Figures in a column followed by the same letter(s) are not significantly different at P=0.05, according to the Duncan's Multiple Range Test.

Table 3. . Effect of herbicides on number of green leaves/plant of *C. rotundus* (2004/05 and 2005/06 seasons)

Treatment	Season 2004/05			Season 2005/06		
	Weeks after application			Weeks after application		
	2	6	8	2	6	8
Un-weeded control	7.4167a	6.6667a	5.5833a	7.0000a	6.443a	6.8900a
Hand-weeded control	0.0000e	0.0000b	0.0000b	0.0000c	0.000b	0.0000c
Gx + Gm 3.81L+3.81L	3.9167d	8.0833a	6.1667a	5.1133b	5.780a	4.8900b
Krismat 1.79 kg	5.4167bcd	7.6667a	5.6667a	6.7800a	6.110a	5.2233ab
Krismat 2.38 kg	5.2500bcd	8.833a	5.4167a	6.7800a	7.110a	5.4467ab
Krismat 2.98 kg	4.8333cd	7.4167a	6.0000a	4.8867b	7.000a	6.3333ab
Envoke 0.025 kg	6.5833ab	7.8333a	4.4167a	6.7800a	6.333a	5.5567ab
Envoke 0.030 kg	6.0833abc	8.2500a	5.5000a	7.2233a	6.667a	5.4433ab
Envoke 0.035 kg	6.58333ab	8.0000a	5.6667a	7.1100a	6.777a	4.7800b

Figures in a column followed by the same letter(s) are not significantly different at P=0.05, according to the Duncan's Multiple Range Test**.**



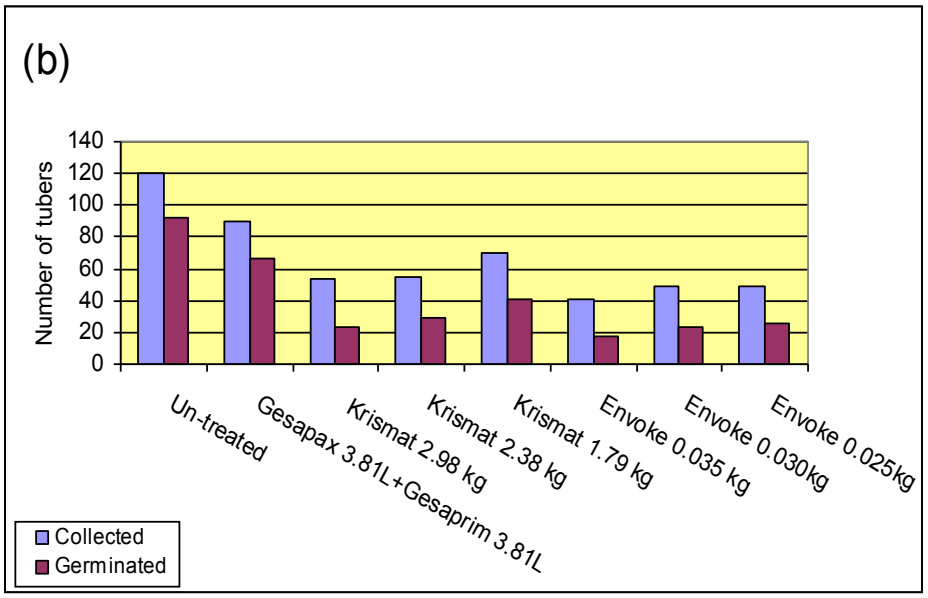


Fig.1. Tuber production and sprouting in the field trials, 2004/05 (a) and 2005/06 (b) seasons

REFERENCES

Anon. (2003). *Manual of Sugarcane Agronomy*. Mauritius Sugar Industry Research Institute (MSIRI), Societe de Technologie Agricole et Sucriere de Maurice, Raduit. Mauritius.

Arevalo, R.A. and Bacchi, O.O.S. (1980). Dissemination of *Cyperus rotundus* L. in sugarcane (*Saccharum* spp.) stalk and rootstock. *Proceedings of the XVII. Congress of the ISSCT*, 1, 125-131. Philippines.

Durigan, J.C.; Timossi, P.C. and Correia, N.M. (2005). Effects of purple nut-sedge plant densities and chemical control on sugarcane yield. *Planta Daninha* 23 (3), 463-469.

Durigan, J.C.; Timossi, P.C. and Leite, G.J. (2004). Chemical control of *Cyperus rotundus*, with and without sugarcane straw cover. *Planta Daninha* 22 (1), 1-8.

Elias, S.A. (1983*). Chemical Control in Tomato, Lycopersicon esculentus* L. *and its Effect on Yield and Quality*. M.Sc. (Agric) thesis, University of Khartoum, Sudan.

Griffin, J. (2004). The Weed Patch. Envoke: A new herbicide for sugarcane.http://www,agronomy.lsu.edu/weedscience/news/Envoke.pdf.

Holm, G.; Donald, L.P. and Jaun, V.P. (1977). *The World's Worst Weeds*. East West Center Publishers, University of Hawaii, Honolulu, U.S.A.

Jordan-Molero, J.E. and Stoller, E.W. (1978). Seasonal development of yellow and purple nut-sedges (*Cyperus esculentus* and *C. rotundus*) in Illinois. *Weed Science* 26, 614-618.

Kranz, J.; Schmutterer, H. and Koch, W. (1977). *Cyperus rotundus*: Diseases, Pests and Weeds in Tropics. pp. 567-571. Springer-Verlag, Berlin, West Germany.

Maurer, W. (2001). Envoke 75 WG. (A-9842 A). Syngenta International Label Text. Syngenta Crop Protection AG, Basel, Switzerland.

Misra, L.P. (1970). Sprouting of nut-sedge in relation to hydrogen ion concentration. *Indian Journal of Weed Science* 2, 90-96.

Patterson, D.T. (1982). Shading response of purple and yellow nutsedges (*Cyperus rotundus* and *C. esculentus*). *Weed Science* 30, 25-30.

Soares, J.E (1999). Weed control with Trifloxysulfuron and Ametryne -A-12001A. in sugarcane, in post-emergence application. Syngenta Report pp.1-26, Brazil. Publisher, Klaus Gehmann, www. Klausgehmann.net March, 1999.

Ubatsch, L. (2000). Purple nut-sedge (*Cyperus rotundus* L). United States Department of Agriculture (USDA) - Natural Resource Conservation Service (NRCS). Plant Guide.

Wills, G.D. (1975). Effect of light and temperature on growth of purple nut-sedge. *Weed Science* 23, 93-96.

Wills, G.D. and Briscoe, G.A. (1970). Anatomy of purple nut-sedge. *Weed Science* 18, 631-635.

Wilson J.K. (1955). Control of terrestrial weeds. Annual Report, 1954-1955. Agricultural Research Division, Sudan
http://plants.usda.gov/plantguide/doc/pg_cyro.doc.

فعالية بعض مبيدات الحشائش على نمو وإنتاج الدرنات و حيويتها لحشيشة السعدة*

محمد عبدالحليم محمد و التوم الصادق[1] على و صلاح التوم الأمين[1]

مركز بحوث قصب السكر،الجنيد-السودان

المستخلص: أجريت تجربة بمركز بحوث قصب السكر بالجنيد فى موسمي 05/2004 و06/2005 لتقييم فعالية بعض مبيدات الحشائش الورقية على نمو وإنتاج وحيوية درنات السعدة. المبيدات التى تمت تجربتها هى كريسمات 75 حبيبات قابلة للبلل (ترايفلوكسى سلفيورون صوديوم + أميترين) بثلاثه معدلات (1.79 و 2.38 و 2.98 كجم من المنتج/هكتار) وإنفوك 75 حبيبات قابلة للبلل (ترايفلوكسى سلفيورون صوديوم) بثلاثه معدلات (0.025 و0.030 و 0.035 كجم من المنتج/هكتار)، واستخدم مخلوط مبيد الأميترين (جيزاباكس 50 سائل) والأترازين (جيزابريم 50 سائل) كشاهد بمعدل 3.81 لتر + 3.81 لتر منتج/هكتار لكل من المبيدين. ظهرت النتائج مكافحة جيدة لحشيشة السعدة بالكيماويات مقارنة بالشاهد. إنفوك 75 حبيبات قابلة للبلل بالجرعة 0.035 كجم منتج/هكتار وجيزاباكس + جيزابريم بالجرعة الموصي بها أديا إلى نقص معنوى (P=0.05) فى عدد نباتات السعدة مقارنة بالشاهد. وأعطى خليط الجيزاباكس + الجيزابريم أقل عدد من الأوراق الخضراء فى نبات السعدة. وأدت المعاملة بمبيدى الحشائش إنفوك 75 وكريسمات 75 إلى نقص فى إنتاج درنات السعدة وقابليتها للإنبات. بناءا على النتائج أعلاه فان التطبيق المتعاقب لمبيدى الإنفوك 75 والكريسمات 75 قد يؤدى إلى نقص كثافة السعدة فى حقول قصب السكر.

---

*جزء من أطروحة تقدم بها المؤلف الأول لجامعة الخرطوم لإستيفاء جزء من مطلوبات درجة الماجستير فى الزراعة.

[1]كلية الزراعة – جامعة الخرطوم، شمبات- السودان