

RESPONSE OF BARNYARDGRASS  
(ECHINOCHLOA CRUS - GALLI) AND RICE (ORIZA SATIVA)  
TO SOME PETROLEUM AROMATIC DERIVATIVES  
AS HERBICIDES TREATMENTS

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SUMMARY

The present investigation was performed to synthesize and test some petroleum aromatic derivatives (propanil -  $SO_2$ , sodium salt of propanil -  $SO_2$  and O-, P-, & m-xylene sulphonamides) as herbicides on barnyardgrass (Echinochloa crus-galli (L.) P. Beauv.) and rice (Oryza sativa) cv Giza 176.

The application of the synthesized herbicides propanil -  $SO_2$  and its sodium salt have no effect on fresh and dry weights of barnyardgrass at one - two - and three - leaf stage when applied at the rates of 0.70, 1.05, 1.40 and 1.75 Kg aifed. Rice plants showed the same trend toward propanil -  $SO_2$  and its sodium salt as barnyardgrass.

By applying either O-, m- or p-xylene sulphonamides at the rates of 250, 500 and 1000 ppm to barnyard grass at half -, one - and three - leaf stage, the m- isomer was the only herbicide affected the growth of the grass when applied at 500 and 1000 ppm.

Rice plants showed no response toward the O-, P- and m-xylene sulphonamides at all rates and times of application.

## INTRODUCTION

Rice (Oryza sativa) is economically an important crop from production, consumption and export point of view in Egypt. It is grown in 420,000 hectare annually. Its production is best suitable to the soil climatic conditions of the Nile-Delta, where 97% of the Egyptian rice is produced in six governorates.

Weeds are one of the major causes of grain yield losses in rice culture in Egypt. The major weed problem is barnyardgrass (Echinochloa crus-galli (L.) P. Beauv.) Hassan and Mahrous, 1989. The ecological requirements of barnyardgrass and rice are very similar: this leads to high competition and as a result to potentially great yield losses.

Herbicides are classified into two major groups, inorganic and organic. Their application involves four categories: band, broadcast, spot treatments, and directed spraying (Ware, 1983).

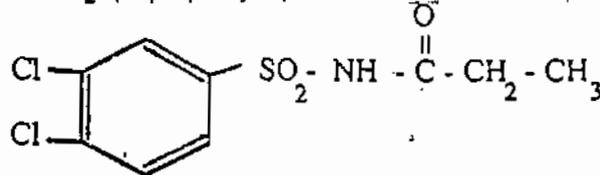
It was reported that the commercial herbicide stam F-34 (propanil) has a significant effect in controlling a broad spectrum of weeds especially that in rice fields (Matsunaka, 1965 and yih et al., 1968 a).

In the present investigation it was planned to prepare and test some petroleum aromatic derivatives (Propanil - SO<sub>2</sub>, sodium salt of propanil - SO<sub>2</sub> and O-, p- and m- xylene sulphonamides) as herbicides on barnyardgrass (Echinochloa crus - galli) and rice (Oryza sativa).

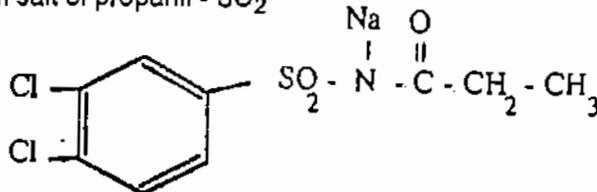
### MATERIALS AND METHODS

#### Small sized herbicides:

- 1 - Propanil - SO<sub>2</sub> (N-propionyl 3,4-dichlorobenzene sulphonamide).



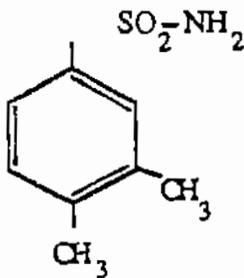
- 2 - Sodium salt of propanil - SO<sub>2</sub>



- 3 - O-xylene sulphonamide (3,4-sulphonamide)

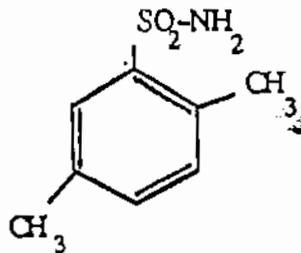
- 4 - P-xylene sulphonamide (2,5-sulphonamide).

- 5 - m-xylene sulphonamide (2,4-sulphonamide).



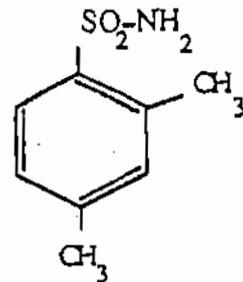
3,4 - Xylene sulphonamide

o - Xylene sulphonamide



2,5 - Xylene sulphonamide

p - Xylene sulphonamide



2,4 - Xylene sulphonamide

m - Xylene sulphonamide

Propanil - SO<sub>2</sub> and its sodium salt were prepared using the methods adopted by Somasekhara, 1968 and El-Dib, 1978. The compounds of o-, p- and m-xylene sulphonamides were prepared according to the methods described by (Hurt and Allison, 1939).

**Green house experiments:**

The herbicidal efficiency of the synthesized herbicides as well as the commercial herbicide propanil (3,4 - dichloropropionanilide) (Stam F- 34) were tested on barnyardgrass (Echinochloa crus-galli (L.) P. Beauv) and Rice (Oryza sativa) cv Giza 176 under greenhouse conditions at Rice Research and Training Centre, Sakka, Kafr El-Sheikh. Seeds were obtained from the same Research Centre. Plants were grown in cylindrical plastic pots 20 cm depth and 20 cm diameter. In each pot 4 Kg of clay loam soil was placed. Some chemical analysis of the used soil was as follows:

PH	Ec ds/m	Co <sub>3</sub> Meq/L	HCo <sub>3</sub> Meq/L	OM %	NH <sub>4</sub> ppm	No <sub>3</sub> ppm	P ppm	K ppm	Zn ppm
7.8	1.1	1.0	1.9	2.1	2.9	19.3	11	625	1.9

Fifteen seeds of each of barnyardgrass and rice were planted per pot at a depth of 1-1.5 cm. After emergence the seedlings were thinned to 10 plants per pot. The plants were grown in a greenhouse (average temperature  $28 \pm 2^{\circ}$  during the day time and  $18^{\circ}$  at night).

Pots were irrigated by saturating the soil several times during the early season to facilitate germination, emergence and growth of young barnyardgrass and rice seedlings. It was flooded first when the plants ranged from 15 to 25 cm tall. Water was maintained on the plants during the season except for draining one day before and reflooding one day after each treatment. Water was drained

from all pots in the fall after rice matured. Rice plants received 40 Kg. nitrogen / fed as urea 46% at 25 days after seeding.

The synthesized herbicides o-, p- and m- xylene sulphonamides were applied as ppm, while propanil SO<sub>2</sub>, sodium salt of propanil SO<sub>2</sub> commercial herbicides was used as Kg ai / fed in a total water emulsion of 200 L / fed., with a CO<sub>2</sub> - pressurized back - pack sprayer at 2.11 Kg / cm<sup>2</sup> fitted with flat - fan spray nozzles # 1004. The boom was positioned 25 cm above each pot.

The herbicides were applied at half - , one - , two - and three - leaf stages of barnyardgrass and rice at different rates.

All treatments were applied postemergence as sprays to unflooded pots through CO<sub>2</sub> back - pack sprayer.

The experimental design was randomized complete block with 10 replications. The pots were rated visually for plants injury within 7 days after herbicide application.

The results were statistically analyzed and significance of treatment differences was estimated through L.S.D. (Snadecor and Cochran, 1969).

#### Estimations:

Fresh and dry weights of shoots of barnyardgrass and rice were recorded at 30 days after seeding. Rice plant height and leaf area were recorded at 30 days after seeding however, total chlorophyll content of, rice leaves were

estimated at 45 days old according to the procedure of (Arnon, 1959). Leaf area was determined using LI - 3100 Area Meter.

At maturity the harvested grains were adjusted to 14% moisture (Smith, 1974). Rice grain yield in grams per pot were obtained. Total nitrogen content of rice grains was determined (Jackson, 1967). The starch content of rice grains was estimated using the method of (Yoschida *et. al.*, 1972).

## RESULTS AND DISCUSSION

The present study was aimed to drive more knowledge about the utilization of the synthesized petroleum aromatic derivatives (propanil - SO<sub>2</sub>, sodium salt of propanil - SO<sub>2</sub>, and o-, p- & m- xylene sulphonamides) as herbicides for managing barnyardgrass which causes severe losses in rice crop yield.

Effect of propanil and the synthesized herbicides propanil - SO<sub>2</sub> and sodium salt of propanil - SO<sub>2</sub> on barnyardgrass (*Echinochloa crus-galli* (L.) P. Beauv.) and rice (*Oryza sativa* L.).

### A. Barnyardgrass:

Table (1) illustrated the effect of propanil and the synthesized herbicides propanil - SO<sub>2</sub> and sodium salt of propanil - SO<sub>2</sub> on the fresh and dry weights of barnyardgrass.

Barnyardgrass at one-, two- and three- leaf stage treated with propanil at rates of 0.70, 1.05, 1.40 and 1.75 Kg aifed was injured moderately to severely.

One to three days after propanil application, both barnyardgrass and rice showed scorching, necrosis and chlorosis.

Leaf chlorosis response of the treated plants might be attributed to the photosynthetic-inhibitory effect of propanil. These observations are in agreement with previous investigations (Nakamura et al., 1968, Ashton and Crafts, 1981 and Matsunaka, 1981) who reported that propanil alters several biochemical changes including photosynthesis.

The injury symptoms of barnyardgrass increased with time till death at 4 - 7 days after propanil treatment. However, injured riceplants recovered at 7 - 15 days after treatment. It is clear from Table (1) that concentrations higher than 0.70 Kg aifed caused complete death of barnyardgrass.

It has been established that the synthesized chemical compounds contain one aryl group linked by  $\begin{matrix} \text{O} \\ || \\ \text{-S-} \\ || \\ \text{O} \end{matrix}$  radical have high significant effect on suppressing great varieties of bacteria and fungi (Swiss patent, 1949, Raffa, 1966 and Marei et al., 1981), Therefore, trials were made to test these derivatives as herbicides in rice crop.

The application of the synthesized herbicides propanil - SO<sub>2</sub> and its sodium salt have no effect on the fresh and dry weights of barnyardgrass at one-, two- and three- leaf stage when applied at the rates of 0.70, 1.05, 1.40 and 1.75 Kg aifed as shown in Table (1). The percent reduction ranged from 0 to 5% which was not significant.

Previous researchs proved the effectiveness of propanil in controlling barnyardgrass (Matsunaka, 1965 and Yih et al., 1968 a). Sierra and Vega (1967) reported that propanil caused a reduction in dry weight of barnyardgrass which became more severe with increasing concentrations.

Propanil applied at 3 to 51 b/acre controlled barnyardgrass one to three inches tall in the one - to four - leaf stage of growth (Smith et al., 1977).

Propanil was found to be a strong inhibitor of RNA and protein synthesis (Moreland et al., 1969). Transpiration has been reported to be reduced by propanil (Ivanova, 1970). In addition abnormal and degenerating chloroplasts as well as deteriorating cellular membranes were found following the use of propanil (Ashton and Crafts, 1981).

#### **B. Rice:**

Tables (2&3) showed the effect of time and rate of propanil application on the vegetative growth of rice. The percent reduction in plant height ranged from (1 to 79%), fresh weight (1 to 81%), dry weight (1 to 80%) and leaf area (1 to 89%). Generally the reduction decreased as the rate of the herbicide increased from 0.70 to 1.75 Kg ai/ha; it decreased as the treatment was delayed from one- to three- leaf stage. Rice plants did not show any response toward the synthesized herbicides (propanil - SO<sub>2</sub> and its sodium salt) at different rates and times of application. The total chlorophyll content of rice leaves was reduced by 20% when propanil applied at rates of 1.05, 1.4 and 1.75 Kg ai/ha. However, propanil- SO<sub>2</sub> and its sodium salt reduced the total chlorophyll content by 20% only at 1.75 Kg ai/ha as shown in Table (3).

Rice grain yield generally reflects the level of the vegetative growth as affected by propanil, propanil - SO<sub>2</sub> and sodium salt of propanil - SO<sub>2</sub>. Time of application and rate of propanil affected grain yield when applied at one-leaf stage, where the percent reduction ranged from 53 to 85% only at higher rates 1.05, 1.40 and 1.75 Kg aifed. The reduction decreased as the time of application was delayed at two - and three - leaf stage of growth. However, rice grain yield was not affected due to the application of propanil - SO<sub>2</sub> and its sodium salt at all rates and times of application as shown in Table (4).

It is clear from the above results that rice plants are more tolerant of propanil than barnyardgrass at the same stage of growth. The injury symptoms exhibited by rice plants after propanil treatment were inconsistent. Even when the injury seems severe rice plants usually recover within two weeks and new leaves that emerge after treatment show no injury symptoms. This may be due to the inhibitory effect of rice enzyme arylacylamidase which was observed to detoxify propanil).

These results were in accordance with ~~previous~~ research reports (Frear and Still, 1968, Akatsuka et al., 1973 and Kodama and Akatsuka, 1975). They found that, in the leaves of rice an arylacylamidase enzyme detoxifies propanil to 3,4 - dichloroaniline and propionic acid, while barnyardgrass leaves contained small amount of the same enzyme.

Previous investigators (Adachi et al. 1966, Still and Kuzirian, 1967 and Yih et al., 1968 b) stated that rice was at least 20 times more effective than barnyardgrass in inactivating propanil which selectively kills barnyardgrass, while rice was slightly injured.

Temporary chlorosis and tip burn on rice leaves may occur soon after treatments with propanil at rates of 3 to 5 lb/acre, but permanent injury does not occur even at rates as high as 12 lb/acre (Smith et al., 1977).

### Effect of the synthesized herbicides o-, p- and m- xylene sulphonamides on barnyardgrass and rice.

#### A. Barnyardgrass:

Table (5), and Photo. ( 1 & 2 ) showed that the synthesized herbicides o- and p- xylene sulphonamides at rates of 250, 500 & 1000 ppm applied to barnyardgrass at half-, one- and two- leaf stage of growth failed to control barnyardgrass satisfactorily where no changes were observed on either the morphological characters or the fresh and dry weights of barnyardgrass, while the m-isomer was the only herbicide affected the growth of barnyardgrass. The plants were stunted within 1 to 3 days following the application of the m-xylene sulphonamide compared with the untreated control. These symptoms increased with time until death. The m-xylene sulphonamide caused greater phytotoxicity on the fresh and dry weights of barnyardgrass. Generally barnyardgrass - control increased as the rate of the m-xylene sulphonamide increased from 250 to 1000 ppm at lower stage of growth. The m-xylene sulphonamide controlled barnyardgrass effectively by 29 and 87% decrease from the untreated control in the half- leaf stage of growth at the rates of 500 and 1000 ppm respectively. The effect decreased as the treatment was delayed from half- to two- leaf stage of growth.

It is clear from the above results that m-xylene sulphonamide controlled barnyardgrass more than o- and p-xylene sulphonamides. This may be attributed to the greater solubility of m-xylene sulphonamide in methyl and ethyl alcohols than o- and p-xylene sulphonamides.

#### **B.Rice:**

The data in Tables ( 6 & 7 ), illustrated that rice plants showed no response toward the synthesized herbicides o- , p- and m-xylene sulphonamides at all rates and times of application. The m-xylene sulphonamide caused slight stunting of rice plants within 1 - 3 days after treatments rather than o- and p-isomers. The injured rice plants recovered within 7 - 15 days and the new leaves that emerged after treatments were uninjured.

The effect of the synthesized herbicides o- , p- and m- xylene sulphonamides on rice grain yield and total nitrogen content, crude protein & starch content of rice grains was illustrated in Table (8). It was clear that rice grain yield showed no response toward the tested herbicides at all rates used. The percent reduction in rice grain yield at half-, one- and two- leaf stage of growth ranged from 0 - 8%, while the percent reduction in total nitrogen content and starch content ranged from 0 - 10% and 0 - 7% respectively. However, all these differences were statistically non-significant.

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Table: 1 Effect of propanil and the synthesized herbicides propanil - SO<sub>2</sub> and sodium salt of propanil - SO<sub>2</sub>, on the fresh and dry weights of barnyardgrass (*Echinochloa crus-galli*) at 30 days after seeding.

Herbicides	Rate of application Kg ai /fed	Fresh weight (g / pot)						Dry weight (g / pot)					
		Leaf stage & % reduction						Leaf stage & % reduction					
		1 lf	%	2 lf	%	3 lf	%	1 lf	%	2 lf	%	3 lf	%
Control (untreated)	-	23.9	0	23.9	0	23.9	0	3.95	0	3.95	0	3.95	0
Propanil	0.70	6.01	75	8.7	64	13	46	0.98	75	1.45	63	2.17	45
	1.05	2.4	90	3.5	85	8.7	64	0.4	90	0.6	85	1.42	64
	1.40	0	100	0	100	2.6	89	0	100	0	100	0.45	89
	1.75	0	100	0	100	0	100	0	100	0	100	0	100
Propanil - SO <sub>2</sub>	0.70	23.9	0	24	0	24	0	3.95	0	3.94	0	4.0	0
	1.05	23.7	1	23.8	1	23.9	0	3.90	1	3.91	1	3.91	1
	1.40	23.2	3	23.3	3	23.5	2	3.85	3	3.83	3	3.89	2
	1.75	22.7	5	22.8	5	23.1	3	3.76	5	3.79	4	3.87	2
Sodium salt of propanil - SO <sub>2</sub>	0.70	23.9	0	23.9	0	24	0	3.94	0	4.0	0	4.0	0
	1.05	23.6	1	23.5	2	23.8	1	3.89	2	3.90	1	3.90	1
	1.40	22.9	4	23	4	23.5	2	3.82	3	3.84	3	3.88	2
	1.75	22.7	5	22.8	5	23.3	3	3.77	5	3.78	4	3.86	2
L.S.D <sub>0.05</sub>		3.2		4.7		5.9		0.45		0.68		0.83	

**Table : 2** Effect of propanil and the synthesized herbicides propanil - SO<sub>2</sub> and sodium salt of propanil - SO<sub>2</sub> on plant height, fresh weight and dry weight of rice (*Oryza sativa*) cv Giza 176 at 30 days after seeding.

Herbicides application Kg ai /fed	Plant height (cm/ plant)												Fresh weight (g/ pot)												Dry weight (g/ pot)											
	Leaf stage & % reduction												Leaf stage & % reduction												Leaf stage & % reduction											
	1If	%	2If	%	3If	%	1If	%	2If	%	3If	%	1If	%	2If	%	3If	%	1If	%	2If	%	3If	%												
Control (untreated)	-	25	0	25	0	25	0	17	0	17	0	17	0	2.87	0	2.87	0	2.87	0	2.87	0	2.87	0													
Propanil	0.70	19	24	22.9	8	24.6	1	12.8	24	16.1	5	16.9	1	2.14	25	2.71	6	2.83	1	2.83	1	2.83	1													
	1.05	11.3	55	22	12	23.9	4	8.5	50	15.3	10	16.3	4	1.43	50	2.67	7	2.74	5	2.74	5	2.74	5													
	1.40	6.8	73	19.3	23	21	16	6.1	64	12.8	24	14.8	13	1.03	64	2.24	23	2.51	13	2.51	13	2.51	13													
1.75	5.3	79	17	32	19	24	3.2	81	12.2	28	13.5	21	0.57	80	2.07	28	2.3	20	2.3	20	2.3	20														
Propanil-SO <sub>2</sub>	0.70	25	0	24.9	0	25	0	16.8	1	16.9	1	17	0	2.89	0	2.90	0	2.88	0	2.88	0	2.88	0													
	1.05	24.1	3	24.5	2	24.7	1	16.6	2	16.8	1	16.9	1	2.86	1	2.84	1	2.85	1	2.85	1	2.85	1													
	1.40	23.5	6	23.3	6	24.1	3	16.1	5	16.3	4	16.7	2	2.75	5	2.79	4	2.81	2	2.81	2	2.81	2													
1.75	22.6	9	22.8	8	23.9	4	15.8	7	15.9	6	16.3	4	2.69	7	2.73	6	2.78	4	2.78	4	2.78	4														
Sodium salt of propanil - SO <sub>2</sub>	0.70	25	0	25	0	24.9	0	16.9	1	16.9	1	17	0	2.90	0	2.88	0	2.90	0	2.90	0	2.90	0													
	1.05	24.5	2	24.3	2	24.3	2	16.5	3	16.6	2	16.8	1	2.83	2	2.85	1	2.84	1	2.84	1	2.84	1													
	1.40	23.1	7	23.6	5	24	4	16	6	16.1	5	16.6	2	2.73	6	2.75	5	2.79	4	2.79	4	2.79	4													
1.75	22.7	9	22.9	8	23.8	4	15.7	7	15.8	7	16.2	5	2.66	8	2.69	7	2.77	4	2.77	4	2.77	4														
L.S.D. <sub>0.05</sub>	3.8		3.6		N.S		2.57		2.41		N.S		0.39		0.47		N.S		N.S		N.S		N.S													

Table 3:- Effect of propanil and the synthesized herbicides propanil - SO<sub>2</sub> and sodium salt of propanil - SO<sub>2</sub> on leaf area and total chlorophyll content of rice (*Oryza sativa*) cv Giza 176.

Herbicides	Rate of application Kg ai / fed	Leaf area (cm <sup>2</sup> / pot ) at 30 days after seeding						Total * chlorophyll mg/g fresh wt.	
		Leaf stage & % reduction						2lf	% red
		1 lf	%	2 lf	%	3 lf	%		
Control (untreated)	-	85	0	85	0	85	0	5	0
Propanil	0.70	57	33	81	5	84	1	5	0
	1.05	32	62	68	20	83	2	4	20
	1.40	16	81	57	33	81	5	4	20
	1.75	9	89	44	48	76	11	4	20
Propanil- SO <sub>2</sub>	0.70	84	1	86	0	86	0	6	0
	1.05	84	1	84	1	85	0	5	0
	1.40	82	4	82	4	84	1	5	0
	1.75	80	6	81	5	83	2	4	20
Sodium salt of propanil- SO <sub>2</sub>	0.70	84	1	85	0	85	0	6	0
	1.05	83	2	84	1	84	1	5	0
	1.40	81	5	82	4	84	1	5	0
	1.75	80	6	80	6	83	2	4	20
L.S.D <sub>0.05</sub>		9		7		N.S		N.S	

\* At 45 days after seeding

Table : 4- Effect of propanil and the synthesized herbicides propanil- SO<sub>2</sub> and sodium salt of propanil -SO<sub>2</sub> on grain yield and total nitrogen , crude protein & starch content of rice grains( *Oryza sativa* ) cv Giza 176.

Herbicides	Rate of application Kg ai/fed	Grain yield ( g / pot )						Total nitrogen		Crude protein		Starch content	
		Leaf stage & % reduction						mg / g grain					
		1 lf	%	2 lf	%	3 lf	%	2 lf	% red	2 lf	% red	2 lf	% red
Control (untreated)	-	34	0	34	0	34	0	21	0	125	0	43	0
Propanil	0.70	22	35	33	3	33	3	19	10	119	5	40	7
	1.05	16	53	30	12	32	6	18	14	113	10	40	7
	1.40	12	65	27	21	31	9	17	19	106	15	39	9
	1.75	5	85	24	29	30	12	17	19	106	15	39	9
Propanil- SO <sub>2</sub>	0.70	34	0	35	0	35	0	21	0	126	0	43	0
	1.05	33	3	33	3	34	0	21	0	125	0	42	2
	1.40	32	6	33	3	33	3	19	10	119	5	42	2
	1.75	31	9	32	6	33	3	19	10	119	5	41	5
Sodium salt of propanil - SO <sub>2</sub>	0.70	34	0	34	0	34	0	21	0	125	0	43	0
	1.05	33	3	33	3	34	0	20	5	125	0	42	2
	1.40	32	6	32	6	33	3	19	10	119	5	41	5
	1.75	31	9	32	6	33	3	19	10	119	5	41	5
L.S.D <sub>0.05</sub>		5		4		N.S		N.S		N.S		N.S	

Table : 5 Effect of the synthesized herbicides o-, p-, and m- xylene sulphonamides on the fresh and dry weights of barnyardgrass (*Echinochloa crus-galli*) at 30 days after seeding.

Herbicides	Rate of application (ppm)	Fresh weight (g/pot)						Dry weight (g/pot)					
		Leaf stage & % reduction						Leaf stage & % reduction					
		1/2 lf	%	1 lf	%	2 lf	%	1/2 lf	%	1 lf	%	2 lf	%
Control (untreated)	-	17.1	0	17.1	0	17.1	0	2.83	0	2.83	0	2.83	0
o-Xylene sulphonamide	250	16.9	1	17	1	17.1	0	2.8	1	2.81	1	2.85	0
	500	16.5	4	16.8	2	17	1	2.76	3	2.78	2	2.8	1
	1000	16	6	16	6	16.6	3	2.65	6	2.66	6	2.74	3
p-Xylene sulphonamide	250	16.9	1	17	1	17.1	0	2.8	1	2.81	1	2.9	0
	500	16.3	5	16.8	2	16.8	2	2.68	5	2.77	2	2.78	2
	1000	15.9	7	15.9	7	16.1	6	2.63	7	2.65	6	2.68	5
m-Xylene sulphonamide	250	16.5	4	16.8	2	16.9	1	2.75	3	2.77	2	2.85	0
	500	12.1	29	16.1	6	16.3	5	2.0	29	2.69	5	2.7	5
	1000	2.3	87	15.8	8	16	6	0.38	87	2.6	8	2.66	6
L.S.D <sub>0.05</sub>		5		N.S		N.S		0.5		N.S		N.S	

**Table 6** Effect of the synthesized herbicides o-, p-, and m- xylene sulphonamides on plant height, fresh weight and dry weight of rice (*Oryza sativa*) cv Giza 176 at 30 days after seeding.

Herbicides	Rate of application (ppm)	Plant height (cm/Plant)						Fresh weight (g/pot)						Dry weight (g/pot)					
		Leaf stage & % reduction						Leaf stage & % reduction						Leaf stage & % reduction					
		1/2 If	%	1 If	%	2 If	%	1/2 If	%	1 If	%	2 If	%	1/2 If	%	1 If	%	2 If	%
Control (untreated)	-	24.9	0	24.9	0	24.9	0	11	0	11	0	11	0	1.83	0	1.83	0	1.83	0
o-Xylene sulphonamide	250	25	0	24.9	0	25	0	11	0	11.1	0	11.1	0	1.84	0	1.83	0	1.84	0
	500	24.5	2	24.7	1	24.8	0	10.9	1	10.9	1	10.9	1	1.81	1	1.82	1	1.82	1
	1000	23.9	4	24	4	24.5	2	10.7	3	10.8	2	10.9	1	1.78	3	1.80	2	1.81	1
p-Xylene sulphonamide	250	24.9	0	25.1	0	25.1	0	11.1	0	11.1	0	11.1	0	1.83	0	1.83	0	1.83	0
	500	24.3	2	24.5	2	24.7	1	10.8	2	10.9	1	10.9	1	1.82	1	1.81	1	1.81	1
	1000	23.8	4	24	4	24.4	2	10.6	4	10.8	2	10.8	2	1.77	3	1.79	2	1.81	1
m-Xylene sulphonamide	250	24.8	0	24.9	0	25	0	10.9	1	11	0	11	0	1.83	0	1.83	0	1.83	0
	500	24	4	24.1	3	24.7	1	10.7	3	10.8	2	10.9	1	1.77	3	1.79	2	1.82	1
	1000	23.6	5	23.8	4	24.3	2	10.5	5	10.7	3	10.8	2	1.75	4	1.77	3	1.81	1
L.S.D <sub>0.05</sub>		N.S		N.S		N.S		N.S		N.S		N.S		N.S		N.S		N.S	

Table 7 : Effect of the synthesized herbicides o -, p -, and m-xylene sulphonamides on leaf area and total chlorophyll content of rice ( *Oryza sativa* ) cv Giza 176.

Herbicides	Rate of application (ppm)	Leaf area (cm <sup>2</sup> / pot ) at 30 days after seeding						Total * chlorophyll mg/g fresh wt.	
		Leaf stage & % reduction							
		1/2 lf	%	1 lf	%	2 lf	%	2lf	% red
Control (untreated)	-	82	0	82	0	82	0	5	0
o-Xylene sulphonamide	250	82	0	83	0	82	0	6	0
	500	80	2	81	1	81	1	5	0
	1000	79	4	79	4	80	2	4	20
p-Xylene sulphonamide	250	83	0	82	0	83	0	6	0
	500	81	1	80	2	82	0	5	0
	1000	78	5	79	4	80	2	4	20
m-Xylene sulphonamide	250	81	1	82	0	82	0	5	0
	500	79	4	79	4	81	1	5	0
	1000	77	6	78	5	80	2	4	20
L.S.D <sub>0.05</sub>		N.S		N.S		N.S		N.S	

\* At 45 days after seeding

Table 8 : Effect of the synthesized herbicides o-, p-, and m-xylene sulphonamides on grain yield and total nitrogen, crude protein & starch content of rice grains (*Oryza sativa*) cv Giza 176.

Herbicides	Rate of application (ppm)	Grain yield (g/pot)						Total nitrogen		Crude protein		Starch content	
		Leaf stage & % reduction						mg / g grain					
		1/2 lf	%	1 lf	%	2 lf	%	2 lf	% red	2 lf	% red	2 lf	% red
Control (untreated)	-	40	0	40	0	40	0	21	0	125	0	42	0
o-Xylene sulphonamide	250	39	3	41	0	41	0	20	5	125	0	42	0
	500	38	5	39	3	40	0	19	10	119	5	40	5
	1000	37	8	38	5	39	3	19	10	119	5	40	5
p-Xylene sulphonamide	250	39	3	40	0	41	0	20	5	125	0	42	0
	500	38	5	38	5	40	0	19	10	119	5	40	5
	1000	37	8	38	5	39	3	18	14	113	10	39	7
m-Xylene sulphonamide	250	38	5	39	3	40	0	19	10	119	5	41	2
	500	37	8	38	5	39	3	18	14	113	10	39	7
	1000	37	8	37	8	38	5	18	14	113	10	39	7
L.S.D <sub>0.05</sub>		N.S		N.S		N.S		N.S		N.S		N.S	



Photo (1) Effect of the synthesized herbicide: m - xylene sulphonamide applied at 250, 500, 1000 ppm on the growth of bamyardgrass (Echinochloa crus-galli) at half- leaf stage.



Photo (2) Effect of the synthesized herbicide m - xylene sulphonamide applied at 250, 500, 1000 ppm on the growth of bamyardgrass (Echinochloa crus-galli) at one - leaf stage.

- 1. Control
- 2. At 250 ppm
- 3. At 500 ppm
- 4. At 1000 ppm