

## **The Influence of Herbicides on Major Field Crops in the Newly Reclaimed Areas of Egypt.**

### **I. Effect of Preemergence Application of Herbicides on Rice, Cotton, Maize, and Wheat Seedling Growth.**

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#### ABSTRACT

Seven herbicides; namely, Atrazine, Linuron, 2,4-D, Trifluralin, Fluometuron, Molinate, and Propanil, were tested in pots for their effect on the seedling growth of wheat, cotton, maize, and rice at the Faculty of Agriculture Experimental Farm, Alexandria, in 1970. Five or six concentrations of the herbicides were used.

Results indicated that wheat seedlings were very sensitive to all herbicides at all concentrations except 2,4-D at the rates of 0.5 and 1.0 l/f (f = faddan = 4,200 m<sup>2</sup>). It was concluded that 2,4-D could be applied as a preemergence treatment to control weeds in wheat at the rate of 1.0 l/f.

Trifluralin and Fluometuron did not injure cotton seedlings up to the rates of 1.0 l/f and 1.5–2.0 kg/f, respectively. However, the other herbicides killed cotton seedlings, especially at the higher concentrations. It was concluded that Trifluralin and Fluometuron might be applied as a preemergence treatment to control weeds in cotton at the rates of 1.0 l/f and 1.5–2.0 kg/f.

Results on rice seedlings indicated that it was possible to use the herbicides, Trifluralin, Molinate, Propanil, and 2,4-D at the rates of 1.0, 2.5, 6.0, and 1.0 l/f, respectively, and Atrazine at the concentration, 1.0 kg/f. Rice seedlings were killed by the higher rates of these herbicides. Moreover, the seedlings were seriously injured by Fluometuron and Linuron, especially at the higher concentrations.

Maize seedlings were very sensitive to all herbicides at all concentrations, except Linuron, Atrazine, and 2,4-D up to the rates of 1.0 kg/f, 1.0 kg/f, and 1.0 l/f, respectively. It was concluded that these latter herbicides and concentrations might be safely applied as preemergence treatments to control weeds in maize.

#### INTRODUCTION

Weeds are the harmful pest that adversely affect the production of field crops. In Egypt, weeds are generally controlled by hand hoeing. Recently, however, a number of

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pre- and postemergence herbicides were introduced by the Ministry of Agriculture to be tried in the fields of the major field crops.

Several investigators studied the effect of such weed killers on the seedling growth of several field crops. Chamberlain and Allen (2) found that wheat was generally quite susceptible to the injury of Atrazine which stopped the growth of several cultivar seedlings. Gowda *et al.* (3), however, reported that wheat germination was slightly affected by the preplanting application of Atrazine. Sand *et al.* (10) found that 2,4-D inhibited the root growth of maize seedlings. Anderson and Whitworth (1) reported that Trifluralin had a stunting effect and prevented the growth of lateral roots of cotton seedlings. The degree of this effect differed with different degrees of herbicidal concentrations. Kasahara *et al.* (7) found that the presowing application of Trifluralin in pots was phytotoxic to rice seedlings. However, Lantican *et al.* (8) indicated that Trifluralin did not affect rice germination but inhibited subsequent seedling growth immediately after germination. Kappelman and Buchanan (6) reported that the preemergence application of Fluometuron and Trifluralin reduced the growth of cotton seedlings in the greenhouse. Oelke and Morse (9) found that rice germination was unaffected by Molinate until the concentration exceeded five ppm. The low concentrations of Molinate stimulated the shoot growth of rice seedlings. Isom *et al.* (5) indicated that the preemergence application of Linuron at rates over one pound per acre might reduce wheat stand.

The objective of this investigation was to study the effect of some preemergence herbicides on the seedling growth of rice, cotton, maize, and wheat under the soil conditions of the newly reclaimed land of the North Sector of the Tahreer Province in Egypt.

## MATERIALS AND METHODS

The present work was conducted in 1970 in pots at the Faculty of Agriculture Experimental Farm, Alexandria, to study the effect of the preemergence application of variable concentrations of seven herbicides, namely: Atrazine (2-chloro-4-ethylamino-6-isopropylamino-s-triazine), Linuron [3-(3,4-dichlorophenyl)-1-methoxy-1-methyl-urea], 2,4-D (2,4-dichlorophenoxyacetic acid), Trifluralin (alpha, alpha, alpha, trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine), Fluometuron [1,1-dimethyl-3-(a,a,a-trifluoro-m-tolyl)urea], Molinate (S-ethyl hexahydro-1H-azepine-1-carbothioate), and Propanil (3,4-dichloropropionanilide), on the germination and seedling development of rice, cotton, maize, and wheat in the North Sector of the Tahreer Province in Egypt. Five or six concentrations of each herbicide were tested. The solutions were prepared by dissolving the proper amount of the herbicide in 70 ml of water for each concentration. The corresponding amount of a herbicide to each concentration was based on the soil surface area of each pot. The herbicides, concentrations, and field crops used in these investigations appear in Table 1. Crop seeds were sown in plastic pots, eight centimeters in diameter after being filled with 25 g of the North Tahreer soil (fine sandy loam). Ten seeds of each crop were planted in each pot. A completely randomized plot design, with three replicates, was used. Seedling emergence percentages were calculated by counting the emerged seedlings in each pot fifteen days after sowing. Seedling height was measured after fifteen and thirty days from sowing. Dry weight was determined for the thirty-day old seedlings in each pot by putting them in a drying oven at 80°C for about 48 hr and until the dry weight was constant. The data was collected and statistically analyzed.

Table 1 Herbicides, concentrations and field crops used in the studies.

Herbicides	Concentrations	Field crops
Atrazine	0.0, 0.5, 1.0, 2.0, 4.0 kg/f <sup>a</sup>	Rice, cotton, wheat
Atrazine	0.0, 0.5, 1.0, 2.0, 6.0 kg/f	Maize
Linuron	0.0, 0.5, 1.0, 2.0, 4.0 kg/f	Rice, cotton, wheat
Linuron	0.0, 0.5, 1.0, 2.0, 6.0 kg/f	Maize
2,4-D	0.0, 0.5, 1.0, 2.0, 4.0 l/f <sup>b</sup>	Rice, cotton, maize
2,4-D	0.0, 0.5, 1.0, 2.0, 6.0 l/f	Wheat
Trifluralin	0.0, 0.5, 1.0, 2.0, 4.0 l/f	Rice, maize, wheat
Trifluralin	0.0, 0.5, 1.0, 1.5, 2.0 l/f	Cotton
Fluometuron	0.0, 0.5, 1.0, 2.0, 4.0 kg/f	Rice, maize, wheat
Fluometuron	0.0, 0.5, 1.0, 1.5, 2.0, 4.0, kg/f	Cotton
Molinate	0.0, 1.25, 2.5, 5.0, 7.5 l/f	Cotton, maize, wheat
Molinate	0.0, 1.25, 2.5, 5.0, 10.0 l/f	Rice
Propanil	0.0, 3.0, 6.0, 9.0, 12.0 l/f	Cotton, maize, wheat
Propanil	0.0, 3.0, 5.0, 9.0, 24.0 l/f	Rice

<sup>a</sup> kg/f = kilograms per faddan (4200 m<sup>2</sup>).

<sup>b</sup> l/f = liter per faddan.

## RESULTS AND DISCUSSION

### I. Effect on rice

The effect of the seven herbicides on rice seedling growth is summarized in Table 2. It is clear that rice seedling emergence in the treated pots was not significantly lower than the control (0.0 treatment) at all concentrations of Trifluralin, 2,4-D, Linuron, and Atrazine. Molinate, however, significantly reduced the seedling emergence percentage only at the highest concentration (10.0 l/f). Such percentage was highly significantly reduced when Fluometuron was applied with the concentrations of 2.0 and 4.0 kg/f and Propanil with 9.0 and 24.0 l/f concentrations.

The average height of fifteen-day old rice seedlings under the Fluometuron, Propanil, and Linuron treatments was highly significantly smaller than the control. An inverse relationship was noted between seedling height and herbicide concentration. Seedling height was unaffected by the lowest concentration of Trifluralin at 0.5 l/f rate. Molinate caused a slight stunting up to 5.0 l/f. Furthermore, it is evident in Table 2 that the concentrations of 2,4-D and Atrazine had no detrimental effect on the seedling height of rice except at the highest concentration of 2,4-D which caused a significant stunting.

Generally, the average height of rice seedlings, at the age of thirty days, showed similar behavior to that of the fifteen-day old seedlings upon the preemergence treatment with Trifluralin, 2,4-D, Propanil, and Linuron, but the seedlings died in the case of the two concentrations: 2.0 and 4.0 kg/f of Fluometuron and the average height of the thirty-day old rice seedlings were significantly reduced by the two concentrations: 2.0 and 4.0 kg/f of Atrazine.

Table 2 indicates that the average dry weight of the thirty-day old seedlings was highly significantly decreased by Trifluralin, Fluometuron, Linuron, and Atrazine preemergence treatments. There was a tendency towards a decrease in dry weight as the concentrations increased. In fact, the high concentrations: 2.0 and 4.0 kg/f of Fluometuron completely killed the thirty-day old rice seedlings. Propanil, Molinate, and 2,4-D had only slight effects on dry weight at the highest concentrations. These results agreed with those of the effect on seedling height. Lantican *et al.* (8) and Oelke and Morse (9) obtained similar results but Kasahara *et al.* (7) reported different effects.

Table 2 Average values for seedling emergence percentage, seedling height at the age of 15 and 30 days, and dry weight of rice seedlings treated with the herbicides (1970).

Herbicides	Concentrations	Average values for			
		Seedling emergence (%)	Seedling height at 15 days (cm.)	Seedling height at 30 days (cm.)	Dry weight at 30 days (g.)
Trifluralin	0.0 l/f	96.6	4.66	16.60	0.015
	0.5 l/f	93.3	4.33	16.10	0.012
	1.0 l/f	100.0	3.83	15.56	0.011
	2.0 l/f	90.0	2.70	10.43	0.009
	4.0 l/f	86.6	1.93	7.26	0.006
L.S.D. (0.05)	—	N.S. <sup>a</sup>	0.53	1.01	0.003
Fluometuron	0.0 kg/f	90.0	5.90	10.03	0.015
	0.5 kg/f	86.6	5.20	6.83	0.007
	1.0 kg/f	80.0	3.66	2.70	0.002
	2.0 kg/f	73.3	2.73	—	—
	4.0 kg/f	66.6	2.36	—	—
L.S.D. (0.05)	—	11.7	0.57	1.67	0.004
2,4-D	0.0 l/f	96.6	4.90	17.00	0.017
	0.5 l/f	96.6	5.13	16.76	0.017
	1.0 l/f	100.0	4.90	16.76	0.016
	2.0 l/f	96.0	4.66	16.23	0.015
	4.0 l/f	90.0	4.26	14.30	0.010
L.S.D. (0.05)	—	N.S.	0.47	0.59	0.003
Molinate	0.00 l/f	93.3	4.9	17.1	0.016
	1.25 l/f	100.0	5.0	16.9	0.016
	2.50 l/f	93.3	5.0	16.5	0.016
	5.00 l/f	93.3	4.7	15.8	0.015
	10.00 l/f	73.3	3.6	9.6	0.010
L.S.D. (0.05)	—	7.7	0.3	0.4	0.003
Propanil	0.0 l/f	90.0	5.7	10.1	0.010
	3.0 l/f	86.6	5.2	8.8	0.010
	6.0 l/f	76.6	3.6	7.0	0.009
	9.0 l/f	60.0	3.5	5.5	0.007
	24.0 l/f	60.0	1.4	2.6	0.006
L.S.D. (0.05)	—	17.3	0.3	0.5	0.002
Linuron	0.0 kg/f	93.3	6.0	17.1	0.013
	0.5 kg/f	93.3	4.7	10.3	0.009
	1.0 kg/f	86.6	2.5	4.1	0.008
	2.0 kg/f	86.6	2.3	3.5	0.007
	4.0 kg/f	83.3	1.1	2.5	0.005
L.S.D. (0.05)	—	N.S.	0.4	0.8	0.003
Atrazine	0.0 kg/f	100.0	4.63	16.56	0.031
	0.5 kg/f	96.6	4.50	16.20	0.014
	1.0 kg/f	100.0	4.43	15.40	0.014
	2.0 kg/f	93.3	4.40	15.30	0.013
	4.0 kg/f	93.3	4.20	15.43	0.008
L.S.D. (0.05)	—	N.S.	N.S.	0.87	0.003

<sup>a</sup>Not significant at the five percent level.

## II. Effect on cotton

The effect of herbicides on cotton seedling growth is summarized in Table 3. Seedling emergence was not significantly affected by any concentration of the herbicides: Trifluralin, Fluometuron, and Molinate. On the other hand, the high concentrations of

2,4-D, Linuron, and Atrazine had significantly reduced the seedling emergence. The lowest concentration of Propanil (3.0 l/f) had no effect but the seedlings could not tolerate the higher rates.

The average height of the fifteen-day old seedlings was highly significantly decreased by the herbicides: Trifluralin, 2,4-D, Molinate, and Propanil, while Fluometuron and Atrazine showed stunting effects when used at the high concentrations of 1.5 and 2.0 kg/f, respectively. There was a gradual increase in the stunting effect as the concentrations increased. It was obvious that Linuron was not effective in this study. Similar trends for the effect on the thirty-day old seedlings were also observed, especially with the herbicides: Trifluralin, Fluometuron, Propanil, Linuron, and Atrazine. However, a different effect was observed with 2,4-D and Molinate in which cotton seedlings were completely killed by all concentrations of both herbicides.

The average dry weights of the thirty-day old seedlings (Table 3) were highly significantly reduced by all treatments, except 2,4-D and Molinate which killed all the seedlings. The effects of Trifluralin, Fluometuron, 2,4-D, Molinate, and Propanil on dry weight were similar to those of the thirty-day old seedling height. Linuron, in this case, caused a significant reduction in dry weight, especially when applied at concentrations above 0.5 kg/f. Atrazine reduced the dry weight at all rates. In general, there was a tendency towards decreased dry weights as the concentrations increased. These results were in close agreement with those reported by Kappelman and Buchanan (6), and disagreed with the results of Anderson and Whitworth (1).

### III. Effect on maize

The effects of the herbicides on maize seedling growth is summarized in Table 4. It is shown in this table that maize seedling emergence was not affected by all herbicide treatments. The fifteen-day old seedling height, however, was highly significantly reduced by all the treatments except those of 2,4-D and Atrazine which showed slight nonsignificant gradually stunting effects as the rates of the herbicide increased. The effect of Trifluralin was more pronounced than that of the other herbicides. Furthermore, the response of the thirty-day old seedling height was similar to that of the fifteen-day old seedling height.

The dry weight of the thirty-day old seedlings was significantly decreased by all treatments except Atrazine which had no detrimental effect. Dry weight, however, was slightly affected by 2,4-D and Linuron, especially at the highest two rates. Similar results were obtained by Graves *et al.* (4).

### IV. Effect on wheat

Data in Table 5 summarize the effects of the herbicides on the seedling growth of wheat. The data indicated that Fluometuron, 2,4-D, and Linuron did not significantly affect the seedling emergence. The other herbicides, however, highly significantly reduced the seedling emergence percentage. The injurious effect of Molinate, Propanil, and Atrazine was more conspicuous at the high concentrations. The height of the fifteen-day old seedlings was significantly shorter under all herbicide treatments than the control. There was a gradual stunting effect which increased as the concentrations increased. The least stunting effect was that of 2,4-D. The data also showed that the

Table 3 Average values for seedling emergence percentage, seedling height at the age of 15 and 30 days, and dry weight of cotton seedlings treated with the herbicides (1970).

Herbicides	Concentrations	Average values for			
		Seedling emergence (%)	Seedling height at 15 days (cm.)	Seedling height at 30 days (cm.)	Dry weight at 30 days (g.)
Trifluralin	0.0 l/f	93.3	8.0	12.3	0.253
	0.5 l/f	93.3	7.5	10.8	0.225
	1.0 l/f	86.6	7.3	10.0	0.167
	1.5 l/f	73.3	6.9	9.0	0.111
	2.0 l/f	70.0	6.3	8.5	0.102
L.S.D. (0.05)	—	N.S.	0.7	1.0	0.032
Fluometuron	0.0 kg/f	93.3	7.5	11.3	0.210
	0.5 kg/f	100.0	7.6	11.3	0.207
	1.0 kg/f	86.6	7.7	11.3	0.200
	1.5 kg/f	93.3	7.3	11.0	0.190
	2.0 kg/f	80.0	7.3	10.5	0.162
	4.0 kg/f	80.0	6.9	10.0	0.150
L.S.D. (0.05)	—	N.S.	0.3	0.3	0.021
2,4-D	0.0 l/f	100.0	10.23	15.53	0.213
	0.5 l/f	93.0	1.43	—	—
	1.0 l/f	93.0	1.00	—	—
	2.0 l/f	90.0	1.00	—	—
	4.0 l/f	76.0	0.60	—	—
L.S.D. (0.05)	—	13.1	0.20	—	—
Molinate	0.00 l/f	100.0	10.30	14.96	0.243
	1.25 l/f	96.6	2.30	—	—
	2.50 l/f	83.3	1.80	—	—
	5.00 l/f	86.6	1.03	—	—
	7.50 l/f	86.6	1.00	—	—
	L.S.D. (0.05)	—	N.S.	0.30	—
Propanil	0.0 l/f	96.6	9.76	15.86	0.070
	3.0 l/f	96.6	7.20	12.16	0.065
	6.0 l/f	80.0	7.40	11.33	0.052
	9.0 l/f	76.6	4.36	10.64	0.044
	12.0 l/f	70.0	3.43	6.06	0.036
	L.S.D. (0.05)	—	15.8	0.25	0.50
Linuron	0.0 kg/f	100.0	8.50	10.80	0.209
	0.5 kg/f	93.3	8.30	10.60	0.206
	1.0 kg/f	100.0	8.06	10.30	0.193
	2.0 kg/f	86.6	7.90	10.00	0.167
	4.0 kg/f	66.6	7.80	9.30	0.150
	L.S.D. (0.05)	—	16.1	N.S.	N.S.
Atrazine	0.0 kg/f	93.3	7.70	11.50	0.233
	0.5 kg/f	93.3	7.60	11.13	0.183
	1.0 kg/f	80.0	7.20	10.80	0.146
	2.0 kg/f	93.3	6.80	10.00	0.109
	4.0 kg/f	60.0	6.20	9.50	0.086
	L.S.D. (0.05)	—	25.3	0.61	0.93

average height of the thirty-day old wheat seedlings was similarly affected as the fifteen-day old seedlings.

The dry weights of the thirty-day old seedlings were significantly decreased by all herbicides. However, 2,4-D showed no injurious effect on the dry weight up to the high

Table 4 Average values for seedling emergence percentage, seedling height at the age of 15 and 30 days, and dry weight of maize seedlings treated with the herbicides (1970).

Herbicides	Concentrations	Average values for			
		Seedling emergence (%)	Seedling height at 15 days (cm.)	Seedling height at 30 days (cm.)	Dry weight at 30 days (g.)
Trifluralin	0.0 l/f	100.0	26.33	44.50	0.116
	0.5 l/f	93.3	15.90	29.26	0.105
	1.0 l/f	93.3	8.00	12.13	0.087
	2.0 l/f	93.3	4.40	8.13	0.047
	4.0 l/f	100.0	3.66	6.06	0.044
L.S.D. (0.05)	—	N.S.	1.34	3.25	0.010
Fluometuron	0.0 l/f	93.3	27.50	45.10	0.110
	0.5 l/f	93.3	27.03	37.76	0.103
	1.0 l/f	93.3	25.40	36.90	0.084
	2.0 l/f	80.0	24.93	31.23	0.084
	4.0 l/f	73.3	24.26	30.86	0.077
L.S.D. (0.05)	—	N.S.	1.44	4.80	0.012
2,4-D	0.0 l/f	100.0	26.83	45.00	0.118
	0.5 l/f	100.0	26.90	45.16	0.118
	1.0 l/f	100.0	26.16	45.00	0.115
	2.0 l/f	100.0	26.30	44.50	0.105
	4.0 l/f	93.3	26.06	44.00	0.060
L.S.D. (0.05)	—	N.S.	N.S.	N.S.	0.007
Molinate	0.00 l/f	100.0	35.23	48.06	0.113
	1.25 l/f	100.0	29.90	36.20	0.109
	2.50 l/f	100.0	26.70	31.53	0.092
	5.00 l/f	100.0	20.00	27.13	0.083
	7.50 l/f	100.0	15.96	18.60	0.061
L.S.D. (0.05)	—	N.S.	0.70	0.69	0.006
Propanil	0.0 l/f	100.0	35.70	47.70	0.130
	3.0 l/f	100.0	37.73	45.76	0.090
	6.0 l/f	100.0	33.40	43.60	0.076
	9.0 l/f	100.0	32.10	41.60	0.067
	12.0 l/f	100.0	31.76	33.13	0.053
L.S.D. (0.05)	—	N.S.	2.70	0.50	0.007
Linuron	0.0 kg/f	93.3	26.5	44.0	0.115
	0.5 kg/f	93.3	26.4	42.9	0.116
	1.0 kg/f	93.3	26.2	42.4	0.110
	2.0 kg/f	86.6	25.8	39.5	0.064
	4.0 kg/f	86.6	23.7	37.2	0.064
L.S.D. (0.05)	—	N.S.	0.7	1.2	0.010
Atrazine	0.0 kg/f	93.3	27.2	44.1	0.116
	0.5 kg/f	93.3	26.3	41.5	0.112
	1.0 kg/f	100.0	27.0	42.0	0.103
	2.0 kg/f	86.6	24.2	39.8	0.106
	6.0 kg/f	86.6	24.8	39.6	0.097
L.S.D. (0.05)	—	N.S.	N.S.	N.S.	N.S.

concentrations (4.0 and 6.0 l/f). These results agreed with those reported by Chamberlain and Allen (2), Gowda *et al.* (3), and Isom *et al.* (5).

According to these results, the following conclusions may be drawn under the conditions of the present investigation:

Table 5 Average values for seedling emergence percentage, seedling height at the age of 15 and 30 days, and dry weight of wheat seedlings treated with the herbicides (1970).

Herbicides	Concentrations	Average values for			
		Seedling emergence (%)	Seedling height at 15 days (cm.)	Seedling height at 30 days (cm.)	Dry weight at 30 days (g.)
Trifluralin	0.0 l/f	90.0	6.30	17.70	0.032
	0.5 l/f	70.0	5.00	15.20	0.026
	1.0 l/f	43.3	3.50	6.10	0.016
	2.0 l/f	30.0	2.00	4.10	0.014
	4.0 l/f	16.6	1.10	2.83	0.012
L.S.D. (0.05)	—	15.2	1.03	1.39	0.010
Fluometuron	0.0 kg/f	86.6	6.60	18.00	0.033
	0.5 kg/f	86.6	4.20	12.90	0.021
	1.0 kg/f	73.3	3.10	7.46	0.015
	2.0 kg/f	70.0	2.20	5.00	0.012
	4.0 kg/f	63.3	1.50	3.30	0.010
L.S.D. (0.05)	—	N.S.	1.23	0.85	0.003
2,4-D	0.0 l/f	96.6	6.80	18.0	0.034
	1.0 l/f	93.3	6.30	17.3	0.033
	2.0 l/f	90.0	5.10	14.8	0.033
	4.0 l/f	90.0	4.20	8.7	0.028
	6.0 l/f	93.3	3.00	4.6	0.020
L.S.D. (0.05)	—	N.S.	0.49	1.1	0.003
Molinate	0.00 l/f	90.0	18.60	23.83	0.019
	1.25 l/f	80.0	11.23	14.43	0.012
	2.50 l/f	50.0	8.60	12.86	0.010
	5.00 l/f	33.3	5.63	11.00	0.006
	7.50 l/f	33.3	3.96	7.50	0.004
L.S.D. (0.05)	—	17.2	0.50	0.62	0.002
Propanil	0.0 l/f	93.3	19.23	25.00	0.017
	3.0 l/f	86.6	15.20	19.63	0.015
	6.0 l/f	43.3	15.06	18.20	0.013
	9.0 l/f	50.0	5.56	8.76	0.008
	12.0 l/f	30.0	3.40	5.96	0.004
L.S.D. (0.05)	—	24.0	0.44	0.47	0.007
Linuron	0.0 kg/f	93.3	7.60	10.13	0.035
	0.5 kg/f	83.3	4.80	7.60	0.025
	1.0 kg/f	73.3	3.80	7.13	0.020
	2.0 kg/f	76.6	3.36	5.26	0.015
	4.0 kg/f	76.6	2.63	4.10	0.008
L.S.D. (0.05)	—	N.S.	0.49	0.60	0.005
Atrazine	0.0 kg/f	86.6	6.50	17.30	0.031
	0.5 kg/f	83.3	6.10	16.10	0.030
	1.0 kg/f	86.6	4.20	14.00	0.025
	2.0 kg/f	73.3	3.50	10.20	0.019
	4.0 kg/f	63.3	3.00	5.00	0.009
L.S.D. (0.05)	—	10.3	0.19	1.07	0.002

### 1. For Rice

- Trifluralin or 2,4-D may be applied as a preemergence treatment with rates up to one liter per faddan.
- It is not recommended to use Fluometuron or Linuron as a preemergence application at any concentration.



- c. Propanil may be used as a preemergence application at the rate of six liters per faddan.
  - d. Atrazine may be applied as a preemergence treatment only at the rate of one kilogram per faddan.
2. *For Cotton*
    - a. Fluometuron may be applied as a preemergence treatment at rates from 1.5–2.0 kg/f.
    - b. Molinate, Linuron, or Atrazine are not recommended as preemergence herbicides at any concentration.
  3. *For Maize*
    - a. Trifluralin, Fluometuron, or Molinate are not recommended as preemergence herbicides at any concentration.
    - b. The herbicide: 2,4-D may be used as a preemergence treatment at the rate of one liter per faddan.
    - c. The recommended rate (1.0 kg/f) of Atrazine is also recommended for weed control in maize fields on the North Tahreer soil.
  4. *For Wheat*
    - a. Trifluralin, Fluometuron, Molinate, Linuron, or Atrazine may not be recommended as preemergence treatments at any concentration.
    - b. The herbicide: 2,4-D may be recommended as a preemergence application at the rate of one liter per faddan.

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