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Influence of some selective herbicides on growth, yield and nutrients content of wheat (*triticum aestivum L.*) plants

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ABSTRACT

Two field experiments were conducted at the experimental station of National Research Center, Shalakan, Kalubia, Egypt, to study the effect of three selective weed killers on growth, yield and nutrients status of wheat plants.

The obtained results could be summarized as follows:

Applying the three herbicides (Panther 55 % Sc, Sinal 10 Sc and Grasp 10 % Ec significant increased the vegetative growth parameters of wheat plants (plant height, No. of spikes/m^2, flag leaf area (cm^2) and No. of grains/spike), straw and grains yields/fed. as well as chemical composition (crude protein %, P %, K % and concentration of Fe and Zn in wheat grains as compared with unwedded control. However, the used herbicides did not show any significant effect on the concentration of Mn and Cu elements.

The highest values of the mentioned parameters (growth yield and chemical composition of wheat plants) were obtained when Panther 55 % Sc herbicide was applied followed by Sinal 10 Sc and Grasp.

All the different concentration of the used herbicides (lower conc., recommended conc. and higher conc.) significantly increased all the growth and yield parameter (except spike length) as well as crude protein, P %, K % and concentration of Fe, Zn, Mn and Cu in wheat grains as compared with unweeded control. The highest values of all the previous parameter were found when the recommended conc. was used followed by the higher conc. and the lower one in decreasing order.

The highest values of all growth, yield and chemical composition were attained by applying of Panther 55 % Sc and using the recommended concentration (0.6 L/fed) while the lowest values were found by using Grasp 10 % Ec under unweeded control.

KEY WORDS: Panther- Sinal- Grasp- wheat- herbicides.

INTRODUCTION

In Egypt, wheat (*triticum asetivum L.*) is considered of the most strategic crops, since bread creates the daily basic source of nutrients of the majority of population. Concerted efforts has recently been forward to increasing wheat productivity by all means of increasing land area, breading for highly yield varieties, genetic condification of local varieties and controlling weeds (Wu *et al*., 2001 and Wicks *et al*., 2002).

Weeds are considered a major problem in wheat field that cause great losses in seed yield because weeds compete directly with plants for light, moisture, carbon dioxide and soil nutrients. Therefore weed control is one of the essential cultural practices for raising the yield and quality of wheat plants. The crop losses due to weed infestation were estimated by 10-50% or even to complete crop failure, based on the type and state of weedy infestation (Cheema *et al*., 1997). Moreover, Nisha *et al*., (1999) stated that the reduction of wheat yield due to weed infestation reached 30.7%.

Conventional methods as documented with many cereal crops, were effectively used for controlling weeds infested wheat, however, the highly cost and shortage in labors for hand weeding are estimated such ways and are no longer applied on many places (Sharara Faida *et al*., 2005).

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Nowadays, herbicides use in wheat production are increasing dramatically for its efficiency and the reliability in controlling weeds in wheat of which panther 55% Sc., Sinal 10 Sc and Grasp 10% Es were from the most popular herbicides (Tag-El-Din *et al*., 1989, El-Metwally 2002, Sharara Faida *et al*., 2006). The previous investigators stated that Sinal 10 Sc and Lentagran herbicides were the best for controlling broad-leaved weeds, Grasp 10% Ec and Iloxan, were the most efficient for grassy weeds, Meanwhile, Panther 55% Sc and Arelon had a special and advantage for controlling both types of weeds (broad and grassy). Few investigations have been done for studying the effect of herbicides on mineral control of cereal crops, especially for the micronutrients.

The aim of the present work was to study the effect of three selective weed killers on growth, yield and nutrients status of wheat plants under field conditions.

MATERIALS AND METHODS

Two field experiments were conducted in two successive seasons at the experimental station of NRC, Shalakan, Kalubia, Egypt. Some physical and chemical analyses of the soil under investigation are shown in Table (1). Wheat (*triticum asetivum L.c.v. Geza 168*) grains were obtained from Agricultural Research Center, Ministry of Agriculture. The grains were sown at the rate of 62 Kg/fed at the 4th week of November in both seasons. The experiment included 12 treatments, three selective herbicides (Phanther 55%Sc, Sinal 10Sc and Grasp 10% Ec) and four concentration i.e 0, 0.4, 0.6 and 0.8 L/fed; 0, 0.02, 0.04 and 0.06 L/fed and 0, 0.8, 1.0, 1.2 L/fed for the previous herbicides respectively. The treatments were distributed in split plot design with eight replicates, where the herbicides in the main plots and the concentration treatments in the sub plots. The sub plot area was 21 m^2, 4 m in width and 5.25 m in length. The herbicides were applied as a foliar application, after 30 days from sowing (3-4 leaf stage). The herbicides were sprayed with water volume of 200 L/fed. Four replicates were used for each treatment. The chemical structure, common/chemical name, type, date and rate of application of each herbicide are shown in Table (2). The normal cultural practices of wheat growing were done. Calcium superphosphate (15.5% P_2O_5, potassium sulphate (48.5% K_2O) and ammonium nitrate 33.5% N) were used at the rate of 200, 100 and 100 Kg/fed. respectively. The first and second fertilizers were applied before sowing and the third one after 3 weeks from sowing.

At harvest time, 20 plants from each treatment were selected at random and the following determinations were recorded: Plant height, flag leaf area (cm^2), No. of spikes, m^2, spike length (cm), and No. of grains/spike.

The central 10 rows of each treatments were harvested and the following data were done: Grain weight/spike (gm), weight of 1000 grains (gm), straw yield ton/fed and grain yield Ardab/fed (Ardab= 150 Kg).

Analysis of soil samples as well as the wheat grains were carried out using standard methods described by Cottenie *et al*., (1982), A.O.A.C. (1990), Black *et al*., (1965) and Bremmer and Mulvaney (1982).

Table 1: Some physical and chemical analysis of the investigated soil.

Mechanical analysis		**Chemical analysis**	
Sand %	47.11	E.C ds/m	**1.49**
Silt %	30.14	pH 1:25	**8.1**
Clay %	22.75	$CaCO_3$ %	**1.80**
Texture	Sandy clay loam	O.M %	**1.10**
Soluble cations meq/l		Soluble anions meq/l	
Ca^{++}	3.59	$CO_3^{=}$	**-**
Mg^{++}	1.19	HCO^{-}	**1.69**
Na^{+}	8.18	Cl^{-}	**8.97**
K^{+}	1.94	$SO_4^{=}$	**4.24**
Micronutrients (ppm)		Macronutrients	
Zn	0.54	Total N %	**0.08**
Fe	4.79	Total P (ppm)	**730**
Mn	1.97	Available P (ppm)	**6.03**
Cu	**0.25**		

Table 2: Chemical (structure, common name and concentration) of the used herbicides.

Treatments (Trade name)	Common name	Chemical name	Rate of Application L/fed	Selectivity	Man factory	Type of application	Time of application (days after sowing)	Physiological stage
Panther 55 % Sc	Isoproturon +Diflufenican	N-(4-isopropylphenyl)-N,N- dimethyl-urea+N-(2,4 diflu-orophenyl)-2-(3 trifluoro- methylphenox)-3-pyridine-carboxamide	0.60	Broad and narrow leaves	Bayer crop science	Post-emergence	30 days	Seedling stage
Sinal 10 Sc	Metosulam	N-(2,6 dichloro-3-methyl Phenyl)-5,7 dimethoxy-(1,2,4)Triazolo (1,5a) Pyrimidine-2-sulphonamide)	0.04	Broad leaved	Dow	Post-emergence	30 days	Seedling stage
Grasp 10 % EC	Tralkoxydim	5(2,4,6 trimethyl-1-phenyl-1-cylohox-2-enone)	1.00	Narrow leaves	Dow	Post-emergence	30 days	Seedling stage

Data obtained during the two seasons were subjected to statistical analysis by the technique of analysis as published by Gomez and Gomez (1984). Combined analysis of the data of the two growing season (chemical analysis) were undertaken and the mean values were compared by L.S.D. at 5% level.

RESULTS AND DISCUSSION

It was found that applying the three herbicides (Pantter 55%Sc, Sinal 10Sc and Grasp10EC) increased the vegetative growth of wheat plants including plant height, No. of spikes/m^2, flag leaf area (cm^2) and No. of grains/spike as compared with unweeded control (Table 3). However, spike length did net give any significant increases as results of using the previous herbicides. These results were true for both growing seasons. The previous growth parameters were significantly and markedly increased as a result of using the panther 55%Sc herbicide as compared with the other two herbicides, Sinal 10Sc and Grasp 10EC. This may be due to the effect of Panther 55%Sc which had a special advantage for controlling both types of weeds (broad and grassy weeds) while Sinal 10Sc herbicide was the best for controlling only the broad leaved weeds. Moreover, Grasp10%EC was the most efficient for the grassy weeds. In this concern Sharara, Faida, *et al*., (2006) concluded that Panther 55%Sc (0.6 L /Fed) and Arelon (1.25L/Fed) were the best effective amongst other treatments in increasing plant height and flag leaf area, of wheat plants which was estimated by up to 22%, which applying Sinal and Lentagran or Grasp and Iloxan alone showed less response in this issue Also, the increases of the wheat growth parameters by using the panther 55%Sc herbicide may be due to the severe decrease in fresh and dry weights of the total weeds (broad and grassy) and consequently the competition was limited and more light, water and nutrients were available to promote wheat growth. These results are in general agreement with those obtained by Abdel-Samie (2001), Ahmed (2001), EL-Metwally (2002) and Sharara, Faida *et al*., (2006).

Data presented in Table (3) reveal that the application of Sinal 10Sc significantly increased plant height, No. of spikes/m^2, flag leaf area (cm^2) and No. of grains/spike in both seasons as compared with applying Grasp 10% ES herbicide. These results may be due to the dominant weeds in the wheat field which was the broad leaved weeds than the grassy weeds as recommended by El-Metwally (2002). These increases in the growth parameters, when Sinal compared with Grasp herbicide may be due to good control of wheat weeds and minimizing weed competition which gave good chance of wheat growth in good condition .The obtained results of the growth parameter of wheat plants are coincided with these obtained by EL-Metwally (2002) and sharara Faida et al., (2006) who concluded that Sinal (Metasalam) is in terms of selectivity and weed control highly sophisticated herbicide designed preliminary for controlling broad-leaves weeds in cereal crops (sultan *et al*., 1999) .

Table (3): Growth parameters (plant height, No. of spikes/m2, Spike length, flag leaf area and No. of grains/spike) of wheat plants as impacted by different herbicides and concentration treatments during two seasons.

Herbicides conc. L/fed	Plant height (cm)		No. of spikes/m^2		Spike length (cm)		Flag leaf area (cm^2)		No. of grain/spike	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season	First season	Second season
unweeded	99.0	100.6	444.3	445.6	10.90	10.50	49.1	50.1	54.0	53.3
Panther 0.40	102.0	105.4	470.2	471.8	11.60	12.00	51.2	52.2	56.0	56.6
55 % 0.60*	106.8	109.2	479.2	481.4	12.50	12.40	54.1	55.1	58.0	58.9
0.80	104.2	106.3	471.2	472.9	12.20	12.10	52.0	53.0	57.0	57.0
Mean	103.1	105.4	466.2	467.9	11.80	11.75	51.6	52.6	56.3	56.5
unweeded	94.7	100.2	438.2	439.0	10.90	10.40	43.0	44.0	48.0	47.3
Sinal 0.02	96.8	103.0	448.1	447.7	11.30	11.90	47.0	46.8	50.0	50.8
10Sc 0.04*	100.6	105.3	459.0	467.8	12.00	12.30	50.0	49.0	52.0	53.5
0.06	97.3	104.0	449.1	448.9	11.40	12.00	48.0	47.9	50.9	51.4
Mean	97.4	103.1	448.6	450.9	11.40	11.65	47.0	46.9	50.2	50.8
Unweeded	93.1	94.1	433.2	434.4	10.80	10.30	39.8	41.0	45.0	44.0
Grasp 0.80	95.5	99.2	440.2	441.4	11.10	11.80	42.2	44.0	47.1	47.1
10 % 1.00*	96.9	102.0	445.1	447.5	12.00	12.30	45.6	46.0	49.0	50.0
1.20	95.9	100.1	442.3	442.3	11.20	11.90	43.1	45.8	47.8	48.0
Mean	95.4	98.9	440.2	441.4	11.30	11.57	42.7	44.2	47.3	47.3
unweeded	95.6	98.3	438.6	439.7	10.87	10.40	44.0	45.0	49.0	48.2
Mean low conc.	98.1	102.5	452.8	453.6	11.33	11.90	46.8	47.7	51.0	51.5
of herb. *	101.4	105.5	461.1	465.6	12.17	12.33	49.9	50.0	53.0	54.1
conc. higher conc.	99.1	103.5	454.2	454.7	11.60	12.00	47.7	48.9	51.9	52.1
LSD herbicide	1.9	3.4	7.9	8.1	NS	NS	2.2	2.6	2.7	1.8
5% Conc.	2.4	3.3	12.6	13.2	NS	NS	2.6	2.5	1.8	2.3
Herb.*Conc.	3.1	3.8	14.1	15.6	NS	NS	3.7	3.6	2.9	3.1

* The recommended concentration of the used herbicides.

Table (4): Yield parameters (grains weight/ spikes, weight of 1000 grains, straw and grain yields) of wheat plants as impacted by different herbicides and concentration treatments during two seasons.

Herbicides conc. L/fed	Grains weight/spike (gm)		Weight of 1000 grains (gm)		Straw yield (ton/fed)		Grain yield Ardab/fed	
	First season	Second season	First season	Second season	First season	Second season	First season	Second season
unweeded	2.08	1.98	35.0	36.1	5260.3	5113.0	23.00	21.01
Panther 0.40	2.41	2.35	38.5	39.2	5270.4	5125.0	25.10	24.11
55 % 0.60*	2.87	2.47	41.5	41.2	5281.7	5135.0	27.70	27.50
0.80	2.50	2.40	38.8	39.4	5271.0	5126.2	25.30	24.21
Mean	2.49	2.37	38.4	39.0	5270.9	5124.8	25.28	24.21
unweeded	2.00	1.80	31.0	33.0	4230.0	4058.8	18.01	19.90
Sinal 0.02	2.12	2.06	34.1	35.9	4240.6	4070.0	20.11	19.68
10Sc 0.04*	2.42	2.37	37.2	39.0	4252.3	4081.6	22.80	21.80
0.06	2.21	2.08	34.2	36.1	4242.1	4071.0	20.30	19.90
Mean	2.19	2.08	34.1	36.0	4241.3	4070.4	20.31	19.57
Unweeded	1.60	1.72	29.8	30.9	4057.8	3765.8	15.80	15.60
Grasp 0.80	1.80	1.94	33.1	33.1	4068.1	3776.1	19.40	17.50
10 % 1.00*	2.15	2.23	35.0	35.9	4080.0	3786.9	22.80	19.90
1.20	1.90	1.96	33.5	33.3	4069.1	3777.2	19.55	17.66
Mean	1.86	1.96	32.9	33.3	4068.8	3776.3	19.39	17.67
unweeded	1.89	1.83	31.9	33.3	4516.0	4312.5	18.94	17.84
Mean low conc.	2.13	2.12	35.2	36.1	4526.4	4323.7	21.54	20.43
of herb. *	2.48	2.45	37.9	38.7	4538.0	433.4.5	24.43	23.07
conc. higher conc.	2.20	2.15	35.5	36.3	4527.4	4324.8	21.72	20.59
LSD herbicide	0.07	0.07	1.2	2.20	133.7	140.6	0.87	0.92
5% Conc.	0.22	0.29	2.0	2.30	10.0	10.2	2.40	2.50
Herb.*Conc.	0.40	0.40	2.9	3.11	38.6	40.0	3.6	2.95

* The recommended concentration of the used herbicides.

They also assumed that Lentagran and Sinal at 0.7 and 0.04 L/fed., respectively are the most preferable herbicides for controlling broad leave weeds in winter wheat. Moreover, Saad *et al*., (2003) provided evidence that Sinal at 0.04 L/fed. was more than 90 % efficient in reducing broad leave weeds when compared with grasses (25%). On the other hand, several workers revealed that Grasp (Tralkoxydium) and Iloxan (Diclofop-methyl) were most reliable herbicides for controlling grassy weeds in wheat field (Tzamir *et al*., 1988 and Tag-El-Din, 1989).

The maximum values of the growth parameters of wheat plants were obtained by Panther 55 % Sc, followed by Sinal 10 Sc (Metosulam) and Grasp 10 % Ec (Tralkoxydium) in decreasing order (Table 3).

Data in Table (4) show positive effect on wheat yield and yield attributes in both season due to herbicides application. Such effects were significant on the characters of grains weight/spike, weight of 1000 grains, straw and grains yield/fed. Application of panther 55% Sc statistically increased all the mentioned yield parameters as compared with those obtained by using Sinal 10Sc and Grasp 10% Ec. These results of the yield parameters took the same trend of the growth parameters of wheat plants (Table 3). The highest values of all the yield parameters under study were obtained by application of panther 55% Sc, follow by Sinal 10 Sc and Grasp 10% Ec in decreasing order. These results may be due to the application of panther 55% Sc was more effective in controlling weeds than the other two herbicides (Sinal and Grasp) and consequently the competition was limited and more light, water and nutrients were available to promote wheat yield attributes if compared with other treatments. Confirm, the obtained results Ahmed et al., (1993) who reported that using Isoproturon herbicide (Panther) in controlling wheat's weed was promising for increasing the yield components (i.e weight of 100 grains), which subsequently reflected in increasing the total grain yield. Dabek-Gad and Bujak (2002) explained that the increasing in grain yield in response to Arelon (like panther) and other related herbicides was just about consequence of increasing ear density per m^2, number and weight of grains per ear and 100 grain weight. Supporting view was recorded by Khalil et al., (2000) who confirmed that Arelon produced more fertile tiller density coupled with more grains per spike at all level of concentrations than the other herbicides treatments. Moreover, El-Metwally (2002) suggested that the significant reduction in growth and intensity of associated weeds were the real reason behind increasing the tell ring capacity, number of spikes/m^2 and hence the total grain yield.

Table (5): Growth parameters (plant height, No. of spikes/m2, Spike length, flag leaf area and No. of grains/spike) of wheat plants as impacted by different herbicides and concentration treatments during two seasons.

Herbicides conc. L/fed	Crude protein %	P %	K %	Micronutrients µg/g dry weight			
				Fe	Zn	Mn	Cu
unweeded	11.8	0.249	0.70	482.0	240.0	107.0	39.0
Panther 0.40	12.0	0.250	0.76	505.1	244.0	109.0	40.0
55 % 0.60*	12.6	0.254	0.81	522.0	248.0	111.0	41.0
0.80	12.3	0.251	0.78	506.6	245.0	110.0	41.0
Mean	12.2	0.251	0.76	503.8	244.3	109.3	40.3
unweeded	11.6	0.198	0.68	470.1	238.0	107.0	39.0
Sinal 0.02	11.9	0.201	0.71	490.2	242.0	109.0	40.0
10Sc 0.04*	12.3	0.230	0.78	510.1	246.0	110.0	40.0
0.06	12.1	0.218	0.74	491.3	243.0	110.0	41.0
Mean	12.0	0.214	0.73	490.4	242.3	109.0	40.0
Unweeded	11.2	0.191	0.61	361.0	234.0	107.0	39.0
Grasp 0.80	11.5	0.209	0.66	374.1	237.0	109.0	41.0
10 % 1.00*	11.8	0.220	0.70	386.2	240.0	111.0	41.0
1.20	11.6	0.211	0.68	375.0	238.0	109.0	41.0
Mean	11.5	0.208	0.66	374.1	237.3	109.0	40.3
unweeded	11.5	0.213	0.66	437.7	237.3	107.0	38.7
Mean low conc.	11.8	0.220	0.71	456.5	241.0	109.0	40.3
of herb. *	12.2	0.235	0.76	472.8	244.7	110.7	40.7
conc. higher conc.	12.0	0.227	0.73	457.4	242.0	109.7	41.0
LSD herbicide	0.07	0.009	0.01	13.0	4.10	NS	NS
5% Conc.	0.25	0.008	0.05	181	2.40	1.2	1.8
Herb.*Conc.	0.32	0.012	0.10	22.3	NS	NS	NS

* The recommended concentration of the used herbicides.

Results presented in Table (5) reveal that all the weed herbicides treatments significantly affected crude protein %, P%, K% and concentration of Fe and Zn in wheat grains, while the used herbicides did not show any significant effects on the concentrations of Mn and Cu elements. The highest values of the mentioned constituents were obtained when Panther 55 Sc herbicide was applied as compared with both Sinal 10Sc and Grasp 10% Ec. The chemical composition of wheat grains took the same trend of growth and yield parameters (Tables 3 and 4). The highest values of crude protein %, P %, K % concentration of Fe and Zn were obtained by panther application followed by Sinal and Grasp in decreasing order. These results may be due to the less competition for nutrients, water and light through limiting weeds infestation with herbicidal treatments due to increasing the uptake of different nutrients. Came to the same results El-Metwally (2002), Saad El-Din *et al*., (2003) and Sharara Faida *et al*., (2006) who reported that all the used control treatments significantly increased crude%, P% and K%.

It can be concluded from Tables 3 and 4, which spraying the different used herbicides i.e Panther, Sinal and Grasp with the different concentrations, significantly increased all the growth and yield parameters (except spike length) i.e plant height, No. of spikes/m^2, flag leaf area (m^2) and No. of grains/spike, weight of 1000 grains, straw and grains yields per feddan as compared with unweeded control.

The highest values of the growth and yield parameters were obtained by using the recommended concentration followed by the lower concentration (< recommended dose) and the higher concentration (>recommended dose) in decreasing order. Data also reveal that the low concentration (< recommended dose) did not show any significantly effect on all the growth and yield components as compared with the higher concentration (>recommended dose). Confirm these results El-Sayed (1998) who stated that growth and N content of forage cowpea seedlings were slightly increased with 2 ppm 2,4-D but they decreased sharply with higher concentrations. The increases in growth and yield parameters of wheat plants could be considered as a reliable index of the effect of herbicides concentration on the integrated metabolism of wheat plants during their growth and the depression in the competition of weeds to wheat plants when herbicides were applied. Also, these increases may be attributed to the increases in No. of spikes/m^2. In this concern, El-Metwally (2002) assumed that lentagran WP and Sinal 10 Sc (used for broad leaves) at the recommended dose of 0.7 and .04 L/fed respectively are the most preferable herbicides for controlling board leave weeds in winter wheat. Recently, Saad El-Din *et al*., (2003) provided evidence the Sinal at the recommended dose of 0.04 L/fed. was more than 90% efficient in reducing broad leave weeds in wheat field. The obtained results in this investigation are in good agreement with those obtained by Sharara Faida *et al*., (2006) who stated that spraying. Panther, Sinal and Grasp herbicide at the recommended doses (0.6, 0.04 and 1.0 L/fed respectively) gave the excellent results for controlling either broad or narrow leave weeds, which were estimated by up to 98% and 86% respectively as compared with control (unweeded control). They added that Panther herbicide being used as selective herbicide for controlling both types of weeds as compared with control. Also, foliar application of Sinal (0.04 L/fed) and Grasp (1.0 L/fed) each alone were superficially the lowest efficient in increasing wheat yield and its components as compared with other herbicides treatments (Panther herbicide).

Data presented in Table (5) show that the concentrations of the used herbicides (lower concentration (<recommended dose), recommended dose and higher concentration (>recommended dose) significantly increased crude protein %, P %, K % as well as all the content of the micronutrients (Fe, Zn, Mn and Cu) in wheat grains as compared with the unweeded control. The highest values of all the chemical composition of wheat grains were found by application the recommended doses of the used herbicides followed by the higher concentration and the lower one in decreasing order. Data also show that there was non significantly differences between the higher and the lower doses of the used herbicides on the chemical composition of the wheat grains.

Data presented in Tables 3 and 4 show that the effect of the interaction between herbicides application and the used concentrations significantly affected all the growth and yield parameters except the spike length. Data in Table (5) reveal that the interaction between herbicides application and the used concentration significantly affected crude protein %, P %, K % and Fe concentration (µg/g dry weight), while the concentrations of Zn, Mn and Cu did not show any significant affect.

The highest values of all growth and yield parameters (Tables 3 and 4) as well as the chemical composition (Table 5) were attained by application of Panther 55 % Sc and using the recommended concentration (0.6 L/fed), while, the lowest values were found by application of Grasp 10 Ec and under the unweeded control.

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