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Effect of magnetized water on the germination of Cotton seeds (*Gossypium hirsutum* L.) under different conditions of saline stress

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Abstract

A laboratory experiment was designed with two factors by using completely randomized design (CRD) with three replicates to determine the effect of saline stress and magnetized water on the germination of cotton seeds. The first factor included salt concentrations of (0, 3, 6, 9 $ds.m^{-1}$), and the second factor included magnetized water with intensity of 1000 gauss and distilled water (control treatment). The seeds were planted on blotting paper and experimental units were placed inside germinator at temperature in the range of 20-30ºC for 12 days**[9]**. The results showed that the use of magnetized water caused a significant increase in the studied traits (germination percentage, germination speed, radicle length, plumule length, and the weight of seedlings)as compared to non-magnetized water. In addition, saline irrigation water has significantly reduced all studied traits as compared to the use of distilled water (0 $ds.m^{-1}$). There was also a significant interaction between concentrations of salinity and magnetized water, in which magnetism has improved the properties of studied trails under saline conditions as compared to non-magnetized water.

Keywords: Magnetized water; Germination; Cotton seeds; Saline stress.

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Introduction

The quantity and quality of irrigation water of the important factors that determine the production of irrigated crops, including cotton. As a result of the availability of good-quality water in the past, the quality of irrigation water has not been emphasized. But, the large expansion of high demand on freshwater, its scarcity and insufficiently, for expansion agricultural production, so most countries in the world have used Saline water as a primary or secondary source of irrigation on the grounds that some crops bear salinity levels in irrigation water, but salinity problem has emerged through the reduction of germination percentage and properties of germination, Ahmad *et. al.* (1) found after the application of the experience of cultivating the cotton plant at Flowerpot in green house, the saline water irrigation ($8ds.m^{-1}$) caused a significant decrease in germination rate, average germination time, length of plumule and length of the radicle, which gave averages of (27%, 5.3days, 1.3cm, 2.1cm) respectively, compared with using distilled water, which showed an average of (91% 2.6days, 4.4cm, 5.1cm) respectively. Nazir *et. al.* (12) indicated after applying an experiment on cotton seeds, increase the salinity of the irrigation water caused a significant decrease in rate of germination, length plumule, length of the radicle and dry weight of the plumule, where the levels (4, 8 $ds.m^{-1}$) gave averages percentage of germination of (46.66%, 2%) respectively, length of the plumule 2.2 and 1.9 cm respectively, length of the root 3.4 and 2.3cm and dry weight of plumule 0.19 and 0.13g, respectively. It is clear that salinity is one of the most important problems that caused the reduction of agricultural production so many researchers adopted the method of coexistence with salinity through

the use of methods of modern irrigation, including the method of irrigation by using magnetized water processor, who has been water obtained after passing through the magnetic field a particular**.** The techniques of magnetic water studied by many researchers. Barefoot and Reich(5) found, that magnetized water facilitates and accelerates absorption it by seeds during germination compared to normal water. Hatium and Alatei(8) confirmed, the magnetically treated water acquires a latent energy that regulates random water loads on a regular basis, giving it a high ability to enter and absorb it by the seed coats when the germination process begins(11)**,** After applying a laboratory experiment on cotton plant, the use of magnetized water levels (1000, 2000, 3000 gauss) caused a significant increase in germination rate and length of root, where giving averages (41.00%, 1.821 cm) (49.125%, 2.125 cm) and (58.00%, 2.625 cm) respectively, as compared to non-magnetized water, and also found that magnetized water caused a significant reduction at the speed of germination, where it gave an averages of (5.337, 4.937 and 4.462 seedling/days) respectively, as compared with non-magnetized water, which gave an average of 7.725 seedling/ days.

This study was conducted to determine the salinity levels in which cotton seeds can grow, as well as role of magnetized water in improving the bearing of cotton seeds to different levels of salt water

. Materials and Methods

A laboratory experiment was carried out in the laboratories of the college of Agriculture / Sumer University to study the role of magnetized water in stimulating the properties of Abland cotton seed germination under salt stress conditions. A factorial experiment with CRD design was used with four replicates. The first factor

consisted of two types of water: magnetized water passing through the Bi-Polar system magnetization system with (1in) diameter, magnetic flood density (1000 gauss) which symbolized by Wm, the second factor was non-magnetized water (W0), The second factor consisted of salt stress levels (0, 3, 6, and 9 $ds.m^{-1}$), which symbolized by (S0, S1, S2, S3), respectively. The main solution was prepared from sodium chloride salt with one gram concentration and then the required concentrations were obtained according to the study factors and according to the mitigation law:

$C_1V_1 = C_2V_2$

where C_1 is the concentration of the original solution (storage), V_1 is the volume of the original solution, C_2 is the required concentration and V_2 is the required volume, and multiplication by (×106), Thus for all the required concentrations. The seeds were germinated in Petri dishes and papers filter at a rate of 15 seed per dish. The seeds were placed in an incubator at 30°C, and the studied traits were then calculated after the end of the standard test period(9)**.**

1. Standard germination test: Natural seedlings were calculated only after the end of the examination period (the twelfth day of cultivation)(9)**.** and then converted the results into percentages according to the following formula:

$$\text{Percentage of germination} = \frac{(\boldsymbol{germinate\ seeds\ number})}{(\boldsymbol{total\ seeds\ number})} \times \mathbf{100} \qquad \ldots\ldots\ldots (1)$$

2. The average time of germination: the time required for germination, estimated from the proposed equation by **(10).**

The average time of germination $= \frac{(g1t1+g2t2\ldots gntn)}{(seedling\ total\ seed)} \times 100$ ..... (2)

Where: g = number of seeds grown that day

T = number of days from the date of cultivation

3. Length of plumule and radicle (cm): 10 natural seedlings were taken after the end of the duration of examination the standard (12) days, and then the root separated from the contact point with the seed, and separated the plumule from the contact point with the central embryonic peduncle, severally, and were measured by the ruler(4)**.**

4. Dry weight of plumule (mg):the plumule was separated from the central embryonic of peduncle area for five natural seedlings, and then placed on paper bags perforated in an electric oven at 70°C **(2),** until the stability of weight. then the dry weight of plumule was calculated by dividing the total root weight of the plumule on their number.

Statistical analysis

The statistical analysis of the data was done for all studied traits. The statistical program was used and the averages was measured by a significant difference (LSD) at the probability level of 0.05(3)**.**

Results and Discussion

Effect of water salinity on some characteristics

The results of Table (1) showed that the water quality had a significant effect on the studied germination traits. The water magnetization caused a significant increase in germination rate and speed of germination, giving the average of (56.62% and 3,386 seedlings.day^{-1}) respectively, compared to the non-magnetized water which the average was (46.96% and 2,317 seedlings.Day^{-1}). This significant increase can be attributed to the fact that water

magnetization facilitated the arrival of water to the fetal cells and thus stimulated the enzymes of the germination of amylase and invertase to convert the starch in the seed into carbohydrate, and encourages it to germinate **[6].** It was also found that magnetized water caused a significant increase in length of the radicle and the length of the plumule and the dry weight of the rosette if it gave averages (1.9358 cm, 2.909 cm and 0.1635 g) respectively compared to non-magnetized water which gave averages of (1.5373 cm, 2.566 cm, 0.14000 g) respectively, and can be attributed to the current biological processes in the plant as facilitating the movement of water inside the cells due to the hydrolysis of magnetized water and by improving the permeability of cellular membranes and increasing ion exchange due to the change in the intracellular and extracellular effort(13).

The results of (Fig 1) showed that the increase of water salinity level resulted in a significant decrease in the studied germination traits. The treatment of 9 dec.m^{-1} gave the lowest average germination percentage and germination speed, giving the average of 40.89% and 1,680 seedlings.day^{-1} of respectively, compared to the control treatment, which gave a average of 65.8% and 4,339 seeds perday^{-1}, this reduction in the percentage and duration of germination with increased salinity concentration could be attributed to increased concentration of sodium ions and chlorine in seeds and their negative effect on the enzymatic activity of amylase and invetase which are responsible for the transformation of starch into carbohydrates as well as inhibition of the role of water within the seeds by reducing its absorption to complete the process of germination(6)**.** This was confirmed by Faraj *et.al*. (7)**.**

Table 1: Effect of water quality and salinity on some traits of cotton seed germination

Water quality	Salinity ds.m^{-1}	Percentage of germination	Speed of germination Seedlings)	Length of Plumule (cm)	Length of Radicle (cm)	Dry weight Of Plumule (cm)
W0	0	58.31	3.708	3.028	2.1033	0.1816
	3	51.58	2.510	2.803	1.7200	0.1560
	6	41.56	1.813	2.413	1.2467	0.1222
	9	36.41	1.237	2.021	1.0793	0.1001
W1	0	73.28	4.970	3.692	2.9167	0.2259
	3	56.92	3.663	3.010	2.0667	0.1753
	6	50.88	2.787	2.703	1.6467	0.1397
	9	45.38	2.123	2.230	1.1133	0.1130
LSD		1.758	0,0963	0,0971	0,06275	0,01055
W0		46.96	2,317	2,566	1,5373	0,1400
W1		56.62	3,386	2,909	1,9358	0,1635
$LSD_{0.05}$		0.879	0,0482	0,0485	0,03138	0,00528
0		65.80	4,339	3,360	2,5100	0,2038
3		54.25	3,087	2,907	1,8933	0,1656
6		46.22	2,300	2,558	1,4467	0,1310
9		40.89	1,680	2,125	1,0963	0,1066
$LSD_{0.05}$		1.243	0,0681	0,0687	0,04437	0,00746

Effect of salinity on some germination characteristics

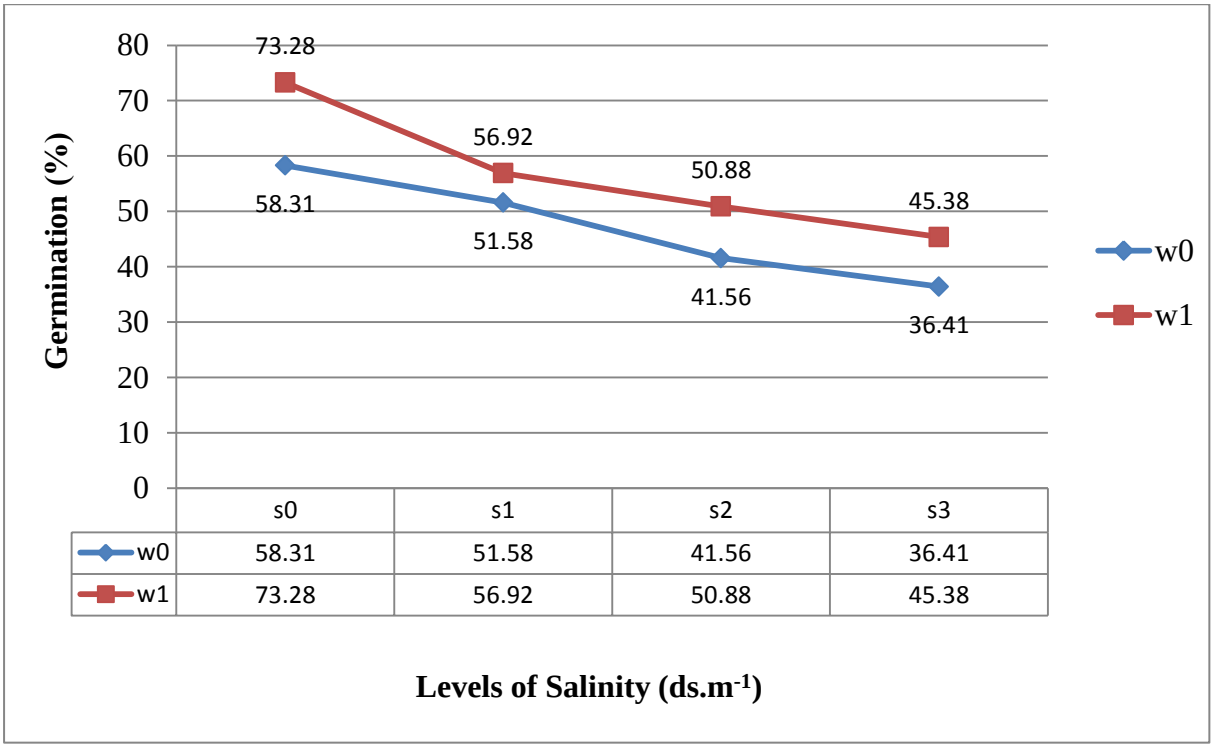
that the salinity levels, especially the high ones, increase of the osmosis pressure, which reduces the absorption of seeds to the water, although available, while moderate levels are suitable culture to stimulate seeds to germinate, This reduction by increasing the water salinity is due to the osmosis pressure and then the water pressure, causing a decrease in water readiness and this is know as the effect of osmosis.

It was also found that the treatment of 9-ds.m^{-1} caused a significant decrease for the length of the radicle and the length of the plumule and the dry weight of the plumule which gave a mean (1.0963 cm, 2.125 cm, 0.1066 g) respectively as compared to the comparison treatment which gave an average of (2.5100 cm, 3.360 cm, 0.2038 g) respectively, and this decrease probably due to the effect of sodium chloride on the growth of plants and the activity of some physiological processes and the effect of salinity on division of the thread, causing the decline of cells division and elongation the time required for division(14)**.** Salinity reduces the number of cells and their size as a result of inhibition of the division and cellular expansion(13).

Effect of interaction between the magnetized water and salinity on some of germination characteristics

There was a significant interaction between the water magnetization and salinity levels (Fig 1, 2, 3, 4 and 5) on germination percentage (%), germination speed (seedlings.day^{-1}), length of plumule (cm) ,length of radicle (cm) and dry weight of plumule (gm.), where was the values of interaction (1.758, 0.0963, 0.0971, 0.06275 and 0.01055) respectively. The results showed that the magnetized water improved the performance of the seed under salinity levels. This is due to the

fact that magnetization works to breaks salt crystals and make them less influence, destroy the hydraulic bonds of water and reduce the surface tension(6), which facilitates the absorption of water, increases germination rate as well as the number of seeds germinated during the time duration ,the low viscosity of water causes increasing of water permeability of the walls of cells leads to rapid division of cells, it is directly reflected along the plumule and the radical and It was found that irrigating the plants with magnetized water reduces the absorption of chlorine and sodium because the magnetic field works to break the salt, separate the salt crystals from absorption, wash the soil from the boron.



	s0	s1	s2	s3
w0	58.31	51.58	41.56	36.41
w1	73.28	56.92	50.88	45.38

Fig 1: the effect of interaction between magnetized water and salinity on germination percentage %

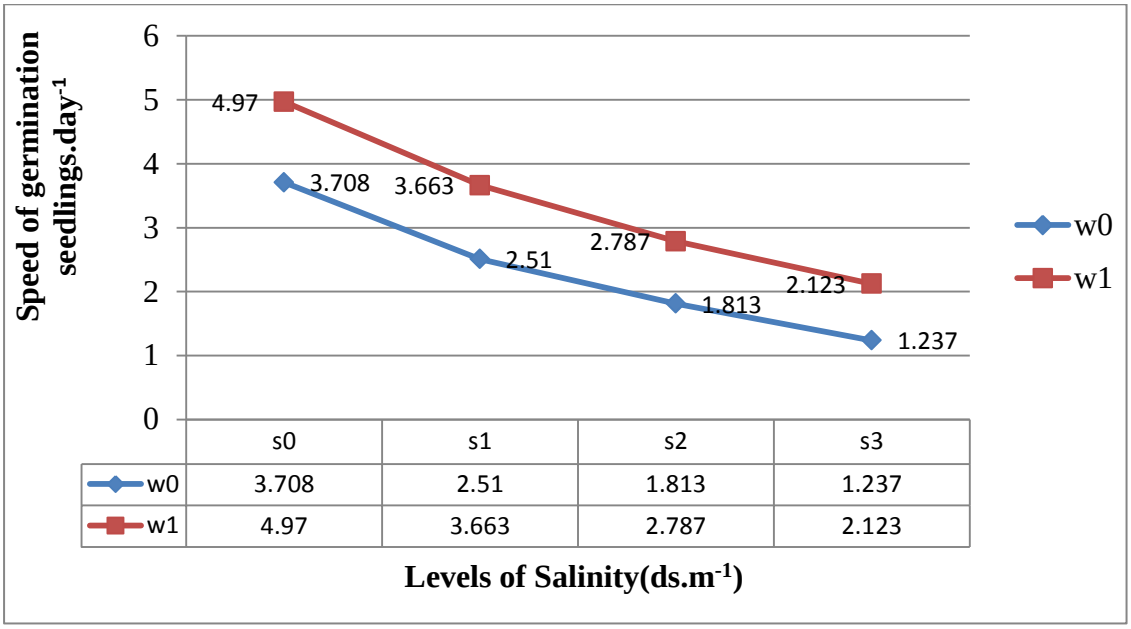


Fig 2: The effect of interaction between water magnetization and salinity at the speed of germination (seed / day).

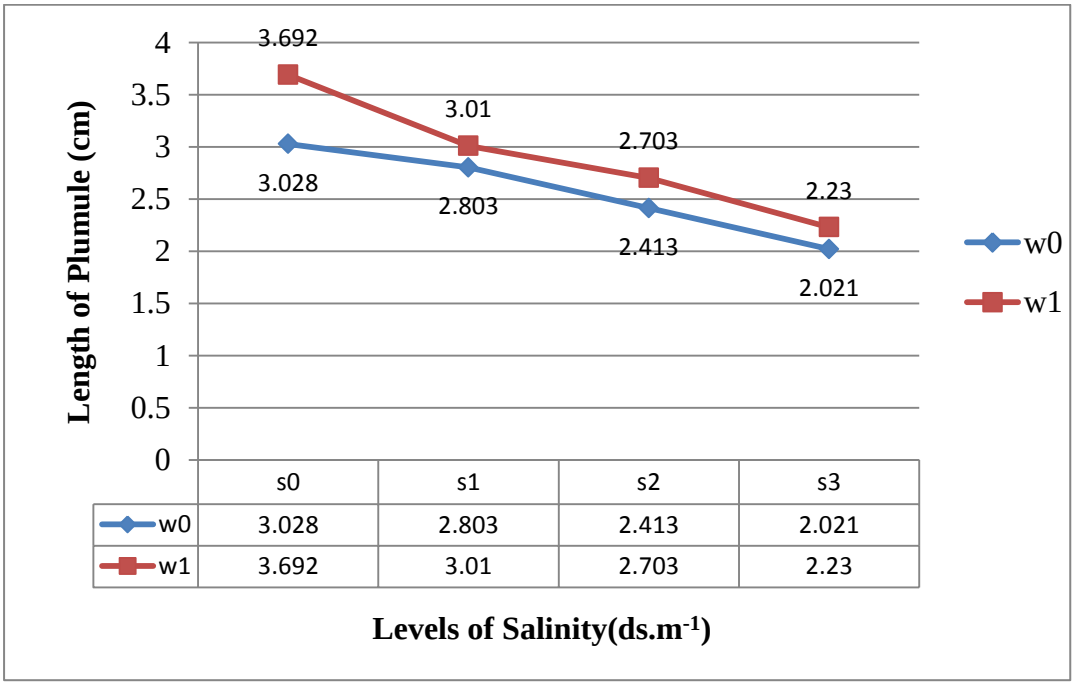
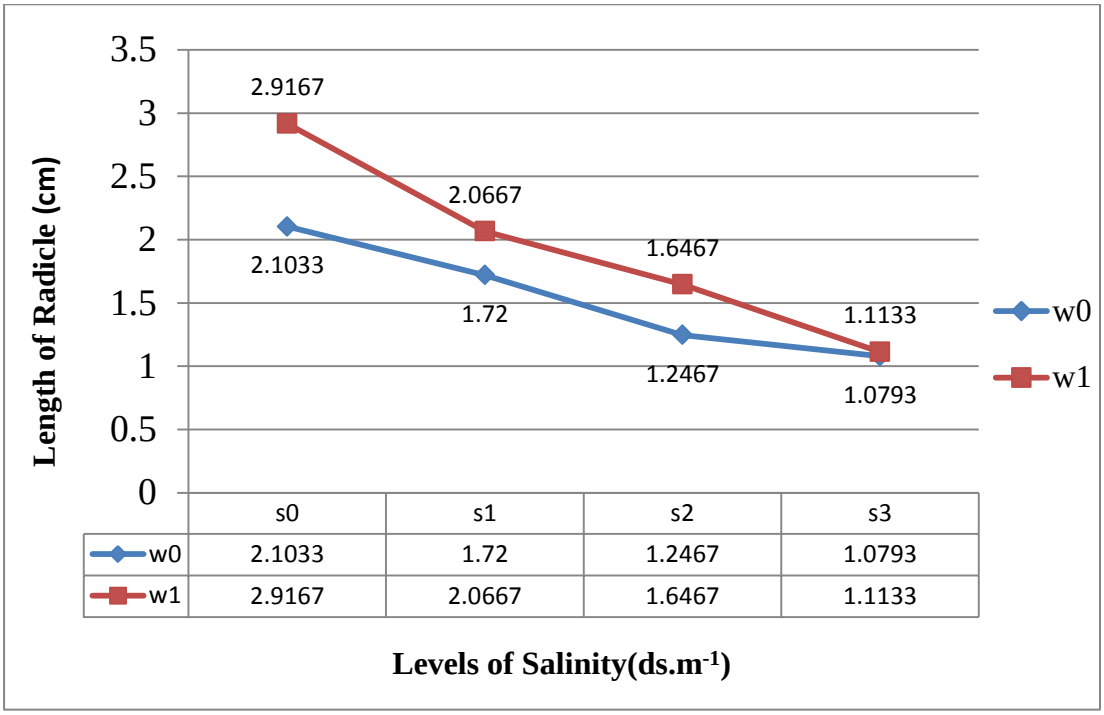
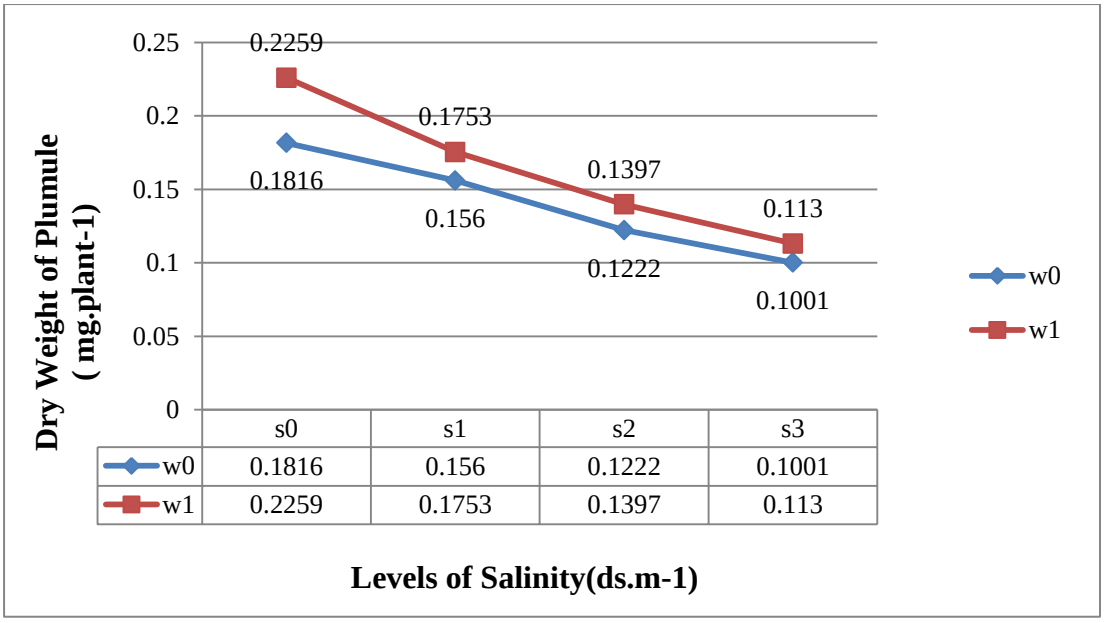


Fig 3: The effect of interaction between water magnetization and salinity on the length of the plumule (cm)



	s0	s1	s2	s3
w0	2.1033	1.72	1.2467	1.0793
w1	2.9167	2.0667	1.6467	1.1133

Fig 4: The effect of interaction between water magnetization and salinity on the length of the radicle(cm)



	s0	s1	s2	s3
w0	0.1816	0.156	0.1222	0.1001
w1	0.2259	0.1753	0.1397	0.113

Fig 5: The effect of interaction between magnetized water and salinity on the dry weight of the plumule (mg)

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