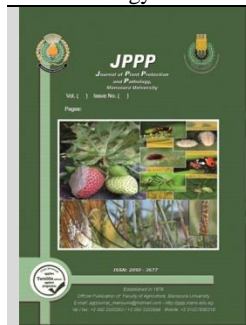# Journal of Plant Protection and Pathology

Stunting in Growth of Cotton Seedlings by Treating Seed with The Fungicide Tebuconazole and Fludioxonil (Eleven)

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ABSTRACT

In the course of evaluating the newly released fungicide Eleven, for controlling damping-off of cotton seedlings, a severe stunting was observed on growth of the surviving seedlings after treating seed with the fungicide. We employed a biometrical approach to demonstrate that the increase in the biosynthesis of abscisic acid (ABA) was the most likely explanation for the observed stunting. The present study also demonstrated that Eleven in itself was effective in controlling damping-off of cotton seedlings caused by *Rhizoctonia solani*. However, despite this efficiency, the application of Eleven for controlling the disease is not a desirable practice, due to its phytotoxic effect on growth of the surviving seedlings.

Keywords: cotton, Fungicide, Tebuconazole, Fludioxonil stunting.

INTRODUCTION

Cotton seedling damping-off is caused by a complex of seed-borne and soil-inhabiting organism. These organisms are found in all cotton producing areas of Egypt.

Although the populations of inciting organisms differ from area to area, the pathogen most commonly involved in the disease complex is *Rhizoctonia solani* (El-Samawaty *et al.*, 1999). The disease occurs as pre-germination decay of the seed, decay of the seedling on the way to soil surface (pre-emergence damping- off, partial or complete girdling of the emerged seedling at or near the soil surface ("sore shine" or post-emergence damping-off), and seedling root-rot (Watkins, 1981).

Cotton seedling damping-off is difficult to control due to the broad host range of the pathogens involved in the disease, and long viability of their resting structures.

Commercially acceptable resistant cultivars are currently unavailable in Egypt. Large-scale application of solarization and fumigation to reduce resting structures in soil is expensive and difficult to achieve. Thus, the widespread use of seed-dressing fungicides for controlling the disease has become indispensable under Egyptian conditions (Aly *et al.*, 2017).

Despite the unequivocal importance of seed-dressing fungicides in controlling damping-off of cotton seedlings, some reports have underlined their undesirable side effects on growth of cotton seedlings. For example, the seed-dressing fungicides Rhizolex T, Mon-cut, and Tendro caused significant stunting in growth of cotton seedlings, which was associated with considerable increase in abscisic acid (ABA) content (Mohamed and Akladious, 2017). In another study also on cotton, the seed-dressing fungicide Bastin showed the same deleterious effect on growth of cotton seedlings (Mohamed *et al.*, 2018).

ABA (abscisin II, dormin) is a terpenoid plant hormone that exerts numerous different, mainly inhibitory, effects on the growth and development of many plant species. It is active, possibly in association with gibberellic acid in the promotion of leaf and fruit abscission and the control of dormancy. It prevents cell elongation and shoot growth and also inhibits seed germination and some tropic responses. At physiological concentrations, ABA is not toxic to plants. A large proportion of ABA is synthesized in the chloroplasts. The rate of synthesis increases dramatically when the plant is under stress, especially from water shortage. ABA overrides the normal diurnal pattern of stomatal opening and closure and causes the stomata to close during the day. This response decreases water loss by transpiration in times of drought (Blackmore and Tootill, 1984; Allaby, 2012).

The newly released seed-dressing fungicides have been routinely tested under greenhouse conditions in Cotton and Fiber Crops Diseases Research Sections, for efficiency in controlling damping-off of cotton seedlings.

In the course of evaluating the newly released seed-dressing fungicide Eleven (Table 1), we observed severe stunting on seedlings after treating seeds with the fungicide.

Table 1. Application rate, active ingredient, and formulation of the fungicide Eleven[a] used in the present study.

Application rate/Kg seeds	Active ingredients[b]	Formulation[c]
1ml	6% Tebuconazole + 4% Fludioxonil	FS

[a]**Trade name**
[b]**Common name**
[c]**Flowable formulation for seed treatment.**

In the present study, we employed a biometrical approach to demonstrate that the increase in the biosynthesis of ABA is the most likely explanation for the observed stunting. We also evaluated the efficiency of Eleven in controlling damping-off of cotton seedlings.

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MATERIALS AND METHODS

Rhizoctonia solani isolate

A highly pathogenic isolate of *R. solani* (AG-4) was used in the present study. This isolate was randomly selected from the fungal culture collection of Cotton Diseases Research Section, plant pathology Research Institute, Agriculture Research Center, Giza, Egypt. The isolate was originally isolated from roots of cotton seedlings infected with damping-off and collected from cotton experimental plots in Sakha Agricultural Research Station.

Greenhouse experiments

The present study was carried out by using autoclaved clay loam soil uninfested or infested with *R. solani* inoculum at a rate of 1 g/Kg soil. the uninfested or the infested soil was dispensed in 15-cm-diameter clay pots the fungicide Eleven was added to dry seeds of cotton cultivars Giza 86 and Giza 90 at a rate of 1ml/Kg seeds.

The seeds were shaken thoroughly in plastic bags for five minutes and allowed to dry before being planted in the pots (20 seeds/pot). In the control treatments, Eleven was not added to seeds. There were five pots for each treatment. Pots were randomly distributed on greenhouse benches under two temperature regimes (38±5°C and 37±3°C). Percentages of preemergence damping-off were recorded 15 days after planting while each of post emergence damping-off survival, plant height, and dry weight was recorded 45 days after planting.

Determination of ABA

Extraction of ABA was carried out according to the method described by Shindy and Smith (1975) and its identification and quantification were carried out using GLC (Varien Vesta, 6000) according to Vogel (1975).

Statistical analysis of the data

The experimental design of the greenhouse pot experiments was a randomized complete block with five replicates (Blocks). Percentage data were subjected to appropriate transformation before carrying out the analysis of variance (ANOVA) to produce approximately constant variance. Least significant difference (LSD) was used to compare treatment means. T test was used to compare between ABA content in cotton seedlings when seeds were treated or untreated with the fungicide Eleven. Correlation analysis was used to evaluate the degree of association between ABA content and plant height. Statistical analysis was carried out by SPSS 6.0 statistical package.

RESULTS AND DISCUSSION

Analysis of variance (ANOVA) shown in Table 2 indicated that cultivar was a highly significant source of variation in preemergence damping-off, postemergence damping-off, and survival while it was a nonsignificant source of variation in plant height and dry weight.

Treatment was a very highly significant source of variation in preemergence damping-off, survival, and plant height while it was a nonsignificant source of variation in the other growth variables. Cultivar×treatment interaction was a nonsignificant source of variation in all the growth variables. This lack of significant interaction indicated that effects of treatments on growth variables were not affected by the tested cultivar – that is treatments and cultivars acted independently of each other.

Table 2. Analysis of variance of effects of cotton cultivars, some treatments and their interaction on growth variable of cotton seedlings grown under high temperature regime (38±5°C).

Growth variable and sources of variation[a]	D.F.	M.S.	F.value	P>F
Preemergence damping-off				
Replicate	4	163.894	1.115	0.369
Cultivar (V)	1	1475.496	10.042	0.004
Treatment (T)	3	2225.690	15.148	0.000
T×V	3	173.368	1.180	0.335
Error	28	146.933		
Postemergence damping-off				
Replicate	4	1.558	0.852	0.505
Cultivar (V)	1	19.502	10.661	0.003
Treatment (T)	3	1.289	0.704	0.557
T×V	3	4.051	2.215	0.108
Error	28	1.829		
survival				
Replicate	4	206.855	1.287	0.299
Cultivar (V)	1	2786.896	17.341	0.000
Treatment (T)	3	2512.135	15.632	0.000
T×V	3	61.221	0.381	0.767
Error	28	160.709		
Plant height				
Replicate	4	12.325	0.593	0.671
Cultivar (V)	1	47.655	2.291	0.141
Treatment (T)	3	142.694	6.861	0.001
T×V	3	16.201	0.779	0.516
Error	28	20.797		
Dry weight				
Replicate	4	0.008	1.843	0.149
Cultivar (V)	1	0.000	0.061	0.807
Treatment (T)	3	0.006	1.560	0.221
T×V	3	0.005	1.238	0.315
Error	28	0.004		

Due to this nonsignificant interaction, the general means were used to compare between treatments. These comparisons showed that *R. solani* was pathogenic in the preemergence stage as it significantly increased preemergence damping-off (Table 3). Eleven was effective in reducing preemergence damping-off in the infested soil from 62 to 18% (Table 3).

Table 3. Effects of some treatments, cotton cultivar, and their interaction on preemergence damping-off under high temperature regime (38±5°C).

Treatment	No.	Giza 90 %	Giza 90 Trans.[a]	Giza 86 %	Giza 86 Trans.	Mean %	Mean Trans.
Untreated seed in autoclaved soil[b]	T1	24	28.926	14	19.330	19	24.128
Treated seed in autoclaved soil	T2	34	35.568	20	25.376	27	30.472
Untreated seed in infested soil[c]	T3	68	56.358	56	51.642	62	54.000
Treated seed in infested soil	T4	30	33.084	6	9.000	18	21.042
Mean		39	38.484	24	26.337		

[a] **Percentage data were transformed into arcsine angles before carrying ANOVA to produce approximately constant variance.**
[b] **seed was not treated with Eleven.** [c] **Soil was infested with *Rhizoctonia solani* at a rate of 1 g/Kg soil.**
LSD (p≤0.05) for cultivar = 7.590
LSD (p≤0.05) for treatment = 10.733
LSD (p≤0.05) for cultivar× treatment interaction is nonsignificant

R. solani was nonpathogenic in the postemergence stage (Table 4). Therefore, the comparison between untreated and treated seed in the infested soil was meaningless.

Table 4. Effects of some treatments, cotton cultivar, and their interaction on postemergence damping-off under high temperature regime (38±5°C).

Treatment	No.	Cotton cultivar					
		Giza 90		Giza 86		Mean	
		%	Trans.[a]	%	Trans.	%	Trans.
Untreated seed in autoclaved soil[b]	T1	14	3.508	0.0	0.710	7	2.109
Treated seed in autoclaved soil	T2	8	2.486	2	1.216	5	1.851
Untreated seed in infested soil[c]	T3	10	2.992	2	1.216	6	2.104
Treated seed in infested soil	T4	2	1.216	4	1.474	3	1.345
	Mean	8.5	2.551	2	1.154		

[a] **Percentage data were transformed into** $\sqrt{X+0.5}$ **before carrying ANOVA to produce approximately constant variance.**
[b] **seed was not treated with Eleven .** [c] **Soil was infested with** *Rhizoctonia solani* **at a rate of 1 g/Kg soil.**
LSD (p≤0.05) for cultivar = 0.847
LSD (p≤0.05) for treatment was nonsignificant
LSD (p≤0.05) for cultivar× treatment interaction was nonsignificant

R. solani isolate was pathogenic in terms of the surviving seedlings as it significantly reduced them by 56.76%. Eleven was effective in controlling the disease as it significantly increased survival by 146.88% (Table 5).

Table 5. Effects of some treatments, cotton cultivar, and their interaction on survival under high temperature regime (38±5°C).

Treatment	No.	Cotton cultivar					
		Giza 90		Giza 86		Mean	
		%	Trans.[a]	%	Trans.	%	Trans.
Untreated seed in autoclaved soil[b]	T1	62	52.024	86	70.670	74	61.347
Treated seed in autoclaved soil	T2	58	49.666	78	63.000	68	56.333
Untreated seed in infested soil[c]	T3	22	25.112	42	37.154	32	31.133
Treated seed in infested soil	T4	68	55.712	90	78.466	79	67.089
	Mean	52.5	45.629	74	62.323		

[a] **Percentage data were transformed into arcsine angles before carrying ANOVA to produce approximately constant variance.**
[b] **seed was not treated with Eleven.** [c] **Soil was infested with** *Rhizoctonia solani* **at a rate of 1 g/Kg soil.**
LSD (p≤0.05) for cultivar = 7.938
LSD (p≤0.05) for treatment = 11.225
LSD (p≤0.05) for cultivar× treatment = interaction was nonsignificant

Regarding plant height, *R. solani* was pathogenic as it significantly reduced it (Table 6). Eleven was ineffective in increasing the plant height. This is because Eleven in itself showed deleterious effect on the plant height. Thus, it reduced it by 43.59% in the autoclaved soil.

It seems reasonable to assume that a large experimental error was associated with the assessment of dry weight. This large experimental error obscured the effects of sources of variation, which they all were nonsignificant. Therefore, it was not possible to determine the effect of Eleven on dry weight (Table 7).

Table 6. Effects of some treatments, cotton cultivar, and their interaction on plant height (cm/plant) under high temperature regime (38±5°C).

Treatment	No.	Cotton cultivar		
		Giza 90	Giza 86	Mean
Untreated seed in autoclaved soil[a]	T1	18.552	18.954	18.753
Treated seed in autoclaved soil	T2	7.974	13.260	10.617
Untreated seed in infested soil[b]	T3	13.942	13.766	13.854
Treated seed in infested soil	T4	9.286	12.506	10.896
	Mean	12.439	14.622	

[a] **seed was not treated with Eleven.**
[b] **Soil was infested with** *Rhizoctonia solani* **at a rate of 1 g/Kg soil.**
LSD (p≤0.05) for cultivar was nonsignificant
LSD (p≤0.05) for treatment = 4.038
LSD (p≤0.05) for cultivar× treatment interaction was nonsignificant

Table 7. Effects of some treatments, cotton cultivar, and their interaction on dry weight (mg/plant) under high temperature regime (38±5°C).

Treatment	No.	Cotton cultivar		
		Giza 90	Giza 86	Mean
Untreated seed in autoclaved soil[a]	T1	0.192	0.168	0.180
Treated seed in autoclaved soil	T2	0.126	0.144	0.135
Untreated seed in infested soil[b]	T3	0.220	0.162	0.191
Treated seed in infested soil	T4	0.132	0.176	0.154
	Mean	0.168	0.163	

[a] **seed was not treated with Eleven.**
[b] **Soil was infested with** *Rhizoctonia solani* **at a rate of 1 g/Kg soil.**
LSD (p≤0.05) for cultivar was nonsignificant
LSD (p≤0.05) for treatment was nonsignificant
LSD (p≤0.05) for cultivar× treatment interaction was nonsignificant

Anova (Table 8) showed that cultivar was a significant, a highly significant, and a very highly significant source of variation in preemergence damping-off, postemergence damping-off, and survival, respectively while it was a nonsignificant source of variation in plant height, and dry weight. Treatment was a very highly significant source of variation in all growth variables while it was a significant source of variation in dry weight. Cultivar×treatment interaction was a significant source of variation in preemergence damping-off, survival, and plant height while it was a nonsignificant source of variation in the other growth variables. It is worth noting that the significant cultivar×treatment interaction was detected only under the low temperature regime.

The significant cultivar×treatment interaction (Table 9) indicated that the effect of treatments on preemergence damping-off varied depending on the tested cultivar. Due to the significant of the interaction, an interaction least significance difference (LSD) was used to compare between treatment means within each cultivar.

These comparisons showed that *R. solani* was nonpathogenic on Giza 90 while it was pathogenic on Giza 86. Therefore, evaluating the efficiency of Eleven in controlling damping-off on Giza 90 was meaningless. On the other hand, Eleven was effective in reducing

preemergence damping-off by 70.83% on Giza 86. *R. solani* was nonpathogenic in the postemergence stage regardless of the tested cultivar (Table 10). Therefore, evaluating Eleven in controlling postemergence damping-off was meaningless.

Table 8. Analysis of variance of effects of cotton cultivars, some treatments and their interaction on growth variable of cotton seedlings grown under low temperature regime (37±3°C).

Growth variable and sources of variation[a]	D.F.	M.S.	F.value	P>F
Preemergence damping-off				
Replicate	4	127.705	0.888	0.484
Cultivar (V)	1	634.173	4.408	0.045
Treatment (T)	3	1123.606	7.810	0.001
T×V	3	423.801	2.946	0.050
Error	28	143.864		
Postemergence damping-off				
Replicate	4	3.512	3.120	0.031
Cultivar (V)	1	7.885	7.004	0.013
Treatment (T)	3	5.317	4.722	0.009
T×V	3	0.162	0.144	0.933
Error	28	1.126		
survival				
Replicate	4	119.256	0.874	0.492
Cultivar (V)	1	1131.351	8.290	0.008
Treatment (T)	3	1531.829	11.224	0.000
T×V	3	417.009	3.056	0.045
Error	28	136.473		
Plant height				
Replicate	4	5.236	0.749	0.567
Cultivar (V)	1	15.240	2.179	0.151
Treatment (T)	3	166.455	23.804	0.000
T×V	3	21.012	3.005	0.047
Error	28	6.993		
Dry weight				
Replicate	4	0.005	1.108	0.373
Cultivar (V)	1	0.003	0.646	0.428
Treatment (T)	3	0.014	3.399	0.031
T×V	3	0.002	0.414	0.744
Error	28	0.004		

Table 9. Effects of some treatments, cotton cultivar, and their interaction on preemergence damping-off under low temperature regime (37±3°C)

Treatment	No.	Cotton cultivar					
		Giza 90		Giza 86		Mean	
		%	Trans.[a]	%	Trans.	%	Trans.
Untreated seed in autoclaved soil[b]	T1	32	34.162	10	14.018	21	24.090
Treated seed in autoclaved soil	T2	24	28.800	8	10.624	16	19.712
Untreated seed in infested soil[c]	T3	40	39.004	48	43.846	44	41.425
Treated seed in infested soil	T4	12	17.706	14	19.330	13	18.518
Mean		27	29.918	20	21.954		

[a] **Percentage data were transformed into arcsine angles before carrying ANOVA to produce approximately constant variance.**
[b] **seed was untreated with Eleven.**
[c] **Soil was infested with *Rhizoctonia solani* at a rate of 1 g/Kg soil.**
LSD (p≤0.05) for cultivar× treatment interaction= 15.020

Table 10. Effects of some treatments, cotton cultivar, and their interaction on postemergence damping-off under low temperature regime (37±3°C).

Treatment	No.	Cotton cultivar					
		Giza 90		Giza 86		Mean	
		%	Trans.[a]	%	Trans.	%	Trans.
Untreated seed in autoclaved soil[b]	T1	4	1.722	0.0	0.710	2	1.216
Treated seed in autoclaved soil	T2	4	1.722	0.0	0.710	2	1.216
Untreated seed in infested soil[c]	T3	12	3.250	6	2.228	9	2.739
Treated seed in infested soil	T4	4	1.722	2	1.216	3	1.469
Mean		6	2.104	2	1.216		

[a] **Percentage data were transformed into** $\sqrt{X + 0.5}$ **before carrying ANOVA to produce approximately constant variance.**
[b] **seed was untreated with Eleven.**
[c] **Soil was infested with *Rhizoctonia solani* at a rate of 1 g/Kg soil.**
LSD (p≤0.05) for cultivar = 7.510
LSD (p≤0.05) for treatment = 10.621
LSD (p≤0.05) for cultivar× treatment interaction was nonsignificant

Regarding survival, *R. solani* was pathogenic as it significantly reduced it by 38.96% regardless of the tested cultivar. Eleven was effective in increasing survival by 78.72% in infested soil (Table 11).

Table 11. Effects of some treatments, cotton cultivar, and their interaction on survival under low temperature regime (37±3°C) .

Treatment	No.	Cotton cultivar					
		Giza 90		Giza 86		Mean	
		%	Trans.[a]	%	Trans.	%	Trans.
Untreated seed in autoclaved soil[b]	T1	64	53.354	90	75.982	77	64.668
Treated seed in autoclaved soil	T2	72	58.422	92	79.376	82	68.899
Untreated seed in infested soil[c]	T3	48	43.846	46	42.516	47	43.181
Treated seed in infested soil	T4	84	69.046	84	69.340	84	69.193
Mean		67	56.167	78	66.803		

[a] **Percentage data were transformed into arcsine angles before carrying ANOVA to produce approximately constant variance.**
[b] **seed was untreated with Eleven.** [c] **Soil was infested with *Rhizoctonia solani* at a rate of 1 g/Kg soil.**
LSD (p≤0.05) for cultivar = 7.938
LSD (p≤0.05) for treatment = 11.225
LSD (p≤0.05) for cultivar× treatment interaction was nonsignificant

In terms of plant height, *R. solani* was nonpathogenic on Giza 90 while it was pathogenic on Giza 86 because it significantly reduced plant height by 25.42%.

Eleven was not effective in improving plant height of Giza 86 in infested soil. This is because Eleven in itself showed deleterious effect on plant height as shown in the autoclaved soil (Table 12).

Regarding dry weight, *R. solani* was nonpathogenic. Therefore, evaluating the efficiency of Eleven in controlling the disease was meaningless (Table 13).

Effect of the seed-dressing Eleven on ABA content of two cotton cultivars was investigated under greenhouse conditions (Table 14). Fourty five days after treating seeds with Eleven, ABA concentration in seedling tissues increased by 84% (Table 14). ABA concentration, as expected, was negatively correlated with plant height (r = -0.65, P = 0.09) as shown in Table 15.

Table 12. Effects of some treatments, cotton cultivar, and their interaction on plant height(cm/plant) under low temperature regime (37±3˚C).

Treatment	No.	Cotton cultivar		
		Giza 90	Giza 86	Mean
Untreated seed in autoclaved soil[a]	T1	21.782	23.358	22.570
Treated seed in autoclaved soil	T2	11.630	15.882	13.756
Untreated seed in infested soil[b]	T3	20.140	17.420	18.780
Treated seed in infested soil	T4	13.652	15.482	14.567
	Mean	16.801	18.04	

[a] seed was untreated with Eleven.
[b] Soil was infested with *Rhizoctonia solani* at a rate of 1 g/Kg soil.
LSD (p≤0.05) for cultivar× treatment interaction= 3.312

Table 13. Effects of some treatments, cotton cultivar, and their interaction on dry weight (mg/plant) under low temperature regime (37±3˚C).

Treatment	No.	Cotton cultivar		
		Giza 90	Giza 86	Mean
Untreated seed in autoclaved soil[a]	T1	0.306	0.268	0.287
Treated seed in autoclaved soil	T2	0.248	0.242	0.245
Untreated seed in infested soil[b]	T3	0.314	0.276	0.295
Treated seed in infested soil	T4	0.206	0.222	0.214
	Mean	0.269	0.25	

[a] seed was untreated with Eleven.
[b] Soil was infested with *Rhizoctonia solani* at a rate of 1 g/Kg soil.
LSD (p≤0.05) for cultivar was nonsignificant
LSD (p≤0.05) for treatment = 0.056
LSD (p≤0.05) for cultivar× treatment interaction was nonsignificant

Table 14. Comparison between Abscisic acid content[a] in cotton seedlings when seeds were treated[b] or untreated with the seed-dressing fungicide Eleven.

Estimate (SE)[c]		Mean difference	t.value	p.value	Increase (%)[f] in treated seeds
Untreated	Treated				
0.025[d](0.007)	0.046[e](0.003)	0.021	2.84	0.07	84

[a] Abscisic acid content was estimated in mg/100g fresh weight.
[b] Seeds were treated with Eleven at a rate of 1ml/Kg seeds.
[c] Standard error
[d] Mean of four replicates
[e] Mean of four replicates
[f] $\dfrac{\text{Mean difference}}{\text{Estimate in untreated seeds}} \times 100$

Table 15. correlation between abscisic acid content (X) and plant height (Y) of cotton seedlings under the effect of different environmental conditions in autoclaved soil.

Environmental conditions					
Environment no.	Treatment with Eleven[a]	Cultivar	Temperature regime	abscisic acid[d] content	plant height[e]
E1	Untreated	Giza 90	High[b]	0.009	18.90
E2	Treated	Giza 90	High	0.050	7.97
E3	Untreated	Giza 86	High	0.019	18.95
E4	Treated	Giza 86	High	0.044	13.23
E5	Untreated	Giza 90	Low[c]	0.038	21.78
E6	Treated	Giza 90	Low	0.052	11.63
E7	Untreated	Giza 86	Low	0.032	23.36
E8	Treated	Giza 86	Low	0.038	15.88

[a] The seed-dressing Eleven was applied at a rate of 1 ml/Kg seeds.
[b] High temperature regime (38±5˚C)
[c] Low temperature regime (37±3˚C)
[d] mg/100 g fresh weigh
[e] cm/plant
Linear correlation coefficient (r)= -0.63, P= 0.09, and n= 8.

Under nonstressful conditions, ABA in plant cell is maintained at low levels, ABA can increase dramatically in response to enviromentall stresses. The degradation of ABA appears to be suppressed by stress and activated by ABA and stress relief (Xiong and Zhu, 2003). Therefore, it seems reasonable to conclude that the observed increase in ABA concentration after treating seeds with Eleven could be attributed to the chemical stress caused by Eleven, which increased ABA by 84% and consequently reduced plant height proportionally. However, this conclusion did not ruled out the possibility that other growth regulators may also be involved in the observed stunting.

Eleven consists of two ingradients (Table 1). Therefore, stunting of seedlings resulting from the application of Eleven could be attributed to the individual effect of one ingradient or the combined effect of the two ingradients.

From practical point of view, stunting of cotton seedlings at early growth stage could be deleterious to cotton productivity because it may allow cotton weeds to become more quickly established and so increase the competition between weeds and the retarded cotton seedlings.

In conclusion, the present study demonstrated that Eleven in itself was effective in controlling damping-off of cotton seedlings caused by *R. solani*. However, despite this efficiency, the application of Eleven for controlling damping-off of cotton seedlings is not a desirable practice due to its phytotoxic effect on growth of the surviving seedlings.

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التقزم فى نمو بادرات القطن الناجم عن معاملة البذرة بمادتى تيبيوكونازول و فلوديوكسانيل (إليفين)

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عند تقييم المبيد الفطرى إليڤين، الذى سمح بتداوله مؤخرا، لمقاومة مرض موت بادرات القطن، لوحظ تقزم شديد على البادرات السليمة بعد معاملة البذرة بهذا المبيد. أمكن بتحليل معطيات الدراسة إحصائيا۔ التوصل إلى أن الزيادة فى تركيز حمض الأبسيسك هو السبب الأكثر احتمالا لتقزم البادرات. تدل نتائج الدراسة الحالية على أنه رغم فاعلية المبيد الفطرى إليڤين فى مقاومة مرض موت بادرات القطن المتسبب عن فطر الريزوكتونيا سولانى, إلا أنه من غير المرغوب فيه توظيفه فى مقاومة المرض نظرا لما له من تأثير سام على نمو بادرات القطن السليمة.