

STUDIED OF TOLERANCE OF SOME EGYPTIAN COTTON CULTIVARS FOR DROUGHT (WATER STRESS)

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ABSTRACT

Two experiments were carried out at Sakha Agricultural Research Station , Cotton Research Institute , to study the effect of drought on morphological , yield , yield components and physiological traits in some cotton cultivars . This study comprised some Egyptian cotton cultivars i.e. G.91, G.89, G.85, G.88, G.70, G. 89x G.86 , G.89 x Pima S6, G.86 and G.80. Were planted under drought condition which take five once irrigation and normal condition, which take eight once irrigation as control .

The results obtained could be summarized as follows :-

- 1- Cultivars differently responded to drought conditions.
- 2- Drought condition tended to decreased number of fruiting branches , dry weight , plant height , leaf area index, boll weight , seed and lint cotton yield per plant , seed index , lint percentage , number of bolls per plant , total chlorophyll , proteine and oil percentage in seeds.
- 3- The proline content in leaves was increased as a result of water stress conditions (drought) .
- 4- G.86 and G.80 observed the highest values of content of proline in leaves and had a highest yield and its components under drought stress.
- 5- For plant breeder , these results very important to select plants had higher proline content in leaves as indicator to obtained plants more tolerant to drought and highly yielding .

INTRODUCTION

The development of drought tolerant crops has hindered by lack of knowledge of precise physiological parameters that are diagnostic of genetic potential for improved productivity under water deficit condition . Cotton is especially interesting to study genetic potential for adaptation to water deficit. Cotton originated from perennial plants adapted to semiarid , subtropical environment , which experience periodic drought and temperature extremes Ahamad *et al.* (1989) Delauncy and Verma (1993) ; Ronde *et al.* (2000) Esmail and Abdel-Sttar (2001). Adequate emergence and uniform distribution of seedlings are important factors for cotton yield . in many areas, the surface layer of soil becomes dry after cotton seed are sown because of rapid soil water evaporation Mcdanial (2000),Basal *et al* (2005) and Li-Zhibo *et al.* (2006).

Sever drought on cotton plants will slow plant development and cause small bolls and squares to shed.Establishment and prebloom irrigations affect total yield but water deprivation following bloom and into boll development also affects lint quality .

If managed properly,cotton could withstand drought on infrequent irrigated,coarse textured,sandy soil with hot, dry conditions from jun 1 through

the end of August . Even during peak bloom , cotton will use only 0.3 to 0.4 inch of water per day . Irrigated cotton fields , of course , respond well to additional moisture with yields escalating as moisture needs are met . Bucks *et al.* (1982)) and (Grinaes and Yamada (1982) and Voloudakis *et al.* (2002)

Many plants , including halophytes accumulation proline to high levels in response to osmotic stress. Such as water stress . Kamel *et al.* (1995). Also Badran (2006) found that, praline content in cotton leaves were increased in both seasons when plants were grown at different levels of stress and significant differences among cotton genotypes under investigation.

The objective of this research was to evaluate yield potential of nine cultivars under drought conditions to identify drought tolerant cotton cultivars and determine the variations for various characters, which may help for selection programs.

MATERIALS AND METHODS

Tow experiments were conducted at Sakha Agricultural Research Station , Cotton Research Institute, to study the effect of water stres(drought) on yield , yield components , morphological and physiological traits of cotton plants. Nine cotton cultivars belong to *Gossypium barbadense* .L. showed a great variability in their performances were used during two successive seasons 2006 and 2007.

Table 1: The pedigree of nine cotton varieties under study :

No.	Variety	Pedigree
1	G.91	(G.81 x G.83)
2	G.89	(G.75 x 6022)
3	G.85	(G.67 x C.B.58)
4	G.88	(G.77 x G.45)B
5	G.70	(G.59.A x G.51.B)
6	G.89 x G.86	(G.89 x G.86)
7	G.89 x Pima S6	(G.89 x Pima S6)
8	G.86	(G.75 x G.81)
9	G.80	(G.66 x G.73)

A randomized complete blocks design with three replications with one row in each plot . The row was 4.0 meters long , 60 cm a part and 40 cm between hills . The hill was thinned to one plant . The usual cultural practices were followed throughout the growing season . Hence forward the plants under stress toke five irrigated and the un-treated plants (control – normal) were toke eight irrigated .The same experimental design was used in the 1st and 2rd season.

Data for morphological, yield, yield components, and physiological traits were recorded on five plants from every plot.

The following traits were measured :-

A- morphological traits :-

1- Number of fruiting branches per plant (No.of F.B./P.)

- 2- Plant height in centimeters (P.h.cm.)
- 3- Total dry weight in gram (D.W.gm)
- 4- Leaf area index (L.A.I. cm²)
- B- yield and yield components traits :-
 - 1-Boll weight (B.W.)
 - 2-Seed cotton yield per plant (S.C.Y./P.gm)
 - 3-Lint cotton yield per plant (L.C.Y./P.gm)
 - 4-Lint percentage (L%)
 - 5-Seed index (S.I.gm)
 - 6-Number of bolls per plant (No.of.B./P.)
- C-physiological traits :-
 - 1-Total chlorophyll
 - 2-Proline concentration.
 - 3-Protein percentage.
 - 4-Oil percentage

Analyses of variance were made according to Steel and Torrie (1961) using the least significant differences (L.S.D.) . Proline concentration was measured according to Bates *et al.* (1973). Oil and protein in seeds were determined using A.O.A.C. methods (1975). Total chlorophyll were determined to Arnon (1949) .

RESULTS AND DISCUSSION

1- The analysis of variances :-

A- Morphological traits :-

The results of the analysis of variances and the mean squares for morphological traits of normal and water stress of all genotypes are shown in the Table 2. The results revealed that the mean squares of cultivars for all the studied traits showed highly significance with the except of number of fruiting branches in drought at 2007 season which showed insignificant . As well as , the replications mean squares were insignificant for all the studied traits in normal and drought stress at the two growing seasons 2006 and 2007 . Except of number of fruiting branches , plant height under drought condition at 2006 season and dry weight in normal condition at 2006 season .

B-Yield and yield components traits :-

The mean squares for yield and yield components traits of normal and water stress of some cotton cultivars are presented in Table 3. The results indicated that the mean squares of cultivars for all the studied traits showed highly significance in normal and drought stress . In addition, the replication mean squares were insignificant for all the studied traits with a few exceptions .

C-Physiological traits :-

The results of the analysis of variances and the mean squares of the physiological traits are presented in Table 4. The results also indicated that all the studied traits were highly significant with except total chlorophyll in normal at 2006 season which was insignificant value. The replication should insignificant differences with a few exception.

Table (2): The analysis of variances and the mean squares for morphological traits of some cotton cultivars under normal and water stress .

S.O.V	d.f.	Number of fruiting branches				Plant height				Dry Wight				Leaf area index			
		Normal		Drought		Normal		Drought		Normal		Drought		Normal		Drought	
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Replication	2	2.67	0.57	1.65**	0.08	89.9	191.4	193.7**	34.04	2.17**	0.45	0.25	0.41	11.67	9.36	265.5	23.62
Genotypes	8	3.12**	1.99	3.49**	1.48	713.4**	408.5	557.5**	417.6**	9.88**	9.46**	7.51**	4.49**	2803.7**	2639.9**	1474.4**	1572.9**
Error	16	0.45	1.32	0.14	0.64	47.9	105.7	21.27	19.99	0.16	0.33	0.43	0.66	227.2	276.6	416.4	45.61

*,** significant at 0.05 and 0.01 level of probability, respectively

Table (3): The analysis of variances and the mean squares for yield and yield components traits of some cotton cultivars under normal and water stress .

S.O.V	d.f.	Boll Weight				Seed cotton yield				Lint cotton yield			
		Normal		Drought		Normal		Drought		Normal		Drought	
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Replication	2	0.024**	0.005	0.029	0.001	57.68	241.3**	22.84	0.059	5.22	40.81**	2.81	0.023
Genotypes	8	0.164**	0.181**	0.136**	0.512**	445.3**	463.9**	130.1**	115.8**	93.15**	107.94**	22.32**	21.89**
Error	16	0.003	0.013	0.010	0.125	21.81	25.98	15.58	6.27	3.74	3.67	2.04	0.96

*,** significant at 0.05 and 0.01 level of probability, respectively.

table (3) Cont.

S.O.V	d.f.	Lint percentage				Seed index				Number of bolls/plant			
		Normal		Drought		Normal		Drought		Normal		Drought	
		2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
Replication	2	0.467	0.817	0.004	0.001	0.197	0.001	0.456**	0.368*	2.49	49.36	12.99	4.37
Genotypes	8	17.37**	18.33**	17.38**	18.65**	0.446**	0.359**	0.662**	0.489**	25.90**	29.95**	19.79**	23.54**
Error	16	0.782	0.468	0.335	1.15	0.094	0.036	0.073	0.084	4.45	3.17	3.24	3.95

*,** significant at 0.05 and 0.01 level of probability, respectively

2-The mean performances :-

A- Morphological traits :-

The mean performances of morphological traits of some cotton cultivars were determined under normal and water stress conditions and the results are presented in Table 5.

The results indicated that the highest mean was G.86 for number of fruiting branches at normal and water stress in the tow seasons . The same results were for leaf area index with mean values 478.4, 481.7, 298.0 and 321.0 cm² under normal and water stress at 2006 and 2007 seasons , respectively . On the other hand , the lowest values were G.70 with mean values 378.4 and 381.8 cm² at the control and 143.7 cm² at water stress in 2007 season.

For plant height , the results indicated that the lowest means was G.89 x pima S6 in normal and drought at 2006 and 2007 seasons with the mean values 122.5, 125, 90.10 and 102.3 cm . In addition the highest mean for the same traits was G.86 in normal at 2006 and drought at 2007 with the mean values 162.5 and 135 cm , respectively Regarding dry weight traits , G.80 cultivar was the superior cultivar in under normal (2006) conditions , as well as , drought (2006 and 2007) with the mean values of 20.17, 16.10 and 16.75 gm., respectively . While, . G.86 cultivar was the lowest mean performances in 2006 . 2007 under drought with the mean values 11.77 and 12.86 gm ., respectively .

C- Yield and yield components traits :-

The mean performances of means of normal; and water stress on yield and yield components traits of some cotton cultivars in 2006 and 2007 seasons were determined and the results are presented in Table 6. the means showed that the G.86 variety was the superior and have the highest means for most of studied traits in normal and drought conditions at 2006 and 2007 seasons such as boll weight , seed cotton yield per plant and lint cotton yield per plant with the mean values 3.07, 3.01, 246, 2.53, 89.29, 93.22, 48.65, 48.96, 35.33, 37.17, 18.10 and 18.06 , respectively . As well as, for seed index G.86 was the highest means in normal with the mean values 9.38 and 9.57 , respectively . The same results were for number of bolls per plant with values 29.31, 31.02 and 19.80 in normal 2006 and 2007 , as well as, 2006 drought conditions , respectively . the lowest values were G.70 , G.89 and G.80 for most of studied traits .

The results also indicated that decreased the means when the varieties were in water stress if we compared it with normal or control conditions . that's results for all the studied traits .

These results were generally in agreement with the results obtained by Bucks *et al.* (1988); Delauncy and Verma (1993); Ronde *et al.* (2000) ;Rajagopal and Dhopte (2002); Reddy and Kumari(2004) and Li-Zhibo *et al* (2006).

C-Physiological traits :-

The means performances of normal and water stress on physiological traits of some cotton cultivars at 2006 and 2007 seasons calculated and the results found in Table 7.

Table (4) : The analysis of variances and the mean squares for physiological traits of some cotton cultivars under normal and water stress .

Oil percentage				Protein percentage				Proline concentration				Total chlorophyll				d.f.	S.O.V
Drought		Normal		Drought		Normal		Drought		Normal		Drought		Normal			
2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006		
0.006	0.013	0.005	0.013	0.043	0.283*	0.010*	0.014	0.001	0.013	0.025*	0.027	0.001	0.009	0.13	0.04	2	Replication
0.780**	1.54**	1.353**	0.773**	4.89**	4.83**	4.872**	4.621**	0.134**	0.159**	0.391**	0.388**	0.62**	0.61**	0.44**	0.35	8	Genotypes
0.031	0.040	0.016	0.037	0.048	0.057	0.003	0.009	0.002	0.015	0.007	0.018	0.038	0.004	0.01	0.17	16	Error

*,** significant at 0.05 and 0.01 level of probability, respectively.

Table (5): The mean performances of morphological traits of some cotton cultivars under normal and water stress.

Cultivars	Number of fruiting branches				Plant height				Dry Wight				Leaf area index			
	Normal		Drought		Normal		Drought		Normal		Drought		Normal		Drought	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
G.91	17.90	17.77	15.37	16.33	150.17	137.5	127.5	120.0	17.50	16.50	15.50	15.90	411.7	418.4	242.4	267.5
G.89	17.80	16.77	15.77	16.00	122.87	130.0	121.5	115.0	19.75	20.00	15.95	14.60	438.9	434.4	265.7	293.3
G.85	16.70	15.87	14.27	15.00	130.00	131.0	117.5	110.0	15.65	14.85	14.50	14.25	411.7	408.4	286.1	289.0
G.88	16.60	15.77	13.50	15.00	127.60	137.5	132.5	135.0	20.15	18.50	14.95	14.85	440.6	433.3	291.7	301.2
G.70	16.17	16.00	16.07	15.50	150.0	140.0	125.0	127.6	15.50	15.50	13.25	13.95	378.4	381.8	245.2	243.7
G.89xG.86	16.17	15.87	15.27	15.60	162.5	152.5	134.1	132.7	17.00	15.75	12.75	13.65	439.9	443.4	283.0	305.0
G.89x Pima S6	16.23	16.00	15.23	15.00	122.5	125.0	90.10	102.3	16.92	16.67	12.75	13.49	410.3	408.7	234.0	274.5
G.86	19.00	17.67	17.17	16.77	157.7	162.5	130.0	135.0	17.95	18.85	11.77	12.86	478.4	481.7	298.0	321.0
G.80	16.20	15.87	15.97	15.27	135.0	135.0	110.0	115.0	20.17	18.50	16.10	16.75	388.9	394.6	266.2	279.0
L.S.D.0.05	1.16	1.98	0.636	1.344	11.98	17.80	7.98	7.74	0.459	0.996	1.139	1.406	26.04	28.79	35.30	11.64
L.S.D.0.01	1.60	2.74	0.876	1.906	16.50	24.52	11.00	10.66	0.647	1.372	1.569	1.937	35.95	39.67	48.70	16.11

Table (6): The mean performances of yield and yield components traits of some cotton cultivars under normal and water stress.

cultivars	Boll Weight				Seed cotton yield				Lint cotton yield			
	Normal		Drought		Normal		Drought		Normal		Drought	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
G.91	2.38	2.42	2.26	2.26	50.41	65.40	31.94	34.28	18.58	25.17	11.57	11.99
G.89	2.75	2.82	2.34	2.25	53.62	63.85	29.45	33.75	20.54	24.21	10.57	11.95
G.85	2.75	2.27	2.27	2.33	61.39	61.18	29.97	36.01	22.04	22.17	9.77	11.52
G.88	2.47	2.44	1.99	2.09	60.83	51.32	34.01	38.75	20.55	17.44	11.14	12.18
G.70	2.52	2.54	2.11	2.20	51.40	66.32	38.48	35.30	17.17	21.77	11.80	10.67
G.89xG.86	2.87	2.91	2.06	2.13	71.82	82.68	23.22	43.86	28.45	32.99	12.07	16.14
G.89xPima S6	2.67	2.63	1.76	2.24	62.76	65.60	27.15	27.51	23.49	25.17	9.34	9.67
G.86	3.07	3.01	2.46	2.53	89.29	93.22	48.65	48.96	35.33	37.17	18.10	18.06
G.80	2.38	2.54	2.12	2.03	56.78	47.69	39.25	39.57	22.57	27.98	14.72	14.23
L.S.D.0.05	0.095	0.197	0.173	0.155	8.08	8.82	6.83	4.33	3.35	3.32	2.47	1.69
L.S.D.0.01	0.131	0.273	0.239	0.213	11.14	12.15	9.41	5.49	4.61	4.57	3.41	2.33

Cont 6

cultivars	Lint percentage				Seed index				Number of bolls/plant			
	Normal		Drought		Normal		Drought		Normal		Drought	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
G.91	36.86	38.40	36.22	34.99	8.34	8.86	7.01	8.03	21.31	27.01	14.11	15.19
G.89	38.30	37.92	35.90	35.41	8.50	8.62	7.97	8.34	19.49	22.62	12.66	15.09
G.85	35.91	36.21	32.45	31.93	8.54	9.14	7.75	7.50	22.35	27.03	12.83	15.52
G.88	33.83	33.99	32.76	31.45	8.76	9.18	8.49	8.50	24.62	21.08	17.05	18.52
G.70	33.40	32.75	30.60	30.08	8.43	8.56	7.64	7.88	20.40	26.08	18.45	19.21
G.89xG.86	39.58	39.88	36.32	36.83	9.22	9.01	8.50	8.29	25.08	28.45	16.18	20.61
G.89x Pima S6	37.52	38.36	34.46	35.17	8.65	9.07	7.99	8.81	23.51	25.03	15.46	12.29
G.86	39.58	39.89	37.20	36.87	9.38	9.57	8.33	8.58	29.31	31.02	19.80	19.38
G.80	39.67	37.54	37.54	35.96	8.28	8.39	8.03	7.99	23.83	29.39	18.49	19.49
L.S.D.0.05	1.53	1.18	1.002	1.858	0.53	0.42	0.33	0.50	3.65	3.11	3.08	34.39
L.S.D.0.01	2.11	1.63	1.38	2.560	0.73	0.64	0.45	0.69	5.02	4.24	4.25	4.74

Table (7): The mean performances of physiological traits of some cotton cultivars under normal and water stress.

Cultivars	Total chlorophyll				Proline concentration				Protein percentage				Oil percentage			
	Normal		Drought		Normal		Drought		Normal		Drought		Normal		Drought	
	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007	2006	2007
G.91	4.63	5.54	4.31	5.25	3.37	3.42	3.43	3.54	25.07	25.13	24.40	23.88	20.78	20.70	20.18	20.68
G.89	4.83	4.84	4.68	4.63	3.11	3.13	3.20	3.24	25.18	25.98	24.06	23.73	20.28	20.26	20.03	20.18
G.85	4.88	4.89	4.71	4.68	3.06	3.03	3.23	3.20	25.80	25.85	24.05	24.60	21.10	21.88	21.08	21.10
G.88	5.31	5.30	4.32	5.25	3.38	3.29	3.54	3.44	21.82	21.87	20.85	20.89	20.65	20.43	20.06	20.32
G.70	5.25	5.39	4.31	4.70	3.58	3.11	3.80	3.22	25.75	25.75	25.35	25.30	21.35	21.48	21.09	21.35
G.89xG.86	5.08	4.99	4.68	4.83	3.14	3.15	3.30	3.28	25.23	25.13	24.20	24.40	20.18	20.30	19.88	20.18
G.89x Pima S6	4.68	4.76	4.17	4.20	3.29	3.18	3.35	3.23	25.18	25.28	23.75	23.43	20.22	20.25	19.31	20.22
G.86	4.83	4.91	4.77	4.65	3.12	3.12	4.26	4.22	24.88	24.93	24.20	23.88	19.98	20.25	18.95	19.98
G.80	5.68	5.89	5.53	5.68	3.73	3.71	3.90	3.91	25.94	25.95	24.92	24.79	21.25	21.60	20.50	21.25
L.S.D.0.05	0.718	0.173	0.111	0.337	0.212	0.077	0.232	0.145	0.164	0.095	0.413	0.379	0.333	0.219	0.346	0.305
L.S.D.0.01	0.989	0.239	0.151	0.465	0.392	0.107	0.320	0.199	0.226	0.131	0.569	0.523	0.459	0.302	0.477	0.420

For total chlorophyll the results indicated that G.80 variety has the highest mean for normal and drought at tow seasons with the mean values 5.68, 5.89,5.53 and 5.68 , respectively . On the other hand , the G.89 x Pima S6 crosses was the lowest values with the values 4.76 in 2006 normal and 4.17 , 4.20 in 2006 and 2007 seasons in drought , respectively .

For praline concentration the results indicated that high concentration with drought stress and the highest mean with the G.80 variety in 2006 and 2007 normal and the G.86 variety in 2006 and 2007 drought with the mean values 3.73, 3.71, 4.26 and 4.22 , respectively and the lowest values was the G.85 variety.

For protein percentage the results indicated that high percentage in normal conditions and decreased when the plants in drought conditions . In the same time , the results cleared that for oil percentage the G.86 variety was the lowest values at normal and drought in the tow seasons with the mean values 19.98, 20.75, 18.95 and 19.98 % , respectively . but the G.70 variety was the highest values for the same traits and has values 21.35, 21.09 and 21.35 % in 2006 normal , 2006 and 2007 drought , respectively . From these results we found that when the varieties was under water stress the values of traits were decreased with the except praline concentration .

These results were in common agreement with the results obtained by many authors among them Kamel *et al.* (1995); Ronde *et al.* (2000); Singh and Singh (2001); Ghajari and Zeinali (2003) Basal *et al* (2005)andBadran(2006).

Cultivars differences in water stress or drought tolerance might be correlated with differences in proline content in cotton leaves as well as , its accumulation into the leaves.

From the previous results . it could be concluded that differences in drought tolerance occur not only between crop species but also among cultivars .

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دراسة علي تحمل بعض أصناف القطن المصري لظروف الإجهاد المائي
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أجريت تجربتان حقليتان بمزرعة محطة البحوث الزراعية بسخا - مركز
البحوث الزراعية خلال موسمي ٢٠٠٦ و ٢٠٠٧ لدراسة تأثير الجفاف علي الصفات
المورفولوجية و صفات المحصول ومكوناته بجانب الصفات الفسيولوجية للقطن المصري.
استخدم في هذه الدراسة تسعة أصناف وهي جيزة ٩١؛ جيزة ٨٩، جيزة ٨٥، جيزة ٨٨،
جيزة ٧٠، جيزة ٨٩ X جيزة ٨٦، جيزة ٨٩ X ليمسا ٦، جيزة ٨٦ والصنف جيزة ٨٠.
الأصناف تحت نظام الجفاف أخذت خمسة ريات طوال الموسم والأصناف تحت
الظروف الطبيعية أخذت ثمانية ريات طوال الموسم.

ومن النتائج المتحصل عليها يمكن استنتاج الآتي :-

- ١- وجدت اختلافات كبيرة بين التراكيب الوراثية المستخدمة نتيجة للزراعة تحت ظروف
الجفاف
- ٢- أدت المعاملة بالجفاف إلي انخفاض ملحوظ في عدد الأفرع الثمرية ، الوزن الجاف
للنبات ، ارتفاع النبات ، مساحة سطح الورقة ، وزن اللوزة ، محصول القطن الزهر
والشعر ، معامل البذرة . التصافي ، عدد اللوز علي النبات ، إجمالي الكلوروفيل و
النسبة المئوية للبروتين والزيت في البذور .
- ٣- تركيز البرولين في الأوراق زاد زيادة ملحوظة تحت نظام المعاملة بالجفاف .
- ٤- الصنف جيزة ٨٦ والصنف جيزة ٨٠ اظهرا اعلي محتوى من تركيز البرولين في
الأوراق تحت ظروف الجفاف وهذا كان متبوعا بزيادة في المحصول ومكوناته في
هذين الصنفان تحت ظروف الجفاف .
- ٥- من هذه النتائج يتضح انه من الأهمية لمربي النبات عند بداية برنامج تربية لتحمل
الجفاف أن يقوم باستخدام محتوى الأوراق من البرولين كمؤشر للقدرة علي تحمل
الجفاف والقدرة علي المحصول العالي .