

تأثير الأشعة فوق البنفسجية على فطر فيوزاريوم أوكسيسبورم المنقول ببذور الطماطم والفلفل الأحمر

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الملخص العربي

ترشيد استخدام المبيدات وإيجاد بدائل آمنة للمبيدات فى معاملة البذور ومقاومة الأمراض
المحمولة على البذور.

١- فى دراسة لحصر مرض الذبول الفيوزاريومى لوحظ أن المرض منتشر فى محافظة الجيزة
خلال موسمى ٢٠٠٨-٢٠٠٩ .

٢- دلت تجارب العزل من بذور نبات الطماطم والفلفل أن هناك ٥٥ عزلة تتبع خمس أجناس
فطرية وقد تباينت الفطريات المعزولة وكذلك نسبة تكرارها ومن بين الفطريات المعزولة
كان الفطر فيوزاريوم أوكسيسبوريم هو أكثر الفطريات ظهوراً وتكراراً.

٣- أستخدم صنفين من نباتات الطماطم هما بيتو-٨٦ ورد ستار وصنفين من نباتات الفلفل
هما عمار وشالينا ولوحظ أن هناك مدى واسع من الأختلافات بين أصناف الطماطم
والفلفل تجاة مرض الذبول كما بينت النتائج المتحصل عليها أن صنف الطماطم بيتو ٨٦
وصنف الفلفل عمار أكثر قابلية للإصابة بمرض الذبول بينما صنف الطماطم رود ستار
وصنف الفلفل شالينا أقل قابلية للإصابة.

٤- درس تأثير تعريض بذور صنف الطماطم بيتو ٨٦ وصنف الفلفل عمار الأكثر قابلية
للإصابة للأشعة فوق البنفسجية لدراسة تأثيرها على شدة الإصابة بمرض الذبول
الفيوزاريومى وكذلك معاملة بذور نفس الصنفين بالمبيد الفطرى توبسين إم ٧٠.

٥- كذلك تم تقدير نسبة الأنبات لبذور الطماطم والفلفل المعاملة بالأشعة الفوق البنفسجية على الأطوال الموجية ٢٥٤-٢٦٥ نانوميتر والمدد ١-٣-٥ دقيقة وقد أوضحت النتائج زيادة فى نسبة الأنبات لكلا الصنفين مقارنة بمعاملة المبيد الفطرى.

٦- تم تقدير بعض القياسات النباتية التى تم تعريضها للأشعة الفوق البنفسجية على طول موجى ٢٥٤-٣٦٥ نانوميتر وكذلك معاملة البذور بالمبيد توبسن إم ٧٠ وتأثيره على طول النباتات والوزن الطازج والوزن الجاف لنباتات الطماطم والفلفل الأكثر قابلية للأصابة أوضحت النتائج أن تأثير المعاملة بالأشعة الفوق البنفسجية على الأطوال الموجية السابقة ولمدة خمس دقائق كانت أكثر فاعلية فى زيادة القياسات النباتية بالمقارنة بالنباتات المعاملة بالمبيد الفطرى.

EFFECT OF ULTRA VIOLET ON *FUSARIUM OXYSPORUM* TRANSMITTED BY TOMATO AND RED PEPPER SEEDS

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ABSTRACT: *Tomato and red pepper were widespread in all investigated fields of Giza governorate. The isolated fungi were varied in their, frequency and virulence. Also tomato and red pepper cultivars were varied in their susceptibility to the wilt disease. Tomato variety C.V. Peto-86 and Red pepper variety c.v. Amar seeds when exposed to ultraviolet rays at 254 nm for 1, 3 and 5 minutes minimized the severity of infection. As for exposure of both cultivars after 5 min. The highest effect in decreasing severity of infection after occurred 35 day of inoculation. Meanwhile, ultraviolet radiation at 365 nm for 1,3, and 5 min. gave the same trend on both cultivars compared with fungicidal treatments. Seed exposure to U. V radiation (254nm and 365nm) and seed dressing by the Topsin M70 of cv. Peto-86 of tomato and Amar red pepper have significantly increased the tested plant parameters. The increasing of all plant parameters was increased by increasing U.V exposure time after 42 days from planting. Meanwhile seeds of both susceptible cultivars when treated with the chemical fungicide as recommended dose were less affected during this period 2008-2009 growing seasons.*

Key words: *Plant disease-varieties-tomato-red pepper-ultra violet radiation-seed pathology-fungicide*

INTRODUCTION

Tomato and red pepper are considered one of the most economic vegetable crops in Egypt either for local consumption or exportation

purposes. Tomato and red pepper are subjected to attack by numerous diseases wherever the crops are planted. Fungal pathogens are considered as damaging agents causing considerable reduction of its production. The wilt disease used by *Fusarium oxysporum* Synder and Hasen cause serious effects on tomato and red pepper plants either in nurseries or in the fields. It is the main reason for re-plantation and increasing of tomato and red pepper production costs (Awad, 1990). These crops are highly affected during the seasons of early summer and Nile plantation in Upper Egypt and the reclaimed sandy regions of Nubariya and Ismailia. Ultra violet radiation are considered anew protect method from some transmitted diseases by seeds i.e. wilt and downy mildew (El-sheikh Aly, et al 1998). The ultra violet treatment of the seeds of significant economic importance for Farmers, where pesticides are more expensive treatment for the treatment and ultra violet are also considered less dangerous to public health of fungicides.

MATERIALS AND METHODS

1- Isolation, Purification and Identification of the Causal Organisms:

Samples of tomato and red pepper seeds were collected from Giza governorate, survey was carried out during two seasons 2008-2009. The seeds were transferred to Petri dishes containing moist sterilized filter paper and 25 seeds were cultured in each dish. The dishes were then incubated at 25°C for 15 days after which the emerged fungus was counted and purified using the single spore technique (Hansen, 1926) and or hyphal tip method (Ricker and Ricker, 1936). The isolated fungus was identified microscopically either to the generic or species level according to the description of (Gilman, 1957).

2- Cultivars Susceptibility:

Two tomato Red Star and peto-86 and two red pepper cultivars namely, Chilina and Amar cultivars namely were screened for their reaction against *Fusarium oxysporum*. The seeds of each cultivar were sown in previously prepared sterilized clay pots (25 cm in diam.). Five seeds were sown in each pot and three pots were used for each treatment. Seeds of each cultivar were used as control. All the pots were kept in the greenhouse at 27± °C for 42 days. The plants received the normal agricultural practices for irrigation and fertilization. Infection percentage and disease severity were estimated for one week according to Waltz and Arthur (1973).

3- Ultra violet radiation:

Tomato c.v. Peto-86 and Amar red pepper c.v. seeds were used to study the effect of UV irritation, and fungicide i.e. Topsin M70 on wilt development under greenhouse condition during 2008-2009 seasons. Peto-86 and Amar

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seeds were put in cloth sacks and exposed to UV radiation on at 254 nm the short wave and 365 nm the long wave for 1, 3 and 5 ,minutes, (EL-Sheikh Ali et al1999) while unexposed seeds of all both cultivars were used as check treatments. The irradiated seeds of each cultivars were sown directly in pots (25 cm in diam.) contain about 9 kg clay soil. Five seeds were sown in each pot, irrigated every 3 days. Three replicates were used for each treatment, each replicate contained 5 plants. The disease severity was recorded after 35 days from sowing for one week as mentioned before. Also, seeds of tomato and red pepper were treated by chemical fungicide i.e. Topsin M 70% at the rate of (3g/kg seeds). Treated seeds were kept for 24 hours then transferred to pots containing sterilized clay soil directly and disease severity was determined as mentioned before also some plant parameters including plant height (mm), fresh and dry weight of shoot were determined and percentage of emergence after seeds U.V treated.

RESULTS

1- Survey and isolation of the causal organisms:

Tomato and red pepper wilt disease was surveyed in four different varieties during two successive seasons 2008, 2009. Data presented in Table (1) revealed that a total number of 55 fungal isolates were isolated from surface sterilized seeds. Identification trials showed that the isolated fungi belonged to five genera and two species. Five different fungi were isolated and these fungi varied in their frequency. Among the isolated fungi *Fusarium oxysporum* was the most prevalent and was present in all examined samples the inspected seeds a high frequency compared with the other isolated fungi, being 36.36 %. The frequency of the other fungi was low and ranged from 10.9-23.64%. It is also obvious from data in Table (1) that the highest number of fungal colonies yielded during isolation trials was obtained from Amar c.v. On the other hand, the lowest number of colonies was obtained from samples collected from c.v Red Star of tomato 8 isolates and c.v Chilina of red pepper isolates...

Table (1): Survey and frequency of fungi isolated from diseased seeds samples of tomato and red pepper cultivars collected from Giza Governorate.

Isolate fungi	No. of isolated fungi from seeds								Total	Frequency %
	Tomato				Red pepper					
	Red Star		Peto-86		Chilina		Amar			
	No.	%	No.	%	No.	%	No.	%		
<i>Fusarium oxysporum</i>	4.0	50	7	43.7	3	37.5	6	26	20	36.36

<i>Alternaria tenuis</i>	2.0	25	4	25	0.0	0.0	0.0	0.0	6	10.9
<i>Drechslera sp</i>	0.0	0.0	0.0	0.0	2	25	7	30.4	9	16.36
<i>Curvularia sp</i>	0.0	0.0	0.0	0.0	3	37.5	10	43.5	13	23.64
<i>Cladosporium sp</i>	2.0	25	5	31.3	0.0	0.0	0.0	0.0	7	12.74
Total	8.0		16		8		23		55	

No. : No. of isolates

% : frequency (%) for each cultivars

2- Cultivars susceptibility to *Fusarium* wilt:

Data in Table (2) indicate that there was a wide variation in cultivars reaction. The used isolate of *Fusarium oxysporum* caused a higher percentage of disease severity on Tomato C.V. Peto-86, followed by Amar Red pepper c.v. The different between any two cultivars was significant.

Studying of cultivars reaction showed that tomato cv. Peto-86 of and red pepper c.v Amar was highly susceptible. However Red Star tomato c.v and Chilina of red pepper were less susceptible against *Fusarium oxysporum*.

Table (2): Cultivars reaction to an isolate *Fusarium wilt* on tomato and red pepper

Cultivars	Verities	Untreated plant(check)	% disease severity after;(days)	
			35	42
Tomato	Red Star	0	8.22	15.30
	Peto-86	0	12.35	19.35
Red pepper	Chilina	0	6.33	8.22
	Amar	0	10.35	15.30
L.S.D at 5 % for			0.08	1.08

3- Ultra violet radiation and fungicidal treatments:

1- Effect of ultra violet on wilt disease of tomato and red pepper:

Exposing tomato and red pepper seeds of susceptible cultivars Peto-86 and Amar to ultra violet radiation for different durations was studied to 2008-2009 seasons. Seeds of the same cultivars were treated with Topsin M 70 fungicide for comparison with U.V effect.

Ultra violet radiation at 245 nm and 365 nm significantly decreased severity of infection with wilt disease compared with the check plants in both tomato Peto-86 and red pepper Amar susceptible cultivars in (Table, 3). The reduction in disease severity increased with increasing exposure time of

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seeds in both cultivars to U.V rays from 1, 3 and 5 minutes,. Similar trend is recognized with progress of infection, up to 42 days after inoculation of both tomato and red pepper varieties regardless of the wave length used. Generally,u.v was more effective in the control of tomato wilt than pepper wilt.

In the same time seeds of both susceptible cultivars when treated with to chemical fungicide i.e. Topsin M 70 at recommended doses were not efficient during this period and relative variety resistance (RVR) during 2009 growing season. Also it was clear from data presented in (Table3) that

Table 3

exposing to U.V at 254nm or 365 nm for 1,3and5 minutes and fungicide i.e. Topsin M70 significantly decreased severity of infection caused by *Fusarium Oxysporum* if compared with the check plants differences between the irradiated seeds and unirradiated seeds of both cultivars were always significant however exposing Peto-86 tomato seeds and Amar red pepper seeds to ultra violet for 1,3and5 minutes protected tomato and red pepper plants from infection with the pathogen. In the time the percentage of emergence was recorded in Table (3) revealed that the percentage of emergence of both expose cultivars were increase in both exposure time at 254 and 365 nm comparative with check treatment during 2008-2009 seasons.

4-: Effect of u.v on some parameters of tomato and red pepper:

Data in Table (4) reveal that all treatment, have significantly increased the tested plant parameters i.e. plant height and fresh and dry weight of shoot system. U.V at 254 and 365 nm significantly increased all parameters compared with the check plants and fungicide treatments of both cultivars. The increasing of all parameters increased by increasing exposure time of tomato and red pepper seeds to U.V after 42 days from planting. Seeds of both susceptible cultivars when treated with Topsin M70 chemical fungicide as recommended dose were not efficient during 2008-2009.

DISCUSSION

In Egypt, wilt diseases are well known on many important plant species. Tomato and red pepper wilt disease is a wide spread and destructive in the numerous and open field. During progress of the present investigation extensive survey through out Giza governorate four varieties was conduct to determine the occurrence and the frequency of various fungi associated with diseased tomato and red pepper seeds. Result showed that a total number of 55 isolates of fungus representing 5 genera and two species where obtained. The isolated fungi varied in their frequency. Whilst, *F.oxysporum* was most dominant fungus with high frequency. These results are in agreement with those recorded by Saponaro *et al.*, (1985) who isolated the pathogen from wilted tomato plants. Also, it was obvious that the frequency of isolated fungi different in one governorate, the highest percentage of isolated fungi that

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were recorded in tomato seeds. While the lowest was obtained from red pepper seeds. This may be due to the susceptibility of the cultivated cultivar and /or the different meteorological conditions prevailing in Giza governorate. Similar results were obtained by Fassihiani (1985) who stated that the wilt disease was developed rapidly as the temperature increased.

Studing of tomato and red pepper cultivars reaction to *Fusarium wilt* that c.v. Peto-86 was highly susceptible followed by Amar, Red Star and Chilina c.v. were less susceptible to *Fusarium oxysporum*. This may be attributed to the morphological characters and chemical component of the cultivar dependent on their genetic constitution. These results are in harmony with those obtained by Kuwata *et al* (1994).

Table 4

Ultra violet radiation and chemical methods has more recently become accepted by plant pathologists as safety economic and possibly of disease control strategies effect since it enhanced some tomato and red pepper parameters e.g. plant height and fresh and dry weight at shoots. Similar results were obtained by Hibar *et al* (2007) and Singh *et al* (2007). In the present study, it was clear that seeds of Peto-86 tomato susceptible variety and Amar red pepper susceptible variety which exposed to U.V rays at 254 and 365 nm showed more resistance and increasing of plant height, fresh shoot weight and dry shoot weight compared with unexposed to U.V radiation. The reduction of disease severity and increase of plant height, fresh weight and dry shoot weight increased with increasing exposure time of seeds in both cultivars to U.V rays from 1,3and5 minutes. As for exposure time of peto-86 and Amar seeds for 5 minutes gave the highest effect in decreasing severity of infection after 35 and 42 days of inoculation and increasing of plant height fresh shoot weight and dry shoot weight after 42 days from inoculation U.V radiation at 254nm for 1,3 and5 minutes gave the same trend on both cultivars. Meanwhile U.V rays at 365nm at different periods gave the same effect in reducing severity of infection on Peto-86 and Amar after 35 and 42 days of inoculation and increasing of plant height, fresh shoot weight, and dry shoot weight after 42 days from infection. At the same time different between the irradiated and unirradiated seeds of both cultivars were always significant. However exposing Peto-86 seeds or Amar seeds to U.V for 1, 3 and 5 minutes protected tomato and red pepper plants from infection. Exposed Peto-86 and Amar seeds to U.V rays at 254 and 365 nm for 5 minutes gave the highest effect in reducing severity of infection caused with *Fusarium oxysporum* after 35 and 42 days after inoculation. This result could be exposed in the height of fact, that U.V works on the enzyme and never destroys the spores of the pathogen. These results are in agreement with those obtained by Zhenetskya *et al* (1996) who found that a destructive disease of cucumber caused by *P. cubensis* has been observed in Belarus since (1985) as alternative to chemical treatment, a physical method using

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advice for bactericidal irradiation of seeds at 254nm U.V rays, El-sheikh Ali et al (1998), Abdel-Monium (2001), Hibar et al (2007) and Singh et al (2007).

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تأثير الأشعة فوق بنفسجية على فطر فيوزاريوم أوكسيسبورم المنقول ببذور الطماطم والفلفل الأحمر

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ترشيد استخدام المبيدات وإيجاد بدائل آمنة للمبيدات فى معاملة البذور ومقاومة الأمراض المحمولة على البذور.

٧- فى دراسة لحصر مرض الذبول الفيوزاريومى لوحظ أن المرض منتشر فى محافظة الجيزة خلال موسمى ٢٠٠٨-٢٠٠٩ .

٨- دلت تجارب العزل من بذور نبات الطماطم والفلفل أن هناك ٥٥ عزلة تتبع خمس أجناس فطرية وقد تباينت الفطريات المعزولة وكذلك نسبة تكرارها ومن بين الفطريات المعزولة كان الفطر فيوزاريوم أوكسيسبوريم هو أكثر الفطريات ظهوراً وتكراراً.

٩- أستخدم صنفين من نباتات الطماطم هما بيتو-٨٦ ورد ستار وصنفين من نباتات الفلفل هما عمار وشالينا ولوحظ أن هناك مدى واسع من الأختلافات بين أصناف الطماطم والفلفل تجاة مرض الذبول كما بينت النتائج المتحصل عليها أن صنف الطماطم بيتو ٨٦

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وصنف الفلفل عمار أكثر قابلية للإصابة بمرض الذبول بينما صنف الطماطم رود ستار
وصنف الفلفل شالينا أقل قابلية للإصابة.

١٠- درس تأثير تعريض بذور صنف الطماطم بيتو ٨٦ وصنف الفلفل عمار الأكثر قابلية
للإصابة للأشعة فوق البنفسجية لدراسة تأثيرها على شدة الإصابة بمرض الذبول
الفيوزاريومي وكذلك معاملة بذور نفس الصنفين بالمبيد الفطري توبسين إم ٧٠.

١١- كذلك تم تقدير نسبة الأنبات لبذور الطماطم والفلفل المعاملة بالأشعة فوق البنفسجية
على الأطوال الموجية ٢٥٤-٢٦٥ نانوميتر والمدد ١-٣-٥ دقيقة وقد أوضحت النتائج
زيادة فى نسبة الأنبات لكلا الصنفين مقارنة بمعاملة المبيد الفطرى.

١٢- تم تقدير بعض القياسات النباتية التى تم تعريضها للأشعة فوق البنفسجية على طول
موجى ٢٥٤-٣٦٥ نانوميتر وكذلك معاملة البذور بالمبيد توبسن إم ٧٠ وتأثيره على
طول النباتات والوزن الطازج والوزن الجاف لنباتات الطماطم والفلفل الأكثر قابلية للإصابة
أوضحت النتائج أن تأثير المعاملة بالأشعة فوق البنفسجية على الأطوال الموجية
السابقة ولمدة خمس دقائق كانت أكثر فاعلية فى زيادة القياسات النباتية بالمقارنة
بالنباتات المعاملة بالمبيد الفطرى.

تأثير الأشعة فوق بنفسجية على فطر فيوزاريم أوكسيسبورم المنقول
ببذور الطماطم والفلفل الأحمر

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١٣- فى دراسة لحصر مرض الذبول الفيوزاريومى لوحظ أن المرض منتشر فى محافظة الجيزة خلال موسمى ٢٠٠٨-٢٠٠٩ .

١٤- دلت تجارب العزل من بذور نبات الطماطم والفلفل أن هناك ٥٥ عزلة تتبع خمس أجناس فطرية وقد تباينت الفطريات المعزولة وكذلك نسبة تكرارها ومن بين الفطريات المعزولة كان الفطر فيوزاريم أو كسيسبوريم هو أكثر الفطريات ظهوراً وتكراراً.

١٥- أستخدم صنفين من نباتات الطماطم هما بيتو-٨٦ ورد ستار وصنفين من نباتات الفلفل هما عمار وشالينا ولوحظ أن هناك مدى واسع من الأختلافات بين أصناف الطماطم والفلفل تجاة مرض الذبول كما بينت النتائج المتحصل عليها أن صنف الطماطم بيتو ٨٦ وصنف الفلفل عمار أكثر قابلية للإصابة بمرض الذبول بينما صنف الطماطم رود ستار وصنف الفلفل شالينا أقل قابلية للإصابة.

١٦- درس تأثير تعريض بذور صنف الطماطم بيتو ٨٦ وصنف الفلفل عمار الأكثر قابلية للإصابة للأشعة فوق البنفسجية لدراسة تأثيرها على شدة الإصابة بمرض الذبول الفيوزاريومى وكذلك معاملة بذور نفس الصنفين بالمبيد الفطرى توبسين إم ٧٠.

١٧- كذلك تم تقدير نسبة الأنبات لبذور الطماطم والفلفل المعاملة بالأشعة فوق البنفسجية على الأطوال الموجية ٢٥٤-٢٦٥ نانوميتر والمدد ١-٣-٥ دقيقة وقد أوضحت النتائج زيادة فى نسبة الأنبات لكلا الصنفين مقارنة بمعاملة المبيد الفطرى.

Effect of ultra violet on fusarium oxysporum transmitted by.....

١٨- تم تقدير بعض القياسات النباتية التي تم تعريضها للأشعة فوق البنفسجية على طول موجى ٢٥٤-٣٦٥ نانوميتر وكذلك معاملة البذور بالمبيد توبسن إم ٧٠ وتأثيره على طول النباتات والوزن الطازج والوزن الجاف لنباتات الطماطم والفلفل الأكثر قابلية للأصابة أوضحت النتائج أن تأثير المعاملة بالأشعة فوق البنفسجية على الأطوال الموجية السابقة ولمدة خمس دقائق كانت أكثر فاعلية فى زيادة القياسات النباتية بالمقارنة بالنباتات المعاملة بالمبيد الفطرى.

Table (3): Effect of ultra violet radiation on Fusarium wilt disease during 2008-2009 seasons:

Ultra violet Treatment	Exposure Time(min)	Disease severity during 2008 %season after (days)				% Disease severity during 2009 season after (days)				% Emergence during	
		Peto-86 tomato		Amar red pepper		Peto-86 tomato		Amar red pepper		2008	2009
		35 days	42 days	35 days	42 days	35 days	42 days	35 days	42 days		
Radiation at 254 nm	1	10.3	17.71	8.22	12.35	9.55	19.71	9.55	14.33	95	94
	3	6.33	15.30	6.33	10.35	8.22	16.22	8.22	10.35	98	97
	5	4.52	12.35	5.12	8.22	6.33	9.55	6.33	8.22	98	97
Radiation at 365 nm	1	12.35	19.35	10.35	14.33	12.35	17.71	12.35	16.22	97	98
	3	8.22	16.22	8.22	12.35	9.55	16.22	9.55	14.33	99	99
	5	6.33	13.33	6.33	10.35	8.22	12.35	8.22	10.35	99	100
Topsin M70	3g/kg seeds	12.35	19.35	10.35	13.33	14.33	19.35	12.35	15.30	85	90
Check	-	17.33	25.24	12.35	15.30	17.33	25.24	14.33	17.71	65	70

L.S.D at 5%for
 Season(s) = 1.08
 Cultivars(c) =0.91
 S x C = 1.03

Table (4): Effect of Ultra violet radiation and fungicide on growth parameter of tomato and red pepper plants after 42 days during 2008-2009 seasons:

U.V treatment	Exposure time(min)	2008						2009					
		Tomato (Peto-86)			Pepper (Amar)			Tomato (Peto-86)			Pepper (Amar)		
		P.H (cm)	S.F.W (g)	S.D.W (g)	P.H (cm)	S.F.W (g)	S.D.W (g)	P.H (cm)	S.F.W (g)	S.D.W (g)	P.H (cm)	S.F.W (g)	S.D.W (g)
Radiation at (254)	1	14.3	7.1	4.3	22	2.1	0.6	14.2	7.1	4.3	20	2.1	0.6
	3	16.9	8.2	4.8	24	3.2	0.6	16.7	8.2	4.8	24	3.2	0.6
	5	20.6	9.1	6.2	27	4.1	0.6	20.4	9.1	6.2	26	4.1	0.6
Radiation at (365)	1	35.1	9.7	6.2	24	5.3	2.2	35.2	9.7	6.2	25	5.3	2.2
	3	40	9.9	6.9	27	6.2	2.3	39.9	9.9	6.9	28	6.2	2.3
	5	48	9.9	6.9	30	6.7	3.4	48.3	9.9	6.9	29	6.7	3.4
Topsin M70	-	35.1	8.2	6.9	21	2.3	0.5	35.3	8.0	6.9	21	2.3	0.5
Check	-	12.2	5.2	3.1	17	1.8	0.4	12.5	5.1	3.1	18	1.8	0.5

P.H = Plant Height; S.F.W = Shoot Fresh weight; and S.D.W = Shoot Dry Weight

L.S.D at 5% for

P.H
9.16

S.F.W
270.68

S.D.W
69.02