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MANAGEMENT OF OKRA POWDERY MILDEW

Zaher, Effat A.; K.A. Abada and Marwa A. Zyton
Plant Pathol. Dept., Fac. of Agric., Cairo Univ. , Giza , Egypt .

ABSTRACT

Four trials of disease management, *i.e.* varietal resistance, methods of irrigation, antioxidants and fungicides were tested to evaluate their role in managing okra powdery mildew caused by *Erysiphe cichoracearum* DC.

The four tested okra cvs. were liable to infection by the disease.. However, Japanese cv.(resistant) showed the lowest infection and gave the highest fruit yield followed by Hendi cv. (moderately resistant).Meanwhile, both Balady Red and Balady Green cvs. were highly susceptible and gave the lowest fruit yield.

Methods of irrigation , *i.e.* drip , flood and spray caused significant variations in the severity of the disease. Spraying method resulted in high reduction in the disease with great increase in fruit yield compared to the other two methods.

All the tested antioxidants, *i.e.* ascorbic acid, citric acid, manitol and salicylic acid caused significant reduction in the disease severity with significant increase in the fruit yield compared to the control treatment. In addition, salicylic acid was the most efficient one in this regard followed by citric acid then ascorbic acid. Meanwhile, manitol showed the lowest effect.

All the tested fungicides, *i.e.* Karathane, Rubigan, Sumi-8, Thiovit Jet, Topas and Vectra caused significant reduction in the percentages of the germinated conidia of *E.cichoracearum*. In addition, Topas followed by Sumi-8 then Rubigan and Vectra (systemic fungicides) caused the highest inhibitory effect. Meanwhile, Thiovit Jet followed by Karathane (non-systemic fungicides) showed the lowest effect.

Spraying okra plants with the tested fungicides caused significant reduction in the severity of the disease compared to control treatment. The reduction in the disease severity showed, to some what, the same trend of the effect of tested fungicides on conidial germination. This reduction in the disease was reflected on the obtained fruit yield.

INTRODUCTION

Okra, *Hibiscus esculentus* L. syn. *Abelmoschus esculentus* (L.) Moench,locally known as bamia/bamya is an important vegetable crop in Egypt and other countries.

Under Egyptian conditions, during 2005 growing season, the cultivated area with okra in Delta and Upper Egypt reached about 15068 feddans with total fruit yield 106039 tons with an average of 7.04 ton / feddan. In addition, about 866 feddans were cultivated with okra in the new reclaimed lands with total fruit yield 1979 tons with an average of 3.44 ton / feddan (Agric. Statis. Dept., Min. of Agric. Egypt, 2005).

Okra is liable to infection by many bacterial, fungal and viral diseases (Shamsher *et al.*, 1988) as well as physiological disorders. However, fungal diseases, especially powdery mildew caused by *Erysiphe cichoracearum* DC is the most important fungal disease, which causes harmful effect to the plant growth and fruit yield.

This work was planned to test many trails of disease control in order to throw some light on the most efficient and safety trials.

MATERIALS AND METHODS

1- Varietals susceptibility:

Field studies were conducted on (sandy- loamy soil) located at Behera governorate was prepared for sowing okra using the flood irrigation as usual during the beginning of March, 2006 and 2007 growing seasons. The land was divided into plots of 21 m².

Four okra cultivars, *i.e.* Balady Green, Balady Red, Hendi and Japanese were sown in plots of 21m². Four randomized plots were used for each cultivar. The plants were left to the natural infection by the disease (the back history of this location indicated to the severe infection by the disease every year). All agricultural practices, *i.e.* space of sowing, hoeing, irrigation, fertilization and insects control were employed as the recommendations of the Ministry of Agriculture, Egypt.

2- Effect of irrigation method:

Field studies were conducted on (sandy- loamy soil) located at Behera governorate was prepared for sowing okra(Balady Red cv.) using drip, flood and spray irrigation as usual by the beginning of March, 2006 and 2007 growing seasons. The land was divided into plots of 21 m². All agricultural practices were employed as mentioned before. The plants were left to the natural infection by the disease. Four plots were used for each irrigation methods.

3-Effect of antioxidants:

This experiment was carried out at Plant Pathol. Dept., Fac. Agric., Cairo Univ. at Giza during mid of March , 2007 growing season. Four antioxidants namely ascorbic acid, citric acid, manitol and salicylic acid were used for spraying okra (Balady Red cv.) plants grown in plots (1x1 m). The plants were left to the natural infection by the disease as well as the artificial inoculation by shaking okra leaves infected by powdery mildew collected from the location of the experiments. The plants were sprayed by the tested antioxidants, each alone, at 50 mM before the appearance of the disease symptoms by about two weeks. In addition, the plants were also sprayed 5 times with two weeks intervals. Plants sprayed by water only served as control treatment. Four randomized plots were used for each treatment.

4- Effect of fungicides:

4-1- Effect of some fungicides on conidial germination:

Six fungicides namely Karathane, Rubigan, Sumi-8, Thiovit Jet, Topas and Vectra (Table, 1) were used to test their inhibitory effect on the germination of *E. cichoracearum* conidial *in vitro*. In this regard, stock solution was prepared from the tested fungicides depending on their active ingredient. Serial concentrations, i.e. 0.0, 25, 50,100,250, 300, 350,400 and 500 ppm. were prepared. Each concentration was sprayed using an automizer (fine drops of spray) on clean glass slides and left to air dry. Infected okra leaves (about three weeks old) showing severe powdery mildew infection were shaken on the glass slides to fall-off the conidia . Glass slides were put on glass rods in Petri-dishes (two in each dish) containing distilled water (100 % relative humidity). The dishes were sealed with paraffin wax and incubated at 25º ±1 C. Five dishes were used for each concentration. Two lactophenol-cotton blue drops were put on each slide just before examination for conidial germination, then the germinated conidia on each slide (ten fields) were counted, 24 hours after incubation using light microscope. Also, germination percent was assessed at zero time of the experiment to determine the percentage of germinated conidia at this time.

4-2: Effect on disease management:

Field studies were conducted on(sandy- loamy soil) located at Behera governorate was prepared for sowing okra(Balady Red cv.) using the flood irrigation method as usual during the beginning of March, 2006 and 2007 growing seasons. The land was divided into plots of 21 m^2 .All agricultural practices were employed as mentioned before. The plants were left to the natural infection by the disease .Each fungicide was sprayed on the plants at the beginning of the appearance of disease symptoms, then replicated 6 times with two weeks interval. Plants sprayed by water only served as control treatment. Four randomized plots were used for each treatment.

Table (1): Trade name, common name, chemical structure and recommended dose of the tested fungicides.

Trade name	Active ingredient	Chemical name	Recommended dose
Karathane	Dinocap	1-methylheptyl-1-ethylhexyl-and 1-propylpentyl-isomers (26).	100 ml.
Rubigan	Fenarimol	alpha-(2-chlorophenyl)-alpha-(4chlorophenyl)-5- pyrimidinemethanol	20 ml.
Thiovit Jet	Micronized sulphur	80% sulphur	250 g.
Topas	Penconazole	1-[2-(2,4-dichlorophenyl)pentyl]-1H-1,2,4-triazole	20 ml.
Sumi-8	Diniconazole	[(2,4-dichlorophenyl)methylene]-a-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol	35 ml.
Vectra	Dinotefuran	1-[[4-bromo-2-(2,4-dichlorophenyl) tetrahydro-2-furanyl]methyl]-1H-1,2,4-triazole	100 ml.

5- Disease assessment:

The old okra leaves were periodically examined (more liable to infection) and classified into categories, Disease severity was then calculated using 0 -11 scale devised by Towsend and Heuberger (1943) using the following formula.

$$\textbf{Disease severity (\%)} = \frac{\sum (n \times v)}{11\,N} \times 100$$

Where;

n = Number of leaves in each category.
v = Numerical values of symptoms of each category.
N = Total number of the examined leaves.
11= Maximum number of numerical values of symptoms category.

Also, the number of fruits / plant and the average weight of fruits / plot were estimated and taken into consideration.

6- Statistical analysis:

All also the obtained data were statistically analyzed using the descriptions of Snedecor (1967) and LSD was calculated (Fisher, 1948).

RESULTS

1-Varietal susceptibility:

Data presented in (Table, 2) indicate that all the four tested okra cultivars were liable to the natural infection by powdery mildew. Balady Red cv. was the most susceptible one followed by Balady Green cv., being 59.3 and 57.1% disease severity on the average, respectively without significant differences. Meanwhile, Japanese cv. was highly resistant followed by Hendi cv., being 30.9 % and 33.4 % on the average, respectively without significant differences.

The severity of powdery mildew disease was, to some what, reflected on the number of fruits / plant and the average of fruit yield / plot. In this regard, Japanese cv. gave the highest fruit yield either for plant (197.3 fruit) or for plot (57.8 kg. /plot of 21 m2) .on the other hand; Balady Red cv. gave the lowest values, being 109.2 fruit and 38.8 kg., on the average, respectively.

No significant differences were found in the values of diseases severity number of fruits / plant and fruit yield of both seasons.

Table (2): Reaction of four okra cultivars to the natural infection by powdery mildew and their fruit yield, field experiment at Behera governorate during 2006 and 2007 growing seasons.

Cultivars	%, Disease severity during seasons of		Mean	Average number of fruits / plant during seasons of		Mean	Average Fruit yield(kg) / plot (21m²) during seasons of		Mean
	2006	2007		2006	2007		2006	2007	
Balady(Green)	57.9	56.3	57.1	110.4	111.8	111.1	39.2	39.4	39.3
Balady(Red)	60.1	58.4	59.3	108.2	110.2	109.2	38.5	39.0	38.8
Japanese	31.7	30.0	30.9	196.6	198.0	197.3	58.8	56.8	57.8
Hendi	34.2	32.5	33.4	182.8	184.8	183.8	54.0	54.4	54.2
Mean	46.0	44.3	----	149.5	151.2	---	47.6	47.4	-----

L.S.D. at 5% for: Cultivars (C) =	3.1	4.3	2.7
Seasons (S) =	n.s.	n.s.	n.s
C x S =	4.4	5.1	3.6

2- Method of irrigation:

(Table, 3) shows that powdery mildew of okra as well as the number of fruits/ plant and average fruit yield / plot were significantly affected by the method of irrigation. In this regard, spray irrigation method resulted in decreasing the severity of the disease to low value (19.8 % disease severity) and gave high number of fruits / plant (90.7 fruit) and 43.6 Kg fruit yield / plot of 21 m^2. Significant differences were detected in the estimated fruit yield of both drip (57.4 %, 86.2 fruit / plant and 35.8 kg. / plot of 21 m^2, respectively) and flood of irrigation (59.3 %, 109.2 fruit/ plant and 38.8 kg. / plot of 21 m^2, respectively).

Table (3): Effect of method of irrigation on the natural infection of okra by powdery mildew (Balady Red cv.) and fruit yield, field experiment at Behera governorate during 2006 and 2007 growing seasons.

Method of irrigation	%,Disease severity during seasons of		Mean	Average number of fruits/plant during seasons of		Mean	Average Fruit yield(kg)/plot (21 m²) during seasons of		Mean
	2006	2007		2006	2007		2006	2007	
Drip	58.1	56.6	57.4	85.3	87.0	86.2	34.5	37.0	35.8
Flood	60.1	58.4	59.3	108.2	110.2	109.2	38.5	39.0	38.8
Spray	20.0	19.6	19.8	90.4	91.0	90.7	43.0	44.2	43.6
Mean	46.1	44.9	----	94.6	96.1	---	38.7	40.1	-----

L.S.D. at 5% for: Cultivars (C) = 2.7 3.6 2.5
Season (S) = n.s. n.s. n.s.
C x S = 3.9 4 2.8

3- Antioxidants:

Data in (Table,4) show that the tested antioxidants, *i.e.* ascorbic acid, citric acid, manitol and salicylic acid resulted in significant reduction to the severity of the disease on okra plants (Balady Red cv.) with significant increase in the number of fruits / plant and fruit yield / plot (one m^2) compared with control treatment.

Table (4): Effect of spraying okra plants (Balady Red cv.) with some antioxidants on the severity of powdery mildew and fruit yield,greenhouse experiment.

Antioxidant	%Disease severity	No. of fruits/plant	Average of fruit yield / plot (one m²).
Ascorbic acid	32.8	90.0	268.4
Citric acid	31.0	91.3	273.0
Manitol	37.8	87.0	261.5
Salicylic acid	29.4	94.3	281.0
Control	64.6	80.7	236.3
L.S.D. at 5 %	3.2	4.1	2.7

This decrease was more pronounced when salicylic acid was sprayed on okra plants (29.4 % disease severity). Also, this treatment produced the highest values of fruit number / plant (94.3 fruit) and fruit yield / plot (281.0 g). On the other hand, manitol was the lowest efficient one. The corresponding values recorded 37.8 %for disease severity, 87.0 fruit / plant and 261.5 g. / plot, respectively. Control treatment recorded 64.6 %disease severity, 80.7 fruit / plant and 236.3 g. / plot, respectively.

4- Effect of some fungicides:

4-1: Effect on conidial germination:

Results (Table, 5) reveal that all the tested fungicides, i.e. Karathane, Rubigan, Sumi-8, Thiovit Jet, Topas and Vectra caused significant reduction in conidial germination of *E. cichoracearum*, 24 hours after incubation at 25 ±1 C° and 100% relative humidity, compared to control treatment. This reduction was gradually increased by the gradual increase in the concentration of the tested fungicides. The fungicide Topas gave the highest inhibition, being 18.1% germination followed by Rubigan, being 18.3% germination without significant differences. Meanwhile, the fungicide Thiovit Jet showed the lowest effect (62.3 % germination) followed by Karathane (52.3 % germination) with significant difference between the two values. In addition, control treatment recorded 84.6 % germination.

Table (5): Effect of different fungicide concentrations on conidial germination of okra powdery mildew, 24 hours after incubation at 25±1 C° at 100%relative humidity.

Fungicide	% Conidial germination at (ppm).*										Mean
	25	50	100	150	200	250	300	350	400	500	
Karathane	77.2	70.0	66.2	60.4	54.4	48.6	44.0	39.2	35.0	28.0	52.3
Rubigan	47.8	45.0	39.8	32.2	14.6	0.0	0.0	0.0	0.0	0.0	18.3
Sumi-8	55.2	50.4	45.2	41.0	35.6	30.0	18.6	0.0	0.0	0.0	27.6
Thiovit	84.0	80.6	74.0	69.0	65.4	60.0	56.4	50.6	43.6	39.2	62.3
Topas	49.6	44.0	38.4	29.8	14.0	0.0	0.0	0.0	0.0	0.0	18.1
Vectra	58.6	52.2	49.0	47.6	39.4	31.2	27.4	19.0	10.2	0.0	33.5
Control	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6	84.6
Mean	65.3	61.0	556.7	52.1	44.0	36.3	33.0	27.6	24.8	21.7	-------

*** The percentage of conidial germination at zero time is 2.6 %.**

L.S.D. at 5 % for: Fungicides (F) = 2.8 , Concentrations (C) = 4.1 and F x C = 3.7.

4-2: Effect on disease severity and fruit yield:

Data presented in (Table, 6) reveal that all the tested fungicides exhibited significant reduction in disease severity with significant increase in the number of fruits / plant and fruit yield / plot (21 m^2) compared with control treatment. In this regard, the fungicide Vectra was the most efficient one which recorded 6.1% disease severity, followed by Topas 7.4%, on the average) then Sumi-8 and Rubigan, being 8.1 and 8.6 %, on the average respectively. Meanwhile, the fungicide Thiovit-Jet showed the lowest effect (18.9%, on the average) followed by Karathane (15.2 %, on the average).The averages of the number of fruits/plant and fruit yield/plot (21 m^2) were also significantly increased due to application of the tested fungicides.

The obtained values showed the same trend, to great extend, to the efficiency of the fungicides. In this respect, the fungicide Vectra resulted in the highest values, being 161.3 fruit and 59.6 kg. /plot of 21 m^2, on the average. Meanwhile, plants sprayed with Thiovet-Jet gave the lowest figures, being 140.4 fruit and 48.9 kg. /plot (21 m^2), on the average. Control treatment recorded 59.3 % disease severity, 109.2 fruit/plant and 38.8 kg. /plot (21 m^2), on the average.

DISCUSSION

Four trials of disease control, *i.e.* resistant cultivars, method of irrigation, antioxidant and fungicides were employed to test their efficiency in this regard.

The four tested okra cvs. showed great variation in their reaction to the infection by powdery mildew. In this respect, Japanese cv. was the most resistant one followed by Hendi cv. Meanwhile, Bladdy Red cv. was the most susceptible one followed by Balady Green cv. In addition, the severity of infection was, to some what, reflected on the obtained fruit yield. It is well known that varietal resistance is one of the major trials of controlling many diseases including okra powdery mildew (Joi and Shende, 1979; Jamblhale and Nerkar,1983 ;Harender-Raj *et al.*,1993 and Neeraja *et al*.,2004). However, the variation in the produced fruit yields of the tested cvs. may be due to mainly to their genetic composition in addition to the stress of the infection by the causal of powdery mildew.

It has been found that spray irrigation method was of great efficiency in reducing the infection by the disease compared with flood and drip irrigation methods .The reduction in the disease due to spraying method resulted also in an increase in the obtained fruit yield. The obtained results are expected. It is well known that free water causes great damage to the conidia of powdery mildew fungi, which rapture occurs to cell wall of the conidia. Furthermore, the frequent irrigation daily by spray irrigation caused washing to conidia that found on okra leaves and low chance was found to success the establishment of the infection. Morsy(1994) found that spray irrigation method caused great reduction to the infection by chocolate spot of faba bean compared with flood and drip irrigation methods. Band *et al.* (2007) found that the more frequently irrigated okra plants were more severely infected by powdery mildew than the less frequently irrigated plants.

The obtained data indicated that using any of the tested antioxidants resulted in significant reduction in severity of the disease with significant increase to fruit yield compared with control treatment. Dean and Kuc (1985), Kuc and Rush (1985) and Doubrava *et al.* (1988) mentioned that induced acquired resistance by antioxidants is persistent and nonspecific for a pathogen. In addition, induced acquired resistance can be induced by simple chemical substances as well as by biotic agents. However, Lancake (1981) mentioned that unlike elicitors of phytoalexins accumulation, elicit at the site of application, and may be responsible for localized protection, inducer of systemic resistance and/or sensitize the plant to respond rapidly after infection. These responses induced phytoalexin accumulation and lignifications (Dean and Kuc, 1985 and Kuc and Rush, 1985) and induced or enhance activities of chitinase and glucanse (Metranx and Boller, 1986). Furthermore, Fouly (2004) reported that the mechanism of systemic acquired resistance is apparently multificated, likely resulting in stable, broad spectrum disease management and could be used preventatively to blaster general plant health, which resulted in long lasting protection. Apart from this, Linthorst (1991) reported that salyciclic acid induced many proteins similar in nature to the pathogenesis related proteins. Chen *et al.* (1993) and Chandra *et al.* (2001) cloned and sequenced that salycilic acid binding protein which exhibited catalase activity and elevated amounts of $H_2 O_2$ by inhibiting catalase activity. The use of acquired resistance was successfully tested by many investigators under Egyptian conditions to minimize the infection by many diseases (Aly and Afifi,1989; Ibrahim,1998 ;Abo Taleb,2001 ; Hilall,2004; Fouly,2004 and Abada *et al,*2008).

The use of fungicides is the short way to cause high harmful effect on the fungal pathogens and result in obtaining adequate results in disease management. The obtained data revealed that all the tested fungicides, *i.e.* Karathane, Rubigan, Sumi-8, Thiovit Jet, Topas and Vectra caused signification reduction in the conidial germination of *E. cichoracearum* compared to control treatment. This reduction was gradually increased by the gradual increase in the concentration of the tested fungicides. The fungicide Topas gave the highest inhibitory effect followed by Rubigan then Vectra and Sumi-8 without significant differences (systemic fungicides). Meanwhile, the fungicide Thiovit Jet (micronized sulphur) was the lowest efficient one followed by Karathane (contact or non-systemic fungicides). Shivanna *et al* (2006) tested nine systemic and four non-systemic fungicides against conidial germination of *E.cichoracearum* the causal of okra powdery mildew and found that systemic fungicides caused more inhibitory effect than non-systemic ones .The *in vitro* results were in the same trend of the *in vivo* results. Controlling okra powdery mildew by fungicides was frequently reported by many investigators (Singh *et al*, 1998; Naik and Nagaraja, 2000; Rhaman and Bhattiprolu, 2005 and Shivanna *et al*, 2006) and the efficiency of the tested fungicides was greatly differed.

In conclusion, Both Japanese and Hendi cvs. could be recommended as resistant cvs. and their high fruit yield with using the spray irrigation method due to applying the fungicides is recommended if the severity of the disease is high with using non-systemic ones such as Karathane and Thiovit Jet. Furthermore, using antioxidants could be used as alternative method for disease management or could be used in alternation with non-systemic fungicides.

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مكافحة مرض البياض الدقيقي في الباميــة

عفت عبد المجيد زاهر، خيري عبد المقصود عبادة و مروة عبد اللطيف زيتون .
قسم أمراض النبات - كلية الزراعة- جامعة القاهرة، الجيزة .

تم اختبار أربع طرق لمكافحة مرض البياض الدقيقي في البامية والذي يسببه الفطر إريسفي سايكوراسيرم وهى الأصناف المقاومة وطرق الرى ومضادات الأكسدة والمبيدات الفطرية .

كانت أصناف البامية الأربعة المختبرة قابلة للإصابة بالمرض وقد كان الصنف ياباني هو الأقل قابلية للإصابة، كما أعطى أعلى محصول، تلاه الصنف هندي (متوسط المقاومة) . بينما كان الصنفان البلدي الأحمر والبلدي الأخضر هما الأكثر قابلية للإصابة كما أنهما كانا الأقل محصولا .

أحدثت طرق الري بالتنقيط والغمر والرش اختلافات معنوية في شدة الإصابة بالمرض ، حيث تسبب الرى بالرش في خفض كبير في شدة الإصابة بالمرض مع زيادة محصول الثمار مقارنة بطريقتى الرى الأخرتين .

أحدثت كل مضادات الأكسدة المختبرة وهى حامض الأسكوربيك وحامض الستريك والمانيتول وحامض الساليسلك انخفاضا معنويا في المرض مع حدوث زيادة معنوية في محصول الثمار مقارنة بالنباتات الغير معاملة (المقارنة) . بالإضافة لذلك فقد كان حامض السالسلك هو الأكثر فعالية في هذا المضمار، تلاه حامض الأسكوربيك ثم حامض الستريك، بيما كان المانيتول هو الأقل فعالية .

تسببت كل المبيدات الفطرية المختبرة وهى الكاراثين والروبيجان والسومي-إيت والثيوفيت جيت والتوباس وفيكترا في حدوث انخفاض معنوى للنسبة المئوية للجراثيم الكونيدية النابتة للفطر إريسفي سايكوراسيرم ، بالإضافة لذلك فقد سجل المبيد توباس تلاه المبيد سومي-إيت ثم المبيد روبيجان فالمبيد فيكترا (مبيدات جهازية) أعلى نسب تثبيط للإنبات. بينما كان المبيد ثيوفيت جيت تلاه المبيد كاراثين (مبيدين غير جهازيين) الأقل فعالية في هذا الصدد.

أدى رش نباتات البامية بالمبيدات الفطرية المختبرةإلى خفض شدة الإصابة بالمرض بدرجة معنوية مقارنة بنباتات المقارنة ، وكان الإنخفاض في شدة الإصابة بالمرض متماشيا مع تأثير هذه المبيدات على انبات الجراثيم الكونيدية. وقد انعكس هذا الإنخفاض في المرض على محصول الثمار الناتج ، حيث حدثت زيادة معنوية في محصول الثمار نتيجة استخدام هذه المبيدات.

Table (6): Effect of spraying okra plants (Balady Red cv.) with some fungicides on severity of powdery mildew and fruit yield, field experiment at Behera governorate during 2006 and 2007growing seasons.

Fungicides	% Disease severity during seasons of		Mean	Average number of fruits/plant during seasons of		Mean	Average Fruit yield(kg)/plot (21 m²) during seasons of		Mean
	2006	2007		2006	2007		2006	2007	
Karathene	15.4	15.0	15.2	137.0	138.2	137.6	52.5	53.1	52.8
Rubigan	8.7	8.4	8.6	153.6	154.2	153.9	58.2	59.0	58.6
Thiovit Jet	19.6	18.1	18.9	140.0	140.8	140.4	48.4	49.3	48.9
Topas	7.8	7.0	7.4	158.8	160.0	159.4	58.0	58.0	58.0
Sumi-8	8.1	8.1	8.1	152.0	153.0	152.2	57.2	57.4	57.3
Vectra	6.1	6.0	6.1	160.4	162.2	161.3	59.2	60.0	59.6
Control	60.1	58.4	59.3	108.2	110.2	109.2	38.5	39.0	38.8
Mean	18.0	17..3	----	144.3	145.5	---	53.1	53.7	-----

L.S.D. at 5% for:

Cultivars (C) =	**2.2**	**3.3**	**3.5**
Season (S) =	**n.s.**	**n.s.**	**n.s.**
C x S =	**3.4**	**3.6**	**3.1**