Effect of Temperature on Mycelial Growth of *Botrytis cinerea* and *Rhizopus stolonifer* and Development of Peach Fruit Rots

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ABSTRACT

Effect of different temperatures on mycelial growth and development of peach fruit rots caused by *Botrytis cinerea* and *Rhizopus stolonifer* were studied. The results showed that Optimum temperature for attaining maximum mycelial growth was ranged from 20-25°C for *B. cinerea* and 25-30°C for *R. stolonifer*. The optimum temperature for development of fruit rot caused by *B. cinerea* was 25°C, whereas it was 30°C for rots caused by *R. stolonifer*. The lowest degree of infection was recorded at 10°C for the two tested fungi. The percentage of fruit weight loss increased with the increasing of incubation temperature. This was true for both healthy fruits and those inoculated with any of the two tested fungi. Insignificant effect was found for temperatures on pH and titratable acidity in fruits infected with the two tested fungi. However, significant increase in the percentage of titratable acidity was recorded in fruits inoculated with *R. stolonifer* and incubated at 25-30°C. Fruits inoculated with each of the tested two fungi and kept at 20-30°C showed the higher values of total phenolic compounds compared with control. However, insignificant differences in phenolic compounds content was found between diseased and healthy fruits at 10°C. Total soluble sugars and non-reducing sugar contents were markedly decreased in inoculated fruits at 20 to 30°C. On the other hand, insignificant differences were found in reducing sugar content in inoculated fruits stored at different temperatures. However, fruits inoculated with *B. cinerea* and incubated at 15-25°C gave the highest mean values of reducing sugar content. The tested fungi were differed in their ability to produce pectolytic and cellulytic enzymes *in vitro* and *in vivo* at different temperatures. Generally, the highest activities of the enzymes PME, PMG, PG and Cx *in vitro* and *in vivo* were detected at temperatures ranged from 20-25°C, for *B. cinerea* and 25-30°C for *R. stolonifer*. There were insignificant differences between polyphenol oxidase and peroxidase activities of the tested fungi grown at different temperatures *in vitro*. On the contrary, the activities of these oxidative enzymes were significantly increased in inoculated fruits with increasing of temperature at the range from 10 to 30°C.

INTRODUCTION

Botrytis cinerea Pers.: Fr., and *Rhizopus stolonifer* (Ehrenb.: Fr.) are known as important postharvest pathogens on peach "*Prunnus persica* L." Batsch which cause serious losses during harvesting, marketing and storage(Margosan, *et al.*, 1997). Postharvest pathogens generally grow best at 20 to 25°C depending upon the fungus species a few responding optimally at slightly higher temperatures. The maximum temperatures for growth are typically about 32-38°C, but some species can grow at higher temperature. At a temperature of –1 to 0°C only a limited group of fungi can be expected to pose

difficulties. By for the most important of these is *B. cinerea* and *P. expansum*. Some postharvest pathogens having minimum temperatures for growth of about 5°C or higher, have developmental stages very sensitive to low temperature. *R. stolonifer* and *Aspergillus niger* are examples (Sommer, 1985). The aim of this study was first to determine *in vitro* influence of temperature on mycelial growth and on the enzyme activities in culture filtrates of the two tested fungi and second to study the influence of temperature on the development of fruit rots and on some physical, chemical and physiological properties of peach fruits inoculated with *B. cinerea* or *R. stolonifer*.

MATERISLS AND METHODS

1. Effect of different temperatures on mycelial growth.

To study the effect of different temperatures on radial growth of the two tested fungi *Botrytis cinerea* and *Rhizopus stolonifer*, the causal agents of peach fruit rots, plates containing PDA medium for each fungus were inoculated at the center with a uniform 4 mm equal disc cut from the margin of 3-7 days old culture grown on PDA. Inoculated plates were incubated at different temperatures (10, 15, 20, 25 and 30°C). Five replicates were used for each treatment and radial growth was recorded after 3 days for *R. stolonifer* and 7 days for *B. cinerea* from inoculation and the averages were calculated.

2. Effect of different temperatures on the development of postharvest peach fruit rots

Apparently healthy and uniform mature peach fruits were washed, surface sterilized and inoculated with each tested fungus as mentioned by Hong *et al.*, (1998). Control fruits were also injected by sterile distilled water. Inoculated and control fruits were incubated at different temperatures (10, 15, 20, 25 and 30°C). The test was done with three replicates per treatment and eight fruit per replicate. Disease development was recorded daily for 5 days after inoculation by measuring lesion diameter and the degree of infection of decayed fruits were calculated as mentioned by Horsefall and Heuberger, (1942). The samples were taken for determination of physical, chemical and physiological properties of fruits at the end of the incubation period. Fruit weight loss was estimated by initially weighing 8 fruits and then weighing the same fruits at the end of storage and their weight loss was calculated as percentage. The pH and titratble acidity using 0.1N NaOH were determinated (A.O.A.C.,1986). Total soluble sugar, non-reducing sugar and reducing sugar were determined according to Thomas and Dutcher, (1924). The activity of pectin methyl esterase (PME) was measured according to the modified method used by smith, (1958), the activities of polymethyl galacturonase (PMG) and cellulase (Cx) was measured according to the method used by Talboys and Bush, (1970) and the activity of polygalacturonase (PG) was determined as mentioned by Hancock *et al.*, (1964). For determination of polyphenol oxidase

(PPO) activity, the method described by Broesh, (1954) was used and the activity of peroxidase (PO) was determined according to the method suggested by Sumner and Somers, (1953). Total phenolic compounds was determined according to Swain and Hillis, (1959). Tests were carried out through the two successive seasons (2000 & 2001) using three replicates per treatment.

3. Effect of different temperatures on the enzymes activity of fungi in culture filtrates.

The peach isolates of *R. stolonifer* and *B. cinerea* were used in this study. The pectolytic, cellulolytic and oxidative enzymes produced by these two isolates were studied *in vitro* by growing the fungus in 100 ml Erlenmeyer flasks containing 25 ml Czapek Dox Broth supplemented by 1% apple pectin or polygalacturonic acid for pectolytic enzymes, 1% carboxymethyl cellulose (CMC) for cellulolytic enzyme (Cx) and 0.1% catechol or pyrogallol for oxidative enzymes. The inoculated flasks were incubated at different temperatures (10, 15, 20, 25 and 30°C) for 10 days. Cultural filtrates were obtained by filtrating the fungal growth media through several layers of cheesecloth and centrifuged at 4000 rpm for 20 minutes. The clear supernatants were utilized as crude enzyme to estimate enzymes activities immediately or kept in freezer at –5°C for further studies.

RESULTS AND DISCUSSION

Data (Table 1 and Fig. 1) indicated that the temperature had a significant effect on mycelial growth of the two studied fungi. The optimum temperature for *B. cinerea was* ranged from 20 to 25°C and gave the lowest linear growth on 30°C. On the other hand, *R. stolonifer* produced maximum linear growth within the range of 25 to 30°C. Meanwhile the results (Table 2 and Fig. 2) also showed that the optimal temperature for attaining maximum degree of infection on peach fruits inoculated with *B. cinerea* was 25°C, whereas it was 30°C for those inoculated with *R. stolonifer.* Disease severity Markedly decreased at the other tested temperatures. Similar results were obtained by other workers (Sommer, 1985; El-Tobshy and Baraka, 1986; Tadrous, 1991 and Abbass, 1999).

Generally, infection started to appear one day after incubation at all tested temperatures. However, fruits incubated with *B. cinerea* and stored at 10°C or those inoculated with *R. stolonifer* and kept at 10-15°C did not show any rot symptoms after the first day of incubation (Fig. 3). Starting from the second day of incubation at any of the tested temperatures, fruits inoculated with each of the two tested fungi showed a pronounced progress in lesion diameters. Such observations were supported by the *in vitro* experiments carried out in the present study concerning the effect of temperature on the growth and development of the tested fungi on PDA medium. Maximum growth rates were attained at 20-25°C for *B. cinerea* and 25-30°C for *R. stolonifer.*

Table 1. Mycelial growth of *B. cinerea* and *R. stolonifer* on PDA medium at different temperatures

Temperature (°C)	Linear growth (cm)	
	B. cinerea	*R. stolonifer*
10	2.070* c	0.000 d
15	6.650 b	4.570 c
20	7.790 a	7.170 b
25	7.250 ab	8.600 a
30	0.740 d	8.130 a

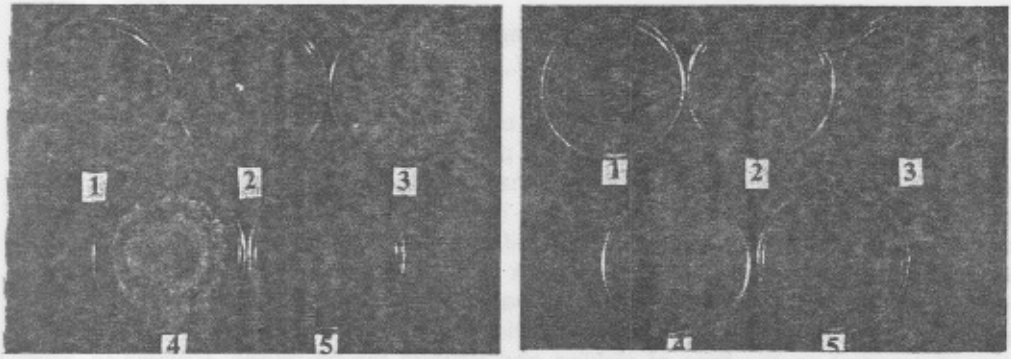
* values are the mean of colony diameters of 5 dishes,
Different letters in a column denote significant differences according to Duncan's multiple range test at 0.05 level of probability.

Table 2. Effect of different temperatures on the degree of infection of peach fruits with the tested fungi .

Temperature (°C)	Degree of infection %*	
	B. cinerea	*R. stolonifer*
10	29.167 b	20.833 c
15	42.500 b	26.667 c
20	60.833 a	50.000 b
25	67.500 a	84.167 a
30	55.833 a	95.000 a

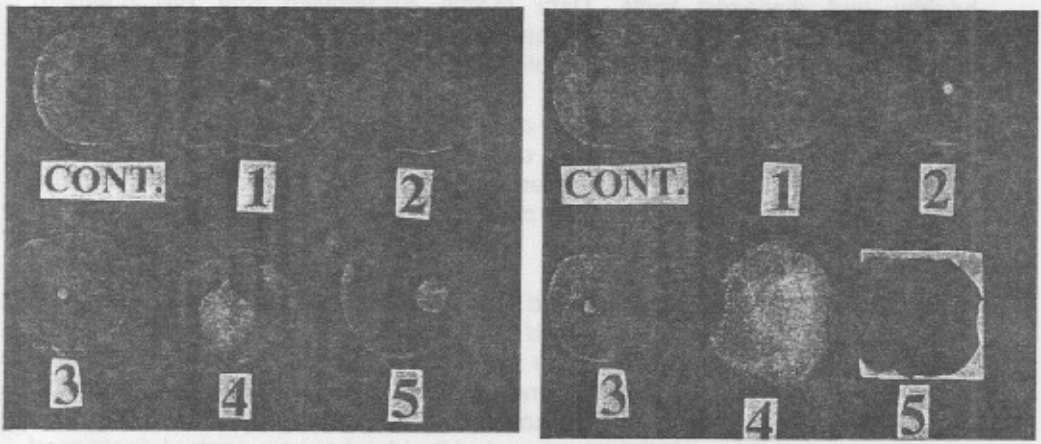
$$\text{*Degree of infection (\%)} = \frac{\text{Sum of individual ratings}}{\text{No. of fruits assessed}} \times \frac{100}{5}$$

Different letters in a column denote significant differences according to Duncan's multiple range test at 0.05 level of probability.



R.stolonifer *B.cinerea*

Fig.1. Effect of different temperatures on mycelial growth of the two tested fungi on PDA medium. (1) 10°C, (2) 15°C, (3) 20°C, (4) 25°C and (5) 30°C.



B.cinerea *R.stolonifer*

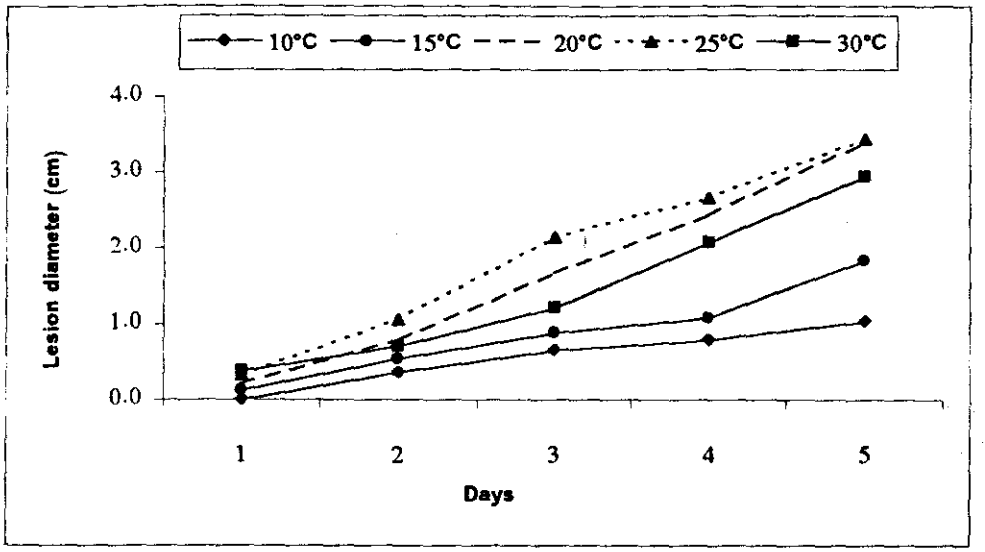
Fig.2. Effect of different temperatures on the infection by postharvest fruit-decaying fungi . (cont.) non inoculated fruits. (1) 10°C, (2) 15°C, (3) 20°C, (4) 25°C and (5) 30°C.

These observations were similar to those reported by Sommer, (1985), Abdel-Malek, (1987), Tadrous, (1991), Jalil *et al.*, (1997), Chen *et al.*, (1998) and Abbass, (1999).

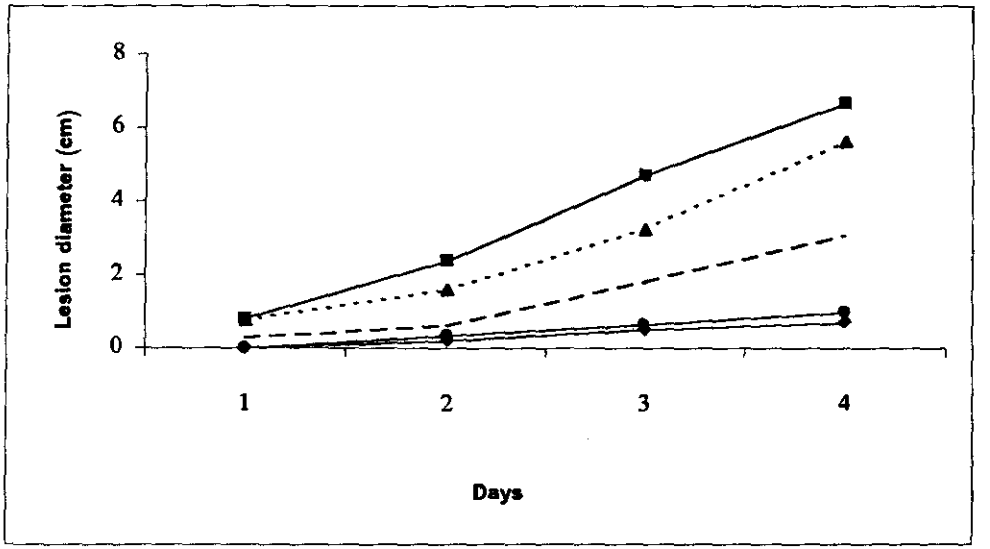
The present work was studied the effect of different temperatures on some physical, chemical and physiological properties in healthy and diseased peach fruits. The obtained data indicated that there was an increase in weight loss of healthy and diseased fruits with the increase in temperature during the storage period (Table 3). There were significant differences between healthy and diseased fruits only at 25-30°C. Boreck *et al.*, (1985) stored plum fruits of six cultivars for up to thirteen days at various temperatures (0-17°C) and determined the losses during storage period. They mentioned that storage losses depended on the time of picking and storage temperatures. Results in Table 4 showed that there were insignificant differences in pH and titratable acidity among the different tested temperatures in both healthy fruits and those inoculated with the two tested fungi during the storage period. However, fruits inoculated with *R. stolonifer* and stored at 25-30°C exhibited a significant increase in titratable acidity and showed the highest degree of infection especially at 30°C. This conclusion was in agreement with that of Kumar and Chitkara, (1983) and Gonzalez *et al.*, (1992).

Concerning the effect of different temperatures on phenolic content in healthy and diseased fruits, Data (Table 5) showed that the optimum temperature (20-30°C) for rot development was the same as that required for attaining maximum amounts of phenolic content in diseased fruits. These results are in agreement with the findings of Hussin, (1976), Abdel-Malek, (1987), Baraka *et al.*, (1987) and Hegazi *et al.*, (1993) they reported that the infected plant tissues contained high amount of phenols in comparison with the healthy ones. Moreover, results of the present investigation indicated that there were insignificant differences in phenolic content of uninoculated fruits exposed to different storage temperatures.

Data (Table 6) demonstrated that the total soluble sugars and non-reducing sugars markedly decreased in diseased fruits stored at 20 to 30°C. This range of temperature almost the same range at which the highest degrees of infection with the two tested fungi were obtained. These results are in agreement with the findings of Baraka *et al.*, (1987), Gaber *et al.*, (1990 b) and Ekundayo and Okigbo, (1991) who reported that total sugars content decreased in infected fruits. Our results showed that, there were insignificant differences in reducing sugar content of diseased fruits stored at different temperatures. However, fruits inoculated by *B. cinerea* and kept at 15-25°C gave the highest mean values of reducing sugars. These were in agreement with the findings of many authors who reported that such increase in reducing sugars was proved to be associated with infected fruits (Abdel-Rehim *et al.*, 1973 and Tarabeih *et al.*,



B. cinerea



R. stolonifer

Fig. (3). Effect of different temperatures on the development of fruit rots caused by *B. cinerea* and *R. stolonifer*.

Table 3. Effect of inoculation with B. *cinerea* or R. *stolonifer* different temperatures on weight loss percentage of peach fruits .

Temperature (°C)	Fruit weight loss (%)		
	B. cinerea	*R. stolonifer*	Control
10	5.057 d	3.957 d	4.173 d
15	9.287 c	7.877 c	7.187 c
20	12.103 c	12.073 bc	9.667 c
25	23.090 b	27.733 a	18.110 b
30	26.357 a	28.520 a	21.787 a

Control = uninoculated fruits.

Different letters in a column denote significant differences according to Duncan's multiple range test at 0.05 level of probability.

Table 4. The juice pH and percentage of titratable acidity of uninoculated and fruits inoculated with *B. cinerea* or *R. stolonifer* after 5 days of incubation at different temperatures.

Temperature (°C)	pH			Percentage of titratable acid		
	B. cinerea	*R. stolonifer*	Un-inoculated	*B. cinerea*	*R. stolonifer*	Un-inoculate
10	3.49 a	3.60 a	3.60 a	0.344 a	0.344 b	0.240 a
15	3.47 a	3.66 a	3.72 a	0.414 a	0.317 b	0.294 a
20	3.31 a	3.52 a	3.74 a	0.453 a	0.426 b	0.259 a
25	3.41 a	3.44 a	3.75 a	0.515 a	0.623 a	0.236 a
30	3.39 a	3.27 a	3.72 a	0.375 a	0.665 a	0.337 a

Different letters in a column denote significant differences according to Duncan's multiple range test at 0.05 level of probability.

1977). Generally, there were insignificant differences in total soluble sugars, reducing and non-reducing sugars in healthy fruits stored at different temperatures at the end of the storage period. In general, healthy fruits contained higher amounts of sugars compared with those of diseased fruits.

Results of pectolytic and cellulytic enzymes activities in cultural filtrates of *B. cinerea* and *R. stolonifer* after incubation at different temperatures (Table 7) showed that the maximum activity of PME enzyme was obtained at 20°C for *B. cinerea* and 25-30°C for *R. stolonifer*. Maximum activities of PMG enzyme were detected in the filtrates of *R. stolonifer* and *B. cinerea* at 25°C. On the other hand, optimum temperature for PG enzyme activity of *B. cinerea* was attained at 20-25°C and for *R. stolonifer* at 30°C. The maximum Cx enzyme activity of *B. cinerea* was found at 20°C and 25°C for *R. stolonifer*. These results were partially in line with the findings of Pasha, (1982), Larios *et al.*, (1989), Baily and Pessa, (1990) and El-Shaieb and Malibari, (1995) who found that the optimum temperature for the production of pectolytic and cellulytic enzymes by fungi varied according to the type of fungus itself.

Determinations of the pectolytic and cellulytic enzymes illustrated that fruits inoculated with *B. cinerea* gave the highest activities of PME, PMG, PG and Cx enzymes at temperatures ranged from 20-25°C, while fruits inoculated with *R. stolonifer* showed the highest enzyme activities within the range of 25°C to 30°C (Table 8). The pathogenic ability of these fungi at the same range of temperature may suggest the correlation between the activities of these enzymes and pathogenicity. Such correlation has been previously reported by Yash *et al.*, (1989), Gaber *et al.*, (1990 a), Seif El-Nasr *et al.*, (1990), Kim *et al.*, (1991), Kaul and Sharma, (1992), Yao *et al.*, (1996), Shangwu *et al.*, (1998) and Bruton *et al.*, (1998).

According to the results of the present study, it can be concluded that there was agreement between the optimum temperatures for pectolytic and cellulytic enzymes activities *in vitro* or *in vivo* and those for attaining maximum degrees of infection. Moreover, enzyme activities of the two tested fungi were gradually dropped less or above the optimum temperature. Pasha, (1982) reported that the highest level of PG enzyme that produced by *Aspergillus aculeatus* was obtained at incubation temperature of the range 28-32°C and the higher incubation temperature resulted in a sharp drop in enzyme activity. In contrast to the above results, there were insignificant differences among the different temperature in their effects on pectolytic and cellulytic enzymes activities in healthy fruits. For this reason the changes in enzyme activities in diseased fruits caused by invaded fungi.

Data (Table 9) also revealed that the tested fungi produced polyphenol oxidase (PPO) and peroxidase (PO) enzymes in cultural filtrates at

Table 5. Phenolic compounds content in uninoculated fruits and those inoculated with *B. cinerea* or *R. stolonifer* after 5 days of incubation at different temperatures.

Temperature (°C)	Phenolic compounds content (mg/gm fruit tissue)		
	B. cinerea	*R. stolonifer*	Uninoculated
10	1.086 c	0.923 b	0.769 a
15	1.120 bc	1.344 ab	0.808 a
20	1.568 a	1.190 ab	0.763 a
25	1.453 abc	1.521 a	0.584 a
30	1.498 ab	1.523 a	0.564 a

Different letters in a column denote significant differences according to Duncan's multiple range test at 0.05 level of probability.

Table 6. Sugar content (total, reducing and non-reducing) in uninoculated fruits and those inoculated with *B. cinerea* or *R. stolonifer* after 5 days of incubation at different temperatures.

Temperature °C	Total soluble sugars (mg/gm fruit tissue)			Reducing sugars (mg/gm fruit tissue)			Non-reducing sugars (mg/gm fruit tissue		
	B. cinerea	*R. stolonifer*	Uninoculated fruits	*B. cinerea*	*R. Stolonifer*	Uninoculated fruits	*B. cinerea*	*R. stolonifer*	Uninoculated fruits
10	66.667 a	64.261 a	63.459 a	8.247 b	14.662 a	19.244 a	58.419 a	49.599 a	44.216 a
15	55.212 ab	64.376 a	61.054 a	22.337 a	10.767 a	17.182 a	32.875 b	53.608 a	43.872 a
20	40.894 b	47.995 a	65.865 a	18.213 ab	17.296 a	19.587 a	22.68 b	30.699 b	46.277 a
25	41.924 b	34.250 b	50.401 a	18.557 ab	17.640 a	17.526 a	23.368 b	16.609 b	32.875 ab
30	39.862 b	30.699 b	42.726 a	8.591 b	13.173 a	16.724 a	31.271 b	17.526 b	26.002 b

Different letters in a column denote significant differences according to Duncan's multiple range test at 0.05 level of probability.

Table 7. Enzyme activities in culture filtrates of *B. cinerea* or *R. stolonifer* after 7 days of incubation at different temperatures

Temperature (°C)	Pectolytic enzymes activities						Cellulase (% reduction of viscosity)		Oxidative enzymes activities			
	Pectin methyl esterase µMcooH x 10^{-3}/min/gm (units of enzyme)		Polymethyl galacturonase (% Reduction of viscosity)		Polygalacturonase (% Reduction of viscosity)				Polyphenol oxidase (units of enzyme)		Peroxidase (units of enzyme)	
	B. cinerea	*R. stolonifer*	*B. cinerea*	*R. stolonifer*	*B. cinerea*	*R. stolonifer*	*B. cinerea*	*R. stolonifer*	*B. cinerea*	*R. stolonifer*	*B. cinerea*	*R. stolonifer*
10	1.273 c	0.579 b	4.167 c	8.330 c	4.018 b	7.885 b	13.534 a	5.263 b	0.494 a	0.328 a	9.050 a	10.305 a
15	4.861 a	2.538 b	9.936 bc	10.256 bc	17.204 ab	8.961 b	31.830 a	12.531 ab	0.406 a	0.417 a	13.012 a	10.288 a
20	5.671 a	3.124 b	21.795 ab	21.795 ab	44.444 a	27.240 ab	39.348 a	31.579 ab	0.639 a	3.333 a	9.591 a	6.265 a
25	3.819 ab	5.324 a	25.321 a	33.333 a	44.803 a	36.201 a	36.842 a	39.850 a	0.794 a	1.011 a	10.520 a	6.961 a
30	2.315 bc	5.324 a	9.615 bc	26.603 a	22.222 ab	36.918 a	35.840 a	35.088 ab	0.428 a	0.733 a	13.614 a	5.569 a

Different letters in a column denote significant differences according to Duncan's multiple range test at 0.05 level of probability.

Table 8. Pectolytic and cellulytic enzymes activities in uninoculated fruits and those inoculated with *B. cinerea* or *R. stolonifer* after 5 days of incubation at different temperatures.

Temperature °C	Pectin methyl esterase (μ McooH x 10^{-3}/min/gm) (units of enzyme)			Polymethyl galacturonase (% Reduction of viscosity)			Polygalacturonase (% Reduction of viscosity)			Cellulase (% reduction of viscosity)		
	B. cinerea	*R. stolonifer*	Uninoculated fruits	*B. cinerea*	*R. stolonifer*	Uninoculated fruits	*B. cinerea*	*R. stolonifer*	Uninoculated fruits	*B. cinerea*	*R. stolonifer*	Uninoculated fruits
10	3.383 b	4.305 b	3.690 a	7.862 b	7.862 c	8.491 a	14.506 a	11.420 c	8.025 a	8.100 c	10.903 c	13.707 a
15	11.379 a	3.998 b	4.613 a	9.434 b	10.063 bc	12.893 a	13.580 a	14.506 bc	8.025 a	18.069 b	16.199 bc	14.642 a
20	15.684 a	8.611 b	6.766 a	17.610 a	16.981 b	16.666 a	14.815 a	20.062 abc	10.185 a	26.168 a	23.053 b	15.888 a
25	14.147 a	18.452 a	6.458 a	19.182 a	25.472 a	15.723 a	20.062 a	26.234 ab	11.111 a	27.726 a	30.530 a	18.691 a
30	11.686 a	16.299 a	7.381 a	15.409 ab	17.296 b	15.409 a	20.062 a	27.469 a	10.802 a	23.987 a	36.760 a	19.314 a

Different letters in a column denote significant differences according to Duncan's multiple range test at 0.05 level of probability.

Table 9. Oxidative enzymes (Polyphenol oxidase and peroxidase) activities in uninoculated fruits and those inoculated with *B. cinerea* or *R. stolonifer* after 5 days of incubation at different temperatures.

Temperature (°C)	Polyphenol oxidase (units of enzyme)			Peroxidase (units of enzyme)		
	B. cinerea	*R. stolonifer*	Un-inoculated fruits	*B. cinerea*	*R. stolonifer*	Un-inoculated fruits
10	13.133 b	15.867 d	16.933 a	34.421 c	23.205 c	32.874 a
15	19.067 b	17.400 cd	17.000 a	35.768 b	27.846 c	28.619 a
20	25.533 ab	24.200 bc	12.333 a	58.013 a	42.930 b	28.620 a
25	30.533 a	28.667 ab	10.867 a	65.748 a	83.925 a	27.459 a
30	31.200 a	36.800 a	12.133 a	78.510 a	76.577 a	23.205 b

Different letters in a column denote significant differences according to Duncan's multiple range test at 0.05 level of probability.

any of the tested temperatures. These results were in agreement with Chakraborty and Nadi, (1978), Abdel-Malek, (1987) and Seigle-Murandi *et al.*, (1992). From the present findings, there were insignificant differences among the different temperature in their effect on oxidative enzyme activities during fungal cultivation. In the current research, the oxidative enzyme activities of PPO and PO in fruits inoculated with *B. cinerea* or *R. stolonifer* gradually increased according to the increase of the storage temperature from 10 to 30°C. According to the available literature, the infected tissues had considerably higher activities of peroxidase and polyphenol oxidase than those in healthy ones (Chakraborty and Nadi, 1978; Baraka *et al.*, 1987 and Hegazi *et al.*, 1993). In addition, Jianzhang, *et al.* (1997) and Borua and Das (2000) reported that the increase in activities of polyphenol oxidase and peroxidase in susceptible varieties after infection reflected the response of the host to check the attack of pathogen.

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الملخص العربى

تأثير درجات الحرارة على النمو الميسيليومي للفطرين بوترايتس سيناريا و رايزوبس ستولونيفير و تطور عفن ثمار الخوخ

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تم دراسة تأثير درجات الحرارة المختلفة على النمو الميسيليومي للفطر بوترايتس سيناريا والفطر رايزوبس ستولونيفير و تطور عفن ثمار الخوخ المتسبب عن هذان الفطران. اظهرت النتائج ان درجة الحرارة المثلي للحصول على أعلى نمو مسيسليومي فطر بوترايتس سيناريا تراوحت بين ٢٠-٢٥°م بينما تراوحت بين ٢٥-٣٠°م للفطر رايزوبس ستولونيفير ، كانت درجة الحرارة المثلى لحدوث عفن ثمار الخوخ المتسبب عن الفطر بوترايتس سيناريا هي ٢٥°م بينما كانت درجة الحرارة ٣٠°م هي الدرجة المثلى لحدوث عفن الثمار المتسبب عن الفطر رايزوبس ستولونيفير ، من ناحية أخرى لوحظت أقل معدلات لإصابة الثمار بكلا الفطرين على درجة حرارة ١٠°م . وجد أن الفاقد في الوزن في الثمار السليمة والمصابة بكلا الفطرين قد ارتفع مع ارتفاع درجات الحرارة أثناء التخزين ، لم توجد فروق معنوية بين درجات الحرارة المختلفة في تأثيرها على الرقم الهيدروجيني ونسبة الحموضة الكلية في الثمار المصابة بكلا الفطرين المختبرين ، باستثناء الثمار المصابة بالفطر رايزوبس ستولونيفير حيث أظهرت زيادة معنوية في نسبة الحموضة عند التحضين على درجات حرارة تراوحت بين ٢٥-٣٠°م . لم توجد فروق معنوية بين الثمار السليمة والمصابة بكلا الفطرين المختبرين في محتواها من المواد الفينولية الكلية عند التحضين على درجة حرارة ١٠°م بينما أدى ارتفاع درجات حرارة التحضين إلى ٢٠-٣٠°م إلى ارتفاع محتوى الثمار المصابة من المواد الفينولية مقارنة بالثمار السليمة . انخفض بوضوح محتوى ثمار الخوخ المصابة من السكريات الكلية والسكريات غير المختزلة عند التخزين على درجات حرارة تراوحت بين ٢٠-٣٠°م ومن ناحية أخرى لم تلاحظ فروق معنوية بين تأثير درجات الحرارة المختلفة على محتوى الثمار المصابة من السكريات المختزلة ، عدا الثمار المصابة بالفطر بوترايتس سيناريا والتي احتوت على محتوى من السكريات المختزلة عند التخزين على درجات حرارة تراوحت بين ١٥- ٢٥°م . اختلف الفطريات المختبرة في قدرتهما على إنتاج الإنزيمات البكتينية والسليلوزية سواءاً في الراشح المزرعي أو في أنسجة الثمار المعداة و على درجات الحرارة المختلفة . ولقد أظهر الفطر بوترايتس سيناريا أعلى نشاط لإنزيمات البكتين ميثيل استيريز ، البولي ميثيل جلاكتيروناز ، البولي جلاكتيروناز والسليوليز سواءاً في الراشح المزرعي أو في أنسجة الثمار المصابة عند التحضين على درجات حرارة تراوحت بين ٢٠-٢٥°م . ولقد أظهر أن الفطر رايزوبس ستولونيفير نفس النشاط الإنزيمي عند التحضين على درجات حرارة تراوحت بين ٢٥-٣٠°م .