

Effect of Some Meteorological Factors on Downy Mildew Disease of Cucurbit Crops in Ismailia Governorate

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Abstract: Positive relationship among the prevailing meteorological factors and disease severity of cucurbits downy mildew disease caused by the fungus *Pseudoperonospora cubensis* (Berk and Curtis) Rostovzev was found. The study was implemented during the cultivation periods of different cucurbits crops during the two years 2006 and 2007 at Ismailia Governorate. The cucurbit varieties used in this investigation were arranged according their susceptibility referring to determine disease severity on cucumber, melon, cantaloupe, squash and watermelon. Disease severity was higher in 2007 than in 2006. The thermal range 14 – 24 C, relative humidity from 61 to 66 % and dew point between 13 - 20 were the effective meteorological factors on disease incidence and severity.

Keyword: meteorological factors; *Pseudoperonospora cubensis*; cucurbit crops.

INTRODUCTION

Cucurbit plants are occupied the third position after tomato and potato crops. They are among the most important vegetables crops grown in open field and protected cultivation (glasshouse, plastic houses and tunnels), (Shama *et al.*, 1998). According to the Central Horticultural and Agricultural Crops Administration, Ministry of Agriculture the total cultivate area of cucurbits cultivation reached approximately 85702 faddans at 2009 / 2010 season represented about 11.97 % of the total vegetable crops area, yielded 746636 tons of cucurbit fruits.

Under the Egyptian environmental conditions cucurbits plants are attacked with different fungal diseases reduce the production considerably from early spring till autumn seasons (Ahamed, *et al.*, 2000).

Downy mildew of cucurbits, is one of the most prevalent foliar diseases caused by *Pseudoperonospora cubensis*. The disease was recorded for the first time in Egypt on cucumber grown in the open field by (El-Helaly *et al.* 1963).

Also, the disease is annually found on squash, cucumbers, pumpkins, muskmelons, and other cucurbits. Yield losses was expected from 30 to 80 % if disease severity reached 50 -100%, (El-Nagar 1991).

The pathogen is presents and develops in a high humidity and often causes severe epidemics (Reuveni, 1997). Environmental factors influenced spore viability and spore germination of *P. cubensis*, (Timchenko, *et al.*, 1989).

Temperatures and humidity affected the formation of zoospore mass of *P. cubensis* in water drops on glass slides. Optimum temperature for sporangial germination

was 14-18 °C. Sporangia on dry slides at RH 10-100% at 17-18 °C were not germinated. Sporangial viability was maintained in water drops at 10 °C up to 15 days, at 5-7 °C, 13-15 °C and 22-25 °C to 5, 3 and 2 days, respectively and at 30 -32 °C to 1 day, (Kuznetsov 1980).

The highest sporangial distribution was recorded at a height of 25 cm above ground level. Air temperature, relative humidity (RH), and rain rate significantly affected downy mildew development. Multiple regression equation revealed that increasing a temperature unit reduced disease severity, while increasing a unit of RH and rain increased the disease severity, (Sharma, *et al.*, 2003).

The major goal of the recent research was to throw lights on the influence of some meteorological factors on disease incidence of cucurbits downy mildew disease caused by *P. cubensis* under the environmental conditions of Ismailia Governorates.

MATERIALS AND METHODS

Meteorological factors such as temperature, relative humidity, dew point and wind speed were recorded to study their effect on disease severity of cucurbits downy mildew caused by the fungus *Pseudoperonospora cubensis* under the environmental conditions of Ismailia Governorates.

The study was implemented during the cultivation periods of these economic and important vegetable crops during the two successive years 2006 and 2007. Table (1) indicates the cucurbit varieties and cultivars involved in this investigation.

Table (1): Cucurbit cultivars and their scientific name.

Cucurbit spices	Scientific name	Cultivars
Cucumber	<i>Cucumis sativus</i> L.	Bitra-Alfa
Melon	<i>Cucumis melon</i> var. <i>reticulatus</i> L.	Ananas El-Dokki
Cantaloupe	<i>Cucumis melon</i> var. <i>cantaloupensis</i> L.	Galia
Squash	<i>Cucurbita pepo</i> L.	Escandarani Arlika
Watermelon	<i>Citrullus lanatus</i> L.	Giza I

The chosen fields were frequently examined during the plantation period through the two years of study. Randomize samples of cucurbit leaves were collected weekly and visually examined to determine the infected leaf surface. The mean of infected area was calculated according to (Horsfall and Barrette 1945) to determine disease severity. Examination of cucumber, cantaloupe and melon was started from February while watermelon and squash were started examined from March. Data obtained were tabulated and discussed.

RESULTS AND DISCUSSION

Meteorological factors were recorded at Ismailia Governorate during the two successive years of study, 2006 and 2007. At the same time, severity of cucurbit downy mildew disease was determined according to Horsfall and Barrette (1954). Cucurbits crops i.e cucumber, melon, cantaloupe, squash and watermelon were included in this investigation Tables (2,3,4,5 and 6), show the obtained results. Tabulated data clear a positive relationship among disease severity and the prevailing meteorological factors during survey periods. Generally, results obtained revealed that disease severity was higher during the year 2007 than that obtained in the year of 2006. However, it was obvious

that disease severity was generally increased accompanied with increasing of the temperature, RH%, dew point. After disease severity was reached to its maximum percentage it started to decrease. Also, the meteorological factor at the maximum percentage was differed from cucurbit crop to another. Also, disease severity was affected due to the prevailing meteorological factors.

Table (2) shows the prevailing meteorological factors during the period from February to September of the two years of the study. At the same time, disease severity of downy mildew on cucumber plants was calculated as mentioned before and then tabulated as percentage of infected surface mean.

Data obtained reveal that disease severity was higher in the year 2007 than in 2006. Also, the higher percentage of infected surface of leaves (disease severity %) was obtained at August while the lowest one was observed at March in both years of study. The increase of disease severity may be attributed to the prevailing temperature (27.55 – 28.82 C), RH (60.13 – 61.35 %) and dew point (20.24- 20.58) at the same period. Data tabulated at Table (3) expressed the obtained results of disease severity of downy mildew disease on melon.

Table (2): Disease severity of downy mildew on cucumber and the prevailing meteorological factors during the two years 2006 and 2007 at Ismailia Governorate.

Month	2006					2007				
	Disease Severity %	Temp	RH%	Dew point	Wind km/h	Disease Severity %	Temp	RH%	Dew point	Wind km/h
February	23.2	14.43	66.68	7.5	11.18	25.5	14.43	66.39	7.46	11.46
March	19.6	16.74	59.19	7.87	9.94	20.2	16.68	59.77	7.55	11.45
April	22.4	20.43	59.5	10.67	14.1	23.1	19.6	57.9	9.73	13.67
May	24.4	22.97	59.28	13.17	20.14	24.4	24.9	55.1	14.03	14.1
June	32.6	26.2	57.8	16.5	22.4	32.6	27	57.03	16.6	10.23
July	44.1	27.55	61.35	18.77	26.4	46.4	28.81	60.13	19.55	11.39
August	40.1	28.94	64.45	20.42	36.6	42.2	28.52	63.77	20.58	10.23
September	36.1	26.6	63.13	18.23	38.4	36.1	26.13	64.13	18.17	10.1
October	21.4	23.29	61.35	14.87	24.3	26.6	24.26	68.13	17.23	6.84
November	20.3	17.07	66.07	9.93	18.8	20.3	19.27	65.47	11.6	6.93
December	36.1	13.52	69.13	7.1	20.4	36.1	14.61	65.94	7.16	7.9

Table (3): Disease severity of downy mildew on melon and the prevailing meteorological factors during the two seasons 2006 and 2007 at Ismailia Governorate.

Month	2006					2007				
	Severity %	Temp	RH%	Dew point	Wind km/h	Severity %	Temp	RH%	Dew point	Wind km/h
February	16.2	14.43	66.68	7.5	11.46	16.6	14.43	66.39	7.46	11.46
March	22.4	16.74	59.19	7.87	9.94	20.4	16.68	59.77	7.55	11.45
May	23.1	22.97	59.28	13.17	10.14	24.4	24.9	55.1	14.03	14.1
June	26.6	26.2	57.8	16.5	9.33	26.6	27	57.03	16.6	10.23
July	30.7	27.55	61.35	18.77	10.13	31.7	28.81	60.13	19.55	11.39
August	31.5	28.94	64.45	20.42	8.58	32.5	28.52	63.77	20.58	10.23
September	37.8	26.6	63.13	18.23	9.33	38.8	26.13	64.13	18.17	10.1

Recorded results in Table (3) involved disease severity during the period of melon cultivation from February to September of the two years of study at Ismailia Governorate. Also, the prevailing meteorological factors were added to the same table. Attempting to find out a relationship between the meteorological factors and disease severity cleared that the highest percentage of infected surface with downy mildew on melon plants was obtained at September when the thermal range was in between 26.13 - 26.60 C, RH from 63.13- 64.13 and dew point ranged between 18.17 - 18.23 during the studying years. At the same time, the lowest disease severity was obtained at February then it began to increase gradually due to the prevailing meteorological factors under investigation.

Discussion of recorded data in Table (4) shows positive relationship between disease severity of downy mildew on squash plants and the meteorological factors. The former table shows that highest infection on squash was obtained in November during the two years of search while the lowest one was obtained at March. The same trend in respect of cucumber and melon was observed disease severity was higher in the year 2007 than 2006.

Recorded results in Table (5) involved disease severity % during the period of cantaloupe cultivation from February, March and April to December of the two years of study at Ismailia Governorate. Also, the prevailing meteorological factors were added to the same table. There are a relationship between the meteorological factors and disease severity cleared that the highest percentage of infection with downy mildew on cantaloupe plants was obtained at October when the thermal range was in between 23.29- 24.26 C, RH from 61.35-68.13 and dew point ranged between 14.87-17.23 during the studying years. At the same time, the lowest disease severity was obtained at March then it began to increase gradually due to the prevailing meteorological factors under investigation. The former table shows that highest percentage of on cantaloupe was obtained in November during the season 2007.

While Table (6) shows the obtained data in September during the season 2006 whereas, obtained data in June during the season 2007 relation to watermelon. Table (7) indicates the maximum severity of downy mildew disease on the tested cucurbit crops during the two growing seasons 2006 and 2007. In addition the meteorological factor at Ismailia Governorate was also recorded.

Table (4): Disease severity of downy mildew on squash and the prevailing meteorological factors during the two years 2006 and 2007 at Ismailia Governorate.

Month	2006					2007				
	Disease Severity %	Temp	RH%	Dew point	Wind km/h	Disease Severity %	Temp	RH%	Dew point	Wind km/h
March	9.8	16.74	59.19	7.87	9.94	10.2	16.68	59.77	7.55	11.45
April	12.4	20.43	59.5	10.67	14.1	10.8	19.6	57.9	9.73	13.67
September	10.6	26.6	63.13	18.23	18.4	12.4	26.13	64.13	18.17	10.1
October	16.6	23.29	61.35	14.87	14.3	18.8	24.26	68.13	17.23	6.84
November	22.2	17.07	66.07	12.93	8.8	23.4	19.27	65.47	11.6	6.93
December	8.4	13.52	69.13	7.1	20.4	8.2	14.61	65.94	7.16	7.9

Table (5): Disease severity of downy mildew on cantaloupe and the prevailing meteorological factors during the, two seasons 2006 and 2007 at Ismailia Governorate.

Month	2006					2007				
	Disease Severity %	Temp	RH%	Dew point	Wind km/h	Disease Severity %	Temp	RH%	Dew point	Wind km/h
February	10.2	14.43	66.68	7.5	11.18	10.2	14.43	66.39	7.46	11.46
March	8.4	16.74	59.19	7.87	9.94	8.4	16.68	59.77	7.55	11.45
April	12.3	20.43	59.5	10.67	14.1	12.3	19.6	57.9	9.73	13.67
May	25.2	22.97	59.28	13.17	20.14	24.2	24.9	55.1	14.03	14.1
June	24.4	26.2	57.8	16.5	22.4	25.4	27	57.03	16.6	10.23
October	36.1	23.29	61.35	14.87	24.3	36.2	24.26	68.13	17.23	6.84
November	23.2	17.07	66.07	9.93	18.8	36.1	19.27	65.47	11.6	6.93
December	20.3	13.52	69.13	7.1	20.4	20.3	14.61	65.94	7.16	7.9

Table (6): Disease severity of downy mildew on watermelon and the prevailing meteorological factors during the, two seasons 2006 and 2007 at Ismailia Governorate.

Month	2006					2007				
	Disease Severity %	Temp	RH%	Dew point	Wind km/h	Disease Severity %	Temp	RH%	Dew point	Wind km/h
March	8.2	16.74	59.19	7.87	9.94	9.4	16.68	59.77	7.55	11.45
April	16.4	20.43	59.5	10.67	14.1	17.7	19.6	57.9	9.73	13.67
May	23.1	22.97	59.28	13.17	10.14	23.1	24.9	55.1	14.03	14.1
June	24.4	26.2	57.8	16.5	9.33	24.4	27	57.03	16.6	10.23
September	31.2	26.6	63.13	18.23	9.33	31.7	26.13	64.13	18.17	10.1
October	25.6	23.29	61.35	14.87	8.48	28.2	24.26	68.13	17.23	6.84
November	23.2	17.07	66.07	9.93	6.7	23.2	19.27	65.47	11.6	6.93
December	20.3	13.52	69.13	7.1	6.68	20.3	14.61	65.94	7.16	7.9

Table (7): Maximum disease severity of downy mildew disease on the tested cucurbit crops during the two growing seasons 2006 - 2007 and the meteorological factors at Ismailia Governorate.

Verities	Month	2006					2007				
		Disease Severity %	Temp	RH %	Dew point	Wind km/h	Disease Severity %	Temp	RH%	Dew point	Wind km/h
Cucumber	July	44.1	27.55	61.35	18.77	26.4	46.4	28.81	60.13	19.55	11.39
Melon	September	37.8	26.6	63.13	18.23	9.33	38.8	26.13	64.13	18.17	10.1
Cantaloupe	October	36.1	23.29	61.35	14.87	24.3	36.1	24.26	68.13	17.23	6.84
Squash	November	22.2	17.07	66.07	12.93	8.8	21.4	24.26	68.13	17.23	6.84
Watermelon	September	31.2	26.6	63.13	18.23	9.33	31.7	26.13	64.13	18.17	10.1

Finally, data obtained during the growing seasons of the years 2006 and 2007 cleared that meteorological factors prevailed during studying periods played an important role on disease severity and occurrence of the cucurbits downy mildew disease. Following downy mildew of cucurbits caused by *Pseudoperonospora cubensis* (Berk and Curt) Rostow at Ismailia Governorate illustrated the different reactions of the tested cucurbits hosts used in these trials. Cucumber, melon, cantaloupe, squash and watermelon were examined to determine their responsibility to downy mildew infection. These different reactions may be attributed to the morphological, anatomical structure and also their chemical components. Moreover, the meteorological factors especially temperature, RH% and dew point were the more affective factors due to their effect on the movement of stomata to face late the entering of swimming zoospores. Determined disease severity revealed that it was different from year to another depending upon the prevailing meteorological factors. Accordingly, disease severity was higher in 2007 than in 2006. This may be due to the happened changes in the prevailing temperature and RH%. The differences in the crop duration also affected disease incidence and severity. Therefore, increasing duration period and prevailed the suitable factors increased disease severity. Accordingly, cucumber, melon and cantaloupe were the most infected ones while watermelon and squash showed the lesser disease severity. These above mentioned conclusions were

confirmed by Kuznetsove (1980) and Sharma *et al.* (2003)

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تأثير بعض العوامل المناخية على مرض البياض الزغبي على محاصيل القرعيات في محافظة الاسماعيلية

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تبين من رصد و تسجيل العوامل المناخية السائدة خلال فترة زراعة و نمو محاصيل القرعيات المختلفة (الخيار . الشمام . الكنتالوب . الكوسة . البطيخ) بمحافظة الإسماعيلية فى عامى ٢٠٠٦ و ٢٠٠٧ أن هنالك علاقة موجبة بين شدة الإصابة بمرض البياض الزغبي و العوامل المناخية السائدة أثناء موسم النمو و أنها قد اختلفت من محصول لآخر و من سنة لآخرى.
 فقد اظهرت النتائج المتحصل عليها ان الخيار والشمام والكنتالوب كانوا الأكثر تعرضا لشدة الإصابة فى حين قلت شدة الإصابة على الكوسة ثم البطيخ كما كانت نسبة شدة الإصابة اعلى فى عام ٢٠٠٧ منها فى عام ٢٠٠٦ نتيجة للتغيرات المناخية التى حدثت خاصة فى درجة الحرارة والرطوبة النسبية.
 و قد لوحظ أن انخفاض درجة الحرارة و زيادة الرطوبة أو العكس يقللان من حدوث و شدة الإصابة بمرض البياض الزغبي على القرعيات. وتبين أن المدى الحرارى اللازم لحدوث أكبر شدة إصابة يتراوح ما بين ١٧ - ٢٨ درجة مئوية و رطوبة نسبية ما بين ٦١ - ٦٨ % و نقطة ندى ما بين ١٢ - ١٩.