Egypt. J. Agric. Res., 73(4),1995.

CERCOSPORA BETICOLA SACC AND ITS EFFECT ON SUGAR BEET PLANTS

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(Manuscript received 23 November 1992)

Abstract

Cercospora beticola was isolated during 1988 in Egypt. Production of large number of conidia was attempted on different media and temperatures. Also, sugarbeet plant chemical composition was determined in relation to leaf spot infection by the fungus.

Both potato dextrose agar and beet leaf extract media incubated under 25°C for 4 weeks, produce the greatest amount and number of conidia.

Infection of sugarbeet leaves with the fungus caused a remarkble decrease in chlorophyll a and b. The reduction in chlorophyll was maximum with the variety "Trible" followed by "Ceres poly 3" , while the "Raspoly" variety was slightly affected.

The total sugar content was inversely proportional to the infected area (disease index) of the leaf. Gradual decrease was noticed as the severity of infection increased. Also, sucrose in roots decreased as the severity of infection by *C.beticola* increased. This resulted in a negative coefficient value as correlated with the characters under investigation and the disease index caused by *C.beticola.* This decrease results in a 0.02, 0.01 and 0.01 tonnes sugar losses per feddan for each one percent diseased area per plant for the three varieties, respectively.

INTRODUCTION

Cercospora leaf spot, is a highly destructive disease of sugarbeet (Beta vulgaris L.) in many parts of the world. This disease, is an economic threat to the sugarbeet industry, especially in Europe. Cercospora leaf spot is most destructive in regions where warm, humid, summer weather prevails, including spain,

the southern portions of Germany and Fegions Besides, its occurrence in many other areas in the world, such as New Zealand, Brazil, Yugoslavia, USSR, India, Northern Greece, USA and Egypt.

In Egypt, El-Kholi (1984) had reported this disease for the first time in Noubaria Sector.

Weather conditions which favour the disease are favorable, temperature around 15-25°C, rainfall and wind directly affect the development of the fungus, the rapidity of conidia production and secondary infection. Canova (1959) in study of the biology and epidemology of C.beticola found that infection was less active at 30°C than at 25°C, and infection was more active in mature than in young or older leaves of sugarbeet plants. Forsyth et al. (1963) found that the infection sites on the shriveled leaves of sugarbeet infected with C.beticola are excellent sources of conidia for the air-borne dispersion of this organism whenever relative humidity is high.

The leaf-spot organisms attack mainly the blades or the sugar-making tissue. Many changes in chlorophyll and caroteniods in infected sugarbeet plants with leaf spots (with other pathogens or microorganisms) reflect a metabolic disturbance associated with infection. Also, the lower sugar content in diseased blades and petiolated to a slower rate of manufacture in diseased blades and to some extent the sugar being utilized by the pathogen, Leanard (1939).

Hence, it was considered of interest to investigate the effect of different degrees of infection with *C.beticola* on the composition of the plant and the ability of the blade to carry on photosynthesis.

MATERIALS AND METHODS

An isolate of *Cercospora beticola* Sacc., was obtained during 1988 from naturally infected fields of sugarbeet grown from multigerm seed (variety, Trible) at kafr El-Sheikh Governorate and maintained on beet leaf agar prepared as described by Forsyth et al. (1963).

An attempt was made to produce large number of C.beticola conidia by agar culture. Consequently, a comparison was made of the type of culture and yield of conidia produced on three media, beef leaf agar (BLA), potato dextrose agar (PDA) and pepton agar (PA).The average diameters of 10 colonies after four weeks incubation at 25°C on culture growth for 1,2,3 and 4 weeks was studied.

Chemical composition in relation to leaf spot infection by C.beticola was studied :

180- days - old sugarbeet plant of three commercial varieties, i.e., Trible, Cerse poly 3 and Raspoly were collected from the field at Kafr El-Sheikh with six categories of disease severity, 0,3,6,12, 25 and 50%. Six plants per category were divided to 3 replicates (2 plants per replication), leaves and roots per replication were cut into small portions and mixed. Determination of disease severity, according to Grainger (1949) and modified by El-Kholi (1988) was followed and which are based on a scale of 0 to 5 with 0 = no apparent infection and 5 = 50% with more defoliation.

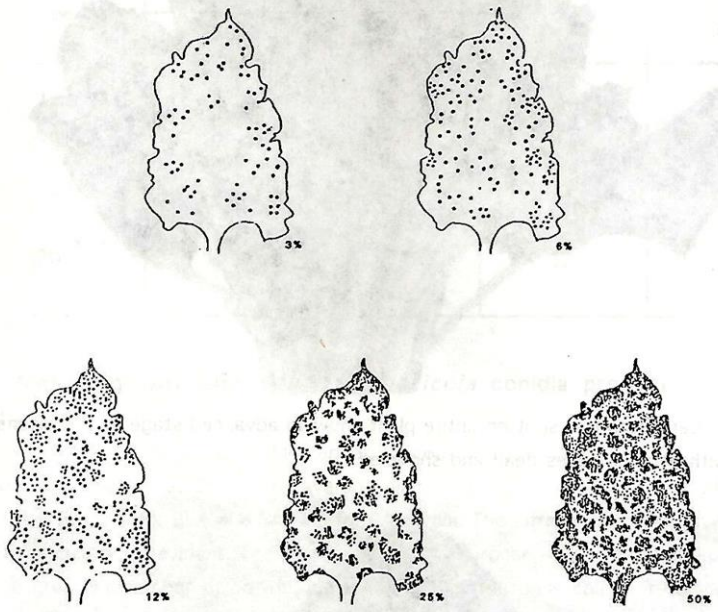

Fig.1. Assessment key for sugarbeets "Disease index"

Chlorophyll content was determined in 80% aqueous acetone extract as mg/g dry weight according to the method by Arnon (1949), the total sugars in leaves was determined according to Sheffer and Hartman (1921), and the sucrose percent was evaluated using sacharimeter appaatus by the method of Le-Docte (1927). Dry matter g/leaf was determined.

RESULTS DISCUSSION

The causal organisms :

Figure (2) shows a diseased plant and figure (3) shows a diseased leaf infected with cercospora leaf spot. The spots were isolated on the leaf with little or no coalescing and several leaves were brown and shribeled in the entire plant.

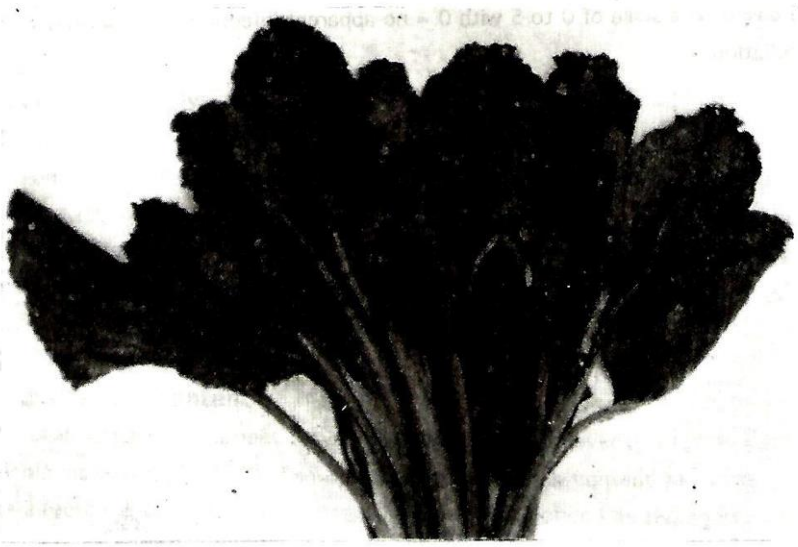

Figure 2 Cerospora leaf spot on entire plant showing advanced stage of the disease, with several leaves dead and shriveled.

Figure 3 : Cerospora leaf spot infection on leaf of sugarbeet. (Dis, Index 3%).

Effect of temperature on growth of *C.beticola* after 4 weeks on BLA medium at 15,20 25 and 30°C :

The optimum temperature using the BLA wedium was determined by comparing rates of culture growth at 15,20 25 and 30°C over a period of 4 weeks. Temperature has a profound effect on the fungus linear growth. The best growth was obtained at 25°C followed by incubation at 20°C which was only slightly lower, Table (1).

Table 1 . Effect of temperature on growth of *C.beticola* for 4 weeks on BLA medium at 15,20,25 and 30°C.

Temperature	Growth of *C.beticola* (mm) after 4 weeks on BLA			
	1 week	2 week	3 week	4 week
15 °C	20	25	40	48
20 °C	20	45	64	68
25 °C	20	50	72	80
30 °C	15	45	52	56

Effect of growth and Yield of *C.beticola* conidia produce on 3 media:

Table (2) illustrates differences in colony diameter of *C.beticola* after 4 weeks incubation at 25°C. The average diameter of 10 colonies were 83.4 mm for PDA, 72.2 mm for BLA and 30 mm for PA media. The difference in the development of the cultures is evident. The best media for our purpose would be the one producing the greatest number of conidia in short time. Microscopial count of conidia shows that BLA media was the best medium of these tested, for the production, of conidia (Table2).

Table 2 . Growth and yield of *C.beticola* conidia production on three media.

Media	Diameter culture media (mm)	Conidia / ml
PDA	83	10.000
BLA	76	40.000
Pa	30	3.000

The comparative effect of the *C.beticola* on :

a) Chlorophyll content :

The infection of sugarbeet leaves with C.beticola caused a remarkable decrease in chlorophyll a and b content as shown in Table (3). The content of these pigments decreases gnadually in leaves with the increase in disease index. Moreover, the reduction in chlorophyll was most clear with the variety Trible followed by ceres Poly 3, while the Raspoly variety was slightly affected. The rate of chlorophyll resynthesis distinctly decreased compared with the control of each variety under investigation.

b) Leaf dry weight :

The results of the present work (Table 3), revealed that leaf dry weight percent of healthy leaves was higher than leaves infected with C.beticola. Dry weight was reduced from 22.49% in healthy leaves to 18.44% in diseased leaves, a reduction of more than 18% for the Trible variety was apparent, when severity was 50% or more.

c) Total sugar content :

Total sugar in sugarbeet leaves decreased as the severity of infection with C.beticola increased (Table 3). The decrease in total sugar content was proportional to the infected area of the leaf. Gradual decrease was noticed as the severity of infection increased (3,6 and 12% as disease index). The lowest level of total sugars was recorded for the 25% and 50% infection as compared with the healthy control of each variety.

d) Sucrose percent in roots :

Toble (3) represents the effect of different disease index on sucrose percent. Sucrose in sugarbeet roots decreased as the severity of infection of leaves with C.beticola increased. The reduction was evident with the most susceptible variety Trible, where it reached 26.35% with the disease index 50%.

e) Observed correlation coefficient, between disease index and each of the studied characters :

Table (3) shows an inverse relationship between disease index and each of the studied parameters. This relation is proportional to the severity of the disease and

results in a negative correlation coefficients. A negative complete correlation between disease index and dry matter %, chlorophyll a and b, total sugars in leaves as mg/g dry weight and percent losses in roots is apparent for the three varieties (Table 3).

The sugar total losses are calculated for each disease index category and varied from 0.036 Ton/fed. for variety Raspoly at disease index 3% and 0.792 Ton/fed. for variety Trible.

Regression coefficient (Table 3) showed that there is an average decrease of 0.09%, and 0.03% sucrose in roots for Trible, Ceres poly 3 and Raspoly, respectively, for each 1% diseased area per plant (Disease Index). This decrease results in a 0.02, 0.01 and 0.01 Tonnes sugar losses per feddan for each 1% diseased area per plant for the three varieties respectively.

DISCUSSION

Cercospora leaf spot is thought to be favored by a minimum temperature of 10°C at night and 20°C during the day with relative humidity above 95% for at least 10 hours within the canopy of the crop . The present results agree with those reported by Hull (1960) and Miscke (1960). Changes in leaf colour is one of the obvious effects of fungal infection in sugarbeet fields. This affects the chlorophyll which is vital in the assimilation activity of the plant.

Table (3) demonstrated significant losses of chlorophyll level in leaves infected which C.beticola compared with the corresponding healthy ones. The reduction obtained was more pronounced in chlorophyll a than chlorophyll b. Also, the content of these pigments decreases as the severity of infection increases (Table 3). This may explain the lower sugar content in diseased blades as compared with similar healthy tissue and may be related to a slower rate of sugar manufacture in diseased blades and to that some of the synthesized sugar is being utilized by the pathogen, Leonard (1939).

Healthy leaf dry weight was higher than that of infected with C.beticola. Goodman et al. (1967) indicated that the decline in dry weight of infected plants than in the healthy one was due to the increase in rate of respiration in the diseased plants.

Table 3. Dry matter %, chlorophyll mg/g dry matter, total sugar in leaves mg/g dry mater, sucrose % in roots as affected by *C.beticola* and simple correlation coefficient (r)* between disease index and each of the studied characters in beets.

Variety and disease index	Dry matter %	Chlorophyll		Total sugars in leaves mg/g dry Wt	Sucrose % in roots	Sucrose losses Ton / fed
		a	b			
Tribel						
Control	22.9	10.85	3.19	20.57	16.7	0.000
3%	21.73	9.95	2.66	20.24	16.3	0.072
6%	20.49	9.71	1.22	19.94	15.8	0.162
12%	20.33	8.09	1.15	19.32	14.9	0.324
25%	19.15	7.38	0.69	17.90	14.1	0.468
50-more	18.44	5.86	0.61	15.95	12.3	0.792
r	-0.90	-0.95	-0.74	-1.00	-0.95	0.98
b					-0.09	0.02
Ceres poly						
Control	23.35	12.75	4.02	21.75	17.4	0.000
3%	23.20	11.59	3.54	21.41	17.1	0.054
6%	22.30	10.49	3.54	20.55	16.9	0.090
12%	22.11	9.46	1.83	19.20	16.3	0.198
25%	21.40	8.02	1.79	18.96	16.0	0.252
50-more	20.20	6.15	1.59	17.15	14.4	0.540
r	-0.97	-0.95	-0.80	-0.96	-0.99	0.099
b					-0.06	0.01
Raspoly						
Control	23.40	11.17	3.29	20.99	16.5	0.000
3%	23.11	10.71	3.14	20.80	16.3	0.36
6%	22.42	10.53	2.22	20.60	16.1	0.072
12%	21.79	10.20	2.09	20.20	15.8	0.120
25%	21.63	9.61	1.78	19.00	15.5	0.180
50-more	00.00	0.00	0.00	0.00	00.0	0.000
r	-0.89	-0.97	-0.86		-0.86	0.98
b					-0.03	0.01

r and b : Simple correlation and regression coefficient.

The leaf spot organism attacks mainly the blades or sugar-making tissug. The reduction in total sugar content in leaves and sucrose in roots were proportional to the infected area of the leaf, (Table 3). The destruction of the foliage reduces yield and produces a lower sugar content. These results are in harmony with the results of Vestal (1933), Nagel and Leonard (1940) and Forsyth and Braodwell (1962).

ACKNOWLEDGMENT

The author would like to thank Prof. Dr. A.I. Allam, Sugar Crops, Res. Inst., ARC, for helpful discussions and comments.

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فطر Cercospora beticola Sacc وتأثيره على مكونات نباتات بنجر السكر

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تم اختبار مجموعة من البيئات والتحضين على درجات حرارة مختلفة لفترات زمنية وذلك للحصول على أفضلها لنمو وإنتاج الجراثيم الكونيدية للفطر Cercopora beti cola تحت الظروف المعملية وكذلك دراسة تأثير الاصابة بالفطر على المكونات الكيميائية لبعض اصناف بنجر السكر التجارية المنزرعة فى محافظة كفر الشيخ تحت درجات مختلفة من الاصابة.

تم الحصول على أفضل نمو ميسليومى للفطر على بيئة مستخلص البطاطس والدكستروز PDA بينما اعطت بيئة مستخلص أوراق بنجر السكر BLA أعلى معدل لتكوين الجراثيم الكونيدية بعد ٢ أسابيع من التحضين على ردجة ٢٥م.

أدت إصابة الفطر C. betocila لأوراق بنجر السكر إلى نقص فى الكلوروفيل b, a وكان الصنف Tribleأكثر الأصناف حساسية يليه الصنف Ceres poly 3 وكان أقلها تأثيرا الصنف Raspoly.

لوحظ نقص تدريجى للمواد السكرية الكلية بالورقة وكذلك السكروز الموجود بالجذور للنباتات المصابة وكان هناك إرتباط واضح لهذا النقص مع درجات الاصابة Dis-ease index للورقة وكان النقص إيجابيا وذلك عند دراسة معامل الإرتباط (r) للصفات المختبرة (كلوروفيل b , a والسكريات المتكونة فى الورقة والجذر) مع درجات الإصابة المختلفة للورقة Disease index.