The Identity of the Fungus Causing Anthracnose of Olives in South Africa.

By

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In South Africa all the diseases that affect olive trees are of fungal origin (Gorter, 1959). Of these, anthracnose is perhaps the most destructive. The fruit-decay for which it is responsible was known in the late twenties to occur in the coastal regions of the western Cape Province (Verwoerd, 1928). It was not before 1935, however, that the cause of the disease was identified as an anthracnose fungus of the *Gloeosporium* type.*

When the writer investigated this disease in 1938, he was struck by the fact that the causal fungus produced a bright red pigment in its hyphae on various culture media. This was unlike the cultural characteristics that Biraghi (1934) had described for *Gloeosporium olivarum* Alm., a fungus which has, until now, been considered the only known agent of anthracnose in olives. In addition it was found that the disease could attack the flowers (Gorter, 1960), a symptom which had not been described before.

Thus the question arose whether the local anthracnose fungus should be considered a variant of *G. olivarum* Alm. or whether it was a closely related species. It was essential to compare it with olive anthracnose fungi from other parts of the world as well as with fungi responsible for similar fruit tree diseases. Investigations concerning these comparisons, a preliminary account of which has appeared elsewhere (Gorter, 1956) are reported in detail below.

Materials and Methods

As these investigations were started immediately prior to World War II, isolates of olive anthracnose fungi could be obtained only from a limited number of countries. In the first place, isolates were obtained from Portugal, the country from which the disease was originally described (Almeida, 1899). Other isolates came from Italy via the "Centraal Bureau voor Schimmelcultures" at Baarn, Holland and from California in the United States of America. Shortly after the war, cultures were obtained direct from Italy.†

Two aspects of the fungi were studied in detail viz. the cultural characteristics of the mycelium on various culture media and the morphology of spores produced on these media. The agar media used were prepared according to the specifications of Rawlins (1933). Colours of mycelium and acervuli were recorded by comparing with the standard colours described by Ridgway (1912). Spore measurements were made by suspending the spores in cooled melted water agar and examining a drop of the suspension between a slide and a cover slip under the microscope. The congealed agar prevented movement of the spores during measurement with an eyepiece micrometer.

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* Specimen No. 33360, Stellenbosch-Elsenburg Mycological Herbarium, collected by Dr. B. J. Dippenaar.

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Valid conclusions about the dimensions of spores can be drawn only if the number of spores measured is enough to allow for a statistical analysis. According to Blumer (1926) at least 100 spores should be measured to obtain regular variation curves for length and width which are essential requirements for such an analysis. Thus measuring 100 spores from each isolate on a given substrate was adopted as a standard procedure.

The spore measurements were analysed in two different ways. To determine the modus, i.e. the most common spore size, the measurements were arranged in correlation tables similar to those used by Levine (1928). Differences in shape between the spores of the various fungi were determined by applying the discriminant function to spore measurements as proposed by Baten (1944).

Spore shapes of all the olive anthracnose isolates were determined. In addition the spore shapes of the anthracnose fungi from a few comparable diseases were studied, i.e. strains of *Glomerella cingulata* (Stoneman) Sp. & v. Schr., *Colletorichum gloeosporioides* Penz. and *Gloeosporium limetticolum* Clausen. They are respectively the cause of anthracnose in apples, oranges and limes. Cultures of these fungi were obtained from the " Centraal Bureau voor Schimmelcultures " with exception of a chromogenic strain of *Glomerella cingulata* which was kindly provided by Dr. M. C. Goldsworthy of Beltsville, Maryland in the United States of America.

Stock cultures of the fungi were maintained on oatmeal agar because it provided the best culture medium for the production of spores. On most other agar media, including potato-dextrose agar sporulation decreased with successive transfers and soon stopped altogether.

Cultural Characteristics

In Table 1, the cultural characteristics of olive anthracnose isolates from four different countries situated in three continents have been compared on three agar culture media. The most striking difference between the South African isolate and the others is the entirely different colour of the substrate mycelium. In the three overseas isolates it is a shade of olive green but in the local fungus it is bright red.

Differences in pigmentation were also noted in the acervuli of the two types of fungi. This was shown by the following experiment. Sevillano olives were divided in two groups which were respectively inoculated with the W.P. (South Africa) and U.S.A. (California) isolates of the olive anthracnose fungi. After four days incubation under moist conditions at 27°C, an abundance of acervuli was produced on affected fruit. The acervuli of the W.P. isolate, had an " orange-rufous " colour while those of the U.S.A. isolate were " cinnamon rufous ". On potato-dextrose agar their colours were " salmon-orange " and " apricot buff " respectively.

Similar differences in colour of substrate mycelium and acervuli were encountered if the W.P. isolate was compared with the anthracnose fungi from similar diseases except in the case of the chromogenic strain of *Glomerella cingulata*. The existence of a chromogenic strain characterized by the production of a red pigment on potato-dextrose agar was originally discovered by Shear & Wood (1913). In 1943 a similar strain was isolated by M. C. Goldsworthy from an unknown variety of apple near Washington, D.C. (Andes & Keitt, 1950). It was this strain that was compared with the W.P. isolate of the olive anthracnose fungus (see Table 2). The comparison shows that as far as cultural characteristics are concerned the differences between the two fungi are so small that they could be identical.

TABLE 1.—Cultural characteristics of four olive anthracnose isolates from four different countries on three agar media.

Cultural Characters *	Strain of the fungus	Agar Medium		
		Potato-dextrose	Oat-meal	Czapek-Dox
Development of aerial mycelium	W.P. (South Africa)	Well developed; hyphae somewhat loose	Sparsely developed; hyphae loose	Moderately developed; hyphae closely aggregated
	λα (Portugal).....	Well developed; hyphae loose	Moderately to fairly well developed; hyphae loose	Fairly well developed; hyphae fairly closely aggregated
	C.B.S. (Italy).....	Well developed; hyphae somewhat loose	Moderately developed; hyphae loose	Fairly well developed; hyphae closely aggregated
	U.S.A. (California)	Well developed; hypae loose	Fairly well developed; hyphae loose	Fairly well developed; hyphae closely aggregated
Colour of aerial mycelium	W.P.....	Light greyish olive	Pale olive grey....	White.
	λα.....	White with dark greenish olive centre	White.....	White
	C.B.S.....	Greyish olive....	Dusky yellowish green	White
	U.S.A.....	Greyish olive....	Dusky olive green	White
Colour of substrate mycelium	W.P.....	Nopal red.....	Scarlet.....	Coral red
	λα.....	Yellowish olive to dark greenish olive	White with olivaceous black (2)	Cardridge buff
	C.B.S.....	Dark olive.....	Dusky yellowish green	Pale olive buff
	U.S.A.....	Olivaceous black (2)	Dusky olive green	Cardridge buff
Relative speed of mycelium growth	W.P.....	1	1	1
	λα.....	± 5/6	± 5/6	± 5/6
	C.B.S.....	± 1	± 2/3	± 1
	U.S.A.....	± 2	± 2	± 2

*All descriptions were made of 7-days-old cultures, grown in the dark at 25°C.

TABLE 2.—Cultural characteristics of *Gloeosporium* spec. (W.P.) from olive and *Glomerella cingulata* (chromogenic strain) from apple, on three agar media.

Cultural Characters *	Fungus	Agar Medium		
		Potato-dextrose	Oatmeal	Czapek-Dox
Development of aerial mycelium	*Gloeosporium* spec. (W.P.)	Well developed; hyphae somewhat loose	Sparsely developed; hyphae loose	Moderately developed; hyphae closely aggregated
	Glomerella cingulata (chromogenic strain)	Well developed; hyphae loose	Sparsely developed; hyphae loose	Sparsely developed; hyphae closely aggregated
Colour of aerial mycelium	*Gloeosporium* spec. (W.P.)	Light greyish olive	Pale olive grey....	White
	Glomerella cingulata (chromogenic strain)	Light greyish olive	Pale olive grey....	White
Colour of substrate mycelium	*Gloeosporium* spec. (W.P.)	Nopal red.....	Scarlet.....	Coral red
	Glomerella cingulata (chromogenic strain)	Pomegranate purple	Old rose to deep vineceous	Carmine to coral red
Relative speed of mycelium growth	*Gloeosporium* spec. (W.P.)	1	1	1
	Glomerella cingulata (chromogenic strain)	± 1	± 1	± 1

* See footnote Table 1.

SPORE MEASUREMENTS

The spore dimensions of *Gloeosporium olivarum* were originally described by Almeida (1899) as 15–27 × 4–6 μ. Cabral (1941), who reinvestigated the disease in Portugal mentions the following dimensions: 9·4–22·5 × 3·7–5·6 μ. In the case of the local olive anthracnose isolate the writer determined the dimensions from its natural habitat as being 12·9–19·7 × 3·7–6·4 μ (Mean: 16·48 × 4·88 μ). This shows good agreement in spore size between the fungi from the two countries and if only this morphological character were taken into account there would be no reason to consider the local anthracnose fungus different from *Gloeosporium olivarum* Alm. However, it was observed that the olive anthracnose isolates from Italy and California, although culturally similar to the Portuguese isolates, had slightly thicker spores and a closer study of spore shapes was therefore considered necessary.

At first only culturally similarly looking fungi were compared including those from related anthracnose diseases. They were grown on oatmeal agar for about four weeks at a temperature of 25°C. Of each culture 100 acervuli spores were examined under the microscope at a magnification of 900 ×. In Table 3 the spore measurements are analysed according to mean, variation and modus. Results of comparisons between spore shapes according to their discriminant functions are given in Table 4. Modus

values as well as spore shapes show that the spores of *Gloeosporium olivarum* (4 Port.) and *G. limetticolum* are identical. The same applies to the spores of *Gloeosporium olivarum* (U.S.A.) and *Glomerella cingulata*. The spores of *Gloeosporium olivarum* (C.B.S.) and *Colletotrichum gloeosporioides* may also be considered identical in spite of the fact that the F-value for the difference in spore shape is significant (Table 6). Saunders (1939) has pointed out that the significance of a difference must be accepted with reservations if the number of degrees for freedom in a statistical analysis is very low unless the significance, i.e. the F-value, is very high. As this is not so in our case and as the modus of the spore measurements for both fungi is the same, the shape of their spores can be considered identical.

TABLE 3.—Spore sizes of six different anthracnose fungi from acervuli which had developed after four weeks' growth on oatmeal agar at 25°C.

Fungus Species	Spore sizes in μ		
	Mean	Variation	Modus
Glomerella cingulata	12·57 × 5·12	10·0–14·1 × 4·6–5·8	12·5 × 5
Gloeosporium olivarum (C.B.S.)	14·53 × 4·88	11·7–16·6 × 4·6–5·4	14·1 × 5
Gloeosporium olivarum (4 Port.)	12·87 × 3·97	10·0–15·0 × 3·3–4·6	12·5 × 4·1
Gloeosporium olivarum (U.S.A.)	12·31 × 5·06	10·0–14·1 × 4·2–5·8	12·5 × 5
Gloeosporium limetticolum	12·78 × 4·01	9·1–16·6 × 3·3–5·0	12·5 × 4·1
Colletotrichum gloeosporioides	14·26 × 5·24	12·5–15·8 × 4·6–5·8	14·1 × 5

TABLE 4.—Results of comparisons of the discriminant functions of spore shapes with reference to different combinations of anthracnose fungi.

Fungus Species	F-Value	Significance at 1% point*
Gloeosporium olivarum (4 Port.) and Glomerella cingulata	± 424	Highly significant
Gloeosporium olivarum (4 Port.) and Gloeosporium olivarum (C.B.S.)	± 317	Highly significant
Gloeosporium olivarum (4 Port.) and Gloeosporium limetticolum	± 1·3	Not significant
Gloeosporium olivarum (4 Port.) and Colletotrichum gloeosporioides	± 404	Highly significant
Gloeosporium olivarum (4 Port.) and Gloeosporium olivarum (U.S.A.)	± 314	Highly significant
Gloeosporium olivarum (C.B.S.) and Glomerella cingulata	± 225	Highly significant
Gloeosporium olivarum (C.B.S.) and Colletotrichum gloeosporioides	± 7·5	Just significant
Gloeosporium olivarum (C.B.S.) and Gloeosporium olivarum (U.S.A.)	± 182	Highly significant
Gloeosporium olivarum (U.S.A.) and Glomerella cingulata	± 1·1	Not significant

* Determined from the Tables of Fisher and Yates (1938)

Thus, the comparison showed that the culturally similar olive anthracnose isolates from different countries have, according to spore size, a closer resemblance to related anthracnose fungi than to each other. From this it might well be concluded that olives are subject to attack by a number of closely related anthracnose fungi. If this is indeed the case then a comparison of the spores of the local olive anthracnose fungus with those of the chromogenic strain of *Glomerella cingulata* as well as those of the Portuguese anthracnose fungus might be expected to throw more light on the identity

of the local fungus. The spores of the said fungi were therefore compared not only with each other but also with the spores of a number of other olive anthracnose isolates as well as those of *Gloeosporium limetticolum* and of *Colletotrichum gloeosporioides*. The fungi were again grown on oatmeal agar for four weeks at 25C°, but this time the acervuli spores were examined under the microscope at a magnification of 1100 ×. The spore sizes and differences in shape are shown in Tables 5 and 6 respectively.

TABLE 5.—Spore sizes of eight different anthracnose fungi from acervuli which had developed after four weeks growth on oatmeal agar at 25°C.

Fungus Species	Spore sizes in μ		
	Mean	Variation	Modus
Gloeosporium species (W.P.).....	13·32 × 4·40	10·7–16·0 × 4·0–5·0	13·3 × 4·3
Glomerella cingulata (chrom. strain)...	12·53 × 4·55	10·0–15·3 × 4·0–5·3	12·7 × 4·7
Gloeosporium olivarum (4 Port.).....	12·93 × 4·25	10·0–16·7 × 3·7–5·0	13·3 × 4·3
Gloeosporium limetticolum.....	13·35 × 4·30	10·0–16·7 × 3·7–5·0	13·3 × 4·3
Gloeosporium olivarum (C.B.S.).....	14·37 × 5·15	12·0–16·7 × 4·7–6·0	14·0 × 5·3
Colletotrichum gloeosporioides.....	14·10 × 5·35	12·6–16·0 × 5·0–5·6	14·0 × 5·3
Gloeosporium olivarum (315, Italy)....	15·31 × 5·05	12·7–17·3 × 4·3–5·7	15·3–16·0 × 5·0
Gloeosporium olivarium (319, Italy)...	16·21 × 5·01	14·0–18·7 × 4·3–5·7	16·0 × 5·0

TABLE 6.—Results of comparisons between the discriminant functions of spore shapes with reference to different combinations of anthracnose fungi

Fungus Species	F-Value	Significance at 1% point*
Gloeosporium species W.P. and Glomerella cingulata (chrom. strain)	± 5	Just significant
Gloeosporium species W.P. and Gloeosporium olivarum (4 Port.)	± 7	Just significant
Gloeosporium species W.P. and Gloeosporium limetticolum	± 4	Not significant
Gloeosporium species W.P. and Gloeosporium olivarum (C.B.S.)	±203	Highly significant
Gloeosporium olivarum C.B.S. and Colletotrichum gloeosporioides	± 22·5	Significant
Gloeosporium olivarum C.B.S. and Gloeosporium olivarum (315, Italy)	± 38	Significant
Gloeosporium olivarum (315, Italy) and Gloeosporium olivarum (319, Italy)	± 22	Significant

* See footnote Table 4.

Table 5 shows that the modus values for the spores of both olive anthracnose fungi from Portugal and South Africa were identical while those for the chromogenic strain of *Glomerella cingulata* were but slightly different. Differences in the latter were in fact so small that for practical purposes their modus values could be considered identical with those of the two olive anthracnose fungi. This was confirmed by a comparison of their spore shapes (Table 6) which showed that differences in the shape between the spores of the local olive anthracnose fungus and those of the chromogenic strain of *Glomerella cingulata* were even smaller than between the spores of the two olive anthracnose fungi just mentioned. The identity of the spore sizes and shapes of the local anthracnose isolate from olives and *Gloeosporium limetticolum* from limes is obvious. The above findings and the fact that the spore size of *G. limetticolum* was

found identical with *G. olivarum* (4 Port.) all point to identical spore shapes in the anthracnose fungi from olives in Portugal and South Africa, the anthracnose fungus from limes and the chromogenic strain of the anthracnose fungus from apples.

On the other hand there was a distinct difference in shape between spores of the local olive anthracnose fungus and olive anthracnose isolates from Italy. This is found clearly expressed in the different modus values. These values greatly resemble the values for *Colletotrichum gloeosporioides*, in fact they are identical for the C.B.S. isolate and *C. gloeosporioides*. A study of their spore shapes revealed the interesting fact that their differences were of the same order as between different isolates of *G. olivarum* in Italy. As the variability of *Colletotrichum gloeosporioides* is well known (Burger, 1921) those facts strengthen the possibility that anthracnose of olives in Italy is caused by strains of *Colletotrichum gloeosporioides*.

Although it has now been ascertained that the local anthracnose fungus of olives was not only culturally identical with the chromogenic strain of *Glomerella cingulata* but also identical as far as spore shape is concerned, the question remained how to name the fungus. The answer depended on whether this chromogenic strain should indeed be considered a form of *G. cingulata*. We have already seen that it differed from this fungus in having narrower, more pointed, spores. Moreover, Andes & Keitt (1950) stated that the chromogenic strain, and in fact all strains with narrow pointed atypical spores, have never produced perithecia, not even in cross breeding experiments. However, still another difference was found, viz. the way in which spores are produced on potato-dextrose agar. Shear & Wood (1913) already pointed out that the chromogenic strain produced an abundance of spores in the aerial mycelium of the fungus when grown on potato-dextrose agar. It was also noted that these spores were slightly smaller than those produced in the acervuli. The identical phenomenon was observed for the South African olive anthracnose fungus. It now remained to ascertain whether this phenomenon did also occur in cultures of *Glomerella cingulata* and *Colletotrichum gloeosporioides*.

Therefore, a chromogenic and a non-chromogenic strain of *Glomerella cingulata* were grown on potato-dextrose agar for four weeks at 25°C. For purposes of comparison, cultures of *Colletotrichum gloeosporioides*, *Gloeosporium limetticolum* and olive anthracnose isolates from Portugal, Italy and South Africa were also included in this test. Measurements were made of spores borne on the hyphae as well as in the acervuli. The measurements are recorded in Table 7. These show that all species with a spore width $<5\ \mu$ have a spore size which depends on whether the spores were formed on the hyphae or in the acervuli. Fungi with a spore width $>5\mu$ like *Colletotrichum gloeosporioides* and the non-chromogenic form of *Glomerella cingulata* are shown to possess negligible differences in the dimensions of the two types of spores.

While the mycelium spores were produced in abundance in the first group of fungi—spores narrower than 5 μ—they were sparsely formed in the second group giving the impression of being widely dispersed growing acervuli spores. The difference in the two groups of fungi is further illustrated in the following comparison of spore size variation in mycelium and acervuli spores of *Gloeosporium olivarum* ($\lambda\alpha$ Port.) and *Colletotrichum gloeosporioides*. For *C. gloeosporioides* the variation in length and width of both types of spores were practically the same:—

variation mycelium spores: $9{\cdot}1–17{\cdot}1 \times 4{\cdot}0–6{\cdot}3\ \mu$,
variation acervuli spores: $12{\cdot}5–18{\cdot}3 \times 4{\cdot}5–6{\cdot}3\ \mu$.

In the case of *Gloeosporium olivarum* ($\lambda\alpha$ Port.) there is no such overlapping of the variations:—

variation mycelium spores: $4{\cdot}5–10{\cdot}3 \times 2{\cdot}3–4\ \mu$,
variation acervuli spores: $9{\cdot}1–14{\cdot}9 \times 3{\cdot}4–4{\cdot}6\ \mu$.

The figures show clearly that in this case *two* kinds of spores are involved.

TABLE 7.—Mean spore dimensions in μ of different anthracnose fungi after four weeks growth on potato-dextrose agar at 25°C

Fungus Species	Mycelium spores		Acervuli spores	
	Length	Width	Length	Width
Gloeosporium olivarum ($\lambda\alpha$ Port.)	7·02 ± 0·12	3·12 ± 0·04	11·82 ± 0·11	4·09 ± 0·03
Gloeosporium olivarum (4 Port.)*	8·61 ± 0·13	3·51 ± 0·03	12·97 ± 0·16	4·37 ± 0·04
Gloeosporium limetticolum.....	10·41 ± 0·17	3·63 ± 0·04	13·00 ± 0·15	4·43 ± 0·05
Gloeosporium spec. (W.P.).....	9·57 ± 0·14	3·60 ± 0·05	13·88 ± 0·10	4·40 ± 0·07
Glomerella cingulata (chrom. strain)	7·79 ± 0·16	3·40 ± 0·04	13·70 ± 0·12	4·77 ± 0·05
Glomerella cingulata.....	11·19 ± 0·14	5·00 ± 0·04	11·84 ± 0·11	5·13 ± 0·07
Gloeosporium olivarum (C.B.S.)	13·30 ± 0·13	5·00 ± 0·04	13·99 ± 0·09	4·97 ± 0·03
Colletotrichum gloeosporioides..	14·01 ± 0·23	5·14 ± 0·04	14·16 ± 0·13	5·34 ± 0·06

* Mycelium spores entirely free from acervuli spores could not be obtained.

DISCUSSION AND CONCLUSIONS

The foregoing investigations have established firstly that the local anthracnose fungus of olives is morphologically and culturally indistinguishable from the chromogenic strain of *Glomerella cingulata* that Dr. M. C. Goldsworthy isolated from apples. Secondly it was shown that isolates of *Gloeosporium olivarum* and related anthracnose fungi fall into two groups which are defined as follows:—

(*a*) the *Glomerella-Colletotrichum* group which is characterized by conidio-spores with a width modus equal or larger than 5 μ and which although very variable in size, have similar dimensions on potato-dextrose agar whether borne on individual hyphae or in acervuli.

(*b*) the *Gloeosporium* group characterized by conidiospores with a width modus smaller than 5 μ and which produces two types of spores—micro and macroconidia—on potato-dextrose agar, each with comparatively little variation in size. In this type of anthracnose fungus production of perithecia has never been observed.

It could be asked, however, whether distinctions based on differences in spore size are valid reasons for distinguishing anthracnose fungi. Some investigators (Krüger, 1913, Burger 1921) maintain that spore size is not a good criterion. However, they base their opinions largely if not exclusively on the large variability in the length of spores and fail to appreciate the importance of spore width as a shape-giving factor. The foregoing experiments have clearly shown that under varying conditions of growth the width of spores varies much less than the length. In addition the statistical analyses carried out showed that with regard to spore shape width was a more important factor than length. Therefore, in the opinion of the author, spore dimensions, or rather spore widths, may undoubtedly be used as a differential character for the identification of anthracnose fungi.

From the description of the two groups it is obvious that the chromogenic strain of *Glomerella cingulata* falls into the second group and its designation as *Glomerella cingulata* is therefore incorrect. In this connection it should be remembered that Edgerton (1915) has already distinguished between perithecia-forming and non-perithecia-forming anthracnose fungi from apples, identifying the latter by the name *Gloeosporium fructigenum* Berk. and that the author of the name (Berkeley, 1856) has noted that the spores of this fungus were not as variable as those from

a similar perithecia-forming isolate from grapes. The chromogenic strain and the identical South African anthracnose fungus from olives should therefore be considered a form of *Gloeosporium fructigenum* Berk. They could be conveniently called **Gloeosporium fructigenum** *Berk. f.* **chromogenum** *Gorter* form. nov. [=M. C. Goldsworthy's chromogenic strain of *Glomerella cingulata* (Stoneman) Spauld. & v. Schrenk *loc. cit.*]. This fungus causes apparently not only an anthracnose disease of apples and olives but also of peaches (Ramsay *et. al.* 1951).

The identity in spore size and the similarity of most cultural characteristics in *G. fructigenum* Berk. f. *chromogenum*, *G. olivarum* Alm. from Portugal and *G. limetticolum* Clausen show that these three fungi are very closely related and it is felt that this should be expressed in the name. Hence, *Gloeosporium olivarum* Alm. should be renamed **Gloeosporium fructigenum** *Berk. f.* **olivarum** (*Alm.*) *Gorter* comb. nov. [=*Gloeosporium olivarum* Alm. *loc. cit.*] while *Gloeosporium limetticolum* Clausen should be called **Gloeosporium fructigenum** *Berk. f.* **limetticolum** (*Clausen*) *Gorter* comb. nov.

The investigations have also shown that *Gloeosporium fructigenum* f. *olivarum* and *Gloeosporium fructigenum* f. *chromogenum* are apparently not the only fungi capable of causing anthracnose disease in olives. There is evidence that olives are also subject to attack by *Colletotrichum gloeosporioides* Penz. from citrus and *Glomerella cingulata* (Stoneman) Spauld. & v. Schrenk from apples. The similarity of Italian isolates of olive anthracnose fungi and *Colletotrichum gloeosporioides* Penz. is strengthened by the fact that Ciccarone (1947) discovered the presence of long flexible hyphae at the periphery of the acervuli in Italian isolates which remind one somewhat of setae. Von Arx (1957 a), who most probably studied the Italian isolate present in the " Centraal Bureau voor Schimmelcultures " even goes so far as to consider *Gloeosporium olivarum* Alm. a synonym for *Colletotrichum gloeosporioides* Penz. As at present the latter fungus is commonly indicated by its perithecial stage it should be called *Glomerella cingulata* (Ston.) Spauld. & v. Schrenk var. *crassispora* Wr. in accordance with the terminology used by Wollenweber & Hochapfel (1949) so as to distinguish it from the apple anthracnose fungus which the same authors have called *Glomerella cingulata* (Ston.) Spauld. & v. Schrenk var. *brevispora* Wr.

After completion of the present comparative study of olive anthracnose fungi, von Arx (1957 b) has published an extensive revision of the genus *Gloeosporium*. If his opinion—that *Gloeosporium* should be dropped in favour of *Colletotrichum* as a generic name—finds international recognition, then the above described forms of *Gloeosporium fructigenum* should be referred to as forms of *Colletotrichum fructigenum* (Berk.) Vassil. (Vassiljewski & Karakulin, 1950). Von Arx's opinion that this fungus is a synonym of *Colletotrichum gloeosporioides* is of course not sustained.

Summary

The fungus which causes anthracnose of olives in South Africa was found to be a form of *Gloeosporium fructigenum* Berk. It has been given the name of *Gloeosporium fructigenum* Berk. f. *chromogenum* Gorter form. nov. [=M. C. Goldsworthy's chromogenic strain of *Glomerella cingulata* (Stoneman) Spauld. & v. Schrenk *loc. cit.*]. *Gloeosporium olivarum* Alm., which was originally described as the cause of olive anthracnose in Portugal has been renamed *Gloeosporium fructigenum* Berk. f. *olivarum* (Alm.) Gorter comb. nov.

Evidence has been presented that olives are not only subject to anthracnose diseases caused by the above mentioned fungi but also by two varieties of *Glomerella cingulata* viz.: *G. cingulata* (Ston.) Spauld. & v. Schrenk var. *brevispora* Wr. from apples and *G. cingulata* (Stonem.) Spauld. & v. Schrenk var. *crassispora* Wr. (=*Colletotrichum gloeosporioides* Penz.) from citrus.

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