

The Fungus Genus *Alternaria* Nees. In Bombay-Maharashtra-I *)

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(With 18 Figs.)

Introduction.

This is primarily a survey enumeration and characterization of genus *Alternaria* which is of great economic importance inciting leaf spots, blights, folliicular as well as blossom often assuming a wide-spread and destructive role. Strangely enough, this fungus genus has not received adequate and intensive attention in India in respect of its taxonomy due to it. References to previous literature showed that the number of species of *Alternaria* reported till 1960 in Bombay-Maharashtra was only eleven. The fungus genus is represented by 35 species in India so far, according to Butler and Bisby (1960). Although some work on the pathology of this interesting genus has been carried out in India, no attention has been paid to the consolidated survey of this important genus. Most of the species reported in India including those in Bombay have been in the nature of records and enumerations without any concerted critical investigations on their characterization, diagnosis, comparative studies, host range and other important criteria. The work reported on individual species is thus, scattered with more emphasis on pathology. The early work on the taxonomy of this genus is by the foreign workers, who have contributed much in this field. Elliott (1917), Young (1926), Nolla (1927), Wiltshire (1933) and recently Neergaard (1945) have greatly helped in formulating our present concept, limitations and taxonomic criteria employed in delimiting species in this genus and *Stemphylium* Wallr. (= *Macrosporium* Fr.).

It was therefore, considered desirable to undertake a detailed survey and comparative studies into and account of this interesting genus as it occurs in the State of Bombay-Maharashtra. The fungus occupies an important position in respect of its economic impor-

*) Part of thesis submitted for the Ph. D. Degree (Agriculture) of the Poona University, India. (1964).

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tance. In spite of excellent work carried out on the taxonomy of this genus by the foreign pioneer workers mentioned above and others who preceded them, there were several interesting features and lacunae awaiting further examination and critical study.

Historical Review.

A detailed review of the historical position and taxonomy of this genus since it was first established by Nees (1817) has been published by Neergaard (1945) and recently by Tweedy and Powell (1963) and needs no repetition.

Review of Indian Literature.

The early contributions and work done by Indian workers on this genus in India have been recently reviewed by Das Gupta (1958). Since then several workers like Edward (1957), Rangaswami and Venkata Rao (1957), Agarwal and Bhave (1959), Rangaswami et al (1960 and 1961), Rao, P. N. (1962), Rao, V. G. (1961, 1962, 1963), Mathur et al (1960) and Raghunath (1963) have variously reported on several species of *Alternaria* inciting leaf spots, blights, and even blossom blights of many economic hosts including agricultural and garden plants, mainly dealing with pathology, host-range and control, and only occasionally describing new species.

Recently Siddiqui (1963) carried out a detailed study into the spp. of *Alternaria* obtained from 13 hosts from India and concluded on the basis of morphology and host relationship that all the isolates studied by him belonged to the group, *A. tenuis* Auct. The work of Siddiqui (1963) is probably the first of its kind in India, dealing with the characterisation and comparative studies into the genus, although it was limited in scope to some specific species.

The foregoing review shows the scattered nature of the investigations carried out in India, in this important genus with special emphasis on pathology, host-range, physiology and control.

It was therefore considered desirable to undertake a consolidated survey for and investigations into this important genus as it occurs in Bombay-Maharashtra (India) based on fresh collections with special reference to its occurrence, distribution, morphological characterizations, diagnostic characters with detailed illustrations with a view to aid the future monographist of this genus in his undertaking.

In the descriptions and characterization of species studied, the writer has followed the species concept as defined and accepted by Wiltshire (1933, 1938) and recently confirmed by Neergaard (1945).

Materials and Methods.

The present study is based primarily on fresh collections of this fungus genus made by the writer in different localities and habits of the State, mostly in Poona during 1960—64 irrespective of its economic significance obtained on as many as 92 hosts many of which, however, are of economic importance belonging to 33 host families. The characterisation of the species is based on critical examination of many collections of the same species obtained at different habitats and measurements of two hundred spores obtained from naturally infected hosts dependig upon the extent of variations found in the particular species. The counts were made from mounts made in lacto-phenol. The manner of formation of conidia and their catenulations were determined by placing the surface sterilized material undermoist chambers and examination 'in situ'. The syp-sporulating material was incubated in Petri-dishes lined with moist filter papers to obtain good sporulation. The emergence of the fungus was determined through examination of free-hand sections. Isolations on culture media was also resorted to in certain special cases for comparative studies in doubtful species.

This part deals with 20 species of *Alternaria*, occuring in Bombay-Maharashtra, which have been arranged alphabetically. Collections of *Alternaria tenuis* Auct. have been excluded from this treatment and will form part of a separate communication.

Description of Species.

1. *Alternaria amaranthi* (Peck.) Venkat. (Fig. 1)

Syn.: *Macrosporium amaranthi* Peck. Bull. Torrey. bot. Cl. 493: 1895 (Sacc. 14: 1096: 1899).

Venkatakrishnaiah: Phytopathology: 42: 668; 669; 1952.

Infection spots irregular to angular, small, amphigenous, dark brick-red to snuffy-brown, with clearcut margins, marginal to scattered, often coalescing and inciting defoliation.

Conidiophores dark-brown, blunt and scarred at apex, simple, slightly bulged at the base, septate (1—5), non-constricted, solitary or in fascicles of 2—4, emerge out by rupturing the host tissue or through the stomatal openings, measure $21-55 \times 4.2-6.5 \mu$.

Conidia pale brown, catenulate, (2—6) with a short, non-septate to septate beak, clavate to muriform with 1—3 longitudinal septa and 4—10 cross septa, measure $37.8-92.4 \times 8.4-12.6 \mu$.

Incites leaf spots in *Amaranthus paniculatus* L. Collected by Vasant Rao, (10—11—1960) Poona.

The present collection is characterised by larger and thinner conidia as compared to those described by Venkatakrish-

naiah (1952) ($31.5-71 \times 12-20 \mu$) and besides was not found to incite blossom blight, typical of the Bangalore Collection.

2. *Alternaria amorphophalli* Vasant Rao. (Fig. 2)
Mycopath. et Mycol. Appl. **17** (1): 44-46, 1962.

Infection spots epiphyllous, scattered with a dark-brown margin and a light centre, depressed, often producing shot-hole effect, $7-21 \times 4-10$ mm.

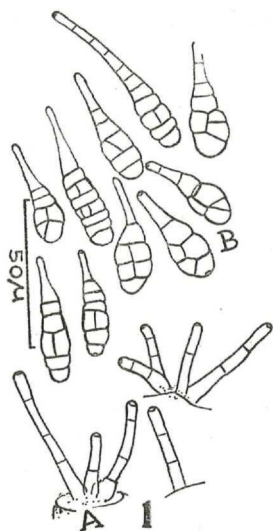


Fig. 1. *Alternaria amaranthi*. A. Conidiophores. B. Conidia.

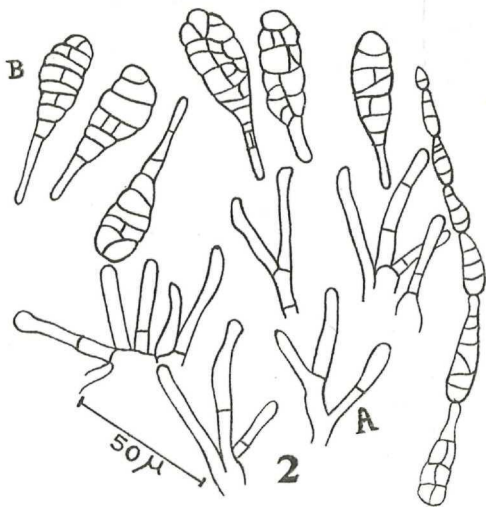


Fig. 2. *Alternaria amorphophalli*. A. Conidiophores. B. Conidia.

Conidiophores often fasciculate rarely solitary, breaking through host tissue, epiphyllous, often branched, brown, 1 to 2 septate, straight or irregularly bent, geniculate, bulbous at the base and rounded at the apex, sometimes with a single terminal scar, $33.5-126 \times 4.2-6.2 \mu$.

Conidia in long chains of 4 to 10 when young, falling apart at maturity, dirty brown, obovate to obclavate, with rounded base, tapering towards the apex, drawn out into septate or non-septate beak, with 3 to 7 cross and 2-5 longitudinal and oblique septa, constricted at the septa except in the region of beaks, $46.2-92.4 \times 33.5-50.5 \times 12.5-21 \mu$ (without beak).

Incites leaf spots and blight in *Amorphophallus campanulatus* Blume, collected by Vasant Rao (15-9-1960), Poona.

3. *Alternaria araliae* Greene. (Fig. 3).

Syn.: *Macrosporium araliae* Dearness and House.

Index of Fungi I. 1940. Trans. Wisc. Acad. Sci. Arts.

Lett. 42: 80, 1953, Index of Fungi (Petraik's list)

Vol. II, Part 8: 143; 1954.

Leaf spots epiphyllous, mostly marginal, deep chocolate-brown, irregular in outline, scattered.

Conidiophores dark-brown, straight to wavy, solitary or in fascicles of 2-8 rounded and scarred at apex, simple, septate (2-5), emerge through stomata or rupturing the epidermis, measure $42-92.4 \times 4.2-6.3 \mu$. (few measured upto 126μ in length).

Conidia dark-brown, muriform, scarred at base as well as apex with a short rudimentary beak, catenate (3-6) with 2-5 longitudinal and 4-7 cross septa, measure $46.2-65.0 \times 9-16.5 \mu$.

Incites leaf spots in *Aralia chinensis* L. collected by Vasant Rao (2-8-1962) Poona.

This species is a new addition to the Indian fungi.

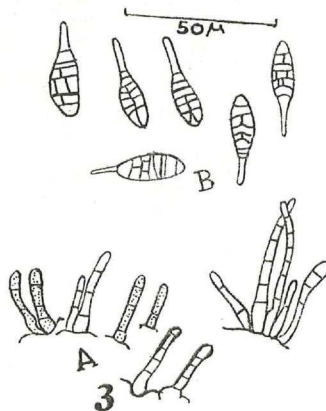


Fig. 3. *Alternaria araliae*. A. Conidiophores. B. Conidia.

4. *Alternaria brassicae* (Berk.) Sacc. (Fig. 4).

Syn.: *Macrosporium brassicae* Berk. Sacc. 4: 546: 1886.

Infection spots circular, zonate, light brown to greyish brown, scattered, mostly marginal, measuring 2—10 mms, often coalescing to form long, irregular patches. Black spots of typical nature are also produced on the curds or the heads of the cauliflower.

Conidiophores smoky grey or greyish olive, scarred at the apex, slightly bulged at the base, mostly solitary, sometimes in fascicles of 3 to 5, septate (1—5), straight to wavy, emerge through rupturing the diseased part, measure $29.4-126 \times 4.2-6.5 \mu$.

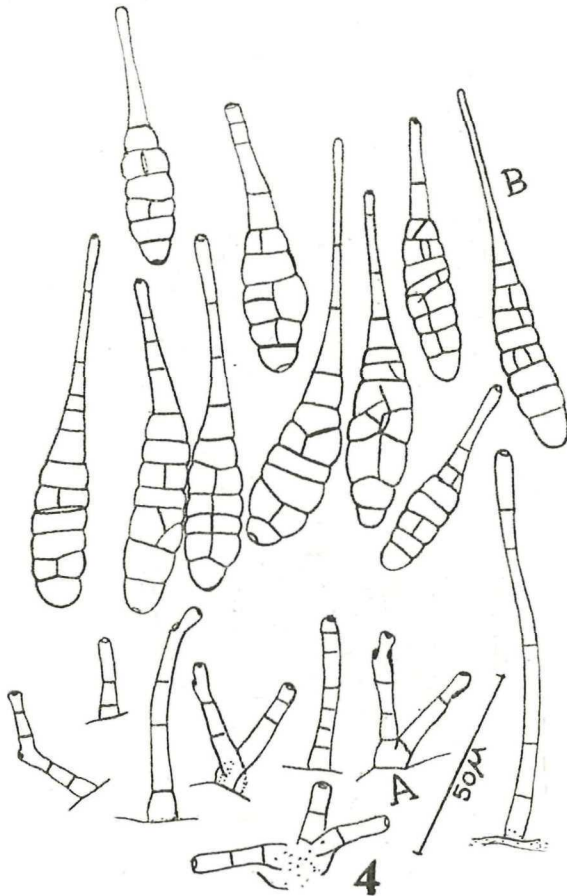


Fig. 4. *Alternaria brassicae*. A. Conidiophores. B. Conidia.

Conidia solitary or in short chains of 2—5, obclavate, greyish-olive, with a short non-septate to septate beak, scarred at apex, with 1—7 longitudinal septa and 5—11 cross septa, slightly constricted at cross septa, and measure $63-172.2 \times 8.5-16.8 \mu$.

Incites leaf spot in *Brassica oleracea* var. *botrytis* L., *B. oleracea* var. *caulocarpa* L. and *B. juncea* Coss., collected by Vasant Rao (5. 9. 1962) Poona.

5. *Alternaria brassicicola* (Schwein) Wilt. (Fig. 5).

Syn.: *Helminthosporium brassicicola* Schweintz.

Trans. Amer. Phil. Soc. N. S. 4: 279: 1832.

Wiltshire, S. P.: Mycol. Paper. C. M. I. 20: 8: 1947.

Infection spots dark brown to black, circular, zonate, surrounded by pale yellowish-green band, about 2—8 mms.

Conidiophores solitary or in fascicles of 2—5, merge out by rupturing the epidermis or through the stomata, dark olivaceous-brown bulged at base, scarred (1 to 6) and rounded at apex, sometimes branched, measure $33.6-76 \times 5.3-6.5 \mu$.

Conidia catenulate upto 12, light olivaceous-brown, nearly cylindrical to oblong, usually tapering slightly towards the apex or sometimes obclavate, non-beaked, with 0—5 longitudinal and 4—13 cross septa, constricted at cross septa, (usually a central pore

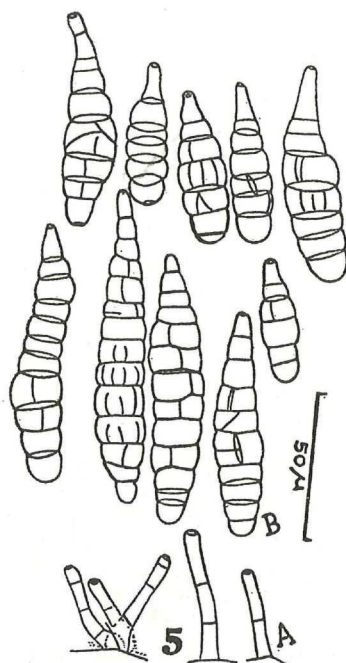


Fig. 5. *Alternaria brassicicola*. A. Conidiophores. B. Conidia.

or septum ring is frequently visible in the cross walls), scarred at apex, measure $54.6-113.5 \times 11-22 \mu$.

Incites leaf spots in *Brassica oleracea* var. *Capitata* L. collected by Vasant Rao (5—9—1962) Poona.

6. *Alternaria burnsii* Uppal, Patel and Kamat. (Fig. 6)

Indian J. Agric. Sci.: **8** (1): 61: 1938.

Infection spots first pale-brown later become dark-brown, mostly marginal and apical, often spreading and infection succulent stems and blossoms inciting blight.

Conidiophores simple, erect or slightly bent, few branched,

light olive, septate (1—5), slightly bulged near the base, rounded and scarred at the apex, measuring $21-58.8 \times 3-5.2 \mu$.

Conidia obovate to obclavate with rounded base, olive brown, tapering to the apex which may be drawn into septate or non-septate beak, scarred at base, borne singly on the host, with 0—4 longitudinal and 4—9 cross septa, constricted at cross septa, measure $25.5-105 \times 8.4-20 \mu$. (including beaks).

Incites blight in *Cuminum cyminum* L. collected by Vasant Rao (18—12—1962), Poona.

Uppal, Patel and Kamat (1938) studied the etiology of this disease and the pathogen in detail. The disease is of economic importance in Gujarat, India.

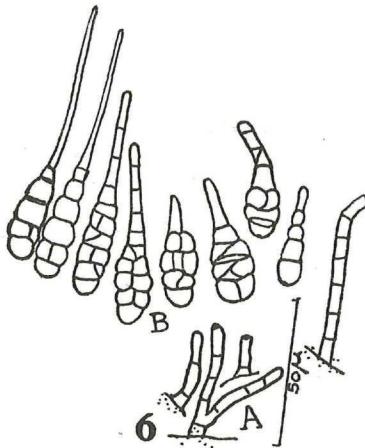


Fig. 6. *Alternaria burnsii*. A. Conidiophores. B. Conidia.

7. *Alternaria carolinaeana* Unamuno (Fig. 7).
Ann. Jard. bot. Madr. **1**: 9—59; 1941. (Abs. in R. A. M. **20**:
495: 1941).

Infection spots epiphyllous, pale brown to dirty dark-brown, oval to irregular, scattered or marginal. In severe cases affected leaves become brittle and roll upwards.

Conidiophores short, straight to slightly bent, few geniculate near the apex, dark-brown solitary or in fascicles of 2—5, emerge through the host tissue or stomata, not constricted at septa, scarred at apex, 2—4 septate, few branched, measure $50.4-84.0 \times 6.5-8.4 \mu$.

Conidia mostly double-walled, elongate to clavate, pale brown, scarred at base and apex, with 1—4 longitudinal and 3—8 cross septata not constricted at septa, mostly solitary, rarely in chains of 2—3 with a hyaline septate medium beak, measure $45-142 \times 12.5-20 \mu$ including the beak.

Incites leaf spots in *Dahlia variabilis* Desf. collected by Vasant Rao (20—8—1961), Poona.

This species was described on *Dahlia variabilis* Desf. in 1941 from Spain by Unamuno, L. M. and has been recorded for the first time in India.

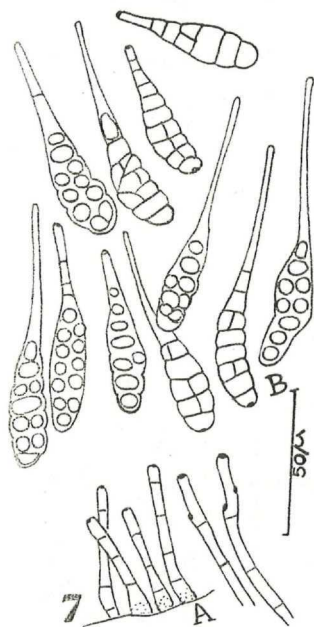


Fig. 7. *Alternaria carolinacana*. A. Conidiophores. B. Conidia.

8. *Alternaria carthami* Chowdhury (Fig. 8).
J. Indian bot. Soc. **23**: 65: 1944.

Infection spots dark-brown, mostly circular (3—9 mms.) epiphyllous, sometimes with concentric rings, scattered, often coalescing to produce irregular lesions.

Conidiophores simple, short, scarred at apex, few branched, mostly solitary, few in groups of 2—4, emerge out bursting the epidermis or through the stomata, 2—5 septate, dark-brown, measure $33.6—94.5 \times 5.25—8.5 \mu$.

Conidia solitary or in chains of 2, scarred at apex, with long septate to non-septate beak, light brown, obclavate with 1—3 longitudinal septa and 4—8 cross septa, constricted at cross septa, measure $42—105 \times 10.5—17 \mu$.

Incites leaf spots in *Carthamus tinctorius* L. collected by Vasant Rao (10—10—1962), Poona.

Some collections of this host showed infection in the form of distinct angular leaf spots, which were associated with *Alternaria*

zinniae Pape. with characteristic long, filiform, septate, hyaline or coloured beaks and double-walled conidial body.

9. *Alternaria cepulicola* Vasant Rao.

Sydowia, Ann. Mycol. **17** (1—6): 71—72 (1964).

Infection spots dark purplish-brown, with a paler outer zone, scattered, oval to irregular, resulting in blight and withertip.

Conidiophores dark olivaceous-brown, short, simple, solitary or in fascicles of 2 to 5, emerge through rupturing the diseased tissue, septate (1—7), bulbous at the base and rounded and distinctly scarred at the apex, rarely geniculate, measure $29.4-90.3 \times 8.4-12.6 \mu$.

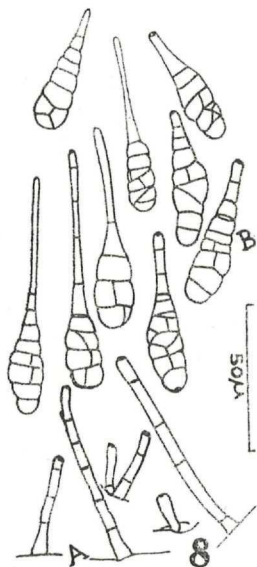


Fig. 8. *Alternaria carthami*. A. Conidiophores. B. Conidia.

Conidia olivaceous pale-brown, mostly double-walled, scarred at the base, generally solitary, rarely in short chains of 2 to 3, short beaked, obclavate to muriform, broader at the base, with 2 to 7 longitudinal and 6 to 15 cross septa, thick-walled, smooth, deeply constricted at septa, measure $58.8-184.8 \times 21-46.2 \mu$.

Incites leaf blight and withertip in *Allium cepa* L. collected by Vasant Rao (10—9—1962), Poona.

10. *Alternaria chenopodii* Raabe.

(Fig. 9).

Hedwigia **78**: 86: 1939.

F. Petrak: Index of Fungi: **8**: 6, 1936—1939, C. M. I.

Kew, England.

Infection spots epiphyllous, oval to irregular, scattered few marginal, pale olive-brown, papery, 5—12 mms.

Conidiophores simple, dark olivaceous-brown, with an apical scar, 1–6 septate, bulged at base and rounded at apex, solitary or in fascicles of 2–6, emerge out by rupturing the epidermis or through the stomata, unbranched, usually straight, few curved, measure $38\text{--}109.2 \times 5.25\text{--}6.3 \mu$.

Conidia pale olive-brown, obclavate to muriform, catenulate (2 to 3) with basal and apical scars, with 1–4 longitudinal and 2–8 cross septa with constrictions in cross walls, measure $33.6\text{--}60 \times 11.5\text{--}16.8 \mu$.

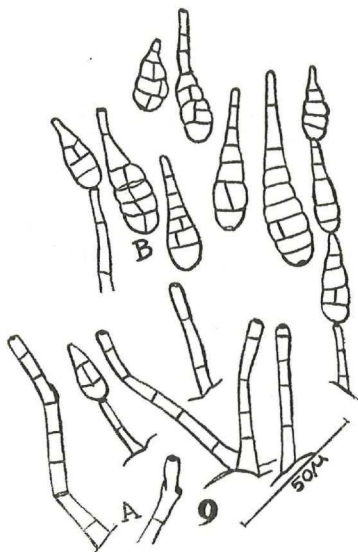


Fig. 9. *Alternaria chenopodii*. A. Conidiophores. B. Conidia.

Incites leaf spots in *Chenopodium album* L. collected by Vasant Rao (28–11–1962) Poona.

This species was described by Raabe in 1939, producing leaf spots on *Chenopodium bonus-henricus* L. from Germany. The present collection is thus a new host record and the species a new addition to the Fungi of India.

11. *Alternaria chrysanthemi* T. Schemidt (Fig. 10).

Pfl. SchBer. **21**: 1–2, 13–20; 1958. (Abs. in R. A. M. **37**: 724; 1958).

Leaf spots dark-brown to black circular to irregular, often coalescing to form large patches, scattered.

Conidiophores simple, dark-brown, bulged at base, rounded and scarred at apex, 1–5 septate, solitary or in groups of 2–5, emerge through stomata or host tissue, measure $25.2\text{--}84 \times 4\text{--}7.6 \mu$.

Conidia in short chains of 2—5, obovate to oblong with a medium septate beak, brownish with 1—5 longitudinal and 3—10 cross-septa, constricted at septa, scarred at base, measure $27.5-130.2 \times 12.6-18.9 \mu$.

Incites leaf spots and blossoms which turn dirty dark-brown to sooty brown, petals becoming brittle and fall away easily, imparting a blighted appearance to the crop. The disease is very common and destructive in cold season. (November to January) damaging the flowers and greatly reducing their market value. This species was originally described by T. Schmidt (1958) as causing a serious

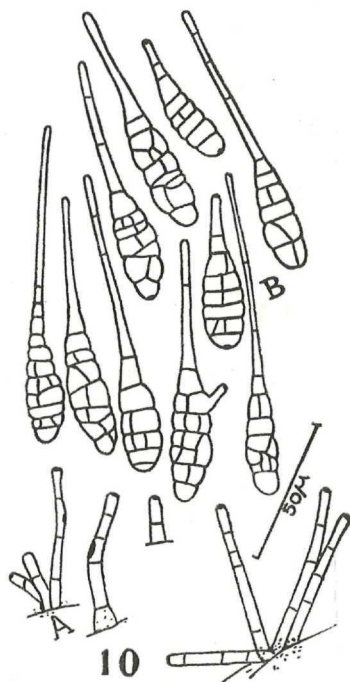


Fig. 10. *Alternaria chrysanthemi*. A. Conidiophores. B. Conidia.

leaf spot disease on *Chrysanthemum maximum* L. from Austrian Tyrol.

Chrysanthemum indicum L. is thus a new host record for the fungus and species an addition to the Fungi of India.

12. *Alternaria citri* Pierce.

(Fig. 11).

Syn.: *Macrosporium citri* Mc. Alpine, 1899.

Victoria Dept. Agric. **132**: 1899.

Pierce, N. B. Bot. Gaz: **33**: 234—235, 1902.

Roy, T. C. Bull. Bot. Soc. Bengal: **2**: 160: 1948.

Uppal, Patel and Kamat: Fungi of Bombay, Res. Bull. No. **176**: 28: 1934.

Leaf spots oval to irregular, mostly marginal, dull-brown to dark-brown, with a dark raised margin, later becoming dark-brown due to copious and profuse sporulation of the fungus.

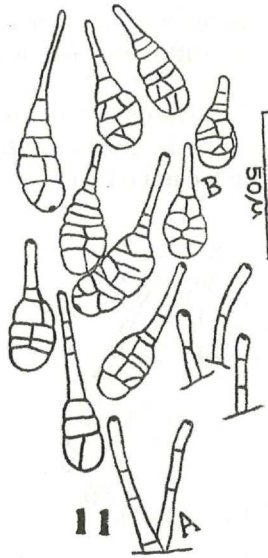


Fig. 11. *Alternaria citri*. A. Conidiophores. B. Conidia.

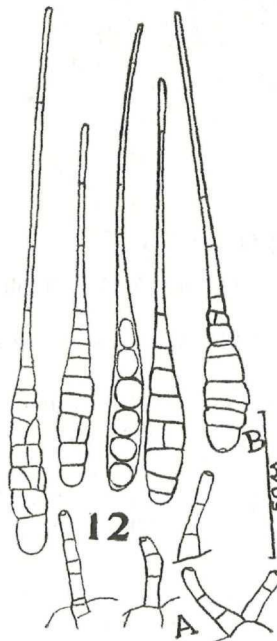


Fig. 12. *Alternaria crassa*. A. Conidiophores. B. Conidia.

Conidiophores simple, short, straight to slightly curved, brownish with terminal scar, solitary or in groups of 2—3; septate, emerge through the epidermis or stomata, measure $42-79 \times 4-6.3 \mu$.

Conidia obclavate with a short septate or non-septate beak, transverse septa 4—8 and longitudinal septa 2—4, few with oblique septa, constricted at cross septa, catenulate, measure $40-84 \times 12.6-21 \mu$.

Incites leaf spots in *Citrus sinensis* Osbeck. and *C. medica* var. *acida* L. collected by Vasant Rao (22—7—1962), Poona.

This species has been reported on *Citrus chrysocarpa* L. from Kalimpong (W. Bengal) by Roy (1948) and on *Citrus sinensis* (W. Bengal) by Roy (1948) and on *Citrus sinensis* Osbeck in Bombay by Uppal, Patel and Kamat (1934). *Citrus medica* var. *acida* is thus a new host record for this fungus.

13. *Alternaria crassa* (Sacc.) Rands. (Fig. 12).

Syn.: *Cercospora crassa* Sacc.

Rands: *Phytopathology* 7: 337: 1917.

Leaf spots circular to oval, sometimes zonate, pale brown to dark-brown, epiphyllous, scattered, few per leaf with distinct margins.

Conidiophores short, bulged at base and scarred at apex, mostly solitary, rarely in groups of 2, pale-brown, septate (1—3) measure $33.6-63 \times 6.3-8.5 \mu$.

Conidia elongate to fusiform with long hyaline septate beaks, double-walled, with 0—4 longitudinal septa; 5—11 cross-septa, solitary, light-brown, scars not distinct, measure $101-218.5 \times 12.6-15 \mu$ with beak, beaks measure $67.2-130.2 \times 3.2-4.2 \mu$.

Incites leaf spots in *Datura stramonium* L. and *D. metel* L. collected by Vasant Rao (18—8—1961) Poona.

This species has been listed in the old Bombay State by Uppal, Patel and Kamat (1934) on *Datura chlorantha* and *D. fastuosa* L. and *Datura fastuosa* L., *Datura stramonium* L. and *D. metel* thus, are new host records for this species in this State.

14. *Alternaria crotalaricola* Vasant Rao.

Sydowia, *Ann. Mycol.* 17: 70—71: 1964.

Infection spots epiphyllous, oval to irregular, pale dirty-brown, scattered with a clear cut margin, mostly marginal, sometimes resulting in shot-holes.

Conidiophores dark-brown, solitary or in fascicles of 2—3, emerge through stomata or rupturing the epidermis, septate (2—5), slightly bulged at the base, rounded and scarred at the apex, rarely branched, measure $50.4-84 \times 4.2-6.3 \mu$.

Conidia pale to olivaceous-brown, clavate to obclavate with a muriform body and short to medium-sized beak, scarred at the base and apex, in short chains of 2 to 5 with 5—12 cross and 1—5 longi-

tudinal septa with few oblique septa, constricted at septa, cell-wall smooth, measure $46.2-170 \times 13.65-21 \mu$. (with beaks) and $37.8-63 \times 13.65-21 \mu$. (without beaks).

Incites leaf blotch and shot-holes in leaves of *Crotalaria juncea* L. collected by Vasant Rao (25-9-1962) Poona.

15. *Alternaria cyamopsidis* Rang. and Venkat.

(Fig. 13).

Indian Phytopath. 10: 23: 1957.

Infection spots epiphyllous, round to irregular (2-12 mms.) scattered, pale pallide-brown to dark sometime with a pale yellow

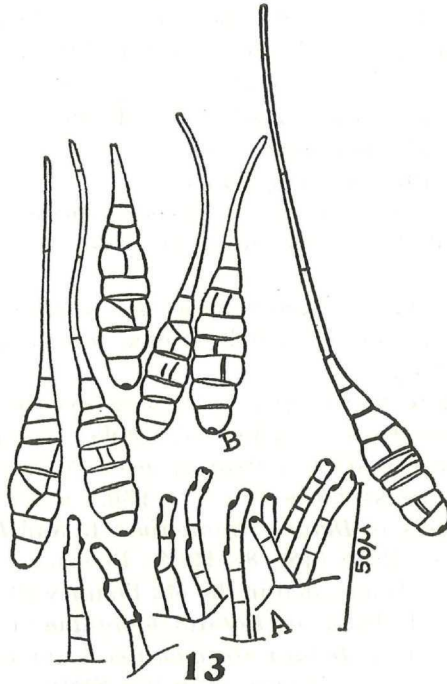


Fig. 13. *Alternaria cyamopsidis*. A. Conidiophores. B. Conidia.

margin encircling the spots, few marginal and apical, with concentric zonations demarked with light brown lines, often merging to produce large necrotic areas and inciting defoliation.

Conidiophores amphigenous, solitary or in fascicles of 3-6, emerge out rupturing the host tissue or through stomata, bulged at base, rounded and scarred at apex, greyish-olive, geniculate with prominent scars, 2-5 septate, slightly constricted at septa, measuring $21-42 \times 6.3-8.4 \mu$.

Conidia light greyish-olive, obclavate to muriform, catenulate (2-4) with 2-5 longitudinal and 6-8 cross septa with constrictions at the septa, scarred at the base, with long hyaline to olive

coloured septate to non-septate beaks, measuring $84-210 \times 16.8-27.3 \mu$. (including beak); beaks measuring $42-105 \times 4.2-5.25 \mu$.

Incites leaf spots, blight and defoliation in *Cyamopsis tetragonoloba* D. C. collected by Vasant Rao (29-10-1962), Poona.

This disease and the pathogen inciting it were first described by Rangaswami and Venkat Rao (1957) causing blight of cluster beans from Coimbatore (Madras, India).

Uppal, Patel and Kamat, (1934) on the other hand, have listed *A. brassicae* (Berk). Sacc. on this host collected from Khed, Poona (India).

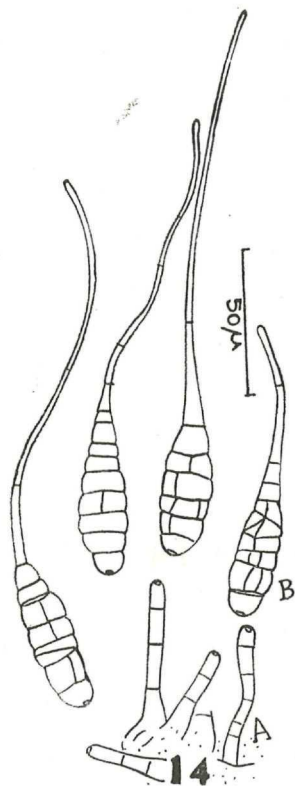


Fig. 14. *Alternaria dauci*. A. Conidiophores. B. Conidia.

16. *Alternaria dauci* (Kuhn) Groves and Skolko (Fig. 14).
Syn.: *Sporidesmium exitiosum* Kuhn var. *dauci* Kuhn.

Groves and Skolko: Canad. J. Res. Sect. C. **22**: 222: 1944.

Infection spots epiphyllous, dark-brown to dirty black, minute, mostly marginal, about 2-4 mms.

Conidiophores dark olivaceous-brown, stout and rigid, bulged at base, rounded and scarred at apex, short, straight, 2-5 septate, slightly constricted at septa, mostly solitary rarely in groups of 2-3,

emerging through epidermis or stomata, measure $25.5-92.5 \times 6.3-8.5 \mu$.

Conidia pale olivaceous-brown, solitary, scarred at base, drawn out into long, filiform, septate or non-septate beaks, obclavate to elongate with 1—7 longitudinal and 6—9 cross septa, constricted at septa, measure $134.5-227 \times 15.75-21 \mu$. (including the beak). Beaks long hyaline to pale brown, 0—3 septate, measure $80-151.2 \times 2.1-4 \mu$.

Incites leaf spots in *Daucus carota* L. and *Peucedanum graveolens* Benth. collected by Vasant Rao (26—9—1963), Poona.

This species is confined to Umbeliferous hosts and has been found to incite a serious blight of *Peucedanum graveolens* Benth. in Poona (India) during the monsoon months.

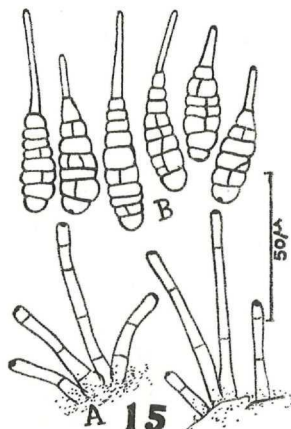


Fig. 15. *Alternaria dianthi*. A. Conidiophores. B. Conidia.

17. *Alternaria dianthi* Stevens and Hall. (Fig. 15).

Syn.: *Alternaria brassicae* (Berk.) Sacc. v. *dianthi* Zimmerman, 1924.

Stevens and Hall: Rep. Divis. Biol. N. Carol. Expt. Sta. 72—75; 1909.

Sacc: **22**: 1410; 1913.

Infection spots epiphyllous, dark-brown to black, oval to irregular, scattered or marginal with leathery texture.

Conidiophores simple, rarely branched, solitary in fascicles of 3—4, 2—4 septate slightly constricted at septa, bulged at base, emerging through the epidermis or stomata, deep-brown, with a single terminal scar, measure $46.2-12.6 \times 4.3-6.5 \mu$.

Conidia clavate to muriform, drawn out into a short beak which is septate or non-septate, light-brown, catenulate (2—4), cross-septa

5—11, vertical 2—5, constricted at cross septa, measure $46.0—138.5 \times 10.5—21 \mu$.

Incites leaf spots and blights to *Hibiscus esculentus* L. and *H. cannabinus* L. collected by Vasant Rao (2—8—1961) Poona.

The species is of great economic importance and causes severe type of blight on the two hosts often inflicting great damage during the wet season.

This species has been reported on *Saponaria vacaria* from Delhi (India) and *Dianthus caryophyllus* L. (cultivated carnation) causing a serious blight (Butl. and Bisby, 1932) and also on *Hibiscus tiliaceus* L. from Lahore (W. Pakistan) causing leaf spot and wilt (Choudhuri 1927).

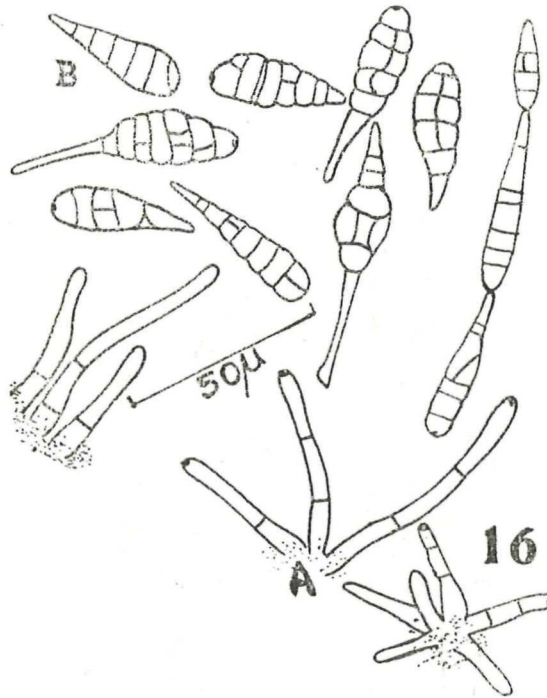


Fig. 16. *Alternaria dioscoreae*. A. Conidiophores. B. Conidia.

18. *Alternaria dioscoreae* Vasant Rao.

Curr. Sci. **30**: 470—471, 1961.

Infection spots epiphyllous, scattered, irregularly ovoid, dark-brown in colour, 15×9 mm.

Conidiophores single or in fascicles, dark-brown, emerging through stomata, epi- as well as hypophyllous, erect, more or less bent, 1—2 septate, not constricted, bulbous at base and rounded at apex, often with a single terminal scar, $25.2—92.4 \times 4.2—5.2 \mu$.

Conidia abundant on host, in short chains (2—3), deep-brown, obovate to obclavate, rounded at base, tapering towards apex, drawn into a non-septate beak, with 4—7 cross and 2—3 longitudinal septa, oblique septa rare, constricted at septa, $48.3—79.8 \times 12.5—14.5 \mu$ (with beak), $35.7 \times 13 \mu$ (average without beak).

Incites leaf spot and blight in *Dioscorea alata* L. collected by Vasant Rao (5-9-1960) Poona.

19. *Alternaria fasciculata* (Cooke and Ell.) Jones and Grout. (Fig. 17).

Syn.: *Macrosporium fasciculatum* Cooke and Dill.

Bull. Torrey. bot. Cl. **24**: 257, 1897.

Simmons, S. A., Plant Dis. Repr. **31**: 17: 1952.

Infection spots dirty dark-brown to black, irregular in long patches, mostly apical and marginal.

Conidiophores dark-brown, short, bulged at base, rounded and scarred at apex, solitary or in fascicles of 2-8, 1-5 septate, emerge out by rupturing the epidermis measure $40-90.3 \times 4-7 \mu$.

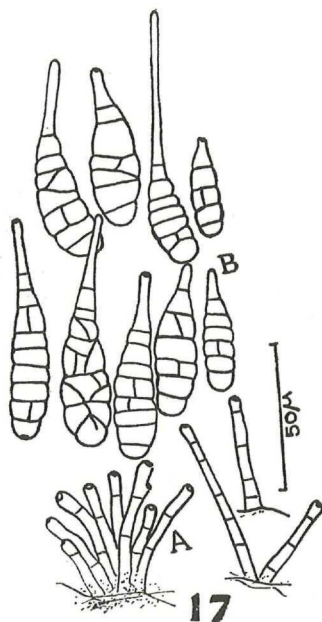


Fig. 17. *Alternaria fasciculata*. A. Conidiophores. B. Conidia.

Conidia clavate to obclavate, with a short beak, scarred at base, light-brown, with 5-9 cross and 1-5 longitudinal septa, constricted at septa, catenulate (2-5) measure $63-105 \times 10.5-22 \mu$.

Incites leaf spots in *Gladiolus* sp. collected by Vasant Rao (14-12-1961), Poona.

This is very common and valuable garden plant and widely cultivated for its elegant spikes of flowers. This disease and the pathogen inciting it have been reported by Simmons (1951) to be destructive to *Gladiolus* causing severe leaf blight first described from Ontario, Canada. The species is a new record to India.

20. *Alternaria gomphrenae* Togashi (Fig. 18).

Togashi, K. Bull. Imper. Coll. Agric. and Forestry. Morioka, Japan, 9: 1—16, 1926. (Abst. in R. A. M. 5: 671: 1926).

Infection spots amphigenous, dirty dark-brown, oval to irregular scattered, mostly marginal to apical, with a light border.

Conidiophores short, dark-brown, septate, simple, (2—6), solitary or in fascicles of 2—5, straight or slightly wavy, with apical scars, bulged at base, emerge out rupturing the epidermis or through the stomata, measure $29-68 \times 4.2-5.25 \mu$.

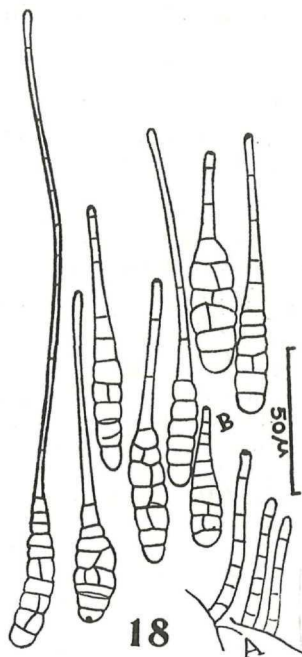


Fig. 18. *Alternaria gomphrenae*. A. Conidiophores. B. Conidia.

Conidia pale olive-brown, obclavate to elongate, in short chains of 2—4, tapering towards apex which is drawn out into a long filiform, unbranched, septate, pale-olive beak, with terminal and basal scars; 0—4 longitudinal septa and 6—17 cross septa, measure $63-210 \times 12.6-21 \mu$ (including beaks). Beaks septate, long filiform measure $42-159 \times 3.15-5.25 \mu$.

Incites leaf spots in *Gomphrena globosa* L. collected by V a s a n t R a o (5—9—1963) Poona, India.

A g a r w a l et al (1961) have reported this species to incite blight of *Gomphrena globosa* L. from Jabalpur (M. P., India). The writer's collection was invariably found associated with the common species, *A. tenuis* Auct. probably as a saprophyte. *A. gomphrenae* is a new record for Bombay-Maharashtra.

Acknowledgements.

The writer is deeply indebted to Professor M. N. Kamat for his absorbing interest and guidance throughout these studies. He is also grateful to Government of India, University Grants Commission, New Delhi, for the award of a Junior Research Fellowship and to Dr. F. Petrak, Wien (Austria) for kindly going through the Manuscript. Grateful thanks are also due to Dr. Georg L. McNew, Director, Boyce Thompson Institute for Plant Research Inc. Yonkers, New York (U. S. A.) for his constructive and helpful criticism and suggestions, which have greatly helped in the improvement of the text.

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