J. Phytol. Res. 10 (1-2): 25-29, 1997

INFECTION OF *ALBUGO CANDIDA* (PERS. EX LEV.) KUNZE IN MUSTARD SEEDS

JYOTSANA SHARMA*, KAILASH AGRAWAL and DALBIR SINGH**
Department of Botany, University of Rajasthan, Jaipur - 302 004, India.
* Department of Botany, Vedic P.G. Girls College, Jaipur - 302 004, India.
** Department of Botany, Agrawal College, Jaipur - 302 003, India.

Seeds of mustard (*Brassica juncea* Coss.) naturally infected with *Albugo candida* (Pers. ex Lev.) Kunze and carrying an oospore load of 8700 spores/g were categorised and studied. Cleared wholemount preparations and microtome sections revealed the fungal mycelium in seed coat of 4 and 10 per cent bold-symptomless seeds whereas in 100 and 100 per cent symptomatic seeds, respectively. In bold white-crusted seeds, the mycelium was observed in seed coat and endosperm. Bold-discolored seeds with white mycelium and oospores and shrivelled-discolored seeds carried the mycelium in seed coat, endosperm and cotyledons but the oospores in seed coat only.

Keywords: *Albugo candida;* Histopathology; Mustard seed.

Introduction

White rust caused by *Albugo candida* (Pers. ex Lev.) Kunze is an important disease of crucifers including rape and mustard occurring throughout India[1-3]. The oospores of *A. candida* have been detected in seed washings in *Brassica campestris* and *B. juncea*[4-6]. Although the histopathology of hypertrophied inflorescence and stem has been investigated[1], there is no study on *A. candida* infected seeds.

Materials and Methods

Seed sample (no. 2918, Cv. RL-18) of mustard (*Brassica juncea* Coss) naturally infected with *Albugo candida* carrying a heavy oospore load of 8700 oospores/g in seed washing test was selected. The seeds were categorised on the basis of dry seed examination. Each category was handled separately using clearing and wholemount preparations[7] and microtome sectioning[8]. In the former, 50 seeds per category and in the latter 10 seeds per category were used. Microtome sections were stained with safranin - fast green combination and some with cotton blue.

Results and Discussion

Dry Seed Examination:- The percentage of seeds of different categories, namely (I) bold-symptomless, (II) bold white-crusted (Fig. 1A), (III) bold-discoloured with white mycelium and oospores and (IV) shrivelled - discoloured seeds was 88, 5, 5 and 2 respectively. Symptomless and white-cursted seeds did not differ in size but the crusted region was raised, looking like blisters. The seeds in other two categories were smaller than symptomless seeds.

Structure of Seed :- Seeds of mustard are spherical, reddish brown to black, with marked reticulations and minute stipples. Anatomically, the seed comprises seed coat, endosperm and a curved embryo with two conduplicate cotyledons and an embryal axis (Figs. IF, 2A). The seed coat consists of flattened epidermis, subepidermis, palisade layer of thick-walled pigmented cells of unequal height and layer of compressed parenchyma. The outer two layers are not very distinct at maturity. Endosperm is 1-layered[9].

Cleared Wholemount Preparations :- Epidermis and sub-epidermis were isolated as one unit. Bold - symptomless seeds revealed broad, coenocytic, branched and intercellular mycelium of *Albugo candida* in seed epidermis and subepidermis in 4% seeds only. But, similar mycelium as well as oospores of the pathogen were observed in this zone in 100% seeds of all the categories of symptomatic seeds (Fig. 1B, C). Different stages of oospore development were also observed in these preparations. In symptomatic seeds, fungal mycelium also invaded palisade layer (Fig. 1D) in 26, 44 and 56 per cent and endosperm in 10, 18 and 42 per cent seeds of II, III and IV categories respectively. 8 and 18 per cent embryonal infection (Fig. IE) was observed in the last two categories respectively.

Microtome Section :- In bold - symptomless seeds only 1 out of 10 seeds revealed mycelium in seed coat whereas in other categories, it was universally present (Figs. 1G-I, K, 2B-D). Infection caused slight (Figs. IG, 2B) to conspicuous increase in parenchyma layers (Fig. 1H). The increase was maximum in seeds with white mycelium and oospores (category III) becoming upto 8 layers while in uninfected seeds, there are only 2 layers. The cells also showed hypertrophy (Figs. 1H, I, 2C).

Different stages from unfertilized oogonia, antheridia (Fig. 1J) to mature oospores were observed in inter-cellular spaces. The palisade layer had weak thickening particularly of the radial walls in sections of symptomatic seeds of all categories (Figs. 1G-1, 2B-D). No infection could be observed in the compressed parenchyma layer in any category.

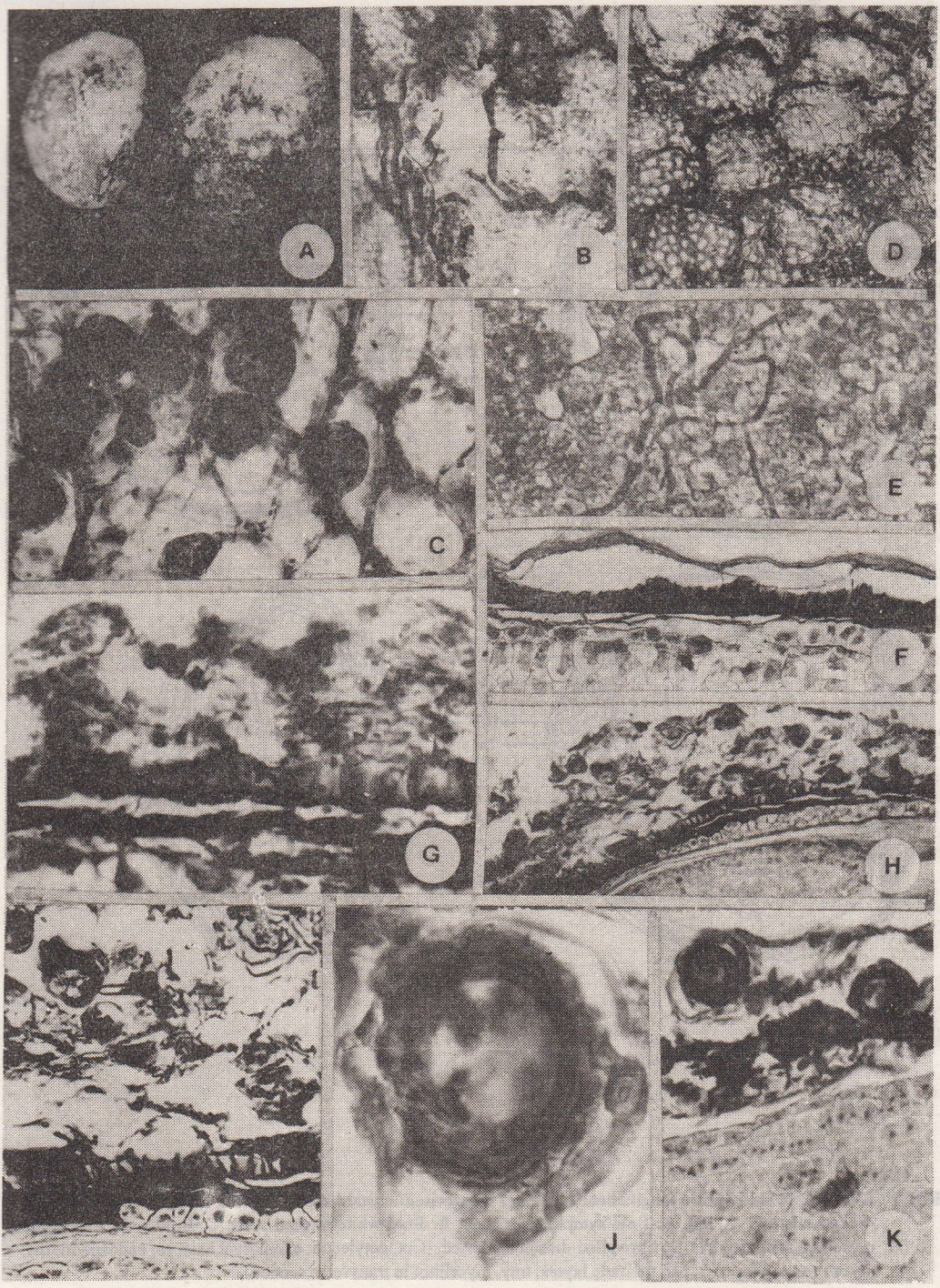
The fungus occasionally invaded endosperm and embryo. In endosperm, bits of mycelium could be observed in 1, 3 and 4 seeds in II, III and IV categories respectively. Embryonal infection was recorded in 1 and 2 seeds in the III and IV categories only in the peripheral layers.

This report regarding mycelial and oospore infection of *A. candida* in mustard seeds is interesting. Similar infection of *Albugo bliti* was observed in seeds coat of *Amaranthus retroflexus*[10]. It will be of interest to determine the period of survival of this infection in mustard seeds and its role in transmission of the disease, particularly in light of recent reports[5] about short survival period of soil-borne oospores of *Albugo candida.*

Acknowledgements

J. Sharma is grateful to Council for Scientific and Industrial Research (CSIR), New Delhi for providing financial assistance.

Fig.1A-K: Histopathology of *A. candida* infected mustard seeds. **A.** White-crusted seeds (X 15). **B-E.** Cleared wholemount preparations of seed components showing mycelium and oospores of *A. candida.* **B, C.** Epidermis (X 125), **D.** Palisade layer (X 125), **E** Cotyledon (X 250). **F-K.** Microtome longitudinal sections of categorised seeds showing mycelium and oospores. **F.** Normal seed coat, endosperm and embryo of bold-symptomless seed (X 125); **G.** White-crusted seed showing mycelium in seed coat, enlarged cells of epidermis and subepidermis and weakened radial thickening of palisade cells (X 125); **H, I.** Seeds with white mycelium and oospores showing increased number of parenchyma layers of seed coat (X 50 and 125 respectively); **J.** Mature seed to show oogonium and antheridium in seed coat (X 500); **K.** Shrivelled-discoloured seed showing oospores and mycelium in seed coat (X 125).


A
B
D
C
E
F
G
H
I
J
K

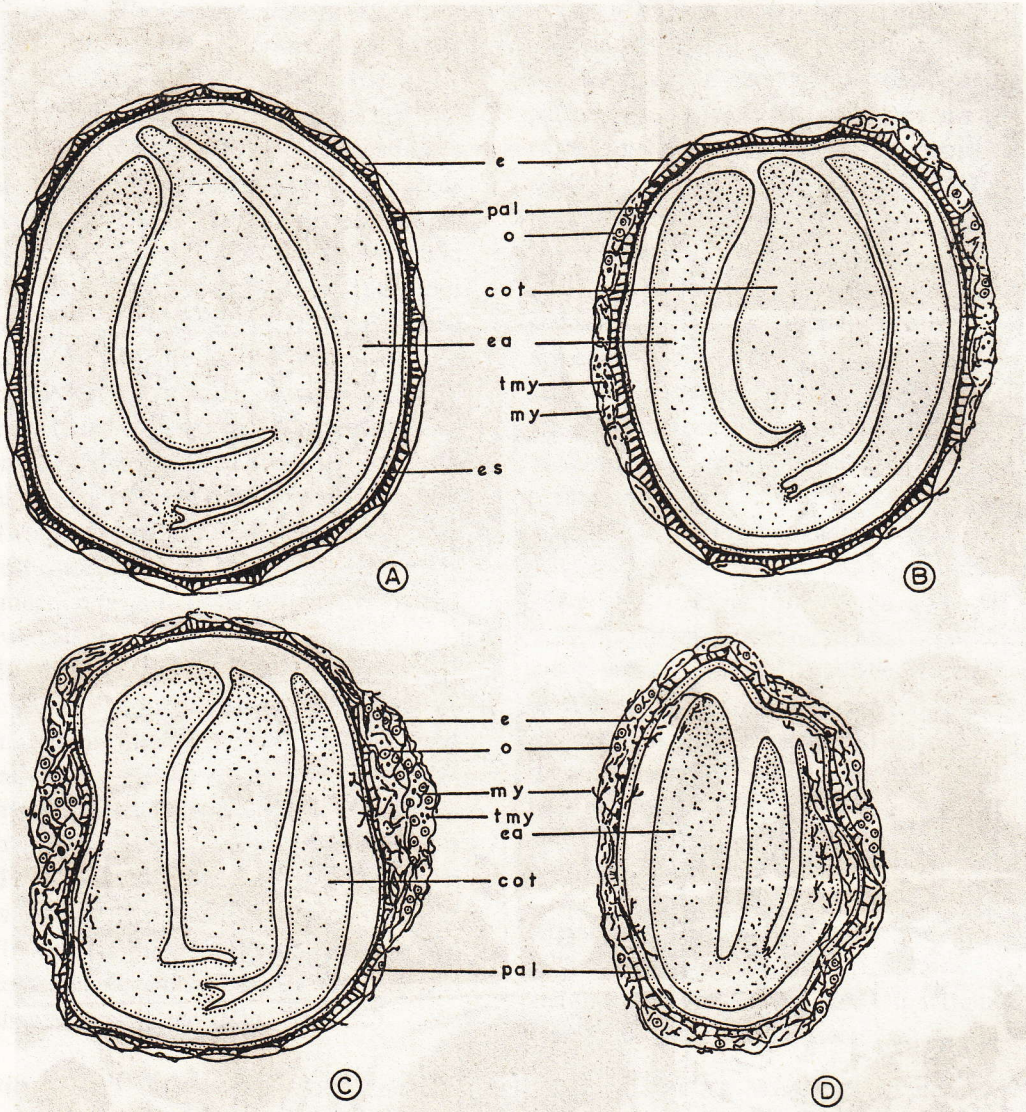


Fig. 2 **A-D:** Semidiagrammatic longitudinal section of categorised mustard seeds showing location and expanse of *Albugo candida* (X 23). **A.** Bold-symptomless seed; **B.** Bold white-crusted seed; **C.** Bold seed with white mycelium and oospores; **D.** Shrivelled-discoloured seed. (Cot, cotyledon; e, embryal axis; es, endosperm; my, mycelium; o, oospores; pal, palisade layers; tmy, mycelium in transverse section).

References

1. Vasudeva R S 1958, *Rapeseed and Mustard;* 77-81 Ed. D P Singh (Hyderabad, India Oilseed Committee).
2. Bilgrami K S, Jamaluddin and Rizwi M 1979, *Fungi of India;* (New Delhi, India : Today & Tomorow's Printers).
3. Anonymous 1988, *Technology for maximising production of rapeseed - mustard in Rajasthan.* (Hyderabad, India : Ex. Bull. V : ICAR Publication, Directorate of Oilseeds Research).
4. Petrie G A 1975, *Can. Plant Dis. Surv.* **55** 19
5. Verma U and Bhowmik T P 1988, *Int. Tropical Plant Dis.* **6** 265
6. Sharma J, Agrawal K and Singh D 1990, *J. Indian Bot. Soc.* **69** 197
7. Singh D, Mathur S B and Neergaard P 1977, *Seed Sci. & Technol.* **8** 85
8. Johansen D A 1970, *Plant Microtechnique*; (New York, U. S. A. : McGraw Hill).
9. Vaughan J G 1970, *The structure and utilization of oil seeds*; (London, UK : Chapman & Hall Ltd.)
10. Melhus I E 1931, *Iowa State Coll. J. Sci.* **5** 185