DISCUSSION
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Alternaria blight of crucifers caused by *Alternaria brassicae* (Berk.) Sacc. was brought to books for the first time by an English scientist, Berkeley (1836). In India, the presence of the fungus was noted by Mason (1928) on "Sarson", *Brassica campestris* (herbarium material) from Pusa, Bihar.

In the present investigation, during the collection of disease materials, the disease was found both on seedlings and the fully grown plants. Affected seedlings damped-off while older parts exhibited numerous spots on leaves, stem and pods (Figs. 2,3,6). Spots on leaves were in the form of concentric rings, light brown to dark brown in colour measuring 0.5 to 12.0 mm in diam. and seen coalescing to each other in advanced stages (Fig. 5). These symptoms resemble well to those described earlier for Alternaria blight of crucifers by Neergaard (1945), Wiltshire (1947), Dey (1948), Vanterpool (1950), Mc Donald (1959), Chantasri and Weber (1963), Ellis (1971) and Subramanian (1971). Circular dark brown and black lesions on pods and elongated lesions on stems were also observed.

Morphological characters of the pathogen identified as *A. brassicae* were in complete agreement with the specifications given by earlier workers (Grove and Skolko, 1944;
Out of twelve liquid media, Kirchoff's medium was found to be the best while PDA was found as best solid medium. Richard's medium was also found good in both forms. The performance of mustard leaf extract in the both forms was also good. There was no definite trend in the preference of the pathogen for synthetic or natural media. Some natural media like PDA and mustard leaf extract supported sufficient growth but natural media such as corn-meal and oat-meal fared rather poorly (Tables 1 and 2). Good growth of the pathogen on mustard leaf extract agar or mustard leaf extract in liquid form is quite expected since the extract was obtained from one of its established host.

Sporulation of the pathogen was excellent not only in media which supported excellent growth but also in media in which moderate growth occurred. On some media like Asthana and Hawker's agar and Czpeck's agar, growth was poor but sporulation was good. On the other hand, in some media like corn-meal, both growth and sporulation were poor (Tables 1 and 2).

Satisfactory growth as well as excellent sporulation on malt extract medium as recorded are similar with the findings of Neergaard (1945) and Taber et al. (1968). Performance of the media differed to some extent with a change of
their forms, as there was no clear cut correlation between
dry weight of the fungus and its linear growth. For example,
best linear growth was recorded on potato dextrose agar
whereas the maximum mycelial growth was obtained on Kirchoff's
medium in liquid state. Potato-dextrose in liquid form did
not perform so well. On the other hand, corn-meal in the
liquid state supported comparatively better growth but the
same in the solid form fared poorly.

A considerable variation was noted in the colony
characters of *A. brassicae* on various media (Table 3). The
mycelium was usually light brown to brownish grey. Conidia
were brown, mostly born singly with long beaks or sparingly
in chains of two and sometimes three. Elliot (1917),
Changsri and Weber (1963) and Prasada et al. (1970) also
observed similar colony characters of the fungus.

In earlier reports (Neergaard, 1945; Limasset, 1955;
Changsri and Weber, 1963; Taber et al., 1968) temperature has
been stated to play a vital role in the growth and sporula-
tion of the pathogen under study. A temperature range between
21 and 28°C with an optimum round 23°C has been reported to
be favourable for *A. brassicae* by various workers (Taber et al.,
1968; Neergaard, 1945; Limasset, 1955; Changsri and Weber, 1963;
Czyżewska, 1969). In the present study, growth of *A. brassicae*
occurred between a temperature range of 5 to 30°C. Both
growth and sporulation were excellent at temperatures ranging
between 23 and 25°C. However, 23°C was the best amongst all (Table 6). These findings are in line with those of earlier works on *A. brassicae*.

Studies on effects of light on growth and sporulation of the fungus revealed that alternating light and darkness supported better growth and sporulation than complete darkness or continuous light. Complete darkness, however, induced growth better than continuous light but sporulation was poorer (Table 7). Earlier reports on the effect of light on sporulation in *Alternaria* species, however, are very conflicting. Dillonweston (1936) found that strong light induced sporulation in *A. solani* while Klaus (1941) observed that weak intensity of light was sufficient for inducing sporulation in *Alternaria* species. The effect of alternate light and darkness on *A. brassicae* with respect to growth and sporulation observed in the present study are similar to those of Gupta *et al.* (1972). However, their observations that continuous light completely inhibited growth and sporulation of *A. brassicae* was not corroborated by the present study. Alternate light and darkness have been found conducive for growth and sporulation of some other pathogenic Deuteromycetes like *Cercospora dolichi* (Singh, 1933) and *Colletotrichum capsici* (Misra and Mahmood, 1960).

Experiments on the effects of relative humidity on growth and sporulation of the pathogen indicated that the pathogen could grow at all the relative humidity levels
between 30-100 per cent. Growth gradually improved with increase in the relative humidity level and highest growth was obtained at 100 per cent relative humidity followed by 97 per cent. In general, relative humidity above 78 per cent was found quite favourable to mycelial growth and sporulation (Table 8). There appears to be no work yet done on this aspect of the pathogen under study, but similar behaviour to humidity has been reported by Misra and Singh (1963) for Helminthosporium turcicum and Bais (1969) for Curvularia lunata.

The pathogen grew well at all pH levels tested (2.9-9.2) but sporulation occurred only at pH values ranging between 3.5 and 8.5. Lowest and highest pH levels tried supported very poor growth and spore formation. Both growth and sporulation were poorer at lower levels and gradually increased to reach at highest at 6.5 pH beyond which growth gradually declined (Table 9). These findings are in close agreement with those obtained earlier on the same pathogen by Gupta et al. (1969), Welch et al. (1969) and Prasada et al. (1970). Results reported for other Alternaria spp. (Chowdhury, 1944; Riley, 1949; Arya and Prasada, 1953; Crossan, 1954) also provide enough support to above findings.

Pathogenic fungi usually exhibit certain degree of specificity in utilizing various nutritional substances for their growth and sporulation. Carbon occupies an unique
position among the essential elements required by the living organisms. But nutritional values of different carbon sources differ and the same source of carbon is utilized with varying degrees of efficiency by different fungi (Lilly and Barnett, 1951).

Addition of carbon through various sources invariably boosted the growth and sporulation of the pathogen. Out of 11 carbon compounds tested, highest growth was recorded in the medium carrying starch followed by cane sugar, sucrose and D-glucose. The pathogen made poor growth and sporulation on glycerol (Table 10). Supremacy of the starch has also been established by earlier findings on the same fungus reported by Taber et al. (1968). Moreover, the fact that other carbon compounds studied (cane sugar, sucrose, D-glucose, dextrin and D-galactose) also favoured vegetative and reproductive growth, notwithstanding the degree of their effect, is supported by the studies of Gupta et al. (1969) on *A. brassicaceae*; Tandon and Chaturvedi (1963), Singh and Khanna (1966) and Fulton and Bollenbacher (1968) on other *Alternaria* spp.

Further, out of the two monosaccharides used, D-glucose was found better source than D-galactose. Cochrane (1958) has mentioned that D-galactose may be used only when it is converted into a phosphorylated derivative of glucose which is able to enter the main respiratory pathway. Among the disaccharides, cane sugar and sucrose performed almost alike and their performance was better than lactose and maltose.
Cane sugar has not been tested so far by other workers whereas several reports (Horne, 1933; Carter, 1934; Pawar and Patel, 1957; Joly, 1962; Tandon and Chaturvedi, 1963; Rao and Apparao, 1965; Singh and Khanna, 1966; Fulton and Bollenbacher, 1968) support the trend found here for other disaccharides.

Polysaccharides play an important role in the nutrition of pathogenic fungi. Starch, a polysaccharide, supported highest fungal growth in the present study. Performance of dextrin was, however, average. Szelenyi and Becze (1928) while determining the assimilative capacity and enzymatic action of *Alternaria solani* during its vegetative growth period found that a large quantity of starch was utilized. In the opinion of Lilly and Barnett (1951) utilization of these substances by fungi depends upon the production of necessary hydrolytic enzymes.

Although two sugar alcohols were better than control but their performance was inferior to many of the other carbon sources. Performance of D-mannitol was also not good while that of glycerol, on the other hand, was poorest of all the sources. It partly supports the finding of Taber et al. (1968) They observed that D-mannitol was a poor carbon source for *A. raphani* and *A. brassicaceae* where as a good source for *A. brassicicola*. It shows that there is a definite difference between the fungi for their likings of the same source.
Like other living organisms nitrogen is required by fungi not only for structural build-up but also other physiological activities. Performance of various nitrogen compounds in supporting growth and sporulation of the pathogen shows that barring peptone, nitrate sources of nitrogen proved in general superior to ammonium group of compounds (Table 11). Similar findings have been reported by Gupta et al. (1969) for A. brassicae; Tandon and Chaturvedi (1963) and Singh and Khanna (1966) for A. tenuis. The efficacy of peptone was best among the nitrogen sources tried while sodium nitrate proved the next best. Taber et al. (1968) also reported peptone as the good nitrogen source together with potassium nitrate. The least growth and poor sporulation of the present fungus were recorded on ammonium molybdate. If sporulation is taken into consideration, thio-urea can also be juxtaposed with it. Poor performance of thio-urea has also been reported by Grewal (1955) for A. tenuis. Excessive ammonia as well as the presence of sulphur may be the possible cause for poor behaviour of thio-urea.

Organisms must either synthesize or obtain oxogenous supply of different amino acids they require for the synthesis of protein (Lilly and Barnett, 1951). A number of amino acids were tried in this investigation and were observed differing in their efficiency of nourishing the isolate under test. DL-threonine, DL-valine, L-cystine, L-proline and L-iso-leucine including control containing L-asparagine
were conducive for growth and sporulation both, whereas
the rest of the amino acids did not support better growth
(Table 12). This aspect of \textit{A. brassicae} has not been studied
earlier. In case of other \textit{Alternaria} spp. however, leucine
and glycine (Taber \textit{et al.}, 1968), DL-aspartic acid (Powar
\textit{et al.}, 1957), alanine and glycine (Grewal, 1955) are reported
to favour mycelial growth and sporulation. This variation
may be due to preference for certain amino acids by the
present pathogen. Leonian and Lilly (1938) testing 24 amino
acids also failed to identify some amino acids which may be
termed best for all the fungi.

Fungi, in general, utilize different essential
metallic and non-metallic elements for the build-up of their
vegetative and reproductive structures (Lilly and Barnett,
1951). Phosphorus also plays an important role in various
physiological activities particularly in energy transfer
in many forms of life (Bhargava, 1945; Agarwal, 1957). The
same is true also for \textit{A. brassicae}. It was observed that
without the aid of phosphorus (control) it could make only
a slight growth and failed to sporulate. On the other hand,
when phosphorus was supplied through various sources, it
could grow and sporulate well (Table 13). Out of the eight
compounds highest mycelial growth and sporulation were
obtained in the medium containing potassium monohydrogen
phosphate which was found to be the best by Singh and Tandon
(1967) for \textit{A. tenuis} and Jaurihar and Mehta (1972) for
Fusarium moniliforme. A trend of greater mycelial growth accompanied by better sporulation noticed in the present study is identical to that stated by Lilly and Barnett (1951).

Requirement of sulphur for the growth of various fungi has also been emphasized by Agarwal (1958), Bhargava and Tandon (1963) and Jaurihar and Mehta (1972). On the other hand, it has been found to remain unutilized in the medium (Srivastava, 1950; Agarwal, 1957). All the thirteen sulphur sources improved both the vegetative and reproductive growth of A. brassicae. Potassium sulphate was found to be the best in respect of the mycelial growth and sporulation. The next best was magnesium sulphate. The effect of sodium bisulphite, zinc sulphate, sodium sulphate and sodium sulphite was moderate (Table 14). Potassium sulphate closely followed by magnesium sulphate as better source of sulphur was also found by Srivastava (1950) for Curvularia spp. Magnesium sulphate has been reported to be the best sulphur source also for A. tenuis by Tandon and Chaturvedi (1963) and for Alternaria citri and A. tenuis by Hasija (1969). Sodium bisulphite and zinc sulphate which performed well in the present investigation have already been reported to be the best sources for isolates of Colletotrichum gloeosporioides f. sp. alatae by Singh and Prasada (1967). Sodium sulphate was also moderately good for the present test organism. Lilly and Barnett (1951) stated that sulphur in sulphate form in
general is preferred mostly by many fungi for their growth and sporulation. But *A. brassicae* was not favoured by some of the sulphate forms like copper sulphate, calcium sulphate, ferrous sulphate, ammonium sulphate, sodium thio-sulphate and manganese sulphate.

The vitamin requirements of the fungus are of interest both in regard to basic knowledge of its nutrition and possible relation to its pathogenic capabilities (Leben and Keitt, 1948). Ever since the publication of the paper of Schopfer (1934), a number of workers (Robbins, 1938; Hawker, 1939; Lilly and Barnett, 1947; Beckman et al., 1953; Sadasivan and Subramanian, 1954; Tandon and Bilgrami, 1957; Misra and Mahmood, 1961; Singh, 1963; Sankhala and Mathur, 1967) from time to time have advocated the importance of vitamins in the nutrition of various fungi. Some fungi are capable of synthesizing vitamins necessary for their vegetative and reproductive growth while there are others which depend on exogenous supply of required vitamins (Mathur et al., 1950).

The present pathogen was able to make good mycelial growth and excellent sporulation even without the aid of exogenous vitamin supply which is an evidence of its proto-trophic nature in this respect. However, addition of biotin, nicotinic acid, ascorbic acid and thiamine improved the mycelial growth to a great extent (Table 15). This may be due to that the addition of these vitamins supplied the
nutrients which the pathogen could not synthesize itself. As observed here, Singh and Prasad (1967) and Vir and Grewal (1973) also reported increased growth of various fungi by adding biotin. Misra and Mahmood (1961) recorded better growth by thiamine in *Colletotrichum capsici* but Elliot (1949) and Vir and Grewal (1973) on the contrary observed insignificant influence of thiamine on some other fungi. Favourable effect of ascorbic acid, as obtained in the present investigation, has also been reported by Shukla and Sarkar (1972) while stimulatory effect of nicotinic acid has been observed by Prasada *et al.* (1970) on the pathogen under present study.

Six vitamins viz., pentothemic acid, riboflavin, choline, folic acid, pyridoxine and inositol were found to arrest the growth. Such inhibitory effects of tivamins for a variety of pathogens are on record (Mathur *et al.*, 1950; Lilly and Barnett, 1951).

Hormones, endogenous chemical substances, influence reproductive and vegetative growth and other vital processes of living organisms. The pathogen under study seems to be self-sufficient for its hormone requirements which is clear from the fact that it made very good vegetative growth and abundant sporulation even without exogenous supply of growth regulators. Beta-indol butyric acid and 2,4-dichlorophenoxy acetic acid, however, improved its growth. The rest of the growth regulators tested affected the pathogen adversely (Table 16). Similar role of beta-indol butyric acid and
2,4-dichlorophenoxy acetic acid has also been observed by Chatrath and Bajaj (1964), Singh (1964), Sankhla and Mathur (1967) and Haware (1969) for other fungi. On the other hand, inhibitory role of some of the growth regulators has been reported earlier by Cohen et al. (1965) and Haware (1969) for some other fungi.

Many of the factors which influence vegetative growth also affect spore germination (Lilly and Barnett, 1951; Mukadam and Deshpande, 1977). Temperature is one of the most important external factors which influence spore germination qualitatively and as well as quantitatively. Generally at normal temperature spores of *A. brassicae* started germinating within four hours of incubation. Spore germinated within a temperature range of 10-28°C. However, considerable spore germination occurred at the temperature range of 21-25°C, highest being at 23°C. Temperatures below optimum were comparatively more suitable than those higher to optimum (Table 17). These results are partly supported by the studies of Rangel (1945) in which he observed that temperatures between 17.2-21.1°C were ideal for spore germination of *Alternaria herculea*.

Moisture is the next prime factor necessary for germination (Ferguson, 1902; Broadfoot, 1926). Imbibition is the first step of process of germination. Sometimes spores swell even more than twice their original size (Bonner, 1948; Mandels and Norton, 1948) and on further expansion, volume of protoplasm
can sometimes increase more than ten times (Tompkins, 1929). Germination studies conducted on the spores of the isolate under study have shown that the spores germinated at all levels of relative humidity tested. At 84 per cent relative humidity, germination was the poorest. An increase gradually improved the per cent germination. Highest germination occurred at 100 per cent relative humidity and the effect of 97 per cent relative humidity was very close to it (Table 18). These results are in close conformity with those obtained earlier by Chowdhury (1937) for the same fungus.

Carbon sources, used in the present investigation, in general increased spore germination of *A. brassicae*. Starch, a polysaccharide, encouraged highest spore germination followed by cane sugar, sucrose (disaccharides) and D-glucose (monosaccharide). Some of the sugar alcohols (D-mannitol and sorbitol) also encouraged the germination but their overall performance was comparatively poor (Table 19). Polysaccharides and disaccharides have also been reported to be good sources of carbon for a number of *Alternaria* spp., including *A. brassicae* by Szelenyi and Becze (1928), Carter (1934), Pawar and Patel (1957), Joly (1962), Rao and Apparao (1965), Taber *et al.* (1968) and Gupta *et al.* (1969).

Nitrogen is another element essential for various functional as well as structural necessities of fungi (Lilly and Barnett, 1951). Response of the present pathogen to
various treatments also corroborated this view. Germination was comparatively smaller in a medium devoid of nitrogen than in media containing different nitrogen sources employed in the study (Table 20). Best germination was effected by peptone and sodium nitrate. Taber et al. (1968) have also made likewise report for A. raphani particularly for peptone and potassium nitrate.

The results on effect of exogenous application of vitamins on spore germination are quite in line with those discussed earlier on vegetative growth and sporulation of the pathogen. Most of the vitamins tested discouraged the spore germination. The increased spore germination observed in some was also marginal when compared to control (Table 21). These observations further strengthen the belief that the pathogen is prototrophic. The results are similar in many respects to those reported by Lewis (1952), Taber et al. (1968) and Prasad et al. (1970).

Spore germination responded to growth regulators almost in the same way as in case of vitamins. Slight increase in germination occurred with application of Beta-indol butyric acid and 2,4-dichlorophenoxy acetic acid. Others growth regulators were inhibitory (Table 22). Stimulatory effect of Beta-indol butyric acid and 2,4-dichlorophenoxy acetic acid has been reported by Bais (1969) for Curvularia lunata. But Singh (1969) found 2,4-dichlorophenoxy acetic
acid an inhibitory substance for the spores of Colletotrichum falcatum. The pathogen, *A. brassicae* is apparently auxoauto-
trophic.

Observations on survival, perpetuation and secondary spread of the disease reveal that the pathogen remained viable for more than a year in diseased plant debris lying in the field serving as the primary source of inoculum. This indicates that the pathogen survives in the soil on plant-debris. Soil-
borne nature of *A. brassicae* has been observed by Weimer (1924), Raabe (1939), Bickerton (1943) and Darpoux (1945). Other *Alternaria* spp. have also been found to be soil-borne (Higgins, 1941; Wheeler, 1958; Ramm and Lucas, 1963).

In addition to this soil-borne nature, the present pathogen was also observed to be internally seed-borne as it appeared on the diseased seeds even after surface sterilization. Diseased seeds are thus another source of primary infection and play major role in the primary disease cycle. These results ascertaining the seed-borne nature of *A. brassicae* fall quite in line with the findings of Chupp (1935), Pape (1941), Groves and Skolko (1944), Rangel (1945), Czyzewska (1958) and Mc Donald (1959).

Diseased plant debris and diseased seeds, the two primary sources of infection, were found to affect the crops differently. If the diseased plant debris serve as primary source of infection as observed in pot experiments, the
conidia infect the lower leaves of the healthy plants and infection spreads to upper ones. The diseased seeds, on the other hand, either produce diseased seedlings or result in their pre-emergence damping-off. Secondary spread of the pathogen is by means of air-borne conidia produced in diseased spots. These results are similar to the findings of Ramm and Lucas (1963) for *A. longipes*.

Inoculation of plants of different ages revealed that the growing young seedlings primarily from healthy seeds became readily infected. The susceptibility was maximum in 10-day-old plants. Thereafter susceptibility decreased with increase in the age of host plants. The minimum susceptibility was obtained in 120-day-old plants (Table 23). Lower most leaves or oldest leaves on the plants exhibited greater and bigger spots that the upper ones. Saad and Hagedorn (1969) also obtained similar findings with *A. alternata*. Gulyas (1930) observed that *Alternaria* spp., causing brown spots of tobacco, established itself first on weakened leaves which have lost some of their turgor and therefrom spread to normal leaves. Grummer (1955) is also of the view that tolerance to the pathogen diminishes when carbohydrates are depleted, proteins are hydrolysed and synthetic machinery of the cell is in weakened state.

The results obtained with regard to minimum period of incubation indicated that the plants removed from moist chamber after 12 h and 24 h did not show any infection whereas
humidity fluctuated between 77.60 and 88.56 to 38.12 and 47.75 per cent respectively. Thereafter, the disease intensity was found to be moderate (Table 26). It is thus apparent that atmospheric temperature during the maximum disease intensity period is very much close to that found optimum both for mycelial growth and spore germination in cultures i.e. 23°C. Mc Donald (1959) also reported 21°C ideal temperature for disease development. Similarly, Van Schreven (1953) also reported optimum development of disease by A. brassicaceae at temperature between 20 and 24°C.

Chemical analysis of the seeds of 17 cultivars of rapeseed and mustard indicated that the disease reduced the oil content upto 35.97 per cent but increased the protein content slightly (Table 26). These results are in conformity with those obtained by Nijhawan and Hussain (1964) who have reported the adverse effect of disease on oil content and favourable effect on protein content.

The host-range studies of A. brassicaceae indicated that it may attack almost all the species of the genus Brassica along with plants such as Raphanus sativus, Eruca sativa in Cruciferae, Convolvulus arvensis (Convolvulaceae), Anagallis arvensis (Primulaceae) and Chenopodium album (Chenopodiaceae) (Table 27). Different species of Brassica and their varieties and several other species of the family Cruciferae are reported to be infected by A. brassicaceae (Neergaard, 1945; Darpoux, 1945; Borg, 1949; Flik and Saaltink, 1950; Mc Donald, 1959; Bhandar, 1963; Husain and Thakur, 1963; Bhandar and Maini,
1965; Prasada et al. (1970). *C. arvensis* and *A. arvensis* found to be infected by *A. brassicae* in the present study have already been reported as its host by Saharan et al. (1982). However, there is apparently no published record of infection of *C. album* by *A. brassicae*. *C. album* is a very common weed growing in crop fields in plains of India.

The use of resistant varieties is most economical method of plant disease control. Performance of various cultures/varieties of "Toria", "Lahia" "Yellow sarson", "Brown sarson" and "Rai" under field conditions against Alternaria blight was observed. The cultures/varieties of "Rai" viz. CSR Nos. 43, 142, 440, 622 and 741 were found to be disease free whereas some cultures/varieties i.e. CSR Nos. 18, 45, 46, 57, 74, 100, 102, Kranti etc., exhibited field resistance. Some of the cultures/varieties of 'Toria' and 'Lahia' were moderately resistant (Tables 28-35).

All the cultures/varieties of "Rai" found free, resistant and moderately resistant and of 'Toria' and 'Lahia' found moderately resistant under natural conditions, became susceptible to highly susceptible to the pathogen in artificial inoculations (Table 36). The field resistance shown by some cultures/varieties was thus not stable and therefore it was apparently not genetically controlled. Some strains of *B. juncea*, *B. nigra* and *B. alba* have been reported to be moderately resistant. One strain of *B. napus* and two
strains of *B. alba* from Sweden were found to be highly resistant, the latter appearing to be immune to blight (Husain and Thakur, 1963; Bhandar and Maini, 1965). Such resistance or immunity was not exhibited by any culture/variety examined in the present study.

Testing and finding out the most affective fungicide against the disease was the next step towards control measures for the disease. *In vitro* studies revealed that Dithane M-45, Dithane Z-78, Ziram, Difolatan-80, Blitox-50, Thiram, Brestan-60 and Benlate were most effective fungicides as they completely checked the growth of *A. brassicae* (Table 37). Sankhla et al. (1972) have observed that Dithane M-45 completely checked *A. triticina*. Misra and Singh (1965) also observed organic fungicides to be the most effective against *A. tenuis*. Dithane Z-78 has been reported to be effective for controlling *A. cucumerina* (Khandelwal and Prasada, 1970) and *A. brassicae* (Prasada et al., 1970). Bedi and Singh (1972) also found Dithane Z-78 inhibiting sporulation of *A. alternata* to a great extent. Four newly synthesised compounds also inhibited *A. brassicae* *in vitro*.

Six fungicides were used in seed-dressing for controlling the seed-borne infection. The best results were obtained with Benlate followed by Dithane M-45, Dithane Z-78, Ziram, Difolatan-80 and Blitox-50 (Table 38). Earlier workers have also emphasized the seed treatment for control of this
disease. Application of Bordeaux mixture plus 0.5 per cent lead or calcium arsenate controlled infection of cabbage and cauliflower by *A. brassicae* (Nielsen, 1933). Good control of the black rot of carrot induced by *Alternaria radicina* was obtained by seed treatment with Germisan and Sanagram (Neergaard, 1936). Crosier and Patrick (1940) found control of *A. brassicae* by application of mercurial dusts as seed treatment. In seed disinfection tests against *A. solani* of tomato, new improved Ceresan and Ceresan jr. gave perfect control of seed-borne infection, with little or no seed injury after several months of storage in the laboratory (Higgins, 1941).

The results obtained from field trials on fungicidal sprays indicated that Dithane M-45 performed best followed by Dithane Z-78, Ziram, Difolatan-80, Benlate and Blitox-50 (Table 39). Singh and Singh (1971) also reported Dithane M-45 and Dithane Z-78 effective in controlling the leaf blight of wheat by *A. tritici*na. The efficacy of Dithane M-45 as observed in the present investigation are similar to those reported by Kolte and Tiwari (1978). Singh and Bhowmik (1985) observed that Difolatan-80 and Dithane M-45 were the most persistent and effective both in reducing the leaf blight intensity and increasing seed yield of "Pusa bold" rai. In field trials against *A. brassicae* causing blight of radish, Blitox-50 gave the best results (Chand and Jatian, 1969).
while working out the economics of field application of fungicide Dithane M-45 which was most effective in earlier trials, it was noticed that four sprays at 15 days intervals beginning when the crop was a month old was most economical in terms of profit (Table 40). This schedule of application of the fungicides for the control of Alternaria blight of oil-seed crucifers may be recommended to growers for use on field scale. Since no resistant cultivar is available to growers, this method of control is effective as well as economical.