CHAPTER IV

DISCUSSION

The salient features that emerge from the present investigations on Helminthosporiose of ragi include the incidence, survival, host and fungal physiology in relation to parasitism and seed-borne inoculum of *Drechslera nodulosa* and its fate during storage. The studies also include evaluation of certain fungicides *in vitro* and *in vivo* against *D. nodulosa*. The results of the present investigations are discussed in the light of the knowledge already gained in this regard.

Amongst many diseases that have been reported on ragi (*Eleusine coracana* (L.) Gaertn.) from Karnataka (India), seedling blight and leaf spot caused by *D. nodulosa* (Berk. and Curt.) Subram. and Jain is a major disease on which sufficient information has been accumulated (Coleman, 1920; Mitra and Mehta 1934b; Venkatkrishnayya, 1935; Venkatkrishnanich, 1954; Govindu et al., 1966; Govindu and Shivanandappa, 1967; Govindu et al., 1970). The knowledge on the present investigations might add some more information in understanding the problem towards its entirety.

Distinct differences in the severity of leaf spot incidence were evident on ten popular varieties of *E. coracana* tested for reaction to the helminthosporium disease in potted plants under artificial inoculation (Tables 1, 2 and 3 and Plate 1). Govindu et al., (1970) have reported that while screening ragi varieties for Helminthosporiose resistance, two leaf lesion types were recognised viz.,
non-progressive and progressive, taking into account both the types of lesions the scale was adapted. While we do not dispute their findings, as both types of lesions were observed on all the varieties, however, it may be pointed out that there is no reference to the progressive type of lesions and the rapidity with which they enlarged, which is also important for scoring infection in screening varieties for disease resistance, as observed in case of rice to *H. oryzae* (Padmabai Pushpanalou, 1960). In the present study, in addition to the number of spots present per leaf the rapidity of the lesion enlargement (Table 3) has also been given due consideration in categorising the varieties. Accordingly, the varieties H22, ROH2, and PR202 were resistant under these circumstances while Purna, Annapurna and Chavory exhibited a lesser degree of resistance and termed as moderately resistant. The other varieties Hanse, ECW854, HPB7-6 and BC4840 were susceptible. Govindu et al., (1970) while screening the world collections and also collections from different states of India, stated that among the popular varieties that were being grown in Karnataka, considerable number (39/71) were available as resistant varieties. Govindu and Sivanandappa (1972) reported that varieties of ragi from Tamil Nadu, Karnataka and Orissa showed highest number of combined moderate resistance to blast, resistance to *Fusarium oxysporum* and *Sclerotium-wilt*.

The existence of different strains of the pathogen with various degrees of virulence and the host varieties
with varietal susceptibility have been reported in *Drechslera oryzae* to rice (Stakman, 1947) *Helminthosporium gramineum* to barley (Mohammad and Mahmoud, 1973) *H. setivum* to barley, oats and wheat (Wood, 1962), *H. tritici- repentis* to wheat (Mishra and Singh, 1972) *H. turcicum* to sorghum (Miare and Mishra, 1971) and *D. nodulosa* to *ragi* (Vidhyasekaran, 1971b, 1974). Based on the relative virulence on resistant and susceptible varieties of *ragi*, the six isolates of *D. nodulosa* obtained from different sources were found pathogenic and the variation in the reaction of resistance and susceptible varieties were the same for all the isolates (Table 4). Among these 6 isolates (Tables 4 and 5), Isolate III was more virulent on all the varieties followed by I, II, IV, V, while Isolate VI was least virulent. Depending on the pathogenic potentialities on resistant and susceptible plants, all six isolates were recognised into 6 different groups. In general, all the leaf isolates (I, II and III) irrespective of all source from which they were obtained were found to be more virulent and distinct from the rest of the seed isolates (IV, V and VI). Nevertheless, the differences among these 6 isolates can not be neglected since physiological aspects of the isolates, a criteria which was also recognised to distinguish physiologic forms (Christenson, 1925; Bonde, 1929; Neergaard, 1945) indicate considerable differences (Table 24, 25, 26, 27, 28 and 29). Similar variation and occurrence of such different strains in *D. nodulosa* is reported by Vidhyasekaran (1971b).
The seedling blight, which is the second severe phase of the disease was also noticed on the crops in many parts of Karnataka (Venkatakrishnaiah, 1954). This was mainly due to soil-borne inoculum where the incidence depends on various factors both soil and environment. The disease was reported to be severe during the period of excessive rainfall (Coleman, 1929; Venkatakrishnaiah, 1954). In the present investigations the effect of some of the soil factors are discussed.

The seedling blight incidence increased with the increase of soil inoculum at all moisture levels tried. At low moisture levels (30%) the seedling blight was more severe at both pre- and post-emergence stages when compared to the higher moisture levels (75% and 100%). This could be due to better survival and colonization activity at low moisture levels of the pathogen (Vidhyasagar, 1971b). The reduced damage with the increase in the soil moisture may be due to decreased aeration in soil which deprives the organism from proper supply of oxygen needed for the optimum growth and activity of the pathogen as reported in Sclerotium rolfsii which cause foot-rot of wheat (Reddy and Patil Kulkarni, 1972). Similar observations at low moisture levels were also reported in case of P. oryzae (Padmabai Luke, 1971).

Wood (1962) reported that on barley the most severe seedling damage occurs at the extreme temperatures which limits the growth of the host and that the effect of soil temperature is primarily on the host. Results of the present study however indicates that most severe seedling mortality
of ragi occurs at soil temperatures between 20° to 30°C with maximum at 30°C (Table 7). This corresponds with the optimum growth range of both host and pathogen (Table 26). Similar observations were made by Hynes (1936) to P. ultimum, and Selvaraj et al., (1973) in case of foot-rot and wilt of piper betle to Phytophthora parasitica var. piperina.

The effect of soil pH on development of seedling blight of ragi unlike temperature appears primarily on pathogen (Table 10), since ragi was found to thrive well at all ranges of pH levels tried (Table 11). Seedling blight of ragi was most severe at soil pH level 7.0 where the optimum growth of the pathogen was obtained. Bateman (1962) observed similar relationship of soil pH to development of Poinsettia root-rot caused by Thielaviopsis basicola, Rhizoctonia solani and Pythium ultimum.

The most severe seedling mortality and the delay in germination at lower depths was evident in all the varieties (Table 12) and this perhaps may be due to mechanical strength of the soil (Kaney, 1970). Similar observations on the incidence of root-rot in wheat were made (Grenay, 1946). The fungus colonized in most of the ungerminated seeds particularly, in varieties Heman and BCW854. This could be explained by assuming, that grain medium acts as the best suited one for D. nodulosa growth and multiplication (Govindu et al., 1970).
As mentioned earlier, in infested soil the pathogen could cause both pre- and post-emergence seedling blight, in course of its survival as a saprophyte, during off season or in the absence of host, resulted in its loss of virulence (Vidhyasekaran, 1971b). In order to know the fate of *D. nodulosum* inoculum in the soil during subsequent sowing seasons or to ensure whether the pathogen is already exterminated or still in virulent condition, the baiting technique was developed to assess quantitatively the survival of pathogen. In the present experiment, the theoretical relationship between infective propagule concentration and lesion development on culms as expressed as $10^g x$ and $Y = K + n b^{-X}$ ($Y = 13.5 + (203.00)(0.58)^{-X}$) have a reasonable fit and this curve (Fig.4) can be used to assess the population of *D. nodulosum* in soil. The baiting technique developed was quite efficient and sensitive enough to bait even when the level was 4 propagules per gram of soil.

The results followed the same pattern as those of Sadasivan (1939) for *Fusarium roseum f. corni* on wheat straw, Yarwood (1946) and Taso and Cunnatti (1964) for *Thielaviopsis basicola* (Berk and Br.) F.f. on carrot discs, Avizohar - Hershonzon et al., (1968) for *Sclerotium rolfsii* f.sp. on sugar beet segments, Aberdeen and Patil Kulkarni (1969) for *Ceratocystis paradoxa* (de scymess) Moreau on sugarcane discs and Padmabai Luke (1971) for *Holminthosporium oryzae* on rice straw bits.
A common difficulty encountered by plant pathologists is to maintain a culture in a sporulating condition in the laboratory. *D. nodulosa* is known to cease its degree of virulence and subsequent sporulation due to repeated transfers or sub-culturing on a medium, which is very essential for maintenance (Vidhyasagar, 1971b). The culm culture developed by using susceptible baited *ragi* culms was found to solve the problem of maintenance of virulence in *D. nodulosa*. Though there was a gradual loss in viability of spores with time in stock culture, there was no loss of virulence. This was judged by the sporulating capacity by sub-culturing on fresh PDA for over a period of 30 months (Fig. 5).

On the baited culms, after incubation the fungus sporulated profusely within 6 days. Such "Host involved" cultural techniques have been reported to be more advantageous over synthetic media for multiplication of inoculum (Joshi, et al., 1969). Variation in pathogen due to saltation and adaptation to a particular medium or the frequency and extent of genetic changes may be of great importance especially in experimental work, because the degree of virulence could be changed and the pathogenic capability of a given isolate could be even lost. Such erratic changes in pathogen due to the above conditions (Buxton, 1959 and 1960) can also be avoided by this technique. In addition to the above advantage, this was found to be an easy method for harvesting spores for the preparation of inoculum without mycelial bits.
Since a relatively high ascorbic acid content has been correlated with greater cellular activity (King, 1938) it seems obvious that the resistant varieties (H22 and ROH2) tested here, have a higher metabolic status than the susceptible ones (Hamsa and BCW854). The higher content of ascorbic acid in resistant varieties might be one of the factors contributing to resistance to the leaf-spot fungus, as observed in Helminthosporiose of Oryzae sativa L., by Padmabai Pushpanaden (1957). They are of the opinion that the actual concentration of ascorbic acid in tissues, at any given time represents the 'excess' formed in the synthesis over that used in metabolism, since Ascorbic acid is synthesized from sugars it also seems probable that the accumulation of sugars in diseased tissues (Vidyasokaran, 1974) affected the synthesis rather than the process of utilization and thereby the depleting trend might have resulted in infected plants (Table 15). The depletion of ascorbic acid in diseased plants may also be ascribed to its being lost due to increased oxidation in diseased tissues as suggested in case of oats to Victorin - a toxin produced by Helminthosporium victoriae (Krupka, 1959).

The variation in number and type of fungi associated and their frequency of occurrence with 10 different varieties of ragi grain is well advocated (Table 17, 18, and 19). Such qualitative and quantitative differences in the microbial population were attributed to the facts that due to variation viz., (a) physicochemical nature of the seed (b) agricultural
operations (c) storage (d) climatological conditions of
the locality under sampling (Mishra and Kanoujia, 1973). The
present observations of variation are similar to the earlier
reports on rice (Gosh, 1951; Tsunoda, 1952), sorghum (Narm-
sinhana and Rangaswani, 1969a), ragi (Growal and Mahendra Pal,
1966). As evident from the results, the variation in fungal
flora was noticed within the same ragi variety at different
intervals of storage. Fresh seeds were associated with more
number and diverse type of fungi (Table 17) and with lapse
of time due to storage, the number as well as frequency
occurrence decreased (Table 18 and 19). This may be due to
the fact that in the beginning the fungi grew at the cost
of the seed as long as food and moisture supply were adequate.
But in course of time, the microecological conditions of the
seed is disturbed and the environmental set-up becomes less
favourable to a number of fungi due to depletion in food
level and low moisture supply (Christenson and Kaufmann,
1965).

The frequency occurrence of these fungi from seeds at
different periods of storage revealed some definite patterns.
In general, all the fungi were found to decline in their
frequency occurrence during storage. Species belonging to
Aspergillus and Fusarium occurred constantly. This indicated
their survival on the seeds under storage condition. On
the other hand species belonging to Drechlera, Pyricularia,
Curvularia and Alternaria were found to decline very rapidly
and in most of the varieties they were eliminated. The continuous occurrence of some species, and reduced frequency or absence of other fungi in later stages of storage, may be ascribed to unfavourable storage conditions or lack of capacity of competition (Gilman and Samoniuk, 1948; Campbell, 1962). Some of the genera such as Mucor, Mortierella, Huminola and Stemphylium which were not present at the time of storage could be isolated in the later stages. This supports the fact, that the seed in turn also play some part in regulating the physiological set-up of fungi and the same seed may be acted upon by different micro-organisms under a different set of climatological conditions (Wallace, 1973).

Due to storage, a number of changes occurs in seeds. This include loss of viability, discoloration, heating and mustiness, production of toxins. Under these conditions those fungi best suited to this changed environment are now allowed to establish (Christensen, 1957; Christensen and Kaufmann, 1969). The other genera such as Chaetomium, Cladosporium, Phoma, Mirospora, Stachybotrys and Penicillum were poorly associated with one or the other variety of seeds and were most inconsistent in their frequency occurrence.

The genus Chaetomium is of considerable importance, since species of the genus decompose cellulose and destroy various types of foodstuffs and agricultural seeds. Skolko and Groves (1948, 1953) have isolated a number of species of Chaetomium on agricultural seeds. In the present investigations
four species of Chaetomium have been isolated from different varieties of ragi seeds (Table 17), of which C. robustum Arce. from variety Annapurna is the first report from India. The other species C. globosum Kunze ex Fries and C. foniculwm Cokeley from variety Cauvery and C. indicum Corday from Purna have also been isolated which have been reported from various substrata from India (Lodha, 1964; Mukherjee, 1966).

D.nodulosa which causes seedling blight and leaf-spot of E.coracana, a major disease on this crop (Ramakrishnan, 1963) was found associated with almost all the varieties with a maximum frequency occurrence (Table 17) and it was mostly externally seed-borne (Fig.6). This observation is in conformity with the earlier reports of Grewal and Mahendra Pal. (1966). They observed that its internally seed-borne nature was not more than 9.2% but in the present studies it was observed that in the varieties H sanctioned BCW954 it was 18.0 and 26.0% internally seed-borne. The viability of conidia of D. nodulosa as observed by Narasimhan (1933) was high even after 30 months under normal storage conditions. Though the viability of these spores declined rapidly, they remained viable on 4 out of 10 varieties tested even after 30 months of storage. The loss of viability of D. nodulosa spores in course of 30 months of storage on seed paralleled with the results of loss of their viability on culms. This evidently proves that the conidia of D. nodulosa can survive up to 30 months on seed (Table 19) as well as on culms (Fig.5).
There are numerous reports on the reduction of germinability of the different stored grains due to the activity of the fungi up to 80-100% (Christensen, 1955, 1957; Arnolik et al., 1956; Govindaswamy et al., 1957; Padmanabhan, 1957; Papavizas and Christensen, 1957; Christensen and Kaufmann, 1965; Narasimhan and Rangaswani, 1969). In the present investigations the loss of viability due to storage was pronounced; it ranged between 3 to 51% (Table 21) in different varieties of ragi tested. In general it was found that the loss of viability was in relation to total percent of infection by fungi and also the number of fungi associated (Fig.7). However, seeds with fairly higher moisture content were associated with more number of fungi and high percentage of infection. Christensen (1955), Padmanabhan (1957), Govinda- swamy et al., (1972) reported that the species of Aspergillus were mostly responsible for the viability loss in rice seeds. Similar results have been obtained in the present investigation on varieties of ragi infested with species of Aspergillus. Forgacs (1962), Conduer et al., (1963), Spensley (1963) and Diener and Davis (1966a and b) reported that aflotoxin production by A. flavus damaged the seeds to a considerable degree. Some of the other fungi like Drechslera, Fusarium, Curvularia and Alternaria were also found associated with most of the varieties which also contribute their might to the loss of viability as observed earlier by Srinivasa et al., (1972) and Oblisani et al., (1972) in case of rice and ragi.
It has been reported earlier that fungi produce toxins which inhibit the germination of seeds of crop plants (Scheffer and Pringle, 1961; Wing, 1962; Scheffer, et al., 1964; Padmanabhan, 1967; Vidhyasekaran and Subramaniam, 1970b). Similar results were obtained in the present investigations. It was observed that 5 out of 7 fungi tested (Table 22) exerted adverse effect on seed germination. Culture filtrates of D. tetramora, Fusarium sp. Aspergillus flavus, A. niger and Curvularia lunata contained more toxins and inhibited seed germination significantly, while D. nodulosa and Pyricularia oryzae the pathogenic fungi that cause ample damage to the ragi crop had little effect on seed germination. Such decrease in germination by culture filtrates may be ascribed to toxic substances secreted by the fungi in the liquid medium (Padmanabhan, 1967); Reddy and Joseph Bagyaraj, 1969). D. nodulosa has been reported to produce toxins (Vidhyasekaran, 1972, 1972). Curtis (1958) also noticed the root curvature of ragi seedlings when grown in culture filtrates of A. niger. In some cases however certain fungal species promote seed germination (Roy and Pandey, 1971; Roy et al., 1971). This is common mostly among the rhizosphere fungi.

Occurrence of microbial inhibitors on the seed coat of many plants has been recognised to be one of the defence mechanisms against the attack of pathogens. These may be considered as 'pro-formed factor' of resistance independent of infection (Ark and Thompson, 1958; Klason and Goodman, 1967; Srivastava and Mishra, 1971). Seed coat of ragi exerted
a selective behaviour and it was evident from the results of
the present investigations in which seed coat leachate was
found to be inhibitory to a number of fungi including
*D. nodulosa* (Table 23), present on seeds. This may be due to
the presence of antifungal substance(s) on the seed coat of
ragi (Balasubramanian and Rangaswami, 1967; Purushothaman, 1971). As evidenced from the present study, aqueous seed
ccoat leachates from white seeds (Hansa and BCW854) inhibits
spore germination of all the fungi to a lesser degree than red seeds (H22, ROH2). However, white seeds (Hansa and
BCW854) were found to be associated with a number of fungi
(Table 16) and usually with high percentage of infection.
This may be due to difference in the amount of such germin-
ation inhibitor as observed by Krishna Sastry and Dawson
(1966). Further, the inhibitor(s) present on ragi seed coat
is reported to contain substances which are phenolic in nature
(Purushothaman, 1971). The participation of phenolic
compounds in the defence reaction in plant against infectious
agents has been well recognised (Kuc, 1966). The quantita-
tive evaluation of such antifungal substances on different
varieties of ragi need further investigation.

The germ-tube malformation of *D. nodulosa* (Plate 5) due
to seed coat leachate was characteristic and a similar case
of abnormal germ-tube formation in this fungus, due to
antifungal substances has been reported by Azooz Ahmad
and Sullia (1973).
Further, the presence of strains with different degrees of virulence in *D. nodulosa* is evidenced in India (Vidhyan- sekaran, 1971b, 1974). However, there is need for a precise information about the race picture obtainable in Karnataka which could eventually help in planning suitable breeding programme for resistant varieties in the state. Hence, in the present investigations physiological studies on six isolates of *D. nodulosa* was undertaken and the results are discussed hereunder.

Six isolates of *D. nodulosa* showed marked differences in their growth and sporulation on nine different media. Though all the isolates made good growth, they differed markedly in both growth and sporulation. Such preference to media by *D. nodulosa* isolates for growth and sporulation was reported by Mitra and Mehta, 1934b, Luttrell, 1957; Hegde et al., 1969; Mishra, 1973. Based on the growth and sporulation the six isolates could be differentiated separately as different strains. Among the isolates, leaf isolates (I, II and III) were found to be comparatively better than the seed isolates (IV, V and VI) in their growth response and sporulation (Table 24 and Fig.8).

The pH of the medium exerted profound influence on the growth of the isolates. All the isolates gave maximum growth at pH 6.0 which was significantly more than that of other pH levels. This indicated that the optimum pH for the growth was 6.0. Beyond this pH on either side the growth gradually decreased showing double optima for pH requirements. Such
type of results have been reported in *D. nodulosa* (Hegde, et al., 1969); *D. oryzae* (Singh, 1967); *Colletotrichum lindenuthianum* (Hegde and Munjal, 1970) and *Pyricularia oryzae* (Srikant Kulkarni, 1973). The earlier studies (Mitra and Mehta, 1934a) on the effect of pH on *D. nodulosa* established that the fungus was capable of growing at a wide range of pH 3.8 to 10.00 with an optimum at 7.1. Hegde et al. (1969) recorded the optimum as 4.6 for the growth of *D. nodulosa* isolates and Mishra (1973) noted the optimum pH to be 7.0. Based on the pH requirements again the present isolates could be classified under 6 different groups.

Temperature is a decisive factor for growth, production of spores and also development of perfect stages in a number of fungi and each fungus has its temperature range for the growth and sporulation (Hawker, 1950). Depending on the influence of temperature on growth and sporulation the six isolates could be classified under 3 groups (II, I and III; and IV, V, VI). Hegde et al. (1969) recorded 40°C as lethal temperature for isolates they studied. Though none of the present isolates could grow at 40°C but when transferred to 30°C the isolates showed survival capacity. However, the optimum temperature for all the isolates was found to be 30°C and the minimum 10°C. These observations are in accordance with Hegde et al., (1969) Vidhyasekaran (1971b).

*In vitro* inhibition of *D. nodulosa* by 6 fungicides and an antibiotic varied significantly among themselves and also
in their concentrations (Table 30 and 31 and Plate 6 - 1, 2, 3, 4, 5, 6 and 7). In the present investigations it is clear that Bangtan (Capten) was most effective among all the fungicides tried against *P. nodulosa* and this is in conformity with the earlier findings of Hogde and Sivanandappa (1968). They had tried only four concentrations and further they did not specify the effective dosage concentration. The minimum concentration they tried was 1000 µg/ml. In the present studies the concentrations tried include 5 µg/ml to 1000 µg/ml and it was observed that even at a lower concentration as 100 µg/ml was found quite effective and superior to other fungicides used.

Sivanandappa *et al.*, (1968) and Hogde *et al.*, (1969) emphasized that a fungicide has to be selectively toxic to the particular pathogen against which it is administered. Likewise, in the present investigation application of the fungicide Capten, both *in vitro* (Table 30 and 31) and *in vivo* (Table 35) was found to be most effective against *P. nodulosa*. However, it may be possible from the present findings and with the findings of Hogde *et al.*, (1969) to specify it for better control of this disease.

The other fungicides viz., Brassicol, Difolatan and NF - 48, inhibited *P. nodulosa* to an appreciable degree (Table 30 and 31 and Plate 6). However, Hogde and Sivanandappa (1968) failed to observe any inhibition of this fungus by Brassicol. The other chemicals, Triforine and
Cycloheximide, though found to inhibit in \textit{in vitro} studies (Table 31 and 33) were found to be phytotoxic \textit{in vivo} studies at their effective dosage concentration (Table 35).

Rich (1960) has reported that Brassicicol does not prevent spore production and spore germination, but it can inhibit hyphal growth. This agrees with the present studies (Table 30) and except Brassicicol all inhibited sporulation at all the concentrations used.

\textit{D. nodulosa} at higher concentration of Bangton produced structures closely resembling synnemata (Plate 6, 8). The production of such synnema like structures, has also been reported in the fungus under treatment with systemic fungicide Triforine at concentrations 50 and 100 \(\mu g/ml\) (Sullia and Sivakumara Swamy, 1974). This phenomenon appears to be rather unique, since this fungus is generally not known to produce synnemata. (The hyponycetes producing synnemata are classified under a separate family Stilbotae). A new species of \textit{Drechelora} was recently erected (Patil and Rao, 1972) on the basis of the ground of formation of conidiophores in fascicles "almost like synnemata". The induction of similar structures in a species not known to form synnemata under normal conditions shows that this character in \textit{D. nodulosa} is not taxonomically dependable and is, perhaps a response of the fungus to physiological stress under altered conditions. The induction of abnormalities in the morphology of a fungus is an observation of interest which calls for further investigations on the mechanism of action of the fungicides.
From the results of vapour-phase fungistatic nature of these fungicides (Table 34) it is clear that the fungicides Hinosan, Triforine and Difolatan released volatile toxicants which inhibited D. nodulosa. While Bungtan (Captan), NF-48, and PQNB, exhibited very little or nil volatile toxicity. Though Brassicol reported as vapour phase fungistat (Rich, 1960) it failed to inhibit the growth of D. nodulosa. Among these fungicides that exhibited volatile toxicity towards D. nodulosa, Hinosan was more effective than Triforine, while Difolatan was the least effective.

In vivo tests (Table 35) of the fungicide against disease incidence showed that it could be drastically controlled by application of all except, Triforine and Cycloheximide at their effective dosage concentrations without any effect on host. Though Triforine and Cycloheximide completely controlled the incidence, caused appreciable phytotoxic effects on the host. Similar results of phytotoxicity with Triforine (Fuchs, 1971; Sullia and Sivakumara Swamy, 1974) and Cycloheximide (Ford et al., 1958; Strong and Knapendon, 1955; Jones and Swartwout, 1961; Wilson and Ark, 1958) have been reported. Some positive results were also obtained with Triforine (Fuchs et al., 1971) and Cycloheximide (Hilton, 1963) in some cases at low concentrations. So the suitability of these two compounds for the control of helminthosporium disease in ragi could be suggested, since these fungicides shows fungistatic action even at low concentrations (Table 31 and
Further, the low phytotoxicity and the higher fungitoxicity at a given concentration would suggest that these could be of therapeutic value in case a critical concentration is evolved at which there is no phytotoxic effect.