Intensive agriculturing is the motto of twenty first century of the world. India being the country with large area of agriculture activities therefore all the attempts regarding intensive agriculturing are very essential to meet the need of food supplies to ever increasing load of population. The seeds of crops with high yielding, varieties free from the pathogens, is an important aspect for intensive agriculturing. It is clear from the literature that seeds in the most of the crops are found associated with variety of pathogens including fungi, bacteria, virus, nematodes. If such infested seeds are used for sowing purposes it may result in the crop loss due to saviour disease incidence. Fungi are the prominent microorganisms which are carried by crop seeds and such fungi are known as seed-borne fungi or seed mycoflora. In the present work studies were carried out to understand mycoflora load of different crops belonging to cereals, pulses, oil seeds, vegetables, spices and condiments. Similarly attempts have been also made to find out biocontrol measures. The results are discussed here.

It is understood from the results summarized in the table (1 to 10) that the maximum seed mycoflora of cereals yielded twentyone fungi, pulses – fifteen fungi, oilseeds – eighteen, vegetables – nineteen, spices and condiments – fifteen fungi. Among the fungi recorded from cereals
Alternaria alternata, Aspergillus flavus, Curvularia lunata, Fusarium oxysporum, Penicillium notatum, Drechslera tetramera; pulses – Alternaria tenuis, Aspergillus niger, A. flavus, C. lunata, F. roseum, P. notatum; Oilseeds – Alternaria alternata, Aspergillus niger, A. flavus, A. ustus, Fusarium oxysporum, F. roseum, P. notatum, Rhizopus nigricans, Vegetables – A. alternata, Aspergillus flavus, F. oxysporum, Drechslera tetramera, Trichoderma viride; Spices and condiments – Alternaria tenuis, Aspergillus flavus, A. niger, A. fumigatus, Fusarium semitectum, Penicillium and Rhizopus sp. were found to be dominative. Similar types of reports about the incidence of fungi were reported in case of cereals (Bhale and Khare, 1982), Navi et al., (1999), Patil and Pandule (2001); pulses (Deo and Gupta, 1980), Chavan and Danai, 1993, Sonawane, 2000, Gachande, 2001); Oilseeds (Sandikar, 1990, Chavan and Danai, 1993; Umatale, 1995); Vegetables – (Patil et al., 2000, Datar et al., 1992, Bharaswadkar, 2003, Vidyaskaran et al.,1980), Spices and condiments – (Srivastava, 1985, Prasad, 1981, Chavan, 2002) have been made. This clearly indicates that seeds irrespective of the crop showed association of seed borne fungi. Isolation and identification of seed mycoflora was kept as the major aspect of the studies and at the same time control of seed borne fungi due to seed treatment at the time of seed plating was an important aspect of the study. Therefore the seeds treated with different plant extracts whenever used for isolation of seed mycoflora. It was found that there was significant reduction in the incidence of fungi in the plates. This clearly indicates that
use of plant extracts as seed treatment for the control of seed borne fungal pathogens would be most useful and eco-friendly way of controlling plant diseases. Similar type of inhibitory effect of plant extracts on the incidence of seed borne fungi or on the activities of the fungi have been reported by many workers as Khanna and Chandra (1976); Bhowmick and Vardhan (1981); Reddy (1987); Shenoi et al. (1993); Ansari (1995), Dubey (1998); Kurucheve and Padmavati (1998).

An extensive screening of plant extracts nearly 151 grows naturally or cultivated were used for preparation of plant extracts and tested against seed mycoflora of different crops and the results are given in table 11. The results are highly useful that most of the plants significantly inhibited incidence of fungi on the seeds. Among such plant extracts of *Aegle marmelos* (L.) Corr., *Azadirachta indica* A. Juss., *Catharanthus roseus* (L.) G. Don., *Datura stramonium* L., *Jatropha curcas* L., *Lantana camera* L., *Ocimum sanctum* L., *Polyalthia longifolia* (Sonn) Thw., *Tridex procumbens* L., *Vitex negundo* L., proved promising significant results. This clearly gives an idea for sustainable agriculture in spite of killing the useful of microflora of soil with the use of toxic chemicals in the form of fungicides and pesticides naturally biodegradable plant extracts can be the better answer. Hence the present study can be highly useful to the farmers, to use of plant extracts prepared in own fields with no expenditure for the control of seed borne diseases in the crops by treating the seeds with plant extracts at the time of sowing. Similar type of results regarding the use of plant
extracts for the control of plant pathogenic fungi have been reported by different workers such as Mishra and Tiwari (1992); Shivpuri et al., (1998); Abraham and Prakashan (2001); Sharma et al., (2004) Swami and Mukadam (2006).

**Physical factors**

Effect of physical factors like incubation period, temperature, pH and light (Tables 13 to 16) were studied.

It was observed that while growing the pathogens in nutrient medium physical factors affects the metabolic activities, in the presence of NLE. On 3rd day incubation period except *Penicillium notatum* none of the fungi showed sporulation. It was observed that due to presence of NLE maximum growth occurred on 15th day of incubation. It clearly indicates that toxicity of NLE was responsible to delay the growth and sporulation of test fungi. Similar type of observations were reported by Charya and Reddy (1982) where the optimum incubation period more than week in case of *Fusarium oxysporum, Rhizoctonia solani* and *Phoma exigua*.

Experiments were carried out at eight different pH values and the observations clearly indicates that the maximum growth of fungi at 5.5 pH value. Similarly all fungi grows maximum at 25°C to 35°C. Intensity of different light also studied and the observations showed that alternate light and dark light intensity was ideal for the growth of fungi. Various workers reported their views on fungal growth against physical factors. Patil and
Shashtri (1982) says that 20°C to 30°C was ideal temperature for the growth of pathogens.

Looking into the promising inhibitory effect of neem leaf extract on incidence of seed-borne fungi. The affectivity of neem leaf extract was further studied in the laboratory on growth, sporulation, toxin and enzyme production of certain selected seed-borne fungi.

It was found the effect of various nutrient sources like carbohydrate, nitrogen sources, vitamin sources, phosphorus sources, mixed with neem leaf extract. It is clear from the result summarized in the table 17 that the presence of carbohydrate like glucose, sucrose reduces the toxicity of neem leaf extract for inhibition of fungal growth. At the same time in the presence of CMC (carboxymethyl cellulose) like carbohydrate the toxicity of neem remain constant. This clearly indicates that seed borne fungi in the presence of sugars like glucose, sucrose did not respond to the toxicity of neem plant. But in their absence the toxicity is significant. Stimulation of growth in the presence of different sugars may be the point of consideration for decrease in the toxicity of neem. Stimulatory effect of sugars on growth have been reported by several workers. Charya and Reddy (1982) reported that only glucose source stimulates among the source of carbohydrates, the growth and enzyme production, whereas, Chavan (1993) reported that Aspergillus ruber, A. glaucus, Sphaerica violecia, Trichoderma viride and Fusarium dimerum grow luxuriantly in presence of glucose and fructose. But they are
totally inhibited growth and sporulation in CMC which clearly indicates that the incapability of cellulose production by the fungi.

NLE at 10% concentrated mixed with 10 different nitrogen sources, five different phosphorus sources and six different sulphur sources showed great variation in the fungal growth (Tables 19 and 20). Among nitrogen sources *Aspergillus flavus* did not respond to the toxicity of NLE whereas, other fungi grow moderately. Among phosphorus sources sodium dihydrogen phosphate and calcium phosphate sources were stimulatory even in the presence of NLE against the five tested fungi. Among the six different sulphur sources were studied and the results clearly indicates that fungi in the presence of NLE reduces the mycelium growth moderately but the sporulation was increased. This type of work was supported earlier by several workers.

Patil and Shastri (1982) supported the variation in the requirements of nitrogen sources in case of *Alternaria alternata*. Similarly Gachande (2001) reported dia sodium phosphate, Ammonium phosphate proved to be completely inhibitory in *Fusarium oxysporum* and *Macrophomina phaseolina*. He also noted that sodium thiophosphates inhibitory in *Alternaria alternate* and Ammonium thiosulphate in case of *Macrophomina phaseolina*, whereas MgSO₄ supported the enzyme activity in *Aspergillus flavus, Curvularia lunata* and *Drechslera tetramerara*.

In the presence of neem leaf extract mixed with different supplementary sources like vitamins, antibiotics, fungicides and salts (tables
21 to 24), this clearly indicates that NLE inhibited the growth of *Alternaria alternata* in presence of ascorbic acid, pyridoxine and nicotinic acid. Whereas, *Aspergillus flavus* and *Penicillium notatum* showed stimulatory growth and sporulation in presence of NLE mixed with vitamin sources.

At the same time in presence of antibiotics sources Ampicillin, Terramycin showed stimulatory growth of *Alternaria alternata* and *Curvularia lunata*, whereas other antibiotics sources like Grisonin, Streptomycin, Hostacyclin inhibited the growth of *Alternaria alternata* and *Fusarium roseum* in presence of NLE. Such type of observation have been reported by Waghmare (1996) in case of seed-borne *Fusarium* sp..

Looking into the promising inhibitory effect of NLE mixed with different fungicides (table 24) it was also found that the NLE mixed with bavistin proved inhibitory for growth and sporulation of *Fusarium roseum* and *Penicillium notatum* and thiride proved inhibitory for *Curvularia lunata* and *Alternaria alternata* respectively. While bliton showed stimulatory effect on growth of *Penicillium notatum*. Such type of work have been supported by different workers such as Rao and Ramkrishna (1999) studied comparative efficacy of leaf extract of piper betle and carbendazim on *Colletotrichum fulcataum*.

Kamble *et al.*, 2006) studied twelve plant leaf extracts along with Agrochemicals like endosulphan, Monocrotolos, Streptomycin, Mycostatin, Aureofungin, Sodium chloride and Boron gave the promising results in the management of *Alternaria alternata, Fusarium oxysporum, Rhizoctonia*
bataticola. Among the twelve leaf extracts *Salvia aegyptiaca* at 10 % concentration with 10 ppm, monocrotosfos completely inhibited the growth of *Fusarium oxysporum* f. *Spinaciae*.

**Biological control:**

During the past three decades crop production has been greatly influenced by the dramatic increase in the use of pesticides. Indeed, these compounds have played an externally important role in obtaining the maximal yield potential of almost every commercial crop by reducing yield losses caused by plant pathogens and other pests. However, due to indiscriminate and excessive use of these potentially hazardous, chemicals, several environmental threat and health problems to mankind and livestock’s etc. have arisen. Intensive use of chemical fertilizers and pesticides combined with poor management of water shades has resulted in severe water stress, pesticides contamination of water and agricultural products in addition to unacceptable degradation of soil, resulting in disruption of ecosystem over large areas. Pesticide contamination of food, water reservoirs and soil, has become a fact of life.

Marathwada possess a very rich flora with a great biodiversity. Naik (1998) reported 155 families with 746 genera and 1645 species from this region. Most of the higher plants contribute their uses in medicines and the uses of these plants are in consequently. Reports regarding the uses of different botanicals related to Indian medicine clearly indicates that the families like Fabaceae, Poaceae, Euphorbiaceae, Asteraceae, Rubiaceae,
Cucurbitaceae, Solanaceae, Malvaceae and Convolvulaceae play an important role in antifungal property (Graph 12).

Considering the importance of eco-friendly management of the pathogens experiments were carried out by using aqueous extracts of separate part against the five test fungi.

It is understood from the results summarized in the table 11 that all the tested fungi inhibited the growth and sporulation at more or less degree. However, NLE was proved highly inhibitory for the growth and sporulation followed by *Datura stramonium* and *Ocimum sanctum*. Sporulation of *Alternaria alternata* was totally inhibited by *Azadirachta indica*, *Datura Stramonium* and *Ocimum sanctum*, *Polyalthia longifolia* and *Vitex negundo*. Whereas, *Fusarium roseum* inhibited the sporulation in *Aegle marmelos*, *Azadirachta indica* and *Ocimum sanctum*. However, it is interesting to note that sporulation of *Aspergillus flavus* and *Penicillium notatum* do not inhibited completely in any leaf extracts of tested botanicals. Bhowmick and Vardhan (1981) studied the ten medicinal plants tested for antifungal activity against *Curvularia lunata*. Whereas *Cinnamomum camphora*, *Catharanthus roseus* were inhibited the growth, sporulation and spore germination. Similarly, Elkaffash *et al.*, (1998) screened 48 plants for their antifungal activity against *Fusarium oxysporum* f. sp. *nivenum*, *Rhizoctonia solani*, *Botrytis cinera* etc. and they showed that eight plants having high level of antifungal activity.
The effect of stem extracts at 10 % aqueous concentration was studied against the five tested pathogens (table 26) It was also found that *Penicillium notatum* did not inhibited with the toxicity of botanicals. But *Fusarium roseum, Alternaria alternata* inhibited with *Aegle marmelos* and *Curvularia lunata* with *Polyalthia longifolia* and *Tridex procumbens*. Gourinath and Manoharachary (1991) observed that the different concentration of stem extracts of *Eucalyptus lanceolatus* exhibited 50 to 70 % inhibition in the conidial germination of four pathogenic fungi. However, Gahangaonkar and Mukadam (2001) tested the bark extracts of the neem tree against the *Alternaria pori, Fusarium oxysporum, Aspergillus niger, A. flavus, Penicillium notatum, Macrophomina phaseolina* from the onion bulbs for their antifungal activity and they found the extracts of stem was to be highly inhibitory for the most of the fungi. While, Gawai (2004) showed the effect of extracts of stem of *Lantana camera* and *Curcuma longa* on the growth of two fungal pathogens of cabbage and tomato. The stem extract of *Curcuma longa* were found to be inhibitory for the growth of *Alternaria solani* than the *A. brassicae*.

Root extracts are very commonly used against several diseases to the plants and human beings. Fungitoxicity of root extracts of ten botanicals were studied (Table 27). It was observed that all the tested fungi inhibited in the extract of *Azadirachta indica* followed by *Datura stramonium, Ocimum sanctum* and *Polyalthia longifolia*. Similar types of observations were reported earlier by several workers. Charya et al., (1979) used the root
extracts of *Lawsonia inermis* and *Prosopis juliflora* against the *Drechslera rostrata* and *Curvularia lunata*. However, Gourinath and Manoharachary (1991) stated that the root extracts of *Eucalyptus lanceolatus* were found to be least toxic and inhibited to some extent the spore germination of phytopathogens.

Toxicity of flower extracts was also studied (Table 28) and it was interesting to note that flower extract of *A. indica* inhibited in all tested fungi. However, *Alternaria alternata*, *Curvularia lunata* and *Fusarium roseum* also inhibited the mycelium growth in other flower extracts. Selvamani and Latha (2005) reported antimicrobial capacity of the flowers of *Cassia alata*. The affectivity of seed extracts against the tested fungi was studied (Table 29) and it was found that the seed extract of *Aegle marmelos* and *Azadirachta indica* proved highly inhibitory than the seed extracts of other botanicals.

In order to know the toxicity of plant products like essential oils latex and gum were supplemented in the nutrient media (Tables 30 to 32). Clove oil, camphor oil, Eucalyptus oil and Tulsi oil are proved highly inhibitory. However, black piper and castor oil inhibited the growth of *Aspergillus flavus* and *Curvularia lunata*. Camphor oil and black piper oil retarded the growth of *Fusarium roseum*. Castor oil inhibited the growth of *Alternaria alternata*. Considering the results application of oil is strongly recommended for the stored seeds for longer duration. Similar types of
Inhibitory activities were recorded with plant gum and latex against five test fungi.

In order to know the fungal toxicity in presence of NLE mixed with different solvents (Table 33) against the five test fungi. It was also observed that the NLE mixed with solvents like ether, acetone inhibited *Alternaria alternata*. Acetone, diethyl ether and methanol extracts inhibited the growth of *Aspergillus flavus*. Such types of work have been reported by earlier workers such as Ramesh *et. al.*, (1991); Mishra and Tiwari (1992); Madhavi Adhav (1999); Kamble and Bhale (2001); Ganesan *et. al.*, (2004).

To observe the role of *Trichoderma* sp. in the management of seed-borne fungi (Table 34) it was observed that species of *Trichoderma* play eco-friendly role in the management of five tested fungi. Considering this fact the application of *Trichoderma* is strongly recommended against the seed-borne pathogens. And such type of work have been supported by many workers such as Weindling (1932); Elad *et. al.*, (1981); Sivan and Chet (1986); Baker (1989); Adams (1990); Devaki *et. al.*, (1992); Mathivanan *et. al.*, (2005) and recently Patale (2005).

To know the antifungal activity of algal biomass fresh water algae were tested (Table 35). And it was found that *Chara grovesii, Cladophora callicoma* and *Syctonema coactile* extracts showed inhibitory to the fungi like *Alternaria alternata, Aspergillus flavus, Curvularia lunata, Penicillium notatum* and *Fusarium roseum* respectively. This clearly indicates that the
algal extracts have some antimicrobial properties and hence this work should be carried out.

Fungi produces secondary metabolites which includes toxic substances (toxins) which may kill the host tissues and results into severity of the disease. Studies were carried out in order to understand the effect of leaf extracts of certain plants on toxin production in fungi. And it is clearly understood from the results summarised in the tables 37 to 40 that the leaf extracts of *Datura stramonium*, *Ocimum sanctum*, *Polyalthia longifolia*, *Vitex negundo* and neem significantly reduce the toxin production in the fungi. This clearly suggests that use of botanicals could be a beneficial aspect for the control of toxin production in fungi.

The seed-borne fungi specially during storage deteriorate seeds and this is mostly harmful if the fungi are efficient in production of amylase, protease and lipase enzymes. These enzymes degrade starch, protein and lipids respectively present in the seeds. Therefore the studies were carried out to see the effect of plant extracts on production of these enzymes. It is clear from the results summarised in the tables 41 to 43 that the use of plant extracts definitely would be helpful in the control of seed biodeterioration by inhibiting growth and enzyme production of the pathogens. Control of protease, lipase and amylase by using various chemicals have been reported by several workers such as Bhowmick and Choudhary (1982); Abraham and Prakashan (2001).
Seeds are loaded with microbes, which causes biodeterioration of seeds. However, several chemicals are used to control the associated mycoflora but in order to avoid exclusive reliance of chemicals, Henceforth role of effective microorganisms and botanicals are seem to be effective and eco-friendly to manage the activity of seed borne pathogens.