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BIOCONTROL OF SEED MYCOFLORA OF PULSES: A LENITIVE PERSPECTIVE TO MOLLIFY PHYTOPATHOGENESIS

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PREFACE

The present times are an era of information global eruptions from innumerable sources. Time is becoming scanty to transform information into applicable knowledge. The knowledge originating from laboratory has difficult path to reach common public.

The present book is an attempt to present the research findings to public especially people pondering over the degrading condition of our mother nature. There are politicians and capitalists barons forming nexus to extricate maximum profit at the cost of nature. Industrialization, raising cement *jungles* in cities and urban areas, indiscriminate application of fertilizers and pesticides and allied activities has been contributed to the degradation of Mother Nature. Fast foods ultimately, coercing farmers to make fast crops by irrationally harnessing pesticides and fertilizers. This impatient 'Fastness' for food comfort and profit is 'Ghastly' leading mother nature towards deterioration. Time has reached to review the dilapidated condition of Mother Nature and revive ways to reconcile original state of our planet; else we are making a big Frankenstein out of our greedy development that would ultimately engulf ourselves.

The book elaborates research on pulse crop diseases and its natural cure. The research work has enlisted fungal pathogens inflicting to pulse crops, pathogenicity of the fungal organisms, adverse effects of this ensuing pathogenesis and measures to control the pathological conditions of crop by using easily and locally available plant powders and extracts. The work seems a simple and insignificant one but aims are genuine and caring for Mother Nature. The prime aim of the research is to explore potentially effective biocontrol that would be ecofriendly and inexpensive. The work may in a verdant effort and nascent one but collaborative and coordinated supports from politician, capitalists, academicians, environmentalist, philanthropist, NGOs and common masses would certainly be fruitful. Pedagogical outcomes remain esoteric and sometimes unheeded; it may be due to various reasons. But at least academicians must coordinate, collaborate and mobilize general public to bring results shut within four walls of laboratory in public domain.

Some global appeals that have been made by scientist of the world who served warning notices to the humanity and inspiring campaign carried out by a visionary girl of Sweden who In August 2018, initiated a global movement by skipping school. She spent her

days in front of the Swedish Parliament, holding a sign that read “School Strike for Climate.” The movement soon got internationally recognized as Fridays for future, Youth for climate, Youth for strike for climate. These two immediate triggers inspired me to pen this book. The research thesis remains in the confines of research library but a book in simpler form may be readable to the commoners. This is my little effort to put the entire work before common public and make them aware of the work that had been took place within the confines of laboratory. It may be feasible to bring these results in field with the help of farmers and other stakeholders.

I tried with my capacity to put the arcane results before common people through this book. Hope people from all walks of life would heed at the genuine efforts of mine and try to make this ailing mother earth rejuvenate and salubrious for all sentient beings.

Thank you

- ***Dr. Ashok Kandhare***

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- ***Dr. Ashok Kandhare***

Content

INTRODUCTION

Plants are important entities in nature. They play vital role in balancing environment and human life in general and subsisting human and animal livelihood in particular. Beside this, plants are being utilized in different fields of mankind since time immemorial. The phytodiversity has been utilized by mankind in various domains of life, such as human diet, agriculture and Ayurveda. Ayurveda is 4000 years old and still prevalent (Patwardhan and Hooper, 1991); that include 'Susruta samhita' (1000 BC), 'Charak samhita'. The oldest treatise of Ayurveda lists about 350 plants (Ray and Gupta, 1965). Plants contain numerous bio-chemicals with certain bioactive principles. These bio-chemicals are utilized for various purposes, such as to control human diseases, animal diseases and plant diseases too. Plant diseases caused by fungi, bacteria, viruses and insects were treated by numerous plants. Application of plant extracts was attempted by Democritus in 470 BC (Sharville, 1960).

Now a days use of pesticides and various chemicals are playing havoc in environmental degradation producing adverse effects on entire animal and human life. Therefore utilization of eco-friendly plant products for pathological curing and boosting of plant growth has become necessary. It is need of time to use phytodiversity for pathological curing of plants.

India has plethora of phytodiversity and its utilization is acquiring new dimensions in present times. Indian plant diversity represents 7% of world's flora (Chakraborti, 2004). Nearly 45,000 plant species constitute the Indian plant diversity. Indian plant diversity is rich in endemism. About 4900 species of flowering plants are endemic.

Plant resources have made substantial contribution to human welfare. The progress of human beings has been associated with the use of plant resources especially for the supply of food, fuel, fiber and medicine. Indian economy depends greatly on the number of wild plant species. Human beings have cultivated more than 7000 plant species for food. Today only 20 species provide 90% of the world's food and just three species mainly wheat, rice and maize supply more than 50% of the world's food. Plant diversity is a great source of medicines. The bio-chemicals present in the vast majority of the plant species are the great reservoirs of new and potential drugs. The plant resources are the major sources of the antimicrobial agents. In our country use of plant resources in pathological curing is much less compared to our vast phytodiversity.

In Nanded, a district of the Maharashtra State, many plant species are very common, dominant and produce a huge waste biomass. Nanded district comprises sixteen revenue talukas and forms the part of the Deccan Plateau of India. Nanded district is situated at about 365m above mean sea level. Godawari is the main river flowing from west-east to east and south-east collecting water on its way from several large and small tributaries. It enters Andhra Pradesh and ultimately merges in to the Bay of Bengal.

Major part of the Nanded region is characterized by deep black soil, hot summer and general dryness throughout the year except during the monsoon season. The average day temperature ranges from 27.2 ^{o}C to 38 ^{o}C while it falls from 26 to 20 ^{0}C during night. The highest during summer day being about 42.9 ^{o}C while the lowest during winter nights being about 10 ^{o}C .The relative humidity for major part of the year is between 35 to 50%. The average rainfall is about 900 to 910 mm / year.

Modern era is very particular about health hazards caused by the use of allopathic medicines. Thus herbal medicines becoming popular day by day for the treatment of almost all the diseases. The herbal medicines are cheaper, safe and easily available.

About 80% population in this region still depends on the traditional medicines for their primary health care needs. The Ayurveda, Unani and Siddha are emerging again popular and they are in great demand. About 1,645 plant species have been recorded from this region and only about 350 plant species are used as medicinal plants (Naik, 1998). Nanded region is blessed with wide variety of soil and agro-climatic conditions supporting a large variety of plants and these have larger demand in the global market. It is also clear from the literature that several workers have studied extensively quantitative and qualitative nature of the medicinal plants only for the treatment of diseases of human beings.

The vegetation of this region is divided into tropical dry deciduous scrub jungles and vast tract of dry grasslands on the basis of climate. The forests are confined to the Kinwat, Bhokar and Hadgaon talukas of the district. The dominant plants of these forests are *Tectona grandis, Dalbergia latifolia, Bachanania lanzan, Terminalia arjuna* etc.

There are about 250,000 to 500,000 plants out of these even 5% are not being tested for biological activities (Farnsworth *et al.,* 1977). Considering these facts, it is relevant to explore potentialities of various plants for their probable antifungal and stimulatory activities in relation to seed germination, seedling emergence; especially seeds of pulses.

Pulses are the second most important group of food plants belonging to the family Leguminoceae. They form an important and indispensable part of our daily diet. It is important source of dietary proteins, essential amino acids and micronutrients such as calcium and iron. Therefore pulses are important source of protein and essential amino acids for major vegetarians. About 88 percent of proteins consumed in India are of vegetable origin, dependence on animal proteins being very less. Legumes are greatly used as food and are next to cereals. They are also used as green manures due to root nodules containing nitrogen fixing bacteria.

The pulses like Green gram (*Vigna radiata*), Black gram (*Vigna mungo* L), and Chick pea (*Cicer arietinum* L.) Pigeon pea (*Cajanus cajan* L) etc are cultivated in Marathwada region of Maharashtra during Kharif and rabbi seasons, either as sole or intercrops, under rain fed or irrigated conditions.

Pulses are cultivated all over the world; India has distinction of being the world's single largest producer of pulses. The area under production of pulses in India is approximately 20-24 million hectares. The major pulse growing states are Rajasthan, Madhya Pradesh, Maharashtra Uttar Pradesh, Orissa, Bihar, Haryana, Andhra Pradesh, Tamil Nadu, Punjab, West Bengal and Gujarat.

Green gram (*Vigna radiata* L.):

Green gram (*Vigna radiata* L.) is an annual plant with herbaceous bushy appearance. It attains a height of 1-3 feet, being more or less erect. The axillary raceme inflorescence is with variously yellow colored flowers in cluster. The fruit is typically a slender pod, measuring 3-4 inches long and bearing small, slightly flattened, globular seeds. The seeds are usually green in color but the cotyledons are used as *dal*.

The plant requires 25-35 inches rainfall. It is cultivated both as a Kharif as well as Rabi crop. The Kharif crop is sown around June or July and Rabi crop in September or October. Within three months, the plant is harvested.

Seeds show 24 g protein, 56.7 g carbohydrate/100g of edible part of the seeds, thiamin (0.47mg), and riboflavin (0.27mg), iron (7.3mg) (Manay and Shadaksharaswamy, 1987).

Black gram (*Vigna mungo* L.):

Black gram (*Vigna mungo* L.) is an herbaceous annual plant with spreading procumbent branches, commonly referred as 'wooly pyool' due to presence of brown hairs

covering stem. Inflorescence is represented by a long stout, hairy axis bearing a group of 5-6 yellow flowers.

In India it is commonly grown as a Kharif crop where rainfall is 30-35 inches. Usually cultivated in June -July and harvested within 3-4 months. The major crop cultivating states are Madhya Pradesh, Uttar Pradesh, Punjab, Maharashtra, West Bengal, Andhra Pradesh and Karnataka.

Black gram is important for its high phosphoric acid content. It contains 24g protein/100g of seeds and carbohydrates 59.6g/100 g of seeds show that it is nutritious pulse. It also has good amount of phosphorus (385mg) iron (10.2mg), thiamin (0.42 mg), riboflavin (0.20mg), niacin (2mg) and vitamin C (3mg) (Manay and Shadaksharaswamy, 1987).

Chick pea (*Cicer arietinum* L.):

Chick pea (*Cicer arietinum* L.) is small much branched plant attaining height of about 2 feet. The leaves are pinnately compound the papilionaceous flowers are solitary and the pods contains one or two seeds.

It is cultivated in dry cool climate during Rabi season in the regions with low to moderate rainfall. It is cultivated as intercrop along with Jowar, Wheat, and Bajra etc during October-November. The crop is harvested after about 3-4 months in February – March.

It is mainly cultivated in Uttar Pradesh, Punjab, Rajasthan, Madhya Pradesh, Bihar, Maharashtra, Andhra Pradesh, West Bengal, Tamil Nadu and Karnataka.

The malic and oxalic acids from the leaves of Chick pea are useful in intestinal disorders. It contains protein 20.5g/ 100g of seeds and carbohydrates 59.6 g/ 100g of seeds with thiamin (0.30mg), riboflavin (0.15mg), niacin (2.9mg), vitamin C (3mg) and phosphorous (312 mg) (Manay and Shadaksharaswamy, 1987).

Pigeon pea (*Cajanus cajan* L.):

Pigeon pea (*Cajanus cajan* L.) is an annual shrub of about 6-7 feet. The inflorescence is a typical axillary raceme bearing papilionaceous flowers. It is cultivated as a mixed crop with Kharif cereals in low rainfall areas. Sowing is done in June – July and harvested after 6-8 months, between January - February. It is commonly cultivated in Uttar Pradesh, Orissa, Rajasthan, Maharashtra, Bihar and Tamil Nadu.

It contains protein 20.4 g/100 g of seeds and carbohydrates are 60.4 g/100 g of seeds suggesting that it is also good source of protein and carbohydrates, it also contain thiamin (0.45mg), niacin (2-9mg) and riboflavin (0.19mg). It has better quality of fiber (7g/ 100g of seeds) (Manay and Shadaksharaswamy, 1987).

These pulse crops are affected by different fungal pathogens as seed mycoflora which is harmful to seed health and seed content and ultimately to yield. Association of the fungi with the seeds has found to be harmful to the seed health and seed content. Such seeds are found to be harmful both for agriculture and human consumption. Such infected seeds may carry many pathogens; as shown by studies in the case of leguminous crops (Saxena and Sinha, 1977; Saxena and Gupta, 1981; and Maheshwari *et al.* 1984).

It is clear from the literature that, several workers have studied extensively qualitative and quantitative nature of seed mycoflora, role of seed-borne fungi in seed germination and seedling emergence of pulses. It is also evident from literature that, there are many common plants in the region that can be used in controlling seed-borne diseases.

Use of these commonly available plants in the region have not been much tried for the control of seed-borne diseases earlier. Considering these facts, effects of extracts of different plant species on seed mycoflora and seed health of pulses have been selected for the present studies.

Part- A

Isolation, identification and pathogenicity of seed-borne fungi of pulses:

The first part of the studies is devoted for screening of seed-borne fungi and pathogenicity of different pulses using different methods and conditions. During the study, seeds of the test pulses were collected as described by Neergaard (1977) from different sources to make composite sample. These seeds were plated on Agar plates and moist blotter plates for fungal screening. Total seventeen fungi (*Alternaria tenuis*, *Alternaria alternate, Aspergillus carbonarius, Aspergillus flavus, Aspergillus niger, Aspergillus nidulans, Aspergillus fumigatus, Cladosporium spp., Colletotrichum truncatum, Chetomium globosum, Curvularia lunata, Drechslera tetramera, Fusarium moniliforme, Fusarium oxysporum, Penicillium spp., Rhizopus stolonifer, Macrophomina phaseolina*) were isolated from the test pulses, on Agar plates and Moist blotters. Agar plates showed more fungal incidence compared to moist blotters. Among seventeen fungi isolated and

identified, the common and dominant fungi were *Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger, Drechslera tetramera, Fusarium oxysporum* and *Rhizopus stolonifer*. These fungi were brought in pure cultures and maintained in laboratory for further studies. The fungal enzymes and toxins as secondary metabolites reduced the seed germination, root, and shoot lengths and seedling emergence. *Aspergillus niger, Aspergillus flavus, Fusarium oxysporum* caused maximum damage to the seeds of test pulses. The toxins produced by the common and dominant seed-borne fungi of pulses were studied by growing fungi on GN medium and seed flour medium of different test pulses. It was found that all the test fungi culture filtrates (CF) caused adverse effects on seed germination, root length, shoot length and seedling emergence of all pulses. Among all test fungi *Aspergillus niger* and *Aspergillus flavus* were having more damaging effects on pulses; followed by *Drechslera tetramera*, *Aspergillus fumigatus* and *Rhizopus stolonifer* respectively. Enzymes produced by test fungi like protease and amylase caused seed biodeterioration of pulses. Protease and amylase production was common by seed-borne fungi. Among all test fungi *Fusarium moniliforme*, *Aspergillus flavus* and *Aspergillus niger* were most effective in producing both enzymes respectively. The role of these predominant fungi in seed germination and seedling emergence of the pulses have been evaluated and the results are reported. Effects of some common and dominant seed-borne fungi of pulses were studied in relation to dry weight, protein and starch content of seeds of pulses. It was observed that, all test fungi caused reduction in dry weight, protein and starch content of test pulses.

Part – B

Biocontrol of seed-borne fungi of pulses:

The second part of the thesis is devoted to pathogenicity and biocontrol of seed-borne fungi of pulses using different plant parts powder in GN medium. It was found that, different plant powders were effective in controlling growth and sporulation of the common and dominant seed-borne fungi. Among all test plants *Ocimum basilicum*, *Ocimum americanum* L., *Ocimum sanctum* L., *Cyperus rotundus, Azadirachta indica* and *Ruelia tuberosa* L. caused better restrictive effect on growth and sporulation of test fungi.

Part – C

Studies on plant extracts and seed health of pulses:

Third part of the thesis deals with studies of plant extracts and seed health of pulses. During the study seed germination, seed mycoflora and seedling emergence was considered to evaluate the effect of selected plant extracts. It was found that 50% petroleum ether extract of different plant parts such as root; stem and leaf were effective in controlling seed mycoflora of pulses. Total fifty plants were screened during the study from the region; but eighteen plants showed better antifungal and seed health supportive activity. Plants such as *Ocimum americanum L., Ocimum sanctum L., Ocimum basilicum, Azadirachta indica, Cyperus rotundus* etc showed better antifungal activity and enhanced seed germination, seedling emergence, shoot length and root length of pulses.

It is need of the hour that anthropogenic activities be gradually minimized to save the mother earth from imminent irreparable damage. In agriculture sector profiteering is rapaciously engulfing the Mother Nature and dangerously leading towards colossal damage to entire earth comprising abiotic and biotic components. The present work is an attempt to minimize nearly lethal damage to the biosphere by harnessing the natural resources to control seed mycoflora adversely affecting to the crops in general, pulses specifically. It is necessary to explore nature itself to cure the pathological sufferings of plants and ultimately safeguard the earth planet. There are numerous potentially viable plant species are available in native locations that could of used to guard crops against microbial nescience. Irrational use of artificial pesticides, fungicides has been playing havoc on entire ecosystem. There is large hue and cry from developed and developing countries to terminate further devastating damage to the ecosystem. Euphemistic political appeals are not yielding any beneficial effects to humanity and whole world. It is high time to heed the ongoing attempts in academic arenas to formulate ecofriendly measures to refurbish our planet which is on the verge of dangerous damage. All the stakeholders must act and propagate the idea of using plant based fungicides, pesticides in agricultural practices.

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METHODOLOGY ADOPTED

Isolation, identification and pathogenicity of seed-borne fungi of pulses:

1. **Collection of seed samples:**

The methods prescribed by Neergaard (1977) have been adopted for the collection of seed samples. Seed samples of Green gram, Black gram, Chick pea and Pigeon pea were collected from field, market places from Nanded. A composite seed sample for each of the pulse crop was made by mixing the individual seed sample together, preserved in gunny bags at room temperature during the studies.

2. **Detection of seed mycoflora:**

The seed-borne fungi of different pulses, different categories and stored seeds of pulses were detected by moist blotter (B) and agar (A) plate methods as recommended by ISTA (1966), De Tempe (1970), Neergaard (1977) and Agrawal (1981). The procedure of moist blotter (B) and agar (A) plate methods is described as below.

3. **Moist blotter plate method:**

In moist blotter plate method; a pair of white blotter papers of 8.5 cm diameter was jointly soaked in sterile distilled water and placed in pre-sterilized borosil glass Petri-plates of 10 cm diameter. Ten seeds were placed at equal distance aseptically on the moist blotter paper. The plates were incubated at room temperature for ten days. On eleventh day the seeds were examined under microscope for the preliminary determination of seed mycoflora. The seed-borne fungi found on each and every seed were isolated and identified, brought into pure cultures and maintained on PDA (Potato Dextrose Agar) slants for further studies.

4. **Agar plate method:**

In agar plate method; 25 ml of sterilized PDA medium of pH 5.6 was poured in pre-sterilized borosil glass petri-plate of 10 cm diameter. The petri-plates were allowed to cool at room temperature; then ten seeds of test pulses were placed at equidistance under aseptic condition. The plates were incubated at room for ten days. On eleventh day the seeds were examined under microscope for the preliminary determination of seed mycoflora. The seed-borne fungi found on each and every seed were isolated and identified, brought into pure cultures and maintained on PDA (Potato Dextrose Agar) slants for further studies.

5. Isolation and identification of seed-borne fungi of pulses:

The isolated seed-borne fungi of test pulses were identified on the basis of colony character, texture, color and sporulation with naked eye and microscopically. Identifications were confirmed with the help of authentic manuals (Subramanian; 1971, Neergaard and Mathur; 1980, Jha; 1993 and Mukadam; 1997). Pure cultures of the identified fungi were made and maintained on PDA (Potato Dextrose Agar) slants.

6. Effect of common and dominant seed-borne fungi of pulses on seed germination, seedling emergence, shoot and root length of pulses:

In order to study the effect of common and dominant seed-borne fungi of pulses on the seed health of pulses, the test pulses like Green gram, Black gram, Chick pea and Pigeon pea were surface sterilized with 0.1% $HgCl_2$. These seeds were then washed repeatedly with sterilized distilled water to remove traces of $HgCl_2$. After washing, the seeds were separately treated with spore suspension of the common and dominant seed-borne fungi of pulses. Such artificially infested seeds were used to study percent seed germination, shoot, root length and percent seedling emergence separately. The seeds treated with sterile distilled water served as control.

7. Seed germination method:

In order to evaluate the effect of seed-borne fungi on percent seed germination, shoot and root length, the seeds of the test pulses were infested separately as mentioned above. These seeds were incubated in sterilized moist blotters at room temperature for ten days. After incubation period, percent seed germination, shoot and root length of each seeds of pulses was recorded.

8. Seedling emergence method:

In order to evaluate the effect of seed-borne fungi on percent seedling emergence, shoot and root length, the seeds of the test pulses were infested separately as mentioned above. These seeds were sown in earthen pots (25 cm diameter) filled with sterilized soil. After ten days of sowing, on eleventh day percent seedling emergence, shoot and root length of each pulse was recorded. In order to record root length and shoot length seedlings were uprooted washed in distilled water, placed on filter paper and measurements were taken using meter scale.

9. Preparation of spore suspension:

Spore suspension of common and dominant seed-borne fungi of pulses were prepared separately by adding 10 ml of sterile distilled water into the sporulating pure cultures of seed-borne fungi of pulses; maintained on PDA slants for seven days at room temperature. The slants were shaken and content was filtered through muslin cloth to separate mycelium and spore. The filtrate thus obtained was used as spore suspension.

10. Effects of stem, root and leaf powders of different plants on growth of common and dominant seed-borne fungi of pulses:

i. Collection of plants and preparation of plant parts powder:

During present studies, eighteen plants available in the area were selected. The plants were identified from their morphological characters using 'Flora of Marathwada' (Naik, 1998). The collected plants were cut into different parts like stem, leaves and root. All parts were surface sterilized with 0.1% $HgCl_2$ and subsequently washed to remove disinfectant; with sterile distilled water. These plant parts were kept for drying in hot air oven at 60°C for 48 hours.

The dried plant parts such as leaf, stem and root were crushed into powder with the help of grinder. The powders were passed through sieve to get fine powder. The powders of different plant parts were stored in polythene bags for the study.

11. Effects of petroleum ether extract of different plant parts on seed mycoflora and seed health of pulses:

The effect of different plant parts extracts was studied on seed health of pulses comprising seed mycoflora, seed germination, seedling emergence, shoot and root length of pulses, like Green gram, Black gram, Chick pea and Pigeon pea.

i. Preparation of petroleum ether plant extracts:

Five g powder of each of the plant parts was dissolved separately in mixture of 50 ml petroleum ether and 50 ml distilled water; in 250 ml borosil glass conical flasks. The flasks were kept in oven (Metlab) for 24 hours at 60°C and the content was filtered through Whatman filter paper No.1. The filtrates were used as 5% plant extracts.

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EXPERIMENTAL RESULTS

A) Isolation, identification and pathogenicity of seed-borne fungi of pulses:

1. Studies on seed mycoflora of different pulses:

During present studies seed mycoflora of different pulses like Green gram, Black gram, Chick pea and Pigeon pea were screened. For detection of fungal flora of each pulse, moist agar (A) and blotter (B) plate methods were employed. Four hundred seeds from composite samples of each pulse were tested during the study. The seeds were plated separately on moist blotter plates and agar plates and incubated for ten days at room temperature. On eleventh day the plates were examined for various aspects of their seed mycoflora.

2. Seed mycoflora of Green gram (*Vigna radiata* L.) (Table 1):

Table 1: Incidence of seed mycoflora of Green gram (*Vigna radiata* L.) by blotter (B) and agar (A) Plate method (after ten days of incubation)

Sr. No.	Seed mycoflora	Incidence of seed mycoflora (%)	
		B	A
1	*Alternaria alternata*	10	15
2	*Alternaria tenuis*	25	42
3	*Aspergillus carbonarius*	00	12
4	*Aspergillus flavus*	67	70
5	*Aspergillus fumigatus*	25	61
6	*Aspergillus nidulans*	28	25
7	*Aspergillus niger*	55	60
8	*Chetomium globosum*	00	03
9	*Cladosporium spp.*	00	20
10	*Colletotrichum truncatum*	00	05
11	*Curvularia lunata*	12	23
12	*Drechslera tetramera*	25	55
13	*Fusarium moniliforme*	20	45
14	*Fusarium oxysporum*	15	35
15	*Penicillium spp.*	06	15
16	*Rhizopus stolonifer*	18	60

In order to detect seed mycoflora of Green gram, the seeds were plated on moist blotter (B) and agar (A) Plates separately. The percent incidence of seed-borne fungi was recorded and presented in Table l.

The tabulated results show that, total sixteen fungi were reported form Green gram seeds. The incidence seed mycoflora was more on agar plate compared to moist blotter plate.

Considering over all seed-borne fungal mycoflora of the seed, *Aspergillus flavus* showed maximum percent incidence on agar (70%), followed by *Aspergillus fumigatus* (61%) *Aspergillus niger* (60 %), *Rhizopus stolonifer* (60%), *Drechslera tetramera* (55 %), *Fusarium moniliforme* (45 %) and *Alternaria tenuis* (42 %). *Chetomium globosum*, *Colletotrichum truncatum*, *Aspergillus carbonarius* and *Cladosporium* spp. showed no incidence on blotter and very less incidence on agar plates. Remaining fungi showed minimum incidence both on blotters and agar plates.

3. Seed mycoflora of Black gram (*Vigna mungo* L.) (Table 2):

In order to detect seed mycoflora of Black gram; the seeds were plated on moist blotter (B) and agar (A) Plates separately. The percent incidence of seed-borne fungi was recorded and presented in Table 2.

Results in Table show that, total sixteen fungi were reported form Black gram seeds. The incidence seed mycoflora was more on agar plate compared to moist blotter plate.

Fungi like, *Aspergillus niger* (90%), A*spergillus flavus* (80%), *Aspergillus fumigatus* (77%), *Drechslera tetramera* (70%), *Rhizopus stolonifer* (62 %) and *Fusarium moniliforme* (55%) were found to be dominant on the seeds. *Chetomium globosum*, *Colletotrichum truncatum* were absent on blotter plate,

Whereas *Curvularia lunata*, *Penicillium* sp. were absent on agar plates and minimum on blotter. *Cladosporium* sp., *Curvularia lunata*, *Penicillium* spp. were least on blotters; whereas *Chetomium globosum*, *Colletotrichum truncatum*, *and Alternaria alternata* were least on agar plates.

Table 2: Incidence of seed mycoflora of Black gram (*Vigna mungo* L.) by blotter (B) and agar (A) Plate method (after ten days of incubation)

Sr. No.	Seed mycoflora	Incidence of seed mycoflora (%)	
		B	A
1	*Alternaria alternata*	15	06
2	*Alternaria tenuis*	22	40
3	*Aspergillus carbonarius*	29	20
4	*Aspergillus flavus*	60	80
5	*Aspergillus fumigatus*	57	77
6	*Aspergillus nidulans*	24	28
7	*Aspergillus niger*	67	90
8	*Chetomium globosum*	00	01
9	*Cladosporium spp.*	02	06
10	*Colletotrichum truncatum*	00	02
11	*Curvularia lunata*	05	00
12	*Drechslera tetramera*	58	70
13	*Fusarium moniliforme*	48	55
14	*Fusarium oxysporum*	08	22
15	*Penicillium spp.*	05	00
16	*Rhizopus stolonifer*	33	62

4. Seed mycoflora of Chick pea (*Cicer arietinum* L.) (Table 3):

In order to detect seed mycoflora of Chick pea; the seeds were plated on moist blotter (B) and agar (A) Plates separately. The percent incidence of seed-borne fungi was recorded and presented in table. The tabulated results show that, total seventeen fungi were reported form Chick pea seeds. The incidence seed mycoflora was more on agar plate compared to moist blotter plate.

The most dominant fungi were, *Aspergillus flavus* (A 86 %, B 67%), followed by *Aspergillus niger* (A 82%, B 70%), *Drechslera tetramera* (A 70%, B 55 %) and *Aspergillus fumigatus* (A 63 %, B 48 %). Fungi like *Alternaria alternata*, *Aspergillus carbonarius*, *Chetomium globosum*, C*ladosporium* spp. were absent on blotter and showed least incidence on agar. Similarly *Colletotrichum truncatum* was absent on agar and *Rhizopus*

stolonifer, *Alternaria tenuis, Penicillium* spp. and *Macrophomina phaseolina* were least on agar and blotter.

Table 3: Incidence of seed mycoflora of Chick pea (*Cicer arietinum*) by blotter (B) and agar (A) Plate method (after ten days of incubation)

Sr. No.	Seed mycoflora	Incidence of seed mycoflora (%)	
		B	A
1	*Alternaria alternata*	00	10
2	*Alternaria tenuis*	18	35
3	*Aspergillus carbonarius*	00	28
4	*Aspergillus flavus*	67	86
5	*Aspergillus fumigatus*	48	63
6	*Aspergillus nidulans*	21	16
7	*Aspergillus niger*	70	82
8	*Chetomium globosum*	00	06
9	*Cladosporium spp.*	00	10
10	*Colletotrichum truncatum*	02	00
11	*Curvularia lunata*	35	27
12	*Drechslera tetramera*	55	70
13	*Fusarium moniliforme*	38	63
14	*Fusarium oxysporum*	40	50
15	*Macrophomina phaseolina*	10	05
16	*Penicillium spp.*	12	32
17	*Rhizopus stolonifer*	22	37

5. Seed mycoflora of Pigeon pea (*Cajanus cajan* L.) (Table 4):

In order to detect seed mycoflora of Pigeon pea; the seeds were plated on moist blotter (B) and agar (A) Plates separately. The percent incidence of seed-borne fungi was recorded and presented in Table 4.

Results in the table show that, total fourteen fungi were reported form seeds. The incidence seed mycoflora was more on agar plate than the moist blotter plate.

The seed mycoflora of Pigeon pea showed dominance of *Aspergillus flavus* (A 90 %, B 62 %), followed by *Aspergillus fumigatus* (A 80 %, B 72 %), *Aspergillus niger* (A 78 %, B

52%), *Drechslera tetramera* (A 75 %, B 60 %) and *Rhizopus stolonifer* (A 58 %, B 32 %). Fungi like *Aspergillus carbonarius* on blotter and *Macrophomina phaseolina* on agar plate were absent.

Aspergillus carbonarius (A 2 %), *Macrophomina phaseolina* (B 7 %), *Alternaria alternata* (B 12 %, A 6 %), *Penicillium* spp. (B 11% and A 28%), *Aspergillus nidulans* (B 6% and A 20%) were minimum on agar and blotter respectively.

Table 4: Incidence of seed mycoflora of Pigeon pea (*Cajanus cajan* L.) by blotter (B) and agar (A) Plate method (after ten days of incubation)

Sr. No.	Seed mycoflora	Incidence of seed mycoflora (%)	
		B	A
1	*Alternaria alternata*	12	06
2	*Alternaria tenuis*	27	25
3	*Aspergillus carbonarius*	00	02
4	*Aspergillus flavus*	62	90
5	*Aspergillus fumigatus*	72	80
6	*Aspergillus nidulans*	06	20
7	*Aspergillus niger*	52	78
8	*Curvularia lunata*	31	36
9	*Drechslera tetramera*	60	75
10	*Fusarium moniliforme*	38	67
11	*Fusarium oxysporum*	20	37
12	*Macrophomina phaseolina*	07	00
13	*Penicillium spp.*	11	28
14	*Rhizopus stolonifer*	32	58

B) Pathogenicity of common and dominant seed-borne fungi of pulses on seed germination, seedling emergence, shoot and root length of pulses

In order to study effects of common and dominant seed-borne fungi of pulses on seed health of pulses, the test pulses like Green gram, Black gram, Chick pea and Pigeon pea were surface sterilized with 0.1 % $HgCl_2$ and subsequently washed to remove the fungicide. These seeds were than inoculated with 2 ml of spore suspension of common and dominant seed-borne fungi of pulses and incubated on moist blotter at room temperature for ten days. On eleventh day seed germination, shoot and root length were recorded. The seeds without inoculation of common and dominant seed-borne fungi of pulses were served as control.

To study seedling emergence, the seeds of pulses like; Green gram, Black gram, Chick pea and Pigeon pea were surface sterilized with 0.1% $HgCl_2$ and then washed thoroughly with sterile distilled water. Such seeds were inoculated with 2 ml spore suspension of common and dominant seed-borne fungi of pulses. These seeds were than sown in earthen pots (25 cm diameter) containing sterilized soil and grown for ten days and on eleventh day percent seedling emergence, shoot and root length was recorded.

1. Effect of common and dominant seed-borne fungi of pulses on seed germination, shoot length and root length of Green gram (Table 5):

Table 5: Effect of common and dominant seed-borne fungi of pulses on seed health (seed germination, shoot length and root length) of Green gram (*Vigna radiata* L.) by blotter plate method (After ten days of incubation)

Sr. No.	Infestation by common and dominant seed-borne fungi	Seed health		
		Seed germination (%)	Shoot length (cm)	Root length (cm)
1	*Aspergillus flavus*	40	2.2	3.1
2	*Aspergillus fumigatus*	50	2.0	2.2
3	*Aspergillus niger*	30	1.5	3.0
4	*Drechslera tetramera*	60	4.0	3.4
5	*Fusarium moniliforme*	70	3.0	3.8
6	*Rhizopus stolonifer*	80	2.2	4.2
7	Control	100	6.3	5.1

The artificially infested seeds as described above were incubated for ten days and on 11th day results were recorded in Table 5. The results reveal that, all common and dominant seed-borne fungi of pulses of Green gram retarded percent seed germination shoot and root length in the test seed of pulses.

Aspergillus niger causes maximum reduction in seed germination (30 %) followed by *Aspergillus flavus* (40 %) and *Aspergillus fumigatus* (50 %). On the contrary *Rhizopus stolonifer* and *Fusarium moniliforme* showed better seed germination (80 % and 70 % respectively).

There was maximum suppression in shoot and root lengths due to fungi like *Aspergillus niger* and *Aspergillus fumigatus*.

2. Effect of common and dominant seed-borne fungi of pulses on seed germination, shoot length and root length of Black gram (Table 6):

The artificially infested seeds as described above were incubated for ten days and on 11th day results obtained are recorded in Table 6.

Table 6: Effect of common and dominant seed-borne fungi of pulses on seed health (seed germination, shoot length and root length) of Black gram (*Vigna mungo* L.) by blotter plate method (After ten days of incubation)

Sr. No.	Infestation by common and dominant seed-borne fungi	Seed health		
		Seed germination (%)	Shoot length (cm)	Root length (cm)
1	*Aspergillus flavus*	50	1.0	0.0
2	*Aspergillus fumigatus*	89	2.1	4.1
3	*Aspergillus niger*	30	2.2	3.1
4	*Drechslera tetramera*	60	2.1	4.1
5	*Fusarium moniliforme*	70	3.1	3.2
6	*Rhizopus stolonifer*	40	2.1	4.1
7	Control	90	5.0	4.0

The results indicate that, all the common and dominant seed-borne fungi of pulses showed suppression in seed germination, shoot and root length of the pulse. The seed-borne fungus *Aspergillus niger* was most restrictive on seed germination showing only 30 % seed germination (control 90 %) followed by *Rhizopus stolonifer* (40 %) and *Aspergillus flavus* (50 %). *Aspergillus fumigatus* did not affect much adversely the seed germination compared to control. *Aspergillus flavus* caused much reduction in shoot length and completely inhibited growth of root.

3. Effect of common and dominant seed-borne fungi of pulses on seed germination, shoot length and root length of Chick pea (Table 7):

The results in the table 7 show that, all common and dominant seed-borne fungi of pulses caused reduction in seed germination shoot and root length of the pulses in more or less degree. *Drechslera tetramera* showed maximum retardation in seed germination (20 %) followed by *Aspergillus flavus* (30 %) and *Aspergillus niger* (40 %). *Drechslera tetramera* completely inhibited shoot length, where as *Aspergillus niger* showed much reduced shoot length (1 cm, control 3.4 cm) and much reduced root length (1.1 cm, control 6.1).

Table 7: Effect of common and dominant seed-borne fungi of pulses on seed health (seed germination, shoot length and root length) of Chick pea (*Cicer arietinum* L.) by blotter plate method (After ten days of incubation)

Sr. No.	Infestation by common and dominant seed-borne fungi	Seed health		
		Seed germination (%)	Shoot length (cm)	Root length (cm)
1	*Aspergillus flavus*	30	2.0	2.1
2	*Aspergillus fumigatus*	60	4.1	5.2
3	*Aspergillus niger*	40	1.0	1.1
4	*Drechslera tetramera*	20	0.0	1.2
5	*Fusarium moniliforme*	60	2.2	3.4
6	*Rhizopus stolonifer*	50	2.1	4.1
7	Control	100	3.4	6.1

The results in the table show that, all common and dominant seed-borne fungi of pulses caused reduction in seed germination shoot and root length of the pulses in more or less degree. *Drechslera tetramera* showed maximum retardation in seed germination (20 %) followed by *Aspergillus flavus* (30 %) and *Aspergillus niger* (40 %). *Drechslera tetramera* completely inhibited shoot length, where as *Aspergillus niger* showed much reduced shoot length (1 cm, control 3.4 cm) and much reduced root length (1.1 cm, control 6.1).

4. Effect of common and dominant seed-borne fungi of pulses on seed germination, shoot length and root length of Pigeon pea (Table 4):

The result in the table show that, all common and dominant seed-borne fungi of pulses caused reduction in seed germination shoots length and root length of the pulse in more or less degree.

Seed germination was much adversely affected by *Aspergillus flavus* (40 %, control 90 %), than *Fusarium moniliforme* and *Aspergillus niger* with both showing seed germination of 60 %. Shoot length was completely suppressed and root length was minimum in case of *Aspergillus niger*. However there was increase in shoot length over control in case of *Drechslera tetramera* (4.2 cm) and also increase in root length in case of *Aspergillus flavus* (4.5 cm) over control.

Table 4: Effect of common and dominant seed-borne fungi of pulses on seed health (seed germination, shoot length and root length) of Pigeon pea (*Cajanus cajan* L.) by blotter plate method (After ten days of incubation).

Sr. No.	Infestation by common and dominant seed-borne fungi	Seed health		
		Seed germination (%)	Shoot length (cm)	Root length (cm)
1	*Aspergillus flavus*	40	1.1	4.5
2	*Aspergillus fumigatus*	70	3.2	4.1
3	*Aspergillus niger*	60	0.0	1.0
4	*Drechslera tetramera*	80	4.2	3.4
5	*Fusarium moniliforme*	60	1.2	1.1
6	*Rhizopus stolonifer*	70	3.1	4.0
7	*Control*	90	3.3	4.2

5. Effect of common and dominant seed-borne fungi of pulses on seedling emergence, shoot length and root length of Green gram (Table 9):

The seeds of Green gram were artificially infested with their common and dominant seed-borne fungi and sown equidistance in earthen pots. After ten days seedling emergence, shoot and root length were recorded and presented in the table.

The results clearly suggest that, all common and dominant seed-borne fungi of pulses caused more of less reduction in seedling emergence, shoot and root length of Green gram.

The fungi *Aspergillus niger* and *Drechslera tetramera* affected most adversely the seedling emergence (40 % each, control 90 %), shoot length (5 cm, control 14 cm), and root length (5 cm, control 10 cm) respectively. The fungus *Rhizopus stolonifer* affected less adversely to seedling emergence compared to rest of the fungi (seedling emergence 80 %, control 90 %), shoot length (12 cm, control 14 cm) and root length (10 cm, control 10 cm). Shoot length was less affected in case of seeds infested with *Fusarium moniliforme* (13 cm, control 14 cm). Root length was not affected in case of seeds treated with *Rhizopus stolonifer* and *Aspergillus fumigatus* but more root length (12 cm) was recoded in case of seeds infested with *Fusarium moniliforme* over control.

Table 9: Effect of common and dominant seed-borne fungi of pulses on seed health (seedling emergence, shoot length and root length) of Green gram (*Vigna radiata* L.) by pot sowing method (After ten days of incubation)

Sr. No.	Infestation by common and dominant seed-borne fungi	Seed health		
		Seedling emergence (%)	Shoot length (cm)	Root length (cm)
1	*Aspergillus flavus*	50	10	9
2	*Aspergillus fumigatus*	60	10	10
3	*Aspergillus niger*	40	5	5
4	*Drechslera tetramera*	40	7	7
5	*Fusarium moniliforme*	70	13	12
6	*Rhizopus stolonifer*	80	12	10
7	Control	90	14	10

6. Effect of common and dominant seed-borne fungi of pulses on seedling emergence, shoot length and root length of Black gram (Table 10):

The seeds of Black gram were artificially infested with their common and dominant seed-borne fungi and sown equidistance in earthen pots. After ten days seedling emergence, shoot and root length were recorded and presented in the table.

The results presented in the table shows that, all common and dominant seed-borne fungi of pulses affected adversely seedling emergence, shoot and root length in more or less degree of Black gram. The fungi which caused much reduction in seedling emergence of Black gram were *Aspergillus niger* (40 %, control 100 %), followed by *Aspergillus flavus* and *Fusarium moniliforme*. In case of *Drechslera tetramera* seedling emergence was much closer to that of control (80 %, control 100%). There was much reduction in shoot and root length in seedlings due to the *Aspergillus flavus*.

Table 10: Effect of common and dominant seed-borne fungi of pulses on seed health (seedling emergence, shoot length and root length) of Black gram (*Vigna mungo* L.) by pot sowing method (After ten days of incubation)

Sr. No.	Infestation by common and dominant seed-borne fungi	Seed health		
		Seedling emergence (%)	Shoot length (cm)	Root length (cm)
1	*Aspergillus flavus*	50	06	07
2	*Aspergillus fumigatus*	60	09	10
3	*Aspergillus niger*	40	10	08
4	*Drechslera tetramera*	80	12	09
5	*Fusarium moniliforme*	50	09	10
6	*Rhizopus stolonifer*	60	11	12
7	Control	100	16	17

7. Effect of common and dominant seed-borne fungi of pulses on seedling emergence, shoot length and root length of Chick pea (Table 11):

The seeds of Chick pea were artificially infested with their common and dominant seed-borne fungi and sown equidistance in earthen pots. After ten days seedling emergence,

shoot and root length were recorded and presented in the table. The results reveal that, all common and dominant seed-borne fungi of pulses caused reduction in seedling emergence, shoot and root length of Chick pea in more or less degree.

Much reduction in seedling emergence was recorded with *Aspergillus flavus*, *Drechslera tetramera* and *Aspergillus niger* (respectively 30 %, 30 % and 50%). There was much reduction in shoot and root length due to *Aspergillus niger*, *Aspergillus flavus* and *Drechslera tetramera*.

Table 11: Effect of common and dominant seed-borne fungi of pulses on seed health (seedling emergence, shoot length and root length) of Chick pea (*Cicer arietinum* L.) by pot sowing method (After ten days of incubation)

Sr. No.	Infestation by common and dominant seed-borne fungi	Seed health		
		Seedling emergence (%)	Shoot length (cm)	Root length (cm)
1	*Aspergillus flavus*	30	07	06
2	*Aspergillus fumigatus*	80	09	08
3	*Aspergillus niger*	50	06	05
4	*Drechslera tetramera*	30	08	09
5	*Fusarium moniliforme*	70	07	10
6	*Rhizopus stolonifer*	60	09	10.2
7	Control	90	10.2	15.2

8. Effect of common and dominant seed-borne fungi of pulses on seedling emergence, shoot length and root length of Pigeon pea (Table 12):

The seeds of Pigeon pea were artificially infested with their common and dominant seed-borne fungi and sown equidistance in earthen pots. After ten days seedling emergence, shoot and root length were recorded and presented in the table.

The tabulated results show that, all common and dominant seed-borne fungi of pulses were having negative effect on seedling emergence, shoot and root length of Pigeon pea.

Aspergillus niger was main fungus in reducing seedling emergence of the test seeds (50 %, control 90 %); followed by *Aspergillus fumigatus* (60 %, control 90 %) and *Aspergillus flavus* (60 %). There was great reduction in the shoot length over control due to *Aspergillus fumigatus*, *Fusarium moniliforme*, *Drechslera tetramera* etc. Root length was also reduced to greater extent due to infestation of *Fusarium moniliforme, Drechslera tetramera, Rhizopus stolonifer and Aspergillus fumigatus etc.*

Table 12: Effect of common and dominant seed-borne fungi of pulses on seed health (seedling emergence, shoot length and root length) of Pigeon pea (*Cajanus cajan* L.) by pot sowing method (After ten days of incubation)

Sr. No.	Infestation by common and dominant seed-borne fungi	Seed health		
		Seedling emergence (%)	Shoot length (cm)	Root length (cm)
1	*Aspergillus flavus*	60	14	15
2	*Aspergillus niger*	50	12	13
3	*Drechslera tetramera*	70	10	12
4	*Fusarium moniliforme*	80	09	11.3
5	*Aspergillus fumigatus*	60	08	12.5
6	*Rhizopus stolonifer*	70	11	12.2
7	Control	90	15.2	17

C) Effects of root, stem and leaf powders of different plant parts on growth of common and dominant seed-borne fungi of pulses

In present work attempts were made to control pathogenic activity of common and dominant seed-borne fungi of pulses with the help of some selected plants (18 plants). For this, powders of different parts of these plants were separately added to liquid glucose nitrate medium (GN 100 ml + 5 g plant part powder) in 250 ml conical flasks. To these flasks 2 ml of spore suspension of each common and dominant seed-borne fungus of pulses was added separately. These flasks were then incubated for ten days at room temperature. On eleventh day spore and mycelium from the cultures were separated by passing through muslin cloth. The spores of the test fungi thus obtained were used to study sporulation frequency by observing under different microscopic fields. The mycelial mat that was collected in muslin cloth, dried on filter paper in oven at 60°C for 24 hours and dry mycelial weight was recorded.

1. Effect of root, stem and leaf powder of different plants on growth of common and dominant seed-borne fungus of pulses: *Aspergillus flavus* (Table 13):

In order to study effect of root, stem and leaf powder of different plant parts on the seed-borne fungus *Aspergillus flavus*, the fungus was grown on GN medium that was supplemented with 5g plant parts powder separately in conical flask. These flasks were incubated for ten days at room temperature. On eleventh day dry mycelial weight and sporulation of the fungus was recorded.

Table 13: Effect of root, stem and leaf powder of different plants on growth of common and dominant seed-borne fungus *Aspergillus flavus* (After ten days of incubation)

Sr. No.	Plants used	GN medium + 5 gm powder of	Dry weight of mycelium (mg)	Sporulation
1	*Acorus calamus* L.	Leaf	100	+++
		Rhizome	60	++
2	*Adenanthera pavonia* L.	Leaf	103	+++
		Stem	89	+++
		Root	60	++

3	*Azadirachta indica* A. Juss.	Leaf	40	++
		Stem	35	+
		Root	55	++
4	*Butea monosperma* (Lam.) Taub.	Leaf	93	++
		Stem	92	++
		Root	100	++
5	*Carum copticum* Benth and Hook. f.	Leaf	91	++
		Stem	103	+++
		Root	99	++
6	*Ciba pentandra*	Leaf	55	++
		Stem	70	++
		Root	75	++
7	*Croton tiglium* L.	Leaf	35	++
		Stem	58	++
		Root	97	+++
8	*Cyperus rotundus* L.	Leaf	43	++
		Rhizome	29	+
9	*Eucalyptus globulus* Labill.	Leaf	42	++
		Stem	50	+++
		Root	52	+++
10	*Melingtonia hortensis*	Leaf	77	+++
		Stem	82	++
		Root	68	+++
11	*Muntangia calabura* L.	Leaf	85	++
		Stem	97	++
		Root	102	+++
12	*Murraya koinigii* (L.) Spreng.	Leaf	43	++
		Stem	70	++
		Root	98	+++
13	*Ocimum basilicum* L.	Leaf	21	+
		Stem	25	+
		Root	32	++
14	*Ocimum americanum* L.	Leaf	20	+
		Stem	31	+
		Root	38	++

15	*Ocimum sanctum* L.	Leaf	27	++
		Stem	33	++
		Root	40	++
16	*Ruelia tuberose* L.	Leaf	99	++
		Stem	92	+++
		Root	100	+++
17	*Samania saman* (Jacq.) Merr.	Leaf	70	+++
		Stem	78	++
		Root	102	+++
18	*Tagetis erecta* L.	Leaf	93	+++
		Stem	68	++
		Root	95	++
19	Control	GN medium	120	+++

- No sporulation, + Low sporulation

++ Moderate sporulation, +++ High sporulation

The fungus grown on GN medium without supplementation of any plant parts powder served as control. The results presented in the table revealed that, all the test plant parts powder showed restrictive affect on growth of mycelium and sporulation of the test fungus in more or less degree. The most effective plants that caused maximum reduction in dry mycelial weight of the fungus were *Ocimum americanum* L. (leaf 20 mg), *Ocimum basilicum* L. (leaf 21 mg, stem 25 mg) and *Ocimum sanctum* L. (leaf 27 mg). The plants that caused minimum reduction of mycelial weight were *Adenanthera pavonia* L. (leaf 103 mg), *and Carum copticum* Benth and Hook. f. (103 mg), *Muntangia calabura* L. (root 102 mg) and *Samania saman* (root 102 mg).

Four plants such as *Azadirachta indica* A. Juss (stem), *Cyperus rotundus* L. (rhizome), *Ocimum basilicum* L. (leaf, stem) and *Ocimum americanum* L. (leaf and stem) caused low sporulation in the test fungus. Rest of the plants showed moderate to high sporulation.

2. Effect of root, stem and leaf powder of different plant on growth of common and dominant seed-borne fungus of pulses: *Aspergillus fumigatus* (Table 14):

In order to study effect of root, stem and leaf powders of different plant on seed-borne fungus *Aspergillus fumigatus* the fungus was grown on GN medium containing 5g

plant parts powder in conical flasks. These flasks were incubated for ten days at room temperature. The dry mycelial weight and sporulation of the fungus was recorded on eleventh day.

Table 14: Effect of root, stem and leaf powder of different plants on growth of common and dominant seed-borne fungus - *Aspergillus fumigatus* (After ten days of incubation)

Sr. No.	Plants used	GN medium + 5 gm powder of	Dry weight of mycelium (mg)	Sporulation
1	*Acorus calamus* L.	Leaf	37	++
		Rhizome	33	+++
2	*Adenanthera pavonia* L.	Leaf	32	++
		Stem	44	++
		Root	38	++
3	*Azadirachta indica* A. Juss.	Leaf	20	+
		Stem	40	+
		Root	30	++
4	*Butea monosperma* (Lam.) Taub.	Leaf	52	++
		Stem	60	++
		Root	51	++
5	*Carum copticum* Benth and Hook. F.	Leaf	52	++
		Stem	60	++
		Root	62	+++
6	*Ciba pentandra*	Leaf	37	++
		Stem	52	++
		Root	44	++
7	*Croton tiglium* L.	Leaf	63	+++
		Stem	80	++
		Root	70	++
8	*Cyperus rotundus* L.	Leaf	40	++
		Rhizome	70	+++
9	*Eucalyptus globulus*. Labill.	Leaf	44	++
		Stem	38	++
		Root	30	+++

10	*Melingtonia hortensis*	Leaf	66	++
		Stem	59	++
		Root	70	++
11	*Muntangia calabura* L.	Leaf	37	++
		Stem	42	++
		Root	31	++
12	*Murraya koinigii* (L.) Spreng.	Leaf	70	++
		Stem	66	++
		Root	97	+++
13	*Ocimum basilicum* L.	Leaf	32	++
		Stem	36	++
		Root	42	++
14	*Ocimum americanum* L.	Leaf	60	++
		Stem	50	++
		Root	40	++
15	*Ocimum sanctum* L.	Leaf	20	+
		Stem	29	+
		Root	18	+
16	*Ruelia tuberosa* L.	Leaf	37	++
		Stem	100	++
		Root	90	++
17	*Samania saman* (Jacq.) Merr.	Leaf	106	+++
		Stem	95	+++
		Root	100	+++
18	*Tagetis erecta* L.	Leaf	40	+++
		Stem	80	++
		Root	70	++
19	Control	GN medium	95	+++

- No sporulation, + Low sporulation

++ Moderate sporulation, +++ High sporulation

The fungus grown on GN medium without supplementation of any plant parts powder served as control. It is clear from the result that, all the test plant parts powder showed restrictive effect on the growth of mycelium and sporulation of the test fungus in more or less degree.

The most effective plants that caused maximum reduction of dry mycelial weight of the test fungus were *Ocimum sanctum* L. (root 18 mg and leaf 20 mg), *Azadirachta indica* A. Juss (leaf 20 mg and root 30 mg) and *Eucalyptus globulus*. Labill. (root 30). The plants that showed stimulatory activity on mycelial growth of the test fungus were *Samania saman* (Jacq.) Merr. (leaf 106 mg and root 100 mg), Ruelia *tuberosa* L. (stem 100 mg), *Murraya koinigii* (L.) Spreng. (root 97 mg) and *Samania saman* (Jacq.) Merr. (leaf 106 mg and root 100 mg).

Sporulation was least with effect of plants *Azadirachta indica* A. Juss (leaf and stem) and *Ocimum sanctum* L. (leaf, stem and root). All parts of *Samania saman* (Jacq.) Merr. caused highest sporulation and rest of the plants showed moderate to high sporulation.

3. Effect of root, stem and leaf powder of different plants on growth of common and dominant seed-borne fungus of pulses: *Aspergillus niger* (Table 15):

Effect of root, stem and leaf powders of different plant on seed-borne fungus *Aspergillus niger* was studied by growing the fungus on GN medium containing 5g plant parts powder in conical flasks flasks were incubated for ten days at room temperature.

Table 15: Effect of root, stem and leaf powder of different plants on growth of common and dominant seed-borne fungus - *Aspergillus niger* (After ten days of incubation)

Sr. No.	Plants used	GN medium+ 5 gm powder of	Dry weight of mycelium (mg)	Sporulation
1	*Acorus calamus* L.	Leaf	68	+++
		Rhizome	80	+++
2	*Adenanthera pavonia* L.	Leaf	101	+++
		Stem	93	++
		Root	88	++

3	*Azadirachta indica* A. Juss.	Leaf	40	++
		Stem	20	+
		Root	38	++
4	*Butea monosperma* (Lam.) Taub.	Leaf	61	++
		Stem	40	++
		Root	80	++
5	*Carum copticum* Benth and Hook. f.	Leaf	68	+++
		Stem	50	++
		Root	53	++
6	*Ciba pentandra*	Leaf	35	++
		Stem	52	++
		Root	62	++
7	*Croton tiglium* L.	Leaf	132	+++
		Stem	97	++
		Root	99	++
8	*Cyperus rotundus* L.	Leaf	32	++
		Rhizome	47	+
9	*Eucalyptus globulus*. Labill.	Leaf	40	+
		Stem	48	++
		Root	88	++
10	*Melingtonia hortensis*	Leaf	55	+++
		Stem	70	+++
		Root	81	+++
11	*Muntangia calabura* L.	Leaf	61	++
		Stem	99	+++
		Root	82	++
12	*Murraya koinigii* (L.) Spreng.	Leaf	60	++
		Stem	68	++
		Root	80	++
13	*Ocimum basilicum* L.	Leaf	21	++
		Stem	28	+
		Root	38	+
14	*Ocimum americanum* L.	Leaf	18	+
		Stem	35	+
		Root	40	+

15	*Ocimum sanctum* L.	Leaf	33	++
		Stem	40	+
		Root	52	+
16	*Ruelia tuberose*	Leaf	90	+++
		Stem	40	+++
		Root	97	+++
17	*Samania saman*	Leaf	52	++
		Stem	70	+++
		Root	80	++
18	*Tagetis erecta* L.	Leaf	66	++
		Stem	88	++
		Root	102	+++
19	Control	GN medium	98	+++

- No sporulation, + Low sporulation

++ Moderate sporulation, +++ High sporulation

The dry mycelial weight and sporulation of the fungus was recorded on eleventh day. The fungus grown on GN medium without supplementation of any plant parts powder served as control.

The results presented in Table shows that, most of the plant part powders showed suppressive activity on dry mycelial weight except few plants that showed stimulatory activity. All plant parts showed more or less restrictive activity on sporulation.

The plants with maximum inhibitory effect on mycelial dry weight of the test fungus were *Ocimum americanum* L. (leaf 18 mg), *Azadirachta indica* A. Juss (stem 20 mg) and *Ocimum basilicum* L. (leaf 21 mg). Some plants showed stimulatory activity to the mycelial dry weight of fungus. They were *Croton tiglium* L. (leaf 132 mg), *Tagetis erecta* L. (root 102 mg) and *Adenanthera pavonia* L. (leaf 101 mg), and where as *Croton tiglium* L. (root 99 mg) and *Muntangia calabura* L. (stem 99 mg) failed to arrest growth of mycelium of the test fungus.

Sporulation was minimum in six plants such as *Azadirachta indica* A. Juss (stem), *Cyperus rotundus* L. (rhizome), *Eucalyptus globulus*. Labill. (leaf), *Ocimum basilicum* L. (stem and root), *Ocimum americanum* L. (leaf, stem and root) and *Ocimum sanctum* L. (stem and root). With treatment of rest of the plants sporulation was moderate to high.

4. Effect of root, stem and leaf powder of different plant on growth of common and dominant seed-borne fungus of pulses: *Drechslera tetramera* (Table 16):

In order to study effect of root, stem and leaf powder of different plant parts, the fungus *Drechslera tetramera* was grown on GN medium supplemented with 5g plant parts powder in conical flasks. These flasks were incubated for ten days at room temperature. On eleventh day, dry mycelial weight and frequency of sporulation was noted. The fungus grown on GN medium without any supplementation of plant parts powder served as control. The results presented in the table indicate that, almost all plants showed suppressive effect on fungal growth.

The most effective plants that caused maximum reduction in mycelial dry weight of the test fungus were *Ocimum basilicum* L. (leaf 7 mg, stem 8 mg and root 9 mg), *Ocimum sanctum* L. (leaf 8 mg), *Azadirachta indica* A. Juss (root 10 mg), *Ciba pentandra* (leaf 10 mg), *Cyperus rotundus* L. (rhizome 10 mg) and *Carum copticum* Benth and Hook. f. (leaf 12 mg). Slight stimulatory activity on mycelial growth was reported in *Tagetis erecta* L. (root 95 mg), similarly *Samania saman* (Jacq.) Merr. was less effective in reducing mycelial weight of the test fungus (stem 70 mg).

Most of the plants could reduce the sporulation. Maximum reduction in sporulation was shown by the plants such as *Ocimum americanum* L. (stem, leaf and root), *Ocimum sanctum* L. (stem, leaf and root), *and Ruelia tuberosa* L. (leaf), *and Acorus calamus* L. (leaf), *Azadirachta indica* A. Juss (leaf, stem and root) etc. *Samania saman* (Jacq.) Merr. showed high sporulation in its all parts powder (leaf, stem and root). Rest of the plants showed moderated to high sporulation.

Table 16: Effect of root, stem and leaf powder of different plants on growth of common and dominant seed-borne fungus –*Drechslera tetramera* (After ten days of incubation)

Sr. No.	Plants used	GN medium + 5 gm powder of	Dry weight of mycelium (mg)	Sporulation
1	*Acorus calamus* L.	Leaf	13	+
		Rhizome	22	++
2	*Adenanthera pavonia* L.	Leaf	28	++
		Stem	30	++
		Root	42	+++

3	*Azadirachta indica* A. Juss.	Leaf	18	-
		Stem	20	+
		Root	10	+
4	*Butea monosperma* (Lam.) Taub.	Leaf	19	++
		Stem	18	++
		Root	22	++
5	*Carum copticum* Benth and Hook. F.	Leaf	12	++
		Stem	17	++
		Root	19	++
6	*Ciba pentandra*	Leaf	10	+
		Stem	19	+
		Root	20	++
7	*Croton tiglium* L.	Leaf	30	++
		Stem	38	++
		Root	32	++
8	*Cyperus rotundus* L.	Leaf	17	++
		Rhizome	10	+
9	*Eucalyptus globulus*. Labill.	Leaf	13	++
		Stem	25	++
		Root	29	++
10	*Melingtonia hortensis*	Leaf	30	++
		Stem	32	+++
		Root	37	+++
11	*Muntangia calabura* L.	Leaf	30	++
		Stem	38	++
		Root	40	+++
12	*Murraya koinigii* (L.) Spreng.	Leaf	18	++
		Stem	30	++
		Root	20	++
13	*Ocimum basilicum* L.	Leaf	07	+
		Stem	08	+
		Root	09	++
14	*Ocimum americanum* L.	Leaf	10	+
		Stem	11	-
		Root	11	+

15	*Ocimum sanctum* L.	Leaf	08	+
		Stem	10	+
		Root	19	+
16	*Ruelia tuberosa* L.	Leaf	12	+
		Stem	19	++
		Root	23	++
17	*Samania saman* (Jacq.) Merr.	Leaf	60	+++
		Stem	70	+++
		Root	55	+++
18	*Tagetis erecta* L.	Leaf	38	++
		Stem	35	++
		Root	95	++
19	Control	GN medium	80	+++

- No sporulation, + Low sporulation

++ Moderate sporulation, +++ High sporulation

5. Effect of root, stem and leaf powder of different plants on growth of common and dominant seed-borne fungus of pulses: *Fusarium moniliforme* (Table 17):

Studies were carried out to evaluate effect of root, stem and leaf powder of different plant parts on seed-borne fungus *Fusarium moniliforme*. The fungus was grown on GN medium containing 5g of plant parts powder in conical flasks. These flasks were incubated for ten days at room temperature. After incubation period dry weight of mycelium and sporulation was recorded. The fungus grown on GN medium lacking any plant parts powder served as control. The results in the table show that, almost all plants with some exception reduced the dry mycelial weight of the fungus in more or less quantity.

Table 5: Effect of root, stem and leaf powder of different plants on growth of common and dominant seed-borne fungus – *Fusarium moniliforme* (After ten days of incubation)

Sr. No.	Plants used	GN medium + 5 gm powder of	Dry weight of mycelium (mg)	Sporulation
1	*Acorus calamus* L.	Leaf	12	+
		Rhizome	28	++

2	*Adenanthera pavonia* L.	Leaf	30	++
		Stem	37	++
		Root	40	++
3	*Azadirachta indica* A. Juss.	Leaf	28	++
		Stem	21	+
		Root	22	+
4	*Butea monosperma* (Lam.) Taub.	Leaf	61	++
		Stem	68	++
		Root	55	++
5	*Carum copticum* Benth and Hook. F.	Leaf	22	++
		Stem	52	+++
		Root	28	++
6	*Ciba pentandra*	Leaf	21	++
		Stem	32	++
		Root	38	+++
7	*Croton tiglium* L.	Leaf	52	++
		Stem	40	++
		Root	58	++
8	*Cyperus rotundus* L.	Leaf	21	++
		Rhizome	29	+
9	*Eucalyptus globulus*. Labill.	Leaf	30	++
		Stem	35	++
		Root	40	++
10	*Melingtonia hortensis*	Leaf	38	++
		Stem	28	++
		Root	31	++
11	*Muntangia calabura* L.	Leaf	28	++
		Stem	32	++
		Root	39	+++
12	*Murraya koinigii* (L.) Spreng.	Leaf	38	++
		Stem	40	++
		Root	51	++
13	*Ocimum basilicum* L.	Leaf	08	+
		Stem	10	+
		Root	09	+

14	*Ocimum americanum* L.	Leaf	05	+
		Stem	12	+
		Root	10	+
15	*Ocimum sanctum* L.	Leaf	18	++
		Stem	21	++
		Root	27	++
16	*Ruelia tuberosa* L.	Leaf	19	++
		Stem	28	++
		Root	32	++
17	*Samania saman* (Jacq.) Merr.	Leaf	78	++
		Stem	90	+++
		Root	88	+++
18	*Tagetis erecta* L.	Leaf	35	++
		Stem	40	++
		Root	55	++
19	Control	GN medium	75	+++

- No sporulation, + Low sporulation

++ Moderate sporulation, +++ High sporulation

Maximum dry weight reduction was reported in case of plants *Ocimum americanum* L. (leaf 5 mg), *Ocimum basilicum* L. (leaf 8 mg, root 9 mg and stem 10 mg) followed by *Acorus calamus* L. (leaf 12 mg). *Samania saman* (Jacq.) Merr. showed stimulatory effect on dry weight (stem 90 mg and root 88 mg) and supportive action (leaf 78 mg) on the dry weight of mycelium of the test fungus. Similarly *Butea monosperma* (Lam.) Taub. could not reduce mycelial growth of the fungus much (stem 68 mg, leaf 61 mg and root 55 mg).

Sporulation was minimum due to powders of *Azadirachta indica* A. Juss (stem and root), *Ocimum basilicum* L. (all parts), *and Ocimum americanum* L. (all parts). Rest of the plants could case moderate to high sporulation of the test fungus.

6. Effect of root, stem and leaf powder of different plants on growth of common and dominant seed-borne fungus of pulses: *Rhizopus stolonifer* (Table 18):

During present work effect of root, stem and leaf powder of different plant parts on fungal growth was studied. For this, the fungus *Rhizopus stolonifer* was grown on GN media containing 5g of plant parts powder in conical flasks. These flasks were incubated for ten days at room temperature. After incubation dry mycelial weight and sporulation of the fungus *Rhizopus stolonifer* was observed.

The fungus grown on GN medium without supplementation of any plant parts powder served as control. The results in the table 6 show that, almost all plants with few exceptions inhibited growth of the test fungus. The plants that inhibited mycelial growth of the fungus maximum were *Ocimum basilicum* L. (leaf 17 mg), *Azadirachta indica* A. Juss (root 20 mg), *Ocimum americanum* L. (leaf 22 mg), *Croton tiglium* L. (leaf 27 mg) and *Ocimum sanctum* L. (leaf 27 mg). Some plants showed supportive or stimulatory activity on the test fungus, like *Tagetis erecta* L. (leaf 107 mg, stem 100 mg and root 103 mg). Least reduction in dry mycelial weight was recorded in case of plant *Acorus calamus* L. Sporulation was reduced by all plants with few exceptions. *Acorus calamus* L. reduced sporulation maximum followed by *Ocimum sanctum* L.

Table 18: Effect of root, stem and leaf powder of different plants on growth of common and dominant seed-borne fungus – *Rhizopus stolonifer* (After ten days of incubation)

Sr. No.	Plants used	GN medium + 5 gm powder of	Dry weight of mycelium (mg)	Sporulation
1	*Acorus calamus* L.	Leaf	97	+
		Rhizome	98	+
2	*Adenanthera pavonia* L.	Leaf	93	+++
		Stem	60	++
		Root	70	++
3	*Azadirachta indica* A. Juss.	Leaf	35	+
		Stem	60	++
		Root	20	+
4	*Butea monosperma* (Lam.) Taub.	Leaf	88	+++
		Stem	92	++
		Root	77	++
5	*Carum copticum* Benth and Hook. F.	Leaf	52	++
		Stem	77	++
		Root	80	+++
6	*Ciba pentandra*	Leaf	61	++
		Stem	80	++
		Root	70	+++
7	*Croton tiglium* L.	Leaf	27	+
		Stem	50	++
		Root	30	++

8	*Cyperus rotundus* L.	Leaf	32	++
		Rhizome	40	++
9	*Eucalyptus globulus*. Labill.	Leaf	52	++
		Stem	40	++
		Root	60	++
10	*Melingtonia hortensis*	Leaf	70	++
		Stem	70	++
		Root	83	++
11	*Muntangia calabura* L.	Leaf	76	++
		Stem	52	++
		Root	80	+++
12	*Murraya koinigii* (L.) Spreng.	Leaf	50	++
		Stem	68	++
		Root	67	++
13	*Ocimum basilicum* L.	Leaf	17	+
		Stem	50	++
		Root	28	+
14	*Ocimum americanum* L.	Leaf	22	+
		Stem	40	++
		Root	30	+
15	*Ocimum sanctum* L.	Leaf	27	+
		Stem	32	+
		Root	38	++
16	*Ruelia tuberosa* L.	Leaf	55	++
		Stem	60	++
		Root	40	++
17	*Samania saman* (Jacq.) Merr.	Leaf	52	++
		Stem	70	+++
		Root	58	+++
18	*Tagetis erecta* L.	Leaf	107	+++
		Stem	100	+++
		Root	103	+++
19	Control	GN medium	100	+++

- No sporulation, + Low sporulation

++ Moderate sporulation, +++ High sporulation

D) Effects of petroleum ether extracts of different plant parts on seed mycoflora and seed health of pulses

During present studies attempts were made to protect seed health in terms of seed mycoflora, seed germination, seedling emergence, shoot and root length of pulses using different plant extracts. The plant extracts were obtained in 1:1 petroleum ether and water as described in materials and methods.

Seeds of each test pulses like Green gram, Black gram, Chick pea and Pigeon pea were soaked in extracts separately for 24 hours. After soaking, these seeds were used to study seed mycoflora on blotters, seedling emergence, shoot and root length of the pulses.

1. Effect of petroleum ether extract of different plant parts on seed mycoflora and seed health (seed germination, shoot length and root length) of Green gram (*Vigna radiata* L.) by blotter method (Table19):

In order to study effect of plant extracts on seed mycoflora, seed germination, shoot and root length of Green gram. The seeds of the test pulse were soaked in petroleum ether extract for 24 hours. These soaked seeds were plated on moist blotter plates and incubated for ten days at room temperature. On eleventh day seed mycoflora, seed germination, shoot and root length were recorded. Seeds soaked in sterile distilled water without any plant parts extract served as control.

It is evident from the tabulated results that, plant extract of all test plants showed inhibitory effect on seed mycoflora and supporting or stimulatory effect on seed germination, shoot and root length of test pulse, with few exceptions.

The plants that caused maximum reduction in seed mycoflora were *Ocimum basilicum* L. (leaf 9 %, stem 10 %), *Ocimum americanum* L. (stem 10 %, root 10 % and leaf 15 %), *Azadirachta indica* A. Juss (leaf 10 %, stem 20 % and root 30 %) and *Cyperus rotundus* L. (leaf 10 % and rhizome 30 %). Plants like *Samania saman* (Jacq.) Merr. (root 60 %, leaf 50 % and stem 50 %), *Melingtonia hortensis* (root 60 % and stem 50 %) and *Croton tiglium* L. (stem 50 %) were less effective in controlling seed mycoflora of test pulse.

Enhanced seed germination and stimulatory effect was reported in plant extract of *Ocimum basilicum* L. (leaf 100 %, stem 100 % and root 100 %), *Ocimum sanctum* L. (leaf 100 %, stem 100 % and root 80 %), *Azadirachta indica* A. Juss (leaf 100 %, stem 80% and root 90 %) etc. seed germination was inhibited due to the extracts of *Ruelia tuberosa* L. (leaf 20 %) and *Acorus calamus* L. (rhizome 50 % and leaf 60%).

Table 19: Effect of petroleum ether extract (petroleum ether and water 1:1) of different plant parts on Seed mycoflora and seed health (seed germination, shoot and root length) of Green gram (*Vigna radiata* L.) on blotters (after ten days of incubation)

Sr. No.	Source plant	50% petroleum ether + 5gm powder of	Seed mycoflora (%)	Seed germination (SG)		
				SG (%)	RL (cm)	SL (cm)
1	*Acorus calamus* L.	Leaf	30	60	5.8	2.7
		Rhizome	40	50	6.7	05
2	*Adenanthera pavonia* L.	Leaf	20	60	3.1	2.1
		Stem	40	70	4.1	4.4
		Root	50	100	5.3	4.5
3	*Azadirachta indica* A. Juss.	Leaf	10	100	5.1	3.2
		Stem	20	80	5.6	3.1
		Root	30	90	5.2	4.1
4	*Butea monosperma* (Lam.) Taub.	Leaf	40	70	5.8	03
		Stem	30	90	5.5	4.1
		Root	20	100	5.6	4.5
5	*Carum copticum* Benth and Hook. f.	Leaf	42	90	5.5	3.1
		Stem	20	100	5.2	02
		Root	30	80	4.2	3.3
6	*Ciba pentandra*	Leaf	17	100	5.1	04
		Stem	21	80	06	4.7
		Root	20	90	5.3	3.1
7	*Croton tiglium* L.	Leaf	30	100	5.3	2.2
		Stem	50	90	6.3	4.3
		Root	40	90	5.6	3.8
8	*Cyperus rotundus* L.	Leaf	10	100	5.8	4.6
		Rhizome	30	70	5.2	3.3
9	*Eucalyptus globulus*. Labill.	Leaf	10	100	05	04
		Stem	10	80	4.5	3.3
		Root	20	90	5.1	4.2

10	*Melingtonia hortensis*	Leaf	42	90	05	4.2
		Stem	50	100	5.3	4.3
		Root	60	80	5.3	4.2
11	*Muntangia calabura* L.	Leaf	36	90	06	05
		Stem	20	90	5.1	4.2
		Root	20	80	5.2	03
12	*Murraya koinigii* (L.) Spreng.	Leaf	40	100	06	2.3
		Stem	27	60	04	2.9
		Root	28	100	5.6	4.3
13	*Ocimum basilicum* L.	Leaf	09	100	6.6	4.2
		Stem	10	100	06	4.7
		Root	30	100	6.4	4.1
14	*Ocimum americanum* L.	Leaf	15	80	5.3	4.1
		Stem	10	90	5.2	4.3
		Root	10	100	5.5	3.2
15	*Ocimum sanctum* L.	Leaf	20	100	06	3.1
		Stem	30	100	06	4.2
		Root	40	80	5.7	05
16	*Ruelia tuberosa* L.	Leaf	38	30	4.3	3.3
		Stem	30	90	3.6	3.1
		Root	40	60	4.2	3.3
17	*Samania saman* (Jacq.) Merr.	Leaf	50	100	5.3	3.2
		Stem	50	90	03	2.9
		Root	60	70	5.1	4.2
18	*Tagetis erecta* L.	Leaf	34	60	05	4.2
		Stem	30	100	5.3	4.3
		Root	40	90	02	03
19	Control	Sterile distilled water	60	70	05	4.6

RL – Root length, SL – Shoot length

Root length was maximum in *Acorus calamus* L. (rhizome 6.7 cm); *Ocimum basilicum* L. (leaf 6.6 cm and root 6.4 cm) and *Croton tiglium* L. (stem 6.3 cm). Root length was suppressed in *Tagetis erecta* L. (root 2 cm).

In majority of the cases there was less growth in shoot length over the control except in few cases like *Ciba pentandra* (stem 4.7 cm), *Ocimum basilicum* L. (stem 4.6 cm) and *Ocimum sanctum* L. (root 5 cm) and it was at par with control in *Cyperus rotundus* L. (leaf 4.6 cm).

2. Effect of petroleum ether extract of different plant parts on seed mycoflora and seed health (seed germination, shoot length and root length) of Black gram (*Vigna mungo* L.) by blotter method (Table 20):

During the study effect of different plant parts extract on seed mycoflora, seed germination, shoot and root length of Black gram was studied, for this the test seeds were soaked in petroleum ether extract for 24 hours. These soaked seeds were then plated on moist blotter plates and incubated for ten days at room temperature. After incubation seed mycoflora, seed germination, shoot and root length was recorded. The seeds soaked in sterile distilled water served as control.

The results presented in the table 44 show that, almost all plants showed restrictive effect on seed mycoflora and stimulatory or supportive activity on seed germination, shoot and root length in more or less quantity.

Maximum seed mycoflora was reduced by the plant extract of *Ocimum americanum* L. (stem 10 % and leaf 20 %), *Ocimum basilicum* L. (leaf 20 % and stem 22 %), *Cyperus rotundus* L. (rhizome 22 % and leaf 30 %) and *Murraya koinigii* (L.) Spreng. (leaf 22 %). Increased seed mycoflora over the control was noticed in *Carum copticum* Benth and Hook f. (root 60 %), *Murraya koinigii* (L.) Spreng. (stem 60 %) and *Samania saman* (Jacq.) Merr. (leaf 70 %, root 60 %). Seed mycoflora at par with control was found in *Melingtonia hortensis* (root), *Murraya koinigii* (L.) Spreng. (root), *Ruelia tuberosa* L. (stem) and *Tagetis erecta* L. (leaf).

Many plants (fourteen) showed enhancing effect on seed germination of the pulse. A few are *Azadirachta indica* A. Juss (leaf 100 % and root 100 %), *Butea monosperma* (Lam.) Taub. (stem 100 %), *Carum copticum* Benth and Hook. f. (root 100 %), *Cyperus rotundus* L. (rhizome 100 %) etc. Some of plant extracts showed reduced root length, however few extracts stimulated root length, *Ocimum basilicum* L. (leaf 6.5 cm, stem 6.8 cm) and *Ocimum sanctum* L. (root 6.2 cm). Increase in shoot length over the control was noticed in the seeds treated with majority of plant extracts.

Table 20: Effect of petroleum ether extract (petroleum ether and water 1:1) of different plant parts on Seed mycoflora and seed health (seed germination, shoot and root length) of Black gram (*Vigna mungo* L.) on blotters (after ten days of incubation)

Sr. No.	Source plant	50% petroleum ether +5gm powder of	Seed mycoflora (%)	Seed germination (SG)		
				SG (%)	RL (cm)	SL (cm)
1	*Acorus calamus* L.	Leaf	30	80	5.2	5.2
		Rhizome	40	90	05	05
2	*Adenanthera pavonia* L.	Leaf	30	100	5.8	5.8
		Stem	30	90	4.9	4.9
		Root	40	90	05	05
3	*Azadirachta indica* A. Juss.	Leaf	40	100	2.4	2.4
		Stem	30	90	5.6	5.6
		Root	30	100	4.8	4.8
4	*Butea monosperma* (Lam.) Taub.	Leaf	21	80	5.3	5.3
		Stem	32	100	5.2	5.2
		Root	40	90	05	05
5	*Carum copticum* Benth and Hook. f.	Leaf	30	80	5.6	5.6
		Stem	20	90	04	04
		Root	60	100	05	05
6	*Ciba pentandra*	Leaf	12	90	05	05
		Stem	40	80	5.3	5.3
		Root	20	90	5.1	5.1
7	*Croton tiglium* L.	Leaf	30	100	4.8	4.8
		Stem	47	70	4.3	4.3
		Root	40	80	5.1	5.1
8	*Cyperus rotundus* L.	Leaf	30	100	5.2	5.2
		Rhizome	22	100	4.6	4.6
9	*Eucalyptus globulus*. Labill.	Leaf	25	100	5.2	5.2
		Stem	37	90	04	04
		Root	38	40	3.4	3.4

10	*Melingtonia hortensis*	Leaf	32	70	5.3	5.3
		Stem	40	90	5.3	5.3
		Root	50	40	5.6	5.6
11	*Muntangia calabura* L.	Leaf	29	70	04	04
		Stem	40	65	05	05
		Root	40	70	5.5	5.5
12	*Murraya koinigii* (L.) Spreng.	Leaf	22	88	5.1	5.1
		Stem	60	90	5.8	5.8
		Root	50	76	05	05
13	*Ocimum basilicum* L.	Leaf	20	80	6.5	6.5
		Stem	22	80	6.8	6.8
		Root	29	70	4.8	4.8
14	*Ocimum americanum* L.	Leaf	20	70	2.6	2.6
		Stem	10	100	3.9	3.9
		Root	20	100	4.5	4.5
15	*Ocimum sanctum* L.	Leaf	27	60	06	06
		Stem	23	90	5.9	5.9
		Root	30	80	6.2	6.2
16	*Ruelia tuberosa* L.	Leaf	30	60	5.1	5.1
		Stem	50	100	5.1	5.1
		Root	40	40	04	04
17	*Samania saman* (Jacq.) Merr.	Leaf	70	100	03	03
		Stem	40	40	03	03
		Root	60	80	5.2	5.2
18	*Tagetis erecta* L.	Leaf	50	90	5.2	5.2
		Stem	30	100	05	05
		Root	40	90	2.9	2.9
19	Control	Sterile distilled water	50	60	6.0	3.5

RL – Root length, SL – Shoot length

3. Effect of petroleum ether extract of different plant parts on seed mycoflora and seed health (seed germination, shoot length and root length) of Chick pea (*Cicer arietinum* L.) by blotter method (Table 21):

In order to study effect of plant extracts on seed mycoflora, seed germination, shoot and root length of Chick pea. The seeds of the test pulse were soaked in petroleum ether extract for 24 hours. These soaked seeds were plated on moist blotter plates and incubated for ten days at room temperature. On eleventh day seed mycoflora, seed germination, shoot and root length were recorded, the seeds soaked in sterile distilled water served as control.

Table 21: Effect of petroleum ether extract (petroleum ether and water 1:1) of different plant parts on Seed mycoflora and seed health (seed germination, shoot and root length) of Chick pea (*Cicer arietinum* L.) on blotters (after ten days of incubation)

Sr. No.	Source plant	50% petroleum ether + 5gm powder of	Seed mycoflora (%)	Seed germination (SG)		
				SG (%)	RL (cm)	SL (cm)
1	*Acorus calamus* L.	Leaf	33	70	5.7	4.6
		Rhizome	50	70	05	2.8
2	*Adenanthera pavonia* L.	Leaf	20	70	06	2.7
		Stem	60	50	5.7	4.0
		Root	30	70	4.8	2.9
3	*Azadirachta indica* A. Juss.	Leaf	18	100	06	4.0
		Stem	22	77	5.5	2.8
		Root	30	80	6.5	3.8
4	*Butea monosperma* (Lam.) Taub.	Leaf	20	90	4.7	2.8
		Stem	28	100	3.7	3.0
		Root	50	70	5.5	3.5
5	*Carum copticum* Benth and Hook. f.	Leaf	27	100	6.1	3.2
		Stem	31	70	5.7	2.7
		Root	22	100	5.7	3.6
6	*Ciba pentandra*	Leaf	30	100	06	03
		Stem	36	60	05	3.7
		Root	28	90	6.1	4.5

7	*Croton tiglium* L.	Leaf	30	80	5.9	3.2
		Stem	24	70	5.7	4.3
		Root	40	80	4.1	3.2
8	*Cyperus rotundus* L.	Leaf	30	80	4.6	3.0
		Rhizome	18	77	5.3	4.3
9	*Eucalyptus globulus*. Labill.	Leaf	23	100	3.6	2.3
		Stem	37	90	05	4.0
		Root	42	90	5.1	4.3
10	*Melingtonia hortensis*	Leaf	50	80	5.5	4.0
		Stem	20	90	5.5	3.3
		Root	70	70	5.1	3.2
11	*Muntangia calabura* L.	Leaf	29	90	06	2.7
		Stem	10	70	4.3	3.0
		Root	30	100	4.1	2.7
12	*Murraya koinigii* (L.) Spreng.	Leaf	29	100	05	3.6
		Stem	36	90	5.9	3.9
		Root	40	55	05	3.6
13	*Ocimum basilicum* L.	Leaf	08	100	5.9	4.7
		Stem	10	80	05	3.1
		Root	30	60	06	3.8
14	*Ocimum americanum* L.	Leaf	13	80	05	4.2
		Stem	20	77	07	4.3
		Root	31	90	6.3	0.3
15	*Ocimum sanctum* L.	Leaf	10	100	05	0.4
		Stem	12	90	3.2	1.7
		Root	40	100	06	3.5
16	*Ruelia tuberosa* L.	Leaf	40	90	03	3.0
		Stem	20	70	5.1	4.3
		Root	10	100	4.5	3.2
17	*Samania saman* (Jacq.) Merr.	Leaf	30	100	05	3.6
		Stem	20	70	4.7	3.4
		Root	25	100	06	3.5

18	*Tagetis erecta* L.	Leaf	30	100	06	3.4
		Stem	40	80	4.3	3.0
		Root	30	100	5.5	3.6
19	Control	Sterile distilled water	55	70	5.8	4.1

RL – Root length, SL – Shoot length

The results shows that, almost all plant extracts showed inhibitory effect on seed mycoflora and stimulatory effect on seed germination shoot and root length, with few exceptions in more or less quantity.

Maximum inhibitory effects on seed mycoflora were shown by *Ocimum basilicum* L. (leaf 8 % and stem 10 %), *Ocimum sanctum* L. (leaf 10 % and stem 12 %), *Ocimum americanum* L. (leaf 13 %) and *Cyperus rotundus* L. (rhizome 18 %). Increase in seed mycoflora over the control was noticed in case of *Adenanthera pavonia* L. (stem 60 %) and *Melingtonia hortensis* (root 70 %).

Increase in shoot length was reported in *Ocimum americanum* L. (stem 7 cm), followed by *Muntangia calabura* L. (leaf 6 cm) and *Samania saman* (Jacq.) Merr. (root 6 cm). Maximum increase in root length was recorded in *Ocimum basilicum* L. (leaf 4.7 cm).

4. Effect of petroleum ether extract of different plant parts on seed mycoflora and seed health (seed germination, shoot length and root length) of Pigeon pea (*Cajanus cajan* L.) by blotter method (Table 22):

In order to study effect of plant extracts on seed mycoflora, seed germination, shoot and root length of Pigeon pea. The seeds of the test pulse were soaked in petroleum ether extract for 24 hours. These soaked seeds were plated on moist blotter plates and incubated for ten days at room temperature.

On eleventh day seed mycoflora, seed germination, shoot and root length were recorded, the seeds soaked in sterile distilled water served as control. The results presented in the table suggests that, all test plants showed restrictive effect on seed mycoflora and stimulatory action on seed germination, shoot and root length in more of less degree, with few exceptions.

Table 22: Effect of petroleum ether extract (petroleum ether and water 1:1) of different plant parts on Seed mycoflora and seed health (seed germination, shoot and root length) of Pigeon pea (*Cajanus cajan* L.) on blotters (after ten days of incubation)

Sr. No.	Source plant	50% petroleum ether +5gm powder of	Seed mycoflora (%)	Seed germination (SG)		
				SG (%)	RL (cm)	SL (cm)
1	*Acorus calamus* L.	Leaf	60	80	5.2	03
		Rhizome	20	90	1.1	3.6
2	*Adenanthera pavonia* L.	Leaf	18	80	4.2	1.1
		Stem	23	60	5.3	3.9
		Root	27	90	4.2	3.5
3	*Azadirachta indica* A. Juss.	Leaf	30	100	3.7	2.7
		Stem	20	100	3.9	2.8
		Root	50	100	6.3	2.8
4	*Butea monosperma* (Lam.) Taub.	Leaf	50	100	5.3	2.9
		Stem	30	80	4.8	2.9
		Root	32	100	06	3.2
5	*Carum copticum* Benth and Hook. f.	Leaf	33	100	5.6	3.7
		Stem	30	80	5.2	3.8
		Root	40	100	06	03
6	*Ciba pentandra*	Leaf	22	90	4.7	04
		Stem	32	70	3.1	02
		Root	20	20	06	2.9
7	*Croton tiglium* L.	Leaf	27	100	05	3.2
		Stem	36	80	05	2.2
		Root	48	90	06	2.9
8	*Cyperus rotundus* L.	Leaf	20	100	05	2.7
		Rhizome	22	90	6.1	3.3
9	*Eucalyptus globulus*. Labill.	Leaf	20	100	06	3.3
		Stem	12	70	5.3	2.7
		Root	18	100	5.4	3.6

10	*Melingtonia hortensis*	Leaf	10	70	5.6	2.7
		Stem	30	60	5.1	3.2
		Root	10	90	4.3	3.5
11	*Muntangia calabura* L.	Leaf	14	60	05	2.1
		Stem	30	20	4.6	1.1
		Root	60	100	05	3.5
12	*Murraya koinigii* (L.) Spreng.	Leaf	10	90	05	02
		Stem	20	50	06	2.4
		Root	20	100	5.6	1.9
13	*Ocimum basilicum* L.	Leaf	12	100	5.8	3.4
		Stem	10	90	06	04
		Root	20	90	6.1	3.3
14	*Ocimum americanum* L.	Leaf	10	80	05	4.2
		Stem	10	100	5.6	3.7
		Root	20	81	5.8	3.3
15	*Ocimum sanctum* L.	Leaf	23	80	5.6	3.6
		Stem	10	90	5.8	3.3
		Root	20	60	5.9	3.7
16	*Ruelia tuberosa* L.	Leaf	40	30	5.2	3.4
		Stem	50	25	4.7	01
		Root	30	100	4.1	2.2
17	*Samania saman* (Jacq.) Merr.	Leaf	30	70	5.8	3.4
		Stem	55	100	06	03
		Root	55	90	5.7	3.3
18	*Tagetis erecta* L.	Leaf	60	80	5.5	3.2
		Stem	30	100	05	2.9
		Root	28	90	4.7	3.5
19	Control	Sterile distilled water	60	60	5.5	3.1

RL – Root length, SL – Shoot length

Seed mycoflora was suppressed maximum due to plant extracts of *Ocimum americanum* L. (leaf 10 % and stem 10 %), *Ocimum sanctum* L. (stem 10 %), *Ocimum basilicum* L. (stem 10 %), *Melingtonia hortensis* (leaf 10 % and root 10 %), *Acorus calamus* L. (rhizome 20 %) etc. Seed mycoflora at par with control was recorded in extract of *Acorus calamus* L. (leaf 60 %), *Muntangia calabura* L. (root 60 %) and *Tagetis erecta* L. (leaf 60 %).

Seed germination was stimulated due to majority of plant extracts with maximum being due to *Acorus calamus* L., *Azadirachta indica* A. Juss, *Butea monosperma* (Lam.) Taub. *Carum copticum* Benth and Hook. f., *Croton tiglium* L., *Eucalyptus globulus*. Labill., *Ocimum basilicum* L., *Samania saman* (Jacq.) Merr. and *Tagetis erecta* L. In few plant extracts like *Ciba pentandra* (root 20 %), *Muntangia calabura* L. (stem 20 %), *Murraya koinigii* (L.) Spreng. (stem 50 %) and *Ruelia tuberosa* L. (leaf 30 % and stem 30 %) seed germination was inhibited. In majority of the plant extracts root and shoot length was increased over the control with few exceptions.

5. Effect of petroleum ether extract of different plant parts on seed health (seedling emergence, shoot length and root length) of Green gram (*Vigna radiata* L.) by pot cultivation method (Table 23):

In order to study effect of plant extracts on seedling emergence, shoot and root length of Green gram. The seeds of the test pulse were soaked in petroleum ether extract for 24 hours. These soaked seeds were sown in earthen pots containing sterilized soil and grown for ten days at room temperature. On eleventh day seedling emergence, shoot and root length were recorded, the seeds soaked in sterile distilled water served as control.

It is evident from the tabulated result that, all the plant parts extract were found to be supportive or stimulatory for seedling emergence, shoot and root length of the test pulse in more or less degree, with minor exceptions.

There is seedling emergence with stimulatory effect by some plants like *Ocimum basilicum* L., *Ocimum americanum* L. (leaf 100 %) followed by *Ocimum sanctum* L. and *Azadirachta indica* A. Juss (leaf 100 % each). Minimum seedling emergence was shown by *Murraya koinigii* (L.) Spreng. (stem 30 %) and *Adenanthera pavonia* L. (root 40 %), rest of the plants were with more or less supportive effect on seedling emergence.

Table 23: Effect of petroleum ether extract (petroleum ether and water 1:1) of different plant parts on seed health (seedling emergence, shoot length and root length) of Green gram (*Vigna radiata* L.) after ten days of sowing

Sr. No.	Source plant	50% petroleum ether + 5gm powder of	Seedling emergence		
			Seedling emergence (%)	RL (cm)	SL (cm)
1	*Acorus calamus* L.	Leaf	60	12	13
		Rhizome	50	14	14.2
2	*Adenanthera pavonia* L.	Leaf	50	13.1	14
		Stem	70	12.5	13
		Root	40	15.5	14.3
3	*Azadirachta indica* A. Juss.	Leaf	100	15	15.2
		Stem	80	14	13.3
		Root	82	13.3	15
4	*Butea monosperma* (Lam.) Taub.	Leaf	60	12	13.2
		Stem	50	10.3	11.3
		Root	80	11.2	10.3
5	*Carum copticum* Benth and Hook. f.	Leaf	60	12.2	13
		Stem	80	13	12.2
		Root	50	12.5	14
6	*Ciba pentandra*	Leaf	50	12.2	12.4
		Stem	70	11.1	10.2
		Root	80	15.2	14.3
7	*Croton tiglium* L.	Leaf	60	12.2	13
		Stem	50	13	13.4
		Root	80	12.2	13
8	*Cyperus rotundus* L.	Leaf	85	15.1	16
		Rhizome	90	16	16.5
9	*Eucalyptus globules*. Labill.	Leaf	60	15.4	15.6
		Stem	60	15.8	14.5
		Root	80	12.1	13

10	*Melingtonia hortensis*	Leaf	50	12	10
		Stem	50	13	13.5
		Root	60	09	10
11	*Muntangia calabura* L.	Leaf	70	08	06
		Stem	60	08	08
		Root	70	10	12
12	*Murraya koinigii* (L.) Spreng.	Leaf	60	07	10
		Stem	30	5.6	05
		Root	70	7.6	08
13	*Ocimum basilicum* L.	Leaf	100	18	16.5
		Stem	90	15.4	15
		Root	90	12	11.3
14	*Ocimum americanum* L.	Leaf	100	16	16.2
		Stem	80	15.2	15
		Root	90	14.5	15
15	*Ocimum sanctum* L.	Leaf	100	16.4	15
		Stem	80	15	15.3
		Root	80	15.4	14.8
16	*Ruelia tuberosa* L.	Leaf	60	12.2	13
		Stem	80	15	15.2
		Root	50	12.3	14
17	*Samania saman* (Jacq.) Merr.	Leaf	50	09	11
		Stem	60	08	08
		Root	70	06	10
18	*Tagetis erecta* L.	Leaf	80	11	12
		Stem	60	11.3	13
		Root	50	12.2	12
19	Control	Sterile distilled water	50	13	14

RL – Root length, SL – Shoot length

Root length was much better in *Ocimum basilicum* L. (leaf 18 cm) compared to control, followed by *Ocimum sanctum* L. (leaf 16.4 cm). Root length reduction over control was noticed in *Murraya koinigii* (L.) Spreng. (stem 5.6 cm) followed by *Samania saman*

(Jacq.) Merr. Shoot length was better in *Ocimum basilicum* L. (16.5 cm) compared to control and other plant extracts.

6. Effect of petroleum ether extract of different plant parts on seed health (seedling emergence, shoot length and root length) of Black gram (*Vigna mungo* L.) by pot sowing method (Table 24):

In order to study effect of plant extracts on seedling emergence, shoot and root length of Black gram. The seeds of the test pulse were soaked in petroleum ether extract for 24 hours. These soaked seeds were sown in earthen pots containing sterilized soil and grown for ten days at room temperature. On eleventh day seedling emergence, shoot and root length were recorded and presented in the table, the seeds soaked in distilled water served as control.

It is evident from the tabulated result that, all the plant extracts were found to be supportive or stimulatory for seedling emergence, shoot and root length of the test pulse in more or less degree, with some exceptions. Maximum seedling emergence was reported in the plants like *Azadirachta indica* A. Juss (leaf 100 %), *Cyperus rotundus* L. (rhizome 100 %), *Ocimum basilicum* L. (leaf 100 %) and *Ocimum sanctum* L. (leaf 100 %). These plant extracts showed stimulatory activity on the test pulse for seedling emergence. Majority of plant extracts were having stimulatory effects on root length, *Ocimum sanctum* L. (stem) and *Cyperus rotundus* L. rhizome

Table 24: Effect of petroleum ether extract (petroleum ether and water 1:1) of different plant parts on seed health (seedling emergence, shoot length and root length) of Black gram (*Vigna mungo* L.) after ten days of sowing

Sr. No.	Source plant	50% petroleum ether+5gm powder of	Seedling emergence		
			Seedling emergence (%)	RL (cm)	SL (cm)
1	*Acorus calamus* L.	Leaf	80	10.2	11
		Rhizome	60	12.3	12.5
2	*Adenanthera pavonia* L.	Leaf	55	12.3	13
		Stem	67	13.3	14
		Root	70	15	15

3	*Azadirachta indica* A. Juss.	Leaf	100	16	16.3
		Stem	90	13.4	14
		Root	78	12	10
4	*Butea monosperma* (Lam.) Taub.	Leaf	90	09	11
		Stem	70	08	10
		Root	60	12	12.5
5	*Carum copticum* Benth and Hook. f.	Leaf	50	11	12.4
		Stem	40	13.4	14.3
		Root	70	15	14.3
6	*Ciba pentandra*	Leaf	80	16	15.2
		Stem	50	15.4	14
		Root	70	11.3	13
7	*Croton tiglium* L.	Leaf	55	12.2	10
		Stem	60	10	11
		Root	40	08	10
8	*Cyperus rotundus* L.	Leaf	90	15.5	15
		Rhizome	100	16.3	17
9	*Eucalyptus globulus*. Labill.	Leaf	90	14.2	12.5
		Stem	50	12.3	13.2
		Root	50	14.5	14.8
10	*Melingtonia hortensis*	Leaf	60	15	16
		Stem	40	10	10.3
		Root	50	08	11
11	*Muntangia calabura* L.	Leaf	15	07	07
		Stem	40	12	12.3
		Root	40	11	12.3
12	*Murraya koinigii* (L.) Spreng.	Leaf	90	14	15
		Stem	30	12	10
		Root	80	13	13
13	*Ocimum basilicum* L.	Leaf	100	11.4	11
		Stem	80	10.8	09
		Root	77	12.2	13

14	*Ocimum americanum* L.	Leaf	98	15.5	12.3
		Stem	80	14.8	15
		Root	72	13.8	15
15	*Ocimum sanctum* L.	Leaf	100	15.4	14
		Stem	80	16.3	15.3
		Root	67	17	15.6
16	*Ruelia tuberosa* L.	Leaf	50	12	13
		Stem	90	12.4	13
		Root	70	10	11
17	*Samania saman* (Jacq.) Merr.	Leaf	60	11	10
		Stem	80	10.4	11
		Root	55	12.2	12
18	*Tagetis erecta* L.	Leaf	60	09	11
		Stem	40	05	09
		Root	50	12	10
19	Control	Sterile distilled water	57	12.5	11.3

RL – Root length, SL – Shoot length

7. Effect of petroleum ether extract of different plant parts on seed health (seedling emergence, shoot length and root length) of Chick pea (*Cicer arietinum* L.) by pot cultivation method (Table 25):

In order to study effect of plant extracts on seedling emergence, shoot and root length of Chick pea. The seeds of the test pulse were soaked in petroleum ether extract for 24 hours. These soaked seeds were sown equidistance in earthen pots containing sterilized soil and grown for ten days at room temperature. On eleventh day seedling emergence, shoot and root length were recorded, seeds soaked in sterile distilled water served as control.

It is evident from the tabulated result that, all the plant extracts were found to be supportive or stimulatory for seedling emergence, shoot and root length of the test pulse in more or less degree, with some exceptions.

Table 25: Effect of petroleum ether extract (petroleum ether and water 1:1) of different plant parts on seed health (seedling emergence, shoot length and root length) of Chick pea (*Cicer arietinum* L.) after ten days of sowing

Sr. No.	Source plant	50% petroleum ether + 5gm powder of	Seedling emergence		
			Seedling emergence (%)	RL (cm)	SL (cm)
1	*Acorus calamus* L.	Leaf	50	10	09
		Rhizome	40	12	10
2	*Adenanthera pavonia* L.	Leaf	70	9.3	09
		Stem	50	11.2	10
		Root	60	08	09
3	*Azadirachta indica* A. Juss.	Leaf	100	12	13
		Stem	90	13	12
		Root	78	14	11
4	*Butea monosperma* (Lam.) Taub.	Leaf	50	12.3	10
		Stem	80	09	08
		Root	60	12.3	11
5	*Carum copticum* Benth and Hook. f.	Leaf	60	11	11.2
		Stem	70	10.2	11
		Root	50	09	07
6	*Ciba pentandra*	Leaf	50	15	10
		Stem	60	14	13
		Root	40	10	08
7	*Croton tiglium* L.	Leaf	50	12.3	09
		Stem	40	11	09
		Root	60	09	07
8	*Cyperus rotundus* L.	Leaf	80	16.3	15
		Rhizome	93	15.5	10
9	*Eucalyptus globulus*. Labill.	Leaf	100	12.3	10
		Stem	88	10	12.8
		Root	83	11	12

10	*Melingtonia hortensis*	Leaf	70	05	04
		Stem	40	12	10
		Root	60	12.3	11.3
11	*Muntangia calabura* L.	Leaf	70	11	12.4
		Stem	50	11.5	12
		Root	40	08	07
12	*Murraya koinigii* (L.) Spreng.	Leaf	55	12.3	11
		Stem	80	14	13.2
		Root	90	12	10
13	*Ocimum basilicum* L.	Leaf	90	07	08
		Stem	80	06	07
		Root	70	12	10
14	*Ocimum americanum* L.	Leaf	100	13.5	11
		Stem	87	11	12
		Root	80	09	10
15	*Ocimum sanctum* L.	Leaf	92	15.6	14
		Stem	100	13	12.5
		Root	80	12	11
16	*Ruelia tuberosa* L.	Leaf	100	12.3	11
		Stem	60	11	12.3
		Root	70	10.2	10
17	*Samania saman* (Jacq.) Merr.	Leaf	60	03	02
		Stem	80	02	03
		Root	50	12	10
18	*Tagetis erecta* L.	Leaf	60	07	06
		Stem	40	06	08
		Root	12	12	11.2
19	Control	Sterile distilled water	56	12	10

RL – Root length, SL – Shoot length

There was maximum seedling emergence due to plant extracts of *Azadirachta indica* A. Juss (leaf 100 %), *Eucalyptus globulus*. Labill. (leaf 100 %), *Ocimum americanum* L. (leaf

100 %), *Ocimum sanctum* L. (stem 100 %) and *Ruelia tuberosa* L. (leaf 100 %). These plant extracts showed stimulatory effects on seedling emergence (control 56 %).

Shoot and root lengths were stimulated due to extracts of *Cyperus rotundus* L. (leaf 16.3 cm) and *Ocimum sanctum* L. (leaf 14 cm). some extracts had inhibitory effects on shoot and root length. 16.3 cm each, *Ocimum americanum* L. leaf 15.5 cm, *Ocimum sanctum* L. leaf and *Ciba pentandra* stem 15.4 cm each etc.

Most of the plant extracts had stimulatory effects on root and shoot length. Maximum stimulatory effect was seen in *Cyperus rotundus* L. (rhizome 17 cm), *Azadirachta indica* A. Juss (leaf 16.3 cm), *Ocimum sanctum* L. (root 15.6 cm and stem 15.3 cm) etc. Few extracts were having inhibitory effect on shoot length.

8. Effect of petroleum ether extract of different plant parts on seed health (seedling emergence, shoot length and root length) of Pigeon pea (*Cajanus cajan* L.) by pot cultivation method (Table 26).

In order to study effect of plant extracts on seedling emergence, shoot and root length of Pigeon pea. The seeds of the test pulse were soaked in petroleum ether extract for 24 hours. These soaked seeds were sown in earthen pots containing sterilized soil and grown for ten days at room temperature. On eleventh day seedling emergence, shoot and root length were recorded, seeds soaked in sterile distilled water served as control.

It is evident from the tabulated result that, almost all the plant extracts were found to be supportive or stimulatory for seedling emergence, shoot and root length of the test pulse in more or less degree, with few exceptions.

Leaf extracts of *Azadirachta indica* A. Juss, *Eucalyptus globulus*. Labill., *Ocimum americanum* L., *Ruelia tuberosa* L. and stem extracts of *Ocimum sanctum* L. were stimulatory to seedling emergence (60-100 % and control 56 %). seedling emergence was inhibited in stem (40 %) extracts of *Tagetis erecta* L.

Maximum stimulation in root length was recorded in plant extract of *Cyperus rotundus* L. (leaf 16.3 cm), where as it was inhibited maximum in stem extract of *Samania saman* (Jacq.) Merr. (2 cm). shoot length was reported maximum in *Muntangia calabura* L. (leaf 15.2 cm) and least in *Samania saman* (Jacq.) Merr. (leaf 6 cm).

Table 24: Effect of petroleum ether extract (petroleum ether and water 1:1) of different plant parts on seed health (seedling emergence, shoot length and root length) of Pigeon pea (*Cajanus cajan* L.) after ten days of sowing

Sr. No.	Source plant	50% petroleum ether + 5gm powder of	seedling emergence		
			Seedling emergence (%)	RL (cm)	SL (cm)
1	*Acorus calamus* L.	Leaf	50	10	08
		Rhizome	80	12	10
2	*Adenanthera pavonia* L.	Leaf	70	15.2	14
		Stem	60	14	12
		Root	50	12	11
3	*Azadirachta indica* A. Juss.	Leaf	90	13.3	12
		Stem	80	15.6	13.1
		Root	93	14	12.3
4	*Butea monosperma* (Lam.) Taub.	Leaf	70	13	11
		Stem	60	12	12
		Root	50	11	12
5	*Carum copticum* Benth and Hook. f.	Leaf	40	11	09
		Stem	30	10	11
		Root	50	10.3	10
6	*Ciba pentandra*	Leaf	70	12.3	12.3
		Stem	80	15.2	14
		Root	60	17	15
7	*Croton tiglium* L.	Leaf	70	16	13
		Stem	60	12	11
		Root	50	10	08
8	*Cyperus rotundus* L.	Leaf	86	16.3	10
		Rhizome	90	10.4	09
9	*Eucalyptus globulus*. Labill.	Leaf	100	11.4	11
		Stem	83	11	08
		Root	90	12	07

10	*Melingtonia hortensis*	Leaf	80	13.6	12
		Stem	70	14.2	15
		Root	80	12.2	13
11	*Muntangia calabura* L.	Leaf	60	08	09
		Stem	70	12.3	13
		Root	60	14	15.2
12	*Murraya koinigii* (L.) Spreng.	Leaf	50	15	14
		Stem	70	16.2	13.4
		Root	80	14.2	12.5
13	*Ocimum basilicum* L.	Leaf	82	16	14.5
		Stem	78	15.3	14
		Root	77	14.3	15
14	*Ocimum americanum* L.	Leaf	100	16	13
		Stem	83	16.2	15
		Root	90	12	10
15	*Ocimum sanctum* L.	Leaf	90	15	12
		Stem	80	15.2	13
		Root	68	11	10
16	*Ruelia tuberosa* L.	Leaf	60	12	12
		Stem	80	08	10
		Root	70	04	08
17	*Samania saman* (Jacq.) Merr.	Leaf	60	16	06
		Stem	40	02	12
		Root	20	12.4	11
18	*Tagetis erecta* L.	Leaf	30	11.1	10
		Stem	40	09	10
		Root	90	11	10
19	Control	Sterile distilled water	40	10.7	10

RL – Root length, SL – Shoot length

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DISCUSSION

Nature has provided all the means to sustain over the period of time. There are different developmental means through artificialities. These artificialities are growing beyond the limits of natural sustenance. Practice of artificial synthetic chemicals has been a tool for many generations to control microbial menace to the plants. The persistent use of these synthetic fungicides, pesticides has lead our ecosystems on verge of devastation. We are now suffering the dangerous fallouts of unbridled application of pest controls. It is now high time to rethink over the calamities that we are facing. Therefore, use and application of plant oriented fungicides and pesticides are becoming mandatory in order to salvage our ecosystem.

During present work, pulses like Green gram, Black gram, Chickpea, and Pigeon pea were studied for their seed-borne fungi and their effects on the seeds. The role of different seed-borne fungi in inhibiting seed germination, seedling emergence, shoot length and root length was investigated. The ensuing fungal inhibitory effect is attributed to the biochemical secretions of the fungi, given out during the course of infection to the seeds of pulses. Considering different adverse effects of fungal activities on seeds of different pulses, studies were carried out to investigate potential of different plant extracts to control the seed mycoflora and its effects on seed health of pulses.

Seeds were plated on moist blotter papers and agar plates **(ISTA, 1966)** for screening of seed-borne fungi of the test pulses. The seeds of Green gram and Black gram showed sixteen fungi each, Chick pea showed seventeen fungi and Pigeon pea showed fourteen fungi as their seed mycoflora. The most dominant fungi on all the test pulses were *Aspergillus flavus, Aspergillus fumigatus, Aspergillus niger, Drechslera tetramera, Fusarium moniliforme* and *Rhizopus stolonifer*.

It has been reported that, seed mycoflora was more on agar plates than on moist blotter paper in all test pulses. This suggests that nutrient from the medium might have played an important role for luxuriant growth of fungi. But the fungi reported on moist blotters were exclusively grown on the seed content therefore these fungi were more exclusive to the respective seeds of pulses. Similar observations were made by Panchal (1984) on Jowar and in some legumes (Bhikane, 1988). It was observed that, *Chetomium globosum*, *Cladosporium* spp. *Colletotrichum truncatum* were almost absent or negligible as seed mycoflora of test pulses, probably due to predominance or antagonistic effects of fungi like *Aspergillus niger*, *Aspergillus flavus, Aspergillus fumigatus*, *Fusarium moniliforme*,

Drechslera tetramera etc. Similar evidences have been given by Aulakh *et al.* (1976), where they found that, in agar plate *Aspergillus niger*, *Penicillium* spp. and *Rhizopus* spp. suppressed the growth of other fungi on Maize seeds. The artificially infested seeds of pulses indicate that, there is considerable reduction in seed germination, shoot length and root length of test pulses. These seeds also showed marked reduction in seedling emergence.

The fungi *Aspergillus niger*, *Aspergillus flavus* and *Drechslera tetramera* caused maximum loss in seed germination, seedling emergence, shoot length and root length of all the test seeds of pulses.

The seed-borne fungi affect seed health of pulses by affecting seed germination, shoot length and root length. This can be due to different toxic bio-chemicals produced by seed-borne fungi during pathogenesis, which counters growth regulators needed for germination and emergence. Panchal (1984) also found inhibition of seed germination and seedling emergence in Jowar due to seed mycoflora. The results show that, *Aspergillus niger, Aspergillus flavus, Drechslera tetramera* were common and dominant seed-borne fungi of pulses that affected most adversely to the seed germination, shoot length and root length of all test pulses. It is also noted that, *Fusarium moniliforme* in case of Green gram stimulated root length, *Aspergillus flavus* in case of Black gram completely inhibited root growth and in case of Pigeon pea stimulated root length and *Aspergillus niger* in case of Pigeon pea completely inhibited shoot length. This suggests that, some fungal bio-chemicals have strong inhibitory actions on seed health and at the same time have stimulatory effects. Mathur *et al.* (1975) found that, species of *Fusarium* produced different abnormalities in germinating seeds of Jowar. Bhale *et al.* (1982) observed seedling blight in Jowar due to *Curvularia lunata* and *Fusarium moniliforme*. Thakur and Prasad (1983) reported inhibitory nature of *Fusarium moniliforme* in Wheat seed germination. Danai (1994) reported variable percentage inhibition of seed germination of Bajra, Maize and Wheat infested with *Aspergillus* spp. Giri and Patel (1999) reported seed discoloration and inhibition of seed germination due to *Bipolaris sorokiniana* in Wheat. Niranjana *et al.* (2000) observed reduced seed germination and seedling emergence in case of musk melon due to dominant and pathogenic seed-borne fungi. Dhingra *et al.* (2003) suggested that, seed-borne fungal pathogens reduced seedling emergence and quality of seeds of *Dalbergia nigra* in Brazil. High infestation of fungi on seeds of Chick pea adversely affected the germination (Arshad Javaid *et al.*, 2005). Similarly *Alternaria alternata*, *Botrytis cinerea* and *Myrothecium verrucaria* detected from pepper or bell paper seeds were pathogenic to

the fruits and seedling after artificial inoculation (Nishikawa *et al.*, 2006). During present study different plant parts powders were tried in order to control seed-borne fungi. Among all tested plants *Ocimum americanum* L., *Ocimum basilicum* L., *Ocimum sanctum* L., *Azadirachta indica* A. Juss, *Cyperus rotundus* L., *Eucalyptus lanceolatus*, *Murraya koinigii* (L.) Spreng. were found to be effective in reducing seed mycoflora of the test pulses. These plant powders found to reduce dry mycelial weight and sporulation of the common and dominant seed-borne fungi of pulses. *Croton tiglium* L. and *Tagetis erecta* L. in case of *Aspergillus niger* and *Aspergillus flavus*, *Murraya koinigii* (L.) Spreng. and *Samania saman* (Jacq.) Merr. in case of *Aspergillus fumigatus* and *Rhizopus stolonifer*, *Tagetis erecta* L. in case of *Drechslera tetramera*, *Samania saman* (Jacq.) Merr. were found to be stimulatory to mycelial growth of respective fungi.

Petroleum ether extracts of different plants were studied for their effects on seed mycoflora and seed health (seed germination, seedling emergence, shoot length and root length) of Green gram, Black gram, Chick pea and Pigeon pea, simultaneously. The results indicate that, plant extracts while causing effects on seed mycoflora also cause effects on seed health.

The plant extracts of *Ocimum sanctum* L., *Ocimum americanum* L., *Ocimum basilicum* L., *Azadirachta indica* A. Juss, *Cyperus rotundus* L., *Eucalyptus lanceolatus*, *Ruelia tuberosa* L. etc. reduced seed mycoflora and stimulated seed germination, seedling emergence, shoot and root lengths of pulses in variable degrees.

Three plant parts like leaf, stem and root were used in the experiments. Extracts prepared from leaf of most of the test plants were found more effective against seed mycoflora and stimulatory for seed germination, seedling emergence, shoot length and root length of the test pulses. The results also suggest that, none of the test plant extracts could completely inhibited seed mycoflora and plants like *Samania saman* (Jacq.) Merr., *Melingtonia hortensis*, *Tagetis erecta* L. were less effective on seed mycoflora and seed health as well. Similar findings were recorded on different crops by various workers like Gomati *et al.* (2000), Ahmed and Aquil (2003), Patni *et al.* (2005), Oana Rosca-Casian *et al.* (2007) and Duraipandiyan and Ignacimuthu (2007).

Time is pertinent to practice natural methods to revitalize the agriculture land that has been deteriorated during past many years. In vitro studies that are in verdant phase must be supported by the capitalists all over the world. It is the prevalent pervading trend of profiteering that has been infatuating entire world through the nexus of politicians and

capitalists. There are efforts from miniscule rationalists to restore the dilapidated state of the environmental condition. The sane doyens of the respective fields may heed the research work that is presented in this present book. The author of the book expects that the use of botanicals to control the mycoflora dampening yield of the crops be considered for future planning of agricultural tasks.

A glance towards global scenario of increasing synthetic and anti ecological means of pest control suggests that we humans are nonchalantly practicing hazardous chemical considering fast profits. Following graphical figures from different sources indicate the enhanced use of fungicides and pesticides. This is resulting in consequences leading to extinction of various flora and fauna. Similarly, it is causing health hazards of higher lethality to humankind. Thus, it should be a lesson to reconsider our anthropogenic activities that are adversely affecting to all biome of the planet. Global warming, rise in levels of sea water, glacier melting etc. to enlist few would be sufficed.

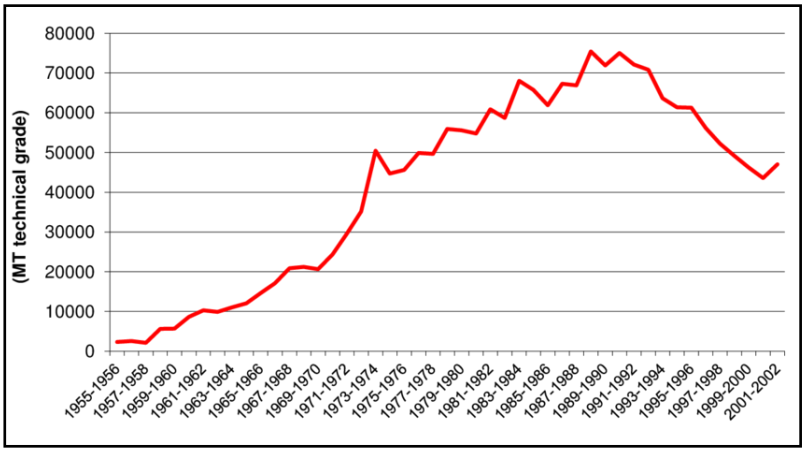

Figure 1: Gradual increase in pesticide application in Indian agriculture from 1955 to 2002 (Courtesy: Ranjit Kumar, ICAR)

The above graph represents gradual increase in pesticide application in Indian agriculture from 1955 to 2002. This tremendous increase in synthetic pest controls has been deteriorating the ecosystem.

The pesticide sales have increased with an average annual growth rate of 21 % since 2007. This is alarming for the humankind to minimize application of synthetic pest controls and switch over to 'Biocontrol' of phytopathological conditions.

A significant warning is also issued by consortium of world scientist (William Ripple *et al.,* 2017) expressing great concern to humanity against tremendous pollution. Therefore, we all should at least minimize the use of synthetic chemicals to cure our plants and promote use of biopesticides.

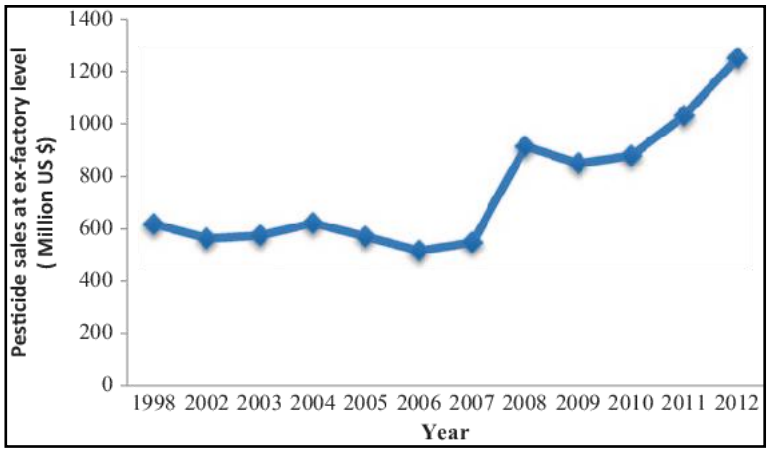

Figure 2: Gradual increase in pesticide sales during 1998 to 2012

(Courtesy: Wenjun Zhang, Sun-Yat Sen University, China)

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36 **Paper presented:**

1. "Effects of culture filtrate of seed-borne fungi on seed health (seed germination, seedling emergence, shoot and root length of green gram (*Vigna radiate* L.). National conference on Plants: Biology to Biotechnology, 23rd and 24th **February 2008**.

2. "Effects of some common and dominant seed borne fungi on seed health of pulses". National conference on current trends in biological science, R. K. Talreja college, Ulhasnagar. **2011**.
3. "Bioprospecting of some angiospermic plants against common and dominant seed borne fungi of pulses". State level seminar, Mahatma Phule college of arts, science and commerce, Panvel. **2nd February 2012**
4. "Effect of common and dominant seed-borne fungi of pulses on seed germination, shoot length and root length of Chick pea". National level conference, Dr. Babasaheb Ambedkar college of arts, commerce and science, Mahad. **7th and 8th February, 2014**.
5. "Mycotoxic effect of seedborne fungi on seed health of Chickpea". National level conference on Plant pathology; Rajarshi Shau College, Latur. **February 2-3, 2014.**
6. "Effect of common and dominant seed-borne fungi on total starch content of pulses". National conference on 'Conservation of Natural Resourses and Biodiversity for sustainable development'. Nya. Tatyasaheb Athalye Arts, Ved. S.R. Sapre commerce and Vid. Dadasaheb Pitre science college, Devrukh, Dist. Ratnagiri, M.S. **December 4-6; 2014.**
7. "Effect of petroleum ether extract of different plant parts on seed mycoflora and seed health (seed germination, shoot length and root length) of Green gram (*Vigna radiata* L.) by blotter method. Two day national conference on 'Fungal Diversity And Their Applications' Guru Nanak College of Arts, Science and Commerce, G.T.B. Nagar, Mumbai, 400037. **December, 11-12, 2015**.
8. Seed mycoflora and seed health of Chickpea (*Cicer arietinum* L.) in storage periods and its cure with different plant powders. National conference on 'Know your pulses' Guru Nanak College of Arts, Commerce and Science, G.T.B. nagar, Mumbai. **31st August, 2016**.
9. "Active Bio-chemicals of native plants involved in control of some pathogenic seed-borne fungi of Pulses". National Conference on advances in chemical sciences, Yeshwant Mahavidyalaya, Nanded, **31st August 2019**.

10. Extracurricular activities:

1. Working as **co-investigator** in U.G.C. funded minor research **project**, entitled "*Application of powder and/or extracts of parts of few non-poisonous plants for preservation of edible oil seeds."* **2009**.

2. Appointed as subject expert for interview in Sahyadri Vidyalaya, Shilfata, Khopoli. **2010**.
3. Appointed as '**Subject expert**' for selecting a candidate for the post of Lecturer in Botany at Konkan Gyanpeeth Arts, Science and Commerce college, Karjat, District Raigad. **2011**.
4. Member of criterion III, **research consultancy** and extension, **2012**.
5. Delivered oration on **"Scientific attitude"** at Badlapur high school, Badlapur, on 19 December **2012**.
6. Chairman mission '**Jagar Janivancha**', a government sponsored mission to create gender equality among student. **2012**.
7. Appointed as external examiner for M.Sc. practical, Science college, Nanded; on 11 April and 12 April **2013**.
8. Appointed as external examiner to assess Ph.D. thesis entitled "Studies in biochemical changes in leaves of Adulsa (*Adhatoda zeylanica* Medic.) due to fungal diseases"; in Swami Ramanand Tirth Marathwada University, Nanded by letter dated 6th February **2013**.
9. Appointed as examiner for district level science exhibition "Inspire Award" by education department, Alibag on 22nd August **2013**.
10. Appointed examiner for M.Sc. Herbal medicine practical examination in Swami Ramanand Tirth Marathwada University, Nanded, on **07.04.2014**
11. Appointed examiner for M.Sc. Herbal medicine practical examination in Swami Ramanand Tirth Marathwada University, Nanded, on **21.04.2014**
12. Appointed as panel judge for science exhibition held in Don Bosco English Medium School, Badlapur. **November 25; 2014.**
13. Appointed as judge for elocution competition held at Neral vidya mandir, Neral. **December 19; 2014.**
14. Appointed as K.C.M. College, Gymkhana chairman for the year 2015-16. Letter dated **30.11.2015.**
15. Appointed as member of FIST, programme of MHRD Government of India. Letter dated **7.12.2015**.
16. Appointed as examiner for M.Sc. Botany, S.R.T.M.U. Nanded. **May, 2016**.
17. Appointed as chairperson criterion VII 'Innovative practices', NAAC committee, latter dated **18.04.2016.**

18. Appointed as associate editor of International journal of Agriculture Sciences, ISSN: 0975-3710 EISSN: 0975-9107, **March 2016**.
19. Article "Marching Indian democracy" Mahamanwacha Mahagranth, ISBN 987-93-83471-01-0, page 445-447, **August 2016**.
20. Appointed member of the board of paper setter in M.Sc. herbal medicine modern analytical technique- IV. Swami Ramanand Tirth Marathwada University, Nanded. Letter dated: **17.01.2017**.
21. Appointed as member college complaint redressal committee member, 26.07.2017.
22. Appointed as member of the board of paper setter in the M.Sc. Herbal Medicine, semester I, Modern Analytical Technique IV (CBCS pattern) in Swami Ramanand Tirth Marathwada University, Nanded. **Letter dated: 8.08.2017**.
23. Appointed as Vice-chancellor's nominee subject expert for CAS of Mandangad college faculty held at CKT College Panvel, on **21.04.2018**.
24. Appointed as member of college Research committee for the year 2018-19 (letter 270/2018-19).
25. Appointed as member of Library committee for the year 2018-19, (letter No. 269/2018-19; dated 21.07.2018).
26. Appointed as member of college SC, ST, OBC advisory committee for the year 2018-19; (letter No. 268-2018-19; dated 21.07.2018).
27. Appointed as in charge of event Fine art A for the youth festival zonal round of Mumbai University held at K.M.C. college, Khopoli on 9 august 2018; (letter 294/ 2018-19).
28. Appointed as member of the board of paper setter in M.Sc. Herbal medicine semester I Modern analytical technique IV (CBCS Pattern) by vice chancellor/ Board of examination Swami Ramanand Tirth Marathwada University, Nanded (SRTMUN); (letter Exam/sci/PG/ 2018-19/ date 3.10.2018).

BIOCONTROL OF SEED MYCOFLORA OF PULSES: A LENITIVE PERSPECTIVE TO MOLLIFY PHYTOPATHOGENESIS

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About Book

The book is an outcome of a research work carried out in the field of Botany (Plant pathology). The work is an ecofriendly effort to cure diseased plants not by using synthetic chemicals but naturally derived plant biochemical. The researcher and author of the book is sensitized and actuated by the pervading pollution that is in future sure to lead dangerous end of humankind and rest of the living world. Various genuine efforts by environmentalists motivated the author to translate rather enigmatic scientific work into layman's language. It is not only botanist, agriculturalist or cultivator famer related to this work but common citizen of the nation must join this campaign of refurbishing the Mother Nature which is the subsisting ground for all living beings. Ecosystem is the life and soul of all living entities therefore; it becomes duty of all humans to collectively join in the efforts to search for natural means to save this earth. This book enunciates the ways to cure the ailing plants and make them free of disease and ultimately fill our stomach. This seems to be insignificant work and very conventional but it has its lasting repercussions. We therefore, must initiate the task gradually it will acquire magnificent dimensions. It is my genuine hope that our dreams to save this earth from imminent downfall will come true if all of us take the task on mind. I earnestly appeal all my friends and people to read this book and ponder over the subject that is directly governing our existence, that protecting our planet form polluting anthropogenic activities.

About Author

Dr. Ashok Sadhu Kandhare

Dr. Ashok Sadhu Kandhare is presently working as Head, Department of Botany, K.M.C. College, Khopoli. He has 20 years of teaching experience. He worked as a lecturer in various colleges in Nanded, Department of life sciences, University of Mumbai, Kalina, Santacruz, Mumbai. He completed M. Sc. in Botany with specialization Plant Pathology. He was awarded with Ph. D. in Botany in the field of Seed Pathology. along with Ph. D. he qulified with NET in 2002. The topic of research for the Ph. D. of Dr. Kandhare was "Studies on effects of some plant extracts on seed mycoflora and seed health of pulses". Dr. Kandhare published 35 research papers in various national and international reputed journals. He presented the research work on the platforms of more than nine conferences of national and international level. He worked as co-investigator for U.G.C. funded minor research project, "Application of powder and/or extracts of parts of few non-poisonous plants for preservation of edible oil seeds" in 2009. He is working on various college level and university level committees as an member. He is working as Associate Editor of International Journal of Agriculture Sciences. . He served his duties as Referee in various science exhibitions, elocution competition, etc.

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