

## *Chapter IV*

# Results      Discussions

Food plants are having the great and unique importance for human being. ~~On these plants the human being dependent for their~~ nutrition. Essential constituents like carbohydrates, protein, fats, oils, minerals and vitamins are supplied by food plants to human body. Chief sources of food are provided by dry seeds and fruits of cereals, legumes, vegetable seeds and oil seeds. Plants providing chief sources of the food are:

Cereals:- Carbohydrates are obtained by cereals like Rice, Wheat and Maize.

Legumes / Pulses:- Legumes provide proteins, ~~which are very important supplement in human diet and~~ are used as supplementary food.

Oil seeds:- Oils and fats constitute one of the most essential ingredients of the human diet.

Vegetables:- All parts of plants are rich sources of carbohydrates (starch etc.) minerals, vitamins and protective food (Verma, 1984).

The crop plants are attacked by pathogens which develop various kinds of diseases among them. Which result in the reduction in viability and germination of seeds as well as seedling mortality. The seeds get contaminated with these pathogens ~~either~~ in the field, storage, transport etc. Amongst these pathogens, fungal pathogens are found to be more serious as they damage seeds in the field and storage. Therefore it was decided to study the fungal pathogens associated with different types of seed plants grown in and around Satara.

Following is the list of crop seeds which were considered for ~~evaluation~~ of seed mycoflora:-

- **CEREALS**
  - ◆ *Sorghum bicolor* L. Moench. (Sorghum)
  - ◆ *Triticum aestivum* L. (Wheat)
  - ◆ *Zea mays* Linn. (Maize)
- **PULSES**

- ◆ *Cajanus cajan* (L.) Millsp. (Pigeon pea)
- ◆ *Cicer arietinum* L. (Gram)
- ◆ *Pisum sativum* L. (Pea)
- ◆ *Vigna mungo* (L.) Hepper. (Urdbean)
- **OIL SEEDS**
  - ◆ *Arachis hypogea* L. (Groundnut)
  - ◆ *Glycin max* L. Merril. (Soybean)
  - ◆ *Helianthus annus* L. (Sunflower)
- **VEGETABLE SEEDS**
  - ◆ *Abelmoschus esculentus* L. (Okra)
  - ◆ *Capsicum annum* L. (Chilli)
  - ◆ *Cyamopsis tetragonoloba* Taub. (Cluster bean)
  - ◆ *Phaseolus vulgaris* L. (French bean)

During present study, the seed samples were examined according the ISTA rules to find out inert matter. The amount of inert matter associated with different crop seeds is shown in Table- 1. The maximum percentage of inert matter was observed in *Sorghum bicolor* L. Moench. (Sorghum) and minimum percentage of inert material was found in *Phaseolus vulgaris* L. (French bean). It may be due to differences in seed size.

The seeds were also examined to find out discoloured and shrunken seeds and results are recorded in Table-2. The percentages of disfigured seeds were maximum in *Sorghum bicolor* L. Moench. and *Arachis hypogaea* L. about 13 percent. Most of the seeds were dark in colour and did not show the luster of healthy seeds and were small in size (Plate fig. 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53). The percentage of discolored and shrunken seeds was the least in *Capsicum annum* L. (Chilli) which was about 3 percent.

Dry seeds showed various types of symptoms of varying degree. Necroses and discoloration are the symptoms produced by fungi and other microorganisms. Most of these discoloration was due to saprophytes or weak parasites that are harbored the seed during storage.

Table – 1

SEED MYCOFLORA

Dry Seed Examination – Inert Material

	Percentage of Inert matter
<i>Sorghum bicolor</i> L. Moench. (Sorghum)	9
<i>Triticum aestivum</i> L. (Wheat)	8
<i>Zea mays</i> Linn. (Maize)	5
<i>Cajanus cajan</i> (L. ) Millsp. (Pigeon pea)	7
<i>Cicer arietinum</i> L. (Gram)	6
<i>Pisum sativum</i> L. (Pea)	7
<i>Vigna mungo</i> (L.) Hepper. (Urdbean)	5
<i>Arachis hypogaea</i> L. (Groundnut)	8
<i>Glycin max</i> L. Merril. (Soybean)	3
<i>Helianthus annus</i> L. (Sunflower)	4
<i>Abelmoschus esculentus</i> L. (Okra)	6
<i>Capsicum annum</i> L. (Chilli)	3
<i>Cyamopsis tetragonoloba</i> Taub. (Cluster bean)	5
<i>Phaseolus vulgaris</i> L. (French bean)	2

**Table – 2**

**SEED MYCOFLORA**

**Dry Seed Examination – Disfigured Seeds**

	Percentage of discoloured and shrunken seeds
<i>Sorghum bicolor</i> L. Moench. (Sorghum)	13
<i>Triticum aestivum</i> L. (Wheat)	8
<i>Zea mays</i> Linn. (Maize)	10
<i>Cajanus cajan</i> ( L. ) Millsp. ( Pigeon pea )	12
<i>Cicer arietinum</i> L. (Gram)	10
<i>Pisum sativum</i> L. (Pea)	7
<i>Vigna mungo</i> (L.) Hepper. (Urdbean)	5
<i>Arachis hypogaea</i> L. (Groundnut)	13
<i>Glycin max</i> L. Merril. (Soybean)	7
<i>Helianthus annus</i> L. (Sunflower)	9
<i>Abelmoschus esculentus</i> L. (Okra)	6
<i>Capsicum annum</i> L. (Chilli)	3
<i>Cyamopsis tetragonoloba</i> Taub. (Cluster bean)	7
<i>Phaseolus vulgaris</i> L. (French bean)	9

# Cereals

Cereals are important food plants which provide basic food. In fact majority of human population depends on the cereals. Cereals appear to have originated in or near mountainous regions of the subtropical and tropics. The cereals are Sorghum, Wheat, Maize, Rice, Barley, Rye, Oats and Millets. Cereals have many advantages as food plants because they contain large amount of carbohydrates and proteins as well as some vitamins (Verma, 1984).

***Sorghum bicolor* L. Moench. (Sorghum).**

Grain sorghum is an important food crop particularly grown India in arid and semi arid tropical areas. It provides staple food for human consumption and fodder for animal.

For this study Sorghum was used because this cereal is the main source of food in and around Satara.

In the present investigation, ectophytic and endophytic seed mycoflora associated with sorghum have been studied. The seeds were visually examined by naked eye and under binocular and 13% of seeds were <sup>found</sup> shrunken and discoloured (Plate fig.1). The results are recorded in Table-3. During incubation fungi produced various coloured colonies on seeds and culture plates. Mycoflora <sup>were</sup> identified on the basis of morphology, colour and conidial arrangement on conidiophores.

In the present investigation, endophytic mycoflora <sup>found</sup> were not recorded. According to the present study, ectophytic mycoflora with total <sup>found</sup>

number of 31 fungal species belonging to 7 genera were isolated from the sorghum seeds by using three methods, Blotter Method and Dry Seed Inoculation Method and Seed Suspension Test.

In this study the highest number of fungi were detected by Blotter Method (22 species) used for studying ectophytic mycoflora, followed by Dry Seed Inoculation (16 species) and Seed Suspension Test (10 species).

In view of the total mycoflora, genus *Aspergillus*, at the 1<sup>st</sup> position containing 17 species followed by *Alternaria* (6 species), *Penicillium* (3 species), *Rhizopus* (2 species). Three genera, *Mucor*, *Actinomucor*, *Verticillium* were represented by single species.

*Mucor javanicus* was only species of *Mucor* detected by three methods mentioned earlier. Fungal species isolated from Dry Seed Inoculation Method and Blotter Method were *Rhizopus combodina*, *Alternaria humicola*, *A. burnsii*, *A. palandui*, *Aspergillus amstelodami*, *A. fumigatus*, *A. japonicus*, *A. oryzae*, *A. pulverulentus*, *A. versicolor*, *Penicillium oxalicum*. By using Seed Suspension Test and Blotter Method, fungal species recorded were *R. oryzae*, *Aspergillus repens*, *A. violaceo-fuscus*. Fungi reported by Blotter Method were *Actinomucor repens*, *Alternaria brassicae*, *Aspergillus flavus*, *A. flavipes*, *A. fonsecaeus*, *A. humicola*, *A. ustus*. Only three species, *Aspergillus chevalieri*, *Penicillium corylophilum*, *Verticillium* sp. were isolated by Dry Seed Inoculation Method. Five species belonging to three genera were isolated by only Seed Suspension Test which were *Alternaria carthami*, *A. citri*, *Aspergillus alliaceus*, *A. candidus*, *Penicillium citrinum*.

The species which have been reported in present work were, *Alternaria humicola*, *Aspergillus candidus*, *A. flavipes*, *A. flavus*, *A. fumigatus*, *A. niger*, *A. versicolor*, *A. repens*, *A. ustus*, *Penicillium*



*citrinum* on sorghum seeds, ~~which~~ were also reported earlier by Bhadraiah and Ramarao (1987).

### *Triticum aestivum*, L. (Wheat)

Wheat is world's most widely cultivated food crop. It is important for nutritive value and which contains more proteins than other cereals.

For present study Wheat was used because this cereal is the main source of food in and around Satara. Seed mycoflora of this cereal was studied. Many workers have studied seed mycoflora of Wheat.

In the present study, the seeds were visually examined. Percentage of shrunken and discoloured seeds (Plate fig. 5) 8 %. Ectophytic mycoflora developed are recorded in Table- 4 and endophytic mycoflora are recorded in Table -5.

Ectophytic fungi, representing eleven species belonging to five genera are recorded from wheat seeds by using Dry Seed Inoculation Method, Seed Suspension Test and Blotter Method. Endophytic mycoflora representing, four fungal species belonging to three genera are reported.

Seed Suspension Test used for studying ectophytic mycoflora has shown highest (7) number of fungal species associated with wheat however 5 fungal species of ectophytic mycoflora were detected by Dry Seed Inoculation Method and Blotter Method.

While considering total number of seed fungi, It was observed that, *Aspergillus* with 6 species, *Penicillium* with 2 species, and *Rhizopus*, *Alternaria* and *Curvularia* with only one species were developed.

*Penicillium citrinum* was isolated by three methods mentioned earlier. *Aspergillus lutescens*, *Curvularia barreriae* were isolated by both, Dry Seed Inoculation Method and Seed Suspension Test.

By using Seed Suspension Test and Blotter Method, only one species *Aspergillus erythrocephalus* was detected. *Aspergillus niger* was found in with Dry Seed Inoculation and Blotter Methods.

*Rhizopus artocarepi* was reported by Dry Seed Inoculation Method. *Alternaria alternata*, *Aspergillus chevalieri*, *Penicillium nigiricans* were reported by Seed Suspension Test. Two species, *Aspergillus fonsecaeus*, *A. parasiticus* were detected by Blotter Method.

In the present investigation Seed Suspension Test showed better result than Blotter Method and Dry Seed Inoculation Method.

In case of endophytic mycoflora, four species belonging to three genera were reported. These were *Aspergillus amstelodami*, *A. fonsecaeus*, *Cladosporium cladosporioides* and *Rhizopus combodia*.

The species which have been reported in present work i.e. *Alternaria alternata*, *Aspergillus niger*, *Penicillium* sp., *Rhizopus* sp., were also reported earlier by Tamuli and Nath (2007).

### ***Zea mays* Linn. (Maize).**

Maize or Indian corn has been the chief contribution as cereals of the new world. It is used as food for man and feed for animal. Maize can grow in warm weather. Maize is adapted to all environmental conditions. (Verma, 1984).

In the present investigation, ectophytic and endophytic seed mycoflora associated with maize have been studied. The seeds were visually examined by naked eye and under binocular and about 10 % of seeds were found shrunken and discoloured (Plate fig. 9). Study of ectophytic mycoflora was done by using Blotter Method and Agar Plate Method. In the Agar Plate Method, seed mycoflora was studied by Seed Suspension and Dry Seed Inoculation Method. Ectophytic fungi of maize are recorded in Table- 6 and endophytic fungi are recorded in Table- 7.

A total number of 32 species of ectophytic fungi belonging to 5 genera were isolated by using three methods mentioned earlier. The mycoflora was dominated by *Aspergillus*. While in case of endophytic mycoflora, 4 species belonging to 2 genera were recorded.

Blotter Method used for studying ectophytic mycoflora of Maize has shown highest (24) number of fungal species, followed by Seed Suspension Test (18) fungal species and Dry Seed Inoculation Method (15) fungal species. While taking into account the total mycoflora, genus *Aspergillus* ranked first with 25 species followed by 4 species of *Penicillium*. In addition three genera detected were *Alternaria*, *Rhizopus* and *Verticillium* represented by one species each.

*Aspergillus amstelodami*, *A. insecticola*, *A. lutescens*, *A. oryzae*, *A. phoenicis*, *A. repens*, *A. violaceo-fuscus*, *Penicillium atramentosum* were isolated by three methods mentioned earlier.

By using Seed Suspension Test, *Aspergillus alutaceus*, *A. castaneus*, *A. erythrocephalus*, *A. quercinus*, *A. rubber* and *A. wentii* were detected. By using Blotter Method, *Alternaria burnsii*, *Aspergillus fumigatus*, *A. humicola*, *A. fonsecaeus*, *A. niveus*, *A. pulverulentus*, *A. unguis*, *Penicillium rugulosum*, *P. oxalicum* were recorded.

*Rhizopus* was found to occur on seeds of maize. *Rhizopus combodina* over-grew and covered the seeds completely preventing the seeds from germination by causing seed rot.

Four genera, *Alternaria*, *Aspergillus*, *Penicillium*, *Verticillium* were recorded. The genus *Alternaria* was represented by one species *Alternaria burnsii*. *Aspergillus* contained 25 species and 4 species of *Penicillium* recorded were *Penicillium atramentosum*, *P. javanicum*, *P. oxalicum*, *P. rugulosum* on seeds of maize.

Among these techniques Blotter Method proved to be the best. The studies done to find out endophytic mycoflora revealed four fungal species belonging to two genera. *Aspergillus chevalieri*, *A. niger*, *A. pulverulentus* and *Cladosporium cladosporioides* were observed.

Fungal species recorded during this work, *Aspergillus niger*, *A. fumigatus*, *Penicillium* sp. were reported earlier by Shafique and Arshad *et al.* (2005) and frequently occurring fungi were *A. flavus*, *A. niger*, *A. ruber*, *A. terreus*, *Penicillium* sp. fungi detected in present study were also reported earlier by Paul and Mishra (1992).

Table - 3

## MYCOFLORA ASSOCIATED WITH SORGHUM SEEDS

## Ectophytic Mycoflora

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox ) medium	
			Dry Seed	Seed Susp.
1.	<i>Actinomucor repens</i> Schost.	+	---	---
2.	<i>Alternaria brassicae</i> (Berk.) Sacc.	+	---	---
3.	<i>A. burnsii</i> Uppal, Patel and Kamat.	+	+	---
4.	<i>A. carthami</i> Chowdhury.	---	---	+
5.	<i>A. citri</i> Ellis and Pierce.	---	---	+
6.	<i>A. humicola</i> Oudemans.	+	+	---
7.	<i>A. palandui</i> Ayyangar .	+	+	---
8.	<i>Aspergillus alliaceus</i> Thom and Church.	---	---	+
9.	<i>A. amstelodami</i> ( Mang) Thom and Church.	+	+	---
10.	<i>A. chevalieri</i> ( Mang .) Thom and Church	---	+	---
11.	<i>A. candidus</i> Link ex Fries .	---	---	+
12.	<i>A. flavus</i> Link ex Fries.	+	---	---
13.	<i>A. flavipes</i> ( Bain. and Sart.) Thom and Church.	+	---	---
14.	<i>A. fonsecaeus</i> Thom and Raper.	+	---	---
15.	<i>A. fumigatus</i> Fresenius.	+	+	---
16.	<i>A. humicola</i> Chaudhuri and Sachar.	+	---	---
17.	<i>A. japonicus</i> Saito.	+	+	---
18.	<i>A. niger</i> Van Tieghem.	---	+	+
19.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	+	+	---
20.	<i>A. pulverulentus</i> (McAlpine) Thom.	+	+	---
21.	<i>A. repens</i> (Corda) de Bary.	+	---	+
22.	<i>A. ustus</i> (Bainier) Thom and Church.	+	---	---
23.	<i>A. versicolor</i> (Vuillemin) Tiraboschi.	+	+	---
24.	<i>A. violaceo-fuscus</i> Gasperini	+	---	+
25.	<i>Mucor javanicus</i> Wehmer.	+	+	+
26.	<i>Penicillium citrinum</i> Thom.	---	---	+
27.	<i>P. corylophilum</i> Dierckx .	---	+	---
28.	<i>P. oxalicum</i> Currie and Thom .	+	+	---
29.	<i>Rhizopus combodia</i> Vuillemin.	+	+	---
30.	<i>R. oryzae</i> Went et. Gerlings.	+	---	+
31.	<i>Verticillium</i> sp.	---	+	---

Endophytic fungi were absent.

**Table - 4**

**MYCOFLORA ASSOCIATED WITH WHEAT SEEDS**

**Ectophytic Mycoflora**

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Alternaria alternata</i> (Fries) Keissler.	---	---	+
2.	<i>Aspergillus chevalieri</i> (Mang.) Thom and Church	---	---	+
3.	<i>A. erythrocephalus</i> Berk and Curt.	+	---	+
4.	<i>A. fonsecaeus</i> Thom and Raper.	+	---	---
5.	<i>A. lutescens</i> Bainier ex Thom and Church.	---	+	+
6.	<i>A. niger</i> van Tieghem.	+	+	---
7.	<i>A. parasiticus</i> Speare.	+	---	---
8.	<i>Curvularia barreriae</i>	---	+	+
9.	<i>Penicillium citrinum</i> Thom.	+	+	+
10.	<i>P. nigricans</i> Bainier ex Thom.	---	---	+
11.	<i>Rhizopus artocarpi</i> Raciborski.	---	+	---

**Table - 5**

**MYCOFLORA ASSOCIATED WITH WHEAT SEEDS**

**Endophytic Mycoflora.**

SR. NO.	FUNGAL FORMS
1	<i>Aspergillus amstelodami</i> ( Mang) Thom and Church.
2	<i>A. fonsecaeus</i> Thom and Raper.
3	<i>Cladosporium cladosporioides</i> (Fr.) de Vries.
4	<i>Rhizopus combodia</i> Vuillemin.

Table - 6

## MYCOFLORA ASSOCIATED WITH MAIZE SEEDS

## Ectophytic Mycoflora.

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Alternaria burnsii</i> Uppal, Patel and Kamat.	+	----	----
2.	<i>Aspergillus alutaceus</i> Berk and Curt.	----	----	+
3.	<i>A. amstelodami</i> ( Mang ) Thom and Church.	+	+	+
4.	<i>A. carbonarius</i> ( Bainier ) Thom.	+	----	+
5.	<i>A. castaneus</i> Patterson.	----	----	+
6.	<i>A. chevalieri</i> ( Mang . ) Thom and Church.	+	+	----
7.	<i>A. erythrocephalus</i> Berk and Curt.	----	----	+
8.	<i>A. flavus</i> Link exfries.	+	+	----
9.	<i>A. fONSECAEUS</i> Thom and Raper.	+	----	----
10.	<i>A. fresenii</i> Subram.nom.nov.	---	+	+
11.	<i>A. fumigatus</i> Fresenius.	+	----	----
12.	<i>A. humicola</i> Chau. and Sach.	+	----	----
13.	<i>A. insecticola</i> Subram. nom. nov.	+	+	+
14.	<i>A. lutescens</i> Bainier ex Thom and Church.	+	+	+
15.	<i>A. niger</i> van Tieghem .	+	+	----
16.	<i>A. niveus</i> Blochwitz.	+	----	----
17.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	+	+	+
18.	<i>A. parasiticus</i> Speare.	----	+	+
19.	<i>A. phoenicis</i> (Corda)Thom.	+	+	+
20.	<i>A. pulverulentus</i> (McAlpine) Thom.	+	----	----
21.	<i>A. quercinus</i> (Bainier) Thom and Church.	----	----	+
22.	<i>A. repens</i> (Corda)de Bary.	+	+	+
23.	<i>A. ruber</i> (Bremer) Thom and Raper.	----	----	+
24.	<i>A. unguis</i> (Emil-Weil and Gaudin) Thom and Raper.	+	----	----
25.	<i>A. violaceo-fuscus</i> Gasperini.	+	+	+
26.	<i>A. wentii</i> Wehmer.	----	----	+
27.	<i>Penicillium atramentosum</i> Thom.	+	+	+
28.	<i>P. javanicum</i> Van Beyma.	+	+	----
29.	<i>P. oxalicum</i> Currie and Thom.	+	---	----
30.	<i>P. rugulosum</i> Thom.	+	----	----
31.	<i>Rhizopus combodina</i> Vuillemin.	+	----	+
32.	<i>Verticillium</i> sp.	+	+	----



**Table - 7**

**MYCOFLORA ASSOCIATED WITH MAIZE SEEDS**

**Endophytic Mycoflora.**

<b>SR. NO.</b>	<b>FUNGAL FORMS</b>
1	<i>Aspergillus chevalieri</i> ( Mang.) Thom and Church.
2	<i>A. niger</i> van Tieghem .
3	<i>A. pulverulentus</i> (McAlpine) Thom.
4	<i>Cladosporium cladosporioides</i> ( Fr.) de Vries.

# **Explanation of plate number I**

**Plate Fig. no. 1 - 4**

## **Sorghum**

### **1. Normal and Abnormal seeds.**

### **2. Blotter Method.**

1. *Penicillium oxalicum* Currie and Thom.
2. *Alternaria brassicae* (Berk.) Sacc.

### **3. Dry Seed Inoculation Method.**

3. *Aspergillus flavus* Fresenius.
4. *A. niger* Van Tieghem.
5. *Alternaria burnsii* Uppal, Patel and Kamat.
6. *Penicillium corylophilum* Dierckx.

### **4. Seed Suspension Test.**

7. *Alternaria citri* Ellis and Pierce.
8. *Aspergillus candidus* Link ex Fries.
9. *Penicillium citrinum* Thom.

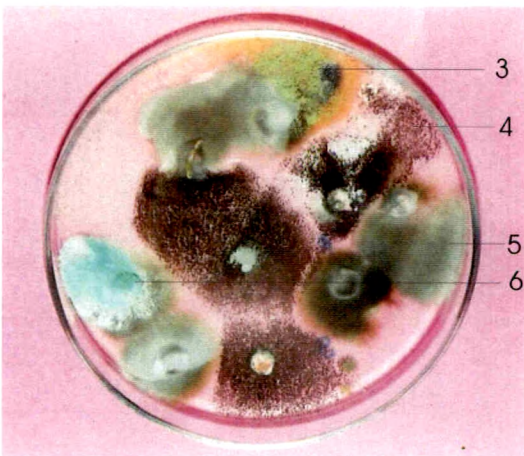
Plate No. I  
Plate Fig. No. 1 to 4  
Sorghum



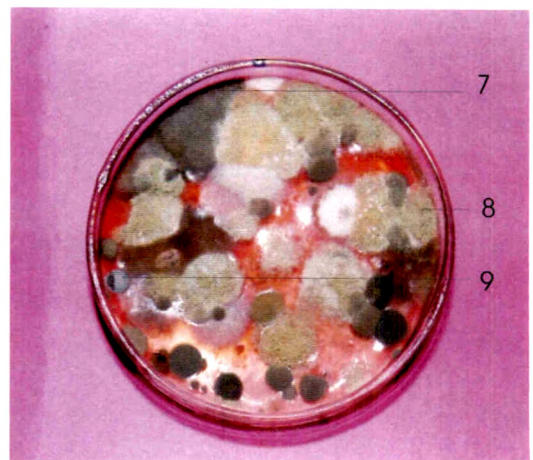
1



2



3



4

## **Explanation of plate number II**

**Plate Fig. no. 5 - 8**

### **Wheat**

**5. Normal and Abnormal seeds.**

**6. Blotter Method.**

1. *Penicillium* sp.
2. *Aspergillus niger* Van Tieghem.

**7. Dry Seed Inoculation Method.**

3. *Penicillium* sp.
4. *Aspergillus niger* Van Tieghem.

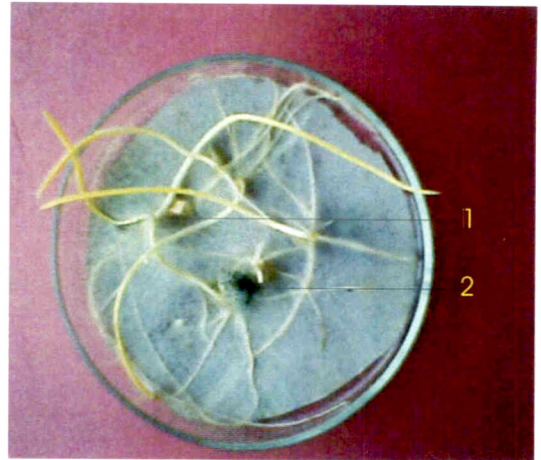
**8. Seed Suspension Test.**

5. *Rhizopus artocarp* Raciborski.
6. *Aspergillus* sp.
7. *Alternaria* sp.

Plate No. II  
Plate Fig. No. 5 to 8  
Wheat



5



6



7



8

## **Explanation of plate number III**

**Plate Fig. no. 9 - 12**

### **Maize**

#### **9. Normal and Abnormal seeds.**

#### **10. Blotter Method.**

1. *Alternaria burnsii* Uppal, Patel and Kamat.
2. *Aspergillus niger* Van Tieghem.
3. *Penicillium oxalicum* Currie and Thom.

#### **11. Dry Seed Inoculation Method.**

4. *Aspergillus* sp.
5. *Aspergillus niger* Van Tieghem.

#### **12. Seed Suspension Test.**

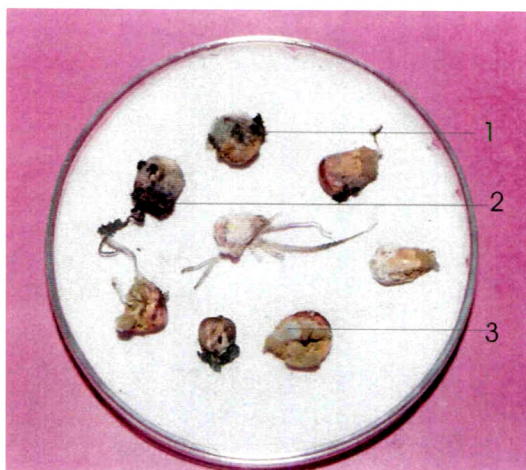
6. *Aspergillus niger* Van Tieghem.
7. *Penicillium* sp.



Plate No. III  
Plate Fig. No. 9 to 1  
Maize



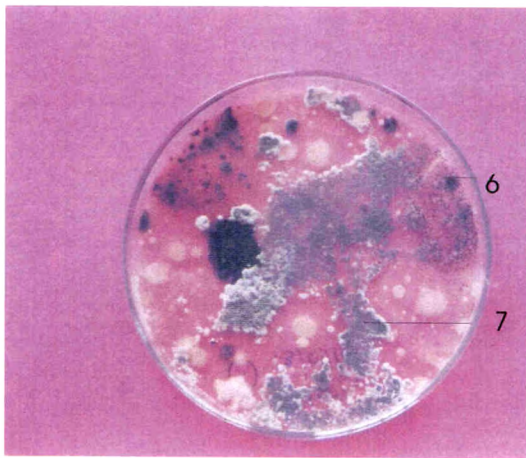
9



10



11



12

# Pulses



Legumes are sources of food as next to cereals. They are popularly known as pulses. They play important role in people's diet. Legumes are grown all over the world however the greatest variety of legumes is grown in the tropics and subtropics. Pulses include Peas, Lentils, Pigeon pea, Chickpea, Mungbean etc. They grow easily and mature rapidly. They are highly nutritious; supply not only proteins but also carbohydrates, fats, vitamins and some minerals also the immature seeds of pulses are used as vegetables (Verma, 1984).

For study of the mycoflora associated with the seeds, seed samples of following pulses were collected from crop fields and farmers and were stored in sterilized containers. Seeds of *Cajanus cajan* (L.) Millsp. (Pigeon pea), *Cicer arietinum* L. (Gram), *Pisum sativum* L. (Pea), *Vigna mungo* (L.) Hepper were available in and around the Satara. For the study of seed mycoflora, the visual evaluation, Blotter Method, Dry Seed Inoculation Method and Seed Suspension Test were used.

### ***Cajanus cajan* (L.) Millsp. (Pigeon pea, Arhar, Tur).**

For this study Pigeon pea was used because this pulse is the main pulse crop cultivated in and around the Satara.

In the present investigation, ectophytic and endophytic seed mycoflora associated with pigeon pea has been studied. The seeds were visually examined by naked eye and under binocular and about 12 % of seeds were found shrunken and discoloured (Plate fig. 13). Study of ectophytic mycoflora was done by using Blotter Method and Agar Plate Method. In the Agar Plate Method, seed mycoflora was studied by Seed Suspension and Dry Seed Inoculation method and the results are recorded in Table – 8. Endophytic fungi are recorded in Table- 9.

Ectophytic fungi, representing 20 fungal species belonging to 2 genera were detected from pigeon pea seeds. Dominant genus was *Aspergillus* (19 species) and *Penicillium* was represented by single species. Endophytic fungi, represented four species.

Dry Seed Inoculation Method used for studying ectophytic mycoflora has shown highest (15) number of fungal species however, Blotter Method has shown (7) and Seed Suspension Test has shown 6 fungal species.

*Aspergillus amstelodami*, *A. oryzae* were observed by three methods mentioned earlier. *Aspergillus chevalieri*, *A. sydowi* were detected by Dry Seed Inoculation Method and Seed Suspension Test. *Aspergillus unguis* and *A. niger* were isolated by both, Dry Seed Inoculation Method and Blotter Method.

By using Dry Seed Inoculation Method *Aspergillus alliaceus*, *A. fresenii*, *A. lutescens*, *A. parasiticus*, *A. proliferans*, *A. quercinus*, *A. ustus*, *A. wentii*, *A. versicolor* were detected. Two species, *Aspergillus flavipes* and *Penicillium oxalicum* were isolated by using only Seed Suspension Test. Fungal species reported by Blotter Method were *Aspergillus insecticola*, *A. japonicus*, *A. violaceo-fuscus*.

In the present analysis, Dry Seed Inoculation Method has given better result than Blotter Method and Seed Suspension Test.

The studies done to find out endophytic mycoflora have revealed four species of *Aspergillus*, *Aspergillus amstelodami*, *A. chevalieri*, *A. niger* and *A. oryzae*.

*Aspergillus niger* and *A. parasiticus* were also reported earlier from pigeon pea seeds by Pandey, Kumar and Tripathi (2007).

### ***Cicer arietinum* L. (Gram)**

Gram or chickpea is annual or perennial herb or perennial shrub. They are tolerant to drought and require low management. In India chickpea is most commonly grown as either intercrop or in rotation with wheat, as winter (rabi) crops following millet or sorghum (Verma, 1984).

Study the mycoflora associated with the gram seeds was undertaken because it is also commonly cultivated pulse crop in and around Satara.

For the present investigation the seeds were visually examined, to find out percentage of shrunken and discoloured seeds (Plate fig.17) which was 10 %. ectophytic mycoflora observed during present investigation, are recorded in Table- 10 and endophytic mycoflora are recorded in Table – 11.

In ectophytic mycoflora, 23 species of fungi belonging to 10 genera were observed. 9 species of *Aspergillus*, 3 species of *Alternaria* and *Fusarium*, 2 species of *Rhizopus*, and 6 genera i.e. *Cladosporium*, *Curvularia*, *Drechslera*, *Mucor*, *Penicillium*, *Verticillium* with one species each were recorded.

Seed Suspension Test showed 22 fungal species, Dry Seed Inoculation Method showed 16 fungal species and Blotter Method showed 4 fungal species.

*Alternaria dianthicola*, *Aspergillus niger* and *A. oryzae* were detected by three methods mentioned earlier. *Alternaria tenuis*, *A. tenuissima*, *Aspergillus flavipes*, *A. flavus*, *A. fumigatus*, *Fusarium oxysporum*, *F. moniliforme*, *F. solani*, *Mucor abundans*, *Rhizopus nodosus*, *R. stolonifer*, *Verticillium tenerum* were reported by Seed Suspension Test and Dry Seed Inoculation Method.

*Aspergillus candidus*, *A. niveus*, *A. parasiticus*, *A. terreus*, *Penicillium purpurgenum* were reported by Seed Suspension Test. *Drechslera australiensis* were detected only by Blotter Method.

Seed Suspension Test proved to be the best for Gram than Dry Seed Inoculation Method and Blotter Method.

In the study of the endophytic mycoflora, four species belonging to two genera were recorded which were *Aspergillus amstelodami*, *A. chevalieri*, *A. niger* and *Rhizopus combodina* on seeds of Gram.

The fungal species which have been reported in present study, *Fusarium moniliforme*, *F. oxysporum* and saprophytic fungi like *Aspergillus niger* and *A. flavus* were also reported earlier by Dawar, Syed and Ghaffar (2007) from Pakistan.

### ***Pisum sativum* L. (Pea.)**

Pea is also important leguminous crop of India grown in winter. Green pea is used for vegetable. Pea requires a moderate cool climate.

For the present study the seeds were examined visually and it was found that 7 % of seeds were shrunken and discoloured (Plate fig. 21). The seed mycoflora was studied by using Agar Plate and Blotter Method. In the Agar Plate Method, seed mycoflora was studied by Seed Suspension and Dry Seed Inoculation Method. The results of ectophytic mycoflora of pea observed are recorded in Table - 12 but endophytic fungi were not found to grow.

Ectophytic mycoflora, representing 16 species belonging to 6 genera were detected. *Aspergillus* was dominant containing 11 species and remaining 5 genera were represented by single species each.

Ten fungal species were detected in Dry Seed Inoculation Method and 7 fungal species of ectophytic mycoflora were detected by Blotter Method. Seed Suspension Test showed 6 fungal species.

*Penicillium javanicum* was observed in all methods mentioned earlier. *Aspergillus flavus* was present in Dry Seed Inoculation Method and Seed Suspension Test. *Aspergillus amstelodami* was reported in Seed Suspension Test and Blotter Method. *Aspergillus repens* and *A. fumigatus* were detected in Dry Seed Inoculation Method and Blotter Method.

The fungal species *Curvularia lunata*, *A. nidulans*, *A. niger*, *A. oryzae* and *Rhizopus combodia* were detected in Dry Seed Inoculation Method. *Aspergillus carbonarius*, *A. quercinus*, *Cladosporium cladosporioides* were observed in Seed Suspension Test. *Aspergillus chevalieri*, *Mucor abundans* were recorded by Blotter Method. However, endophytic mycoflora were not observed in Pea.

### ***Vigna mungo* (L.) Hepper. (Urdbean)**

Urdbean is an important pulse crop grown throughout India. Urdbean fix atmospheric nitrogen because it is leguminous crop and thus help in restoring soil fertility.

Urdbean was selected for this study because it is planted in and around Satara. In the present study, the seeds were visually examined to find out percentage of shrunken and discoloured seeds (Plate fig. 25) which was 5 %. The seed mycoflora of was studied by using agar plate and blotter methods. In the Agar Plate Method, seed mycoflora was studied by Seed Suspension and Dry Seed Inoculation Method. The results of ectophytic mycoflora of urdbean are recorded in Table- 13. Endophytic fungi were not found.

Sixteen species belonging to 5 genera of ectophytic fungi were detected from urdbean seeds. Seed Suspension Test used for studying ectophytic mycoflora showed highest (10) number of species; Dry Seed Inoculation Method showed (7) species and Blotter Method showed (5) species.

*Fusarium oxysporum* was reported when all the three methods were used. *Mucor abundans* was detected in Seed Suspension Test and Blotter Method. *Rhizopus oryzae*, *Penicillium janthinellum* and *A. niger* were observed in Seed Suspension Test and Dry Seed Inoculation Method.

*Aspergillus awamori*, *A. insecticola*, *A. phaeocephalus* were recorded in only Dry Seed Inoculation Method. *Aspergillus carbonarius*, *A. sydowi*, *A. ustus*, *A. versicolor* and *A. violaceo-fuscus* were isolated by only Seed Suspension Method. *Aspergillus candidus*, *A. oryzae* and *A. quercinus* were observed only by Blotter Method.

Therefore Seed Suspension Test proved to be best for Urdbean mycoflora study.

Similar reportes were recorded by previous workers e. g. *Aspergillus niger* was also reported earlier by Bilgrami, Jamaluddin and Roy (1976) and the genera *Fusarium*, *Penicillium*, *Mucor* and *Rhizopus* were also reported by Shailbala and Tripathi (2004).

Table - 8

## MYCOFLORA ASSOCIATED WITH PIGEON PEA SEEDS

## Ectophytic Mycoflora.

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Aspergillus alliaceus</i> Thom an Church.	---	+	---
2.	<i>A. amstelodami</i> ( Mang) Thom an Church.	+	+	+
3.	<i>A. chevalieri</i> ( Mang) Thom and Church.	---	+	+
4.	<i>A. flavipes</i> ( Bain and Sart. ) Thom and Church.	---	---	+
5.	<i>A. fresenii</i> Subram. nom. nov.	---	+	---
6.	<i>A. insecticola</i> Subram. nom. nov.	+	---	---
7.	<i>A. japonicus</i> Saito.	+	---	---
8.	<i>A. lutescens</i> Bainier ex Thom and Church.	---	+	---
9.	<i>A. niger</i> Van Tieghem.	+	+	---
10.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	+	+	+
11.	<i>A. parasiticus</i> Speare.	---	+	---
12.	<i>A. proliferens</i> G. Smith.	---	+	---
13.	<i>A. quercinus</i> (Bainier) Thom and Church.	---	+	---
14.	<i>A. sydowi</i> (Bainier ) Thom and Church.	---	+	+
15.	<i>A. ustus</i> (Bainier) Thom and Church.	---	+	---
16.	<i>A. unguis</i> (Emil-Weil and Gaudin) Thom and Raper.	+	+	---
17.	<i>A. versicolor</i> (Vuillemin) Tiraboschi.	---	+	---
18.	<i>A. violaceo-fuscus</i> Gasperini.	+	---	---
19.	<i>A. wentii</i> Wehmer.	---	+	---
20.	<i>Penicillium oxalicum</i> Currie and Thom.	---	---	+

Table - 9

## MYCOFLORA ASSOCIATED WITH PIGEON PEA SEEDS

## Endophytic Mycoflora.

SR. NO.	FUNGAL FORMS
1	<i>Aspergillus amstelodami</i> ( Mang) Thom and Church.
2	<i>A. chevalieri</i> ( Mang) Thom and Church.
3	<i>A. niger</i> Van Tieghem.
4	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.



**Table - 10**  
**MYCOFLORA ASSOCIATED WITH GRAM SEEDS**  
**Ectophytic Mycoflora.**

SR. NO.	FUNGAL FORMS	METHODS		
		Blott er Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Alternaria dianthicola</i> Neergaard.	+	+	+
2.	<i>A. tenuis</i> Auct.	-	+	+
3.	<i>A. tenuissima</i> ( Kunze ex Pers ) Wilts.	-	+	+
4.	<i>Aspergillus candidus</i> Link ex Fries.	-	-	+
5.	<i>A. flavipes</i> ( Bain and Sart. ) Thom and Church.	-	+	+
6.	<i>A. flavus</i> . Link ex Fries.	-	+	+
7.	<i>A. fumigatus</i> Fresenius.	-	+	+
8.	<i>A. niger</i> Van Tieghem .	+	+	+
9.	<i>A. niveus</i> Blochwitz.	-	-	+
10.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	+	+	+
11.	<i>A. parasiticus</i> Speare.	-	-	+
12.	<i>A. terreus</i> Thom.	-	-	+
13.	<i>Cladosporium cladosporioides</i> ( Fr .) de Vries.	-	+	+
14.	<i>Curvularia lunata</i> ( Wakker ) Boed.	-	-	+
15.	<i>Drechslera australiensis</i> ( Bugni.) Sub. & Jain.	+	-	-
16.	<i>Fusarium oxysporum</i> Schl.	-	+	+
17.	<i>F. moniliforme</i> Schl.	-	+	+
18.	<i>F. solani</i> (Mart.)Sacc.	-	+	+
19.	<i>Mucor abundans</i> Povah.	-	+	+
20.	<i>Penicillium purpurgenum</i> Stoll.	-	-	+
21.	<i>Rhizopus nodosus</i> Namy.	-	+	+
22.	<i>R. stolonifer</i> ( Her.ex Link ) Lind.	-	+	+
23.	<i>Verticillium</i> sp.	-	+	+

**Table - 11**  
**MYCOFLORA ASSOCIATED WITH GRAM SEEDS**  
**Endophytic Mycoflora.**

SR. NO.	FUNGAL FORMS
1	<i>Aspergillus amstelodami</i> ( Mang) Thom an Church.
2	<i>A. chevalieri</i> ( Mang) Thom and Church.
3	<i>A. niger</i> van Tieghem.
4	<i>Rhizopus combodina</i> Vuillemin.

Table - 12

MYCOFLORA ASSOCIATED WITH PEA SEEDS

Ectophytic Mycoflora.

SR. NO.	FUNGAL FORMS	METHODS		
		Blott er Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Aspergillus amstelodami</i> ( Mang.) Thom and Church.	+	---	+
2.	<i>A. carbonarius</i> ( Bainier ) Thom.	---	---	+
3.	<i>A. chevalieri</i> ( Mang .) Thom and Church.	+	---	---
4.	<i>A. flavus</i> Link ex Fries.	---	+	+
5.	<i>A. fumigatus</i> Fresenius.	+	+	---
6.	<i>A. lutescens</i> Bainier ex Thom and Church.	+	+	---
7.	<i>A. nidulans</i> ( Eidam ) Wint.	---	+	---
8.	<i>A. niger</i> Van Tieghem.	---	+	---
9.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	---	+	---
10.	<i>A. quercinus</i> (Bainier) Thom and Church.	---	---	+
11.	<i>A. repens</i> (Corda) de Bary.	+	+	---
12.	<i>Cladosporium cladosporioides</i> ( Fr. ) de Vries.	---	---	+
13.	<i>Curvularia lunata</i> ( Wakker ) Boed.	---	+	---
14.	<i>Penicillium javanicum</i> Van Beyma.	+	+	+
15.	<i>Mucor abundans</i> Povah.	+	---	---
16.	<i>Rhizopus combodina</i> Vuillemin.	---	+	---

Endophytic Mycoflora were not observed.

**Table - 13**

**MYCOFLORA ASSOCIATED WITH URDBEAN SEEDS**

**Ectophytic Mycoflora.**

SR . NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Aspergillus awamori</i> Nakazawa.	-	+	-
2.	<i>A. candidus</i> Link ex Fries.	+	-	-
3.	<i>A. carbonarius</i> ( Bainier ) Thom.	-	-	+
4.	<i>A. insecticola</i> Subram. nom. nov.	-	+	-
5.	<i>A. niger</i> Van Tieghem.	-	+	+
6.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	+	-	-
7.	<i>A. phaeocephalus</i> Durieu and Montagne.	-	+	-
8.	<i>A. quercinus</i> (Bainier) Thom and Church.	+	-	-
9.	<i>A. sydowi</i> (Bain and Sart.) Thom and Church.	-	-	+
10.	<i>A. ustus</i> (Bainier) Thom and Church.	-	-	+
11.	<i>A. versicolor</i> (Vuillemin) Tiraboschi.	-	-	+
12.	<i>A. violaceo-fuscus</i> Gasperini.	-	-	+
13.	<i>Fusarium oxysporum</i> Schl.	+	+	+
14.	<i>Penicillium janthinellum</i> Thom.	-	+	+
15.	<i>Mucor abundans</i> Povah.	+	-	+
16.	<i>Rhizopus oryzae</i> Went et. Gerlings.	-	+	+

**Endophytic Mycoflora were not observed.**

## **Explanation of plate number IV**

**Plate Fig. no. 13 - 16**

### **Pigeon pea**

#### **13. Normal and Abnormal seeds.**

#### **14. Blotter Method.**

1. *Aspergillus niger* Van Tieghem.
2. *A. oryzae* (Ahlburg in Korschelt) Cohn.

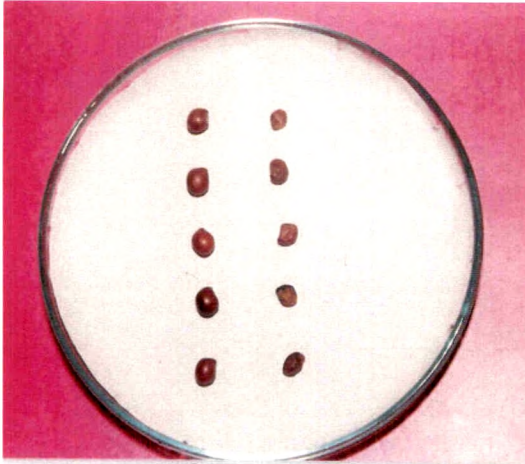
#### **15. Dry Seed Inoculation Method.**

3. *A. oryzae* (Ahlburg in Korschelt) Cohn.
4. *Aspergillus niger* Van Tieghem.

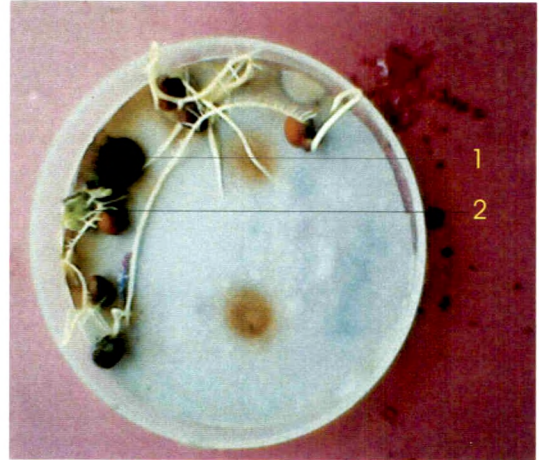
#### **16. Seed Suspension Test.**

5. *Penicillium oxalicum* Currie and Thom.
6. *A. sydowi* (Bainier) Thom and Church.

Plate No. IV  
Plate Fig. No. 13 to 16  
Pigeon pea



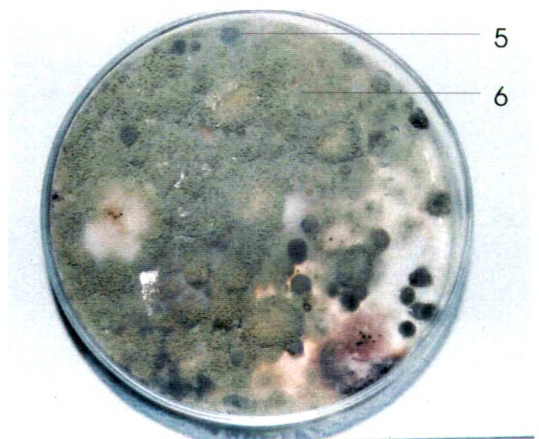
13



14



15



16

## **Explanation of plate number V**

**Plate Fig. no. 17 – 20**

### **Gram**

#### **17. Normal and Abnormal seeds.**

#### **18. Blotter Method.**

1. *Alternaria* sp.
2. *Aspergillus niger* Van Tieghem.

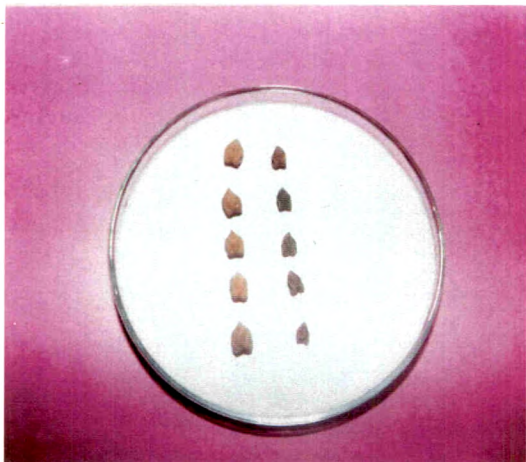
#### **19. Dry Seed Inoculation Method.**

3. *A. oryzae* (Ahlburg in Korschelt) Cohn.
4. *Aspergillus niger* Van Tieghem.

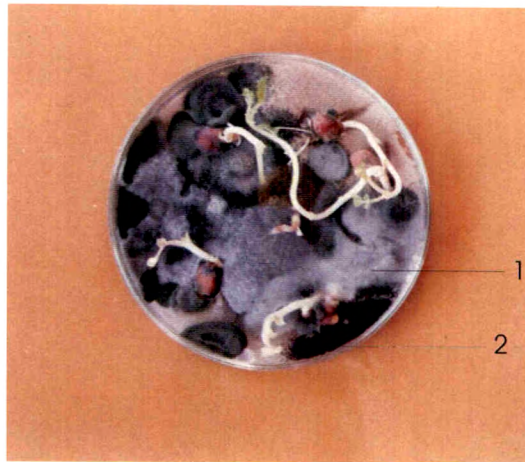
#### **20. Seed Suspension Test.**

5. *Aspergillus niger* Van Tieghem.
6. *Alternaria* sp.
7. *Aspergillus* sp.

Plate No. V  
Plate Fig. No. 17 to 20  
Gram



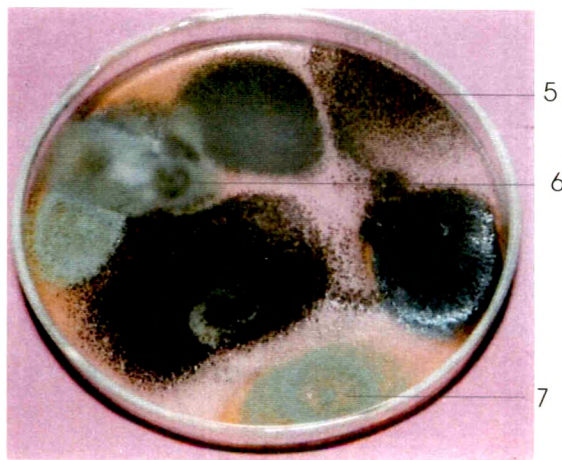
17



18



19



20

## **Explanation of plate number VI**

**Fig no. 21 – 24**

**Pea**

**21. Normal and Abnormal seeds.**

**22. Blotter Method.**

1. *A. fumigatus* Fresenius.

**23. Dry Seed Inoculation Method.**

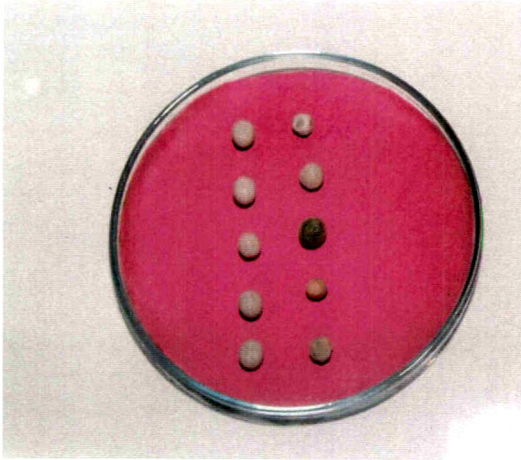
3. *Aspergillus niger* Van Tieghem.
4. *A. flavus* Link ex Fries.

**24. Seed Suspension Test.**

5. *Aspergillus* sp.



Plate No. VI  
Plate Fig. No. 21 to 24  
Pea



21



22



23



24

## **Explanation of plate number VII**

**Plate Fig. no. 25 – 28**

**Urdbean**

**25. Normal and Abnormal seeds.**

**26. Blotter Method.**

1. *Aspergillus niger* van Tieghem.
2. *Aspergillus* sp.

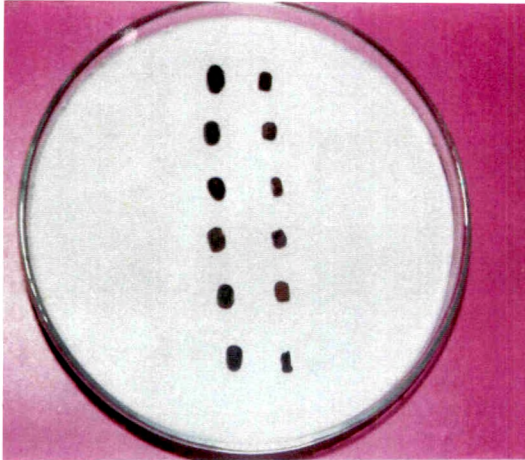
**27. Dry Seed Inoculation Method.**

3. *Aspergillus* sp.
4. *Aspergillus niger* Van Tieghem.

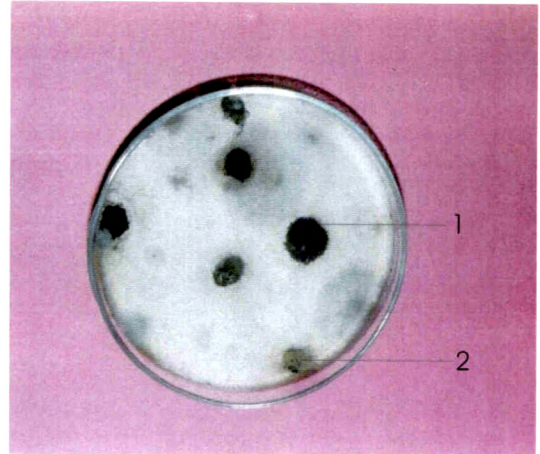
**28. Seed Suspension Test.**

5. *Penicillium* sp.
6. *Fusarium* sp.
7. *Aspergillus* sp.

Plate No.VII  
Plate Fig. No. 25 to 28  
Urdbean



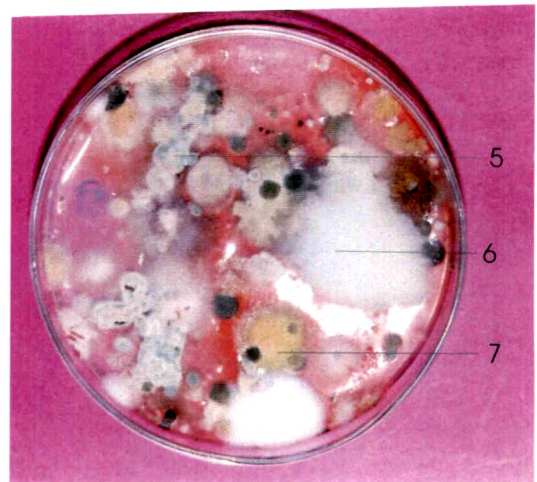
25



26



27



28

# Oil Seeds

Edible oil and fats are major source of human nutrition. The fatty acids in edible oil are required by the body as a vehicle for carrying vitamins (Chandvaria, 1991)

For study of mycoflora associated with the oil seeds, *Arachis hypogaea* L. (Groundnut), *Glycin max* L. Merril. (Soybean) and *Helianthus annus* L. (Sunflower) were selected as they are grown in and around the Satara. For this study visual evaluation, Blotter Method, Dry Seed Inoculation Method and Seed Suspension Test were used.

#### ***Arachis hypogaea* L. (Groundnut).**

When seeds were visually examined, percentage of discoloured and shrunken seeds was found to be 13% (Plate fig. 29). The results of ectophytic mycoflora of groundnut observed during present investigation are recorded in Table -14 and those of endophytic mycoflora are recorded in Table 15.

During the study of ectophytic mycoflora, highest number of fungi i.e.39 were recorded on seed with Blotter Method followed by Seed Suspension Test i.e. 17 species and 14 species were observed by Dry Seed Inoculation Method. This clearly indicates that Blotter Method favored the growth of more number of fungi by providing suitable microclimate.

In the present investigation, total numbers of 43 species of fungi belonging to 6 genera were detected. While taking into

account of the total number of fungi, associated with groundnut, genus *Aspergillus* ranked first displaying 33 species followed by *Penicillium* (3 species), *Rhizopus* (3 species), *Mucor* (2 species), *Alternaria* (1 species) and *Fusarium* (1 species). Except the species of *Penicillium* and *Fusarium*, all other fungi sporulated quite freely and formed characteristic colonies. These two fungal genera were detected only on Seed Suspension Test.

The fungal species *Aspergillus amstelodami*, *A. chevalieri*, *A. niger*, *A. flavus*, *A. lutescens*, *A. oryzae*, *A. parasiticus*, *A. quercinus* and *A. ustus* were reported by three methods mentioned earlier. *Alternaria alternata*, *Rhizopus artocarepi*, *R. oryzae* and *R. combodia* were observed on the seed surface and detected by Dry Seed Inoculation Method and Blotter Method. Five fungal species isolated by Seed Suspension Test and Blotter Method, were *Aspergillus alutaceus*, *A. candidus*, *A. repens*, *A. ruber* on seeds of groundnut. *Fusarium oxysporum* was reported by Dry Seed Inoculation Method and Seed Suspension Test.

By using Seed Suspension Test, *Penicillium chrysogenum*, *P. jaxanicum* and *P. oxalicum* were reported. By using Blotter Method 22 species were detected. Out of these, 20 species were of *Aspergillus* and 2 species were of *Mucor*. By using Blotter Method, species observed on groundnut seeds were *A. atropurpureus*, *A. carbonarius*, *A. erythrocephalus*, *A. fumigatus*, *A. humicola*, *A. insecticola*, *A. japonicus*, *A. luchuensis*, *A. nanus*, *A. nidulans*, *A. niveus*, *A. phoenicis*, *A. pulverulentus*, *A. sclerotiorum*, *A. sydowi*, *A. terreus*, *A. unguis*, *A. versicolor*, *A. violaceo-fuscus*, *A. wentii*, *Mucor circinelloides* and *M. griseo-cyaneus*.

The studies done to find out endophytic mycoflora revealed five fungal species belonging to two genera. They were fungal

~~species~~ *Aspergillus amstelodami*, *A. chevalieri*, *A. candidus*, *A. niger* and *Rhizopus combodia*.

Seed borne mycoflora of groundnut investigated during this study included *Aspergillus candidus*, *A. japonicus*, *A. luchuensis*, *A. terreus*, *A. wentii*, *A. flavus*, *Aspergillus niger* and *Fusarium oxysporum* which were reported ~~detected~~ earlier by Dawar, Ghaffar, Shaukat and Rasheed (2004).

Fungal species *Aspergillus flavus* and *A. niger* detected in present investigation, were reported to be pathogenic, which could reduce seed germination and length of root and shoot in seedling as observed earlier by Singh, Rawal and Bhargava (2004).

### ***Glycin max* L. Merril. (Soybean).**

Soybean is rich source of <sup>good</sup> best quality protein and oil. It is considered to be oil seed crop due to its high oil content.

For this study Soybean was selected because it is extensively cultivated now a day as a source of edible oil in and around Satara.

For the present study, the seeds were visually examined, by naked eye and under binocular microscope and it was observed that 7 % of seeds were shrunken and discoloured (Plate fig. 33). The seeds mycoflora was studied with reference to its ectophytic and endophytic mycoflora. Ectophytic fungi of this oil seed are recorded in Table – 16 and endophytic fungi are recorded in Table -17.

Twenty species of ectophytic fungi belonging to eight genera were observed during the present study. The genus *Aspergillus* with 13 species was dominant. *Alternaria*, *Cladosporium*, *Curvularia*, *Dictylaria*, *Penicillium* *Fusarium* and *Rhizopus* were represented by single species. In this study Blotter Method showed highest number species i.e. 13 followed by Seed Suspension Test (11 species) and Dry Seed Inoculation Method with 9 fungal species.

The three species *Alternaria alternata*, *Rhizopus combodina*, and *Aspergillus niger* were commonly observed in all the three methods. *Aspergillus chevalieri*, *A. flavus*, *A. fresenii*, *A. phoenicis* were detected by Dry Seed Inoculation Method and Blotter Method. *Aspergillus japonicus*, *A. oryzae*, *A. ustus*, *Fusarium oxysporum* were observed by Blotter Method and Seed



Suspension Test. And *Aspergillus alliaceus* was observed by Dry Seed Inoculation Method and Seed Suspension Test.

*Cladosporium cladosporioides*, *A. niveus* and *A. amstelodami* were reported by Dry Seed Inoculation Method. Three fungal species, *Aspergillus nidulance*, *Curvularia lunata*, *Dictylaria* sp., were detected by Seed Suspension Test. Where as *Aspergillus fonsecaeus* and *Penicillium oxalicum* were recorded by Blotter Method.

In the present investigation Blotter Method showed better growth fungi which may be due to availability of sufficient moisture for fungal growth.

During the study of endophytic mycoflora, four fungal species belonging to two genera were recorded. And they were *Aspergillus fonsecaeus*, *A. fresenii*, *A. niger* and *Cladosporium cladosporioides*.

Fungal species observed during the present analysis i.e. *Cladosporium cladosporioides*, *Alternaria alternata*, *Curvularia lunata* and species of *Aspergillus*, *Pencillium* and *Rhizopus* have been reported earlier by Gupta (2001).

### ***Helianthus annus* L. (Sunflower).**

Sunflower is cultivated successfully in temperate, tropical and subtropical climate.

Sunflower seeds were selected for this study because it is a source of edible oil and therefore it is cultivated in and around Satara.

In the present study, the seeds were visually examined, by naked eye and under binocular microscope and it was observed that 9 % seeds of sunflower were shrunken and discoloured (Plate fig.37). Ectophytic fungi of this oil seed are recorded in Table – 18 but there were no endophytic fungi growing on the seeds.

Only three ectophytic fungal species were detected by using three methods. *Aspergillus niger* was detected by three methods mentioned earlier. *Aspergillus insecticola* was reported by Seed Suspension Test and Blotter Method. *Actinomucor* was observed by Dry Seed Inoculation Method and Blotter Method.

Less number of fungi may be due to some possible reasons like sunflower is <sup>an</sup> exotic species with hard seed coat and low moisture content ~~in seed~~.

Table - 14

## MYCOFLORA ASSOCIATED WITH GROUNDNUT SEEDS

## Ectophytic Mycoflora.

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Alternaria alternata</i> (Fries) Keissler.	+	+	-
2.	<i>Aspergillus alutaceus</i> Berk and Curt.	+	-	+
3.	<i>A. amstelodami</i> ( Mang.) Thom and Church.	+	+	+
4.	<i>A. atropurpureus</i> Zimmermann.	+	-	-
5.	<i>A. candidus</i> Link ex Fries.	+	-	+
6.	<i>A. carbonarius</i> ( Bainier ) Thom.	+	-	-
7.	<i>A. chevalieri</i> ( Mang.) Thom and Church.	+	+	+
8.	<i>A. erythrocephalus</i> Berk. and Curt.	+	-	-
9.	<i>A. flavus</i> Link ex Fries.	+	+	+
10.	<i>A. fumigatus</i> Fresenius.	+	-	-
11.	<i>A. humicola</i> Chaudhuri and Sachar.	+	-	-
12.	<i>A. insecticola</i> Subram. nom. nov.	+	-	-
13.	<i>A. japonicus</i> Saito.	+	-	-
14.	<i>A. luchuensis</i> Inui.	+	-	-
15.	<i>A. lutescens</i> Bainier ex Thom and Church.	+	+	+
16.	<i>A. nanus</i> Montagne.	+	-	-
17.	<i>A. nidulans</i> (Eidam ) Winter.	+	-	-
18.	<i>A. niger</i> Van Tieghem.	+	+	+
19.	<i>A. niveus</i> Blochwitz.	+	-	-
20.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	+	+	+
21.	<i>A. parasiticus</i> Speare.	+	+	+
22.	<i>A. phoenicis</i> (Corda)Thom.	+	-	-
23.	<i>A. pulverulentus</i> (McAlpine) Thom.	+	-	-
24.	<i>A. quercinus</i> (Bainier) Thom and Church.	+	+	+
25.	<i>A. repens</i> (Corda) de Bary.	+	-	+
26.	<i>A. ruber</i> (Bremer) Thom and Raper.	+	-	+
27.	<i>A. sclerotiorum</i> Huber.	+	-	-
28.	<i>A. sydowi</i> (Bain. and Sart.)Thom and Church.	+	-	-
29.	<i>A. terreus</i> Thom.	+	-	-
30.	<i>A. unguis</i> (Emil-Weil and Gaudin) Thom and Raper.	+	-	-
31.	<i>A. ustus</i> (Bainier) Thom and Church.	+	+	+
32.	<i>A. versicolor</i> (Vuillemin) Tiraboschi.	+	-	-
33.	<i>A. violaceo-fuscus</i> Gasperini .	+	-	-

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp
34.	<i>A. wentii</i> Wehmer.	+	-	-
35.	<i>Fusarium oxysporum</i> schl. ex. Fries.	-	+	+
36.	<i>Mucor circinelloides</i> Van Tieghem.	+	-	-
37.	<i>M. griseo – cyaneus</i> .	+	-	-
38.	<i>Penicillium chrysogenum</i> Thom.	-	-	+
39.	<i>P. javanicum</i> Van Beyma.	-	-	+
40.	<i>P. oxalicum</i> Currie and Thom.	-	-	+
41.	<i>Rhizopus artocarepi</i> Raciborski.	+	+	-
42.	<i>R. oryzae</i> Went et. Garlings.	+	+	-
43.	<i>R. combodia</i> Vuillemin.	+	+	-

( + ) ..... Present.

( — )..... Absent.

**Table - 15**

## **MYCOFLORA ASSOCIATED WITH GROUNDNUT SEEDS**

### **Endophytic Mycoflora.**

SR. NO.	FUNGAL FORMS
1	<i>Aspergillus amstelodami</i> ( Mang.) Thom and Church.
2	<i>A. chevalieri</i> ( Mang.) Thom and Church.
3	<i>A. candidus</i> Link ex Fries.
4	<i>A. niger</i> Van Tieghem.
5	<i>Rhizopus combodia</i> Vuillemin.

Table - 16

## MYCOFLORA ASSOCIATED WITH SOYBEAN SEEDS

## Ectophytic Mycoflora.

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek;s (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Alternaria alternata</i> (Fries) Keissler.	+	+	+
2.	<i>Aspergillus alliaceus</i> Thom and Church.	-	+	+
3.	<i>A. amstelodami</i> ( Mang) Thom an Church.	-	+	-
4.	<i>A. chevalieri</i> ( Mang .) Thom and Church.	+	+	-
5.	<i>A. flavus</i> Link ex Fries.	+	+	-
6.	<i>A. fonsecaeus</i> Thom and Raper.	+	-	-
7.	<i>A. fresenii</i> Subram. nom. nov.	+	+	-
8.	<i>A. japonicus</i> Saito.	+	-	+
9.	<i>A. nidulance</i> ( Eidam) Winter.	-	-	+
10.	<i>A. niger</i> Van Tieghem.	+	+	+
11.	<i>A. niveus</i> Blochwitz.	-	+	-
12.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	+	-	+
13.	<i>A. phoenicis</i> (Corda)Thom.	+	+	-
14.	<i>A. ustus</i> (Bainier) Thom and Church.	+	-	+
15.	<i>Curvularia lunata</i> ( Wakker )Boedijn.	-	-	+
16.	<i>Cladosporium cladosporioides</i> ( Fr. ) de Vries.	-	+	-
17.	<i>Dictylaria</i> sp.	-	-	+
18.	<i>Fusarium oxysporum</i> Schl.	+	-	+
19.	<i>Penicillium oxalicum</i> Currie and Thom.	+	-	-
20.	<i>Rhizopus combodina</i> Vuillemin.	+	+	+

Table - 17

## MYCOFLORA ASSOCIATED WITH SOYBEAN SEEDS

## Endophytic Mycoflora.

SR. NO.	FUNGAL FORMS
1	<i>Aspergillus fonsecaeus</i> Thom and Raper.
2	<i>A. fresenii</i> Subram. nom. nov.
3	<i>A. niger</i> van Tieghem.
4	<i>Cladosporium cladosporioides</i> ( Fr.) de Vries.

**Table - 18**

**MYCOFLORA ASSOCIATED WITH SUNFLOWER SEEDS**

**Ectophytic Mycoflora.**

SR. NO.	FUNGAL FORMS	METHODS		
		Blott er Test	Czapeks Dox medium	
			Dry Seed	Seed Susp.
1.	<i>Actinomucor repens</i> Schost.	+	+	-
2.	<i>Aspergillus insecticola</i> Subram. Nom. Nov.	+	-	+
3.	<i>A. niger</i> Van Tieghem.	+	+	+

**Endophytic Mycoflora were not observed.**

## **Explanation of plate number VIII**

**Plate Fig. no. 29 – 32**

### **Groundnut**

#### **29. Normal and Abnormal seeds.**

#### **30. Blotter Method.**

1. *Aspergillus candidus* Link ex Fries.
2. *A. atropurpureus* Zimmermann.

#### **31. Dry Seed Inoculation Method.**

3. *Aspergillus lutescens* Bainier ex Thom and Church.
4. *A. niger* Van Tieghem.
5. *Rhizopus artocarepi* Raciborski.
6. *Fusarium oxysporum* Schl. ex. Fries.

#### **32. Seed Suspension Test.**

7. *Penicillium oxalicum* Currie and Thom.
8. *Aspergillus* sp.

Plate No. VIII  
Plate Fig. No. 29 to 32  
Groundnut



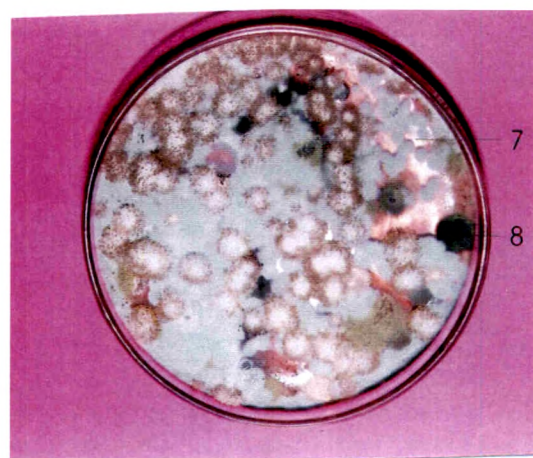
29



30



31



32



## **Explanation of plate number IX**

**Plate Fig. no. 33 – 36**

### **Soybean**

#### **33. Normal and Abnormal seeds.**

#### **34. Blotter Method.**

1. *Aspergillus niger* Van Tieghem.
2. *A. flavus* Link ex Fries.

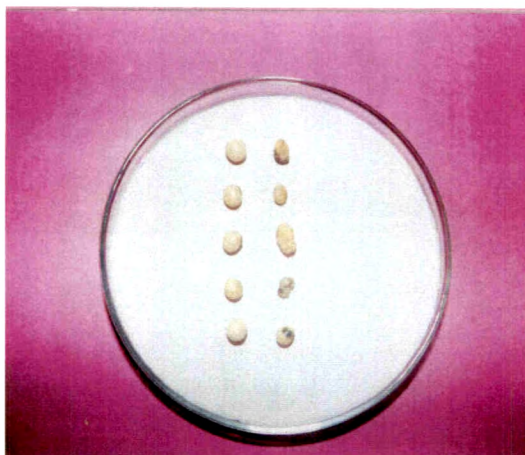
#### **35. Dry Seed Inoculation Method.**

3. *Aspergillus niger* Van Tieghem.
4. *Aspergillus* sp.

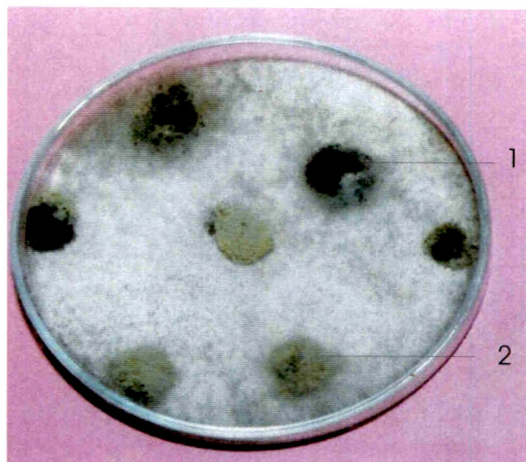
#### **36. Seed Suspension Test.**

5. *Fusarium oxysporum* Schl.
6. *Aspergillus* sp.

Plate No. IX  
Plate Fig. No. 33 to 36  
Soybean



33



34



35



36

## **Explanation of plate number X**

**Plate Fig. no. 37 – 40**

### **Sunflower**

**37. Normal and Abnormal seeds.**

**38. Blotter Method.**

1. *Aspergillus niger* Van Tieghem.

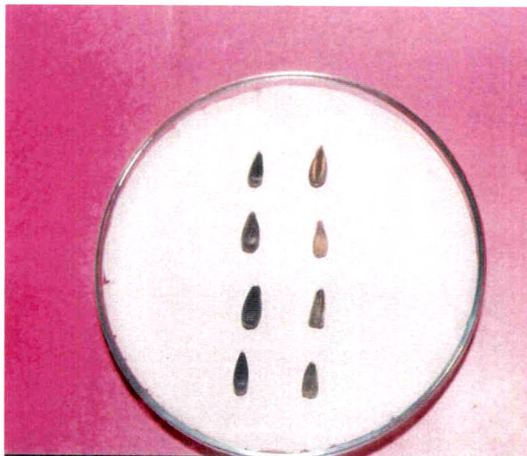
**39. Dry Seed Inoculation Method.**

2. *Aspergillus niger* Van Tieghem.

**40. Seed Suspension Test.**

- 3 / 4. *Aspergillus niger* Van Tieghem.

Plate No. X  
Plate Fig. No. 37 to 40  
Sunflower



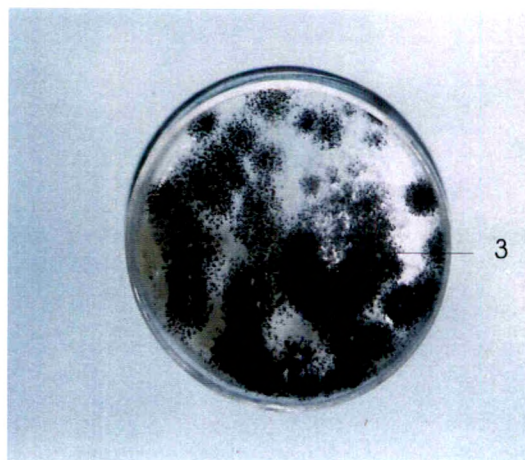
37



38



39



40

# Vegetable Seeds

Vegetables are important part in daily diet because they contain proteins, minerals and vitamins therefore they are considered as “protective supplementary food” which is required for normal functioning of human metabolic processes

Vegetables included in this study to explore seed mycoflora were Okra, Chilli, Clusterbean and French bean.

### ***Abelmoschus esculentus* L. (Okra, Bhendi )**

Bhendi is one of the popular vegetables in India. It is cultivated for its immature fruits, used as a vegetable.

In the present study, the seeds of Okra were visually examined, by naked eye and under binocular microscope and it was found that 6 % of seeds were shrunken and discoloured (Plate fig. 41). Ectophytic Mycoflora are recorded in Table – 19. Endophytic Mycoflora are recorded in Table – 20.

In the study of ectophytic mycoflora, 8 species belonging to 5 genera were isolated from seeds. Number of fungal species, observed by Dry seed Inoculation Method were 5 species, by Blotter Method were 4 species and by Seed Suspension Test were 3 species.

Among them 4 species were of *Aspergillus* and 4 genera representing single species were of *Cladosporium*, *Fusarium*, *Mucor* and *Rhizopus*.

*Rhizopus stolonifer* was detected by three methods. *Aspergillus flavus* and *Fusarium oxysporum* were reported by Dry seed Inoculation Method and Blotter Method. Two fungal species reported only by Dry Seed Inoculation Method, were *Aspergillus amstelodami* and *Cladosporium cladosporioides*. Two species of *Aspergillus* were isolated by Seed Suspension Test. *A. chevalieri*, *A. phoenicis* and *Mucor* sp. could grow on the seeds when moisture was provided by Blotter Method.

In the study of endophytic mycoflora, five species belonging to three genera were recorded. They were *Alternaria palandui*, *Aspergillus amstelodami*, *A. niger*, *A. quercinus* and *Cladosporium cladosporioides*.

The fungal species *Aspergillus flavus* reported in present investigation was also reported by Beebi Rezeena and Ahmad (2007).

### ***Capsicum annum* L.(Chilli).**

Chilli is one of the most valuable crops of India. It is grown in tropical and subtropical regions.

Chilli was selected for this study because it is used for various cooking preparation in and around Satara.

In the present investigation, the seeds were visually examined by naked eye and under binocular microscope and (3 %) of seeds were found shrunken and discoloured (Plate fig. 45). Ectophytic mycoflora <sup>is</sup> recorded in Table -21. Endophytic Mycoflora could be not found during present study.

A total 9 ectophytic fungal species belonging to 6 genera were observed. Seed Suspension Test used for studying ectophytic mycoflora has shown the highest number i.e. 7 fungal species however, only 3 fungal species of ectophytic fungi were detected by Dry Seed Inoculation Method and Blotter Method.

The fungal species *Aspergillus amstelodami* and *Rhizopus combodina* were reported by Blotter Method and Seed Suspension Test. *Aspergillus quercinus* and *A. repens* were observed by Dry Seed Inoculation Method and Seed Suspension Test.

*Aspergillus chevalieri* was detected by Blotter Method. *Actinomucor repens* was the genus reported by Dry Seed Inoculation Method. Three genera observed by Seed Suspension Test were, *Cladosporium*, *Fusarium* and *Trichocladium*.

In the present investigation Seed Suspension Test gave good results. Endophytic Mycoflora did not develop and hence not recorded.

The genera *Aspergillus*, *Fusarium* and *Rhizopus* were recorded earlier also by Singh (2007).



***Cyamopsis tetragonoloba* Taub.**

**(Cluster bean)**

Cluster bean is grown for green vegetable and dry seeds, and also used for extraction of gum. It is cultivated in many parts of India.

For this study Cluster bean was selected because it is used as vegetable in and around Satara.

In the present investigation, the seeds were visually examined, by naked eye and under binocular microscope and 7 % of seeds were found to be shrunk and discoloured (Plate fig. 49). Ectophytic fungi are recorded in Table - 22 and endophytic fungi are recorded in Table- 23.

In ectophytic mycoflora 10 fungal species belonging to 3 genera were reported on seeds of clusterbean. *Aspergillus* was dominant genus representing 8 species. *Cladosporium* and *Rhizopus* were represented by single species.

Blotter Method used for studying ectophytic mycoflora has shown highest number of fungal species i. e. six and 4 fungal species were detected by Dry Seed Inoculation Method and Seed Suspension Test.

*Aspergillus oryzae* was observed by three methods mentioned earlier. *Aspergillus alutaceus* was observed in Dry Seed Inoculation Method and Blotter Method. *Rhizopus combodina* was reported by Seed Suspension Test and Blotter Method. *Aspergillus castaneus*, *A. flavipes*, *A. japonicus* and *A. ruber* were detected by Dry Seed Inoculation Method. *Aspergillus chevalieri* and *Cladosporium cladosporioides* were detected by Seed Suspension Test. *Aspergillus unguis* was reported only by Blotter Method.

In the study of, endophytic mycoflora, three fungal species belonging to two genera were recorded. They were *Alternaria palandui*, *Aspergillus amstelodami* and *A. niger*.

*Aspergillus niger* recorded during present investigation was recorded earlier by Bhatia and Singh *et al.* (1995).

***Phaseolus vulgaris* L.**

**(French Bean).**

French bean is commonly cultivated for dry seeds.

It was selected because it is one of the commonly cultivated vegetables in and around Satara.

In the present study, the seeds were visually examined, by naked eye and under binocular microscope and 9 % of seeds recorded were shrunken and discoloured (Plate fig. 53). Ectophytic fungi <sup>are</sup> recorded in Table- 24. Endophytic fungi <sup>are</sup> recorded in Table -25.

In the present investigation of ectophytic mycoflora 28 fungal species belonging to 6 genera were recorded on seeds of French bean. Highest Number of fungal species i. e. 16 were observed with Dry Seed Inoculation Method however, 9 fungal species were detected by Seed Suspension Test. Blotter Method revealed 11 fungal species of ectophytic mycoflora.

*Aspergillus* was dominant genus representing 23 species. Three genera, *Curvularia*, *Dictyoarthrinum* and *Torula* were represented by single species and *Penicillium* was represented by two species.

*Aspergillus amstelodami*, *A. lutescens* and *A. niger* were detected by three methods. *Aspergillus candidus* was detected by Seed Suspension Test and Dry Seed Inoculation Method.

*Aspergillus alliaceus*, *A. chevalieri*, *A. flavus*, *A. flavipes*, *A. nidulans*, *A. oryzae*, *A. proliferens*, *A. quercinus*, *A. repens*, *A. ustus*, *Penicillium chrysogenum* and *Torula* sp. were reported by Dry Seed Inoculation Method. *A. carbonarius*, *Aspergillus insecticola*, *Curvularia lunata* and *Dictyoarthrinum* sp. were detected by Seed Suspension Test. *Aspergillus humicola*, *A. niveus*, *A. parasiticus*, *A. pulverulentus*, *A. sydowi*, *A. unguis* and *A. versicolor* were reported by Blotter Method.

Three fungal species, *Aspergillus niger*, *Cladosporium cladosporioides*, and *Rhizopus combodina* were recorded as endophytic mycoflora.

*A. flavus*, *A. niger* and *Cladosporium cladosporioides* were reported earlier by Paul in 2002.

Table - 19

## MYCOFLORA ASSOCIATED WITH OKRA SEEDS

## Ectophytic Mycoflora.

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Aspergillus amstelodami</i> (Mang.) Thom and Church.	-	+	-
2.	<i>A. chevalieri</i> (Mang.) Thom and Church.	-	-	+
3.	<i>A. flavus</i> Link ex Fries.	+	+	-
4.	<i>A. niger</i> Van Tieghem.	+	-	-
5.	<i>A. phoenicis</i> (Corda) Thom.	-	-	+
6.	<i>Cladosporium cladosporioides</i> (Fr.) de Vries.	-	+	-
7.	<i>Fusarium oxysporum</i> Schl. ex. Fries.	+	+	-
8.	<i>Mucor abundans</i> Povah.	+	-	-
9.	<i>Rhizopus stolonifer</i> Vuillemin.	+	+	+

Table - 20

## MYCOFLORA ASSOCIATED WITH OKRA SEEDS

## Endophytic Mycoflora.

SR. NO.	FUNGAL FORMS
1.	<i>Alternaria palandui</i> Ayyangar .
2.	<i>Aspergillus amstelodami</i> (Mang.) Thom and Church.
3.	<i>A. niger</i> Van Tieghem.
4.	<i>A. quercinus</i> (Bainier) Thom and Church.
5.	<i>Cladosporium cladosporioides</i> (Fr.) de Vries.

**Table - 21**

**MYCOFLORA ASSOCIATED WITH CHILLI SEEDS**

**Ectophytic Mycoflora.**

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox) medium	
			Dry seed	Seed Susp.
1.	<i>Actinomucor repens</i> Schost.	-	+	-
2.	<i>Aspergillus amstelodami</i> ( Mang.) Thom and Church.	+	-	+
3.	<i>A. chevalieri</i> ( Mang .) Thom and Church.	+	-	-
4.	<i>A. quercinus</i> (Bainier) Thom and Church.	-	+	+
5.	<i>A. repens</i> (Corda) de Bary.	-	+	+
6.	<i>Cladosporium cladosporioides</i> ( Fr. ) de Vries.	-	-	+
7.	<i>Fusarium oxysporum</i> Schl. ex. Fries.	-	-	+
8.	<i>Trichocladium</i> sp.	-	-	+
9.	<i>Rhizopus combodina</i> Vuillemin.	+	-	+

**Endophytic Mycoflora were not observed.**

**Table - 22**

**MYCOFLORA ASSOCIATED WITH CLUSTER BEAN SEEDS**

**Ectophytic Mycoflora.**

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Aspergillus alutaceus</i> Berk. Curt.	+	+	---
2.	<i>A. castaneus</i> Patterson.	---	+	---
3.	<i>A. chevalieri</i> ( Mang.) Thom and Church.	---	---	+
4.	<i>A. flavipes</i> ( Bain and Sart. ) Thom and Church.	---	+	---
5.	<i>A. japonicus</i> Saito.	---	+	---
6.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	+	+	+
7.	<i>A. ruber</i> (Bremer) Thom and Raper.	---	+	---
8.	<i>A. unguis</i> (Emil-Weil and Gaudin) Thom and Raper.	+	---	---
9.	<i>Cladosporium cladosporioides</i> ( Fr. ) de Vries.	---	---	+
10.	<i>Rhizopus combodina</i> Vuillemin.	+	---	+

**Table no. 23**

**MYCOFLORA ASSOCIATED WITH CLUSTER BEAN SEEDS**

**Endophytic Mycoflora.**

SR. NO.	FUNGAL FORMS
1	<i>Alternaria palandui</i> Ayyangar .
2	<i>Aspergillus amstelodami</i> (Mang.) Thom and Church.
3	<i>A. niger</i> Van Tieghem.

**Table - 24**  
**MYCOFLORA ASSOCIATED WITH FREANCH BEAN.**  
**Ectophytic Mycoflora.**

SR. NO.	FUNGAL FORMS	METHODS		
		Blot ter Met hod	Czapek's (Dox) medium	
			Dry Seed	Seed Susp.
1.	<i>Aspergillus alliaceus</i> Thom an Church.	-	+	-
2.	<i>A. amstelodami</i> ( Mang) Thom an Church.	+	+	+
3.	<i>A. candidus</i> Link ex Fries.	-	+	+
4.	<i>A. carbonarius</i> ( Bainier ) Thom.	-	-	+
5.	<i>A. chevalieri</i> ( Mang.) Thom and Church.	-	+	-
6.	<i>A. flavus</i> Link ex Fries.	-	+	-
7.	<i>A. flavipes</i> ( Bain and Sart. ) Thom and Church.	-	+	-
8.	<i>A. humicola</i> Chau. and Sach.	+	-	-
9.	<i>A. insecticola</i> Subram. nom. nov.	-	-	+
10.	<i>A. lutescens</i> Bainier ex Thom and Church.	+	+	+
11.	<i>A. nidulans</i> ( Eidam ) Winter.	-	+	-
12.	<i>A. niger</i> Van Tieghem.	+	+	+
13.	<i>A. niveus</i> Blochwitz.	+	-	-
14.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	-	+	-
15.	<i>A. parasiticus</i> Speare.	+	-	-
16.	<i>A. proliferens</i> G. Smith.	-	+	-
17.	<i>A. pulverulentus</i> (McAlpine) Thom.	+	-	-
18.	<i>A. quercinus</i> (Bainier) Thom and Church.	-	+	-
19.	<i>A. sydowi</i> ( Bainier ) Thom and Church.	+	-	-
20.	<i>A. repens</i> (Corda)de Bary.	-	+	-
21.	<i>A. ustus</i> (Bainier) Thom and Church.	-	+	-
22.	<i>A. unguis</i> (Emil-Weil and Gaudin) Thom and Raper.	+	-	-
23.	<i>A. versicolor</i> (Vuillemin) Tiraboschi.	+	-	-
24.	<i>Curvularia lunata</i> ( Wakker ) Boed.	-	-	+
25.	<i>Dictyoarthrinum</i> sp.	-	-	+
26.	<i>Penicillium chrysogenum</i> Thom.	-	+	-
27.	<i>P. expansum</i> Link ex Fries.	+	-	+
28.	<i>Torula</i> sp.	-	+	-

**Table - 25**  
**SEED MYCOFLORA OF FREANCH BEAN ( RAJAMA ).**  
**Endophytic Mycoflora**

	FUNGAL FORMS
1	<i>Aspergillus niger</i> Van Tieghem.
2	<i>Cladosporium cladosporioides</i> ( Fr. ) de Vries.
3	<i>Rhizopus combodina</i> Vuillemin.

## Comparison of seed mycoflora :

Sr n o.	NAME OF FUNGUS	Sorghum	Wheat	Maize	Pigeonpea	Gram	Pea	Urdbean	Groundnut	Soybean	Sunflower	Okra	Chilli	Clusterbean	Frenchbean
1.	<i>Actinomucor repens</i> Schost.	+	-	-	-	-	-	-	-	-	+	-	+	-	-
2.	<i>Alternaria alternata</i>	-	+	-	-	-	-	-	+	+	-	-	-	-	-
3.	<i>Alternaria brassicae</i> (Berk.) Sacc.	+	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	<i>A. burnsii</i> Uppal, Patel and Kamat.	+	-	+	-	-	-	-	-	-	-	-	-	-	-
5.	<i>A. carthami</i> Chowdhury.	+	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	<i>A. citri</i> Ellis and Pierce.	+	-	-	-	-	-	-	-	-	-	-	-	-	-
7.	<i>A. dianthicola</i> Neergaard.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
8.	<i>A. humicola</i> Oudemans.	+	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	<i>A. palandui</i> Ayyangar .	+	-	-	-	-	-	-	-	-	-	+	-	+	-
10.	<i>A. tenuis</i> Auct.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
11.	<i>A. tenuissima</i> ( Kunze ex Pers ) Wilts.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
12.	<i>Aspergillus alliaceus</i> Thom and Church.	+	-	-	+	-	-	-	-	+	-	-	-	-	+
13.	<i>A. alutaceus</i> Berk and Curt.	-	-	+	-	-	-	-	+	-	-	-	-	+	-
14.	<i>A. amstelodami</i> ( Mang) Thom and Church	+	+	+	+	+	+	-	+	+	-	+	+	+	+
15.	<i>A. atropurpureus</i> Zimmermann.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
16.	<i>A. awamori</i> Nakazawa.	-	-	-	-	-	-	+	-	-	-	-	-	-	-
17.	<i>A. carbonarius</i> ( Bainier ) Thom.	-	-	+	-	-	+	+	+	-	-	-	-	-	+
18.	<i>A. castaneus</i> Patterson.	-	-	+	-	-	-	-	-	-	-	-	-	+	-
19.	<i>A. chevalieri</i> ( Mang .) Thom and Church	+	+	+	+	+	+	-	+	+	-	+	+	+	+
20.	<i>A. candidus</i> Link ex Fries .	+	-	-	-	+	-	+	+	-	-	-	-	-	+
21.	<i>A. erythrocephalus</i> Berk and Curt.	-	+	+	-	-	-	-	+	-	-	-	-	-	-
22.	<i>A. flavus</i> Link ex Fries.	+	-	+	-	+	+	-	+	+	-	+	-	-	+
23.	<i>A. flavipes</i> ( Bain. and Sart.) Thom and Church.	+	-	-	+	+	-	-	-	-	-	-	-	+	+
24.	<i>A. fonsecaeus</i> Thom and Raper.	+	+	+	-	-	-	-	-	+	-	-	-	-	-
25.	<i>A. fresenii</i> Subram.nom.nov.	-	-	+	+	-	-	-	-	+	-	-	-	-	-
26.	<i>A. fumigatus</i> Fresenius.	+	-	+	-	+	+	-	+	-	-	-	-	-	-
27.	<i>A. humicola</i> Chaudhuri and Sachar.	+	-	+	-	-	-	-	+	-	-	-	-	-	+
28.	<i>A. insecticola</i> Subram. nom. nov.	-	-	+	+	-	-	+	+	-	+	-	-	-	+
29.	<i>A. japonicus</i> Saito.	+	-	-	+	-	-	-	+	+	-	-	-	+	-
30.	<i>A. luchuensis</i> Inui.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
31.	<i>A. lutescens</i> Bainier ex Thom and Church.	-	+	+	+	-	+	-	+	-	-	-	-	-	+
32.	<i>A. nanus</i> Montagne.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
33.	<i>A. nidulans</i> ( Eidam ) Wint.	-	-	-	-	-	+	-	+	+	-	-	-	-	+
34.	<i>A. niger</i> Van Tieghem.	+	+	+	+	+	+	+	+	+	+	+	-	+	+
35.	<i>A. niveus</i> Blochwitz.	-	-	+	-	+	-	-	+	+	-	-	-	-	+



	NAME OF FUNGUS	Sorghum	Wheat	Maize	Pigeonpea	Gram	Pea	Urdbean	Groundnut	Soybean	Sunflower	Okra	Chilli	Clusterbean	Frenchbean
36.	<i>A. oryzae</i> (Ahlburg in Korschelt) Cohn.	+	-	+	+	+	+	+	+	+	-	-	-	+	+
37.	<i>A. parasiticus</i> Speare.	-	+	+	+	+	-	-	+	-	-	-	-	-	+
38.	<i>A. phoenicis</i> (Corda) Thom.	-	-	+	-	-	-	-	+	+	-	+	-	-	-
39.	<i>A. phaeocephalus</i> Durieu and Montagne.	-	-	-	-	-	-	+	-	-	-	-	-	-	-
40.	<i>A. proliferens</i> G. Smith.	-	-	-	+	-	-	-	-	-	-	-	-	-	+
41.	<i>A. pulverulentus</i> (McAlpine) Thom.	+	-	+	-	-	-	-	+	-	-	-	-	-	+
42.	<i>A. quercinus</i> (Bainier) Thom and Church.	-	-	+	+	-	+	+	+	-	-	+	+	-	+
43.	<i>A. repens</i> (Corda) de Bary.	+	-	+	-	-	+	-	+	-	-	-	+	-	+
44.	<i>A. ruber</i> (Bremer) Thom and Raper.	-	-	+	-	-	-	-	+	-	-	-	-	+	-
45.	<i>A. sclerotiorum</i> Huber.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
46.	<i>A. sydowi</i> Thom and Church.	-	-	-	+	-	-	+	+	-	-	-	-	-	+
47.	<i>A. terreus</i> Thom.	-	-	-	-	+	-	-	+	-	-	-	-	-	-
48.	<i>A. unguis</i> (Emil-Weil and Gaudin) Thom and Raper.	-	-	+	+	-	-	-	+	-	-	-	-	+	+
49.	<i>A. ustus</i> (Bainier) Thom and Church.	+	-	-	+	-	-	+	+	+	-	-	-	-	+
50.	<i>A. versicolor</i> (Vuillemin) Tiraboschi.	+	-	-	+	-	-	+	+	-	-	-	-	-	+
51.	<i>A. violaceo-fuscus</i> Gasperini	+	-	+	+	-	-	+	+	-	-	-	-	-	-
52.	<i>A. wentii</i> Wehmer.	-	-	+	+	-	-	-	+	-	-	-	-	-	-
53.	<i>Cladosporium cladosporioides</i> ( Fr. ) de Vries.	-	+	+	-	+	+	-	-	+	-	+	+	+	+
54.	<i>Curvularia barreriae</i>	-	+	-	-	-	-	-	-	-	-	-	-	-	-
55.	<i>Curvularia lunata</i> ( Wakker ) Boedijn.	-	-	-	-	+	+	-	-	+	-	-	-	-	+
56.	<i>Dictylaria</i> sp.	-	-	-	-	-	-	-	-	+	-	-	-	-	-
57.	<i>Dictyoarthrinum</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	+
58.	<i>Drechslera australiensis</i> . ( Bugni.) Sub. & Jain.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
59.	<i>Fusarium oxysporum</i> Schl.ex Fries.	-	-	-	-	+	-	+	+	+	-	+	+	-	-
60.	<i>F. moniliforme</i> Schleldon	-	-	-	-	+	-	-	-	-	-	-	-	-	-
61.	<i>F. solani</i> (Mart.) Sacc.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
62.	<i>Mucor abundans</i> Povah.	-	-	-	-	+	+	+	-	-	-	+	-	-	-
63.	<i>M. circinelloides</i> Van Tieghem.	-	-	-	-	-	-	-	+	-	-	-	-	-	-
64.	<i>M. griseo – cyaneus</i> .	-	-	-	-	-	-	-	+	-	-	-	-	-	-
65.	<i>M. javanicus</i> Wehmer.	+	-	-	-	-	-	-	-	-	-	-	-	-	-
66.	<i>Penicillium atramentosum</i> Thom.	-	-	+	-	-	-	-	-	-	-	-	-	-	-
67.	<i>P. citrinum</i> Thom.	+	+	-	-	-	-	-	-	-	-	-	-	-	-
68.	<i>P. chrysogenum</i> Thom.	-	-	-	-	-	-	-	+	-	-	-	-	-	+
69.	<i>P. corylophilum</i> Dierckx .	+	-	-	-	-	-	-	-	-	-	-	-	-	-
70.	<i>P. expansum</i> Link ex Fries.	-	-	-	-	-	-	-	-	-	-	-	-	-	+
71.	<i>P. javanicum</i> Van Beyma.	-	-	+	-	-	+	-	+	-	-	-	-	-	-

Sr n o.	NAME OF FUNGUS	Sorghum	Wheat	Maize	Pigeonpea	Gram	Pea	Urdbean	Groundnut	Soybean	Sunflower	Okra	Chilli	Clusterbean	Frenchbean
72.	<i>P. janthinellum</i> Thom.	-	-	-	-	-	-	+	-	-	-	-	-	-	-
73.	<i>P. nigricans</i> Bainier ex Thom.	-	+	-	-	-	-	-	-	-	-	-	-	-	-
74.	<i>P. oxalicum</i> Currie and Thom .	+	-	+	+	-	-	-	+	+	-	-	-	-	-
75.	<i>P. purpurgenum</i> Stoll.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
76.	<i>P. rugulosum</i> Thom.	-	-	+	-	-	-	-	-	-	-	-	-	-	-
77.	<i>Rhizopus artocarp</i> i Raciborski.	-	+	-	-	-	-	-	+	-	-	-	-	-	-
78.	<i>R. combodia</i> Vuillemin.	+	+	+	-	+	+	-	+	+	-	-	+	+	+
79.	<i>R. oryzae</i> Went et. Gerlings.	+	-	-	-	-	-	+	+	-	-	-	-	-	-
80.	<i>R. nodosus</i> Namyslowski.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
81.	<i>R. stolonifer</i> ( Her.ex Link ) Lind.	-	-	-	-	+	-	-	-	-	-	+	-	-	-
82.	<i>Trichocladium</i> sp.	-	-	-	-	-	-	-	-	-	-	-	+	-	-
83.	<i>Torula</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	+
84.	<i>Verticillium</i> sp.	+	-	+	-	+	-	-	-	-	-	-	-	-	-

## **Explanation of plate number XI**

**Plate Fig. no. 41 – 44**

**Okra**

### **41. Normal and Abnormal seeds.**

### **42. Blotter Method.**

1. *Aspergillus niger* Van Tieghem.
2. *Rhizopus stolonifer* Vuillemin.

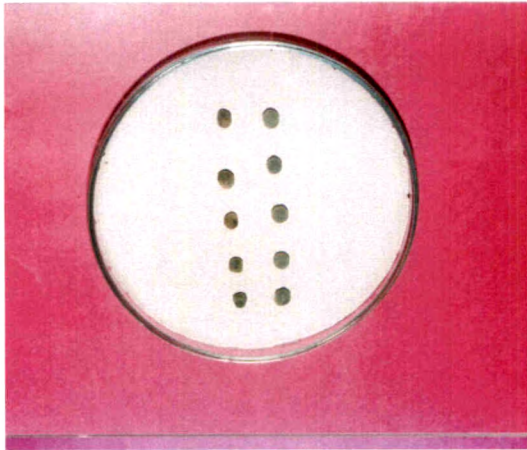
### **43. Dry Seed Inoculation Method.**

3. *Aspergillus amstelodami* (Mang.) Thom and Church.
4. *Fusarium oxysporum* Schl. ex. Fries.

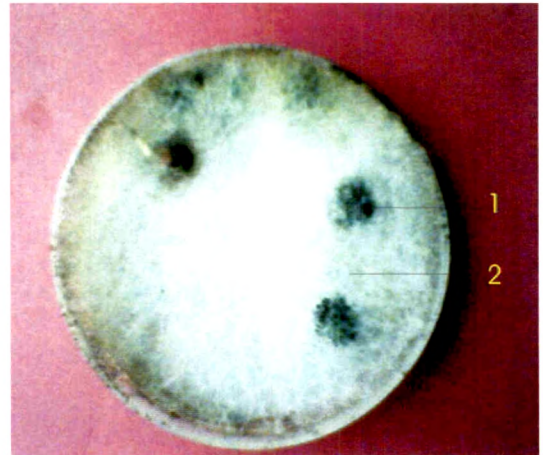
### **44. Seed Suspension Test.**

5. *Aspergillus chevalieri* (Mang.) Thom and Church.

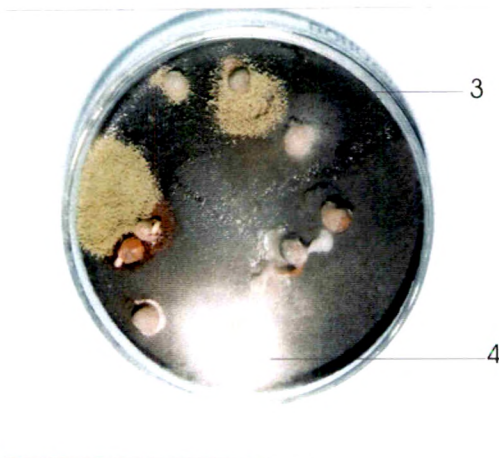
Plate No. XI  
Plate Fig. No. 41 to 44  
Okra



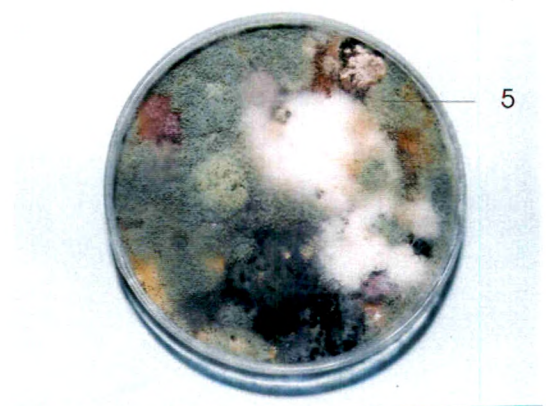
41



4



43



44

## **Explanation of plate number XII**

**Plate Fig. no. 45 – 49**

### **Chilli**

**45. Normal and Abnormal seeds.**

**46. Blotter Method.**

1. *Aspergillus niger* Van Tieghem.

**47. Dry Seed Inoculation Method.**

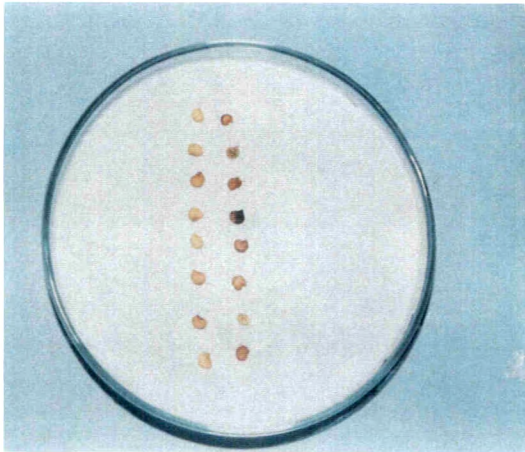
2. *Rhizopus combodina* Vuillemin.

**48. Seed Suspension Test.**

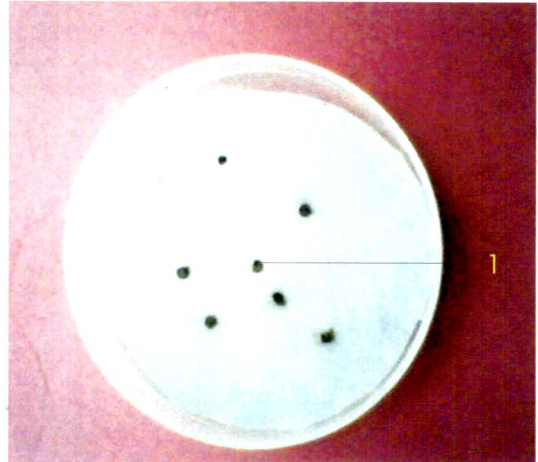
3. *Rhizopus combodina* Vuillemin.

4. *Aspergillus* sp.

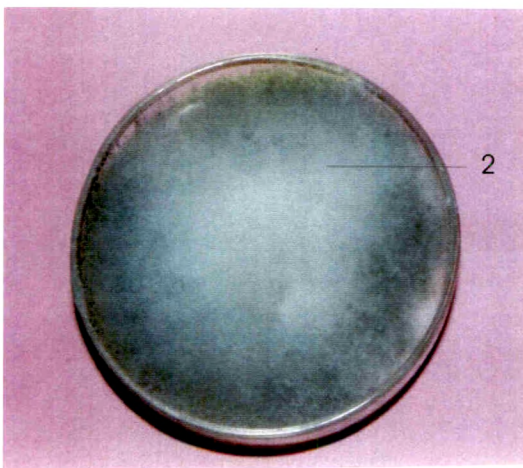
Plate No. XII  
Plate Fig. No. 45 to 48  
Chilli



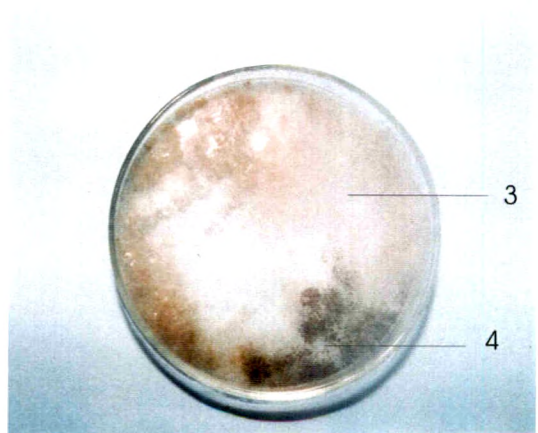
45



46



47



48

## **Explanation of plate number XIII**

**Plate Fig no. 49 – 52**

**Cluster bean**

**49. Normal and Abnormal seeds.**

**50. Blotter Method.**

1. *Rhizopus combodina* Vuillemin.

**51. Dry Seed Inoculation Method.**

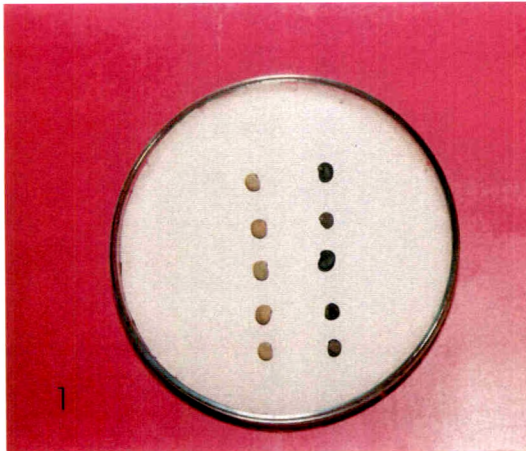
2. *Aspergillus oryzae* (Ahlburg in Korschelt) Cohn.

**52. Seed Suspension Test.**

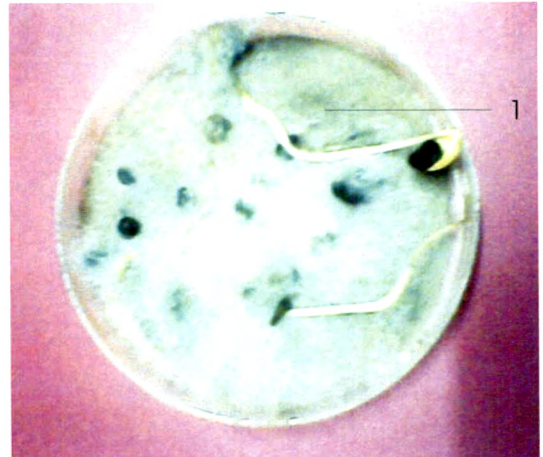
3. *Aspergillus oryzae* (Ahlburg in Korschelt) Cohn.



Plate No.XIII  
Plate Fig. No. 49 to 52  
Cluster bean



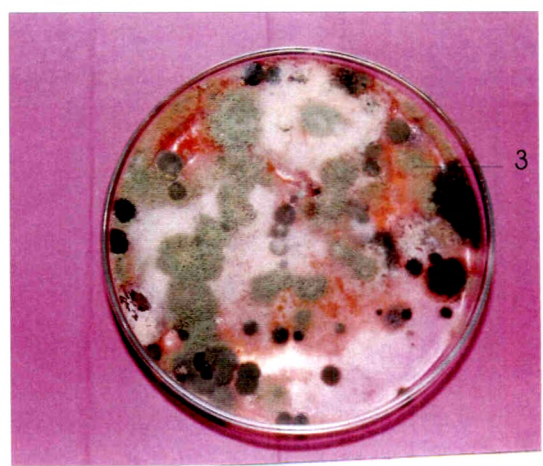
49



5



51



52



## **Explanation of plate number XIV**

**Fig no. 53 – 56**

**French bean**

### **53. Normal and Abnormal seeds.**

### **54. Blotter Method.**

1. *Aspergillus niger* Van Tieghem.
2. *Aspergillus* sp.
3. *Aspergillus alliaceus* Thom and Church.

### **55. Dry Seed Inoculation Method.**

4. *Aspergillus flavus* Link ex Fries.
5. *A. niger* Van Tieghem.

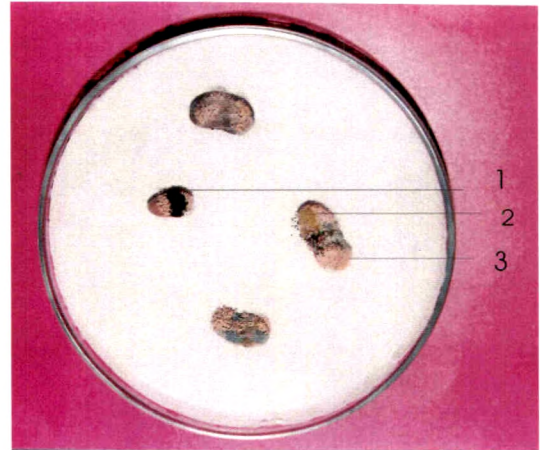
### **56. Seed Suspension Test.**

6. *Aspergillus* sp.
7. *Penicillium expansum* Link ex Fries.

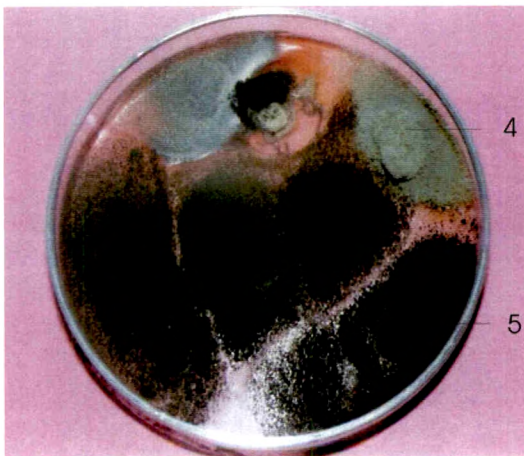
Plate No. XIV  
 Plate Fig. No. 53 to 56  
 French bean



53



54



55



56

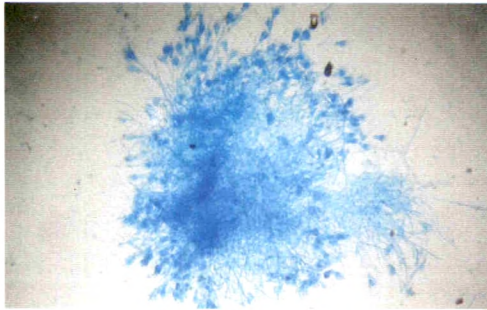
## **Explanation of plate number XV**

### **Plate Fig. no. 57 – 66**

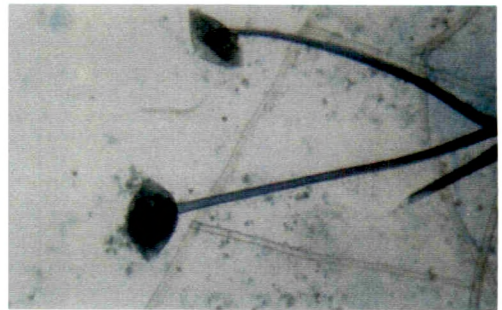
- 57.** *Penicillium oxalicum* Currie and Thom. X 150
  
- 58.** *Rhizopus combodia* Vuillemin. X 650
  
- 59.** *Alternaria palandui* Ayyangar. X 650
  
- 60.** *A. burnsii* Uppal, Patel and Kamat. X 650
  
- 61.** *A. citri* Ellis and Pierce. X 650
  
- 62.** *A. carthami* Chowdhury. X 650
  
- 63.** *Aspergillus carbonarius* ( Bainier ) Thom. X 650
  
- 64.** *A. oryzae* (Ahlburg in Korschelt) Cohn. X 650
  
- 65.** *A. violaceo-fuscus* Gasperini. X 650
  
- 66.** *A. amstelodami* ( Mang) Thom and Church. X 650



Plate No. XV  
Plate Fig. No. 57 to 66



57



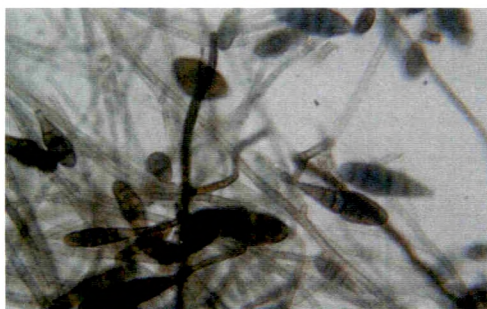
58



59



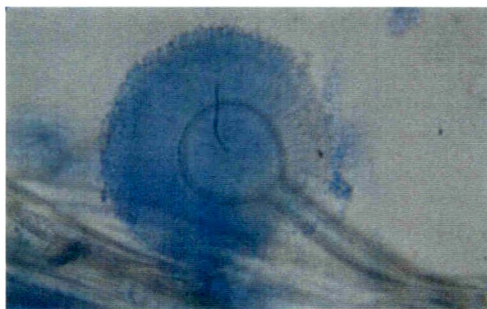
60



61



62



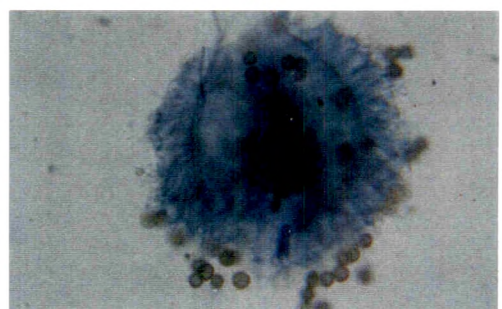
63



64



65



66

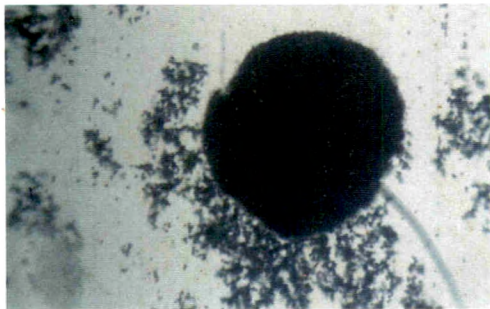
## **Explanation of plate number XVI**

### **Plate Fig. no. 67 – 76**

- 67. *Aspergillus niger* Van Tieghem. X 650**
- 68. *A. atropurpureus* Zimmermann. X 650**
- 69. *Penicillium citrinum* Thom. X 650**
- 70. *Aspergillus phoenicis* (Corda) Thom. X 650**
- 71. *A. pulverulentus* (McAlpine) Thom. X 650**
- 72. *A. sydowi* (Bainier ) Thom and Church. X 650**
- 73. *A. nidulans* ( Eidam ) Wint. And Hull/ cells X 150**
- 74. *A. phaeocephalus* Durieu and Montagne. X 650**
- 75. *A. amstelodami* ( Mang) Thom and Church. X 650**
- 76. *A. chevalieri* ( Mang .) Thom and Church X 650**



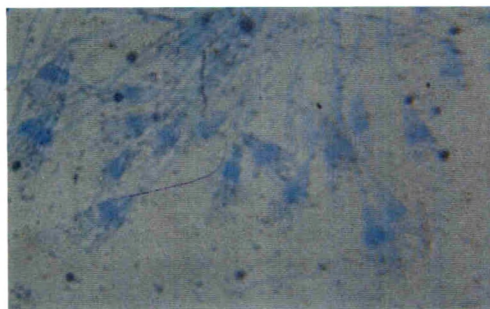
Plate No. XVI  
Plate Fig. No. 67 to 76



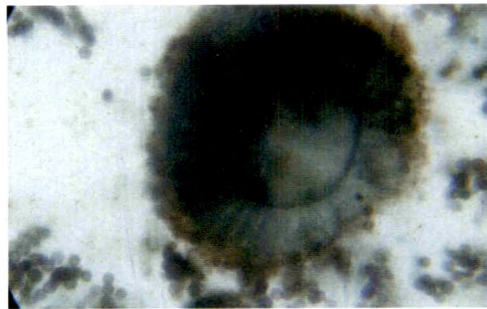
67



68



69



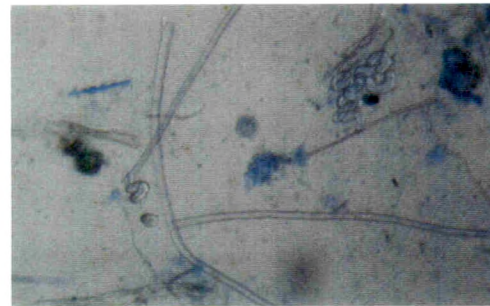
70



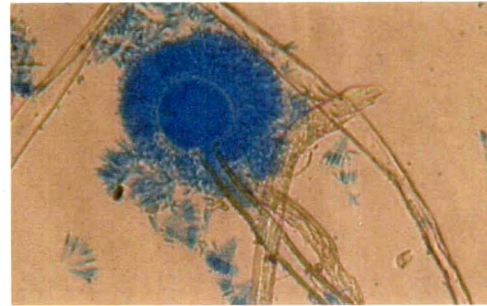
71



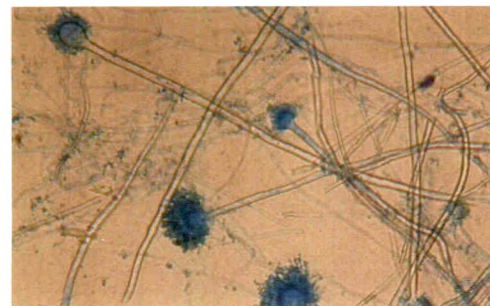
72



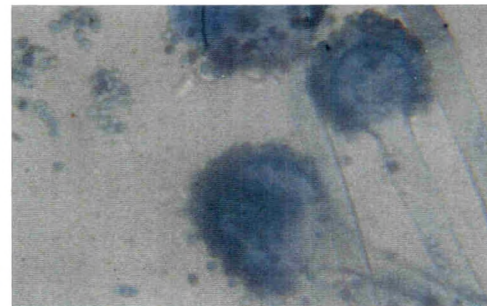
73



74



75



76