CHAPTER FOUR

DESCRIPTIVE

OBSERVATIONS

(A) RHIZOSPHERE STUDY

As envisaged, in the present investigation, the study of rhizosphere mycoflora of two Solanaceous fruit-vegetable crop plants viz., Tomato and Brinjal has been undertaken. For this purpose the popular hybrid cultivars 'Rupali' and 'Mahyco-56' of tomato and brinjal, respectively, were selected. These plants were grown as winter crops. The seeds of these varieties were procured from market and sown on 29/10/1994 on special beds to raise the saplings. In order to avail two different agroclimatic conditions, the saplings were then transplanted at two different localities viz., Shivaji University Campus, Kolhapur and a private farm at Chinchwad, (Tal : Shirol, Dist : Kolhapur). The soil at both these localities was 'Murumi' type. The pH of the soil at the former locality was 7.95 while at the latter locality it was 7.8. The rhizosphere mycoflora of both the crops was studied at different stages (30, 60, 90, 120 and 150 day stages) of growth. Observations of each variety at each locality were recorded seperately.

Fungi in the rhizosphere of tomato plants :

The rhizosphere mycoflora of tomato ('Rupali' cultivar) plants grown in Shivaji University Campus, Kolhapur (S.U.C., Kolhapur) was studied at 30, 60, 90, 120 and 150 day stages.

The fungal population was estimated by dilution-plate method from the rhizosphere and non-rhizosphere soil. The total fungal population and number of species is illustrated in Table No. I.

From Table No. 1, it is evident that the fungal popualtion per gram of rhizosphere soil was maximum at 120 day stage. The population was minimum at 60 day stage. At 90 day stage there was an increase in the population which showed an increasing trend upto 120 day stage. At 150 day stage, however, there was a slight decrease in the fungal population. The maximum number of species was recorded at 30 day stage while only one species was recorded at 120 day stage with a population of 24,000. In general, a decreasing trend was observed in case of number of species recorded with respect to the increasing stages of growth. At all stages, except at 60 day stage, the fungal population and number of species recorded in the rhizosphere soil were always higher than from that of non-rhizosphere soil.

Distribution of Fungi :

The fungal flora obtained from rhizosphere soil samples in tomato ('Rupali') plants grown at S.U.C., Kolhapur at different stages of growth showed striking fluctuations. At the 30 day stage Cladosporium herbarum occurred as the dominant species while species of Aspergillus, Fusarium, Penicillium and Trichoderma occurred as subdominant forms. The fungi like

Table No. 1 : Total fungal population of rhizosphere soil and non-rhizosphere soil in tomato ('Rupali') plants grown at Shivaji University Campus, Kolhapur.

Age in days	30 ($\times 10^3$)	60	90	120	150
Total fungal population/g in rhizosphere	18000	8000	1500	30000	24000
No. of species	7	6	5	3	1
Total fungal population/g in non-rhizosphere	2000	12000	1000	3000	2000
No. of species	2	7	1	3	2

Trichoderma and Cladosporium occurred in non-rhizosphere soil at this stage. At 60 day stage a more or less a similar mycoflora occurred in rhizosphere as well as non-rhizosphere soils. The common fungi were Penicillium, Phoma and Humicola, however, in rhizosphere soil Volutella and Phoma occurred as dominant forms while Chaetomium and Trichoderma occurred as dominant forms in the non-rhizosphere soil. The fungal population in the rhizosphere at 90 day stage showed the dominance of Yeast and Coniothyrium sp. while species of Penicillium, Aspergillus and Humicola ~~occurred as sub~~less dominant. In the non-rhizosphere soil species of Humicola occurred at this stage. At 120 day stage in rhizosphere soil fungi like Rhizoctonia solani, Coniothyrium and Pyrenochaeta were recorded and in the non-rhizosphere soil Phomopsis, Phialotabus and Monoascus were isolated in equal proportion and none of them occurred as dominant form. Volutella ciliata occurred as a single dominant species at 150 day stage while fungi like Zygorhynchus and Penicillium were isolated from non-rhizosphere soil in more or less equal proportion.

The rhizosphere mycoflora of tomato ('Rupali' cultivar) plants grown at a private farm in Chinchwad (Dist. Kolhapur) was studied at 60, 90, 120 and 150 day stages alongwith the mycoflora from non-rhizosphere soil. The total fungal population and number of species is illustrated in Table No. 2.

Table No. 2 : Total fungal population of rhizosphere and non-rhizosphere soil in tomato ('Rupali') plants grown at Chinchwad (Dist. Kolhapur)

Age in days	60	90	120	150
Total fungal population/g in rhizosphere	1000	20000	4000	-
No. of species	1	2	3	-
Total fungal population/g in non-rhizosphere	2000	5000	2000	2000
No.of species	2	4	2	2

The data given in Table No.2 reveals that the fungal population at this locality was highest at 90 day stage. The population at 60 day stage was the lowest. At 120 day stage too the population showed a sudden decrease. At this locality the crop completed its growth season before reaching the 150 day stage. The number of species recorded in rhizosphere soil showed no clear trend and comparatively less number of species were isolated at this locality. The non-rhizosphere soil showed more or less similar population and same number of species were recorded at all the stages except at 90 day stage where the population as well as number of species recorded were marginally higher as compared to other stages.

Distribution of fungi :

The fungal flora obtained from rhizosphere soil samples from tomato ('Rupali') plants grown at Chinchwad exhibited more or less similar species composition to that obtained in non-rhizosphere soil. At 90 and 120 day stages species of Trichoderma and Aspergillus were occurring as dominant forms respectively while species of Coniothyrium, Gymnoascus and Pyrenochaeta occurred as co-dominant forms in the rhizosphere and non-rhizosphere soil. At 60 day stage species of Yeast occurred in rhizosphere while species of Aspergillus and Phoma were isolated in more or less equal proportion from non-rhizosphere. The rhizosphere soil showed the dominance

of Trichoderma viride at 90 day stage but at 120 day stage the species of Aspergillus were found to be dominant, however, Trichoderma viride occurred as associated co-dominant at this stage.

Fungi in the Rhizosphere of Brinjal plants :

The rhizosphere mycoflora of brinjal ('Mahyco-56') plants grown in S.U.C., Kolhapur was studied at 30, 60, 90, 120 and 150 day stages. The fungal population was estimated by dilution-plate method from the rhizosphere and non-rhizosphere soil. The total fungal population and number of species is illustrated in Table No. 3.

From the table No. 3, it is evident that the population was highest at 30 day stage. It decreased sharply at 60 day stage. The population, however, increased again at 90 day stage and in later stages it showed a decreasing trend and at 150 day stage lowest population was recorded. The number of species recorded in the rhizosphere during early stages of growth was more, it decreased sharply as the growing season came to its fag-end. In non-rhizosphere soil, except at a few stages, the population as well as the number of species recorded were less.

Distribution of fungi :

The fungal population obtained from rhizosphere soil

Table No. 3 : Total fungal population of rhizosphere soil and non-rhizosphere soil in brinjal ('Mahyco-56') plants grown at Shivaji University Campus, Kolhapur

Age in days	30	60	90	120	150
Total fungal population/g in rhizosphere	80000	6000	10000	2000	1000
No. of species	5	5	5	1	1
Total fungal population/g in non-rhizosphere	2000	12000	1000	3000	2000
No. of species	2	6	1	3	2

samples from brinjal ('Mahyco-56') plants grown in S.U.C., Kolhapur showed remarkable variations in species composition. At 30 day stage sterile mycelia were dominant and species of Aspergillus, Cladosporium and Phoma occurred as co-dominant forms while in non-rhizosphere soil species of Cladosporium and Trichoderma occurred in equal proportion. At 60 day stage the rhizosphere soil showed species of Volutella as dominant form while fungi like Humicola, Phoma, Cladosporium and sterile mycelium occurred as subdominant. During this stage species of Chaetomium and Trichoderma ~~occurred as~~ were dominant while fungi like Penicillium, Aspergillus, Phoma and Humicola ~~occurred as~~ were subdominant ~~forms~~ in non-rhizosphere soil. At 90 day stage in rhizosphere soil again species of Volutella occurred as dominant while fungi like Penicillium, Aspergillus and Thamnidium occurred as associated co-dominants. As the plants matured the fungal flora declined in quality and quantity and fungi like Coniothyrium and Circinella were isolated at 120 and 150 day stages respectively. In general, the rhizosphere mycoflora showed dominance of species of Volutella during the period of intensive vegetative growth. In the non-rhizosphere soil a more or less heterogenous population was recorded and 14 species were isolated.

The rhizosphere mycoflora of brinjal ('Mahyco-56') plants grown at the private farm in Chinchwad was studied at 60, 90, 120 and 150 day stages alongwith the fungal population from

non-rhizosphere soil. The total fungal population and number of species recorded at this locality is illustrated in Table No. 4.

The data given in Table No. 4 reveals that the rhizosphere fungal population was highest at 90 day stage. The population was lowest at 120 and 150 day stages while at 60 day stage the population was fairly higher. The fungal population of non-rhizosphere soil was always lower than the population of rhizosphere soil at all the stages of growing season. As regards the number of species in rhizosphere of brinjal no clear trend was discernible and it was showing more or less similar number of species in rhizosphere and non-rhizosphere during different stages; the number of species was only marginally higher in rhizosphere.

Distribution of Fungi :

The fungal flora isolated from rhizosphere soil samples from brinjal ('Mahyco-56') plants grown at Chinchwad revealed a well discernible dominance of some species of fungi.

At 60 day stage sterile mycelia occurred as dominant form while Trichoderma occurred as subdominant form. In non-rhizosphere soil fungi like Aspergillus and Phoma occurred. At 90 day stage in rhizosphere Cladosporium herbarum was dominant while species of Aspergillus and Penicillium were isolated as subdominant forms. Interestingly at 120 and 150 day stages in

Table No. 4 : Total fungal population of rhizosphere soil and non-rhizosphere soil in brinjal ('Mahyco-56') plants grown at Chinchwad (Dist. Kolhapur).

Age in plants	60	90	120	150
Total fungal population/g in rhizosphere	30000	70000	14000	14000
No. of species	2	3	3	4
Total fungal population/g in non-rhizosphere	2000	5000	2000	2000
No. of species	2	4	2	2

the rhizosphere soil Paecilomyces varioti existed as the dominant species while species of Penicillium, Aspergillus and Coniothyrium occurred as subdominant forms.

In non-rhizosphere soil fungi like Aspergillus, Trichoderma, Gymnoascus and Pyrenochaeta occurred during different stages of growing season at this locality.

Comparative Results :

In this work rhizosphere fungi of two fruit-vegetable crops viz., Tomato ('Rupali') and Brinjal ('Mahyco-56') grown at two different locations have been studied. The total number of fungal species and their percentage of distribution at different ages of tomato and brinjal plants grown at two localities are illustrated in Table No. 5 to 14. The comparative results obtained at different stages of growth from these varieties in the respective localities are as follows :

Comparison of Fungi in rhizosphere of tomato at the two locations :

The fungal population and total number of species at 60 day stage in rhizosphere of tomato were higher at S.U.C., Kolhapur, however at 90 day stage the total fungal population was higher at Chinchwad but the no. of spp. recorded was less. At 120 day stage there was a sudden decline in fungal population at Chinchwad as the plants were advancing towards senescence but at S.U.C., Kolhapur the population was higher and the plants had completed their life cycle and perished but at S.U.C.,

Table No.5 : Percentage distribution of species of fungi in 30 days old tomato ('Rupali') plants.

Species of fungi	Locality: Shivaji University Campus, Kolhapur	
	Rhizosphere	Non-rhizosphere
Circinella simplex	-	-
Thamnidium elegans	-	-
Zygorhynchus heterogamus	-	-
Chaetomium globosum	-	-
Gymnoascus subumbrinus	-	-
Monoascus sp.	-	-
Aspergillus flavus	-	-
A. fumigatus	-	-
A. nidulans	-	-
A. niger	-	-
A. stellatus	16.66	-
A. sydowi	-	-
A. terreus	-	-
A. ustus	5.55	-
A. versicolor	-	-
Cladosporium herbarum	50.0	50.0
Coniothyrium fuckelii	-	-
Fusarium solani	11.11	-
Fusarium sp.	5.5	-

Table No. 5 (contd.)

Species of fungi	Locality : Shivaji University Campus, Kolhapur	
	Rhizosphere	Non-rhizosphere
Humicola brevis	-	-
Humicola fusca-atra	-	-
Paecilomyces varioti	-	-
Penicillium herquei	-	-
P. miczynskii	-	-
P. purpurogenum	-	-
P. simplicissimum	5.55	-
Phialotabus sp.	-	-
Phoma glomerata	-	-
Phoma sp.	-	-
Phomopsis sp.	-	-
Pyrenochaeta coeli	-	-
P. decipiens	-	-
Trichoderma viride	5.55	50.0
Volutella ciliata	-	-
V. piriformis	-	-
Yeast (budding)	-	-
Rhizoctonia solani	-	-
Sterile mycelia	-	-

Table No. 6 : Percentage distribution of species of fungi in 60 days old tomato ('Rupali') plants

Species of fungi	Locality: Shivaji University Campus, Kolhapur		Locality: Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Circinella simplex	-	-	-	-
Thamnidium elegans	-	-	-	-
Zygorhynchus heterogamus	-	-	-	-
Chaetomium globosum	-	30.76	-	-
Gymnoascus subumbrinus	-	-	-	-
Monoascus sp.	-	-	-	-
Aspergillus flavus	-	-	-	50
A. fumigatus	-	-	-	-
A. nidulans	-	-	-	-
A. niger	-	-	-	-
A. stellatus	-	-	-	-
A. sydowi	-	-	-	-
A. terreus	-	7.69	-	-
A. ustus	-	-	-	-
A. versicolor	-	-	-	-
Cladosporium herbarum	-	-	-	-
Coniothyrium fuckelii	-	-	-	-
Fusarium solani	-	-	-	-
Fusarium sp.	-	-	-	-

Table No. 6 (Contd.)

Species of fungi	Locality:Shivaji University Campus, Kolhapur		Locality:Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-Rhizosphere	Rhziosphere	Non-rhizosphere
Humicola brevis	-	7.69	-	-
Humicola fusca-atra	12.5	-	-	-
Paecilomyces varioti	-	-	-	-
Penicillium herquei	-	15.38	-	-
P. miczynskii	-	-	-	-
P. purpurogenum	12.5	-	-	-
P. simplicissimum	-	-	-	-
Phialotabus sp.	-	-	-	-
Phoma glomerata	25	7.69	-	50
Phoma sp.	-	-	-	-
Phomopsis sp.	-	-	—	-
Pyrenochaeta coeli	-	-	-	-
P. decipiens	-	-	-	-
Trichoderma viride	-	23.07	-	-
Volutella ciliata	25	-	-	-
V. piriformis	12.5	-	-	-
Yeast (budding)	-	-	100.0	-
Rhizoctonia solani	-	-	-	-
Sterile mycelia	12.5	-	-	-

Table No.7 : Percentage distribution of species of fungi in 90 days old tomato ('Rupali') plants.

Species of fungi	Locality: Shivaji University Campus, Kolhapur		Locality;Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Circinella simplex	-	-	-	-
Thamnidium elegans	-	-	-	-
Zygorhynchus heterogamus	-	-	-	-
Chaetomium globosum	-	-	-	-
Gymnoascus subumbrinus	-	-	-	40
Monoascus sp.	-	-	-	-
Aspergillus flavus	-	-	-	-
A. fumigatus	6.66	-	-	-
A. nidulans	-	-	-	-
A. niger	-	-	-	20
A. stellatus	-	-	-	-
A. sydowi	-	-	-	-
A. terreus	-	-	-	-
A. ustus	-	-	-	-
A. versicolor	-	-	-	-
Cladosporium herbarum	-	-	-	-
Coniothyrium fuckelii	13.33	-	50	-
Fusarium solani	-	-	-	-
Fusarium sp.	-	-	-	-

Table No. 7 (contd.)

Species of fungi	Locality: Shivaji University Campus, Kolhapur		Locality: Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Humicola brevis	6.66	100	-	-
Humicola fusca-atra	-	-	-	-
Paecilomyces varioti	-	-	-	-
Penicillium herquei	-	-	-	-
P. miczynskii	-	-	-	-
P. purpurogenum	-	-	-	-
P. simplicissimum	6.66	-	-	-
Phialotabus sp.	-	-	-	-
Phoma glomerata	-	-	-	-
Phoma sp.	-	-	-	-
Phomopsis sp.	-	-	-	-
Pyrenochaeta coeli	-	-	-	20
P. decipiens	-	-	-	-
Trichoderma viride	-	-	50	20
Volutella ciliata	-	-	-	-
V. piriformis	-	-	-	-
Yeast (budding)	66.66	-	-	-
Rhizoctonia solani	-	-	-	-
Sterile mycelia	-	-	-	-

Table No. 8 : Percentage distribution of species of fungi in 120 days old tomato ('Rupali') plants

Species of fungi	Locality: Shivaji University Campus Kolhapur		Locality : Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhisozphere	Rhizosphere	Non-rhizosphere
Circinella simplex	-	-	-	-
Thamnidium elegans	-	-	-	-
Zygorhynchus heterogamus	-	-	-	-
Chaetomium globosum	-	-	-	-
Gymnoascus subumbrinus	-	-	-	-
Monoascus sp.	-	33.33	-	-
Aspergillus flavus	-	-	-	-
A. fumigatus	-	-	-	-
A. nidulans	-	-	50	50
A. niger	-	-	25	-
A. stellatus	-	-	-	-
A. sydowi	-	-	-	-
A. terreus	-	-	-	-
A. ustus	-	-	-	-
A. versicolor	-	-	-	-
Cladosporium herbarum	-	-	-	-
Coniothyrium fuckelii	33.33	-	-	-
Fusarium solani	-	-	-	-
Fusarium sp.	-	-	-	-

Table No. 8 (Contd.)

Species of fungi	Locality : Shivaji University Campus Kolhapur		Locality:Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Humicola brevis	-	-	-	-
Humicola fusca-atra	-	-	-	-
Paecilomyces varioti	-	-	-	-
Penicillium herquei	-	-	-	-
P. miczynskii	-	-	-	-
P. purpurogenum	-	-	-	-
P. simplicissimum	-	-	-	-
Phialotabus sp.	-	33.33	-	-
Phoma glomerata	-	-	-	-
Phoma sp.	-	-	-	-
Phomopsis sp.	-	33.33	-	-
Pyrenochaeta coeli	-	-	-	-
P. decipiens	33.33	-	-	-
Trichoderma viride	-	-	25	50
Volutella ciliata	-	-	-	-
V. piriformis	-	-	-	-
Yeast (budding)	-	-	-	-
Rhizoctonia solani	33.33	-	-	-
Sterile mycelia	-	-	-	-

Table No.9 : Percentage distribution of species of fungi in 150 days old tomato ('Rupali') plants

Species of fungi	Locality: Shivaji University Campus, Kolhapur		Locality ; Chinchwad (Dist. Kolhapur)	
	Rhziosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Circinella simplex	-	-	-	-
Thamnidium elegans	-	-	-	-
Zygorhynchus heterogamus	-	50	-	-
Chaetomium globosum	-	-	-	-
Gymnoascus subumbrinus	-	-	-	-
Monoascus sp.	-	-	-	-
Aspergillus flavus	-	-	-	66.66
A. fumigatus	-	-	-	-
A. nidulans	-	-	-	-
A. niger	-	-	-	-
A. stellatus	-	-	-	-
A. sydowi	-	-	-	-
A. terreus	-	-	-	-
A. ustus	-	-	-	33.33
A. versicolor	-	-	-	-
Cladosporium herbarum	-	-	-	-
Coniothyrium fuckelii	-	-	-	-
Fusarium solani	-	-	-	-
Fusarium sp.	-	-	-	-

Table No. 9 (Contd.)

Species of fungi	Locality: Shivaji University Campus Kolhapur		Locality : Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Humicola brevis	-	-	-	-
Humicola fusca-atra	-	-	-	-
Paecilomyces varioti	-	-	-	-
Penicillium herquei	-	50	-	-
P. miczynskii	-	-	-	-
P. purpurogenum	-	-	-	-
P. simplicissimum	-	-	-	-
Phialotabus sp.	-	-	-	-
Phoma glomerata	-	-	-	-
Phoma sp.	-	-	-	-
Phomopsis sp.	-	-	-	-
Pyrenochaeta coeli	-	-	-	-
P. decipiens	-	-	-	-
Trichoderma viride	-	-	-	-
Volutella ciliata	100	-	-	-
V. piriformis	-	-	-	-
Yeast (budding)	-	-	-	-
Rhizoctonia solani	-	-	-	-
Sterile mycelia	-	-	-	-

Kolhapur the plants were still in the fruiting stage and a fairly higher population of Volutella ciliata was recorded.

In the rhizosphere of tomato at 60 day stage at S.U.C., Kolhapur a heterogenous population (Table No.6) consisting of species of Phoma, Volutella, Penicillium, Humicola and sterile mycelium was observed. The population at Chinchwad was minimum and showed presence of yeast. At 90 day stage the population increased at both the localities (Table No.7) but number of species recorded was higher at S.U.C., Kolhapur. Yeast (66.66%) was found to be dominant while fungi like Coniothyrium, Penicillium, Aspergillus and Humicola occurred in the range of 6.66% to 13.33%. At Chinchwad, Trichoderma and Coniothyrium were recorded with 50% distribution for both species. At 120 day stage highest population was recorded at S.U.C., Kolhapur with fungi like Rhizoctonia, Coniothyrium and Pyrenochaeta with a distribution of 33.33% for each. At the Chinchwad locality species of Aspergillus (75%) were dominant while Trichoderma viride occurred as subdominant (Table No.8).

Comparison of mycoflora in the rhizosphere of brinjal at the two localities :

The fungal population and number of species in rhizosphere of brinjal ('Mahyco-56') plants at 60 day stage exhibited a lot of variation at the two localities. At Chinchwad the population was higher but number of species recorded was lower. At 90 day stage the fungal population increased at both

the localities but the number of species isolated was higher at S.U.C., Kolhapur. At 120 and 150 day stages the total fungal population as well as number of species recorded at S.U.C., Kolhapur was for more less compared to the Chinchwad locality (Table No. 3 and 4).

The fungal population at 60 day stage at S.U.C., Kolhapur showed a heterogenous population. Species of Volutella was dominant with a 33.33% distribution while fungi like Cladosporium, Phoma, Humicola and sterile mycelium occurred with 16.66% distribution for each (Table No. 11). At Chinchwad locality alongwith sterile mycelia, the presence of antagonistic fungus Trichoderma viride was recorded. At 90 day stage the population at both the locations was similar and at Chinchwad Cladosporium (57.14%) was dominant while at S.U.C., Kolhapur again Volutella (50%) consolidated its dominance.

At 120 and 150 day stages, there was a sudden decline in the population and number of species recorded in the rhizosphere of brinjal at S.U.C., Kolhapur. In contrast at Chinchwad during these stages a constant and fairly higher population was observed with a remarkable and discernible dominance of Paecilomyces varioti (about 85.71% and 50% distribution at 120 and 150 day stages respectively). Species of Coniothyrium was recorded at 120 day stage in S.U.C., Kolhapur while at 150 day stage it was recorded at Chinchwad.

Table No. 10 : Percentage distribution of species of fungi in 30 days old brinjal ('Mahyco-56') plants

Species of fungi	Locality : Shivaji University Campus, Kolhapur	
	Rhizosphere	Non-rhizosphere
Circinella simplex	-	-
Thamnidium elegans	-	-
Zygorhynchus heterogamus	-	-
Chaetomium globosum	-	-
Gymnoascus subumbrinus	-	-
Monoascus sp.	-	-
Aspergillus flavus	-	-
A. fumigatus	-	-
A. nidulans	-	-
A. niger	-	-
A. stellatus	-	-
A. sydowi	-	-
A. terreus	-	-
A. ustus	-	-
A. versicolor	12.5	-
Cladosporium herbarum	12.5	50.0
Coniothyrium fuckelii	-	-
Fusarium solani	-	-
Fusarium sp.	-	-

Table No. 10 (contd.)

Species of fungi	Locality : Shivaji University Campus, Kolhapur	
	Rhizosphere	Non-rhizosphere
Humicola brevis	-	-
Humicola fusca-atra	-	-
Paecilomyces varioti	-	-
Penicillium herquei	-	-
P. miczynskii	-	-
P. purpurogenum	-	-
P. simplicissimum	-	-
Phialotabus sp.	-	-
Phoma glomerata	-	-
Phoma sp.	12.5	-
Phomopsis sp.	-	-
Pyrenochaeta coeli	-	-
P. decipiens	-	-
Trichoderma viride	-	50
Volutella ciliata	-	-
V. piriformis	-	-
Yeast (budding)	-	-
Rhizoctonia solani	-	-
Sterile mycelia	62.5	-

Table No.11 : Percentage distribution of fungi in 60 days old brinjal ('Mahyco-56') plants.

Species of fungi	Locality: Shivaji University Campus Kolhapur		Locality : Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Circinella simplex	-	-	-	-
Thamnidium elegans	-	-	-	-
Zygorhynchus heterogamus	-	-	-	-
Chaetomium globosum	-	30.76	-	-
Gymnoascus subumbrinus	-	-	-	-
Monoascus sp.	-	-	-	-
Aspergillus flavus	-	-	-	50
A. fumigatus	-	-	-	-
A. nidulans	-	-	-	-
A. niger	-	-	-	-
A. stellatus	-	-	-	-
A. sydowi	-	-	-	-
A. terreus	-	7.69	-	-
A. ustus	-	-	-	-
A. versicolor	-	-	-	-
Cladosporium herbarum	16.66	-	-	-
Coniothyrium fuckelii	-	-	-	-
Fusarium solani	-	-	-	-
Fusarium sp.	-	-	-	-

Table No. 11 (Contd.)

Species of fungi	Locality: Shivaji University Campus, Kolhapur		Locality: Chinchwad (Dist: Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Humicola brevis	-	7.69	-	-
Humicola fusca-atra	16.66	-	-	-
Paecilomyces varioti	-	-	-	-
Penicillium herquei	-	15.38	-	-
P. miczynskii	-	-	-	-
P. purpurogenum	-	-	-	-
P. simplicissimum	-	-	-	-
Phialotabus sp.	-	-	-	-
Phoma glomerata	16.66	7.69	-	50
Phoma sp.	-	-	-	-
Phomopsis sp.	-	-	-	-
Pyrenochaeta coeli	-	-	-	-
P. decipiens	-	-	-	-
Trichoderma viride	-	23.07	33.33	-
Volutella ciliata	33.33	-	-	-
V. piriformis	-	-	-	-
Yeast (budding)	-	-	-	-
Rhizoctonia solani	-	-	-	-
Sterile mycelia	16.66	-	66.66	-

Table No.12 : Percentage distribution of fungi in 90 days old brinjal ('Mahyco-56') plants

Species of fungi	Locality: Shivaji University Campus Kolhapur		Locality: Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Circinella simplex	-	-	-	-
Thamnidium elegans	10.0	-	-	-
Zygorhynchus heterogamus	-	-	-	-
Chaetomium globosum	-	-	-	-
Gymnoascus subumbrinus	-	-	-	40
Monoascus sp.	-	-	-	-
Aspergillus flavus	-	-	-	-
A. fumigatus	-	-	-	-
A. nidulans	10.0	-	-	-
A. niger	10.0	-	-	20
A. stellatus	-	-	-	-
A. sydowi	-	-	28.57	-
A. terreus	-	-	-	-
A. ustus	-	-	-	-
A. versicolor	-	-	-	-
Cladosporium herbarum	-	-	57.14	-
Coniothyrium fuckelii	-	-	-	-
Fusarium solani	-	-	-	-
Fusarium sp.	-	-	-	-

Table No. 12 (Contd.)

Species of fungi	Locality : Shivaji University campus Kolhapur		Locality : Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Humicola brevis	-	100.0	-	-
Humicola fusca-atra	-	-	-	-
Paecilomyces varioti	-	-	-	-
Penicillium herquei	-	-	-	-
P. miczynskii	20	-	-	-
P. purpurogenum	-	-	14.28	-
P. simplicissimum	-	-	-	-
Phialotabus sp.	-	-	-	-
Phoma glomerata	-	-	-	-
Phoma sp.	-	-	-	-
Phomopsis sp.	-	-	-	-
Pyrenochaeta coeli	-	-	-	20
P. decipiens	-	-	-	-
Trichoderma viride	-	-	-	20
Volutella ciliata	50	-	-	-
V. piriformis	-	-	-	-
Yeast (budding)	-	-	-	-
Rhizoctonia solani	-	-	-	-
Sterile mycelia	-	-	-	-

Table No.13 : Percentage distribution of fungi in 120 days old brinjal ('Mahyco-56') plants

Species of fungi	Locality : Shivaji University Campus Kolhapur		Locality : Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Circinella simplex	-	-	-	-
Thamnidium elegans	-	-	-	-
Zygorhynchus heterogamus	-	-	-	-
Chaetomium globosum	-	-	-	-
Gymnoascus subumbrinus	-	-	-	-
Monoascus sp.	-	33.33	-	-
Aspergillus flavus	-	-	-	-
A. fumigatus	-	-	-	-
A. nidulans	-	-	-	50
A. niger	-	-	7.14	-
A. stellatus	-	-	-	-
A. sydowi	-	-	-	-
A. terreus	-	-	-	-
A. ustus	-	-	-	-
A. versicolor	-	-	-	-
Cladosporium herbarum	-	-	-	-
Coniothyrium fuckelii	100.0	-	-	-
Fusarium solani	-	-	-	-
Fusarium sp.	-	-	-	-

Table No. 13 (Contd.)

Species of fungi	Locality : Shivaji University Campus, Kolhapur		Locality: Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Humicola brevis	-	-	-	-
Humicola fusca-atra	-	-	-	-
Paecilomyces varioti	-	85.71	-	-
Penicillium herquei	-	7.14	-	-
P. miczynskii	-	-	-	-
P. purpurogenum	-	-	-	-
P. simplicissimum	-	-	-	-
Phialotabus sp.	-	33.33	-	-
Phoma glomerata	-	-	-	-
Phoma sp.	-	-	-	-
Phomopsis sp.	-	33.33	-	-
Pyrenochaeta coeli	-	-	-	-
P. decipiens	-	-	-	-
Trichoderma viride	-	-	-	50
Volutella ciliata	-	-	-	-
V. piriformis	-	-	-	-
Yeast (budding)	-	-	-	-
Rhizoctonia solani	-	-	-	-
Sterile mycelia	-	-	-	-

Table No. 14 : Percentage distribution of fungi in 150 days old brinjal ('Mahyco-56') plants.

Species of fungi	Locality : Shivaji University Campus Kolhapur		Locality: Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Circinella simplex	100.0	-	-	-
Thamnidium elegans	-	-	-	-
Zygorhynchus heterogamus	-	50	-	-
Chaetomium globosum	-	-	-	-
Gymnoascus subumbrinus	-	-	-	-
Monoascus sp.	-	-	-	-
Aspergillus flavus	-	-	-	66.66
A. fumigatus	-	-	-	-
A. nidulans	-	-	14.28	-
A. niger	-	-	-	-
A. stellatus	-	-	-	-
A. sydowi	-	-	-	-
A. terreus	-	-	-	-
A. ustus	-	-	-	33.33
A. versicolor	-	-	-	-
Cladosporium herbarum	-	-	-	-
Coniothyrium fuckelii	-	-	35.30	-
Fusarium solani	-	-	-	-
Fusarium sp.	-	-	-	-

Table No. 14 (Contd.)

Species of fungi	Locality : Shivaji University Campus Kolhapur		Locality : Chinchwad (Dist. Kolhapur)	
	Rhizosphere	Non-rhizosphere	Rhizosphere	Non-rhizosphere
Humicola brevis	-	-	-	-
Humicola fusca-atra	-	-	-	-
Paecilomyces varioti	-	-	50	-
Penicillium herquei	-	50	-	-
P. miczynskii	-	-	-	-
P. purpurogenum	-	-	-	-
P. simplicissimum	-	-	-	-
Phialotabus sp.	-	-	-	-
Phoma glomerata	-	-	-	-
Phoma sp.	-	-	-	-
Phomopsis sp.	-	-	-	-
Pyrenochaeta coeli	-	-	-	-
P. decipiens	-	-	-	-
Trichoderma viride	-	-	-	--
Volutella ciliata	-	-	-	-
V. piriformis	-	-	-	-
Yeast (budding)	-	-	-	-
Rhizoctonia solani	-	-	-	-
Sterile mycelia	-	-	-	-

Comparison of mycoflora in non-rhizosphere soils at the two locations :

It was observed that non-rhizosphere mycoflora at the two localities differed qualitatively and quantitatively. At 60 day stage a heterogenous population of fungi in the range of 7.69% to 30.76% at S.U.C., Kolhapur was observed but the population at Chinchwad was less heterogenous (Table No.6). Phoma glomerata and species of Aspergillus were isolated from both the localities. In addition, fungi like Chaetomium, Penicillium, Trichoderma and Humicola were isolated from S.U.C., Kolhapur locality. At 90 day stage the trend was reversed and there occurred a heterogenous population at Chinchwad in the range of 20% to 40%. The species of Gymnoascus occurred as dominant and Trichoderma and Aspergillus as subdominant at this locality. At S.U.C., Kolhapur the population was lower and only Humicola sp. was recorded. At 120 day stage the population in both the soils was more or less similar but the species composition differed. Species of Aspergillus and Trichoderma were isolated in equal proportion from Chinchwad locality while species of Phomopsis, Phialotabus and Monoascus were isolated with a 33.33% distribution for each species at S.U.C., Kolhapur locality. At 150 day stage species of Aspergillus were completely dominant in non-rhizosphere soil at Chinchwad locality where A. flavus showed 66.66% and A.ustus 33.33% distribution. At S.U.C., Kolhapur only two species were isolated in equal proportion. A Phycomycete : Zygorhynchus and a species of Penicillium were isolated at this stage.

The striking feature of the non-rhizosphere soil was that, not a single species of Penicillium and Fusarium was isolated at Chinchwad locality. The overall fungal population in non-rhizosphere soil was much less as compared to rhizosphere soil.

Comparison of mycoflora of tomato and brinjal at S.U.C., Kolhapur

It was observed that rhizosphere mycoflora of tomato and brinjal at S.U.C., Kolhapur showed less variations with respect to population as well as the number of species recorded. At 30 day stage 7 species were isolated in tomato rhizosphere while 5 species were recorded in brinjal. At 60 and 90 day stages the number of species recorded were more or less similar. At 120 day stage more species were recorded in tomato while at 150 day stage they were nearly equal but the population was far more higher in rhizosphere of tomato.

At 30 day stage in rhizosphere of tomato fungi like Cladosporium, Penicillium, Aspergillus and Fusarium were occurring while in rhizosphere of brinjal sterile mycelia, Aspergillus, Cladosporium and Phoma were recorded (Table No.5). At 60 day stage a striking similarlity in the species composition and their distribution was observed (Table No.6 and 11). At this stage sterile mycelia, Phoma glomerata, Volutella ciliata and Humicola fusca-atra occurred in rhizosphere of both the plants. At 90 day stage in rhizosphere of brinjal species of

Volutella occurred as dominant while in rhizosphere of tomato yeast occurred as dominant form. Species of Penicillium and Aspergillus occurred in the rhizosphere of both the plants. At 120 day stage in rhizosphere of both the plants species of Coniothyrium thrived well but 150 day stage the species composition was showing variations and species of Volutella occurred in rhizosphere of tomato while species of Circinella occurred in rhizosphere of brinjal.

Comparison of mycoflora of tomato and brinjal at Chinchwad locality :

The population recorded at 60 day stage in the rhizosphere of tomato at this locality was minimal but in rhizosphere of brinjal it was fairly higher (Table No. 2 and 4) and species of yeast, sterile mycelium and Trichoderma viride were isolated. The population at 90 day stage in the rhizosphere of both the plants differed substantially. Cladosporium herbarum was dominant in rhizosphere of brinjal while fungi Trichoderma and Coniothyrium occurred as dominant forms in rhizosphere of tomato. Paecilomyces varioti dominanted in the rhizosphere of brinjal at 120 and 150 day stages while species of Aspergillus dominated the rhizosphere of tomato plants at the fag-end of the growing season.

General distribution of fungi in the rhizosphere of tomato and brinjal :

It has been observed that species of Volutella occurred

as dominant species at 60 day stage in rhizosphere of both the crops at S.U.C., Kolhapur locality and species of composition was also found to be similar but at Chinchwad yeast and sterile mycelium occurred as dominant forms in rhizosphere of tomato and brinjal respectively. At 90 day stage in the rhizosphere of tomato, yeast occurred as dominant form while Volutella ciliata dominated the rhizosphere of brinjal at S.U.C., Kolhapur. At Chinchwad locality at this stage Cladosporium herbarum occurred as dominant species in brinjal and species of Trichoderma and Coniothyrium co-existed as dominant forms in tomato rhizosphere. At Chinchwad locality at 120 day stage species of Paecilomyces occurred as dominant form in rhizosphere of brinjal and species of Aspergillus were dominant in rhizosphere of tomato. Paecilomyces continued its dominance till the end of growing season in the rhizosphere of brinjal.

It was observed that the species of Fusarium were significantly not isolated from the rhizosphere of both the plants as well as the non-rhizosphere soils at both the localities except in the initial saplings raising plots. Another important feature was the absence of Penicillium in the non-rhizosphere soil and rhizosphere of tomato at Chinchwad locality but interestingly the rhizosphere of brinjal exhibited the presence of Penicillium (14.28%) at 90 day stage and at 120 day stage (7.14%). Another diagnostic feature of rhizosphere of brinjal at this locality was the presence of Paecilomyces varioti as

a dominant form during 120 and 150 day stages. It is remarkable that only 2 Phycomycetes members (Thamnidium and Circinella) were isolated in rhizosphere of brinjal, one (Zygorhynchus) in non-rhizosphere soil and none in the rhizosphere of tomato at S.U.C., Kolhapur. No Phycomycete was recorded in rhizosphere of both plants at Chinchwad locality.

It is evident from this data that fluctuations in rhizosphere population occurred at various stages of growth. These fluctuations might be due to the utilization of root exudates by rhizosphere fungi which positively affect and increase the mycoflora of rhizosphere, however, at the same time antagonistic substances from roots may be released which inhibit the fungal growth (Clarke and Parkinson, 1960; Parkinson and Clarke, 1961). Due to this inhibitory activity, fungal population of rhizosphere is reduced. The reduction in the fungal population was observed at 60 day stage at both the localities in both the crops.

(B) STUDY OF POST-HARVEST DISEASES

I : FRUITS

1. Achras sapota L. (Sapodilla, Chiku)

It is a tropical, evergreen fruit tree. The fruit is delicious and contains 12 to 14 percent sugar. The ripened fruit pulp has pleasant flavour and is rich in vitamins. The fruits are generally eaten fresh. This tree is commonly cultivated in either kitchen-gardens or in orchards on large scale for commercial purposes. The tree flowers thoroughout the year in several flushes but has two conspicuous blossoming seasons, October-November and February-March. The peak arrival of these fruits in the markets is, therefore, January-February and May-June.

Following diseases were recorded :

(i) Pestalotia rot (Pl. Fig. 80)

Symptoms : During storage the fruits of sapodilla were attacked by a fungus which develops white, superficial mycelium which is restricted to skin only, covered by black coloured fruiting bodies forming black spots on the fruits. Severe spotting gives shabby appearance to fruits and lowers their market value. The fruits start decaying early lowering their durability.

Causal organism : Pestalotia sapotae P.Henn., Hedwigia 48 : 17, 1908. (Pl. Fig. 92 and 111).

Colonies with raised black acervulii. Conidia 5-celled, clavate - fusiform, straight or somewhat curved, 24-26 x 8-9 min, intermediate cells coloured, exterior cells hyaline, bearing 3, rarely 4, widely divergent simple setulae by terminal cell.

(ii) Sooty mould :

Symptoms : A powdery black sooty mass covering some injured parts of unripe fruits was observed. It badly disfigured the fruits and lowered their market value. The fungus was entirely superficial and did not affect the internal pulp. The sooty growth is preceded by injuries by scale insects.

Causal organism : Microxyphium coffeanum Bat. & Matta, Quaderno 31 : 122. 1923.

Hyphae superficial; pycnidia flask-shaped, brown, 200-250 x 15-25 µm; pycnidiospores hyaline, 3 x 1.5 µm, one celled and accumulated as a shining spore mass at the mouth.

2. Anona reticulata L. (Bullock's heart, Ramphal)

This is a common and popular fruit next to custard apple. It is not cultivated on a field scale but grows wild or in private kitchen gardens. It contains 12.5% glucose and 2% proteins. The fruit comes to maturity during January-March.

Following diseases and disorders were recorded :

(i) Fruit rot : (Pl. Fig. 81)

Symptoms : The fruit initially develops a pink coloured

rot which ultimately becomes black coloured. In culture, the causal organism develops pink colouration while colonies become black coloured after a few days. The fruit becomes soft and completely disintegrated and light.

Causal organism : Botryodiplodia theobromae Pat.(Pl.Fig.93)

In culture, initially the developmental form Macrophoma develops which secretes pink coloured pigment in the medium. Later the fungal colonies develop into Botryodiplodia and become black coloured. Pycnidia erumpent to submerged, spherical to globose, black, thick-walled, stromatic, ostiolate, generally papillate and measured 115-120 µm in diameter. Pycnidiospores elliptical, 1-septate, dark-brown, slightly constricted at the septa and measured 21-31 x 13-17 µm.

In addition to this rot, on dry mummified fruits following saprophytic organisms were recorded :

a) Cylindrocladium parvum Anderson

b) Cladobotryum sp.

3. Anona squamosa L. (Custard apple, Sitaphal)

Custard apple is a wild tree generally growing in the poorer soils of the hilly tracts and seldom cultivated on a field scale. It is a common fruit tree in kitchen gardens and farm houses. The fruits provide best nutrition and are rich in sugar and vitamin content. The main season for this fruit is early part of the cold season.

Following diseases were recorded :

(i) Black rot

Symptoms : The disease produced dark-brown to black necrotic lesions on the rind mostly starting from stalk-end and ultimately encircling the entire fruit. The green or half-ripe fruits are attacked by the fungus. Heavily infected fruits become dark-purple, internal pulp disintegrates, becomes dark-brown, brittle and light in weight.

Causal organism : Botryodiplodia theobromae Pat.

(ii) Phoma rot

Symptoms : This disease develops in the form of black necrotic spots which may initiate the rot. At the advanced stage of disease development other fungi such as Botryodiplodia invade the fruit and cause devastating damage to fruits.

Causal organism : Phoma psidii P. Henn. (Pl.Fig. 113 and 105)

Pycnidia sub-epidermal, dark-brown, gregarious, ostiolate, measured 88.5 - 210 µm in diameter. Pycnidiospores 1-celled, hyaline, cylindrical, measure 10-21 x 4-7 µm and yellow coloured in mass.

In addition to these diseases, on dry, mummified fruits saprophytic fungus Fusarium decemcellulare Brick was found growing forming a pinkish-white mycelial mat.

4. Citrus medica var. acida L. (Lemon, Nimboo)

The fruits are rich in vitamin C and D. The fruit juice is refrigerant and astrigent. The fruit juice is used in preparation of refreshing drinks. The fruits are used to prepare pickles. Commercially, citric acid is obtained from these fruits. The tree bears fruits all the year round due to successive flowering.

Following diseases were recorded :

(i) Blue mould :

Symptoms : This fruit suffers from decay and rotting by a common mould. The decay emits a strong fermenting or alcoholic odour. Fruits in the heap become slimy and give a look of mummification.

Causal organism : Penicillium italicum Wahmer

It produces dull blue coloured colonies with a narrow fringe of white margin becoming grey-green when old. Conidiophores arise directly from the substratum from repent hyphae. Chains of conidia loosely divergent and long.

(ii) Waxy rot (Pl. Fig. 82)

Symptoms : The disease generally develops from the stalk-end but may also develop on other areas. It is manifested in the form of roughly circular, water-soaked, slimy areas with dull-white colonies of fungus. The infected areas enlarge under favourable conditions of storage. The incidence of the disease

was high (20-25%) during mansoon season. The decayed fruits emit strong alcoholic odour.

Causal organism : Geotrichum candium Link

The fungus produces short, cylindrical arthrospores by fragmentation of the matured hyphae. They measured 6-19 x 3-5 µm, cylindrical, hyaline and thick-welled.

On continued storage these fruits are attacked by secondary (saprophytic) invaders such as Aspergillus niger van Tieghem.

5. Citrus reticulata Blanco (Orange, Santra)

This fruit is sweet and juicy. It is a rich source of vitamin C. It is also used for preparation of refreshing drinks. These fruits are generally arriving from Nagpur. The main season is February-March.

Following disease was recorded :

(i) Green mould (Pl. Fig. 83)

Symptoms : The fruits are severely damaged by a commonly occurring, devastating green mould which generally starts at the stalk-end and produces a white (powdery) mycelium which soon becomes light green coloured. The decay emits a strong, fermenting alcoholic odour. The fruits become slimy and give a look of mummification.

Casual organism : Penicillium digitatum Saccardo

It produces dirty green, fast growing powdery colonies.

6. Musa paradisiaca L. (Banana)

Banana is one of the cheapest fruit. These fruits are sold at affordable prices throughout the year. It is extensively grown in heavy rainfall regions of India. It is largely grown in Kitchen gardens, farm houses as well as on field scale under irrigation. The fruits have good nutritional value and excellent taste. They are rich in vitamins, minerals and sugars. It is one of foreign exchange earner agricultural produce which is being exported to countries like Russia and Middle East. A large number of varieties including Basrai, Mutheli, Velchi and Rasbal are grown.

Following diseases were recorded :

(i) Fusarium rot (Pl. Fig. 84)

Symptoms : This disease is of common occurrence. It is characterised by appearance of water-soaked patches which later become dark-brown, leathery, oval to irregular in any part of the fruit and overgrown with rosy powdery fungal colonies on the infected skin. The infection was more severe in fruits detached from the main branches. This disease is common in hot storage places which are specially prepared for rapid ripening of fruits and was noticed on both ripe and unripe fruits.

Causal organism : Fusarium roseum Link (Pl.Fig.98,99 & 106)

Sporodochia loose, minute, dull-rose coloured, scattered

to gregarious, subcutaneous to erumpent. Conidia 0 to 5 septate, oval or long, spindle to sickle-shaped, but mostly 5 septate spores are produced largely.

Another Fusarium rot was noticed on the injured fruits. The injury may be caused during post harvest handling. The fungus showed white mouldy growth on the injured part. From these infected parts Fusarium roseum Link and Fusarium moniliformae Sheldon were isolated.

(ii) Black rot caused by Gloeosporium

Symptoms : This disease occurs on ripening fruits and causes severe damage. The disease develops rapidly in storage due to high temperature, humidity and faulty ventilation of store-houses where the fruits are kept in large heaps, covered with tarpaulin sheets. The disease starts developing from stalk as well as blossom-end of the fruits and finally encircles them, thus setting up a rot. The lesions show small, tiny, pinkish colonies of the fungus.

Causal organism : Gloeosporium musarum Cke. and Massee (Pl. Fig. 108)

Sporodochia abundent, scattered, subcutaneous, pink in mass. Conidia cylindrical, 1-celled, hyaline and 9-13 x 4-5 µm.

(iii) Black rot caused by Thielaviopsis

In a local variety of banana called "Deshi" pink coloured spots were observed which turned into dark black spots. These spots later coalesced together and reached upto the stalk resulting in the decay of the fruit.

Causal organism : Thielaviopsis paradoxa (De Seynes) Hoehn (Pl. Fig. 172)

In culture the organism produced pink coloration but it was overgrown by a bacterial colony. The relationship of the association of bacterium and Thielaviopsis was not further studied.

7. Psidium guajava L. (Guava)

Guava is a popular fruit and is widely grown in India and used by common people on account of its sweet pulp. Ripe fruit emits sweet aroma and is refreshingly acidic in flavour. It is widely used in preparation of jams and jellies. It is considered as a poor man's fruit. It is a rich source of vitamin C and minerals such as Calcium and Phosphorus.

Following diseases were recorded :

(i) Anthracnose

Symptoms : Green as well as half-ripe fruits are found to develop circular, black, sunken, necrotic specks. The infection was restricted to the skin in the form of fruit blemish. In advanced stages, these specks show numerous sunken black fruiting bodies.

Causal organism : Colleototrichum psidii Curzi

Acervulif black, setose, 85-270 µm in diameter. Setae simple, dark-brown, septate, 42-110 x 4-5 µm, Conidia cylindrical, hyaline, 1-celled, 12.0-16 x 3-4 µm and hyaline.

(ii) Fruit canker

Symptoms : Brown coloured, necrotic, cankerous, deep lesions and cracking the skin of fruit were observed; giving the fruit an ugly appearance.

Causal organism : Sclerotium rolfsii Sacc.

(iii) Fruit rot

Symptoms : A rot with water-soaked lesions was observed; the fruits became soft and emitted foul odour.

Causal organism : Penicillium sp.

(iv) Black spots (Pl. Fig. 85)

Symptoms : On green and half-ripe guava fruits small centrally depressed spots with pink colouration were observed. These spots turned into black coloured spots.

Causal organism : Aspergillus sp.

8. Pyrus malus, L. (Malus pumila, Apple)

Apple is undoubtedly the most important temperate fruit. It is the premier table fruit of the world. There are number of varieties of apple but in India only a few are commercially important. The variety Ambri is extensively cultivated in Kashmir. The fruit is sweet with firm flesh and exceedingly good transport quality. It has an attractive aroma and practically no acidity. Arrival of fruits from Kashmir, Bangalore and Simla.

Following diseases were recorded :

(i) Alternaria rot (Pl. Fig. 86)

Symptoms : The fruits show circular black spots which develop into necrotic brown coloured, irregular patches resulting in depressions. The rotten fruits emit strong alcoholic odour.

Causal organism : Alternaria alternata (Fr.) Keissler

Conidia formed in long, often branched chains, obclavate, obpyriform, ovoid or ellipsoidal, often with a short conical or cylindrical beak, with upto 8 transverse and usually several longitudinal or oblique septa and measured 20-37 (-60) x 9 - 13 (- 18) µm; beak pale and short.

(ii) Blue mould (Pl. Fig. 87)

Symptoms : Excessive rotting of apples due to a blue mould, probably due to injuries sustained during post-harvest handling, was commonly observed. The lesions leak out watery excretions.

Causal organism : Penicillium expansum Link

(iii) Black spots

Symptoms : Small, tiny black spots forming irregular groups on the skin of the fruits were observed. They were crowded on stalk-end and sometimes spreading on the whole fruit.

Causal organism : Trichoderma viride Pers. ex. Fries (Pl. Fig. 100)

Colonies were deep green coloured; tufts of hyphae bearing conidiophores; spore mass and some sterile hyphae appear in culture; conidiphores indefinite, consisting of an unbranched or branched stalk, bearing phialides laterally and terminally; phialides surmounted by heads, rarely by short chains, of slimy spores; conidia hyaline or bright coloured, 1-celled, thin-welled and dry.

9. Vitis vinifera L. (Grape)

Recently this fruit has become a foreign exchange earner agricultural produce for India. It is extensively cultivated in sub-tropical countries of the world. However, 80 percent of the yield is used for wine making and 10 percent is used as fresh fruit. Grape is digestive, stomachic, purifier and enriches the blood. It is good for lungs, liver and kidney. It is useful in old fevers. Fruit contains vitamin A and traces of vitamin B and C. Arrival of fruits from Nashik, Nipani and Tasgaon (Sangli).

Following diseases were recorded :

(i) Black dry rot

Symptoms : Slightly whitish,, black, roughly circular spots were observed on the berries. The spots were showing a mouldy growth of the fungus. The lesions increased in size on storage. It substantially decreased the market value.

Causal organism : Phoma sp. (Pl. Fig. 101)

(ii) Black wet rot

Symptoms : Circular, black, water-soaked spots were observed on the berries. On storage they showed leakage of watery substance. This rot also caused substantial losses to farmers due to decreased market value.

Causal organism : Phoma psidii P. Hennings (Pl. Fig. 101)

It has been observed that in this disease Phoma psidii was probably the primary pathogen. In association with this fungus Pestalotia menezesiana and a sterile mycelium grow resulting in a black and wet rot.

Pestalotia menezesiana Bres. and Torr. (Pl. Fig. 110)

Conidia clavate-fusiform, 5-celled, 20-25 x 7-9 µm, curved, tapering into conical basal cell, setulae 3; in culture produced white mycelium bearing raised black spots.

10. Ziziphus jujuba Lamk. (Ber)

This fruit tree grows wild and now is being cultivated on field scale. The tree bears heavily during the cold months. It is a popular fruit with village people and often fetches good price depending upon the variety. Attempts are being made to improve the quality of this fruit by budding. It is one of the richest source of vitamin C and also contains vitamin A and B. The fruit is dried and used as a desert fruit.

Following disease was recorded :

(i) Fruit rot (Pl. Fig. 88)

Symptoms : This disease was observed in the form of depresions on the skin of fruit which later turned black and finally in a rot.

Causal organism : Ulocladium chartarum (Preuss) Simmons
= Alternaria chartarum Preuss (Pl.Fig.114)

Conidia commonly in chains of 2-10, ellipsoidal or obovoid, often with short false beaks, smooth to verruculose with 1-5 (commonly 3) transverse and several oblique or longitudinal septa, 18.5 - 38 x 11.5 - 19 µm, thick-walled and brown.

Alongwith this pathogen secondary invaders such as Cladosporium cladosporioides (Fres.) de Vries and vegetative mycelium with well developed chlamydospores were also recorded.

II. VEGETABLES

1. Allium cepa L. (Onion)

Onion is one of the common vegetables. The scaly bulb consists of a pungent taste.

Following disease was recorded :

(i) Black mould rot

Symptoms : The bulbs show black streaks between the outermost dry scales with thin, sometimes diffused black

powdery mass of the causal fungus. Both red and white varieties are infected. The infection develops mostly through injuries in bulbs which have not been well dried before storage thus bringing considerable losses to the vendors.

Causal organism : Aspergillus niger van Tieghem

2. Allium sativum L. (Garlic)

This is also another important tuber vegetable which is commonly used in spices and other preparation in kitchen. It has many medicinal properties. It keeps in control the cholesterol level in blood. It is pungent in taste.

Following disease was recorded :

(i) Black mould rot (Pl. Fig. 89)

Symptoms : This disease is characterised by the copious growth of dust-like mass consisting of fungal spores and remaining concealed in between scales of the bulb. It is thrown out in the form of black sooty powder on peeling. The tubers loose usual strong smell of garlic. Consequently such bulbs fetch low market price.

Causal organism : Aspergillus niger van Tieghem

3. Capsicum annuum L. (Chillies)

Chillies are largely cultivated in India. It is one of most important items in the diet of Indians. It is very pungent to taste.

On dried fruits of chillies some dirty white spots were

observed. It disfigured the chillies and lowered the market price. These infected parts developed Fusarium sp. in culture.

4. Coccinia indica W. and A. (Tondli)

This fruit is used as vegetable or eaten raw. It is a rich source of vitamin A.

Following diseases were recorded :

(i) Fruit rot

Symptoms : A soft rot with depressed black circular spots with water-soaked lesions was observed.

Causal organism : Fusarium sp.

(ii) Cladosporium rot (Pl. Fig. 90)

Symptoms : Black fungal growth on unripe fruits was observed. This infection occurred due to injuries made in the skin by insects. The fruits showed necrotic spots which decayed on storage.

Causal organism :Cladosporium herbarum Link ex Fries

5. Coriandrum sativum L. (Coriander)

On the leaves of coriander brown, necrotic leaf spots were observed which reduced the market value.

Causal organism : Alternaria zinniae M.B. Ellis

6. Hibiscus cannabinus L. (Ambadi)

This is a popular vegetable generally used in daily domestic preparation in addition to its use in extracting fibre

from its stem. A leaf spot was noticed on the foliage caused by Cercospora abelmoschi Ellis & Everhart.

7. Ipomoea batata Lamk. (sweet potato) (Pl. Fig. 91)

This is one of the important tuber vegetable crop which is rich in starch.

Following disease was recorded :

(i) Rhizopus rot

Symptoms : This disease is characterised with large water-soaked necrotic areas covered with black webby growth of the fungus resulting in a soft decay emitting foul smell.

Causal organism : Rhizopus nigricans Ehremberg (Pl. Fig.103)

8. Solanum tuberosum L. (Potato)

Potato is an important tuber crop and grown all over India for its use in the daily diet. It provides good nutrition and is probably the cheapest and the best starchy food.

On the potato tuber a rot incited by Fusarium sp. was recorded. The tuber was covered by the mycelial mat of the fungus.

9. Trigonella foenum-graecum L. (Fenugreek, Methi)

On this important leaf vegetable, a leaf spot disease caused by Cercospora traversiana Sacc. was observed.