Chapter IV
Results
and
Discussion

Result and Discussion :

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. Groundnut is oil seed crop and gram is leguminous crop. Oil seeds, legumes are chief sources of food.

Plants providing chief sources :

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

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

The crop plants are attacked by many seed borne fungi 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. This affects the market value of seeds. Therefore the control of seed borne fungi during storage and market was the important point to be considered.

In the present investigation groundnut and gram crop were carried by taking into following aspects.

1) Field observation by photographic method
2) Seed treatment of seeds of the crops groundnut and gram.
3) Identification of fungal colonies in control blotter plates

Groundnut

Groundnut is a oil seed crops. 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).

Field Observation :

Groundnut crop is generally taken during kharip season. For study field survey observation regarding groundnut are –

After taking the photos of quadrates from all corners of the field, it was found that there is no 100% germination of seeds (Plate Fig. 1 to 2). About 5% of seeds were not germinated. The reason for that is loss of viability of seeds. The seeds which were germinated are found to develop upto seeding stage. 2 to 5% seedling were found diseased or abnormal. The healthiness of plants shows disease resistance of that crop to fungal attack.

The petri dishes are kept under observation for germination of seed. Various concentration of sulpher has been tried by changing period of treatment.

Treatment of 1% sulpher on groundnut seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 1. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration (1%) for 6 hours time period for seed germination percentage was maximum in *Arachis hypogeae* L. about 100%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is most favourable for seed germination and controlling fungal growth.

Treatment of 1% sulpher on groundnut seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 2. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration (1%) for 12 hours time period for seed germination percentage in *Arachis hypogeae* L. is about 80%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for seed germination.

Treatment of 1% sulpher on groundnut seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 3. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (1%) for 12 hours time period for seed germination percentage in *Arachis hypogeae* L. is about 60%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for seed germination.

Treatment of 2% sulpher on groundnut seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 4. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration (1%) for 6 hours time period for seed germination percentage was maximum in *Arachis hypogeae* L. about 100%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is most favourable for seed germination and controlling fungal growth.

Treatment of 2% sulpher on groundnut seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 5. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (1%) for 12 hours time period for seed germination percentage in *Arachis hypogeae* L. is about 70%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for seed germination.

Treatment of 2% sulpher on groundnut seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 6. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration (1%) for 12 hours time period for seed germination percentage in *Arachis hypogeae* L. is about 50%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for seed germination.

Treatment of 5% sulpher on groundnut seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 7. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration (1%) for 6 hours time period for seed germination percentage was maximum in *Arachis hypogeae* L. about 100%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is most favourable for seed germination and controlling fungal growth.

Treatment of 5% sulpher on groundnut seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 8. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration (1%) for 12 hours time period for seed germination percentage in *Arachis hypogeae* L. is about 80%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for seed germination.

Treatment of 5% sulpher on groundnut seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 9. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (1%) for 12 hours time period for seed germination percentage in *Arachis hypogeae* L. is about 50%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for seed germination.

From table 1 to 9, it is clear that 5% sulpher treatment for 6 hours gives best results where germination percentage is 100%. Thus it is most favourable seed treatment while 5% sulpher for 12 and 24 hours gives 50 – 80% seed germination for each which takes that this concentration (5%) for 12 and 24 hours is favourable for groundnut seed. Only 100% seed germination is suitable

On the basis of above it is concluded that in case of groundnut sulpher is a best seed treatment solution at 5% concentration for 6 hours time period to manage seed borne pathogen in vivo.

In case of groundnut crop seed treatment with sulpher are useful to control seed borne diseases. (Plate Fig. 3)

Treatment of 0.1% $HgCl_2$ on groundnut seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 10. The percentage of seed germination was observed (Plate Fig. 4), after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.1%) for 6 hours time period for seed germination percentage was minimum in *Arachis hypogeae* L. about 40%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is harmful for seed germination.

Treatment of 0.1% $HgCl_2$ on groundnut seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 11. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.1%) for 12 hours time period for seed germination percentage was minimum in *Arachis hypogeae* L. about 20%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is harmful for seed germination.

Treatment of 0.1% $HgCl_2$ on groundnut seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 12. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.1%) for 24 hours time period for seed germination percentage was minimum in *Arachis hypogeae* L. very low i.e. about 0%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period causes poisoning for seed germination.

Treatment of 0.2% $HgCl_2$ on groundnut seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 13. The percentage of seed germination was observed (Plate Fig. 5), after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.2%) for 6 hours time period for seed germination percentage was minimum in *Arachis hypogeae* L. very low i.e. about 10%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period causes poisoning for seed germination.

Treatment of 0.2% $HgCl_2$ on groundnut seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 14. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.2%) for 12 hours time period for seed germination percentage was minimum in *Arachis hypogeae* L. very low i.e. about 0%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period causes poisoning for seed germination.

Treatment of 0.2% $HgCl_2$ on groundnut seeds for 24 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 15. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.2%) for 12 hours time period for seed germination percentage was minimum in *Arachis hypogeae* L. very low i.e. about 0%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period causes poisoning for seed germination.

Treatment of 0.05% $HgCl_2$ on groundnut seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 16. The percentage of seed germination was observed (Plate Fig. 6), after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.05%) for 6 hours time period for seed germination percentage was maximum in *Arachis hypogeae* L. about 100%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is most favourable for seed germination and controlling fungal growth.

Treatment of 0.05% $HgCl_2$ on groundnut seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 17. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.05%) for 12 hours time period for seed germination percentage in *Arachis hypogeae* L. is about 50%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for seed germination.

Treatment of 0.05% $HgCl_2$ on groundnut seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 18. The percentage of seed germination was observed (Plate Fig. 7), after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.05%) for 24 hours time period for seed germination percentage in *Arachis hypogeae* L. is about 50%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for seed germination.

From table 10 to 18 it is clear that 0.05% $HgCl_2$ treatment for 6 hours gives best results where germination percentage is 100%. Thus it is most favourable seed treatment (Plate Fig. 8) while 0.05% sulpher for 12 and 24 hours

gives 50% seed germination for each which takes that this concentration (0.05%) for 12 and 24 hours is favourable for groundnut seed. Only 100% seed germination is suitable.

On the basis of above it is concluded that in case of groundnut $HgCl_2$ is a best seed treatment solution at 0.05% concentration for 6 hours time period to manage seed borne pathogen.

When seed were visually examined, percentage of discoloured and shrunken seeds (Plate fig. 9). The results of seed borne fungi of groundnut observed during present investigation are recorded in table No. 19.

During the study of seed borne fungi from control plates, 39 species were recorded on seed with Blotter method. This clearly indicates that Blotter method favoured the growth of more number of fungi by providing suitable microclimate. While taking into account of the total number of fungi, associated with groundnut genus *Aspergillus* displaying 33 species followed by *Penicillium* (3 species), *Rhizopus* (3 species), *Mucor* (2 species), *Alternaria* (1 species) and *Fusarium* (1 species). By using Blotter method, species observed on groundnut seeds were seed borne fungi of groundnut investigated during this study included *Aspergillus candidus, A. japonicas, A. luchuensis, A. terreus, A. wentii, A. flavus, Aspergillus niger* and *Fusarium oxysporium* 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).

Table No. 1

Treatment of 1% sulpher on Groundnut seeds for 6 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Most favourable concentration for treatment
25/9/2009	24 hours	20	
26/9/2009	48 hours	40	
27/9/2009	72 hours	60	
28/9/2009	96 hours	90	
29/9/2009	120 hours	100	

Table No. 2

Treatment of 1% sulpher on Groundnut seeds for 12 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	10	
26/9/2009	48 hours	20	
27/9/2009	72 hours	40	
28/9/2009	96 hours	50	
29/9/2009	120 hours	80	

Table No. 3

Treatment of 1% sulpher on Groundnut seeds for 24 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	10	
26/9/2009	48 hours	20	
27/9/2009	72 hours	40	
28/9/2009	96 hours	60	
29/9/2009	120 hours	60	

Table No. 4

Treatment of 2% sulpher on Groundnut seeds for 6 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Most favourable concentration for treatment
25/9/2009	24 hours	20	
26/9/2009	48 hours	40	
27/9/2009	72 hours	70	
28/9/2009	96 hours	100	
29/9/2009	120 hours	100	

Table No. 5

Treatment of 2% sulpher on Groundnut seeds for 12 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	20	
26/9/2009	48 hours	40	
27/9/2009	72 hours	60	
28/9/2009	96 hours	70	
29/9/2009	120 hours	70	

Table No. 6

Treatment of 2% sulpher on Groundnut seeds for 24 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	20	
26/9/2009	48 hours	40	
27/9/2009	72 hours	40	
28/9/2009	96 hours	50	
29/9/2009	120 hours	50	

Table No. 7

Treatment of 5% sulpher on Groundnut seeds for 6 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Most favourable concentration for treatment
25/9/2009	24 hours	50	
26/9/2009	48 hours	90	
27/9/2009	72 hours	100	
28/9/2009	96 hours	100	
29/9/2009	120 hours	100	

Table No. 8

Treatment of 5% sulpher on Groundnut seeds for 12 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	20	
26/9/2009	48 hours	40	
27/9/2009	72 hours	60	
28/9/2009	96 hours	70	
29/9/2009	120 hours	80	

Table No. 9

Treatment of 5% sulpher on Groundnut seeds for 24 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	10	
26/9/2009	48 hours	20	
27/9/2009	72 hours	40	
28/9/2009	96 hours	50	
29/9/2009	120 hours	50	

Table No. 10

Treatment of 0.1% $HgCl_2$ on Groundnut seeds for 6 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment		Harmful
30/10/2009	24 hours	10	
31/10/2009	48 hours	20	
1/11/2009	72 hours	40	
2/11/2009	96 hours	40	

Table No. 11

Treatment of 0.1% $HgCl_2$ on Groundnut seeds for 12 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment		Harmful
30/10/2009	24 hours	10	
31/10/2009	48 hours	10	
1/11/2009	72 hours	20	
2/11/2009	96 hours	20	

Table No. 12

Treatment of 0.1% $HgCl_2$ on Groundnut seeds for 24 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment		Poisoning to seed
30/10/2009	24 hours	0	
31/10/2009	48 hours	0	
1/11/2009	72 hours	0	
2/11/2009	96 hours	0	

Table No. 13

Treatment of 0.2% $HgCl_2$ on Groundnut seeds for 6 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment	00	Poisoning to seed
30/10/2009	24 hours	00	
31/10/2009	48 hours	00	
1/11/2009	72 hours	00	
2/11/2009	96 hours	10	

Table No. 14

Treatment of 0.2% $HgCl_2$ on Groundnut seeds for 12 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment	00	Poisoning to seed
30/10/2009	24 hours	00	
31/10/2009	48 hours	00	
1/11/2009	72 hours	00	
2/11/2009	96 hours	00	

Table No. 15

Treatment of 0.2% $HgCl_2$ on Groundnut seeds for 24 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment	00	Poisoning to seed
30/10/2009	24 hours	00	
31/10/2009	48 hours	00	
1/11/2009	72 hours	00	
2/11/2009	96 hours	00	

Table No. 16

Treatment of 0.05% $HgCl_2$ on Groundnut seeds for 6 hours

Date	Germination time	Germination %	Remark
11/11/2009	Seed Treatment		Most favourable concentration for treatment
12/11/2009	24 hours	10	
13/11/2009	48 hours	50	
14/11/2009	72 hours	80	
15/11/2009	96 hours	90	
16/11/2009	120 hours	100	

Table No. 17

Treatment of 0.05% $HgCl_2$ on Groundnut seeds for 12 hours

Date	Germination time	Germination %	Remark
11/11/2009	Seed Treatment		Favourable
12/11/2009	24 hours	10	
13/11/2009	48 hours	30	
14/11/2009	72 hours	40	
15/11/2009	96 hours	50	
16/11/2009	120 hours	50	

Table No. 18

Treatment of 0.05% $HgCl_2$ on Groundnut seeds for 24 hours

Date	Germination time	Germination %	Remark
11/11/2009	Seed Treatment		Favourable
12/11/2009	24 hours	10	
13/11/2009	48 hours	20	
14/11/2009	72 hours	40	
15/11/2009	96 hours	50	
16/11/2009	120 hours	50	

Table No. 19

Fungi in control plate for groundnut

Sr.No.	Fungal forms	Control Blotter Method
1	*Alternaria alternate* (Fries) Keissler	+
2	*Aspergillus alutaceus* Berk and Curt	+
3	*A. amstelodami* (Mang.) Thom and Church	+
4	*A. atropurpureus* Zimmermann.	+
5	*A. candidus* Link ex Fries.	+
6	*A. carbonarius* (Bainier) Thom.	+
7	*A. chevalieri* (Mang.) Thom and Church.	+
8	*A. erythrocephalus* Berk. And Curt.	+
9	*A. flavus* Link ex Fries.	+
10	*A. fumigates* Fresenius	+
11	*A. humicola* Chaudhuri and Sachar.	+
12	*A. insecticola* Subram. Nom. Nov.	+
13	*A. japonicas* Saito.	+
14	*A. luchuensis* Inui.	+
15	*A. lutescens* Bainier ex Thom and Church.	+
16	*A. nanus* Montagne.	+
17	*A. nidulans* (Eidam) Winter.	+
18	*A. niger* Van Tieghem.	+
19	*A. niveus* Blochwitz.	+
20	*A. oryzae* (Ahlburg in Korschelt) Cohn.	+
21	*A. parasiticus* Speare	+
22	*A. phoenicis* (Corda) Thom.	+
23	*A. pulverulentus* (McAlpine) Thom.	+
24	*A. quericinus* (Bainier) Thom and Church	+
25	*A. repens* (Corda) de Bary.	+
26	*A. ruber* (Bremer) Thom and Raper.	+
27	*A. sclerotiorum* Huber.	+
28	*A. sydowi* (Bain. And Sart.) Thom and Church.	+

Sr.No.	Fungal forms	Control Blotter Method
29	*A. terreus* Thom.	+
30	*A. unguis* (Emil-Weil and Gaudin) Thom and Raper	+
31	*A. ustus* (Bainier) Thom and Church.	+
32	*A. versicolor* (Vuillemin) Tiraboschi.	+
33	*A. violaceo-fuscus* Gasperini	+
34	*A. wentii* Wehmer.	+
35	*Fusarium oxysporum* schl. Ex. Fries.	-
36	*Mucor circinelloides* Van Tieghem.	+
37	*M. griseo – cyaneus.*	+
38	*Penicillium chrysogenum* Thom	-
39	*P. javanicum* Van Beyma.	-
40	*P. oxalicum* Curie and Thom.	-
41	*Rhizopus artocarepi* Raciborski.	+
42	*R. oryzae* Went et. Garlings.	+
42	*R. combodia* Vuillemin	+

Explanation of Plate No. I

Plate Fig. No. 1 – 2

Groundnut

1) Field Survey

2) Field Survey

Plate No .I
Plate Fig.No 1 - 2
Groundnut

(1)

(2)

SD

Explanation of Plate No. II

Plate Fig. No. 3 to 4

Groundnut

3) Treatment of 1% sulpher on groundnut seed for 6 hours

1% concentration for 6 hours time period for seed germination percentage maximum in *Arachis hypogeae* L. is about 100%

4) Treatment of 0.1% $HgCl_2$ on groundnut seed for 6 hours

0.1% concentration for 6 hours time period for seed germination percentage maximum in *Arachis hypogeae* L. is about 40%

Plate No .II
Plate Fig.No 3 - 4
Groundnut

(3)

52 (4)

Explanation of Plate No. III

Plate Fig. No. 5 to 6

Groundnut

5) Treatment of 0.2% $HgCl_2$ on groundnut seed for 6 hours

0.2% concentration for 6 hours time period for seed germination percentage maximum in *Arachis hypogeae* L. is about 10%

6) Treatment of 0.05% $HgCl_2$ on groundnut seed for 06 hours

0.02% concentration for 6 hours time period for seed germination percentage maximum in *Arachis hypogeae* L. is about 100%

Plate No .III
Plate Fig.No 5 - 6
Groundnut

(5)

(6)

Explanation of Plate No. IV

Plate Fig. No. 7 – 8

Groundnut

7) Treatment of 0.05% $HgCl_2$ on groundnut seed for 24 hours

0.05% concentration for 6 hours time period for seed germination percentage maximum in *Arachis hypogeae* L. is about 50%

8) Treatment of 0.05% $HgCl_2$ on groundnut seed for 6 & 24 hours

Plate No .IV
Plate Fig.No 7-8
Groundnut

(7)

(8)

Explanation of Plate No. V

Plate Fig. No. 9 – 10

Groundnut

9) Normal and abnormal seeds

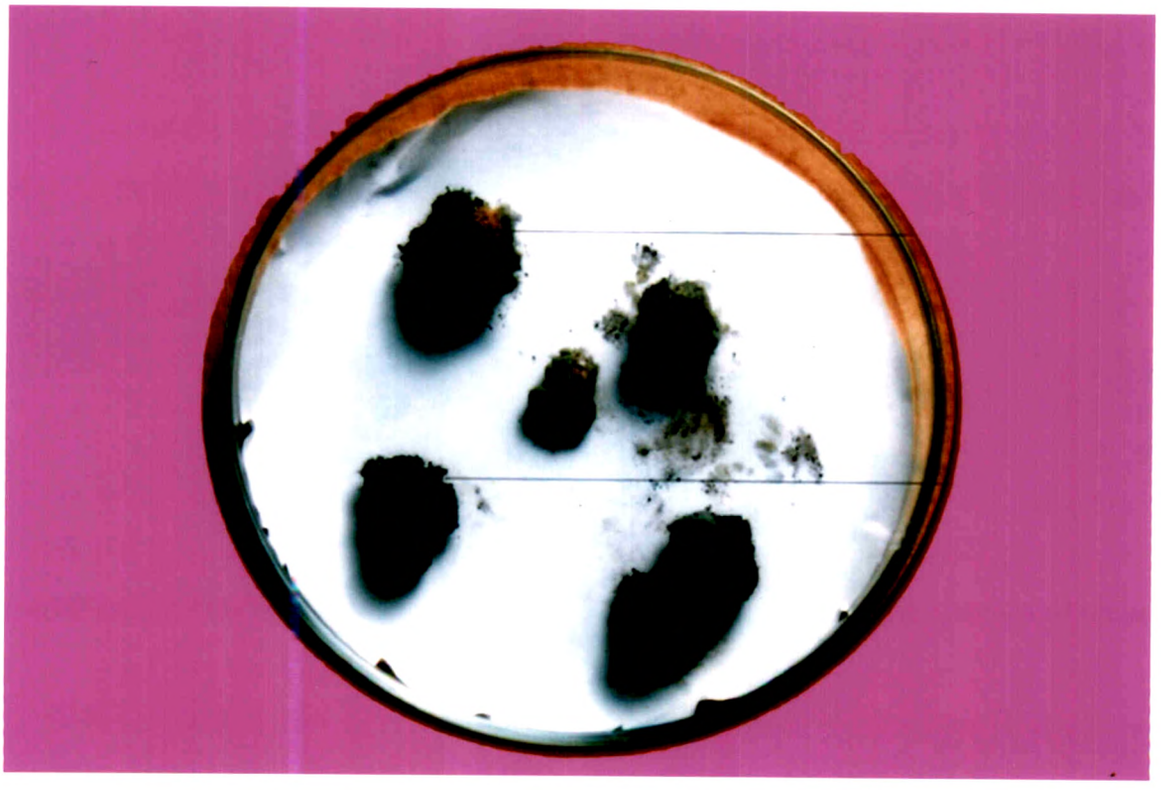
10) Control Blotter Method

1. *Aspergillus candidus* Link ex Fries.

2. *A. atropurpureus* Zimmermann

Plate No .V
Plate Fig.No 9 -10
Groundnut

(9)



(10)

Gram

Gram is a legumes crop. Legumes are sources of food. 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 are highly nutritious, supply not only proteins but also carbohydrates fats, vitamins and some minerals also the immature seeds of pulses are used vegetable (Verma 1984).

Field observations :

Gram crop is generally taken during rabi season. For study field survey observation regarding gram crop in and around Satara district. After taking the photographs from all corners of the field, it was found that there is 100% germination of seeds (Plate Fig. 11 to 14). The crop will be healthy crop.

Treatment for 1% sulpher on gram seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 20. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration for 6 hours time period for seed germination percentage was maximum in *Cicer arietinum* is about 100%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is most favourable for germination.

Treatment for 1% sulpher on gram seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 21. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration for 12 hours time period for seed seed germination percentage was maximum in *Cicer arietinum* is about 80%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for germination.

Treatment for 1% sulpher on gram seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 22. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration for 24 hours time period for seed seed germination percentage was in *Cicer arietinum* is about 60%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for germination.

Treatment for 2% sulpher on gram seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 23. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration for 6 hours time period for seed seed germination percentage was maximum in *Cicer arietinum* is about 100%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is most favourable for germination.

Treatment for 2% sulpher on gram seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 24. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration for 12 hours time period for seed germination percentage was in *Cicer arietinum* is about 60%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for germination.

Treatment for 2% sulpher on gram seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 25. The percentage of seed germination was observed, after

each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration for 24 hours time period for seed seed germination percentage was in *Cicer arietinum* is about 50%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for germination.

Treatment for 5% sulpher on gram seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 26. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration for 6 hours time period for seed seed germination percentage was maximum in *Cicer arietinum* is about 100%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is most favourable for germination.

Treatment for 5% sulpher on gram seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 27. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration for 12 hours time period for seed seed

germination percentage was maximum in *Cicer arietinum* is about 70%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for germination.

Treatment for 5% sulpher on gram seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 28. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. The maximum germination percentage was also recorded. This concentration for 24 hours time period for seed seed germination percentage was in *Cicer arietinum* is about 50%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration period is favourable for germination.

From table 19 to 27 it is clear that 5% sulpher treatment for 6 hours gives best results where germination percentage is 100%. Thus it is most fourable seed treatment while 5% sulpher for 12 and 24 hours gives 50 to 70% seed germination for each which takes that this concentration (5%) for 12 and 24 hours is fourable for gram seed. Only 100% seed germination is most favourable.

On the basis of above it is concluded that in case of gram sulpher is a best seed treatment solution at 5% concentration for 6 hours time period to manage seed borne pathogen.

In case of gram crop seed treatment with sulpher are useful to control seed borne diseases. (Plate Fig. 15)

Treatment of 0.1% $HgCl_2$ on Gram seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 29. The percentage of seed germination was observed (Plate Fig. 15), after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.1%) for 6 hours time period for seed germination percentage was in *Cicer arietinum* is about 40%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is harmful for seed germination.

Treatment of 0.1% $HgCl_2$ on Gram seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 30. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.1%) for 12 hours time period for seed germination percentage was low in *Cicer arietinum* is about 30%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is harmful for seed germination.

Treatment of 0.1% $HgCl_2$ on groundnut seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 31. The percentage of seed germination was observed (Plate Fig. 16), after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.1%) for 24 hours time period for seed germination percentage was in *Cicer arietinum* very low i.e. about 0%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period causes poisoning for seed germination.

Treatment of 0.2% $HgCl_2$ on Gram seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 32. The percentage of seed germination was observed (Plate Fig. 17), after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.2%) for 6 hours time period for seed germination percentage was minimum in *Cicer arietinum* very low i.e. about 0%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period causes poisoning for seed germination.

Treatment of 0.2% $HgCl_2$ on groundnut seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 33. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.2%) for 12 hours time period for seed germination percentage was minimum in *Cicer arietinum* is very low i.e. about 0%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period causes poisoning for seed germination.

Treatment of 0.2% $HgCl_2$ on Gram seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 34. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.2%) for 24 hours time period for seed germination percentage was minimum in *Cicer arietinum* is very low i.e. about 0%, this concentration is harmful and it causes seed poisoning. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period causes poisoning for seed germination.

Treatment of 0.05% $HgCl_2$ on Gram seeds for 6 hours :

6 hours seed treatment for germination percentage results are recorded in Table No. 35. The percentage of seed germination was observed (Plate Fig. 18), after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.05%) for 6 hours time period for seed germination percentage was maximum in *Cicer arietinum* is about 100%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is most favourable for seed germination and controlling fungal growth.

Treatment of 0.05% $HgCl_2$ on Gram seeds for 12 hours :

12 hours seed treatment for germination percentage results are recorded in Table No. 36. The percentage of seed germination was observed, after each 24 hours (days) the germination percentage was recorded and observation tables were prepared. This concentration (0.05%) for 12 hours time period for seed germination percentage in *Cicer arietinum* is about 50%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for seed germination.

Treatment of 0.05% $HgCl_2$ on Gram seeds for 24 hours :

24 hours seed treatment for germination percentage results are recorded in Table No. 37. The percentage of seed germination was observed (Plate Fig. 19), after each 24 hours (days) the germination percentage was recorded and

observation tables were prepared. This concentration (0.05%) for 24 hours time period for seed germination percentage in *Cicer arietinum* is about 50%. Seed borne fungi did not appear treated seeds this was only due to effect of chemical treatment, due to chemical concentration the fungal spores were killed and seed become free from fungal propagules.

Therefore this concentration and period is favourable for seed.

From table 29 to 37 it is clear that 0.05% $HgCl_2$ treatment for 6 hours gives best results where germination percentage is 100%. Thus it is most favourable seed treatment (Plate Fig. 20) while 0.05% $HgCl_2$ for 12 and 24 hours gives 50% seed germination for each which takes that this concentration (0.05%) for 12 and 24 hours is favourable for gram seed. Only 100% seed germination is most favourable.

On the basis of above it is concluded that in case of gram $HgCl_2$ is a best seed treatment solution at 0.05% concentration for 6 hours time period to manage seed borne pathogen.

In case of gram crop seed treatment with $HgCl_2$ are useful to control seed borne diseases.

For the present investigation the seeds were visually examined, to find out percentage of shrunken and discoloured seeds (Plate Fig. 21) The results of seed borne fungi of gram observed during present investigation are recorded in Table No. 38. Control blotter plate showed 4 fungal species (Plate Fig. 22). *Alternaria dianthicola, A. niger, A. oryzae, Drechslera australiensis.* The fungal species which have been reported in present study. Saprophytic fungi like *Aspergillus niger* were also reported earlier by Dawar, Sed and Ghaffar (2007) from Pakistan.

Table No. 20

Treatment of 1% sulpher on Gram seeds for 6 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Most favourable concentration for treatment
25/9/2009	24 hours	20	
26/9/2009	48 hours	40	
27/9/2009	72 hours	70	
28/9/2009	96 hours	100	
29/9/2009	120 hours	100	

Table No. 21

Treatment of 1% sulpher on Gram seeds for 12 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	10	
26/9/2009	48 hours	20	
27/9/2009	72 hours	40	
28/9/2009	96 hours	50	
29/9/2009	120 hours	80	

Table No. 22

Treatment of 1% sulpher on Gram seeds for 24 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	10	
26/9/2009	48 hours	20	
27/9/2009	72 hours	40	
28/9/2009	96 hours	60	
29/9/2009	120 hours		

Table No. 23

Treatment of 2% Sulpher on Gram seeds for 6 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Most favourable concentration for treatment
25/9/2009	24 hours	20	
26/9/2009	48 hours	70	
27/9/2009	72 hours	90	
28/9/2009	96 hours	90	
29/9/2009	120 hours	100	

Table No. 24

Treatment of 2% sulpher on Gram seeds for 12 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	10	
26/9/2009	48 hours	20	
27/9/2009	72 hours	40	
28/9/2009	96 hours	50	
29/9/2009	120 hours	60	

Table No. 25

Treatment of 2% sulpher on Gram seeds for 24 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	10	
26/9/2009	48 hours	20	
27/9/2009	72 hours	40	
28/9/2009	96 hours	50	
29/9/2009	120 hours		

Table No. 26

Treatment of 5% sulpher on Gram seeds for 6 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Most favourable concentration for treatment
25/9/2009	24 hours	30	
26/9/2009	48 hours	40	
27/9/2009	72 hours	50	
28/9/2009	96 hours	80	
29/9/2009	120 hours	100	

Table No. 27

Treatment of 5% sulpher on Gram seeds for 12 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	10	
26/9/2009	48 hours	20	
27/9/2009	72 hours	40	
28/9/2009	96 hours	60	
29/9/2009	120 hours	70	

Table No. 28

Treatment of 5% sulpher on Gram seeds for 24 hours

Date	Germination time	Germination %	Remark
24/9/2009	Seed Treatment		Favourable
25/9/2009	24 hours	10	
26/9/2009	48 hours	30	
27/9/2009	72 hours	40	
28/9/2009	96 hours	50	
29/9/2009	120 hours	50	

Table No. 29

Treatment of 0.1% $HgCl_2$ on Gram seeds for 6 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment		Harmful
30/10/2009	24 hours	10	
31/10/2009	48 hours	20	
1/11/2009	72 hours	40	
2/11/2009	96 hours	40	

Table No. 30

Treatment of 0.1% $HgCl_2$ on Gram seeds for 12 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment		Harmful
30/10/2009	24 hours	10	
31/10/2009	48 hours	20	
1/11/2009	72 hours	30	
2/11/2009	96 hours	30	

Table No. 31

Treatment of 0.1% $HgCl_2$ on Gram seeds for 24 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment	00	Poisoning to seeds
30/10/2009	24 hours	00	
31/10/2009	48 hours	00	
1/11/2009	72 hours	00	
2/11/2009	96 hours	00	

Table No. 32

Treatment of 0.2% $HgCl_2$ on Gram seeds for 6 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment	00	Poisoning to seeds
30/10/2009	24 hours	00	
31/10/2009	48 hours	00	
1/11/2009	72 hours	00	
2/11/2009	96 hours	00	

Table No. 33

Treatment of 0.2% $HgCl_2$ on Gram seeds for 12 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment	00	Poisoning to seeds
30/10/2009	24 hours	00	
31/10/2009	48 hours	00	
1/11/2009	72 hours	00	
2/11/2009	96 hours	00	

Table No. 34

Treatment of 0.2% $HgCl_2$ on Gram seeds for 24 hours

Date	Germination time	Germination %	Remark
29/10/2009	Seed Treatment	00	Poisoning to seeds
30/10/2009	24 hours	00	
31/10/2009	48 hours	00	
1/11/2009	72 hours	00	
2/11/2009	96 hours	00	

Table No. 35

Treatment of 0.05% $HgCl_2$ on Gram seeds for 6 hours

Date	Germination time	Germination %	Remark
11/11/2009	Seed Treatment		Most favourable concentration for treatment
12/11/2009	24 hours	10	
13/11/2009	48 hours	30	
14/11/2009	72 hours	60	
15/11/2009	96 hours	80	
16/11/2009	120 hours	100	

Table No. 36

Treatment of 0.05% $HgCl_2$ on Gram seeds for 12 hours

Date	Germination time	Germination %	Remark
11/11/2009	Seed Treatment		Favourable
12/11/2009	24 hours	10	
13/11/2009	48 hours	20	
14/11/2009	72 hours	40	
15/11/2009	96 hours	50	
16/11/2009	120 hours	50	

Table No. 37

Treatment of 0.05% $HgCl_2$ on Gram seeds for 24hours

Date	Germination time	Germination %	Remark
11/11/2009	Seed Treatment		Favourable
12/11/2009	24 hours	10	
13/11/2009	48 hours	30	
14/11/2009	72 hours	40	
15/11/2009	96 hours	50	
16/11/2009	120 hours	50	

Table No. 38

Fungi in control plate for Gram

Sr.No.	Fungal forms	Control Blotter Method
1	*Alternaria dianthicola* Neergard	+
2	*A. tenuis* Auct.	-
3	*A. tenuissima* (Kunze ex. Pers) wilts.)	-
4	*Aspergillus candidus* Link ex. Fries	-
5	*A. flavipes* (Bain and Sart.) Thom and Church	-
6	*A. flavus.* Link ex Fries	-
7	*A. fumigates* Fresenius	-
8	*A. niger* Van Tieghem	+
9	*A. niveus* Blochwitz	+
10	*A. oryzae* (Ahlburg in Korschelt) Cohn.	+
11	*A. terreus* Thom.	-
12	*Drechslera qustraliensis* (Bugni.) Sub. & Jain	+

Groundnut and Gram seeds changing period and concentration of sulpher and $HgCl_2$ treatment

	Ground nut									Gram								
Sulpher Treatment	1%			2%			5%			1%			2%			5%		
	6 Hr	12 Hr	24 Hr	6 Hr	12 Hr	24 Hr	6 Hr	12 Hr	24 Hr	6 Hr	12 Hr	24 Hr	6 Hr	12 Hr	24 Hr	6 Hr	12 Hr	24 Hr
	100	80	60	100	60	50	100	80	50	100	80	60	100	60	50	100	70	50
$HgCl_2$ Treatment	0·1%			0·2%			0·05%			0·1%			0·2%			0·05%		
	6 Hr	12 Hr	24 Hr	6 Hr	12 Hr	24 Hr	6 Hr	12 Hr	24 Hr	6 Hr	12 Hr	24 Hr	6 Hr	12 Hr	24 Hr	6 Hr	12 Hr	24 Hr
	40	20	0	10	0	0	100	50	50	40	30	0	0	0	0	100	50	50

Explanation of Plate No. VI

Plate Fig. No. 11 – 12

Gram

11) Field Survey

12) Field Survey

Plate No .VI
Plate Fig.No 11 -12
Gram

(11)

(12)

Explanation of Plate No. VII

Plate Fig. No. 13 – 14

Gram

13) Field Survey

14) Field Survey

Plate No .VII
Plate Fig.No 13 - 14
Gram

(13)

(14)

Explanation of Plate No. VIII

Plate Fig. No. 15 – 16

Gram

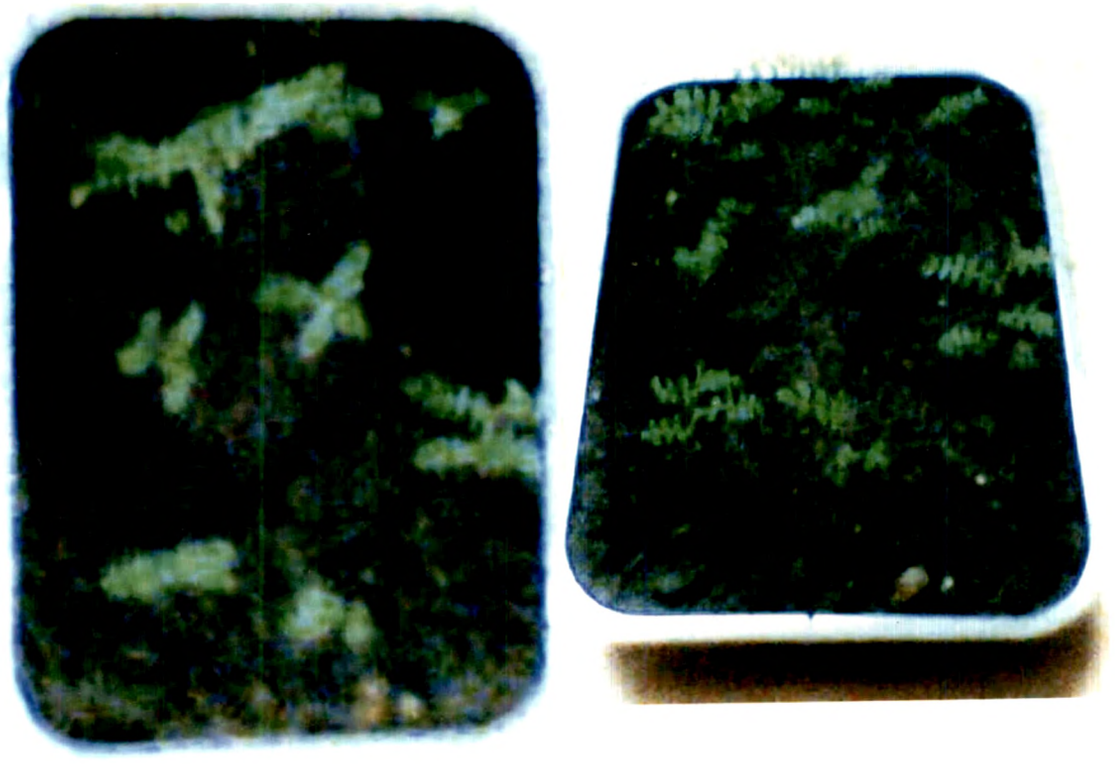
15) Treatment of 1% sulpher on gram seed for 6 hours

1% concentration for 6 hours time period for seed germination percentage maximum in *Cicer arietinum* L. is about 100%

16) Treatment of 0.1% $HgCl_2$ on gram seed for 24 hours

0.1% concentration for 6 hours time period for seed germination percentage maximum in *Cicer arietinum* L. is about 0%

Plate No .VIII
Plate Fig.No 15 - 16
Gram



(15)

(16)

Explanation of Plate No. IX

Plate Fig. No. 17 – 18

Gram

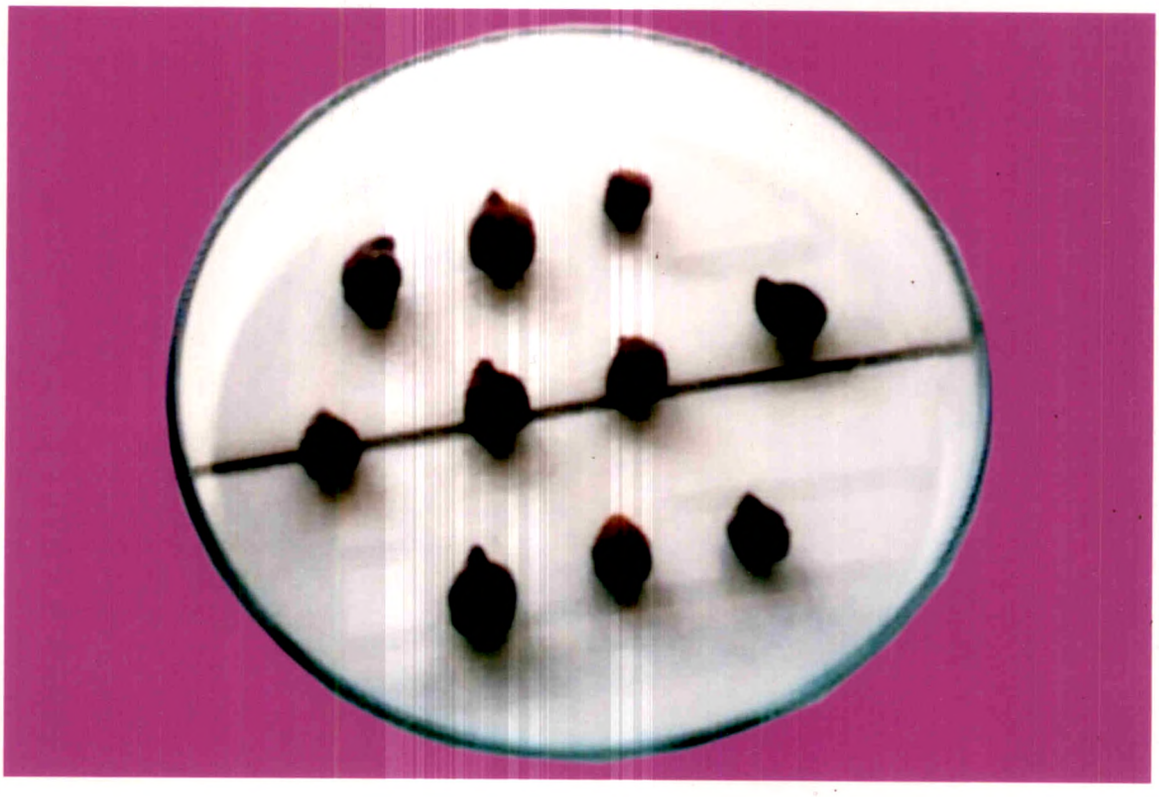
17) Treatment of 0.2% $HgCl_2$ on gram seed for 6 hours

0.2% concentration for 6 hours time period for seed germination percentage maximum in *Cicer arietinum* L. is about 0%

18) Treatment of 0.05% $HgCl_2$ on gram seed for 6 hours

0.05% concentration for 6 hours time period for seed germination percentage maximum in *Cicer arietinum* L. is about 100%

Plate No . IX
Plate Fig.No 17 - 18
Gram



17

18

Explanation of Plate No. X

Plate Fig. No. 19 – 20

Gram

19) Treatment of 0.05% $HgCl_2$ on gram seed for 24 hours

1% concentration for 6 hours time period for seed germination percentage maximum in *Cicer arietinum* L. is about 50%

20) Treatment of 0.05% $HgCl_2$ on gram seed for 6 & 24 hours

Plate No .X
Plate Fig.No 19 - 20
Gram

(19)

(20)

Explanation of Plate No. XI

Plate Fig. No. 21– 22

Gram

21) Normal and abnormal seeds

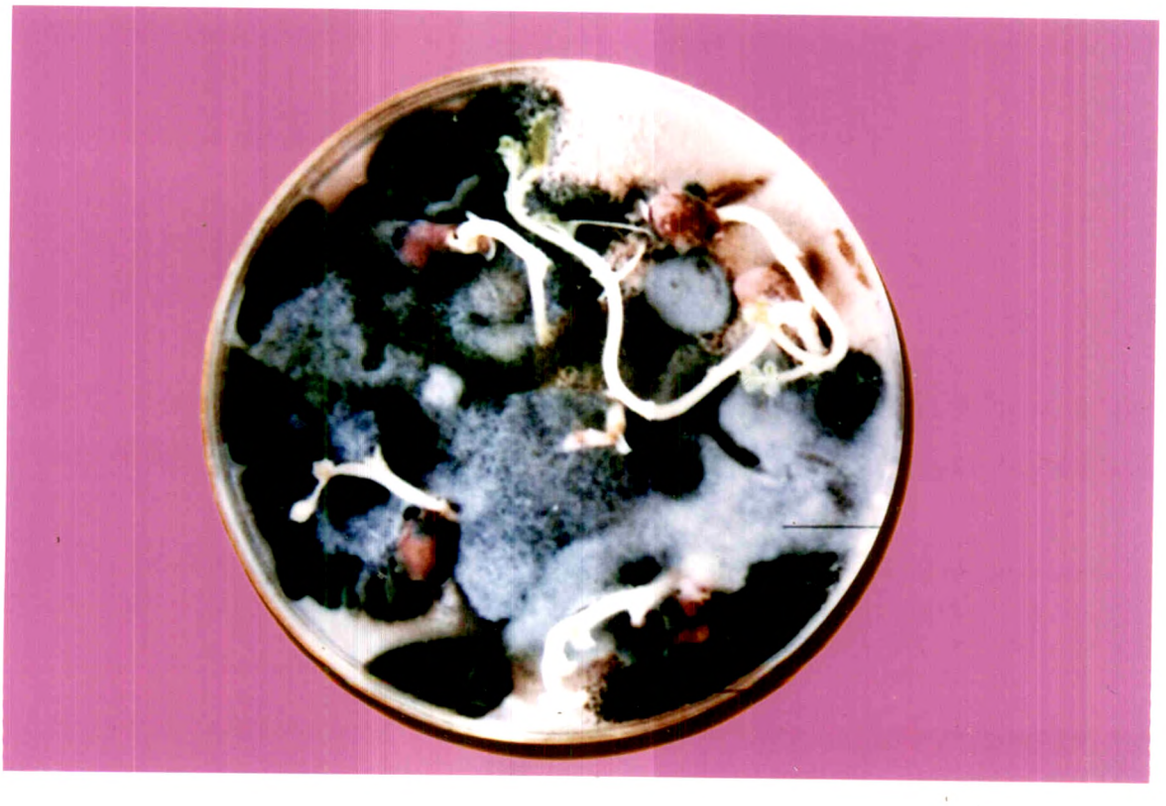
22) Control Blotter Method

1. *Alternaria* sp.

2. *A. niger* Van Tieghem.

Plate No XI
Plate Fig.No 21 - 22
Gram

(21)



(22)