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STUDIES ON PATHOGENICITY OF RHIZOME ROT OF GINGER (*GINGIBER OFFICINALIS* L.)

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In the present study four methods viz., Cork borer method, Knife injury method, Pinprick method and intact surface spray were used to evaluate the percentage of rhizome rot caused by microflora of ginger. Five test fungi viz., *Aspergillus flavus, A. nidulan, A. niger, Fusarium oxysporum, F. solani, Rhizoctonia solani* and one test bacteria *Xanthomonas* sp. were used for the study. Cent percent rot was observed in the case of bacterium inoculated rhizome by Cork borer method and Knife injury method. No rot was observed when surface sterilized rhizome was sprayed with the seven test pathogens.

Keywords: Microflora; Pathogens; Rhizome rot.

Rhizome rot of ginger occurs in India, Pakistan, Bangladesh, Srilanka, Japan and Fiji Island. In India, the disease is reported from almost all ginger growing areas but is particularly severe in South India such as in Kerala, which produce about 70% of total ginger production in the country. Rhizome rot is not confined only to the crop in the field but also causes 80-90 percent loss of corms in storage[1]. In the field, the losses may vary from 8-15 percent. However, in some low-lying infested fields there may be total loss.

Infestation by field fungi normally takes place before harvest and they generally die out during storage. Thus, they are responsible for the losses mainly in the fields. In storage, a large number of species of *Aspergillus* and *Penicillium* have generally been encountered not only from the surface of the stored commodity but also from the deeper surface. Of various fungi encountered, only few may be actively responsible for the storage decay and can thus be taken as pathogenic forms .Others behave simply as secondary invaders that may assist the actual pathogens. The present work was undertaken with a view to find out the various fungi including the bacterial species of *Xanthomonas* that were associated with the ginger rhizomes in field and storage, which are actually involved in bringing about the invasion of the tissue and cause rot during storage. The preliminary survey of the fields and storage pits of the farmers indicated that injuries during harvesting, handling and transportation were main causes of invasion by bacteria, nematodes and fungal species. The succulent nature of the stored material further helps not only in the entry of the pathogens but also in their profuse growth and sporulation resulting finally in the rapid development of the rot. The different fungi isolated from the tissues of the rhizomes thus get many opportunities to invade and spoil the harvest during the different post harvest operations.

In the present study, the fresh rhizomes were collected from the fields of Barua Sagar Jhansi, Utter Pradesh, where this crop is grown on large scale. Healthy rhizomes of almost equal size were surface sterilized using 0.1% solution of $HgCl_2$ following by three successive washings with sterilize water. These were then dipped in 90% alcohol for two minutes and again washed with sterile water and inoculated with the different internally borne organisms separately following the techniques as described below.

1. Cork borer Method[2] - Sterilized cork borer of 0.25 cm diameter was used to make a small cavity about 0.25 cm deep in the centre of the rhizome. In each cavity, a small amount of inoculum taken from the periphery of a 7 days old culture was kept and the bit of the tissue was replaced and sealed with wax.

2. Knife injury method[3] - With the help of a sterilized knife, a shallow (about 1mm deep) streak approximately 0.5 cm long was made and the inoculum from a seven days old culture was gently applied over the injured surface with the help of a sterilized spatula.

3. Pin prick method[4]- In a small area of about 0.5 square cm 10 pricks just about 1mm deep were made with the help of a sterilized pointed pin and then the inoculum was applied gently on the pin pricked surface with a sterilized spatula as above.

4. Intact Surface Spray- The surface of the sterilized rhizome that was having no injury was sprayed with the suspension of the inoculum, prepared by shaking one disc of 0.25 cm diameter of fungus taken from a 7 days old culture in 10 ml of sterilized distilled water. For *Rhizoctonia solani* the suspension of the inoculum was gently sprayed over the surface in a thin layer.Corresponding controls were also maintained .For each method rhizomes @20 per organism and 20 for each control used were taken randomly from the fresh stock. Incubation was done at 28°C temperature and the observations were recorded after 15 and 30 days. Each experiment was repeated twice. The

Table 1. Percentage of rot produced by the microflora as tested by different methods of the 15 and 30 days incubation

S.No.	Fungi	Cork Borer Method		Knife Injury Method		Pin Prick Method		Intact Surface Spray	
		15 Days	30 Days	15 Days	30 Days	15 Days	30 Days	15 Days	30 Days
1.	*Aspergillus flavus*	2.1	2.8	1.6	1.8	0	0	0	0
2.	*A .nidulans*	1.4	2.3	0.9	1.3	0	0	0	0
3	*A .niger*	18.5	53.2	11.7	46.8	2.3	3.9	0	0
4	*Fusarium oxysporum*	4.9	5.2	2.4	3.6	0	0	0	0
5	*F .solani*	4.2	4.8	1.8	2.3	0	0	0	0
6	*Rhizoctonia solani*	19.3	39.7	14.2	37.3	6.7	15.3	0	0
7	*Xanthomonas* sp.	100	100	100	100	23.5	39.6	0	0

percent rot was calculated following Prasad and Bilgrami[5].

$$\text{Percent rot} = \frac{\text{Total weight of the rotted tissue from 20 rhizomes} \times 100}{\text{Initial weight of all the 20 rhizomes}}$$

Results of the different experiments conducted for testing the pathogenicity, summarized in Table 1, indicated that with cork borer and knife injury methods all the fungi tested including the *Xanthomonas* sp. produced rot. Cent percent rot was observed in the case of bacterium inoculated rhizome just within 15 days of incubation. *Rhizoctonia solani* and *Aspergillus niger* were the two fungal species that gave appreciable rot, viz., 19.3 and 18.5% after 15 days and 39.7 and 53.2% rot at the end of 30 days incubation respectively by cork borer method, and 14.2 and 11.7% after 15 days and 37.3 and 46.8% at the end of 30 days incubation respectively with knife injury method. The remaining fungi i.e. *Fusarium solani, F. oxysporum, Aspergillus flavus, A. nidulans* gave comparatively poor results as even at the end of 30 days incubation period, the maximum rot observed was 5%. These can be categorized as weak pathogens.

With pin prick method it was observed that none of these weak pathogenic form could produce any rot even after 30 days incubation at 28°C temperature, further it was noted that the percent rot produced by *Xanthomonas sp., Rhizoctonia solani and Aspergillus niger* was also appreciably low, viz., 23.5, 6.7 and 2.3% after 15 days and 39.6, 15.3 and 3.9% after 30 days respectively.

The surface sterilized rhizomes when inoculated by applying the inoculum gently on the apparently uninjured surface exhibited no rot by any of the seven pathogen, thus proved their wound parasitic nature by all these. Hence, the pathogens require some sort of mechanical injury as pre requisite for initiating their activity. Role of wounds in bringing about the post harvest infections in fruits has been emphasized by several workers[6-13]. According to them, some sort of mechanical injury is necessary for successful entry of the pathogen.

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