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*Research Paper*

# Survey of Rhizome Rot and Wilt Disease Incidence of Ginger in Major Growing Area of Darjeeling Hill, India

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Ginger production in major growing areas of Darjeeling hills, West Bengal, India during recent years has suffered tremendously. As it is annual crop and needs very less care with high economic return, it is popular among low income group of farmers. Rhizome rot disease caused by fungi (*Pythium* spp., and *Fusarium oxyporium* f. sp. *zingiberi*) and bacteria [*Pseudomonas* (*Ralstonia*) *solanacearum*] are the major problems all over ginger growing areas of India. The main reason being the occurrence of disease having complex etiology and so far a very little work has been done in this regards. The basic information viz. quantification of disease incidence in the region, symptoms type and its distribution, cropping patterns and other agronomic practices, time of initiation of the disease etc. The key information for formulating effective management strategies are lacking. So, a survey was undertaken during the year 2005 and 2006 in ginger growing area to gather the basic information as well as to collect plant and soil samples from ginger fields for further study. About 80-84 % of the plots suffered from the disease severely during both 2005 and 2006 ginger growing season. From the survey, it was observed that June- July was the most vulnerable period for initiation and spread of the disease and the less incidence of the disease were noticed if the disease initiates after the second fortnight of July. Further, it was also observed that more than 3-4 years crop rotation coupled with cultivation of buckwheat, coarse cereals and cruciferous crops as preceding crop was found to be a better option for management of rhizome rot and wilt disease complex of ginger.

**Key Words:** Ginger, Rhizome rot and wilt, disease survey and Darjeeling hill.

## INTRODUCTION

Ginger (*Zingiber officinale* Rosc.) rhizomes are basically Indian spice used for cooking as well as for alternative medicines. It is used for culinary purpose not only in India but to prepare some continental dishes in all over the world. Also an important commercial crop grown for its aromatic rhizomes which are used as a spice and medicine (Sharma et al., 2010). It is cultivated in almost all the tropical and subtropical parts of India. India is the

largest producer of ginger in the world accounting for about one-third of the total world output followed by Thailand and Japan. It is an important crop that earns a sizeable amount of foreign exchange for the country (Tarafdar and Saha, 2007).

The eco-crop model of DIVA – GIS indicated that Orissa, West Bengal, North-eastern states and Kerala are environmentally most suitable for ginger cultivation (Utpala et al., 2006).

Total area under ginger cultivation in West Bengal is about 8.01 thousands hectares with a production of 16.66 thousands tones (Shanmugavelu et al., 2002) of which hilly region of Darjeeling district occupies only 1.1 thousands hectares having a total production of 9.68 thousands tones (Anonymous, 1982). Ginger cultivation in Darjeeling hills has started since long back probably from the days of unrecorded history. The area during these days has experienced a tremendous decline in the acreage and productivity of ginger due to the occurrence of disease having complex etiology involving fungi, bacteria and nematodes.

The disease complex caused by fungi, bacteria and nematodes are the major problems in ginger cultivation all over the ginger growing areas of India. Diseases are important production constraints of ginger and often associated with *Ralstonia solanacearum*, *Pythium* spp., *Fusarium oxysporum* and *Pratylenchus coffeae* (Rajan et al., 2002 and Stirling et al*.,* 2009). The crop suffers from several diseases among them bacterial wilt (*Ralstonia solanacearum)* is a serious problem in Kerala and North-East region of the country especially in Sikkim and West Bengal (Sarma and Anandaraj, 2000). Rhizome rot (also known as soft rot) is one of the most destructive diseases of ginger worldwide (Dohroo, 2005), with losses of 50–90% (Nirmal, 1992). Overall, disease severity in West Bengal is 1.05-25% (Chatterjee et al., 1997), but in Darjeeling district this disease appears in its severe form frequently causing total loss of the crop. Successful control measures for this disease complex are still limited due to the complex epidemiological factors of the pathogens, a wide range of host plants, interaction with parasitic nematodes, and environmental factors such as high rainfall and favourable temperature and humidity in the hilly agro-ecological region that favour the development of the pathogen. However, certain agronomic practices viz. field sanitation, crop rotation, removal and destruction of weeds/ alternate host, selection of healthy seed materials for planting, good drainage etc. will be very helpful in minimizing the pathogen load in the field or in a particular environment thereby minimize the extent of crop loss by this disease complex. Weeds that grows in and around ginger field consistently harbour high populations of bacterial wilt pathogen and may serve as an alternate host, and indicator plant for, this pathogen (Shintaku, 2006). In case of tomato wilt bacterial population declined after cowpea and rice, but not after eggplant. The population also declined after soil was left fallow, indicating that a suitable host plant is required to maintain the bacterial population (Michel et al., 1996).

The lower rhizome rot incidence in Wanjoo area of Korea Republic is thought to be associated largely with the cultivation practice that is unique in those areas where ginger and paddy are rotated in the paddy field. Attributes, such as first year cultivation of upland paddy, crop rotation, rain-protected cultivation, underground tube irrigation, sandy loam soil, good drainage, steeply inclined cultivation site and planting of disinfected or healthy seed rhizome resulted in lower disease incidence (Kim et al*.,* 1996).

Inter cropping ginger with capsicum resulted in 76 % control of yellows disease of ginger (Dohroo et al*.,* 1997). Hence, in addition to the quantification of disease incidence in the region, the present study was carried out also to find certain agronomic practices adopted by the farmer that has a bearing with the extent of disease outbreak.

## MATERIALS AND METHODS

Under the aegis of Regional Research Station (Hill zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong, a real time basis fixed survey was conducted to study the relative incidence of rhizome rot and wilt disease complex of ginger at 15 days interval.

The survey was undertaken in 96 plots from 14 different villages and 103 plots from 12 different villages of Kalimpong sub-division under Darjeeling District of West Bengal during May-October in the years 2005 and 2006, respectively. The detailed locations of area surveyed have been presented in (Table 1a and 1b), respectively. The different parameters like severity of rhizome rots and wilt disease complex, associated pathogen with the disease complex, symptomatology, crop rotation and cropping pattern, variety grown, seed rhizome size and its source, practice of seed treatment and mother rhizome extraction, nutritional and disease management practices and disease progress during monsoon months and their relevance to the disease incidence were also studied in detail. Infected rhizomes, plants and rhizospheric soil from the surveyed locations were collected for isolation and enumeration of the pathogen following standard method. In all the surveyed plots, the data related to the relative disease incidence of rhizome rot and wilt disease complex of ginger in 2 $m^2$ marked area of 5 different locations of farmers field were recorded at 15 days interval, starting from May onwards. For assessing the effect of time of initial occurrence on rhizome rot and wilt disease incidence of ginger, the data were recorded at 7 days interval in 14 different locations. Plots showing above 50 % diseased plant were rated as high, below 50 % but above 20 % as medium and below 20 % as low in disease incidence. Absence of any

**Table 1a.** Relative incidence of rhizome rots and wilt disease complex of ginger as estimated in the year 2005.

| Block/Sub-division | Village cluster | No. of Plots | No. of plots rated in disease incidence as reported by farmers | | | |
|---|---|---|---|---|---|---|
| | | | H | M | L | N |
| Kalimpong | Bhalukhop | 12 | 4 | 6 | 1 | 1 |
| Subdivision | Bhagey | 5 | 3 | 2 | 0 | 0 |
| | Sangsey | 5 | 1 | 2 | 2 | 0 |
| | Takling | 10 | 6 | 3 | 1 | 0 |
| | Soreng | 6 | 0 | 1 | 2 | 3 |
| | Upper Menchu | 8 | 3 | 4 | 1 | 0 |
| | Sakyong | 5 | 2 | 2 | 1 | 0 |
| | Samdong | 6 | 4 | 2 | 0 | 0 |
| | Upper Dalep | 5 | 3 | 2 | 0 | 0 |
| | Kagey | 12 | 6 | 5 | 1 | 0 |
| | Daragaon | 7 | 5 | 1 | 1 | 0 |
| | Faper Khetti | 5 | 2 | 2 | 1 | 0 |
| | Ambiok | 4 | 3 | 1 | 0 | 0 |
| | Gorubathan Tar | 6 | 6 | 0 | 0 | 0 |
| Total | | 96 | 48 | 33 | 11 | 4 |
| Percent of Total | | | 50 | 34.4 | 11.5 | 4.2 |

H = High (Above 50% disease incidence) ; M = Medium (20-50% disease incidence) L = Low (Less than 20 % disease incidence); N = No disease.

**Table 1b.** Relative incidence of rhizome rots and wilt disease complex of ginger as estimated in the year 2006.

| Block /Sub-division | Village cluster | No. of Plots | No. of plots rated in disease incidence as reported by farmers. | | | |
|---|---|---|---|---|---|---|
| | | | H | M | L | N |
| Kalimpong | Bongbusty | 15 | 7 | 3 | 3 | 2 |
| Subdivision | Bhalukhop | 12 | 7 | 3 | 2 | 0 |
| | Sangsey | 6 | 2 | 1 | 2 | 1 |
| | East Paiyoung | 13 | 5 | 4 | 3 | 1 |
| | Munsoong | 8 | 7 | 1 | 0 | 0 |
| | Chisopani | 6 | 3 | 2 | 1 | 0 |
| | Deorali | 9 | 6 | 2 | 0 | 1 |
| | Sukbir Khani | 10 | 7 | 2 | 0 | 1 |
| | Lingsey | 6 | 2 | 2 | 1 | 1 |
| | Nimbusty | 7 | 6 | 1 | 0 | 0 |
| | Kuapani | 6 | 4 | 2 | 0 | 0 |
| | Malbusty | 5 | 3 | 1 | 1 | 0 |
| Total | | 103 | 59 | 24 | 13 | 7 |
| Percent of Total | | | 57.3 | 23.3 | 12.6 | 6.8 |

H = High (Above 50% disease incidence) ; M = Medium (20-50% disease incidence) L = Low (Less than 20 % disease incidence); N = No disease.

diseased plant in the plot rated as nil for disease incidence.

## RESULTS AND DISCUSSION

The survey was undertaken to study the relative incidence of rhizome rot and wilt disease complex at different ginger growing locations in Kalimpong sub-division of Darjeeling district of West Bengal during the most vulnerable period of the crop i.e. the peak of monsoon season (May to October) of the years 2005 and 2006. Incidence of the disease in each of the surveyed plot was estimated and designated as high / medium / low disease incidence area based on percent of disease infected plants. About 50-57.3 % of the plots were rated as high, 23-34 % as moderate, 11.5-12.6 % as low and about 4-7 % showed no disease incidence during both years in Kalimpong subdivision (Table 1a and 1b). Considering high and medium classes together, 80-84 % of the plots appeared to suffer from the disease severely during both years 2005 and 2006 ginger growing season.

**Table 2.** Studies on disease incidence, symptom types and rotation duration under surveyed villages of Kalimpong sub-division.

| Locations | Disease incidence (%) | Symptom types | Previous crop taken | Rotation followed (Year) |
|---|---|---|---|---|
| Bhalukhop | 48 | Wilting,Yellowing and wilting, | Maize, Rice, Bean, Raddish, Potato | 2-3 |
| Bhagey | 65 | Wilting, Yellowing and wilting. | Maize, Potato, Solanaceous Vegetables, Colocasia | 1-2 |
| Sangsey | 32 | Wilting, Yellowing and wilting, | Buckwheat, Maize Cowpea, Kodo millet, Mustard | 3-4 |
| Takling | 59 | Wilting, Yellowing and wilting, Yellowing. | Ginger intercropped with orange, Potato, Maize | 1-2 |
| Soreng | 10 | Yellowing and wilting. Yellowing | Finger millet, Buckwheat, Mustard, Raisag Maize | 4-5 |
| Upper Menchu | 51 | Wilting, Yellowing and wilting. | Tomato, Beans, Potato, Maize | 1-2 |
| Sakyong | 45 | Wilting, Yellowing and wilting, | Mustard, Wheat, Maize, Cowpea | 2 |
| Samdong | 60 | Wilting, Yellowing and wilting. | Tomato, Maize, Chilli | 1-2 |
| Upper Dalep | 60 | Wilting, Yellowing and wilting, Yellowing | Bean, Pea, Maize, Potato | 1-2 |
| Kagey | 56 | Wilting. | Potato, Maize, Chilli, Kodo millet, Rice, Cabbage. | 2 |
| Daragaon | 61 | Wilting, Yellowing and wilting. | Maize, Beans, Potato, Solanaceous Vegetables | 1-2 |
| Faper Khetii | 52 | Wilting, Yellowing and wilting. | Maize, Kodo millet, Tomato, Raisag | 2 |
| Ambiok | 66 | Wilting. | Maize, Potato, Chilli, Tomato | 1-2 |
| Gorubathan Tar | 75 | Wilting, Yellowing and wilting. | Maize, Potato, Chilli, Tomato, Yam | 1 |
| Average | 52.86 | | | |

**Table 3.** Effect of time of initial occurrence on rhizome rots and wilt disease incidence of ginger in surveyed villages of Kalimpong sub-division.

| Locations | Diseases incidence (%) | Initiation of disease |
|---|---|---|
| Bhalukhop (Location IV) | 40.2 | 2nd week of July |
| Bhagey (Location III) | 61.4 | 3rd week of June |
| Sangsey (Location IV) | 25.6 | 3rd week of July |
| Takling (Location III) | 57.2 | 4th week of June |
| Soreng (Location II) | 13.2 | 4th week of July |
| Upper Merchu (Location VII) | 52 | 2nd week of July |
| Sakyong (Location III) | 40.2 | 3rd week of July |
| Samdong (Location V) | 52.5 | 1st week of July |
| Upper Dalep (Location I) | 55.4 | 1st week of July |
| Kagey (Location IV) | 47.9 | 4th week of June |
| Daragaon (Location II) | 53.8 | 1st week of July |
| Faper Khetii (Location II) | 50.9 | 1st week of July |
| Ambiok (Location III) | 64.9 | 4th week of June |
| Gorubathan Tar (Location VI) | 70.1 | 3rd week of June |

Only 4-7 % of the surveyed plots escaped the disease under Kalimpong sub-division of hill agro-ecological region. Thus from the present investigation it may be concluded that rhizome rot and wilt disease complex was the most important biotic stress of ginger under hill agro-ecological region. Again, the study was also conducted in the year 2005 for identifying the locations having different level of rhizome rot and wilt disease complex incidence from 14 different villages of Kalimpong sub-division (Table 3). Low level of disease incidence was observed in different plots under Soreng village and moderate levels of disease incidence were observed in Sangsey, Sakyong and Bhalukhop villages, whereas higher levels of disease incidence were noticed from the rest of the surveyed villages (Table 2). Low to moderate disease incidence were recorded in the ginger plots having

preceding crops like buckwheat, coarse cereals and cruciferous crops, whereas the plots having preceding crops of solanaceous vegetables, potato, yam showed higher levels of disease incidence.

Moreover, it was also observed that lower disease incidence was recorded in the villages where longer crop rotation was followed. It was also noticed that the disease incidence was high in the villages where only 1-2 years crop rotation was followed. Thus, from the present investigation it may be concluded that more than 3-4 years crop rotation coupled with cultivation of buckwheat, coarse cereals and cruciferous crops as preceding crop was found to be a better option for management of rhizome rot and wilt disease complex of ginger.

The survey was also conducted during May to October 2005 to notice the time of initial occurrence of rhizome rot and wilt disease complex at specific location. The disease symptoms were first observed during June - July at different locations (Table 3). Higher incidence of the disease was observed in the plots where initiation of the disease occurred during second fortnight of June.

## CONCLUSION

The survey results thus indicated that June- July was the most vulnerable period for initiation and spread of the disease and the less incidence of the disease were noticed if the disease initiates after the second fortnight of July. More than 3-4 years crop rotation coupled with cultivation of buckwheat, coarse cereals and cruciferous crops as preceding crop was found to be a better option for management of rhizome rot and wilt disease complex of ginger.

## AUTHORS` DECLARATION

We declare that this study is an original research by our research team and we agree to publish it in the journal.

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