

Management of Ginger (*Zingiber officinale* Rosc.) Rhizome Rot in Darjeeling and Sikkim Himalayan Region

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Introduction

Ginger (*Zingiber officinale* Rosc.) is important cash in Darjeeling and Sikkim Himalayan region. As it is annual crop and needs very less care with high economic return, it is popular among low income group of farmers. It is widely cultivated and has ready market in the village level in this region. Rhizome rot disease caused by fungi (*Pythium* spp., and *Fusarium oxysporium* f. sp. *zingiberi*) and bacteria [*Pseudomonas* (*Ralstonia*) *solaniserum*] are the major problems all over ginger growing areas of India. Hayward 1994 also reported the bacterial wilt from China, Indonesia, Malaysia, and Thailand. The pathogen outbreak in Australia during 1960s were subject to strict quarantine and other control measures and it is believed that *Pseudomonas* (*Ralstonia*) *solaniserum* bio-var 4 is eradicated now from this country. There was decline of 6.7% in national production in India 1994-95 as compared to that of 1993-94 mainly due to rhizome rot disease. Many cultivars and local races are facing the threat of extinction for many reasons other than disease.

Rhizome Rot Management

Rhizome rot is a complex problem caused by multiple factors. The important pathogens causing rhizome rot of ginger are discussed below. Beside pathogens, the acidic soil condition of the soil is another important factor for the disease. September onwards there will be little loss since by then temperature goes down and the rainfall is almost stopped.

Bacterial Wilt:

The bacterial wilt is the most important diseases of all and is very serious. 95% of the ginger growing areas are infected with this disease in both Darjeeling and Sikkim Hills. It is very easy to identify and spreads very fast. The infection starts with wilting symptom of leaves without getting

yellow colouration and as the disease progress, leaves droops down and within two days topples down producing petrifying smell (Fig. 1). It spreads very fast and is caused by bacteria *Ralstonia (Pseudomonas) solaniserum*. The infected plant rhizome also gets rotted and smells very bad. It gives milky ooze from seriously infected plants (Chart No. 1).

Fungal Diseases

The fungal or yellowing of ginger is another important disease and found to occur in both Darjeeling and Sikkim Hills. Like bacterial wilt it also spreads very fast. The plant infected with this disease looks yellow which starts from the lowermost leaf on the leaf margins that progress very fast to the upper leaves (Fig. 2). Usually it occurs with bacterial wilt but can be easily identified with that of wilting. Like bacterial wilt, it cannot be identified in the seed rhizome. The disease is caused by fungi *Fusarium oxysporium* and *Pythium* sp. *Pythium* sp. usually appears along with the bacterial wilt causing soft rot. *Fusarium* is invariably associated with nematode *Pratylenchus* and results in storage losses.

Nematode Problem

In Darjeeling and Sikkim Hills, 54% of seed rhizomes are contaminated with nematode (*Pratylenchus* sp.). Seed, roots, rhizome and rhizosphere soil are infected with nematode. Unlike other pathogenic organisms, it is very difficult to identify the plants infected by nematodes. Occasionally infected plants show stunted growth with burning/drying at the leaf tips. The plants may also show root knot or root hairs. But the seed rhizomes infested with nematode can be identified which looks shrivelled with sunken or swollen patches on the skin surface.

Management Practices

- (i) When an infected field is harvested in December, implements used like, Darjeeling Fork, spade, basket (doko) etc. must be thoroughly washed before storing/using in another field.
- (ii) Do not allow anyone to enter the field
- (iii) To kill the pathogens in wet field (khet), the water is allowed to remain there continuously for 30 days, which ensures the complete eradication of the pathogens.
- (iv) As far as possible, use own seed materials and always avoid burrowing and purchasing from the market or neighbourhood
- (v) Maintain proper drainage in the field
- (vi) The seed rhizome may be given chemical treatment before planting with systemic fungicides like Carbendazim 0.2% for 30 minutes for fungal diseases
- (vii) The nematodes can be managed by giving seed rhizomes hot water treatment at 51°C for 10 minutes before planting (Fig. 3).
- (viii) Soil application of furadon or neem cake before planting also takes care of nematodes

Biological and other Management Practices

Tricoderma spp. Can be used along with the FYM that helps in reducing disease incidence. Seed rhizomes can be solarised by keeping 'ready for planting seed rhizome pieces' inside the polythene for two hours. The temperature of the seed rhizomes so placed inside the polythene slowly increases up to 45°C and the bacteria (*Ralstonia solaniserum*), which are thermo sensitive are killed. This method ensures the reduction of inoculum level inside the rhizome. While solarising, seed rhizomes are thinly spread for uniform exposure to sunlight. The germination is affected if it is exposed for more than two hours. But again like soil solarisation, the intensity of heat is less in the hills and two hours may or may not be sufficient to kill the bacteria. This method is still under experiment.

Important Precautionary Measures for Prevention of Disease

The most important precautionary measure for prevention of disease is the use of healthy seed for planting. Secondly selection of land has to be done properly and sloppy land where water does not get stagnant must be selected. If the sloppy land is not available and one wishes to cultivate ginger on either upland or wetland, it has to be planted in raised beds with proper drainage system. Crop rotation within three to four years is a must. The plots where disease appeared before, always avoid cultivation of ginger in the same plot. If the field is infected earlier by bacterial wilt, it is advisable to cultivate paddy after which certified ginger seed can be cultivated because the bacterial pathogens cannot survive in places where water continuously remain for more than 30 days. The beds must be raised at least 10 inches high and it is better to have only three rows in a bed. The seeds sold in the market are mostly infected with the disease and such seeds must not be planted. The seeds from the infected field should never be used. It is always better to grow own seed in own land. To identify a healthy seeds one has to identify whether the seeds have healthy roots, robust, thick, well filled with good eyes, without shrinkage and spots, eyes should not be rotted and should not be watery. The field must be inspected regularly for the disease appearance and more often when it rains.

Mother rhizome extraction has to be done carefully without disturbing the root and the baby rhizome. It is advisable to plant smaller pieces of seed rhizome avoiding mother rhizome extraction. After mother rhizome extraction, beds must be earth up. Weeding must not be done during rainy days. While inspecting the healthy plants/plots must be marked and kept for planting in the next season. Marking has to be done properly otherwise when plant matures and gets dried up, it will be very difficult to find out the marked plots. The remaining plots can be sold out.

Soil Amendments for correcting soil pH

The soil pH correction is very essential as the availability of the macro and micro nutrients depends on the pH of the soil. Soil reaction is the most important single chemical characteristic influencing many physical and chemical properties of soil. Plant growth and microorganism activities depend upon the soil reaction and the factors associated with it. The places that are far off can use agricultural lime to minimise the expenses on carrying and transportation. The quantity of lime application in a particular field/land depends on the existing soil pH and for increasing one unit of soil pH, 4 quintals of lime or 8 quintals of dolomite has to be applied per acre. It is broadcasted on the soil and the land is ploughed for turning soil upside down. While applying, the following points must be considered.

1. Liming should never be done during rainy season
2. It has to be done 30 days before planting *i.e.*, one cannot plant anything within 30 days of lime/dolomite application in the soil

3. Soil must contain sufficient moisture for proper reaction with lime/dolomite

Cultivation of ginger following the above mentioned technique, one can avoid rhizome rot disease and enhance the production as well.



Fig. 1: Bacterial wilt infected ginger plant



Fig. 2: Fungal disease in ginger



Fig. 3: Hot water treatment of ginger seed rhizome