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Mini Review

Evaluation and Selection of Different Management Practices of Ginger Rhizome Rot

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Abstract

Ginger (*Zingiber officinale Rosc*.) is one of the commercial spice crop grown whose underground part Rhizome is used as spice. In Ginger, Rhizome rot is the most destructive disease that causes economic damage of 50-90% to the crop. Nepal is the 4th largest producer of Ginger but this disease limits the yield, productivity and marketable Rhizomes. Ginger Rhizome rot is a complex disease incited by more than 24 pathogens among them *Pythium apahidermatum*, *Pythium myriotylum* (11 sp. of *Pythium*), *Fusarium oxysporum f. sp. zingiberi and Ralstonia solanacearam* are the major pathogens. Application of systemic chemical pesticides such as Ridomil MZ (0.2%), Bavistin 0.1%, Apron 35 WS, Dithane M 45, Metalaxyl, Chlorox (10 %), Copper oxychloride 0.3% effectively control the disease but results in the serious risk in the human health and environmental hazards. Therefore, an alternative approach that are eco-friendly and economically viable effective management approach are developed. These approach includes improve cultural practices, physical method, Biological methods and Nano-technology that effectively control the soil as well as seed borne pathogens that causes Rhizome rot diseases. This review is aimed to discuss various effective disease management practices that are being developed from research innovations and methods practiced in different part of world.

Keywords: Ginger; Pythium; Rhizome rot; *Trichoderma*

Introduction

Ginger (*Zingiber officinale*) is a spice crop whose rhizome, ginger root or ginger, is widely used as a spice and a folk medicine (Ginger, 2006) It is a herbaceous perennial which grows annual pseudo stems (false stems made of the rolled bases of leaves) about a meter tall bearing narrow leaf blades. The inflorescences bear pale yellow with purple flowers and arise directly from the rhizome on separate shoots (Sutarno et al., 1999). Ginger is one of the important cash crops for the small farmers in Nepal. Ginger (*Zingiber officinale Rosc*) is among the important and widely used spice crops throughout the world.

Globally, Nepal is the fourth largest ginger producer after China, India and Indonesia (Poudyal, 2011). In FY 2016/17, Nepal's total ginger production was 279504 MT, out of which about 60% was exported (MOAD, 2018). India is the main export market for Nepalese ginger and accounts for close to 94% of Nepal's fresh ginger export and six percent of processed ginger (NMDP, 2016)

Ginger is affected by a number of diseases. Of them, rhizome rot caused by *Pythium aphanidermatum*, *Pythium myriotylum* is the most prevalent and damaging one. Rhizome rot may reduce 50% Rhizome production (Poudyal, 2012). According to ANSAB (2011), rhizome production has been reduced upto 70% due to rhizome rot infestation in Nepal (ANSAB, 2011). If rhizome rot is not controlled properly it may cause complete crop failure after few year of continuous infections.

The pathogen of the disease is both seed and soil-borne and causes huge damage if congenial condition prevails during the growing period. The tip of the leaves turns yellow and the chlorosis proceeds downwards ultimately resulting in withering and death of the leaf. The foot of the plant and the rhizomes turn pale. Watery and soft appearance becomes evident on just above the ground level. The rhizomes gradually decompose turning into a decoying mass of

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tissues enclosed by the comparatively tough rind (Singh, 1978), which causes serious yield reduction. Literatures indicate that the disease can be managed by adopting organic amendments, fungicides and using antagonist in abroad (Sharma, 1991; Ram, 1999 & 2000).

Status of Ginger

Disease Havoc on Ginger

Various diseases are prevalent on Ginger. Among various diseases Rhizome Rot, Bacterial wilt, *Fusarium* yellows, Root-Knot nematode, *Pythium* soft rot, Bacterial soft rot, Sunburn, lime induced chlorosis etc are major. Rhizome rot may reduce 50% Rhizome production (Poudyal, 2012). According to ANSAB (2011), rhizome production has been reduced upto 70% due to rhizome rot infestation in Nepal (ANSAB, 2011). If rhizome rot is not controlled properly it may cause complete crop failure after few year of continuous infections.

Management Practices of Rhizome Rot

There are various management practices of Rhizome rot of ginger. Various researches are being carried out to find out the appropriate management practices of the prevalent disease in Nepal as well as other countries.

Cultural Control

Cultural control is particularly most important in the management of this disease. It is the only practical way to manage it:

Site

Small beds should be used with adequate drainage around the bed either on flat ground or on a slope, so that the plants in the beds are isolated if soft rot occurs and the disease does not get transmitted to healthy ones (Acharya and Regmi, 2015). Rainwater can wash spores in the soil from "diseased" fields to the new healthy crop (Trujillo, 1964).

- **Crop Rotation**: As Ginger, taro (*Colocasia*), giant taro (*Alocasia)*, beans and capsicum are susceptible to the Rhizome rot pathogen, should not be planted in the same field. Crop susceptible to rhizome rot should be rotated at least for 4 years with the crops such as Plant cassava, rice, maize, and yam which do not suffer from soft rot (Jackson, 2017; Pordesimo and Raymundo, 1963).
- **Source of seed**: The seed i.e. Rhizome of Ginger should be free from rhizome rot (Dake, 1995). The ginger Rhizome obtained from neighbours should not be used as the seed unless it was monitored for soft rot.
- **Weeds**: Field should be kept weed free, as many of the weeds are the hosts of the pathogen.
- **Use of resistant variety:** ZO-16 variety of ginger was found to be resistant against Rhizome rot disease in the experiment on screening of different varieties of ginger against Rhizome Rot disease in Orissa and Maran (Senapat & Ghose, 2005; Paily, 1973).
- **Mulching: Mulching:** Das (1999) showed that the plots mulched with neem (*Melia azadirachta*) leaves (2.5 kg/m^2) were completely free from rhizome rot (*P. aphanidermatum*).
- **Soil P^H:** The fungus prefers the acidic P^H

Biological Control

- *Trichoderma koningii, Trichoderma virens, Trichoderma harzianum and Trichoderma viride* were found to grow quickly and dominate the causal organism of Rhizome Rot, *Pythium spp* within 15 days resulting in the prevention of disease (Kannahi *et al*., 2016; Gupta *et al*., 2010).
- As Rhizome Rot is caused by *Pythium* and *Fusarium* species which are seed borne as well as soil borne pathogen. Research revealed that Hot water treatment of Rhizome at 50°C temperature for 10 min results in eradication of pathogenic fungus. Similarly, *Trichoderma herzianum* was found to be inhibited minimum at that temperature of Hot water as compared to *T. hamatum and Streptomyces spp* and more effective Bio-control agent for pathogenic fungal inhibition (Thakur *et al*., 2017; Navanath, 2018; Acharya *et al*., 2016).
- *Trichoderma harzianum, T. viride, Azadirachta indica* and *Agave americana* were found to be most effective in reducing mycelial growth of *Fusarium oxysporum* f sp. zingiberi Trujillo and *Pythium aphanidermatum* among the different bio-control agents in the research conducted in Himanchal of India preventing the incidence of disease (Sharma, 1998).
- Fresh and fermented extract of *Nicotiana tabacum* and Jeevatu (5%) (a mixed product of beneficial microbes) followed by (onion+garlic+chili) + urine (1:3) fermented extract was found to be effective in reducing disease incidence and diseased rhizome yield and increasing the fresh rhizome yield, Tillers per clump, plant height etc (Acharya *et al*., 2016).
- By placing the Rhizome inside polythene and placing under sunlight results in slowly increase in the temperature upto 45°C for 2 hrs resulting in elimination of thermo sensitive pathogens like Pathogen but precaution should be followed as more than 2 hrs results in the declined germination percentage of Rhizome (Rai *et al*., 2006).
- 10-15 days before sowing, *Trichoderma* sp. @2.5kg/50kg farmyard manure/ha should be applied to control *Pythium* and fertilize the soil or, apply neem-cake to the field at 200 kg/ha.

- The combinations of *Boerhaavia diffusa* leaves and powder of *Azadirachta indica* seeds were applied into soil at the time of land preparation, which ultimately reduced infection intensity of *Pythium* in ginger up to 89% as compared to untreated control (Gupta *et al*., 2013).
- Macrolichen *Usnea pictoides G.Awasthi* (Parmeliaceae) was found to inhibit the growth of *Fusarium oxysporum f.sp. zingiberi* and *Pythium aphanidermatum* resulting in the control of rhizome rot disease to some extent (Vinayaka *et al*., 2014).
- *Pythium apahidermatum* and *Fusarium oxysporum* f.sp. *zingiberi* fungus were found to be inhibited >50% by 40% concentration of cow urine (Rakesh *et al*., 2013).

Chemical Control

- Cabriotop (Pyrachlostrobin (5 %) + Matiram (55 %)) @ 3 g/L followed by Blitox 50 WP @ 2 g/L water, was found to most effective in increasing plant growth and reducing disease severity of rhizome rot of ginger (Hosain *et al*., 2018) in the experiment conducted at the Plant Pathology Research Field of Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh.
- Soil application of fungicides like metalaxyl (fosetyl-aluminum/Ridomil) which can be drench alone or in combination with other fungicides such as Apron 35 WS and Dithane M 45 is found to be best to control rhizome rot caused by *Pythium* (Ramachandran *et al*., 1989; Chase *et al*., 1985; Hwang *et al*., 2001).
- The Rhizomes or seed should be dipped in Ridomil MZ (0.2%) + Bavistin 0.1% or Topsin M (0.2%) for 20 minutes and air dried before planting has been found most effective for disease management with highest fresh rhizome yield, lowest disease severity and least rhizome production (Elliott, 2003; Acharya *et al*., 2016).
- Chemical treatment of ginger Rhizome with systemic fungicides like 0.2% for 30 minutes before planting results in prevention of fungal diseases.
- A major insect of ginger, Rhizome fly (Calobata spp.) which is found to be associated with rhizome rot of *Pythium* sp. can be managed by applying Chloropyrifos 20 EC (insecticide) + Diathane M-45 (Mancozeb 80 WP) and Bavistin (Carbendazim 50 DF) (both pesticides) (Gautam and Mainali, 2016).
- The disease incidence was found to be lowest (5.98 %) using seed treatment with Ridomil gold (0.2%) and its 2 times soil drenching followed by seed treatment with Chlorox (10 %) (Islam *et al*., 2017).
- Copper oxychloride @0.3% treatment for 30 minutes and air dried before sowing of rhizome effectively suppressed the disease development (5.16%) at 150th day after planting in the field (Lalfakawma *et al*., 2014).
- Metalaxyl or phosphorus acid if regularly applicated can control the soft rot of ginger.

Conclusion

As Rhizome rot is one of the serious disease of Ginger reducing the production upto 70%, So proper management strategies should be followed. Among the various management approaches of the disease, eco-friendly and economically viable effective management approach are developed. These approach includes improve cultural practices, physical method, Biological methods and Nano-technology that effectively control the soil as well as seed borne pathogens that causes Rhizome rot diseases. If the disease is not controlled by the above approach lastly chemical approach of disease management should be followed which includes applications of systemic chemical pesticides such as Ridomil MZ (0.2%), Bavistin 0.1%, Apron 35 WS, Dithane M 45, Metalaxyl, Chlorox (10 %), Copper oxychloride 0.3%. If these approaches of disease management are done, then this prevalent disease can be effectively managed.

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