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Jeevatu: One of the Best Bio-Agents for the Control of Soft Rot of Ginger

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Abstract. Nepal occupies third position in the world in terms of ginger production after India and China. The soft rot caused by some fungus like *Pythium spp*., *P. aphanidermatum*, *Fusarium solani*, etc attack ginger rhizome separately and sometimes together and massively affect the ginger production. It is very difficult to control disease properly without deteriorating environment in sustainable way. It is reported that, about 70 % rhizome productions has been found reduced due to soft rot infestation, and if not controlled properly complete crop failure will occur after few year continuous infestations. Several researches have been conducted to control soft rot and several chemicals have been used to control the disease in India and abroad, but no any concrete solution has been found and no any correct chemicals have been identified yet to control the disease properly. A preliminary experiment was conducted in Lalitpur district of Nepal to control soft rot of ginger by using *Jeevatu* and *Jeevatu* based organic liquid manure. From this experiment, use of *Jeevatu*, particularly *Jeevatu* based organic liquid manure, is found to have played vital role in soft rot control and no further spreading of the disease was observed after the application of *Jeevatu* based organic liquid manure in the field.

Keywords: Ginger, *Jeevatu*, Soft rot

1. Introduction

Nepal occupies third position in the world in terms of ginger production after India and China respectively (B.K. Poudyal, 2011). Demand of Ginger is increasing every year in the world market due to its diverse products and use (FAO, 2009). Ginger is one of the best cash crops of most of the farmers of mid hills of SAARC nations including Nepal, Bhutan and India. Among the several factors affecting the ginger production, one of the prime factors is the soft rot causes by few soil fungi like *Pythium spp*., *P. aphanidermatum*, *Fusarium solani*, etc. These fungi attack ginger rhizome separately and sometimes together. The disease may reduce 50 % rhizome production (Anonymous, 2005). According to Anonymous (2011), 70 % rhizome production will be reduced due to soft rot infestation in Nepal. If soft rot is not controlled properly it may cause complete crop failure after few year continuous infections.

Several agronomical practices and chemicals like proper drainage, use of healthy and vigorous rhizomes, seed rhizome treatment with Mancozeb @ 0.25% + Carbendazim 0.1% or Ridomil MZ (0.2%) or Topsin M (0.2%) before storage and during plantation, 3 or 4 years crop rotation, (Anonymous, 2005; Anonymous, 2011; B.K. Poudyal, 2011; Sheldon M. Elliott, 2003) etc has been recommended to control soft rot disease, but once the disease enters into the ginger field, it is almost impossible to control properly by using only chemical fungicides. Moreover, use of chemicals to control the disease is criticized throughout the world due to its detrimental effects on environment. Several researches have been conducted to control soft rot and several chemicals have been used to control the disease in India and abroad but no any concrete solution has been found and no any correct chemicals have identified yet to control the disease properly. Eventually, it has forced scientist to find out the best eco-friendly alternatives to control soft rot disease of ginger.

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Jeevatu, non poisonous useful to ecosystem services is package of beneficial microbes (Lactic acid bacteria, *Azotobacter*, Phosphorus solubilizing bacteria, Potash solubilizing bacteria, *Trichoderma*, Photosynthetic bacteria and yeast) formulated by *Nepalese Farming Institute*, a non-profiteering organization. It is now commercially available in Nepal. Several experiments have been conducted to control diseases by using *Jeevatu* in several crops like root knot nematodes of tomato, club root of cauliflower, late blight of tomato, etc and found very effective to control such disease (K.B. Paudel, and A. Paudel, 2010).

2. Materials and Method

This experiment was carried out at Imadol VDC, ward no. 5, Lalitpur district of Nepal to control soft rot of ginger by using *Jeevatu* and *Jeevatu* based organic liquid manure.

2.1. Preparation of Compost

Initially, decomposed farm yard manure was collected from vicinities and treated with *Jeevatu* (1 liter *Jeevatu* with 19 liter water) by using water-can to sprinkle the solution thoroughly. Treated FYM was left for 25 days for complete decompose.

2.2. Planting Material

100 kilogram of ordinary ginger rhizomes were collected from Kalimati Wholesale Market, Kathmandu in the third week of March 2010. The rhizomes were enough for the cultivation of 1 Ropani (about 500 sq. mt.) of land.

2.3. Treatment of Rhizome

Immediately after detaching rhizomes with hands, all seed rhizome pieces were dipped in to *Jeevatu* solution (1 liter *Jeevatu* with 19 liter water) for 30 minutes as in figure 1.

2.4. Plantation

Shed dried seed gingers were planted by using abundant amount of farm yard manure (2 m. ton) and chemical fertilizers (8 Kg DAP, 4 Kg Urea, 6 Kg MOP, 2 Kg Bioenzyme, 1 Kg Micro nutrient mixture) per 500 sq. mt land. Planting was completed within 6 days from March 26 to 31, 2010.

2.5. Preparation of *Jeevatu* based Organic Liquid Manure

Jeevatu based organic liquid manure was prepared three months later on July, 2010. Compost 25 kg, ordinary water 50 liter and 1 liter *Jeevatu* was thoroughly mixed to make the slurry and packed in white 500 gauge plastic bag and placed inside pit to prepare liquid manure. Liquid manure was stirred thoroughly twice a week by hand.

2.6. Application of Liquid Manure

After the disease symptoms were detected in the field during the last week of August 2010, application of liquid manure in the field were started from 19 September 2010.

2.7. Treatment and Replication

Four different treatments of *Jeevatu* T-1 (1 part *Jeevatu* with 19 part water), T-2 (1 part *Jeevatu* based organic liquid manure with 2 part water), T-3 (1 part *Jeevatu* based organic liquid manure with 3 part water) and control T-4 (only ordinary tap water) were tested for the role of organic liquid manure in soft rot control of ginger. No any chemicals were tested to control the soft rot in this experiment. Seven replications of each treatment were made considering about 1 m^2 area (about 15 seed rhizomes) for one treatment. Total area occupied by 1 replication was 4 sq. mt. hence, 28 sq.mt area in all 7 replications. Each replication was separated by using coconut rope. All the treatments and replications were arranged in a completely randomized manner and all the experiments were conducted only once for the experiment. The replication and treatments were made after the infestation of soft rot disease was seen in the field.

2.8. Laboratory Test

Infected rhizome was sent to plant pathology laboratory of Nepal Agriculture Research Council (NARC), Khumaltar, Lalitpur, on 19 September 2010 to identify the causes of disease and laboratory test report was

collected on 3rd October 2010.

2.9. Statistical Analysis

The result was very much obvious and no any statistical tools were used to test the result. The results of different treatments were compared with each other.

Fig. 1: Treatment of seed rhizome in *Jeevatu*

Fig. 2: Preparation of *Jeevatu* based organic liquid manure

Fig. 3: Yellowing of leaves

3. Result and Discussion

3.1. Yellowing of Leaves

Yellowing of leaves and stunted growth were observed during the last week of August particularly the plants near drainage where water logging was severe as in figure 3. After yellowing of the leaves, tip of the lower leaves were found brown and all above ground shoots were completely dried out and collapsed. Similar symptoms were also described by anonymous, 2005; anonymous, 2011; B.K. Poudyal, 2011; Sheldon M. Elliott, 2003), etc.

3.2. Soft rot of Rhizome

Two weeks later, after the yellowing of the leaves, the infected plants were found severely affected by soft rot. The typical symptom of soft rot was found watery soft rhizome, off flavor and easily collapse of shoots from the decay rhizome as in figure 4. According to the report of the plant pathology laboratory of Nepal Agriculture Research Council (NARC), Nepal, the soft rot of rhizome was caused by two pathogenic fungi *Fusarium solani* and *Pythium spp*. According to Sheldon M. Elliott, (2003), several microbes like *Fusarium* spp., *Rhizoctonia solani*, *Pythium* spp., and the root knot nematode *Meloidogyne* spp. and bacterium *Pseudomonas* spp. have been isolated from diseased rhizomes. Similarly, *Pythium spp* and *P. aphanidermatum* were also detected in infected rhizome at Sikkim, India (Anonymous, 2005).

3.3. Defoliation of Rhizome

The shoots of all severely infected clumps were detached from the rhizome. Rhizomes without shoots were unable to rejuvenate from any treatment, and those rhizomes without shoots died gradually and degenerated in the soil few weeks later, as shown in figure 5.

Fig. 4: Symptom of soft rot

Fig 5: Rhizomes without shoots

3.4. Effect of *Jeevatu* on Soft Rot Control

The use of bio agent *Jeevatu*, particularly *Jeevatu* based organic liquid manure, plays vital role in soft rot control, without which it is impossible to cure the disease properly. According to result, only 6 clumps were found infected by disease in which only two clumps (R-3, T1 and R-6, T2) were found severely infected and all shoots were collapsed, unable to rejuvenate by any treatment and finally degenerated in the soil. Likewise, one clump treated by treatment 1 [*Jeevatu* with 19 liter water (R-7, T1)], one clump treated by treatment 2 [2 part water with 1 part *Jeevatu* based organic liquid manure (R-2, T2)], and two clumps treated by treatment 3 [3 part water with 1 part *Jeevatu* base organic liquid manure (R-3, T3 and R-6, T3)] were cured. The soft rot was found completely cured after 10 times soil drenching (drenching at the rate of twice a week). Although the field was damp and rain was continue, after the application of *Jeevatu* and *Jeevatu* based organic liquid manure in the field, no further spreading of the disease was observed. It might be due to the detrimental effect of *Jeevatu* and *Jeevatu* based organic liquid manure on pathogenic fungus. Interestingly, one clump severely infected by soft rot treated by treatment 3 [3 part water with 1 part *Jeevatu* based organic liquid manure (R-3, T3)] was cured and half of the rhizome was decayed and rest half remain healthy shown in figure 6 below.

Competition on space and absorption of nutrients, toxins produced by *Jeevatu* microbes, repellent effect, anti-feeding effect, direct invasion on pathogenic microbes and killing, etc are some of the probable factors to control the disease, however, it is yet to carry out thorough study in these aspects. Further investigation on these aspects has to be done in near future. Overall, the health and growth of the plant treated by *Jeevatu* based organic liquid manure was found better than plants treated by *Jeevatu* alone from visual observation. It might be due to the additional nutrients supplied by *Jeevatu* based organic liquid manure to the ginger plant.

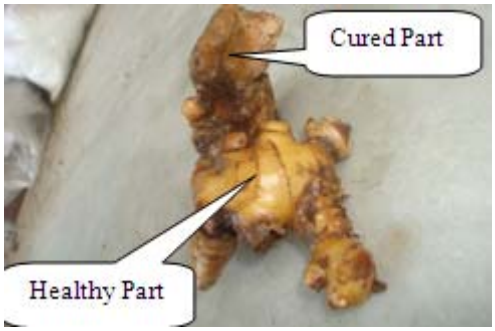

Fig. 6: Rhizome cured by *Jeevatu* based organic liquid manure

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R-1	R-2	R-3	R-4	R= Replication; T= Treatment
T1	T3	T2	T4	
T4	T2	T1	T3	T-1 = 19 part water with 1 part *Jeevatu*: T-2 = 2 part water with 1 part *Jeevatu* based organic liquid manure: T-3 = 3 part water with 1 part *Jeevatu* based organic liquid manure: T-4 = Control, only tap water:
T3	T1	T4	T1	
T2	T4	T3	T2	

R-5	R-6	R-7	**Result**
T3	T2	T1	R-2, T2= Infected rhizome cured R-3, T1= Rhizomes without shoots, later degenerated R-3, T3= Infected rhizome cured R-6, T2= Rhizomes without shoots, later degenerated R-6, T3= Infected rhizome cured R-7, T1= Infected rhizome cured No any other clumps were infected
T1	T3	T4	
T2	T4	T2	
T4	T1	T3	