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Effect of Botanicals and Chemicals on Rhizome Rot Disease of Ginger

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Abstract

Four experiments were conducted at Gazipur, Madhupur, Bogra and Khagrachari to develop the appropriate management package for rhizome rot in replicated manner following randomized complete block design with 11 treatments having plant materials, chemicals and poultry bedding during 2014-15 cropping season. The germination was found 53 to 97 % at Bogra whereas it was higher (84-97 %) at Gazipur and Madhupur field at Tangail (88-96 %). The germination ranged from 59-83 % in Khagrachari. The disease incidence was the lowest (5.98 %) using seed treatment with Ridomil gold (0.2%) and its 2 times soil drenching followed by seed treatment with Chlorox (10 %) in all locations. The highest disease incidence (64.94 %) was recorded in the control plots of all locations. The highest yield 22.92 t/ha was obtained in seed treatment with Chlorox (10 %) followed by seed treatment using Ridomil and its 2 times soil drenching (18.11 t/ha) at Gazipur. All treatments gave higher yield compared to control irrespective of locations.

Keywords: *Rhizome rot, Integrated Management, Ginger, Bangladesh*

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1. INTRODUCTION

Ginger (*Zingiber officinale* Rosc.) is one of the most essential spices where it is grown in the world including Bangladesh. It has special significance for tropical countries where it is produced and consumed in large quantities (Rahim, 1992).The useful parts of this crop are the rhizome (Purseglove *et al.,* 1988). In western countries ginger is widely used for culinary purpose in ginger bread, biscuits, cakes, pudding, soups and pickles. It is a frequent constituent of curry powder. It is also used in medicine as a carminative and aromatic stimulant to the gastrointestinal tract, externally as an aphrodisiac and internally as a pubefaciant and counter irritant. Ginger now is used popularly as chewing purpose (Purseglove *et al.,* 1988).

Ginger is much more used in Bangladesh as spices and is cultivated more or less all over the country. The widely cultivated area in the country are: Bandharban, Rangamati, Chittagong, Chittagong hill tracts, Khagrachori, Jessore, Khulna, Pabna, Rangpur, Dinajpur, Panchagarh, Nilphamari, Mymensingh and Tangail. Bangladesh produces only 43,000 metric tons of ginger from an area 8000 hectare as against the requirement of 96,000 metric tones per annum (Akhter *et al.,* 2005). At farmer's level, the average yield is 5.54 tons/ha, which is very low as compared to other ginger growing countries of the world. The yield per unit area in the country is not enough to fulfill the annual requirement/demand of the country. So every year a good amount of ginger is imported in exchange of foreign currency. In our country diseases is the major limiting factor for ginger cultivation. Among the diseases, rhizome rot is the most devastating one.

To reduce disease infection, best method is to use disease free rhizomes for planting (Bertus, 1942; Elliot, 2003). Since the disease is internally seed borne also, seed treatments can reduce the infection to a limited extent. Various types of seed treatment have been tried by many workers prior to storage and also prior to planting including chemicals and hot water. Many chemicals have been tried by different workers for seed steeping such as Mercuric chloride (0.1%), Bavistin 0.3%, Dithane M-45 0.3% and Terrazole 0.2%, (Iyer *et al.*, 1984); Ridomil (Rathaiah, 1987); Captan, Captofol and Mancozeb (Das *et al*., 1990). Two varying duration of seed steeping in the chemical solution viz. 30 minutes and 60 minutes were found to be equally effective (Iyer *et al.,* 1985; Razu *et al*., 1985). The other important source of infection is the infected soil. Elliot (2003) recommended crop rotation. In most of the

growing areas, crop rotation of 3-5 years is practiced as routine. Proper drainage of excess water in the fields is recommended to reduce the disease spread. Early sowing of the crop during May and June has been found to suffer less damage by soft rot disease (Iyer *et al.,* 1984). Application of soil amendments is another method of reducing soil inoculum of the pathogen. Among the various amendments, application of neem cake is found to be reduced the soft rot incidence (Sadanandan and Iyer, 1986; Singh and Tomar, 2009) and different plant extracts (Sagar *et al*., 2007). Biological control of the pathogen by using well established antagonists has been attempt by several workers. The use of *Trichoderma harzianum* in controlling rhizome rot is suggested long ago by Thomas (1939). Antagonistic activity of *Trichoderma* species in dual cultures against causal fungi of rhizome rot of ginger was demonstrated by Bhardwaj and Gupta (1987). Steeping inoculated rhizome is a spore suspension of *T. viridae* was quite effective against *P. aphanidermatum* and *Fusarium equisetti* on seed ginger (Rajan *et al*., 2002). Another method of controlling the disease in the field is through fungicides. Soil and seed treatment with metalaxyl formulations (Ridomil 5G and Apron 35 WS) gave the best control of the disease in fungus infected plots (Ramchandra *et al.,* 1989). Once a clump becomes infected, it is impossible to eradicate pathogen. Hence, it is necessary to resort preventive measures. But there is no proper method available to control rhizome rot diseases at present. As the pathogen perpetuates in soil, so it is very difficult to control. In Bangladesh condition, no systemic research work has been done on the control of this disease. Rhizome rot of ginger is a prevalent problem to the farmers with the resultant effect of reduce yield. Available literatures indicate that the incidence of rhizome rot in the field can be minimized in different ways. So it is high time to develop effective control measures to enhance ginger production in Bangladesh. The present study was undertaken to develop the appropriate management technology for rhizome rot disease of ginger.

2. MATERIALS AND METHODS

The experiments were conducted at Gazipur, Madhupur, Bogra and Khagrachari.during 2014-15 cropping season to find out the appropriate control measure of rhizome rot disease of ginger through botanicals and chemicals. The experimental plot was prepared with five ploughing and cross ploughing followed by laddering to break the clods as well as to level the soil. Recommended fertilizer doses and proper intercultural operations were applied in all the experiments. The weeds and stubbles of previous crops were collected and removed from the soil. Cowdung 5t/ha, N@ 140kg/ha, P @ 54 kg/ha and K @ 117 kg/ha were applied. The entire quantity of cowdung, P and half of K were applied during final land preparation. The one half of N was applied at 50 days after transplanting (DAP). The rest of K and N was applied with two equal splits at 80 and 110 DAP. The experiments were carried out following Randomized Complete Block Design with three replications. Size of the unit plot was 3.0m and 2.0 m and plant spacing was 50 cm x 25 cm. BARI Ginger -1 was used in the experiment. There were 11 treatments in the experiments viz. T_1= Mustard oil cake (300kg/ha), T_2= Mustard oil cake (600kg/ha), T_3= Neem oil cake (300kg/ha), T_4= Poultry refuge (5t/ha), T_5= Stable Bleaching Powder (SBP) @ 20kg/ha, T_6= SBP (30kg/ha), T_7= Normal Bleaching Powder (100kg/ha), T_8= Seed treatment with Bavistin + 2 times soil drenching with Bavistin, T_9= Ridomil seed treatment + 2 times soil drenching with Ridomil, T_{10}= Ridomil seed treatment + 2 times soil drenching with Secure and T_{11}= control.

Rhizomes were planted on April 20, 2014. Three weeding were done at 20, 40 and 60 days after planting and five irrigations were applied just after five days of each weeding. Other intercultural operations were done to maintain the normal hygienic condition of the crop in the field. The treatments were laid out following RCBD with three replications. In the Plant Pathology field experiment at Gazipur, seed treatment with Clorox was included in the treatment T_5 instead of seed treatment with Stable Bleaching Powder (20kg/ha). A shade was provided over the experiment of Madhupur field at Tangail. Germination, disease incidence and yield data were recorded from the experiments. The recorded data were analyzed statistically to find out the level of significance and variance was analyzed following Duncan's New Multiple Range Test.

(DMRT).

3. RESULTS AND DISCUSSION

The germination of ginger was found 53.0 to 97.0 % at Bogra whereas it was higher 84.0-97.0% and 88-96% at Plant Pathology Field, BARI, Gazipur and Madhupur Field. The germination was found lower ranging from 59.0-83.0 % in Khagrachari (Table 1). The probable reason for lower germination at Khagrachari may be toxicity of the cakes, poultry refuse and stable bleaching powder which were not properly decomposed before sowing seeds (rhizome). In the other location the germination was about 90.0% and above.

The highest germination by 97.0% was recorded in the treatment T_9- Ridomil applied as seed treatment + 2 times soil drenching with Ridomil followed by 96.0, 93.0 and 92.0% was found in the treatments T_{10} where Ridomil was used as seed treatment + 2

times soil drenching with Secure, T_8- Bavistin used as seed treatment + 2 times soil drenching with Bavistin and T_7 at Bogra. The lowest germination 53.0% was observed in the treatment T_5 when stable bleaching powder @20kg/ha was used at Bogra.

At Gazipur, the highest germination percentage of 97.0 was found in the treatment T_5- Chlorox followed by 95, 95 and 94%, respectively in T_2- Mustard oil cake (600kg/ha), T_4- Poultry refuge (5t/ha) and T_7 -Bleaching powder (100kg/ha). The lowest germination 84.0% was observed in the treatment T_6 where SBP (30kg/ha) was used. Under shade condition at Madhupur, the highest germination percentage of 96.0 was found in the treatment T_1 and the lowest was observed in treatment T_9 (88.0%) and T_{10}- Ridomil seed treatment + 2 times soil drenching with Secure.

In Khagrachori, the maximum germination percentage of 83.0 was found in T_7 -Bleaching powder (100kg/ha) and the lowest germination percentage of 59.0 was recorded in T_2- Mustard oil cake (600kg/ha) may be due to toxicity created by improper decomposition of cakes (Table 1).

Table 1. Effect of different treatments on germination of ginger at various locations during 2015-16

Treatments	Germination (%)			
	SRC, Bogra	Plant Pathology Field, BARI	Madhupur	HARC, Khagrachari
T_1= Mustard oil cake (300kg/ha)	89.0	92.0	96.0	59.0
T_2= Mustard oil cake (600kg/ha)	87.0	95.0	91.0	65.0
T_3= Neem oil cake (300kg/ha)	91.0	92.0	94.0	75.0
T_4= Poultry refuge (5t/ha)	85.0	95.0	95.0	78.0
T_5= SBP (20kg/ha)	53.0	97.0*	92.0	76.0
T_6= SBP (30kg/ha)	82.0	84.0	94.0	77.0
T_7= Bleaching powder (100kg/ha)	92.0	86.0	94.0	83.0
T_8= Bavistin seed treatment + 2 times soil drenching with Bavistin	93.0	94.0	90.0	73.0
T_9= Ridomil seed treatment + 2 times soil drenching with Ridomil	97.0	88.0	88.0	70.0
T_{10}= Ridomil seed treatment + 2 times soil drenching with Secure	96.0	91.0	88.0	71.0
T_{11}= Control	91.0	88.0	95.0	77.0

* In the Plant Pathology field at Gazipur, seed treatment with Clorox, 10% was included in the treatment T_5 instead of seed treatment with Stable bleaching powder, 20kg/ha.

All the treatments effectively controlled rhizome rot disease of ginger compared to control (Table 2). The highest disease incidence was 54.45% in the control treatment and the lowest disease incidence was found 8.00% where Ridomil was used as seed treatment and 2 times its application as soil drenching in Bogra. The higher disease incidence 52.51%, 45.65% and 44.72% were found in the treatment T_2, T_1 and T_3, respectively. The lower disease incidence ranging from10.00% and 11.00% was recorded in the treatment T_6 and T_5 (Table 2) and the treatment T_9 was ranked as the best in controlling rhizome rot.

In the Plant Pathology Field, BARI, Gazipur, the highest disease incidence 51.35% was recorded in control plot preceded by 49.48%, 42.58% and 41.81% in treatment T_2, T_1 and T_3. The lowest disease incidence by 7.00% was found in the treatment T_9 (Table 2). In the Madhupur Field, the maximum disease was observed in control plot (49.40%) while the lowest disease incidence 5.98% was recorded in treatment T_9 (Table 2). At the Khagrachari location, disease incidence was the highest 64.94% in the untreated control plot and the lowest was 11.10 % in the treatment T_9 (Table 2). In general, ginger seed when treated with Ridomil and two fold its application as soil drench fond to be the best treatment (T_9) package in controlling rhizome rot. Application of SBP@ 20 and 30 kg/ha i.e. T_5 and T_6 treatment occupied the 2nd and 3rd places; also able to reduce disease in the present study.

Table 2. Efficacy of treatments on rhizome rot incidence of ginger at various locations during 2015-16

Treatments	Disease incidence (%)			
	SRC, Bogra	Plant Pathology Field, BARI	Madhupur	HARC, Khagrachari
T_1= Mustard oil cake (300kg/ha)	45.65 b	42.58 b	42.00 b	48.76 c
T_2= Mustard oil cake (600kg/ha)	52.51 a	49.48 ab	47.89 a	55.64 b
T_3= Neem oil cake (300kg/ha)	44.72 b	41.81 c	39.52 b	47.90 cd
T_4= Poultry refuge (5t/ha)	39.33 c	36.21 d	34.04 c	44.51 d
T_5= SBP (20kg/ha)	11.00 fg	5.00 h	10.33 e	14.10 g
T_6= SBP (30kg/ha)	10.10 g	10.12 g	10.65 e	14.00 g
T_7= Bleaching powder (100kg/ha)	23.30 d	20.21 e	18.95 d	24.30 e
T_8= Bavistin seed treatment + 2 times soil drenching with Bavistin	19.22 e	16.13 f	14.95 d	22.33 ef
T_9= Ridomil seed treatment + 2 times soil drenching with Ridomil	8.00 g	7.00 gh	5.98 f	11.10 g
T_{10}= Ridomil seed treatment + 2 times soil drenching with Secure	14.76 f	8.76 gh	6.86 ef	19.85 f
T_{11}= Control	54.45 a	51.35 a	49.40 a	64.94 a
CV (%)	4.10	6.56	5.00	6.0

* In the Plant Pathology field at Gazipur, seed treatment with Chlorox, 10% was included in the treatment T_5 instead of seed treatment with Stable bleaching powder, 20kg/ha. Letter(s) in a column with same letter do not differ significantly at P= 0.5.

The yield was found the highest 22.92 (t/ha) from T_5 (Chlorox 10%) at the Plant Pathology Field, Gazipur (Table 3) while the lowest yield 4.54 t/ha was recorded in control treatment at Khagrachari (Table 3). However, all treatments showed the better yield compared to control treatment at the all locations.

Table 3. Effect of different treatments on yield (t/ha) of ginger at various locations during 2015-16

Treatments	Yield (t/ha)			
	SRC, Bogra	Plant Pathology Field, BARI	Madhupur	HARC, Khagrachari
T_1= Mustard oil cake (300kg/ha)	8.20 bc	14.44 cd	13.21 bc	6.30 bc
T_2= Mustard oil cake (600kg/ha)	9.90 abc	12.49 d	12.10 c	7.95 abc
T_3= Neem oil cake (300kg/ha)	11.80 ab	12.49 d	12.00 c	9.60 ab
T_4= Poultry refuge (5t/ha)	11.44 ab	12.77 d	11.54 c	9.48 ab
T_5= SBP (20kg/ha)	11.80 ab	22.92 a	14.85 abc	9.70 ab
T_6= SBP (30kg/ha)	11.88 ab	12.77 d	14.16 abc	9.80 ab
T_7= Bleaching powder (100kg/ha)	11.00 ab	16.66 bcd	11.46 c	9.00 ab
T_8= Bavistin seed treatment + 2 times soil drenching with Bavistin	12.10 ab	16.66 bcd	14.95 abc	10.00 ab
T_9= Ridomil seed treatment + 2 times soil drenching with Ridomil	14.35 a	18.88 ab	17.79 a	12.14 ab
T_{10}= Ridomil seed treatment + 2 times soil drenching with Secure	8.33 bc	17.49 bc	17.34 ab	6.26 bc
T_{11}= Control	5.85 c	6.42 e	6.28 d	4.54 c
CV (%)	5.10	5.21	2.67	6.7

* In the Plant Pathology field at Gazipur, seed treatment with Clorox, 10% was included the treatment T_5 instead of seed treatment with Stable bleaching powder, 20kg/ha. Letter(s) in a column with same letter do not differ significantly at P= 0.5.

The seed treatment with Chlorox (10.0%) alone showed positive effect in controlling rhizome rot disease of ginger as well as provided higher yield at the Plant Pathology Field Gazipur. In general, seed treatment with Ridomil and its two-fold application as soil drenching during vegetative period effectively control ginger rhizome rot. The effects of integrated approach on the incidence of rhizome rot disease of ginger was assessed by the scientists of BARI, during 2011-12, 2012-13 and 2013-14. Botanicals, chemicals, poultry bedding etc. were used in the experiments by the BARI Scientist. The results revealed that botanicals and chemicals had a significant influence on the incidence of rhizome rot disease and yield of ginger (BARI, 2013, BARI, 2014 and BARI, 2015). Ramchandran *et al*. (1989) are in agreement with the present findings. They found that soil and seed treatment with metalaxyl formulations (Ridomil 5G and Apron 35 WS) gave the best control of the rhizome rot disease of ginger in fungus infected plots. The above mentioned information is newly developed through present research activity which could reduce rhizome rot disease of ginger and accelerate the yield in the country, if applied properly.

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