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Evaluation and selection of appropriate management package of ginger rhizome rot disease in field condition

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Abstract: *Ginger (Zingiber officinale Rosc., Zingiberaceae) is an important commercial crop in tropical and subtropical countries. The whole plant is refreshingly aromatic but it is the underground rhizome (raw or processed) which is valued as spice. Nepal occupies fourth position in the world in terms of ginger production after India, China, and Indonesia, respectively. Among the several factors affecting the ginger production, one of the prime factors is the rhizome rot caused by few soil fungi like Pythium spp., Fusarium spp, etc. These fungi attack ginger rhizome separately and sometimes together sometimes causing more than 50%-70% loss in rhizome production. Among several chemicals, botanicals and bio-pesticides tested against rhizome rot disease of ginger, seed treatment with hot water and Trichoderma and soil application of Trichoderma as well have been found effective in disease management in a eco-friendly way. Cultural practice of raised bed with good drainage has also been found effective to minimize rhizome rot disease in field condition. In case of use of safer chemicals, seed treatment with Ridomil mz 0.2% + Bavistin 0.1% combination has been found the most effective for disease management with highest fresh rhizome production, lowest rhizome rot severity and least diseased rhizome production.*

Key words: *eco-friendly, ginger, management, rhizome rot*

I. Introduction

Ginger (Zingiber officinale Rosc., Zingiberaceae) is an important commercial crop in tropical and subtropical countries. The rhizome or modified underground stem of ginger is used worldwide as a spice for flavoring a multitude of foods and food products. It is also used in medicines, particularly in traditional medicines of South Asian countries including China (Dohroo, 2012).

Ginger is obtained from the underground stems or rhizomes of Zingiber officinale (Rosc.) which is an herbaceous tropical perennial belonging to the family Zingiberaceae. It is usually grown as an annual crop. The whole plant is refreshingly aromatic but it is the underground rhizome (raw or processed) which is valued as spice. Its medicinal value is increasingly being recognized nowadays. Ginger has originated in South- East Asia. The name itself supports this view. The Sanskrit name 'Singabera' has given rise to Greek 'Zingiberi' and later the generic name Zingiber. Ginger is cultivated in several parts of the world, and the most important countries being viz., India, China, Nigeria, Sierra Leone, Indonesia, Bangladesh, Australia, Fiji, Jamaica and Nepal (Dohroo, 2012).

Nepal occupies fourth position in the world in terms of ginger production after India, China, and Indonesia, respectively (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 rhizome rot caused by few soil fungi like Pythium spp., Fusarium spp, etc. These fungi attack ginger rhizome separately and sometimes together. The disease 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. If rhizome rot is not controlled properly it may cause complete crop failure after few year of continuous infections.

Several chemical pesticides like Mancozeb 0.25%, Carbendazim 0.1%, Ridomil MZ (0.2%), Topsin M (0.2%) (ANSAB, 2011; Poudyal, B.K. 2011; Sheldon M. Elliott, 2003), botanicals like neem, garlic, agave, onion lantana, walnut, soap nut etc (Dohroo, 2012; Rai, 2006) as well as biological agents like Trichoderma spp., Jeevatu etc (Poudyal, B.K. 2011; Dohroo, 2012; Rai, 2006) has been tested and used in field level for the disease management.

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This research was carried out at National Ginger Research Program (NGRP), Kapurkot Salyan (1480 masl) to compare the performance of different safer chemicals, botanicals and biological agents and also the combination of these treatments against rhizome rot disease of ginger and identify the appropriate management package of rhizome rot disease in field condition.

II. Materials And Methods

1.1. Experiment 1: Soil solarization and use of bio-agents for control of rhizome rot disease of ginger

A field experiment was conducted in RCB design with seven treatments along with three replications during crop season of 2011 at NGRP, Kapurkot Salyan (1480 masl). Various treatments including soil solarization and Trichoderma (soil application @ 1kg Trichograma/20 kg FYM/ropani) along with raised bed (15cm) were tested for the rhizome rot disease management of ginger. Solarization was done one month prior to ginger planting. Experiment was laid out and planted during the third week of April with row to row and plant to plant spacing of 30 x 30 cm in a plot size of 3m x 1.2m = 3.6m^2. Seed rhizome was treated before planting in Indofil M-45 @ 2.5g/L + Bavistin @ 1g/L solution. Fertilizer was applied @ 30 mt/ha FYM + 75:50:50 kg/ha NPK. Weeding was done two times during crop season. The observations on plant population, tiller no, plant height, fresh rhizome yield, diseased rhizome yield were recorded and analyzed using MSTAT-C tools.

Result:

The result of the experiment has been summarized and presented in table 1. Statistical analysis of fresh rhizome yield (mt/ha) was found significant. Raised bed + Solarization + Trichoderma incorporated produced the highest fresh rhizome yield (26.11mt/ha) followed by the raised bed (25.25mt/ha) only. Ginger planted in solarized (dry) field produced the lowest (15.55 mt/ha) fresh rhizome yield. All other traits such as tiller/clump, plant height, initial stand, final stand, diseased rhizome yield, rhizome rot scale were found as statistically at par with each other. However, highest rhizome rot severity was found on Raised bed + Solarization plot with the rotted rhizome yield of 4.25 mt/ha.

Table 1: Effect of soil solarization and bio-control agent for rhizome rot disease management at GRP, Kapurkot, Salyan during 2011/2012

SN	Treatments	Final plant #/m^2	Tiller/clump	Plant height	Fresh rhizome yield mt/ha	Diseased rhizome yield mt/ha	Rhizome Rot (1-5 scale)	Mother rhizome yield mt/ha
1	Solarization (Dry)	10.09	6.13	69.93	15.55	5.00	1.16	3.88
2	Solarization (Wet)	10.46	7.20	70.00	18.61	3.33	1.33	3.70
3	Trichoderma	9.63	6.80	70.73	17.22	3.14	1.00	4.44
4	Raised bed	10.18	8.20	73.33	24.25	2.77	0.50	4.44
5	Raised bed + Solarization	9.53	9.93	73.33	21.11	4.25	1.66	3.70
6	Raised bed + Solarization + Trichoderma	10.74	7.86	77.86	26.11	2.77	1.00	5.55
7	Control	9.72	7.00	70.33	17.77	3.70	0.50	4.07
	CV %	5.20	16.86	9.04	18.68	32.29	87.12	20.69
	P test	NS	NS	NS	*	NS	NS	NS
	LSD value				6.67			

NS – Not significant * – Significant ** – Highly significant

1.2. Experiment 2: Evaluation of different Fungicides and Organic Compounds to minimize the rhizome rot disease.

The experiment was carried out during 2010/2011 at Ginger research Program (GRS), Kapurkot, Salyan to evaluate the effect of different fungicides including organic compounds to minimize the rhizome rot disease of ginger. Experiment was laid out in RCB design along with eight treatments and each treatment was replicated thrice. Other standard agronomic practices like weeding, irrigation, manuring to raise the crop were followed as per recommendation. Observations like plant number, tiller number, plant height, diseased %, fresh rhizome yield, disease rhizome yield, mother rhizome yield were recorded.

Result: The experiment revealed highly significant effect of different treatments on plant stand and mother rhizome yield. The significant effect was seen among different treatments on the tiller/clump, plant height, fresh rhizome yield, diseased rhizome yield and rhizome rot scale. The treatment Ridomil mz (0.2%) + Bavistin (0.1%) showed lowest rhizome rot severity (1.33) with lowest diseased rhizome yield (0.29 mt/ha). However, fresh rhizome yield was found highest (39.40 mt/ha) on hot water followed by Ridomil mz 0.2% + Bavistin 0.1% (37.03 mt/ha) treated seed rhizome. The lowest fresh rhizome yield (22.00 mt/ha) was observed on

treatment Seed solarization for 2 hours. Highest mother rhizome yield (6.59 mt/ha) was found in treatment Saf (0.3%) + Timur (50kg/ha) soil application followed by Ridomil mz 0.2% + Bavistin 0.1% (6.37mt/ha). Plant population (10.96 plant/m^2) and plant height (60.93cm) were found highest in the treatment Saf (0.3%) along with highest disease rhizome yield (3.55mt/ha), disease severity (3.0) and tiller/clump (4.33). Thus treatment Ridomil mz 0.2% + Bavistin 0.1% (37.03 mt/ha) was found better for rhizome treatment for the management of rhizome rot disease of ginger.

Table 2: Evaluation of different Fungicides and Organic Compounds to minimize the rhizome rot disease in ginger 2012/13.

Treatments	plant#/m^2	Tiller/clump	Plant height cm	FR yield mt/ha	DR yield mt/ha	MR yield mt/ha	Rhizome rot (1-5 scale)	Rhizome rot disease incidence %
1.Bavistin 0.1% + Indofil 0.25%	8.84	4.0	55.13	29.18	1.40	4.66	2.0	22.12
2.Fluaginam (0.4%)	8.96	3.93	55.73	29.11	1.18	6.14	1.66	17.13
3.Saf (0.3%)	10.96	3.80	60.93	22.29	3.55	5.33	3.0	19.21
4.Ridomil mz (0.2%)+ Bavistin (0.1%)	9.25	3.60	55.13	37.03	0.29	6.37	1.33	20.76
5.Saf (0.3%)+ Timur(50kg/ha) soil application	10.07	4.33	59.60	35.40	1.70	6.59	2.33	21.35
6.Saf (0.3%) + Saf soil drenching	9.25	3.93	55.93	33.33	1.03	4.44	1.66	20.71
7.Trichoderma seed treatment (10gm/lt) + soil appln (1kg Trichograma/20 kg FYM/ropani)	8.81	4.0	55.53	28.74	0.37	4.00	1.66	30.42
8.Hot water seed treatment (50^0 c for 10 minute)	9.77	4.66	56.86	39.40	3.55	5.63	2.33	17.48
9.Seed solarization, 2 hours.	6.22	4.26	50.40	22.00	0.88	1.92	2.0	19.39
CV %	11.69	22.71	10.08	22.12	157.55	20.96	50.69	23.83
P test	**	NS	NS	NS	NS	**	NS	NS
LSD value	1.83					1.81		

NS – Not significant * – Significant ** – Highly significant

III. Discussion

Experiment done on soil solarization and use of Trichoderma as bioagent revealed that ginger planting in Raised bed (15cm) + Solarization + Trichoderma (soil appln@ 1kg/20 kg FYM/ropani) incorporated proved to give highest fresh rhizome per unit area (26.11mt/ha). Thus this treatment combination along with standard cultivation practice with rhizome treatment with Indofil M-45 @ 2.5g/L + Bavistin @ 1g/L solution can be used for higher fresh rhizome production. Even raised bed only can also give better result (25.25mt/ha) when treated rhizome are planted with given cultivation practice. Rai (2006) reported that if the land for ginger cultivation is not slopy, raised bed (10 inch from ground) with proper drainage system is important precautionary measures to prevent diseases. According to Jayashree et.al. (2014) selection of healthy rhizomes, soil solarization and incorporation of Trichoderma, seed treatment and soil application of biocontrol agents like Trichoderma, PGPR or Pseudomonas multiplied in suitable carrier media such as coir pith compost, well rotten cow dung or quality neem cake may be done at the time of sowing and at regular intervals to keep the rhizome rot disease in check. In Kerala, Anoop (2014) report that where raised bed system is practiced, comparatively less disease incidence was observed.

Among the chemicals and organic compounds evaluated against rhizome rot of ginger, treatment Ridomil mz (0.2%) + Bavistin (0.1%) was found better for rhizome seed treatment for the management of rhizome rot disease of ginger. Though this treatment combination gave 2^{nd} ranking of yield (37.03 mt/ha) as compared to the hot water treatment (50ºC for 10 min) of rhizome which gave the highest yield of 39.40 mt/ha, the rhizome treated with Ridomil (0.2%) and Bavistin (0.1%) gave the lowest rot severity (1.33) with lowest diseased rhizome yield (0.29 mt/ha).

Among ten different fungicides viz. Ridomil, Dithane M-45, Rovral, Folicur, Darsbun + Ridomil, Knowin, Bavistin, Mataril, Furadan tested against rhizome rot of ginger, the combined dose of Darsbun and Ridomil used as seed treatment and soil drenching respectively resulted lesser number of infected plants per bed than those treated with other treatments as well as control. It was also found that combined dose of Darsbun and Ridomil gave the highest yield followed by single treatment of Ridomil and Mataril (Chowdhury et.al., 2009). Tariq et.al. (2012) reported that among different fungicides tested against the four wilt pathogens viz, Fusarium oxysporum, Phytopthora capsici, Rhizoctonia solani and Sclerotium rolfsii under in- vitro conditions, the fungicides viz, Captan, Carbendazim, Metalaxyl and Carboxin which were found effective under in-vitro

conditions. Seed treatment + seedling treatment + spraying of Carbendazim + Metalaxyl proved most effective and recorded 59.8% disease reduction over check under field conditions.

Trichoderma seed treatment with soil application though is safer management practice, it gave average fresh rhizome production in both experiments (25.25mt/ha and 28.74mt/ha respectively). Dohroo (2012) also reported that biological control of Pythium soft rot disease is very difficult task because of rapid germination of sporangia in response to rhizome or root exudates followed by immediate secondary infection during rainy season and ability to cause subsequent progress in infection leading to further long term rhizome and root rot. He also reported that rhizome seeds treated with Trichoderma filtrate (50%) combined with garlic extract (50%) significantly controlled soft rot disease beside improving the growth of plant. Also at field studies, the use of hot water rhizome treatment (47ºC for 30 min) combined with soil application of T. harzianum @2.5kg/50kg FYM/ha followed by four periodic drenching of COC@ 0.3% at 15 days' interval during rainy season proved highly efficacious in limiting soft rot disease besides improving the yield and growth parameters of ginger plant.

IV. Conclusion

Among several chemicals, botanicals and bio-pesticides tested against rhizome rot disease of ginger, seed treatment with hot water (50ºC for 10 min) and Trichoderma (10gm/lt) and soil application of Trichoderma (1kg Trichograma/20 kg FYM/ropani) as well have been found effective in disease management in a eco-friendly way. These two treatments could be combined to give more efficacious result on rhizome rot control in field condition. In case of use of safer chemicals, seed treatment with Ridomil mz (0.2%) + Bavistin (0.1%) combination has been found the most effective for disease management with highest fresh rhizome production, lowest rhizome rot severity and least diseased rhizome production.

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