World Journal of Agricultural Research, 2016, Vol. 4, No. 4, 128-131
Available online at http://pubs.sciepub.com/wjar/4/4/5

DOI:10.12691/wjar-4-4-5

Management of Ginger Rhizome Fly (*Calobata* sp.) and Associated Rhizome Rot (*Pythium* sp.)

Janarjan Gautam[1], Ram Prasad Mainali[2,*]

[1]National Ginger Research Program, Nepal Agricultural Research Council, Kapurkot, Salyan, Nepal
[2]Entomology Division, National Agriculture Research Institute, Nepal Agricultural Research Council, P.O.Box 976, Kathmandu Nepal
*Corresponding author: mainalism.rp@gmail.com

Abstract Rhizome fly (*Calobata* spp.) is a major insect pest of ginger associated with rhizome rot. A field experiment was conducted at Ginger Research Program (GRP), Salyan (1520 masl) during the year 2013 - 2014 to develop rhizome fly and associated rhizome rot (*Pythium* sp.) management technology. One insecticide (Chloropyrifos 20 EC) and two fungicides [Diathane M-45 (Mancozeb 80 WP) and Bavistin (Carbendazim 50 DF)] including untreated check (control) were tested solely or in combination against rhizome fly and associated rhizome rot in RCBD with three replications. The overall result revealed that the two-stage application (seed rhizome treatment and soil drenching) and treatments having more combinations of options was found to be better than treatment with single application or having less combinations of options. The combined use of 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin per liter of water in two stage i.e. seed rhizome treatment before planting and soil drenching one month after ginger germination, recorded significantly lowest (0.32 mt/ha) rhizome fly infected rhizome and the highest fresh rhizome yield (20.89 mt/ha). It is therefore, recommended that this combination, being efficient to provide maximum protection, can be utilized as a valuable chemical integration in rhizome fly and associated rhizome rot management in ginger.

Keywords: *rhizome rot complex, rhizome fly, chemical integration, ginger, pest management*

Cite This Article: Janarjan Gautam, and Ram Prasad Mainali, "Management of Ginger Rhizome Fly (*Calobata* sp.) and Associated Rhizome Rot (*Pythium* sp.)." *World Journal of Agricultural Research*, vol. 4, no. 4 (2016): 128-131. doi: 10.12691/wjar-4-4-5.

1. Introduction

Ginger (*Zingiber officinale* Rose.) is an important rhizomatous spice, medicine, cash as well as industrial crop. It is being grown in about 42 percent (24,226 ha) of total major spices cultivated area (57,479 ha) of Nepal which produce 276,150 Mt rhizome with the productivity of 11.40 Mt/ha [1]. The national average productivity of ginger is quite low and is mainly associated with many biotic (rhizome rot, rhizome fly, white grub and other minor diseases and insect pests) as well as abiotic (soil fertility degradation) factors that are often found in farmer's field at various ginger growing places [3].

Rhizome fly is a serious devastating insect pest of ginger. The maggots of the rhizome flies were found to be associated with the rhizome rot due to which decaying and rotting of the rhizomes was common in farmer's field [6]. Reference [5] reported that rhizome fly, shoot borer, mites, and white grub were also associated with the ginger rhizome rot complex. A survey conducted by Ginger Research Program (GRP) in major ginger growing district of Nepal revealed that the damage of rhizome fly was found responsible for initiating or hastening the rhizome rot complex [2]. Rhizome treatment at planting followed by soil drenching at 50 DAP with chlorpyriphos (20 EC) has been reported effective in controlling fly incidence [7]. The rhizome rot is more common during rainy season [6]. In Himachal Pradesh, India, rhizome treatment with Indofil M-45 (0.25%) + Bavistin (0.1%) and soil application of Phorate (12 kg/ha) (now banned in Nepal) managed rhizome rot and increased the yield. Rhizome treatment with DM-45 @ 2 gm/litre of water + Bavistin @ 1 gm /litre of water before storage and prior to planting has been reported to minimize the rhizome rot severity [4].

It is also apparent that the most of the reported research activities are centered on either rhizome fly management or rhizome rot management not both. The mitigation of this research gap could provide breakthrough in management of ginger's major pests. Hence, the reported research herein was conducted to find out the effective management of ginger rhizome fly and associated rhizome rot management technology for quality rhizome production.

2. Material and Methods

An experiment was conducted at GRP, Salyan during the normal ginger growing season of 2013 and 2014 to study the effect of insecticide (Chloropyrifos 20 EC), fungicides [DM-45 (Mancozeb 80 WP) and Bavistin (Carbendazim 50 DF)] and their combinations treated on seed rhizome and soil to minimize the rhizome fly infestation in ginger field. The monthly agro-

meteorological data at studied site is presented in Annex 1 and Annex 2.

A plot size of 4.8 m^2 was used. Farm Yard Manure (FYM) and fertilizers were applied @ 30 t/ha and NPK @ 75: 50: 50 kg/ha, respectively. Planting was done during the first week of April in 40 cm x 30 cm geometry. The eight treatments namely, (i) ginger seed rhizome treated with 2.5 g DM-45 + 1 g Bavistin per liter of water; (ii) ginger seed rhizome treated with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin per liter of water; (iii) ginger seed rhizome treated with 4 ml Chloropyrifos per liter of water and drenching same dose of Chloropyrifos; (iv) ginger seed rhizome treated with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin per liter of water and drenching with same dose of DM-45 (v) ginger seed rhizome treated with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin per liter of water and drenching same dose of Bavistin (vi) ginger seed rhizome treated with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water and drenching same dose of DM-45 + Bavistin (vii) ginger seed rhizome treated with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin per liter of water and drenching same dose of DM-45 + Bavistin + Chloropyrifos (viii) Control (Untreated ginger rhizome) were laid out in RCBD. The treatments were replicated thrice. After dipping in given solution (as described in treatment) for one hour all the treated rhizomes were dried in the shade before planting. One month after ginger germination soil drenching with pesticide solution @100 ml per plant (as described in treatment) was done. Mulching with dry leaves was done immediately after planting. Weeding was done twice during the crop season. The rhizome were harvested during the first week of December (after leaves and pseudo stems became dry and fallen down). The observations on initial plant stand (after full germination of seed rhizome), tiller number, plant height, final plant stand (plant population at the time of rhizome harvesting), fresh rhizome yield (FRY), rhizome fly infected rhizome yield (RFLY) and mother rhizome yield (MRY) were recorded and analyzed using statistical software MSTAT-C.

3. Result and Discussion

3.1 Effect on Yield Attributing Traits and Fresh Ginger Rhizome Yield

The effect of the different pesticides and their combination on yield attributing traits and different category of rhizome yield population is depicted in Table 1. The initial plant population, tiller number and plant height were statistically insignificant among the treatments, however, the fresh rhizome yield varied significantly with the treatments. Seed rhizome treated and soil drenched with the combination of 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin per liter of water produced the highest (20.89 mt/ha) fresh rhizome yield followed by the seed rhizome treated with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin per liter of water (17.05 mt/ha) and soil drenched with 4 ml Chloropyrifos (16.63 mt/ha). The above combinations of pesticides also retrieved highest mother rhizome yield ranging from 2.23 – 2.92 mt/ha. Ginger rhizome planting without the use of any chemical pesticides had lowest fresh (9.98 mt/ha) and mother rhizome yield (1.20 mt/ha). It is evident that insecticide Chloropyrifos and fungicides Diathane M- 45 and Bavistin were found compatible with each other.

Table 1. Effect of different treatment combinations on yield attributing traits and rhizome yield of ginger at GRP, Salyan during 2013 and 2014

		Initial plant stand/m^2	Tiller /clump	Plant height, cm	Rhizome yield, mt/ha	
					Fresh	Mother
Year	2013	7.97	5.80	49.43	16.67	2.22
	2014	8.31	6.37	63.71	13.00	1.78
Management practices	Ginger seed rhizome treatment with 2.5 g DM-45 + 1 g Bavistin/liter of water	8.29	5.53	60.24	11.93	1.78
	Ginger seed rhizome treatment with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water	8.17	5.93	60.66	17.05	2.31
	Ginger seed rhizome treatment with 4 ml Chloropyrifos and soil drenching with same dose of Chloropyrifos	8.11	6.86	58.70	16.63	2.92
	Ginger seed rhizome treatment with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water and soil drenching with same dose of DM-4	7.93	6.06	56.86	14.74	2.18
	Ginger seed rhizome treatment with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water and soil drenching with same dose of Bavistin	8.18	5.46	55.40	13.21	1.68
	Ginger seed rhizome treatment with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water and soil drenching with same dose of DM-45 + Bavistin	8.06	5.43	57.86	14.24	1.68
	Ginger seed rhizome treatment with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water and soil drenching with same dose of DM-45 + Bavistin + Chloropyrifos	8.38	7.40	58.96	20.89	2.23
	Control	8.03	6.03	43.90	9.98	1.20
	CV %	3.36	21.11	16.63	21.69	39.92
	Significance of F-test statistics	NS	NS	NS	**	*
	LSD (p=0.05)				5.36	0.45

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

3.2 Effect on Final Plant Population and Rhizome Fly Infected Rhizome Yield

The statistical analysis revealed non- significant result for first year (2013) and significant result for second year (2014) for the final plant population at the time of harvesting. In 2013 plant numbers varies from 7.63 – 8.12 per m^2 where as in 2014 seed rhizome treated and soil drenched with the combinations 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter produced highest (8.14/m^2) plant population (Table 2). The rhizome fly infected rhizome yield among the treatments was found highly significant in both the year. The lowest mean rhizome fly infected rhizome yield (0.32 mt/ha) was found in the treatment ginger seed rhizome treated and soil drenched with the combination of 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin per liter of water followed by the treatment ginger seed rhizome treated and drenched with 4 ml chloropyrifos (0.57 mt/ha). Ginger rhizome planting without the use of any pesticide produced highest rhizome fly infected yield (2.76 mt/ha). The yield gap between pesticides treated and untreated rhizome was found 2.44 mt/ha. It is evident that rhizome rot and rhizome fly was found to be associated with each other and for their management seed rhizome treatment and drenching with the combination of 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water is effective to minimize rotting and infestation of rhizome and produce highest fresh and mother rhizome yield.

Table 2. Effect of different treatment combination for final plant population and rhizome fly infected ginger rhizome yield at GRP, Salyan during 2013 and 2014.

Management practices	Final plant stand/m^2			Rhizome fly infected rhizome yield, mt/ha		
	2013	2014	Mean	2013	2014	Mean
Ginger seed rhizome treatment with 2.5 g DM-45 + 1 g Bavistin/liter of water	7.84	7.77	7.81	2.25	1.40	1.82
Ginger seed rhizome treatment with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water	8.05	7.48	7.76	0.34	0.85	0.60
Ginger seed rhizome treatment with 4 ml Chloropyrifos and soil drenching with same dose of Chloropyrifos	7.77	8.07	7.92	0.39	0.76	0.57
Ginger seed rhizome treatment with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water and soil drenching with same dose of DM-4	7.63	7.48	7.56	0.66	0.66	0.66
Ginger seed rhizome treatment with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water and soil drenching with same dose of Bavistin	7.84	6.96	7.40	0.55	1.71	1.13
Ginger seed rhizome treatment with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water and soil drenching with same dose of DM-45 + Bavistin	8.12	7.25	7.69	0.62	0.88	0.75
Ginger seed rhizome treatment with 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin/liter of water and soil drenching with same dose of DM-45 + Bavistin + Chloropyrifos	8.05	8.14	8.10	0.17	0.48	0.32
Control	7.96	6.96	7.47	3.63	1.89	2.76
CV %	3.83	5.92		32.66	20.15	
Significance of F-test statistics	NS	*		**	**	
LSD (p=0.05)		0.779		0.618	0.382	

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

4. Conclusion

The rhizome fly and rhizome rot was found to be associated. The insecticide, Chloropyrifos and fungicides Diathane M- 45 and Bavistin were found to be compatible with each other. Ginger rhizome seed treatment during planting with the combinations 4 ml Chloropyrifos + 2.5 g DM-45 + 1 g Bavistin per liter water and soil drenching with same dose one month after germination provide maximum protection with highest fresh and mother rhizome yield with lowest infestation. It will be worthy to focus future research on testing of lower dose of pesticides than used in present research.

Acknowledgements

The author is grateful to Mr. Govind KC and Mr. Bandhuraj Baral former and present coordinator of GRP for providing necessary facilities and encouraging for conducting this experiment. Thanks are due to the staff of GRP for their support. Thank is also extended to Prof. Dr. Durga Mani Gautam for helping in preparing this manuscript.

References

[1] ABPSD. Statistical information on Nepalese agriculture 2013/14 (2070/071). Agri-Business Promotion and Statistics Division, Ministry of Agriculture and Cooperatives, Government of Nepal, Kathmandu, Nepal. 2014.

[2] Gautam, J and Acharya, B. Survey and monitoring of insect pest and disease of ginger in Nepal. *Nepalese Journal of Agricultural Sciences* 2014, 12: 118-123.

[3] GRP. Annual technical report 2009/2010. National Ginger Research Program (NGRP), Kapurkot, Salyan, Nepal, 2010.

[4] KC, G. Ginger cultivation technology. Leaflets in nepali language. Nepal Agriculture Research Council, Ginger Research Program, Kapurkot, Salyan 2010.

[5] Sah, DN, Malla, S and Pokharel, D. Integrated management of rhizome rot disease of ginger in the hills of Nepal. Lumle technical paper. Agriculture Research Station Lumle, Pokhara, Nepal. 2001.

[6] Sharma, BP, Shrestha, SK and Giri, YP. "Present status of diseases and insect pests of ginger in Nepal". *In: Proceedings of the second national horticulture research workshop* on 13-15 May 1998, Khumaltar, Lalitpur, Nepal. Nepal Agriculture Research Council (NARC), 173-178.

[7] Sontakke, B. K. and Roul, P. K. Integrated management of rhizome fly, *Mimegralla coeruleifrons* infesting ginger crop. College of Agriculture (O.U.A.T.) Chiplima, Sambalpur - 768 025, Orissa, India. 2007.

Annexes

Annex 1. Monthly Agro-meteorological Data at GRP Kapurkot, Salyan (1480 masl), 2013/14

Nepalese month	Period	Temperature °C		Cumulative rainfall (mm)	Mean relative humidity %	Wind Velocity Km/hr
		Mean				
		Max	Min			
Baisakh	IInd fortnight of April	21.18	15.18	64.4	68.93	2.25
	Ist fortnight of May	26.13	17.73	0.0	61.68	2.68
Jestha	IInd fortnight of May	24.81	19.62	3.3	75.62	1.35
	Ist fortnight of June	23.86	19.00	125.6	69.93	1.23
Ashad	IInd fortnight of June	21.46	18.40	393.0	78.73	1.61
	Ist fortnight of July	21.53	20.00	183.1	80.06	0.57
Shravan	IInd fortnight of July	22.25	20.37	593.0	78.93	0.46
	Ist fortnight of August	22.87	19.81	376.9	77.87	0.50
Bhadra	IInd fortnight of August	21.73	19.73	107.0	79.40	0.42
	Ist fortnight of September	22.46	18.06	23.9	81.00	0.35
Ashwin	IInd fortnight of September	22.66	18.20	36.8	77.33	0.41
	Ist fortnight of October	19.43	16.43	54.4	76.25	0.27
Kartik	IInd fortnight of October	19.00	14.00	14.0	76.00	0.98
	Ist fortnight of November	18.50	11.85	0.0	75.00	2.23
Mangsir	IInd fortnight of November	16.13	9.93	0.0	73.06	1.32
	Ist fortnight of December	15.53	9.26	0.0	71.46	0.87
Poush	IInd fortnight of December	13.50	7.31	0.0	66.56	2.29
	Ist fortnight of January	12.86	7.20	13.0	69.06	1.76
Magh	IInd fortnight of January	14.56	10.62	36.0	67.31	1.62
	Ist fortnight of February	17.42	12.92	2.0	67.85	3.03
Falgun	IInd fortnight of February	15.50	10.50	50.0	71.92	2.09
	Ist fortnight of March	17.07	11.42	22.0	72.5.0	3.50
Chaitra	IInd fortnight of March	22.12	11.18	5.0	67.50	4.36
	Ist fortnight of April	24.86	13.40	2.0	59.06	3.55
Total/Average		19.89	14.67	2105.4	1743.01	1.65

Annex 2. Monthly Agro-meteorological Data at GRP Kapurkot, Salyan (1480 masl), 2014/15.

Nepalese month	Period	Temperature °C		Cumulative rainfall (mm)	Mean relative humidity %	Wind Velocity Km/hr
		Mean				
		Max	Min			
Baisakh	IInd fortnight of April	26.58	15.82	0	60.41	2.37
	Ist fortnight of May	27.42	17.64	16.5	64.5	2.51
Jestha	IInd fortnight of May	28.41	17.82	32	63.82	1.41
	Ist fortnight of June	28.71	19.71	15.8	69.78	1.22
Ashad	IInd fortnight of June	26.37	19.87	126.7	73.03	0.61
	Ist fortnight of July	24.87	19.62	313.6	79.12	0.23
Shravan	IInd fortnight of July	24.80	18.20	143.3	76.43	0.19
	Ist fortnight of August	24.12	19.25	354.5	80.56	0.08
Bhadra	IInd fortnight of August	24.66	18.53	37.9	79.2	0.03
	Ist fortnight of September	24.43	17.53	103.4	78.62	0.11
Ashwin	IInd fortnight of September	23.53	16.64	27.3	78.42	0.06
	Ist fortnight of October	23.29	13.17	37.5	76	0.41
Kartik	IInd fortnight of October	21.25	11.00	0	71.03	0.53
	Ist fortnight of November	20.87	10.68	0	73.25	0.54
Mangsir	IInd fortnight of November	18.39	7.96	0	76.75	0.41
	Ist fortnight of December	18.23	6.06	34	72.53	1.53
Poush	IInd fortnight of December	16.34	3.40	16	70.68	0.64
	Ist fortnight of January	14.28	5.57	61	71	0.55
Magh	IInd fortnight of January	15.35	5.26	3.9	67.94	1.09
	Ist fortnight of February	15.41	6.08	18.4	69.2	2.34
Falgun	IInd fortnight of February	17.96	8.56	21	72.84	1.05
	Ist fortnight of March	18.25	10.10	55.1	67.85	1.63
Chaitra	IInd fortnight of March	21.50	12.26	11.5	70.7	0.34
	Ist fortnight of April	21.92	12.38	22.9	66.61	1.44
Total/Average		**21.95**	**13.04**	**1452.3**	**72.09**	**0.88**