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Reaction of ginger cultivars against rhizome fly, *Mimegralla coeruleifrons* and its management

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ABSTRACT: Among different ginger cultivars evaluated at College of Horticulture, Bidar, Karnataka, India during 2013 and 2014for their reaction to rhizome fly, *Mimegralla coeruleifrons* Macquart (Micropezidae: Diptera),the cultivars 'Rio-de-janerio' and 'Humnabad local' recoded lower dead ginger plants, shoot infestation, rhizome infestation, lowest tunnel length, tunnel breadth in infested rhizomes and highest weight of the rhizome (infested and healthy) and yield. The treatment (Application of neem Cake @800 kg/acre at the time planting + ginger seed treatment with chlorpyriphos 20 EC @ 2ml/l of water and drenching with same dose of chlorpyriphos) recorded highest plant stand,tillers/clump, plant height and rhizome yield during.

Key Words: Ginger, management, *Mimegralla coeruleifrons,* resistance

INTRODUCTION

Ginger (*Zingibe rofficinale* Rosc.) is an important spice and medicinal crop grown worldover. India is the leading producer of ginger with an area of 1.58 lakh hectares and production of 7.45 lakh tones (Jayshree *et al.,* 2015). Ginger cultivation in India is beset with spectrum of problems among which insect pests are the major ones. More than 30 species of insects have been reported to infest the crop in India including under storage (Devasahayam and Koya, 2004). Rhizome fly is a serious devastating insect pest of ginger (Janarjan and Ram, 2016).The adult flies lay the eggs in the soil around the rhizome and maggots emerged introduce micro-organism after primary feeding and is known to cause the damage to the extent of 25 to 31 per cent (Ghorpade *et al.*, 983). The maggots of these flies bore in to the rhizome and feed on the internal content. The pest can be controlled by spraying 0.05% methyl parathion at monthly intervals (Anonymous, 1985). The pupal stage is responsible for carryover of the pest from one season to another through rhizomes used for planting. The peak period of infestation in endemic areas is from mid August to mid October (Ghorpade *et al.*, 2008). However, an intensive spray of chemicals can lead to the residues in the produce and become cause for health concern. Further, there is acute shortage of information regarding management of rhizome fly.

Hence, to identify cultivars resistant to the pest and thereafter to ascertain the appropriate management proposition to contain the rhizome fly present investigation were undertaken.

MATERIALS METHODS

Reaction of Ginger cultivars

An experiment was conducted during *kharif* 2013, 2014, 2015and 2016 at College of Horticulture, Bidar, Karnataka in Randomized Block Design with a plot size of 3m X 1m. Ten ginger cultivars *viz.,* Humnabad Local, Himagiri, Rio-de-Janerio, Suprabha, Himachal, Suruchi, Suravi, ISSR-Vardha, ISSR-Mahima and ISSR-Rejitha wereplanted at a spacing of 20cm X 30cm (rhizome to rhizome X row to row) and the crop was raised by following recommended package practices for the region (Anonymous, 2013) except spray of insecticides against insect pests. The cultivars were tested for rhizome fly (*Mimegralla coeruleifrons*) incidence under natural conditions during 2013 and 2014. The total number of ginger plants and the number of dead plants were recorded from each ginger genotype after germination and the percentage of dead plants of ginger were calculated. Similar way ginger shoot infestation and rhizome infestation were calculated. Mean length of tunnel, breadth of tunnel, weight of healthy rhizome, weight of the infested rhizome from 10 randomly selected samples and yield were recorded. The experiment was replicated three times. The data was subjected to statistical analysis (ANOVA) to determine the significance of treatments. The means were compared by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) at P=0.05.

Table 1. Reaction of different ginger cultivars to rhizome fly, *Mimegralla coeruleifrons*

Genotype	2013			2014		
	Dead ginger plants (%)	Shoot infestation (%)	Rhizome infestation (%)	Dead ginger plants (%)	Shoot infestation (%)	Rhizome infestation (%)
Rio-de-Janerio	9.12^{e}(17.56)	7.60^{e}(16.00)	10.42^{e}(18.81)	5.50^{e}(17.95)	7.78^{e}(16.22)	10.61e (19.00)
Himagiri	15.54^{d}(23.19)	14.03^{d}(21.97)	16.92^{d}(24.27)	15.86^{d}(23.50)	14.31^{d}(22.22)	17.05^{d}(24.43)
Humnabad local	9.25^{e}(17.76)	7.72^{e}(16.11)	10.57^{e}(19.00)	9.57^{e}(18.05)	7.90^{e}(16.32)	10.70^{e}(19.09)
Suprabha	17.06^{c}(24.43)	15.50^{c}(23.19)	18.31^{c}(25.33)	17.38^{c}(24.65)	15.78^{c}(23.42)	18.44^{c}(25.40)
Himachal	17.17^{c}(24.50)	15.63^{c}(23.26)	18.48^{c}(25.48)	17.49^{c}(24.73)	15.91^{c}(23.50)	18.61^{c}(25.55)
Suruchi	18.24^{b}(25.25)	16.72^{b}(24.12)	19.40^{b}(26.13)	18.56^{b}(25.55)	16.90^{b}(24.27)	19.53^{b}(26.21)
Suravi	19.45^{ab}(26.21)	17.90^{a}(25.03)	20.79^{a}(27.13)	19.77^{ab}(26.42)	18.18^{a}(25.25)	20.92^{a}(27.20)
ISSR-Vardha	19.56^{ab}(26.28)	18.12^{a}(25.18)	20.97^{a}(27.28)	19.88^{ab}(26.49)	18.40^{a}(25.40)	21.10^{a}(27.35)
ISSR-Mahima	20.18^{a}(26.71)	18.61^{a}(25.55)	21.40^{a}(27.56)	20.50^{a}(26.92)	18.89^{a}(25.77)	21.53^{a}(27.63)
ISSR-Rejitha	18.57^{b}(25.55)	17.03^{b}(24.35)	19.81^{ab}(26.42)	18.89^{b}(25.77)	17.31^{b}(24.58)	19.94^{ab}(26.49)

Note: Figures in parentheses are arc sine transformed values used for statistical analysis.

Table 2. Mean length, breadth of tunnel, weight of rhizome and yield as influenced by rhizome fly infestation

Genotype	2013					2014				
	Length of tunnel (cm)	Breadth of tunnel (cm)	Weight of healthy rhizome (g)	Weight of infested rhizome (g)	Yield (Q/ha)	Length of tunnel (cm)	Breadth of tunnel (cm)	Weight of healthy rhizome (g)	Weight of infested rhizome (g)	Yield (Q/ha)
Rio-de-Janerio	0.77^{e}	0.27^{f}	146.20^{a}	141.7^{a}	195.14^{a}	0.82^{e}	0.27e	146.70^{a}	141.6^{a}	196.1^{a}
	(1.33)	(1.13)	(12.13)	(11.95)	(14)	(1.35)	(1.13)	(12.15)	(11.94)	(14.04)
Himagiri	1.13^{d}	0.86^{a}	125.50^{b}	119.7^{b}	139.40^{e}	1.18^{d}	0.89^{a}	126.00^{b}	119.55^{b}	140.2^{e}
	(1.46)	(1.36)	(11.25)	(10.99)	(11.83)	(1.48)	(1.34)	(11.27)	(10.98)	(11.88)
Humnabad local	0.80^{e}	0.29^{e}	145.0^{a}	139.4^{a}	191.20^{a}	0.85^{e}	0.33^{e}	145.50^{a}	140.35^{a}	192.3^{a}
	(1.34)	(1.14)	(12.08)	(11.85)	(13.86)	(1.36)	(1.15)	(12.10)	(11.88)	(13.90)
Suprabha	1.40^{c}	0.40^{d}	70.50^{e}	65.1^{c}	170.30^{e}	1.45^{c}	0.42^{d}	71.00^{e}	65.01^{c}	171.5^{e}
	(1.55)	(1.18)	(8.46)	(8.13)	(13.08)	(1.57)	(1.19)	(8.49)	(8.12)	(13.13)
Himachal	1.44^{c}	0.40^{d}	71.70^{e}	66.4^{c}	182.0^{b}	1.50^{c}	0.43^{d}	72.20^{e}	66.30^{e}	183.0^{b}
	(1.56)	(1.18)	(8.53)	(8.21)	(13.53)	(1.58)	(1.20)	(8.56)	(8.20)	(13.56)
Suruchi	1.78^{b}	0.50^{e}	52.35^{d}	47.1^{d}	155.10^{d}	1.85^{b}	0.54^{e}	52.85^{d}	47.00^{d}	156.1^{d}
	(1.67)	(1.22)	(7.30)	(6.94)	(12.49)	(1.69)	(1.24)	(7.34)	(6.93)	(12.53)
Suravi	1.92^{ab}	0.46^{c}	48.00^{e}	43.2^{e}	145.40^{e}	1.97^{ab}	0.47^{c}	48.50^{e}	43.10^{e}	146.2^{e}
	(1.71)	(1.21)	(7.00)	(6.65)	(12.08)	(1.72)	(1.21)	(7.04)	(6.64)	(12.13)
ISSR-Vardha	1.96^{ab}	0.48^{c}	48.15^{e}	43.5^{e}	143.30^{e}	1.99^{ab}	0.45^{c}	48.65^{e}	43.40^{e}	144.1^{e}
	(1.72)	(1.22)	(7.01)	(6.67)	(12.00)	(11.73)	(1.20)	(7.05)	(6.66)	(12.05)
ISSR-Mahima	2.12^{a}	0.56^{b}	39.18^{f}	34.5^{f}	123.20^{f}	2.12^{a}	0.58^{b}	39.68^{f}	34.40^{f}	124.2^{f}
	(1.77)	(1.25)	(6.34)	(5.96)	(11.14)	(1.77)	(1.26)	(6.38)	(5.95)	(11.19)
ISSR-Rejitha	1.81^{b}	0.54^{b}	51.10^{d}	46.5^{d}	153.10^{d}	1.87^{b}	0.56^{b}	51.60^{d}	46.40^{d}	154.0^{d}
	(1.68)	(1.24)	(7.22)	(6.89)	(12.41)	(1.69)	(1.25)	(7.25)	(6.88)	(12.45)

Note: Figures in parentheses are ($\sqrt{(X + 1)}$) transformed values used for statistical analysis

Table 3. Effect of different treatments on yield attributing traits and rhizome yield of ginger cv. Humnabad Local during *kharif,* 2015

Treatment	Initial plant stand/m²	Final plant tillers/clump	Number of (cm)	Plant height yield (Q/ha)	Rhizome
Application of Neem Cake @800 kg/acre at the time planting	16.66[a] (4.20)	11.20[e] (3.49)	5.74[c] (2.6)	47.50[e] (6.96)	158.65[f] (12.63)
Ginger seed treatment with Chlorpyriphos 20 EC @2ml/litre of water	16.43[a] (4.17)	13.55[b] (3.81)	6.40[b] (2.72)	53.76[c] (7.4)	173.70[c] (13.21)
Ginger seed treatment with Chlorpyriphos 20 EC @2ml/litre of water and drenching with same dose of Chlorpyriphos	16.21[a] (4.15)	14.10[b] (3.88)	6.75[b] (2.78)	56.50[c] (7.58)	181.79[bc] (13.51)
Application of Neem Cake @800 kg/acre at the time planting + Ginger seed treatment with Chlorpyriphos 20 EC @2ml/litre of water and drenching with same dose of Chlorpyriphos	16.27[a] (4.16)	15.25[a] (4.03)	7.48[a] (2.91)	64.05[a] (8.06)	195.69[a] (14.02)
Ginger seed treatment with quinolphos 25 EC @2ml/litre of water	16.52[a] (4.19)	12.5[d] (3.67)	6.15[c] (2.67)	48.68[d] (7.04)	160.73[e] (12.71)
Ginger seed treatment with quinolphos 25 EC @2ml/litre of water and drenching with same dose of Quinolphos	16.33[a] (4.16)	13.10[c] (3.75)	6.31[bc] (2.70)	51.75[bc] (7.26)	166.67[d] (12.94)
Application of Neem Cake @ 800 kg at the time planting + Ginger seed treatment with Quinolphos 25 EC @2ml/litre of water and drenching with same dose of Quinolphos	16.5[a] (4.18)	14.50[a] (3.94)	7.21[a] (2.86)	60.38[b] (7.83)	185.32[b] (13.64)
Untreated control	16.34[a] (4.16)	10.56[f] (3.40)	5.55[d] (2.55)	44.25[f] (6.57)	140.79[g] (11.90)

Note: Figures in parentheses are ($\sqrt{(X + 1)}$) transformed values used for statistical analysis

Based on the results obtained for the reaction of ginger cultivars against rhizome fly during 2013 and 2014, Humnabad Local (a leading ginger cultivar in northern Karnataka) was planted during 2015 and 2016 to evaluate eight treatments including untreated check (Table 3) against rhizome fly, *Mimegralla coeruleifron.* The experiment was replicated three times. Initial plant stand, final plant stand, number of tillers/clump and plant height from 10 randomly selected tagged plants were registered and rhizome yield as influenced by rhizome fly infestation were recorded from each plot. The data was subjected to statistical analysis (ANOVA) to determine the significance of treatments. The means were compared by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) at P=0.05.

RESULTS AND DISCUSSION

Reaction of Ginger cultivars

The percentage of dead ginger pants after germination varied significantly among the ginger genotypes. Significantly lowest dead ginger plants were recorded in Rio-de-Janerio (9.12%) and Humnabad Local (9.25%) which were statistically on par with each other. The ISSR- Mahima registered highest plant death (20.18%) (Table 1). The Rio-de-Janerio and Humnabad Local were again the best with lowest shoot infestation of 7.66 and 7.72 per cent, respectively. Highest shoot infestation was observed in ISSR-Mahima (18.61%). The rhizome infestation in Rio-de-Janerio (10.42%) and Humnabad Local (10.57%) was lowest during 2013. The trend observed during 2014 for above parameters was

Table 4. Effect of different treatments on yield attributing traits and rhizome yield of ginger cv. Humnabad Local during *kharif,* 2016

Treatment	Initial plant stand/m²	Final plant stand/m²	Number of tillers/clump	Plant height (cm)	Rhizome yield (Q/ha)
Application of Neem Cake @ 800 kg/acre at the time planting	16.53[a] (4.18)	11.10[e] (3.47)	5.70[c] (2.58)	47.48[d] (6.96)	156.15[f] (12.53)
Ginger seed treatment with Chlorpyriphos 20 EC @ 2ml/litre of water	16.30[a] (4.15)	13.46[b] (3.80)	6.38[b] (2.71)	53.72[c] (7.39)	171.20[e] (13.12)
Ginger seed treatment with Chlorpyriphos 20 EC @ 2ml/litre of water and drenching with same dose of Chlorpyriphos	16.08[a] (4.13)	14.01[b] (3.87)	6.72[b] (2.77)	56.47[c] (7.58)	179.29[bc] (13.42)
Application of Neem Cake @ 800 kg/acre at the time planting + Ginger seed treatment with Chlorpyriphos 20 EC @ 2ml/litre of water and drenching with same dose of Chlorpyriphos	16.14[a] (4.14)	15.16[a] (4.01)	7.44[a] (2.90)	64.03[a] (8.06)	193.19[a] (13.93)
Ginger seed treatment with quinolphos 25 EC @ 2ml/litre of water	16.39[a] (4.23)	12.41[d] (3.66)	6.13[c] (2.67)	48.64[cd] (7.04)	158.23[e] (12.61)
Ginger seed treatment with quinolphos 25 EC @ 2ml/litre of water and drenching with same dose of Quinolphos	16.20[a] (4.14)	13.01[c] (3.74)	6.28[bc] (2.69)	51.72[bc] (7.26)	164.17[d] (12.85)
Application of Neem Cake @ 800 kg at the time planting + Ginger seed treatment with Quinolphos 25 EC @ 2ml/litre of water and drenching with same dose of Quinolphos	16.37[a] (4.16)	14.42[a] (3.92)	7.17[a] (2.85)	60.36[b] (7.83)	182.82[b] (13.55)
Untreated control	16.21[a] (4.14)	10.49[f] (3.38)	5.53[d] (2.55)	44.21[e] (6.72)	137.20[g] (11.75)

Note: Figures in parentheses are ($\sqrt{(X + 1)}$) transformed values used for statistical analysis

similar as in 2013. The tunnel length was lowest in Rio-de-Janerio (0.77cm) and Humnabad Local (0.80 cm) (Table-3). Whereas, ISSR-Mahima recorded highest tunnel length (2.12cm). The Rio-de-Janerio and Humnabad Local were significantly superior over other genotypes by recording lowest tunnel breadth of 0.27 cm and 0.29cm, respectively, whereas, tunnel breadth was highest in Himagiri (0.86 cm). The weight of the healthy rhizomes was higher in Rio-de-Janerio (146.20 gm) and Humnabad Local (145.0gm) and was lowest in ISSR-Mahima (39.18gm). Similarly, Rio-de-Janerio and Humnabad Local recorded significantly higher weight of infested rhizome 141.7gm and 139.40gm, respectively. Again lowest infested rhizome weight was recorded in ISSR-Mahima (34.5 gm). Rio-de-Janerio and Humnbad Local were best by registering Highest yield of 195.14q/ha and 191.20q/ha, respectively. Lowest yield was recorded in ISSR-Mahima (123.20q/ha). Similar trend was observed during 2014.

Management of rhizome fly

The treatment (application of Neem Cake @800 kg/acre at the time planting + Ginger seed treatment with Chlorpyriphos 20 EC @2ml/litre of water and drenching with same dose of Chlorpyriphos) was best by recording highest final plant stand (15.25), tillers/clump (7.48), plant height (64.05cm) and rhizome yield (195.69q/ha), followed by, the treatment (Application of Neem Cake @800 kg at the time planting + Ginger seed treatment with Quinolphos 25 EC @ 2ml/litre of water and drenching with same dose of quinolphos) (Table-4). Untreated control recorded lowest final plant stand (10.56), tillers/clump (5.55), plant height (44.25cm) and rhizome yield (140.79q/ha). Similar trend was observed during 2016.

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