Environment & Ecology 27 (1) : 1—4, 2009
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Symptomatological Variation of Rhizome Rot-Wilt Complex Disease of Ginger under Terai Agro-Ecological Region of West Bengal

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Abstract

Ginger is one of the most important spice crops in India. In India, ginger is cultivated in almost all the states. Besides Kerala, the leading ginger producing states are Karnataka, West Bengal, Andhra Pradesh, Orissa, Sikkim, Meghalaya and Himachal Pradesh. In West Bengal, ginger ranks in top order among the major spices and its cultivation is mostly confined to terai and hilly zone. Ginger suffers from a wide variety of diseases caused by fungi, bacteria and nematodes. Rhizome rot-wilt complex is a serious disease of ginger, causing considerable economic loss to growers in different countries. This disease is caused by a complex of pathogens. A survey was done in eight villages of Coochbehar block II region to study the symptoms and the severity of this disease in that region. Two types of symptoms were found, one is quick wilting (type 1 symptom) and the other is slow wilting and yellowing (type II symptom). In terai region of West Bengal, type II type of symptom is common than type I symptom. Type II symptom is mainly associated with fungal infection (*Pythium* sp. and *Fusarium* sp.) and type I symptom is associated with mainly bacterial infection (*Ralstonia* sp.). Highest population of *Fusarium* sp. and lowest population of *Ralstonia* sp. were observed in type II type symptom. Nematodes were also observed in all the surveyed plots.
Key words : Ginger, Rhizome rot-wilt complex, Symptom variation, Fungal infection, Bacterial infection.

Ginger is one of the most important spice crops traded internationally and domestically for spices, medicine, food such as salted ginger and beverage. India is the largest producer (391.2 thousand tonnes from 110.6 thousand hectares) (1) and exporter of ginger in the world. In India, ginger is cultivated in almost all the states. In West Bengal, ginger ranks in top order among the major spices and its cultivation is mostly confined to terai and hilly zones. Diseases are one of the major impediments behind the poor production of ginger. Ginger suffers from a wide variety of diseases caused by fungi, bacteria and nematode. Rhizome rot-wilt disease complex of ginger is a serious disease of ginger, causing considerable economic loss to growers in different countries. In India, this disease complex is prevalent in most of the ginger growing areas and may cause losses to the extent of 50% or more (2). About 8.5% of India's earnings from agricultural and allied products come from spices, which constitutes 1.24% of the total export earnings during 1999—2000 (3).

Methods

Disease Survey of Ginger under Cooch Behar Block II Region

A survey on severity of rhizome rot and wilt disease complex of ginger was conducted in 41 plots of eight different villages of Cooch Behar block II during June —October, 2005. The detailed locations of surveyed area are enlisted in Table 1. The different parameters like severity of rhizome rots and wilt disease complex, pathogens, associated, symptomatologies were studied in detail. In the surveyed area the infected rhizomes, plants and rhizospheric soil were collected for isolation and enumeration of the pathogen following standard method.

Table 1. Relative intensity of rhizome rot-wilt disease as estimated in 2005. H—High, M—Medium, L—Low, N—Nil.

Block	Village cluster	No. of plots	No. of plots rated in disease intensity As reported by farmers H	M	L	N
Cooch Behar block-II	Pundibari	7	1	3	2	1
	Picherdanga	5	2	2	1	-
	Sakunibala	6	-	1	2	3
	Khagribari	6	2	1	2	1
	Madhupur	5	1	1	1	2
	Dauguri	6	2	2	1	1
	Bahannaghar	2	1	1	0	0
	Kalaraikuthi	4	-	2	1	1
	Total	41	9	13	10	9
	Percent of Total		22.0	31.7	24.4	22.0

Rating of Disease Intensity in Farmer's Field

The survey was made to study the relative intensity of the disease in 41 plots of eight villages of Cooch Behar block II during June—October, 2005. In all the surveyed plots the data related to the relative disease intensity of rhizome rot and wilt disease complex of ginger in 1 m^2 marked area of five different location of farmers field were recorded at 45-day intervals. The number of plants counted varied from 250–750 per plot depending upon the size of the plot. Plots showing above 40% diseased plant were rated as high, below 40% but above 20% were rated as medium and plots showing below 20% diseased plant were rated as low in disease intensity. Absence of any diseased plant in plot rated as nil for disease intensity.

Isolation of Fungi from Soil and Infected Rhizomes

The fungi were isolated from the soil by dilution plating method on potato dextrose agar (PDA), potato dextrose agar with bavistin (PDA with bavistin) and *Pythium* specific medium. The plates were then incubated at 27 C (± 2) and morphologically different colonies were picked up and purified. Fungi were also isolated from the infected ginger pieces of about 20–30g following standard methods in these media.

Isolation of Pathogenic Bacteria from Soil, Infected Rhizomes and Pseudo-stems.

Isolation of pathogenic bacteria was done from ginger grown soil, infected rhizome and infected pseudo-stem of Cooch Behar and Kalimpong subdivision. Following standard soil sampling method the collection of soil from infected ginger field was done. Ten grams of soil thus obtained was crushed with sterilized mortar pestle and shaken with 100 ml of sterilized distilled water for 10–20 minutes to obtain a bacterial suspension. The bacterial suspension thus obtained were used for isolation of *Ralstonia solanacearum* by dilution plating method on TZC (tetrazolium chloride) medium. The colony forming unit (cfu) were counted on the plates after 48 hour of the growth at 28 ± 1C and morphologically fluidal colonies with pink center were picked up and purified. Pathogenic bacteria were also isolated from infected rhizomes and pseudo-stems following standard methods. The purified *Ralstonia solanacearum* cultures isolated from infected soil and rhizomes and pseudo-stem were preserved in sterilized water at 4 C.

Table 2. Symptoms and pathogen association with rhizome rot and wilt disease complex of ginger.

Location	Symptoms	Pathogen associated Fusarium	Pythium	Ralstonia	Nematode
Pundibari	Yellowing, wilting	+	+	+	+
Picherdanga	Faded color young leaf, Yellowing, wilting with bacterial odor from rotten rhizome	+	+	+	+
Khagribari	Yellowing, wilting	–	+	+	+
Sakunibala	Yellowing	+	–	–	+
Madhupur	Yellowing, wilting	+	+	–	–
Dauaguri	Yellowing, wilting, bacterial ooze from rotten rhizome	+	+	+	+
Bahannaghar	Yellowing and wilting	+	+	–	+
Kalarai kuthi	Yellowing and wilting	+	–	+	+

Results and Discussion

Disease Intensity as Estimated in Cooch Behar Block II in 2005

Based on the assessment of the disease the 41

Table 3. Relative distribution of two symptom types in 32 plots located in Cooch Behar Block II region.

Village	No. of plots	Type I	Type II	Type I and type II
Pundibari	6	1	1	4
Picherdanga	5	2	-	3
Sakunibala	3	-	3	-
Khagribari	5	1	1	3
Madhupur	3	-	3	-
Dauguri	5	1	-	4
Bahannghar	2	-	2	-
Kalarai kuthi	3	1	1	1
Total	32	6	11	15

Table 4. Enumeration of associated pathogens in soil.

Block	Village	Population of associated pathogen/g of soil *Fusarium* spp.	*Pythium* spp.	*Ralstonia* spp.
Cooch Behar block II	Pundibari	27×10^3	7.5×10^2	17×10^6
	Picherdanga	22×10^3	23×10^3	29×10^6
	Khagribari	2.0×10^3	15×10^3	25×10^6
	Sakunibala	43×10^3	2.0×10^3	8.0×10^5
	Madhupur	32×10^3	11×10^3	2.0×10^6
	Dauaguri	25×10^3	13×10^3	25×10^6
	Bahannaghar	22×10^3	27×10^3	3.0×10^6
	Kalarai kuthi	21×10^3	17×10^3	18×10^6

plots could be categorized (Table 1). Nearly 22% of the plots were rated as high, 32% as moderate, 24% as low and nearly 22% shows no disease incidence. Taking high and moderately high classes together, 54% of the plots appeared to suffer from the disease severely. Villages of Cooch Behar block II reporting no disease were distributed randomly and no village in this block was free from disease exclusively. In spite of the wide severity, about 22% plots escaped the disease under Cooch Behar block II in the terai agro-ecological region (Table 1).

Symptoms and Pathogen Association with Rhizome Rot and Wilt Disease Complex of Ginger

Based on the field observation of the disease at different locations of the 41 plots two characteristic types symptom manifestations were observed (Table 2). First was faded yellowing of leaves and quick wilt followed by extensive rotting of rhizomes with foul odor and second was yellowing, slow wilting followed by partial or complete rotting of rhizomes. The first type of symptom is named as type I and second type of symptom as type II. The presence of nematode was observed in almost all the surveyed plots for studying the disease intensity. *Ralstonia solanacearum* is primarily associated with type I type of symptom whereas in type II symptom fungal pathogens (either *Fusarium* or *Pythium* or both) were associated. Table 3 indicates that 34% surveyed plots were mainly affected by type II symptom, a slow wilt soft rot type of symptom and 19% surveyed plots were affected by type I symptom, a quick wilt type of symptom. The fungal pathogen (either *Fusarium* or *Pythium* or both) were primarily associated with type II symptom and *Ralstonia solanacearum* is associated with type I symptom. About 47% of the diseased plots showed both type 1 and type II types of symptoms (Tables 2 and 3). This result is in accordance with earlier reports (4) that *Pythium* sp. and *Fusarium* sp. cause soft rot and yellows of ginger respectively, but in most of the cases both the pathogens are involved. They also reported that sometimes *Ralstonia solanacearum (= Pseudomonas solanacearum)* biotype III is also associated.

Enumeration of Associated Pathogen Population in Rhizome Rot Wilt Affected Soils

The enumeration of pathogen population present in the rhizome rot wilt infected soils of the region was done following the method of serial dilution in pathogen specific medium and the data were presented in Table 4. Table 4 indicates that *Fusarium, Pythium, Ralstonia* and nematode were present in all the soil samples collected from the eight villages of Cooch Behar block II region. However, highest population of *Fusarium* (43×10^3) and lowest population of *Ralstonia* (8×10^5) were observed in the Sakunibala village of the region. Only type II symptom of rhizome rot and wilt disease complex was observed in Sakunibala village. Fairly higher populations of all the pathogen were observed in the infected soil of Picherdanga village and here both type I and type II symptoms were observed. The nematodes were present in almost all the plots surveyed.

Identification of the Pathogens Associated with the Rhizome Rot and Wilt Disease Complex

Two different types of *Fusarium* from the infected rhizome and soil from villages of the region were recorded. Both F_1 and F_2 types of cultures were sent to Agharkar Research Institute for species level identification and F_1 was identified as *Fusarium solani* and F_2 as *Fusarium moniliforme.* Among the two types of *Fusarium* sp., *Fusarium solani* was dominating in both the soil and rhizome of eight different villages of the region. Morphological and biochemical characterization of pathogenic bacterium was done following standard methods. Biovar determination was done following the methods of Hayward (5). The isolated bacteria were identified as *Ralstonia solanacearum* biovar III. This observation was in accordance with the findings of Kumar et al. (6) who also reported biovar III ginger *Ralstonia solanacearum* isolate from Kerala and Karnataka.

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