



## SHORT COMMUNICATION

## Evaluation of ginger germplasm for resistance to soft rot caused by *Pythium myriotylum*

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Ginger (*Zingiber officinale* Rosc.), an important spice crop is highly susceptible to soft rot caused by species of *Pythium*. The disease is of soil borne nature and the pathogen multiplies with the build up of soil moisture. Younger sprouts are more susceptible to the pathogen. At the early stage of infection, collar region of affected pseudo stem becomes water soaked which later spreads to the rhizome resulting in typical soft rot. Different species of *Pythium* viz., *P. vexans*, *P. myriotylum*, *P. graminicolum*, *P. aphanidermatum*, *P. zingiberum*, *P. ultimum* and *P. splendens* were observed as pathogens from various ginger growing regions. Among the pathogens, *P. myriotylum* is found as the predominant pathogen in many parts of the country and outside (3, 9, 2, 5). Several fungicides have been reported as effective in controlling the disease. However fungicide drenching schedules and their effectiveness is severely hampered due to incessant rain when the crop is at the most vulnerable stage for infection. Since, many of these control measures are not that much effective, development of resistant varieties is the most effective alternative to escape from the heavy crop loss occurring due to this disease.

In this study, ginger accessions maintained in the spice germplasm repository at IISR, Calicut were evaluated for identifying sources of resistance against soft rot disease. A total of 650 accessions were subjected to screening towards *P. myriotylum*. Prior to evaluation, the screening procedure was standardized to optimize the type and dose of inoculum. The method suggested by Dake and Edison (3) was followed with slight modifications.

Three types of inocula with two different dosages were tested by soil inoculation method. In the first method homogenized mycelial suspension prepared from *P. myriotylum* culture grown for seven days in potato dextrose broth (PDB) was used. Here the mycelial mat was harvested from the broth and homogenized in warring blender for 1 minute in sterile distilled water and the inoculum density was adjusted optically at 500nm wave length as done by Tripathi and Grover (10). This homogenized mycelia suspension at OD 2.0 contained approximately 600-800 mycelial bits/ml equivalent to  $2 \times 10^{10}$  cfu/ml. In the second method *P. myriotylum* culture grown for seven days on PDA and then

homogenized as above along with agar was used. This suspension contained a cfu of  $2 \times 10^{10}$  /ml. Thirdly mycelial plugs cut from seven day old *P. myriotylum* culture on PDA was inoculated directly to the plant base.

Fresh ginger rhizomes of variety Mahima (20g each) were planted in sterilized potting mixture (soil, sand and farm yard manure, 1:1:1) in earthenware pots (12"x12"), and grown for up to 3-5 pseudo stem stage. These plants were inoculated with mycelial suspension as prepared above @ 25 ml and 50 ml pot<sup>-1</sup> and mycelia plugs of 10 mm and 5mm @ 10nos. pot<sup>-1</sup>.

Significant differences were not observed between different types of inocula for disease reaction. Homogenized mycelium from potato dextrose broth and agar culture were found equally effective in expressing soft rot symptoms in ginger as evidenced from the pseudo stem infection in 7-10 days in both the cases. Yellowing of the lower leaves, decay of the collar portion and falling of the pseudo stem with a slight disturbance occurred within ten days of inoculation when compared to mycelial plug inoculation. With mycelial plugs, the infection was found little slower than mycelial suspension and it took 10-15 days for expressing soft rot symptoms. So, for screening accessions homogenized mycelial suspension was used throughout the experiment.

For screening, ginger accessions were raised in solarized potting mixture under green house conditions and grown to 3-5 pseudo stem stage. The plants were inoculated with homogenized mycelium from agar culture @ 100ml/pot to ensure higher doze of inoculum and were watered regularly to maintain soil moisture. Observations were recorded at regular intervals up to maximum tillering stage by counting the number of pseudo stem infected. After every observation, the infected pseudo stems were removed to ensure new infections.

Accessions showed soft rot symptoms from 7-60 days of inoculation. Few accessions took 7-14 days while others took 15-60 days. Certain accessions did not show any symptoms till harvest. Based on the time taken for infection, the accessions were initially made into four groups as group 1= infection in 7-14 days; group 2= 15-30 days; group 3= 31-60 days and group 4 = >60 days. From this grouping it was found that 41.06% of the accessions took infection in

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**Table 1.** Rating ginger accessions based on infection (%)

Scale	Accession Nos.	Rating
1 (0-5 % infection)	6,31, 32, 33, 57, 97, 107, 130, 206, 208, 251, 261, 264, 273, 274, 291, 342, 357, 375, 394, 434, 526, 527 (5.66%)	Resistant (R)
2 (6- 20 % infection)	5, 17, 24, 25, 30, 35, 36, 37, 40, 44, 60, 62, 64,66, 69, 76, 83, 77, 85, 90, 91, 95, 96, 98, 101, 106, 108, 11, 184,197, 205, 220, 224, 227,242, 246, 247, 262, 269, 272, 278, 295, 349, 369, 376, 400, 401, 412, 416, 430,445, 448, 467, 477, 480, 487,501, 505, 19, 522, 523, 524, 525, 529 (15.76%)	Moderately Resistant (MR)
3 (21-50% infection)	2, 3, 9, 13, 14, 15, 18, 21, 22, 26, 28, 29, 34, 38, 41, 42, 45, 50, 56, 58, 61, 67, 68, 72, 73, 74, 75, 78, 86, 87, 92, 93, 94, 104, 114, 115, 116, 127, 129, 131, 139, 142, 144, 145, 154, 157, 158, 159, 160, 164,165,167,171, 176, 178, 179, 190, 191, 192, 194, 195, 198, 203, 209, 210, 211, 216, 217, 219, 221, 222, 229, 231, 232, 234, 235, 238, 239, 240, 241, 244, 245, 248, 252, 253, 255, 256, 257, 258, 260, 263, 265, 266, 267, 270, 271, 275, 276, 279, 280, 281, 282, 283, 284, 285, 287, 289, 290, 292, 294, 297, 298, 340, 341, 343, 346, 347, 348, 350, 352, 354, 355, 356, 358, 372, 374, 384, 390,391, 393, 395, 398, 399, 402, 404, 405, 409, 411, 418, 419,420, 428, 431, 432, 436, 441, 446, 447,449, 463, 464, 465, 468, 470, 471, 472, 473, 474, 475, 484, 488, 489, 492, 493, 496, 497, 506, 508, 511, 512, 514, 516, 518,518, 519, 522, 525, 528, 532, 533, 534, 538, 540, 541, 542, 543, 547, 550, 576, 581 (46.80%)	Moderately susceptible (MS)
4 (>50% infection)	1,7,8, 12, 20, 23,43, 46, 48,49, 51, 53, 59,65, 70,71,79, 81,82, 84, 89, 103, 109,110, 117, 121, 128, 134, 135,137, 141,146, 151, 153, , 162, 181,182, 187, 199,196,, 200, 201, 202, 204, 207, 212, 214, 215, , 218 223, 225, 226, 228, 230, 233, 236, 237, 243, 249, 254, 268, 277, 286, 288, 293, 296, 338, 351,, 353, 383, 385, 386, 387, 388, 389, 392, 396,397, 403, 408, 410, 413, 415, 422, 424, 425, 429 433, 435, 442, 443, 444, 452, 476, 478, 479, 481, 482, 485, 486, 490, 491, 494, 495, 498, 499, 503, 507, 509, 510, 513, 517, 520 528, 530, 535, 536, 539, 552, 563 (29.55%)	Highly Susceptible (HS)

7-14days, 31.74% in 15-30days, and 20.65% in 31-60 days. After 60 days 5.8% showed infection only or showed no infection till harvest of ginger plants.

The accessions were then rated based on the percent infection in a 1-4 scale, where, 1=0-5% infection as resistant; 2=6-20% as moderately resistant; 3 = 21-50% as moderately susceptible and 4= >50 % infection as highly susceptible (Table 1). In this rating 29.55% of the accessions were found highly susceptible having a disease incidence of >50% whereas 5.66% showed resistance with 0-5% infection till harvest. 15.76 % of the accessions showed moderate resistance (6-20% infection ) and 46.8% showed moderate susceptibility (21-50% infection).

The overall data on infection of accessions showed that only < 7 % of the accessions are having the relative resistance to the pathogen (Table 1). The highly susceptible accessions succumb to soft rot within 7-14 days while the moderately susceptible accessions took more than 30 days.

Few ginger accessions / varieties were screened earlier by different workers. They followed different methods of inoculation. Here we standardized the quantity of inoculum as well as the inoculation method for screening the accessions. Balakrishnan (1) screened 148 accessions of ginger against *P. aphanidermatum* using culture disc inoculation method and shortlisted five accessions having below 50% (35.71- 49.0%) infection. All other accessions showed infection in the range of 50-100%. However, wild varieties like Indonesian wild, Zingiber species, Kanyakumari and Karakkal showed high degree of resistance. No infection could be noticed in these lines. Senapati and Sugata (8) screened 134 ginger varieties against rhizome rot complex in eastern ghat high land zone of Orissa (Pottangi) under field conditions and assessed the varieties based on percentage disease incidence (PDI). They recorded the

**Table 2.** Details of ginger accessions showing resistance to *P. myriotylum*

Sl.No.	Acc. No.	Passport No & Name
1	6	CLT 006 (Burdwan)
2	31	CLT-G-0031 (PGS 6)
3	32	Not available
4	33	CLT-G-0033 (PGS 9)
5	57	CLT-G-0057(Pulpally, Nadan)
6	97	CLT-G-0097(Tura local-1)
7	107	CLT-G-0107 (Mizo)
8	130	CLT-G-0130 (Nepal-1)
9	206	CLT-G-0206 (Konni local)
10	208	CLT-G-0208(Thodupuzha)
11	251	CLT-G-0251(Wayanadan local)
12	261	CLT-G-0261(Basar local)
13	264	CLT-G-0264 (Agarthala)
14	273	CLT-G-0273 (Mawdwar)
15	274	CLT-G-0274 (N.H 6/1)
16	291	CLT-G-0291 (Jorhat)
17	342	Not available
18	357	Not available
19	375	CLT-G-0375 (Ginger cultivated)
20	394	CLT-G-0394 (Nadan)
21	434	CLT-G-0434 (Hawaian)
22	526	CLT-G-0526 (Local type)
23	527	CLT-G-0527 (Local type)

disease incidence based on direct counting method as described by Das (4). Savita and Prasad (7) screened seven ginger varieties against rhizome rot using *P. aphanidermatum* and rated on a 0-5 scale and found Maran and Wayanad as

moderately resistant showing 10 and 19% PDI. In the present screening we used *P. myriotylum* for screening since it is found as the predominant pathogen in causing soft rot of ginger in India (2,5). Similarly soil inoculation method was adopted as a standard procedure for screening ginger because it was found as an ideal method, which is closely mimicking the natural conditions, for screening ginger rhizome against bacterial wilt caused by *Ralstonia solanacearum* (6).

Thus based on the screening, 23 accessions (5.6%) were shortlisted as resistant to soft rot (Table 2) with infection (PDI) ranging from 0-5% and 64 accessions (15.76%) as moderately resistant with PDI ranging from 6-20%. Since the relatively resistant accessions took longer time for infection, it is advantageous that these accessions can be saved from severe infection by drenching chemicals before it is getting infected. But in the other cases, because of immediate response of the accessions to the pathogen, control measures will not be that much effective. So for limiting the incidence of soft rot disease in ginger, these relatively resistant accessions will be a boon to the farmers who were threatened with heavy crop loss due to this disease.

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