BREEDING BANANAS FOR NEMATODE RESISTANCE

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ABSTRACT: India is the largest producer of banana. It is liable to attack by different pathogens, especially nematodes. Taking into account the yield loss of 40%, caused by nematodes, a breeding programme was taken up at Horticultural College & Research Institute, TNAU, Coimbatore to produce hybrids resistant to banana nematodes, Radopholus similis, Pratylenchus coffeae and Helicotylenchus multicinctus. It involved screening and identification of sources of resistance and hybridization with susceptible cultivars which otherwise have better horticultural traits. Totally, 3506 crosses were made using resistant and susceptible cultivars, synthetic hybrids of all ploidy levels and also with commercial diploids. Among the successful crosses obtained seven hybrids H 203 (H 59 x Ambalakadali), H 205 (H 65 x Pisang Lilin), H 207 (H 89 x Anaikomban), H 213 (H 201 x Ambalakadali), H 230 (H 201 x H 110), H 235 (H 66 x Anaikomban) and H 237 (H 5 x Ambalakadali) were found to be tolerant to nematodes. The level of tolerance was assessed from soil and root population of nematodes at different stages of crop growth and the percentage of lesion on root and corm of the newly developed hybrids.

Key Words: Banana, breeding, Musa, nematodes, resistance

INTRODUCTION

Banana is the most important fruit crop in India with a production of 13.2 million tonnes per annum from 4.2 lakh hectares and having a share of 32 per cent of the total fruit production. Even though it ranks first, banana is prone to attack by several pathogens. Among them, the plant parasitic nematodes cause serious economic loss. The most destructive and widely distributed nematode is the burrowing nematode, Radopholus similis (Cobb) followed by root lesion nematode, Pratylenchus coffeae (Zimmerman) and the spiral nematode, Helicotylenchus multicinctus (Cobb). Hence selection of nematode resistant or tolerant cultivars and resistance breeding provide a scope for boosting the performance and yield of bananas. Screened cultivars of good breeding potential and synthetic hybrids such as H59, H65, H89 and H201 evaluated for their horticultural traits and nematode resistance (Priya Devi, 1998) were effectively utilized for this breeding work to impart resistance. Totally 3,506 crosses were made and the resulted hybrids were assessed for resistance.

MATERIALS AND METHODS

Seedlings obtained from successful hybrids were planted at 1.8 x 1.8 m spacing. These

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hybrids were with better breeding potential or male and female fertility such as Ambalakadali, Anaikomban, Pisang Lilin, Nivediyakadali and Red Banana. The synthetic hybrids were H6, H59, H65, H66, H89, H110 and H201. No nematicide was applied during planting or afterwards. Observations on soil and root population were made at third, fifth and seventh month after planting. Soil and root samples were pooled to form one composite sample. Roots were processed by root maceration technique. Total number of nematodes in roots was calculated by multiplying nematodes counted in the one ml sample by 500 ml. Soil samples were processed by Cobb's wet sieving and sedimentation technique. The nematodes were extracted by Baermann Pan method. Counts are reported here as number of nematodes per 250 cc soil and 5 g roots. Lesion damage to root and corn tissues were determined by two separate evaluations. The lesion index of the root was estimated by measuring the length of roots with lesioned tissue and is expressed in percentage. The lesion index of the corn denotes the area of rhizome surface with lesion and is expressed as an arbitrary grading from 0 to 4 grade as indicated below:

0 - Clean
1 - 1 to 3 not more than 1 cm in diameter
2 - 3 to 6 small to medium size lesions not more than 2 cm in diameter.
3. - 10 to 25% of the rhizome surface with lesions.
4. - More than 25% of the rhizome surface with lesion that coalesce (O’ Bannan, 1968).

The rating of the hybrids was done based on the parameters as adopted by Pinochet (1988).

The damage interpretation was made by adding the nematodes extracted from soil and root samples.

RESULTS AND DISCUSSION

The details of banana hybrids involved, infection rating, population in soil and root, levels of resistance for the successful 14 hybrids are presented in the Table 1. Among the 14 crosses 7 hybrids viz., H 203 (H59 x Ambalakadali), H 205 (H65 x Pisang Lilin), H 207 (H89 x Anaikomban), H 213 (H201 x Ambalakadali), H 230 (H201 x H110), H 235 (H66 x Anaikomban), H 237 (H6 x Ambalakadali) were found to be tolerant to three nematodes.

The total nematode population ranged between 6,598 in the hybrid H 201 x H 110 and 13,226 in H 201 x Red Banana cross. Among the nematode species, *R. similis* recorded larger population in soil than in root sample followed by *P. coffeae* and *H. multicornis*. The lesion index in the roots varied from 12 to 33 per cent and the corm grade between 1 and 3 among the hybrids. The degree of loss depends on the population density of the nematode. The nematodes though can dwell in the soil they cannot enter the roots of tolerant hybrids and multiply at faster rate (Gowen, 1994). In the present investigations the number of nematodes in root sample was 1.20 to 2.80 times less than that in soil samples. It indicated that there is one nematode in root sample for a mean of 2.33 nematode in soil. As nematode population interacted with root destruction and corm damage apart from soil and root population, lesion index in roots and corms were assessed and levels of resistance compiled accordingly.

Irrespective of ploidy level nematode spp. attacked all the banana hybrids. In the present investigation evaluation of 14 synthetic hybrids of banana indicated that there was not complete or total resistance but only there was a differential range in the degree of tolerance to nematode incidence. The percentage of root lesion index was low in tolerant hybrids compared to susceptible hybrids. The tolerant hybrids were derived by pollen complementation from Ambalakadali, Anaikomban and H 110. Pinochet
<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Hybrid No.</th>
<th>Radopholus similis</th>
<th>Helicotylenchus multicinctus</th>
<th>Pratylenchus coffeeae</th>
<th>Total nematode population</th>
<th>Lesion index (root %)</th>
<th>Corm grade</th>
<th>Level of resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>H59xAM</td>
<td>H203</td>
<td>370 636 874</td>
<td>312 502 800</td>
<td>260 506 786</td>
<td>8962</td>
<td>15</td>
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<tr>
<td>H65xAN</td>
<td>H204</td>
<td>260 475 758</td>
<td>242 376 700</td>
<td>156 348 600</td>
<td>6598</td>
<td>12</td>
<td>1</td>
<td>T</td>
</tr>
<tr>
<td>H65xPL</td>
<td>H205</td>
<td>376 526 900</td>
<td>100 224 684</td>
<td>52 204 600</td>
<td>9864</td>
<td>22</td>
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<tr>
<td>H89xAN</td>
<td>H207</td>
<td>372 292 324</td>
<td>86 206 544</td>
<td>40 176 520</td>
<td>8376</td>
<td>14</td>
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<tr>
<td>NVDKxPL</td>
<td>H209</td>
<td>406 340 700</td>
<td>280 440 502</td>
<td>472 426 894</td>
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<tr>
<td>H201xAM</td>
<td>H213</td>
<td>406 340 700</td>
<td>388 500 550</td>
<td>344 426 894</td>
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<tr>
<td>H201xAN</td>
<td>H218</td>
<td>406 340 700</td>
<td>560 606 446</td>
<td>790 706 606</td>
<td>10806</td>
<td>27.5</td>
<td>2</td>
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<tr>
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<td>H226</td>
<td>490 224 400</td>
<td>420 614 1050</td>
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<tr>
<td>H201xH110</td>
<td>H230</td>
<td>526 276 560</td>
<td>186 292 536</td>
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<tr>
<td>H201xRed</td>
<td>H233</td>
<td>406 340 700</td>
<td>156 274 710</td>
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<tr>
<td>H6xAM</td>
<td>H234</td>
<td>492 696 1004</td>
<td>470 844 1216</td>
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<tr>
<td>H86xAM</td>
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<td>580 868 1294</td>
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<td>370 504 774</td>
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<tr>
<td>H6xAM</td>
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<td>476 324 728</td>
<td>280 752 910</td>
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</table>

*Soil population
**Root population
AN-Analikomban
AM-Ambalakadali
PL-Pisang Lilin
NVDK-Nivediyakadali

S-Susceptible
T-Tolerant
(1988a, 1992) have indicated that Anaikomban one of the diploid male parents involved in this study is a good source of resistance to R. similis. In case of other hybrids, resistance must have been contributed either by the male parent or by the ovular parent however in the case of some hybrids the genetic basis for resistance/tolerance could not be ascertained as both the parents of the resultant tolerant hybrids have been known to be susceptible. Further only limited population could be evaluated as many of the seeds obtained after crossing were either sterile or did not germinate. Involvement of multiple genes conditioning the nematode resistance in bananas has been suggested by Rowe and Richardson (1975). The present work indicated that there is ample scope to develop tolerant genotypes if not resistant ones by selective hybridization with choice male parent or by using synthetic hybrids.

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REFERENCES


Compendium of Tropical Fruit Diseases. APS press, St. plant MN, USA.


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