Apparent Resistance of Groundnut Cultivar Robut 33-1 to Bud Necrosis Disease

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ABSTRACT

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Bud necrosis disease (BND), caused by tomato spotted wilt virus (TSWV) and transmitted by thrips *Frankliniella schultzei*, is the most important virus disease of groundnut in India. A high-yielding cultivar, Robut 33-1, was identified in field tests as having 50–90% lower BND incidence than the commonly grown cultivar TMV 2. The resistance is passive; i.e., when Robut 33-1 plants are infected either by sap inoculation or by infective thrips, they develop normal symptoms of BND. Robut 33-1 plants did not adversely affect the longevity and fecundity of *F. schultzei*; however, in field tests, thrips infestation was lower on Robut 33-1 than on TMV 2. This indicates a nonpreference of thrips for cultivar Robut 33-1, resulting in low incidence of BND.

Bud necrosis disease (BND) is the most important virus disease of groundnut in India (1). In Andhra Pradesh State, an annual loss of about 15,000 tons of groundnuts has been estimated for the November–December-sown crop (2). BND is caused by tomato spotted wilt virus (TSWV) (5) and transmitted by two species of thrips, mainly *Frankliniella schultzei* (Trybom) and to a lesser extent by *Scirtothrips dorsalis* Hood (3). No totally resistant genotype of 2,000 groundnut accessions was found after exposure to natural infection of BND. However, two cultivars, Robut 33-1 and NC Ac 343, had 50 and 73%, respectively, less disease than commonly grown cultivar TMV 2. Robut 33-1 has been released in Andhra Pradesh State and has good yield potential, whereas NC Ac 343 is not commercially acceptable. The causes of low BND incidence in Robut 33-1 are reported in this paper.

MATERIALS AND METHODS

The field experiments were carried out on alfisol fields at the research farm of the International Crops Research Institute for the Semi-Arid Tropics near Hyderabad, India. The 1978 and 1981 rainy season trials were conducted on low-fertility soils in a pesticide-free area from June to October. The 1979 and 1980 rainy season trials (June to October) and all postrainy season trials (December to April) were grown on irrigated alfisol fields. The experimental plots were at least 100 m from buildings and trees, etc., to minimize the effects on distribution and landing of thrips (8,9). Guard rows of unsprayed groundnuts (cultivar TMV 2) were sown around each test plot. Unplanted areas and alleyways were kept to a minimum to reduce possible effects of the pattern of bare soil and crops on thrips alighting (8,9).

Incidence of BND was studied in Robut 33-1 in comparison with two commonly grown cultivars, TMV 2 and M 13, in four rainy (sowing date first week of July) and two postrainy (sowing date 15 December) seasons. The cultivars were grown on 100-m^2 plots replicated four times in a randomized block design. Plant spacing was 15 cm within and 75 cm between rows. Thrips were counted on the three youngest leaves of 10 randomly selected plants, and numbers of BND-affected plants were recorded at weekly intervals in each plot.

Two separate glasshouse trials were conducted to compare the susceptibility of Robut 33-1 (Virginia bunch), TMV 2 (Spanish bunch), and Gangapuri (Valencia cultivar) to BND. The TSWV virus was maintained in cultivar TMV 2 by sap inoculation of second quadrifoliate-stage seedlings. In the first trial, test seedlings were grown in 12.5-cm-diameter pots, kept in the open for 20 days, and sprayed frequently with insecticides. The seedlings were then brought into the glasshouse, inoculated with TSWV by sap inoculation (5), and thereafter maintained in the glasshouse at 25–30 C until symptoms developed.

In the second glasshouse trial, the relative susceptibility of Robut 33-1 and TMV 2 seedlings to TSWV was tested by inoculating them with infective adult thrips of *F. schultzei*. Four hundred just-hatched nymphs from a virus-free colony of thrips were given 3 days of acquisition access to young infected leaflets of cultivar TMV 2 with clear ring spot symptoms. Nymphs were then transferred to healthy leaflets and maintained there until adults emerged. Adult thrips 1–2 days old were used singly in transmission tests (3). To determine the acquisition rates by *F. schultzei* from Robut 33-1 and TMV 2 cultivars, seedlings were sap-inoculated with TSWV obtained from TMV 2, and 200 just-hatched nymphs were released on 10 infected leaflets of TMV 2 and Robut 33-1. After 3 days of acquisition access, they were transferred to healthy leaflets of individual cultivars until adults emerged. Adult thrips 1–2 days old were then released singly on 7-day-old seedlings of test cultivars. Urd bean (*Vigna mungo* cv. UPU-2) seedlings were used as the susceptible control.

Survival and fecundity of *F. schultzei* on Robut 33-1 and TMV 2 were compared in the laboratory by caging five females and one male on single groundnut leaflets, each kept in a glass vial 3 cm long by 1 cm in diameter. There were eight replicates. Fresh leaflets were provided daily, and the exposed leaflets in which eggs were laid were maintained for about 10 days, during which the incubation period of eggs was completed and nymphs emerged and were counted daily. This trial was carried out at 28 C during the day and 21 C at night.

RESULTS

Robut 33-1 had consistently lower incidence of BND than the other two cultivars in four rainy and two postrainy

Table 1. Incidence of bud necrosis disease in groundnut cultivars Robut 33-1, TMV 2, and M13 during different seasons

	Percent BND incidence					
	Rainy season				Postrainy season	
Cultivars	1978	1979	1980	1981	1978–1979	1979–1980
TMV 2	71	100	92	59	82	35
Robut 33-1	38	50	35	3	50	21
M 13	55	58	40	7	72	30
SE (±)	2.4	1.6	3.6	3.0	4.4	1.3
C.V. (%)	7.7	7.6	11.1	21.8	11.3	4.0

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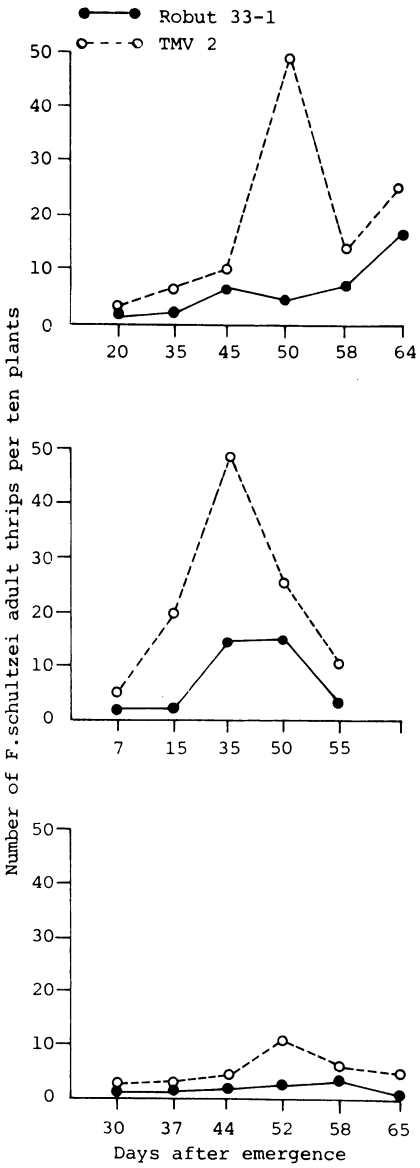

Fig. 1. Number of *Frankliniella schultzei* adults on groundnut cultivars Robut 33-1 and TMV 2.

seasons (Table 1). Infestation of thrips was also lower on Robut 33-1 than on TMV 2 in three of these rainy season trials (Fig. 1).

Robut 33-1 was as susceptible to TSWV as TMV 2 or Gangapuri when inoculated mechanically or by infective thrips (Tables 2 and 3). The acquisition rates of TSWV by *F. schultzei* from Robut 33-1 and TMV 2 were also similar (Table 3).

Mean survival of adult *F. schultzei* on both Robut 33-1 and TMV 2 was 10 days, and a few survived as long as 23 days on each cultivar. The mean fecundity on TMV 2 (23.8) was not significantly different from that on Robut 33-1 (24.7).

DISCUSSION

Bud necrosis is the most destructive virus disease of groundnut in many groundnut-growing areas of India and is potentially important in several others. This disease was regarded as minor a decade ago (10). None of the released cultivars are resistant to BND. Robut 33-1 is the first commercially acceptable cultivar with a moderate but stable resistance to BND. This cultivar can be used in areas of high BND incidence. The resistance to BND in this cultivar is due to low infestation of *F. schultzei* under field conditions. Under laboratory conditions, this cultivar is as susceptible to TSWV as TMV 2 and there are no differences between Robut 33-1 and TMV 2 in either acquisition or inoculation rates by *F. schultzei*. The survival and fecundity of *F. schultzei* is also not adversely affected by Robut 33-1 plants. Thus, the field resistance of Robut 33-1 results from low infestation of *F. schultzei* and can be termed "clendusity" (4).

The cultivar Robut 33-1 differs from TMV 2 in two aspects that could alter the preference of thrips: 1) It has dark green foliage compared with the yellowish green foliage of TMV 2. The dark green foliage is a varietal character and not associated with a specific rhizobial strain. 2) It has a spreading bunch growth habit compared with the upright bunch growth habit of TMV 2. This results in more rapid coverage of ground by Robut 33-1 than by TMV 2, and also, the crop height of Robut 33-1 is much less than that of TMV 2. These differences can affect the thrips' preference. For example, thrips are attracted more to yellow than to dark green. Effects of differential ground coverage and foliar color on alighting of aphids resulting in altered spread of aphidborne virus diseases are well known (6,7). Such effects need to be elucidated for cultivar Robut 33-1 in relation to BND incidence.

Table 2. Transmission of tomato spotted wilt virus to groundnut cultivars Robut 33-1, Gangapuri, and TMV 2 by sap inoculation

	Test 1				Test 2			
	Robut 33-1		TMV 2		Robut 33-1		Gangapuri	
Dilution	Diseased/ total	Diseased (%)	Diseased/ total	Diseased (%)	Diseased/ total	Diseased (%)	Diseased/ total	Diseased (%)
$10^{-0.5}$	19/30	63	20/31	64	25/25	100	25/25	100
$10^{-1.0}$	NT[a]	···	NT	···	20/25	80	18/25	72
$10^{-1.5}$	10/29	34	8/29	27	20/25	80	18/25	72
$10^{-2.0}$	NT	···	NT	···	5/25	20	8/25	32

[a] Not tested.

Table 3. Transmission of tomato spotted wilt virus to and acquisition from the groundnut cultivars Robut 33-1 and TMV 2 by *Frankliniella schultzei*

	Transmission		Acquisition	
Cultivar	Diseased/ total	Percent transmission	Diseased/ total	Percent acquisition
TMV 2	15/79	19.0 a[z]	25/45	55.5 a
Robut 33-1	15/66	24.6 a	35/66	53.0 a
Urd bean (UPU-2, control)	17/28	60.7 b	17/31	54.8 a

[z] Values in a column followed by different letters are significantly ($P = 0.05$) different according to an F-test.

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