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Resistance in groundnut genotypes to Kalahasti malady caused by the stunt nematode, *Tylenchorhynchus brevilineatus**

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Abstract. A severe nematode disease of groundnut, popularly called 'Kalahasti malady', caused by the nematode *Tylenchorhynchus brevilineatus*, has been prevalent since 1976 in certain parts of Andhra Pradesh, India. A total of 1599 groundnut germplasm accessions and breeding lines were screened for resistance to the nematode disease in replicated trials on a farmer's field in a disease hot spot location during 1985–6. Twenty-three genotypes were identified as resistant and they had disease scores of 2·0 or less on a 1–5 disease scale. Of these, 14 genotypes were confirmed to be resistant in advanced screening trials in the 1986 rainy and the 1985/6 and 1986/7 post-rainy seasons. Resistance to the nematode was stable in all three trial sites in the 1986/7 post-rainy season. Most of the resistant genotypes have undesirable pod/seed characteristics. One of the resistant genotypes is a high-yielding breeding line (TCG 1518) and this is being released for use in disease-affected areas of Andhra Pradesh State.

1. Introduction

A nematode-caused disease of groundnut characterized by brownish-black discoloration of the pod surface and reduced pod size was first observed in the 1975/6 post-rainy season irrigated crops in the Kalahasti area of Chittoor district, Andhra Pradesh, India (Reddy *et al.*, 1984). Since then, the disease has been serious and widespread in Chittoor district and has also been observed in parts of the neighbouring Nellore district. This disease is locally known as 'Kalahasti malady'. The disease is most severe in sandy soils. It occurs in the same area year after year in both rainy and post-rainy seasons, but is more severe in the post-rainy season. Pod yield losses of 20–50% are common in severely infested fields (Reddy *et al.*, 1984; Siva Rao *et al.*, 1986). Although the disease can be controlled by soil applications of aldicarb and carbofuran, these pesticides are costly and are not readily available to small-scale farmers in India. In recent years efforts have been made to identify sources of resistance to this nematode disease of groundnut. This paper reports results of screening of 1599 groundnut germplasm accessions and breeding lines for resistance to the nematode-caused disease.

2. Materials and methods

Screening of groundnut germplasm and breeding lines was started in the 1985 rainy season and continued in the subsequent 1985/6 post-rainy and 1986 rainy seasons. A total of 1599 genotypes were screened.

All resistance screening trials were carried out on a farmer's field in Guttivaripalle village in Chittoor district of Andhra Pradesh, India. The field, a light sandy loam soil, was heavily infested with the nematode *Tylenchorhynchus brevilineatus*, and was selected because it had a long history of the Kalahasti malady. The nematode density was estimated using a modified Baermann funnel technique (Southey, 1970). Average nematode density at sowing of groundnut was 2·3 nematodes g^{-1} soil. All trials were irrigated.

2.1. Preliminary screening

All screening trials were carried out in randomized block designs with two replications. Genotypes were grown in replicated plots of two rows 30 cm apart and 5 m long, with seeds sown singly at 10 cm spacing along the rows. Rows of a highly susceptible check cultivar JL 24 were sown after every five plots of test genotypes. In the 1985 rainy season, 357 erect bunch (EB) and 275 spreading bunch (SB) type groundnut germplasm and breeding lines were screened in two separate trials.

Average nematode density at the end of the screening trial in the 1985 rainy season was 1·3 nematodes g^{-1} soil.

Resistance screening was concentrated on the EB lines (Spanish and Valencia types) in subsequent seasons since short-duration EB cultivars are preferred by farmers in Andhra Pradesh State where the disease occurs. In the 1985/6 post-rainy season 559 lines were screened and in the 1986 rainy season 408 additional lines were screened.

Nematode densities were 1·36 and 1·1 g^{-1} soil in the 1985/6 post-rainy and 1986 rainy seasons, respectively.

All lines were harvested at maturity, and 25 randomly selected plants from each plot were scored for incidence and severity of the disease using a 1–5 scale in which 1 = no disease symptoms evident; 2 = a few small dark brown to black lesions to cover 1–25% on some pods, pods of

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normal size; 3 = many small lesions coalescing to cover 25–50% of pod surfaces, all pods affected, pods of normal size; 4 = many lesions coalescing to cover 50–75% of pod surfaces, all pods affected, pods of smaller than normal size; and 5 = many lesions coalescing to cover 75% of pod surfaces, all pods affected, pods of much smaller than normal size.

2.2. *Advanced screening*

From the 1985 rainy season preliminary screening trial, 24 lines were selected that had mean disease scores ranging from 1·7 to 2·5 (14 lines had disease score up to 2·0) and, together with a susceptible check cultivar (JL 24), were evaluated in the 1985/6 post-rainy season in a randomized block design with three replications.

In the 1986 rainy season, 23 selected genotypes (13 from the 1985 rainy season and 10 from the 1985/6 post-rainy season preliminary screening trials) with disease scores of 2·0 or less and the susceptible check cultivar JL 24 were tested for disease resistance.

In the 1986/7 post-rainy season, 14 selected genotypes (Table 1) were further tested in replicated trials in four farmers' fields with previous history of severe disease incidence. The susceptible cultivar JL 24 was included in all trials. Two fields were in the village of Guttivaripalle, and the other two in the village of Jinkalametta in Chittoor district.

At the commencement of the trials in the 1986/7 post-rainy season, average nematode populations were 1·7 and 2·1 g^{-1} soil in two fields in Guttivaripalle, and 1·6 and 1·9 g^{-1} soil in two fields of Jinkalametta village.

3. Results

The disease incidence and severity were high (4·4–4·8 disease score) and uniform in the susceptible check cultivar JL 24 in all screening trials. Of 357 EB and 275 SB lines tested in the 1985 rainy season, 15 EB and 39 SB lines were resistant as they had disease scores of 2·0 or less. There were marked differences in disease severity within EB and SB lines. In EB lines, disease scores ranged from 1·7 to 4·7, and in SB lines from 1·2 to 4·0. Of 559 germplasm and breeding lines screened in the 1985/6 post-rainy season, 20 had disease scores of 2·0 or less and were considered resistant. The susceptible cultivar JL 24 had a mean disease score of 4·8. Of 408 lines tested in the 1986 rainy season, only three lines had disease scores of 2·0 or less. Disease scores ranged from 1·7 to 4·2 in test lines, while the susceptible check JL 24 had a mean disease score of 4·7.

Most of the lines evaluated in the 1985/6 post-rainy season had disease reactions similar to those shown in the 1985 trial, but five lines (ICG 1088, ICG 3700, ICG 3263, ICGS 6, and ICGS 65) had significantly ($P = 0·5$) higher disease scores (2·8–3·6 compared with 2·2–2·5 in 1985). The disease scores ranged from 1·4 to 3·6 in the selected lines. The susceptible check cultivar JL 24 had a mean disease score of 4·7. In the 1986 rainy season all selected lines were confirmed as resistant to the disease. Disease scores of 14 selected lines tested for three seasons (1985 and 1986 rainy and 1985/6 post-rainy seasons) are given in Table 1. All these lines were also resistant in trials on four farmers' fields in the 1986/7 post-rainy season. Disease scores ranged from 1·6 to 2·0 in the resistant lines, and in the susceptible check cultivar from 4·6 to 4·8.

Table 1. Kalahasti malady disease scores of 14 selected groundnut genotypes

Genotype		Mean disease score[2] ± SE		
ICG No.[1]	Other identity	1985 rainy season	1985/6 post-rainy season	1986 rainy season
1697	NCAc 17090	2·0 ± 0·44	1·4 ± 0·07	1·5 ± 0·14
4110	Ah 7864	1·7 ± 0·14	1·5 ± 0·20	1·5 ± 0·25
6322	RMP 12	2·0 ± 0·55	1·4 ± 0·23	1·4 ± 0·12
7889	Tripp 2622	2·0 ± 0·28	2·1 ± 0·45	1·7 ± 0·12
7897	Tarapoto (ECU)	1·9 ± 0·14	1·7 ± 0·36	1·6 ± 0·15
7898	Blakeslee 4	2·2 ± 0·07	1·6 ± 0·17	1·6 ± 0·15
10933	SPZ 474 Flesh	1·8 ± 0·28	1·3 ± 0·15	1·5 ± 0·25
10939	SPZ 480 Gasp	2·2 ± 0·77	1·5 ± 0·25	1·6 ± 0·20
10943	SPZ 483 Purple	1·8 ± 0·14	1·6 ± 0·17	1·5 ± 0·23
10963	SPZ 494 Light	2·1 ± 0·14	1·4 ± 0·20	1·7 ± 0·08
10964	SPZ 496 Light purple	1·7 ± 0·00	1·8 ± 0·15	1·6 ± 0·22
11083	SPZ 491 Light purple	2·0 ± 0·21	1·3 ± 0·32	1·6 ± 0·11
ICGV 87135	ICGS 62	2·0 ± 0·07	1·4 ± 0·05	1·5 ± 0·11
TMV-10-1	TCG 1518	–[4]	1·9 ± 0·45	1·6 ± 0·19
7827	JL 24[3]	4·7 ± 0·03	4·7 ± 0·03	4·4 ± 0·08

[1] ICRISAT Groundnut Accession Number.

[2] Scored on a 1–5 scale where 1 = no disease; 2 = a few small lesions on surface, normal-sized pods; 3 = many small lesions covering 25–50% of pod surface, normal-sized pods; 4 = 50–75% of pod surface discoloured, pods slightly reduced in size; 5 = over 75% of pod surface discoloured, pods much reduced in size.

[3] Susceptible check cultivar.

[4] Not tested.

Table 2. Sources of resistance to Kalahasti malady of groundnut

Genotype			Botanical variety	Seed colour	Country of origin
ICG No.[1]	Identity	Other identity			
1697	NCAc 17090	–	*fastigiata*	Light tan	Peru
1710	NCAc 17135	–	*fastigiata*	Purple	Peru
4110	Ah 7864	–	*hypogaea*	Tan	USA
6022	Baladi bunch	NCAc 927	*fastigiata*	Purple	Sudan
6322	RMP 12	–	*hypogaea*	Variegated tan/white	Burkina Faso
6340	Tarapoto	PI 350680	*fastigiata*	Purple	Honduras
7887	WC 1206	PI 390595	*fastigiata*	Purple	Peru
7889	Tripp 2622	PI 393517	*fastigiata*	Off-white	Peru
7897	Tarapoto (ECU)	PI 405132	*fastigiata*	Purple	Peru
7898	Blakeslee 4	PI 407454	*fastigiata*	Tan	Ecuador
10025	SPZ 470 Flesh	PI 476162	*fastigiata*	Tan	Peru
10909	SPZ Gasp	PI 476144	*fastigiata*	Variegated tan/brown	Peru
10913	SPZ 455 Gasp 1	PI 476147	*fastigiata*	White	Peru
10928	SPZ 468 Flesh	PI 476160	*fastigiata*	Tan	Peru
10933	SPZ 474 Flesh	PI 476166	*fastigiata*	Tan	Peru
10939	SPZ 480 Gasp	PI 476172	*fastigiata*	Tan	Peru
10943	SPZ 483 Purple	PI 476175	*fastigiata*	Purple	Peru
10954	SPZ 488 Purple	PI 476180	*fastigiata*	Purple	Peru
10963	SPZ 494 Purple	PI 476186	*fastigiata*	Purple	Peru
10964	SPZ 496 Light purple	PI 476188	*fastigiata*	Light purple	Peru
11083	SPZ 491 Light purple	PI 476183	*fastigiata*	Light purple	Peru
–	ICGS 62	ICGV No. 87135	*hypogaea*	Red	India
–	TCG 1518	TMV-10-1		Red	India

[1] ICRISAT Groundnut Accession Number.

Descriptions of these lines and nine other lines found resistant to the nematode-caused disease are in Table 2.

4. Discussion

The present investigations demonstrated the presence of high levels of resistance in various germplasm accessions to the nematode-caused disease, 'Kalahasti malady'. Most of the resistant genotypes have undesirable pod and/or seed characteristics, e.g. prominent beak and reticulations, and thick shells. Some of the lines (NCAc 17090, PI 350680, NCAc 17135, NCAc 927, PI 390595) are also resistant to rust and late leaf spot diseases (Subrahmanyam *et al.*, 1980). Most of the resistant genotypes have pods with hard shells and prominent ribbing, indicating that morphological characters of pods are probably associated with resistance.

Four of the resistant lines (TCG 1518, ICGS 62, Ah 7864 and RMP 12 (ICG 6322)) have acceptable pod and seed characters. RMP 12 is a released cultivar in Senegal where it was bred for resistance to groundnut rosette virus disease. TCG 1518 is a high-yielding breeding line developed by the Andhra Pradesh Agricultural University (APAU) breeders at the National Agricultural Research Project (NARP), Tirupati. This variety is now being released as 'Tirupati 3' for use in the disease-affected areas of Andhra Pradesh State (Raja Reddy, C., personal communication). ICGS 62 is another high-yielding line bred at ICRISAT (Dwivedi, S. L., personal communication).

Availability of genetic resistance to the disease, and of effective chemical control, provides a sound basis for integrated disease management, and this may be further improved by incorporation of appropriate cultural practices and of cropping systems which include a break in cultivation of successive groundnut crops.

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