RESEARCH PAPERS — TRABAJOS DE INVESTIGACION

REACTIONS OF SOME RICE CULTIVARS TO THE ROOT-KNOT NEMATODE, *MELOIDOGYNE INCOGNITA* [REACCION DE ALGUNOS CULTIVARES DE ARROZ AL NEMATODO NODULADOR, *MELOIDOGYNE INCOGNITA*]

J.D. Babatola, Nematology Division, National Cereals Research Institute, Private Mail Bag 5042, Ibadan, Nigeria.

Accepted:
26.I.1980
Aceptado:

ABSTRACT

In a survey of nematodes affecting rice, the root-knot nematode, *Meloidogyne incognita* was found to occur in all the surveyed upland rice growing areas of Southern Nigeria. Forty-four rice cultivars were screened for resistance to *M. incognita* in a glasshouse with a temperature range of 15-35° C and also in the field. The reactions of the cultivars varied from very susceptible to resistant based on the proportion of the total root system galled. Single terminal galls were always found on rice roots, but occasionally multiple galls occurred along the roots. Lateral roots were also galled terminally. Such terminal galling prevented further growth of the roots, and often rot organisms caused decay of older, galled roots. Infected susceptible rice plants manifested general chlorosis, poor tillering and sometimes wilting which led to eventual death. Resistant cultivars Vars 13a[2]/103/F 2591/5/3, IR 20 and Var 54/6/6/6 had very few and small galls and necrotic lesions close to the growing points of the roots.
Key Words: Oryza sativa, plant breeding, nematode control.

INTRODUCTION

The root-knot nematode, *Meloidogyne* (Goeldi) spp. is a very important pest of major food crops in Nigeria (2). In a survey of plant parasitic nematodes affecting upland rice in Southern Nigeria, juveniles of *M. incognita* (Kofoid & White), Chitwood) were encountered in both soil and rice root samples (1). In Japan, Ichinohe (8) also observed the same nematode species on an upland rice cultivar. Van der Linde (19) reported infection of rice by *M. incognita, M. javanica* and *M. arenaria thamesi* in South Africa. *M. graminicola* was reported on rice in India and Laos (5, 10). The typical galling of roots caused by the nematode has been observed on rice. Growth of such infected roots was usually retarded or stopped. Yellowing of leaves have also been observed.

Israel *et al* (10) reported differences in varietal reaction to the root-knot nematode, *M. incognita acrita*. Some cultivars have been found to be resistant to *M. graminicola* (14).

This paper reports the reactions of upland rice cultivars to the root-knot nematode, *M. incognita*.

MATERIALS AND METHODS

M. incognita infected cowpea roots grown on soil from rice fields were washed

thoroughly in water. The roots were chopped in 0.5cm pieces and eggs and juveniles were extracted as described by Hussey & Barker (7). Three seeds each of 44 cultivars were planted in 5 litre pots filled with steam-sterilised soil and each cultivar was replicated 5 times. As soon as the seeds germinated, the seedlings were thinned to two per pot and each pot received 10,000 eggs and juveniles of *M. incognita*. The plants were kept in a glasshouse at a temperature range of 15° to 35°C and watered regularly.

The seedlings were carefully uprooted and the roots washed 42 days after inoculation. The roots were scored for percentage of root system galled according to the scheme in Table 1 (13). Galled roots were excised and stained with acid fuchsin in lactophenol (4).

All the 44 cultivars were planted on a root-knot infested field. Ten stands of each variety were uprooted two months after planting and scored for percentage root galling.

Table 1. Relation between gall rating values and percent of roots galled.

Gall rating value	Percent roots galled
1 = Immune, no galling	
2 = Highly resistant	>0 - 5% of roots galled
3 = Resistant	6 - 25% of roots galled
4 = Moderately resistant	26 - 50% of roots galled
5 = Susceptible	51 - 75% of roots galled
6 = Highly susceptible	76 -100% of roots galled

RESULTS

All 44 cultivars were infected by *M. incognita* in the glasshouse but reactions varied from resistant to susceptible. In the field however, there were more resistant reactions (Table 2).

Susceptible rice cultivars showed general chlorosis, poor tillering, and at times wilting which led to eventual death. Root galling was usually single and terminal. Lateral roots were also galled.

Multiple galling on a root occurred occasionally especially on very susceptible cultivars. Terminal galling terminated root growth. Rot organisms also caused decay of heavily galled roots. The most resistant cultivars were Var. $13a^2/103/F2591/5/3$, IR 20 and Var. 54/6/6/6. Although terminal galling was observed on the cultivars, these were very small and few in number. Stained roots of susceptible cultivars revealed up to 4 or 5 females feeding inside a root tip. FARO 11 (Os 6), a widely grown upland rice cultivar in Nigeria, was very susceptible. The resistant cultivars did not show any chlorosis or impaired growth in any form.

Table 2. Root-gall rating of rice cultivars grown in the glasshouse and in the field on soil infested with the root-knot nematodes, *Meloidogyne incognita*.

Upland rice cultivars	Root-gall rating	
	Glasshouse	Field
Var 13a^{2}/103/F2591/5/3	1.4	1.0
IR 20	1.4	1.0
Var 54/6/6/6	1.4	1.0
IKONG PAO	1.6	1.0
I.E.T. 1444	1.6	1.0
VAR IGUA PELATELD	1.8	1.0
M 1336/1/2	2.6	1.0
Var 1808/6/6/6	2.8	1.0
TOS 4169	3.0	1.0
TOS 2583	3.0	1.6
IR 1746-226/-1-1-2	3.0	1.8
IR 1750-F5^{B}-S	3.0	1.0
TOS 4030	3.6	1.6
TOS 2581	3.6	1.4
IR 1746-226-1-13	3.6	2.0
IR 2053-52-2-3	3.6	1.8
IR 1746-226-1-2-3	3.8	2.0
IR 1529-430-3	3.8	2.0
903/1/2	4.0	1.0
9B 4/6	4.0	1.0
TOS 4090	4.0	2.0
Var 949/1/2	4.0	1.0
MORO BEREKAN	4.0	1.6
AUS 76	4.2	1.8
IAC 25	4.2	1.8
Var 949M/9/2	4.2	2.2
IRAT 23	4.2	2.2
IR 2043-103	4.2	2.2
TOS 4031	4.6	1.8
AUS 61	4.6	1.8
DOURADO PRECOCE	4.6	1.6

Table 2. Continued

Upland rice cultivars	Root-gall rating	
	Glasshouse	Field
194 11/2	4.8	2.6
IR 1154/243-1	4.8	3.0
TOS 4172/M.C554	5.0	2.4
I.A.C. 4090	5.0	2.4
Var-63-83	5.2	1.8
IR 1750-F5B-2	5.2	1.6
IR 1134	5.2	2.2
TOS 4121	5.2	1.8
TOS 4106	5.4	1.4
FAROX 56/30	5.4	3.6
B K N 65 17-23-3-2	5.6	3.8
FARO 11	5.6	3.6
PEROLA	5.6	3.6

DISCUSSION

The occurrence and wide distribution of the root-knot nematodes, *Meloidogyne* spp, in the major upland rice growing areas of Nigeria (1, 2) constitute a potential production problem. This problem is made more complex by the wide host range of the root-knot nematode in these areas (2, 6, 9). Associations of root-knot nematodes with rice have been reported in Senegal (3), Thailand (18) Comoro Islands (20) Brazil (12) and India (15). Reactions of rice cultivars in the glasshouse varied from resistant to susceptible. FARO 11 (Os 6) which has been widely grown in the upland rice zone is very susceptible to *M. incognita.* Field reactions were not as pronounced as in the glasshouse apparently because of low levels of the nematode in the soil.

IR 20 which was observed to be very resistant to *M. incognita* in this study has also been found to be resistant to *M. graminicola* (17). The roots of resistant cultivars in this study had a thick cover of root hairs previously observed by Jena & Rao (10) in rice cultivars resistant to *M. graminicola.* There is evidence of some resistance in some of the rice cultivars to *M. incognita.* Rao *et al.* (14) and Roy (16) observed similar reactions in rice cultivars in India. Sangtian (18) also recorded tolerant reactions in rice to the root-knot nematodes in rain dependent areas.

Acknowledgement: I gratefully acknowledge the funding of this work by the Director, National Cereals Research Institute, Ibadan Nigeria.

RESUMEN

En un sondeo nematológico de la zona arrocera de secano en la parte meridional de Nigeria *Meloidogyne incognita* demostró estar presente en todas los campos mues-

treados. Se estudiaron 44 variedades de arroz en un experimento de invernadero (15-35°C) y también en el campo para determinar el grado de resistencia a *M. incognita*. La reacción de las variedades varió entre altamente susceptibles a resistentes en una evaluación basada en la proporción del sistema radical con nódulos. Nódulos individuales en posición terminal se detectaron en todas las raíces aunque ocasionalmente también se observaron nódulos múltiples a lo largo de las raíces. Las raíces laterales también mostraron nodulación terminal. La nodulación terminal impidió el desarrollo de las raíces y a menudo se observó pudrición de las raíces viejas y noduladas. Las plantas de arroz susceptibles infectadas manifestaron clorosis generalizada, des arrollo estolonal pobre y a veces marchitamiento y consecuentemente muerte de las plantas. Las variedades resistentes Vars 13a²/103/F 2591/5/3, IR 20 y Var 54/6/6/6 mostraron pocos nódulos y muy reducidos así como lesiones necróticas en la cercanía de los puntos de desarrollo de las raíces.
Claves: Oryza sativa, fitomejoramiento, combate de nematodos.

LITERATURE CITED

1. Babatola, J.O. 1979. Nematology Report NCRI Ibadan, Nigeria 27pp; *2.* Caveness F.E. 1967. End of tour report USAID/MANR Lagos; *3.* Fortuner, R. 1975. Cahiers ORSTROM Serie Biologie, Nematologie 10(3): 147-159; *4.* Franklin, M.T. & Goodey, J.B. 1949. J. Helminth., 23: 175-178; *5.* Golden, A.M. & Birchfield W. 1968. Pl. Dis Reptr. 52: 423; *6.* Guiran G. De. 1971. In "Les nematodes des cultures. Journaux francaises d'etudes et d'information pan's 3-5 November, 1971 ACTA; *7.* Hussey, R.S. & Barker K.R. 1973. Pl. Dis. Reptr. 7: 1025-1028; *8.* Ichinohe, M. 1955. Jap. J. App. Zool 20: 75-82; *9.* Idowu, A.A. 1979. M.Sc. Thesis Ahmadu Bello Univ., Zaria. 138pp; *10.* Israel, P., et al. 1964. 10th FAO-IRC Working Party on Rice Production and Protection Manila 3pp (Mones graphol.); *11.* Jena, R.N. & Rao, Y.S. 1977. Proc. Indian Acad. Sci. B. 86(1): 33-38; *12.* Monteiro, A.R. 1968. Solo 60(2): 81; *13.* Olowe T. 1976. Proc. of Research Planning Conference on root-knot Meloidogyne spp. p. 15-19. I.I.T.A. Ibadan, Nigeria; *14.* Rao, Y.S. et al .1969. All India Nematology symposium. New Delhi, India, August 21-22, 1969 p. 59; *15.* Rao, Y.S. & Biwas, H. 1973. Indian J. Nematol. 3, 74; *16.* Roy, A.K. .1973. Indian J. Nematol. 3, 72-73; *17.* Roy, A.K. 1975. Zeitschrift für pflanzenkrankheiten Pflanzenchutz 286 (6/7): 384-387; *18.* Sangtain, C. 1978. Int. Rice Res. Newsletter 3 (2) 7; *19.* Van der Linde. 1956. Nematologica 1, 177-183; *20.* Vuong-Huu-Hai 1972. Document, Institut de Recherches Agronomique a 'Madagascar No. 341. 21pp.