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EVALUATION ON RESISTANCE OF *PINUS MASSONIANA* TO *BURSAPHELENCHUS XYLOPHILUS*¹

by

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Summary. Inoculation of seedlings, young and mature trees of *Pinus massoniana* with *Bursaphelenchus xylophilus* demonstrated different levels of resistance to the nematode.

Masson pine (*Pinus massoniana* Lamb.) is an important component of the pine forests of Southern China. Infestation of masson pines by the pinewood nematode, *Bursaphelenchus xylophilus* (Steiner and Buhner, 1934) Nickle, 1970 was first reported by Cheng (1987) in Jiangsu Province, China and this was further confirmed by Zhou and Cheng (1993) in investigation from 1986 to 1989. Opinions on the resistance of masson pines to *B. xylophilus* are somewhat controversial (Ohba *et al.*, 1984; Yang *et al.*, 1987) and therefore trials were undertaken to establish the level of resistance as a basis for a breeding strategy.

Materials and methods

Five to six years old seedlings of *P. massoniana* were grown in individual pots maintained in a screenhouse under controlled conditions at Nanjing University. Two sources of masson pines were used, one from Luhe County, Jiangsu Province and the other from Fuyang County, Zhijiang Province. Also, field-grown seedlings (1-2 yrs old), young trees (ca 10 yrs), and established trees (>25 yrs old) were selected in Nanjing, Jiangsu Province to test according to the method of Linit *et al.* (1987).

A population of *B. xylophilus* was obtained from a dying masson pine in Jurong County, Jiangsu Province and cultured on *Botrytis cinerea* Pers. growing on potato dextrose agar.

Seedlings, young and established trees were inoculated

with 1000, 5000, 20000 nematodes per seedling or tree, respectively. Sterile water was inoculated as a control in each test.

Results and discussions

Masson seedlings from Luhe and Fuyang maintained in a screenhouse were all infested with *B. xylophilus* and a large percentage of them died (Table I). These results are similar to those of Cheng *et al.* (1986). Many of the 1-2 yr old seedlings grown under field conditions in Nanjing that were inoculated with 1000 nematodes per seedling were killed (Table II). None of the ca 10 yrs old trees inoculated with 5000 nematodes died, which is similar to the results reported by Wang *et al.* (1992); but about 30% of trees that were more than 25 years old died after artificial inoculation with 20000 nematodes per tree. Pinewood nematodes were found in all treated seedlings or tree. All the pines used as controls remained healthy and no pinewood nematodes were isolated from the *P. massoniana*.

P. massoniana has been reported to be highly resistant to *B. xylophilus* (Ohba *et al.*, 1984; Yang *et al.*, 1987). This is not supported by our results although resistance/susceptibility may vary with the age of the masson pine. However, the increasing incidence of masson pine wilt disease, resulting from *B. xylophilus* infestation in infested areas in China (Zhou and Cheng, 1993) suggests that some resistant sources of masson pine are not likely to be readily available for breeding purposes.

¹ The authors are indebted to Prof. C. D. Fang for his advice.

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TABLE I - Resistance to pinewood nematode from two sources.

Source	Inoculum	No. trees	Dis. incidence %	Mortality	Pf/Pi
Luhe	1000	5	100	80	4.53
	0	5	0	0	0
Fuyang	1000	10	100	70	14.60
	0	10	0	0	0

Pf: Final numbers of nematodes per seedlings; Pi: initial nematode inoculum per seedlings.

TABLE II - Resistance of masson pines of different age to the pinewood nematode.

Age (yrs)	Inoculation		No. trees	Mortality %	Number of nematodes per pine
	Date	Inoculum			
1-2	1988	0	10	0	-
		1000	7	86	++
ca 10	1987	0	20	0	-
		5000	20	0	+
		1988	0	10	0
> 25	1987	5000	10	0	+
		20000	12	33	++
	1988	0	10	0	-
		20000	10	30	++

+ fewer than inoculum; ++ more than inoculum; - no nematodes.

Many reports showed that the age of the pine trees is one of the most important factors affecting the results of inoculation. Linit *et al.* (1987) found that the mortality of *P. sylvestris* L. and *P. echinata* Mill. differed between seed-

lings and established trees. We also found the significant difference in resistance among different ages of *P. massoniana*. Our finding that established masson pine was moderately resistant confirmed field observations of widespread nematode-associated mortality in *P. massoniana* (Zhou and Cheng, 1993). Therefore, objective appraisal of resistance must be made on established trees under field conditions.

The reasons for the apparent contradictions between our results and those of Yang *et al.* (1987) obtained in Hunan Province may be due to different inoculation time and the source of masson pine. There are many masson sources in China and different levels of resistance to *Matsucoccus matsumurae* among sources have been reported (Ge *et al.* 1987). So whether resistance to pinewood nematode differs among pine sources requires further confirmation.

Literature cited

- CHENG H. R., 1987. The alarm of *Pinus massoniana* infested naturally with *Bursaphelenchus xylophilus*. *Plant Quarantine*, 2: 77-79.
- CHENG H. R., LIN M. S. and QIAN R. J., 1986. On morphology identification of *Bursaphelenchus mucronatus* and its pathogenicity. *J. Nanjing Agricul. Univers.*, 2: 55-61.
- GE Z. H. and LU Q. H., 1987. A study on resistance of different provinces in *Pinus massoniana* to Japanese pine bark scale (*Matsucoccus matsumurae* Kuwana). *Subtrop. For. Sci. Tech.*, 15: 26-32.
- LINIT M. J. and TAMURA H., 1987. Relative susceptibility of four pine species to inoculation by pinewood nematode, *Bursaphelenchus xylophilus*. *J. Nematol.*, 19: 44-50.
- OHBA K., FURUKOSHI T., KURINOBU S. and ISHII K., 1984. Susceptibility of subtropical pine species and provinces to pinewood nematode. *J. Jap. For. Soc.*, 66: 465-468.
- WANG Q. M., WU L. C., YANG B. J., WU K. G., FONG P. X., XU D. E. and LI Y. Z., 1992. Masson pine's susceptibility to the nematodes. *For. Pest Dis.*, 4: 4-7.
- YANG B. J., WANG Q. L., ZHUI W. D., LI E. C. and YU T., 1987. On some pine resistance to *Bursaphelenchus xylophilus*. *Acta. Phytopathol. Sinica*, 17: 211-214.
- ZHOU G. L. and CHENG H. R., 1993. Studies on the infection of *Pinus massoniana* with pinewood nematode, *Bursaphelenchus xylophilus*. *Acta Phytopathol. Sinica*, 23: 81-84.