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The Leaf and Bud Nematode, *Aphelenchoides besseyi*, its Identification, Economic Importance and Control Measures. A Review

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ABSTRACT

The white tip disease of rice (*Oryza sativa* L.) caused by *Aphelenchoides besseyi* Christie was first discovered in Japan around 1940. It is seed borne disease widely distributed and occurs in the most rice growing area all over the world**.** This nematode is able to infest rice in various environments but infestation and damage are generally greater in irrigated lowland than in upland rice**.** The upper 2-5 cm tip of the rice leaf turns pale yellow to white in the tillering stage. Flag leaves are characteristically shortened and twisted at their apical portions and symptoms are most conspicuous at the booting stage. The nematode is located first inside the leaf sheath of rice seedlings although the numbers are always small. The increase in numbers rapidly occurs on the young panicles at the booting stage and then proceeds to the exterior of the glumes and later inside the paleae in rice grains**.** The white tip nematode was detected on *Setaria viridis, Cyperus polystachyus* and *Imperata cylindrical*. It is known to occur in millet, strawberry, *Vanda* orchids, *Chrysanthemum*, *Saintpaulia*, and other hosts. Control measures against white tip nematode mainly depend on 1- Water soaking and air- drying of rice seeds, 2- Soaking of rice seeds in aqueous emulsions or solutions of nematicides, 3- Cultural practices, 4- Using hot water and 5- Planting resistant or tolerant rice varieties.

Key words: *Aphelenchoides besseyi*, identification, economic importance, control measures.

Introduction

The white tip disease of rice (*Oryza sativa* L.) caused by *Aphelenchoides besseyi* Christie 1942 was first discovered in Japan around 1940 (Ichinohe, 1972). It is seed borne disease widely distributed and occurs in the most rice growing area in Asia, USSR, Tropical America and Africa (Franklin and Siddiqi, 1972, Fortuner and Williams. 1975, and Ou, 1985). Recently, it has been described from Egypt (Amin 2001a) and Europe countries including Italy (Moretti, 1997 and Cotoneo and Moretti 2001) and Turkey (Ozturk and Enneli, 1997). This nematode is able to infest rice in various environments but infestation and damage are generally greater in irrigated lowland than in upland rice (da Silveira *et al.,* 1977). Korayem (2002) stated that *Aphelenchoides besseyi* causes white tip disease of rice and may be introduced to Egypt through the imported dwarf rice cultivars or varieties used in breeding program.

The aim of this review to study the leaf and bud nematode, *Aphelenchoides besseyi*, in relation to its identification, economic importance and control measures on rice pants in Egypt and all over the world..

Economic importance:

The level of *A .besseyi*- infected grains in the tested locality in Egypt was not severe (95-120 nematodes/100 seed) in comparison to that in other countries in the world (Korayem, 2002). The level of this nematode was 3000 to 10,000 individuals/100 seeds in Sierra Leone (Fomba 1984), and it was 68 nematodes/seed in Tanzania (Taylor et al. 1972). Estimation of grain yield loss was 1.7 to 2% in Egypt (Korayem 2002) compared to grain loss of 54% in USSR (Popova, 1984). Amin (2001b) reported that after soaking of rice grain in tap water for a week, the number of extracted nematodes was 600/g grains. This represents 10% of the total nematode numbers found in 1 g of grains (i.e. 6000 individuals/g). It has caused variable yield losses in different countries ranging from 14.5 to 46.7% in Japan (Nishizawa and Yamamoto, 1951), 40- 50% in USA (Atkins and Todd 1959), 29 to 46% in Taiwan (Hung, 1959), 41 to 71% in USSR (Tikhonova, 1966) and 20 to 60% in India (Rao *et al*., 1985). In China, yield losses can be as high as 45% when plant infestation levels exceed 50% (Tsay *et al.,* 1998).

Taxonomy and morphology:

Allen (1952) studied the morphology of the leaf nematode and demonstrated that the white tip nematode referred to as *Aphelenchoides oryzae* Yokoo 1948 is identical to *A. besseyi* Christie 1942. Amin (2001a) described *A. besseyi* from rice fields for the first time in Egypt. Morphologically, the Egyptian population well

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corresponds to the classic descriptions of *A. besseyi* as it shows only some minor differences in the lengths of stylet and spicule.

Symptoms:

The upper 2-5 cm tip of the leaf turns pale yellow to white in the tillering stage caused by the leaf nematode. Flag leaves are characteristically shortened and twisted at their apical portions and symptoms are most conspicuous at the booting stage. The white tips of leaves of infected plants are not always manifest in certain varieties and/or particular growing conditions (Ichinohe, 1972). Korayem (2002) reported this nematode from Egypt. He showed that examination of infected leaves during early growth stage (July-August) clarified that the most conspicuous symptoms is the emergence of the chlorotic tips of leaves resulting in whitening of 1-2 cm of the leaf tip. This flag leaves later become necrotic, wrinkled distorted and occasionally twisted, whilst the rest of the leaf appear normal.

Nematode bionomics:

The leaf and bud nematode is located first inside the leaf sheath of rice seedlings although the numbers are always small. The increase in numbers rapidly occurs on the young panicles at the booting stage and then proceeds to the exterior of the glumes and later inside the paleae (Goto and Fukatsu, 1952). At harvest stage, they coil up and become quiescent in the seeds. The number of viable nematodes infesting seeds varies ranging from 0- 64 per seed, the numbers in 100 seeds from severely and slightly affected paddies were 1211 and 132, respectively of which nearly 90% inhabited the inner surface of the husks and the rest were on the kernel (Fukano 1962). The nematode is attracted to the young, growing parts of rice plants and to the aqueous extract of the germinating seeds, but not to the ungerminated seeds, husks or other old plant parts (Goto and Fukatsu, 1956).

Host range:

The white tip nematode is known to occur on a rather wide range of hosts. Yoshii and Yamamoto (1950) reported that *Setaria viridis* (foxtail) may be infected by the nematode and *Panicum sanguinale* (crab grass) and *Cyperus iria* may be slightly infected, but not *Panicum* (*Echinochloa*) *crus-galli* (barnyard grass). They also showed that the ear – blight disease of Italian millet (*Sitaria italic*) is caused by the same nematode and that exceedingly large numbers of nematodes can be found in infected ears. Huu-Hai-Vuong (1969) detected the white tip nematode on *Cyperus polystachyus* and *Imperata cylindrical*. It is known to occur in millet, strawberry, *Vanda* orchids, *Chrysanthemum*, *Saintpaulia* and other hosts.

Control measures:

1- Water soaking and air- drying of rice seeds:

Hoshino and Togashi (2000) showed that after soaking rice seeds in water for 48hr.at 25C+5°C, portion of white tip or leaf nematode died. After air-drying at the same temperature and for the same period, the percentage of died nematodes increased. Corrected nematode mortality for each treatment was calculated as described by Abbott (1925) to exclude the initial mortality in the sample as follows: % corrected mortality =

$$\frac{\%\text{survival for untreated control- }\%\text{survival after treatment} \times 100}{\%\text{ survival for untreated control}}$$

Where % survival is obtained by subtracting % mortality from 100.

Since a portion of the survivors of water-soaking of seeds were killed by subsequent air drying, net mortality from the combined treatments (m_3) must satisfy the following equation:

M_3=1(1-m_1) (1-m_2) where m_1 and m_2 express mortalities caused by water-soaking and air drying, respectively.

When rice seeds are soaked in water, it absorbs water and swells quickly (Hoshikawa, 1975). Swelling may increase the pressure within rice seeds. Respiration also rapidly increases (Takahashi, 1955). Thus, it can be proposed that some nematodes are killed and others are stressed by high pressure, CO_2 and low oxygen content within inhibited seeds. If so, the respiratory stress may contribute to nematode mortality during air-drying after soaking. Another plausible explanation for mortality during air- drying is that freshly hydrated nematodes are physiologically unprepared to survive desiccation (Hoshino and Togashi 2000).

2- *Soaking of rice seeds in aqueous emulsions or solutions of nematicides:*

This included soaking of rice seeds in nematicides as fenitrothion, fenthion and cartap for 24 hr. After soaking, the seeds were air- dried for a few days until they are soaked again in water for sprouting (Chiyonishio and Nakazawa, 1988). Amin and Al-Shalaby (2005) reported that soaking rice seeds in different concentrations of the nematicide, cadusafos (Rugby 20%) and oxamyl (Vydate 24%) for 24 hours showed that cadusafos at 200 and 400 ppm achieved maximum leaf nematode mortality without damage to seed sprouting.

3- *Using hot water:*

Since the white tip nematode is seed borne, seed treatment with hot water has been studied by several workers. Yoshii and Yamamoto(1951) first used a soak in water at 50 and 51°C for 5-10 minutes following soaking in water at below 20°C for 16-20 hours, later, they suggested that immersion of dry seeds in water 56-57°C for 10-15 minutes,60 days before sowing destroyed all seed-borne pathogens. They reported that injury to the seeds occurred only at 60°C applied for more than 20 minutes. Amin and Al-Shalaby (2005) found that soaking of rice seeds infected with *A. besseyi* in hot water at 70°C for 15 minutes and hot air-drying treatment at 70°C for 24 hours showed best results in controlling white tip nematode without any effect on sprouting.

4- *Cultural practices:*

Certain cultural practices have been recommended to reduce damage from *A. besseyi*. Cralley (1949) recommended early planting (in April). Yoshii and Yamamoto (1951) reported that by advancing the time of sowing by 60 days, nematode infection could be avoided. Cralley (1956) found that seeding directly into water instead of before flooding with water resulted in only a small percentage of infected plants. From pot experiment, Tamura and Kegasawa (1957-1959) concluded that (1) the ability of the nematode to infect rice seedlings appeared to be less in wet soil than in flooded soil., (2) plants grown at a high temperature in the glasshouse had more injured stems caused by *Sclerotium oryzae* than plants kept in shade, but the number of white tip nematodes was smaller in the grains from the former and (3) the effects of nitrogen, calcium silicate and urea fertilizers on nematode injury were indistinct.

5- *Planting resistant or tolerant rice varieties:*

Fukano and Yokoyama (1951) concluded that in testing varietal resistance, both the number of fungus-infected stems and the degree of white tip should be considered because some varieties are infected without showing white tip symptoms. Goto and Fukatsu (1956) found that the rate of white tip nematode multiplication was lower in resistant than in susceptible varieties.

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