DISTRIBUTION OF THE RICE WHITE TIP NEMATODE, *APHELENCHOIDES BESSEYI*, IN RICE GROWING AREAS IN THE THRACE REGION OF TURKEY

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Summary. A study was conducted to determine the distribution of *Aphelenchoides besseyi* and its effect on yield components in the rice growing areas of the Thrace region of Turkey. Ninety paddy seed samples were collected in 2007 and 62 in 2008. Analysis showed that 18.8% and 43% of fields, in 2007 and 2008, respectively, were infested. In the infested samples, nematode densities were in the range 9-20,600 specimens/100 g of paddy seed. There was a significant negative correlation between the density of *A. besseyi* specimens in infected seed samples and the weight of 1000 grains in 2008. The effect of *A. besseyi* on the susceptible cv. Halilbey showed that panicles with white tip symptoms were significantly shorter (27.1%) and lighter (60.7%) than those without white tip symptoms.

Keywords: Infestation rate, *Oryza sativa*, yield loss.

The rice growing area of Turkey was 994,929 ha in 2008 when only licensed crops are considered. In the same year the total production was 753,325 tons. The contribution of the entire Thrace region to national production is 55.2% and, within the region, the contributions of Edirne, Tekirdag and Kırklareli provinces to national production are 49.3%, 4% and 1.9%, respectively.

The white tip nematode, *Aphelenchoides besseyi* Christie, is a severe ectoparasite of rice, *Oryza sativa* L. The nematode enters rice florets, proliferates with a short generation time of about 10 days at 25 °C and undergoes anhydrobiosis as adults and fourth-stage juveniles within seeds beneath the glumes (Nandakumar *et al.*, 1975; Hollis and Keoboonrueng, 1984). *Aphelenchoides besseyi* has been reported from most of the rice growing countries of Africa, North, Central and South America, Asia, Europe, and the Pacific. Yield losses vary with cultivar, year, temperature, cultural practices, and other variable factors. In infested fields, the average losses range from 10 to 30%. In fields where all plants have been attacked, maximum losses of up to 70% for the most susceptible cultivars and of 20% for the most resistant cultivars have been reported (Prot, 1992).

In Turkey, *A. besseyi* was first reported in 1995 in the Ipsala district (Edirne province) and Gonen district (Balıkesir province) (Ozturk and Enneli, 1997). In Balıkesir and Çanakkale provinces, Marmara region, northwest of Turkey, the nematode occured in 11.7% of seed samples (Mısırlıoglu and Pehlivan, 2000). In the north of Turkey, the infestation rate of *A. besseyi* in seed samples was 7.8% in Çankırı province and 15.3% in Çorum province (Karatas, 2007). However, no systematic sampling had been conducted and no information was available on the impact of the nematode on rice yield in Turkey. Therefore, a survey of *A. besseyi* was undertaken in the Thrace region of Turkey to assess the distribution of the nematode in some selected irrigated rice areas, its levels of infestation in the paddy seed and its effect on yield components of the susceptible rice cv. Halilbey.

The survey was undertaken in 2007 and 2008. Paddy panicles were collected from the rice growing areas during the harvesting period using systematic sampling methods. The Global Positioning System (GPS) was used to determine the coordinates of the sampling sites. Rice was harvested when 80% of the paddy seeds had become straw yellow colour, during September and October. At least 100 paddy panicles were collected from twenty different points of the same field and taken to the laboratory, where they were held at 10 °C until processed. Seed samples were also collected from rice processing factories. In 2007, 47 samples were collected from the paddy plantations and 43 samples from the factories that process rice. In 2008, 30 samples were collected from the plantations and 32 from the factories. During the 2007 year study, panicles were collected irrispective of the presence or not of white tip symptoms,. In 2008, instead, only panicles showing white tip symptoms were sampled.

Mister, modified Baermann's funnel (Stirling *et al.*, 1999) or Whitehead's methods (Whitehead and Hemming, 1965) were used to extract the white tip nematode from the paddy seeds. Sub-samples of 10 g of seed per sample were processed with the mister Baermann's funnel method and 50 g with Whitehead's method. The paddy seeds were separated from their glumes and then glumes and seeds (brown rice) were placed in the same

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Fig. 1. Districts of rice growing areas in the Thrace Region part of Turkey, where sampling for *Aphelenchoides besseyi* took place in 2007 and 2008. *In parentheses: (no. of samples infested with *A. besseyi*/no. of non-infested samples).

screen or same cup. Samples were held at room temperature (25 °C) for 3 days during both extraction methods. The mister method was set up to spray a mist of water for 15 seconds in every 2 minutes. After extraction, the water suspension (approximately 20 ml) was collected from the bottom of each funnel in the mister methods. With the Whitehead's method, 40 cm long, 20 cm wide, 5 cm deep trays were used. After the extraction process, a 20 µm filter and a vacuum pump were used to concentrate the nematodes into a small volume of water (approximately 20 ml).

The nematodes in two 1 ml aliquants of water suspension from each extract were counted in counting dishes, using a stereomicroscope at 32× magnification, and the average of the two counts was calculated and referred to 100 g of seeds.

To examine the effects of white tip nematodes on yield components, ten plants were separately collected from crops showing white tip symptoms and from crops without symptoms of *A. besseyi* infection, planted to rice cv. Halilbey. Panicle lengths and weights were recorded for each panicle, fertile and sterile kernels were counted. The weight of 1000 kernels of panicles with and without white tip symptoms and nematode density per 100 seeds were calculated.

In 2007, 21.3% of the samples collected from the fields and 16.3% of those collected from the processing factories were infested with *A. besseyi* (Fig. 1), with an average of 18.8% of rice samples infested.

In 2008, 43% of the samples collected from the fields and the same percentage of those collected from the factories were infested with *A. besseyi* (Fig. 1).

The greatest density of *A. besseyi*, 20,680 specimens/100 g of seed, was found in a sample from Ipsala district in 2008, from a plantation where the susceptible rice cv. Halilbey was grown. Seventy-seven percent of plants in this field had white tip symptoms on the flag leaf when five randomly selected plants per m^2 were examined. Tulek (2009, unpublished) observed a yield loss of 57.9% caused by *A. besseyi* to cv. Halilbey when 324 specimens of *A. besseyi*/panicle were found during the flowering stage and an average of 233.4 (120.5-423.4) specimens of *A. besseyi*/100 paddy seeds were recorded at harvest. This shows that, if white tip nematode is not controlled, severe yield loss must be expected.

The six most infested seed samples contained 1728-20,680 *A. besseyi* specimens/100 g of seed. In eleven samples, the numbers of *A. besseyi* were in the range 100-851/100 g of seed, while 27 samples contained 9-96 *A. besseyi* specimens/100 g of seed. More nematodes were extracted from the samples collected in 2008 than in 2007.

The effects of *A. besseyi* on the susceptible cv. Halilbey included that of panicles with white tip symptoms being significantly shorter (27.1%) and lighter (60.7%) than those without white tip symptoms (Table I). The number of fertile kernels per panicle was decreased by 46.1% and sterile kernel numbers were increased (88.1%) due to *A. besseyi* infestation. Also, the weight of 1000 kernels was decreased by 30.4% and there was a significant (P = 0.01) negative correlation between the

Table I. Population density of *Aphelenchoides besseyi* in rice grains and its influence on yield components in irrigated rice, cv. Halilbey, in the Thrace region of Turkey.

Yield component	Plant without white tip symptoms	Plant with white tip symptoms	Percent of increase (+) or decrease (-)	CV%	$LSD_{0.05}$
Panicle length (cm)	16.9 a[1]	12.3 b	-27.09**	10.3	1.77
Panicle weight (g)	5.7 a	2.3 b	-60.66**	29.1	1.17
Filled grain (no.)/panicle)	159.0 a	85.7 b	-46.10**	25.4	31.6
Sterile grain (no)/panicle	12.6 a	23.7 b	+88.10*	46.1	4.46
1000 kernel weight (g)	31.9 a	22.2 b	-30.37**	9.5	2.59
A. besseyi/100 grains	10.9 a	741.6 b	+6703.67**	28.8	190.8

(**) P<0.01 (*) P<0.05

[1]In each lines, means followed by different letters are significantly different according to LSD tests at P = 0.05.

numbers of *A. besseyi* specimens per 100 seeds and the weight of 1000 grains (r = -0.6418, significant at P = 0.01) in the infected seed samples in 2008.

In conclusion, in six seed samples, the density of *A. besseyi* was much larger than the economic damage threshold of 30 specimens of *A. besseyi*/100 seeds, determined by Fukano (1962). The most important cause of the broad distribution of the nematode in the Thrace region and elsewhere in Turkey is the use of infected seeds. Farmers use their own or exchanged, probably infected, seeds for sowing. Moreover, irrigation water moves across different rice fields. All of this favours the spread of the nematode. Therefore, farmers should be encouraged to use rice seeds certified as free of nematodes and avoid the movement of irrigation water across different fields.

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