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Incidence and distribution of *Aphelenchoides besseyi* in rice areas in Iran

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Aphelenchoides besseyi is a seed-borne nematode and the causal of rice white- tip disease. It has been recorded in most rice-growing areas of the world. In 1982 it ranked tenth and was regulated by nine countries, but in 2002 it ranked second with 70 countries regulating it. Although the nematode has been reported from north of Iran, there is not enough knowledge about It's distribution in rice-growing areas. Thereby, this research tries to assess distribution and incidence of the nematode in different areas. To determine these, 885 seed samples were collected from rice fields. Samples were investigated for exist of nematode by Coolen & D-Herd method. Typical leaf symptoms of the disease are infrequently observed, but panicle symptoms of malformed inflorescences and seed deteriorated were observed in rice fields. The highest disease incidence with largest nematode population was observed in Mazandaran (71%), Golestan (58%), and Guilan (53%) provinces. Approximately 61% of seed samples collected from north of Iran, were found to be infested with the nematode and about 75% infested seed samples had 100-825 nematodes per 50 gram grains. One of the susceptible cultivar had 1050 nematodes per 100 grains. Khuzestan, Fars, West Azarbaijan and Lorestan provinces were new records of occurrence the nematode.

Key Words: *Aphelenchoides besseyi* - Distribution - Incidence - White tip Disease

Introduction

White-tip disease of rice, caused by *Aphelenchoides besseyi*, has been found in upland or irrigated rice in many rice growing countries in Asia, Tropical America, USSR and Africa (Franklin and Siddiqi, 1972; Fortuner and Williams, 1975; Ou, 1985). Recently it has been reported from Egypt (Amin, 2002) and Europe countries including Italy (Moretti, 1997; Cotoneo and Moretti, 2001) and Turkey (Ozturk and Enneli, 1997).

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

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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 at*., 1985). In China, yield losses can be as high as 45% when plant infestation levels exceed 50% (Tsay *et al.*, 1998).

The nematode was first reported occurring in Iran in 1971 (Kheiri, 1971). Subsequent reports indicated that the nematode was widespread in rice environments in north of Iran (Talachian and Akhiani, 1976; Tanhamaafi and Mahdavian, 1993; Elahinia and Mahdavian, 1998; Pedramfar *et al*., 2001). Although white- tip disease has been reported from different regions in north of Iran, the incidence and distribution of it in all rice cultivated areas is unknown. Therefore a survey of *A. besseyi* in Iran was undertaken and its symptoms under field conditions, the extent of its distribution in some selected rice areas, the levels of infestation and its effects on yield components were investigated.

Materials and methods

Incidence and distribution of the disease

During the 2003-2005 cropping seasons, a survey of farmers' rice fields and cultivars was made in different region of Iran. The objective was done by visiting rice fields at crop maturity and obtaining a few panicle from farmers in each of the randomly selected village/town. Where the fields were already harvested, some seed samples from storages and names of rice cultivars were obtained directly. In the 2003 cropping season, rice seed collection was limited to three north provinces (Guilan, Mazandaran, Golestan) only as the nematode was earlier observed to be more widely distributed in these subecosystems. The most hectares of these lands are devoted to rice which is broadcast in April-May and harvested in September-October. A further collection was obtained in 2004 and 2005 from the farmers in all areas and assessed for the nematode. A set of 50 gram seed samples from each location was extracted by Coolen and D-Herds' method (Coolen and D-Herd, 1972). The extracted nematodes were counted and their identity confirmed microscopically. Based on the presence of nematodes, seed samples were indexed at different levels of infestation. During this study, a total of 885 rice seed samples of 14 provinces were examined.

Effects on yield components

Ten apparently healthy panicles and ten panicles showing white- tip symptoms were collected from each of ten different white- tip infested fields planted with cv. Alikazemi at Guilan. Length and weight of these panicles

were recovered and the panicles were threshed separately. Filled and sterile grains in each panicle were counted and then the grains of ten panicles were bulked from each field to obtain the 1000 grain weight and also to estimate the nematode population in 100 grains.

Results

Incidence and distribution

Chlorotic discoloration in 2 to 5 cm on the leaf tip of seedling as a diagnostic symptom was occurred in low frequent under Iran conditions (Fig. 1-A). At the booting stage, the flag leaf of the affected plant was characteristically shortened, twisted and often distorted or split longitudinally. Complete or partial emergence of panicles occurred on infested plants with whitish spiklets on the tip or throughout. The affected spikelets were shrunken and unfilled (Fig. 1-B).

Fig. 1. The characteristic symptoms of white- tip disease: A) White- tip symptoms on rice leaves. B) Malformed and Sterile panicle caused by *Aphelenchoides besseyi* in rice fields' condition.

The survey indicated that seven from totally fourteen examined provinces were infested (Fig. 2). Among the 885 seed samples, 361 fields (41%) were infested. The severity of infestation in these fields was as follows: 60.1% seeds had low infestations (0-500 nematodes per 50g seeds), 23.8% seeds had moderate infestations (500-1000 nematodes per 50g seeds) and 16.1% seeds with higher infestation levels were recorded. From this survey Mazandaran (71%), Golestan (58%), and Guilan (53%) districts respectively were identified as the most important endemic areas for white-tip disease while other provinces had low incidence of the nematode (Table 1). The extracted populations of *A. besseyi* were high in Mazandaran (0-2500 nematode per 50g seeds), Guilan (0-2250) and Golestan (0-1250) in a descending rank. The

Mazandaran not only had the highest incidence of the disease but also had maximum severity amongst the all infested provinces (Table 1).

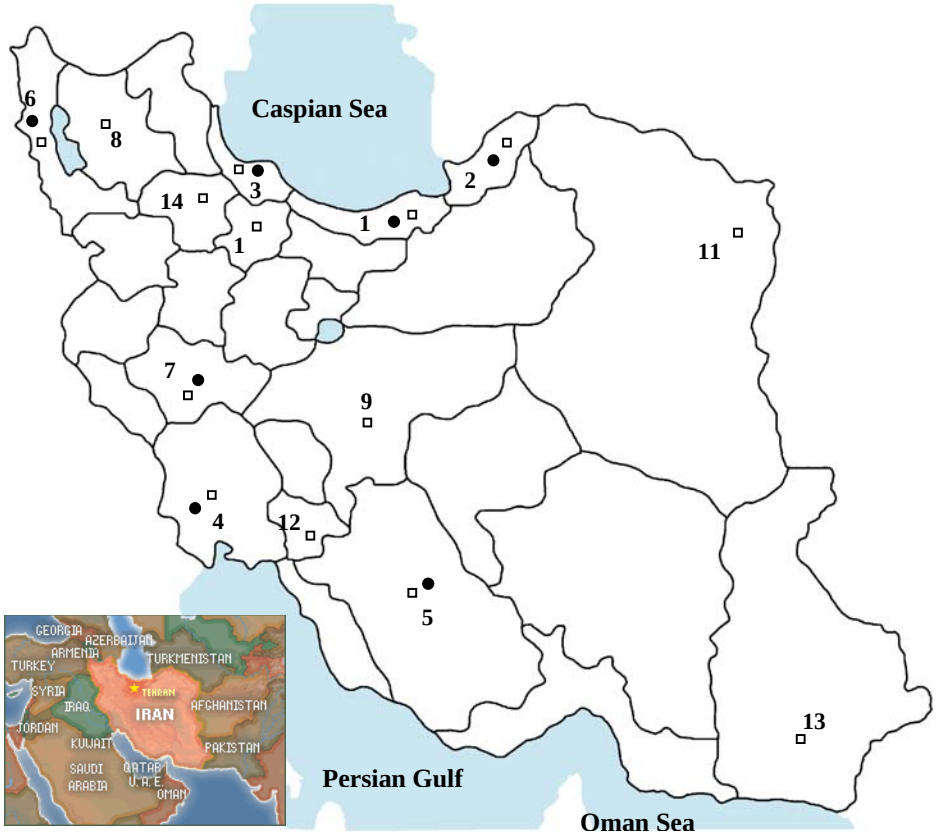

Fig. 2. Distribution of *A. besseyi* in selected rice areas of Iran (□ = sampling places; • = infected places).

It was found that the cvs. Alikazemi and Hashemi, grown widely in Guilan province, were infested in highly level. Although the number of samples taken of some variety such as Tarom were low, these were found to be susceptible to white- tip nematode both in terms of infestation levels and nematode members per 50 g seeds (Table 2). A few samples had more than 500 nematodes per 50 g seeds, while most of the samples having less than 500 nematodes. However, there were varietals differences both in infestation level and in the numbers of nematodes in seeds (Table 2).

Table 1. Incidence of *Aphelenchoides besseyi* in rice seed samples from rice fields in Iran.

Province	Local position on the map	Number of samples	Percent of infestation	Number of nematodes per 50g seeds
Mazandaran	1	182	71	0-2500
Golestan	2	111	58	0-1250
Guilan	3	297	53	0-2250
Khuzestan	4	59	8	0-240
Fars	5	49	8	0-150
West Azarbaijan	6	14	7	0-90
Lorestan	7	15	7	0-50
East Azarbaijan	8	22	0	0
Esfahan	9	38	0	0
Ghazvin	10	20	0	0
Khorasan	11	10	0	0
Kohgiluyeh va Buyer Ahmad	12	31	0	0
Sistan va Baluchestan	13	12	0	0
Zanjan	14	25	0	0

Table 2. White-tip nematode infestation in farmers stored seed samples at harvest in Guilan provinces.

Rice variety	Number of seed samples infested with *A. besseyi*	Percent of infestation with*A. besseyi*	Average numbers of *A. besseyi* per 50 g seeds
Alikazemi	47	53 .4	570
Hashemi	55	46.2	650
Hassani	5	45.4	336
Binam	4	44.4	211
Ramezani	3	42.8	386
Tarom	10	40	575
Deilamani	7	38.9	345
Domsiah	3	33.3	289
Hassansarayi	2	33.3	237
Khazar	6	17.1	196

Effects on yield components

The effects of *A. besseyi* on panicle yield in cv. Alikazemi (Table 3) indicated that panicles with white-tip symptoms were significantly shorter by 29.3% and lighter by 41.9% than the panicles without disease symptoms. The diseased panicles had few filled grains and the sterile grains were increased. The weight of 1000 grains from diseased panicles decreased by 54.5% and the

nematode population per 100 seeds in diseased panicles (650) was significantly higher than in panicles without apparent disease symptoms (59) (Table 3).

Table 3. Population density of white- tip nematode in rice grains and its influence on yield components in rice cv. Alikazemi.

Yield component	Plant without disease symptoms	Plant with disease symptoms	Percent of increase (+) or decrease (-)	t- value
Panicle length (cm)*	30.4	21.5	-29.3	32.14**
Panicle weight (g)*	3.1	1.8	-41.9	29.07**
Filled grain (no.)/ panicle*	110	34	-69.1	45.06**
Sterile grain (no.)/ panicle*	15	52	+246.7	34.09**
1000 grain weight (g)	22	10	-54.5	28.46**
Nematodes/ 100 grains	59	650	+1001.6	15.12**

**Significant at P=0.01 level by t-test.
*Means at 10 samples.

Discussion

Examination of panicles at harvest and seed samples from farmers' store, indicated that the white- tip nematode is distributed in the rice cultural areas of Iran. The symptoms on leaves, e.g. whitening of the leaf tip during the vegetative stage that observed lowly, and the shortened, twisted and sterile panicle seen during the reproductive stage of rice were similar to that reported (Ou, 1985). The presence of nematode infested grains on the uppermost part of the panicle or throughout the panicle, together with the apparently healthy grains is in accordance with the previous report (Steele, 1970).

Differences noted in the level of nematode infestation of rice seed samples obtained from rice grown under north and other regions conditions were probably due to the climatically differences in the rice environments. *A. besseyi* is reputed to occur in greater numbers in flooded rice fields than elsewhere (Ichinohe, 1972; Ou, 1985). It is suggested that the intermittent flooding of rice fields in north compared to other regions cause the crop is exposed to infection from water-bone inocula at a younger, more easily invaded stage, thus allowing more time for nematode development and multiplication. The circumstance would also allow nematode dispersal and re-infection. However, the reasons for the greater number of nematodes and high infestation levels of seeds were not investigated but it is possible that flood water, high atmospheric humidity and free moisture on the leaf surface during flood might play an important role in spread and multiplication of the nematode. On the other hand, the build- up of nematode populations in farmers' rice cultivars with a long history of

cultivation in north of Iran was probably due to cultivar susceptibility to the nematode that grown continuously.

Assessment of both the stored and fresh seed samples of rice revealed that about 39.9% seed samples were infested with *A. besseyi* and contained more than 500 nematodes per 50g seeds. Fukano (1962) in Japan, indicated that 30 or more live nematodes per 100 grains may be the possible economic threshold level in a susceptible cultivar. This would suggest that *A. besseyi* is causing yield loss of rice in the north of Iran. The results revealed that the susceptible cv. Alikazemi (Table 2) in which a high level of grain sterility and reduction in yield component was influenced by infestation of the nematode, significantly (Table 3).

Rice white-tip nematode is widely distributed because of its dissemination in seed, but its importance varies between regions, countries and localities. Within a locality, the incidence and severity of the disease can change from year to year and are strongly influences by environmental factor, cultural practices and local rice types. In conclusion, seeing the widespread occurrence of *A. besseyi* in rice cultivars in Iran, there is a need to investigate the ecology, crop loss assessment and bionomics of the nematode in rice fields.

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