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OCCURRENCE, DISTRIBUTION AND EPIDEMICS OF WHITE TIP NEMATODE, *Aphelenchoides bessey* ON RICE PLANTS IN EGYPT.

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ABSTRACT

The occurrence of white tip nematode, *Aphelenchoides besseyi* was found to reflect a lengthy association with natural vegetation or climatic variations within different regions in Egypt that are diverse enough to influence the pattern of nematode distribution and/or occurrence. Three methods of nematode extraction, i.e. Baermann funnel, plate and sieving were used for nematode extracting. Three nematode inoculum levels, i.e. 250, 500, 1000 individuals/plant) were used, 5 days after rice transplants to study nematode symptoms throughout growth stages. Under field conditions, twenty-seven rice growing areas were selected according to easy access or nematode infected expectations, choicing 3-4 fields for each selected area throughout Nile Delta and surveyed randomly to record both healthy and diseased plants. In the meantime, at booting stage, samples of 200 grams of fresh rice panicles were cut to small pieces, soaked in water for 48 hours to collect and record the extracted nematodes. Results emphasized that the damage, infection and plant symptoms were positively correlated with nematode inoculums level. Nematode extracts or isolation and separation methods indicated that Baermann funnel technique gave the best nematode counts and was considered to be the most efficient extraction method. Dynamic interactions of rice-nematode symptoms were found to influence numerous complex biological processes. The spatial model was chosen, and was considered to be the appropriate to represent the spatial nature of rice epidemics. It was found out that the resulting model can implement as a computer programme proving to be one of the useful investigative tools. Results indicated that Biala region (Kafr El-Sheikh) was highly epidemic, whereas Dakahlia and Sharkia Governorates were moderately epidemic. On the other hand, El-Senblawain area (Dakahlia Governorate) was considered to be non-epidemic for *A.besseyi* infestation. The breeding program indicated that either local cultivars, Giza 178, Giza 176 and Giza 181 or different tested lines were more resistant varieties to nematode infections, however symptoms were noticed. Among 53 cultivars or lines, only 20 were found to be highly resistant, while Giza 171 was considered to be highly susceptible cultivar.

Keywords: epidemics, resistant varieties, spatial model, white tip nematode, *A. besseyi*.

INTRODUCTION

White tip nematode, *Aphelenchoides besseyi* is considered one of the serious pest of rice plantations in Egypt. The aim of the present study was to throw some contributions on surveying nematode occurrence, inoculum levels, extraction and/or isolation, distribution and understanding nematode epidemics through mathematical modeling.

Rice plant is a member of the grass family. Archeological evidence indicates a sophisticated rice cultivation system existed in China over 7,000 years old. There are 110 rice producing countries in the world, ranging from Himalayan mountains to low land delta areas. Rice is the stable food in Asia, Latin America, some parts of Africa, and the Middle East area (Scheneman and Deren, 2002).

In Egypt, rice is considered as one of the most important field crops. It contributes about 20% of the total cereal consumption, and also as cash export crop. Annually more than one million feddans are cultivated with rice, producing 4-5 million tons of paddy with an average of 3.65 tons/ fed. (8.6 tons/ ha), which is considered to be one of the highest product per unit area's averages in the world (Rice Res. and Training Center. Tech Recomendation for rice crops, Sci. tech. bull. 2003, Ministry of Agric., Egypt; and El-Sherif (1997).

Aphelenchoides besseyi is widely distributed and occurs in most rice growing areas all over the world (Ou, 1985). The known distribution of *A. besseyi* on rice includes : Australia, Ceylon, Cameron, Islands, Cuba, El-Salvador, Hungary, India, Indonesia, Italy, Japan, Madagascar, Mexico, Pakistan, Philippines, Taiwan, Thailand, former USSR (Feaking, 1970) and in the most countries of Central and West Africa (Barat *et al.*, 1969; Vuong, 1969; Franklin and Siddiqi, 1972; Furtuner and Williams, 1975). *A. besseyi* was first recorded from Japan (Kakuta, 1915). In the USA the disease was first recorded in the Southern United States in `1953, but was attributed to a nutrient deficiency (Ou, 1972). From 1959 to 1996, *A. bessey* was detected only twice in California by CDFA nematologists throughout a survey proposal in 1997 which emphasised that this survey would provide, or sound basis for possibly certification for elimination of. *A. besseyi.*

In Egypt, Amin (2002) recorded *A. besseyi* for the first time during a survey of plant parasitic nematodes in the paddies of Dukahlia and Sharkia governorates in Nile Delta of Egypt. Moreover, Tahwaai village where paddy areas of South Dakahlia governorate were cultivated with Giza 171 and Reiho cultivars achieved the highest levels of *A. baesseyi* infestations in rice grains as well as straw (Khalil and El-Sheirif, 2003).

Feeding of *A. besseyi* at leaf tips in rice results in whitening the top of 3-5 cm of the leaf, leading to necrosis (describe as "white tip" of rice by Yokoo, 1948). Distortion of the flag leaf that encloses the panicle may happen. Diseased plants are stunted, lack vigor and produce small panicles and may show high sterility, distorted glumes and small and distorted kernels (Ou, 1972). The most conspicuous symptoms occur at the tillering stage (Taylor, 1969).

A full understanding of the underlying population dynamics and genetics is essential in order to the effective control strategies to be formulated (Cornel *et al.*, 2000). The dynamics of pest populations are complex, making the prediction of outbreaks difficult. Mathematical modeling and computer simulation provide ways to help unravel such complex systems and understand how pests interact with the environment and with other organisms. Modeling approaches are used to ensure efficient use of resources in integrated pest management programs to predict the likely impact of new control measures, and to compare economic returns from different control strategies (Holt and Chancellar,1996,1997; Holt *et al.*, 1997 and Holt, 2002)..

Nishizawa *et al.* (1953) showed that the amount of inoculum (husks of diseased grains) affects the symptoms, including length of stems; weight of ears, weight of 1000 grains etc. on the susceptible rice cv. Zuiho, but not on the symptomless Nankai No.3. Goto and Fukatsu (1956) tested in the field 20 cultivars inoculated with husks of diseased seeds and evaluated the tested cultivars according to its susceptibility and symptoms. Todd and Atkins (1958) succeeded in inoculating plants by injecting a suspension of nematodes into the inside of the leaf sheath.

Therefore the objectives of this paper include : (1)diagnosis of white tip disease and its occurring problems, (2)general detection and surveys, (3)geographical distribution of rice cultivars and lines , in the choosen four Nile Delta Governorates in Egypt.

MATERIALS AND METHODS

1- Nematode Extraction:

Extraction techniques must yield live nematodes at the end of the used procedure, but it is always better to have numbers of healthy specimens of *A. besseyi* nematode. The most convenient methods are usually Baermann funnel, tray extraction (Goodey, 1957) and sieving (Cobb, 1918) techniques, because these methods allow to handle sufficiently large samples, and also minimize nematode mortality (De Ley, 1995; Bloemers and Hodda, 1995). Unlike trays, Baermann funnels often need to stand more than one day (resulting in a longer number of asphyxiated worms) and may need to be tapped repeatedly (which requires to spread out subsequent handling over a longer time and in repetitive steps).

In the present study, the plate and sieving procedure (Cobb, 1918) was used for extracting nematodes from small rice plant samples during booting and maturing stages. In booting stage, 200 grams of fresh panicles were cut to small pieces, soaked for 48 hours for extraction by the different methods Nematode counts were recorded in the maturing stage, 1000 dry grains of naturally infested grain were soaked for 48 hours, and the extracted nematodes were evaluated for each extraction procedure (Siddiqi, 1997; Sardenelli *et al.*, 2002).

2. Symptoms and Population Dynamics:

Three inoculum levels i.e. 500 and 1000 individuals/plant were used 5 days after rice transplanting to study the effect of *A. besseyi* on rice plant symptoms throughout plant growth stages. Nematode populations per plant were also estimated as follows : Based on chlorotic discolorations of the leaf sheath just below the collar, rice seedlings (Giza 171) were selected and marked by bamboo stalkes for recording symptoms at different growth stages. Three samples, each of 25 plants (stems or panicles) showing symptoms were taken at each growth stage. The extracted nematodes were counted and their identity were confirmed microscopically. Percentage of plants showing symptoms of the disease were estimated from counts on each sampling day in the same field.

3- Nematode Incidence and Distribution:

Twenty-seven rice growing areas were selected based on easy access or nematode infested expectations however,a representative of typical rice situations and/or areas. Three to four fields in each of these selected regions were surveyed randomly to record the number of healthy and diseased plants. Eighty one rice samples were chosen from Kafr El-Sheikh, Dakahlia, Beheira and Sharkia Governorates.

Samples of 200 grams of fresh rice panicles were cut to small pieces (1cm in length) and mixed with 100 ml of water for a period of 30 seconds, then soaked for 48 hours in booting stages. Based on the presence of nematodes, mean number of nematodes in the collected samples from different areas throughout Nile Delta were recorded when ten panicle samples were taken, then threshed resulting and the nematodes were counted and identified.

A spatial model was developed to predict *A. besseyi* distribution throughout rice growing regions especially in the choosen four Nile Delta Governorates. The study chosen sites were Kafr El-Sheikh, Dakahlia, Beheira and Sharkia Governorates. *A. besseyi* counts were used for data handling, storage, analyzing and running the model. According to nematode counts, *A. besseyi* distribution throughout Nile Delta was classified to 5 groups according suggested by authors to the damage severity. Independent variables and coefficients of the model were determined using logistic regression of the measured variables, (Sharov, 1996) vegetation durability, distance to open water and depth of water was significantly affected nesting probability.

4. Cultivars and lines evaluation :

Rice plant diseased samples (25 plants for each 5 replicates) were evaluated according to white tip disease symptoms in rice growing areas in pre-heading stage. The mean number of *A. besseyi* population was evaluated in Table 4. Fifty three old and new rice cultivars (under tested experiments), distributed throughout were evaluated against their susceptibility or *A. besseyi* damage. The tested cultivars and lines were arranged in Table 4.

5. Statistical analysis :

Means were compared to the Duncan's multiple range test (DMRT). Analysis was performed by the software a micro computer programme for the design, Management and Analysis of Agronomic Research Experiments (Irristat Michigan state Univ.k, USA, 1993).

RESULTS

1- Effect of extraction method on nematode population:

Results of the different extraction methods from infected wet soaking rice grain (in the booting stage) indicated that Baermann funnel was the best method (Table1) for separating white tip nematode (263.3 individuals) as compared with the plate and sieving methods (182.3 and 216.33 individuals), respectively. Also, the extraction of dry rice grains (Table 2) indicated that Baermann funnel was significantly the best method for separating *A. besseyi* (165.7 individuals) as compared with the other two methods (129.3 and 46.3 individuals for funnel and sieving methods, respectively).

Table (1): Number of *A. besseyi* extracted from 200 grams of panicle fresh weight (Giza 171) by different extraction methods for 48 hours

Reps.	Methods of extraction		
	Baerman funnel	Plate	Sieving
R1	423	325	410
R2	270	170	200
R3	97	52	40
Mean	263.66 a	182.30 ab	216.33 ab

Table (2): Number of *A. besseyi* extracted from 1000 dry rice grains (Giza 171) by different extraction methods for 48 hours

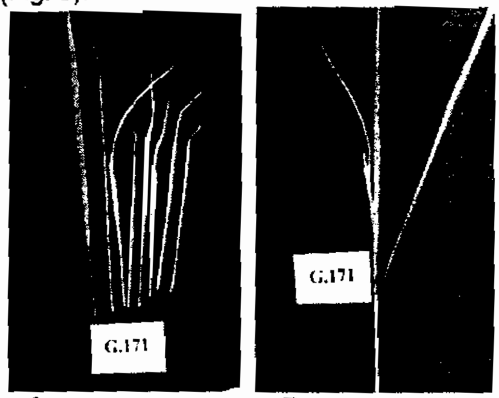
Reps	Methods of extraction		
	Baerman funnel	Plate	Sieving
R1	215	168	49
R2	170	150	50
R3	112	70	40
Mean	165.66 a	129.30 ab	46.33 b

2- Symptoms and population dynamics:

Chlorotic discoloration in an area 0.5 to 2.0 cm on the leaf sheath just below the collar of rice seedlings was found to be the most diagnostic symptom under Egyptian conditions. At the elongation stage, approximately a 2-5 cm length of the leaf tip of the affected plants appeared to be whitish. Also, chlorotic stripes along the edge of the affected leaf were always recognized. At the booting stage, it was clear that the flag leaf of the affected plant was characteristically shortened, twisted, crinkled, and often distorted or splitted longitudinally. Complete or partial emergence of panicles occurred on the infected plants with whitish spikelets on the tip, or throughout the whole plant. The affected spikelets were shrunken and unfilled.

Examination of plants throughout the growing season revealed that full symptoms (Fig.1) of white tip disease were noticed after 60 days from grain sowing (panicle initiation stage) in all the tested nematode inoculum levels (250, 500 and 1000 individuals/plant). Also, the numbers of infected plants were positively increased during the booting stage (90 days), whereas full symptoms (Fig.2) were noticed and estimated during heading stage (120 days).

In the meantime, the number of *A. besseyi* per plant was indicated that the highest nematode population occurred at the booting or flowering stage of the crop (Fig. 3).



A B

Fig.1. Rice leaf symptoms of Giza 171 (A) infected with *A. besseyi* and (B) its effect on rice panicles.

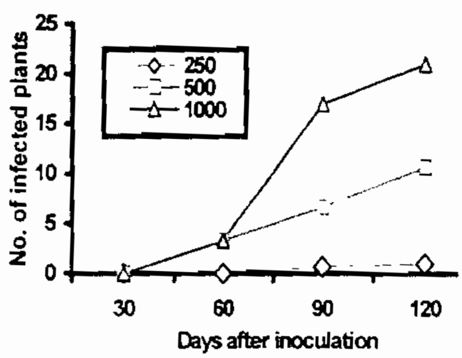


Fig.2
Effect of white tip nematode inoculum levels on number of infected rice plants (Giza 171) at different growth stages

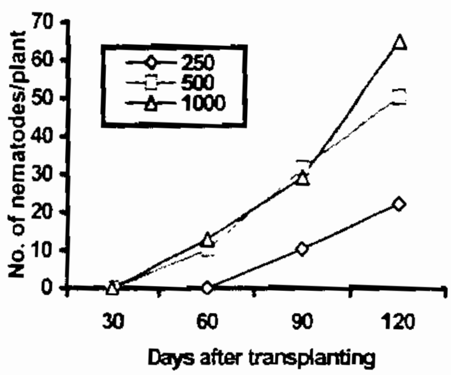


Fig. .3
Effect of white tip nematode inoculum levels on nematode number of rice plants (Giza 171 at different growth stages

A. besseyi inoculum levels had a significant effect on rice plant symptomlogy as shown from Fig.2 & 3. It was found out that full symptoms appeared after 120 days after rice grain cultivation in all nematode inoculum levels. Results also indicated that a positive correlation was detected between increasing nematode inoculum and rice plant symptoms (Fig. 2). The number of *A. besseyi* was significantly increased with nematode inoculum level. (Fig. 3), which indicates that 250, 500 individuals/plant, were 10-15 and 8-40 individuals/ plant, respectively. No significant differences existed between 500 and 1000 individuals/plant after 90 and 120 day

3- Nematode incidence and distribution:

The survey studies indicated that most of the rice-planted areas were infected with white tip disease that is widely distributed in Egypt, especially in the Nile Delta region. The examined 27 areas and 81 fields (Table 3), were divided in to 3 categories according to the severe infestation as follows: (1) low infestation (18.5%), (2) moderate infestation (66.7%), (3), high infestation levels (14.8%) (Fig.4B). From that survey and according to *A. besseyi* population counts, nematode distribution throughout the Nile Delta could be classified to 5 main groups as shown in (Fig.4).

The most important endemic areas for white tip disease (Fig.4A), were consider to be Biala, Fowa area (Kafr El-Sheikh Governorate) and Benoub Zarif basin (Dakahlia Governorate.

Table (3): Mean number of *A. besseyi* from 200 g. vegetative fresh weight of rice plants from four choosen Egyptian Governorates.

No.	Governorate	Area	Mean ± S.D.		
1.		Biala	290.00	±	36.056
2.		El-Hamoul	113.33	±	32.146
3.		Fowa	210.00	±	95.394
4.	Kafr El-Sheikh	Meseer	190.00	±	115.330
5.		Sakha	138.33	±	61.712
6.		Matbool	105.00	±	13.229
7.		Alroughama	136.67	±	94.516
8.		Sheerbin	140.33	±	53.482
9.		Belkas	135.67	±	55.824
10.		Belqueen	156.67	±	40.415
11.		Temei Elamdeed	143.33	±	83.267
12.	Daakahlia	Mansoura	93.33	±	25.166
13.		El-Senblawain	76.66	±	360.551
14.		Aga	193.33	±	16.073
15.		Hood Elbalat basin	121.67	±	41.932
16.		Eltamanin basin	173.33	±	55.076
17.		Benoub Zarif basin	265.67	±	44.792
18.		Zarzoura	100.00	±	30.00
19.	Beheira	Damanhour	133.33	±	58.595
20.		Abou Homos	173.67	±	46.694
21.		Kafr El-Dawar	121.67	±	65.256
22.		Abou Kebir 1	137.00	±	46.872
23.		Abou Kebir 2	175.00	±	22.913
24.	Sharkia	Belbais	175.67	±	51.052
25.		Zagazig	105.67	±	1.154
26.		Kafr Sakr	150.33	±	49.501
27.		Hehia	119.33	±	88.512

The authors recommend a spatial model for the mean and correlation of highly dispersal count data, and apply it to individual-level of the white tip nematode, *A. besseyi*. Our model uses the negative binomial distribution, whose shape parameter is a convenient index of over-dispersion. Spatial association is quantified in terms of characteristic length, which has an intuitive interpretation as the distance over which correlation decreases by half.

Table (4): Evaluation of 53 commercial rice cultivars and lines for naturally infested with white tip rice nematode *Aphelenchoides besseyi.*

	Cultivars and lines	Mean		Cultivars and lines	Mean
1.	Giza 177	7.4	28.	GZ 6031-17-3-3-1	2.5
2.	Giza 178	0.0	29.	GZ 5828-3-1-1-1	152
3.	Giza 176	0.0	30.	GZ 5831-10-1-2-1	1.4
4.	Sakha 101	2.6	31.	GZ 5953-6-3-2-1	0.6
5.	Sakha 102	18.0	32.	IR 66160-5-2-3-2	0.4
6.	Giza 181	0.0	33.	GZ 6310-13-1-1-2	0.0
7.	GZ 5830-63-1-2	3.6	34.	GZ 5920-5-2-1-1	0.0
8.	GZ 5385-29-3-2 (Saka 104)	0.4	35.	GZ 5895-14-1-1-1	5.3
9.	GZ 5603-3-2-2-1	0.0	36.	GZ 5890-26-3-3-1	1.25
10.	GZ 5721-19-7-1-1	0.0	37.	GZ 5837-24-1-3-1	0.0
11.	GZ 5842-7-1-1-1	12.2	38.	GZ 5954-7-1-2-1	0.0
12.	GZ 5963-1-2-1-1	2.3	39.	Egyptian Yasmine	0.8
13.	GZ 5470-14-1-2 (Giz182)	0.0	40.	GZ 5310-20-2-1	3.8
14.	GZ 5288-41-1-3	10.8	41.	GZ 5310-20-3-3	5.0
15.	GZ 5291-71-2	1.0	42.	GZ 5320-5-1-1	4.6
16.	GZ 5310-20-3-2	0.8	43.	GZ 5680-1-1-2	7.0
17.	GZ 5317-6-2-2	11.2	44.	GZ 5702-13-3-3	0.0
18.	GZ 5574-13-3-1	4.0	45.	GZ 5721-19-1-1	0.0
19.	GZ 5578-2-1-2	8.0	46.	GZ 5830-59-10-2	1.8
20.	GZ 5582-9-1-1	3.6	47.	GZ 5830-63-1-2 (Sakh103)	2.4
21.	GZ 5830-4-2-1	17.6	48.	GZ 5844-60-3-2	4.8
22.	GZ 5830-48-2-2	8.4	49.	GZ 5470-14-1-2	0.0
23.	GZ 5830-58-3-3	6.8	50.	GZ 1368-5-4	0.0
24.	HR 5824-B-3-2-3	2.0	51.	GZ 5385-29-3-3	0.0
25.	GZ 5385-3-2-3-1	0.0	52.	GZ 5594-23-1-2	0.0
26.	GZ 5385-3-2-3-1	0.0	53.	GZ 5121-5-2-1	0.0
27.	GZ 6001-4-3-1	0.0	54.		

0.0 = Highly resistant
0.1- 4.9 = Resistant
5-9.9 = Susceptible
10.0. = Highly susceptible

4. Cultivars and lines evaluation :

Data presented in (Table 4) indicates that among the 53 tested rice cultivars and lines, it could be stated according to *A. besseyi* infection four categories could be detected (as suggested by authors) as follows:

a- **Highly resistant** : 20 cultivars and lines as Giza 178, Giza 176, Giza 181 and GZ 5603-3-2-2, GZ5721-19-7-1,GZ 5470-14-1-2,GZ 5385-3-2-3-1, GZ 5385-3-2-3-1, GZ 6001-4-3-1, GZ 6310-13-1-1-2, GZ 5920-5-2-1-1, GZ 5837-

24-1-3-1, GZ 5954-7-1-2-1, GZ 5702-13-3-3, GZ 5721-19-1-1, GZ 5470-14-1-2, GZ 1368-5-4, GZ 5385-29-3-3, GZ 5594-23-1-2, GZ 5121-5-2-1 (See Table 4).

b- **Resistant**, 20 cultivars and lines namely, Sakha, 101, GZ 5830-63-1-2, GZ 5385-29-3-2, GZ 5963-1-2-1-1, GZ 5291-71-2,GZ 5310-20-3-2, GZ 5574-13-3-1,GZ 5582-9-1-1, HR 5824-B-3-2-3, GZ 6031-17-3-3-1, GZ 5831-10-1-2-1, GZ 5953-6-3-2-1, IR 66160-5-2-3-2, GZ 5890-26-3-3-1, Egyptian Yasmine, GZ 5310-20-2-1, GZ 5320-5-1-1, GZ 5830-59-10-2 GZ 5830-63-1-2 and GZ 5844-60-3-2 . On the other hand,

c. **Susceptible**: 7 cultivars and lines were evaluated as GZ 177, GZ 5578-2-1-2, GZ 5830-48-2-2, GZ 5830-58-3-3, GZ 5895-14-1-1-1, GZ 5310-20-3-3 and GZ 5680-1-1-2. Finally,

d. **Highly susceptible**: 6 cultivars and lines namely as Sakha 102, GZ 5842-7-1-1-1, GZ 5288-41-1-3,GZ 5317-6-2-2, GZ 5830-4-2-1 and 5828-3-1-1-1 .

DISCUSSION AND CONCLUSION

Examination of rice plants at the vegetative, booting, flowering and heading stages from rice-growing regions, indicated that the white tip nematode is widely distributed in rice areas of the Nile Delta of Egypt. The symptoms on leaves, e.g. whitening of the leaf tip during the vegetative stage, and the shortened, twisted and crinkled flag leaf seen during the reproductive stage of rice plants (flowering and heading stages) were similar to that reported in other types of rice (Yoshi & Yamamoto, 1950 & 1951; Todd & Atkinson, 1958; Muthkrishnan, *et al.* (1974); Ou, 1985 and Rahman & Miah, 1989).

The chlorotic stripes along one edge of the leaf of an infested rice plants were noticed as leaf symptoms under Egyptian conditions as noticed by Abdel-Hadi from 1978 till now. The occurrenc of nematode infested grains on the uppermost part of the panicle or throughout the panicle, together with the apparently healthy grains agrees with the report made for other types of rice (Steele, 1970; Rahman & Miah, 1989). It was found that the cholorotic symptoms on the leaf are similar for both ufra and white tip diseases but the whitening appears on the tip of the leaf for white tip but starts at the base of leaf sheath for ufra: in white tip, then the tip of the affected leaf becomes thin and thread-like (Rahman and Miah, 1989) .

Our results indicated that the rice plants were more affected by *A.besseyi* during the tillering stage before booting stage and the number of nematodes per infested plant was also high, which could be due to high rate of nematode development and multiplication under pre-flooded conditions. These results were in contrast with those reported by Rahman & Miah, 1989. Also, the maximum numbers of nematodes in grains at heading stage were recorded were coud to be similar to those found by Nandakumar *et al.*, (1975).

A lot of extraction tools and techniques have been developed, mostly because no single technique would be considered to be efficient to all sizes and kinds of nematodes (Hooper, 1990 and Bloemers and Hodda, 1995).

The review indicates that the paucity examples of the dynamical consequences of macroparasites on their hosts may reflect both (i) the difficulties inherent in teasing out the effect of parasites in complex ecological systems with many potentially confounding factors; and the fact that (ii) it is difficult to obtain funding for long-term studies of multispecies system (Albon *et al.* 2002; Halvorsen and Bye, 1999).

Atkins and Todd (1959) reported that the more resistant cultivars rarely showed foliar or panicle symptoms, although they contained nematodes and their yields. Efficient ways of detecting within cultivar variation in rice varieties obtained from national and international germ plasm collections. Seventy-one (71) rice cultivars were evaluated for within-cultivar variation using a combination of phenotype, Randomly fragment length polymorphism (RFLP) and microsatellite or simple sequence length polymorphism (SSLP). Variation between duplicate accessions within a cultivar was detected even in cultivars that had been purified by the phenotypic evaluation (Olufowote *et al.* 1997). Nishizawa (1953a) summarizing the results of field experiments from 1949 to 1952, concluded that nine cultivars, Norin No.8, Tozan No.36, 37, 38 and 58, Nankai No.3, Asa-Hi (not Asahi) and Asahi No.1 (from Fukuoka and Kagoshima) were symptomless; six cultivars, e.g., Norin No.6, 37 and 39, Norin-mochi No.5, Saikai No.37 and Nakaze Ginbozu were resistant; while 24 other cultivars were moderately susceptible and nine were highly susceptible. Resistance is inherited from Asa-Hi. There were more variations of symptoms from year to year than in resistant cultivars. Norin No.8, Norin-mochi No.5 and Hatsushimo showed only slight symptoms, and Asahi No.1, Aichi-Asahi and Kinai-Omachi No.2 were very susceptible. Hung (1959) found the Ponlai cultivars Chianung 242, Kaohsiung 10 and Taichung 65 to be very susceptible in Taiwan but leading native cultivars did not show white tip symptoms. Park & Lee (1976) reported distinct differences in resistance among 20 commercial cultivars in Korea; Tongil and related cultivars were highly resistant (0%) while Fukunohana had 46.6% diseased culms.

The white tip nematode, *A. besseyi* is seed borne, the nematode is easily transmitted from locality to locality. Under rice environments, the nematodes could also be water dispersed from an infested field to healthy field. Therefore the results suggest that seeds from infested areas should be treated before sowing to control and prevent further spread of the nematode in rice areas as is done with other types of rice.

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تواجد وانتشار ووبائية نيماتودا إبيضاض القمة على نباتات الأرز فى مصر

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*****مركز البحوث والتدريب في الأرز بسخا - مركز البحوث الزراعية**

تعتبر نيماتودا إبيضاض القمة فى الأرز واحدة من أهم الآفات التى تصيب حقــول الأرز بمصر، وتساهم الدراسة الحالية فى حصر وظهور مرض ابيضاض القمة النيمــاتودى فــى الأرز وطرق استخلاص وعزل ومحاولة فهم وبيائية النمياتودا وذلك من خلال استخدام بعــض النمــاذج الرياضية المعروفة، وتعتبر هذه الدراسة تسجيل أولى لتواجد وانتشار ووبائية هذا المــرض فــى مصر.

وقد وجد من خلال الدراسة التي تم إجرائها أن معدلات ظهور هذا المرض تتناسب إلى حد كبير مع النمو الطبيعي لنباتات الرز كما أنها تختلف فى مناطق زراعة الأرز المختلفة فى مصــر حسب اختلاف مناخ المنطقة من الناحية البيولوجيه على توزيع ومعدلات الظهور وقد استخدم ثلاث طرق لفصل النيماتودا (أقماع بيرمان والأطباق والمناخل) وقد تم استخدام ثلاثة مستويات للعــدوى (٢٥٠، ٥٠٠، ١٠٠٠ فرد نيماتودى لكل نبات) وذلك بعد خمسة أيام من نقل الشــتلات لــلأرض المستديمة لدراسة أعراض الإصابة خلال مراحل النمو المختلفة للأرز. وقد تم اختيار ٢٧ موقعــا لأخذ العينات يتوقع فيها أن تكون مصابة بحيث اشتمل كل موقع على ثلاثة إلى أربعة حقول فــى

مناطق الدلتا المختلفة وقد تم تحديدها عشوائيا لتسجيل مدى إصابتها بالنيماتودا وفى نفس الوقت تم أخذ عينات من السنابل الخضراء الطازجة (٢٠٠جم فى مرحلة طرد السنابل) وذلك بتقطيعها الـــى قطع صغيرة ونقعها فى الماء لمدة ٤٨ ساعة ثم تم تجميع وتسجيل النيماتودا المستخلصة.

أكدت النتائج المتحصل عليها أن أعراض الإصابة بالنيماتودا ونسبة الإصابة بها ترتبط ايجابياً بمستوى تركيز اللقاح المستخدم، وقد أوضحت النتائج أيضاً أن استخدام طريقة أقماع بيرمان كانت أفضل وأكفأ الطرق للحصول على أعلى عدد من النيماتودا .

أظهرت النتائج أن أعراض الإصابة بنيماتودا ابيضاض القمة فى الرز تتفاعل ديناميكيا وتتأثر بالعمليات البيولوجية المختلفة والمعقدة وقد تم اختيار النموذج المكانى الإحصائي واعتبراً أنه النموذج الملائم لتمثيل الطبيعة المكانية لدراسة وبائية النيماتودا ويمكن أن يطبق هذا النموذج كبرهان لإمكانية إستخدام برامج الحاسب الآلي فى دراسة النيماتودا، وقد أكدت نتائج الدراسة أن منطقة بيلا وفوة بمحافظة كفرالشيخ وحوض بنوب ظريف بمحافظة الدقهلية كانت (أكثر المناطق وبائية) بينما كانت بعض مناطق محافظات كل من الشرقية والدقهلية (متوسطة الوبائية)، ومن الناحية الأخرى أعتبرت الدراسة أن مركز السنبلاوين بمحافظة الدقهلية كانت الإصابة منتشرة ولكن بصورة (غير وبائية).

أوضحت الدراسة أن بعض الأصناف الممثلة منها على سبيل المثال لا الحصر (جيزه ١٧٨، ١٧٦، ١٨١ وبعض السلالات الجديدة) كانت أكثر الأصناف مقاومة للنيماتودا على الرغم من ظهور بعض أعراض الإصابة بها، وكان من بين ثلاثة وخمسون صنفاً وسلالة تمت دراستها عشرون فقط منها كانت أكثر مقاومة بينما كان الصنف جيزه ١٧١ من أكثر الأصناف قابلية للإصابة.