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Rice production practices and farmers' perception of the white tip nematode (*Aphelenchoides besseyi* Christie) in Ghana

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ABSTRACT

Objective: Surveys were undertaken in four major rice growing regions of Ghana namely; Northern, Western, Ashanti and Volta in December 2002 to September 2003. The purpose was to investigate rice production practices and particularly determine farmers' perception of the white tip nematode, *Aphelenchoides besseyi*.

Methodology and results: Questionnaires were designed, pre-tested, revised and administered in the four regions. Fifty farmers were randomly selected for the study. About 95 % of the respondents from the Northern, 30 % from the Western and 90 % from the Ashanti region were illiterate. Sixty-four per cent of farmers from the four regions owned the lands they cultivated. Lack of credit facility was a major production constraint. Yield was largely variable across the regions with the highest production occurring in the Volta region. Three of the regions cultivated rice as a sole crop. Only farmers in the Western region practiced both sole and mixed cultures. All varieties were infested with *A. besseyi* except IDAS 85 and Viono sampled from the Volta region.

Conclusion and application of findings: None of the respondents involved in the study was aware of the white tip nematode, *A. besseyi* the causal agent of the white tip disease in rice. Rice yields were generally low and seed for planting must be treated against the white tip nematode*, Aphelenchoides besseyi*.

Key words*: Aphelenchoides besseyi*, Ghana, *Oryza sativa*, sustainable management strategy.

INTRODUCTION

The white tip nematode, *Aphelenchoides besseyi* Christie, is seed borne and causes the white tip disease of rice, *Oryza sativa* L (Ou, 1985). The disease has been reported in most rice-growing areas of the world including Iran (Pedramfar *et al.,* 2001), Italy (Cotoneo & Moretti, 2001), Turkey (Ozturk & Enneli, 1997) and Egypt (Amin, 2002). In Ghana, farmers use rice seed saved from the previous season's crop stored at room temperature for cultivation the following season. Rice seed is sown directly in the paddy or upland fields. The nematode has been reported to emerge from the soaked seed and begins to attack the seedling as it develops (Tamura & Kegasawa, 1958). The pest is found between leaf sheaths at the seedling stage (Fukano, 1962) and in cavities above the growing tip of the rudimentary culm and on the young leaf surrounded by the innermost leaf sheath during the tillering stage (Goto & Fukatsu, 1952). Togashi & Hoshino (2001) reported that the mean number of *A. besseyi* per seed increased as field expression of white tip disease increased. The most conspicuous symptom is the emergence of the chlorotic tips of new leaves from the leaf

sheath (Figure 1). These tips later dry, curl and turn brown, whilst the rest of the leaf may appear normal (Bridge *et al.,* 2005).

Figure 1: A, B and **C** show white tip disease symptoms (chlorotic tips of new leaves)

Viability of infected seed is lowered; germination is delayed (Tamura & Kegasawa, 1959). Infected plants have reduced vigour and height (Todd & Atkins, 1958) and are usually stunted (Fukano, 1962). Most importantly, *A. besseyi* cause poor growth and yield loss in rice (Bridge *et al.,* 2005). The importance of this study is based on the fact that the white tip disease is capable of devastating a whole rice field and the menace constitutes a threat to the rice industry in Ghana. For sustainable rice production, farmers' practices must be ascertained for possible improvement to increase yield. The prevalence of the pest needed to be assessed before sustainable, effective and environmentally acceptable management strategy could be prescribed. Proper identification of the pest and population levels is essential for studies on its management. In Ghana, such base line information is scanty. Also lacking is information on farmers' perception of the pest. If farmers are aware of the pest and appreciative of its damage potential, it will greatly facilitate implementation of recommended management strategies.

MATERIALS AND METHODS

Fifty rice farmers were randomly selected between December 2002 and September 2003 from four rice-growing regions of Ghana. Twenty from the Northern region and ten farmers each from the Western, Ashanti and Volta regions. Both open and closed ended questionnaires were designed, pre-tested, revised and administered in the four regions. To make sure reliable responses were given by respondents, questions asked before were later asked again to test the veracity of responses. To gain the confidence of respondents to open up to the interviewer, the purpose of the study was well explained to them. Approximately 500 g of rice seed was sampled from the barns of each of the respondents for isolation of the white tip nematode. In all, fifteen different varieties of rice were sampled.

Assessment of *A. besseyi* frequency: A total of fifty samples of rice, i.e. 20 samples from the Northern and 10 each from the Western, Ashanti and Volta regions of Ghana, from a total of fifteen different cultivars of rice were randomly collected from farmers' barns during the survey. The cultivars were four from the Northern region (TOX 3107, Mandii, Kukulubehi and Rock), two from the Western region (Agya Amoa and Red Rice), four from the Ashanti (Mr. More, 08, Mr. Harry and

Mandii), and six from the Volta regions (Kawomo, Viono, WAB 209-5-HB, Damansah, Adaisi and IDSA 85). Cv. Mandii was sampled both in the Northern and Ashanti regions. Four sub-samples from each of the 50 samples were assessed for presence of the white-tip nematode, *A. besseyi*. All samples were extracted for the pest using the modified Baermann funnel method. After 24 hours of extraction, suspension was fixed with TriethanolAmine-Formalin (TAF) and nematodes were identified (CIH, 1978) under a stereo microscope at magnification 100 x.

Statistical Analysis: Percentages were used to analyze all data collected during the survey.

RESULTS

Table 1 showed the biodata of the respondents from the different study areas. There were more male farmers in the Northern and Western regions whilst females predominated in the Ashanti and Volta regions. Greater proportion of the farmers in the study areas was young (< 55 years). Interestingly, more farmers from the study areas were married. Illiteracy rate was greater in the Northern and Ashanti regions whilst all farmers in the Volta region had formal education.

TABLE 1: Biodata of respondents (%).

Region	Sex		Age (years)						Marital status		Level of education			
M		F	16-25	26-35	36-45	46-55	56-60	>60	Married	Single	Illit.	Prim	Mid	Sec
Northern	85	15	15	30	10	40	5	0	100	0	95	0	0	5
Western	80	20	10	30	20	20	10	10	60	40	30	10	50	10
Ashanti	40	60	10	20	30	30	10	0	80	20	90	10	0	0
Volta	20	80	10	10	50	30	0	0	100	0	0	40	30	30

Illit. = illiterate, Prim = primary, Mid= middle, Sec = secondary

Farmers relied on three sources of labour; hired casual, exchange labour and household members' assistance (Table 2). Every farmer in the study benefited from assistance of family members in their farming operations. Respondents were unanimous that labour was readily available in all the regions. Approximately 90 % of farmers in the Volta region owned the land they cultivated, while 60 % of farmers in the Ashanti region did not own their lands. Farmers in three regions; Northern, Western and Ashanti never subjected their seed to any form of treatment before sowing. Approximately, 60 % of farmers in the Volta region primed seed and 20 % pre-germinated seed before sowing (Table 2).

TABLE 2: Factors of production (%)

Region	Source of labour			Labour availability			Land ownership		Seed treatment	
	Hired casual	Exchange labour	Household members	Scarce	Moderate	Readily available	Yes	No	Priming	Pre-germinate
Northern	60	35	100	0	0	100	55	45	0	0
Western	100	0	100	0	20	80	80	20	0	0
Ashanti	100	0	100	0	10	90	40	60	0	0
Volta	60	40	100	0	0	100	90	10	0	40

Farmers involved in the survey cultivated rice because it was a cash crop and a reliable food security staple (Table 3). Ninety per cent of Northern region farmers, 72 % of Western region, 40 % of Ashanti region and 70 % of Volta region farmers respectively mentioned lack of credit as a major constraint to rice production. Pests, particularly rodents and birds were frequently encountered by farmers in the four regions (Table 3).

TABLE 3: Responses of farmers to various questions on their farming activities (%)

Region	Production constraints			Pests encountered			Reasons for the crop		
	Lack of credit	Disease/pests	Lack of marketing	Birds	Rodents	Beetles	Cash crop	Food source	Ready market
Northern	90	0	10	50	20	30	80	20	0
Western	70	20	10	90	10	0	70	10	20
Ashanti	40	60	0	70	30	0	70	30	0
Volta	70	30	0	60	40	0	60	30	10

Generally, farmers operated at the subsistence level, cultivating between 1 and 5 acres of land seasonally (Table 4). In three of the regions, rice was cultivated as a sole crop. However, in the Western region, both sole and mixed cultures were practiced. Farmers' experience in rice farming varied and ranged from one to twenty odd years across the regions. Yield was largely variable. About 60 % of farmers in the Ashanti region recorded between 11and 15 bags/acre, 50 % of Western region farmers had between 6 and 10 bags/acre, 15 % of Northern region farmers had between 16 and 20 bags/ acre and 40 % of farmers in the Volta region realized over 20 bags/acre. Finally, none of the 50 farmers interviewed was aware of *Aphelenchoides besseyi*, the causal agent of the white tip disease of rice (Table 4).

TABLE 4: Responses of farmers to various questions on their farming activities (%)

Region	Length of farming (years)			Scale of operation		Yield/acre (bags)					Farming system		Awareness of rice nematodes	
	1-10	11-20	>20	Subsistence 1-5	Large >5	1-5	6-10	11-15	16-20	>20	Sole	Mixed	Aware	Unaware
Northern	65	20	15	90	10	10	40	30	15	5	100	0	0	100
Western	70	30	0	90	10	30	50	10	10	0	40	60	0	100
Ashanti	50	50	0	90	10	20	20	60	0	0	100	0	0	100
Volta	50	20	30	90	10	10	20	10	20	40	100	0	0	100

Assessment of *A. besseyi* frequency: Among the different regions surveyed the most heavily infested seed came from the Northern (80 %), followed by the Western (72.5 %), Ashanti (67.5 %) and Volta (25 %). The cv. Mandii (10 samples from the Northern region and 3 samples from the Ashanti region) was 100 % infested with *A. besseyi*. All cultivars were found infested to some extent in the Northern, Western and Ashanti regions. In the Volta region, however, the cultivars IDSA85 and Viono were not infested by the nematode (Table 5).

TABLE 5: Incidence of *Aphelenchoides besseyi* in stored rice seed.

Region	Cultivar	Samples	Intensity of infection of sub-samples (4/sample				% infected total sub-samples per region
			–	+	++	+++	
Northern	TOX 3107	4	5	8	3	0	
	Mandii	10	0	9	23	8	
	Kukulubehi	4	2	8	6	0	
	Rock	2		4	1		
	Total	20	3			0	80.0
Western	Agya Amoa	8		18	3		
	Red Rice	2	9	5	1	2	
	Total	10	2			0	72.5
Ashanti	Mr. More	4		9	2		
	08	1	5	1		0	
	Mr. Harry	2	3	3	0	0	

	Mandii	3	5	2	0	0	
	Total	10	0		8	2	67.5
Volta	Kawomo	2		2			
	Viono	1	6	0	0	0	
	WAB 209-5-HB	3	4	5	0	0	
	Damansah	2	7	2	0	0	
	Adaisa	1	6	1	0	0	
	IDSA 85	1	3	0	0	0	
	Total	10	4		0	0	25.0

DISCUSSION

The deleterious effects of *A. besseyi* on rice production make it imperative to devise sustainable management strategies to curb the menace. Nishizawa (1976) and Uebayashi *et al.* (1976) reported that rice kernels infected by *A. besseyi* are predisposed to secondary infection by saprophytes such as *Enterobacter agglomerans* which causes black, wedge-shaped spots on grain. Also, McGrawley *et al*. (1984) found that *Sclerotium oryzae* (stem rot) disease rating and population density of *A. besseyi* on rice cv Nova 76 was increased by concomitant infection of both organisms and their effect on yield was synergistic.

Most of the 50 farmers involved in the study, were in their prime ages and only a few were unmarried. These parameters, coupled with availability of labour and the fact that most farmers cultivated their own lands, should have permitted large-scale farming, but this was not the case. One reason that might have accounted for the subsistence level of operation could be attributed in part, to the fact that more than half of the respondents were illiterate who lacked the skill to expand their holdings. Another reason could be lack of credit, which was identified as a major production constraint. Perhaps farmers just couldn't access credit because of their low academic background. Undoubtedly, the formation of co-operative associations might facilitate access to credit from financial institutions. In the current study, farmers recorded low level of production per acre basis. This was consistent with the observation that infestation of rice by *A. besseyi* which causes the white tip disease reduces yields significantly (Bridge *et al.,* 2005).

Apart from managing the pest to boost production, a look must also be taken at the potential of the varieties being used as most of the local varieties are known to be low yielding. Improved varieties are essential for higher yields. Technical know-how disseminated by extension agents could also boost production. Farmers in the current study used part of the previous season's seed for sowing. In instances where *A. besseyi* incidence is high, considering the fact that *A. besseyi* is seed borne (Ou, 1985), farmers practice of using seed from previous season's produce for cultivation could increase the inoculum levels of the pest at the beginning of the cropping season, and the incidence and effect of the pest could be correspondingly high. Ultimately, yields would decline. The use of high yielding varieties, better agronomic practices, management of pests and diseases and access to credit facility are critical to higher yields in rice production. Environmentally healthy nematode control strategies must be employed to manage the white tip-nematode, *A. besseyi*.

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