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Management of whip smut of sugar cane (*sporisorium. scitamineum* sydow & h. sydow.) with some plant extracts with fungicidal actions

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ABSTRACT

Preliminary survey results from sugar cane farms in zone A of Niger state showed some promise in the use of neem leaves, neem fruits (*Azadirachta indica* A Juss) and combretum bark *(Combretum glutinosum*) extracts in the management of sugar cane whip smut (*S. scitamineum* Syd). Consequently, studies were conducted at the National Cereals Research Institute, Badeggi (Lat. 9° 045'N; Long. 6° 07'E, Alt 70.57m absl) during the 2007/2008 planting season to evaluate the efficacy of some plant extracts on whip smut of sugar cane (*S. scitamineum*. Results showed that the two plants' extract excited good control on whip smut either as leaf or fruit powder. Best control was obtained from neem leaf and neem fruit extracts' at 60 g/l which significantly recorded the least incidence of *S. scitamineum* and had higher cane yields than combretum and mancozeb treated canes. Sugar cane growers, especially chewing cane growers could have alternative products for the management of whip smut which causes serious yield decline in ratoon of chewing cane fields. Further studies are required to isolate the active ingredients of these plant species for packaging and use as purified botanical fungicides.

KEYWORDS

Combretum glutinosum;
Azadirachta indica;
Sugar cane growers;
Chewing cane growers;
Botanical fungicides.

INTRODUCTION

Of the four known forms of smut, whip smut (*Sporisorium scitamineum)* is the most widespread and has been of importance in many sugar cane growing areas. Whip smut is a serious disease of sugar cane and reaches epidemic proportions where susceptible cultivars are grown[22]. Smut also causes significant qualitative and quantitative losses to cane growers worldwide[24].

Several control measures have been adopted to reduce the effect of whip smut in sugar cane throughout the world. The most effective of these being the use of resistant varieties[1, 2], though an easy and cheap control measure, takes long time to achieve.

In the interim, therefore, palliative control measures such as chemical dips of planting setts and many other cultural control practices are employed to reduce whip smut effect. Preplant treatment of seed pieces with Bayleton (Triadimefon), Vanguard (CGA-64251), Agallol (Methoxy ethyl mercury chloride) and Vitavax - 200 (carboxin) protected and reduced smut in the developing plants in tests conducted in Hawaii, India, North Africa, South Africa

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and Nigeria[14]. Preplant dips of cane in mancozeb, chlorothalonil, pyroquilon, metalaxyl + carboxin + furathiocarb at 1.99, 1.88kg ai ha $^{-1}$ respectively significantly reduced smut in both plant and ratoon crops in Nigeria[23, 24].

Continuous use of synthetic fungicides is not environmentally friendly and has resulted in the development of resistant races of pests and pathogens. Olufolaji, (1993) and Dike *et al.*, (1996) suggested the need to source for other alternatives that are ecologically sound and compatible with the socio–economic conditions of the farming communities.

This search has shown the possession of protective mechanisms such as repellency and pesticide action by a number of plants. Thus a large number of different species like the Neem, *Azadirachta indica* A. Juss and *Combretum glutinosum* contain natural pesticide properties, and have been used as sources of pesticides for pest and disease control[6, 18].

Neem extracts products such as leaves, fruits and oil have been reported to control powdery mildew of cucumber and apple and soil borne diseases like damping off of seedlings and a wide range of fungal diseases[13, 9, 17, 8, 20,21, 11].

The present study consisted of a survey of sugar cane farmers' cane fields and the methods they employed to combat *S. scitamineum*. The survey results showed that neem leaves, neem fruits and combretum bark reduced the effects of *S. scitamineum* on sugar cane. Consequently a field study was set up to validate the survey results with the view to identifying the effective rates at which these botanicals will give their best activity on *S. scitamineum.*

MATERIALS AND METHODS

The study consisted of field survey for whip smut incidence on farmers' sugar cane fields in eight local government areas (LGAs) of Niger state, a screen house study and a field trial.

Survey/ survey area

The survey was conducted to identify and determine the incidence and severity of whip smut disease of sugar cane in zone A of Niger State and also to investigate the efficacy of the management approaches adopted by farmers in their attempts to control the disease.

Zone A is bordered by Kogi State to the South, Zone B and Abuja to the East, Zone C to the North and Kwara State to the West. The zone comprises eight Local Government Areas namely: Lapai, Agaie, Katcha, Bida, Gbako, Lavun, Edati and Mokwa. Inhabitants of this zone are the Nupes, the Kakandas, the Debos and few Hausa immigrants. The main occupation of the people in the zone is farming, blacksmithing, weaving and fishing.

Five out of the eight Local Government Areas in the zone were randomly selected for sampling and include Katcha, Lavun Gbako, Agaie and Mokwa. Two locations were also randomly selected from each of the 5 selected Local Government Areas, giving a total of 10 locations. These locations were: Agaie and Kutirko in Agaie Local Government; Badeggi and Cece in Katcha Local Government; Doko and Dabban in Lavun Local Government; Edozhigi and Kusotachi in Gbako Local Government; Wuya reke and Jebba North in Mokwa Local Government.

Primary and secondary survey methods were adopted for the survey. The primary method involved the use of questionnaires, while in the secondary method use was made of reference books, journals, magazines and bulletins. Verbal interviews were also conducted to further identify relevant information not captured by the questionnaires. Thirty farmers were randomly selected from each of the 10 locations (i.e. 60 farmers from each of the 5 selected Local Government Areas) giving a total of 300 farmers. Consequently, 300 questionnaires were administered but 286 were recovered.

Preparation of plant extracts

Neem fruits

Neem fruits collected were washed in sterile water, shade dried and pounded in a mortar with the kernel stored in polythene bags at room temperature for use the following day.

Neem leaves

Collected neem leaves were also washed in ster-

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ile water and pounded fresh in a sterilized mortar and stored in polythene bags at room temperature for use the following day.

Combretum bark

Combretum bark was decorticated; sun dried and ground using an electric motorized mill to obtain a very fine powder which was stored in polythene bags at room temperature for use later.

Preparation of smut teliospores suspension and inoculation

Fresh smut whips were collected in the early hours of the day between 6.30-7.30am following the method of Nasr (1977) as modified by Wada (2005). They were dried for one hour under the shade, scrubbed with hands covered with sterile gloves to obtain smut teliospores. The teliospores were sieved using a 53µm mesh.

Ten grammes (10g) of the sieved teliospores were weighed and sealed in cellophane bags and stored in the refrigerator in the laboratory for inoculation process at a later date. They were subsequently emptied into 25 litres of sterilized water with a concentration of 2.5g/l, representing 6 x 10^6teloispores/ml and stirred to obtain a homogenous suspension of the teliospores and aseptically inoculated on 3-budded sugar cane setts for 1hour. They were then removed and incubated overnight in wet sterile jute bags for 14hrs.

Treatment with plant extracts' solutions & Mancozeb 80 WP

The inoculated cane setts were removed and immersed in three concentrations - 40g/1, 60g/1 and 80g/1 – of each of the plant extracts, namely neem leaves, neem fruits, combretum bark and Mancozeb at 0.5g/l. The plant extracts' were prepared by soaking the earlier prepared neem fruits powder, neem leaves powder as well as the combretum bark powder in sterile water overnight. The inoculated cane cuttings were immersed in each of the extract and Mancozeb solutions for 1hr before removing for planting in the field.

Planting

Field

The treated cane setts were removed and planted in a field trial which was laid out in a split plot design in three replicates with two varieties (Bida Local and NG – D10) as main plots, while the plant extracts and synthetic fungicide treatments at three concentrations 40g/1, 60g/1, and 80g/1 each for neem leaves, neem fruits and *combretum* bark extracts, were tested in the sub plots measuring 4m x 5m on a well prepared land at the Upland Sugar cane Research Experimental field at National Cereals Research Institute, Badeggi.. A synthetic fungicide, mancozeb 80 WP was included as check, while each test plant's extract treatment had a control where inoculated canes were not immersed in their suspensions/solutions. Necessary agronomic practices of fertilizer application, weeding and watering were carried out as appropriate. Data were collected on germination, establishment at 21 and 42 days after planting respectively, whip smut incidence at 3 and 6 months after planting as well as the treatment effects on the cane girth and stalk weight at harvest. These were subjected to the analysis of variance and the means were separated using standard error of difference (SE**).**

RESULTS AND DISCUSSION

The preliminary survey results of the cane growers' crop protection practices presented in TABLE 1 showed that 69.6% of the farmers treated their seed before planting. Among these, 50.8% use synthetic chemicals while 26.6% and 22.6% use ash and herbs respectively. Among those that used herbs for seed treatment before planting. 60% used either neem leaf or neem fruit extracts. The use of other plant protectant extracts were represented by 22.2%, 11.1% and 6.7% respectively for pawpaw leaf, sheabuter bark and C*ombretum* bark extract. The different methods of plant extract preparation and application were also recorded during the survey.

Over 57% of the surveyed farmers pound and soak the herbs overnight to remove the extract for seed treatment and 28.9%, 8.9% and 4.4% respectively, boiled the herbs to remove the extracts. The herbs used by the respondents include neem leaf, pawpaw leaf, sheabuter bark and *Combretum* bark,

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TABLE 1: Seed treatment, materials, herbs and herbs preparation for Seed treatment used by farmers in zone A

Farmers that treat their seed before planting	Frequency	Percentage
Farmers that treat their seed	199	69.6
Farmers that do not treat their seed	87	30.4
Total	286	100
Materials used for seed treatment		
Synthetic pesticide	101	50.8
Ash	53	26.6
Herbs	45	22.6
Total	199	100
Herbs used for treatment		
Neem leaf and fruit extract	27	60.00
Pawpaw leaf extract	10	22.2
Sheabuter bark extract	05	11.1
Comretum bark extract	03	6.7
Total	45	100
Herbs preparation for seed cane treatment		
Boiling to remove the extract	13	28.9
Pounding and soaking over night to remove the extract	26	57.8
Pounding and soaking for two days to remove the extract	04	8.9
Sun drying and grinding to form powder	02	4.4
Total	45	100

but majority of the respondents use neem leaf and fruit extracts. Most farmers that use herbs for seed treatment prepared the herbs by pounding and soaking over the night to remove the extracts.

Chimanikire. (1994) reported that for efficient use of plant protectants, they must neither be boiled, pounded and soaked in water over night nor sun dried and pound to form the powder. In the present survey it was found that 68.9% of the farmers soaked the planting materials in the extracts for 30 minutes before removing for planting and this practice worked for them as reported by other workers[5, 16].

Germination and establishment were generally poor which could possibly be due other factors than the effects of the treatments, since the results from the control were better. However, *combretum* bark treated canes at 40g/l enhanced germination (53.6%) better than the other treatments. Bida local variety of sugar cane gave better germination and seedling establishment (73.4%) than NG-D10 irrespective of the treatments probably because it possessed inherent ability to withstand adverse environmental stress than NG-D10 (TABLE 2).

Significant at P = 0.05

Effect of plant extracts on smut incidence

Findings from this study revealed that *Combretum* bark at 40g/l does not seem to control smut while neem leaf and fruit at 60g/l each, gave the best control of smut. Neem leaf at 80g/l, neem fruit at 40g/l, and Mancozeb 80 WP at 0.5g/l, also gave good control of smut (TABLE 3).

The result also revealed that Bida local variety of sugar cane which is native to the zone, had higher smut incidence than NG-D10 that is alien to the zone which had no smutted stalk, giving an indication that it is resistant to whip smut disease of sugar cane. Stoll (2005) asserted that plant species that have been in use for a considerable period of time under subsistence agriculture are able to combat pest and disease attack. The reaction of

Bida local variety to *U scitaminea* in the present study is at variance with the assertion by Stoll (2005) and the differential reaction could be due to the differences in the genetic constitutions of the two cane varieties.

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TABLE 2 : Effect of plant extracts on germination and establishment of sugar cane at badeggi, Nigeria

Variety	% Germination at 21 DAP	% Establishment at 42 DAP
Bida Local	53.6	73.4
Niger D10	27.7	28.8
S.E	1.36	1.16
Sig	*	*
Treatment		
Neem leaf at 40g/l	38.7	46.0
Neem leaf at 60g/l	40.0	44.0
Neem leaf at 80g/l	40.7	50.0
Neem fruit at 40g/l	36.0	42.0
Neem fruit at 60g/l	40.7	43.3
Neem fruit at 80g/l	40.7	52.7
Combretum at 40g/l	50.0	72.0
Combretum at 60g/l	43.3	62.0
Combretum at 80g/l	38.0	43.3
Mancozeb at 0.5g/l	39.3	64.7
Control 0	38.7	38.0
S.E.	3.73	3.17
Sig.	*	*
Interaction	N S	N S

Effect of plant extracts on yield components and yield of sugar cane

The effect of plant extracts on some yield components and yield of sugar cane are presented in TABLE 3. The plant extracts at their different rates as well as the check mancozeb recorded significant differences on stalk number, stalk length, leaf area, stalk girth and cane weight.

Cane setts treated with *Combretum* bark at 40g/l and those untreated produced significantly the higher number of stalks followed by those treated with Combretum bark at 60g/l. Hill and Waller (1988) reported that production of high numbers of stalk is the result of *S. scitamineum* action on infected canes due to termination of their apical growth thus creating profuse tillers from the base to compensate for the loss.

For the two test cane varieties which have different genetic make up, the differences in the number of stalks between them could not necessarily be due to the effect of *S. scitamineum* effects on sugar cane results in thin stalks, narrow leaves and stunted growth among others[15, 24].

Application of neem leaves extract at 80g/l produced the longest stalks which were not significantly longer than stalks from neem leaves, neem fruit and *Combretum* bark treatments at 60g/l. The test varieties, Bida local and the farmers' popular variety NG 10,

Similarly recorded significant differences in their stalk lengths. Stalk length is an important trait in whip smut studies. Peros (1984), reported that affected plants by *S. scitamineum* remain shorter because of the termination of their apical growth. The significantly longer stalks produced from neem leaves extract treatments at 80g/l show that at this concentration, *S. scitamineum* effect was inhibited resulting in the unaffected canes producing rigorous growth with longer stalks.

On plant girth, neem leaves and neem fruit extracts at 80g/l and 60g/l respectively as well as combretum bark extract at 60g/l produced the biggest stalks. The differences between the test varieties Bida local variety and the popular farmers' variety "NG-10" could not be due to the effects of the treatments since they are genetically different with Bida local being bigger than the farmers' popular variety NG 10. *U. scitaminea* effects on sugar cane

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TABLE 3 : Effect of plant extracts on whip smut incidence, yield components and stalk yield of sugar cane at badeggi, Nigeria

Treatment - Variety	Number of Stalks/Plot 3MAP	% smutted stalks AP	Stalk length 5MAP	Number of Stalks/Plot 6MAP	% smutted length 5MAP (cm)	Stalk length MAP (cm)	Stalk girth MAP	Yield tha-1
Bida local	72.07a	5.17a	77.59a	107.33a	28.65a	93.68a	3.10	110.4
Niger D10	21.11b	0.00b	64.207b	36.53b	0.00b	64.41b	3.02	91.3
S.E	3.05	0.62	1.68	6.00	2.23	1.83	0.06	17.80
Sig Level	**	**	**	**	**	**	N.S	*
NL 40g/l	39.67b	1.84	71.56	61.00b	16.81	81.06	3.2	82.4
NL 60g/l	40.67b	0.00	70.92	49.33bc	5.19	80.67	3.2	64.3
NL 80g/l	56.33b	1.39	79.39	81.33ab	6.09	88.39	3.4	112.3
NF 40g/l	28.67b	2.08	64.06	39.33c	9.08	68.50	3.1	96.8
NF 60g/l	37.33b	0.73	63.78	49.67bc	5.01	76.14	3.2	91.6
NF 80g/l	41.50b	4.01	70.28	56.67b	9.66	76.61	2.9	52.7
CB 40g/l	67.33a	2.59	64.92	133.33a	19.91	79.50	3.2	55.9
CB 60g/l	64.33ab	2.75	70.22	108.67a	18.04	85.83	3.26	54.4
CB 80g/l	39.00b	4.80	73.28	59.67b	10.21	76.56	3.03	49.9
Man 0.5g/l	48.00b	2.61	72.79	76.00ab	12.02	78.28	3.1	94.8
Con 0	41.67b	4.44	73.39	56.33b	20.60	70.56	2.6	41.3
S.E	8.35	1.70	4.61	16.41	6.21	5.01	0.16	22.64
Sig	*	N.S	N.S	*	N.S	N.S	N.S	*
Interaction	NS	NS	NS	NS	NS	NS	NS	NS

Means followed by similar letter(s) are not significantly different at P=0.05 according to duncan's multiple range test (DMRT)

results in thin stalks, narrow leaves and stunted growth among others[15, 24].

The leaf area of the test cane varieties showed the effectiveness of the treatments or lack of it in the present study. The neem leaves and neem fruits extracts at 80g/l and 40g/lrespectively recorded the broadest leaves indicating that *S. scitamineum* did not affect the canes from which they were produced. This is because *S. scitamineum* effects on infected canes include production of grass like appearing leaves, which become narrow and widely spaced with consequent poor yield. In the present study, treatments with broader leaved canes produced commensurate high cane yields than those with narrow leaves where the effects of *S. scitamineum* were high.

Bida local significantly recorded higher yield than the farmers' popular variety NG 10 probably due to their differences in genetic characters rather than the effect of *S. scitamineum* and the lack of potency by the plant extracts. The plant extracts exerted different potency activity on the treated canes. However, neem leaves and neem fruits extracts at 80g/l and 60g/l respectively recorded higher cane yields than canes from the other extracts treatments, which were, however, not significantly different from each other.

The significantly higher cane weight produced by Bida local is not surprising as Akobundu (1987) reported that the chewing cane (Bida local) gives higher yield than the industrial canes. In the present study, the farmers' popular variety NG 10, which though not identified supposes to be a lost industrial cane variety, hence the yields differential between them.

CONCLUSION

In conclusion, the present study has shown that neem leaves and fruits extracts at 80g/l and 60g/l as well as combretum bark extract at 60g/l have potent activities on *S. scitamineum* which improved yield components and yield of sugar cane. The identified

neem extracts' potency on *S. scitamineum* calls for intensive studies in the isolation of the active elements in these plants extracts for purification and aesthetic packaging in usable forms by cane growers.

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