Effect of *Helopeltis* Bug on Inflorescence Blight of Cashew (*Anacardium occidentale* L.) in Elluwankulama Seed Garden and Identification of Pathogen/s

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ABSTRACT

There is a serious damages by *Helopeltis* bug on cashew, may result in secondary infections like inflorescence blight, dieback and anthracnose reducing the considerable amount of yield. Two experiments were conducted to determine the effect of *Helopeltis* bug and pathogen on inflorescence blight of Cashew and to identify the pathogen/s. The severity of blighted lesions and *Helopeltis* damaged lesions under four treatments in Elluwankulama cashew seed garden were measured and a pathogan was isolated in Potato Dextrose Agar (PDA) medium, identified using literature sources and authenticated by artificial inoculation to healthy inflorescences and shoots. The field experiment revealed that the *Helopeltis* bug was the main cause for blight and fungus was the secondary pathogen. The disease could be significantly controlled by the application of Carbaryl that controls *Helopeltis* bug. Two types of fungi, *Cryptosporiopsis spp.* and *Botryodiplodia theobromae* were isolated from blighted panicles and only *Botryodiplodia theobromae* was pathogenic.

KEY WORDS - *Botryodiplodia theobromae*, Cashew, *Cryptosporiopsis spp*, Fungal pathogen, *Helopeltis bug*, Inflorescence blight, Pesticide.

INTRODUCTION

Tree nuts have been one of the oldest sources of food for human beings. Cashew (*Anacardium occidentale*: Anacardiaceous) leads them in world production with 450,000 tons row nuts annually and ranks third in international trade with 20% of market after hazel nuts (29%), and almonds (21%) (Rajapakse, 1980). Cashew is grown in most parts of SriLanka especially in the North, North Western, Southern and Eastern provinces of Sri Lanka. Total area under cultivation of cashew in Sri Lanka in year 2000 was 29136 ha. During the latter part of the last decade, the area under cultivation as well as total bearing extent have gradually increased due to various efforts taken by the Sri Lanka Cashew corporation to increase Cashew production in Sri Lanka. But the average yield of cashew is low (300-350 Kg / ha/ Year) as compared to other cashew producing countries (Jayasekara *et al.*, 2003).

Earlier, cashew has been considered as a crop which tolerates pests and diseases and also as a crop which does not require serious attention regarding pest control. But now there are serious evidences that there is a serious threat from pests and diseases to cause severe crop losses (Ohler, 1979). The cashew pest *Helopeltis anatonii* signort, 1858 (Heteroptera: Miridae) is the most serious pest in cashew in all cashew growing areas of Sri Lanka. It feeds on tender succulent shoots, inflorescences, immature nuts and apples resulting in drying of shoots, blighting of inflorescences and immature nut fall. Severe infestation causes about 30% yield loss (Anon, 1996). Inflorescence blight is the malady, characterized by the drying of floral branches with an estimation of higher crop losses. Nambiar (1978) further stated that the inflorescence blight is primarily caused by *Helopeltis antonii* infestation and the fungi associated with it, are only secondary saprophytic colonizers, which are not pathogenic (Mandal, 1997). Die back or blight which occurs as a secondary damage when the feeding punctures are infected by the secondary pathogens such as *Colletotrichum gloesporioides*, *Botryodiplodia spp.*, *Phomopsis anacardiae* and etc. (Ranaweera, 2003). The initial symptom is appearance of water soaked lesions on the surfaces of inflorescence branches, shoots and also immature nuts and apples. Gummy exudation may occur in lesions. After 2-3 days they become brown, and enlarge in size. The affected parts then dry up and become black, presenting scorching appearance. When the shoots are damaged, they start drying up from tip downwards and hence the name die back (Jayasekara *et al.*, 2003). Field trials have established that the control of insect pest feeding activity on cashew will prevent the occurrence of black lesions and shoot die back and increase yields (Anon, 1997).

The main cause of the disease is not yet fully understood in Sri Lanka, whether it is due to a fungal pathogen, combination of pests and fungi or any other. Prospects for chemical control are limited. Therefore, understanding the type of pathogen, the process of infection and mechanisms of resistance can provide valuable information to optimize the management of the disease.

MATERIALS AND METHODS

1. *Determination of the Effect of Helopeltis Bug and Fungi on InflorescenceBlight.*

The experiment was carried out at the Cashew Seed garden, Elluwankulama, Puttlam located in Low Country Dry Zone (DL_{1a}) from March to January 2006. Sixteen cashew trees of a same clone and at

five years of age, from an area higher incidence of inflorescence blight were selected.

Fertilizer management, weed management and other cultural practices were carried out according to the recommendation of Sri Lanka Cashew Coperation. Four treatments, Carbaryl (T1), Copper Oxychloride (T2), combination of Carbaryl followed by Copper Oxychloride (T3) and water as a control (T4) were applied before the emergence of panicles and continued at each fortnight. One treatment per tree was applied using a power sprayer during early in the morning when wind speed was very low and *Helopeltis* bug was active. Twenty panicles per tree were randomly selected and the size of *Helopeltis* damaged lesions and size of blighted lesions of panicles were measured once in fortnight.

Disease Assessment and Statistical Analysis

Disease severity and *Helopeltis* damage severity, as percentages, in the panicles were assessed once in two weeks by using the score scale (Table 1).

Table 1 - Score scale of disease and *Helopeltis* damage severity:

Score	Severity of the infection
0	No any visual symptoms
1	Total length of panicle branches with Visual symptoms is 1-10 cm.
2	Total length of panicle branches with Visual symptoms is 11-20 cm.
3	Total length of panicle branches with Visual symptoms is 21-30 cm.
4	Total length of panicle branches with Visual symptoms is 31-40 cm.
5	Total length of panicle branches with Visual symptoms is 41-50 cm.
6	Total length of panicle branches with Visual symptoms is 51-60 cm.
7	Total length of panicle branches with Visual symptoms is 61-70 cm.
8	Total length of panicle branches with Visual symptoms is 71-80 cm.
9	Total length of panicle branches with Visual symptoms is 81-90 cm.
10	Total length of panicle branches with Visual symptoms is 91-100 cm.

Severity (%) was computed using the following formula,

$$\text{Severity } (\%) = \frac{nt}{NT} x100$$

Where,

n = number of panicles in each score

t = score

N = maximum score in the scale

T = total number of observations

The experiment was laid out in a completely randomize block design (RCBD) with four replicates. Statistical analysis of the data obtained in the experiment was done by using Statistical Analysis System (SAS) software package (SAS, 1998).

2. *Study on the pathogen/s of inflorescence blight*

The experiment was carried out at the Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila from April to August 2006.

Samples of blighted panicles and shoots were collected from five areas, Elluwankulama, Kamandoluwa, Narammala, Kuliyapitiya and Makandura. The identification of the pathogen/s was done by standard plant pathological tests which include isolation and pathogencity testing (Agrios, 1983). Authenticity of the organisms was confirmed by referring to CMI charts (Johnston and Booth, 1983) and artificially inoculating to healthy plants.

2.1 Isolation of Pathogen/s

Potato dextrose agar (PDA) medium was used as a culture medium to isolate any fungal organism from the tissues of panicles and shoots affected by inflorescence blight. Media were prepared as described by Johnston and Booth (1983) and autoclaved at 121 ^{0}C and 15 psi for 20 minutes. All glassware and other isolation instruments were sterilized at 170 ^{0}C for two hours. Diseased inflorescence and shoot parts were prepared by washing with tap water; dipping in a 5 % bleach solution then washing three times with sterilized distilled water. Petri dishes with PDA were inoculated by diseased inflorescence and shoot parts (approx. 5 mm long) in a laminar air flow cabinet. Inoculated plates were incubated for 4-5 days in an incubator at 28°C.

2.2 Identification and Authentication.

Pathogencity was tested using standard pathological methods (Agrios, 1983). The pathogens of inflorescence blight in cashew were examined. An isolated fungus was identified using a microscope (SERICO) and plant pathological books (Johnston and Booth, 1983 and Paul Holliday, 1996). Separate standard suspension cultures of isolated fungi (20 X 10^4 spores /ml) were prepared for the inoculation. Six healthy inflorescences and six healthy shoots were selected to confirm the disease. Four inflorescences and four shoots were inoculated with standard suspension cultures of fungi and the rest with sterilized distilled water as control. Inoculations were made separately to confirm the disease for all the polythene bags. Disease symptoms were recorded once in two days. Diseased shoots and panicles were re cultured and identified to confirm the pathogen.

RESULTS AND DISCUSSION

1. *Determination of the effect of Helopeltis bug and fungi on inflorescence blight*

The severities of damage by the *Helopeltis* bug at first two sampling dates were not significant while it was significant in application of Carbaryl and the combination of Carbaryl followed by Copper Oxychloride at third sampling date (Table 3). *Helopeltis* bug population was not initially built up hence there were no treatment effects. *Helopeltis* population was started to develop after the second sampling date and therefore, a treatment effect was observed at third sampling date. Thereafter, *Helopeltis* damage readings could not be taken as most of the lesions were converted into the blighted lesions. Inflorescence blight commenced to develop at the peak stage of the *Helopeltis* damage (Figure 1). It revealed that the damages on Cashew inflorescences by the *Helopeltis* bugs have a direct effect on inflorescence blight.

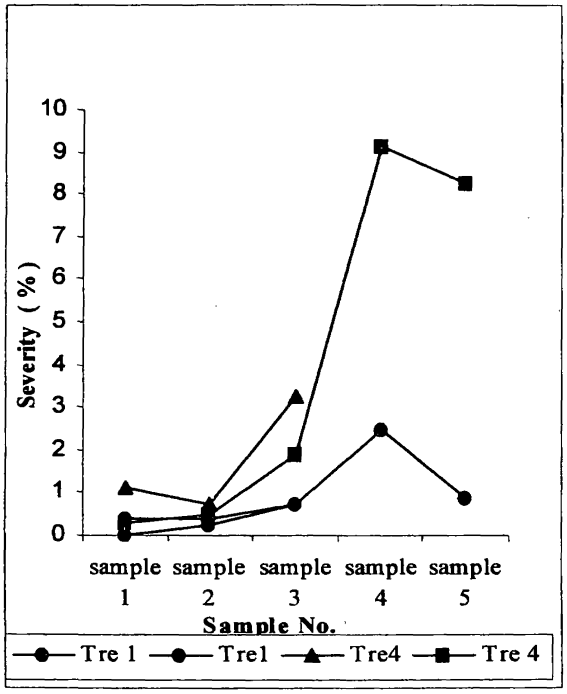

Figure 1 - Variation of *Helopeltis* damage and Disease severity levels:

The severity of disease was not significant at first two sampling dates. Considerable damages of *Helopeltis* were not available at initially therefore disease severity was also low. However, treatments of Carbaryl and the combination of Carbaryl followed by Copper Oxychloride were significant from third sampling date onwards (Table 2). There was no significant difference between control and Copper Oxychloride and also between Carbaryl and the combination of Carbaryl followed by Copper Oxychloride. Therefore application of Copper Oxychloride was not effective. However Carbaryl and the combination of the Carbaryl followed by Copper Oxychloride performed well while the Carbaryl was the best treatment to control inflorescence blight as far as the convenience and the cost are concerned.

Table 2 - Disease severity parameters of Cashew on five sampling dates:

Trt	Disease severity (%)				
	30-Mar	15-Apr	30-Apr	15-May	29-May
T1	2.44 [a]	2.44 [a]	3.46 [bc]	8.89 [b]	3.79 [b]
T2	2.44 [a]	1.01 [a]	8.10 [a]	17.74 [a]	15.73 [a]
T3	1.01 [a]	0.00 [a]	1.01 [c]	9.29 [b]	5.22 [b]
T4	3.03 [a]	3.46 [a]	7.36 [ab]	17.52 [a]	16.62 [a]
CV	118.35	130.52	50.69	12.68	34.32

Treatment means having common letters are not significantly different at 0.05 levels.

Table 3 - Severity of *Helopeltis* damage parameters of Cashew on three sampling dates:

Treatment	*Helopeltis* damage severity (%)		
	30-Mar	15-Apr	30-Apr
T1	1.43 [a]	2.02 [a]	4.20 [a]
T2	4.20 [a]	3.28 [a]	10.82 [b]
T3	2.44 [a]	1.43 [a]	2.44 [a]
T4	5.22 [a]	3.88 [a]	10.82 [b]
CV	8.15	115.39	36.79

Treatment means having common letters are not significantly different at 0.05 levels.

2. *Identification of pathogen/s*

Three days after the inoculation, two types of fungal mycelia were observed on the PDA medium. One type of the fungal colonies was grayish colour and fluffy with abundant aerial mycelium. Under the microscopic observation, conidiophores were hyaline, simple, sometimes septate rarely branched and cylindrical. Conidia were initially aseptate, hyaline, granulose, sub ovoid to ellipsoid oblong, thick walled, base truncate while mature conidia were one septate, often longitudinally striate. This colonial and spores characters were similar to the characters of *Botryodiplodia theobromae* .

Colonies of the second type of the fungus were light brown in colour with white to grayish wool like mycelium. The Spores could be observed one day after the culturing and they were large, brown in colour and spined. Colony and spore characters were not resembling any known fungus. However, closely similar colonial characters have been observed in *Cryptosporiopsis* spp., which causes a recently discovered disease of cashew leaf and nut blight in Tanzania (Anon. 2006).

Koche's postulations on healthy cashew shoots and inflorescences showed that *Botryodiplodia theobromae* is the virulent type of fungus, which caused the inflorescence blight and shoot die back. Initial symptoms were shown seven days after the inoculation. In controls, no any symptom was observed. The other type of fungi did not show any symptom.

CONCLUSIONS

This study revealed that the application of insecticide reduces the severity level of blight on panicles, which is thought to be the precursor of the disease. Hence, controlling of the *Helopeltis* bug is the main factor to control the inflorescence blight on Cashew. Fungicide treatment is not effective in controlling the disease. However, further studies would be necessary to find out occurrence of the disease under different climatic conditions and different *Helopeltis* population levels.

Inflorescence blight occurs on the experimental trees as a secondary infection when the feeding punctures are infected by the pathogen *Botryodiplodia theobromae.*

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