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Susceptibility of *Eucalyptus* Species and Clones to Red Gum Lerp Psyllid, *Glycaspis brimblecombei*, (Hemiptera: Psyllidae) in Mbizi Forest Plantation, Tanzania

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Abstract**—** *Glycaspis brimblecombei is a sap-sucking insect that feeds on Eucalypts. The pest is native to Australia. The nymph feeds on eucalypt leaves and secretes honeydew with which they construct a waxy cover (called a lerp) around themselves. This cover is whitish and conical in shape and shelters the insects until the adult stage. The insect is considered a serious pest that causes leaf discoloration, severe leaf drop, twig dieback and some tree mortality on some Eucalyptus species. In October 2016, the red gum lerp psyllid was recorded for the first time in Mbizi forest plantation in Tanzania infesting Eucalyptus camaldulensis and different Eucalyptus clones. A study was conducted to determine the susceptibility of Eucalypt germplasm to the insect pest. Results showed that E. camaldulensis was more infested followed by GC 514, GC 167, GC 584, GC 15, GC 785 clones while GC 940 was the least infested. Eucalyptus grandis was not infested. Stakeholders can be able to use the susceptibility grouping of the Eucalyptus germplasm to determine what to plant in areas of red gum lerp psyllid infestation. Similar research work should be carried in all major host tree growing areas to determine susceptibility groups for the areas.*

Keywords**— Glycaspis brimblecombei, the red gum lerp psyllid, Tanzania, new record, Eucalyptus germplasm.**

I. INTRODUCTION

Glycaspis brimblecombei (Homoptera: Psylloidea) is commonly referred to as the red gum lerp psyllid. It is native to Australia. The species was first detected outside Australia in *Eucalyptus* plantations causing infestations in California in 1998 (Brennan & Gill, 1999). In a few years, from 2001 to 2008, red gum lerp psyllid was recorded in Florida and Mexico, Chile, Brazil, Argentina, Ecuador, Peru, Hawaii, Uruguay, Venezuela (Burckhardt *et al*., 2008; FAO, 2012). In Europe, the first record of the red gum lerp psyllid dates to 2007 in Portugal and Spain followed by Italy and France in 2010 and 2011 respectively (Valente & Hodkinson, 2009; FAO, 2012; CABI, 2012). In Africa, red gum lerp psyllid was first reported in 2001 in Mauritius, in 2004 in Madagascar and in 2012 in South Africa (EPPO, 2012). In Tanzania, the pest was first recorded in October of 2016 causing infestation on *E. camaldulensis* and different *Eucalyptus* clones on Tanzania Forestry Research Institute (TAFORI) experimental plots planted in Mbizi forest plantation. The origin of the importation has not yet been elucidated.

Lerp insects usually live in colonies of mixed stages. Females of the red gum lerp psyllid lay between 45 and 700 eggs. The eggs hatch in 10 to 35 days depending on temperature and other environmental conditions (FAO, 2012). After hatching, young nymphs or "crawlers" move about the host plant searching for a place to settle, usually settling within 48 hours of hatching. Once settled, they insert their stylets (mouthparts) onto the leaf and begin feeding on the xylem. As the nymphs feed, they secrete honeydew which they use to construct a waxy cover (called a lerp) around themselves. This cover is whitish and conical in shape and shelters the nymphs until they attain the adult stage (Dahlsten & Rowney, 2000; FAO, 2012, CABI, 2012; EPPO, 2012). The red gum lerp psyllid is considered a serious pest that causes leaf discoloration, severe leaf drop, twig dieback and some tree mortality on some *Eucalyptus* species. Red gum lerp psyllid feeds on several *Eucalyptus* species, mainly *E. camaldulensis* Dehnh., but also on other species including *E. globulus* Labill., *E. diversicolor* F. Muell., *E. lehmannii* (Schauer) Benth., *E. blakelyi* Maiden, *E. nitens* H. Deane et Maiden, *E. tereticornis* Sm., *E. bridgesiana* R. T. Baker, *E. brassiana* S. T. Blake and *E. mannifera* Mudie (Brennan & Gill, 1999; 2001; Nagamine and Heu, 2001; Laudonia and Garonna, 2010).

Eucalypts occupy about 10% of the total area of forest plantations in the country of about 550,000 hectares (ha). These eucalypts provide goods and services which contribute to individual livelihoods and national economies in the tropics as well as to reduce pressure on natural forests. There is clear information on a number of

insect pests attacking eucalypts such as stem borers, defoliators, sap suckers and gall forming insects (Kumari, 2009; Petro, 2015). This information includes major hosts, nature and extent of the damage, impact and control. However, little information is available on red gum lerp psyllid which has just recorded in Tanzania for the first time in October of 2016. Therefore, this study was undertaken to determine the susceptibility of Eucalypt germplasm to the insect pest in Mbizi forest plantation, Tanzania. The study was initiated to generate valuable information to forest managers, policy makers, plant protectionists, research and training institutions and individuals' small eucalypt growers in country to find ways of managing the pest situation accordingly.

II. METHODS

Study Area

The study was conducted in a newly established trial plot in Mbizi Forest Plantation. The trial plot was established by TAFORI in March 2015 with the aim of testing growth performance of different *Eucalyptus* germplasm. Mbizi forest plantation is one of 19th forest plantations owned by the Government. The plantation was established in 2013. It has a total area of about 4000 ha. Out of the total plantation area, only 1207 ha are planted. About 99.5% of the planted area is planted with *Pinus patula*. The rest is planted with *Eucalyptus grandis* (5 ha) and *Grevillea robusta* (2 ha) (Petro *et al*., 2016a). The plantation is located in Sumbawanga district, Rukwa region, southern Tanzania and lies between 7°49' and 7°57' S and 31°37' and 31°45'E at altitudes ranging from 1903 to 2373 m a.s.l (Petro *et al*., 2016b). Mbizi is bordered by Lake Rukwa in the North-East and various villages of Sumbawanga Municipality in the South and South East. The area has unimodal rainfall pattern between November to April. The mean annual rainfall ranges between 800 and 900 mm. Drier months are May to October. The area is cool from March to August and warm in the rest of the months.

Sampling and Data Collection

Three plots measuring 12m by 12m were randomly established in each of *E. camaldulensis*, *E. grandis*, *E. camaldulensi* × *E. grandis* (GC) 15, GC 167, GC 514, GC 584, GC 785, GC 940 clones in the trial plot. Assessment of red gum lerp psyllid infestation was done by visual scoring of all trees falling in every plot for incidence (proportion of infested trees) and severity of red gum lerp psyllid. The incidence of red gum lerp psyllid infestation on trees was based on the absence or presence of waxy cover (lerp) on a tree (**Plate 1**). The red gum lerp psyllid severity was assessed visually on the whole crown foliage whereby the following subjective scales were used: (1) none (trees with no visible lerps); (2) minor (trees with lerps in <25% of total shoots); (3) moderate (trees with lerps in 25–50% of total shoots); and (4) severe (trees with lerps in >50% of total shoots).

Plate.1: Red gum lerp psyllid on a Eucalyptus leaf, showing white conical lerps of the nymphs in TAFORI trial plot in Mbizi Forest Plantation

Data Analysis

Descriptive statistics were used to determine the total number of infested trees (incidence) and the number of trees in each severity class of red gum lerp psyllid infestation per plot. The average severity (AS) per plot was calculated as described by Sharma & Sankaran (1988):

$$AS = \frac{(1\times a) + (2\times b) + (3\times c) + (4\times d)}{N \text{ (Total number of trees assessed per plot)}}$$

where 1, 2, 3 and 4 are severity categories and a, b, c and d are the numbers of trees examined in each severity category. Red gum lerp psyllid damage index in each plot was calculated as the product of AS and incidence (proportion of infested trees) per plot. Analysis of variance (ANOVA) in the SAS package was used to test the significance of variation of incidence, AS and damage index between germplasm. In all analyses, significance was determined at $p < 0.05$.

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III. RESULTS AND DISCUSSION

Of the total 536 trees examined, results showed that GC 514 formed the major part (13.8%), followed by *E. camaldulensis* (13.4%), GC 584 (13.2%), GC 167 (13.1%), GC 940 (12.3%), GC 15 & *E. grandis* (11.8%) and GC 785 (10.6%) (Table 1). Distinct differences were observed in incidence, average severity and damage index of red gum lerp psyllid between *Eucalyptus* germplam. The incidence was significantly higher on *E. camaldulensis*, GC 514 and GC 167 than other *Eucalyptus* germplasm ($F_{7,16}$ = 68.02; p < .0001). The average severity and damage index were significantly higher on *E. camaldulensis* and GC 514 than other *Eucalyptus* germplasm ($F_{7,16}$ = 85.17; p < .0001 and $F_{7,16}$ = 94.71; p < .0001 respectively). *Eucalyptus camaldulensi* and GC 514 had higher number of infested trees (21% & 14% of total trees sampled) having lerps on more than 50% of total shoots (severity class 4, Table 1). Results further showed that *E. grandis* was not infested by red gum lerp psyllid. In a study on determining infestation intensity of *Leptocybe invasa* of different *Eucalyptus* species, Nyeko *et al*. (2010) reported that *Eucalyptus* species showing a damage index (DI) = 0 were considered to be resistant, 0 < DI < 0.1 (tolerant), 0.1 ≤ DI < 0.5 (moderately susceptible), and DI ≥ 0.5 (highly susceptible). Therefore, basing on such classification, *E. grandis* (with DI = 0.0) can be classified as resistant, GC 940 (0.1) as tolerant, GC 785 and GC 15 (0.4) as moderately susceptible while GC 584 (0.6), GC 167 (1.1), GC 514 (1.6) and *E. camaldulensis* (1.8) are highly susceptible. This variation in infestation, to a large extent is genetically controlled (Nadel & Slippers, 2011). These findings are in line with Hurley & Greyling (2013) who reported that *Eucalyptus* species differ in their susceptibility to attack by the red gum lerp psyllid with *E. camaldulensis* being highly susceptible and *E. grandis* being more tolerant. Similarly, Paine (2000) reported that although the psyllid feeds on plant fluids from a broad range of *Eucalyptus* species, it prefers to colonize members of the red gum species group, particularly river gum (*E. camaldulensis*). Dahlsten & Rowney (2000) reported that the psyllid was recorded on 27 *Eucalyptus* species in California, including *E. camaldulensis*, *E. rudis*, *E. globulus*, *E. diversicolor*, and *E. sideroxylon* although damage occurs in only a few species, with *E. camaldulensis* being the worst damaged. In 2010, red gum lerp psyllid was observed in different localities of the Campania Region in Italy and in the whole Mediterranean region and it was noticed to be more susceptible to red gum, *E. camaldulensis* than other *Eucalyptus* species (Laudonia & Garonna, 2010).

Table.1: Variation in incidence, severity and damage index of red gum lerp psyllid infestation in different Eucalyptus germplasm in TAFORI trial plot in Mbizi Forest Plantation

Eucalyptus germplasm	Total sample	Incidence (%)	Average severity	Damage index	Severity class (% of total samples)			
					1	2	3	4
E. camaldulensis	72	73.6[a]	2.4[a]	1.8[a]	26	28	25	21
GC 514	74	71.7[a]	2.2[a]	1.6[a]	28	34	24	14
GC 167	70	61.2[a]	1.9[b]	1.1[b]	39	44	9	9
GC 584	71	36.3[b]	1.5[c]	0.6[c]	63	25	7	4
GC 15	63	28.5[b]	1.5[c]	0.4[c]	71	27	2	0
GC 785	57	26.6[b]	1.3[cd]	0.4[c]	74	12	7	7
GC 940	66	4.6[c]	1.1[d]	0.1[d]	95	3	2	0
E. grandis	63	0.0[c]	1.0[e]	0.0[e]	100	0	0	0
F(7,16)		68.02	85.17	94.72				
p-value		<0.0001	<0.0001	<0.0001				

For each incidence, average severity and damage index, values followed by the same letter within a column are not significantly different at 5% probability level.

IV. CONCLUSIONS AND RECOMMENDATIONS

Glycaspis. brimblecombei, commonly called red gum lerp psyllid was recorded for the first time in October, 2016 in Mbizi forest plantation in Tanzania. The study has shown that there is high variability of red gum lerp psyllid infestation on the tested *Eucalyptus* germplasm. Results showed that *E. camaldulensis* was more infested followed by GC 514, GC 167, GC584, GC 15, GC 785 and GC 940 was the least while *E. grandis* was not infested. This is an indication that host plant resistance strategy is a viable management option of this pest. Stakeholders can be able to use the susceptibility grouping of the *Eucalyptus* germplasm to determine what to plant in areas of red gum lerp psyllid infestation. In order to assist management decisions, a survey is recommended in all areas where

eucalypts are planted in Tanzania to obtain accurate information on the distribution and host associations.

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