



Incidence and severity of the mistletoe *Tapinanthus globiferus* on guava and lime and its mechanical control in the Gezira State, Sudan

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Abstract: Mistletoes of the genus *Tapinanthus* (Loranthaceae) are stem hemiparasite comprising about 250 species in East and West Africa. Mistletoe (*Tapinanthus globiferus*) (A. Rich.) van Tieghem, which possess straight pentamerous colourful red flowers, causes severe damage to lime (*Citrus aurantifolia* Swingle) and guava (*Psidium guajava* M.) in orchards along the Blue Nile banks in central Sudan. The main purpose of this research was to find an environmentally friendly approach for the management of mistletoe in orchards fruit trees. Specific objectives were: to evaluate the presence, degree of damage caused by the parasite, and the awareness of farmers, and then use this information to assess possible control measures. A survey was conducted in 2009/2010 by interviewing 186 farmers in the study area (Wad Medani and Hisahisa Provinces) in the Gezira State, a major producer of fruits in the State. The survey results indicated that the incidence of the parasite was 73% in Wad Medani and 23% in Hisahisa. About 70% of the respondents were familiar with the parasite, and 64% of the interviewed farmers practiced traditional pruning by using logging axe, most of the farmers failed to control the parasite. Severely infected orchards were selected for assessment of potential preventive control methods using severe pruning, regular pruning using long handled shears and traditional pruning with logging axe. The results revealed that severe pruning reduced infection by 76% and severity index by 94% in guava. However, traditional pruning using axe reduced infection by only 2.2% and severity by 45%. Regular pruning in lime trees using long handled shears reduced infection by 50% and severity index by 80%. Using the traditional methods in lime orchards reduced severity by 18% with no effect on infection percentage. In conclusion, severe pruning and regular pruning using long handled shears were found to be effective in controlling the parasite in guava and lime trees. These methods were easy to accomplish, and not expensive.

Keywords: Pruning, long handled shears, logging axe

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Introduction:

Mistletoes of the genus *Tapinanthus* (Loranthaceae) are stem hemiparasites of about 250 species in East and West Africa. The plant, which possess straight pentamerous colourful

red flowers, inflict damage on coffee, citrus, guava other fruits and ornamental trees (Viccer, 1981). The nature of sticky seeds enhances the distribution by birds and other animals (DelRio *et al.*, 1996 and

Aukema, 2004). The mistletoe *Tapinanthus globiferus* (A. Rich.) van Tieghen, occurs in most citruses and guava producing areas along the Blue Nile banks in central Sudan (Zaroug *et al.*, 2009). These plants have no root system and parasitize the host plants; they debilitate the tree and reduce the fruit-bearing area. Damage from mistletoes, involves the death of branches distal to the infection. More serious damage occurs in poorly-managed orchards and/or under drought stress conditions, situations that often lead to the death of the host (Boussim, *et al.* 2004). Recently, mistletoes infection on orchard trees has rapidly increased in Sudan.

The primary control methods of mistletoes are pruning of infected branches and removing or eradicating severely infected trees (Hawksworth, 1983; Butin, 1995; Wood and Reilly, 2004). Removal of mistletoe plants from infected branches does not kill the parasite and resprouting from the haustorial system often occurs. Although chemical, biological and genetic controls have been and are still being investigated, particularly for dwarf mistletoe, these methods have not been shown to be practical or economical so far (Shamoun and Dewald, 2002).

Pruning is required for proper citrus care. It includes, regular removal of sprouts, elimination of dead and diseased branches, and the low-hanging branches (skirting) may need to be removed. Pruning is also practiced to control mistletoe, but the infected branches are cut irrespective of the point of attachment of the parasite to the host. In both lime and guava trees severe pruning is sometimes practiced to eliminate deadwood, and diseased limbs in order to renew tree growth. However, complete destruction of severely infected guava trees is commonly practiced to control the mistletoe in Sudan.

The main purpose of this research was to find an environmentally friendly approach for managing mistletoe in orchards fruit trees. The specific objectives included: evaluating the

presence, degree of damage caused by the parasite and farmers' awareness. The information obtained is to be used to develop possible control measures.

Materials and Methods

The study area lies along the Blue Nile banks in two provinces: Hisahisa (14° 44' 47" N, 33° 17' 43" E) and Wad Medani (14° 24' 30.20" N, 33° 31' 47.88" E), Gezira State, Central Sudan. The area is famous for growing guava, lime trees and vegetables.

In 2009 and 2010, 186 farmers, in two different provinces, Wad Medani (96) and Hisahisa (90) in the Gezira State, Central Sudan were interviewed with specific respect to their experiences and approaches to control mistletoe infection. The questionnaire form consisted of questions that assessed the awareness of farmers concerning mistletoe biology, occurrence of the parasite, and control methods used by farmers. The survey form and questionnaire form were prepared and then farmers were interviewed orally during field visits arranged by the Extension Service, Department of Agriculture, Gezira State Central Sudan. The data were analysed by SPSS Software version 11 to determine the frequency and confidence level of the questionnaire data.

Severely infected orchards were selected for the assessment of potential preventive control methods. Severe pruning of guava trees, regular pruning of lime trees using long handled shears were practiced in farmers' orchard in Hisahisa province, Gezira State. These methods were compared with traditional pruning using logging axe.

Degree of infection was evaluated first in June 2009 and reevaluated in July 2010 to assess the effect of severe and regular pruning as compared to traditional pruning. The degree of infection was evaluated by two methods. One simply involved measuring percentage of infected trees. For the second method, severity of infection on each tree was rated on the scale 0-4 (0 = no infection, 1 = low infection

with 1-5 haustoria/tree, 2 = moderate infection
with 6-10 haustoria/tree, 3= severe infection

with 11-15 haustoria/tree and 4 = very severe
infection with ≥ 16 haustoria /tree.

A severity index(y) for each sample was then calculated using the formula:

$$y = \frac{(0 \times a) + (1 \times b) + (2 \times c) + (3 \times d) + (4 \times d) + (5 \times e)}{a + b + c + d + e} \times \frac{100}{4}$$

Where a, b, c, d, and e are number of trees which fall into the increasing infection categories 0-4 (Mathiasen *et al.*, 2008).

Severe pruning in guava trees:

Severe pruning is sometimes practiced to eliminate deadwood and diseased limbs in order to renew tree growth. It is accomplished by using logging axe to cut the whole branches as appeared in Plate. 1 (a) and in this research it was used to control mistletoe. For this purpose a total of 300 guava trees were pruned as explained above in an orchard in Hisahisa. To evaluate the degree of infection 5 samples each consisted of 20 trees were evaluated in June 2009 before pruning and re-evaluated in July 2010 after severe pruning.

Regular pruning in lime trees using long handled shear:

Lime trees are widely grown in central Sudan for its edible acid fruit. The tree seldom grows more than 5m high and if not pruned becomes shrub-like. Its branches spread and are irregular, with short, stiff twigs, small leaves, and many small, sharp thorns. A total of 300 lime trees were pruned using the long handled shear with saw and cutter in an orchard in Hisahisa. They were cut regularly at short intervals with continuous inspection of the orchard using long handled shears with cutter and saw. It was accomplished by cutting the infected branch at least 20-30 cm behind the haustorium. The handle is about 3 meters long, which enables the labour to cut mistletoe infected branches at the tops of lime trees. To evaluate the degree of infection 5 samples each consisted of 20 trees were evaluated in June 2009 before regular pruning and re-evaluated in July 2010 after pruning.

Finally, traditional pruning in guava and lime trees:

Traditional pruning is required for regular removal of sprouts, elimination of dead and diseased branches. Also the bottom of the canopy in lime trees may need to be removed and it is sometimes used to control the mistletoe.

The farmers use logging axe and cut the infected branches irrespective of the point of attachment. Since it was difficult to leave any trees without pruning the traditional pruning method was used as a control. The degree of infection was evaluated using the same procedure mentioned above. Moreover, the infected trees were assessed twice once in June 2009, then reassessed after one year and compared with the two methods mentioned above using T-test

Results

The survey results showed that the incidence of the parasite was 73% in Wad Medani and 23% in Hisahisa. Seventy percent of the respondents were familiar with the parasite and about 64% of the interviewed farmers practiced traditional pruning by using logging axe (Table 1).

The results revealed that severe pruning in guava significantly reduced infection of mistletoe by 76% and severity index by 94% (Table 2, Plate 1). However, traditional pruning using logging axe reduced infection of mistletoe in guava trees by only 2.2% and severity by 45%. Regular pruning using long handled shears in lime fruit trees also significantly reduced infection of mistletoe by 50% and severity index by 80% (Table 3). Using the traditional methods in lime orchards had no effect on infection percentage, however, it reduced severity index by 18% (Table 3).

Table 1: Mistletoe incidence, awareness among interviewed farmers and the current status of control in two provinces in the Gezira State, Sudan

Variables	Wad Medani (%)	Hisahisa (%)
Incidence	73.0	23.0
Farmers Awareness	70.0	70.0
Control using traditional pruning	64.0	65.0
Number of interviewed farmers	96.0	90.0

Table 2: Effects of severe and traditional pruning methods in controlling mistletoe on guava trees

Treatment	June 2009		July 2010	
	% Infected tree	Severity index	% Infected trees	Severity Index
Severe pruning	91.7**	83.5**	21.7	5.4
Reduction %			76.3	93.5
Traditional pruning	90.0	66.1	70.0	36.2
Reduction %			2.2	45.2

* Significant at $p \leq 0.05$ using T test.

** Significant at $p \leq 0.01$ using T test.

Table 3: Effects of regular pruning using long handled shear and traditional pruning methods in controlling mistletoe on lime trees

Treatment	June 2009		July 2010	
	% Infected trees	Severity index	% Infected trees	Severity index
Regular pruning with Long handled shears	92.5**	54.4**	45.0	11.3
Reduction %			50.3	79.2
Traditional pruning	79.7	56.9	81.5	46.9
Reduction %			-	17.6

* Significant at $p \leq 0.05$ using T test.

** Significant at $p \leq 0.01$ using T test.

Discussion

The results of the survey indicated that farmers consider mistletoe to be a major pest on lime and guava trees in the two provinces surveyed. Although 70% of the respondents were familiar with the parasite and about 64% of the interviewed farmers practiced traditional pruning by using logging axe, however, most of them failed to control the

parasite (Table 1). This was indicated after assessment of the degree of infection where the percentage of infected trees was reduced by only 2.2% in guava and no reduction was observed in infected lime trees after traditional pruning (Table 2 and 3). The same genus was reported to cause severe damage on coffee, citrus and guava trees in East and West Africa (Viccer, 1981). In addition, the

parasite was reported to cause drastic damage in citrus and Guava in Sinar State, Sudan (Zaroug *et al.*, 2009).

Pruning is the simplest curative and most affordable method to control mistletoes, at least in guava. It is efficient only if the host branch is cut at several-centimetres below the level of attachment of the parasite to eliminate the haustorial system entirely (Parker and Riches, 1993). However, this method is time-consuming and dangerous for people who are removing the parasite especially in lime trees. The available methods of control in Sudan are pruning, which could be preventive if it was done properly and regularly, or the removal of the infected trees, a destructive method. Unfortunately, pruning is not done properly: since the farmers remove only the haustorium of the parasite which leads to vigorous resprouting of the parasite. As mentioned, the accurate method is to cut the infected branch at least 20 -30 cm behind the haustorium (Parker and Riches, 1993). In addition, the removal of infected branches should be done regularly at short intervals with continuous inspection of the orchard.

According to the results the use of long handled shear reduced the incidence and severity of mistletoe infection in lime trees significantly as compared to the traditional pruning. It also, allowed the farmer to prune lime trees easily and effectively. In addition to controlling mistletoe, pruning is also required for proper care of lime trees to remove sprouts, deadwood, diseased limbs and skirting i.e. the removal of low-hanging branches. However, the spreading and irregular growth of branches with stiff twigs and many small sharp thorns make the traditional pruning very difficult.

In this research the usage of severe pruning reduced the incidence of mistletoe in guava trees by more than 76% and severity index by more than 79%, compared to traditional pruning which reduced infection of mistletoe Oxford University Press, New York.

in guava trees by only 2.2% and severity by 45%. Although, severe pruning is effective in controlling the parasite, even so, the farmer will lose one season's fruit crop. However, subsequent new growth and the resultant increase in the production with improved quality will compensate for the loss.

In conclusion regular pruning using long handled shears was found to be effective in controlling mistletoe in lime trees, easy to accomplish and not expensive. On the other hand, severe pruning was effective to control mistletoe in guava trees and to remove old dry branches and diseased limbs to renew tree growth. At present, these two methods could be strongly recommended for the protective control of mistletoe (*T. globiferus*) parasitizing lime and guava in Sudan. Other methods should be investigated particularly biological control since chemical control on fruit trees is hazardous. It is noteworthy that proper understanding of the parasite biology and ecology is imperative for development of effective control methods.

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a



b



c



Plate 1. Control of mistletoe in guava using severe pruning method:

a: Guava trees after severe pruning in June 2009, **b:** Early stages of recovery of guava tree canopy, resprouting of host branches, **c:** Guava tree canopy recovered, and started to bear fruit one year after severe pruning in July 2010

حدوث وشدة الإصابة بطفيل القلع (*Tapinanthus globiferus*) على أشجار الجوافة والليمون
ومكافحته ميكانيكياً في ولاية الجزيرة - السودان

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المستخلص:

القلع أو العنبة نبات زهري غير كامل التطفل يتطفل علي سيقان النباتات العائل ويتبع الجنس (*Tapinanthus*) والعائلة (*Loranthaceae*). يشتمل الجنس علي 250 نوع تنتشر في شرق وغرب افريقيا. يتميز القلع بالأزهار الحمراء الطويلة ويسبب تلف كبير في أشجار الليمون والجوافة المزروعة في البساتين المنتشرة علي ضفتي النيل الأزرق في وسط السودان. هدفت هذه الدراسة لايجاد طريقة صديقة للبيئة للتحكم والحد من انتشار الطفيل في البساتين. الأهداف الخاصة للدراسة شملت تقييم انتشار الطفيل، شدة الإصابة، ومدى معرفة المزارعين بهذا الطفيل، والاستعانة بهذه المعلومات لتقييم طرق المكافحة الممكنة. أجريت المسوحات في العام 2010/2009م بمعاينة 186 مزارع في موقع الدراسة (محافظة ودمدني والحصاحيصا) في ولاية الجزيرة والتي تعتبر منتج رئيس للموالح والجوافة في الولاية. أوضحت النتائج أن نسبة الإصابة في ودمدني 73% وفي الحصاحيصا حوالي 23%. حوالي 70% من المزارعين الذين شملهم البحث علي معرفة بالطفيل وحوالي 64% منهم يمارسون مكافحة الطفيل بالتقليم التقليدي باستخدام الفأس، الا أن معظمهم فشلوا في مكافحة الطفيل. تم اختيار بساتين ذات إصابة عالية بغرض تقييم طريقة فعالة لمكافحة الطفيل مستخدمين: طريقة القطع الجائر، التقليم المنتظم باستخدام مقص ذو ذراع طويلة، والتقليم التقليدي باستخدام الفأس. أوضحت النتائج أن استخدام التقليم الجائر في أشجار الجوافة قلل الإصابة بنسبة 76% وشدة الإصابة بحوالي 92% مقارنة بالتقليم التقليدي حيث كانت نسبة الإصابة 2.2% فقط وشدة الإصابة 45%. أما التقليم المنتظم باستخدام المقص ذو الذراع الطويل في أشجار الليمون قلل الإصابة بنسبة 50% وشدة الإصابة بنسبة 80%، في حين أن استخدام الطريقة التقليدية في أشجار الليمون قلل الإصابة بنسبة 18% دون حدوث تغيير في شدة الإصابة. خلصت الدراسة الي أن طريقتي التقليم الجائر والمنتظم باستخدام المقص ذو الذراع الطويل في أشجار الجوافة والليمون ذات فعالية في مكافحة الطفيل هذا بالإضافة إلي سهولة تطبيقها وقلّة التكلفة.