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#### Mitigating Antestia Bug Damage and the Potato Taste Defect in Rwandan Coffee

Andrew Gerard & Joseph Bigirimana

#### Introduction

Coffee production is a critical source of income for hundreds of thousands of Rwandan families. How lucrative coffee production is, however, depends on the cost of producing coffee and the price farmers receive at market. The coffee pest “antestia bug” and the potato taste defect (PTD) have the potential to reduce farmer incomes. The antestia bug can significantly diminish the volume of coffee cherries that can be sold; PTD reduces the value of coffee, market price available to farmers, and volume purchased by international buyers. Researchers and practitioners have hypothesized a relationship between the antestia bug and PTD for some time. However, a recent study by Bigirimana et al. provides evidence that it is possible to reduce the incidence of PTD by controlling antestia (Bouyjou, et al., 1999; Bigirimana, et al., 2018). This brief summarizes these findings, and pairs them with data from the African Great Lakes Region Coffee Support Program (AGLC) to suggest barriers to pesticide use, and potential avenues for improved antestia and PTD control.

#### Problem: Losses from the antestia bug and reduced value from PTD

The antestia bug, *Antestiopsis thunbergii* (Gremelin) (Hemiptera: Pentatomidae) is a harmful coffee pest with variants across East Africa. It feeds on coffee cherries at different stages of development and maturation as well as on green shoots, leaves, and flower buds (Kirkpatrick, 1937). The antestia bug can cause up to 40% yield loss, which can reduce smallholder farmers’ already slim financial margins and make coffee production unprofitable (Gesmalla et al., 2016). Thus, even without a connection between the antestia bug and PTD, the antestia bug would be a highly damaging insect.

#### Key Findings

- The potato taste defect (PTD) reduces the value of coffee in Africa’s Great Lakes Region, and in doing so decreases farmer incomes.
- The antestia bug is an East African coffee pest that can cause up to 40% of coffee cherry loss.
- While scholars have suggested that the antestia bug may cause PTD, a new study presents experimental evidence that controlling antestia reduces PTD.
- This study also shows that Fastac (10% alpha-cypermethrin) and organic pyrethrum-based pesticides, when combined with pruning, are effective at controlling antestia and reducing PTD.
- While the percentage of farmers using pesticide has increased since 2015, 24.41% of farmers still do not use pesticide.
- Further, most farmers do not receive training on antestia control.
- Policy recommendations to improve antestia and PTD control can be found on pages 4-5.

However, evidence suggests that the antestia bug does cause or enable PTD in coffee. Potato taste is a flavor defect that makes coffee taste like raw potatoes. It occurs in coffees from the Great Lakes Region of Africa (e.g., Burundi, Rwanda, Democratic Republic of Congo, etc.). While in some cases it can be smelled in green coffee, it is much more pungent in roasted coffee, so it is possible for affected coffee to make it through sorting and to roasting before being detected.

Potato taste defect diminishes the flavor experience of roasted coffee, reducing its value or causing it to be rejected by roasters and consumers. This has an economic effect on producers, because PTD can reduce the value of coffee paid to farmers and cooperatives if buyers discount the prices they will pay for the lots of coffee that they believe may be defective or purchase smaller volumes of Rwandan coffee than they would otherwise. Beyond this, international buyers may more generally reduce prices they are willing to pay for Rwandan coffee, whether or not there is specific evidence of PTD. For example, one exporter has calculated a PTD “discount” that may lower the price of all Rwandan coffee on the world market (Smith, 2014). If reduced trust in the quality of Rwandan coffee causes buyers to offer lower prices or hesitate to purchase Rwandan coffee, improving prices and increasing farmer incomes requires reducing the impact of antestia as well as PTD.

Studies have suggested that the presence of PTD in coffee is associated with insect damage, especially damage from the antestia bug, however two important questions remain to be answered, and are the focus of this brief (Bouyjou et al., 1999; GKI, 2014; Jackels et al., 2014).

Question 1: Can controlling the antestia bug reduce the incidence of PTD?

Question 2: If so, how can farmers better control antestia?

### Findings on antestia and PTD

In 2014-2015, the Rwanda Agriculture Board (RAB) conducted an experiment to determine whether the antestia bug caused PTD, and what antestia control methods were most effective. They conducted this research using funding from the Potato Taste Challenge Prize, which was organized by the Alliance for Coffee Excellence and the Global Knowledge Initiative. Joseph Bigirimana and colleagues at Michigan State University completed this project with support from AGLC.

This study first evaluated the effectiveness of integrated pest management using pruning alone or in combination with several commercially available pesticides against a field population of antestia bugs. Previous research had shown that pruning was effective in reducing antestia populations because antestia prefer a shaded, damp



Image 1: Antestia bug, *Antestiopsis thunbergii* (Gremelin) (Hemiptera: Pentatomidae). Photo: Bigirimana.

(Bigirimana, et al., 2012). Second, it assessed the relationship between these treatments and the occurrence of PTD in coffee using laboratory and field tests. The pesticides tested in the trials were: 1) Confidor (17.8% imidacloprid); 2) Fastac (10% alpha-cypermethrin); 3) Pyrethrum 5EW (5% pyrethrins), 4) Pyrethrum EWC (2.19% pyrethrins and 10% sesame) and 5) Agroblaster (8% pyrethrins). Of these, Confidor was historically the most commonly used pesticide in Rwanda, however in recent years Fastac has been more commonly used (CEPAR, 2018). In laboratory bioassays, pesticides were applied to groups of 15 bugs placed in a petri dish using a hand sprayer. Field trials were conducted in three major coffee growing regions of Rwanda: Rubona, Gakenke and Kirehe.

### Results for antestia bug mortality

Significant differences were found among pesticides on the percentage of antestia bugs killed both in laboratory and field conditions. The percent mortality was higher for pyrethroid, Fastac (Alpha-cypermethrin), and pyrethrins (Pyrethrum 5EW and Pyrethrum EWC + Sesame) than the percent mortality for Confidor. Mortality from Confidor increased over time, but still provided a lower mortality rate than Pyrethrum 5EW and Agroblaster 12 hours post-treatment. At the field level, pruning alone registered statistically higher insect mortality than unpruned coffee trees without pesticide application (i.e., the control plots).

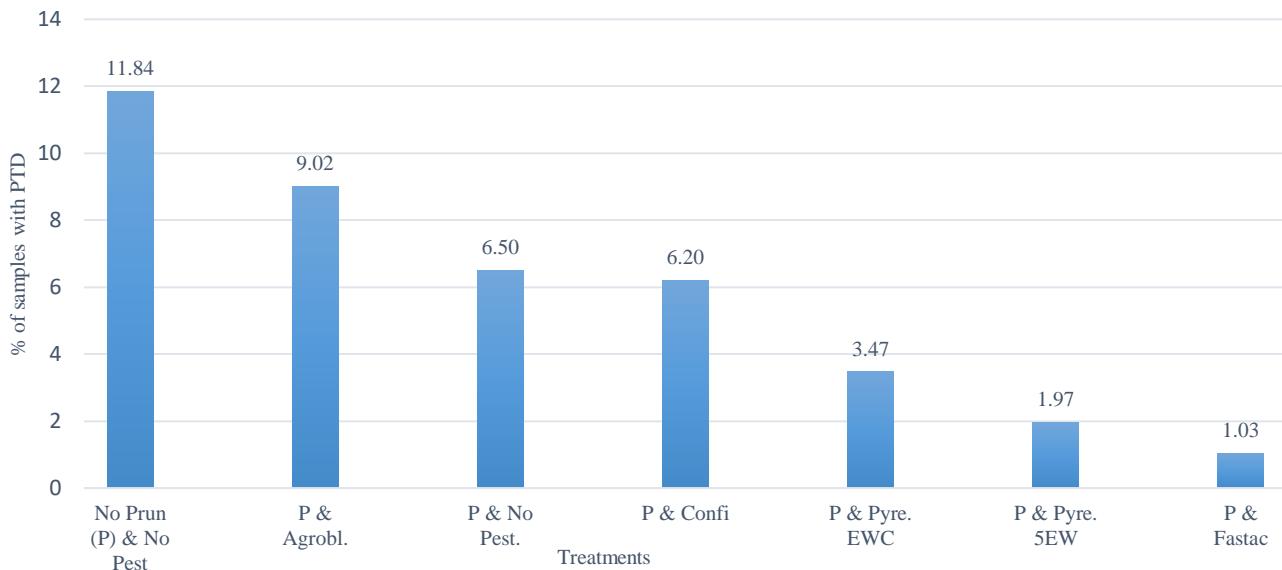
## Results for potato taste defect

To test the relationship between antestia and PTD, coffee cherries were harvested from treatment and control plots and sensory tested for PTD. Three kilograms of ripe cherries were collected from each test plot six months after spraying. Cherries were collected over a one-month period and were hand pulped, wet processed, and dried. Each sample was roasted and sensory tested or “cupped,” with the primary objective being to detect whether samples had or did not have PTD.

Significant differences in PTD incidence were observed among treatments. Treatment with Fastac in pruned

coffee trees resulted in the lowest PTD and the control had the highest incidence (about 12 times that of Fastac spraying in pruned plots). Pruned plots treated with Fastac or Pyrethrum 5EW had the lowest PTD incidence on average, but plots sprayed with Pyrethrum 5EW had twice the PTD incidence of those treated with Fastac. Additionally, the control had twice the PTD incidence of pruning alone, which had the same PTD incidence as pruned plots treated with Confidor (Fig. 1)

Figure 1: Percent of samples with PTD by treatment type (P = pruning)



In this study, PTD was correlated with antestia density and the extent of damage caused by antestia. These findings are compatible with recent tests showing a correlation between PTD and low-density green coffee, which is often caused by insect damage (Montenegro, 2015). The study suggests that pruning combined with pesticide application—especially Fastac and other pyrethrum-based pesticides—provides better control of antestia bug and significantly reduces PTD compared to either pruning or pesticide alone.

## Findings on pesticide availability and use

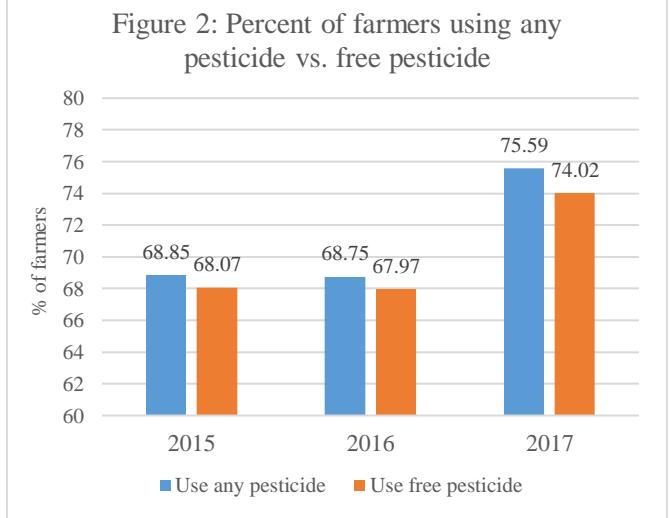
If the antestia bug causes PTD, and we have evidence of which pesticides are promising for controlling antestia,

what is the status of farmer engagement in antestia control? Evidence on the status of antestia and PTD knowledge and control comes from a survey of 1,024 farmers taken following the 2015 season, as well as follow-on surveys of ½ of this sample (512 farmers) after the 2016 and 2017 seasons. Surveys were conducted in the AGLC sample districts of Gakenke, Huye, Kirehe, and Rutsiro. A summary of findings is as follows.

1. **Training on antestia control:** An important influence on farmers' ability to control antestia is knowledge about the best practices used to control it. In the AGLC sample, few farmers had received training on controlling antestia. Percentages of farmers who had received

training range between approximately 10-20% across the three years of the AGLC project. According to data from the baseline survey, cooperative membership increases the likelihood of receiving training on antestia control, with cooperative members substantially more likely to receive training than non-cooperative members.

2. **Knowledge of PTD:** Connected to training on antestia is knowledge of PTD itself. The percent of farmers who knew what PTD was ranged between approximately 40-55% in the three years of the AGLC survey. In the baseline survey, farmers who were in cooperatives were significantly more likely to know what PTD was compared to non-cooperative members. This suggests that, beyond providing training on antestia control, cooperatives may play a role in informing farmers about PTD.
3. **Pyrethrum-based pesticide use:** Pyrethrum-based pesticides were effective at controlling antestia, but they also have the benefit of being allowable in organic certified coffee. Unfortunately, few surveyed farmers use pyrethrum. However, more farmers used pyrethrum in 2016 and 2017 than they did in 2015. While less than 1% of farmers who used any pesticides applied pyrethrum-based pesticide in the baseline survey (2015), in 2016 this percentage was up to 6.05% of farmers who used pesticide, and in the 2017 this was 4.49%.
4. **Pesticide distribution:** The percent of farmers using any pesticide has increased over the past three years from 68.65% of sampled farmers to 75.59%, which is an encouraging finding. However, 24.41% of farmers still do not use pesticide. Figure 2 shows the relationship between all pesticide use and “free” pesticide use. Most farmers do not purchase pesticide, but instead receive it for “free” from distribution overseen by the Coffee Exporters and Processors Association of Rwanda (CEPAR) and implemented by local governments and coffee washing stations (CWSs), with some also receiving inputs from cooperatives. Though a small percentage of farmers do not use pesticides because they are certified organic, other groups of farmers—specifically women-headed households—are less likely to use pesticide than other farmers. Many farmers also use less pesticide than experts suggest using,



though the average volume of pesticide used increased between 2015 and 2017. These are important findings from an antestia control perspective, because farmers who do not control antestia in their plantations can introduce PTD into otherwise high quality lots of coffee.

### Implications and policy recommendations

Given findings on the connection between antestia and PTD, and on the challenges farmers face in controlling antestia, it is worth considering which actions might be helpful in controlling antestia and PTD. One consideration when determining how to confront PTD is the coffee quality spillovers or “externalities” that occur among coffee farms. Because Rwanda’s coffee comes primarily from smallholders, and is bulked at CWSs, it is difficult to trace coffee with PTD back to individual farms. So even a small number of farmers who do not control their antestia can create a PTD problem for their neighbors, their cooperatives, and their sectors generally. Thus, it is important to extend antestia control tools and opportunities as widely as possible. The following recommendations are aimed at this goal:

- (1) **Increase access to pyrethrum-based pesticides:** Integrated pest management which combines pruning and pesticide application is an effective option for controlling the antestia bug. Alternating pesticides with different modes of action such as Fastac and pyrethrum may be a useful approach to avoid development of resistance. Therefore, continuing to encourage farmers to use pesticides including pyrethrum is an important strategy. An added benefit of pyrethrum-based pesticides is that

they have a relatively benign environmental footprint and can be used in certified organic coffee production. Incentives for pyrethrum use could involve including it as an option in CEPAR distribution (something already being done at a limited scale), providing discounts on pyrethrum-based pesticides, or other approaches to reduce the cost of pyrethrum-based pesticides.

(2) **Increase access to scientifically based training on antestia control and coffee sorting:** As noted, a relatively small percentage of farmers have received training on antestia. New knowledge is emerging on antestia and PTD, so it is important both that trainings be available to farmers, and that they be based on new science. Fortunately, RAB is involved in innovative PTD research, and so can inform training programs. Opportunities to expand training can focus on working through cooperatives, which already provide training on antestia control and PTD, as well as targeting farmers who are *not* in cooperatives and so may not have access to training. Beyond training on antestia, it is important that farmers, as well as CWS and dry mill managers, understand how sorting coffee can reduce the incidence of PTD. While PTD originates at the farm level, by carefully “floating” cherries, and sorting out insect damaged parchment and green coffee, farmers and CWS and dry mill managers can reduce the incidence of PTD even if some exists in their coffee.

(3) **Further research on what works for antestia control:** The Bigirimana, et al. (2018) study described in this policy brief indicates that combining pruning and pesticide application is effective against antestia bug. However, this is just one approach to controlling antestia and PTD. Government research agencies, universities, and other research entities should explore other pest management options against the antestia bug such as biological control, mating disruption, and “attract and kill.”

(4) **Ensure that all farmers can access the most effective pesticide:** To control PTD, it is important that all farmers be able to control antestia in their plantations. In ensuring access to pesticides, the National Agricultural Export Development Board (NAEB) and CEPAR should study which farmers currently do not receive pesticide and target them for delivery.

(5) **Facilitate farmer investment in pesticide:** Most farmers do not purchase pesticide, but rather rely

entirely on “free” pesticide. To encourage direct farmer investment in pesticides, NAEB, CEPAR, and other stakeholders should identify mechanisms (e.g., improved access to agro-dealers, micro-finance, etc.) to encourage farmers to purchase pesticide on top of what is available through CEPAR and cooperatives. A more basic approach to encouraging investment would be to ensure that farmgate cherry prices remain at levels that reward investment in coffee—investment including the purchase of pesticide.

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