

Measuring the Impact of a New Invasive Ant Species (*Plagiolepis Alluaudi*) on Plant Feeding Insects in South Florida Nurseries

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ABSTRACT

Plagiolepis alluaudi, the little yellow ant (**Figure 1**), is an invasive species from Madagascar that was recently discovered in west Fort Lauderdale in 2017. The ant is noted to be a pest in floricultural and residential areas in parts of the world where it has invaded, but little has been studied about the species' biology and economic impacts. In order to determine how much of a threat this new invasive poses to Florida and what can be done to control it, experiments and surveys have been initiated

to determine where and how far the species has spread in South Florida, what effect *P. alluaudi* has on populations of mealybugs and similar plant feeding insects, and which over-the-counter bait could be effective in controlling the species. Initial results suggest that *P. alluaudi* is spreading at a slower rate than previously anticipated, and that a bait formulation of boric acid and sugar seems to be the most effective in reducing the incidence and abundance of the ant species.

OBJECTIVES AND METHODS

1. Evaluate area-wide control methods to minimize the direct and indirect negative impact of the *P. alluaudi* on nursery ecosystems.
2. Survey the ant diversity in selected Broward County nurseries and neighborhoods, to monitor for *Plagiolepis alluaudi*, and to create a record of the ant community that future studies can compare to in the case of a widespread invasion.
3. Determine the impact of the *P. alluaudi* on mealybug populations and their negative impact on overall plant health.



Figure 1. Workers of *Plagiolepis alluaudi* interacting with mealybugs

METHODS

1) Control methods

Four common over-the-counter ant baits were chosen to be evaluated in this project, Terro®, Optiguard®, Max Force®, and Advion®. These baits were chosen as they are used exceeding frequently in ant control, are available for purchase throughout the state of Florida, and can be legally bought and administered by individuals without pest control certifications. Three independent assays were performed.

1.1) Laboratory non-choice bait assay

A non-choice assay was conducted to examine the efficacy of commercial baits in eliminating *P. alluaudi*. Six 10×10×0.2cm planar arenas were prepared and contained a small amount of cat kibble and a cotton filter pad, saturated with deionized water, to prevent starvation or dehydration.

One of each commercial bait was added to four of the arenas, a 1:1 mixture of sucrose and deionized water was added to the fifth (positive control), while the sixth arena had no additional component added to it (negative control). Ants were collected from the field, and a population of approximately 200 ants was transferred into each of the six arenas. Live ants in each arena were counted every 24 hours for 12 days. This procedure was replicated three times. This experiment was then repeated but baits and controls were diluted by 50% and 75% with water in order to determine if thinner baits would be easier for the notably small ants to consume, but still retain the potency required to eliminate them.

1.2) Field bait recruitment choice assay

A choice assay was conducted in the field to determine which commercial bait *P. alluaudi* would readily forage for when applied in the field. Five 1.5ml vials containing one of the commercial baits and a positive control were placed on a plain sheet of paper near known field populations of *P. alluaudi*. Photos were taken of the vials every five minutes for 1 hour to count for the number of ants foraging on baits over time. This assay was replicated five times.

1.3) Field bait consumption choice assay

Two 1.5ml vials of each of the commercial baits and controls were prepared and weighted. One copy of each bait and control vial was left near a field population of *P. alluaudi*. The remaining copies of the vials were used to take into account evaporation, and were placed in proximity of the experiment, but isolated from the ants. The test was run for 4 hours, all vials were collected afterwards and returned to the lab to be weighted. Bait consumption by *P. alluaudi* was determined through the difference in mass.

2) Ant surveys in South Florida

2.1) Presence in nurseries

Broward County nurseries associated with the FNGLA were approached and asked to participate in this survey. Participating nurseries were surveyed in total by a UF graduate student and a technician. Four to five sugar baits were laid at each nursery to attract ants, which were checked after 1.5h. During this time the nurseries were surveyed by hand. Samples were then taken back to the laboratory, where each ant species was identified and recorded, creating a catalogue of species encountered at each location.

2.2) Presence in residential areas

Surveying was continued towards neighborhoods in Fort Lauderdale centering around the first recorded location of *P. alluaudi*. Public areas were surveyed at random and encountered ant species were recorded. Surveying was typically done by hand, however baits were laid in larger areas such as public parks. Time spent surveying varied depending on the size of the location. Surveying of neighborhoods is still in progress.

3) Mealybug interactions

Interactions between *P. alluaudi* and plant feeding Hemipterans were monitored in the field; it was observed that *P. alluaudi* interacts with *Paracoccus marginatus*, Papaya Mealybugs. Populations of *Pa. marginatus* were reared in a greenhouse on *Hibiscus* plants to create a source of mealybugs to use for the experiments. Four store bought *Hibiscus rosa-sinensis*, red hibiscus, were purchased and placed in a two by two grid near known field populations of *P. alluaudi*. Two of the plants were placed into a water filled container to exclude ants; the other two were placed on the bare soil to include ants. Two plants, one excluding ants and one including them, were inoculated with an ovisac of *Pa. marginatus*, containing approximately thirty nine eggs. This will determine differences in mealybug population growth in the presence or absence of *P. alluaudi*, as well as the spread of mealybugs to new plants in the presence or absence of *P. alluaudi*. All plants were examined three times per week and ovisacs present on the plants were counted and recorded. This process was replicated five times, and the experiment is still in progress. It is expected to be completed by the end of December 2019.

RESULTS

1.1) Laboratory non-choice bait assay

Results (Table 1) of the non-choice assays show that Optiguard® completely eradicated every treatment of ants it was applied to, even when diluted 75%. Advion® proved largely ineffective and failed to eradicate more than 50% of ants in any treatment. Terro® and Max Force® had limited impact, depending on the dilution factor. Undiluted Terro® eliminated around 90% of ants by the end of the assay, and undiluted Max Force® eradicated all ants after the first day of study. When diluted, neither formulation was able to completely eradicate treatments of ants.

Table 1. Percent survivorship of populations of *P. alluaudi* exposed to bait formulations over a period of twelve days. Values are average survival percentage (n=5)

Day	Percent survivorship of <i>P. alluaudi</i> exposed to undiluted bait formulations						Percent survivorship of <i>P. alluaudi</i> exposed to 50% diluted bait formulations						Percent survivorship of <i>P. alluaudi</i> exposed to 75% diluted bait formulations					
	Blank	Control	Terro	Opti guard	Max Force	Advion	Blank	Control	Terro	Opti guard	Max Force	Advion	Blank	Control	Terro	Opti guard	Max Force	Advion
1	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
2	98.61	98.42	66.41	47.48	0	93.04	96.97	97.34	92.21	83.00	40.73	95.02	99.12	99.77	99.44	95.02	56.30	97.77
3	97.78	97.33	61.84	10.89	0	81.21	95.46	96.20	77.10	77.18	33.01	88.11	98.14	98.84	93.75	39.16	51.90	95.73
4	96.76	96.05	56.01	2.29	0	77.28	94.35	95.01	62.22	34.11	27.35	79.892	95.06	95.50	92.11	19.27	46.42	93.12
5	95.01	95.31	46.15	0.57	0	71.78	92.83	92.84	60.06	6.413	23.76	70.37	93.72	93.96	78.64	5.41	40.47	79.99
6	94.63	94.96	20.68	0	0	68.32	91.37	91.27	55.39	2.15	20.83	68.83	91.93	92.15	69.12	4.96	37.27	76.26
7	92.49	93.73	17.96	0	0	66.72	89.21	90.27	51.65	1.07	19.09	65.95	90.27	91.27	63.88	3.19	34.81	66.475
8	91.11	92.15	15.76	0	0	64.73	87.93	88.45	42.30	0.80	17.62	63.63	89.05	89.43	60.90	2.01	34.16	63.05
9	90.55	91.36	13.96	0	0	63.13	87.04	87.41	36.13	0.26	16.21	61.05	87.57	87.15	58.99	0.88	31.18	57.90
10	88.89	89.93	13.51	0	0	61.61	84.92	85.01	31.81	0.26	14.26	58.72	86.64	86.47	56.15	0.20	29.95	56.04
11	87.51	88.74	12.61	0	0	56.58	83.83	83.03	27.38	0	13.03	56.92	85.03	83.59	51.48	0.20	27.04	53.75
12	84.55	86.48	12.162	0	0	45.19	83.15	81.83	24.97	0	10.44	51.95	83.78	82.01	50.07	0.20	25.06	51.75

1.2) Field bait recruitment choice assay

Results of the first choice assay (Figure 2), examining foraging preference via counting ants at bait stations, showed that all commercial baits were foraged on more than a sugar control and all could potentially used in the field. However, this experiment did not measure bait consumption.

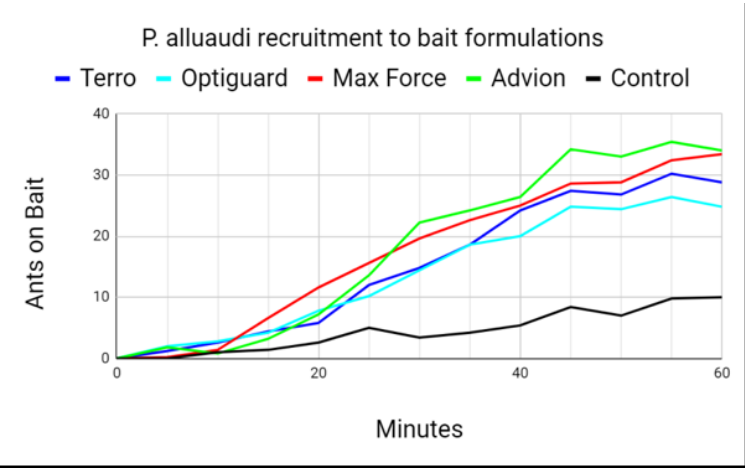


Figure 2. Recruitment of *P.alluaudi* to different bait formulations over a sixty minute period

1.3) Field bait consumption choice assay

Pilot data from the second choice assay, examining preference via measuring the amount of bait consumed by ants, suggest that the ants consumed the same amount of Advion®, Max Force®, and Terro® in the field. Optiguard® and the control were consumed less than the other three baits, and in the same amounts. This experiment is still ongoing.

2.1) Presence of *P. alluaudi* in nurseries

As of this report, no *P. alluaudi* have been detected in any plant nursery within Broward County. This result is preliminary, as surveys were not exhaustive, but indicates that this species is not ubiquitous in this area. Interestingly, ant species that were found at these sites include: *Wasmannia auropunctata* (little fire ant), *Tapinoma melanocephalum* (ghost ant), *Technomyrmex difficilis* (white footed ant), *Paratrechina longicornis* (longhorn crazy ant), *Hyponera punctatissima* (Roger’s ant), *Brachymyrmex sp.* (rover ant), *Solenopsis invicta* (red imported fire ant), *Pheidole megacephala* (big headed ant), *Pheidole navigans* (navigating big headed ant) *Camponotus planatus*, (compact carpenter ant), and *Nylanderia bourbonica* (robust crazy ant). While it is good news that *P. alluaudi* was not found at any of these locations, it should be noted that every species encountered is exotic, and not a single native species was found.

2.2) Presence *P. alluaudi* in residential areas

Residential surveys revealed one new locality where *P. alluaudi* is established; in the Riverside Park neighborhood of Fort Lauderdale, 1.9 miles away from the initial point of discovery for the species. The population discovered was large and robust. Surveys are in progress to determine if other populations occur in this neighborhood and elsewhere in Broward County. We are in communication with pest control companies to help the detection of this new invasive ant species throughout southeast Florida.

3) Mealybug interactions

The mealybug experiments have been initiated, but as they are still in progress. Preliminary data suggest that the presence of *P. alluaudi* may improve the growth of the mealybug population, but it is still too early to confirm. Final mealybug growth data will be acquired in December 2019.

CONCLUSIONS

Although preliminary, this study provides new insights on the biology, the potential pest status, and the control of *P. alluaudi*. While Optiguard® was the most effective bait in eliminating *P. alluaudi* in the laboratory, the ants did not consume it the field as much as other commercial baits. Advion® was the least effective bait in eliminating population of the ant in the laboratory, but ants seemed to prefer it the most in the field. Max Force® appeared to be preferred in the field, but eliminated the ant extremely quickly, in many observations the ants simply become stuck in the syrupy formulation and die on the spot. The speed at which this bait kills the ants may not be ideal as the ants may not have time to share the bait with nestmates and spread the pesticide. Terro® was actively consumed in the field, and was effective in eliminating ants, albeit not the most effective. Although all commercial baits have some level of efficacy, when considering all of this information, it appears that Terro® would be a compromise choice for control of these ants. The bait appears to be consumed in the field, and kills ants slow enough to be shared. A new location of established *P. alluaudi* in Fort Lauderdale, confirmed that this invasive ant is slowly spreading. However, this survey may be under representative of the current ant distribution because of its small size and its putative misidentification with other ants. It could also be attributed to the species appearing to have a strong association with flora, and areas with dense tree canopy, which are often inaccessible on private properties. It is also possible that the intense competition between the numerous invasive ant species in the area is preventing the establishment of *P. alluaudi*, and that less disturbed areas may be more susceptible to invasion from the species. More surveying will be conducted to attempt to find the species at additional locations. Mealybug experiments are still in progress at this time.