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Repellent Effects of Bay, Neem, and Scent Leaf Charcoal Briquettes on Argentine Ants

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ABSTRACT

Background and Objective: Traditionally, societies have employed botanical repellents for numerous generations as a strategy for defense against a variety of insect species. This study aims to assess the repellent effects of charcoal briquettes made from bay, neem, and scent leaves on Argentine ants. **Materials and Methods:** This study synthesized and evaluated briquettes made from bay, neem, and scent leaves using cassava starch as a binder. Varying quantities of carbonized sawdust, cassava starch, and leaves were mixed and shaped into briquettes, then sun-dried for three days. Twenty ants were housed in perforated containers with different treated briquettes to assess their efficacy. The control group had no leaf treatment, and each test was conducted in triplicate. Data from the experiments were analyzed statistically using One-way Analysis of Variance (ANOVA) showed a statistically significant effect ($p<0.05$). **Results:** The findings indicated that each briquette demonstrated a combustion duration of 45 min. The optimal treatment regarding repellency and mortality rate was identified as 100 g of neem leaf, which resulted in an 80% repellency rate within 192 hrs of application, followed by scent leaves with 60% and bay leaves with 50%. The lowest repellency was observed in the control group. **Conclusion:** This experimental endeavor was undertaken with the intent to substitute chemical pesticides with more sustainable, economically viable, and biodegradable organic biopesticide alternatives. The results demonstrated the potential of neem leaf briquettes as the most effective treatment for ant repellency, highlighting their suitability for eco-friendly pest control applications.

KEYWORDS

Repellent effects, charcoal briquettes, bay, neem, scent leaves, Argentine ants

INTRODUCTION

The Argentine ant, *Linepithema humile* (formerly known as *Iridomyrmex humilis*), is indigenous to Northern Argentina, southern Brazil, Bolivia, Paraguay, and Uruguay[1]. This hostile species was unintentionally brought about globally by mankind[2]. According to Silverman and Brightwell[3], Argentine ants are major annoyances in both agricultural and urban environments. They have been shown to seriously damage native arthropod groups[4], vertebrate communities[5], and plant ecosystems[6] throughout their invaded area.

Current control methods rely heavily on chemical pesticides, which pose environmental and health risks. There is a growing need for eco-friendly, sustainable alternatives.

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Numerous studies have been carried out to show that various plant parts have inhibitory qualities against bacteria, fungi, and insects to lessen the harmful effects of these manufactured compounds[7]. Although the anti-insecticidal qualities of several plant species have been investigated, many of them have not yet undergone sufficient evaluation.

Some plants contain components that are toxic to insects. When these components are extracted from the plant and applied to infested crops, they are called botanical pesticides or botanicals. These botanical pesticides are important because they reduce crop losses, and they are eco-friendly, biodegradable, and cheap.

According to Saeed Ben Youssef[8], around the world, biological control of agricultural pests is becoming more and more popular as a way to safeguard agricultural enterprises. Indeed, the growing push to limit the use of hazardous synthetic pesticides in agriculture is the main reason for the increased significance of the biological control of agricultural pests in recent years[9]. This study assessed scent leaves, bay, and neem leaves to expand the hunt for novel insecticidal compounds derived from plants.

Azadirachtin, a tetranortriterpenoid molecule, is the main reason why the neem plant (*Azadirachta indica*) has strong insecticidal effects[10]. By interfering with insect hormone systems, azadirachtin inhibits development and reproduction[11]. Broad-spectrum insecticidal action against a variety of pests, such as flies, mosquitoes, and crop pests, has been demonstrated for neem extracts[12]. Neem is a useful part of integrated pest management plans because of these qualities.

The chemicals eugenol, linalool, and pinene found in the bay leaf plant (*Laurus nobilis*) give it insecticidal qualities[13]. Bay leaf essential oil has been shown to have strong insecticidal effects on agricultural pests, suggesting that it could be used as a natural pesticide[14]. The scent leaf plant, *Ocimum gratissimum*, essential oil contains compounds like eugenol that repel and kill insects due to its scent and insect toxicity[15]. The essential oil extracted from scent leaves has significant insecticidal activity against agricultural pests, making it a potential natural pesticide[16].

Ants are vital to the majority of agroecosystems. However, because they chew on tubing components and cause unequal water distribution along the crops, these insects can sometimes be harmful to agricultural micro irrigation systems[17]. Certain organisms, such as *Solenopsis invicta*, can harm crops either directly or indirectly by consuming them. By removing soil and forming routes, according to de Pedro and Sanchez[17], ants can also cause soil erosion, which can hinder crop growth. This study is aimed at investigating the repellent effects of bay, neem, and scent leaves on charcoal briquettes on Argentine ants for 45 min every day for 1 week.

MATERIALS AND METHODS

Study area: During the 2021-2023 academic year, between the months of February and October, 2024, the research was conducted in the Department of Plant Science and Biotechnology, Faculty of Sciences, University of Port Harcourt, Rivers State, Nigeria.

Collection of plant leaves

Neem leaves: Neem leaves are collected at Port Harcourt Choba, Abuja Campus, and dried under the sun for easy use in an electrical blender.

Scent and bay leaves: The scent leaves and bay leaves were purchased from Choba market and dried under the sun to be blended using an electric blender.

Collection of starch (Cassava starch): Additionally, cassava starch (*Manihot esculentus*) was obtained from Choba Market, which is located at Latitude 6.90483'E and Longitude 4.90069'N. The starch was prepared with hot water to allow it to coagulate, which becomes the binder and makes the briquettes strong enough to mould. Before making the ant repellent, the hot water starch that had already been prepared was allowed to cool.

A collection of sawdust: Sawdust was collected from Rumuosi Market, Nigeria, analysed, and then carbonized until it turned black.

Collection of ant specimens: An ant specimen was collected at Alakahia, whose Latitude is 6.91209'E and its Longitude is 4.88922'N. The Ant specimen was taken to the AEB department for identification. The ant specimen was preserved in 75% ethanol.

Production of the various briquettes

Control: The production of various briquettes involves mixing 100 g of carbonized sawdust with 75, 50, and 25 g of starch to create a sticky, hard texture. The mixture is then placed in a cone-shaped container, dried for three days, and packaged. The control was done without any leaf treatments.

This was done in a series of four bowls with different plant leaves, such as bay, neem, and scent leaves.

- **Bowl A:** Mix 100 g of carbonized sawdust and 100 g of plant leaves. Mix cool starch made with 100 g of starch until smooth and sticky. Shape it into a cone or briquette, place in a container, and let it dry in the sun for three days, and package
- **Bowl B:** Mix 75 g of carbonized sawdust and 75 g of plant leaves. Mix cool starch made with 75 g of starch, then package
- **Bowl C:** Mix 50 g of carbonized sawdust and 50 g of plant leaves. Mix cool starch made with 50 g of starch, then set aside
- **In a final bowl, D:** Mix 25 g of carbonized sawdust and 25 g of plant leaves. Mix cool starch with 25 g of starch

Ant mortality and repellence assay: Twenty Argentine ants were put in a container with perforations in it, and each container also had a briquette with the different plant materials that were employed. Following a 45 min exposure period, the percentage mortality (%) for each concentration was computed by counting the number of dead ants.

Statistical analysis: To examine the differences between treatments, the findings were analysed using a one-way ANOVA, with a statistically significant effect ($p<0.05$).

RESULTS

Ant mortality and repellence assay: Table 1 presents the weight (g) of different treatments; neem, scent, bay, and control at varying treatment levels (100, 75, 50, and 25 g). Neem consistently shows the highest weight across all levels, followed by scent and bay, while the control group exhibits the lowest values. As the treatment weight decreases, a general decline in weight is observed across all treatments, indicating a dose-dependent effect.

Table 2 presents the percentage effectiveness of different treatments; neem, scent, bay, and control at varying treatment weights (100, 75, 50, and 25 g). Neem exhibits the highest effectiveness across all treatment levels, followed by scent and bay, while the control group shows the lowest values. A declining trend is observed in all treatments as the weight decreases, indicating that higher treatment levels result in greater effectiveness.

Table 3 presents the percentage effect of different treatments; neem, scent, bay, and control at varying treatment weights (100, 75, 50, and 25 g). Neem shows the highest positive effect across all levels, followed by scent and bay, while the control group exhibits negative effects at all treatment weights. As the treatment weight decreases, the effectiveness of neem, scent, and bay declines, with bay and control showing increasingly negative effects at lower treatment levels. This suggests that higher treatment weights contribute to a more positive impact, while lower weights, especially in the control group, result in adverse effects.

Repellents with 100 g of treatment: From the results, neem leaves had the highest mortality rate compared to other treatments; at 100 g, neem leaves are highly effective, as shown in Fig. 1.

Repellents for 75 g of treatment: Also, at 75 g of treatment application, neem leaves show the highest mortality rate for all treatments hence, it is highly effective for ant and pest control, as shown in Fig. 2.

Repellent for 50 g of treatment: Figure 3 shows that control has a lower death rate, while treatment 2 has the highest death rate compared to all treatments.

Repellent for 25 g of treatment: Using 25 g of treatments, neem leaves showed the highest death rate, and the control had the least death rate, as shown in Fig. 4.

Table 1: Number of dead ant specimens

Weight of treatment (g)	Neem (%)	Scent (%)	Bay (%)	Control (%)
100	18	16	15	8
75	16	14	14	7
50	14	12	10	5
25	10	8	6	2

Table 2: Mortality rate of the ant specimen

Weight of treatment (g)	Neem (%)	Scent (%)	Bay (%)	Control (%)
100	90	80	75	40
75	80	70	70	35
50	70	60	50	25
25	50	40	30	10

Table 3: Percentage repellent rate of each medicinal plant specimen

Weight of treatment (g)	Neem (%)	Scent (%)	Bay (%)	Control (%)
100	80	60	50	-20
75	60	40	40	-50
50	40	20	0	-65
25	0	-20	-70	-80

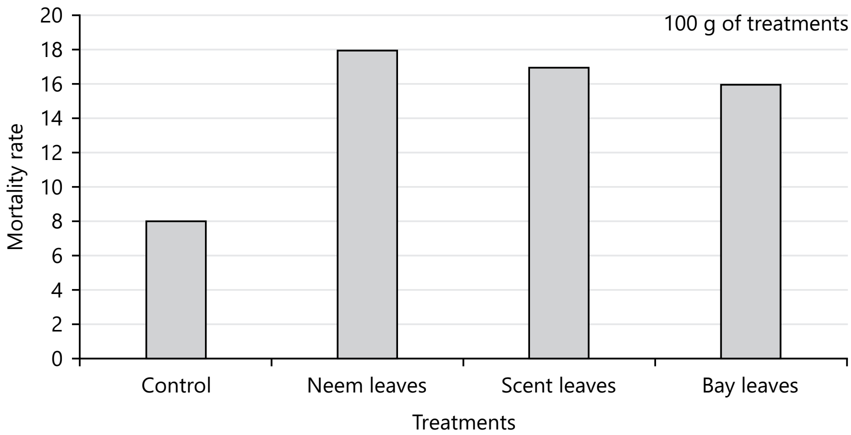

Fig. 1: Effect of 100 g plant leaves repellents on ant

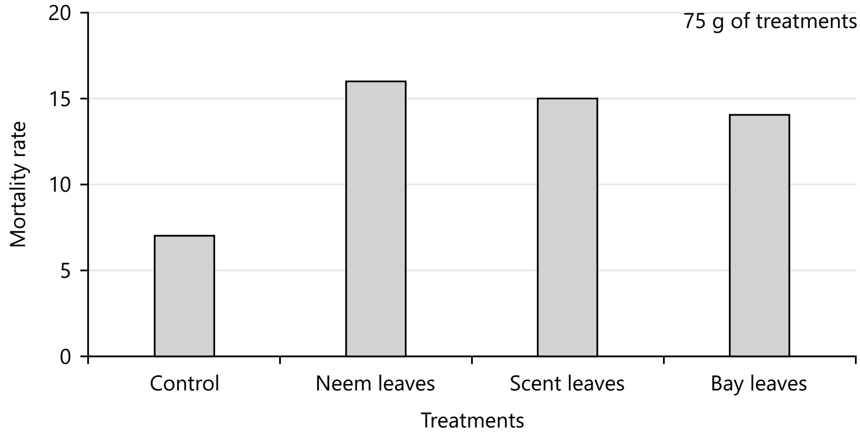

Fig. 2: Effect of 75 g plant leaves repellents on ant

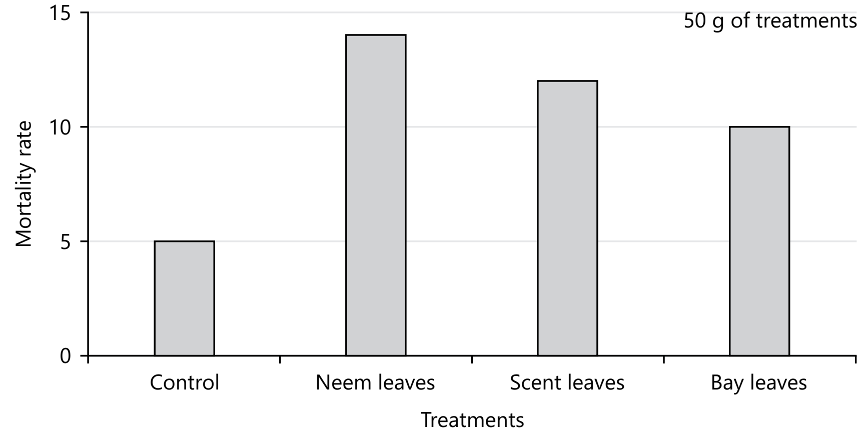

Fig. 3: Effects of 50 g plant leaves repellents on ant

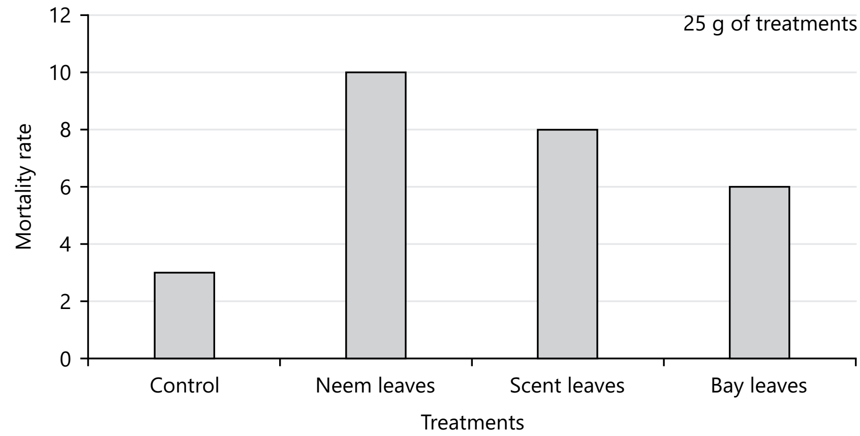

Fig. 4: Effect of 25 g plant leaves repellents on ant

DISCUSSION

The experiments conducted for evaluating repellent effects of bay, neem, and scent leaves charcoal briquettes on Argentine ants revealed that the charcoal briquettes containing neem (*Azadirachta indica*) had effective pesticidal effects on the ants. Among the plant species extracts, the highest outstanding repellence of Argentine ants was observed in neem with 80%, followed by scent leaves with 60%, and bay leaves with 50%. The lowest repellence was observed with the control.

This means neem can also be used to repel ants. This corresponds with the work of Koma[18], who stated that *Ocimum gratissimum*, *Zingiber officinale*, *Xylopia aethiopica*, and *Azadirachta indica* are all useful for controlling pests. This could be a result of the alkaloids and terpenoids present in the leaves. *Azadirachta indica* is also rich in numerous phytochemicals such as alkaloids, steroids, flavonoids, terpenoids, fatty acids, and carbohydrates[19].

The results of the present study also coincide with the work of Goktepe *et al.*[20], who said that neem-based biopesticides have a wide variety of effects against insect pests, including repellence, feeding, toxicity, sterility, and growth regulator action. This is because the allelochemicals found in neem, including azadirachtin, nimbin, nimbidin, nimbolide, nimolic acid, salannin, meliantriol, and azadirachtol, alter the physiological and biochemical functions of the insect system and negate the insect detoxification mechanism, preventing the pest from becoming resistant.

According to Kumar and Navaratnam[21], the main active ingredient in neem, tetranortriterpenoid, exhibits a wide range of bioactivity against various insect species. The strong repellent and toxic effects of neem make it a powerful alternative to synthetic insecticides, particularly in agricultural and public health applications[11].

Bay leaf, although less effective than neem, still showed significant repellent activity. As stated by Batool *et al.*[22], their insect-repelling properties are strengthened by flavonoids, tannins, eugenol, citric acid, carbohydrates, steroids, alkaloids, triterpenoids, and essential oils. Also, results from the research of Chahal *et al.*[23], indicated that bay leaf essential oil may have the potential to control stored grain pests. Given its mild toxicity, bay leaf may be used in conjunction with other plant-based insecticides to increase their effectiveness.

Scent leaf also exhibited the least insecticidal effect in this study, but its repellent activity suggests that it may still serve as an effective tool for repelling insects. The relatively low toxicity may limit its use in severe infestations but supports its role in integrated pest management as a complementary solution. Several conclusions like those of Agbalaka *et al.*[24] have be drawn from research results about scent leaves as insect insect-repelling plant. The results of the study of Egya *et al.*[25], unequivocally demonstrate that *Ocimum gratissimum* leaf extracts can be utilized to control female *Anopheles* mosquitoes instead of synthetic insecticides. This is advantageous since phytochemicals are inexpensive, easily accessible, biodegradable, and environmental friendly; as a result, they may be a viable choice for controlling insects and malaria vectors.

Plants with insecticidal qualities are the source of botanical insecticides, commonly referred to as botanical pesticides. Insecticides can be made from the substances that give these plants their defence systems, which have developed to defend them from insects and other pests.

This study was limited to screening bay, neem, and scent leaves plants with insecticidal properties. Further research should explore the use of many other plant extracts in eco-friendly insecticidal formulations, their potential integration into integrated pest management systems, and the active compounds' mechanism of action.

CONCLUSION

This study concluded that neem leaf, scent leaf, and bay leaf all exhibit insecticidal properties, with neem leaf being the most effective. These plants, particularly neem, offer a promising alternative to chemical insecticides. Further research should explore the development of eco-friendly insecticidal formulations using these plant extracts. The potential use of these extracts in integrated pest management systems should be investigated. Future studies should also explore the mechanism of action of the active compound in these plants.

SIGNIFICANCE STATEMENT

This study successfully demonstrates the efficacy of botanical briquettes derived from neem, scent, and bay leaves as a sustainable, eco-friendly, and cost-effective alternative to chemical pesticides, exhibiting up to 80% repellency against ants and highlighting the potential for organic biopesticide solutions in insect pest management. The study presents a sustainable pest control method using botanical extracts, expanding biopesticide research, and demonstrating the value of interdisciplinary research in addressing complex problems, thereby offering a novel approach to pest control. According to the study, using botanical briquettes as a pest management approach has several advantages, including enhancing public health, supporting environmental sustainability, and yielding financial gains. To increase their accessibility and widespread use, future studies should investigate additional plant extracts that may have pest-control qualities, improve the composition of briquettes, and investigate expanding manufacturing and use.

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