*K*irkuk University Journal for Agricultural Sciences
ISSN:2958-6585
https://kujas.uokirkuk.edu.iq

RESEARCH*ARTICLE*
https://doi.org. 10.58928/ku25.16117

The insecticidal effect of tobacco and rosemary plant powders on black carpenter ant Componotus Sp (Hymenoptera: Formicidae).

Noor Nadhir Kunda[1] **Srwa Masud Khalil[1]**
[1]*Salahadin university, college of agricultural engineering science, Plant protection department, IRAQ.*
*Corresponding Author: Noor.kunda@su.edu.krd.

Received: 07/12/2024 **Revised: 25/01/2025** **Accepted: 10/02/2025** **Published: 01/03/2025**

ABSTRACT

The study explored the effectiveness of plant-derived powders, specifically from tobacco and rosemary, in managing black carpenter ant populations. To evaluate their efficacy, three different concentrations 2.5%, 5%, and 7.5% were tested. The results revealed that the most effective concentration for both plant powders was 2.5%. While higher concentrations, such as 5% and 7.5%, were also tested, they led to excessively high mortality rates among the ants, which, although seemingly advantageous, proved impractical for sustainable ant control. This is because excessively high mortality rates may disrupt ecological balance or lead to overuse of resources, reducing long-term applicability. Interestingly, tobacco powder at the 2.5% concentration stood out as the most effective treatment, demonstrating superior ant control compared to rosemary powder. This suggests that the chemical composition of tobacco contains active compounds, particularly potent against black carpenter ants. These findings highlight the importance of selecting appropriate concentrations to maximize efficacy while minimizing potential ecological risks or unintended consequences. The study underscores the potential of natural, plant-based solutions as an alternative to synthetic chemical pesticides. With increasing concerns over the environmental and health impacts of conventional pesticides, plant powders such as those derived from tobacco offer a promising, eco-friendly option for pest management. Additionally, their natural origin may reduce the likelihood of pests developing resistance, a common issue with synthetic chemicals. Overall, the research demonstrates that tobacco powder, particularly at a 2.5% concentration, can serve as an effective and sustainable tool for controlling black carpenter ants. Further studies could investigate the long-term impacts, application methods, and the potential for integrating such plant-based solutions into broader pest management strategies. These insights pave the way for developing environmentally conscious approaches to pest control.

***Keywords*:** Black carpenter ant, control agents, plant powders, Tobacco, Rosemary, concentrations.

INTRODUCTION

Back carpenter ant Componotus sp are social insects that make their colonies primarily in wood. They hollow out wood to build their nests, they are black, yellowish red, or a combination of black, red and reddish orange. A carpenter ant has only one segment or node between the thorax and abdomen. It also has a circle of hairs at the tip of the abdomen and an evenly rounded thorax when viewed from the side. The most important character of the ants is having a petiole [1]. Carpenter ants undergo complete development (egg, larva, pupa, adult). The pupae are enclosed in cocoons that are often mistaken for eggs. The immature ants (larvae) are white, legless, and look a lot like maggots. Larvae are helpless and are fed food from foraging workers. Workers are able to bring food back to the colony because they can store it in their crops (a specialized pouch near the stomach used for holding food). Although interestingly, adult ants cannot digest solids, so larvae are responsible for liquifying all solid foods. Then, adults ingest the liquid product. Adults then share this food, larvae, and most critically (when we consider control) with the queen. So, larvae may be fairly helpless, but they are not useless! The larvae develop into pupae, which are tan and capsule-shaped. Eventually, new adults emerge from these pupae [2]. The presence of carpenter ants can mean that a building has problems that need attention, such as moisture, rotting wood or other conditions conducive to ant infestation. In general, there are at least 14 species of carpenter ants that destroy wood. Homeowners can minimize damage to their houses by learning how to identify.

the ants, knowing where to look for them, and understanding ways to prevent and control them [3]. Black carpenter ants are among the largest ants. Adults vary in length from about 1⁄4 inch (6 mm) for a minor worker, to 1⁄2 inch (12 mm) for a major worker, and up to 7⁄16 inch (18 mm) for winged reproductive. Each colony has one functional, wingless queen, and queens are 9⁄16 inch (20 mm) long. The ants develop through several stages of metamorphosis: egg, larva, pupa and adult. All four stages can be found in a colony. The adults have six legs, three distinct body regions with a constricted waist, and

prominent, elbowed antennae. Ants belong to the family Formicidae, with the second and third segments of the abdomen reduced to the petioles. [4]

Tobacco (Nicotiana tabacum) is a plant that contains nicotine, an addictive drug with both stimulant and depressant effects, tobacco, one of the most significant nonfood crops, is critical to agriculture worldwide. The tobacco processing business creates a significant amount of hazardous tobacco waste containing nicotine, and only a tiny portion of it gets recycled. Nicotine, the primary component of tobacco products such as cigarettes, is an alkaloid and can be used as an insecticide [5]. Nicotine is an alkaloid and natural insecticide that acts as an anti-herbivore chemical in tobacco plants (Nicotiana rustica (wild Tabacco), Nicotiana tabacum (cultivated tabaco) and other nightshade plants. In tobacco plants nicotine may constitute up to 3 % of the dry weight. The compound mimics the endogenous neurotransmitter acetylcholine and exhibits agonistic effects on most nicotinic acetylcholine receptors. Nicotine has been used as a natural insecticide and is the archetype for many synthetic neonicotinoid insecticides [6]. Thus, some researches revealed that the queen's ability to tend to their brood was notably impaired. Under the 0.25 µg/ml imidacloprid treatment as a major part of tobacco, larval emergence was considerably delayed, and no pupae or adult workers developed. This research clearly demonstrates that sublethal concentrations of imidacloprid have a profoundly negative effect on ant queens and the early development of colonies [7]

Regarding the rosemary is an evergreen bush perennial that grows to a height of two to six feet with pale blue flowers and spiky leathery leaves. It is a member of the mint family, Lamiaceae, along with many other herbs such as oregano, thyme, basil, and lavender. The name rosemary derives from the Latin Ros-marinus, which means dew of the sea. Although native to the Mediterranean landscape where it can be found growing on rocky limestone sea cliffs, it is now cultivated throughout the world as an ornamental and aromatic plant [3]. The extract of rosemary is produced mainly from the leaves. Solvents used for extraction include: ethanol, acetone and hexane, and extraction by means of supercritical CO2 is also popular extracts contain considerable amounts of biologically active substances, e.g. phenolic acids, flavonoids, terpene these components used as pesticides mainly the insecticides and antioxidants [8]. Moreover, rosemary has been shown to have a significant impact on household pests, demonstrating its potential as an effective natural repellent. Various studies have highlighted its efficacy in deterring various pests, including ants, mosquitoes, and other common household insects. The active compounds in rosemary, such as essential oils, contribute to its repellent properties, making it a promising alternative to chemical pest control methods in residential environments.

Materials and Methods

Sample Collection

Samples have been collected from households and stores by hand picking for ants in a specific area, and collection with traps baited with meat, honey, [9]

Preparing Plant Powders:

Preparation of medicinal plants for experimental purposes is an initial step and key in achieving quality research outcome The two plant powders of tobacco (Nicotiana tabacum L.) and rosemary (Salvia rosmarinus Spenn)Leaves of these plants were washed carefully with water, air dried in shade and then ground into fine powder with an electric grinder (DAMAI - China)and powdered plant material is placed into a clean container [10] and [11]

Preparation of the artificial diet:

The artificial diets were prepared by mixing the nutritional elements with control ingredients (plant powders and chemical pesticide) in different concentrations and the compositions of tested diets were (flour, soft bulgur, and sugar with control element), complete or basal diets were developed so the individuals could be survived. A 100 g of the diet was prepared for this study, the components and preparation of this diet were set as described in table (1) [12].

Table (1):The artificial diet ingredients with their rates and different concentration of control agents

Diet component	Used amount /g	Control ingredient	Powder Concentrations/g
Flour	72.5	Tobacco plant	2.5
Fine bulgur	20		
Sugar	5		
Flour	70		

Fine bulgur	20	Tobacco plant	5
Sugar	5		
Flour	67.5		
Fine bulgur	20	Tobacco plant	7.5
Sugar	5		
Flour	72.5		
Fine bulgur	20	Rosemary plant	2.5
Sugar	5		
Flour	70		
Fine bulgur	20	Rosemary plant	5
Sugar	5		
Flour	67.5		
Fine bulgur	20	Rosemary plant	7.5
Sugar	5		
Flour	70		
Fine bulgur	20	Chemical pesticide	%5
Sugar	5		
Flour	75		
Fine bulgur	20	Control	_
Sugar	5		

Design of the Experiment

A CRD design used in this experiment which the treatments are assigned completely at random so that each experimental unit has equal chance of receiving any one treatment Applying Control Agents:

A total sample size (300) of mature individuals of black carpenter ant have been collected and reared on their natural food with considerable success, the plant powders of tobacco and rosemary were mixed with prepared artificial diet in three concentrations the diets with ant individuals (10 ants) were placed in each Petri dishes that moisturized with water once , three replication for each treatment the use of artificial diets is a matter of necessity for techniques requiring large insect populations thus , this was found to be satisfactory for rearing 28 species of ants representing 4 subfamilies of Formicidae [13]

Statistical analysis:

For the laboratory study, analysis of variance was used to check the differences between mortality of the Black carpenter ant with various aqueous plant extracts The data were analyzed using multi-factor analysis of variance (ANOVA) using Statgraphics Centurion XV followed by Fischer's least significant difference (LSD) test to determine statistical differences

between means of mortality at $P \leq 0.05$. The efficacy of several bio-insecticides was evaluated as covariates while the larval mortality and exposure time as response and explanatory variable respectively.

Results and discussion

In a recent study investigating the effects of plant powders on pest control, specifically focusing on tobacco and rosemary extracts at concentrations of 2.5%, 5%, and 7.5%, it was found that the concentration of 2.5% yielded the most promising results. Despite initial expectations, higher concentrations of both tobacco and rosemary extracts led to excessively high mortality rates among the test subjects. Consequently, the concentration of 2.5% was selected for further analysis due to its balanced effectiveness in pest control without causing undue harm to non-target organisms. This finding underscores the importance of carefully considering concentration levels when utilizing plant-based solutions for agricultural purposes, ensuring both efficacy and environmental safety. In light of the findings, it can be stated that there is notable variation in the type of treatments applied to manage the damage caused by the black carpenter ant Componotus sp in the house holds. The insecticidal effect of Persect%5 (permethrin) chemical pesticide with both tobacco and rosemary plant powders exhibited some degree of significancy towards black carpenter ants.

Efficacy of Plant Extract Against Componotus sp

Mortality Percentage of Componotus sp The mortality of black carpenter ant was significantly affected by the type of plant powders utilized in the laboratory test ($F(5,272) = 64.25$, $P < 0.001$). Hence, the highest mortality was noted in Persect chemical pesticide followed by tobacco plant powder that was demonstrated significantly higher mortality effects in comparison with rosemary, that notably reduced presence of ants in treated areas. Moreover, tobacco plant powder was more toxic in comparison to rosemary powder thus, tobacco recorder 65.23% percent mortality rate, and it was not significantly different from chemical pesticide Persect 70.34 % and rosemary recorded 40.28% as illustrated in Figure (1).

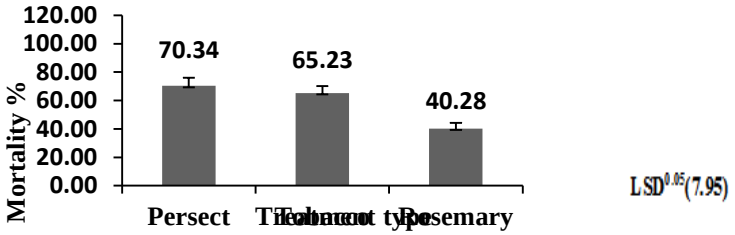

Fig (1): Percentage mortality of *Componotus sp* in response to treatment types

Regarding the efficacy of tobacco and rosemary powders, each at a concentration of 2.5%, in controlling black carpenter ant mortality. The findings revealed that tobacco powders exhibited greater effectiveness in inducing mortality among the black carpenter ants compared to rosemary extract. This observation underscores the potential of tobacco as a potent agent for pest control, particularly against black carpenter ants figure (2)

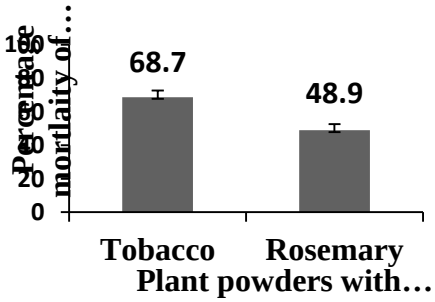

Fig.(2): Percentage mortality of *Componotus sp* in response to 2.5 % concentrations of plant powders

On the other hand, the effect of time on the activity of plant powders reveals intriguing insights into their potency as pest control agents. In a recent experiment, various plant powders were tested for their efficacy against ants, with fascinating results. The positive control, a commercial pesticide, swiftly eliminated the ants in less than 30 minutes, showcasing its rapid action. Contrastingly, tobacco extract exhibited a slightly delayed effect, taking approximately 2 hours to eradicate the ants. Moving further along the spectrum, rosemary extract displayed its potency over a longer duration, requiring around 4 hours to achieve the same result. Notably, the negative control, devoid of any active ingredients, exhibited minimal effect until the 6-hour mark, emphasizing the significant impact of plant powders in pest management. This experiment underscores the dynamic relationship between time and the activity of plant powders, highlighting their potential as sustainable alternatives in pest control practices as shown in figure (3)

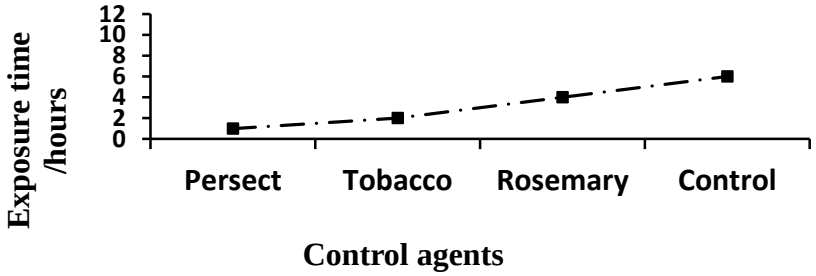

Fig. (3): Percentage mortality of *Componotus sp* in response to exposure time to the control agents

Last of all, it can be discussed that tobacco extract was more effective than rosemary extract in controlling black ants and this is due to the stronger insecticidal properties and solider chemical compounds this superiority may be attributed to the presence of potent insecticidal compounds in tobacco, which exerted stronger repellent and lethal effects on the ants. The observed persistence of tobacco powders further underscores its potential as a long-term solution for black ant control in households as a public health and safe insecticides [14] and [15]. Moreover, considering the effects of time after applying tobacco and rosemary, it's evident that tobacco plant powders require significantly less time than rosemary. This variance can be attributed to the inherent properties of each plant and the compounds they contain. Tobacco contains nicotine, a potent alkaloid known for its rapid absorption and physiological effects, whereas rosemary contains volatile oils and antioxidants that may necessitate more time to manifest their effects. The swift action of tobacco powder could be due to its ability to permeate through membranes quickly and interact with receptors in the body, leading to rapid responses [16]. Conversely, the components of rosemary may require additional time to penetrate tissues and exert their biochemical effects. Therefore, the disparate time frames for the effects of tobacco and rosemary highlight the contrasting pharmacokinetics and mechanisms of action of these botanical substances [10].

Conclusions

In conclusion, our findings suggest that tobacco powder holds greater promise as a natural insecticidal agent for black ant control compared to rosemary extract. Further research could explore the specific compounds responsible for the efficacy of tobacco extract and assess its safety and environmental impact for broader applications in pest management strategies. Exposure to tobacco plant extract can lead to alterations in the behavior of black ants. This may include changes in foraging patterns, locomotion, and communication among colony members. Furthermore, tobacco plant powders has been observed to increase the mortality rate among black ants. This indicates its potential as a form of pest control, although further research is needed to understand its efficacy and potential environmental impact. While, the extract may offer a natural alternative to synthetic pesticides, its use raises concerns about its broader environmental impact.

Researchers need to assess its effects on non-target organisms, soil health, and ecosystem dynamics. On the other hand, investigation identified that specific bioactive compounds within tobacco plant extract responsible for its effects on black ants. Also, the research on the effect of tobacco plant extract on black ants highlights its potential as a natural pesticide but also underscores the importance of further research to fully understand its impacts and applications.

References:

[1]. TAK, J.-H. & ISMAN, M. B. 2015. Enhanced cuticular penetration as the mechanism for synergy of insecticidal constituents of rosemary essential oil in Trichoplusia ni. Scientific reports, 5, 12690.

[2]. GUDETA, B., K, S. & RATNAM, M. V. 2021. Bioinsecticide production from cigarette wastes. International Journal of Chemical Engineering, 2021, 1-15.

[3]. HANSEN, L. D. & ANTONELLI, A. L. 2005. Carpenter ants: their biology and control, Cooperative Extension, College of Agriculture and Home Economics, Washington

[4]. CHEN, J. & OI, D. H. 2020. Naturally occurring compounds/materials as alternatives to synthetic chemical insecticides for use in fire ant management. Insects, 11, 758.
[5]. ELLISON, A. M., GOTELLI, N. J., FARNSWORTH, E. J. & ALPERT, G. D. 2012.A field guide to the ants of New England, Yale University Press.
[6]. [6] MANKOWSKI, M. E., MORRELL, J. J. & LEBOW, P. K. 2021. Effects on brooddevelopment in the carpenter ant Camponotus vicinus Mayr after exposure to the yeast associate Schwanniomyces polymorphus Kloecker. Insects, 12, 520.
[7]. SUITER, D. R., GOCHNOUR, B. M., HOLLOWAY, J. B. & VAIL, K. M. 2021. Alternative methods of ant (Hymenoptera: Formicidae) control with emphasis on the Argentine ant, Linepithema humile. Insects, 12, 487.
[8]. WARD, D. F. 2005. Changes to the classification of ants (Hymenoptera: Formicidae). The Weta, 30, 16-18.
[9]. [PAWŁOWSKA, K., JANDA, K. & JAKUBCZYK, K. 2020. Properties and use of rosemary (L.). Pomeranian Journal of Life Sciences, 66, 76-82.
[10]. HANSEN, L. D. & KLOTZ, J. H. 2005. Carpenter ants of the United States and Canada, Cornell University Press.
[11]. ABDULHAY, H. S. 2012. Insecticidal activity of aqueous and methanol extracts of apricot Prunus armeniaca L. kernels in the control of Tribolium confusum Duval (Coleoptera: Tenebrionidae). Al-Mustansiriyah Journal of Science, 23, 7-18.
[12]. IRIÉ-N'GUESSAN, G., CHAMPY, P., KOUAKOU-SIRANSY, G., KOFFI, A.,KABLAN, B. J. & LEBLAIS, V. 2011. Tracheal relaxation of five Ivorian anti-asthmatic plants: role of epithelium and K+ channels in the effect of the aqueous-alcoholic extract of Dichrostachys cinerea root bark. Journal of Ethnopharmacology, 138, 432-438.
[13]. [13] MILLAR, N. S. & DENHOLM, I. 2007. Nicotinic acetylcholine receptors: targets for commercially important insecticides. Invertebrate Neuroscience, 7, 53-66.
[14]. [ALBUQUERQUE, E. L., LIMA, J. K., SOUZA, F. H., SILVA, I. M., SANTOS, A. A., ARAÚJO, A. P. A., BLANK, A. F., LIMA, R. N., ALVES, P. B. & BACCI, L. 2013. Insecticidal and repellence activity of the essential oil of Pogostemon cablin against urban ants species. Acta tropica, 127, 181-186.
[15]. AMOABENG, B., STEVENSON, P., PANDEY, S., MOCHIAH, M. & GURR, M. 2018. Insecticidal activity of a native Australian tobacco, Nicotiana megalosiphon Van Heurck & Muell. Arg.(Solanales: Solanaceae) against key insect pests of brassicas. Crop protection, 106, 6-12.
[16]. ROMERO, H. & JAFFE, K. 1989. A comparison of methods for sampling ants (Hymenoptera, Formicidae) in savannas. Biotropica, 348-352.

تأثير المساحيق النباتيه التبغ وإكليل الجبل على نمل الاسود Componotus sp. (Hymenoptera: Formicidae).

نور ناظر خندة[1] **سروة مسعود خليل[1]**
[1] قسم وقاية النبات، كلية العلوم الهندسة الزراعية ، جامعة صلاح الدين ، أربيل ، العراق

الخلاصة
تمحورت الدراسة حول فعالية المساحيق المستخلصة من النباتات، وتحديدًا من التبغ وإكليل الجبل، في مكافحة تجمعات نمل الحفار الأسود. لتقييم فعاليتها، تم اختبار ثلاثة تراكيز مختلفة: 2.5%، 5%، و7.5%. أظهرت النتائج أن التركيز الأكثر فعالية لكلا المسحوقين النباتيين كان 2.5%. ورغم اختبار التراكيز الأعلى، مثل 5% و7.5%، إلا أنها أدت إلى معدلات وفيات مرتفعة جدًا بين النمل، مما قد يبدو مفيدًا، لكنه أثبت أنه غير عملي للتحكم المستدام في النمل. يعود ذلك إلى أن معدلات الوفيات المرتفعة جدًا قد تؤدي إلى اضطراب التوازن البيئي أو استنزاف الموارد، مما يقلل من قابليتها للتطبيق على المدى الطويل.ومن المثير للاهتمام أن مسحوق التبغ بتركيز 2.5% كان العلاج الأكثر فعالية، حيث أظهر تفوقًا في مكافحة النمل مقارنة بمسحوق إكليل الجبل. يشير ذلك إلى أن التركيب الكيميائي للتبغ يحتوي على مركبات نشطة فعالة بشكل خاص ضد نمل النجار الأسود. تسلط هذه النتائج الضوء على أهمية اختيار التراكيز المناسبة لتحقيق أقصى قدر من الفعالية مع تقليل المخاطر البيئية أو العواقب غير المقصودة .تؤكد الدراسة على إمكانيات الحلول الطبيعية المستمدة من النباتات كبديل للمبيدات الكيميائية الصناعية. ومع تزايد القلق بشأن التأثيرات البيئية والصحية للمبيدات التقليدية، يقدم مسحوق النباتات مثل التبغ خيارًا واعدًا وصديقًا للبيئة لإدارة الآفات. بالإضافة إلى ذلك، قد يقلل أصلها الطبيعي من احتمالية تطوير الآفات لمقاومة، وهي مشكلة شائعة مع المواد الكيميائية الصناعية .بشكل عام، تُظهر الدراسة أن مسحوق التبغ، خاصة بتركيز 2.5%، يمكن أن يكون أداة فعالة ومستدامة لمكافحة نمل النجار الأسود. يمكن أن تستكشف الدراسات المستقبلية التأثيرات طويلة المدى، وطرق التطبيق، وإمكانية دمج هذه الحلول النباتية في استراتيجيات إدارة الآفات الشاملة. توفر هذه الرؤى أساسًا لتطوير أساليب واعية بيئيًا لمكافحة الآفات.

الكلمات المفتاحيه : نمل الحفار الأسود، عوامل المكافحة، مساحيق نباتية، التبغ، إكليل الجبل، التراكيز.