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# EXTERMINATION OF ANT NESTS IN AGRICULTURAL FIELDS AS REFLECTED IN TALMUDIC LITERATURE

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## Abstract

The current study discusses the damage caused by ants to agricultural fields and the elimination of ant nests according to the Talmudic sources. The Jewish sources describe two methods of extermination of ants' colonies. The first one is by earth taken from another ants' nest. This method is based on the understanding that distant ants' colonies develop different scents, and that strange odour originating from another nest might cause a fright and generate a battle between the local ants. The second method is by inserting ants from a foreign nest and generating a battle between the ants in the colony and the invading ants. The practice of using ants is based on the fact that in the case of invasion by foreign ants, ants secrete alarm pheromones and consequently the ants in the nest under attack fight the invaders.

*Keywords:* Talmudic literature, pest control, Greco-Roman, agriculture, harvester ant

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## 1. Introduction

The damage caused by animals to humans and human property in the ancient world compelled the ancients to deal with the problem using varied methods. Ancient sources contain suggestions for dealing with different species of pests, small and large, in the human environment: on one's body and clothes, in human residences, on domesticated animals, and in agricultural property, i.e. fields and groves, granaries, barns and food storehouses.

Advice and suggestions for dealing with pests in ancient times are mentioned in various literary genres, for instance in religious books in halakhic contexts, in the Greco-Roman agricultural literature [1-5], as well as in Early Christian bestiaries (*Physiologus*) that contain descriptions and features of animals, allegories, and moral contents of a distinctly religious nature [6]. Conventional methods for eliminating (killing or removing) pests in ancient times included several major techniques:

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- A. Physical methods: 1) catching pests manually or capturing them in traps [7]; 2) driving them away by making noise, for instance to repel locust flocks that raided agricultural fields [8, 9]; 3) using fire or smoke to keep pests away or to harm them directly [10].
- B. ‘Chemical’ pest control - keeping pests away by means of naturally-derived substances and concoctions: 1) use of substances from an animal source, for instance placing animal body parts or carcasses from the same species of the pests or from other species [11, 12]; 2) vegetative substances - keeping away pests, usually small pests, by means of strong-smelling or poisonous plants [13]; 3) use of minerals and mixtures of substances and solutions, such as salt [11, XXVIII, 195; 13, Sabbath, 31a; 14], sulphur [12, p. 52], manure [14, p. 82] and dust [7, Shevi’it 2:2; 15, 16]. (On the use of mixtures of substances and solutions for pest control see [17, 18].)
- C. Biological pest control - sending the natural enemies of the pests to prey upon them or to keep them away as done today when using cats to control rodents and snakes [13, Pesahim 112b, Baba Metzia, 97a; 19, 20].

Over the generations, ants were a significant harmful element in human residences and agricultural fields. Ants gathered grain from fields and granaries in their nests and also infested food products and dishes in residential homes. The ancients fought the ants with the means at their disposal, mainly by killing them and destroying their nests. The Roman agricultural literature recommended keeping ants away by various concoctions. One of the main substances used in Roman agriculture to deal with ants and other pests was *amurca* (in Latin, in Greek: ἀμόργη, in English: ‘olive oil lees’), the watery component that runs out when olives are pressed or the lees of olive oil [21, 22]. Cato (234-149 BC) and Varro (116-27 BC) recommend spreading this substance on the threshing floor in order to prevent harm by moles, ants and weeds [11, XVII, 47; 23-25]. Columella (4-70 CE) in his book on trees (‘De arboribus’) recommends preventing ants damage to vines by using a mixture of ground lupine (*Lupinus* sp.) seeds and mashed olives or a decoction of bitumen and oil. He recommends spreading these mixtures on the bottom part of the vine to keep ants from climbing the plants [25, *De arboribus*, XIV, 587].

Paladius, who lived at the turn of the 4<sup>th</sup> century AD, mentions pest control techniques recommended by his predecessors, and adds other ways and substances for dealing with ants. He claims that *amurca* and soot are multi-purpose pesticides for various species of flies and slugs [12]. For specific treatment of ant nests he recommends several methods: 1) placing the heart of an owl in the vicinity of the nest [12]; 2) placing a mixture of moss and sulphur in the nest, on the assumption that its sharp odour will repel the ants and cause them to abandon the nest [12, p. 52]; 3) killing bothersome ants with a mixture of red earth, vinegar, and ash, or alternately red earth, butter, and tar [12, Book 4, X, 177, 181]; 4) for treating trees infected by ants he recommends spraying them with a mixture of purslane and vinegar [12, Book 11, XII, 285]; 5) killing ants and worms with a mixture of ruddle and tar [12, Book 12, VII, 310].

Pest control using a mixture of hyssop stalks (*Origanum* sp.) and sulphur was also recommended in an Aramaic Physiologus published by Land in 1862 [26]. A Syriac-Aramaic book of Medicine published by Budge (1857-1934) advises placing a watery solution containing ground cumin, sulphur and stalks of Henbane (*Hyoscyamus* sp.), whose species also include alkaloids and are therefore poisonous, at the entrance to the nest. Another recommended recipe brought by the author is a mixture of sulphur, mustard, and thorns, to be scattered on the ants' nest [27].

## **2. Purpose of the study**

This paper will discuss the damage caused by ants to agricultural fields and the elimination of ant nests by inserting earth or ants from other nests in the harmful nest, as seen in Mishnaic and Talmudic sources (1<sup>st</sup>-5<sup>th</sup> centuries). The research questions are:

1. How is the damage inflicted by ants on agricultural fields described in the Mishna and Talmud literature?
2. How were ants eliminated by using earth or foreign ants?
3. Is there a rationale for this method of pest control?
4. Are other methods of using ants for pest control known from the ancient world?

## **3. Discussion**

### ***3.1. Damage inflicted by ants on agricultural fields as described in Talmudic sources***

In ancient Jewish literature ants are described ambivalently. On one hand, they are extolled and praised as smart and diligent creatures that persistently gather food to sustain them during the winter. They are also described as symbols of decency and integrity, as they do not steal food gathered by other ants [Proverbs 6.6-8, 30.24-25; 13, Eruvin 100b; 28-30]. Then again, Jewish and foreign sources both note the considerable losses that ants cause farmers, as they gather kernels of grain and legumes in underground tunnels in the fields [11, XVII, 47, XIX, 58; 31; 32]. Eretz Israel sources include the damage caused by ants to wheat crops among other grave types of harm, such as the harm caused by the locust, the breaking of grain stalks by the wind, and grain eaten by animals that invade the fields [33]. Moreover, the Talmud and Midrashic literature describe, sometimes exaggeratedly, the large quantities of kernels stored in ant nests [13, Ta'anit 5a]. ("Said R. Shimon ben Yohai, it is related that three hundred *kur* [1 *kur*=216 liter] were found in its hole, what it gathers from the summer for the winter". [28])

Types of ants known as destructive for farming include the harvester ant (*Messor* sp.), especially the species (*M. semirufus*), common in various parts of Eretz Israel, which consumes mostly seeds and also some insects [34]. The

harvester ant gathers seeds that are on the ground and sometimes also climbs the plant and bites the stalk bearing the fruit, falls to the ground with the fruit, and carries it whole to its nest, a feature described by the Mishna's commentators [35].

The nest of the harvester ant may reach a depth of 3 meters or more (see below) and the quantities stored in one nest are estimated to reach many kilograms [36]. The Israeli entomologist Simon Fritz Bodenheimer (1897-1959) notes that the harvester ant is capable of storing in one nest up to 10 litres of seeds from an area of one dunam [37]. A scientific study evaluating the damage caused by the species *M. barbarus* to an agricultural field notes that sometimes the damage to the grain was significantly greater, even reaching 9.2% of the harvest [38].

From the Mishna it is evident that since the quantity of grain kernels in ant nests might have been significant it was customary to gather and use them. The Mishna determines that the owner of the field is entitled to the kernels in the ant nests located in the part not yet harvested, as well as in the deep tunnels of the nests in the harvested part. In contrast, the poor are allowed to gather the kernels from the upper tunnels [33, p. 48]. A distinction is made between the parts of the nest because deep nests are often very complex and intricate and full of tunnels and rooms with defined functions.

For instance, the nest of the black harvester ant (*M. ebeninus*), one of the most common ants in Eretz Israel, reaches a depth of about 3 meters and the worker ants sort the types of food into different tunnels. The deeper layers that are more protected from cold, water, and predators, house the ants themselves and most of the food is stored there, including seeds that have been peeled by the ants. According to the Mishna, the owner of the field has top priority to receive the best quality and largest amount of kernels and therefore has ownership of the kernels in the bottom layers. In contrast, the poor are allowed to gather the kernels in the upper exposed tunnels that usually contain rotten or unpeeled seeds or those of poorer quality [36, p. 870].

### ***3.2. Exterminating ants using earth from another ant nest***

The sages forbid one from carrying out unessential agricultural work on *Hol ha-Moed* (the intermediate days of Passover and Sukkot). Nevertheless, it was permitted to deal with ant nests in agricultural fields, as postponing this chore until after the holiday might cause damage to the crops. The Tosefta, compiled in the late second century CE, describes how ants were exterminated in the agricultural fields of Eretz Israel: "It is permitted to destroy ant holes on the holiday. How are they destroyed? Raban Shimon ben Gamliel says: A person takes earth from the hole of one and puts it in the hole of the other and they strangle [=kill] each other." [33, p. 367; 39]

Examination of the Tosefta's wording indicates that most manuscripts say that 'earth' should be taken from one ant nest to the nest to be exterminated. (The word *afar* (=earth) is found in Vienna manuscript, National Library-Heb. 20;

Erfurt manuscript, Berlin, Staatsbibliothek-Or. fol. 1220.) In fact, only in Vatican manuscript 108 the wording is: “[One] takes from this hole and puts into that hole” and the word ‘earth’ is not mentioned [Vatican, Bibliotheca Apostolica, Ebr. 108]. This version enables a wider understanding of the element placed in the nest to be exterminated - whether earth, ants or both.

According to the version of the Tosefta that we have before us, the nest is ‘destroyed’ by transferring earth from one nest to another. Obviously, this does not mean filling the hole with earth, as this could be done with any earth whatsoever, rather earth from another ant nest should be placed in the ant colony, an act that might cause a violent confrontation between those in the nest and its elimination. This method of extermination was documented for the first time, as stated, in the second century CE, but it is to be assumed that it was customary among Eretz Israel farmers earlier as well. In any case, there is no way of knowing whether it originates from Eretz Israel agriculture or came from nearby countries and we have yet to find mention of this practice in Roman agricultural literature.

The method of pest control mentioned in the Tosefta was brought and discussed in both Talmuds. The Jerusalem Talmud brings the words of Raban Shimon ben Gamliel in a different version than that evident in the Tosefta: “[One] takes of these and puts them beside those and they strangle each other, but only if a water conduit passes between them” [Leiden, Bibliothek der Rijksuniversiteit, Or. 4720]. Namely, in contrast to the Tosefta, the ants in the harmful nest are exterminated by inserting ants from another nest, and we will further clarify the meaning of this below.

In many versions of the Babylonian Talmud (Moed Katan 6b), according to Raban Shimon ben Gamliel it is necessary to transfer earth from one nest to the other [Gottingen manuscript, Niedersächsische Staats und Universitätsbibliothek, Cod. Ms. hebr.3, Or.13; Vatican manuscript, Bibliotheca Apostolica, Ebr. 134; London manuscript, British Library, Harley 5508]. (In Munich manuscript, Bayerische Staatsbibliothek-Cod. hebr. 95, the words of R. Simon ben Gamliel are missing [40].) In the sugya, the Babylonian amora Abaye (278-338 CE) explains how and under which conditions is it permissible to eliminate the nest. Abaye, who lived far in place and time from the Eretz Israel reality, appears to have been familiar with the technique mentioned in the Tosefta. He says that in order to combat a certain ant nest it is necessary to take earth from a distant ant nest, but he does not explain why it is necessary to maintain a distance between the nests. The reason seems to be that the ants in the nest are not familiar with the foreign earth and its insertion in the nest will cause a fright among the ants in the colony.

According to the tradition brought in the Jerusalem Talmud, it is necessary to use a nest that is separated from the nest under discussion by a water conduit. Ants are unable to cross any amount of water and therefore it is to be assumed that no contact was formed between the nests [33, p. 637; 39]. Abaye, in contrast, is of the opinion that stricter separation is necessary. The foreign ants should be brought from beyond a river over which there is no bridge or wooden board or

even a rope, and they must be at least a *parsa* (about 5 km.) apart. (On the Iranian roots of the term *parsa* (parasang) and its length see [41, 42].) In the next few lines I shall try to offer a possible explanation for the rationale underlying the insertion of earth or ants into the nest under discussion.

### ***3.3. The rationale for inserting earth from another nest into the nest to be exterminated***

In fact, the Tosefta and the Talmuds do not explain why inserting earth from a foreign nest exterminates the ants. In R. Shlomo Yitzchaki's (Rashi, North France 1040-1105) interpretation of the Talmudic sugya, he explains that the ants kill each other "because they smell the earth and are not familiar with this earth" [43]. Hence, Rashi is of the opinion that the mechanism of this extermination technique acts on the ants' ability to smell and identify strange odours. This means that the unfamiliar scent of the earth is perceived by them as a threat and affects their behaviour. It makes them aggressive (apparently due to the need to defend themselves), but their aggressiveness is directed at the other ants. Although Rashi's late explanation obviously does not necessarily reflect the ancients' understanding of the reason for the change in the ants' behaviour, there is a room to sort out what was Rashi's source of information regarding the ants' ability to smell? Did the sages believe that ants have olfactory sense?

Rashi's knowledge of natural matters is based, among other things, on sources written by previous sages, i.e. rabbinical homilies, the Talmud, and the various branches of the Midrash literature [44, 45]. Rashi may have derived his words from Midrash Deuteronomy Rabbah, compiled in Eretz Israel between the late sixth century and the early ninth, which mentions observations of ants held by R. Shimon ben Ḥalafta, a Tanna in the fifth generation, whereby ants identify their food using their olfactory sense. "[There was a] story of one ant that lost its grasp on one [kernel of] wheat and they all came and smelled it but none of them picked it u Along came the ant to which it belonged and took it". [28] On other observations of R. Simon ben Ḥalafta on ants and their activity see [13, Ḥullin 57b]. The fact that ants do not take grains that other ants carry was mentioned in [6, p. 20-21].

The ancients' understanding whereby ants have olfactory abilities is realistic, although they were clearly unfamiliar with the communication mechanism between ants as known to us at present. One of the communication means employed by ants is pheromones, chemicals secreted from various glands in the ant's body. Pheromones are used to mark a path to the food source and many species of ants have alarm pheromones that warn other individuals of the presence of danger [36, p. 373]. The assumption that earth from different nests has a different scent is also well-founded but we don't know where Rashi received this knowledge. The typical scent of the nest is affected by different elements that might change from place to place - the scent of the earth and of the different items in the nest, such as food remnants, dead ants, as well as the

characteristic scent of the ants themselves which also affects the earth in the nest (see below) [18, p. 391].

Accordingly, it may be suggested that insisting on bringing earth from a distant nest was intended to prevent a scent-related association between the nests. Namely, since different scents develop in distant nests, exposure to a 'strange odour' originating from another nest might cause a fright and generate a battle between the ants. In practice, however, there is no way of knowing what damage was in fact done to the nest.

### ***3.4. Terminating activity in a nest by inciting a battle between ants from different colonies***

As stated above, unlike most of the versions of the Tosefta that refer to exterminating ants using earth from another nest, according to the Jerusalem Talmud it is necessary to take ants from another nest and generate a battle between ants from the two colonies. The practice of using ants is based on the fact that in the case of an assault or invasion by ants from a foreign nest, even from the same species, ants secrete alarm pheromones and consequently the ants in the nest under attack fight the invaders [46].

A study conducted by Martin and his associates, focusing on the *Formica exsecta* species, showed that individuals in a certain colony are identified by specific chemicals (Z9-alkene) secreted from the external surface of the ant's body. Any ant or foreign element that enters the nest and does not exude the typical chemicals of those living in the nest ('colony-specific Z9-alkene signature') will be attacked and distanced. Moreover, they showed that a change in the quantity of Z9-alkene among live ants in a nest led to considerable aggressiveness towards them by the other ants. Observations of this type showed that the worker ants constantly survey the vicinity of the nest. When a foreign ant was placed in the area beyond the territory of the nest the ants disregarded its presence, but when an ant was placed at the entrance to their nest it was promptly attacked [47-51].

Defending the nest against foreign ants is a known phenomenon that derives from the concern that the nest will be harmed or taken over. Some species do not establish their own nests rather take over those of others, which they occupy after the original ants die. There are also ant species that are 'slave-makers' (such as *Polyergus lucidus*) who target the nest of another species, plunder the pupae of the worker ants or the mature worker ants themselves, and take them to their own nests, whereupon the foreign worker ants take care of the slave makers' nest [36, p. 373-374; 52; 53].

## **4. Conclusions**

Jewish sources from the Mishna and Talmud period contain two versions of how ants were exterminated in agricultural fields. One is by earth taken from another ants' nest, and the other by inserting ants from a foreign nest and

generating a battle between the ants in the colony and the invading ants. The different versions might reflect different methods of exterminating ant nests common in the ancient world, although the impression is that using ants is more effective.

These methods evolved following observations and experiments held by the ancients on ants and their behaviour. In any case, it is not clear whether and what theory led to their development, for instance Rashi's proposal whereby ants smell and identify the earth of a foreign nest and the scent affects their behaviour. A late midrash indeed notes the ants' olfactory sense, but the sources that deal with the method of extermination do not state explicitly that this is the context underlying these methods' operation.

Interestingly, many medieval commentators and halakhic decisors adhered to the version common among most manuscripts of the Tosefta, whereby it is only necessary to place in the nest earth from another nest [54-56]. Some sages, however, such as Rabbenu Hananel ben Hushiel (1055-965) and R. Menachem ben Solomon ha-Meiri (1249-1316) note that it is necessary to insert earth that contains ants in the harmful nest [57, 58]. The impression is that these two sages combined the different versions, but it is not impossible that their interpretation was affected by a similar method of extermination common in their time.

As a rule, the Tosefta permits extermination of ants on *hol ha-Moed*, and from its first part it seems that any technique aimed at preventing damage is permitted. Raban Shimon ben Gamliel did not wish to restrict the permissible manner of exterminating ants, rather he provides a realistic description of the customary manner of extermination and perhaps a suggestion of how to carry it out. The impression is that Raban Shimon ben Gamliel made use of the halakhic debate to publicize a pest control technique that was popular in his time, and thus transformed the halakhic text into a vehicle for practical information for the benefit of Jewish farmers.

Notably, the trend of integrating beneficial knowledge that deviates from a halakhic issue is familiar from other cases as well. One example of this is the publicizing of a medical prescription within a story about R. Yochanan who contracted scurvy, brought in the context of a halakhic debate on medical care on the Sabbath [13, Avodah Zarah 28a]. The method of ant extermination discussed here joins the considerable agricultural information within the Mishna and Talmud sources and reinforces the statements of the researchers indicating the high agricultural standards in Eretz Israel in rabbinical times [14, p. 14].

The prominent inclination in Greco-Roman and Aramaic sources is to deal with ant damage by using repellent substances or pesticides inserted in the nest. We have as yet found no sources in Roman-agricultural literature indicating the extermination of ants using earth or ants. In fact, the origins of the practice of exterminating by using ants is unknown - whether taken from the agricultural culture of the Roman world or developed independently by Jewish farmers. In any case, the practice before us is clearly based on the ancients' familiarity with the social behaviour of ants.



Exterminating ants using earth from other nests was first mentioned, as stated, in the Eretz Israel literature, but was known in Babylonia as well. Babylonian sages give detailed instructions regarding the distance of the nest from which the earth should be taken and its remoteness from the given nest and the impression is that this was practical knowledge rather than only theoretical suggestions. In any case, in this context as well the question is whether the information of the Babylonian sages was theoretical and originated from their interaction with Eretz Israel and its sages or was this technique known and applied in practice in Babylonian agriculture [59].

Another question that should be asked is whether using ants for purposes of extermination is known from other ancient cultures. Use of ants for extermination was customary in ancient China, but no impact or association can be found with the technique discussed in the current paper [60-62]. The Chinese used the *Polyrhachis lacteipennis* species to exterminate larvae of butterflies and beetles that would drill holes in citrus groves and cause great damage to the trees. Weaver ants build large nests, each containing several thousand individuals. In order to help the ants access agricultural fields, the Chinese would link the fields using bamboo bridges. Such nests were sold in the vicinity of the Canton Province (Guangdong, also: Kwangtung) in the third century CE, and this method of pest control is still utilized by grove owners in northern Burma and northern China [63, 64].

According to Osgood's description in the 19<sup>th</sup> century, similar methods were utilized by date growers in Yemen. Every year farmers bring colonies of carnivorous ants from the hills and place them among the palm trees to exterminate pests [65-67]. Interestingly, in Europe as well ants are used for purposes of extermination, for instance the red ant *Formica rufa* used to reduce insect damage to local forests [68].

The fact that ants fight their own species and even termites is mentioned in medieval Arabic literature and the later traditions may even originate from the classical era. For instance, Abū 'Utmān al-Jāhīz (Basra, d. 869) reports in his zoological book *Kitāb al-Ḥayawān*: "If you put a large ant in the nest of small ants it will devour them all [...] Some termites destroy villagers' homes and eat all they have and do not stop unless ants are born in those villages and then Allah sets the ants on the termites and they exterminate them all". [69-71] Al-Jāhīz comments on the inefficiency of using various substances to exterminate the nests: "It is said: The ants are killed by placing tar or yellow sulphur at the entrance to their nests or by sealing the entrance with hair. I tried to do this and found it to be baseless." [69]

Al-Jāhīz begins by reporting that small ants can be eliminated by using larger ants that devour them. The scientific literature documents large and small ant species. In fact, even within the same species there are individuals that have large heads and are equipped with larger jaws and serve as soldiers whose function is usually defensive. (For example, the genus *camponotus* s is of large ants and *Cardiocondyla* s and, *Solenopsis* s are small genera of ants [36, p. 372].) According to the second tradition, ants that developed spontaneously

(spontaneous generation) [72] were a solution to the termite (*Isoptera*) problem, of which most consume wood and other materials that contain cellulose and are thus harmful to fruit trees and forest trees and even to wooden parts of houses [36, p. 69]. Preying on termites is characteristic of the Matabele ant (*Megaponera analis*), an ant of African origin that invades termite nests and feeds on them, especially the genus *Macrotermes* [73]. According to the testimony of Jāhiz the ants fight the termites and thus reduce the damage they inflict. However, in contrast to the first tradition that describes a practical use of ants, the second describes a natural process with no human intervention aimed at reducing the termite population by means of ants.

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