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Relative abundance and foraging intensity of subterranean termites in date palm plantations in Abu Dhabi Emirate, the UAE

Walid Kaakeh

Department of Aridland Agriculture, College of Food & Agriculture, U.A.E. University, Al-Ain, P.O. Box 17555, U.A.E.

Abstract: The feeding activity on paper rolls by subterranean termites in four locations was measured over 12 months (2003) in four date palm plantations in Abu Dhabi Emirate, the United Arab Emirates (UAE). Three species of termites were identified: the harvester termite *Anacanthotermes ochraceus* (Burmeister), the sand termite *Psammotermes hypostoma* Desmeux, and the small waxy termite *Microcerotermes diversus* Silvestri. The first species was most abundant in all sites. The population of *A. ochraceus* was increased gradually from mid-April through September and started to decline by mid-December. The population of *P. hypostoma* increased gradually from mid-March through August and started to decline by mid-September. The population of *M. diversus* increased gradually from mid-February through September and started to decline by mid-November. There were differences in the number of paper rolls attacked, the number of workers and soldiers recorded, the average number of termites per roll, and the average number of soldiers per 1000 workers. Mixed termite species were observed on few rolls in one site. Termites showed preference to selected date palm cultivars.

Key Words: *Anacanthotermes ochraceus, Psammotermes hypostoma, Microcero-termes diversus*, termites, foraging behavior, date palm.

الوفرة النسبية وكثافة البحث عن الغذاء للنمل الأبيض تحت الأرضي في مزارع نخيل التمر في إمارة أبوظبي، الإمارات العربية المتحدة

وليد كعكه

قسم زراعة الأراضي القاحلة، كلية الأغذية والزراعة، جامعة الإمارات العربية المتحدة، ص.ب. 17555، العين، الإمارات العربية المتحدة

الملخص: تم قياس النشاط الغذائي للنمل الأبيض تحت الأرضي، لمدة 12 شهراً في عام 2003م، على لفافات الورق في أربع مزارع لنخيل التمر تتواجد في أربع مواقع تابعة لإمارة أبوظبي في الإمارات العربية المتحدة. وقد تم تعريف ثلاثة أنواع من النمل الأبيض (الأرضة): الأرضة الحاصدة أو الأرضة اللاشوكية (Burmeister) *Anacanthotermes ochraceus*، أرضة الرمل الثغرية Desneux *Psammotermes hypostoma*، والأرضة الشمعية الصغيرة *Microcerotermes diversus* Silvestri. وكان النوع الأول الأكثر وفرة في كل المواقع. وقد ازداد تعداد عشيرة النوع *A. ochraceus* بشكل تدريجي بدءاً من منتصف شهر أبريل/نيسان إلى شهر سبتمبر/أيلول ثم بدء بالانخفاض في منتصف شهر ديسمبر/كانون الأول. أما تعداد عشيرة النوع *P. hypostoma* فقد ازداد بشكل تدريجي بدءاً من منتصف شهر مارس/آذار ثم بدء بالانخفاض في منتصف شهر سبتمبر/أيلول. وقد ازداد تعداد عشيرة النوع *M. diversus* بشكل تدريجي بدءاً من منتصف شهر فبراير/شباط إلى شهر سبتمبر/أيلول ثم بدء بالانخفاض في منتصف شهر نوفمبر/تشرين الثاني. وجد فارق في عدد لفافات الأوراق المصابة بالنمل الأبيض، والعدد المسجل للشغالات والجنود، ومعدل عدد النمل الأبيض لكل لفافة ورق، وعدد الجنود لكل 1000 شغالة. وقد شوهدت أنواع مختلطة من النمل الأبيض (أكثر من نوع) في بعض لفافات الورق في موقع واحد فقط. وأظهر النمل الأبيض أفضلية تجاه أصناف معينة من نخيل التمر.

كلمات مفتاحية: *Anacanthotermes ochraceus*، *Psammotermes hypostoma*، *Microcerotermes diversus*، النمل الأبيض، سلوكية البحث عن الغذاء، نخيل التمر.

Introduction

Termites have become increasingly important pests of crops and buildings in the United Arab Emirates (UAE), where desert and marginal lands are irrigated for agriculture. Two foraging strategies adopted in the UAE ecosystem: species are either nocturnal or they construct protective soil sheeting or tunnels within which they are shielded from the heat and desiccating effects of the sun. Termites feed on plant material that may be alive, dead or decayed. Some species were capable of reducing wooden structures to dust, and may cause serious damage to buildings.

Several records pertaining to termites in the Arabia Gulf countries, especially in Saudi Arabia, were made (Badawi et al., 1982; Boocock 1979; Nasr et al., 1978). The termite fauna of the Arabian Peninsula comprised of 22 species (Badawi et al., 1986, Chhotani and Bose, 1991). No study of termite fauna in the UAE was previously made in urban and agricultural settings, where the only record for the UAE is a colony of *Heterotermes aethiopicus* (Sjostedt) infesting a house in Al-Ain city, Abu Dhabi Emirate (Boocock, 1979). The cryptic nature of subterranean termites makes behavioral studies very difficult and consequently, little is known on their activity (Harris, 1967). Several attempts were however made to determine the foraging behavior of some species of subterranean termites either by applying the soil core method (Wood et al., 1977), or baiting with attractive materials (LaFage et al., 1973; Haverty et al., 1975; Ohiagu and Wood, 1976; Badawi et al., 1984). The relative abundance and

foraging territory and density of an entirely subterranean species have never been reported in the UAE. Therefore, the objectives of this study were to identify termite species in the date palm plantations, study the relative abundance and foraging intensity of termites, and observe the preference of termites to selected date palm cultivars.

Materials and Methods

Test sites

The experiment was carried out in four date palm plantations located in several cities (Al-Ain, Suwaihan, Al Khazna) in Abu Dhabi Emirate, which is the largest Emirate in the United Arab Emirates (UAE). Thirteen date palm cultivars were grown in the four sites (Bagl, Barhi, Buman, Dabas, Fard, Gabri, Helali, Khalas, Khesab, Khineze, Lulu, Nagal, Reziz).

Foraging Population

The method devised to observe foraging behavior involved clearing the dead wood from ground. One hundred rolls of toilet paper, wrapped with tape to prevent raveling, were placed in holes (10 cm deep) between palm trees at 2-m intervals. The paper rolls served as a food source which attracted the termites to the surface where foraging intensity could be observed on a continuing basis. Observations on the paper rolls were made once during a 24-h period each week for one full year starting early January of 2003. To check for termite foraging activity, each roll was removed separately from its hole, shaken into a plastic container to remove all termites hanging to the bottom and inside of the roll. Termites were counted using a fine camel hairbrush, sorted into castes, and identified. Each roll was then placed back to its hole. Severely attacked rolls were replaced by new ones. A weekly record was kept for each roll indicating the number of workers and soldiers collected, species of termites, and date of first attack. The average number of soldiers per 1000 workers (S/W ratio) was determined for each species in each location.

Termite identification

Preliminary identification of the collected termites in all date palm plantations was made using the available termite keys (Snyder, 1949; Harris, 1967; Fontes, 1985; Myles, 1998; Sands, 1998; Myles, 2004). The confirmation of termite identification was made by sending specimens to the British Museum of Natural History (UK).

Statistical analysis

Sites were not treated as replicates because of differences in non-controlled variables and the large sites necessary for observing termite populations. Each site was considered an unreplicated experimental unit. Therefore, descriptive statistic was implemented in this study. The graphical description (using graphs) and tabular description (using Tables) were used to summarize the data. In addition, a summary statistic was used to calculate certain values (no. workers and soldiers, no. Soldiers, no. attacked rolls, termites per roll and soldier per 1000 workers) to summarize the data.

Results and Discussion

Termite species

Termite species recorded in the four date palm plantations, at various levels of infestations, were the harvester termites *Anacanthotermes ochraceus* (Burmeister), the sand termite *Psammo-termes hypostoma* Desneux, and the small waxy termite *Microcero-termes diversus* Silvestri.

Termite population

Sites 1-3 were each infested with a single termite species; two species were found in site 4. The species *A. ochraceus* was first recorded in mid-April in sites 1 and 4 (Figure 1); its population increased gradually from mid-April through September and started to decline by mid-December. The species *P. hypostoma* was recorded in March in site 2 (three rolls), and in April in site 4 (only one roll); its population increased gradually from mid-March through August and started to decline by mid-September. In site 3, *M. diversus* was first recorded in February; its population increased gradually from mid-February through September and started to decline by mid-November. The population of *A. ochraceus* was higher than other termite species. The populations and the numbers of paper rolls attacked by three termite species had similar trends (Figure 2). Table 1 showed differences in the total number of rolls attacked, the total number of workers and soldiers recorded, the average number of termites per roll, and the average number of soldiers per 1000 workers. The total number of all castes (workers and soldiers) ranged from 737 (*P. hypostoma*) to 13789 (*A. ochraceus*), the total number of soldiers ranged from 48 (1.9% of all castes in *M. diversus*) to 394 (2.85% of all castes in *A. ochraceus*); these numbers were collected from 24 to 350 rolls, with a range of 11.7 to 43.6 termites per roll. The number of termites per roll in this study was much higher than those recorded previously in Egypt (Hosny and Said, 1980; Badawi et al. 1984). Differences in the ratios of soldiers/1000 workers among different termite species were found (Table 1). *A. ochraceus* had ratios of 28.6 and 25.7 in site 1 and 4, respectively. The ratios in *P. hypostoma* reached 29.7 and 21.7 in site 2 and 4, respectively. The ratio in *M. diversus* reached 19.1. Ratios of 28.9, 26.4, and 16.4 were recorded for *Microtermes* sp., *Amitermes villis*, and *Amitermes* sp., respectively; lower ratios of 6.2 and 5.1 were recorded for *Microcerotermes and Anacathotermes,*

respectively (Badawi et al., 1984). Susan et al. (1981) found that the ratio differed between colonies of the wood inhabiting termite, *Pterotermes occidentus*, where the largest colony had a high ratio of 1:41 and two smaller colonies had low ratios of 1:85 and 1:96, respectively.

Table 1. Distribution and foraging intensity of *A. ochraceus*, *P. hypostoma*, and *M. diversus* in four date palm plantation sites in Abu Dhabi Emirate, the UAE.

Site No.	Termite species	No. Workers and Soldiers	No. soldiers	No. Attacked Rolls	Termites per Roll	Soldier / 1000 Workers
1	*A. ochraceus*	13789	394	350	40.5	28.6
2	*P. hypostoma*	3839	114	236	16.8	29.7
3	*M. diversus*	2509	48	218	11.7	19.1
4	*A. ochraceus*	12160	312	287	43.6	25.7
	P. hypostoma	737	16	24	31.4	21.7

Date palm cultivars

Observations on termite infestations on or near date palm cultivars showed differences between termite species in their preferences to selected date palm cultivars (Table 2). The cultivars Khalas, Fard, and Lulu were infested by *A. ochraceus* and *P. hypostoma* in sites 1, 2, and 4. The cultivar Barhi was only infested with *P. hypostoma*. Reziz was only infested by *M. diversus*. The trunks and basal leaves of infested palm trees were thickly encrusted with the shelter tubes of foraging termites. Information on foraging territories and behavior of subterranean termite population in date palm plantations of the UAE are important for developing the control strategies for these three considerable economic termite species. Termites, in this study, locate and feed on toilet paper much more quickly than they do on wooden blocks, which are widely used for assessing effectiveness of chemicals against termite attack. The use of paper rolls as baits, combined with core-sampling and mark-recapture technique, can be implemented to determine the characteristics and foraging intensity of subterranean termites around the world. Future work on termites in the UAE should be undertaken to determine the abundance of termites as being affected by weather factors, and to determine the susceptibility and resistance of other date palm cultivars to these termite species. National survey on the susceptibility of over 120 cultivars is being conducted by the author in all seven Emirates of the UAE.

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Table 2. The susceptibility of date palm cultivars to termite infestations in Abu Dhabi Emirate, the UAE.

Site No.	Termite species	Cultivars grown in each site		Total no. of cultivars
		Termite present	Termite absent	
1	*A. ochraceus*	Khalas, Fard, Khesab, Buman, Gabri, Khineze, Lulu, Dabas	Reziz, Buman, Helali	11
2	*P. hypostoma*	Khalas, Fard, Bagl, Barhi, Nagal, Lulu, Dabas	Reziz, Buman, Gabri, Helali	10
3	*M. diversus*	Khalas, Reziz, Buman, Helali	Bagl, Barhi, Lulu, Dabas	8
4	*A. ochraceus*	Khalas, Fard, Khesab, Gabri, Khineze	Reziz, Buman, Helali	10
	P. hypostoma	Khalas, Fard, Barhi, Lulu,	Reziz, Buman	

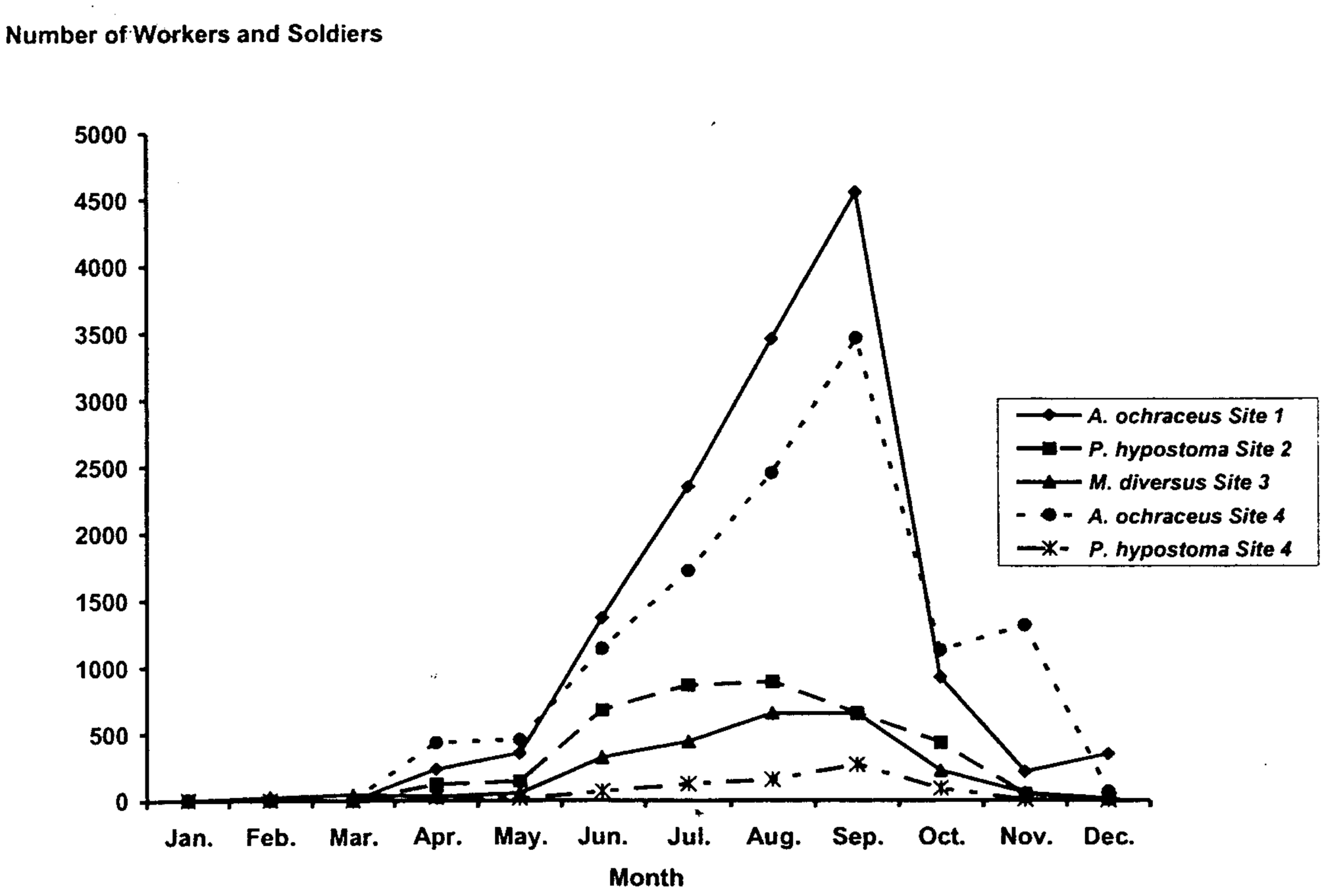

Figure 1. Number of workers and soldiers collected from attacked paper rolls in four date palm plantations throughout the experimental period.

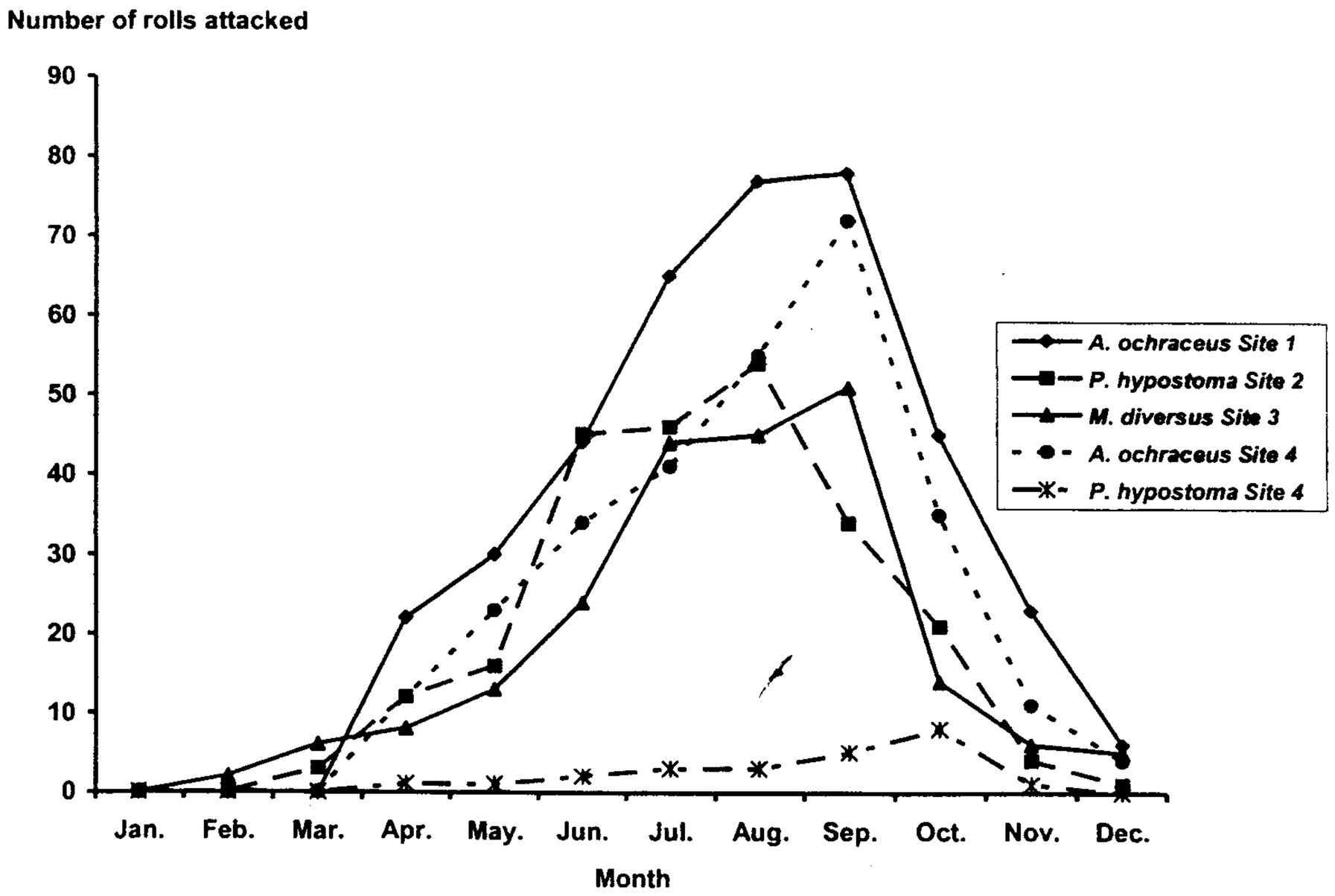

Figure 2. Number of paper rolls attacked by three subterranean termites in 4 date palm plantations.

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