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THE BEST TEMPERATURE ON THE EXTRACTION OF MITES AND SPRINGTAILS WHICH ARE REFLECTING OF SOIL HEALTH

*J.E.Mahdi **L.Abbott ** Z.Solaman

ABSTRACT

The requirements for improving agricultural sustainability need to redefine soil quality.An abundance of soil fauna such as mites and springtails an important way to investigate on the soil health.Because they are multifunctional in improving physical, chemical and biological soil fertility. Chemical and biological processes can influence the stability of soil structure.This review focuses on the effect of temperatures on extraction of soil fauna.To assess soil fauna, several methods have been proposed for use in the standard laboratory method such as heater box method to assess the abundance of mites and springtails on the soil which are reflect of soil health. The goals of this research were (i) to investigate on the best temperature to extract mites and springtail (ii) the effect of site on extraction of mites and springtail.

Therefore using temperature is the best way to measure the diversity and abundance of soil fauna has potential to be assessed. There were significant differences ($P<0.001$) in the number of mites/m^3 when extractions were conducted at different temperatures. Also, there was a significant effect of temperature ($P<0.05$) on the number of springtail/m^3. Also sites were effect on the number of extraction for mites and springtails.

INTRODUCTION

The soil fauna include intermediate-sized animals ranging from those not visible by eye to larger animals such as earthworms, mollusks and spiders. The soil mesofauna are dominated by mites and springtails and have a role in maintenance of structural properties of the soil ecosystem and nutrient cycling (5 8, 9, 21). For example, the springtails are primarily fungivores or detritivores that play an important ecological role in preparing organic material for decomposition (22). The populations of springtails are considered to be controlled by temperatures and moisture (13). According to Hairston et al, (12), the abundance of springtails and mites depends on food available. The predaceous mite commonly feed on springtails. Springtail and mite populations are regulated by soil environmental conditions and the availability of organic matter.

The temperature of soil plays an important role in controlling the populations of soil fauna and their vertical distribution (10,6) used high temperature to extract soil arthropods because soil fauna are sensitive to the temperature Elevated soil

* Directorate of Plant Protection- Ministry of Agric – Baghdad. Iraq
**School of Earth and Environment (M004). The University of Western Australia.
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. temperature has been used to extract it was found soil arthropods in Western Australian soils (18). In this review found that the means of mite's number in compost site was greaterthan other sites. However the means of springtail's number in South site was greater than other sites. In addition, the number of extraction for mite at 25°C was the best and the higher number of springtail was at 35°C. The overall goal of this project was to use temperatures for extraction of soil fauna such as mites and springtails which are reflect of soil health. The objectives of this study were to know the best temperature to extract mites and springtail. Also to know the effect of site on abundance of mites and springtail. The components of this study were include use the standard laboratory methods for extracting soil fauna which is heater box method with four different temperatures and different sites

Figuer 1.Mait (left) and springtai(right)

MATERIALS AND METHOD

SOIL SAMPLES

The soil samples were collected in August (2012)from three locations near the Soil Science Building at University of Western Australia (location 1, 2 and 3). The samples were taken the depth of soil (top 5cm). The soil samples were taken near the soil surface in the morning. The sampling ring was pushed into 5 cm depth of soil. The litter layer was collected from 1 cm topsoil of the sampling ring. The litter layer was brushed off the top soil when the amount was greater than 1 cm.The effectiveness of extracting the soil fauna by the heat extraction method According to Haimi et al (10).

Methodology

Four extraction boxes were used to collect the soil fauna. Each box contained a cover which included a heater and thermostat to control the temperature. Each cover was placed above the funnels to collect the soil fauna in the beakers beneath each funnel. The beakers contained damp plaster of Paris to keep the soil fauna alive [18]. Each box was assigned to different temperature: box 1, 25°C; box 2, 30°C; box 3, 35°C and box 4,40°C.The time of extraction was carried out for 24 hours. Before each of soil sample was emptied into a funnel and the soil fauna was collected subsequently. A layer of mesh and three layers of gauze swabs were placed inside each funnel to prevent soil falling into

collecting jar and also allow the soil fauna pass through the funnel into the jar. The soil samples were placed and numbered in the funnel. The identification and counting the number of soil fauna was carried out using the procedure described on the website (1).

Statistical analysis

The experiment consisted of a 2 x 3 complete factorial design of time of (24 hours) and three sites (location 1, 2 and 3). Six experimental treatments were analysed for the measured variables. The data were analysed using the Analysis of Variance (ANOVA) using statistical package Genstat (Release 9.2, Lawes Agricultural Trust, IACRRothamsted).

RESULT

Effect of temperature and site on mites numbers

There were significant differences ($P<0.001$) in the number of mites/m^3 when extractions were conducted at different temperatures Table 2. The number of mites was reduced ($P<0.05$) as the temperature increased from 25 to 40°C for the compost site (Site 1). However, the number increased when the temperature was increased from 25 to 30°C for the North site (Site 2), followed by a reduction in mite number at 35°C and a further reduction at 40°C. For the South site (site 3), the number of mites extracted remained same when the temperature was increased from 25 to 30°C, but it was reduced when the temperature was increased from 30 to 35C or 40°C. In addition, the number was further reduced when the temperature was increased from 35 to 40°C.

In addition results the showed that the means of mite's number in compost site was greater than North and South sites respectively table 4. In other hand the results showed that the means of mite's number were high at25°C than 30°C to 35C or 40°C table 5

Table 2; Effect of temperature on extraction of mite numbers (mean±sem) from three soils at UWA using the heat extraction method

	Temperature of extraction of soil fauna				
Site	**25°C**	**30°C**	**35°C**	**40°C**	**LSD***
Compost	6150±75 $_a$	2550±225 $_b$	2650 ±25 $_b$	1450±75 $_c$	406
North	800±100 $_c$	2600±50 $_a$	1150±25 $_b$	850±225 $_c$	171
South	1100±50 $_a$	1100±0 $_a$	350 ±75 $_b$	250±75 $_c$	89

*** LSD (Least Significant Difference) was used to compare the statistical difference between two means within rows. Means within rows with different subscripts differ significantly ($P<0.05$).**

Effect of temperature and site on springtail numbers

There was a significant effect of temperature ($P<0.05$) on the number of springtail/m^3 Table3. The number of springtails extracted increased when the temperature increased from 25 to 30°C by 5 fold at the Compost site (Site 1).

However, the number was reduced by 29%when the temperature increased from 30 to 35 or 40°C. A similar pattern was observed at the North site

(Site 2) as the number of springtails increased when the temperature increased from 25 to 30 or 35°C by 5 or 11.5 folds, respectively. This followed a reduction (44%) in the number of springtails when temperature was decreased from 35 to 40°C .At the South site (Site 3), springtails when the temperature was increased from 25 to 35 or 40°C the number extracted increased by 42% or 2 fold, respectively.

In addition the results were showed that the means of springtail's number in South sitewas greater than North and Compost sites respectively table 4.

In other hand the results showed that the means of springtail's number were high at 35°C than 25°C to 30 C or 40°C table 5

Table 3: Effect of temperature on extraction of springtail numbers (mean±sem) from three soils at UWA using the heat extraction method

Temperature of extraction of soil fauna					
Site	**25°C**	**30°C**	**35°C**	**40°C**	**LSD***
Compost	200±4 $_c$	1050±25 $_a$	750±25 $_b$	750±75 $_b$	150
North	200±4 $_c$	1000±4 $_b$	2300±100 $_a$	1300±100 $_b$	261
South	950±75 $_c$	1340±150 $_b$	1350±275 $_b$	1950±175 $_a$	304

*LSD (Least Significant Difference) was used to compare the statistical difference between two means within rows. Means within rows with different subscripts differ significantly (P<0.05).

Table 4: The means of springtail and mite in different sites (Compost, North and South site)

Site	Compost	North	South
Means of springtail	688	1200	1398
Means of mite	3200	1350	700

Table 5: The means of springtail and mite in different temperatures (25°C, 30°C, 35°C and40°C)

Temp	25°C	30°C	35°C	40°C
Means of springtail	450	1130	1467	1333
Means of mite	2683	2083	1383	850

DISCUSSION

Heater-box method was effective in extracting mites and springtails from the soils tested. This method was very stable and easy to be used successfully.

The increasing of temperature may have killed some populations of mites which is consistent with as suggested by Haimi et al (10), Lindberg, (15). However, at the South site (Site 3).The numbers of springtails increased when the temperature was increased meaning springtails were more affected by higher temperature than mites. This is in contrast to previous reports by Block et al (3),Hodkinson et al (11)which showed that mites were less susceptible to high temperatures and desiccation than the springtails. The increasing of temperatures may have led to reduced moisture in the soil enabling them to

move deeper into the soil in response to moisture changes. This is consistent with studies of Ferguson, and Joly (7), Springett (19) who showed that the population of springtails and mites were dependent on the temperature and precipitation.
Also at compost site the number of springtail was increased when the temperature was increased from 25 to 30°C by 5 folds at compost site. However, the number was reduced when the temperature was further increased. Perhaps the increasing of temperature killed some populations of springtails. (20) found "that increasing temperatures may lead to a more rapid breakdown of organic matter in the soil in certain systems" this process can increase the CO_2 level. This was further supported by Loots and Ryke (17) who showed that CO_2 can affect soil fauna.
This findings were in agreement with reports of others Kethley (14), Loots and Ryke (16),Osleret al, (18) who found that the abundance of mite were very high in the compost soil because the presence of the remains of plants organic matter. Also, (18) showed that "The key factor for the large numbers of mites under lupins at the end of the growing season could have been the senescent leaves below the lupins".
At the compost site, the abundance of mites may have been higher than springtails because some mites feed on springtails, as has been found by Berg et al (2) and Ferguson, Joly (7). Therefore, there may have been a negative impact on springtail population growth rate (7).Different responses may be explained by different soil types, differences in other soil conditions (10).
Based on present results, the 25°Cis recommended to extract mites and 35°C to extract springtails, the time of extract was 24 hours. This research objective was different than other such as Micro arthropods which are based on slow increase of temperature from 20°C to 40°C during 4 days extraction period (18). However, the latter findings as well as the present experiment were in contrast with another finding by Osler et al, (18) where they found the extraction of arthropods by modified Tullgren funnels needed 7 days.

CONCLUSION

There were some differences in the number of mites and springtails extracted by the heater box which is usually used in the laboratory because the means of mite's number in compost site was greater than North and South sites respectively and the means of mite's number were high at25°Cthe means of springtail's number in South site was greater than North and Compost sites. Also, the means of springtail's number were high at35°C.

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أفضل درجة حرارة لاستخراج mites and springtails والتي تعكس او تشير الى صحة التربة

جواد عناد مهدي * لين ابوت** زكريا سليمان**

الملخص

تحتاج متطلبات تحسين الاستدامة الزراعية الى اعادة معرفة نوعية التربة ووفرة حيوانات التربة مثل mites and springtails وهو الشي المهم للتحقق من صحة التربة لان لها فوائد متعددة في تحسين خواص التربة الفيزيائية والكيميائية والبايولوجية استقرار بنية التربة .

وتركز هذه الدراسة على تأثيرات درجة الحرارة في استخلاص حيوانات التربة لتحديد ومعرفة وفرة وغزارة حيوانات التربة . توجد طرق مختبرية قياسية عديدة منها طريقة الصندوق الحراري .هذه الطريقة جيدة لمعرفة غزارة ووفرة mites and springtails في التربة اذ تعد هذه الحيوانات مؤشر جيد لصحة التربة ،فكلما كانت صحة التربة عالية .

الهدف من هذه الدراسة هو :

1- للتحقق من معرفة افضل درجة حرارة استخراج الـ mites and springtails .

2- تأثير الموقع في استخراج الـ mites and springtails . لذلك فأن استخدام درجة الحرارة هو افضل وسيلة لقياس وفرة حيوانات التربة وعلى اساسها يمكن ان يتم تقويم صحة التربة .

وقد توصلت الدراسة الى جملة نتائج وكما يأتي :

- هناك فروق ذات دلالة احصائية ($P<0.01$) في عدد الـ m3/mites عندما اجري الاستخراج لحيوانات التربة عند درجات حرارة مختلفة .
- هنالك تأثير كبير لدرجة الحرارة في عدد الـ springtail في m3 . كذلك الموقع كان له تاثير في عدد استخراج كل من الـ springtail و m3 في الـ m3 من التربة.

*دائرة وقاية المزروعات – وزارة الزراعة– بغداد، العراق.

** جامعة غرب استراليا –أستراليا.