

Studies on the Distribution of *Pachycondyla sennaarensis* (Hymenoptera: Formicidae: Ponerinae) in Saudi Arabia. 1. Ar-Riyadh Region*

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Abstract.- In Ar-Riyadh Region in the Kingdom of Saudi Arabia (KSA), the Governorates of Al-Zulfi, Al-Ghat and Al-Majmah (north zone), of Al-Hariq, Al-Aflaj and Hawtat Bani Tamim (south zone), of Hijrat Sa`ad (east zone), of Shaqra, Durma, Al-Qasab, Huraimela`a (west zone) and Riyadh City (central zone) were surveyed for the presence of *Pachycondyla sennaarensis* monthly during the period from December 2007 to December 2009. The ant was not detected in Al-Majmah or Al-Zulfi. It was detected in Al-Ghat and Hijrat Sa'ad only in 2009, while it was found in small numbers in 2008 and in large numbers in 2009 in all west zone Governorates; which suggest that the ant was actively spreading in these localities. Large numbers of the ant were detected in the south and central zones' Governorates during both years. The positive localities were infested more heavily during spring and summer. The ants seemed to have adapted to the hot and dry weather of Riyadh Region especially in spring and summer by establishing the nests in moist sand in irrigated gardens, parks, housing areas and roadside plantations. This ant is a condemned health hazard and more field studies and quarantine measures are essential for its control.

Keywords: Hazardous insect, medical hexapoda, samsun ant, *Pachycondyla sennaarensis*.

INTRODUCTION

Pachycondyla sennaarensis was first described as *Ponera sennaarensis* by Mayr in 1862. The type locality was Sennar in Sudan. Wheeler (1922) found it in many localities in West Africa [as *Euponera (Brachyponera) sennaarensis*]. Levieux and Diomande (1978) described it as the most common ant in the savannah regions in Sudan, being found also across the Sub-Saharan Africa to Somalia and up to the southern edge of the Sahara in Niger, north of Niamey. Taylor (2005) reported it to be present in Senegal, Guinea, Ethiopia, Congo, Zaire, Nigeria and Cameroon. In Iran, Targari and Paknia (2005) reported it from Lar County and Akbarzadeh *et al.* (2006) recorded it from Iranshahr

County while Paknia (2006) reported that it has spread also into the southern provinces of Sistan-Baluchestan, Kerman, Fars, Hormozgan and Bushehr.

Pachycondyla sennaarensis, known as samsun ant, was reported from the Kingdom of Saudi Arabia (KSA) in 1985 (Collingwood, 1985). Later, it was reported from Kuwait, Oman, Yemen (Collingwood and Agosti, 1996) and the United Arab Emirates (Collingwood *et al.*, 1997) as an aggressive ant with a painful sting, and as a scavenger feeding on food refuse and arthropods, as well as raiding bee hives and destroying honey bees (Whitcombe, 1982). In the latter country, it became a recognized public health hazard since its sting has resulted in a few cases of fatal anaphylactic shock (Dib *et al.*, 1992, 1995). A case of anaphylactic shock has been also reported in KSA (Al-Shahwan *et al.*, 2006). Also, several Saudi anaphylactic cases following samsun ant stings reported to local clinics, some of them were critical (Al-Anazi *et al.*, 2009). Therefore, it became necessary to investigate the degree of distribution of this ant in KSA. In the present study, we began this task by investigating the distribution of this ant in Ar-Riyadh Region.

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MATERIALS AND METHODS

Survey areas and periods

A survey of the ant *P. sennaarensis* was undertaken during the period from December 2007 to December 2009 in Al-Riyadh Region. Surveys were performed twice monthly in winter (December, January and February), spring (March, April and May), summer (June, July and August) and autumn (September, October and November). Ar-Riyadh Region was subdivided into east, west, north, south and central zones as illustrated in the map in Figure 1. The north zone included the Governorates of Al-Zulfi (26° 15' N, 45° 00' E), Al-Ghat (25° 34' N, 45° 37' E), Al-Majmah (25° 52' N, 45° 57' E), the south zone included the Governorates of Al-Hariq (23° 53' N, 45° 35' E), Al-Aflaj (22° 00' N, 46° 21' E) and Hawtat Bani Tamim (23° 12' N, 45° 11' E), the east zone included Hijrat Sa`ad (25° 10' N, 47° 58' E), the west zone included the Governorates of Shaqra (25° 34' N, 45° 23' E), Durma (24° 00' N, 45° 55' E), Al-Qasab (25° 13' N, 45° 32' E), Huraimela`a (24° 43' N, 45° 46' E), and the central zone included Riyadh City (24° 30' N, 46° 00' E). Search for samples were made in these urban areas in streets, houses, hospitals, irrigated parks, gardens and farms as well as from the surrounding semidesert areas.

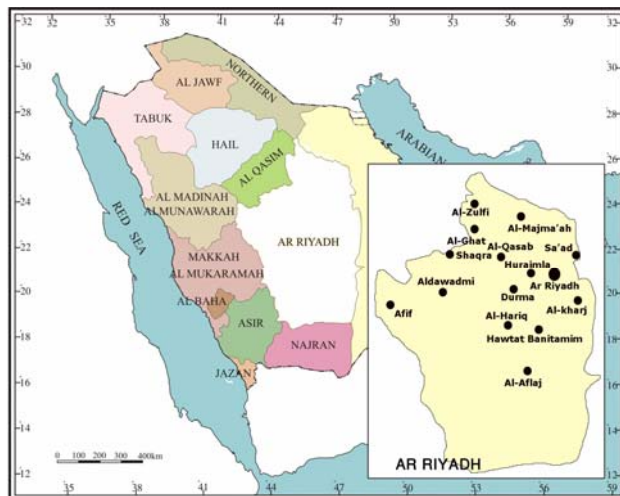


Fig. 1. Map of the Kingdom of Saudi Arabia illustrating the urban centers surveyed for *Pachycondyla sennaarensis* in Ar-Riyadh Region (blanked area) with inset showing the surveyed locations.

Searches were conducted during daylight and during the twilight period before sunset and dawn before sunrise by using flash lights for illumination. Searches consisted of scanning the ground and turning stones to find colonies and forager workers. Forager and stationary specimens were collected directly using featherweight forceps or an aspirator and held in separate vials. Each specimen was labeled with date and time of collection and locality.

Colony sampling

Ant colonies in each defined area were identified and counted. Colony collection for determination of caste types and numbers was performed by digging at a distance of 30-50cm around the orifice(s) of the nest to a depth of 50-100cm and lifting the whole earth mass into a cloth bag to the laboratory. To determine the type and number of the different castes, each earth mass containing a colony was spread out in a large tray, the rim of which was covered with petroleum jell. The whole earth mass was carefully examined and each caste type was placed in a separate jar. Pictures of the different castes and their morphological characteristics were prepared using a scanning electron microscope (SEM, Jeol, Model: 6380 LA).

Sorting ant specimens for identification

The specimens collected from the different localities were usually contained in bags, jars or vials, according to the sample size, mixed with miscellaneous matter. In the laboratory, the field specimens were spread out in Petri dishes, ethyl alcohol was added and the ant samples were manually removed from other materials with the aid of a stereoscopic microscope using watchmaker or a featherweight forceps. The samples were identified using the keys of Collingwood (1985) and Collingwood and Agosti (1996). Three to ten dry specimens from each morphospecies were mounted and stored properly to document the geographic record. A few individuals of workers of each morphospecies were preserved in 70% ethyl alcohol in small specimen vials and sent to Dr. Collingwood at the Leeds Museum in Great Britain for confirmation of identification.

Climatic parameters

Data of the changes in air and soil temperature, relative humidity and rainfall in the study areas were obtained from the Hydrology Division, Ministry of Water and Electricity, Riyadh, Saudi Arabia (the annual reports of 2008 and 2009).

RESULTS

Pachycondyla sennaarensis nests were always present in moist soil in irrigated areas. The nest entrance to the colony was usually circular, 10-20mm in diameter, and was surrounded with piled-up debris resulting from nest excavations (Fig. 2). The number of nest entrances ranged between two and five in hard soil and between three and ten in soft soil.

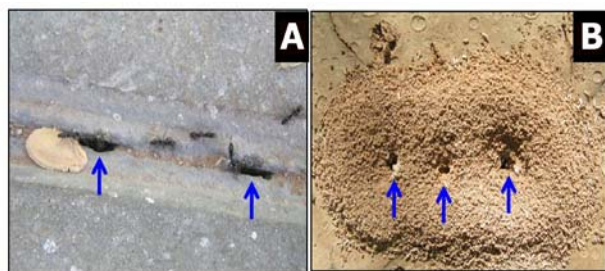


Fig. 2. Entrances of *Pachycondyla sennaarensis* nests (A) in hard soil (B) in soft soil.

In warm seasons, particularly in spring, summer and autumn, forager surface activities began 1h before sunrise and continued for several hours coming to complete halt as the temperature rose at noon time. A second period of activities began 1-2h before sunset and continued to midnight, especially when there were artificial lights. In the cold winter season, outside activities began after sunrise and continued until 2h before sunset.

The winged females were 8-9mm in length with a black body, reddish brown mouthparts and legs and pale yellowish wings (Fig. 3A). The female terminalia was characterized by the presence of a rudimentary sting (Fig. 3B). The smaller winged males were 6-8mm in length and were black in color with brownish yellow mouthparts and deep red-brown legs (Fig. 4A). The male terminalia was

characterized by the presence of a copulatory apparatus (Fig. 4B). The workers were 6-6mm in length; workers from different colonies showed variation in size. The workers had a black body, deep red-brown appendages (Fig. 5A) and their terminalia was characterized by the presence of a prominent sting (Fig. 5A,B). The larvae found in the nests were white in color and varied in size according to stage, measuring 1.9-3.2 mm in length (Fig. 6). They were found in large numbers together with pupae in the damp soil of the nests. The pupae were white in color, found inside orange-colored cocoons (Fig. 7) and measured 4.45mm in length. Eggs were not found in the nest soils.

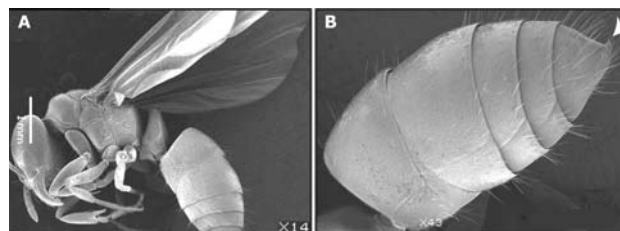


Fig. 3. Scanning electron micrograph of female *Pachycondyla sennaarensis* (A) lateral view, (B) ventral view of abdomen showing sting (arrow).

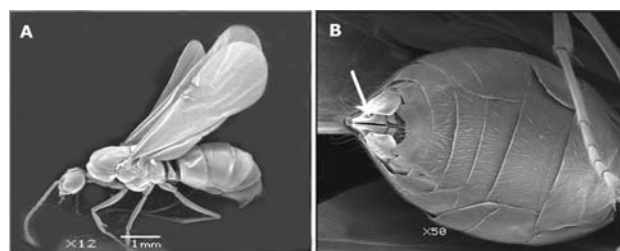


Fig. 4. Scanning Electron Micrograph of male *Pachycondyla sennaarensis* (A) lateral view, (B) ventral view of abdomen showing copulatory apparatus (arrow).

Other ant species present in the collected specimens included *Tapinoma simrothi* Krausse, 1911, *Monomorium niloticum* Emery, 1881, *M. mayri* Forel, 1902 and *Messor meridionalis* (Andre, 1883).

Survey results

The weather data in the five zones during the

years 2008 and 2009 are illustrated in Tables I-V.

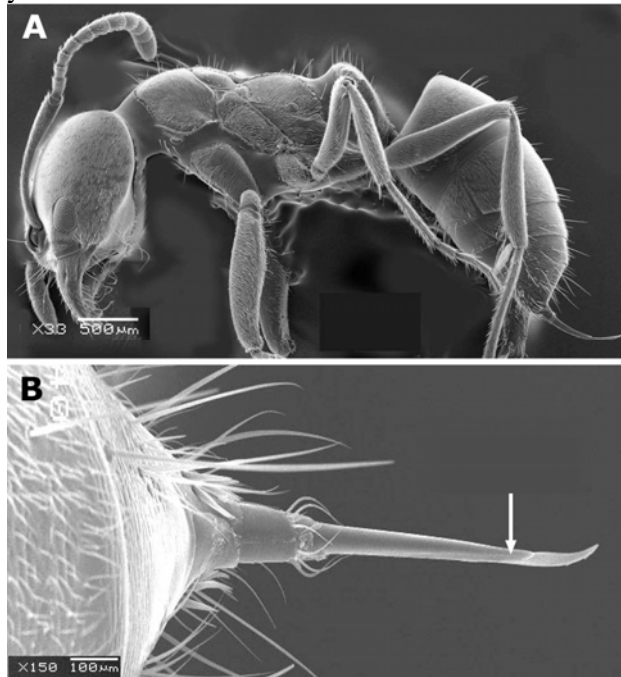


Fig. 5. Scanning electron micrograph of *Pachycondyla sennaarensis* worker (A) lateral view, (B) abdomen showing prominent sting.



Fig. 6. Photomicrograph of different stages of *Pachycondyla sennaarensis* larvae.

North zone of Riyadh

In Majmah Governorate, the following places were surveyed: the farms of Al-A`awajiya, Um-Hazeb, Al-Jaw, Fahd Al-Madlaj and Mohammad Al-Aman as well as a deserted historical city. Wheat and palm trees were cultivated in these farms. In Al-Zulfi Governorate, several streets downtown in Al-Zulfi city and a central square in Alaqa Village were surveyed. The farms of Abdul-Aziz and Saud Al-Farraj, of Al-Shamaliya in Shamaliyat Jalajil and of

Abu Dakhil Sulaiman were surveyed; palm trees and vegetables were present in these farms. The public garden in Hawtat Al-Sudayr containing ornamental shrubs and children play area and a square in Al-Quds district were also surveyed. No ants were found during any of the four seasons throughout both years in Majmah and Al-Zulfi Governorates.



Fig. 7. Photomicrograph of different stages of *Pachycondyla sennaarensis* pupae and their cocoons.

Table I.- Range of means of air and soil temperature, relative humidity and rain fall density in the north zone of Riyadh Region.

Season	Range of means of			
	Air temp. (°C)	Soil temp. (°C)	Relative humidity (%)	Rainfall (mm)
2008				
Winter	12.0-19.0	10.5-20.0	34-45	0.0-5.0
Spring	24.0-31.5	20.4-25.7	30-38	0.0-70.6
Summer	31.0-36.0	23.2-25.2	11-25	0.0
Autumn	21.4-33.0	23.9-25.0	22-48	0.0-129.5
2009				
Winter	12.5-18.4	11.0-18.8	39-55	0.0-7.0
Spring	20.5-32.0	19.4-30.9	32-41	4.8-17.4
Summer	34.0-35.6	32.9-34.5	19-24	0.0
Autumn	25.3-35.2	18.2-32.9	25-35	0.0

Table II.- Range of means of air and soil temperature, relative humidity and rain fall density in the south zone of Riyadh Region.

Season	Range of means of			
	Air temp. (°C)	Soil temp. (°C)	Relative humidity (%)	Rainfall (mm)
2008				
Winter	10.0-19.0	11.8-17.6	31-36	0.0-13.5
Spring	23.0-32.0	21.8-32.5	18-25	0.0-23.6
Summer	34.0-36.2	35.1-35.7	14-18	0.0
Autumn	20.0-31.0	18.8-32.7	14-25	0.0
2009				
Winter	14.0-16.0	11.6-11.8	29-41	0.0-11.0
Spring	24.0-32.0	20.4-32.2	34-43	0.0-49.0
Summer	31.0-34.5	34.0-35.0	24-25	0.0
Autumn	20.0-32.0	19.1-34.0	26-50	0.0

Table III.- Range of means of air and soil temperature, relative humidity and rain fall density in the east zone of Riyadh Region.

Season	Range of means of			
	Air temp. (°C)	Soiltemp. (°C)	Relative humidity (%)	Rainfall (mm)
2008				
Winter	15.0-16.0	15.0-18.0	55-67	0.0-2.7
Spring	19.0-30.0	20.0-32.0	40-57	2.0-31.0
Summer	34.0-35.0	35.0-36.0	24-25	0.0
Autumn	20.0-30.0	22.0-32.0	31-48	0.0
2009				
Winter	10.5-13.0	11.0-14.0	62-72	0.0-11.7
Spring	14.5-28.0	14.0-28.0	20-45	0.0-1.4
Summer	33.0-37.0	34.0-38.0	15-24	0.0
Autumn	19.0-31.5	21.0-32.0	27-58	0.0-26.0

Table IV.- Range of means of air and soil temperature, relative humidity and rain fall density in the west zone of Riyadh Region.

Season	Range of means of			
	Air temp. (°C)	Soiltemp. (°C)	Relative humidity (%)	Rainfall (mm)
2008				
Winter	15.0-16.5	12.6-13.7	22-50	0.0-21.0
Spring	20.0-33.0	18.5-32.9	20-24	0.0-5.0
Summer	-37.5-33.0	31.1-36.9	13-19	0.0
Autumn	-23.5-17.5	18.4-25.6	23-45	0.0-97.0
2009				
Winter	12.5-17.0	10.7-15.5	38-55	0.0-30.0
Spring	20.0-31.0	19.2-32.0	29-38	0.0-38.0
Summer	33.0-34.0	34.0-34.8	20-25	0.0
Autumn	20.0-29.0	19.1-30.1	20-28	0.0

Table V.- Range of means of air and soil temperature, relative humidity and rain fall density in Riyadh city.

Season	Range of means of			
	Air temp. (°C)	Soiltemp. (°C)	Relative humidity (%)	Rainfall (mm)
2008				
Winter	12.0-15.0	13.1-17.9	44-53	0.0-1.5
Spring	22.5-32.5	21.5-30.1	29-32	0.0
Summer	35.0-37.0	28.9-31.1	22-24	0.0
Autumn	21.0-33.0	21.9-31.8	30-55	0.0
2009				
Winter	12.0-18.0	12.7-18.9	35-50	0.0-1.5
Spring	26.5-34.0	19.7-28.2	28-44	1.4-27.5
Summer	36.0-37.5	32.9-36.6	23-27	0.0
Autumn	20.5-33.0	26.9-36.6	30-35	0.0

In Al-Ghat Governorate, the following places were surveyed: Al-Ghat city, the farms of Al-Sa`adoon and Abdalla Al-Ureify as well as a garden on the old highway to Al-Zulfi. Corn and palm trees were cultivated in these farms. No ants were found during any of the four seasons during 2008, but many ants were found in the street at the entrance of Al-Ghat city during spring and summer of 2009.

South zone of Riyadh

In Al-Hariq Governorate, forager workers and colonies were found in Seif Al-Hazzani's farm, in another nearby farm south of Al-Khashab Village, and in Al-Nabawah farm. In Al-Aflaj Governorate, Khalaf Zeid farm, Al-Nab`a dairy and poultry farm, as well as the public garden were surveyed. In Hawtat Bani Tamim Governorate, the public garden and a farm 100km south of Riyadh city were surveyed. Palm trees and grassy plants were present in the farms while ornamental shrubs were present in the public gardens. In all of the three Governorates, Al-Hariq, Al-Aflaj and Hawtat Ban Tamim, forager ants were present in the surveyed areas throughout both years and were more heavily present during spring and summer. Also, monogynal and large polygynal colonies were present and were found to include also numerous males and hundreds of workers.

East zone of Riyadh

In this zone, Higrat Sa`ad and the Sa`ad national park were surveyed. While no ants were found during 2008, many forager ants were found in this zone during spring and summer of 2009.

West zone of Riyadh

In this zone, Huraimela`a, Al-Qasab, Durma and Shaqra Governorates were surveyed. In Huraimela`a and Al-Qasab Governorates, only small numbers of forager ants were found in the public gardens of these Governorates during the first year. However, large nests containing all caste types were found in the public garden in Shaqra Governorate during the second year. In Durma Governorate, small nests containing few ants were found in the public garden while in Qusur Al-Muqbel rest houses only a few forager ants were found. The public gardens and the rest houses in all places contained

ornamental shrubs and children play areas.

Riyadh city

In this city, streets, gardens, public parks, and university and hospital housings in all districts were surveyed. Forager ants were found in every surveyed place during both years of investigation, being more heavily present during spring and summer.

DISCUSSION

The results of the present study indicate that *P. sennaarensis* managed to survive the extremely dry weather of Riyadh Region by building their nests in wet soil in gardens, parks, agriculture fields, road side plantations and near human settlements. However, these ants did not establish detectable colonies in most of the northern zone of Riyadh (Majmah and Al-Zulfi Governorates). Forager ants were detected only during the second year in Al-Ghat Governorate in the north zone and in investigated areas in the east zone. Also, while the ants were detected in small numbers during the first year in Huraimela`a, Al-Qasab and Shaqra in the west zone they were found in large numbers during the second year. Such observations suggest that this ant was, and probably is, in the process of spreading into new localities. Generally, wherever the ants were detected they were present more heavily during the very hot and dry spring and summer seasons. In spring, the mean air and temperatures were up to 33°C and 32.9°C, respectively, and the mean relative humidity and rain fall were rarely above 40% and 38.0mm, respectively. In summer, the mean air and soil temperatures were up to 37.5°C and 36.9°C, respectively, and the mean relative humidity was rarely above 25% while no rainfall took place.

Man-altered habitats in KSA are actively increasing, and human constructions such as irrigated road side plantations, gardens and parks are the dominant means of spread of this ant in the surveyed areas in KSA. Such human activities provide further opportunities for the invasion of this successful species into new locations. In a similar finding, Targari and Paknia (2005) found that *P. sennaarensis* had established only in urban and rural areas and was closely tied to human activity in Lar

County in Iran.

Collingwood (1985) suggested that the Arabian Peninsula is probably the northern limit of *P. sennaarensis* distribution. On the other hand, Paknia (2006) reported that it had spread into more human settlements in Iran in the southern provinces of Sistan-Baluchestan, Kerman, Fars, Hormozgan and Bushehr, with the Jiroft City (28° 41'N) representing the northernmost extension of this species worldwide. However, Collingwood and Agosti (1996) reported this ant from Kuwait (extending from 28° 24' N to 30° 00' N), which is more northern than Jiroft City. Human commerce has probably played a major role in transferring *P. sennaarensis* from Africa to the Arabian Peninsula and Iran across the red sea and Arabian Gulf (Collingwood *et al.*, 1997).

In addition to *P. sennaarensis*, which pose a potential health hazard in urban areas, many arthropods have probably entered KSA on imported goods. Local environmental and health care departments should develop strict routine monitoring programs for this and other harmful species or they may enter unnoticed before their harmful effect on local ecology or public health is realized. Also, information on the entomofauna of the Arabian Peninsula is still scarce and there is a need for extensive studies to obtain appropriate information on desert biodiversity in the light of the considerable habitat alteration taking place in all of the countries in this Peninsula.

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REFERENCES

- AKBARZADEH, K., TIRGARI, S., NATEGHPUR, M. AND ABAEI, M.R., 2006. The first occurrence of fire ant *Pachycondyla sennaarensis* (Hymenoptera: Formicidae), southeastern of Iran. *Pakistan J. biol. Sci.*, **9**: 606-609.
- AL-ANAZI, M., AL-SHAHRANI AND AL-SALAMAM, M., 2009. Black ant stings caused by *Pachycondyla sennaarensis*: A significant health hazard. *Anals. Saudi Med.*, **29**: 207-211.
- AL-SHAHWAN, M., AL-KHENAIZAN, S. AND AL-KHALIFA, M., 2006. Black (samsum) ant induced anaphylaxis in Saudi Arabia. *Saudi med. J.*, **27**: 1761-1763.
- COLLINGWOOD, C., 1985. Hymenoptera: Fam. Formicidae of Saudi Arabia. *Fauna of Saudi Arabia*, **7**: 230-302.
- COLLINGWOOD, C.A. AND AGOSTI, D., 1996. Formicidae (Insecta: Hymenoptera) of Saudi Arabia (Part 2). *Fauna of Saudi Arabia*, **15**: 300-385.
- COLLINGWOOD, C.A., TIGER, B.J. AND AGOSTI, D., 1997. Introduced ants in the United Arab Emirates. *J. Arid Environ.*, **37**: 505-512.
- DIB, G., FERQUSON, R.K. AND SLJIVIC, V., 1992. Hypersensitivity to samsum ant. *Lancet*, **339**: 552-553.
- DIB, G., GUERIN, B. AND BANKS, W.A., 1995. Systemic reactions to the samsum ant: An IgE-mediated hypersensitivity. *J. Allerg. Clin. Immunol.*, **96**: 465-472.
- LEVIEUX, J. AND DIOMANDE, T., 1978. La nutrition des fourmis granivores. II. Cycle d'activité et régime alimentaire de *Brachyponera sennaarensis* (Mayr) (Hymenoptera, Formicidae). *Insect. Soc.*, **25**: 187-196.
- MAYR, G., 1862. Myrmecologische Studien. *Verhandl. Zool.-botan. Gesellsch. Wien*, **12**: 649-776.
- PAKNIA, O., 2006. Distribution of the introduced ponerine ant *Pachycondyla sennaarensis* (Hymenoptera: Formicidae) in Iran. *Myrmecol. Nachricht.*, **8**: 235-238.
- TAYLOR, B., 2005. *The ants of Africa* <http://antbase.org/ants/Africa/distribution_cards/Pachycondyla_sennaarensis.htm>, retrieved on 14 February 2006.
- TIRGARI, S. AND PAKNIA, O., 2005. First record of ponerine ant (*Pachycondyla sennaarensis*) in Iran and some notes on its ecology. *Zool. Middle East*, **34**: 67-70.
- WHITCOMBE, R.P., 1982. *Ants (Formicidae) especially those associated with honeybees (Apis spp.) from the Sultanate of Oman*. Report VII 2C No 3. Durham University. Khabura Development Project. 28pp.
- WHEELER, W.M., 1922. Ants of the American Museum Congo Expedition. A contribution to the myrmecology of Africa. I. On the distribution of the ants of the Ethiopian and Malagasy regions. *Bull. Am. Mus. nat. Hist.*, **45**: 13-37.

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