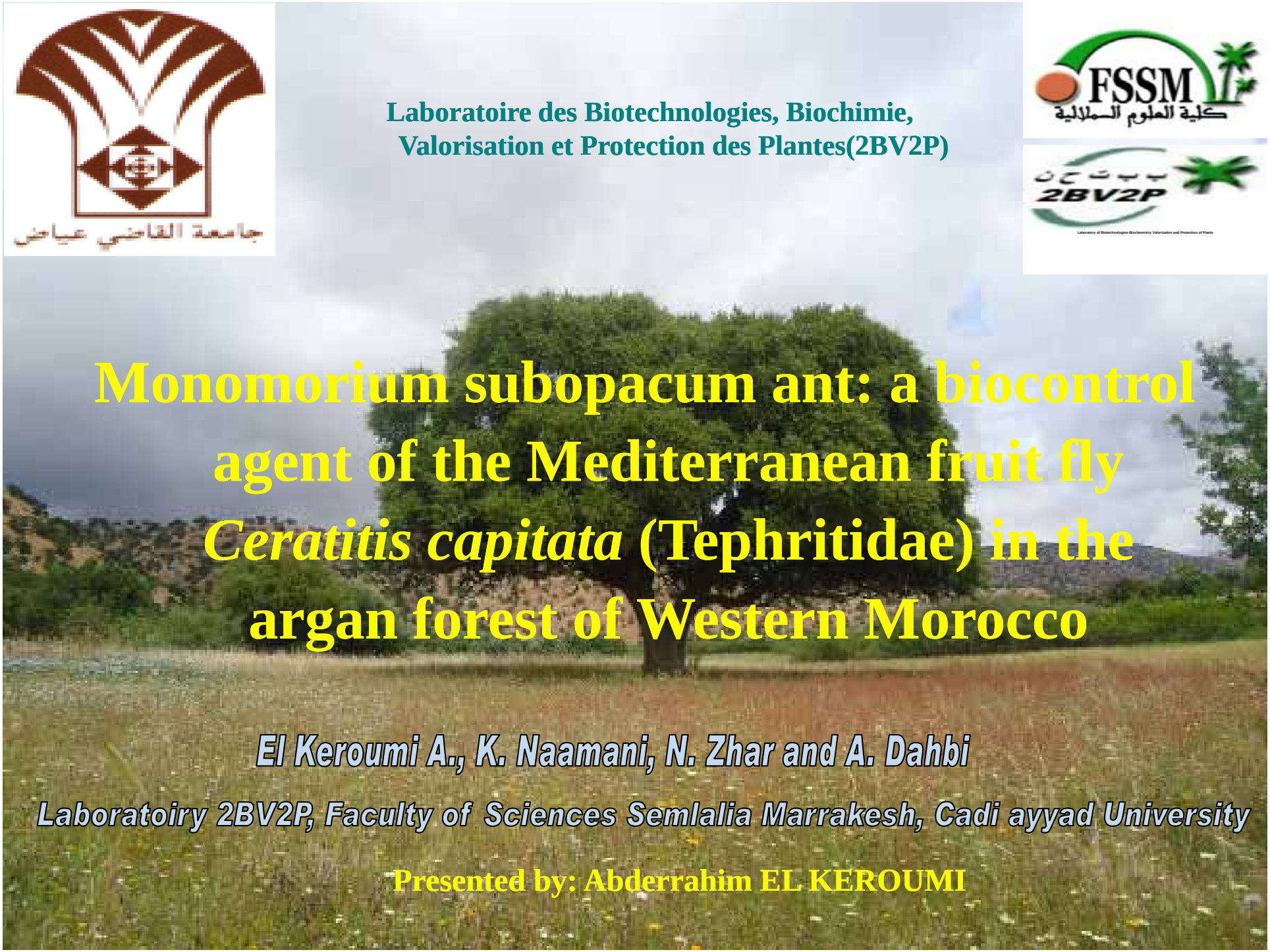

Laboratoire des Biotechnologies, Biochimie,
Valorisation et Protection des Plantes(2BV2P)

Monomorium subopacum ant: a biocontrol agent of the Mediterranean fruit fly *Ceratitis capitata* (Tephritidae) in the argan forest of Western Morocco

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Plan

- Introduction
- Objective of this research
- Part I: Argan forest ant community
- Part II: Predation by ants and abiotic factors of Ceratite larvae mortality below argan trees.
- Part III: Synchronisation of *M. subopacum* circadian activity and the emergence of *Ceratitis capitata* larvae from argan fruit
- Conclusion

Introduction

1. Argan tree

Argania spinosa, **F/ Sapotacées**

- Endemic and emblematic tree of southwestern Morocco, with ecologic and socio-economic roles.
- Reserve of the Biosphere by UNESCO since 1998.

But the arganeraie = gigantic reservoir for the proliferation and dissemination of *Ceratitis capitata*

2. Ceratitis capitata (Wied)

- The most devastating pest of Tephritidae
- World-wide problem of agricultural production
- In Morocco, losses were estimated by 77,062,600 Dh (IAEA, 1990)

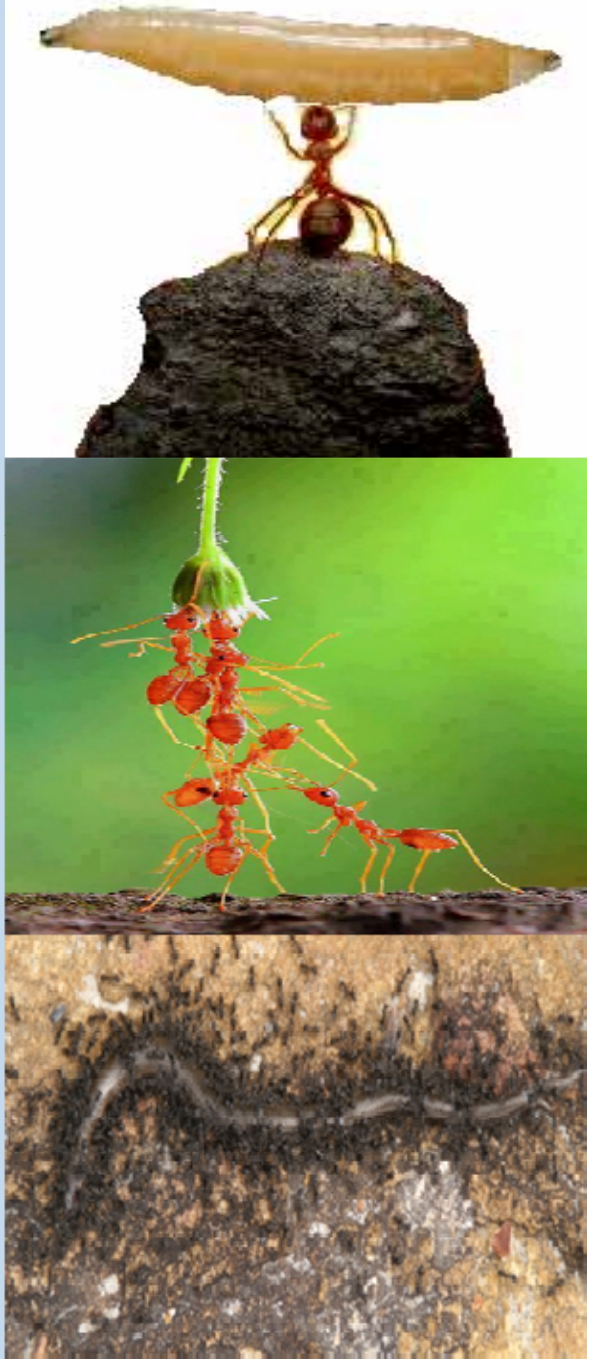
3. Ants in the biocontrol

✓ Recently, ants were verified among the biocontrol agents of more than 50 phytophagous pests (caterpillars, bugs, beetles, flies and trips) in divers ecosystems.

✓ Multiple attributes reinforce the role of ants as promising candidates in the biological control

They are :

- First organisms used against agricultural pests.
- Major components of various terrestrial ecosystems
- Major predators that regulate populations of terrestrial arthropods.



Objectives of this Work

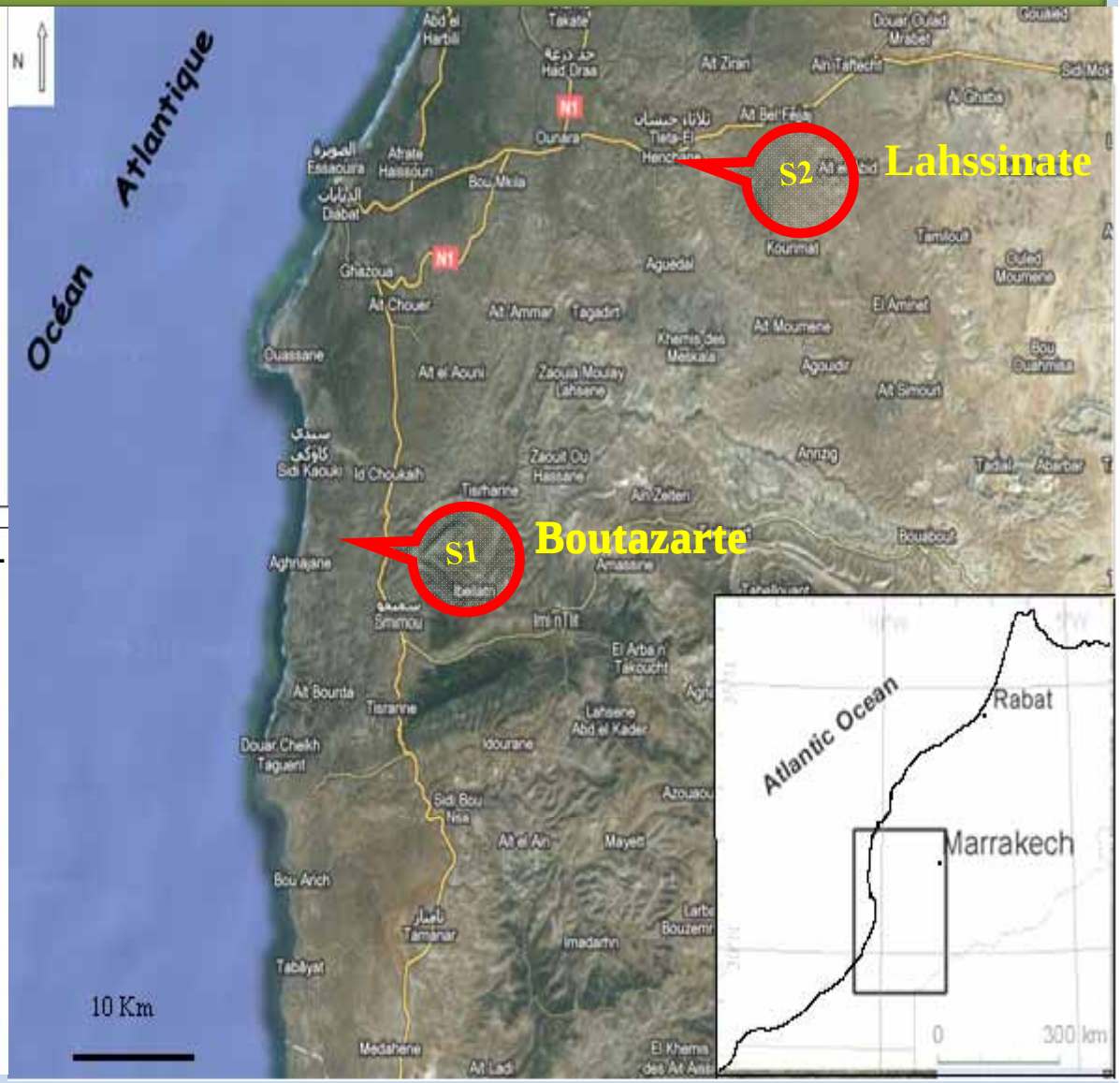
- Argan forest ant species and the ecological attributes of diversity, distribution and seasonal phenology that characterize their communities.

- The role of predatory species and abiotic factors on the mortality of the Medfly larvae in the argan forest.

- Synchronisation of the circadian activity of predatory ants *M. subopacum* and the emergence of the Med-fly larvae from argan fruit in the population control of the Ceratite in the Argan forest

Part I:
Composition and Diversity of argan forest ant community

Materiels and methods: Study sites (Boutazarte and Lahssinate)

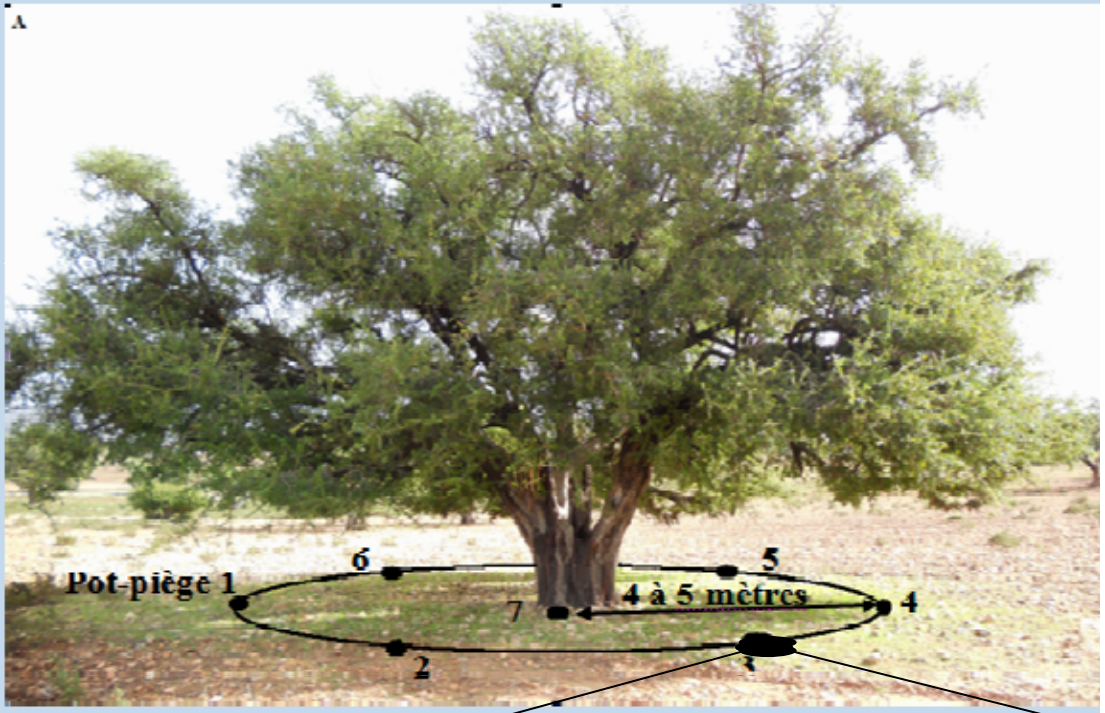


Photographs showing the physiognomy of the two arganeraie study sites. a) Boutazarte (coastal site), and b) Lahssinate (semi-continental site) in the argan forest.

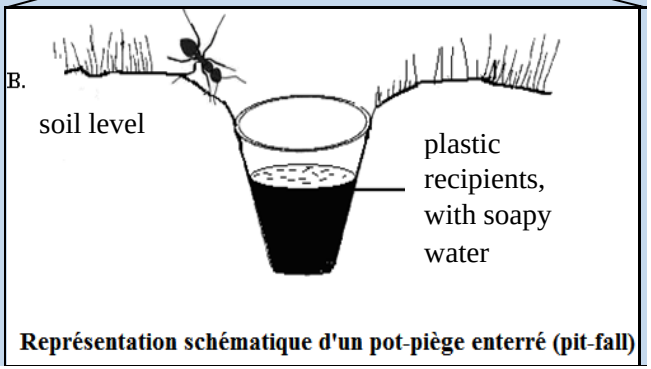
Materiels and methods: Ant sampling (pitfall trap technique)

The study of Argan forest ant community was based on periodical sampling in two chosen sites within the argan forest during the four seasons by the pitfall-traps technique .

- In each site, 10 Argan trees were chosen
- 7 pitfall traps were installed per tree.
- Pitfall traps were left 24h before they were collected
- In the laboratory, ant specimens were separated from other collected fauna and species were identified.



Schematic representation of the location of the pitfall-traps under argan trees



Représentation schématique d'un pot-piège enterré (pit-fall)

Results

Table 1: Total capture, Abondance and Contribution to spatial and seasonal dessimilarity of collected ant species in the study sites

			Boutazarte		Lahssinate	
Les espèces (13)	% dessimilarité		Capture	Abondance moyenne	Capture	Abondance moyenne
	Season	Site				
Fam. Myrmicinae (8sp.)						
Aphaenogaster praedo	2.25	2.11	42	1.26	74	0.81
Aphaenogaster ssp.senilis	3.01	3.4	38	1.14	130	1.42
Aphaenogaster theryi	0.25	0.21	5	0.15	4	0.04
Messor picturatus maura	0.25	0.25	3	0.09	64	0.7
Messor vaucheri	1.28	1.43	7	0.21	219	2.39
Messor capitatus	0.45	0.6	3	0.09	16	0.17
Monomorium subopacum	42.64	40.05	2263	67.84	4540	49.49
Crematogaster scutellaris algerica	0.49	0.33	10	0.3	3	0.03
Fam. Formicinae (4sp.)						
Cataglyphis albicans vaucheri	3.87	2.99	199	6	40	0.44
Cataglyphis viatica	1.41	1.33	17	0.51	103	1.12
Camponotus erigens	0.72	0.56	15	0.39	6	0.07
Camponotus lateralis						
Fam. Dolichoderinae (1sp.)	0.96	1	6	0.15	70	0.74
Tapinoma simrothi	21.83	23.73	730	21.88	3907	42.59
Total			**3338**	**(27%)**	**9176**	**(73%)**

✓13 ant species were captured below argan trees

✓Ants are more abundant at the semi-continental than at the coastal site

✓ 2 two ant species, *Monomorium subopacum and Tapinoma simrothi,* predominated in the arganeraie

Part II:

Predation by ants and abiotic factors of Ceratite larvae mortality below argan trees

Materiels and methods

- In each site, 130 larvae (L3) were experimentally deposited under argan trees within 30 min at most, from 08:00 to 18:00 h during 2 weeks in the late spring (season of argan fruit maturity)

- For each bioassay, event known by each larvae (burrowing or died by predators or by heat shock), the latency of each events and the abiotic factors (soil temperature, texture of the ground, exposure of larvae) were recorded.

- Predatory ant species are identified.

- Predatory behavior of the ant *Monomorium subopacum* was described

Results :

Table 2. Main larval fate of *C. capitata* larvae after their experimental release under Argan trees at the Boutazarte and the Lahssinate site

	Lahssinate	Boutazarte	Total
Burial	**79 (61.54%)**	**72 (55.38%)**	**152 (58.46%)**
Death by heat shock	**27 (20.00%)**	**31 (23.85%)**	**57 (21.92%)**
Predation by arthropods	**24 (18.46%)**	**27 (20.77%)**	**51 (19.62%)**

- Predators were responsible for almost 20% of mortality cases of fruit fly larvae
- Four ant species (*M subopacum., T. simrothi, C. viatica and M. maura picturatus)* occasioned 94% of predation

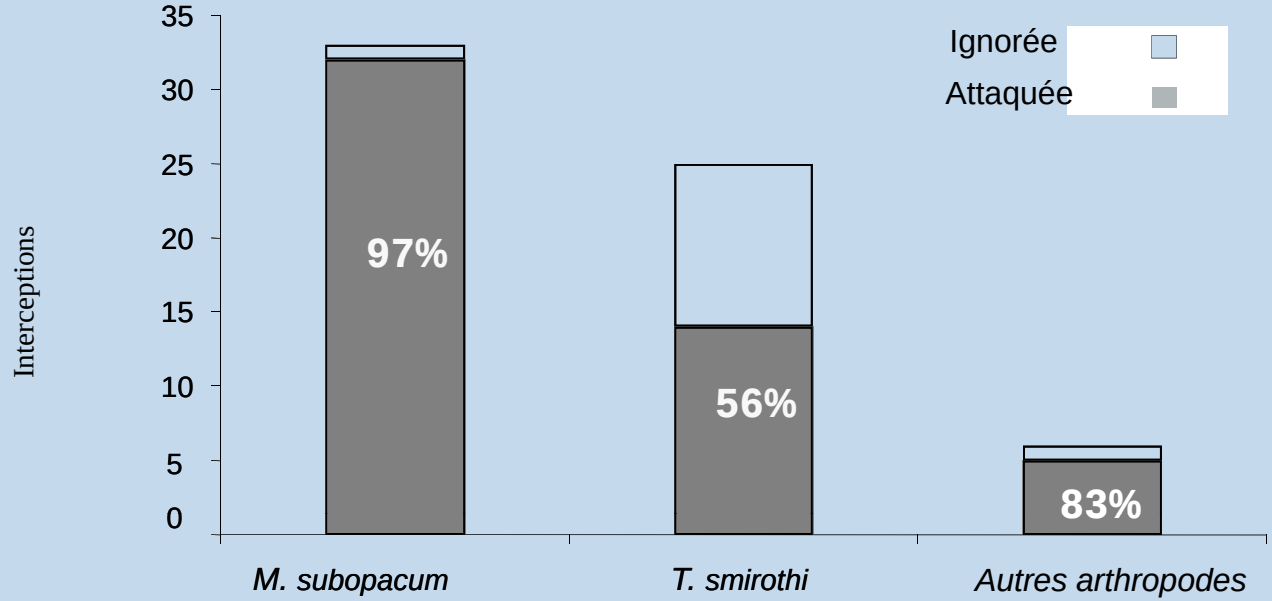


Figure 1: number of attacks Vs 'ignorance' of fruit fly larvae by *M.subopacum, T. simrothi* and other arthropods

Figure 2: *Monomorium subopacum* ant
photo from AntWeb.org

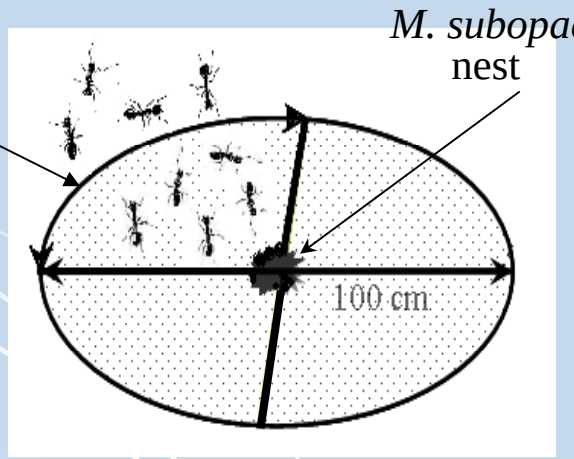
Part III:

Synchronisation of the circadian activity of predatory ants *M. subopacum* and the emergence of the Med-fly larvae from argan fruit

Materiels and methods

Quantification of foraging activity of M. subopacum

- *3 M. subopacum nests* chosen under argan trees.



Quantification of ant Activity on *M. subopacum* nest

Quantification of emergence of mature larvae from argan fruit

- In field condition

Naturally infected fruits placed under Argan trees
Emerged larvae are continuously recorded every hour (for 48 hours)

- In laboratory

- Monitoring the rate of emergence was made every hour continuously until exhaustion emergences (total absence of larvae L3).

Results

M. subopacum circadian rhythm activity

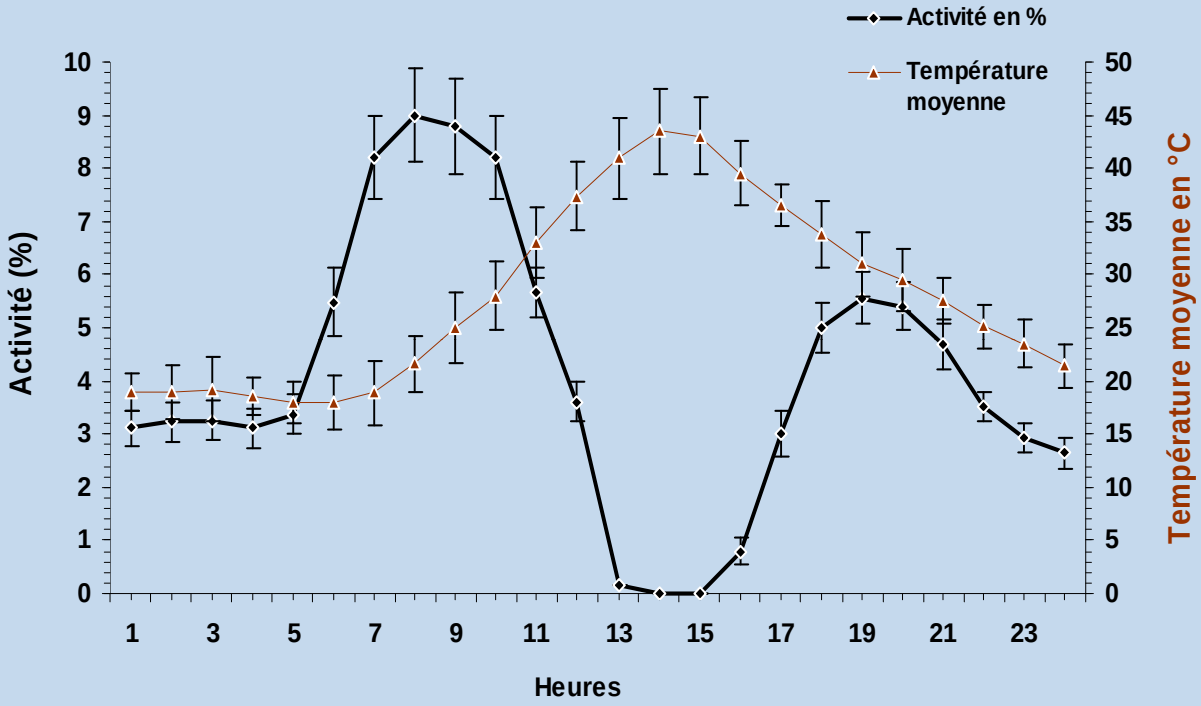


Figure 3: The hourly average activity of *M. subopacum* ant below argan trees

- ✓ - *M. subopacum* is a diurnal species with a bimodal activity rhythm; a main peak between 6am and 11am and secondary peak between 16am and 21am.
- ✓ - The activity of this species is minimal, even nil at maximum temperatures of the day

M. subopacum circadian rhythm activity and dynamic of medfly larvae emergence from argan fruit

Rhythm of Ceratite larvae emergence

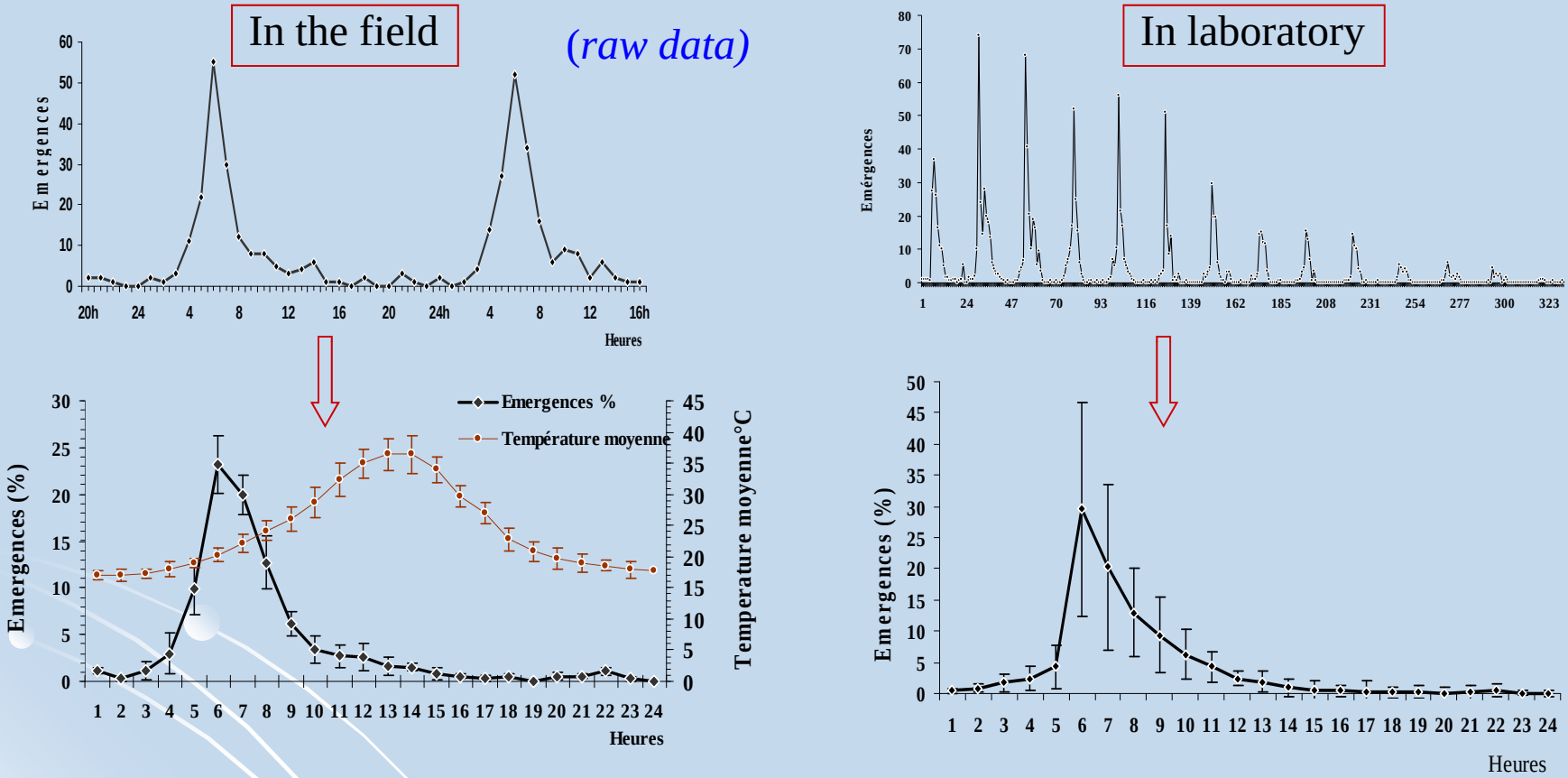


Figure 4: the hourly average of emergence of fruit fly larvae during the nycthemeron

- The emergence with unimodal rhythm and a peak at the beginning of the day reaches its maximum between 6 and 8 hours
- The period between 6am and 7am represents median time of emergence (50% of total emergence)

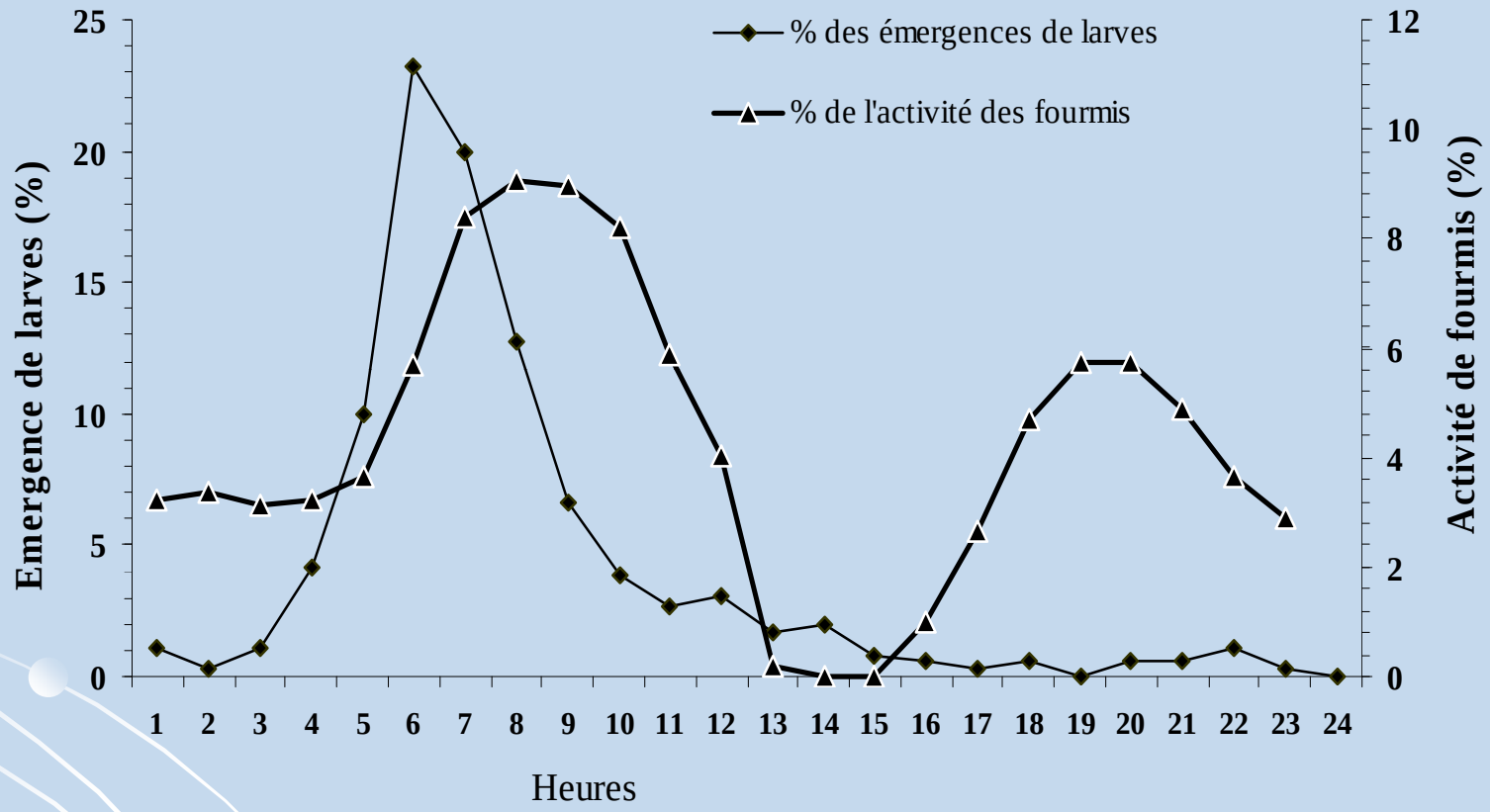


Figure5: concordance of daily hour average activity of *C. capitata* larvae emergence and the locomotor activity rhythm of *M. subopacum*.

Conclusion

Conclusions and perspectives

✓ ***M. subopacum*** **is a dominant species in spatial and seasonal scale in the argan forest.**

✓ ***M. subopacum*** **is the most important species involved in predation of fruit fly larvae below argan fruit.**

✓ **The activity of *M. subopacum* and the emergence of the Mediterranean fruit fly larvae show a marked synchronization and overlapping in their activity rhythms.**

✓ **Those attributes can improve the entomological importance of *M. subopacum* predatory ant as suitable agent of the regulation of *Ceratitis capitata* populations in the argan forest and the neighboring Citrus orchards in the Souss and Lhaouz regions of southwestern Morocco.**


Thanks for your attention