

Toxicity Evaluation of *Dittrichia viscosa* L's Aqueous Extracts in Combination with Bio-Adjuvant *Silene fuscata* on *Chaitophorus leucomelas* Koch. (Hom., Aphididae) and on Biocenotic Resumption of Functional Groups

Fatma zohra Tchaker⁽¹⁾, Othmane Merah^(2,3), Zahr-Eddine Djazouli^{✉(1)}

ABSTRACT

Phytosanitary interventions present harmful effects on environment and favour development of noxious insects resisting to active materials. Copious works took an interest to research of alternative methods to pesticides. Our study aim is to increase extracts toxicity of plant with insecticide activity and to evaluate global efficiency of bio-active molecules. Results have shown important effect of aqueous extracts from *Dittrichia viscosa* on the availability of *Chaitophorus leucomelas* (Hom., Aphididae) with a moderate resumption under the effect of extracts compared to the action of active substance. Analyses showed that aqueous extract ratio of *Dittrichia viscosa* / *Silene fuscata* had an effect more toxic on *C. leucomelas* compared to aqueous extract of the whole *D. viscosa* plant and extracts of different organs. Results pointed out the great discrepancy related to the structuring and arrival order of functional groups under different stress. Biocenotic resumption of functional groups was important under biologic stress effect compared to chemical stress.

Keywords: Bio-adjuvant, Aqueous extract, Insecticide activity, *Chaitophorus leucomelas*, *Populus nigra*, Residual population.

INTRODUCTION

The poplar has an economic importance which cannot be neglected world-wide. As a matter of fact, it is about of pre-eminent production forestry, with rapid growing and easy regeneration that can contribute to fill world-wide deficit in wood (Chevallier, 2000). Countless number of threatening and common species

are associated to poplars (Rotach, 2004). Among these pests, they are known to be heavily attacked by the free-living aphid *Chaitophorus leucomelas*, that has a wide distribution in Europe, Asia, North and South America and North Africa (Heie, 1982; Muñoz and Beeche, 1995; Djazouli *et al.*, 2012). This aphid can reduce plant growth up to 15% (Ramírez *et al.*, 2004; Ramírez and Verdugo 2009; Rubio-Melendez *et al.*, 2011). It has been considered dreadful destroyer for two main reasons (Sauvion, 1995): First of all, they enfeeble directly the plant by removing from phloemienne sap, a part of photosynthesis products, whose amino acids being essential to the plant. These samplings during massive infesting by aphids might cause a stop of plant's growing (Miles, 1989). Second reason is indirect where aphids may favor fungal diseases proliferation, either by

¹ Université Blida 1. Faculté des Sciences de la Nature et de la Vie. Département des Biotechnologies. B.P. 270, route de Soumâa, Blida (Algeria)

² Université de Toulouse, INP-ENSIACET, LCA (Laboratoire de Chimie Agro-industrielle), F-31030 Toulouse, France

³ INRA, UMR 1010 CAI, F-31030 Toulouse, France

✉ zola.tchaker@hotmail.fr

Received on 4/8/2015 and Accepted for Publication on 29/12/2015.

transporting spores, or causing stronger spores' capture when plant becomes slimy with honey dew (Comeau, 1992). Causing consequently a great economic loss. It is therefore necessary to oversee and to preserve poplars' species in ecosystems (Rotach, 2003).

Phytosanitary state management of poplars groves is exclusively limited to chemical pesticides use, as much as way struggle, easy-use, efficient and reliable. These practices have generally an action on environment which widely exceeds target officially aimed and can also create unbalance between populations component ecosystems-agro; hence conflicts birth between agriculture and biodiversity (Thomas, 1999).

These unavoidable conflicts might be avoided thanks to agricultural strategy adoption that could have various ecologic and socioeconomic advantages, notably with regard to food security (Howard-Borjas and Cuijpers, 2002). From this perspective, recourse to biologic methods, particularly through use of plants' aqueous extracts endowed with insecticides activities offer a certain potentiality (Gomez *et al.*, 1997).

In fact, *Dittrichia viscosa* (L.) (Asteraceae), a perennial weed, native to the Mediterranean Basin (Pignatti, 1982), has been used for different therapeutic purposes in traditional pharmacopoeia. Numerous compounds have been isolated and identified from this plant such as flavonoids (Hernández *et al.*, 2007), monoterpenes (Pérez-Alonso *et al.*, 1996) triterpenoids, sesquiterpene lactones and sesquiterpene acids, all structurally related to ilicic acid (Fontana *et al.*, 2007) and polyphenols (Danino *et al.*, 2009). Extracts from this plant have also exhibited phytotoxic (Dor and Hershenhorn, 2004), nematicidal (Oka *et al.*, 2006), antifungal (Cohen *et al.*, 2006) and acaricidal activity (Mansour *et al.*, 2004). *D. viscosa* plays an important role as the host plant for the aphid predator (Perdikis *et al.*, 2007), however its defensive chemistry against

herbivore insects remains unknown.

General context of present study, aimed to discover ways to improve efficiency of bio-pesticides and to estimate global efficiency of bioactive molecules through formulations extending retentivity to the field where incorporating of synergist products *Silene fuscata* (Caryophyllaceae) that is used for the first time as a bio-adjuvant

Giving rise to a non toxic complex when added to aqueous extracts of *D. viscosa*. This combinaison, improves performances of actives principles and allows notably doses reductions, limiting so, their impact on fauna and flora and in final compensate for losses problems during bio-products use. From this perspective, first role of bio-adjutants being necessity to modify physicochemical properties of bio molecules with insecticide activity. Also, it is interesting and useful to improve security and use commodity of these products, their stability and eventually their ability to penetrate into bio attacker.

2. MATERIEL AND METHODS

2.1. Study site

The study has been performed under natural conditions at level of two stations of artificial poplar groves of 8-year- old in central Mitidja; more accurately in region of Soumâa (Algeria). This last one is situated at piedmont of Blidien Atlas at altitude of 80 to 100 m, longitude of 2°45' and latitude of 36° 35' (Loucif and Bonafonte, 1977). During the year of study (2012), cold temperature has been recorded in December with an average of 11°C, while hottest temperature was at July 1st with 33.2°C. Rain-gauge quotient of Emberger Q3 (Sauvage, 1963) classifies study site in subhumid bioclimatic with a soft winter.

2.2. Insect material

Biologic material is limited to individuals of *C. leucomelas* that developed on senescent leaves of *Populus nigra*. This last one is a monoecique insect with evolutive heterogametic cycle characterized by rotating between amphisexual generation and one or generally several generations belonging only parthenogetic females (Grasse *et al.*, 1970). During its development, it is covered by various fauna groups such as ants. Interactions between ants and aphids spread out from mutualism to antagonism. The first ones look for protection and hygiene, while the second ones look for acquisition of nutritional resource that brings the best energy balance-sheet (Devigne and Detrain, 2005). From this perspective containing bio-attacker and its functional groups that estimation of global efficiency of molecules has been advanced.

2.3. Plant material and preparation of aqueous extracts

Retained plant material for aqueous extracts preparation is limited to two spontaneous plants frequent in the Mediterranean region; *Silene fuscata* (Caryophyllaceae) and *Dittrichia viscosa* (Asteraceae). Specimens have been harvested in mountainous region of Chrea (at altitude 980m) at flowering stage during summer and autumn periods. Harvested plants are separated by organ (leaves, stems and roots), cleaned, dried outside sheltered from light and humidity. Plants were ground in powder by propellers mixer (Molinox). Aqueous maceration has been done where 20g of vegetable powder were added to 250ml of distilled sterile water set in hermetic small bottles and submitted to horizontal shaking for 72 hrs at room temperature (25°C). Homogenates have been at first filtrated with help of sterile compresses, then by through of Wattman paper (n°1). The raw extracts obtained have been then,

aseptically kept in Roux sterile bottles of 25cm³ wrapped by aluminium paper to avoid any light damage of molecules, then kept in refrigerator until used (De Souza *et al.*, 1995).

2.4. Phytosanitary products

Pesticide having proved its compared efficiency and product based of the two active substances Thiamethoxam and Lambda-cyhalothrin belonging to two different chemical families neonicotinoids / pyrethroids. The molecule of the neonicotinoids is endowed of three action ways (contact, ingestion and systemic) in jamming membranous permeability and opening of sodium channels (Couteux and Lejeune, 2012).

2.5. Treatments and samplings technique

At the two poplar groves, one has been reserved to biologic applications, whereas the other has been reserved to chemical ones. Three ways of aqueous extracts contribution have been applied which were: extracts of the whole *D. viscosa* plant, aqueous extracts based of different organs (leaf, stem and root) of *D. viscosa* and ratio aqueous extracts of *D. viscosa* and *S. fuscata* at two different dilutions Ratio1 (25% of *D. viscosa* and 75% *S. Fuscata*), Ratio2 (50% of *D. viscosa* and 50% *S. fuscata*). As for phytosanitary product (Thiamethoxam and Lambda-cyhalothrin) the prescribed concentrations Rate (4ml/l) and Half-Rate (2m/l) have been used. While none treated control, running water spraying has been applied. The toxicity evaluation of biologic and chemical products on individuals of *C. leucomelas* has been evaluated for a period of 11 days from application time. The experimentation has been performed in completely randomized block design at three repetitions. From 27 micro-plots obtained and each one contained 8 individuals. Three leaves from cardinal points on five trees taken at random were sampled.

Leaves were kept in plastic bags bearing all necessary information to different treatments. Biologic stages of *C. leucomelas* have been identified on base of external morphologic characteristics with help of binocular magnifying glass (8x10). In the mind to estimate reaction of different functional groups at different stress regimes, water yellow traps were used (Benkhelil, 1992). Three traps were set in each micro-spot at a height of 170 cm. Trapped insects were gathered and identified during the four weeks which had followed treatments applications. In this respect, only experimental micro-spots received synthesis product and aqueous extracts of the whole plant have been considered.

2.6. Evaluation of residual populations

Toxicity evaluation of aqueous extracts and synthesis' insecticide has been performed by residual population's estimation (RP) according to Test of Dunnett (Magali, 2009). Test estimates toxicity of active substances according values of RP. $RP < 30\%$ toxic molecule, $30\% < RP < 60\%$ moderately toxic molecule and $RP > 60\%$ weakly toxic molecule or neuter.

2.7. Data analysis

Type GLM variance analyses have been performed with help of F test for variables according to normal law. Averages comparisons of residual populations were followed by Tukey's test. Among variables sharing usually to total variance, those ones whose contribution was significant at level of 0.05 have been retained. Test was pulled down by software SYSTAT vers.12 SPSS.2009. For each tress regime, average values of entomocenose's daily residual populations, have been compared by test of Wilcoxon (Paired t-test) (Burgio *et al.*, 2006). To explore taxa structure under effect of different treatments, frequencies-rank have been drawn and compared to model of Motomura's geometric series:

$\log(N) = aR + b$; there where N is abundance for a taxon and aR is the slope (Iganaki, 1967). Slopes comparison between taxa have been made with help of software PAST ver. 1.81 (Hammer *et al.*, 2001). Covariance analysis has been led in considering slopes as averages and difference type of x as variances. Probability has been calculated by Barlett's test (Hammer *et al.*, 2001).

3. RESULTS

3.1. Molecules' toxicity on *Chaitophorus leucomelas*' organism

Toxicity results of aqueous extracts compared to effect of Thiamethoxam and Lambda-cyhalothrin are shown in Table (1). Its evaluation showed that aqueous extracts with bio-adjuvant represented at the ratio 1 (*D. viscosa* 25% and *S. fuscata* 75 %) and ratio 2 (*D. viscosa* 50% and *S. fuscata* 50%) expressed more important efficiency compared to whole plant with precocious effect and with longer action duration. Fluctuation examination of residual populations under effect of aqueous extracts of the whole plant of *D. viscosa* although it showed a certain delay in expression of its toxicity, it remained the most efficient compared with aqueous extracts of different organs (leaf, stem and root). On the other hand, leaves aqueous extract pointed out pronounced toxicity compared to aqueous extracts of roots and stems. Analysis showed that Thiamethoxam and Lambda-cyhalothrin under prescribed rate (4ml/l) proved to be more toxic that half-rate (2ml/l) with resumption of residual populations very marked, Table (1).

Residual populations of *C. leucomelas* show highly significant different during all exposition period ($P < 0.01$) (Figures 1a and 1c). Globally, aqueous extracts expressed late toxicity which was maintained until the 6th day. Beyond of this period, it was pointed out weak cenotic resumption at the 7th day which increased after the 9th day of exposition (Figure 1a). Temporal development of residual populations showed that

Thiamethoxam and Lambda-cyhalothrin exerted a shock effect which spread on 8th day of the experiment. From the 9th day, we note biotic activity resumption characterized by important increase of effectives (Figure 1c). Rates results of residual populations displayed significant difference between aqueous extracts ratios (1 and 2) and whole plant compared to aqueous extracts of organs (Figure 1b). According to Dunnett's test, Figure 1b showed toxicity expression existence of aqueous extracts in favour of ratio 2, ratio 1, whole plant, leaf and at last root and stem. Results show that Thiamethoxam and Lambda-cyhalothrin expressed the same degree of toxicity under dose and half-dose (Figure 1d).

3.2. Toxicity of molecules on non target organism (Functional group)

Being anxious in checking homogeneity micro-slopes' for each taxon, an apparatus test (Wilcoxon's test) has been realized on the three samplings relating to period before and after treatments at level of each micro-slope. The whole results are summarized in Table (2). It didn't appear discordance of abundance in both poplar groves relating to different taxa's novelties ($P > 0.05$). After a week exposition to biologic and chemical molecules, test of Wilcoxon allowed to confirm presence of abundance difference between taxa favoured by marginal probability. During the second exposition week, a significant difference has been recorded on treated entomofaun populations ($P < 0.05$), (Table 2).

Application of GLM on availability of main functional groups allowed us to deduct biologic model the more sensitive of the one which tolerates toxicity of molecules (Figure 2). Results of aqueous extract showed a moderate toxic activity during the first week of functional groups, after it did lose its insecticide activity to reach rank of weakly toxic products $P = 0.027$; $P < 0.05$) (Figure 2a). In other point of view, we note that aqueous

extract seems to exert its insecticide effect with moderate manner on Hymenoptera pollinisateurs (*Apis mellifera*) and trophobiontes (*Crematogaster scutellaris* and *Tapinoma nigerrimum*). When hymenoptera trophobiontes (*Pheidole pallidula* and *Formica rufa*) and so the coccinellid predator *Oenopia doublieri* seem to be less sensitive to aqueous extract ($P = 0.041$; $P < 0.05$) (Figure 2b). Results relating to residual populations of functional groups following to application of active substance Thiamethoxam and Lambda-cyhalothrin allowed us to say that last one expressed a moderate toxic effect during the first week on the main groups. This toxicity holds up during the second and third weeks and synthesis molecule did not lose its activity only from the fourth exposition's week ($P = 0.035$; $P < 0.05$) Figure (2c). Results showed that active substance causes toxic effect to the whole populations entomofauniques, with a certain tolerance of trophobionte species, *Formica rufa* ($P = 0.059$; $P > 0.05$) (Figure 2d).

3.3. Impact of different stresses regimes on *Populus nigra* entomocenose ecologic organisation

In total, 81 species belonging to 13 insect orders have been harvested in the two study stations where we have tried studying structural aspect of entomofauniques' *P. nigra* settlement according to exposition time to aqueous extracts of *D. viscosa* and active substance Thiamethoxam and Lambda-cyhalothrin. To understand abundance of taxa under effect of applied molecules, we asked for help of geometric series model of Motomura to seize diagrammed rank-frequency in considering logarithmic values of abundances. Adjusting to geometric series of Motomura model, calculated by Pearson's coefficients was statistically significant under action of different stress regimes during all monitoring periods, Table (3).

Test results of Barlett show absence of significant difference at level of rank-frequency profiles confirmed by

abundance stability and entomocenose ecologic organisation of taxa the most dominant which were Diptera, Hymenoptera, Coleoptera and Heteroptera under effect of aqueous extract of *D. viscosa* during all exposition period, (Table 3 and Figures 3a, b and c). The same analyzed type showed that Thiamethoxam and Lambda-cyhalothrin caused significant disturbances on rank-frequency profiles implying abundance reduction and a gap in entomocenose ecological organisation of Diptera, Hymenoptera and Coleoptera, (Table 3 and Figures 3d, e and f). Superposition of diagrammed rank-frequency of biologic and chemical treatments allowed us to note that residual effect of Thiamethoxam and Lambda-cyhalothrin exerted an important pressure on availability of entomofauniques' populations (Figure 3e) compared to biologic treatment (Figure 3b). Furthermore, it was very important to note large divergences relating to structuring of biocenose and to arrival order of taxa under different regimes of stress. Ephemeral residual effect of molecule has allowed resumption of biocenotic activity at its advantage from the second week (Figure 3c). On the other hand, resumption of biologic activity has not been visible in chemical treatment whose availability remained limited (Figure 3f).

4. DISCUSSION

Vegetal origin substances have always constituted major source to make new substances with therapeutic properties. Copious works showed that plants' extracts have been generally identified as important and natural insecticides resource (Rahuman *et al.*, 2009). To obtain a certain toxicological relevance, it is about first, to be interested to relations between storage of compound and its effects (Ashauer *et al.*, 2006). In this context, this preliminary study aimed to search processes to progress efficiency of new bioactive molecules with biocide activity through blending of synergic products.

4.1. Effects evaluation of biologic and chemical products on *Chaitophorus leucomelas*' populations

Results relative to biologic treatments through applications of whole plants' aqueous extracts, and aqueous extracts ratio (1 and 2) of *D. viscosa/S. fuscata* as well as Thiamethoxam and Lambda-cyhalothrin have shown efficiency precociousness. This interesting effect noted on residual populations present toxicity gradation going from aqueous extracts of whole plants, aqueous extracts ratio of *D. viscosa/S. fuscata* and at last Thiamethoxam and Lambda-cyhalothrin. However, biocenotic resumption of *C. leucomelas* populations has been very distinctive afterwards of chemical applications if we compare it to biologic treatments. That situation brings us to suggest two hypotheses. The first one is relating to characteristic resumption of surviving of *C. leucomelas* which even under chemical stress regime, organism was able to active its metabolism and consequently, recover its homeostasis within reduced lapse of time. That's, advanced hypothesis coincided with conclusions of several workers (Moberg, 1999; Calabrese, 1999). The same authors point out if an individual perceives threat to its homeostasis, by exposition to concentrations effects of synthesis chemical product that caused disturbance of homeostasis allowing organism to react by effect overcompensation, which was called by hormesis phenomena. The second hypothesis which could explain resumption of residual populations under effect of Thiamethoxam and Lambda-cyhalothrin is relative to phenomena of trophobiose. This last one has been very well informed by studies of Chaboussou (1981). According to this theory, massive recourse to pesticides caused fragility in plants by overloading nutrients allowing pests proliferation.

Bioactive molecules effects might vary according to plants, molecule itself, used dose, frequency and treatment opportunity. In the context to estimate toxicity

of *D. viscosa* bioactive molecules, results have shown that effects of biologic treatments based of aqueous extracts ratio of *D. viscosa/S. fuscata* differ from treatments based of aqueous extracts of whole plant on the one hand, and of treatments based of organs' aqueous extracts on the other hand. Aqueous extracts effects of whole plants and organs of *D. viscosa* have expressed according to their origin late interesting effects. In return, resumption of residual populations is characterized by residual populations enough limited. For that, it is necessary to present individually results of each aspect of the study in order to highlight more eminent connections. Data analysis has shown satisfactory insecticide power of aqueous extracts of the whole plants of *D. viscosa*, that assumes obtained aqueous extracts contain various bioactive molecules having been released during extraction process and acting in consortium (=synergy). This hypothesis is strengthened by an enough consequent literature which stipulates that extract of *D. viscosa* have been tested for their antiviral activity (Abad *et al.*, 2000), antifungal (Cafarchia *et al.*, 2002), antimicrobial (Maoz and Neeman, 1998), antibacterial (Squalli *et al.*, 2007), herbicide (Muehlchen *et al.*, 1990), nematicide (Oka *et al.*, 2006), acaricides (Mansour *et al.*, 2004) and insecticides (Alexenizer and Dorn, 2007). Moreover, cultures protection against devastating by vegetable extracts has been studied as well on Lepidoptera larvae (Lee *et al.*, 2002) as on locust larva (Idrissi Hassani, 2000). The same researchers pointed out that *D. viscosa's* extracts caused a decline in chitin content, main element of insect's teguments (Maoz and Neeman, 2000). The obtained results in the present work showed that toxic effect of organs aqueous extracts of *D. viscosa* varies from organ to the other.

Outsourcing of drastic toxic actions from compartment to the other could be explained only by

synthesis performance and/or of tissue accumulation of the last one. The hypothesis consolidates theory of "Optimal Defence" (Zangerl and Bazzaz, 1992), estimating that growth intensity of secondary metabolites was not always identical in different tissues of the plant. Indeed, according to this theory, concentration of secondary compounds was stronger at level of important parts in terms of fitness for plant and at level of zones having high attacks probabilities. Moreover, plants could synthesize various compatible solutes; unity composition varies according to species and organs (Rasanen, 2002). These results and in conformity with the findings of Cosentino *et al.* (1999), who also show that inside of the same vegetable specie, we observe important chemical variations leading to admit existence of chemical races. These results are confirming the study of Jou *et al.* (1997), have showed then that chemical composition of plants might vary from organ to the other. Study results announced that leaves' aqueous extract expressed an insecticide activity more efficient compared to extracts of stems and roots.

Being based on these informations we could say that main classes of secondary metabolites where bioactive molecules were present in aerial part of *D. viscosa*. Advanced hypothesis corroborated copious researches results which pointed out that *D. viscosa* leaves bearded glandular sessile hair, which secreted resinous mixture of secondary metabolites during all leaves' life (Werker and Fahn, 1981). These exudates were constituted of several aglycones flavonoides, of triterpenoides (Grande *et al.*, 1992) having all of them strong allelopathic potential deletion against bioattackers (Fontana *et al.*, 2007). Aqueous extracts ratio of *D. viscosa/S. fuscata* had expressed the most remarkable toxic effect compared to aqueous extracts none formulated. Recourse to use of ratios had allowed increasing insecticide activity of *D. viscosa* and to decrease in the

same time incidence of secondary effects on resumption of residual populations. Under hypothesis that *S. fuscata* bio-adjuvant has accelerated bioactive molecule penetration. This supposes that bio-molecules distribution towards sensible sites of devastating was made in enough short lapse of times. Molecules in suspension in aqueous extract of *D. viscosa* have been carried through cuticular barrier by penetrating power or aqueous extract activator of *Silene* acting as surfactant so aphids were confronted with stable molecule to the limit of its richness in biocides bio-molecules. Several studies reported that penetration of active matter linked to surfactant use was due to capacity of the last one to dissolve this active matter. After water evaporation, surfactant remains on cuticle and would maintain active matter in none crystallized state identical to dissolved state, more propitious to its penetrating. Moreover, surfactants would facilitate distribution of active matters in cuticle (Hayes *et al.*, 2006; Hess and Foy 2000). At last, Stitt and Hurry (2002), Found that adjuvant's influence on formulated products would growth of resistance to the molecule's photo-degradation, owing the fact that it was not synergic. Serrano *et al.* (2006) have shown that biologic surfactants would essentially serve to increase quantity and rapidity of bio-pesticide penetration in treatment plant, thus to increase its action rapidity, to enlarge its functions and to offer it the best adherence and by reducing it washing.

4.2. Effect evaluation of biologic and chemical products on *Populus nigra*'s entomocenose

Studies on impact of active insecticides' substances on fauna availability were numerous and showed in large majority deleterious effects on harmful and useful species (Tietjen and Cady, 2007). These effects depended of life features, demographic parameters and of development stage at application moment. Prowess of

present study was confirmed by none intentional impacts evaluation of sanitary applications on structural diversity of functional groups of *P. nigra* entomocenose. Obtained results had allowed us to note that effect of active matter of Thiamethoxam and Lambda-cyhalothrin exerts a very important pressure on availability of entomofauniques' populations compared to aqueous extracts. These results were comparable to those studied by Cemagref (2007) expressing that pesticides had negative impact, more or less marked according to nature and molecule type and adjuvant, on majority of arthropods. They often had simplistic effect on natural enemies of devastating, and on insects of agronomic usefulness (Burel and Garnier, 2009). Likewise, many studies showed on the contrary, effects none intentional more or less marked on auxiliary arthropods-fauna according to the used molecules, but also according to biologic cycle phase of organisms (Burel and Garnier, 2009). None intentional effect of phytosanitary applications had been as well checked on biocenosis structure and on arrival order of functional groups under different chemical stress regimes. Analysis of populating shows thus, that species spread out very unequally under effect of used treatments. Bodiguel (2003) pointed out that molecules actions with insecticide activity might modify structure of communities by increasing abundance of certain taxa and decreasing abundance of other taxa. We point out as well, that resumption of biocenotic activity is at the advantage of biologic applications where an enough important specimen number took place from the second week after treatment. In return, resumption of biocenotic activity had been visible only beyond of the fourth week in specimen having submitted chemical treatment. This explained ephemeral status of aqueous extracts. In this context some authors mentioned that effects at middle or long terms of pesticides depend of heterogeneity of agro-ecosystems and of organisms mobility, and then of their

capabilities to resettle from refuges zones none treated (Burel and Garnier, 2009). At the same time, other authors had shown that bio-pesticides were less persistent in the environment and require more observation on the ground to determine functioning levels (Isman, 2002).

5. CONCLUSION

Results relating to biologic treatments through applications of *D. viscosa/S. fuscata* aqueous extracts in comparison to chemical treatments have shown notable efficiency. Recourse to aqueous extracts ratio of *D. viscosa/S. fuscata* has allowed amplifying toxic capacity of bio-active molecules whose expression is noted by important death rate and phytosanitary cover time acceptable by comparison to none formulated aqueous

extracts. This interesting effect reported on residual populations' presents toxicity gradation going from organ aqueous extracts, aqueous extracts of whole plant. *D. viscosa/S. fuscata* aqueous' extracts ratios and at last chemical treatment of Thiamethoxam and Lambda-cyhalothrin. However, biocenotic resumption of *C. leucomelas* populations have been very distinctive afterwards of chemical applications if we compare it to biologic treatments. Results showed that none intentional impact of phytosanitary applications on structural diversity of functional groups of *P. nigra* entomocenose was very contrasting where we noted that active matter Thiamethoxam and Lambda-cyhalothrin exerted an important pressure on availability of entomofauniques' populations compared to aqueous extracts.

Table (1). Variation of *C. leucomelas* residual populations under the effect of aqueous extract of *D. viscosa*, *S. fuscata* and of the product of Thiamethoxam/Lambda-cyhalothrin synthesis in natural condition (Mean±S.E)

Period (Days)	Biological treatment			Chemical treatment				
	Aqueous extract of ratio <i>D. viscosa</i> and <i>S. fuscata</i>		Aqueous extract of plant <i>D. viscosa</i>	Aqueous extract of organs <i>D. viscosa</i>			Rate	H-Rate
	Ratio1 (25% and 75%)	Ratio 2 (50% and 50%)		Leaf	Stem	Root		
d1	14.3±2.1	11.6±1.4	47.8±6.2	39.5±5.9	25.7±3.9	93.5±7.4	4.7±0.6	19.2±1.9
d2	3.4±0.5	1.8±0.2	8.0±1.5	21.9±3.3	33.4±4.1	14.3±1.1	3.7±0.4	0.2±0.2
d3	5.4±0.8	3.5±0.4	7.7±0.3	11.6±1.7	11.7±1.1	11.6±0.9	0.0±0.0	8.6±0.8
d4	8.1±1.2	6.8±0.8	5.7±0.1	12.0±1.1	13.3±1.6	11.1±0.8	0.0±0.0	8.9±0.9
d5	34.4±5.2	21.4±2.5	33.4±4.3	32.6±4.9	46.9±5.3	22.2±1.7	0.4±0.6	12.1±1.2
d6	37.2±5.5	22.8±2.5	10.1±1.3	41.5±6.2	46.3±5.7	28.1±2.2	9.3±1.2	12.8±1.2
d7	41.2±6.1	24.3±2.9	19.7±2.5	44.4±6.6	50.2±6.3	36.1±2.8	10.4±1.3	23.2±2.3
d8	45.7±6.7	46.9±5.3	27.2±3.5	61.7±9.2	54.4±6.3	36.2±2.9	19.3±2.5	24.7±2.4
d9	65.7±9.8	43.6±5.2	39.2±5.1	62.5±9.3	57.7±6.4	44.9±3.6	105.7±13.4	66.2±6.6
d10	51.1±7.6	43.3±5.2	40.3±5.23	84.1±12.6	75.2±9.2	69.6±5.5	138.8±18.4	87.8±8.7

d: Days

Table (2). Comparison of the homogeneity of *Populus nigra* entomocenose under the effect of the aqueous extract and of the product of synthesis Thiamethoxam/Lambda-cyhalothrin in natural condition (Mean±S.E)

Taxa	Before treatment (D0)		D0+7days		D0+14days	
	T.L.C.	A.E.	T.L.C.	A.E.	T.L.C.	A.E.
Coleoptera	6.3±0.6	13.1±1.9	7.5±0.91	7.3±0.8	7.5±0.9	8.2±0.9
Hymenoptera	98.8±9.8	64.2±9.6	30.9±3.72	39.2±4.7	3.2±0.3	28.1±3.1
Nevroptera	0.6±0.07	1.6±0.25	0.6±0.08	0.3±0.04	0.1±0.02	0.3±0.04
Diptera	112.6±11.2	115.2±17.2	25.4±3.05	54.3±6.5	21.2±2.5	33.2±3.6
Heteroptera	1.5±0.16	6.2±0.94	0.3±0.04	6.2±0.7	0.3±0.04	3.1±0.3
Isoptera	6.3±0.63	1.2±0.18	1.1±0.1	0.1±0.02	0.4±0.05	0.2±0.03
Homoptera	0.9±0.10	3.3±0.50	1.3±0.1	2.2±0.2	1.6±0.20	1.6±0.1
Lepidoptera	1.4±0.15	0.3±0.05	0.3±0.04	0.1±0.01	0.2±0.03	0.2±0.03
Monoptera	0.3±0.03	1.2±0.18	0.2±0.03	0.1±0.01	0.15±0.02	4.3±0.4
Clopode	0.6±0.07	4.1±0.62	0.1±0.02	0.3±0.04	0.27±0.03	0.2±0.02
Blattoptera	0.6±0.08	1.1±0.17	0.0±0.0	1.1±0.1	0.15±0.02	0.6±0.07
Spider	0.6±0.10	2.1±0.33	0.2±0.03	3.3±0.4	0.18±0.02	2.1±0.2
Gasteropod	0.6±0.26	2.6±0.40	0.1±0.01	1.1±0.1	0.12±0.01	1.1±0.1

D0: Before treatment, A.E.: Aqueous extracts, T.L.C.: Thiamethoxam and Lambda-cyhalothrin, NS: no significant; *:p<0.05: significant probability; **:p<0.001 highly significant probability

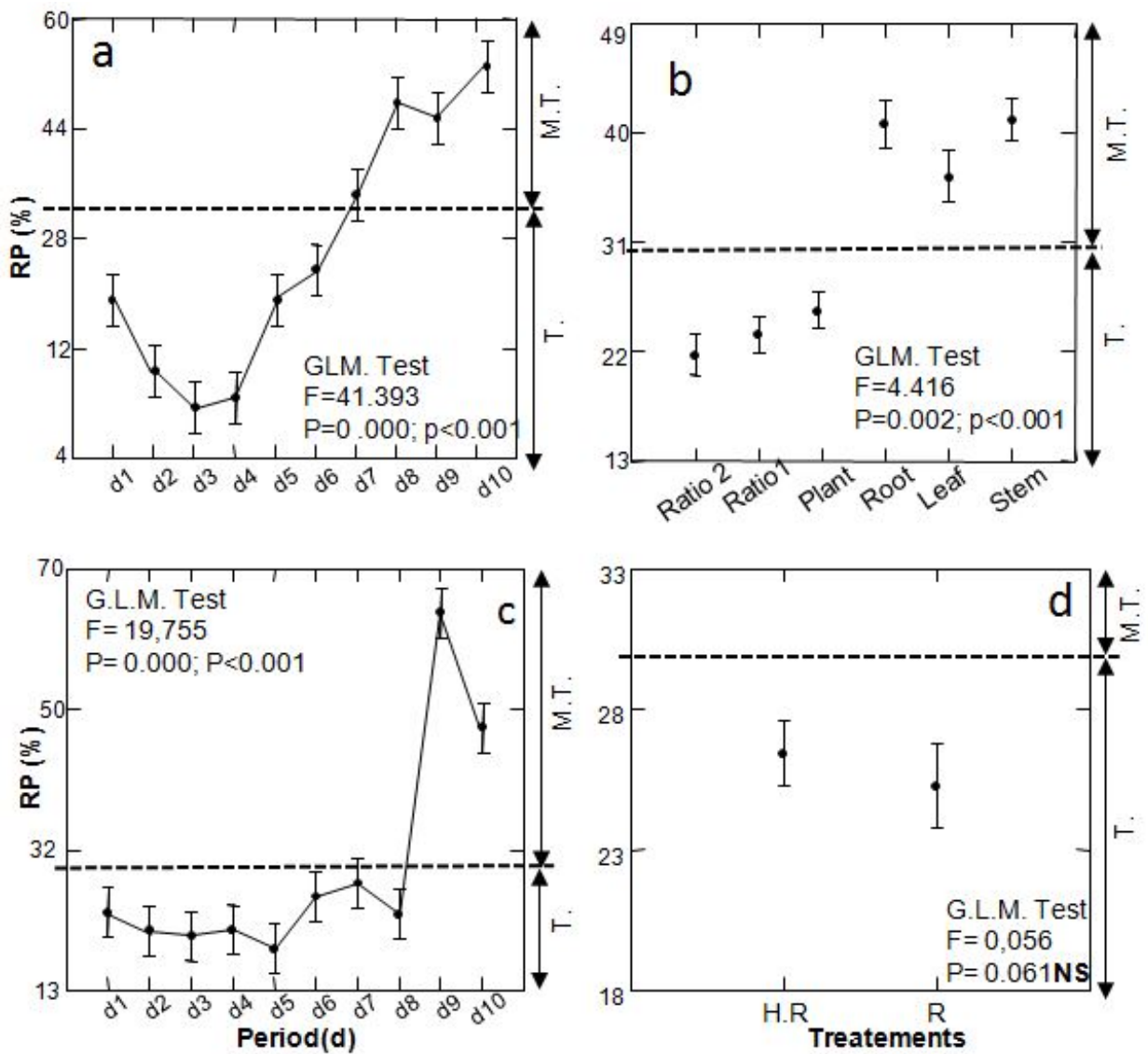


Figure 1. Variance analysis applied to temporal fluctuation of *C. leucomelas* residual populations under effect of aqueous extract of *D. viscosa*, *S. fuscata* and of the product of Thiamethoxam/Lambda-cyhalothrin synthesis in natural condition (Mean±S.E)

R.P.: residual populations; d: days; Ratio1:25% of *D. viscosa* and 75% *S. Fuscata*, Ratio2: 50% of *D. viscosa* and 50% *S. Fuscata*, Plant: Plant *D. viscosa*, Root: Root *D. viscosa*, Leaf: Leaf *D. viscosa*, Stem: Stem *D. viscosa*, HR: Half-Rate; R: Rate; T: Toxic; M.T: fairly toxic; Conditions of the experiment: Natural conditions; Period for conducting the experiment: 19th at 29th November 2012. NS: no significant; *: p< 0.05: significant probability; **: p< 0.001 highly significant probability

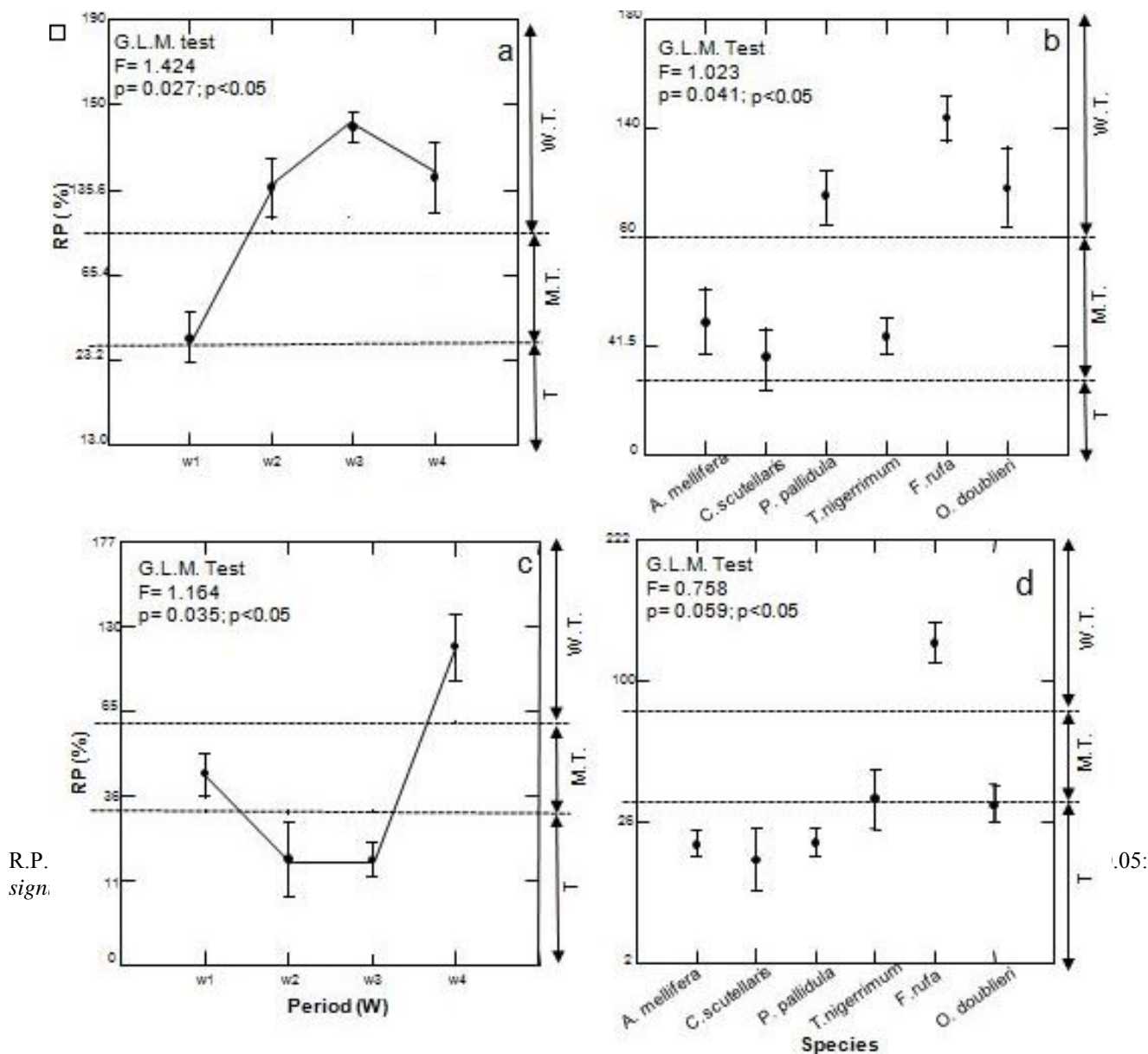


Figure 2. Variance analysis applied to temporal fluctuation of poplar entomocenose residual populations under effect of aqueous extract and product of synthesis Thiamethoxam and Lambda-cyhalothrin in natural condition

D0:Before treatment, NS: no significant; *:P< 0.05: significant probability; **:P< 0.001 highly significant probability

Table 3. Slope comparisons of entomocenose of *Populus nigra* under aqueous extract and product of synthesis Thiamethoxam and Lambda-cyhalothrin in natural condition

	Biological treatment Aqueous extracts			Chemical treatment Thiamethoxam / Lambda-cyhalothrin		
	Before treatment (D0)	D0+7days	D0+14days	Before treatment (D0)	D0+7days	D0+14days
Slopes	-0.305	-0.313	-0.275	-0.322	-0.263	-0.102
Adjustment to Motomura model (p)	4.21×10^{-5}	6.90×10^{-6}	3.50×10^{-6}	3.30×10^{-4}	2.73×10^{-4}	3.73×10^{-3}
Before treatment (D0)	-			-		
D0+7days	0.550 ^{NS}	-		0.447 ^{NS}	-	
D0+14days	0.203 ^{NS}	0.493 ^{NS}	-	0.009 ^{**}	0.050 [*]	-

D0: Before treatment, NS: no significant; *: P < 0.05: significant probability; **: P < 0.001 highly significant probability

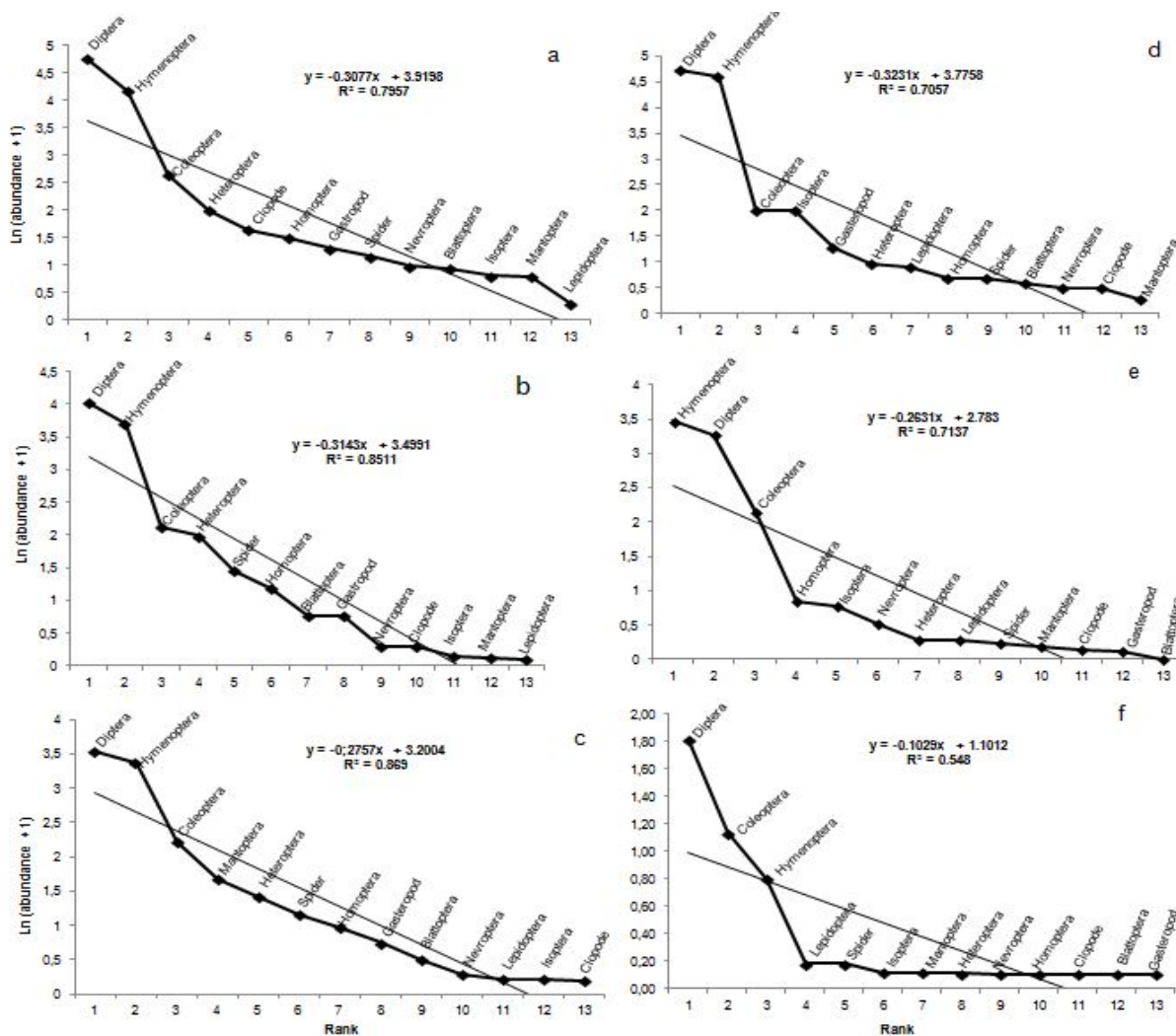


Figure 3. Adjusting of taxa to geometric series of Motomura Model (logarithm of orders abundance – rank).

REFERENCES

- Abad, M.J., Geurra, J.A., Bermejo, P., Iruruzum, A. and Carrasco, L. 2000. Search for antiviral Activity in higher plant extracts. *Phytother. Res.* 14: 604-607.
- Alexenizer, M. and Dorn, A. 2007 Screening of medicinal and ornamental plants for insecticidal and growth regulating activity. *J. Pest. Sci.* 80: 205-215.
- Ashauer, R., Boxall, A. and Brown, C. 2006. Predicting effects on aquatic organisms from fluctuations or pulsed exposure to pesticides. *Environmental Toxicology and Chemistry*, 25: 1899-1912.
- Benkhelil, M.L. 1992. Les techniques de récoltes et de piégeages utilisées en entomologie terrestre. éd. *OPU*. Alger, 68p.
- Bodiguel, L. 2003 Multifonctionnalité de l'agriculture et dispositifs agroenvironnementaux: interrogations sur l'efficacité de la norme. *Revue de Droit Rural*, 317: 606-612.
- Burel, F. and Garnier, E. 2009. Les effets de l'agriculture sur la biodiversité. *Ecological Indicators*, 5: 305-313.
- Burgio, G., Ferrari, R., Boriani, L., Pozzati, M. and Van Lenteren, J. 2006 The role of ecological infrastructures on Coccinellidae (Coleoptera) and other predators in weedy field margins within northern Italy agroecosystems. *Bull. Insectology*, 59: 59-67.
- Cafarchia, C., De Laurentis, N., Milillo, M.A., Losacco, V. and Puccini, V. 2002 Antifungal activity of essential oils from leaves and flowers of *Inula viscosa* (Asteraceae) by Apulian region. *Parass.*, 44:153-156.
- Calabrese, E.J. 1999 Evidence that hormesis represents an "overcompensation" response to a disruption in homeostasis. *Ecotoxicology and Environmental Safety*, 42: 135-137.
- Cemagref, 2007 *Centre national du machinisme agricole, du génie rural, des eaux et des forêts, Sur la tarce des pesticides.* (<http://www.cemagref.fr/presse/index.htm>).
- Chevallier, H. 2000 Populiculture et gestion des espaces alluviaux. *Le Courrier de l'Environnement de l'INRA*, 40:57-62.
- Chaboussou, F. 1981 Les plantes malades des pesticides, Base nouvelle de prévention contremaladies et parasites. Éd. *DEBARD*, Paris, 200p.
- Cohen, Y., Wang, W.Q., Ben-Daniel, B.H. and Ben-Daniel, Y. 2006 Extracts of *Inula viscosa* control downy mildew of grapes caused by *Plasmopara viticola*. *Phytopatology*, 96: 417-423.
- Comeau, A. 1992 La résistance aux pucerons : Aspects théoriques et pratiques,. In: Vincent Ch. et Coderre D. (Eds.), La lutte biologique. Ed. Lavoisier Tec & Doc, Québec, pp. 433-449.
- Couteux, A. and Lejeune, V. 2012 Index phytosanitaire ACTA, 48ème Edition ,956p.
- Cosentino, S., Tuberoso, C. I., Pisano, B., Satta, M., Mascia, V., Arzedi, E. and Palmas, F. 1999 In vitro antimicrobial activity and chemical composition of *Sardinian Thymus* essential oils. *Lett Appl Microbiol.*, 29: 103-105.
- De Souza, C., Koumaglo, K. and Gbeassor, M. 1995 *Évaluation des propriétés antimicrobiennes des extraits aqueux totaux de quelques plantes médicinales*, UNIVERSITE DU BENIN, LOME – TOG .Pharm. Méd. Tra. Afro, pp. 103-112.
- Devigne, C. and Detrain, C. 2005 Foraging responses of the aphid tending ant *Lasius niger* to Spatio-temporal changes in aphid colonies *Cinara cedri*. *Acta Zool. Sinica.*, 51: 161-166.
- Djazouli, Z.E., Tchaker, F.Z. and Petit D. 2012 Etude des effets des variations thermiques sur les caractéristiques biochimiques et monodérales de *Chairophorus leucomelas* (Koch, 1854). *Agrobiologia*, 2(1): 44-51.
- Danino, O., Gottlieb, H.E., Grossman, S. and Bergman, M. 2009 Antioxidant activity of 1, 3-dicaffeoylquinic acid

- isolated from *Inula viscosa*. *Food Res. Int.*, 42:1273-1280.
- Dor, E. and Hershenhorn, J. 2004 Metabolite from *Inula viscosa* is toxic to dodder (*Cuscuta campestris*). (Abstract) In: Proceedings Use of natural compounds for parasitic plant management. 29–31 October, 2004. Naples, Italy.
- Fontana, G., La Rocca, S., Passannanti, S. and Paternostro, M.P. 2007 Sesquiterpene compounds from *Inula viscosa*. *Nat. Prod. Res.*, 20: 824-827.
- Gomez, P., Cubillo, D., Mora, G.A. and Hilje, L. 1997 Évaluons de possibles repelentes de *Bemisia tabaci*. II. Extractos vegetales. *Manejo Integrado de Plagas (Costa Rica)*, 29: 17-25.
- Grasse, P., Poisson, R.A. and Tuzet, O. 1970 Zoologie I Invertébrés, Éd. Mosson, Paris, 935p.
- Grande, M., Torres, P., Piera, F. and Bellido, S.I. 1992 Triterpenoides from *Dittrichia viscosa*. *Phytochem.*, 31: 1826-1828.
- Hammer, Ø., Harper, D.A.T. and Ryan, P.D. 2001 PAST: Paleontological Statistics Software Package for Education and Data Analysis, *Palaeont. Electron.* 4(1): pp. 9-11, http://palaeoelectronica.org/2001_1/past/issue1_01.htm.
- Hayes, T.B., Case, P., Chui, S., Chung, D., Haeffele, C., Haston, K., Lee, M., Mai, V.P., Marjuoa, Y., Parker, J. and Tsui M. 2006 Pesticide mixtures, endocrine disruption, and amphibian declines: are we underestimating the impact?. *Environmental Health Perspectives*, 114 Suppl, 1: 40-50.
- Heie, O.E. 1982 The Aphidoidea (Hemiptera) of Fennoscandia and Denmark II. The family Drepanosiphidae. *Fauna Entomol Scand*, 11: 1-176.
- Hernández, V., del Carmen Recio, M., Máñez, S., Giner, R.M. and Ríos, J.L. 2007 Effects of naturally occurring dihydro-flavonols from *Inula viscosa* on inflammation and enzymes involved in the arachidonic acid metabolism. *Life Sci.*, 81: 480-488.
- Hess, F.D. and Foy, C.L. 2000 Interaction of surfactants with plant cuticles. *Weed Technology* 14: 807-813.
- Howard-Borjas, P. and Cuijpers, W. 2002 “Gender and the management and conservation of plant biodiversity”, in H.W. DOELLE and E. DA SILVA, Biotechnology, in Encyclopedia of Life Support Systems (EOLSS), Oxford, UK, <http://www.eolss.net>
- Idrissi Hassani, L.M. 2000 *Contribution à l'étude phytochimique du harmel Peganum harmala L. (Zygophyllaceae) et étude de ses effets sur la reproduction et le développement du criquet pèlerin Schistocerca gregaria Forsk*, Thèse Doctorat d'Etat. Université Ibn Zohr, Agadir (Maroc).
- Iganaki, H. 1967 Mise au point de la loi de Motomura et essai d'une écologie évolutive. *Vie Milieu*, 18: 153-166.
- Isman, M.B. 2002 Problèmes et perspectives de commercialisation des insecticides d'origine botanique, In. Regnault-Roger, C, Phellogène, B J.R, Vincent C 2002. Biopesticides d'origine végétale. *Tec et Doc*, Paris, pp. 301-312.
- Jou, N.T., Yoshimori, R.B., Mason, G.R. and Liebling, M.R. 1997 Single – tube. nested, reverse transcriptase PCR for detection of viable *Mycobacterium tuberculosis*. *J.Clin. Microbiol.*, 35: 1161-1165.
- Lee, H.K., Park, C. and Ahn, Y.J. 2002 Insecticidal activities of asarones identified in *Acorus gramineus* rhizome against *Nilaparvata lugens* (Homoptera: Delphacidae) and *Plutella xylostella* (Lepidoptera: Yponomeutidae). *Jap. Soc. Appl. Entomol. Zool.*, 37: 459-464.
- Loucif, Z. and Bonafonte, P. 1977 Observation des populations du pou de San José dans la Mitidja. *Rev. Fruits*, 32: 253-261.
- Magali, C. 2009 Lutte intégrée en serres florales et en verger de pomme, Revue éditée dans le cadre du Programme National Agriculture et Développement Durable.
- Mansour, F., Azaizeh, H., Saad, B., Tadmor, Y., Abo-Moch, F. and Said, O. 2004 The potential of Middle Eastern flora as a source of new safe bio-acaricides to

- control *Tetranychus cinnabarinus*, the carmine spider mite. *Phytoparasitica*, 32: 66-72.
- Maoz, M. and Neeman, I. 1998 Antimicrobial effects of aqueous plant extracts on the fungi *Microsporium canis* and *Trichophyton rubrum* and on three bacterial species. *Lett. Appl. Microbiol.*, 26: 61-63.
- Maoz, M. and Neeman, I. 2000 Effect of *Inula viscosa* extract on chitin synthesis in dermatophytes and *Candida albicans*. *J. Ethnopharmacol.*, 71: 479-482.
- Miles, P.W. 1989 Feeding porcess of Aphidoïdae in relation to effects on their food plants in *Aphids*, thier biology, natural enemies and control, Ed. Elsevier, Amsterdam; A.K.Minks & P.Harrewijn, Vol.2A, pp. 321-340.
- Moberg, P.G. 1999 When does stress become distress?. *LaboratoryAnima*, 128: 22-26.
- Muehlchen, A.M., Rand, R. E. and Parke, J.L. 1990 Evaluation cruciferous green manure crops for controlling Aphanomyces root rot of peas. *Plant Dis.*, 64: 651-654.
- Muñoz, R.I. and Beeche, M. 1995 Data on two recently cited species for Chile (Homoptera: Aleyrodidae, Aphididae). *Rev. Chil. Entomol.*, 22: 89-91.
- Oka, Y., Ben-Daniel, B.H. and Cohen, Y. 2006 Control of *Meloidogyne javanica* by formulations of *Inula viscosa* leaf extracts. *J. Nematol.*, 38: 46-51.
- Perdikis, D., Favas, C., Lykouressis, D. and Fantinou, A. 2007 Ecological relationships between non-cultivated plants and insect predators in agroecosystems: the case of *Dittrichia viscosa* (Asteraceae) and *Macrolophus melanotoma* (Hemiptera: Miridae). *Acta Oecol.*, 31: 299-306.
- Pérez-Alonso, M.J., Velasco-Negueruela, A., Duru, M.E., Harmandar, M. and García Vallejo, M.C. 1996 Composition of the volatile oil from the aerial parts of *Inula viscosa* (L.) Aiton. *Flavour Frag. J.* 11, 349-351.
- Pignatti, S. 1982 Flora d'Italia, vol. 3. Edagricole, Bologna, Italy.
- Rahuman, A.A., Bagavan, A., Kamaraj, C., Saravanan, E., Zahir, A.A. and Elango, G. 2009 Efficacy of larvicidal botanical extracts against *Culex quinquefasciatus* Say (Diptera: Culicidae). *Parasitol Res.*, 104: 1365-1372.
- Rasanen, L.A. 2002 *Biotic and abiotic factors influencing the development of N2-fixing symbioses between rhizobia and the woody legumes Acacia and Prosopis*, Academic dissertation in sediments and molluscs from freshwater canals in the Hanoi region".
- Ramírez, C.C. and Verdugo, J.A. 2009 Water availability affects tolerance and resistance to aphids but not the trade-off between the two. *Ecol. Res.*, 24: 881-888.
- Ramírez, C.C., Zamudio, F., Verdugo, J.V. and Nunez, M.E. 2004 Differential susceptibility of poplar hybrids to the aphid *Chaitophorus leucomelas* (Homoptera: Aphididae). *J. Econ. Entomol.*, 97: 1965-1971.
- Rotach, P. 2004 *Poplars and Biodiversity*. In: Koskela, J., De Vries, S.M.G., Kajba, D., Von Wuhlisch, G.,(compilers). 2004. *Populus nigra* Network, Report of seventh (25-27 October 2001, Osijek, Croatia) and eighth meetings (22-24 May 2003, Treppeln, Germany). International Plant Genetic Resources Institute, Rome, Italy: 79-100
- Rubio-Melendez, M.E., Zamudio, F. and Ramírez, C.C. 2011 Susceptibility of *Populus spp.* hybrids to aphids and rusts at three localities of Chile. *Bosque*, 32: 127-134.
- Sauvage, C. 1963 Etages bioclimatiques. Comité National de géographie du Maroc, Atlas du Maroc, notices explicatives, section II : physique du globe et météorologie, Planche n° 6b, 31 pp.
- Sauvion, N. 1995 Effets et modes d'action de deux lectines à mannose sur le puceron du pois, *Acyrtosiphon pisum* (Harris). Potentiel d'utilisation des lectines végétales dans une stratégie de création de plantes transgéniques résistantes aux pucerons, Thèse de Doctorat, INSA Lyon, France. 259 p.
- Serrano, E., Saccharin, P.h. and Raynal, M. 2006 Optimisation des doses de matière actives appliquée à l'hectare de la réduction de doses Synthèse de 5 années d'essais en Midi-Pyrénées, IFVV-Entav/ITV France Midi-Pyrénées-

- V'innopôle - BP 22 - 81310 Liste sur Tarn.
- Squalli, H., El Ouarti, A., Ennabili, A., Ibsouda, S., Farah, A., Haggoud, A., Houari, A. and Iraqui, M. 2007 Évaluation de l'effet anti mycobactérien de plantes du centre-nord du Maroc. *Bull. Soc. Pharm. Bordeaux*, 146:271-288.
- Stitt, M. and Hurry, V. 2002 A plant for all seasons: alterations in photosynthetic carbon metabolism during cold acclimation in Arabidopsis. *Current Opinion in Plant Biology*, 5: 199-206.
- Tietjen, W.J. and Cady, A.B. 2007 Sublethal exposure to a neurotoxic pesticide affects activity rhythms and patterns of four spider species. *J. Arachnol.*, 35:396-406.
- Thomas, M.B. 1999 Ecological approaches and the development of «truly integrated» pest management. *Proc. Natl. Acad. Sci.*, 96: 5944-5951.
- Werker, E. and Fahn, A. 1981 Secretory hairs of *Inula viscosa* (L.) Aiton development, ultra structure and secretion. *Bot. Gaz.*, 142: 461-476
- Zangerl, A.R. and Bazzaz, F.A. 1992 Theory and pattern in plant defense allocation. In: *Plant resistance to herbivore and pathogens, Ecology, evolution, and genetics*, Eds. R.S. Fritz & E.L. Simms, University of Chicago Press, Chicago, pp. 363-391.

تقدير سمية المستخلصات المائية لـ *Erchfildia viscosa* بالخلط مع المادة المساعدة النباتية *Silena fuscata* (Hom., Aphididae) و على حركية العشائر للمجموعات الوظيفية

فاطمة تاخاكر¹، عثمان ميره^{2,3}، زهر الدين دجازولي²

ملخص

يوجد للمعالجة الكيميائية أثر سلبي على البيئة كما تساعد على ظهور حشرات ضارة مقاومة للمواد النشطة المستعملة مقابل هذه الحالة تسعى عدة دراسات للبحث عن طرق علاج بديلة للاستعمال المنتظم لهذه المواد الكيميائية. تهدف هذه الدراسة لرفع سمية المستخلصات المائية النباتية ذات الخاصية المبيدية وتقدير الفاعلية الإجمالية لهذه الجزيئات الطبيعية. أثبتت النتائج أن المستخلصات المائية لنباتة *Dittrichia viscosa* لها مفعول كبير على التوزيع العشائري للمن المسمى *Chaitophorus leucomelas*، مع رجوع ميزه الاعتدال للتركيبية العشائرية مقارنة مع المعالجة الكيميائية. نستنتج من الدراسة أن المستخلصات المائية المكونة من *D. viscosa/ Silena fuscata* لديها مفعول سام على عشائر حشرة المنّ مقارنة مع المستخلصات المائية المكونة من *D. viscosa*. زيادة على ذلك من المهم الإشارة للاختلاف الواضح المتعلق بهيكله واستئناف تطورا للمجموعات الوظيفية تحت تأثير مختلف المواد المستعملة. كما نلاحظ استئناف كثيف للعشائر بعد استعمال المواد البيولوجية مقارنة بالمواد الكيميائية.

الكلمات الدالة: حشرة المن، فاعلية المبيد، المستخلصات المائية، مادة مساعدة نباتية، نبات الحور، حركية العشائر.

¹ قسم التكنولوجيا الحيوية، كلية العلوم الطبيعية، جامعة بلنودة، الجزائر.

✉ zola.tchaker@hotmail.fr

² جامعة تولوز، فرنسا.

³ INRA، تولوز، فرنسا.

تاريخ استلام البحث 2015/8/4 وتاريخ قبوله 2015/12/29.