4. Carinal fork an equilateral triangle. Rami of carinal fork running straight from lamina mesostigmalis to thoracic carina. Central lobe of pronotum tuberculated. Mesepisternal brown band not strongly widened against the alar sinuses 5
- Carinal fork an elongate triangle. Rami of carinal fork narrowed posteriorly. Central lobe of pronotum smooth. Mesepisternal band widened against the alar sinuses . . . . *S. gobica* (FÖRSTER)

5. Internal edge of carinal fork thickened in its distal part. Ovipositor with about 11-13 strong marginal teeth along its distal third. Cerci shorter than, or as long as, S10 . . . . *S. paedisca* (BRAUER)
- Internal edge of carinal fork not thickened. Ovipositor with about 14-16 small teeth on its distal third. Cerci as long as, or longer than, S10 . . . . *S. fusca* (VANDER LINDEN)

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A five year survey of the invertebrate fauna of crop fields and their edges. Part 1. Study area, crop history and methodology

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Summary

Between 1986 and 1990 an intensive sampling campaign has been conducted in Belgian fields with maize or Italian ryegrass and their edge zones by means of many different sampling methods. This first contribution gives a detailed description of the study area including meteorological aspects, the crop history of the fields, the results of a botanical survey of the area, the methods used and information on the sampling periods. It acts as a basis for further publications on the results of the study.

Samenvatting

Tussen 1986 en 1990 werden intensieve bemonsteringen uitgevoerd op Belgische akkers ingezaaid met maïs of Italiaans raaigras en hun randen door middel van diverse bemonsteringsmethodes. Deze bijdrage geeft een gedetailleerde beschrijving van het studiegebied, de teeltgeschiedenis van de onderzochte akkers, de resultaten van een botanische inventaris van het studiegebied, de gebruikte bemonsteringsmethoden en informatie omtrent de bemonsteringsperiodes. Ze vormt een basis voor verdere publicatie van de resultaten van deze studie.

Résumé

Entre 1986 et 1990 une campagne intensive d'échantillonnage a été réalisée en Belgique dans des champs de maïs, d'ivraie italien et dans leurs zones de bordures en utilisant diverses méthodes. Cette contribution donne une description detaillée des sites étudiés, les résultats d'un inventaire botanique, la méthodologie appliquée et des informations sur les périodes d'échantillonage. Elle forme une base pour d'autres publications traitant les résultats de l'étude.

Introduction

In 1986 a detailed study of the invertebrate fauna of crop fields in Belgium was started. The principal aim of the study is to investigate the ecology and dynamics of the araneofauna present in this habitat type. Research on the spider fauna of agricultural fields is very scarce in Belgium. These habitats are, from the araneologists' point of view, relatively uninteresting because the chances of finding species of high faunistical interest are considered to be low. Moreover spiders have received very little attention from the agricultural scientist. As a result, our knowledge of this important arthropod group in agricultural fields is still very incomplete.

In an attempt to fill this gap, we have conducted intensive field and laboratory research on the invertebrate fauna occurring in Belgian fields between 1986 and 1990. We focussed on maize fields and Italian ryegrass fields. Sampling effort was high during this period and several different sampling methods were used.

This paper provides a detailed description of the study area, crop history, botanical diversity, the applied methodology and sampling dates. It is intended as a reference basis for future publications on more detailed results.

Study area

The study was conducted in an agricultural area situated at Melle, approximately 15 km south-east of Ghent (Eastern Flanders, Belgium). About 40 ha of this area is property of the University Ghent (Faculty of Agronomy) and is used as experimental farm. The southern part of the farm consist of a large complex of intensively grazed pastures (ca. 20 ha), whereas the northern part (19.07 ha) consists of arable crop fields (Fig. 1). The choice of these parcels had several advantages: the crop history and the respective agricultural management practices are well known. Moreover, the pedology and hydrology of the area have been mapped in detail.

Another advantage is that the farm contains a well equiped meteorological station (situated in Fig. 1) which records important macroclimatological information in the immediate vicinity of the study sites. Fig. 2 shows the average minimal and maximal temperatures as well as the total amount of precipitation registrated at Melle during the study. From these data we observe three successive harsh winters with periods of severe frost in January 1985, February 1985, February 1986 and January 1987. This is in sharp contrast with 1988 where the average minimal temperatures (measured at 175 cm above soil level) never reached values below zero (Fig. 2). Hot periods were recorded during Summer 1986. 1985 was the driest year and 1986 the sunniest (Fig. 3). These data also illustrate that precipitation is minimal during periods of frost (Fig. 2).

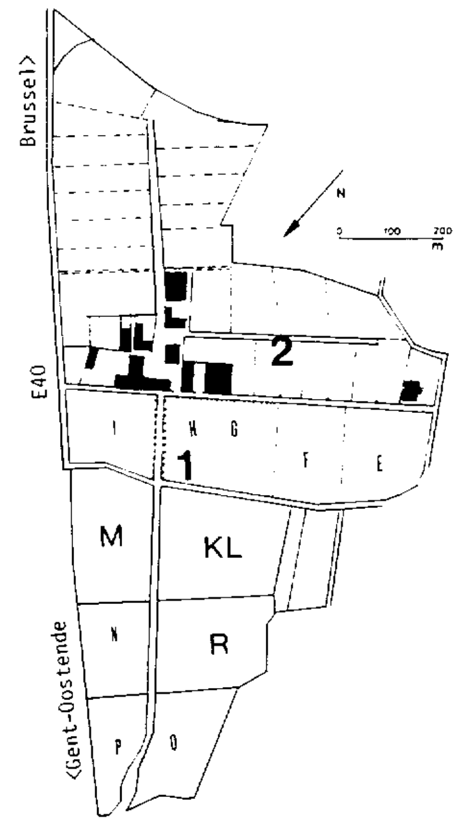

Fig. 1. Map of the experimental farm at Melle with indication of the meteorological station (1) and the southern part consisting of intensively grazed pastures (2).

Study sites

Research was mainly conducted on field KL, R and M (Fig. 1). These are homogeneous from the pedological and hydrological point of view: they consist of loamy sand with a high to medium waterholding capacity.

The different fields measure about 4 ha and their respective crop history is summarized in Table 1. The research concentrated on fields with maize and Italian ryegrass. Fields KL and R were subjected to a three-year crop rotation, being first sown with maize, followed by Italian ryegrass, experimental field with all kinds of crops and again maize. Field M has been a monoculture maize field for a considerable period of time.

The crop history in Table 1 shows the ever increasing importance of maize on the experimental farm at Melle where it replaced winter or summer wheat. This reflects the spectacular increase of maize in the whole of

Eastern Flanders and Belgium (Fig. 4). During ten years the area sown with maize increased in Belgium by 56 % or 47292 ha (Fig. 4; ANONYMUS, 1980-1986)! This increase is mainly at the cost of meadows and pastures which were transformed into high-input agricultural fields. In Belgium, the decrease of the pasture and meadow area is 9 % during ten years or 66227 ha (Fig. 4; ANONYMUS, 1980-1986; SANDERS, 1988).

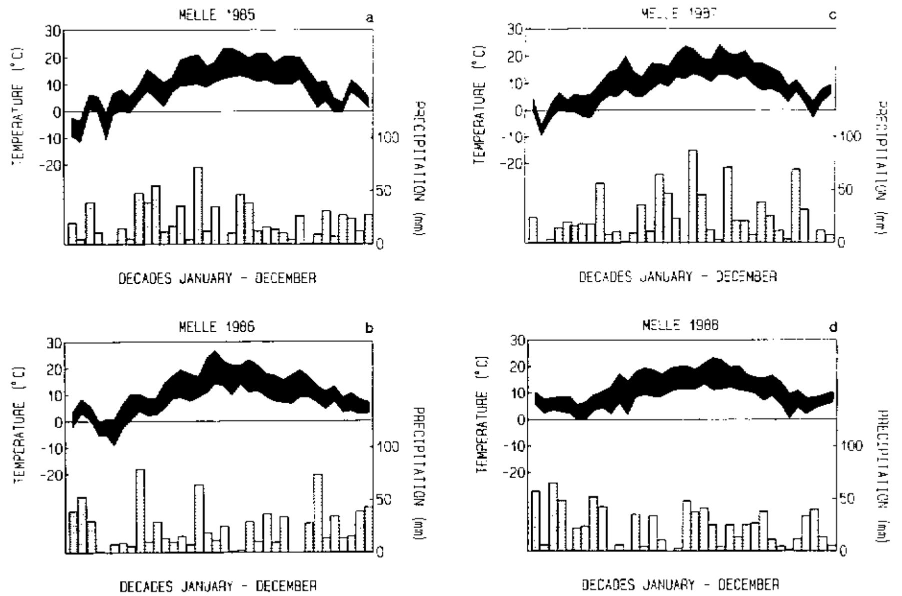

Fig. 2. Average minimal and maximal temperature measured in cabin 175 cm above soil level (left axis, in °C) and total amount of precipitation (histogram, right axis, in mm) at Melle plotted per ten years from January till December for 1985 (2a), 1986 (2b), 1987 (2c) and 1988 (2d).

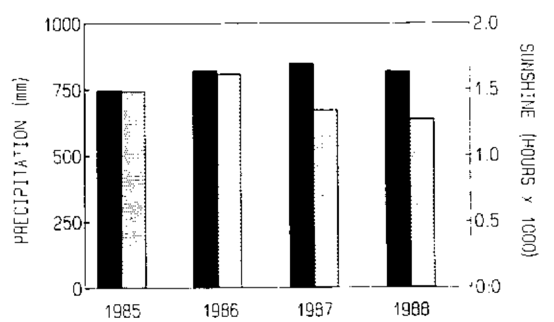

Fig. 3. Total amount of precipitation (dark bars, left axis, in mm) and total number of hours of sunshine (speckled bars, right axis, in thousands) at Melle plotted per year.

Table 1. Crop history of the different fields at Melle since 1977-1978 (if different crops were cultivated per field, their respective cover is indicated in ha between brackets). BR = Brassica sp., IR = Italian ryegrass, PT = experimental field with a mixture of different crops, VB = beet, VM = maize, WT = winter wheat, ZT = summer wheat. The field codes can be situated in Fig. 1.

FIELD	KL	R	M	NP	Q
size in ha	4.52	3.87	3.71	4.12	2.85
1977-1978	IR	PT (2.87) IR (1.00)	WT	ZT	IR
1978-1979	PT (2.50) IR (2.02)	ZT (2.87) PT (1.00)	WT	WT	IR
1979-1980	ZT	IR (2.87) PT (1.00)	IR	PT (2.50) IR (1.62)	WT
1980-1981	VM	PT	WT	VM	PT
1981-1982	PT (3.50) VM (1.02)	VM	VM (3.31) IR (0.40)	IR	VM
1982-1983	VM	IR	VM	PT (3.50) IR (0.62)	VM
1983-1984	IR	PT	VM	VM	VM
1984-1985	PT (3.50) VM (1.02)	VM	VM (3.31) IR (0.40)	IR	VM
1985-1986	VM	IR	VM	PT (3.50) IR (0.62)	VM
1986-1987	IR	PT	VM	VM	VM
1987-1988	PT	VM	VM	VM	VM
1988-1989	VM	VM	VM (1.50) PT (2.21)	PT	VM
1989-1990	WT	PT	VM	VM (2.50) BR (1.69)	VB

Many different agricultural management practices are used on the fields at Melle each year, the most important being plowing, harrowing, fertilizing, mowing (Italian ryegrass), harvesting and pesticide treatments. It is clear that these practices have a considerable influence on the population dynamics of the arthropods present. Weed cover is low in the fields and consists of patches with *Solanum nigrum*, *Stellaria media* or *Atriplex* spp., depending on the crop involved.

This study has taken field edges into account. The edge zones are narrow (about 0.5 - 1 m in width) and grassy without any shrubs or trees. They are mown once a year, normally in June. The most abundant plants occurring in the field edges are *Arrhenaterium elatius*, *Agropyron repens*, *Poa trivialis*, *Rumex acetosa*, *Stellaria media*, *Crepis capillaris* and *Ranunculus repens*. All plant species found in the edge zones are listed in Table 2.

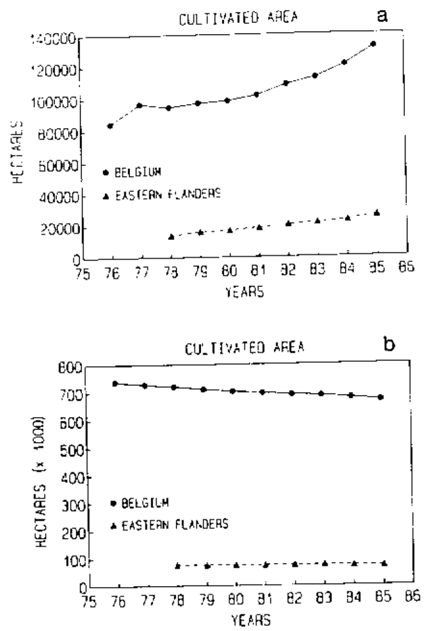

Fig. 4. Evolution in time of the total area of (4a) fodder crops and (4b) pastures in Belgium and Eastern Flanders (source: ANONYMUS, 1980-1986).

Sampling methodology

1. Quadrat sampling

Quadrats of two different sizes (156.25 cm² and 19.63 cm²) were used to obtain absolute abundances and seasonal density fluctuations of the invertebrates present. Methodological discussion concerning quadrat sampling mainly concentrates on the optimal number of quadrats to be taken, their optimal size and the extraction methods (e.g. DONDALE *et al.*, 1971; GREEN, 1979; NEF, 1960; SOUTHWOOD, 1978).

Large quadrats (30 at monthly intervals) were used to assess densities of the macrofauna, small quadrats (15 every two months) for microfauna (*sensu* TISCHLER, 1965). The mean depth of the samples was 12 cm. This proved to be sufficient because the majority of the soil fauna is usually concentrated in the top 10 cm (FORD, 1934; SALT *et al.*, 1948; TISCHLER, 1965). All samples were first manually sorted and then extracted with Tullgren-Berlese devices for approximately 14 days (MACFADYEN, 1953, 1961; TULLGREN, 1918). Catches were fixated in a 4% formaldehyde solution with some detergent added to reduce surface tension.

Quadrat sampling was performed in different field centres and field edges. Details can be deduced from Table 3.

Table 2. Botanical inventory of the field and road edges along KL and R using the TANSLEY-scale. (d = dominant, a = abundant, la = locally abundant, f = frequent, lf = locally frequent, o = occasionally, z = rare). Nomenclature follows DE LANGHE *et al.* (1983).

Scientific name	Dutch name	French name	edge KL	edge R	road edge
Arrhenaterium elatius	Frans raaigras	Ivraie vivace	d	d	a
Elymus repens	Kweek	Chiendent commun	a	a	
Poa trivialis	Ruw beemdgras	Pâturin commun	a		a
Rumex acetosa	Veldzuring	Oseille sauvage	f	f	a
Ranunculus repens	Kruipende boterbloem	Renoncule rampante	f		a
Agrostis stolonifera	Fioringras	Agrostis stolonifère	o		a
Crepis capillaris	Groen streepzaad	Crépis à tige capillaire		la	
Urtica dioica	Grote brandnetel	Grande ortie		la	
Lolium perenne	Engels raaigras	Ray-grass commun			la
Equisetum arvense	Heermoes	Prêle des champs	f	f	f
Dactylis glomerata	Kropaar	Dactyle vulgaire	f	o	o
Stellaria media	Vogelmuur	Mouron des oiseaux	o	f	
Holcus lanatus	Witbol	Houlque velue	o		f
Vicia hirsuta	Ringelwikke	Vesce hérissée			f
Anthoxanthum odoratum	Reukgras	Flouve odorante			f
Linaria vulgaris	Vlasleeuwebek	Linaire commune		lf	
Brassica sp.	Kool	Chou		lf	
Hypericum perforatum	Sint-Janskruid	Millepertuis commun			lf
Trifolium repens	Witte klaver	Trêfle rampant			lf
Trifolium dubium	Kleine klaver	Petit trêfle jaune			lf
Poa annua	Straatgras	Pâturin annuel	o		
Atriplex prostrata	Spiesbladmelde	Arroche hastée	o		
Matricaria recutita	Echte kamille	Matricaire camonille	o	o	
Polygonum aviculare	Varkensgras	Traînasse	o	o	
Taraxacum officinale	Paardebloem	Pissenlit	o	o	o
Capsella bursa-pastoris	Herderstasje	Bourse-à-pasteur		o	
Heracleum sphondylium	Bereklauw	Berce		o	
Plantago lanceolata	Smalle weegbree	Plantain lancéolé		o	o
Rumex obtusifolius	Ridderzuring	Patience à feuilles obtuses		o	
Juncus conglomeratus	Biezeknoppen	Jonc aggloméré			o
Bromus mollis	Zachte dravik	Brome mou			o
Vicia sativa	Voederwikke	Vesce cultivée			o
Cerastium fontanum	Gewone hoornbloem	Céraiste commun			o
Achillea millefolium	Duizendblad	Achilée millefeuille			o
Vicia tetrasperma	Vierzaadwikke	Vesce à quatres graines			o
Rumex crispus	Krulzuring	Patience crépue	z	z	z
Geranium dissectum	Slipbladooievaarsbek	Géranium découpé	z		
Apera spica-venti	Windhalm	Jouet du vent	z		
Sonchus sp.	Melkdistel	Laiteron	z		
Polygonum persicaria	Perzikkruid	Renouée persicaire		z	
Calamagrostis sp.	Struisriet	Calamagrostis		z	
Daucus carota	Peen	Carotte			z
Cirsium arvense	Akkerdistel	Cirse des champs			z
Lotus uliginosus	Moerasrolklaver	Lotier des fanges			z

2. Pitfall trapping

BARBER (1931) is accepted as the 'inventor' of this sampling method. The importance of pitfall trapping for ecological research of soil surface-active invertebrates was clearly realized by TRETZEL (1954, 1955). Since then, the technique has been increasingly used and discussed (e.g. ADIS,

1979; ANDOW, 1984; BOMBOSCH, 1962; DESENDER, 1984; LUFF, 1975; MAELFAIT & BAERT, 1975; UETZ & UNZICKER, 1976; WAAGE, 1985).

Pitfall traps (made of glass, inner diameter 8.8 cm, depth 9 cm) were used to determine species composition, habitat preferences, seasonal activity patterns and spatial distribution. They were installed in 13 stations (each time six traps, emptied at fortnightly intervals) and were operated more than two complete year cycles. Guiding plates (25 x 5.5 cm) were always used to increase capture efficiency. A 4 % formaldehyde solution, with some detergent added, was used for fixation. On KL and R, pitfall trapping was performed in a gradient from the field edge to the field centre. Intermediate stations were at 5 and 10 m distance from the edge (Fig. 5). Sampling dates are summarized in Table 3.

Table 3. Summary of the sampling dates of the complete field sampling campaign for the different methods.

METHOD	SITE DESCRIPTION (n = number of samples taken on each occassion) (i = mean interval between two samples in days)	SAMPLING PERIOD (dd/mm/yy)
QUADRAT SAMPLING ($156.25 cm^2$ quadrats)	Field centre KL (n=30, i=30)	12.03.1986 - 13.03.1987
	Field edge KL (n=30, i=30)	26.03.1986 - 24.12.1986
	Field centre R (n=30, i=30)	12.03.1986 - 22.10.1986 27.02.1989
	Field edge R (n=30, i=30)	26.03.1986 - 03.12.1986
	Field edge M (n=30, i=0)	27.02.1989
QUADRAT SAMPLING ($19.63 cm^2$ quadrats)	Field centre KL (n=15, i=60)	26.03.1986 - 24.12.1986
	Field centre R (n=15, i=60)	26.03.1986 - 05.11.1986
PITFALL TRAPPING	Field edge KL (n=6, i=14)	12.03.1986 - 08.04.1987
	5 m from field edge KL (n=6, i=14)	12.03.1986 - 29.03.1987 21.10.1987 - 21.09.1988
	10 m from field edge KL (n=6, i=14)	12.03.1986 - 29.03.1987
	Field centre KL (n=6, i=14)	12.03.1986 - 29.03.1987
	Field edge R (n=6, i=14)	12.03.1986 - 29.03.1987 02.06.1988 - 21.09.1988
	5 m from field edge R (n=6, i=14)	12.03.1986 - 06.09.1986
	10 m from field edge R (n=6, i=14)	12.03.1986 - 06.09.1986
	Field centre R (n=6, i=14)	12.03.1986 - 06.09.1986 02.06.1988 - 21.09.1988
	Field edge M (n=6, i=14)	02.06.1988 - 21.09.1988
	Field centre M (n=6, i=14)	02.06.1988 - 21.09.1988
ENCLOSED PITFALLS	Field centre KL (n=20, i=14)	15.03.1986 - 29.03.1987
	Field centre R (n=20, i=14)	15.03.1986 - 06.09.1986
TIME-SORTING PITFALLS	Field centre KL (n=1, i=7)	17.05.1986 - 08.07.1987
	Field centre R (n=1, i=7)	05.02.1986 - 10.09.1986
WINDOW TRAPPING	Field centre KL (n=2, i=14)	11.03.1986 - 15.04.1987
	Field centre R (n=2, i=14)	11.03.1986 - 10.09.1986

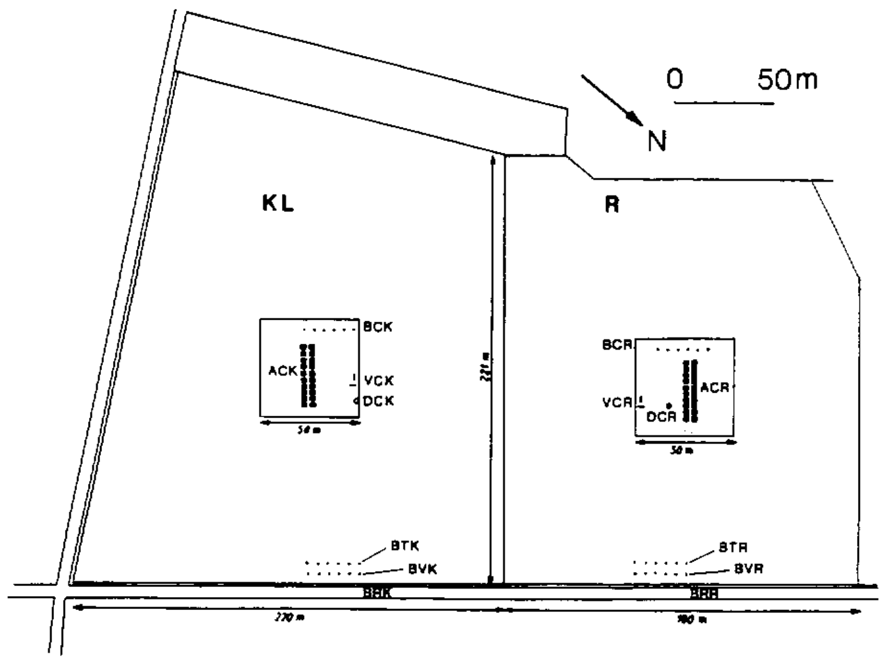

Fig. 5. Sampling design on fields KL and R (cf. Fig. 1). ACK, ACR = enclosed pitfall traps in field centre; BRK, BRR = pitfall traps in field edge; BVK, BVR = pitfall traps at 5 m from field edge; BTK, BTR = pitfall traps at 10 m from field edge; BCK, BCR = pitfall traps in field centre; DCK, DCR = time-sorting pitfall traps in field centre; VCK, VCR = window-traps in field centre.

3. Enclosed pitfall trapping

Pitfall traps placed within enclosures provide reliable information on relative density and minimal absolute density. A theoretical and empirical discussion of the technique can be found in DESENDER & MAELFAIT (1986).

Pitfall traps within enclosures were installed in the centres of KL and R for one year (2 x 20 traps, emptied at fortnightly intervals) (Fig. 5, Table 3). The aluminium enclosures used measure 40 x 40 x 25 cm. One pitfall trap with guiding plates of the type described above, was placed in each enclosure.

4. Time-sorting pitfall trapping

Time-sorting pitfalls permit the recording of diel activity patterns in field conditions. WILLIAMS (1958) improved the technique considerably.

Time-sorting pitfall traps were installed in the field centres of KL and R (two traps, emptied weekly) (Fig. 5, Table 3). The traps have a diameter of 31.5 cm and are 40 cm deep. They fit in a water-proof cylinder which is dug into the ground and which prevents water damage to the electronic system and batteries. A glass cover of 80 x 80 cm protects the system from precipitation. The catches were automatically separated into 12 periods of 2 hours each. The device is constructed in such a way that time differences between an animal entering the trap and its fixation are virtually impossible (see HOUSTON, 1971; LUFF, 1978).

5. Window trapping

An important aspect of the population dynamics of spiders is their aeronautic behaviour enabling them to travel enormous distances (e.g. BRISTOWE, 1939; DUFFEY, 1956; VAN WINGERDEN & VUGTS, 1974, 1979). Methodological studies have been performed in order to registrate and quantify aeronautic behaviour (GREENSTONE *et al.*, 1985a, 1985b). Window trapping is one of them.

Four traps have been installed in order to follow aeronautic behaviour of spiders and flight activity of other arthropod groups. They were operated for more than one year in the centres of KL and R (Fig. 5). Sampling dates are summarized in Table 3. The traps used consist of a glass plate (50 x 50 cm) positioned vertically above two vessels filled with fixative.

6. Additional sampling

Hand collecting and sweep netting was performed at regulary intervals (mostly weekly during 1986, 1987, 1988 and 1989) in the different habitats under study. This mainly provided valuable information on additional species or developmental stages which are hard to collect with other methods.

7. Rearing experiments

A considerable part of the study involved rearing of abundant spider species in order to obtain material for different laboratory experiments. A description of the rearing methodologies can be found in ALDERWEIRELDT (1991), ALDERWEIRELDT & DE KEER (1990) and ALDERWEIRELDT & LISSENS (1988).

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Un nouveau *Xylopsocus* LESNE, 1901, de la région orientale (Coleoptera, Bostrichidae)

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Abstract

Xylopsocus intermedius *DAMOISEAU, n. sp., from North Vietnam, is described and illustrated. The new species is characterized by the following combination of features: mandibles subequal, antennae 9-segmented, posterior edge of elytral declivity bearing tubercles.*

Xylopsocus intermedius DAMOISEAU sp. nov. (Figs 1-2)

Longueur du corps: 5 mm. Dessus du corps brun noir très brillant, dessous du corps, antennes et pattes brun rouge.

Front légèrement convexe et densement granuleux. Mandibules pratiquement identiques, pointues à l'apex.

Antennes de 9 articles. Articles 3 à 6 à peine plus longs que le deuxième article. Articles de la massue sans plages de pubescence.

Pronotum présentant une dent uncinée à l'angle latéral antérieur, mieux visible en vue latérale (cf. fig. 2). Angles postérieurs saillant en un tubercule émoussé. Suture latérale bien visible sur la moitié de la longueur. Région postérieure faiblement râpeuse mais densement ponctuée dans la portion médiane, pratiquement lisse et éparsement ponctuée vers les sutures latérales.

Bord antérieur des élytres ondulé et rebordé entre l'écusson et le calus huméral lisse. Côtés parallèles. Surface avec une ponctuation devenant plus profonde et plus nombreuse de la base vers la mi-longueur; après le milieu et sur la déclivité, ponctuation perdue entre des granules de plus en plus nombreux. Déclivité apicale munie de chaque côté au bord supérieur de deux tubercules non costiformes, semblables, de forme grossièrement