Functional Agro Biodiversity

FAB project in Netherlands means and purposes

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CAH DRONTEN
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Introduction

Actually, a large number of project and researches suggests that the level of functions in agro ecosystems is largely dependent on the level of plant and animal biodiversity present. Our politics and society understand and evaluate the effect of the XX century's agriculture. We made several mistakes with sometimes big mess as results, i-e pesticides like DDT …

European objectives are to improve the good agricultural practices, countries follow different ways to improve that, but all of them understood the importance of biodiversity in agroecosystems. Biodiversity performs a variety of ecological services beyond the production of food, including recycling of nutrients, regulation of microclimate and local hydrological processes, suppression of undesirable organisms and detoxification of noxious chemicals.

In this booklet, we will explain & describe this interaction and the role of biodiversity in securing crop protection. Moreover, we will discover action in netherland through the case of the Functional Agro-Biodiversity **(**FAB) project. We will understanding and learn meaning and characteristic of this action i-e to Flevoland. In third part, we will make one focus on determination of insect (pest and beneficial) in target to improve field determination of insects. In a last part, we will make a draft overview of this question around the world.

Agriculture and Ecological Background

Over the last 40 years, food has become relatively less expensive. At the same time, public concern about the harmful effects of modern agriculture on biodiversity, landscapes and the well-being of rural society has increased. After the 2nd world war agro-politic lifestyle focused on increase of the productivity in target to increase and guarantee food at quantity and at reasonable prices to consumers. Objectives have attained but the modernization of agriculture and food supply had gone on environmental degradation, loss of biodiversity, and negative changes in rural society.

New reforms of agriculture in the EU cast about a multifunctional agriculture that responds to the needs of society. This ethos is being considered not only in economic terms, but also by protecting natural resources, conserving nature and contributing to one diverse rural socio-economy. Since reforms of the CAP in 1992, the Agenda 2000 and the MTR, direct aids to farmers have been advanced by the European Commission for support farmers in return for the provision of public goods in the rural environment, especially the protection and improvement of biodiversity. Also, since 1992, the EU and many Member States have adopted biodiversity strategies which recognize that the rural environment supports the greater part of Europe's biodiversity.

As agriculture represents 50% of the land use activity in Europe, food and agriculture policies have increasingly aimed to encourage the management of farmland so as to lower the negative effects of farming and to conserve and increase biodiversity. Indeed, European biodiversity protection will not be achieved unless European agriculture fully integrates biodiversity imperatives.

The following are the five 'baseline' directives in the area of agriculture and the environment:

1. Birds Directive
2. Groundwater Directive
3. Sewage Sludge Directive
4. Nitrates Directive
5. Habitats Directive.

What is agro-biodiversity?

Agricultural biodiversity encompasses the variety and variability of animals, plants and micro-organisms which are necessary to sustain key functions of the agro-ecosystem, its structure and processes for, and in support of, food production and food security.

(FAO, 1999)

In literature we can found two different aspects for the concept of Agro-biodiversity, on the first hand it's all organisms at place than useful for make durable ecosystem, in a other hand it's limited to species and variety domesticated or valuable by human. In this field of activity it's better to use the global vision of the agricultural biodiversity. Because one ecosystem is a complex world, where all species and all individual are important like a link on chain.

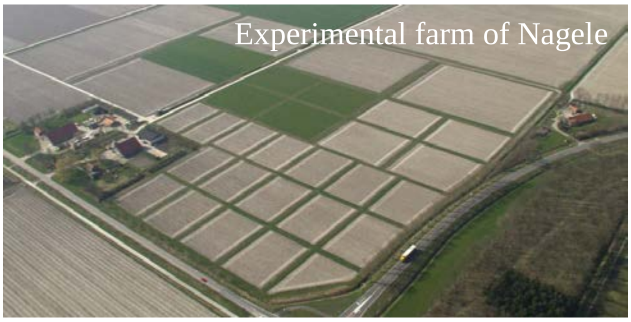
The understanding of agricultural biodiversity has developed during the last three decades from the recognition of the importance of genetic diversity, particularly for crops, and now to the development of the agro-ecosystem. Actually, there are programmes which support biodiversity conservation; e-i SAPARD (Special Accession Programme for Agriculture and Rural Development) and LEADER (Liaisons Entre Actions de Développement de l'Economie Rurale). Some are highly efficient in ecological point of view, like NATURA 2000, but are discuss and criticize by others sides.

In summary, agricultural biodiversity is essentially the interaction of knowledge and genetic resources used for food, biological support or ecological services. The accumulated knowledge is the product of countless generations of farmers, herders and fisher folk. All policies for the conservation and sustainable use of agricultural biodiversity must therefore start from recognition of this contribution, valuing this component and incorporating it into future plans.

Functional Agro-Biodiversity (FAB)
Background

During the last decades, biodiversity in agricultural landscapes in Western Europe has declined considerably. Road verges, watercourses and field margins have become the dominant refuge for biodiversity in agricultural landscapes. Consequently, the role of field margins in the conservation of plants, birds, mammals, butterflies and other groups has received a lot of attention (e.g. Boatman, 1994; Boatman et al., 1999; Tamis et al., 2001). Among many functions (Marshall & Moonen, 2002), field margins may play an important role in conserving pollinators, generalist predators and parasitoids, and may contribute to substantial degrees of natural control of agricultural pests in adjacent field crops (e.g. Thomas et al., 1992; Meek et al., 2002; Collins et al, 2002). Habitat management for the conservation of natural enemies of insect pests is recognized as a valuable strategy in sustainable agriculture (Landis et al., 2000; Gurr et al, 2003). Accumulating evidence shows that generalist predators from field margins can contribute significantly to the suppression of insect pests (Sunderland, 2002; Symondson et al, 2002) and to the reduce of use of chemicals.

FAB project, beginning of research in Nagele



All experiments and sampling were carried out at the experimental farm in Nagele in Netherlands (picture opposite) in the BIOdivers' and 'BIOintensief' systems as described in Van Alebeek et al. (2003). We compare two organic farming systems of six crops and 10 ha each; one system with a network of perennial field margins (21% of total surface) and one system with few margins (5%). Since 2001, pitfall traps, yellow water pans and crop inspections are being used to monitor natural enemies and key insect pests in crops and surrounding field margins (Van Alebeek et al., 2003). Because of the scale of the two systems, replication was not possible, and a full crop-rotation period of six years is required for a statistical analysis. Results from different locations in the two systems within one year, as presented here, are pseudo-replicates and no statistical tests are applicable.

In the open landscape of the Dutch Noordoostpolder, with very few natural landscape elements, we started a large-scale field experiment to investigate whether field margins can attract and conserve predators and parasitoids, and thus contribute to pest suppression. A network of permanent field margins sown with grass and perennials has been laid down on an organic farm to investigate two main questions: how far can field margins be apart and what vegetation diversity is required in order to achieve pest population suppression?

Alebeek IOBC 2003

FAB project was and is running in different area of Netherlands, like Hoeksche Waard and Limburg ; and now in Flevoland !

FAB project in Flevoland

In Flevoland, the project is in partnership with DLV Plants, a consultancy company and 20 farmers divide in 3 area's groups (Schokland, Alikruikweg and Oudebosweg) on 500 Ha with 38 km of border of 3m of width. It is one year-project followed by Mr. van Campen from DLV plant in Dronten. Targets of this project are to promote this method and following the process of experimentation in this new area. During the campaign, demonstrations have been made in two times ; In one hand with professional people like farmers and subventions' folks (LTO Noord Flevoland, water companies, administration of Flevoland) for promoting this process and presenting results. In second hand, with students from Groenhorst College and CAH university, in target to improve skill, knowledge and good agricultural practices of the new generation. Role of DLV was to help and follow farmers during the unwinding of this project ; like consultancy of pesticide employed and specials characteristics of FAB.

The role of field margins

Field margins have always existed in the landscapes and have genuine agricultural functions. In stock farming areas, hedges and walls were maintained to keep stock in or out. In arable land, field margins delineate the field edge and land ownership. In more recent times, a series of subsidiary roles have been identified, reflecting agricultural, environmental, conservation and cultural or historical interests.

Original roles and requirements:

To define the field edge
To be stock- or trespasser-proof, to keep animals in or out
To provide shelter for stock
To provide shelter for crops, particularly as windbreaks
To reduce soil erosion by wind or water
Not to compete with the crop for light, moisture or nutrients
Not to harbour weeds, pests and diseases
To harbour beneficial plants and animals
To act as a refuge or corridor for wildlife

Current and potential functions of field margins:

Promotion of ecological stability in crops
Reducing pesticide use:
Exploiting pest predators and parasitoids
Enhancing crop pollinator populations
Reducing weed ingress and herbicide use
Buffering pesticide drift
Reducing fertiliser and other pollutant movement, especially in run-off
Reducing soil erosion
Promotion of biodiversity and farm wildlife conservation
Maintaining landscape diversity

Beetle banks

A grassy strip across a field (beetle bank) is an over-wintering refuge for spiders and beneficial insects such as ground beetles. These animals are valuable in biological control of pests but, it can provide also new habitat for birds, small mammals and invertebrates (as well beneficial organisms).The technique is used to create semi-natural habitat within large fields, dividing large blocks into smaller areas with a new field margin. The width of the beetle bank should be 2 to 3 m wide and about 0.4 m high ideally, usually with the European grass cocksfoot (*Dactylis glomerata*). Work funded by Heinz Wattie's at Lincoln University has shown that densities of beneficial insects on a two year old beetle bank are over 500 per square metre, compared with fewer than 20 per square metre on non banked areas. Farmers who maintain beetle banks rarely need to use a summer insecticide.

Agricultural practices

Wide margin strips may provide easy access for hedge trimming in late winter, after berries have been eaten, without damage to adjacent arable crops. Strips are also one way of satisfying the requirement not to apply an increasing range of pesticides within 6 m of watercourses. Nevertheless, wide strips in small fields may have significant impacts on the working area within fields. Where annual weeds dominate the field boundary, notably barren brome and cleavers, creation of a perennial grassy margin can form a barrier to weed spread into the adjacent arable crop. Over time, reduced disturbance will also enhance perennials in the boundary, reducing annual weed populations. Provision of semi-natural habitat for beetles, spiders, bees and hoverflies will enhance their populations. Many of these species are beneficial to adjacent arable crops, either as pollinators or as predators of crop pests. Some hoverfly species, for example, require pollen and nectar to feed on as adults, before seeking out colonies of aphids in which to lay their eggs. The emerging hoverfly larvae are voracious aphid predators. Set-aside regulations allow margin strips to be included. Such strips may be for rotational set-aside and moved from field to field, or for non-rotational set-aside. In all cases, the width of set-aside margins has to be 20 m wide, under current EU regulations.

How to perform the test

In Flevoland, the borders are sow on 3 meters strip with a mix of different plants (see below). Because of a dry weather during April 2007, all margins were sowed later at the beginning of May. In consequence during the summer, borders are late in comparison to crops, i-e in 20th of May margins were just in the plantlet stage whereas wheat measured 1 meter!

Composition of border in potato crop

Flowers mixture in Wheat and Potato crops	Botanic family	Dutch name	English name	Distribution		
				Seeds/m²	Kg/m²	(%)
Centaurea cyanus	*Asteraceae*	Korenbloem	Cornflower	45	1,5	7
Coriandrum sativum	*Apiaceae*	Koriander	Coriander	60	6	26
Fagopyrum esculentum	*Polygonaceae*	Boekweit	Buckwheat	23	5,2	23
Vicia sativa	*Fabaceae*	Voederwikke	common vetch	12	4,8	21
Chrysanthemum segetum	*Asteraceae*	Gele Ganzebloem	Corn marigold	59	0,7	3
Foeniculum vulgare	*Apiaceae*	Venkel	Fennel	63	2,5	11
Medicago sativa	*Fabaceae*	Luzerne	Alfalfa	75	1,5	7
Papaver rhoeas	*Papavéraceae*	Klaproos	Common poppy	270	0,3	1
Borago officinalis	*Boraginacées*	Bernagie	Borage	3	0,5	2
				610	23	100

Coriander, fennel and buckwheat are in the top 10 of the most attractive plants for insects. They attract almost all families of insects (pest and beneficial); it's necessary to be more careful in few crops with flies like *Psillia rosae* in carrot or *Delia radicum* in cabbage. However if the beneficial insects population is valorised, it can easily control that pest.

How counting insects?

To count insects we use different traps placed around the field and inside borders. We can use simple, feeding, coloured and sexual traps.

Basic trap is just one container protected against rain, filled with water and soap [1]. With this kind of trap you will catch only organisms that fall inside.
If you use sugar (any sweet things) instead of water, you are making a **Feeding trap**, this kind of trap catches lots of insects of all classes and requires few insects' determination skills and knowledge (see part 3 of this booklet).

The **coloured traps**, usually yellow, are used in different ways:

- the "yellow sticky panel" [2] (it can be blue for catch *Thrips*). Insects are attracted by yellow colour ? and are caught on the sticky panel.
- "the yellow washbowl" [3] (usually use in rape crop). It's working like a basic trap but with the yellow effect.

Coloured traps are more efficient and catch a lot of flying insects.

Sexual traps are highly efficient but just with Lepidoptera class. Male insect is attracted by female pheromone of traps and are caught by a sticky panel. In orchard and wine crops, you can use pheromones protection against Tortricidae family. Means of this idea is to make one big cloud of female pheromone around the field; Consequences are that males cannot found the female because it is lost by pheromone saturation on air. Thiscrop protection process is very efficient for biotechnologies engineering and is used by organic farmers.
We can also employ pheromone traps [4], it is a coloured trap with a pheromone capsule. It is an efficient process for specific species of pests and that is only used for counting.

All kind of traps need to be checked every day or every two days to make a fine insect determination; because after this period, insects' bodies become soft and degraded**.**

[1] Basic trap

[2] yellow sticky panel

[3] the yellow washbowl

[4] pheromone traps

Relationship between insects and plants

How weed-insect interactions may be manipulated as part of a pest management strategy is explored in detail. Weeds are important alternate hosts for insects in sites near cropped fields, but they also offer respite and breeding sites for natural enemies of insect pests. Exactly how the diversity of crops and weeds influence crop loss is not well understood, as there are factors of species richness, plant architecture, and size of patch or field to consider. These interactions and processes are essential to building an understanding that can lead to viable crop production system design.

For learn more about that plants attract beneficial insects

www.organicgardening.com
www.farmerfred.com/plants_that_attract_benefi.html

A flower-feeding

Many beneficial insects that are useful in biological control of pests need pollen and nectar resources. The pollen provides protein and the nectar energy, is two valuable sources especially for bees and some others beneficial insects. Native and non-native biodiversity can be added in the form of flowering plants in paddock margins. A well-researched example is buckwheat. The flowers of this plant are numerous and shallow, so they represent an abundant and easily accessible source of nectar and pollen. Insects such as ladybirds, hover flies and parasitic wasps use buckwheat in large numbers, and biological control of pests can be enhanced as a result. Research in orchards, vineyards and cereals has shown that buckwheat can enhance biological control of pests in these systems by enhancing the numbers, fecundity and longevity of beneficial insects.

"Good Management Practices" by Agriculture Society Inc

Results and discussion
Hibernation in field margin

Field margins are attractive over wintering sites for a range of organisms, especially Carabid beetles. Twice as many carabids survived in field margins compared to field plots without vegetation (Table 1). Generalist predators (carabids, spiders, some rove beetles) hibernate in field margins in densities of at least 150 predators per square meter. But bare field plots also yielded considerable numbers of surviving predators, approx. 100 per m2. Prolonged trapping in the field margins indicated that, after 10 weeks (by the end of May), more than 540 arthropods (of which over 200 predators) per square meter survived wintertime (data not shown). It is assumed that after May still many more arthropods may become active out of hibernation. Overall arthropod and predator densities are well within the ranges reported by others, e.g. Pfiffner & Luka (2000) and Frank & Reichart (2004).

Table 1. Average numbers of soil-surface dwelling invertebrates caught in pitfall traps within 1 m^2 enclosures in different farm habitats during 7 weeks in early spring (March-May), 2004.

	Unmown, biodivers field margins (n=3)	Short mown grass strips (n=3)	Bare soil plots (n=6)
Carabid beetles	101	33	48
Spiders (all families)	35	59	33
Rove beetles (*Staphylinidae*)	66	32	71
Other beetles	112	45	36
Remaining groups	47	32	13
Total catch per m^2	361	200	201

Predator impact on aphid infestations

Predators appear to be responsible for almost 50% mortality after one week exposure (Table 2). This indicates the potential impact of predators on the colonising phase of aphid infestations in spring. The effect of ground dwelling predators on aphid mortality is higher than found in other studies (21% in Holland & Thomas, 1997; 35% in Collins et al., 2002 and 15% in Schmidt et al., 2003). This may be due to the high aphid densities on the banker plants, which normally do not occur under field conditions by the end of May.

Table 2. Average numbers of aphids surviving after one week exposure in enclosures from which predators were removed and with free predator access (end of May, 2004).

	n	# aphids surviving[1]	% mortality due to predation	# predators removed per ring[1]
Before the experiment	8	230 ± 78		
In field margin, predators removed	6	172 ± 130		46 ± 22
In field margin, predators free access	6	88 ± 31	49%	
In wheat, predators removed	14	134 ± 57		39 ± 22
In wheat, predators free access	14	68 ± 61	49%	

1: mean ± standard deviation

Pest suppression in different crops

Monitoring key pests at peak densities (summer wheat and potatoes in July, Brussels sprouts in August or September) revealed that aphid densities in summer wheat were 30% - 50% lower in the BIOdivers system with field margins as compared to the BIOintensief system without margins (Table 3). For aphids in potatoes, densities were 15% - 65% lower in the presence of field margins than without margins. Sunderland (2002) reviewed studies on predation impact and reported 28%-86% aphid reduction in wheat and 80%-88% aphid reduction in potato. We hypothesize that early season predation as shown in the exclusion experiment is an important factor in reducing aphid population pressure. However, in some other key pests, such as Diamond back moth (*Plutella xylostella*) and slugs in Brussels sprouts, the effect of field margins on pest control appears to be negative. Slugs (data not shown) may be stimulated by a better survival and a favourable microclimate in the margins, whereas Diamond back moth may react to increased crop edge length of the smaller plots, divided by field margins, in the BIOdivers system.

Table 3. Key pest densities in three crops in 2002 – 2005 in the BIOdivers system with field margins compared to the BIOintensief system without margins.

	2002	2003	2004	2005
	Aphids in summer wheat (% shoots infested)			
With field margins	13,0 ± 4,4	16,1 ± 10	30,9 ± 8,1	35,3 ± 12,6
Without field margins	24,1 ± 4,3	26,7 ± 5,8	43,5 ± 11,3	57,3 ± 10,9
% aphid reduction	*46%*	*40%*	*29%*	*38%*
	Aphids in potato (% shoots infested)			
With field margins	5,4 ± 2,6	24,8 ± 13,2	58,3 ± 14,2	17,3 ± 12,8
Without field margins	15,2 ± 6,9	43,3 ± 12,3	68,3 ± 9,6	37,3 ± 11,6
% aphid reduction	*65%*	*43%*	*15%*	*54%*
	Diamond back moth in Brussels sprouts (# caterpillars / plant)			
With field margins	---	4,3 ± 2,3	1,8 ± 1,7	0,8 ± 0,5
Without field margins	0,5 ± 0,3	1,9 ± 1,0	1,3 ± 0,6	0,7 ± 0,4
% caterpillar increase	---	*130%*	*32%*	*18%*

Alebeek, article
IOBC 2006

Determination of insects
Draft key of determination

1. With antenna and mandible — **ARTHROPODS** (see table below)

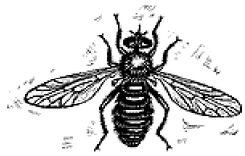
1a. Without antenna and mandible, with chelicerae — **ARACHNIDS**

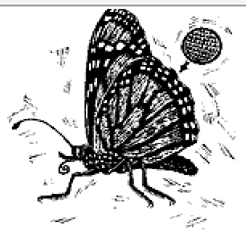
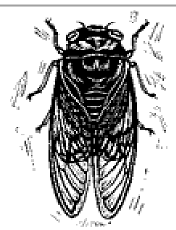
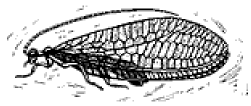
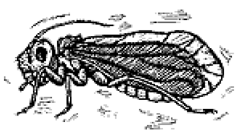
Cephalotorax more or less in 2 parts, small to large size — **Spiders**

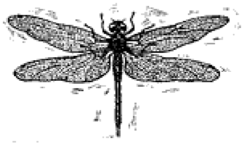
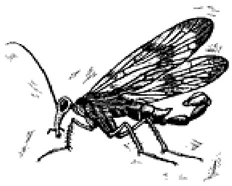
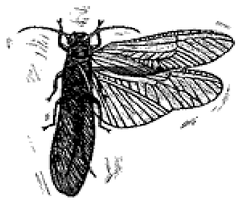
Cephalothorax in 1 part, small size 0,8 to 1,5 mm — **Spiders-mite**

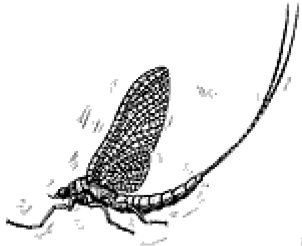
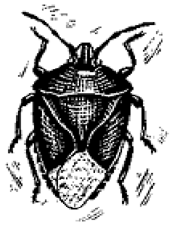
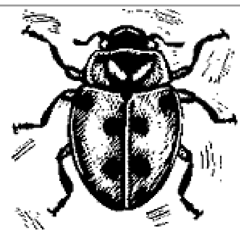
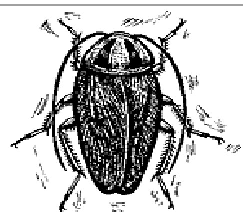
Arthropods - Key A: Arthropods with Six Legs, with Well-Developed Wings.

Only adult arthropods are included, and certain uncommon orders are not included. To use a key, read both descriptions in a couplet (for instance, 1a and 1b). Decide which sounds most like your critter, and move to the next couplet indicated. Should you reach a dead-end, use the numbers in parentheses to backtrack until you reach a couplet that you felt unsure about, and try following the other path. Some orders are found more than once in the keys, because the arthropods occur in different forms.

STEP	FROM	CHARACTERS	ORDER / CLASS
1a		One pair of wings. . . . . go to 2	
1b		Two pairs of wings. . . . . go to 3	
2a	**1a**	Hind wings reduced to tiny knobs (halteres), tip of abdomen without 2-3 thread-like tails	 **DIPTERA** (Flies)
2b	**1a**	Hind wings not reduced to tiny knobs, tip of abdomen with 2-3 thread-like tails **(caudal filaments)**	 **EPHEMEROPTERA** (Mayflies)
3a	**1b**	Front and hind wings have similar texture. . . . . go to 4	
3b	**1b**	Front wings a rigid or leathery covering for clear hind wings. . . . . go to 14	

4a	**3a**	Wings covered with powdery scales, mouthparts usually a coiled tube **(proboscis)** for sucking	 **LEPIDOPTERA** (Moths / Butterflies)
4b	**3a**	Wings not covered with powdery scales, mouthparts not a coiled tube. . . . . go to 5	
5a	**4b**	Wings slope downwards (rooflike) from the center at rest. . . . . go to 6	
5b	**4b**	Wings not held rooflike at rest. . . . . go to 9	
6a	**5a**	Wings covered with hair	 **TRICHOPTERA**
6b	**5a**	Hairless wings. . . . . go to 7	
7a	**6b**	Sucking mouthparts in the form of a rigid beak, often short and bristley antennae, body may look like a thorn	 **HOMOPTERA** (Hoppers)
7b	**6b**	Mouthparts not in the form of a rigid beak, antennae not short and bristley, body never looks like a thorn. . . . . go to 8	
8a	**7b**	Wings with many cross veins	 **NEUROPTERA** (Lacewings)
8b	**7b**	Wings without many cross veins	 **PSOCOPTERA**
9a	**5b**	Front and hind wings similar in size and shape. . . . . go to 10	
9b	**5b**	Front and hind wings not similar in size and shape. . . . . .go to 12	

10a	**9a**	Antennae always short and bristley	 **ODONATA** (Dragonflies & Damselflies)
10b	**9a**	Antennae never short and bristley. . . . . go to 11	
11a	**10b**	Wings held flat over abdomen when at rest, last abdominal segment not enlarged, usually found in colonies	 **ISOPTERA** (Termites)
11b	**10b**	Wings not held flat over abdomen when at rest, males with the last abdominal segment enlarged like a scorpion's stinger and held over the body, not found in colonies	 **MECOPTERA** (Scorpionflies)
12a	**9b**	Body very soft, without a narrow "waist". . . . . go to 13	
12b	**9b**	Body not exceptionally soft, often with a narrow "waist"	 **HYMENOPTERA** (Bees & Wasps)
13a	**12a**	Hind wings wider than front wings, folded underneath like a fan	 **PLECOPTERA** (Stoneflies)

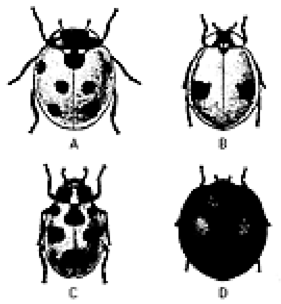
13b	**12a**	Hind wings much smaller than front wings, not folded underneath like a fan	 **EPHEMEROPTERA** (Mayflies)
14a	**3b**	Sucking mouthparts in the form of a rigid beak, front wings with clear tips **(hemelytra)**, overlapping at rest, revealing a triangular panel on the back **(scutellum)**	 **HETEROPTERA** (True Bugs)
14b	**3b**	Chewing mouthparts, front wings without clear tips. . . . . . go to 15	
15a	**14b**	Rigid front wings **(elytra)** meet in a straight line down the middle of the back	 **COLEOPTERA** (Beetles)
15b	**14b**	Front wings not as above. . . . . go to 16	
16a	**15b**	Head visible from above. . . . . go to 17	
16b	**15b**	Head hidden from above by a hoodlike structure **(pronotum)**	 **BLATTARIA**
17a	**16a**	Front legs strong with prominent spines for grasping prey, hind legs long and slender	 **MANTODEA**
17b	**16a**	Front legs without spines or with weak spines, the femora of the hind legs are enlarged for jumping	 **ORTHOPTERA** (Grasshoppers & Crickets

Beneficial insects

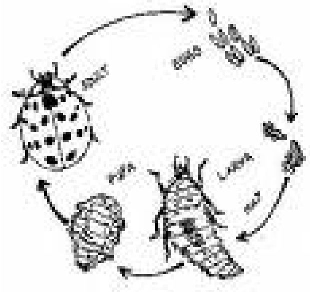
Predators

Predaceous insects and mites function much like other predaceous animals. They consume several-to-many prey over the course of their development, they are free living, and they are usually as big as or bigger than their prey. Some predators, including certain syrphid flies and the common green lacewing, are predaceous only as larvae; other lacewing species, lady beetle, ground beetles, and mantids are predaceous as immatures and adults. Predators may be generalists, feeding on a wide variety of prey, or specialists, feeding on only one or a few related species. Common predators include lady beetles, rove beetles, many ground beetles, lacewings, true bugs such as *Podisus* and *Orius*, syrphid fly larvae, mantids, spiders, and mites such as *Phytoseiulus* and *Amblyseius.*

The Lady bird, *Coccinellidae*



Beetles in this family are known as lady beetles, The vast majority of lady beetles are beneficial predators of soft bodies insects (aphids and scale insects in particular), mites, and insect eggs. In each species, adults and larvae consume similar prey and generally can be found together where their prey is abundant. Most species of lady beetles provide significant levels of pest control if they are not eliminated by insecticides, tillage, or other land-use practices.



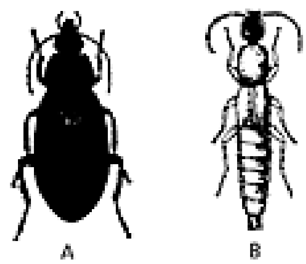
Larval and adult ladybird primarily on aphids; Where aphids are not available, they may feed on scale insects, other small, soft-bodied insect larvae, insect eggs, and mites. Adults also feed occasionally on nectar, pollen, and honeydew (the sugary secretions of aphids, scales, and other sucking insects). Development from egg to adult takes 2 to 3 weeks, and adults live for several weeks to several months, depending on location and time of year.

Coccinella septempunctata, referred to as "C-7" for its seven spots, is a significant natural enemy of several important aphid species, including the pea aphid and the green peach aphid. Other common aphid-feeding lady beetles include the two-spotted lady beetle (*Adalia bipunctata*), and the spotted lady beetle (*Oleomegilla maculata*)..

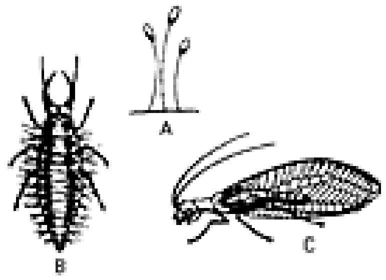
Ground Beetles (*Family Carabidae)* and Rove Beetles (Family *Staphylinidae*)

Adult and larval ground beetles and rove beetles prey on a wide range of insects and are especially important as predators of caterpillars and other soft-bodies insects in field crops, forests, and many other habitats. Together these two families of beetles include nearly 5,000 species.

Both ground beetles and rove beetles are commonly found under plant debris and beneath the soil surface. Many species are nocturnal (active at night) and as a result are not as apparent as other natural enemies. Ground beetles and rove beetles, along with spiders, are the most common predators found in many field crops.



The Green Lacewings, *Chrysopera spp*



Adult green lacewings have delicate, light green bodies, large, clear wings, and bright golden or copper-colored eyes (C). The larvae are small, greyish brown, and elongate and have pincerlike mandibles (B). Green lacewing eggs are found on plant stems and foliage, singly or in small groups on top of a silken stalks which (A). Good strategy for reduce predation and parasitism by keeping the eggs out of reach.

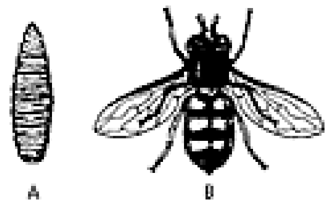
Green lacewing larvae are generalist predators of soft-bodied insects, mites, and insect eggs, but they feed primarily on aphids and are commonly known as "Aphid Lions." Lacewing larvae are also cannibalistic, feeding readily on other lacewing eggs and larvae if prey populations are low. Although adults of some lacewing species are predaceous, Lacewing larvae are naturally tolerant of low rates of several insecticides. Larvae are highly susceptible to many other insecticides, however, and adults tend to be more susceptible than larvae in all cases.

Chrysoperia carnea, the common green lacewing, is the most widely available lacewing species. *Chrysoperia rufilabris* is an eastern lacewing species that is better adapted for use in tree crops. *Chrysoperia rufilabris* adults are predaceous to a limited extent.

Praying Mantids

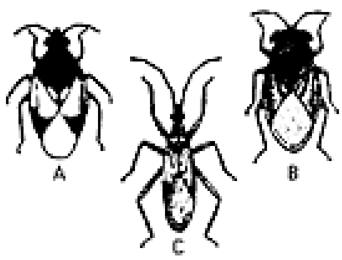
Mantid nymphs and adults are indiscriminate generalist predators that feed readily on a wide variety of insects, including many beneficial insects and other mantids. They are not effective predators on aphids, mites, or most caterpillars. In addition, mantids are territorial, and by the end of the summer often only one adult is left in the vicinity of the original egg case. Adult female mantids produce egg cases that may contain up to two hundred eggs. These eggs remain dormant until early summer when tiny mantid nymphs hatch and begin search for prey. Only one generation of mantids develops each year.

Syrphid flies or Hover Flies (Family *Syrphidae)*



Syrphid flies are common in many habitats. The small, wormlike larvae of many species are found on foliage where they prey on aphids. Adult syrphid flies feed on pollen and nectar. The adults of many species closely resemble bees and wasps but do not sting or bite.

True Bugs (Order *Hemiptera*)



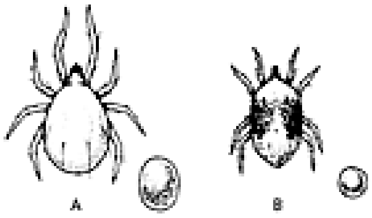
Many species of true bugs are predaceous, and several play important roles in the control of agronomic pests. The minute pirate bug (*Orius insidiousus* (A)) feeds on the eggs of caterpillar pests in corn and other crops; it also feeds on many other small soft-bodied insects. The big-eyed bugs (*Geocoris species* (B)) also prey on caterpillar eggs and other small insects. Damsel bugs (*Nabis species* (C)) are common in gardens and crops, where they feed on aphids and many other pests.

Spiders

All spiders feed on insects or other small arthropods. Most people are familiar with many common web-making species. However, there are many other spiders -- wolf spiders, crab spiders, jumping spiders -- that do not build webs but instead move about and hunt their prey on soil or plants. These less conspicuous spiders can be important in controlling insect pests such as beetles, caterpillars, leafhoppers and aphids.

The Predatory Mites, Phytoseiulus persimilis and Other Species

Predators of two-spotted spider mites *Phytoseiulus* and *Amblyseius* are fast-moving, pear-shaped predators with short life cycles (from 7 to 17 days, depending on temperature and humidity) and high reproductive capacities. They are pale to reddish in color and can be distinguished from two spotted spider mites by their long legs, lack of spots, and rapid movement when disturbed. The eggs of predatory mites are elliptical and larger than the spherical eggs of spider mites. Predatory mite nymphs feed on spider mite eggs, larvae, and nymphs. Adult predators feed on all developmental stages of spider mites.



This mite develops, reproduces, and preys on spider mites most effectively in a temperature range of 21° to 27°C (70-80°F), with relative humidities of 60-90%. Above and below these ranges, Phytoseiulus persimilis is less able to bring twospotted spider mite populations under control.

Thrips predators

In addition to spider mite predators, two species of predatory mites feed primarily on thrips. *Amblyseius cucumeris* and *Amblyseius mckenziei* (or *A. barkeri*) feed on the western flower thrips *Frankliniella occidentalis* and the onion thrips *Thrips tabaci*, both of which may be serious pests in greenhouses. They can subsist for short periods on pollen, fungi, or spider mite ebbs when thrips are not available. These mites require high relative humidities and are not tolerant of insecticides. Short days inhibit egg production by predatory mites, making thrips control difficult during winter months.

Parasitoids

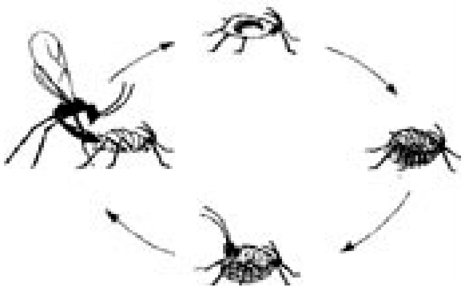
Although parasitoids are similar to true parasites, they differ in important ways. True parasites are generally much smaller than their hosts. As they develop, parasites usually weaken but rarely kill their hosts. In contrast, many parasitoids are almost the same size as their hosts, and their development always kills the host insect. Although parasitoids are sometimes called parasites or parasitic insects, these terms are not completely accurate. In contrast to predators, parasitoids develop on or within a single host during the course of their development.

Tachinid Flies

These flies are rather undistinguished-looking gray or brown flies covered with dark bristles. Most look like other common flies, but they differ markedly in their habits. Adult tachinid flies lay eggs on various caterpillars, beetles and bugs, usually near the head. The eggs hatch almost immediately, and the young maggots tunnel into their host. After feeding internally for a week or more, the tachinid fly larvae eventually kill the host insect. The many kinds of tachinid flies are important natural controls of many insect pests, particularly caterpillars.

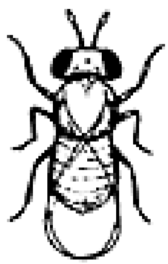
Braconid and Ichneumonid Wasps

These are a large and diverse group of insect parasites. Some are small and attack small insects such as aphids. Others live in the eggs of various pest insects. Larger parasite wasps attack caterpillars or wood-boring beetles.



External evidence of these parasites' activity is often more obvious than with the tachinid flies. For example, aphids that are parasitized by these wasps are typically small and discolored and called "aphid mummies." Other braconid wasp species spin conspicuous pupal cocoons after emerging from a host.

Trichogramma Wasps, Egg Parasitoids



Trichogramma wasps are extremely small, averaging about 0.7 mm in length as adults, the size and host-finding ability of Trichogramma wasps are partially dependent on the species of host egg within which the wasps are reared. There are many species of Trichogramma, and each prefers different hosts. Although several Trichogramma species are generalist parasitoids, many parasitize only one or a few related species. Most Trichogramma species lay their eggs into the eggs of moths and butterflies. A few species parasitize eggs of other kinds of insects. Trichogramma larvae develop within host eggs, killing the host embryos in the process. Instead of a caterpillar hatching from a parasitized egg, one or more adult Trichogramma wasps emerge. Because the caterpillar pests are killed in the egg stage, no feeding damage occurs

Source used: www.edis.ifas.ufl.edu

Biodiversity questions around the world

The effects of a vegetational corridor on the abundance and dispersal of insect biodiversity within a northern California organic vineyard

During 1996 and 1997, two adjacent 2.5 has organic vineyard blocks (A and B) were monitored to assess the distributional and abundance patterns of the Western grape leafhopper Erythroneura elegantula Osborn (Homoptera: Cicadellidae) and its parasitoid Anagrus epos Girault (Hymenoptera: Mymaridae), Western flower thrips Frankliniella occidentalis (Pergande) and generalist predators. The main difference between blocks was that block A was cut across by a corridor composed of 65 flowering plant species which was connected to the surrounding riparian habitat, whereas block B had no plant corridor. In both years, leafhopper adults and nymphs and thrips tended to be more numerous in the middle rows of block A and less abundant in border rows close to the forest and corridor where predators were more abundant. The complex of predators circulating through the corridor moved to the adjacent vine rows and exerted a regulatory impact on herbivores present in such rows. In block B all insects were evenly distributed over the field, no obvious density gradient was detected from the edges into the centre of the field. Although it is suspected that A. epos depended on food resources of the corridor, it did not display a gradient from this rich flowering area into the middle of the field. Likewise no differences in rates of egg parasitism of leafhoppers could be detected in vines near the corridor or in the vineyard centre. The presence of riparian habitats enhanced predator colonization and abundance on adjacent vineyards, although this influence was limited by the distance to which natural enemies dispersed into the vineyard. However, the corridor amplified this influence by enhancing timely circulation and dispersal movement of predators into the centre of the field.

Landscape Ecology, Springer Netherlands C. Nicholls, M. Parrella and A. Altieri

BOX 3: The Haya Traditional cropping technique [49]

The Haya who live in Tanzania, are sedentary with very stable villages occupied under conditions of high population density. They practice a type of mixed husbandry involving tree crops and the keeping of cattle.. The Haya use a distinctive set of crops and cropping techniques for each main type of land. The different combinations of land and cropping techniques make unique farming systems suitable to the weather and soil conditions. Three different field types can be identified each having it's own location-specific combination of cropping system components (e.g. soils, crops, fallow periods, weed, pests and diseases). *Kibanja* located around the homestead on deep soils; bananas are grown in mixture with beans, coffee and several other crops; e.g. *Kikamba*, located at the edge of the *Kibanja;* it may be fallowed for short periods, or cropped with banana, or annual crops (e.g. root crops, groundnuts); *Rweya* located at some distance from the homestead on common land; it may be fallowed and cattle grazed for long periods (5 - 10 years), or cultivated for short periods (1 - 2 years) with bambara nuts, or cassava[50]. This arrangement is deliberate to complement each cropping system. For example, the high diversity and variety of species in the *Kibanja* plot is due to the fertilizing function of the *Rweya* by way of domestic refuse, ashes, mulch and manure mined through cattle[51]

Source: Kamara B, 1997

Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD) work programme distinguishes a number of aspects of agricultural biodiversity. These aspects also reappear in the EU Biodiversity Action Plan for Agriculture.

They include :

- Varieties and species of domesticated plants and animals;
- Components which support ecological functions, such as soil life, pollinators and organisms that regulate diseases and plagues;
- Wild flora and fauna from agricultural areas, including processes among diverse species and exotic elements;
- The role of human activities in the system.

The firs aspect concerns the protection of genetic resources, and the second is more an understanding of ecosystem approach and which way for further diversification.

The Netherlands is working to place sustainable agriculture on the global agenda, based on the strengthening and sustainable use of agri-biodiversity with a fair socio-economic distribution. It is important to link that with the work that is taking place within existing framework such as CBD, FAO, UNEP, UNDP, IUCN, WTO, OECD, but also within industry.

The Netherlands contributes to the application of good agricultural practices on a local level, taking care to closely monitor organic agriculture, low external inputs, agro-forestry and silvo-pastoral systems, integrated pest management and agrarian nature conservation. The goal is not only sustainable management, but also the strengthening of nature, landscapes and habitats, and participation and joint responsibility. In this context, an important concern is also the introduction of biodiversity principles in modern agriculture.

International policy programme 2002-2006, Biodiversity of the Netherlands

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Picture of William Henk, Worked by C.R.