FOOD & BIODIVERSITY

Very Good Agricultural Practice

Guideline on Pesticide Management

Content

1 Introduction 3

2 Pesticides management 3

2.1 Herbicides 3

2.2 Insecticides 4

2.3 Fungicides, bactericides etc. 4

3 More sustainable use of pesticides: Integrated Pest Management 4

3.1 EU Pesticides Directive 4

3.2 Integrated Pest Management (IPM) 5

3.2.1 General Overview 5

3.2.2 Principles of IPM 5

4 No use of chemical pesticides: Organic agriculture 6

5 Very Good Agricultural Practices in Pest Management 8

5.1 General principle of biological pest management in combination with crops adapted to the respective location 8

5.1.1 Handling of very critical substances for biodiversity: 10

5.1.2 Continuous improvement and documentation of pesticide use 10

5.1.3 Appropriate use of pesticides 11

5.1.4 Consultancy / Information / Training 11

Overview of the Project EU LIFE Food & Biodiversity 12

1 Introduction

The LIFE Food & Biodiversity project supports food standards and food companies to develop efficient biodiversity measures and to implement them in their pool of criteria or sourcing guidelines.

In this guideline, we provide information on the current situation of pesticide management in temperate climatic regions, as well as backgrounds for the "very good agricultural practice" proposed in the "Recommendations to improve biodiversity protection in policy and criteria of food standards and sourcing requirements of food companies and retailers".

2 Pesticides management

From an ecological point of view, most crops are monocultures without biodiverse food chains, as few species feed on the crop in limited time periods, and consequently a very limited diversity of arthropod predators (spiders, bugs, etc.) can evolve. In such ecologically poor environment without any antagonists, calamities, i.e. fast populations growth, can easily occur. Pests and diseases can have a considerable impact on the economic output of a farm. Wild flowers compete with the farmed crops, insects harm plants, fungal, bacterial and viral infections decrease yields and can lead to a complete crop failure in humid periods during the summer. Herbicide, insecticides, fungicides, bactericides and other chemical and biological substances target to minimize these economic risks.

Despite the EU-regulations, the application of pesticides is common in conventional European agriculture and pose a tremendous risk to biodiversity in general. Every conventional crop is treated several times with a combination of active substances. The pesticides purpose in general is to erase undesired biodiversity from the cropped area, to prevent quick repopulation and to ideally keep the crop clean and sane until the harvest. Data show that this is achieved to a very large extend and very efficiently, as most arable land is free from any biodiversity.

Pesticides are a big environmental issue for water bodies and the environment in general. Water legislation restricts the application of some extensively used herbicides, and those with high risks of leaching due to their application times. In winter, drain flow is the main transport mechanism; herbicides attached to soil particles can be introduced into water bodies during heavy rains. Careful application of pesticides is the key to minimize collateral damages. The efficiency of the herbicides is directly interlinked with the surface of the plant targeted. Small droplets sprayed have the highest impact, but fine sprays lead to the highest drifts.

2.1 Herbicides

For many crops, competition with wild flora is the most important issue in crop management and herbicides make up a high proportion of farming costs. Herbicides are applied on fairly all conventional managed crops in Europe. The number of applications depends on the product and the efficiency of previous management of wild flora. Herbicides divide into contact and residual, non-selective (so called total herbicides) and selective for a specific group of weeds. The residuals seal the ground and inhibit development of wild plants; contact herbicides enter emerging plants and poison metabolisms. Total herbicides impact all plant species, including the crop. Specific herbicides make use of the fact that monocotyledonous like grass or maize and dicotyledonous plants have slightly different metabolisms and target only some flora.

In many annual crops, total herbicides are applied preventively to exclude competition with wild flora in the seedling phase, which is not allowed according to the European Pesticides Directive 2009/128/EC, as most pre-emergent herbicides can be substituted by mechanical weeding techniques. Glyphosate is an example for a total herbicide working as contact toxin and used as a pre-emergent. Only 0,1 ml/m² of active matter lead to the desired effect. Estimates by NGOs indicate that 75 % of arable land in Central Europe is treated with glyphosate once a year. Wild flowers form the basis of food chains in arable landscapes. Plants like hurtsickle (*Centaurea cyanus*) and corn rose (*Papaver rhoeas*), were common in European agriculture, and declined by 75 % in species numbers and 95 % in population sizes. Many typical farmland species are almost extinct in many agricultural landscapes.

2.2 Insecticides

Some arable crops have a large number of insect pests, varying by region and production methods. Many of these pests occur annually and cause yield losses and economic damage. Insecticides are used to reduce such pests. The application of insecticides should follow the population development of a given pest and might not be needed in some years, in others several applications are due. Broadband insecticides target any arthropod/insect, ovicides, larvicides or acaricides only some stages or groups of species.

The purpose of insecticides is to erase pests and arthropod biodiversity from arable countryside. A group of products discussed here, is neonicotinoides. This group of active substances targets the nervous system of insects. The active matters are up to 11.000 times more effective than e.g. DDT, which was forbidden worldwide in the early 80ies, due to unforeseen effects outside the application on crops. Neonicotinoids also affect non-target groups like mammals and fish.

2.3 Fungicides, bactericides etc.

Fungal infections and the application of fungicides, as in insecticides, must be managed in accordance to an economic threshold model, to comply with the EU pesticides directive. According to the integrated pest management regulations, farmers must monitor diseases and may only apply fungicides (and other pesticides), if the economic loss is outbalanced. When plant protection is applied, targeting diseases inefficiently can lead to resistances; meaning that a disease becomes insensitive to a particular fungicide. Fungicides are commonly applied up to three times in spring. The direct effect on biodiversity here is not as obvious as in the other active matters. The fungus etc. species targeted are often poisonous to arthropods, too, and do not miss in the food chain per se. Still, fungicides have an impact on other, non-targeted fungus species, and thus affect the microflora and -fauna.

3 More sustainable use of pesticides: Integrated Pest Management

In Europe, the application of pesticides has to comply with the integrated pest management concept. Monitoring of the pest levels, crop rotation, mechanical soil preparation, good water and nutrient management, seeding rates and depths, and biological pest control must precede the inevitable use of pesticides. Crop rotation e.g. focuses on the reduction of crop infections by reducing build-ups of insect pests, weeds, nematodes or other soil-borne diseases. Pesticides should only be applied when pests and diseases exceed economic thresholds i.e. yield losses would exceed costs for chemical pest control. The amount of active matter applied needs to be adjusted to the degree of infection. Preventive (i.e. pre-emergent) and calendar spraying, i.e. the application of pesticides without reported signs of diseases or risk assessment, is not allowed according to applicable EU legislation.

3.1 EU Pesticides Directive

„Directive 2009/128/EC “ EU Pesticide Directive.

This directive aims to achieve a sustainable use of pesticides in the EU by reducing the risks and impacts of pesticide on human health and the environment and promotes the application of Integrated Pest Management (IPM) and of alternative approaches on crop protection, such as non-chemical alternatives to pesticides.

Member States were required to adopt National Action Plans (NAPs)[1] to implement the Directive for the first time by November 2012. These plans should contain quantitative objectives, targets, measurements and timetables to reduce the risks and impacts of pesticide use. You should review these plans at least every five years. The Directive identifies specific measures that Member States are required to include in their plans for proper implementation. The main actions relate to:

[1] National Action Plans on sustainable use of pesticides for Europe: https://ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides/nap_en

- Training of users, advisors and distributors
- Inspection of pesticide application equipment
- Prohibition of aerial spraying
- Limitation of pesticide use in sensitive areas
- Information and awareness raising on pesticide risks
- Systems for gathering information on pesticide acute poisoning incidents, as well as chronic poisoning developments, where available

(Source: ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides)

Status quo of implementation in Europe

The commission report published in October 2017 (ec.europa.eu/food/audits-analysis/overview_reports/details.cfm?rep_id=114) indicates a hesitant and delayed implementation of the pesticides directive in the Member States. Member States adopted NAPs, with significant delays in many cases, and with recognizable differences in completeness and coverage. Only five Member State NAPs set measurable targets, which was in the spirit of the directive. Hence, four of these relate to risk reduction and only one foresees an absolute reduction of pesticides. IPM is a cornerstone of the Directive, but Member States do not check compliance with the principles of IPM at individual grower level systematically. Furthermore, Member States have not yet set clear criteria in order to ensure that the general principles of IPM are implemented by all professional users. Observing organizations, such as the Pesticides Action Network, assume that the Commission will not accept this diversity and will insist on the proper implementation of the pesticides directive; infringement procedures are to be expected here.

3.2 Integrated Pest Management (IPM)

3.2.1 General Overview

A cornerstone of the Directive is the promotion of IPM, for which general principles are laid down in Annex III to the Directive. Integrated pest management means careful consideration of all available plant protection methods and subsequent integration of appropriate measures that discourage the development of populations of harmful organisms and keep the use of plant protection products and other forms of intervention to levels that are economically and ecologically justified and reduce or minimize risks to human health and the environment. 'Integrated pest management' emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.

Along with the promotion of organic farming, IPM is one of the tools for low-pesticide-input pest management, which, according to legislation, must be implemented by all professional users.

3.2.2 Principles of IPM

1. The prevention and/or suppression of harmful organisms should be achieved or supported, among other options, especially by:
    a. Crop rotation,
    b. Adequate cultivation techniques (e.g. stale seedbed technique, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing),
    c. Resistant/tolerant cultivars and standard/certified seed and planting material, where appropriate,
    d. Balanced fertilization, liming and irrigation/drainage practices,
    e. Preventing the spread of harmful organisms by hygiene measures (e.g. by regular cleansing of machinery and equipment),
    f. Protection and enhancement of important beneficial organisms, e.g. by adequate plant protection measures or the utilization of ecological infrastructures inside and outside production sites.

2. Harmful organisms must be monitored by adequate methods and tools, where available. Such adequate tools should include observations in the field as well as scientifically sound warning, forecasting and early diagnosis systems, where feasible, as well as the use of advice from professionally qualified advisors.
3. Based on the results of the monitoring, the professional user has to decide whether and when to apply plant protection measures. Robust and scientifically sound threshold values are essential components for decision-making. For harmful organisms, threshold levels defined for the region, specific areas, crops and particular climatic conditions must be taken into account before treatments, where feasible.
4. Sustainable biological, physical and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.
5. The pesticides applied shall be as specific as possible for the target and shall have the least side effects on human health, non-target organisms and the environment.
6. The professional user should keep the use of pesticides and other forms of intervention to levels that are necessary, e.g. by reduced doses, reduced application frequency or partial applications, considering that the level of risk in vegetation is acceptable and they do not increase the risk for development of resistance in populations of harmful organisms.
7. Where the risk of resistance against a plant protection measure is known and where the level of harmful organisms requires repeated application of pesticides to the crops, available anti-resistance strategies should be applied to maintain the effectiveness of the products. This may include the use of multiple pesticides with different modes of action.
8. Based on the records on the use of pesticides and on the monitoring of harmful organisms the professional user should check the success of the applied plant protection measures

(Source: ec.europa.eu/food/plant/pesticides/sustainable_use_pesticides)

4 No use of chemical pesticides: Organic agriculture

Organic production is based on natural systems and cycles, on biological and mechanical production processes and land-related production. The aim is to achieve sustainability, to manage without genetically modified organisms (GMOs) and agrochemicals, i.e. no use of pesticides and herbicides at all. Council Regulation (EC) No. 834/2007 regulates organic production in Europe, setting out the principles, goals and overarching rules of organic production and defining how to label organic products. In organic farming, closed cycles using internal resources and inputs are preferred to open cycles based on external resources. If the latter are used, they should involve:

- Organic materials from other organic farms,
- Natural substances,
- Materials obtained naturally, or
- Mineral fertilisers with low solubility.

In addition, organic production inheres some principles of sustainable agriculture as described in the following subchapters.

Life of soil

The life of soil is crucial for organic plant production. The use of soluble fertilisers is strictly limited and particularly mineral nitrogen fertilisers are not permitted. This, boosting the natural fertility of soils by supporting the activity of soil organisms is crucial, as these organisms (bacteria, fungi, etc.) transfer nutrients to the plants.

Multiannual crop rotation is essential

Organic farmers use multiannual crop rotation, including legumes and other green manure crops, and apply livestock manure or organic material in order to increase the fertility and the biological activity of the soil. In order to maintain or increase the

soil organic matter, and enhance soil stability and soil biodiversity, they prefer appropriate cultivation practices, like tillage. The use of biodynamic preparations is allowed.

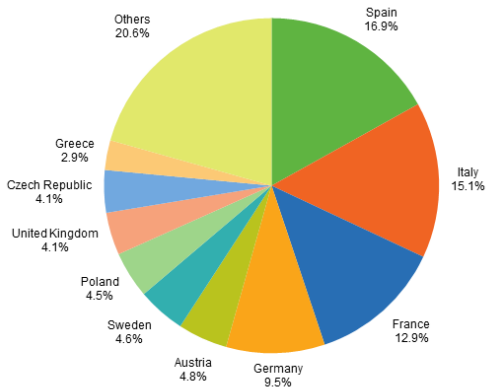
Prevention of pests' development

To prevent the development of pests, diseases and weeds, organic farmers cannot use synthetic pesticides or herbicides at all. Instead, they choose resistant species and varieties and apply a set of traditional and modern agricultural techniques. Multiannual crop rotation and appropriate cultivation techniques play a role in the protection of plants against pests, diseases and weeds. Organic farmers can use on thermal processes (but no fire, as this is forbidden in Europe's agriculture), the use of natural pest enemies, like ladybugs or trichogramma, or mating disruption techniques. In some few cases of an established threat to a crop, specific plant protection products are authorised for use in organic production.

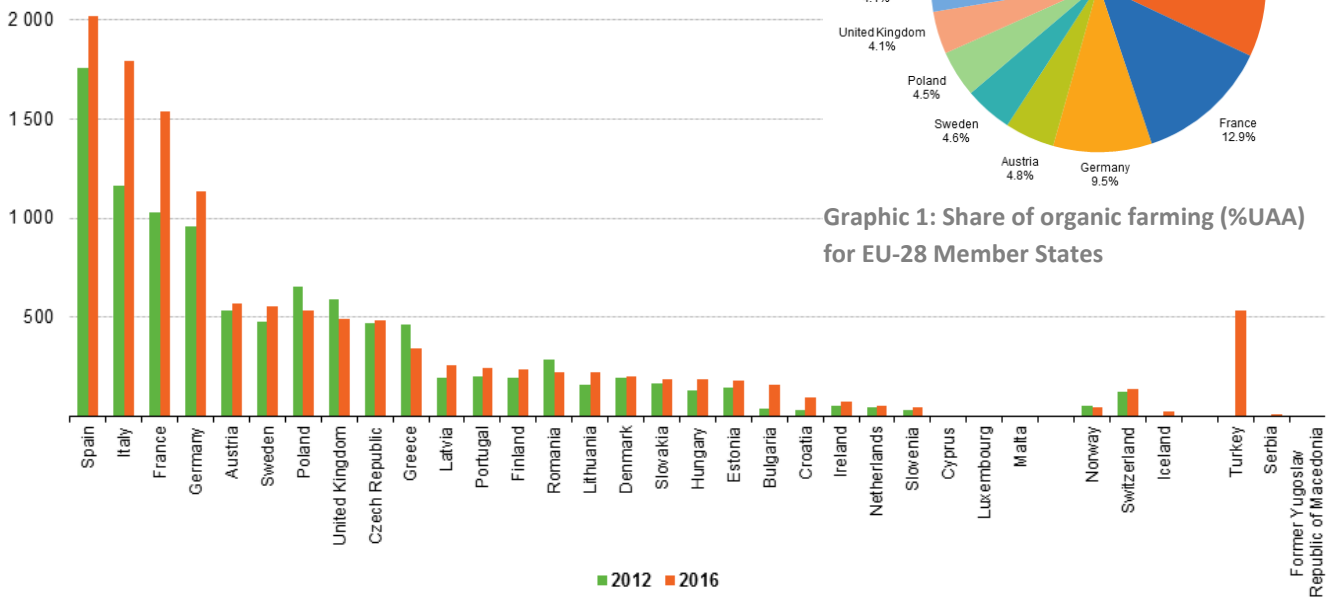
Basic substances

Basic substances allowed in organic agriculture comply with two criteria: i) they are of vegetable or animal origin ii) they are considered to be "foodstuff" according to Annex II of Commission Regulation (EC) No 889/2008. This document contains the list of basic substances allowed in EU organic farming (December 2016) in accordance with Annex II of Commission Regulation (EC) No 889/2008. The references to conditions that apply for their use are included in the list. (Source: ec.europa.eu/agriculture/organic)

In Europe, organic farming makes up 6.7 % of the total utilized agricultural area (UAA). The share of different member states to that number, varies strongly and is shown on the graph to the right. According to Eurostat, the total organic area in the EU-28 was 11.9 million hectares (ha) in 2016 and is still expected to grow in the coming years. The increase in organic area between 2012 and 2016 was 18.7 % (see graphic 1 below). Note that the total organic area is the sum of the 'area under conversion' and the 'fully converted area'. Before an area can be considered as 'organic', it must undergo a conversion process, which may take 2–3 years depending on the crop.



Graphic 1: Share of organic farming (%UAA) for EU-28 Member States



Source: Eurostat (online data code: org_cropar)

Graphic 2: Development of organic farming area (thousand ha) in Europe between 2012-2016

5 Very Good Agricultural Practices in Pest Management

The 2017 report of the commission indicates that IPM is not yet reality in European agriculture. NGOs and the European Commission insist on the proper implementation, as the excessive use of pesticides is a mayor driver in biodiversity loss in Europe. For food standards in Europe and beyond, we released a number of recommendations for proper pest management, which base on the following principles:

- Combine biological pest management with the cultivation of crops adapted to the respective location
- Consequent implementation of all principles of the integrated pest management.
- Reduction of negative impacts from pesticides on biodiversity to a minimum
- Continuous improvement in terms of reduction in quantity and toxicity of pesticides is pursued in the frame of the project
- Exclusion or strict limitation for the application of pesticides harmful for biodiversity
- Proper application of pesticides through training and awareness raising in order to achieve the reduction target

Recommendations to improve biodiversity protection in policy and criteria of food standards and sourcing requirements of food companies and retailers

5.1 General principle of biological pest management in combination with crops adapted to the respective location

Biological pest management is considered as a method of controlling pests such as insects, mites, weeds and plant diseases using other organisms. It relies on ecological principles such as predation, parasitism, herbivory, or other natural mechanisms. As preventive and preparatory measures, biological pest management is an important component of integrated pest management in farms.

We recommend the following for food standards:

- Declaration of biological pest management as a general principle.
- Promotion of locally adapted cultivation in order to avoid the preventive use of pesticides.

Four basic strategies encompass biological pest control:

- Classical (importation) of natural enemies of a pest to reduce populations and limit population growth
- Inductive (augmentation) with a large population of natural enemies for quick intervention
- Inoculate (conservation), in which measures are taken to maintain natural enemies through regular reestablishment or biodiversity friendly measures, which ensure a diverse ecosystem in the crop and thereby inhibit calamities of pests
- Mating disruption can be considered as a biological pest management

Antagonists or biological control agents include predators, parasitoids, pathogens, and competitors against insect pests, bacteria and viruses against some fungus and bacterial plant diseases. Biological control of weeds is achieved with seed eaters, herbivores, including sheep and cattle, and plant pathogens. A reputable international institution on IPM is the Centre for Agriculture and Biosciences International (CABI). CABI's Swiss centre (www.cabi.org/about-cabi/cabi-centres/switzerland/) is a leading authority on the management of invasive weeds and arthropods using biological control. All these methods are applied in practice and do work well, but they require a skilled and well-trained farmer. In contrast to this, agrochemicals are easy to apply and often less costly in terms of time efforts.

Until today, conventional farmers of cereals decide at the beginning of a cultivation season on a plant protection for their crops. In cereals, this may be a strategy following the idea of applying fungicides twice or three times per growing season. In combination with monitoring systems this reduces the need to follow the development of diseases directly on the plot.

Knowing how long certain plant protection substances safeguard the cereals, the next substance is applied when the desired protection can no longer be guaranteed. This ends up in widely established calendar spraying. In principal, farmers are acting opposite to what they do understand as good agricultural practice and against certain laws and directives, which the national authority fails to enforce properly. The use of stained seeds is but another of these precaution measures, counteracting the principles of IPM.

In organic farming, but also in conventional farming, natural predators help to reduce and control pests. The following insects are commonly seen as beneficial in agriculture. However, to foster population of beneficial insects, ecological structures are needed for breeding. Plant protection substances, especially insecticides, need to be reduced to allow the population of these insects to grow.

- Assassin bug
- Damsel bug
- Earwig
- Green lacewing
- Ichneumon wasp
- Lady bugs
- Mealybug destroyer
- Minute pirate bug
- Soldier beetle
- Syrphid fly
- Tachinid fly
- Trichogramma wasp

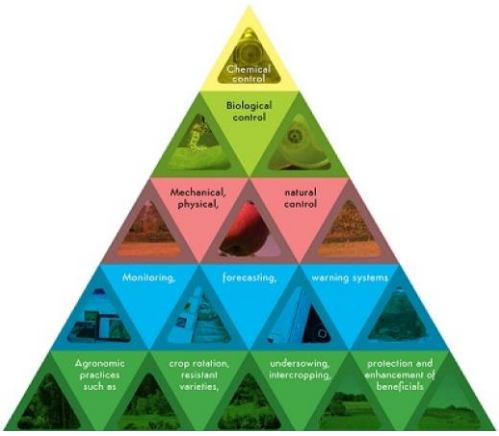

Graphics 3 & 4: Lady bug-larvae and lady bug feeding on aphids

Consequent implementation of all principles of the integrated pest management (IPM):

The standard organisation /company provides crop-based preventive measures and damage thresholds following the basic principles of the Integrated Pest Management:

There is no doubt that IPM will be the standard in Europe in few years. To comply with European regulations, we strongly recommend to the food industry to implement IPM on farms in the supply chains. On the background of implementation processes also in the food industry, timely initiated and executed road maps towards including IPM in the standards is the way forward.

PAN (Pesticide Action Network) Europe has set the IPM triangle in a widely accepted layout (to the left). It shows the different steps that help to avoid and reduce pests and diseases; besides others containing:



Graphic 5: IPM triangle from PAN Europe

- Intercropping
- Crop rotation
- Use of adequate cultivation techniques e.g. seedbed sanitation, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing where appropriate.
- Use of pest resistant/tolerant cultivars and standard/certified seed and planting material.
- Balanced soil fertility and water management, making optimum use of organic matter.

- Prevent spreading of harmful organisms by field sanitation and hygiene measures (e.g., by removal of affected plants or plant parts, regular cleansing of machinery and equipment).
- Protection and enhancement of important beneficial organisms, e.g. by using ecological infrastructures inside and outside the production sites.

It also acknowledges the importance of plant protection substances as a last resort to secure agricultural crops. Thus this triangle may be taken as a guide for farmers, companies and food standards to promote plant protection substances according to what they are, an important measure, but not the first action to take.

Important from a biodiversity point of view:

- Monitoring plans for arthropods are needed. Pest and beneficial organism populations must be monitored weekly during their peak season. The farmers must be trained to identify both, pests and positive effects of beneficial organisms as well as be able to calculate the related damage thresholds. The farmers have to use the appropriate forecasting and diagnostic methods for pathogenic germs (fungal, bacterial germs, virus).

In additions to that, the IPM concept very clearly states that

- Only local spraying devices are used and spraying equipment is calibrated at least every three years.
- The burning of vegetation as a plant protection measure is only allowed if no other alternative measures exist. This must be proven by the documentation of all possible preventive and alternative measures. Farm operators in or close to protected areas can only burn vegetation if this is in accordance and with technical assistance by responsible nature conservation authorities.

5.1.1 Handling of very critical substances for biodiversity:

Currently, farmers rely on the effectivity of substances solely, and do not take into account that toxicity increases with the decrease of active matter per hectare. Today's pesticides are up to 10.000 times more efficient than e.g. DDT.

Therefore, we recommend to standardising organisations and the food industry the following:

- Define a negative list along the examples named above (list of all pesticides that are NOT allowed)
- Define a strategy with clear time-bound targets aimed at the continuous reduction of substances considered harmful to humans and the environment.
- Only use substances not included in the negative list and define appropriate penalties in case infringements should occur.
- Exclude pesticides proven to have damaging effects on bees, pollinating insects, beneficial organisms, amphibians or fish.
- Abuse of very harmful substances (e.g. Glyphosat, Diquat, Paraquat, Glufosinate ammonium, Indaziflam and the salt equivalent versions) and clear regulations when an application could be exceptionally accepted.
- Pre-emergent use of herbicides is not allowed and must be substituted, e.g. by mechanical weeding in early stages.
- No-use of herbicides in the interrow of permanent crops (e.g. vineyards, fruits, hop).
- No-use of pesticides in riparian buffer zones and provision of specific rules for pesticide use adjacent to water bodies and precise information on minimum distances (10 meters) and quality of riparian buffer zones (height, width, vegetation density).
- Save 20 % of area from the use of pesticides in very large crops and managed with alternative techniques.

The Pesticides Action Network PAN provides a list of substances that are highly hazardous (PAN International List of Highly Hazardous Pesticides). Rainforest Alliance provides a similar "List of Prohibited Pesticides" with 152 active ingredients Rainforest Alliance pesticides prohibited for certified farms (Rainforest Alliance - Lists for Pesticide Management - Lists of Prohibited and Risk Mitigation Use Pesticides). These are classified as highly hazardous pesticides according to the definition of the FAO/WHO Panel of Experts on Pesticide Management (JMPM).

5.1.2 Continuous improvement and documentation of pesticide use

When it comes to plant protection substances, a continuous improvement is important to question current practices, to identify potentials for further reduction of pesticides and to better understand the impact farming has on its surroundings.

Many active substances turn out to be more hazardous than expected when introduced to the market and applied to the field. A number of suitable measures for continuous improvement are:

The standard organisation /company

- The use of substances that are harmful to humans and environment as well as the applied quantity of allowed substances are reduced step-by-step. The objective is to exclude high risk pesticides step by step. The PAN list for highly hazardous pesticides is used to identify such pesticides.
- Agrees with other standard organisations /companies on additions to the negative list to avoid that farms with diverse certifications are faced with different negative lists.

The farm operator

- Must continuously document the pesticide applications and other operations carried out to manage weeds and pests, and demonstrate a continuous improvement in the application of pesticides (see treatment index and toxicity index).
- Proves continuous improvement in the use and appropriate handling of pesticides.
- Must receive consultation on the topic of pesticides. Issues to be covered include biodiversity impacts and reduction strategies. The consultation must be independent from the pesticide industry (no consultation by the pesticide industry, sub-contractors or consultants to the industry).

5.1.3 Appropriate use of pesticides

It is self-evident that any use of harmful substances must follow strict regulations to impede both, harm to the farmer, and spills into the environment or other hazards.

- Only authorized and regularly trained staff can use the machinery and apply the pesticides.
- The standard organisation /company must require and randomly check the proper use of chemical-synthetic pesticides: storage, application technology (e.g. maintenance and proper equipment settings), cleaning of equipment and disposal of residual materials / packaging.
- Relating to permanent crops, the standard organisation /company provides specific recommendations for the calculation of a correct spray mixture which is adapted to the respective location.
- Storage facilities for fertilizers and pesticides are to be separated.

5.1.4 Consultancy / Information / Training

The standard organisations or companies play a major role in consultancy and training. This is also true to improve the implementation of pesticides. We propose the standard or company to

- Prepare an annual booklet available to farm operators in which preliminary suggestions for improving performance are formulated
- Commit to produce and disseminate information material (e.g. from FAO) and /or implementing information workshops on pesticide reduction
- Integrate biodiversity aspects appropriately into all training for certified farms, suppliers and quality/product managers
- Seek the expertise of competent persons and organizations in order to ensure the quality of training on biodiversity and the appropriateness according to the target groups

Overview of the Project EU LIFE Food & Biodiversity

Food producers and retailers are highly dependent on biodiversity and ecosystem services but also have a huge environmental impact. This is a well-known fact in the food sector. Standards and sourcing requirements can help to reduce this negative impact with effective, transparent and verifiable criteria for the production process and the supply chain. They provide consumers with information about the quality of products, environmental and social footprints, the impact on nature caused by the product.

The LIFE Food & Biodiversity Project "Biodiversity in Standards and Labels for the Food Industry" aims at improving the biodiversity performance of standards and sourcing requirements within the food industry by:

A) Supporting standard-setting organisations to include efficient biodiversity criteria into existing schemes; and encouraging food processing companies and retailers to include biodiversity criteria into respective sourcing guidelines;
B) Training of advisors and certifiers of standards as well as product and quality manager of companies;
C) Implementation of a cross-standard monitoring system on biodiversity;
D) Establishment of a European-wide sector initiative.

Within the EU-LIFE Project Food & Biodiversity, a Knowledge-Pool with background information linked to agriculture and biodiversity is provided. You can access the Knowledge Pool under the following link:

www.business-biodiversity.eu/en/knowledge-pool

Author: LIFE Food & Biodiversity; Global Nature Fund

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