

PR-5 - 1 (INTEGRATED PEST MANAGEMENT-IPM)

Integrated plant protection has been developed with the aim of managing harmful organisms, which should not be based on and depend solely on the use of chemical substances. Integrated plant protection means the systematic and planned management of harmful organisms and combines various approaches to plant health, based on a combination of biotic, processing, physical, biotechnical and chemical methods of plant protection. Integrated plant protection also means reducing the risk of economy of agricultural production, human health, environmental protection and reduction of negative effects on non-target organisms.

Integrated plant production of crops, fruit, grapes and vegetables is carried out in Slovenia under constant professional supervision by organizations for the control and certification of integrated production. If the cultivation is carried out in accordance with all requirements, the organization for the control and certification of the grower issues a certificate, which is guaranteed that the labeled crops correspond to a higher standard of cultivation.

Integrated pest management principles and guidelines

Integrated plant protection is a process based on knowledge and experience and is open to new ideas, scientific knowledge and technological advancement. It is based on the detection, identification and precise definition of the size of the population of harmful organisms and on the assessment of the economic damage that these organisms can cause.

Integrated plant protection should focus on the objectives of sustainable crop production, where non-chemical, environmentally friendly, plant protection methods and the targeted and cost-effective use of plant protection products are preferred.

The most important principle of integrated plant protection is that we do not decide on the use of plant protection products only when other pest control measures are not effective enough. In this regard, the helpers of "Observation and Forecasting Services", which are based on the on-going monitoring of harmful organisms, weather conditions and the development of plants, are helpful to growers.

Integrated plant protection requires a good knowledge and understanding of the farming system and the combination of smart knowledge of old, existing and new technologies, since the natural balance in crops can not be achieved only by simply reducing the use of plant protection products.

Basic principles of integrated pest management

Integrated plant protection instructions prepared in most countries are similar to those of some international organizations dealing with plant protection (IOBC - International Organization for Biological Control), mainly refer to the eight so-called basic principles that are also defined in European legislation (Directive 2009/128/EC).

Preventive measures

With proper selection of the site (location of the site, soil structure...), appropriate ring and method of production (soil treatment, sowing time, sowing / planting density, cut, educational forms, weed control techniques, sowing of mixed or intermediate crops (where applicable use of resistant / tolerant cultivars, planting or sowing of certified planting / seed material, appropriate fertilization, liming, irrigation or drainage, hygiene measures, creating conditions for the development and dissemination of useful organisms, eg creating so-called ecological niches) , we take care of the good condition of plants and contribute to their better resistance to harmful organisms.

Monitoring of harmful organisms

Regular inspection of crops or monitoring the occurrence, development and spread of harmful organisms is one of the key elements of integrated plant protection. The acquisition of information on the health status of agricultural plants and the development of harmful organisms, the size of the population, the extent of the attack / infection and the biological and potential economic impact of the harmful organism is carried out with producer direct observations directly on the ground and with the help of information "Observatory forecasting services for plant protection" agricultural advisors. In determining the time and space of the most effective integrated plant protection measure, the correct identification (identification) of a harmful organism based on morphological characteristics or in more complex biological, chemical or genetic analyzes is of paramount importance for the selection of the appropriate. On the basis of officially collected biotic data, weather conditions, and on the basis of information and warnings from the "Observation and Forecasting Plant Protection Service", we decide when and when and how we will act.

Thresholds of harm

Integrated plant protection programs are based on the consideration of economic thresholds of harmfulness, critical numbers (if available). Based on the results of the monitoring of harmful organisms and taking into account the levels of harm, producers decide whether to act at a given moment or not.

Use of non-chemical methods of plant protection

Biotic, physical, biotechnical and other non-chemical methods of plant protection have priority over the chemical control of harmful organisms, prior to the use of the plant protection product in case they provide sufficient management of harmful organisms. It is only in cases where, despite the use of non-chemical methods, the level of a harmful organism is unacceptable for the normal production of agricultural plants, we use the use of chemical plant protection products.

Targeted use of the plant protection products

Any use of plant protection products should be targeted as far as possible (use of specific plant protection products) and minimize harm to human health, non-target organisms and the environment.

Reducing the use of plant protection products to the lowest extent

The use of plant protection products, including other plant protection measures, is limited to the level strictly necessary to ensure adequate plant health (eg reduced doses of plant protection products, reduced spraying frequency, partial or target application of plant protection products - eg in species). In doing so, the risk to agricultural crops, as well as the risks to the development of potential resistance of harmful organisms, should be acceptable. Synthetic plant protection products should therefore only be used when necessary, when all other possible methods of controlling harmful organisms, these are ineffective from the point of view of the economy of crop production.

Anti-resistance strategy

The use of an "anti-resistance" strategy, based on the use of plant protection products with different methods and spectrum of action, is particularly important in cases where there is a need for repeated (repeatedly) pest control and for organisms that have already emerged resistant biological breeds.

Observation, monitoring, recording and verification

Through regular and thorough monitoring of harmful organisms and keeping records of the use of plant protection products and other measures of protection, growers regularly check the effectiveness of the plant protection measures applied.

Advantages of integrated pest management

- A more in-depth knowledge and monitoring of harmful organisms and cultivated plants allow a timely and appropriate selection of appropriate measures;
- Due to the reduced use of plant protection products or the use of eco-toxicologically more suitable and narrow-acting plant protection products is a reduced risk to human health, the environment and non-target organisms and reduced exposure of plant health providers;
- Reduced use of plant protection products in the long term leads to financial savings in comparison with conventional plant protection;
- Favorable environmental impacts lead to more stable agricultural production in the long term;
- Integrated plant protection reduces the likelihood of the occurrence of resistant pests of pests against plant protection products.

Disadvantages of integrated pest management

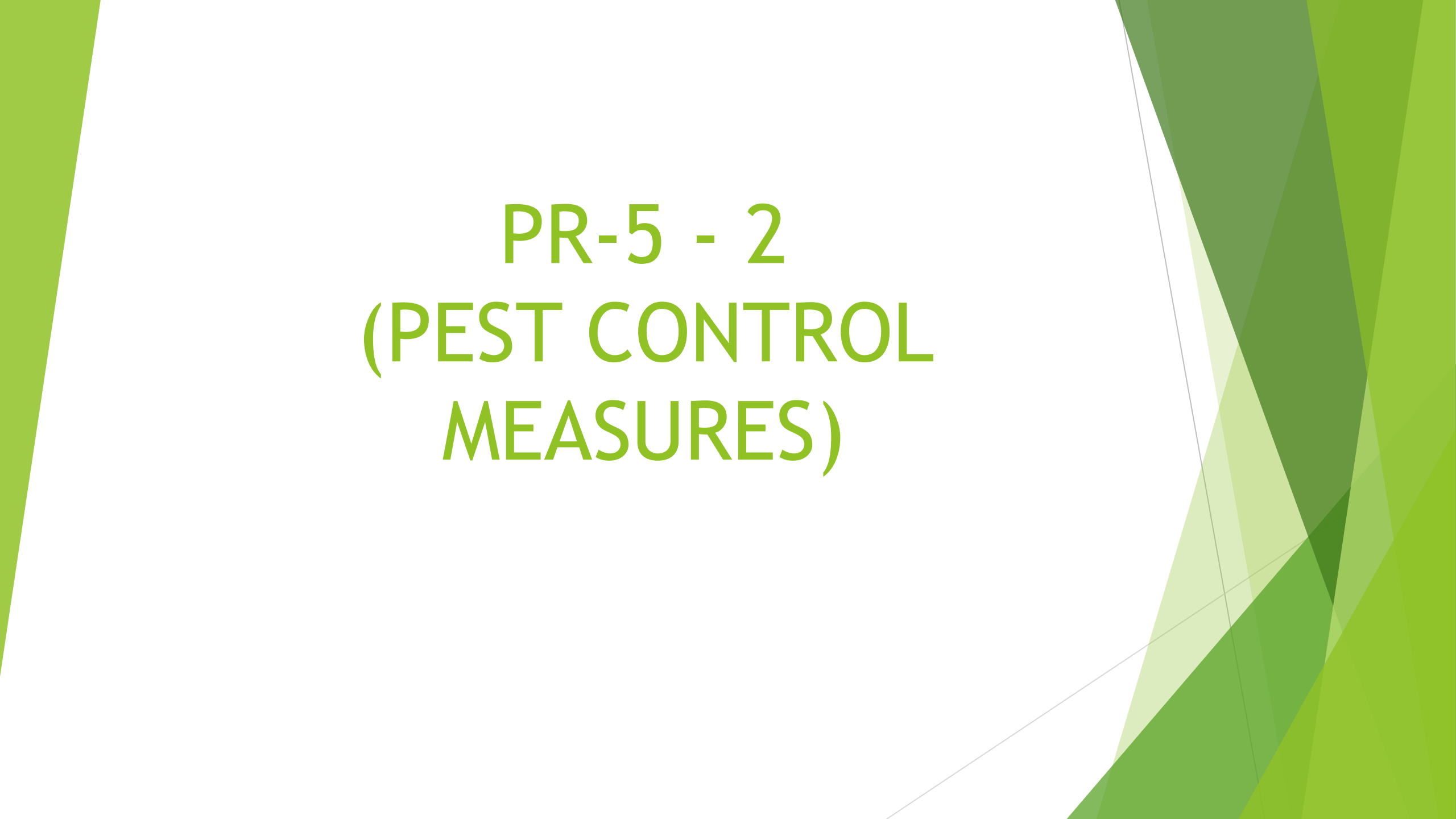
- Integrated plant protection requires more time and knowledge compared to conventional plant protection;
- Greater coordination and the efforts of operators to ensure proper and effective plant protection;
- Integrated plant protection is initially more expensive than conventional plant protection;
- Higher risk of uncontrolled development of harmful organisms.

Requirements for integrated pest management

- Only authorized plant protection products may be used;
- Authorized plant protection products should only be used in the prescribed manner and at the prescribed doses;
- The entry of plant protection products must correspond to the maximum prescribed number of treatments in relation to the preparation;
- Withholding periods must be taken into account;
- About the plant protection products used, producers are obliged to keep records and keep accounts where all the PPPs that have used them must be entered;
- The application of plant protection products must comply with the standards in these instructions and adapted to the growing form and the state of vegetation;
- It is necessary to ensure that the loss of the spray broom due to drift, evaporation or leakage of the sprinkler slurry on and into the ground is minimized;
- Appliances for the application of plant protection products must be tested;
- The users of the PPP must have a valid certificate of acquiring knowledge from phytomedicine;
- Proper storage of plant protection products and the management of their waste. waste packaging;
- The purchase of plant protection products in foreign countries, as well as their use, are not permitted under the Plant Protection Products Act.

The prescribed measures in integrated pest management

- The purchase of plant protection products in foreign countries, as well as their use, are not permitted under the Plant Protection Products Act.
- Mechanical measures: removal of infected parts or whole plants, removal of parasitic plants, mechanical weeding of weeds, use of blinds and covers...
- Biotic measures: The producer creates favorable living conditions for the development of beneficial organisms by: preserving and planting hedges, shrubs and other varieties of plants; cultivates a variety of underpasses; for the shelters of useful animals they are regulated by rocks and piles of branches; sets hatcheries for useful birds; installing high poles to attract birds of prey; observing, introducing and controlling a useful fauna (especially predatory mites, mates, tremors, tanners, swarms, pickles ...).
- Biotechnical measures: use of pheromone baits, acoustic appliances, methods of confusion and other possibilities of catching insects (eg mass catches).
- Chemical measures: Where, despite the application of the above-mentioned measures, the threshold of harmfulness is exceeded, plant protection products may be used.

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PR-5 - 2 (PEST CONTROL MEASURES)

For the control of harmful organisms, the user of plant protection products takes into account the information on the harmfulness threshold (if available), the appropriate time of use of the plant protection product and advices for use of plant protection products. The used plant protection product should be as specific and effective as possible in relation to the purpose of use and should have as few adverse effects on human health, non-target organisms and on the environment, as possible. If are available, low-risk plant protection methods can also be used. The user of plant protection products can obtain this information from public plant health care advisers and on the website of the Ministry of Agriculture, Forestry and Food.

Every user of plant protection products for professional use must observe and implement permitted measures of integrated plant protection on all cultivated areas (own and leased areas).

Measures for prevention the appearance of harmful organisms

Preventive measures

Every user of plant protection products for professional use must plan and carry out the cultivation of plants by implementing preventive measures with the aim of preventing the development of harmful organisms (disease and pest) and weeds.

Location

The requirements in integrated crop production regarding the choice of location are: in a certain location, we can only grow types/cultivars of crops that are suitable in terms of climatic characteristics, the possibility of additional water supply, soil and relief properties.

The recommendations are: depending on the specific conditions of the location, it is necessary to ensure protection from winds and ensure biotic diversity and its positive effects on the environment. Depending on the location (sloping terrain, groundwater, open watercourses, etc.), special attention is needed regarding additional negative impacts on the environment (soil, crop rotation, assortment, fertilization, plant protection, economy of cultivation).

A choosing of a location for growing vegetables, it is necessary to take into account climatic conditions (amount of precipitation, risk of frost, air humidity), type of soil (depth, nutrient content, availability of nutrients, humus content, biological activity of the soil), relief (slope and exposure of the terrain) , water supply (depth of groundwater, possibility of irrigation, soil retention capacity) and infrastructure from an ecological point of view (protection against wind, protection against erosion, preservation of biotopes, water protection).

Soil management

Prohibitions in integrated crop production are:

- treatment of frozen soil;
- basic and pre-sowing treatment of too wet and too dry soils;
- burning of harvest residues (straw, cobs, etc.) is prohibited on the fields;
- year-round lack of soil coverage (most of the spring and summer, the soil must be purposefully sown and cared for).

The required measures in integrated crop production are:

- mechanical weed control at least 1x in each crop (use of “tined weeder” or other methods of mechanical soil treatment);
- land use methods that do not significantly reduce the population of beneficial soil microorganisms (earthworms, etc.) in the long term;
- cultivate the soil in such a way as to prevent soil compaction;
- soil cultivation that preserves soil structure (cultivation of suitably moist soil);
- ensuring sufficient content of humus;
- soil cultivation on sloping fields transverse to the slope (prevention of erosion);
- use a cultivation strategy based on the reduction of residues of plant protection products (crop rotation, compliance with the rules of integrated plant protection);
- create a nutrient balance, check nitrogen needs (fertilization);
- according to the texture of the soil and the requirements of crops, take care of the appropriate pH value of the soil;
- mulching and plowing of crop residues is mandatory already in autumn (e.g. with corn and sorghum due to European corn borer - *Ostrinia nubilalis*).

Crop rotation

Implementation of crop rotation have to be done on at least 50% of all arable fields. An appropriate crop rotation is one that corresponds to the selected cultivation technology (at least a two-year rotation, at least a three-year rotation is recommended).

Prohibitions:

- sequential crop rotation of the main crops of individual crops and related plant species (same genus) is prohibited, except for hops;
- corn can be sown on the same field no more than twice in three years, but never twice in line up (consecutively);
- the field area must be "covered" (not only with weeds) after the harvest (over the summer);
- it is forbidden to have uncovered arable land during the winter in water protection areas and areas, exposed to soil erosion;

Required actions:

- taking into account the effects of crops in rotation on preventing the occurrence of diseases and pests, which may be the result of improper crop rotation;
- changing plant species;
- during the "break", i.e. before replanting hops on the same field, a break of at least two years is mandatory in the crop rotation (Fabaceae are desirable), except in the case of the appearance of verticillium wilt, where it is recommended to implement crop rotation with narrow-leaved plants that prevent the spread of verticillium wilt of hops (*Verticillium nonalfalae* and *Verticillium dahliae*).

Tolerant and resistant varieties

Requirements:

- it is necessary to choose varieties that are as tolerant or resistant as possible to diseases and pests and those with the highest possible threshold of harmfulness due to harmful organisms;
- depending of the production, we choose varieties with certain characteristics (plants with upright leaves and the possibility of increasing the set of plants or plants with wider and drooping leaves with greater coverage - prevention of weeding,...).

Prohibitions:

- the use of genetically modified plants is prohibited;
- for sowing/planting, it is forbidden to use seed that doesn't comply with plant health regulations;

Recommendations:

- it is recommended to use certified seed for sowing/planting;

At growing vegetables, the quality of seeds and seedlings directly affects the development of vegetables and the occurrence of diseases and pests, so it makes sense to use high-quality and healthy seeds or seedlings and to carry out strict selection when growing seedlings (eliminate infected and poorly developed seedlings). It is also recommended to save the label or plant passport after sowing or planting, so that in the event of the occurrence of a controlled disease or pest, the place of origin can be traced.

Low risk plant protection methods

Use of basic substances

Basic substances that can be used for plant protection are those substances that are not problematic in terms of causing hormonal imbalances and do not have neurotoxic or immunotoxic effects. They are authorized for other purposes and are not normally used for plant protection and are not placed on the market as plant protection products, but are nevertheless useful as plant protection products. Basic substances include those substances that meet the criteria for food.

The use of basic substances in the European Union is approved by the European Commission. The European Commission asks the European Food Safety Agency for technical and scientific assistance and an opinion on the application. Based on this opinion, the European Commission approves or disapproves the substance as a basic substance. The permitted basic substance is entered in a special part of the list of approved active substances - "EU Pesticides Database" -

https://food.ec.europa.eu/plants/pesticides/eu-pesticides-database_en#FFS

Use of plant protection product's (PPP's), that are allowed for organic farming

Plant protection product's, that are permitted in organic production, can also be used in integrated production, the list of permitted plant protection product's in the Republic of Slovenia is available at the following link:

http://spletni2.furs.gov.si/FFS/REGSR/FFS_sezn.asp?L=1&S=2&top=1

REPUBLIKA SLOVENIJA MINISTRSTVO ZA KMETIJSTVO, GOZDARSTVO IN PREHRANO UPRAVA RS ZA VARNO HRANO, VETERINARSTVO IN VARSTVO RASTLIN						
seznam FFS, dovoljenih v ekološki pridelavi - Datum izpisa: 12.10.2022 15:19:29						
Ime FFS	Aktivna snov in vsebnost	Vrsta sredstva	Številka odlozbe	Veljavnost registracije	Proizvajalec	Zastopnik
GREE WG	Bacillus Thuringiensis var. Aizawai (50%)	INSEKTICID	U34330-1/22/8 (26.03.2021), U34330-1/20/13 (26.03.2020), U34330-197/14/16 (22.01.2018), U34330-197/14/10 (19.05.2017), U34330-197/14/7 (11.04.2017), U34330-197/14/1 (24.11.2016)	30.04.2024	Mitsui AgriScience International S.A./B.V.	
MYLO - X	Bacillus amyloliquefaciens subsp. plantarum, sev D747 (25%)	FUNGICID, BAKTERICID	U34330-34/17/11 (12.03.2020), U34330-101/19/2 (04.02.2020), U34330-34/17/4 (26.10.2017)	31.03.2026	CBC (Europe) S.r.l.	KARI proiz Duto Ljublj
Q-10	Ampelomyces quisqualis sev AQ10 (58%)	FUNGICID	U34330-172/14/29 (11.07.2021), U34330-172/14/24 (08.12.2020), U34330-101/19/2 (04.02.2020), U34330-172/14/15 (18.07.2019)	31.07.2034	CBC (Europe) S.r.l.	KARI proiz Duto Ljublj
RGOS	olja pomarančevca (84,32%)	FITOREGULATOR	U34330-81/20/17 (13.09.2021)	31.07.2025	Arysta LifeScience Benelux Spri	PICCO
LATIN EC	azadirachtin A (2,6%)	INSEKTICID	U34330-57/19/5 (20.11.2020)	31.05.2025	Certis USA L.L.C.	Mitsui S.A./
ZUMO WG	žveplo (80%)	FUNGICID	U34330-13/19/13 (22.06.2022), U34330-13/19/9 (03.12.2021), U34330-13/19/4 (14.06.2020)	31.12.2023	AZUFERRA Y FERTILIZANTES PALLARES S.A. (AFEPASA)	
ADGE WG	baker v obliki bakrovega oksidlorida (24,5%), baker v obliki bakrovega hidroksida (24,4%)	FUNGICID, BAKTERICID	U34330-91/14/26 (16.12.2020), U34330-91/14/22 (04.11.2019), U34330-91/14/13 (29.01.2019), U34330-91/14/11 (22.12.2017), U34330-91/14/5 (16.10.2017)	31.12.2022	ISAGRO S.p.A.	
ANARG	etilen (4%)	FITOREGULATOR	U34330-114/15/5 (22.02.2018)	31.08.2023	Linde AG	GTG
IO PLANTELLA ARION PROTI PLZEM (staro ime BIO PLANTELLA PROTI POLZEM)	železov (III) fosfat (0,98%)	LIMACID	U34330-53/19/11 (17.06.2021), U34330-53/19/3 (23.12.2019)	31.12.2031	Doff Portland Ltd.	UNIC
IO PLANTELLA KENYATOX	piretrin (0,2%)	INSEKTICID	U34330-34/20/2 (21.07.2020)	31.08.2023	COPYR S.p.a.	UNIC
IOTIP APHICID PLUS	piretrin (0,2%)	INSEKTICID	U34330-1/20/15 (04.06.2020), U34330-32/13/14 (30.01.2019), U34330-32/13/9 (21.12.2016)	31.08.2023	COPYR S.p.a.	BIOT
IOTIP FLORAL	piretrin (1,82%)	INSEKTICID	U34330-1/20/15 (04.06.2020), U34330-99/15/21 (17.03.2017), U34330-99/15/16 (20.10.2016), U34330-99/15/6 (31.03.2016)	31.08.2023	COPYR S.p.a.	BIOT
IOTIP SULFO 800 SC	žveplo (80%)	FUNGICID	U34330-29/18/19 (15.01.2021), U34330-1/20/34 (18.12.2020), U34330-29/18/10 (18.01.2019)	31.12.2022	CIECH Sarzyna Spółka Akcyjna	BIOT
IOTIP UBIJ ME NEŽNO PLUS	piretrin (0,2%)	INSEKTICID	U34330-1/20/15 (04.06.2020), U34330-119/13/11 (30.01.2019), U34330-119/13/5 (19.12.2016)	31.08.2023	COPYR S.p.a.	BIOT
DTANIGARD OD	Beauveria bassiana, sev GHA (10,17%)	INSEKTICID	U34330-1/21/2 (28.04.2021), U34330-50/18/11 (13.11.2019), U34330-50/18/5 (07.05.2019)	30.04.2023	Mycotech Europe Limited	METI
DTANIGARD WP	Beauveria bassiana, sev GHA (22%)	INSEKTICID	U34330-1/21/2 (28.04.2021), U34330-49/18/15 (10.06.2020), U34330-50/18/11 (13.11.2019), U34330-49/18/6 (07.05.2019)	30.04.2023	Mycotech Europe Limited	METI

Non-chemical measures to reduce the occurrence of harmful organisms

Mechanical or physical weed control (machine or manual)

Manual mechanical weed control can be carried out on smaller fields, on bigger fields are using machines (combs, weeder...).)



Mechanical or physical removal of attacked or infected plants, or parts of plants or harmful organisms

It is a measure to remove infected parts of plants (leaves, shoots, cancerous formations, "mummies"...), whole plants and parasitic plants (example: white mistletoe - *Viscum album*). Example: In case of apple powdery mildew (*Podosphaera leucotricha*) or fire blight (*Erwinia amylovora*), infected shoots are removed by cutting, in case of Flavescence dorée (quarantine pest) grapevines must be removed.

Use of beneficial organisms for biotic plant protection

Biotic plant protection is a method of plant protection in which living organisms are used to control plant pests. These living organisms can be "predators" (larvae and adult Coccinellidae, larvae of common green lacewings, Cimicomorpha, predatory mites, thrips, etc.), which help us reduce the population of harmful organisms. Parasitoids lay their eggs in, on or near pests, and the larvae that develop from them then feed on the pests.

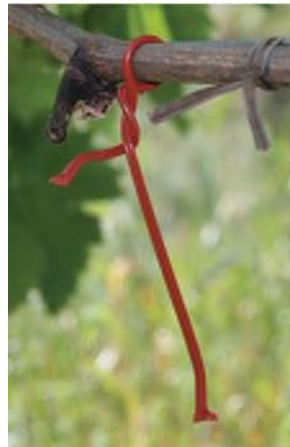
The use of natural enemies in the control of harmful organisms is regulated in Slovenia by the Rule on biotic plant protection (Ur. l. RS 45/06), an important component of this rule is the "List of native species of organisms for biotic plant protection", which currently lists 29 types of biotic agents (19 types of predators, 6 types of parasitoids and 4 types of entomopathogenic nematodes). These are organisms, that are widespread in our natural environment, either due to their nativeness or due to the fact that they were intentionally or unintentionally introduced to Europe from other continents in the past. In Europe, these organisms have proven to be effective natural enemies of pests, while showing no adverse effects on native natural enemies. Proposals for inclusion on the "EPPO List" are considered by members of the EPPO Panel for Biotic Plant Protection.

"confusion" method (pheromone control system)

In viticulture and fruit growing, the method of "confusion" is used with the help of pheromone dispensers. The method is based on false pheromone signals that override the naturally released pheromones of females and thus confuse males when they are searching for females to mate with. The dispensers release the same pheromone that the females release, and in this way confuse the males and therefore they are "confused" when looking for the female during the mating season. As a result, the females are not fertilized and lay infertile eggs from which the pest does not develop.

The list of permitted pheromones is on the following website:

http://spletni2.furs.gov.si/FFS/REGSR/FFS_sezn.asp?L=1&S=4&top=1



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PR-5 - 3
(OPTIMISATION OF THE
USE OF PLANT
PROTECTION PRODUCTS
IN AGRICULTURE)

In 2002, the European Parliament adopted a Thematic Strategy on the Sustainable Use of Pesticides in the form of action programmes to reduce risks to human health and the environment from the use of pesticides. The European Commission has taken these guidelines into account and laid down strict criteria for the authorisation of plant protection products (PPP), the collection of data on the sale and use of PPP and measures under legislation on the sustainable use of PPP. All measures shall be covered by a national action programme with the aim of reducing the risks of the potential impact of PPP on human, animal, drinking water, surface and groundwater and other environments.

The sustainable use of plant protection products (PPP) also includes the policies and measures that we are implementing as a result of the use of PPP with a view to reducing risks and impacts for human and animal health and the environment. PPP users shall be encouraged to use PPP, to implement integrated pest management and to use low-risk PPP. There is also regular information and public awareness of PPP, training of PPP consultants, PPP vendors and users, and inspections of PPP application devices. The sustainable use of plant protection products directs the PPP user towards optimal use, towards preserving the environment and human health.

Use of plant protection products (PPP's) in Slovenia

In Slovenia, most of the older studies on PPP residues in the environment were carried out on crops, water or soil, to which plant protection products came with direct introduction to agricultural land.

When adapting legislation to the European Union, the Law on plant protection products has restricted the use of multi-component PPP due to the detection of residues in the waters and that the use of PPP must be safe (harmless to human health in direct or indirect contact), specific (effective for the control of specific harmful organisms acceptable to non-target organisms) and non-existent (to decompose into simple chemical components without harmful effects on the environment). The "old" active substances were also re-evaluated and dangerous substances were excluded from use. Registration - authorisation to use a specific PPP is granted for a maximum period of 10 years with the possibility of renewal, if applicable. In the event that, on the basis of technical and scientific knowledge, there are reasonable grounds for suspecting that an PPP already registered constitutes a danger to human health and the environment, the Minister of Agriculture shall have the power to restrict or prohibit its use.

The application of the PPP is also governed at European Union level by legislation relating to water protection (Water Framework Directive (2000/60/EC), Groundwater Directive (2006/118/EC) and The Directive on Environmental Quality Standards in the field of water policy (2008/105/EC). In Slovenia, when adapting to this legislation with regard to the requirements of the European Union, two regulations were adopted - the Regulation on the state of surface waters (Official Gazette of the Republic of Slovenia, No. 14/09 and 98/10) and the Groundwater Status Regulation (Official Gazette of the Republic of Slovenia, No. 25/09 and 68/12). These two regulations lay down environmental quality standards for each type of pollution which pose a significant risk to the aquatic environment and to the abstraction of drinking water.

Since 2001, the Plant Protection Products Act requires all PPP users to provide compulsory education (without passing a phytomedicine examination and certificate of knowledge in phytomedicine PPP cannot be purchased and used) and the examination of PPP application devices on plants.

The measures are aimed at informing and informing users of the correct use of PPP (emphasis on the protection of groundwater and surface waters, protection of bees, safe disposal of waste and packaging waste of PPP), promoting integrated and organic production, both to test biotic protection and other non-nuclear methods, as well as to advise the use of less hazardous, less persistent and more degradable PPP, and to better optimize the use of these PPP.

The goals regarding the use of phytopharmaceuticals in Slovenia are as follows:

- reduction of dangers and risks to human and animal health and to the environment due to the use of PPP, including the replacement of the most dangerous substances with safer ones,
- reducing the level of active substances harmful to health in food and drinking water, including replacing the most dangerous substances with safer ones,
- promotion of agricultural production in the sense that PPP are used according to the principles of integrated plant protection only when it is absolutely necessary or economically justified,
- regularly informing and raising awareness of users about the safe use of PPP, encouraging the development and introduction of organic agriculture and other so-natural agricultural practices,
- creating a transparent system for reporting on progress in achieving the strategy's goals and monitoring this progress, including the development of relevant indicators,
- ensuring the sustainable use of PPP for all types of plants while reducing the risk due to the use of PPP.
- the professionally justified use of PPP, which should be based on the improvement of the technological procedures for the production of cultivated plants, with the help of the prognostic service,
- improving the professional competence of PPP users,
- reduction of PPP residues in crops
- reduction of pollution of surface and underground waters due to the use of PPP,
- improved control over the use of PPP (for agricultural and non-agricultural purposes)
- improved control over the disposal of PPP waste packaging,
- establishment of systematic monitoring of PPP impacts on certain non-target organisms (bees, birds, fish...) and
- establishment of systematic monitoring of PPP impacts on the health of PPP users.

Handling training of plant protection products (PPP's)

In Slovenia, the training system for users and distributors of PPP, including lecturers, has been in place for years since 2001 and is carried out in accordance with the Rules on professional training and knowledge testing in phytomedicine (Official Gazette of the Republic of Slovenia, no. 36/02, 41/04, 17/05, 92/06, 99/08, 83/12 - ZPPP-1 and 85/13). The existing training system in phytomedicine is divided into the following groups: training of responsible persons and lecturers in phytomedicine and training of implementers of measures and sellers. The sets differ from each other in the duration of the training, purpose and partially also in content. When the training was established, the key contents were related to plant protection, the use of PPP and legislation in this area. The training material includes the following topics: pathogens and plant pests and the impact of weeds, human health and environmental impacts of PPP, PPP application technique and legislation.

The basic training consists of a course and a written test of knowledge:

- for PPP counselors (at least 35 school hours),
- for PPP sellers (at least 20 school hours),
- for implementers of plant protection measures or PPP users (at least 15 school hours).

Further training is carried out in the form of a course without a written knowledge test and lasts at least:

- for PPP advisors (at least 8 school hours),
- for PPP sellers (at least 6 school hours),
- for implementers of plant protection measures or PPP users (at least 4 school hours).

The content of PPP training includes:

- legislation in the field of PPP;
- fake PPP and methods for identifying them;
- dangers and risks associated with PPP and the way of identifying and controlling these risks in relation to risks for people (PPP users; residents; other bystanders; persons entering treated areas; persons handling treated plants or consuming treated plant parts - PPP poisoning symptoms and first aid measures;
- risks to non-target plants, beneficial insects, wildlife, biodiversity and the environment;
- strategies and techniques of integrated protection of plants against harmful organisms, principles of organic farming, methods of biotic control of harmful organisms;
- safe practices for storage, handling and mixing of PPP and disposal of empty packaging, other contaminated materials and excess PPP (including residual spray slurry);
- personal protective equipment of the PPP user;
- procedures for the preparation of PPP application devices, including their calibration, and for their operation with the least possible risks to PPP users, other persons, non-target animal and plant species, biodiversity and the environment, including water resources;
- use of PPP application devices and their maintenance and special spraying techniques (preventing reliance on non-target surfaces - "drift"...);
- urgent measures to protect human health, the environment, including water resources, in the event of accidental spillage and pollution, as well as extreme weather events that could cause PPP to be washed away;
- management of data on the use of PPP - records of PPP use.

Traffic with plant protection products (PPP's) and their sale

The PPP sales system in Slovenia is regulated in such a way that users can buy PPP without presenting a certificate (for certain PPP, which can be sold without presenting a Certificate of Phytomedicine acquisition, only in specialized PPP stores - the list is available at http://spletni2.furs.gov.si/FFS/REGSR/FFS_sezn.asp?L=1&S=15&top=1; or for certain PPP that are sold without presenting a Certificate of Phytomedicine acquisition in specialized stores with PPP and other stores with exclusively non-food products - the list is available at http://spletni2.furs.gov.si/FFS/REGSR/FFS_sezn.asp?L=1&S=16&top=1) or by presenting the Certificate of acquisition of knowledge in phytomedicine. Distributors, who are legal and natural persons and are responsible for placing PPP on the market (including wholesalers, retailers, sellers and suppliers) deal with the trade and sale of PPP. They must meet the requirements regarding the education and professional qualifications of the staff, premises and equipment, and must have permission from the administration to perform this activity. Distributors who sell PPP in flower shops and non-food stores must also meet the conditions and obtain a permit from the ministry.

The permit for PPP traffic is issued by the administration based on the report of the competent inspector on the fulfillment of the conditions of premises and equipment for PPP traffic and personnel. The administration maintains a register of PPP distributors. The administration reports data on PPP traffic to the Statistical Office of the Republic of Slovenia for the purpose of collecting and processing statistical data on PPP traffic.

Notification and public awareness

Informing and raising awareness of the public takes place in the form of the implementation of various activities of the competent ministry regarding the safe use of PPP, the issue of PPP use in relation to the risk to bees, the recognition of PPP fakes, the correct handling of PPP waste containing dangerous substances, etc. The regulation governing the handling of PPP waste containing dangerous substances already determines the obligations of persons who give or deliver PPP, packaged for final use, directly to the end user, regarding informing customers about the possibility of free delivery of waste PPP at the point of sale or in PPP waste collection points.

The obligation to inform end users is also imposed on PPP waste collectors, who must inform end users:

- on the purpose and goals of collecting PPP waste,
- correct handling of them,
- free broadcasting options
- about the methods of their reuse and disposal.

Information and awareness of users is defined in the Act on PPP in such a way that the Ministry adopts a program of information and awareness in relation to PPP, which includes measures to promote and improve information and awareness of the public about the impacts of using PPP and the impacts of improper handling of PPP waste containing dangerous substances, on human health, non-target organisms and the environment. The public is informed about the risk from the use of PPP and the possible acute and chronic effects of these agents on human health, non-target organisms and the environment. The interested public participates in the preparation of the program.

Application devices for plant protection products (PPP's)

Regular inspection of PPP applicators

Regular inspections of PPP application devices (tractor or self-propelled sprayers and tractor or self-propelled sprayers) are regulated by three regulations (Regulations on obtaining a certificate of compliance of plant protection devices for new devices, Rules on conditions and procedures that must be met and implemented by authorized inspectors bodies for regular inspection of devices for applying plant protection products to obtain authorizations from the Ministry of Agriculture and Forestry and Rules on the content and method of maintaining the register of devices of certified types that have successfully or unsuccessfully passed a regular inspection) on the basis of which the owner of the inspected device receives a control sticker on the flawless operation of the PPP application device .

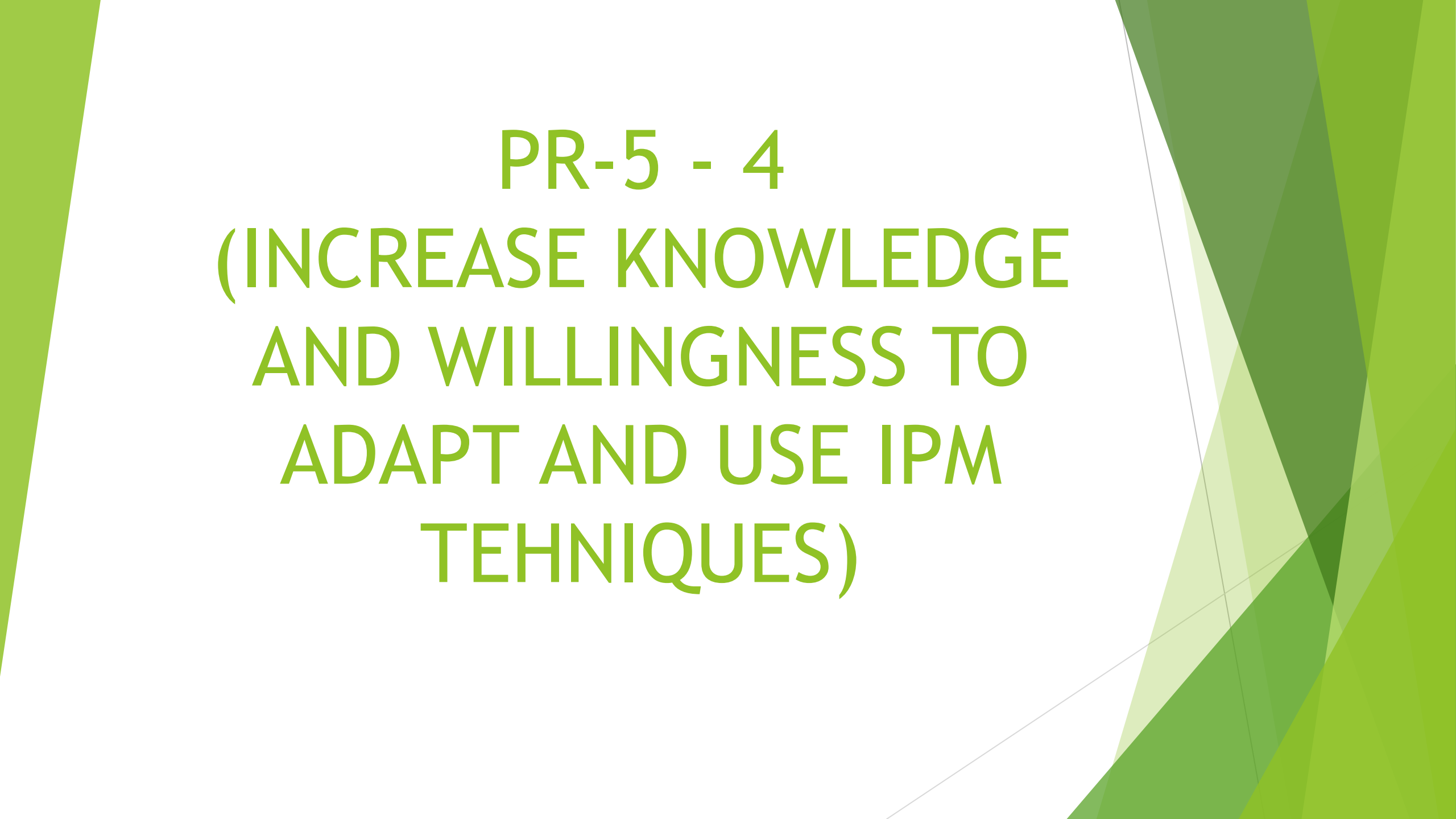
Authorized organizations for inspecting PPP application devices organize field inspections of devices every year in the months of March and April, or before the start of the spraying season. For PPP applicators, the user of spray equipment must pass a device performance test every three years, with the exception of new equipment (the first inspection of the device is after five years, and every subsequent one every three years).

Introducing improved PPP application techniques

PPP users must be familiar with the general principles of good agricultural practice, and before choosing a treated area, each user must assess the possibility of drift and apply PPP in such a way that the product does not rely on neighboring surfaces - "drift". Control organizations must not allow residues of unauthorized PPP in crops, regardless of whether they are the result of reliance on PPP from the environment or their own improper use.

Improved PPP application techniques enable better coverage of the sprayed surface and thus greater efficiency (optimized use of PPP) and less reliance ("drift") of these agents outside the application area during the spraying itself. It is necessary to achieve as little direct drift as possible, which is the result of the movement of air currents during spraying (wind). The extent of drift is highly dependent on the size of the droplets and the wind that affects the path of the droplets to the target. PPP users can influence the reduction of reliance on spray slurry during spraying due to chemical processes and post-application atmospheric phenomena through the decision to use the PPP (at appropriate temperature, humidity, wind).

Drift-reduced nozzles ("anti-drift nozzles") significantly (by 50 to 90%) reduce PPP drift on non-target surfaces. Drift can also be reduced by using suitable sprayers, where PPP drift can be reduced by 75 to 90% with the use of drift reduction nozzles, use of air barriers, consideration of ecological and weather conditions during application and different PPP application techniques.

The background features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, creating a modern and dynamic visual effect.

PR-5 - 4

(INCREASE KNOWLEDGE AND WILLINGNESS TO ADAPT AND USE IPM TEHNIQUES)

The increased use of pesticides in agricultural production poses a threat to human health and the environment. Integrated Plant Protection (IPM) is proposed as an alternative to conventional pest management practices. Implementation of IPM, however, faces several challenges, especially in developing countries. Challenges in implementing IPM programs and adopting IPM practices are closely related to policy, social and psychological factors, extension methods, and training and knowledge. Government goodwill in terms of policy support for alternative pest management is crucial. Until clear policies are established, it will be impossible to promote the use of IPM. New technologies and practices encounter resistance from stakeholders, especially farmers, and the implementation of IPM practices requires careful consideration of psychological and social barriers. Implementation of IPM also faces limitations in training and knowledge, which are mostly held by farmers and advisors. Challenges in IPM implementation influence extension organizations to increase their role in educating farmers on new practices. However, consulting organizations cannot work alone to address the challenges facing IPM and need the support of other stakeholders.

Transfer of knowledge and innovations

Only effective transfer of knowledge and innovations can enable further successful development of Slovenian agriculture, forestry and food industry. These are skills such as: production and processing technology, services, knowledge in the field of environmental protection, all the way to knowledge in the field of entrepreneurship and the introduction of innovative non-agricultural activities on the farm. At the forefront of the transfer of knowledge and innovations is the user (for example, a farmer or forest owner), who must have the support of institutions (for example, public agricultural advisory services, faculties, etc.) that are able to answer his development questions.

Knowledge transfer and information activities take the form of support for vocational training and skills acquisition activities: support is intended for the implementation of courses, workshops, lectures, practical demonstrations or other knowledge transfer activities. Support for demonstration activities and information measures is support intended for practical training of persons active in the agricultural, forestry and food sectors, based on the demonstration of the use of mechanization, procedures, technologies, machines and practices.

Knowledge transfer and information activities

Support for vocational training and skills acquisition activities

Support is intended for the implementation of courses, workshops, lectures, practical demonstrations or other knowledge transfer activities. It enables the acquisition of additional theoretical and practical knowledge for persons active in the agricultural, forestry and food sectors (e.g. farmers, organic farmers, forest owners). Attendance at trainings is free for participants. Courses, workshops, lectures, practical demonstrations or other similar knowledge transfer activities are carried out by persons who are suitably qualified for this. This measure is intended for training that is required upon entry or during the implementation of the obligations of the Agricultural-Environmental-Climate Payments (KOPOP), Ecological Farming (EK) and Animal Welfare (DŽ) measures. Support is also intended for training in many other areas that are important for the target groups, e.g. marketing, management, safe work in the forest, digital skills, processing... Training can include a theoretical and practical part. A special target group is young farmers.

Support for demonstration activities and information measures

The support is intended for practical training for persons active in the agricultural, forestry and food sectors, based on the demonstration of the use of mechanization, procedures, technologies, machines and practices. It enables the acquisition of additional theoretical and practical knowledge for persons active in the agricultural, forestry and food sectors (e.g. farmers, organic farmers, forest owners). Attendance at trainings is free for participants. Demonstrations are carried out by persons qualified to carry out demonstration projects. The target group is people active in the agricultural, food and forestry sectors. This measure is aimed at practical training based on the demonstration of the use of machinery, procedures, technologies, machines and practices. The contents of these projects, with practical demonstrations, contribute to a higher level of knowledge, especially in the technological, economic and environmental fields.

Advisory services, farm management assistance services and farm replacement services

Support to help you use counseling services

The support is intended for the implementation of consultancy on agricultural holdings. The purpose of this support is to improve the specific knowledge and information of persons who wish to or have already joined the measures of KOPOP, EK and DŽ. Beneficiaries of this support are persons under public or private law who provide consultancy services to agricultural holdings and are suitably qualified for this. Counseling is free for the participant.

The measure "Support for assistance in the use of counseling services" is intended for the implementation of counseling for content that is a condition or requirement for the EC, KOPOP and DŽ measures. Within this framework, individual counseling is supported for:

- creation of an animal welfare program, which is one of the conditions necessary for entry into the DŽ measure;

- creation of an activity program, which is one of the conditions necessary for entry into the KOPOP and EK measures;

- creation of an individual plan for the conversion of agricultural holdings from conventional to organic farming, which is mandatory for agricultural holdings that newly enter the EC measure;

- implementation of mandatory individual counseling for beneficiaries included in EC and KOPOP measures, at least once during the duration of the obligation.

Cooperation

The goal of the "cooperation" measure is to speed up the transfer of knowledge and innovations from the research sphere to agricultural practice. The measure is implemented through:

- support for pilot projects and the development of new products, practices, processes and technologies;
- support for horizontal and vertical cooperation between participants in the supply chain for the establishment and development of short supply chains and local markets and for promotional activities at the local level related to the development of short supply chains and local markets;
- support for joint action to mitigate or adapt to climate change and for joint approaches to environmental projects and sustainable environmental practices;
- support for the diversification of agricultural activities into activities related to health care, social inclusion, community-supported agriculture and environmental and food education.

The measure supports various forms of cooperation, which will enable actors in rural areas to more easily overcome the economic, environmental and other limitations they face due to fragmentation and disconnection. The measure will be aimed in particular at promoting cooperation projects, which will aim to achieve higher productivity and, at the same time, greater sustainability in the field of agriculture. Within this framework, special emphasis will be placed on promoting technological development and reducing the negative impacts of agriculture on the environment, especially in the area of biodiversity and the quality of surface and underground water.

Development of new products, practices, processes and technologies

The support is intended to accelerate the transfer of knowledge and innovations from the research sphere to agricultural practice through various forms of cooperation and integration. The aim of the support is to establish cooperation between various actors in the field of agriculture, food industry or forestry in the implementation of projects in the field of technological development and the introduction of innovations in agriculture, forestry or food industry, which will contribute to the achievement of the set goals of rural development.

Support is intended for:

- the development of new or improved products, practices, processes or technologies in the field of agriculture, food or forestry,
- transfer of knowledge into practice and
- dissemination of project results.

Environment and climate change

The aim of this support is to establish cooperation between various actors in the field of agriculture, forestry, environmental protection, nature conservation or water protection in the implementation of projects in the field of environment and climate change, which will contribute to the achievement of rural development goals.

Support is intended for:

a) development and search for solutions, regarding:

- reducing the negative impacts of agriculture or forestry on the environment,
- implementation of joint approaches in the field of agriculture or forestry for the protection of biotic diversity,
- implementation of environmentally efficient agricultural production in water protection and other protected areas and
- reducing or mitigating or adapting to climate change in agriculture or forestry;

b) transfer of knowledge into practice and

c) dissemination of project results.

Caring for the environment and adapting to climate change

The biggest challenge for farmers is how to maintain and increase their own productivity on their farm while taking care of the environment (water, soil, air, biodiversity) and successfully adapting to climate change (drought, floods, hail storms, frost, wind, ice).

Support for investments in agricultural holdings is intended, among other things, for investments in private irrigation systems intended for one user and the purchase of irrigation equipment (which can be intended for irrigation systems for one or more users), the purchase and installation of nets against hail, the purchase and installation of greenhouses, investments in greater environmental efficiency and increasing resistance to and adaptation to climate change, further regulating permanent plantations from the point of view of introducing more marketable varieties and improving production technology, with the aim of agricultural holdings restoring their permanent plantations that were damaged in natural disasters or exceptional phenomena of the last few years (frost, drought, hail).

Support for investments in infrastructure related to the development, modernization or adaptation of agriculture and forestry is intended for the construction of irrigation systems and the technological modernization of irrigation systems intended for multiple users.

Support for investments for the prevention of wind erosion on agricultural land is intended for the establishment of wind defenses as a measure to prevent and adapt to climate change (reducing the consequences of wind erosion) and as a measure to strengthen biodiversity.

Adapting to climate change

Due to global warming, agriculture is facing increasingly frequent occurrences of extreme weather conditions such as hail storms, drought, heat stress and frost. All this is reflected in the quantity and quality of crops and the stability of production. One of the key successes in managing the consequences of climate change is adaptation. The purpose of adaptation is to reduce risks and damage to the environment and human health in a cost-effective manner.

Adaptation to climate change in plant production and livestock breeding is possible by implementing the following measures:

- correct choice of production technologies and varieties;
- appropriate selection of the sowing date, planting of less sensitive crops (e.g. part of the corn silage is replaced with fodder sorghum, planting of appropriate substrates for seedlings of perennial plants);
- modified cultivar;
- introduction of irrigation systems;
- diversification of production;
- proper fertilization.

The public agricultural advisory service, which operates within the framework of the Chamber of Agriculture and Forestry of Slovenia, helps farmers with:

- preparation of technological instructions;
- advising on how to mitigate the effects of climate change and intense weather events;
- I am familiar with the expected climate changes as well as with the necessity of adapting to these changes and with the possibilities of mitigating the consequences;
- monitoring the condition of agricultural areas;
- preparation of the first rough assessment of the condition of agricultural crops in the field in the event of major adverse weather conditions and preparation of a report on their condition;
- informs the Ministry and the Administration for Protection and Rescue of the situation on the ground, and treats the affected farms individually.

Adaptation measures to climate change

Adaptation measures to climate change are encouraged and co-financed through the Rural Development Program or within other programs, projects or regular works and tasks carried out by public services in the field of agriculture.

The most important measures for adapting agricultural production to climate change are:

- co-financing of insurance premiums;
- air defense against hail;
- implementation of measures regarding investments in irrigation and irrigation, investments in anti-flow networks and protected areas, agricultural-environmental-climatic measures such as crop rotation and conservation tillage, production and animal husbandry technologies and raising awareness, training and informing farmers.

Mitigation of the effects of climate change in agriculture

Climate change is already happening, namely rising temperatures, changing precipitation patterns, melting glaciers and snow, rising sea levels, and as a result there are more and more extreme weather events. Warming is most likely caused by the increased concentration of greenhouse gases in the atmosphere, which is the result of emissions due to human activities. If we want to mitigate climate change, we need to reduce or even prevent these emissions in the field of agriculture with quick and effective measures. Measures to reduce greenhouse gas emissions in agriculture directly contribute to better competitiveness of the industry.

Measures to reduce greenhouse gas emissions in agriculture

The most important measures for reducing greenhouse gas emissions are:

- agricultural environmental climate payments,
- organic farming,
- knowledge transfer,
- assistance in using counseling services,
- cooperation,
- introduction of husbandry methods that reduce greenhouse gas emissions,
- measures for more efficient nitrogen circulation in agriculture,
- operation of the public agricultural advisory service.

The background features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, creating a modern and dynamic visual effect.

PR-5 - 5 (PROMOTING ADVANCED IPM STRATEGIES)

Implementing integrated pest, plant disease and weed management practices can be quite a challenge for farmers and consultants. Decision Support Systems (DSS) can assist in on-farm decision making (IPM). Decision support systems (DSS) are an important resource for the advancement of integrated plant protection. SPO helps growers and their advisors improve decisions based on information about potential crop risks. Most systems, especially tactical and operational systems, are intrinsically linked to crop monitoring, as observational data are usually required to run the model, and the results often require more targeted monitoring to define the final result. Monitoring is already a key part of IPM, but it is time-consuming and can be expensive. SPO allows users to focus on monitoring crops or parts of crops that are most vulnerable and where effective protection would have an economic benefit. Such an SPO provides users with the confidence to know whether targeted crop monitoring is required and information on how to do so. This two-step decision-making process allows the use of all IPM techniques, whether preventive or curative. The development of advanced SPO for IPM usually takes the form of new pest-specific systems, so their use may be limited by region and/or access to resources (e.g. climate data).

The aim of the "IPMworks - Wide IPM Farm Demo Network" project is to build a network of farmers across the EU to demonstrate and promote the adoption of IPM strategies through knowledge sharing and mutual learning. Currently, European agriculture is highly dependent on the use of plant protection products (FPS). In most European farms, the protection of crops against harmful organisms (insects, diseases, weeds and others) in order to avoid yield loss mainly (and sometimes exclusively) depends on the use of FFS. Such a high level of use of FFS has led to increased concern about their impact on the environment and human health. In addition, they can also cause long-term problems for farmers, as repeated use of FFS with the same mode of action often results in reduced efficacy due to the development of resistance. According to the European Green Deal, more precisely the farm-to-plate strategy, the EU plans to reduce the use of FFS by 50% by 2030.

New technologies and digitization in agriculture

The digitization system is being introduced gradually and in different areas. In recent years, modern information and communication technology (ICT), such as precision measuring equipment, sensors, probes, geo-positioning systems, drones, robotics, as well as Big Data (large databases), the Internet, has been increasingly used in the field of agriculture. things and artificial intelligence. "Smart agriculture" has great potential to achieve more productive and sustainable agricultural production, as it is based on a more accurate and efficient approach. The most important reason for introducing digitization is economic, but it is also introduced due to other needs. It can bring great benefits in relation to environmental issues, such as more efficient use of water, less use of fertilizers and pesticides, less fuel consumption, optimization of processing...

Agricultural holdings are provided with graphical data on agricultural plots and land use, which they can use to guide agricultural machinery based on the Global Positioning System GNSS, or to plan planting and crop rotation. Some farms also use aerial surveillance - analysis of satellite images or images obtained with smaller drones - to more quickly identify signs of plant diseases, nutrient deficiencies or lack of water in plants. Farms can also use accurate local weather data for irrigation purposes with the goal of reducing water consumption in agriculture and timely protection against pests and diseases. With timely action, they can reduce or even eliminate the consequences of drought. Effective digitization in agriculture requires basic digital records of the area, a well-developed network of agrometeorological stations, an efficient public plant health service that, with the help of various prognostic models and direct monitoring, predicts the development of diseases and pests and advises on the most suitable plant protection strategy. Remote sensing (satellite and aerial photography by drones) represents one of the central approaches for capturing data on crop status. The range of agricultural machinery that can record and/or use data for the implementation of precision agriculture (harvesters, mineral fertilizer spreaders, sprayers, seeders...) is gradually increasing and this enables a faster introduction of digitization in agriculture.

Application of remote sensing in plant protection

Methods of controlling plant diseases and pests assume their uniform spatial distribution in the crop or in the plantation, but in practice they are most often distributed unevenly. Some pests and diseases first appear locally and only later spread over a larger part of the plantation or field. In practice, effective plant protection is connected with the most current and timely monitoring of visible signs of the appearance of diseases and pests, which requires regular inspection of plants. This monitoring or inspection is time-consuming and expensive, and the effectiveness of suppression is related to the experience of the inspector and the timeliness of recognizing the first signs of the phenomenon. Remote sensing methods make it possible to detect the presence of diseases or pests on larger surfaces and in different stages of the phenomenon. In remote sensing, different sensors are used, which are mounted on different supports and allow time and spatial accuracy.

The most common groups of sensors are: RGB, hyperspectral, multispectral, thermal and fluorescence sensors. Although the detection of diseases and pests is possible with sensors of all five groups, the choice of sensor depends on the platform (greenhouse, drones, satellite...) and the desired accuracy. RGB sensors allow determining the presence of disease agents that cause changes in leaves, but their usefulness for determining infections before the development of visible symptoms is limited. The latter is made possible by multi and hyperspectral and thermal sensors. These four groups of sensors can also be used at greater distances (for example on an airplane), with natural lighting. Fluorescence sensors enable accurate disease detection and are therefore suitable for use in limited areas, such as greenhouses and laboratories.



Remote sensing sensor mounts used in agriculture

The most common carriers of remote sensing sensors used in agriculture are satellites, unmanned aerial vehicles ("drones"), aircraft, terrain, laboratories and greenhouses. Due to the heterogeneous spatial distribution of pests and diseases, remote sensing with optical sensors is the most suitable technology for providing information on foci and the extent of infections. Advanced data analysis methods are essential to effectively use remote sensing data to detect plant pests and diseases.



Precision agriculture and digitization in agriculture

For the best utilization of precision agriculture practices, we need suitable machinery and equipment, which is technically supported to enable us to carry it out. Smart machines (mineral fertilizer spreader, seeder, sprayer, grain combine, silo combine...) differ from classic machines by additional functionalities such as "Section Control", which automatically switches the "sections" on and off and thus prevents overlaps at the transitions in the fields and for side-by-side turns, it provides even crop spacing and consistent growing conditions, especially at the field edge, and "Variable rate Control" which allows us to fertilize and spray exactly where and exactly as needed. All machines need a connection to a computer that can control them, but they are usually connected via the ISOBUS controller, which is usually located on the tractor and the data needed to control the fertilizer and spray maps are imported to it. The machinery is controlled via the ISOBUS controller. For successful operation, we also need information about the exact location, which can be obtained from various location systems, one of the most well-known is the GPS system, with which we get an accuracy of 3 to 4 meters, which is enough to apply artificial fertilizers. Greater accuracy is required for spraying and sowing, which can be obtained through RTK and provides us with an accuracy of up to 1 cm. To determine how much of something to dose in a certain area, we first need data on the requirements and the condition of the field. The necessary data can be obtained with a drone or satellite, where with the help of multispectral sensors we can detect the condition of the plants, and produce special vegetation indices, which show us the depressed and healthy conditions of the plot. Since we cannot determine the exact cause based on the image itself, it is necessary to go to the field and determine the causes and adjust further measures based on the findings.

Prediction of crop irrigation using remote sensing

Proper growth and development of plants depends on an adequate amount of water. The low level of agricultural production is, among other things, a consequence of the low productivity of water use. When we decide to irrigate, it is important not to irrigate too much or too little and that the irrigation is carried out in the correct period of time.

The consequences of unprofessional irrigation have a negative impact on:

- the health status of plants, which increases the extent of plant diseases and requires greater consumption of plant protection funds,
- amount of crop,
- the quality and durability of the crop,
- the market value of the crop and thus the competitiveness of production,
- reduced uptake of nutrients into the plant and increased possibility of leaching nutrients from the root zone,
- the effectiveness and degradation of plant protection agents and increases the chances of their being washed out of the soil,
- the efficiency of water use and the economic and environmental sustainability of agricultural production, as it causes excessive consumption of water for irrigation.

Remote sensing of pests

In recent years, the approach of so-called "remote detection of harmful organisms" - electronic traps - has also started to be used in the field of monitoring harmful organisms. With the help of Trapview electronic traps, it is possible to remotely monitor the appearance of pests from the Lepidoptera order, of course those for which there is a pheromone. The device consists of a solar panel, an outer casing and an interior containing electronics for image capture and data transmission and a sticky panel with a pheromone added by the user himself. The device transmits data (an image of a sticky board with catches) via the GPRS protocol to the manufacturer's server, which enables the user to view the catches via a web or mobile application. The introduction of these new technologies in the prognostic service enables the rationalization of procedures, since the current use of pheromone lures requires field visual inspections and thus material costs increase. The device is equipped with a high-resolution video camera, the data is transmitted via the mobile network, so it is possible to monitor catches in the application on a mobile phone or computer. Images of captured butterflies can be monitored via the Trapview application, which also allows the user to view recent and historical images throughout



Figure 3: Trapview electronic trap for monitoring of corn borer

The background features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, creating a modern and dynamic visual effect.

PR-5 - 6
(REDUCING THE USE OF
PESTICIDES IN
AGRICULTURAL
PRODUCTION)

Regarding the reduction of the use of plant protection product (PPP), various non-chemical methods of plant protection are primarily used for the direct control of harmful organisms in integrated plant protection, which limit the populations of harmful organisms below the harmfulness threshold and have priority over chemical suppression (use of PPP). These methods are also referred to as low risk plant protection methods and include physical, biotechnical and biotic measures. Non-chemical plant protection methods also include the use of "low-risk PPP" based on microorganisms, plant extracts and pheromones, other low-risk substances and the use of basic substances.

Reducing the use of PPP on agricultural and non-agricultural areas is possible by using non-chemical methods of protection (mechanical control of harmful organisms, use of basic substances, biotic protection of plants...). In order to avoid as much as possible a greater risk to human health, the use of PPP is restricted or completely prohibited on non-agricultural areas and public areas where the safe use of PPP cannot be ensured, or where harmful organisms can be controlled by alternative methods. At the same time, it is also necessary to consider the possible exposure of people in public areas who could be exposed to risk when using PPP. On non-agricultural areas, such as roadsides, railways, non-chemical methods are used (e.g. weed control using steam...). In terms of reducing the use of PPP, the use of PPP on sports fields is limited to spot use and only if the use of PPP is necessary. This ensures the lowest possible exposure of people staying on the playgrounds after using PPP.

Reduction of ppp use using non-chemical plant protection methods

Physical measures

Physical measures are measures that prevent or limit the access of harmful organisms to cultivated plants and measures for catching or destruction (suppression) of harmful organisms. These measures can be used to reduce the use of PPP whenever possible. Physical measures include:

- cleaning of seeds and other planting material (removal of impurities - weed seeds, removal of infected plants from seed crops or other sources of planting material - in nurseries, mother plantations);
- heat treatment of planting material (immersion of seeds or other planting material (grafts, cuttings...) in a water bath for a certain time at a certain temperature - method of destroying pathogenic bacteria, phytoplasmas or viruses in planting material; exposure of seeds to low temperatures...);
- soil disinfection with the help of water vapor (in horticulture, especially when growing in protected areas);
- cutting out infected plant parts (apple powdery mildew, apple cancer or pear blight...);

- soil cultivation (reduction of the population of harmful insects in the soil - weevils, corn borer...; plowing can influence the emergence and growth of weeds - especially perennial ones);
- various pest control measures (manual removal of pests; washing with water or air stream; use of ash, diatomaceous earth...);
- the use of colored sticky boards, light baits and food baits for catching harmful types of insects (light baits, sticky boards of different colors and food baits are mainly intended to monitor the appearance of pests, but to a lesser extent they also reduce their abundance);
- use of various traps (for catching rodents...) and sound repellents (for birds or rodents);
- preventing pests from accessing plants with obstacles (overlays, insect nets - insect nets, bird nets, high barriers at the edges of fields against insect attacks, fences and electric herders against wild animals);
- mechanical weed control (mechanical or manual weeding, harrowing or brushing, mowing, mulching...) and
- weed control with steam, hot foam, burning with flame (roads, railways...)

Biotechnical measures

Biotechnical pest control measures are procedures that utilize some of the natural reactions of pests to certain chemical stimuli, and include the use of attractants (e.g. pheromones), deterrents and food baits.

Pheromones are substances secreted by insects in small quantities and intended for mutual communication between individuals of the same species. In plant protection, pheromones are mainly used to monitor the populations of certain economic pests in plantations or crops (to monitor various types of beetles - apple, peach, etc.), moths, owls and other pests. With pheromone baits, we determine the presence and abundance of pests in time and space.

Some pest control methods have also been developed based on pheromones, one of which is the method of confusion or confusion. Sex pheromones are used to distract males from finding females to mate with and therefore females lay unfertilized eggs. The bewilderment method is used to control apple and peach curlers. The method is more effective if the pest population is not too large, if the plantation is isolated and if it is in a larger complex.

Pheromones are also used in so-called "mass hunting". Pheromones are used to attract insects to be caught in or on traps. Traps with pheromones must be in the plantation or distributed evenly and in sufficient numbers to the production facility, so that a sufficiently large number of insects can be trapped in them and thus their population and, consequently, the damage they cause can be reduced.

Biotic measures

Biotic protection is a method of protection where one organism is used to reduce the population density of another organism. The goal of biotic protection is for other organisms to interact with pests or pathogens by destroying them or hindering their development. Plant pathogenic fungi also have their opponents (antagonists, pathogens), which either parasitize them or hinder their growth by emitting substances (antibiotics) that harm them, so there is a constant competition between organisms for space and food.

Organisms that, with their way of life, benefit the grower in the control of harmful organisms are called beneficial organisms = natural enemies. In biotic protection, knowledge about the relationships between species is used and with selected beneficial organisms, the populations of harmful organisms are reduced and they are kept below the threshold of economic damage. Beneficial organisms are insects, mites, entomopathogenic nematodes, fungi, bacteria, viruses. They can be used to control insects, mites, fungi, bacteria and even some weeds.

In biotic plant protection, living beneficial organisms are used to control harmful organisms. Depending on the mode of action on harmful organisms, beneficial organisms are classified into four groups:

1.) Predators: they are insects, mites... that feed on plant pests and destroy them. In order to successfully maintain a population of predators, there must be enough pests in the appropriate development stage and established environmental conditions that enable the development of predators. The most successful native beneficial predators among insects and arachnids are ladybugs, ladybugs, thrips, predatory rodents, predatory bedbugs and predatory mites. Predators regulate the abundance of plant pests outdoors and in sheltered areas.

2.) Parasitoids: are insects that are more host specialized than predators. They lay one or more eggs in the host (egg, larva, beetle or adult pest). The hatched larvae of the parasitoid feed on the host's tissue and its appearance changes but does not die immediately. An adult parasitoid emerges from the pest. An example of a parasitoid that is often used in protected areas is the greenhouse leafhopper (*Encarsia formosa*).

3.) Pathogens: are fungi, bacteria or viruses that infect their hosts, insects and other animal organisms. They penetrate inside them, causing them to weaken and possibly even die. The principle of action is parasitism. In insect pathology, they are also called entomopathogenic organisms.

4.) Antagonists: affect the survival or pathogenicity of harmful organisms, but do not use them as a food source. They inhibit the growth and reproduction of harmful organisms by competing with them for food and space (competition) or by disturbing them with substances they secrete (antibiosis).

The approaches in biotic protection are as follows:

- Protective biotic protection: it is based on measures with which we protect indigenous beneficial organisms and provide them with favorable conditions for settlement and reproduction;
- Classical biotic protection: it is a method of biotic protection, when we look for a non-native beneficial organism (most often in the area of origin of the pest) and introduce it to an area where a non-native pest has spread unplanned, which therefore has no effective natural enemies and
- Mass propagation and targeted release of beneficial organisms: The release of beneficial organisms to the place where the pest population needs to be reduced can be either by flood or by seasonal inoculation. Seasonal inoculative introduction of a beneficial species means the introduction of a laboratory or otherwise propagated indigenous or non-native beneficial species into the open air or into a protected area. Such an organism is introduced once or several times during the growing season, with the aim of automatic further reproduction.

Biotic protection has many advantages over chemical protection, because with biotic protection there are no residues of PPP in crops and biotic preparations do not have a grace period, they also do not damage plants, generally do not affect the phenomenon of resistance of harmful organisms, do not pollute the environment and are not dangerous to the people who use them.

The success of biotic protection depends to a large extent on the knowledge of the user, as a good knowledge of harmful organisms and the changes they cause on plants, as well as the thresholds of harmfulness, is necessary. Users must therefore be well trained to monitor the occurrence of harmful and beneficial species of organisms. One of the negative features of biotic protection is that it works slowly. Users must also know the developmental cycle and threshold of usefulness of beneficial organisms. It is also very important to know how we transport and store preparations with beneficial organisms, when we introduce them depending on the size of the pest population, what the conditions are at the place of introduction (temperature, lighting, humidity) and what PPP was used before introduction.

When using beneficial organisms, PPP cannot be used simultaneously, because they are only some PPP compatible with beneficial organisms. Using the wrong insecticide will harm or kill beneficial organisms.

In biotic protection, an essential limitation is that we may only use beneficial organisms that have been proven to be unable to cause harm in the environment by affecting non-target organisms. Types of beneficial organisms can be native or non-native, a native organism (autochthonous) has always been present in an ecosystem, and therefore we do not expect negative impacts when using such an organism. A non-native organism (allochthonous, exotic) is an organism that is not present on the territory or was not present until it was inhabited by humans. Part of the mentioned rulebook are the lists of native and non-native beneficial organisms, the introduction and use of which are permitted in the territory of Slovenia. Only organisms listed on these lists may advise, recommend and advertise.

Reducing the use of ppp using “PPP based on microorganisms, plant extracts, pheromones, other low-risk substances and basic substances”

Under the term PPP we understand all substances that are intended for the protection of plants or plant products for protection against harmful organisms. In integrated plant protection, in order to reduce the use of chemical substances, PPP are preferentially used, which are less dangerous and less burdensome for human health, animals and the environment. This also includes the use of PPP made on the basis of microorganisms, plant extracts, pheromones and low-risk substances. The same legislative regulations apply to the registration and use of these preparations in Slovenia as for chemical PPP. The current list of registered PPPs based on microorganisms, plant extracts, pheromones and low-risk substances is available at the web address:

http://spletni2.furs.gov.si/PPP/REGSR/PPP_sezn.asp?L=1&S=4&top=1

Pest control with entomopathogenic microorganisms

Pest control with entomopathogenic microorganisms is a measure when entomopathogenic fungi, entomopathogenic bacteria or viruses are used to control harmful insect species and the control is based on insect pathology, then we are also talking about microbiotic protection. Fungi, bacteria or viruses must be ready for use, so that they can be stored and applied, while maintaining a high level of vitality in order to be effectively activated after application. Entomopathogenic fungi infect insects in various developmental stages (adult insects, larvae, beetles). Among the entomopathogenic fungi, fungi from the genera *Beauveria* and *Metarhizium* have shown the greatest utility in pest control, although many others are being used and tested. Among entomopathogenic bacteria, *Bacillus thuringiensis* (B.t.) has been widely used for pest control for decades. These bacteria form proteins in the form of crystals, which are converted into toxins in the digestive tract of insects and cause the death of the insect. Entomopathogenic viruses primarily infect insect larvae when they are ingested. Viruses with a narrow range of hosts are particularly suitable for biotic protection. In organic and integrated apple production, the use of a preparation based on the *Cydia pomonella granulosa* virus to control the apple borer has already become established in Slovenia.

Protection against diseases based on fungi and bacteria

In the protection against diseases based on fungi and bacteria, organisms are used, such as fungi and bacteria that parasitize fungi or hinder their reproduction and development. In addition to parasitism, competition, and antibiosis, some beneficial microorganisms also act to increase plant resistance to disease or promote plant growth, which makes it easier to withstand damage caused by harmful organisms. Similar to how we use a protective approach in biotic protection against pests, we can also use microorganisms that are already present in the growing area, or increase their abundance and diversity, in the control of pathogenic fungi or bacteria for plants. By adding organic matter (green manure, organic fertilizers, composted bark and other composts), loosening the soil and ensuring adequate humidity, we encourage the reproduction of saprophytic fungi and bacteria. When using microbiotic preparations to control plant diseases, the warnings regarding mixing with other fungicides must be followed in order not to destroy the active microorganism. The preparations are effective in a limited temperature range, with some of them it is also necessary to pre-prepare the spray slurry to accelerate the germination of spores of the beneficial fungus. There are no withdrawal periods for microbiotic preparations, or they are very short.

Use of PPP based on plant extracts, pheromones and low risk substances

Plant extracts consist of one or more substances found in a plant and obtained from plants or their parts by a process of pressing, grinding, crushing, distillation, extraction, fermentation or other process. Protecting plants from pests involves the use of various substances that are produced in the metabolic processes of plants and that play an important role in protecting the plant from harmful organisms. Among the more well-known and useful substances of plant origin in the world are preparations containing the active substance pyrethrin, which is a natural insecticide obtained in the form of powder or oil of the flea beetle *Chrysanthemum cinerariifolium* or *Chrysanthemum coccineum*. Among the more commercially available preparations with insecticidal activity, we also find an extract obtained from the Neem tree (*Azadirachta indica*) - neem oil. This contains a number of secondary metabolites, including salanin, which acts as a deterrent and deters insects from feeding, and azadirachtin, which inhibits growth in insects and causes disturbances in reproduction and metamorphosis. In addition to its insecticidal effect, neem oil also has a nematocidal, bactericidal and fungicidal effect.

Use of basic substances

Basic substances that can be used for plant protection are those substances that are not problematic, do not cause hormonal imbalances and do not have neurotoxic or immunotoxic effects. They are approved for other purposes and are not normally used for plant protection and are not placed on the market as plant protection products - PPP, but are nevertheless useful for plant protection, either directly in preparations consisting of basic substances. Substances that meet the criteria for food can be considered basic substances. The use of basic substances in the European Union (EU) is approved by the European Commission.

The list of permitted active substances that are approved as basic substances for plant protection can be found on the MKGP-UVHVVR website: <https://www.gov.si teme/osnovne-snovi-za-varstvo-rastlin/>. Next to Slovenian names in the first column, Latin or English names are listed in the second column. Some of these substances can also be used by the user in organic production, which is indicated in the third column

The background features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, creating a modern and dynamic visual effect.

► PR-5 Integrated Pest Management
Recommendations to Cope Climate Change
Challenges

The background features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, ranging from light lime to dark forest green. These shapes are concentrated on the right side of the image, creating a dynamic, layered effect. The left side of the image is a solid, light gray background.

DECREASING NEGATIVE IMPACTS ON THE ENVIRONMENT AND PEOPLE

WHAT ARE PLANT PROTECTION PRODUCTS

- Plant protection products (PPP) are preparations used in agriculture to protect plants and crops from pathogens, weeds and pests. Before placing them on the market, it is necessary to evaluate their active ingredients, which contain substances that may have dangerous properties, and to determine their acceptable use in order to ensure the protection of people and the environment. The process of evaluating active substances and preparations is called registration. We try to reduce the risk to human health and the environment as much as possible by controlling the traffic and use of plant protection products. In Slovenia, as well as other EU members, we mainly support other methods of plant protection before the use of plant protection products, even though we are aware that plant protection products are still important for today's agricultural production. (1)

USE OF PLANT PROTECTION PRODUCTS

- ▶ The way plant protection products are used plays an important role in preventing potential negative impacts of PPP on the environment and human health. PPP must be used in a manner that does not contaminate groundwater and surface water and to prevent reliance of PPP on adjacent surfaces. This should also be done when preparing the spray slurry, removing the remains of the spray and packaging. During use, personal protective equipment is mandatory to protect the user's health. (1)

THE EFFECT OF THE USE OF PLANT PROTECTION PRODUCTS ON PEOPLE

PPP can enter the body in different ways, such as by;

- inhaling aerosols,
- dust and vapors containing pesticides;
- by oral exposure through consumption of food/water; and
- by direct contact skin exposure.

PPP are released into the soil and groundwater, which can end up in drinking water, and pesticide sprays can drift and pollute the air.

The effects of plant protection products on human health depend on the toxicity of the chemical and the length and extent of exposure

PPP can be divided according to their dangerous properties for human health in case of acute exposure into:

- - harmful to health - such PPP cause damage to various organs (liver, kidneys, ...) and organ systems (nerves, bones, ...). Damage mainly occurs after ingestion, skin contact or inhalation
- - irritant - this type of PPP cause suffocation due to irritation of the respiratory tract (lungs, trachea, nose), can cause coughing, watery eyes, irritation of the skin and mucous membranes, which can manifest as inflammation of the skin and mucous membranes.
- - Caustic - this type of PPP causes ulcers and burns of the skin and mucous membranes.

REDUCING THE IMPACT OF PPP ON HUMAN HEALTH

In order to reduce the negative impact of PPP on human health, it is necessary to follow the basic rules of safe use of PPP. The fact is that PPP are not dangerous when used correctly and thus reduce the negative impact on human health as well as on the environment. At the same time, the following steps must be taken into account:

- Before purchasing PPP, we always first check the stocks and at the same time remove all those PPP that have expired. We take such resources to the nearest hazardous waste collection center
- PPP are always stored in appropriate rooms, which must be locked
- We always buy registered PPP. When transporting, we ensure that PPP are transported separately from animals, food, agricultural products and feed, and we ensure the safe transport of PPP to the place of use
- Before use, carefully read the instructions for use
- During the preparation and dosing of PPP, we always wear personal protective equipment, which we also use during spraying and later when cleaning devices for applying PPP. Always wash the gloves after use.

PERSONAL PROTECTION EQUIPMENT



- ▶ We use modern and technically impeccable spraying devices, which prevent point pollution and drifting of the spraying slurry. (4)
- ▶ - After use, empty PPP are properly stored until they are sent to the collection point (4)



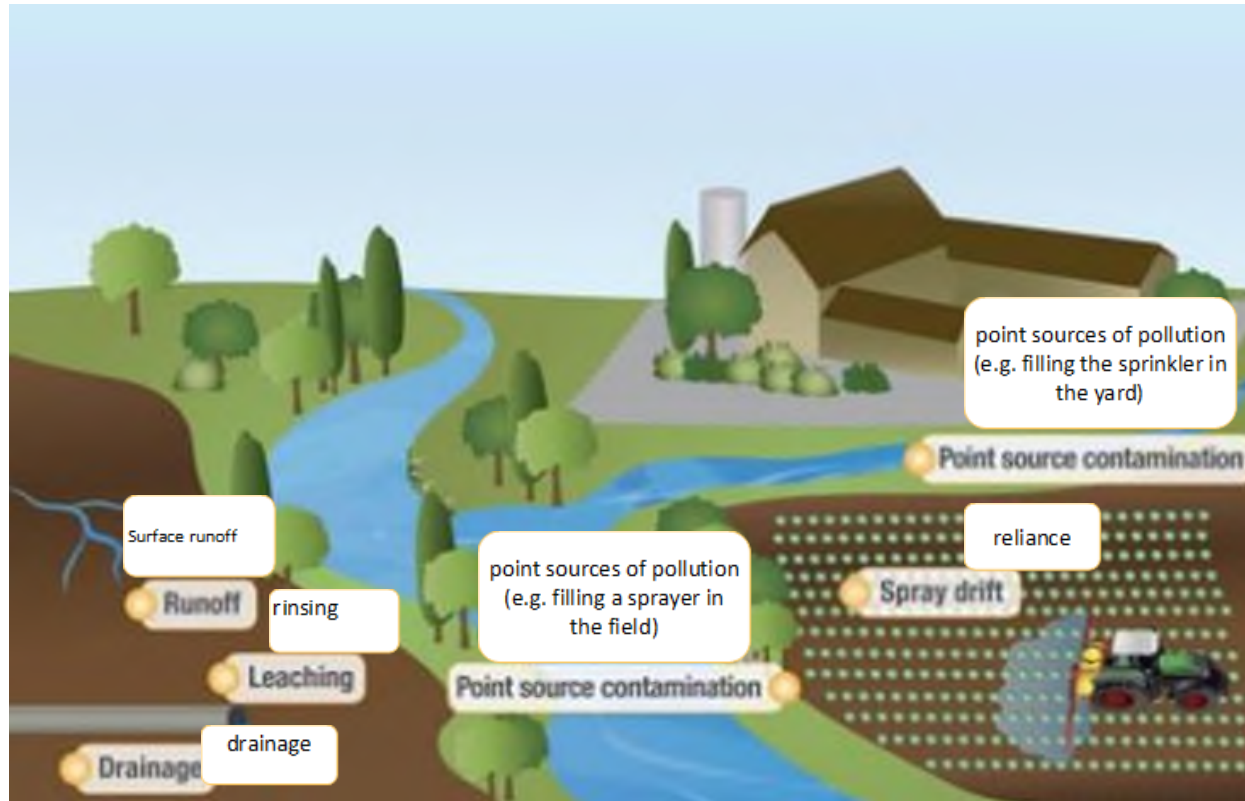
IMPACT OF THE USE OF PPP ON THE ENVIRONMENT AND BIODIVERSITY

PPP are indispensable in food production nowadays, but their improper use can have a very heavy impact on the environment.

In addition to the positive effects of PPP against harmful organisms, their use can have many environmental impacts: they can contribute to the pollution of water sources, air and soil, and due to their toxicity to non-target organisms, they affect important functions of ecosystems, such as natural pest control or pollination.

It is important to be aware of the main causes that can lead to negative impacts on the environment. These causes are: improper disposal of waste PPP and packaging, inappropriate application of spray slurry, spreading of spray slurry outside the treatment area and spills. (3)

IMPACT OF THE USE OF PPP ON THE ENVIRONMENT AND BIODIVERSITY

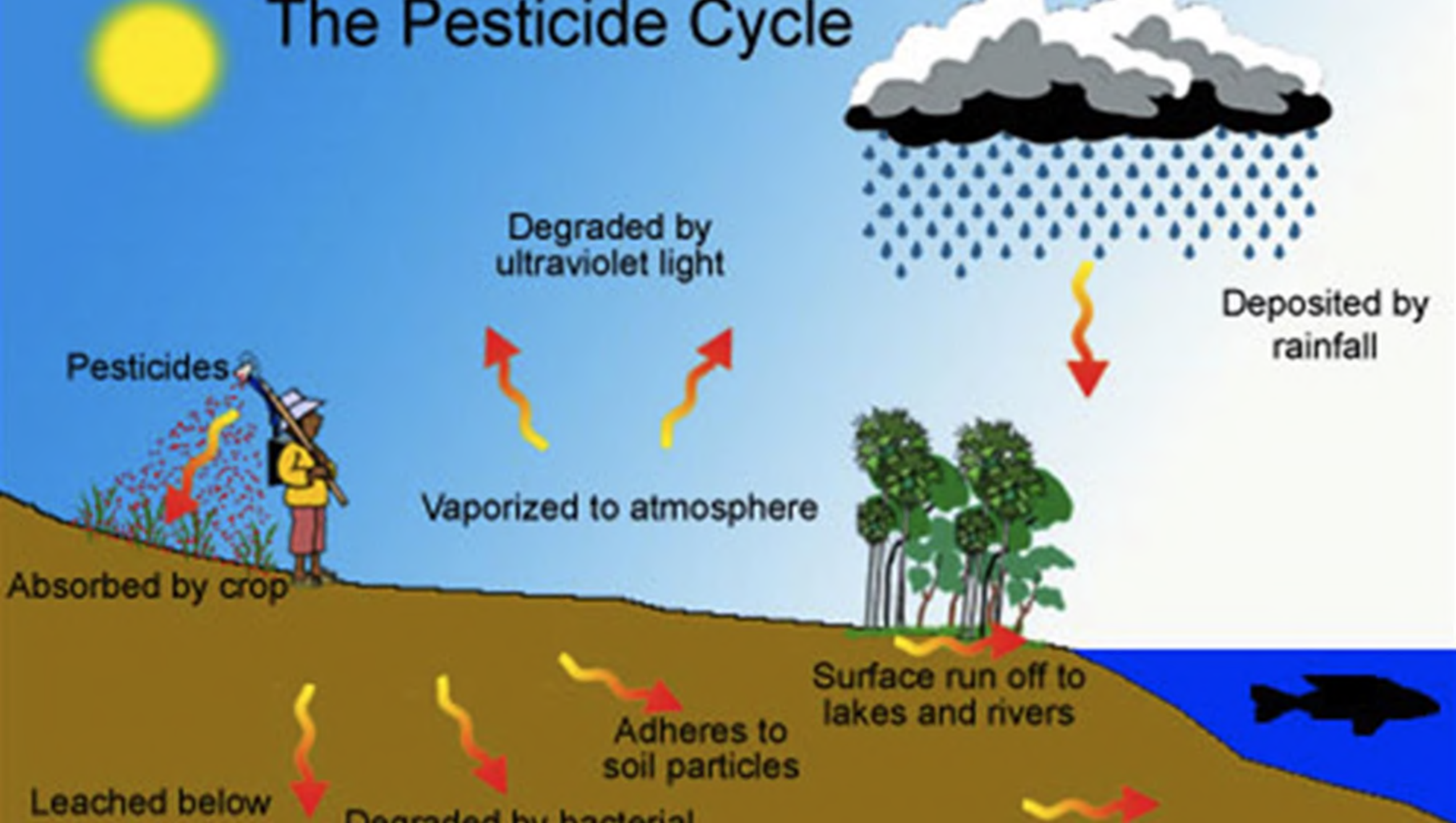


> 50 % pollution
is contributed by
point sources

5 % pollution is
contributed by
reliance

30 % and surface
runoff

The Pesticide Cycle



REDUCING THE IMPACT OF PPP ON THE ENVIRONMENT AND BIODIVERSITY

- In order to reduce the negative impact of PPP on the environment and biodiversity, it is necessary to take measures into account: it is necessary to prevent reliance on neighboring agricultural and non-agricultural areas, on nearby water sources by properly planning the correct application of PPP, by using appropriate spraying machinery and by following the instructions for correct use of PPP.

REDUCING THE IMPACT OF PPP ON THE ENVIRONMENT AND BIODIVERSITY

- ▶ Insofar as the application of PPP is carried out over-relying only on these, the amount of PPP that must be applied to the target organisms is reduced. As a result, the spraying efficiency is reduced.

REDUCING THE IMPACT OF PPP ON THE ENVIRONMENT AND BIODIVERSITY

- It is also recommended to establish so-called green belts in the vicinity of agricultural areas, which are overgrown with dense plant cover, which helps us to reduce the reliance of PPP on e.g. nearby water sources, to neighboring agricultural areas and help prevent surface erosion of spray slurry.

REDUCING THE IMPACT OF PPP ON THE ENVIRONMENT AND BIODIVERSITY

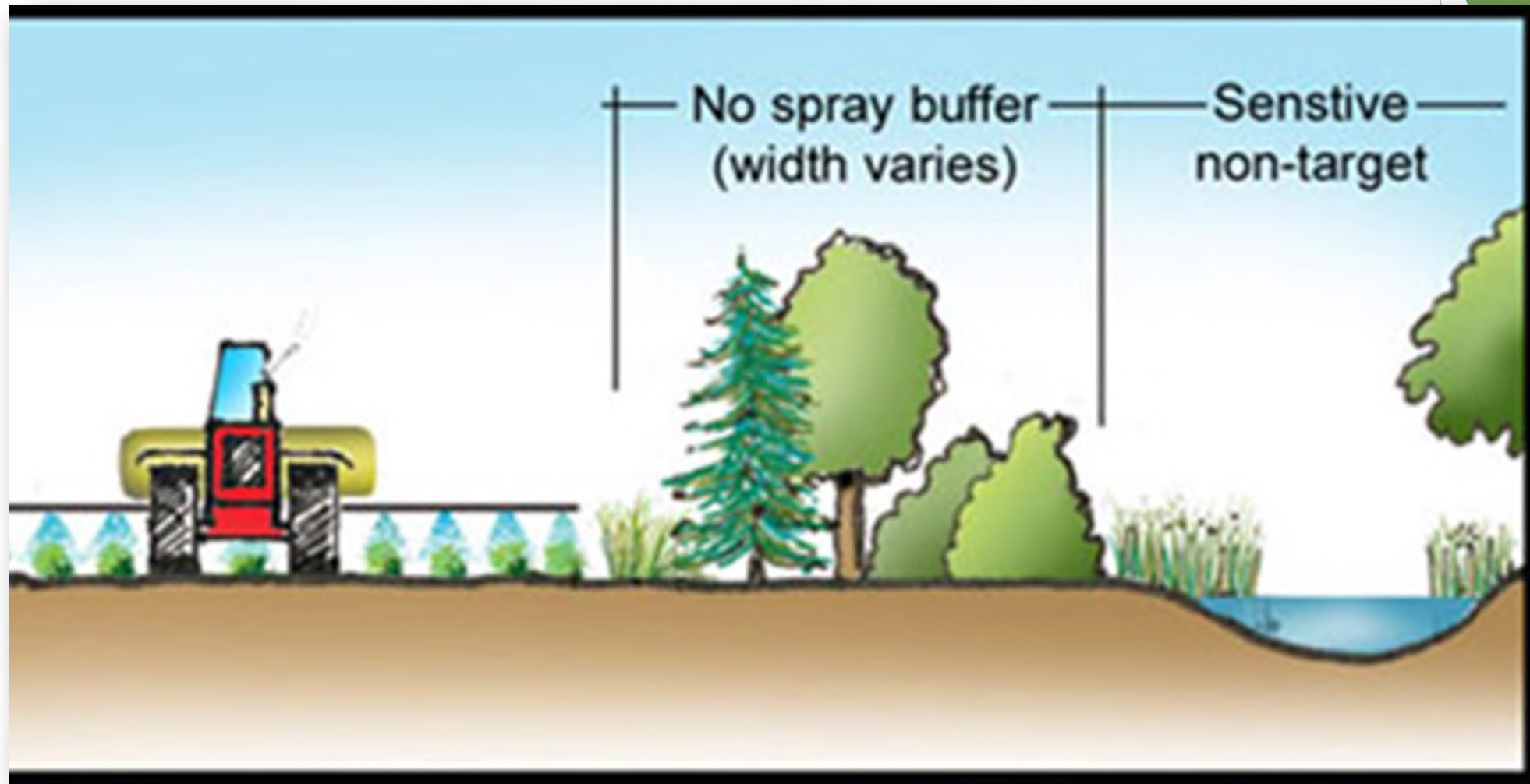
- ▶ Prescribed measures and more detailed methods of correct use of PPP to reduce risks to the environment due to their use must be defined in the national legislation of each country.

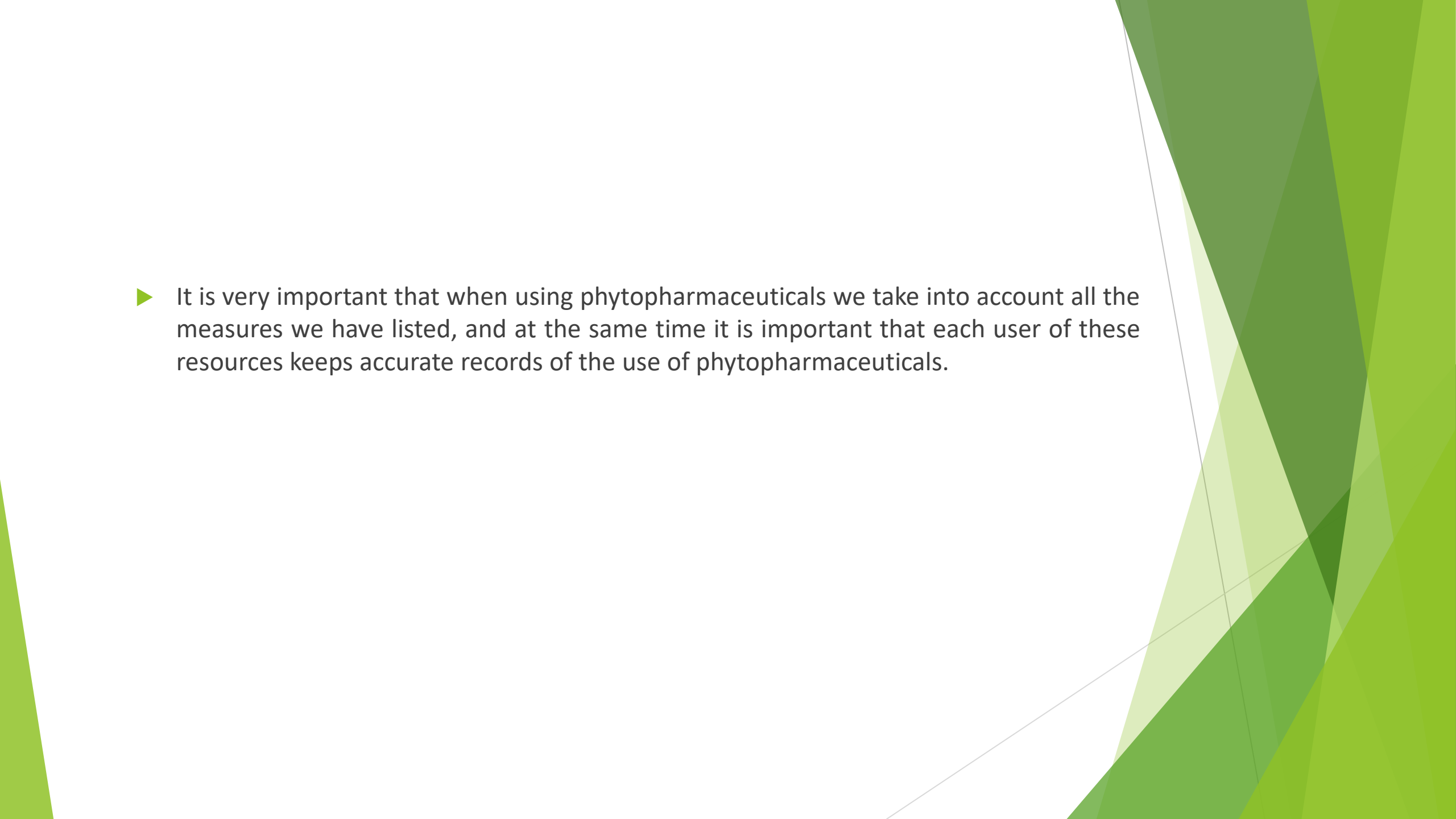
MEASURES TO REDUCE RISK WHEN USING PPP PRODUCTS

- These measures are as follows:
- - When using PPP, care must be taken to never spray over bodies of water (ditches, wells, melioration channels, drainage ditches, etc.).
- - It is necessary to establish an untreated safety belt on agricultural land, for the protection of aquatic organisms. For example, in Slovenia, safety zones are at least 5 meters from 2nd order waters and 15 meters from 1st order waters (rivers, lakes, seas).
- - The selection, application and use of PPP must be adjusted according to the hydrological and climatic conditions of the area and soil properties.
- - There is a greater possibility of surface runoff and erosion on non-vegetated terrains, which can be prevented by establishing green belts, by plowing in layers or across the slope of the inclined terrain, by using minimal cultivation techniques, by mulching during the vegetation period, by covering the soil, by ensuring an adequate supply of organic matter.

MEASURES TO REDUCE RISK WHEN USING PPP PRODUCTS

- ▶ The use of PPP is not permitted on flooded and frozen soil.
- ▶ When implementing irrigation, it is necessary to plan irrigation very carefully and appropriately, taking into account the condition of the soil, the physical and chemical properties of the soil and weather factors.
- ▶ Soil irrigation after PPP application increases leaching and surface runoff similar to rainfall. (3)
- ▶ It is very important that when using PPP we take into account all the measures we have listed, and at the same time it is important that each user of these resources keeps accurate records of the use of PPP.



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- The background of the slide features abstract, overlapping geometric shapes in various shades of green, ranging from light lime to dark forest green. These shapes are primarily located on the right side and bottom of the slide, creating a modern, layered effect. The main content area on the left is white.
- It is very important that when using phytopharmaceuticals we take into account all the measures we have listed, and at the same time it is important that each user of these resources keeps accurate records of the use of phytopharmaceuticals.

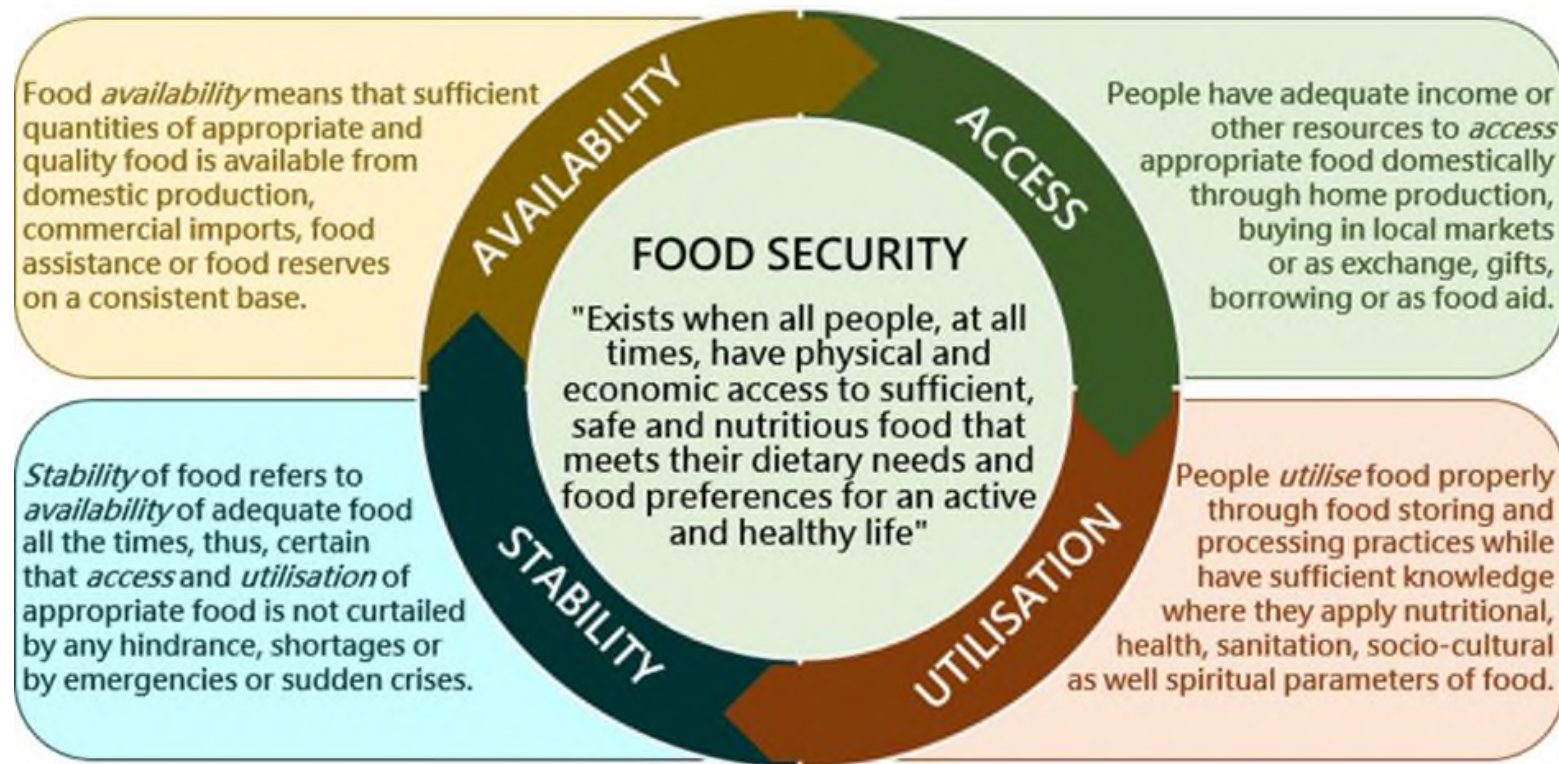
PR-5 Integrated Pest Management Recommendations to Cope Climate Change Challenges

Increase local agricultural production and food self-sufficiency

INTRODUCTION

Food security, as defined by the United Nations' Committee on World Food Security, means that all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life. (1)

Four dimension of food security



FOOD SELF SUFFICIENCY

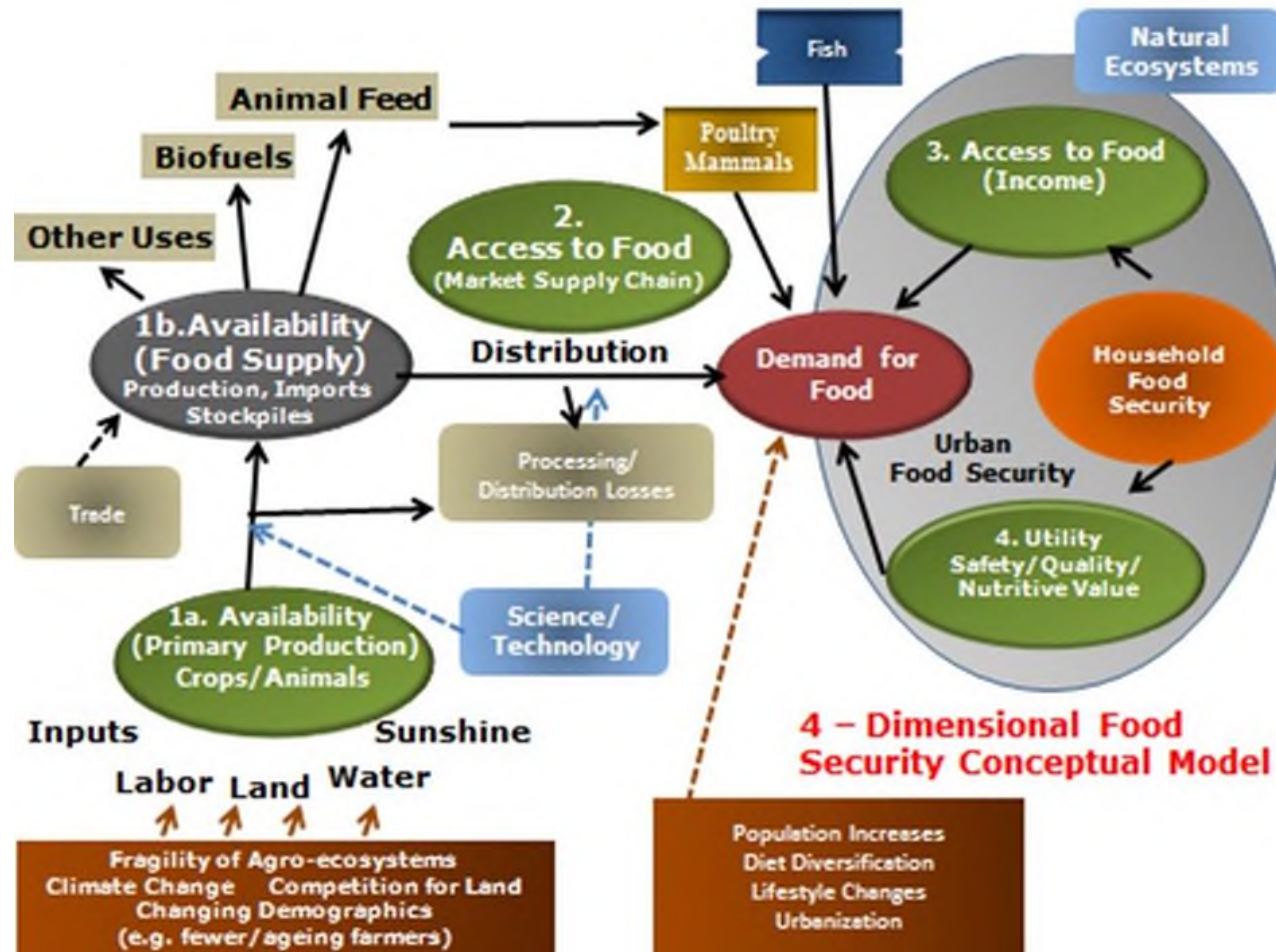
Food Self-Sufficiency (FSS) and price volatility have become a high priority political agenda for governments (2) Increasing crop diversity is an agroecological approach to improve FSS, so small producers can maintain the stability of their food systems, reducing the risks of stress, pest outbreaks or droughts (3).

A region can increase the stability of its food system by building its own FSS [5]. Food production is a starting point in the analysis of sovereignty and food security. Revenue generation through efficient field production provides a real productivity base (4). The traditional agricultural production of production systems determines access to food and obtaining complementary income through the sale of products and by-products; this being considered as the result of the integration of life strategies (5).

CHALLENGES IN FOOD PRODUCTION WHILE ENSURING FOOD SAFETY WITH REDUCED USE OF PHYTOPHARMACEUTICALS

- ▶ "It is expected that the world's population will be increased to one third; The FAO estimates that, if current income and consumption growth trends continue unabated, agricultural production will have to grow by 60 per cent to satisfy the expected increased demands for food and feed.
- ▶ A 60% increase in global food demand will occur by 2050 against 2006 levels due to population increases and changes to food patterns, while climate change will continually impact global food systems" (6).
- ▶ "The number of people affected by hunger globally has been on the rise since 2014 despite food production doubling over the last 3 decades .Over the course of 2019 "two billion people, or 25.9% of the global population, experienced hunger or did not have regular access to nutritious and sufficient food" . (7)
- ▶

4- dimensional Food Security Conceptual Model



- ▶ The fundamental task of agriculture is to provide adequate amounts of unblemished food, or to improve self-sufficiency with agricultural products, which is forced by climate change with increasingly frequent natural disasters, which make food production increasingly unpredictable, and numerous crisis events related to the global economy.
- ▶ Ensuring sufficient quantities of safe food while taking into account the principle of sustainability, preservation of the natural environment, space and biodiversity is not an easy task, as agricultural production is constantly threatened by numerous plant diseases, pests and plant invasive species, which reduce the quality and quantity of crops and directly affect the quality of food and the economy of the production of agricultural plants. In order to achieve the set goal, it is also necessary to focus on caring for the environment and reducing the risks and impacts of the use of phytopharmaceuticals (PPP), which are an important element of plant health protection, on human health and the environment (8)

- ▶ Controlling pests that damage crops and plants is necessary both to safeguard food security and to ensure viable income to farmers for their production.
- ▶ This needs to be done while minimising the risks to people and the environment.
- ▶ Such an approach, using natural methods whenever possible and chemical pesticides as last resort, is called 'integrated pest management' (IPM).
- ▶ Today, the European Commission published a [database](#) presenting an overview of the IPM methods currently available, accompanied by a study assessing their effectiveness and prospects for their further uptake.

The database includes about **1300 examples of practices, techniques and technologies** across [eight IPM principles](#) established at EU and international level, such as:

- ▶ the use of crop rotation and balanced fertilisation,
- ▶ monitoring of harmful organisms,
- ▶ targeted and reduced application and, more importantly, the
- ▶ preference for non-chemical pest control methods.

The database also includes **273 “crop-specific guidelines”** developed by Member States’ national authorities and public bodies to implement the IPM requirements under the [Sustainable Use of pesticides Directive](#) (SUD).

This overview of practices, established following two years of work, shows that there is a great variety in the uptake and implementation options for IPM across EU countries. All examples are presented in national languages with a brief introduction in English.

This toolbox is intended to inspire national authorities, farm advisors etc. to develop and implement IPM approaches after adapting them to local/regional farm and agro-climatic conditions. The database, hosted in the [JRC’s Data-Modelling platform of resource economics](#) (DATAm), will be updated with additional examples on a regular basis. (9)

GENERAL OVERVIEW OF IPM STRATEGY

A cornerstone of the Directive is the promotion of IPM, for which general principles are laid down in Annex III to the Directive. Along with the promotion of organic farming, IPM is one of the tools for low-pesticide-input pest management, and IPM must be implemented by all professional users.

- IPM involves an integrated approach to the prevention and/or suppression of organisms harmful to plants through the use of all available information, tools and methods
- IPM aims to keep the use of pesticides and other forms of intervention only to levels that are economically and ecologically justified and which reduce or minimise risk to human health and the environment.
- Sustainable biological, physical and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.

DEFINITION OF IPM

- ▶ 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 minimise risks to human health and the environment.
- ▶ 'Integrated pest management' emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.

PRINCIPLES OF PEST CONTROL

1. The prevention and/or suppression of harmful organisms should be achieved or supported among other options especially by:
 - crop rotation,
 - use of adequate cultivation techniques (e.g. stale seedbed technique, sowing dates and densities, under-sowing, conservation tillage, pruning and direct sowing),
 - use, where appropriate, of resistant/tolerant cultivars and standard/certified seed and planting material,
 - use of balanced fertilisation, liming and irrigation/drainage practices,
 - preventing the spreading of harmful organisms by hygiene measures (e.g. by regular cleansing of machinery and equipment),
 - protection and enhancement of important beneficial organisms, e.g. by adequate plant protection measures or the utilisation of ecological infrastructures inside and outside production sites.

1. 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.
2. 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.
3. Sustainable biological, physical and other non-chemical methods must be preferred to chemical methods if they provide satisfactory pest control.
4. 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.

1. 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.
2. 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. (10)

THE BENEFITS OF RELYING ON LOCAL AGRICULTURE FOR THE FUTURE

► The importance of local food

A modern man should not be indifferent to what kind of food he eats. From a health point of view, it is recommended to eat seasonal vegetables and fruits from the local environment, as they are usually more optimally ripened and have a higher biological (nutritional) value. Reasons to buy local food are:

► Reduces the distance food travels

Much of the food on supermarket shelves has traveled long distances to reach your plate. By shortening the food chain, consumers can reduce food miles and reduce carbon emissions. Above all, you also reduce the amount of pollution that you indirectly cause through consumption. Buying local can really help reduce your greenhouse gas emissions and your overall impact.

► It's healthier

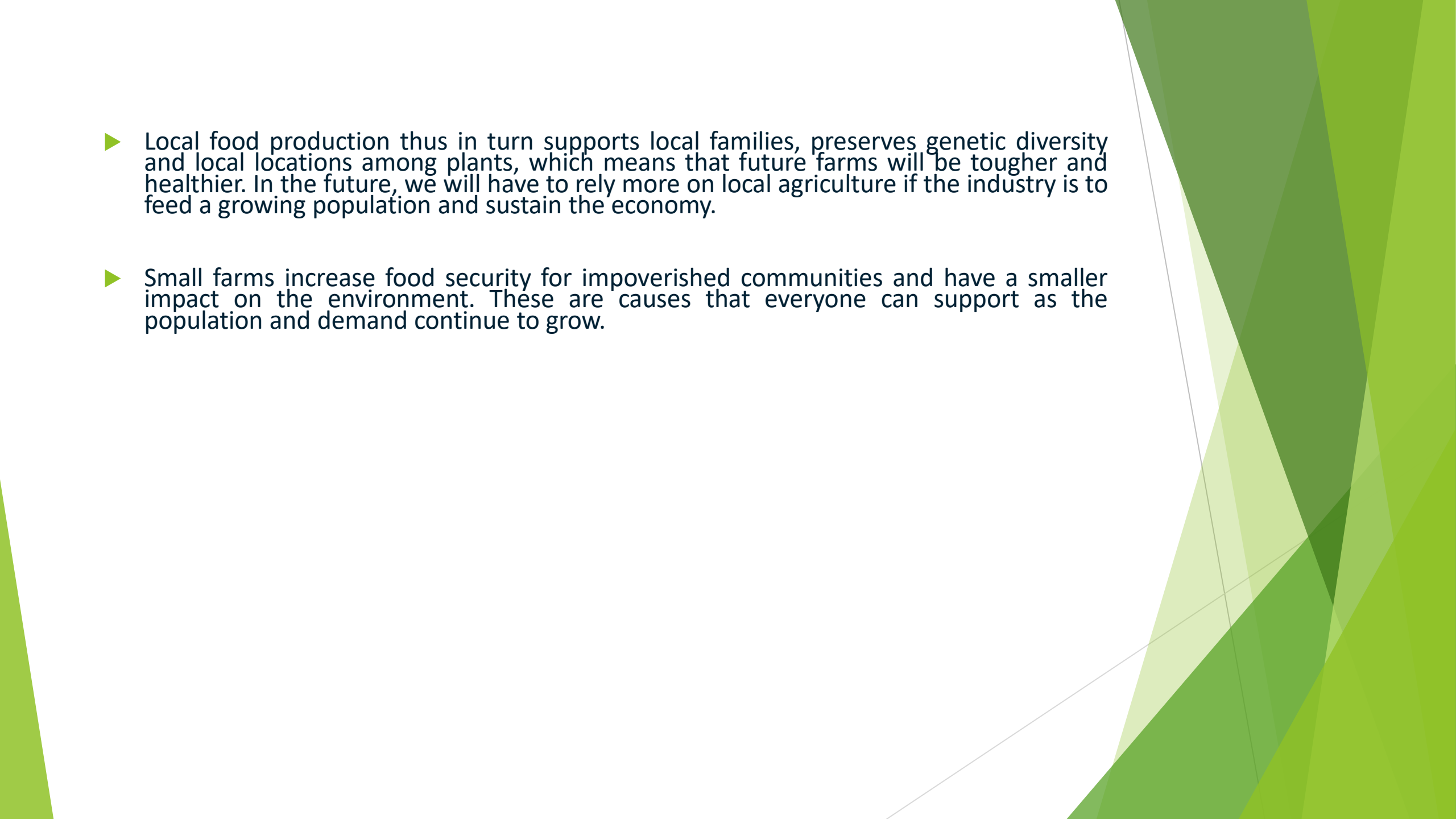
You are more likely to get better quality products if you shop locally. If the source is local, you are guaranteed full traceability back to the farm. No preservatives or other chemicals need to be added to local food to keep it fresh in transit. Fruits and vegetables begin to lose their nutrients within 24 hours of being picked, so locally grown food is most nutrient-dense when picked at the peak of ripeness.

► Less packaging is involved

Shopping at local markets is an opportunity to reduce food and packaging waste. Much of the food produced is wasted from seed to plate, and waste is generated at all stages of the supply chain; from production and harvesting to distribution and consumption (where the highest percentage of waste occurs at this stage).

Why locally produced food should always be your first choice



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- The background of the slide features abstract, overlapping green geometric shapes, primarily triangles and polygons, in various shades of green, creating a modern and dynamic visual effect.
- ▶ Local food production thus in turn supports local families, preserves genetic diversity and local locations among plants, which means that future farms will be tougher and healthier. In the future, we will have to rely more on local agriculture if the industry is to feed a growing population and sustain the economy.
 - ▶ Small farms increase food security for impoverished communities and have a smaller impact on the environment. These are causes that everyone can support as the population and demand continue to grow.