

3. INTEGRATED MANAGEMENT OF AGRICULTURAL PRODUCTION

3.1 Introductory concepts

3.1.1. What is integrated management of agricultural production

3.1.2. Integrated management of agricultural production models

3.2 Implementation of integrated management of agricultural production models

3.2.1. Prerequisites for the implementation of integrated management models

3.2.2. Advantages of standards

3.3 Requirements in the operation of the agricultural enterprise in an integrated farming system

3.3.1. Correct use of fertilisers

3.3.2 Use of pesticides – correct plant protection and management of plant protective products

Self evaluation

Activities

3. Integrated Management of Agricultural Production

INTRODUCTION

This unit will present the concept and advantages of integrated management of agricultural production, as well as the more important quality standards and their application to farming. Particular emphasis will be placed on techniques of plant protection and the use of fertilisers.

EXPECTED RESULTS

When you have finished this chapter, you will be able to:

- Discern the differences between conventional and integrated farming and their products.
- Know the prerequisites for your implementation of an Integrated Management of Agricultural Production model.
- Assess and make better use of natural resources at home, in your arable land and its borders.

KEY WORDS

Integrated management, Quality standard, EurepGAP, Integrated agriculture, Traceability

3.1. Introductory concepts

3.1.1. What is Integrated Management of Agricultural Production

For a long time, agriculture has been practiced as conventional farming using improved varieties, large quantities of chemical pesticides and fertilisers and, in many cases, wasteful use of natural resources. Until recently, the EU encouraged the quantitative production of agricultural products, giving considerably high subsidies to producers, with the result that a series of problems were created which must now be addressed. The impacts of conventional farming are apparent today and mainly centre around weakened soil productivity, the destruction of wildlife, the appearance of toxic residues in agricultural products and the compromised health of farmers.

After the emergence of food-related crises (dioxins in poultry, use of hormones to fatten animals, banned antibiotics, foot and mouth disease, mad cow disease, swine flu, etc.), it has become imperative to ensure the safe and healthy production of agricultural products and foods at all stages of production.

Following the most recent revision of the Common Agricultural Policy (CAP), the EU is now encouraging farmers to produce agricultural products of high quality, placing emphasis on satisfying the expectations of consumers by adhering to practices that respect the environment.

As a result, the application of alternative and innovative forms of agriculture, such as the production of certified quality products as per the principles of good agricultural practices and **integrated crop management**, is one of the main goals of the EU in producing competitive products for international markets. The gradual degradation of the environment and the increasing demand for the production of quality and safe foods have led to the need for **Systems of Integrated Management of Agricultural Production**.

Integrated management recommends a restructuring of production systems with an emphasis on improving farmer skills, the quality of products and the protection and improvement of the environment. **Integrated Management of Production is a farming methodology that improves the competitiveness of products, thus safeguarding the producer's income; it reduces the environmental impacts of agricultural activities; and it addresses society's demand for environmental protection and the production of safe agricultural products.**

This methodology was first applied in some EU countries in the 1970s. Gradually, most of the Member States have begun to adopt it as the technology and expertise to support it now exists. Within this framework, standards have been developed (national, international or trade) which, if implemented correctly, lead to the attainment of a **quality and safety certification label**.

Integrated management is a system of organising an agricultural concern that includes, among others:

- Good Agricultural Practice
- Occupational Safety and Health
- Product Safety
- Traceability
- Environmentally Friendly Actions.

It aims to create the basis for efficient and profitable production of safe and quality agricultural products in an economically viable and environmentally responsible agricultural enterprise, incorporating beneficial natural methods into modern cultivation practices.

The EU Member-States have the ability to attain a certificate for products that are produced according to an integrated management system, which guarantees that a product is good quality, safe and produced under environmentally friendly conditions (excellent environmental management).

The implementation of this system offers advantages for both producers and the environment.

- **It ensures yield and income for the producer**
- **It reduces the environmental impacts of agricultural activities**

It responds to the demands of society and the market for protection of the environment and for agricultural products that are less encumbered by synthetic chemical substances.

Integrated management systems apply to the way tasks are organised and how farms function. The benefits will be evident immediately, but they are expected to reach their maximum potential 4-5 years after initial implementation.

The integrated management system is an environmentally friendly alternative to conventional methods of production according to which the producer drastically reduces the use of chemical preparations and the unchecked application of cultivation interventions. Farmers are required to follow specific production regulations as indicated by the supervising agronomist and to keep documented records of practices used with the aim of ensuring consumer health and the protection of the environment.

The implementation of integrated management systems **ensures**:

- Controls at all stages of the production process.
- Ongoing information and training for producers involved.
- A reduction in production costs with the correct use of water, fertilisers, plant protection materials, etc.
- Health protection for producers and consumers.
- Environmental protection.
- Production of safe and good quality agricultural products that meet market demands.

The implementation of an integrated management system (IMS) is funded by various European programmes. The funding covers expenses in developing the system, training personnel and initial certification.

3.1.2. Integrated Management of Agricultural Production Models

The most important European quality assurance system for primary production of agricultural products is related to the production of products under the European Foodplus **EurepGAP** protocol. EurepGAP is an agricultural product production standard created by the leading European supermarket chains and has been set as a trade standard in accepting agricultural products on European markets. EurepGAP is based on abiding by the Good Agricultural Practice (GAP) standards with regard to the certification of agricultural products. (<http://www.eurepgap.org/Languages/English/about.html>)

EurepGAP has since changed and become influential and recognised world-wide in South and Central America, Africa, Australasia and even Japan and Thailand. It is now called GLOBALG.A.P., emphasising its international character. The renaming of EurepGAP to **GLOBALG.A.P.** was announced at the 8th annual summit meeting of the organisation. The decision to change the name was made in order to emphasise the international role assumed by the standard in transactions between producers and retailers.

GLOBALG.A.P. is a single integrated standard with modular applications for different product groups, ranging from plant and livestock production to plant propagation materials and compound feed manufacturing.

The standard focuses on the analysis and prevention of risk in food safety, on traceability, on health and prosperity of workers, on energy management, environmental pollution and the management of biodiversity.

GLOBALG.A.P.

With regard to agricultural production, it also covers distribution facilities and includes subcontractors to the degree that those responsible for the agricultural enterprise must oversee their activities.

For the time being, specific standards have been developed for production of:

- Fruit and vegetables

- Flowers and ornamentals
- Combinable crops
- Livestock
- Aquaculture
- Green coffee
- Tea

The following table presents a summary of the main **technical requirements** of the GLOBALG.A.P. standard for the production of **fruit and vegetables**:

<p>1. Traceability: The course of products should be traceable from and to the farm.</p> <p>2. Internal Self-inspection: Farmers must undertake at least one independent inspection annually according to the requirements of the GLOBALG.A.P. standard.</p> <p>3. Varieties and rootstock: Trials using seeds and cuttings are documented and quality control systems are implemented in the production of propagation material. The planting of genetically modified organisms (GMO) should comply with laws in effect in the country of production.</p> <p>4. History and management of location: The suitability of new production facilities should be verified and a system of identification should be implemented for each field or greenhouse.</p> <p>5. Soil and subsoil management: The sterilisation of the soil and subsoil should be justified and documented. Erosion control techniques should be implemented.</p> <p>6. Use of fertilisers: The application of fertilisers should be documented. Fertiliser storage areas and equipment or machinery should be maintained in good condition and sludge from human waste treatment should not be used.</p> <p>7. Irrigation: Water from untreated waste should not be used for irrigation. Irrigation methods should take the viability of water sources and water quality into consideration.</p> <p>8. Plant protection:</p> <ul style="list-style-type: none"> • Integrated management of enemies should be implemented. • Chemical substances should be selected by specialised staff and should meet legal requirements of the country of production, as well as of the destination country. <p>Records of applications should be detailed, including such information as location, date, name of product and active ingredient, waiting period before harvest, etc.</p> <ul style="list-style-type: none"> • Application equipment and the area where plant protective materials are stored should be maintained in good condition. • There should be evidence of awareness of maximum residue level requirements in destination countries and compulsory annual inspections of residues. • Care should be taken to safely dispose of empty containers of plant protective materials and expired plant protective materials. <p>9. Harvest: Hygiene-related risks should be assessed and basic hygiene measures should be in</p>
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effect (including access to hand-washing facilities). **10. Production Management:**

- Employees should have received basic instructions related to hygiene management.
- Water used for washing should be potable.
- Therapeutic applications following harvest should meet the legal requirements of the destination country. Records of applications should be maintained.
- Facilities for distribution and storage should be kept clean and secure.

11. Pollution and waste management: Sources of pollution should be identified and appropriate measures should be taken in case of emergency.

12. Health, safety and welfare of employees: Employees who handle dangerous chemical products or equipment should be suitably trained for this purpose. First aid equipment and suitable protective clothing should be provided. Housing on farms should be suitable and basic services should be provided.

13. Environmental issues: The environmental impacts of agricultural activities should be assessed and appropriate measures should be taken in the event of an emergency.

14. Reporting form: There should be a reporting form and a procedure in place to ensure that reports are documented adequately, reviewed and investigated.

15. Energy efficiency: It is recommended that energy efficiency be monitored.

Examples

To better understand the main technical requirements of the GLOBALG.A.P. model for the production of fruit and vegetables, some examples are included.

1. Traceability

The origin of products should be known, as well as the raw materials used in their production. For example, pasteurised milk should state the farm it originates from and it should be possible to trace the origin of feed given to cows in producing the specific milk.

2. Internal self-assessment

Producers should conduct at least one review per year and document the results. For example, at least once a year, dairy farmers should inspect and record on the form provided:

- The inspection of water quality
- The certificate of origin of livestock feed
- The transport of feed with lorries that meet system requirements (they should not be the same as those transporting livestock)
- Correct storage of livestock feed etc.

Note:

According to the standard, those who wish to receive certification for the implementation of an integrated management system should develop **Management Plans** which include:

- Cultivation instructions from agronomist to producers

<ul style="list-style-type: none"> • Complete record of activities taking place at each farm
<ul style="list-style-type: none"> • Producer training
<ul style="list-style-type: none"> • Laboratory analysis
<ul style="list-style-type: none"> • Instructions for environmental protection (e.g. the application of fertilisers should be based on calculating the nutritional elements in the soil or leaves)
<ul style="list-style-type: none"> • Instructions for the protection and safety of workers during plant protection interventions
<ul style="list-style-type: none"> • Calculation of residue persistence time for all pesticides so that a written order on when harvest can begin can be developed, given that the period between the last pesticide application and harvest is a legal requirement for all producers.
<ul style="list-style-type: none"> • Full product codification to ensure recognition of the producer, the field it came from, the date of harvest and all the cultivation activities it has been subjected to.

3.2. Implementation of Integrated Management of Agricultural Production Models

3.2.1. Prerequisites for the implementation of integrated management models

Integrated management can be implemented on an individual basis by isolated producers, but it is preferable to apply it to a cooperative of small agricultural businesses working as a joint venture. Both cases presuppose the availability of scientific support and monitoring by a supervising technical consultant.

Specifically, the implementation of the above system **presupposes the following:**

>Issue of cultivation instructions from an authorised agronomist to producers

Producers receive specific written instructions from their agronomists on all activities that must be undertaken on the farm. With regard to issues of plant protection in particular, producers receive detailed written instructions listing precise amounts of plant protection preparations to be used, the time of intervention, residual persistence of the preparation, protective equipment to be used each time and others.

Most, if not all, products produced in the EU meet certain standards which determine the suitability and safety of their intended use. Therefore, a lift manufacturer who wishes to market the specific product must undergo quality inspection to certify that the product meets required specifications.

Certain agricultural products which, though intended for consumption, were not packaged on the basis of specific quality and safety requirements were an exception to this rule, at least until recently. Most of the time, their production method depended on the good will and conscientiousness of producers and private agronomists.

Integrated management systems and agricultural product certification standards are intended to fill that gap. The regulations are based on an integrated quality control programme for agricultural products that is based on objective data, rather than subjective, which has been the case until now.

>Complete record of activities taking place on the farm

On the other hand, producers are obligated to maintain complete records of the types of interventions undertaken following receipt of the written directives from the agronomist so that any modification, if there is any, can be easily checked and inspected. All product records are

subject to inspection and are part of the documents subject to review under the quality certification system.

Another element typical of certification systems is the ability to document activities that have taken place at any given time. Put simply, that means that to the inspector's question "Did you use the prescribed pesticides at the correct time on your crops," it is not enough to answer "yes." It must be proven that applications were made properly. Proof of the veracity of what is stated is manifested in the records of all activities (documents showing which pesticides were used, how much and when), as well as by presenting all related documentation (invoices, soil or product quality analyses, etc.).

>Producer training

Producers take part in a series of training sessions on topics such as correct plant protection, flushing and adjusting spray equipment, destroying empty pesticide containers, etc.

Training is an essential prerequisite to determining that such a complex and at the same time necessary undertaking as integrated management is a success. Producers should be trained how to properly handle the documentation process while being convinced themselves of the necessity of implementing certification systems.

>Laboratory analysis

During the period that a quality assurance system is being implemented, a series of laboratory analyses, such as soil and leaf tests, is conducted. The specific analyses help the farmer determine the exact quantities of fertiliser that a crop needs without impacting the environment or the farmer financially. Analyses are also conducted by certified laboratories to determine levels of chemical pesticide residues in the final product.

These laboratory tests are a tool to ensure that the directives prescribed by the integrated system have been faithfully implemented. The question of whether spraying was conducted on the prescribed day before harvest and not later can be correctly answered through the laboratory testing for pesticide residues. In the event that spraying was conducted more recently, residues will be higher.

>Environmental protection

All of the cultivation applications that take place on a farm are based on providing documented environmental protection. The application of fertilisers, for example, is based on calculating crop requirements, as indicated by an assessment of nutritional elements in the soil or in the leaves, as well as the distance of the farm from surface water and springs, thus avoiding any significant impact on the environment. In addition, chemical methods of plant protection are selected as a last resort and only after cultivation or mechanical means have been used and parameters with direct impact on the environment have been investigated, e.g. exhaustion of water resources, nitrate pollution and others.

>Protection of the producer

An important factor taken into consideration while implementing a system or EurepGAP is the protection and safety of all those people who contribute to the production of a product. For this reason, the use of protective equipment by producers and workers is required during any plant protection interventions. In addition, all potential risks that could harm workers during the production process should be assessed.

One particular point with regard to the protection of producers should be noted. The system protects producers and ensures their physical safety whether they want it to or not. Therefore, in the event that producers do not take the appropriate protective measures (masks, appropriate clothing, appropriate weather conditions) during spraying with pesticides, they cannot be certified.

>Beginning of harvest

Planning of both quality assurance systems is based on the fact that harvest of agricultural products begins after the residual persistence period of pesticides. All pesticides should include on the label the number of days that must intervene from the date of application to the beginning of product harvest. This time period is called the Pre-Harvest Interval (PHI) and its observance is legally required, not only for producers who adhere to a quality assurance system but also to conventional farmers. Producers who adhere to the abovementioned certification systems begin harvest following written orders from the agronomist, who has calculated the residue persistence periods for all pesticides but has also taken into account all the laboratory tests for residues from chemicals used on crops.

>Traceability

One final but quite significant aspect of the implementation of a EurepGAP system is the application of a traceability system. The term "traceability" refers to full product codification to ensure identification of the producer, the field it came from, the date of harvest and all of the cultivation activities it has been subjected to. The traceability of a product could be very beneficial in the event that for some reason a particular batch from a producer or just one field is rejected. Consider what might happen in the event that the products of numerous producers were identical and non-traceable and only the product of one producer had to be rejected. It should be noted that in order for an agricultural product to reach the stage of being codified as certified, it will have to meet all prescribed certification standard requirements and all required residue analyses, which validate the correct operation of the quality assurance system, will have to be completed.

Following the complete development and implementation of the quality assurance system, the producer or producers group submit an application to a recognised certification body which has been authorised to certify the specific standards (EurepGAP). The certification body conducts an assessment inspection and proceeds with issuing a certificate for the product depending on the degree of compliance (EurepGAP-EN 45011).

In summary, the implementation of the above standards is based on the following principles:

1.	Protection of consumers and public health
2.	Protection of the environment through the reduction of inputs
3.	Protection of producers' health

3.2.2. Advantages of standards

The development, implementation and certification of the quality assurance systems in primary production provide a series of advantages for the producer, for the processor of agricultural products and of course for the final consumer. These advantages mainly focus on the demands of consumers, on environmentally friendly production practices and the safety of producers themselves while conducting their farming activities.

Some of the advantages and benefits of implementing these quality assurance systems for all those involved in the food production chain are briefly outlined below:

a. For the producer

- **Reduction in inputs used in farming.**

It has been shown in practice that when an integrated management system or EurepGAP is implemented correctly on a farm, there is a reduction in quantities of pesticides or fertilisers used without impact on the volume of production or the quality of products. This fact is easily understood if one considers that fertilisers are applied in the exact amounts needed by the crop and only after the appropriate laboratory tests have been conducted to determine the needs of the crop. The use of pesticides is also undertaken only after all alternative methods have been tried and there is a monitoring system in place that indicates chemical intervention is necessary.

The attitude of "just throw on a little more pesticide or fertiliser to be sure" is no longer valid when a particular farm is inducted into some type of certification programme. Therefore, in order for a producer to apply nitrate fertiliser on a field, laboratory analyses should be conducted first on the soil of the specific crop. That way, the producer determines the precise requirements of the soil and can apply the exact amount needed by the specific field for the specific crop. By adhering to an exact process, inputs are reduced and the environment is safeguarded.

- The quality assurance system is a **strategic organisational and marketing tool** for a producers group and leads to further growth through ongoing education, information and the name recognition of the farm. At the same time, the producer or producers group is in a position to prove or document their compliance with the codes of good agricultural practice and the protection of the environment.
- The creation of **added value and competitive advantage** for the agricultural product. If there are five similar products on a supermarket shelf and three of them are certified while two are not, it is more likely that consumers will choose those that are certified, even if they are somewhat more expensive.
- The implementation of such a production system in combination with the certification of an agricultural product automatically creates **added value for the product** while at the same time **setting the farm apart and providing it with brand-name recognition**. All these factors contribute to bolstering the bargaining position of producers.
- **Production is guaranteed** by an independent **certification body** and the **products are safe** for consumption. In addition, **certification** of production constitutes a **passport for exporting products to international markets**.

Consumers have realised that all passenger cars are the same and are therefore willing to pay more to buy one that offers greater safety. They have also become accustomed to the idea that the brand of a particular product guarantees its quality and so would never buy a non-brand name car. Unfortunately, consumers are not as knowledgeable about brand-name agricultural products, believing that, for example, all tomatoes are the same, regardless of the way they are produced (spraying, storage methods and transport, etc.).

Product certification is intended to fill the gap in the agricultural products market and to render these products more competitive in comparison to other, cheaper but non-certified goods that originate from non-EU third countries.

- Protection of **producer physical health** through the staging of **special training** on the correct use of pesticides and the use of protective equipment.
- **Guarantee of subsidies** the producer will receive from the European Union in the coming years.

There is reason to believe that subsidies paid through the EU will be linked to certified quality of products in order to make them more competitive than those from third countries.

b) For the processor of agricultural products

- **Purchasing agricultural products certified** by an independent certification body that they are safe for consumption - certified raw materials.
- The **agricultural product is traceable-codified**, a fact that ensures identification of the producer, the field it came from, the date of harvest and all of the cultivation activities it has been subjected to.

With the establishment of traceability on agricultural products, reliable farmers are rewarded because consumers can see the producers through the products and link them directly to the quality of the products they are buying. This fact also serves as an incentive for producers to improve quality and the competitiveness of the products they produce in general.

For example, take the case of bottled wine. The label often lists not only the brand, the name of the producer and the vintage year, but also the number and the orientation of the vineyard. It is also possible to list the climate conditions that prevailed (heavy rainfall or lack thereof) during the crop year of the grapes used.

- The quality assurance system on the farm can also be used to pass certain **commercial specifications for the product required by the market**. For example, many supermarkets ask exporters to provide products on which certain plant protection products have been used (e.g. Marks&Spencer – Amber List) or products with specific quality specifications.
- The **steady procurement** of certified products with special commercial specifications can be guaranteed through the forging of contracts with growers groups.
- The use of certified agricultural products as raw materials offers **added value and a competitive advantage in the final product** being packaged, which can consequently enter new and more demanding markets more easily.

c) For the consumer

The most important benefit for consumers is that they are buying **safe products** without chemical residues from pesticides and fertilisers. In addition, through the traceability system, they are able to identify the origin of a product and have an official guarantee that the products they are consuming are safe for their health and that they have been produced in an environmentally friendly way.

3.3. Requirements in the operation of the agricultural enterprise in an integrated farming system

Based on the directions of an integrated farming system, producers are called upon to reorient their actions, to develop new skills and to fully utilise benefits generously provided by nature around them through flora and fauna.

3.3.1. Correct use of fertilisers

The "correct use of fertilisers" means that priority is given to the use of natural versus industrial fertilisers. Next, we will see where to find natural fertilisers, how to make natural fertilisers and how to use them.

1. Organic fertilisers

Organic fertilisers come from either the remains of animals (manure, urine, bones, claws, horns etc.), or of plants (reeds, straw, grass, leaves, etc.) or from mixed materials, such as animal litters.

Manure and its importance

This category of organic fertiliser, which is the product of mixing feces and urine from various farm animals together with straw or other materials used for bedding, is the main prerequisite for organic farming.

The fertilising properties of manure are immense because it contains all the main essential nutrients.

Manure makes heavy soils easier to cultivate because aeration is improved and water drains better. It also affects the microflora in the soil because it contains a great number of microorganisms which are mobilised and cause the decomposition of proteins while releasing nitrogen.

Garden produce that is fertilised with organic fertilisers and manure can be stored for longer periods and does not contain as much water.

The manure produced by stabled animals is very important to soil fertility. There are various types of manure, each with different nutritional content.

The quality of manure depends on the type of animal, the way the manure is prepared (fermentation, processing, biology etc.) and on what the animal eats.

It has been estimated that, on average, about 10 tonnes of animal manure provide 50kg nitrogen, 20kg phosphorus, 60kg potassium and 50kg calcium.

There is no doubt that manure from the stable and organic residues from the garden are the best and cheapest fertiliser. The problem, however, is which manure will be used for which plant, how much will be used and when will it be applied. Organic farmers who always use such manure

should know what animal it is from and what the animals have been fed on. This is because, as every conventionally grown agricultural product contains residues from fertilisers, pesticides and toxic substances, manure from livestock will also not be free of various residues.

Fresh, undigested manure can be used directly in the garden, but it should be applied in autumn once the produce has been harvested. It should not be tilled in deeply as it might get mouldy in the cold and wet winter soil. It is spread on the beds which have already been tilled; it is then covered by organic waste found in the garden and left to digest (become humus) until spring, when it can be used on plants.

Manure - Compost

One could say that manure is the heart of the garden. It is a storehouse of organic substances and fertilisers that can nourish plants and trees in a garden or field. For farmers or gardeners who comply with an integrated farming system, compost is of the greatest importance.

The word "compost" derives from the Latin word "compositum", which means "put together" or "compose"; manure is a sum of various organic substances which are combined biologically by nature into a harmonious balance.

The more varied substances compost contains, the better manure will be obtained. Compost needs 1-3 years to mature. If within a year there is no digestion (humus production), it means the compost is not active and intervention is required. It should be turned or stirred, adding some stable manure, lime or other organic substances like clay. Compost is not a rubbish dump, where any waste can be disposed of. The substances that end up there should be able to be processed by the millions of microorganisms present.

It goes without saying that all materials must be organic matter. However, the fact that these materials should not be metal, plastic, glass, paints, rubber etc. is not generally known.

Nevertheless, even some organic substances are not suitable for composting. Bones, offal and meats from various animals have no place in composts. Other substances which should not be placed in compost include: dairy products, cooked leftovers, diseased plants, ashes from wood coated with paint or preservatives, as well as peelings from various fruit (oranges, lemons, etc.) that have been sprayed with pesticides. To enhance the compost, materials containing more nitrogen, such as legumes or nettles or poultry manure or organically based nitrate fertilisers may be added.

2. Green manure

Another type of organic fertiliser is green manure.

This type of soil fertiliser uses mainly nitrogen-fixing plants (legumes) which are incorporated into the soil in a green state or in the flowering phase.

Plants suitable for green manure:

The most common plants suitable for green manure due to their constituents are presented in the table below:

1.	Buckwheat (Fagopyron sagittatum)	7.	Sunflowers (Helianthus annuus)
2.	Peas (Pisum	8.	Rapeseed (Brassica

	sativum)		napus)
3.	Yellow trefoil (Medicago lupulina)	9.	Winter Vetch (Vicia villosa)
4.	White mustard (Sinapis alba)	10.	Red peas (Lathyrus cicera)
5.	Radish (Raphanous sativus)	11.	Phacelia
6.	Vetch (Vicia sativa)	12.	Yellow lupin (Lupinus luteus)

The fresh mass of the above plants is rich in water, starch, protein and nitrogen. It is an essential factor in improving soil fertility and can have a positive impact on the subsequent crop. The green material contains nutritional ingredients that are slowly extracted and assimilated by the plants being cultivated.

Superfluous nutrients are retained by microorganisms without the risk of leaching.

Green manure facilitates the impact of an appropriate crop rotation that can combat weeds and various diseases and help loosen the subsoil with deep-rooted legumes.

It is not necessary to apply green manure every year. Every 4 to 6 years would be enough for tilling the soil while at the same time combating nematodes and supplying food for worms which turn green matter into humus.

Advantages of green manure Accumulation of nitrogen in the soil (N)
Accumulation of humus in the soil
Nutrient leaching is avoided
Utilisation of rain water (development of biomass)
Less erosion (wind, water)
Ground coverage and bolstering of soil biology
Loosening of subsoil through deep roots
Control of weeds (inadequate light)
Control of various harmful factors (nematodes) and greater production as a result of fewer fertilisers and pesticides
Easier ground cultivation (loose, light, porous soil rich in humus)

3.3.2 Use of pesticides – Correct plant protection and management of plant protective products

Along with the expansion of monoculture, pesticides and chemical fertilisers were also extensively used. The proliferation of chemical use in farming noted worldwide had and still has a destructive impact on biodiversity and on the entire food chain, not only for wildlife but also for humans.

The soil gradually loses its nutrients, organisms living in it die, underground water is polluted and the resulting foods that humans eat are loaded with chemicals. The soil's natural capacity to reproduce microorganisms is destroyed and farmers become more and more dependent on fertilisers to maintain production.

Parasiticides used to eliminate parasites cause even greater damage, as along with parasites, other microorganisms and animals useful in maintaining soil fertility or as food for animals that live there, including grasshoppers, mice and birds, are also destroyed. Worse still, the immediate enemy, meaning the specific parasite, becomes resistant to the specific chemical after a few years. As a result, farmers use increasingly greater quantities of chemicals, causing more damage to the fields and to production.

The proliferation of pesticides to increase yield and achieve greater profits has functioned as a boomerang on farm production with the passage of time. Soils are poorer, the use of pesticides is often excessive and unmonitored by an agronomist and the question of what we are eating and what the effects on public health will be is as yet unanswered. Nowadays, more and more farmers are turning to organic farming, without using chemical pesticides but using natural fertilisers, thus increasing its importance in the marketplace. In any case, people, and farmers themselves, would prefer to eat products without chemicals and this requires correct plant protection.

Organic plant protection

Within the context of organic or natural farming, it goes without saying that organic means are also used to protect plants from various harmful pests and diseases.

Any other method, other than using pesticides, chemical fertilisers and weed killers, is a natural method and therefore acceptable, harmless and very inexpensive.

The application of this type of protection in many countries has shown that it is feasible and has satisfactory results. Not only is it economical, but it also provides protection for the soil, livestock and consumers.

Organic protection is based primarily on the availability of beneficial insects, birds or mammals which either feed directly on the harmful organisms or lay their eggs in them, so that when they hatch, the larvae eat the harmful host.

The term "harmful" refers more to the threat brought about by the excessive development of a particular species which results in upsetting the balance in the ecosystem.

The goal of the grower then is to prevent the increase of harmful organisms through preventive measures and organic protection. Isolated entities that are always present in cultivations should not be reason to proceed with using chemical preparations to combat them.

There are many ways to prevent or combat diseases without using toxic chemical substances. Various cultivation methods and application techniques, many of which have been known for a long time, can contribute significantly to disease prevention.

Appropriate tilling, organic fertilisers using plant or live residues, green manure, appropriate crop rotation-alternating suitable crops on the most suitable soil and the bolstering of plant resistance mechanisms through familiar techniques are just some of the methods which can be used nowadays to prevent diseases.

In such a cultivation environment, whether it is a garden or a field or a grove, an excessive increase in harmful organisms is rarely if ever seen.

It is already known that plants grown in soil with humus and which is rich in microorganisms grow hardily and are able to resist various attacks by insects, fungi, bacteria, viruses, etc.

Plant Preparations for Fertilisation and Plant Protection

Organic protection of crops from various diseases and harmful organisms can be accomplished not only with useful birds, insects and mammals, but also with wild flowers with therapeutic properties.

Since antiquity, people around the world have used herbs to protect against and to treat various diseases.

In recent years, many scientists from various countries have studied such plants and have confirmed that they contain substances with therapeutic or protective properties.

Organic farmers in particular who avoid using pesticides and chemical fertilisers have experimented with extracts, macerated washes and tinctures from various herbs in crop protection with satisfactory results.

These preparations are harmless to humans, they leave no residues on products, they do not harm soil biology (microorganisms) and the environment is generally cleaner.

In addition to the above advantages, they are easy to prepare and require minimal costs.

These plants with a strong scent from essential oils and various secretions from roots and leaves keep harmful insects, bugs and rodents (flies, aphids, fungi, beetles, snails, mice, moles, caterpillars etc.) away from plants being cultivated.

Many of these herbs also provide manure water with which produce may be watered. Their ability to supply plants with nutrients is due to the fact that they contain nitrogen, potassium, phosphorus and trace elements which, after the fermentation they must undergo, can be applied to plants. In the next chapter, several such plants are briefly described, along with how they are used and from which diseases the plants may be protected from using their preparations.

The major plant preparations

Most plant preparations are manure water or fertilisers, which act as remedies to keep various harmful organisms away from crops. They are the result of dissolving the plant's constituents after they soak in water for several hours, days or weeks, depending on the plant and the circumstances.

Almost all preparations used with satisfactory results have as a base 10 litres of rain water or water that has sat for several days.

Either wooden or plastic barrels are used as containers, or pails if small quantities are required. In no event should metal utensils be used, as they will rust quickly and have a negative effect on the preparation.

Once the plant cuttings are placed in water, they are stirred so they become thoroughly soaked and left in the sun to boil, or ferment. At this stage, the barrels should be uncovered (for ventilation) and the contents should be stirred occasionally. For safety reasons, however, the barrels should be covered with wire mesh to prevent children from playing with the contents, keep it free of debris and to prevent birds from drinking it. The plant solution is hot, slightly poisonous and has an unpleasant smell.

After two weeks, when fermentation is complete, the liquid is strained and stored in sealable containers. It is now ready to be used as fertiliser or for spraying, depending on the circumstances, after it has been diluted.

Animals of benefit to organic farming

Green and black aphids (lice), apart from weakening plants, as they feed on the sap, also transmit various viruses.

In the organic treatment of these aphids, applying a ground cover of compost, intercropping with cardamom as a repellent and spraying with a mixture of cigarette butts, alcohol and green soap can also be used in addition to various plant preparations.

In addition, insects such as ladybugs, lacewings and hover flies, which are natural enemies of aphids, should be protected (from chemicals) and their presence in the garden or farm should be encouraged.

The earwig (Forficula auricularia), which is completely harmless to humans, is beneficial in gardens because it feeds on lice and other smaller insects. Because it only hunts for food at night, the organic farmer should ensure it has a hiding place and safe refuge during the day. Various types of flower pots, or tins full of straw, wool and dry grasses, have proven to be the best refuge for earwigs during the day. These nests should be hung upside down from a branch and have contact with the trunk.

Porcupine: With its developed sense of hearing and smell, it finds its food at night, including various insects and worms, slugs, mice and even snakes.

Weasel: Like the porcupine, the weasel is also an insect-eating animal. It is a useful animal for organic farmers because, apart from various harmful insects, larvae, mole crickets, etc., it also eats mice.

European Glass Lizard: This reptile looks like a small snake, but is actually a type of lizard. It is completely harmless to humans and domesticated animals. It nests in warm manure and ventures out only at night to feed on slugs, worms and other insects.



European Glass Lizard



Mole

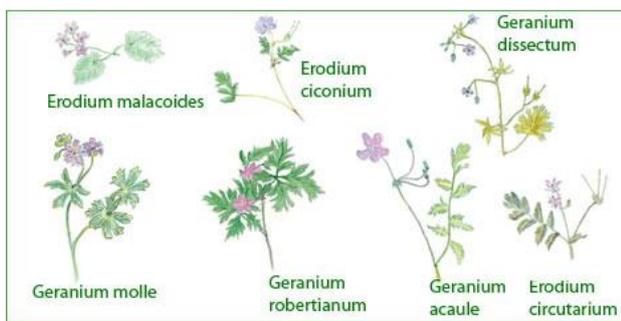
The mole, though it is not very popular with farmers because of the tunnelling it does in gardens, is beneficial for organic farmers because it feeds on various bugs that devour the roots of produce.

Weeds and their importance to the soil

There is no doubt that today's farmers cultivate in a non-ecological way at the expense of natural resources, polluting and poisoning the environment and damaging flora and fauna, the microorganisms in the soil and underground water, with implications for the health of humans and animals with toxic substances in foods.

One of the greatest problems that concerns farmers are the wild plants or weeds that grow in fields and gardens.

Farmers try to control weeds in any way possible, without knowing how important they are for the productivity of their soil, or about the damage farmers cause to the environment or that their actions are threatening certain species of wild plants with extinction, including corncockles, knapweeds, poppies, various species of wild oat and many others.



Various wildflowers



Poppy

Depending on the climatic conditions and the condition of each soil, weeds with special needs and properties may grow to form groups, the so-called plant colonies.

These plant societies are perfectly adapted to their environment and protect the soil from leaching and erosion caused by rain.

Because these weed colonies in fields of arable crops, meadows, vegetable gardens, etc. depend to a great extent on their size, these plant colonies could be used as "bioreactors" in mapping and analysing the soil.

Practical and observant farmers can, with the help of weeds growing in their fields, recognise shortages of or excessive elements in the soil and determine whether the plants to be cultivated are suitable or not for the particular location.

There is ongoing competition among the species in a plant colony which flourish in a particular area, leading to a natural selection of plants for the area.

Through this selection, wild plants emerge and form a perfectly adapted colony alongside the cultivated plants. It is up to the growers to change one or more parameters (light, temperature, water, nutrients, sowing time, etc.) or to use weeds to their advantage through crop rotation, or even to combat some of them at root level.

Weeds like hairgrass and nettles are eliminated through crop rotation with grains and produce.

Another way to prevent the proliferation of some weeds is to delay sowing in spring or autumn when many weeds grow. In addition, certain weeds which prefer high acidity are significantly restricted from growing when calcium is added to the soil, e.g. dockweed, ragwort or wild garlic.

There is a great number of seeds from all types of weeds in the soil, waiting for the appropriate conditions to germinate.

A closer look at piles of dirt or rubble from construction sites, excavations, road works etc. will reveal a large variety of wildflowers and weeds growing and flowering in the first year. Among others, chamomile and poppies are quite common.

In the following year, all kinds of plants will appear, forming plant colonies that dominate and suppress all other plants that do not suit them.

All these plants with their root system do not just absorb nutrients, but also excrete certain substances from their roots which cause various reactions in the soil. In other words, there is an ongoing interaction between the soil and plants.

Weeds as soil indicators

Remaining seeds from weeds in the open are abundant, almost infinite. Oftentimes and almost always after a field or garden has changed, such as when the nitrogen and humus have been used up or there has been a change in pH etc., some weeds disappear and others grow in their place. 1. Plants which indicate soil with high moisture content:

Mentha arvensis
Ranunculus repens
Species of Equisetum
Tussilago farfara
Fumaria officinalis
Lamium purpureum
2. Plants that indicate dry and rocky soil:
Legousia speculum-veneris
Erodium cicutarium
Falcaria vulgaris
3. Plants that indicate light soil rich in humus:
Stellaria media
Mercurialis annua
Urtica urens
Galinsoga parviflora
Species of Euphorbia
4. Plants that indicate nitrogen in the soil:
Galium aparine
Chenopodium album

Echinochloa crus-galli
Species of Lamiaceae
Urtica dioica
Mercurialis annua
Senecio vulgaris
5. Plants that indicate soil acidity (pH) greater than 7:
Salvia pratensis
Onobrychis viciifolia
Viola tricolor
Sinapis arvensis
Euphorbia chamaesyce
6. Plants that indicate soil acidity (pH) less than 7:
Veronica officinalis
Stachys arvensis
Galeopsis tetrahit

EXERCISES FOR SELF-ASSESSMENT

Answer True (T) or False (F) to the following questions:

1. Constant improvement is the process of upgrading a farm's integrated management system to help improve yield within the framework of policies that have been formulated.
 - a) True
 - b) False

2. Traceability is the ability to determine where an agricultural product was produced and its history after production with the help of specific documentation and identification procedures.
 - a) True
 - b) False

3. The improvement programme includes, among other things, a delegation of responsibilities to achieve goals and objectives.
 - a) True
 - b) False

4. It is recommended that measures to avoid soil compression be taken in agricultural production management systems.
 - a) True
 - b) False

Select the correct answer to the following questions:

1. In integrated management systems, communication is related to
 - a) internal communication within the farm
 - b) communication between the farm and customers and competent authorities
 - c) all of the above

2. The integrated management system is a system of organising a farm that includes:
 - a) Good Agricultural Practice
 - b) Occupational Safety and Health

- c) Product Safety
- d) Traceability
- e) all of the above

3. It is enough to use green manure every

- a) year
- b) every 1 to 2 years
- c) every 4 to 6 years
- d) every three months

4. Compost aeration must be done

- a) so that the manure smells like forest soil
- b) to keep aerobic microorganisms alive
- c) for the correct and quick production of humus from organic materials

ACTIVITIES:

1. After gathering information on the wild flora of an area of your choice in your country, determine the type (or types) of soils: moist, dry, nitrate-rich, acidic, alkaline, etc.
2. Find the national standards in effect in your country.
3. If there are nettles in your area (*Urtica dioica* or *Urtica urens*), try to make an extract in water (1kg in 10 litres) and use it while fresh either to spray against lice or in irrigation (fertilisation).
4. Conduct a market survey with regard to the implementation of integrated management – Application of standards to a product or products that interest you.

Specifically:

➤ Visit supermarkets in your town and complete the following table:

Product	Certified	Non-certified	Standard
e.g. Tomatoes	2	3	Agro