

4. PLANT PROTECTION AND USE OF PESTICIDES

4.1. INTRODUCTION

Plant protection means activity involving employment of biological, chemical, quarantine and other measures that protect plants from disease agents, diseases, pests and weeds, or decrease their harmful effects, and also preserve their ecological equilibrium in nature.¹

Plant diseases, pests and weeds are harmful for all agricultural plants without exception. When not using plant protection measures in time, losses of yield comprise 30% on average. The losses may reach 50% and more under favourable conditions for spread of pests. Vegetation damaged by some of the diseases or pests becomes poisonous for humans and animals (Fig. 4.1). Therefore, use of Plant Protection Measures (PPM) is a necessary part of all agricultural plant production technologies.



Fig. 4.1. Not for them farmer grows crop

Good agricultural practice requires to strive not only for high crop yield, but also to produce the products with minimal negative impact on environment.

Majority of plant protection measures affects not only harmful organisms but also it may have a bigger or smaller impact on environment and human health. Therefore, the use of the measures is regulated and must be economically based.

4.2. PLANT PROTECTION METHODS

Various methods are applied to protect cultural plants from diseases, pests and weeds. The methods are agrotechnical, biological, chemical, physical-mechanical and others.

Agrotechnical method is cultivation of agricultural crops under optimal conditions that induce plants to grow and develop rapidly, stimulate natural resistance of plants towards pathogens, hinder spread of harmful organisms in crop fields and decrease their harmful effect on yield and its quality.

Agrotechnical plant protection measures cover right crop rotation, stubble cleaning and autumn ploughing, optimal time of sowing, seed sowing depth, seed rate, balanced fertilisation, and choice of varieties that are more resistant to pathogens.

¹Republic of Lithuania Law on Plant Protection (Lithuanian). 1998 06 04 No. VIII-769

Biological method is the use of natural enemies, i.e. entomophages or parasitic insects, ticks, nematode, bacteria, fungi or viruses to stop or to limit spread of harmful organisms and their harmful effect. Biological method includes care of natural enemies in agroecosystem, which are harmful for pests, artificial reproduction and use for plant protection.

Physical-mechanical method is collection of pests by hand or by special equipment and their elimination, annihilation of pests by heating, cooling or drying of grains, thermal dressing of seeds, removal of damaged plants from crop fields (e.g. removal of potatoes infected by viruses or black leg) and eradication of weeds by mechanical means.

Chemical method is the use of chemical preparations, i.e. chemical compounds having one or some active matters, called pesticides in general, for annihilation of plant diseases, pests and weeds, for limitation of their amount and harm, and for regulation of plant growth.

Integrated plant protection is the complex use of all plant protection methods valuable for a particular case giving preference to non-chemical plant protection measures.

Integrated plant protection measures allow to reduce use of pesticides and at the same time to reduce expenditure for plant protection operations and possible danger of pests to environment. When applying the integrated plant protection method, not only various plant protection measures are used, but also measures that are less harmful towards environment are chosen, e.g. selective preparations that decompose quickly and eradicate only particular species of harmful organisms. Chemical preparations are applied only when real danger for the amount and quality of yield exists (i.e. when the amount of harmful organisms exceeds economic threshold of harm).

Chemical plant protection method, use of pesticides, has the potential of doing harm on environment and health. Therefore, this area of farmers' activity is strictly regulated and continuously controlled.

4.1

Every activity of Lithuanian citizens with respect to plant protection from diseases, pests and weeds with help of chemical or biological plant protection measures has to be performed in compliance with Republic of Lithuania Plant Protection Law² and Rules on Use of Plant Protection Measures.³

All land users are obliged to follow this requirement in the territory of Lithuanian Republic. Both mentioned documents are prepared according to the requirements of corresponding documents of European Union^{4,5} especially in the fields of human health protection and reduction of hazardous pollution.

4.3. DANGERS IN PESTICIDES USE

Chemicals (pesticides) for the protection of plants from diseases, pests and weeds may be not only poisonous for humans and fauna, but they may also pollute water bodies, ground water and soil with hazardous pollutants. Some of the pesticides have phytotoxic properties and they may injure vegetation, which grows besides treated fields. Pesticides are dangerous for humans not only during application, but they may get into our food by the way of treated plants. Stable, slow decomposing pesticides are especially dangerous for environment. They may accumulate in one of the food chains of agroecosystem and going through the chains they may penetrate into human organism through food and water.

² Republic of Lithuania. Law on Plant Protection (Lithuanian). 1998 06 04 No. VIII-769

³ Rules on Use of Plant Protection Means (Lithuanian). - V., 1999.- P.29.

⁴ Council Directive 91/414 EEC

⁵ Commission Directive 93/71 EEC

4.2

Abundant use of pesticides for plant protection from diseases, pests and weeds should be avoided. Alternative methods for plant protection should be used instead of them.

Reduction of pesticides application is possible only when there is a real economic need, switching to new, more effective technologies, improving pesticides spraying equipment and technologies, changing old preparative to new ones more effective that are to be used in smaller doses.

4.4. REDUCTION OF PESTICIDES NEED BY ALTERNATIVE MEASURES**4.3**

Reduction of expenditure for plant protection and in the same time reduction of environmental pollution should be achieved by selection of plant varieties, which choke weeds and are more resistant to diseases and pests. Not the most fertile but more resistant for harmful organisms crop varieties should be selected.

There are possibilities to choose plant varieties for garden and kitchen garden that are more resistant to pathogens. There are available potato varieties resistant to nematodes, less disease susceptible cereal varieties. National Plant Varieties Analysis Centre publishes list of plant varieties most favourable to grow in Lithuania and indicates species resistance to the most harmful pathogens every year.

4.4

Plant resistance to harmful organisms should be increased growing it under better conditions especially during germination when plants are most vulnerable to diseases, pests and weed competition.

Good soil preparation for sowing, optimal sowing terms, proper depth of seed sowing, seed rate and good seed quality offer possibilities for plant to establish and grow quickly shortening the period when plants are attacked intensively by harmful organisms (Fig.4.2). The newest research data on this subject can be found in annually published book of the Lithuanian Institute of Agriculture "Recommendations for Agriculture"⁶ and other publications.

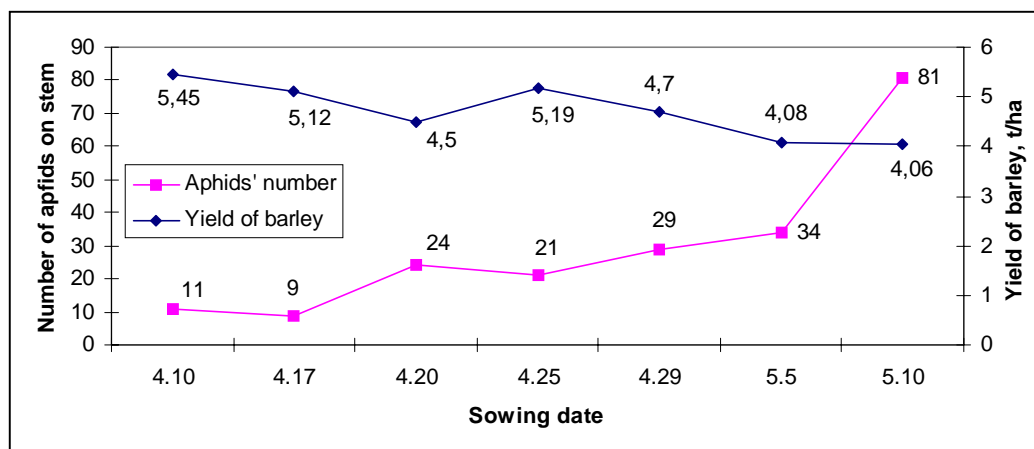


Fig. 4.2. Early sowing of spring crop increases yield, reduces harm made by pests and need of pesticides

⁶ Recommendation for Soil Cultivation//LIA.-Akademija (Lithuanian). -1999.-P.58

4.5

In order to increase natural plant resistance for plant diseases and pests they should be fertilised supplying with all needed nutrients.

Fertilisation with only nitrogen fertilisers diminishes plant resistance to diseases and pests usually.

4.6

Crop varieties in crop rotation should be laid out in such a way that crop seeded in every field would have as less as possible common diseases and pests remained in soil with a plantation grown in the same field before.

Properly organised crop rotation decreases the amount of soil-borne diseases, harm of some weeds and pests stayed for the winter in soil and on the same time need of pesticides. It is very important that plants of the same or related species vulnerable to the same harmful organisms would come back to the same field after as long as possible time period. During planning of plant location in crop rotation, proper choice of plants growing in neighbourhood is very important for plant protection.

4.7

One should avoid growing such crops in neighbourhood if pests or diseases that survived the winter or propagated in early spring in one crop can easily spread to neighbouring crop field.

Pea and bean weevil attacks peas and beans early if to seed them next to clover field. Leaf diseases from winter barley spread very early to closely planted spring barley. Late blight appearing first of all in the early potatoes spreads very fast in neighbouring fields of late potatoes. Therefore, pesticides have to be urgently used for plant protection from pests and diseases that spread early and abundantly. Meanwhile, pesticides are to be applied later or use of pesticides could be avoided at all in the fields located further from source of infection.

4.8

There should be established 10 m a no-spray boundary zone towards plants that have plenty of beneficial insects and territories of vulnerable environment, i.e. water bodies, karst sinkholes, preserves, etc., if plans of land use or designs of the territory do not determine higher requirements.

The scale of herbicide use may be reduced if using mechanical measures for weeding, like cleaning of stubble, deep autumn ploughing and intensive cultivation. It is very important that there would remain no empty, set aside areas in the zones of intensive agriculture, because weeds ripen and spread seeds in such areas. If such areas exist they have to be mowed before ripening of the weed seeds.

4.5. WHEN PESTICIDES MUST BE USED

One of the opportunities to reduce the scale of pesticides application is the right decision about need of pesticides in every crop field. According to current order valid in Lithuania regional plant protection and quarantine posts of National Plant Protection Agency and Agricultural Advisory Service provide information about possible time of appearance of plant diseases and pests and suggest pesticides. But this information is only tentative.

4.9

Land user himself should make an estimate of a real need for plant protection measures when he has evaluated situation in every field. Farmers without agronomic education should take such decisions after consultation with specialists.

The most right decision about feasibility of the pesticides use may be taken using special computer programmes, which systematically utilise data collected from automatic meteorological stations and information about phytosanitary situation in a particular crop field provided by the specialists. These programmes allow choosing not only the optimal time for application of pesticides, but also the lowest feasible pesticides rate and sometimes the programme even suggests not using pesticides at all. Application of such programmes has already started in Lithuania.

Taking decision about feasibility of pesticides use in separate crop field, the economic thresholds of harm of harmful organisms have to be considered in every case.

Information about economic thresholds of harm can be found in prognosis on abundance of plant pests and diseases published by the National Plant Protection Agency every year, in recommendations prepared by Lithuanian Institute of Agriculture and other publications.

4.10

Pesticides should be used only when the amount of harmful organisms in crop field has reached thresholds of harm determined by scientific investigations.

4.6. TECHNOLOGIES OF PESTICIDES USE

Danger of different pesticides for humans and nature depends a lot on chemical as well as on physical characteristics of the pesticides. If there is a possibility to choose, then one should avoid using those pesticides that are very toxic, persistent and harmful for aquatic fauna and beneficial insects.

4.11

It is forbidden to use those pesticides in Lithuania that are not registered and written in the Lists of Professional or Individual Use of Plant Protection Measures, regulating pesticides use in the country.^{7,8}

The most dangerous for humans are the preparations in a form of powder. They sprinkle during weighing and preparation of solutions. More secure preparations are suspensions, emulsions and water-soluble granular.

The less dangerous way of pesticides use from an environmental point of view is seed dressing with fungicides, insecticides and sometimes even with mixture of nutrients and germination stimulants. Seed dressing is usually performed in special room using work safety measures. Seed dressing requires small quantity of preparations and they are spread directly on seeds. Preparations used for dressing are very effective – they protect plants from harmful organisms during germination and establishment. If the seeds of beets, rapes and some of the vegetables are treated in this way, the crop fields do not need to be sprayed against pests and diseases attacking the sprouts.

Much more harmful from environmental point of view is application of pesticides in the way of spraying. Using pesticides in this way only a part of preparations fall on treated plants. Other part falls on soil or they are carried out by air masses to neighbouring fields or

⁷ List of Professional Use of Plant Protection Measures (Lithuanian). - V., 1999.- P. 72.

⁸ List of Individual Use of Plant Protection Measures (Lithuanian). - V., 1999.- P. 16.

water bodies. Because of that quality of spraying of crop fields with plant protection products is an important index of good agriculture.

4.12

Farmers' sprayers have to undergo a regular test and certification in order to ensure their efficient function. Sprinklers of a sprayer should be of equal discharge regulated to spray the needed amount of solution. Pesticides should be sprayed on crop field evenly applying the determined amount of solution and preparation. As big as possible part of pesticides should fall on treated plants and there should be left any non-sprayed or double-sprayed bands of crop field.

The type of sprayer, its preparation for operation, skills of operator and the quality of performed operations determine the quality of spraying (Fig. 4.3 and Fig. 4.4).

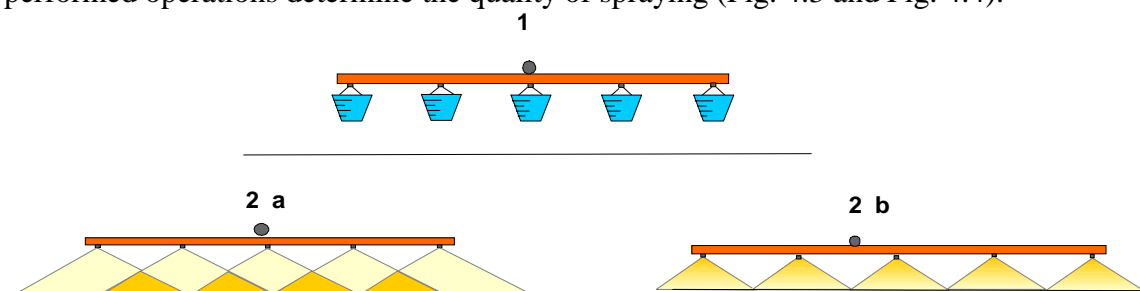


Fig. 4.3. It is needed to check the sprayer and calibrate it before work season: 1. Choose nozzles of equal discharge. 2. Choose optimal boom height above plants that solution would cover the plants more equally: 2a – when spray patterns overlap; 2b – when spray patterns do not overlap

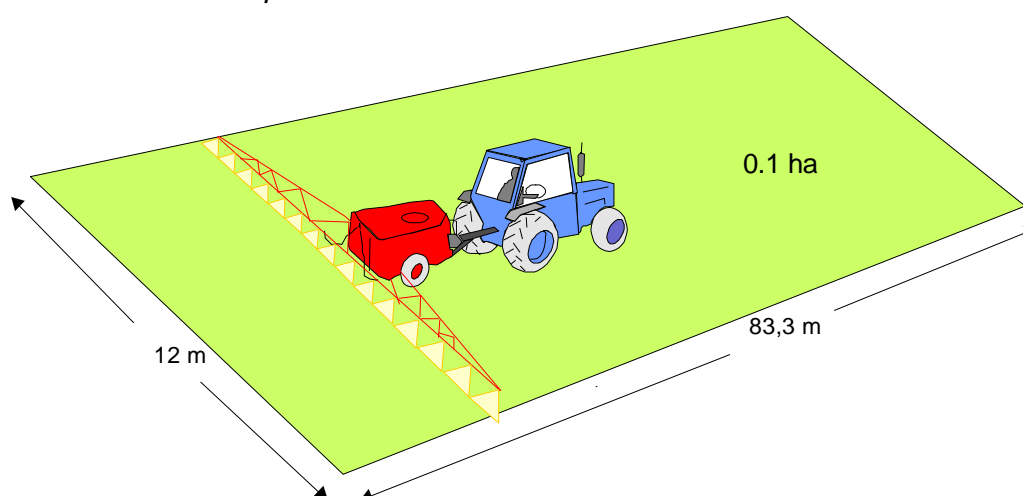


Fig. 4.4. Amount of sprayed solution per area unit has to be checked before starting the operation

4.13

The amount of prepared solution should comply an area to be sprayed. Sprayer should be washed after work. Washing water can be sprayed on the same plants. It is forbidden to wash sprayer or spill used water where the cleaning water can run to drain or other water bodies.⁹

In order not to leave non-sprayed or double-sprayed bands it is needed to use technological ruts or landmarks (Fig. 4.5).

⁹ Rules on Use of Plant Protection Means (Lithuanian). -V., 1999.-P.29.

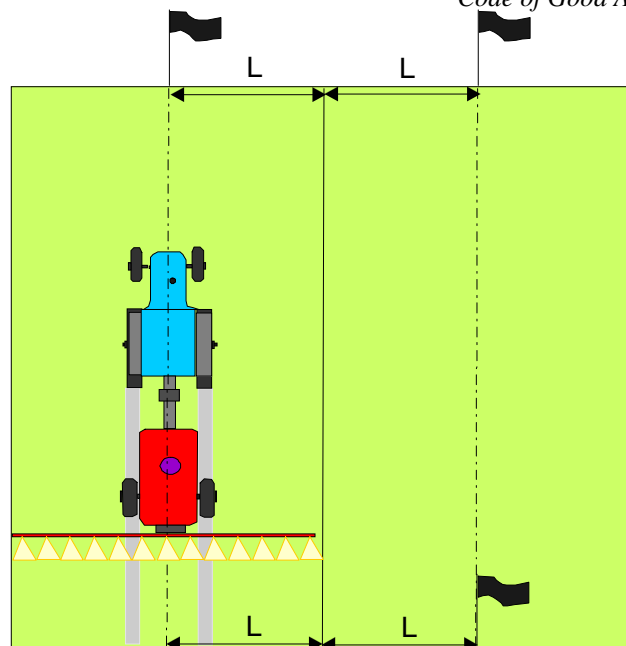


Fig. 4.5. Correct laying out of landmarks before spraying guarantees that there will remain any non-sprayed or double-sprayed bands

Spraying efficiency and work quality are determined also by meteorological conditions, i.e. temperature, relative air humidity and especially wind speed (Fig. 4.6).

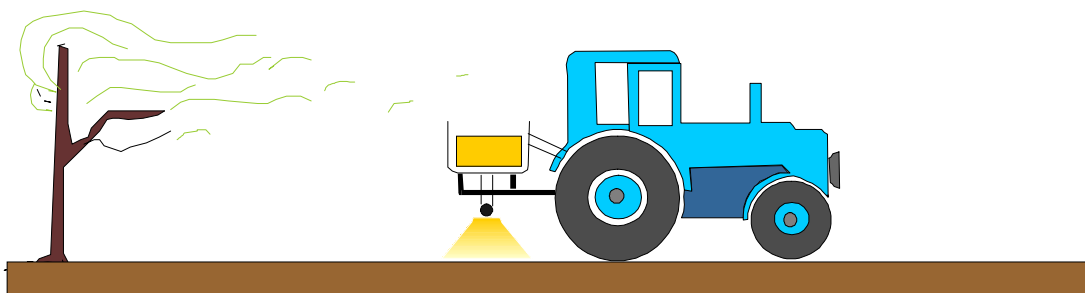


Fig. 4.6. Crop fields may be sprayed while wind speed is less than 4 m/sec.

The meteorological conditions have to meet requirements for the sprayer, which is available. If weather is windy, crop fields should be sprayed in the early morning or late evening when the wind falls. Then probability that the preparation will be carried over the boundary of field is smaller and risk for beneficial insects is lower. It is not allowed to spray crop fields before rain or straight after rain (Fig. 4.7).

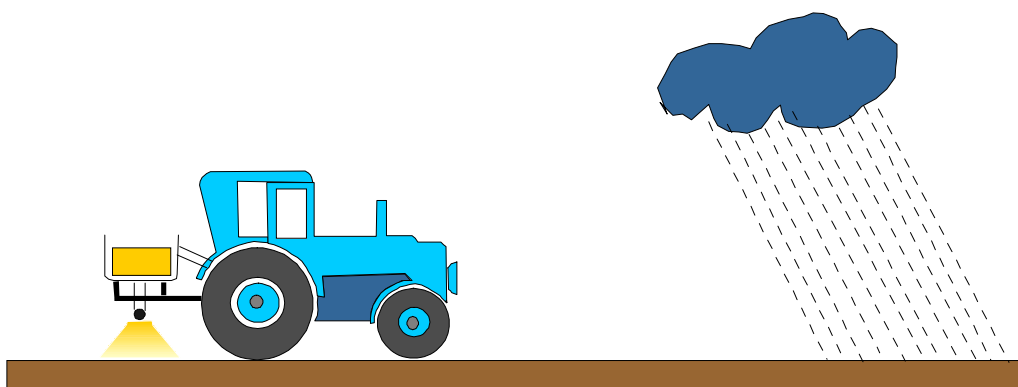


Fig. 4.7. Do not spray crop fields before rain

4.7. SAFE WORK AND ENVIRONMENTAL PROTECTION USING PESTICIDES

All preparations used for plant protection are biologically active substances, more or less dangerous for humans and natural environment.

4.14

Every operation with plant protection preparations has to be carried out exactly following work safety and environmental requirements that are described in detail in the "Rules on Use of Plant Protection Means".¹⁰ The most important requirements are the following:

1. Only trained persons who have acknowledged with the characteristics of preparations and requirements of work safety may work with pesticides.
2. Only healthy persons who have health examination certificates can work with pesticides.
3. It is necessary to use personal safety precautions and to follow rules of hygiene during operations.
4. Use only correct, calibrated and checked prior to operations machines and equipment for spraying of pesticides on crop fields and for dressing of seeds. New sprayers must be certified and sprayers in use must be checked by technical inspection.
5. It is forbidden to apply pesticides on blooming plants. The blooming plants could be sprayed only in exception, following special recommendations.

Badly stored pesticides are very dangerous for humans and environment. A special store that meets sanitary requirements should be assigned for the storage of pesticides in large farms. Small farmers should not pile up big reserves of pesticides, but they should keep minimal quantities of the pesticides correctly packed in their original packages and store them in purposely arranged locked cupboard or box in store place of machinery.

4.15

In large as well as in small farm it is necessary to have a record book of pesticides and to register all operations related to the use of pesticides.¹¹

Not only application of preparations for seed dressing and spraying of crop fields should be registered in the record book of plant protection measures but also date of purchasing of preparation, price and other useful information should be written in a separate section (Annex 4.1). Exact record of purchase and use of plant protection products not only facilitates organisation of plant protection operations and their economical assessment, but also allows correction of mishandling and liquidation of consequences.

Personal precaution means are required for work with pesticides, they have to be used and properly taken care of.

¹⁰ Rules on Use of Plant Protection Means (Lithuanian). -V., 1999.-P.29.

¹¹ Rules on Use of Plant Protection Means (Lithuanian). -V., 1999.-P.29.