PROGRESS

Promoting Green Deal Readiness in the Eastern Partnership Countries

PROGRESS

The project "Preparing Eastern Partnership Countries for the European Green Deal (PROGRESS) is funded by the German Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety (BMUKN) as part of its International Climate Initiative (IKI), implemented in Ukraine by a consortium of organisations led by the German government agency Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, the Organisation for Economic Co-operation and Development (OECD), and the State Institution Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine (IEP).

PROGRESS
Promoting Green Deal Readiness in the Eastern Partnership Countries

On behalf of:
Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety
of the Federal Republic of Germany

IKI INTERNATIONAL CLIMATE INITIATIVE

A modern approach of integrated protection of fruit and berry crops in the context of climate change

Olga GONCHARENKO
PhD in Agricultural Sciences, Senior Research Fellow
Institute of Plant Protection, National Academy of Agrarian Sciences

EUROPEAN BUSINESS ASSOCIATION EBA MOLDOVA ASOCIAȚIA BUSINESSULUI EUROPEAN

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

OECD

REC CAUCASUS

Integrated Pest Management (IPM)

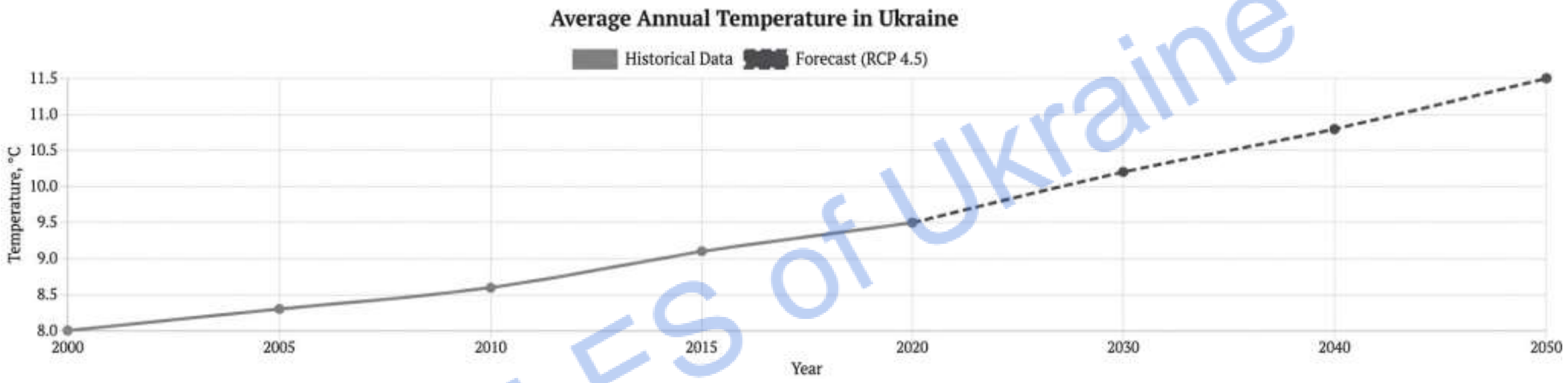
in the context of climate change involves combining agronomic, biological and chemical methods to adapt to droughts, new pests and diseases

- ***Monitoring and forecasting:*** the use of weather station data and computer modelling to track pest population dynamics, as the sum of effective temperatures in Ukraine consistently exceeds normal levels
- ***Biological control:*** prioritising the use of biological agents (based on bacteria, fungi, viruses) and natural enemies (entomophages), which is more environmentally friendly and prevents the development of resistance
- ***Agrotechnical measures:*** aimed at increasing yield and disease resistance, including correct planting, annual pruning, irrigation (70–80% soil moisture), balanced nutrition (nitrogen, potassium, phosphorus) and systematic care (digging, weed control)
- ***Stimulation of resilience:*** the use of growth regulators and anti-stress agents, which help plants accumulate ‘sugars’ for overwintering or withstand extreme heat
- ***Rational chemical protection:*** use of chemical agents only upon reaching economic damage thresholds (EDTs), taking environmental safety into account

PROGRESS
Promoting Green Deal Readiness in the Eastern Partnership Countries

Climate trends in Ukraine (2000–2050)

Temperature changes and their impact on crop phenology



An increase of +2...+3°C by 2050

+1.2...+1.8°C

Temperature rise 2000–2020

Recorded increase in average annual temperature

7–14 days

Shift in phenophases

Acceleration of crop development in spring

↑ **Frequency**

Extreme events

Droughts and heavy rainfall

Mild winters, unpredictable spring frosts

PROGRESS
Promoting Green Deal Readiness in the Eastern Partnership Countries

Impact on pests

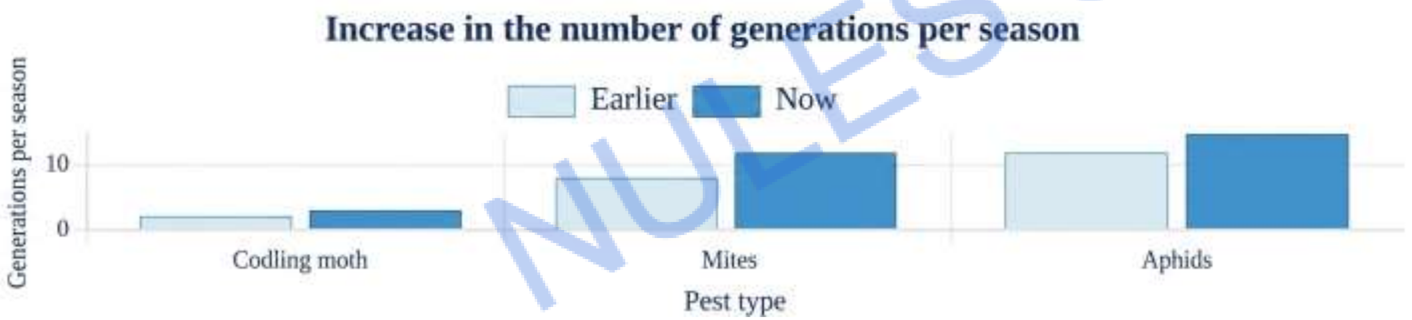
Invasions, increased generations and improved overwintering

New invasive species

Rhagoletis completa Walnut fly
walnut

Drosophila suzukii Fruit fly
strawberries, raspberries

Halyomorpha halys Marbled bug
Polyphagous – all crops



Overwintering and survival

- Increased survival due to mild winters
- Reduction in natural winter mortality
- Earlier onset of activity in spring

Impact on disease-causing agents

Fungal, bacterial and viral pathogens under climate change conditions

Fungal pathogens

Venturia inaequalis *(Apple scab)*

Early infection due to early growth + rain

Botrytis cinerea (*Grey mould*)

A critical problem on strawberries and raspberries

Contributing factors: high humidity and temperature

Bacterial pathogens

Xanthomonas arboricola pv. juglandis (*Walnut blight*)

A major threat to walnut trees

Contributing factors: damp conditions, high temperatures.

Viral diseases

Aphididae (*Aphids*)

Extended season of activity

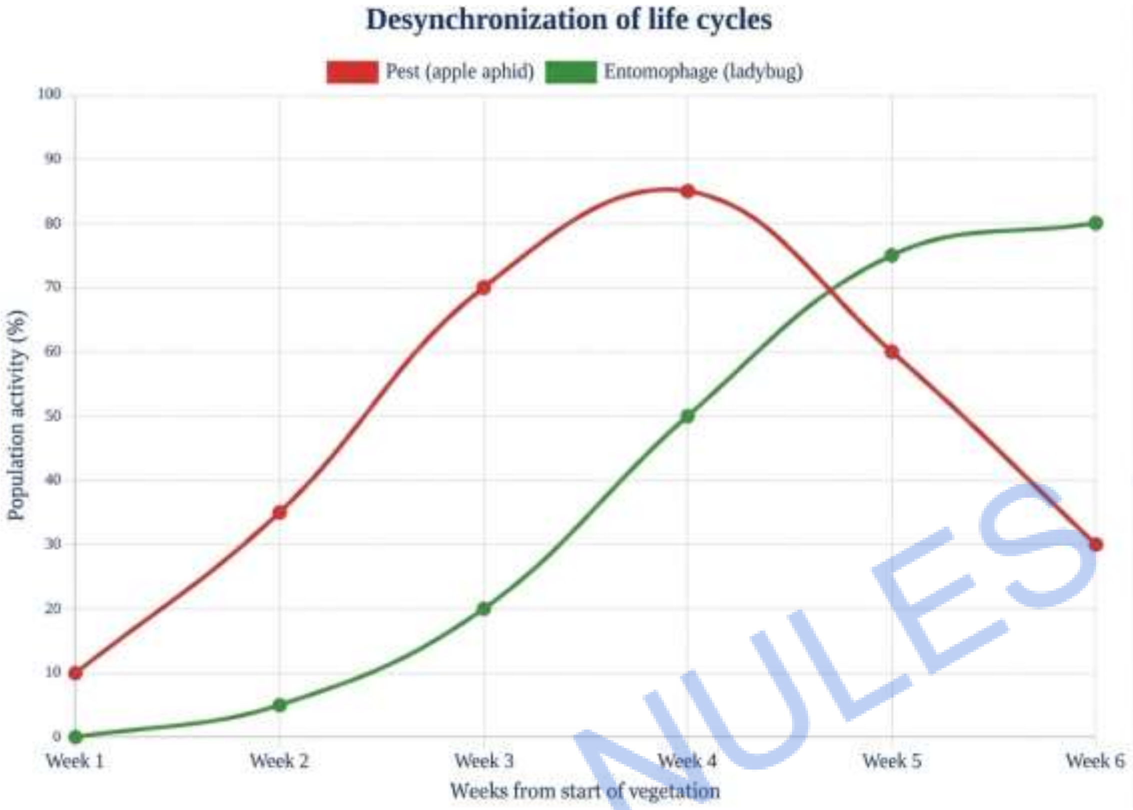
Cicadellidae (*leafhoppers*)

Increase in numbers

Increased risk due to vector activity.

Impact on beneficial organisms

Disruption of natural biological control



Delay in the peak activity of entomophages by 2–3 weeks

Consequences of desynchronisation

- Pests reproduce before predators appear
- A 30–50% reduction in biological control
- Adjustment of entomophagous release dates is required

Heat stress for entomophages

Temperatures
Negative impact on physiology
>35 °C is critical

Reproduction
Decreased fertility
↓ 20–40%

Lifespan
Shorter life cycle
15–25%

Efficiency
Reduced predator activity
↓ 30%

Comprehensive negative impact on the vital functions of beneficial organisms

IPM adaptation strategies

Part 1: Prevention, monitoring and forecasting

Prevention

Resistant varieties

Breeding and introduction of genetically resistant varieties

Microclimate management

Optimisation of crop layout, windbreaks

Diversification

Mixed planting, companion crops

Sanitation

Removal of infected or damaged plant debris, mummified fruit

Reducing the initial infection pressure

Dynamic monitoring

Weather stations

Installation of local weather stations in orchards

Forecasting models

Models for forecasting the development of pests and diseases

DSS

Decision support systems

Pheromone monitoring

Pheromone traps for pest dynamics

Decision-making based on real data

Modern technologies

INNOVATIONS

Mobile apps

Real-time access to DSS

Remote sensing

Aerial plant health monitoring

Digital transformation of IPM

IPM Adaptation Strategies

Part 2: Biological control, breeding, water and chemical control

Biological control

Conservation
Flower strips to support populations of parasitoids/predators

Augmentation
Release of Trichogramma, predatory mites

Microbiome management
Microbiome management
Bacillus, Trichoderma biological products

Compatibility
Selective pesticides that do not harm beneficial organisms

Reduction in chemical load by 40–60%

Water management

Drip irrigation
Efficient water supply during droughts

Mulching
Moisture conservation, reduced crop stress

Drainage systems
Preventing waterlogging during heavy rainfall

Optimising water management under extreme conditions

Selection of resistant varieties

Disease resistance
Vf genes for scab resistance in apple trees (Topaz, Ligol)

Stress tolerance
Drought-tolerant and heat-tolerant varieties

Phenological adaptation
Optimal flowering times to avoid frost

A long-term solution through genetics

Optimisation of chemical protection

Precision application
Spraying based on damage thresholds

Rotation of products
Prevention of resistance through changing modes of action

Integration with biological methods
Combining chemical and biological control agents

Modern products
Low toxicity to beneficial organisms

Reduced resistance and ecotoxicity

Components of Integrated Pest Management (IPM) for fruit and berry crops

Components of integrated pest management	Fruit orchards (apple/pear/stone fruit)	Raspberries	Strawberries	Walnuts
1) Prevention (planning, orchard design)	Well-ventilated site, selection of rootstocks and varieties resistant to scab, powdery mildew and moniliosis; avoid overcrowding; protection from the wind	Well-drained soil; varieties tolerant to grey rot and late blight; trellises for aeration	Raised beds, drip irrigation; mulch (straw, agrotextile) to reduce contact between berries and soil; varieties tolerant to Botrytis and powdery mildew	A site without waterlogging; varieties with relative tolerance to bacterial blight; correct planting patterns for crown aeration
2) Healthy planting stock and quarantine	Certified seedlings free from viruses and bacterial canker; disinfection of tools; isolation of new batches	Certified virus-free seedlings; control of root rot	Only certified seedlings; avoid introducing mites, nematodes and late blight	Certified material; control of quarantine pests and pathogens; tool hygiene during pruning
3) Regular monitoring and record-keeping	Weekly inspections of leaves, fruit and shoots; pheromone traps (fruit moths, leaf rollers), sticky traps; recording of infestations	Inspection of shoots and berries; traps, informal monitoring (aphids, mites, stem pests); control of rot in the fruiting zone	Inspection of flowers and berries for Botrytis; recording of thrips and mites; traps; assessment of weeds and humidity under cover	Yellow sticky traps and pheromone traps for detecting the walnut leaf roller and fruit moth; inspection for bacterial spot; recording of mites and aphids
4) Economic thresholds (ET) and data-driven decisions	Decisions based on traps, phenology (BBCH) and infection risk; EILs for fruit moths, aphids and mites	EPSh for aphids, mites and stem pests; weather-dependent decision for Botrytis	IPM for mites and thrips; for Botrytis — risk-based decisions (moisture + flowering, dense canopy)	Based on traps and phenology; for bacterial blight — based on weather risk (rain, high humidity)
5) Phenological timing of treatments (BBCH/stages)	Critical windows: pink bud–post-flowering; fruit growth; pre-harvest period	Start of shoot growth; bud break–flowering; fruit set	Leaf growth; budding–flowering (key for Botrytis); berry filling	During bud break – against overwintering pest stages. Bud swelling–early growth (bacterial blight)
6) Agronomic practices (microclimate, nutrition, irrigation)	Crown formation, thinning; NPK balance, avoid waterlogging	Pruning of shoots that have borne fruit; tying up; nitrogen control	Mulching; drip irrigation; correct density; removal of old leaves according to best practice	Pruning for aeration; nitrogen control; avoid damage during mechanised work
7) Sanitation (sources of infection, pest reservoirs)	Clearing windfall; destroying mummified fruit; shredding and composting leaves in accordance with regulations	Removal of affected shoots; removal of rotten berries; removal of plant debris	Regular harvesting of overripe, rotten berries; removal of affected parts; clean row spacing	Collection and disposal of fallen fruit; destruction of leaves and fruit with damage; sanitary pruning

8) Mechanical/physical methods	Trapping belts (locally); nets, barriers (where appropriate); mechanical destruction of nests and damaged shoots	Cutting stems with tunnels; local barriers; mechanical removal of pest colonies	Agrofibre, mulch, bird netting; sanitary harvesting of berries; (in greenhouses: ventilation, dehumidification)	Mulching, soil cultivation against pests; harvesting of ‘black’ fruit
9) Biological control and conservation of entomophages	Conservation of predators (ladybirds, lacewings, hoverflies); biological control agents against scale insects and fungi using appropriate technology	Focus on beneficial insects; biological control agents against aphids, mites, and rot (where possible)	Predatory insects against thrips and mites (especially in protected cultivation); biofungicides against Botrytis as a preventative measure	Preservation of entomophages against aphids; biological control agents against rot; reduction of chemical pressure during the period of beneficial insect activity
10) Chemical control	Only when the economic threshold is exceeded, at precise times; observe waiting periods; targeted treatments	Localised treatments when the EIL is exceeded; avoid ‘frequent preventative’ insecticides	Prioritise prevention through microclimate management; treat only when the EPL is exceeded, especially during flowering and rainy periods	Against pests — at the start of flight, egg-laying; against bacterial disease — during dry spells; observing the waiting period before harvest
11) Resistance management (IRAC/FRAC), minimising side effects	Rotate modes of action; select selective products to preserve natural enemies	Same as above; avoid parts of pyrethroid regimes (risk of mite outbreaks)	Same; consider anti-Botrytis MoA	Same; rotate against pests; do not oversaturate with copper (phytotoxicity/accumulation)
12) Weed control (agrocenosis ecology)	Grass cover, green manure with competition control; mowing to reduce moisture and reserves	Clean rows, weed control as a means of controlling aphids and thrips	Clean row spacing, but without exposing the soil; mulch	Weed control under the canopy (fewer damp patches), but taking erosion into account
13) Post-harvest measures (quality, secondary rot, storage)	Rapid cooling, sorting; minimising fruit damage; hygiene of containers and storage facilities	Cooling of berries immediately after harvest; clean containers; rapid sale	Cooling as quickly as possible; hygiene of the harvesting line	Rapid removal of the pericarp, drying to a safe moisture content; clean storage (risk of mould)
14) Environmental restrictions and protection of pollinators	Treatments outside the bees’ flight season; selection of selective products; minimisation of drift	Consideration of flowering and entomophily; localised treatments	High risk of impact on beneficial organisms during the flowering period	Compliance with environmental regulations; minimise treatment during the period of beneficial organism activity
15) Documentation, traceability, IPM audit	Records: traps, weather data, treatments, efficacy; hotspot maps; seasonal analysis	The same + plot history	The same + records of seedling batches, mite outbreaks, grey mould	The same + monitoring of lepidopteran flight and fruit damage by variety and plot
16) Occupational health and safety, food chain safety	PPE, application intervals, sprayer calibration, buffer zones	Similarly; especially during harvesting (residues)	Similarly; strictly adhere to waiting periods (berries)	Similarly; control of dust, aerosols, pre-harvest waiting periods

Risks and challenges for IPM

Critical threats to the effectiveness of integrated pest management

Resistance

HIGH

Development of pest resistance to pesticides due to an increase in the number of generations

- Accelerated development of resistance due to 2–3 additional generations
- Need for constant rotation of products
- Increase in the cost of chemical control by 30–50%

Decreased efficacy of traditional insecticides

Desynchronisation of biological cycles

HIGH

Disruption of interactions in food chains and reduced effectiveness of natural control

- Disruption of 'pest-predator' synchronisation
- Reduction in the effectiveness of biological control by 30–50%
- Need to adjust the timing of entomophagous release

Loss of natural regulatory mechanisms

Unpredictable weather

MEDIUM

Difficulty in forecasting the development of pests and diseases due to extreme weather events

- Sharp temperature fluctuations complicate modelling
- Risk of crop losses due to unforeseen events
- Need for flexible protection strategies

A 20–30% reduction in the accuracy of forecast models

Economic pressure

MEDIUM

Rising costs of plant protection and the need to invest in new technologies

- Increase in protection costs by 40–60%
- Investments in weather stations, DSS, irrigation
- Higher requirements for staff qualifications
- Need for training and retraining

A 15–25% reduction in profitability

Key findings

A comprehensive approach to IPM adaptation

Integration of knowledge
Combining climate data, models and experience for effective solutions

Technological modernisation
Implementation of monitoring, irrigation and DSS systems for precise management

Biological control
Prioritising biological control methods to reduce chemical use

Breeding progress
Introduction of resistant varieties as a long-term and reliable solution

Institutional support
Provision of funding, training and advisory services

International cooperation
Exchange of experience and coordinated monitoring of invasive species

Government support for IRP
- Subsidies for monitoring, biological control agents and drip irrigation
- Training for farmers (workshops, demonstration plots)

Scientific research
- Prediction models for new pests/diseases
- Breeding of adapted varieties

Quarantine
- Enhanced import controls to prevent the introduction of invasive species

Climate services
- Farmers' access to weather forecasts, risk models, DSS

Only a comprehensive approach can ensure effective protection in the face of climate change

PROGRESS

Promoting Green Deal Readiness in the Eastern Partnership Countries

Thank you for your attention