« *Les méthodes de lutte intégrée contre les ennemis des cultures* »

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WHAT IP/IPM IS?

Integrated Production

A complex of adequate farming practices including the optimal use of natural resources, the protection and augmentation of natural antagonists of pest organisms, the elimination of farm operations with negative impact on the agroecosystem. Rotation, multi-component landscape, soil health and suitable fertilization (e.g. no excessive fertilizer use and organic matter preservation), tillage practices ensuring good soil structure, etc. are key parts of the complex of adequate farming practices

WHAT IP/IPM IS?

INTEGRATED PEST MANAGEMENT

This directly concerns harmful organisms and may give the maximum benefits in the framework of IP and IP tools may be also IPM strategies

IPM exclude the prophylactic use of chemicals (while the prophylactic sustainable exploitation of natural resources through adequate farming practices of IP is a positive factor)

Monitoring and forecasting systems are the base to decide if a pest control is needed providing the necessary instruments for the decision (if and when direct plant protection has to be applied)

WHAT IP/IPM IS?

However, the use of non-chemical control options has priority and pesticides are used only as the last resort if other methods do not produce acceptable results

The Integrated approach means trying to get the best protection results also integrating all the sustainable tools/tactics taking into the consideration all the interactions between the harmful organisms, between harmful organisms and beneficials, between control tools, between control tools and harmful organisms and beneficials, etc.

WHAT IP/IPM IS?

THE IPM PROCEDURE ACCORDING THE EUROPEAN DIRECTIVE 128/2009/CE (the most advanced legislation on sustainable plant protection)

IPM ACCORDING TO DIRECTIVE 2009/128/EC

1. Before any decision on pest control is taken, harmful organisms must be monitored with adequate methods and tools, where available; tools should include observations in the field as well as scientifically sound warning, forecasting and early diagnosis systems.

2. Crops may only be treated when and where the assessment has found that levels exceed set economic thresholds.

3. When economic thresholds are exceeded, agronomic solutions, **mainly rotation**, should be considered to prevent crop damage, as tillage timing, choice and changing of sowing dates, and crop rotation interfere with newly established pest populations.

IPM ACCORDING TO DIRECTIVE 2009/128/EC

4. When economic thresholds are exceeded and no agronomic solutions are available, **biological control, physical treatment or another non-chemical pest control** method should be considered as a replacement for chemical treatment.

5. When economic thresholds are exceeded and no agronomic solutions, biological controls, physical treatments or other non-chemical pest control methods are available, chemical treatments should be selected from options that pose the lowest risk to the environment and human health. It should be used so that the risk of pest resistance is minimised

THE PROCEDURE SHOWS HOW IPM INCLUDES ALL THE ALTERNATIVES TO PESTICIDES WITH HIGH ENVIRONMENTAL IMPACT AS THE NEONICOTINOIDS

WHICH CROPS

1) ARABLE CROPS INCLUDING RICE AND VEGETABLES

2) ORCHARDS/VINEYARDS

3) FORESTRY

4) ORNAMENTAL GOLF COURSES

5) LIVESTOCK

AN EXAMPLE: ARABLE CROPS

IPM IN ARABLE CROPS
A REVOLUTION

AN APPROACH COMPLETELY DIFFERENT FROM THE PAST

IPM ACCORDING DIRECTIVE 128/2009/CE ARABLE CROPS: A SPECIAL DIFFICULT CASE

Despite most of the worldwide used pesticides are applied to control parasites in arable crops

IPM STRATEGIES HAVE NOT PLAYED A SIGNIFICANT ROLE IN THESE CROPS YET

(while they have been widely implemented in crops like orchards).

Therefore :

- ARABLE CROPS (MAIZE) represent special, more difficult case for the proper implementation of the Directive 2009/128/CE
- A SPECIAL EFFORT is needed for making successful the directive considering the arable crop framework

ARABLE CROPS IPM FRAMEWORK

A) LOW INCOME CROPS

B) LOW MANPOWER AVAILABILITY

C) GENERAL L0W TECHNICAL KNOWLEDGE

D) DIFFERENTLY FROM ORCHARDS/VINEYARDS (LONG TRADITION) LITTLE TRADITION/EXPERIENCE ABOUT MONITORING AND IPM

WHAT WE NEED?

A) LOW COST STRATEGIES

B) NON TIME CONSUMING TOOLS

C) SUSTAINABLE TECHNICAL TOOLS

DO WE HAVE THE KNOWDLEGE TO IMPLEMENT IPM IN ARABLE CROPS? YES

WHAT DO WE NEED?

- **AREA-WIDE LEVEL (LOW COST/HA)**

- **where needed complementary limited at field evaluation**

WHAT DO WE NEED? AREAWIDE LEVEL

- **TOOLS MAINLY BASED ON SEMIOCHEMICALS**
- **STATISTICAL EVALUATION METHODS (Geostatistics and others)**
- **METEOROLOGICAL INFORMATION – FORECASTING MODELS**
- **AGRONOMIC INFORMATION**

BASIC STRATEGIES

IMMEDIATE DISSEMINATION OF THE AREA-WIDE AND MODEL INFORMATION BY E-MAIL - SMS

FORMATION OF TECHNICIANS

IMPLEMENTATION DISSEMINATION through the Bullettin of Arable Crops

MAIN FEATURES OF THE BULLETIN:

- flexibility, the cadence on average is at least weekly, but it varies according to the needs, since it is closely related to the evolution of crops and pests; the information is forwarded by e-mail and always available on the web-site (http://www.venetoagricoltura.org), while, in case of immediate risk, the alert is given also via SMS;

- preparation: it gives a continuous information on how to react promptly and properly in case of alert message;

- formation: bulletins are designed in a way to provide in-depth information (e.g recognition of symptoms, pests);

- participation: the farmers can use monitoring tools;

- interaction: possibility to ask questions and to propose changes

MAIN MODELS USED

- **WEED IPM**: ALERTINF. EMERGENCE PATTERNS OF THE MAIN WEEDS (PADUA UNIVERSITY)
- **WCR IPM:** DAVIS, EGG, LARVAL DEVELOPMENT OF WCR
- **WCR IPM:** NOWATZKY ADULT/FEMALE DEVELOPMENT PATTERNS
- **BLACKCUTWORM ALERT PROGRAMME:** IOWA UNIVERSITY (ADAPTED TO ITALY)
- **ECB: POPULATION DEVELOPMENT**
- **CROPS: CROPSYST:** CROP DEVELOPMENT PATTERNS
- **FUSARIUM CEREALS**: DISEASE PATTERNS UNDER EVALUATION

AN EXAMPLE AMONG ARABLE CROPS MAIZE

WHICH PESTICIDES/HARMFUL ORGANISM?

A) SOIL INSECTICIDES (WIREWORMS, WCR,…)
B) HERBICIDES
C) POST-EMERGENCE INSECTICIDES (AGAINST BLACKCUTWORMS, ECB,….)
D) FUNGICIDES (SEEDLING DISEASES, FUSARIUM,…..)

MAIN PESTS

1. **SOIL PESTS, SPECIES HARMFUL AT EARLY MAIZE STAGES**

2. **PESTS HARMFUL TO DEVELOPED MAIZE (ECB, HELICOVERPA, ...)**

KEY QUESTION: IS IT POSSIBLE IPM IN MAIZE?

1)WHAT IS THE RISK LEVEL? ARE POPULATIONS LEVELS ABOVE THRESHOLDS EVERYWHERE AND THEN TREATMENTS NEEDED ON ALL FIELDS OR ON FEW OF THEM?

2) ARE IPM STRATEGIES (MONITORING METHODS, RISK ASSESSMENT, TRESHOLDS FOR KEY PESTS, AGRONOMIC AND/OR BIOLOGICAL ALTERNATIVES) AVAILABLE?

1. PESTS AT EARLY STAGES

VIRUSES

Neonics effective but diseases have low incidence, hybrids are usually resistant – resistant hybrids as effective as neonicotinoids

Furlan L, Chiarini F, Balconi C, Lanzanova C, Torri A., Valoti P, Alma A, Saladini MA, Mori N, Davanzo M, Colauzzi M (2012) Possibilità di applicazione della difesa integrata per il controllo delle virosi nella coltura del mais, Apoidea, 1-2, 39 – 44.

Other solutions

INSECTS AND OTHER ARTHROPODS

1. PESTS AT EARLY STAGES: insects and other arthropods

A.BLACKCUTWORMS

B.(WCR) DIABROTICA

C.WIREWORMS

D. OTHER SOIL PESTS, e.g diplopods,.. (low incidence in italy and France)

AN EXAMPLE AMONG MAIZE PESTS:

BLACKCUTWORM

BLACKCUTWORMS KEY QUESTION: IS IT POSSIBLE IPM?

1)WHAT IS THE RISK LEVEL? LOW, < 1%

2)ARE IPM STRATEGIES (MONITORING METHODS, RISK ASSESSMENT, TRESHOLDS FOR KEY PESTS) AVAILABLE? YES, BLACKCUTWORM ALERT PROGRAMME RUNNING SINCE 1991 IN ITALY WITH HIGH PRECISION

A. BLACKCUTWORMS (A. ipsilon)

- OCCASIONAL ATTACKS (last significant outbreaks 1971, 1983)
- LOW ECONOMIC DAMAGE
- ATTACKS NOT PREDICTABLE at sowing
- NEGLIGIBLE CONTROL BY SOIL INSECTICID (ALSO AS SEED COATING) WHEN NEEDED
- ALERT PROGRAMME PREDICTS WHERE AND WHEN POST-EMERGENCE TREATMENTS AR NEEDED

UNJUSTIFIED AT SOWING TREATMENTS

A. BLACKCUTWORMS - IPM

AREA-WIDE LEVEL

- BLACKCUTWORM ALERT PROGRAM
  prediction of moth arrival with pheromone traps
  (evaluation of southern winds, assessment of
  of formation of harfmul instars by a development
  model)

- BULLETIN TO INFORM ABOUT POPULATION DEVELOPMENT

- POSSIBLE FOLIAR TREATMENTS WHEN FOURTH INSTAR FORMS AND WE HAVE AN EARLY ATTACK ABOVE THRESHOLD (5% OF DAMAGED PLANTS) ASSESSED BY SCOUTING

UNJUSTIFIED AT SOWING TREATMENTS

A. BLACKCUTWORMS - IPM

- **COMPLEMENTARY LIMITED IN FIELD EVALUATION**

a) IF AND WHERE POPULATION ARRIVED, LOCAL SCOUTING BASED ON AREAWIDE MONITORING SUGGESTIONS

b) WHEN HARMFUL STAGE FORMS (FOURTH INSTAR, DD ACCUMULATION) IN AREA SPOTTED (a) SCOUTING LOOKING AT DAMAGED PLANTS

c) WHERE WE HAVE AN EARLY ATTACK ABOVE THRESHOLD (5% OF DAMAGED PLANTS) POST-EMERGENCE TREATMENTS

d) EFFECTIVE INSECTICIDES ARE AVAILABLE

AN EXAMPLE AMONG MAIZE PESTS

WCR - DIABROTICA

WCR – DIABROTICA: CAN IPM BE IMPLEMENTED?

1. What is the risk level? Low implementing a general IPM approach

2. Are IPM strategies available (e.g. monitoring methods, risk assessment, key-pest thresholds, agronomic [rotation] and/or biological alternatives)? WCR can be kept below economic thresholds by rotation, the most effective IPM type according to Directive 2009/128/EC – Annex III: IPM of Diabrotica involves implementing rational rotation without chemical treatment (at sowing, or later, against beetles)


Previous crop:
alfa-alfa
Previous crop:
continuos
maize (> 20 Ys)

ONE YEAR WITH ANOTHER CROP, TWO YEARS OF WCR STOP!!!!!!

YEAR 1: “any other crop” after continuous maize – no larvae development – no o or very few beetles from that field

YEAR 2: maize again; no larvae, no beetles because of no egg laying in the “other” crop in YEAR 1

IPM OF WCR

- Rotation: the only fully effective strategy (see Directive 128/2009/EC);
- Rotation may be effective even as a ‘soft’ method (every two or more years when the threshold has been exceeded);

- WCR EGG AND LARVAL DEVELOPMENT MODEL (DAVIS) and ADULT/FEMALE DEVELOPMENT PATTERNS (NOWATZKY) to be used to optimize rotation implementation;
- Some rotation solutions do not reduce the gross margin of livestock/biogas farms;
- Treatment at sowing does not significantly affect WCR population dynamics;
- Insecticide may fail

TREATMENT UNJUSTIFIED AT SOWING

AN EXAMPLE AMONG MAIZE PESTS

WIREWORMS

WIREWORMS: CAN IPM BE IMPLEMENTED?

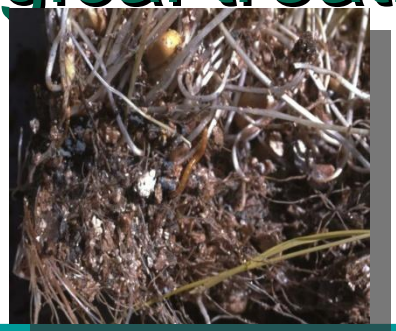
1. What is the risk level? Low (1-5%)

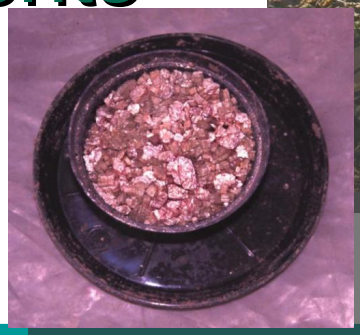
2. Are IPM strategies available (e.g. monitoring methods, risk assessment, key-pest thresholds, agronomic and/or biological alternatives)? Yes, and MUTUAL FUNDS may allow IPM to be implemented rapidly.

CURRENT IPM TOOLS

- Risk factors
- Pheromone traps
- Bait traps
- Agronomic strategies
- Biocidal plants and meal
- Other biological treatments

CROPS PLANTED WHEN AND WHERE THERE IS NO SERIOUS RISK OF ECONOMIC DAMAGE





A NEW "INSURANCE" APPROACH

MUTUAL FUNDS INSTEAD OF INSECTICIDE TREATMENTS

WHEN RISK IS LOW, THE INSURANCE APPROACH IS CONVENIENT AND MUCH SAFER FOR PEOPLE & THE ENVIRONMENT (INCLUDING BEES)

ADVANTAGES OF MUTUAL FUNDS

1. Reduces costs/ha (2015 < 15 €/ha);
2. Covers risks due to mistakes or difficulties in IPM implementation (e.g. delay in black cutworm treatments);
3. Covers other risks, e.g. flooding and drought, not covered by insecticides;
4. Reduces health risk for farmers, as there is no contact with insecticides;
5. No negative impact of insecticides on soil beneficials;
6. No pollution risks for soil and water tables;

ADVANTAGES OF MUTUAL FUNDS

7. No risk to bees and other wild pollinators; more generally, reduces risk to fauna;
8. Covers weather risks, including weather causing soil insecticides to fail (Furlan *et al*. 2011, Ferro and Furlan, 2012, Furlan et al. 2014).

Furlan L., Benevegnu' I, Cecchin A., Chiarini F., Fracasso F., Sartori A., Manfredi V, Frigimelica G., Davanzo M., Canzi S., Sartori E., Codato F., Bin O., Nadal V., Giacomel D, Contiero B (2014) *Difesa integrata del mais: come applicarla in campo*. L'Informatore Agrario, 9, Supplemento Difesa delle Colture, 11-14.

Furlan L., Cappellari C., Porrini C., Radeghieri P., Ferrari R., Pozzati M., Davanzo M., Canzi S., Saladini M.A., Alma A., Balconi C., Stocco M. (2011) *Difesa integrata del mais: come effettuarla nelle prime fasi*. L'Informatore Agrario, 7, Supplemento Difesa delle Colture: 15 – 19.

Ferro G., Furlan L. (2012) *Mais: strategie a confronto per contenere gli elateridi*, 42, L'Informatore Agrario, 42, Supplemento Difesa delle Colture: 63 – 67.

SOME SUCCESSFUL CASE STUDIES
Az. Moizzi, Italy: Results

More than 1,600 hectares of maize untreated, i.e. no soil insecticide, (1984-2015);

9/1600 ha (0.56%) with economic populations (solution: replace maize with other crops);

Seed/plant damage always below 5% (usually 0.1% to 2.5%);

No economic damage: 96% of fields with high stand (> 90% of sown seeds). Some cases of stand reduction (< 5 pp/m^2), mainly due to bird damage;

1. More than € 55,000 saved, no threat to worker health, and no environmental impact.

VENETO AGRICOLTURA OPEN FARMS - OPEN PROTOCOLS

2009 – 2015
No soil insecticides
600 ha land farmed in 7 years
180 ha maize for 6 years
> 1300 ha maize farmed over 7 years
No economic damage by soil insects