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Quality Water for Idaho

The Role of Integrated Pest Management

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Agricultural pesticides are potential pollution threats to surface and groundwater quality. Integrated pest management (IPM) can help protect water quality by minimizing the amounts of pesticides that farmers use and by helping farmers to apply pesticides in ways that decrease the risk of chemicals washing off fields into lakes and rivers or leaching into groundwater.

IPM philosophy: Five commonsense principles

• **There is no silver bullet.** Overreliance on any single control measure can have undesirable effects. IPM combines different control tactics into an overall strategy that balances the strengths of each against any individual weaknesses.

• **Tolerate instead of eradicate.** Keeping fields entirely pest free is neither necessary nor desirable. Most crops can tolerate low pest infestation levels without any yield loss. IPM seeks to reduce pest numbers below economically damaging levels rather than eliminate infestations.

• **Treat the causes of pest outbreaks, not the symptoms.** IPM requires detailed understanding of pest biology and ecology so that the cropping system can be selectively manipulated to the pest's disadvantage. The idea is to make the crop less favorable for pest survival and reproduction while disturbing the rest of the ecosystem as little as possible.

• **If you kill the pests' natural enemies, you inherit their jobs.** Native biological control agents such as lady beetles and parasitic wasps naturally keep many pests in check. IPM strives to enhance the impact of beneficial insects and other natural controls already present.

• **Pesticides are not a substitute for good farming.** A vigorously growing plant can defend itself better against pests than a weak, stressed plant. IPM takes maximum advantage of farming practices that promote plant health and allow crops to escape or tolerate pest injury.

Putting IPM to work in Idaho

Idaho farmers put IPM philosophy into practice by following these three steps:

Step 1. Use cultural methods, biological controls, and other alternatives to conventional chemical pesticides when practical.

Step 2. Use field scouting, pest forecasting, and economic thresholds to ensure that pesticides only are used against real and not perceived pest problems.

Step 3. Match pesticides with field site features so that the risk of contaminating water is minimized.

Step 1: Alternatives to pesticides

Cultural methods are those good farming practices that make the environment less suitable for pest colonization and survival. Crop rotation — planting different crops each season rather than always planting the same crop in the same field — breaks the infestation cycle of immobile pests such as nematodes, disease organisms, and other soilborne pests. Crops such as barley and wheat gain a competitive edge over wild oat and other weeds with increased crop seeding rates and decreased crop row widths. Tillage operations that turn the soil and bury crop debris can lower infestation levels of plant pathogens that spend the winter in the soil or beneath crop residues. However, the answers are seldom simple. Plowing can help control pest problems but also can increase soil erosion.

Two improved cultural methods

Cultural methods include some of the oldest pest control measures known to man. Two improved methods are generating renewed interest in Idaho: cover crops and trap crops.

Cover crops, such as sudangrass and rapeseed, have shown promise for suppressing soilborne diseases of potatoes. These cover crops are grown and then plowed into the soil before the primary crop is seeded. Decomposition products from the cover crops can be directly toxic to pathogens or can indirectly reduce infection rates by favoring competing microorganisms that colonize the root before the pathogen gains a foothold.

Trap crops attract and concentrate pests within a small portion of the field where they easily can be killed with minimal or even no pesticide. One tactic under development is control of sugarbeet cyst nematode with an oil-radish trap crop. Root secretions from the oil-radish stimulate nematode eggs to hatch, but because the trap crop is not a suitable food source, the young nematodes never develop to the adult reproductive stage. Plowing down the trap crop after eggs hatch eliminates the infestation.

Pest-resistant varieties — plants that can tolerate pest injury without yield loss, that kill pests by producing toxic chemicals, or that have lowered attractiveness to pests — are critical to some of Idaho's most important crop commodities. Idaho would not have a sugarbeet industry were it not for sugarbeet varieties with resistance to the curly top virus. Prior to resistant varieties, nearly one-third of the sugarbeet acreage was abandoned annually as the result of curly top. Today, the industry protects itself by planting only those varieties that meet minimum standards for disease resistance.

Biological control involves using predatory, parasitic, and disease-causing organisms for insect pest control as well as using competitive, or even antagonistic microorganisms for weed and disease suppression. One practical method used by Idaho farmers is conservation of the naturally occurring beneficial insects. Diverse communities of lady beetles, lacewings, and parasitic wasps occur in most alfalfa hay fields every year and help to keep damaging aphids in check.

A key to intensifying natural enemy effectiveness is a sparing use of insecticides. Insecticides can contribute to pest outbreaks by eliminating natural enemies and allowing pests to rebound without checks. Farmers who reduce their use of broad-spectrum insecticides can enhance natural biological control and further reduce the need to use insecticides, which in turn reduces the amount of chemical residues that potentially can pollute water.

Step 2: Field scouting, pest forecasts, and thresholds

Inevitably, there are fields where cultural methods and biological controls by themselves fail to keep pest populations from reaching damaging levels or thresholds. Here pesticides are necessary to prevent yield and quality losses. A key principle of IPM is that pesticides should only be used when field examination or "scouting" shows that infestations exceed "economic thresholds," or guidelines that differentiate economically insignificant infestations from intolerable populations (fig. 1).

In some high-value crops such as potatoes, private consultants provide Idaho farmers with pest scouting services and management recommendations on a fee basis. In other field and row crops, industry fieldmen and the farmers themselves do the scouting. The benefit to water quality is that pesticides are used only when and where they really are needed.

Scouting and thresholds play important roles in protecting groundwater quality when they replace preventative or "just-in-case" application of soil-incorporated pesticides. For example, some sugarbeet growers apply insecticides at planting to control the sugarbeet root maggot, an insect that feeds on the taproot and causes serious crop damage. However, there are two problems with planting-time applications. First, there is no way to know if

Types and uses of pesticides

A pesticide is a chemical poison that kills pests. The pesticides commonly used by Idaho farmers include:

Herbicides — Pesticides that kill weeds and other plants
Insecticides — Pesticides that kill insects
Fungicides — Pesticides that kill disease-causing fungi
Nematicides — Pesticides that kill nematodes

Idaho farmers use pesticides for several reasons, including:

Convenience — Ease of use and local availability
Effectiveness — Kill rates commonly exceeding 90 to 95 percent
Corrective action — Often only control option once pests reach outbreak levels

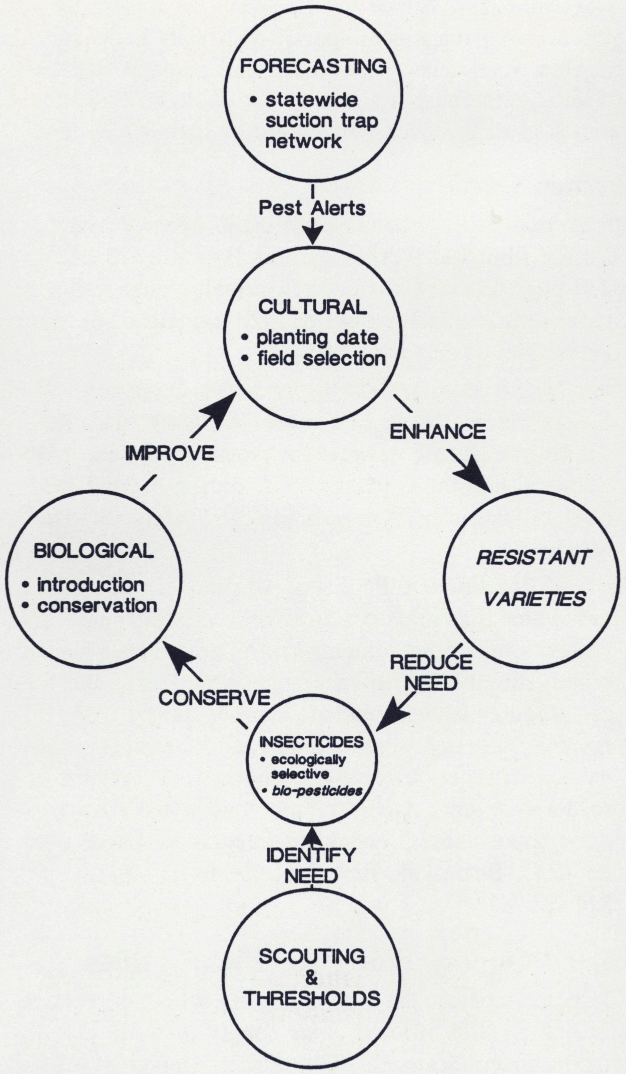


Fig. 3. Conceptual IPM system for Russian wheat aphid control in Idaho. The system depends on biological, cultural, and plant-resistance measures and relegates insecticides to a secondary role. Differences in sizes of component boxes identify their relative importance in the overall IPM strategy; italics designate components still in the research and development phase.

This tactic allows the crop to escape pest colonization by avoiding incoming flights of aphids that occur when summer crops are harvested. The reverse (plant as early as possible) is true for spring-seeded crops. Early plantings allow wheat and barley plants to develop beyond the highly susceptible seedling stage before aphids arrive.

Field selection also can contribute to Russian wheat aphid suppression. Here the idea is to avoid planting cereal crops in fields immediately adjacent to rangeland or large grassy expanses. These areas can serve as reservoirs where aphids survive and multiply during the summer dry season from crop harvest until the next crop is planted.

Aphid-resistant wheat and barley varieties are still in the research and development phase. In addition, work is continuing on the importation and release of exotic parasitic wasps and lady beetles for Russian wheat aphid control and on use of aphid-killing fungi as a biological insecticide.

Insecticides for Russian wheat aphid control can be applied according to two strategies: by incorporating insecticides into the soil at planting time or by spraying them over the top of rows later during the growing season. Rather than automatically apply pesticides, Idaho wheat and barley growers use scouting and forecasting to decide if pesticides really are needed. The need for insecticides at planting time can be gauged from a statewide network of traps that monitor aphid flights. Use of insecticides at planting is recommended only if aphid flights are heavy and planting dates cannot be changed to avoid incoming aphids.

Later during the growing season farmers can scout fields using a system of decision cards (fig. 4) that quickly and accurately identify fields requiring treatment. Because Russian wheat aphid infestations often begin at field edges, spot-spraying a 50-foot-wide strip along the fencerow (versus broadcast application over the entire field) may be all that is required. Spot spraying has the added benefit of allowing biological control agents to survive in unsprayed portions of the field.

For both soil and foliage-applied insecticides, growers can consult tables that list the relative likelihood a specific pesticide will move into surface or groundwater. Tables and supporting information (''Pesticide Properties Data Base'' and ''Soils Ratings for Pesticide Leaching and Surface Loss Potentials'') are available statewide at local Soil Conservation Service offices and at county offices of the University of Idaho Cooperative Extension System.

Summary checklist

• **Reduce risk at the source.** IPM's role in preventing contamination of water by pesticides is to decrease the amount of chemicals used and to decrease the risk that chemicals will leach or run off crop fields.

• **Tolerate versus annihilate.** IPM's objective is to reduce pest numbers to levels that can be tolerated, not to eradicate pests.

• **Build on natural pest controls.** IPM begins with cultural and biological alternatives to chemical pesticides.

Russian wheat aphid
sequential decision cards[1]

Current Information Series No. 884C
March 1991

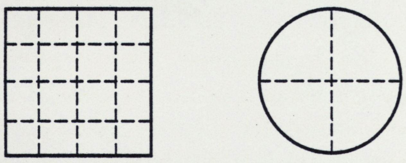
Card 3 Winter and spring grain from head emergence to soft dough

Field/subdivision ID: ________ Crop: ________ Growth stage: ____________ Date: _____

Number of tillers examined	DO NOT SPRAY if tally is less than	RUNNING TALLY (no. tillers with ≥1 RWA)	SPRAY if tally exceeds	Number of tillers examined	DO NOT SPRAY if tally is less than	RUNNING TALLY (no. tillers with ≥ 1 RWA)	SPRAY if tally exceeds
1	■	____	■	26	2	____	6
2	■	____	■	27	2	____	6
3	■	____	■	28	2	____	6
4	■	____	3	29	2	____	6
5	■	____	3	30	2	____	7
6	■	____	3	31	2	____	7
7	■	____	3	32	2	____	7
8	■	____	3	33	3	____	7
9	■	____	4	34	3	____	7
10	■	____	4	35	3	____	7
11	■	____	4	36	3	____	7
12	■	____	4	37	3	____	8
13	■	____	4	38	3	____	8
14	■	____	4	39	3	____	8
15	■	____	4	40	4	____	8
16	■	____	5	41	4	____	8
17	■	____	5	42	4	____	8
18	■	____	5	43	4	____	8
19	1	____	5	44	4	____	9
20	1	____	5	45	4	____	9
21	1	____	5	46	4	____	9
22	1	____	5	47	5	____	9
23	1	____	6	48	5	____	9
24	1	____	6	49	5	____	9
25	1	____	6	50	5	____*	9

■ Means that a decision is not possible; continue sampling.

*If tally = 5 to 9 infested tillers after 50 tillers have been inspected, the infestation is borderline; recheck field in 3 to 5 days.



Field maps: You can use these field diagrams to show field subdivisions that you sampled separately. Draw in landmarks and reference points (buildings, roads, fences, etc.).

[1]Instructions for use of the sequential decision cards are in University of Idaho Current Information Series no. 884, *Sequential Decision Cards: A Tool for Russian Wheat Aphid*

Fig. 4. Wheat growers can tabulate Russian wheat aphid field scouting data on "decision cards" that give an objective signal when and when not to use insecticides.

• **Target pesticide applications.** IPM farmers use pesticides only when field scouting shows that infestations are greater than economic thresholds.

• **Consider the local environment.** When using pesticides, IPM farmers pay special attention to soil and environmental factors that affect leaching and runoff. Ill-chosen pesticides pose needless risks to water quality while decreasing farmer profits.

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Further reading

Introduction to Integrated Pest Management by Mary Louise Flint and Robert van den Bosch. 1983. A 240-page textbook for the nonspecialist who wants a more detailed background on IPM principles. Plenum Press, New York and London.

Wheat Health Management by R. James Cook and Roger Veseth. 1991. 152 pages. A highly readable, yet holistic A-to-Z manual for wheat producers, practitioners, and those interested in getting beyond IPM basics. American Phytopathological Society, St. Paul, Minnesota.

The IPM Practitioner. Published 10 times a year, this newsletter highlights practical IPM methods and products in settings ranging from agricultural, landscape, structural, medical, range, veterinary, and forest. Regular features include state-of-the-art IPM reviews, research notes, conference highlights, journal abstracts, book reviews, products and services, reader's column, calendar, and educational/employment opportunities. From Bio-Integral Resource Center, P.O. Box 7414, Berkeley, CA 94707; (415) 524-2567.

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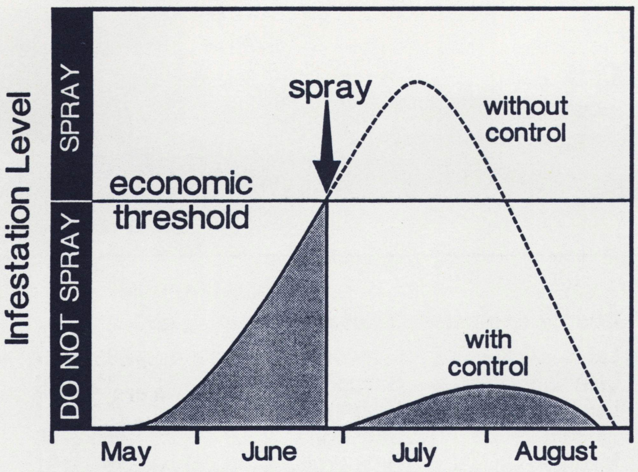

Fig. 1. Economic thresholds (ETs) tell farmers when and when not to use pesticides. Sprays are applied only when the pest infestation grows beyond the ET value. Here the dashed line shows the pest population trajectory without control.

Fig. 2. Idaho sugarbeet growers can assess the need for insecticides by monitoring infestation levels of sugarbeet root maggot with homemade sticky-stake traps. Flies are attracted to the orange trap face where they become mired in a film of insect-trapping adhesive.

insecticides really are needed because root maggot flies do not invade fields and lay eggs until after the crop emerges. Second, several insecticides commonly used for root maggot control pose a comparatively high potential for leaching into groundwater.

The IPM alternative to automatic insecticide application during planting is to monitor fly populations with sticky-stake traps placed at field edges during April and May (fig. 2). Unless captures exceed the economic threshold of 45 to 55 flies, there is no need for insecticides. If fly captures on traps are greater than these thresholds, then beet growers still can apply an insecticide and protect the crop from root maggot feeding. Beet growers in Cassia County using sticky-stakes and thresholds reduced their use of insecticides by 87 percent without decreasing crop yield or quality.

Pest forecasting systems can complement field scouting and economic thresholds by warning farmers of impending outbreaks. One successful system is Idaho's BEACON program (Bean Cutworm Outlook and Notification). BEACON uses a regional network of insect light traps that provides bean and sweet corn growers with advance warning of damage expected from the western bean cutworm. High moth captures in traps pinpoint the location of cutworm damage potential. Farmers use timely alerts published in local newspapers to make cutworm control decisions. Under BEACON, the acreage treated with insecticides has decreased from 45,000 acres to 6,000 acres annually.

Step 3: Site-specific pesticide selection

The final component of IPM is selection of pesticides that pose the least risk of leaching through soil or being transported from fields in runoff water and sediment. The potential for water contamination depends on two primary factors: (1) local environmental features, particularly soil texture, permeability, and organic matter, and (2) properties of the pesticide itself. For additional information, see University of Idaho CIS 865, *Quality Water for Idaho: Pesticides and Their Movement in Soil and Water*.

Excessive irrigation also can increase the potential for pesticide leaching and surface runoff. If the rate of water application is higher than needed to recharge the water storage capacity of the soil, then excess water and dissolved pesticides may percolate beyond the crop root zone and contaminate groundwater.

Putting it all together: An example

There is no single recipe for IPM. The specific mix of control tactics varies with each crop, each insect, each disease, and each weed or other pest. One example is the IPM approach to Russian wheat aphid control in wheat and barley (fig. 3). The IPM strategy relies on biological and cultural methods and looks to insecticides only as a last resort if nonchemical alternatives fail.

Pest management for Russian wheat aphids starts at planting time with cultural methods. Idaho farmers break the aphid infestation cycle by planting fall-seeded wheat and barley as late as feasible.

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