IPM Plan Guide Sheet
Practices for Field Crop Production

Introduction

This tool has been designed as a guide for evaluating on-farm pest management practices for farmers interested in a Natural Resource Conservation Service (NRCS) 595 Integrated Pest Management (IPM) Plan. A 595 IPM plan is one of many practice standards offering financial assistance to farmers to adopt agriculture-minded conservation practices through the NRCS Environmental Quality Incentives Program (EQIP). This evaluation tool outlines industry standards of IPM that have been peer reviewed by universities, independent consultants, nongovernmental organizations, NRCS staff, and other state and federal agencies, and provides site specific information for implementing IPM.

EQIP is a voluntary conservation program with annual signup periods often offered in the winter. The applications are scored and funds are awarded competitively to applicants that propose cost-effective conservation practices, address local priorities, and provide the greatest environmental benefit. Contact your local USDA service center to find out specific signup dates for your state.

EQIP application information by state
http://www.nrcs.usda.gov/programs/eqip/EQIP_signup/2009_signup/index.html

Conservation plan application form – this is the application form required for applying for EQIP funds
Form CCC-1200 http://www.nrcs.usda.gov/programs/eqip/

What is IPM?

IPM is a comprehensive approach to managing pests that uses an array of practices that minimize impacts on the environment, while providing safe, effective and economical means of pest control. The principles and practices of IPM are applied to any setting where pests (e.g., insects, diseases, mammals, birds) are present. IPM practices have the added benefit of offering solutions to pest control that reduce the use of pesticides and protects resources by mitigating their impacts on the environment.

The fundamental principles of implementing IPM are as follows

1. **Pest identification:** Proper identification of pests is necessary to identify the best options for control.
2. **Best biology:** Understand pest life cycles, natural hosts and enemies and environmental conditions that influence pest activity.
3. **Pest monitoring:** Scout and trap for pests and beneficial insects through the growing season, and keep records of all pest activity.
4. **Establish action and economic injury thresholds:** Thresholds are used to determine when pest infestation is severe enough to warrant control.
5. **Select appropriate treatment strategy:** IPM relies on cultural, mechanical, biological and chemical controls for prevention or suppression of pest populations
6. **Evaluate effectiveness of the pest management program:** IPM is not static; make changes that increase the level of IPM that is being practiced from year to year.

PRINCIPLE	PRACTICES	REFERENCES	Field Corn	Soybean	Alfalfa	Wheat
PREVENTION	Use certified pest, weed and disease-free-seeds when available.		Plant hybrids with resistance to leaf blight and stalk rots. If necessary, treat seeds with fungicide if there is a current history of fungal disease in the field.	Plant-disease-free seed with a germination rate of 80% or higher. If necessary, treat seeds with fungicide if there is a current history of fungal disease in the field.		If necessary, treat seeds with fungicide that controls seedling blights, bunt and loose smut.
	Prevent weeds from going to seed. (Example: Cultivate, pull, mow, flame, etc.)	*Flame weeding for agronomic crops*[3]				
	Reduce moisture on plant surfaces to prevent disease incidence. (e.g., avoid overhead irrigation between 6 p.m. and midnight to minimize disease.)					
	Employ methods to avoid spreading pests (pathogens, weeds, and insects). (e.g., work crop when dry, work infested fields last, hose down equipment between fields, etc.)	Principles of Sustainable weed management[5]		Incorporate post-harvest residues if severe disease problems occurred during season from leaf diseases or brown stem rot. Tillage will improve surface drainage and reduce damage from Phytophthora root rot.		Incorporate residues from fields with heavy disease infestation during season.
Preventing pest problems reduces the need for pesticide applications and thus potential impacts of pesticides on resource concerns	Destroy and/or remove crop residues for field sanitation procedures. Include fall tillage where appropriate to control weeds and break pest cycles.	Ohio IPM Elements[1]	Plow under corn refuses in the fall to control European corn borer.			
	Eliminate unmanaged plants that serve as pest reservoirs, such as abandoned crops, volunteers from previous crop, or weed hosts of viruses.					Destroy volunteer wheat, and other weed grasses to reduce inoculums of pathogens in wheat fields.
	Test soil or plant tissue annually to determine proper fertility and pH levels for crop and time application according to crop needs. Apply nutrients, fertilizers, and pH-adjusting agents according to recommendations.	Tri State Fertilizer Recommendations for corn, soybeans, wheat and alfalfa[19], Ohio IPM Elements[1]	If manure is applied, the nitrogen contribution is accounted for and reductions of synthetic nitrogen fertilizer are reduced accordingly.	Maintain soil pH in the 6.5 to 7.0 range. Apply lime, if needed, six to 12 months before planting crop.	Maintain soil pH in the 6.5 to 7.0 range. Apply lime, if needed, six to 12 months before planting crop.	No more than 20 lbs of nitrogen are applied in the fall.

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AVOIDANCE	Rotate crops that break the pest cycle. Do not plant crops from the same family at less than recommended intervals for the identified pest(s).	Ohio IPM Elements[1]	Rotate to crops other than corn.	Rotate soybean with corn or small grains; a two or three year rotation is adequate under most circumstances. At least three years may be necessary for high populations of soybean cyst nematode.	Rotate to corn or small grains, never follow alfalfa with alfalfa.	Never plant wheat after wheat or spelt. A two to three year rotation away from wheat is recommended.
	Match crops to appropriate sites to optimize plant health and avoid known pests. (e.g., avoid planting crops susceptible to fungal diseases in low wet fields.)		Treat seeds with fungicide if there is a current history of fungal disease in the field.	Treat seeds with fungicide if there is a current history of fungal disease in the field.		
	Plant pest and disease-resistant-seed.		Plant Bt corn if in an area that has a history of European corn borer.	Plant varieties with resistance to *Phytophthora* root rot, *Sclerotinia* stem rot. Use soybean cyst nematode resistant varieties in conjunction with rotation to reduce nematode populations.	Plant winter hardy varieties with resistance to *Phytophthora* root rot, A*nthracnose*, *Verticillium* wilt and *Aphanomyces* root rot. Plant potato leaf hopper resistant varieties.	Select high yielding varieties with good straw strength, winter hardiness and resistance to the important diseases in your area. Plant Hessian fly-resistant varieties. Plant after Hessian fly safe date for your county.
Implementing measures to avoid the buildup of pest populations reduces the need for pesticide applications	Adjust planting dates and select cultivars with maturity dates that allow avoidance of early or late-season pests.		Time seeding with adequate soil moisture for rapid germination and to prevent losses from crown, and root rot and seedling diseases.	Time seeding with adequate soil moisture for rapid germination and to prevent losses from crown, and root rot and seedling diseases.	For late summer no-till seeding, plant as early in August as possible to avoid seeding losses due to *Sclerotinia* crown and stem rot.	
	Use and manage trap crops to protect main crop from insect pests and insect-vectored diseases.	CT fact sheet on Perimeter Trap Cropping[6] Use of Soybean as a Trap C[5]				

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MONITORING	Monitor for pests as recommended for each crop. If no monitoring guidelines available, monitor weekly to determine presence, density, and locations of pests and to determine crop growth stage. ****Record findings. Record keeping is required. **** (e.g., scout crops and use other appropriate monitoring aids such as pheromone traps, disease diagnostic tests, etc. Map weeds in the fall to help plan where specific measures may be needed to target problem weeds the following spring.)	Pest Management Guidelines from University of Missouri[33], Field Crop IPM Resources from Illinois State University[34], Ohio IPM Elements[1], Economic Thresholds for Weeds[7], Pest Bulletins [24-39]	1. If western corn rootworm is suspected, place sticky traps in soybean fields and monitor to determine if beetles are large enough to justify treatment the following year; 2. Scout fields for damage from leaf blight at tasseling; 3. Scout fields in the fall prior to harvest to determine level of stalk rot and harvest fields with greatest levels of stalk rot first to avoid losses due to lodged corn.		Scout weekly for alfalfa weevil during first and second cutting. Scout for potato leaf hopper on second and third cuttings. Control when populations reach economic threshold or cut early.	Scout fields from flag leaf emergence through flowering for powdery mildew, leaf rust, *Stagonospora nodorum* leaf and glume blotch.
Monitoring limits pesticide use to those occasions when intervention is needed to prevent economically significant damage to crops.	Use on-farm weather monitoring devices to measure precipitation, humidity, temperature, and leaf wetness and/or use commercial weather prediction service for prevention and control of plant diseases. (e.g., install weather station with rain gauge, hygrometer, maximum and minimum temperature recording equipment, leaf- wetness sensors.)	Skybit[23]				
	Use pest-forecasting tools (e.g., computer modeling software) as additional guides for on-farm pest monitoring activities in conjunction with weather data to predict risk of pest infestation.	Cucurbit Downy Mildew Weather Forecaster[21], Pestwatch[22]				

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	CULTURAL AND PHYSICAL CONTROLS					
SUPPRESSION	Use cover crops, especially pest-suppressing crops (allelopathic), in the rotation cycle to reduce weeds and disease incidence and to improve soil quality.	See references 3-7 for cover crop guidance		Weed control is especially important, as weeds act as hosts for *Sclerotinia* white mold and soybean cyst nematode.		
	Plant using appropriate within- and between-row spacing optimal for crop, site, and row orientation. (e.g., use row spacing and plant densities that assure rapid canopy closure.)	Ohio IPM Elements[1] for crop-specific recommendations.				
	Use reduced tillage and other residue management practices to suppress weeds and maintain soil organic matter as appropriate for crop.	See NRCS practice standards 329, 345, 346 for residue management.	Conserve organic matter with no-tillage or minimum tillage where feasible. Feasibility depends on soil texture, soil moisture and drainage, soil temperature and slope of the land.	Conserve organic matter with no-tillage or minimum tillage where feasible. Feasibility depends on soil texture, soil moisture and drainage, soil temperature and slope of the land.		Conserve organic matter with no-tillage or minimum tillage where feasible. Feasibility depends on soil texture, soil moisture and drainage, soil temperature and slope of the land.
Applying suppression actions only when pest populations exceed the action threshold reduces potential impacts of pesticides on resource concerns.	Use mulches including plastic or reflective mulches for insect or weed control.					
	Inter-seed cover crop within or between rows to suppress weeds.					
	Use mechanical pest controls. (e.g., cultivate, mow, hoe, and hand remove insects and weeds, prune diseased or insect-infested plants, remove diseased plants.)					
	Use physical pest controls and deterrents. (e.g., noise-makers, reflectors, ribbons and predator models.)	Guide to Biological Control[28]				

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SUPPRESSION **Applying suppression actions only when pest populations exceed the action threshold reduces potential impacts of pesticides on resource concerns.**	Maintain or improve soil aeration and drainage to avoid standing water and minimize plant disease. (Example: Use tile drainage, sub soiling, grassed waterways, raised beds, and organic matter additions. Avoid planting in low and wet spots in field.)	.		Improved drainage will reduce damage caused by P*hytophthora* and other seedling diseases		
	BIOLOGICAL CONTROLS					
	Use insect mating disruption devices, if available.					
	Conserve naturally occurring biological controls. (e.g., select pesticides and time applications to minimize impact on beneficial, use floral perimeter crop to attract and support beneficial insects.)	Natural Enemies in Field Crops[20], Environmental Impact of Pesticides (EIQ)[13], Biological Control of Insects and Mites [8]				
	Release beneficial organisms where appropriate. (e.g., release predatory mites for control of two-spotted mites and thrips.)	Biological Control of Insects and Mites [8]				
	Use compost as a soil amendment to increase biological diversity in soil and plant health and suppress plant disease.	Ohio IPM Elements1				
	CHEMICAL CONTROLS					
	Minimize chemical use. Use in conjunction with accurate pest identification and monitoring, action thresholds, alternative suppression tactics (biological, cultural, etc), and judgments based on previous year's weed map and/or pest scouting records. (e.g., use pheromone traps to monitor for corn earworm in sweet corn.)	Weed Control Guide For Field Crops[6], Ohio IPM Elements[1], Economic Threshold for Weeds[7]	Spot or rescue herbicide treatments are based on available economic threshold and weed interference information[7].	Spot or rescue herbicide treatments are based on available economic threshold and weed interference information.	Monitor viability of alfalfa stand to determine whether herbicide application is justified, or if the field should be rotated to another crop. Spot or rescue herbicide treatments are based on available economic threshold and weed interference information.	
	Select pesticides, formulations, and adjuvants based on least negative effects on environment, beneficial (e.g., pollinators, predators, parasites), and human health in addition to efficacy and economics.	See environmental cautions on pesticide label and Environmental Impact of Pesticides (EIQ)[13].				

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SUPPRESSION	Use lowest labeled rate that is effective based on label, scouting results, and Extension-recommended action thresholds for target pest.	Contact state NRCS or Extension office for spray record keeping forms.				
	Limit applications to partial fields or banding to reduce quantity or impact of pesticide. (e.g., spot treat where pests are found or use banding, seed, edge or field perimeter/border treatments.)	Ohio IPM Elements[1] Mass IPM Guide Lines[2] Economic Thresholds for Weeds[7]	Herbicide programs and rates are selected on a field-by-field basis, based on tillage, soil factors, and knowledge about weed populations.	Herbicide programs and rates are selected on a field-by-field basis, based on tillage, soil factors, and knowledge about weed populations.	Herbicide programs and rates are selected on a field-by-field basis, based on tillage, soil factors, and knowledge about weed populations.	
	Calibrate sprayers or applicators prior to use to verify amount of material applied.	Pesticide Calibration Guide[12]				
	Use pesticide-resistance management strategies as appropriate and where required on pesticide label. (e.g., alternate applications of chemicals with different modes of action to avoid development of pest resistance or leave part of crop unsprayed to serve as a refuge for susceptible pests and natural enemies.)	Managing Pest Resistance to Pesticides[14].				
	Use specialized pesticide application equipment to increase efficiency and reduce chemical drift. (e.g., use wiper applicators, digitally controlled adjustable tool bars, direct injection sprayers, double-drop sprayers, laser guided precision sprayers, direct injection, low-drift nozzles, shielded applicators or air induction booms, built-in tank washers, etc.)					
	Use spray-monitoring equipment. (e.g., use water-sensitive cards to measure spray pattern and drift.)					
	Use vegetative buffers, set-backs, or filter strips to minimize chemical movement to sensitive areas such as surface waters, schools, residences, and neighboring crops.					
	Use mitigation practices as necessary in accordance with pest monitoring results, pest predictions, action thresholds, and WinPST output.					

PRINCIPLE	PRACTICES	REFERENCES	Field Corn	Soybeans	Alfalfa	Wheat
	Pesticide applicator must be properly licensed and certified when using restricted use pesticides or when doing custom pesticide applications for hire. Contact state pesticides regulatory agency for license and certification requirements.					
	NOTE: Additional pesticide use requirements from the 595 Practice Standard:	***NOTE:** See documents listed in the attached resource list for additional guidance.				
	> Always follow all pesticide label instructions and environmental cautions.					
	> Store, handle, transport, mix, use, and dispose of pesticides and pesticide containers per state pesticides regulatory agency recommendations and regulations.					
	> Follow state and federal worker protection standards.					
	> When drawing water for pesticide mixing from any surface waters of the state, use anti-siphoning devices and do not use hoses that have been in contact with pesticides.					
	> Do not mix or load pesticides within 50 ft from the high water mark of any surface waters of the state.					

IPM Practices for Field Crop Production

Resource List

IPM Guidelines and Elements

1. IPM Elements. 2000-2009. Ohio Integrated Pest Management Program. http://www.ipm.osu.edu/default.asp

2. IPM Guidelines. 2007. Umass Amherst. http://www.umass.edu/umext/ipm/guidelines/index.html

Cover Crops and Weed Management

3. Sullivan, P. 2001. Flame weeding for agronomic crops. National Sustainable Agriculture. Information Service. ATTRA Publication #CT157 http://attra.ncat.org/attra-pub/PDF/flameweed.pdf

4. Sullivan, P. 2003. Overview of cover crops and green manure. National Sustainable Agriculture Information Service. ATTRA Publication #IP024. http://attra.ncat.org/attra-pub/covercrop.html

5. Sullivan, P. 2003. Principles of sustainable weed management for cropland. http://www.attra.org/attra-pub/PDF/weed.pdf

6. 2009 Weed Control Guide for Field Crops. 2008. MSU Extension Bulletin E-434 http://web2.msue.msu.edu/bulletins/Bulletin/PDF/E0434.pdf

7. Economic Threshold for Weeds. Field Crop Resources at University of Illinois Formula for calculating Economic Treatment Threshold

Insect and Disease Management

8. Mahr, D. L., P. Whitaker, N. M., Ridgway. 2008. Biological control of insects and mites: An introduction to beneficial natural enemies and their use in pest management. Cooperative Extension Publishing.

9. DuFour, R. 2001. Bio intensive integrated pest management. National Sustainable Agriculture Information Service. ATTRA Publication #IP049. http://www.attra.org/attra-pub/ipm.html ATTRA Nematode Fact Sheet

10. Everts, K., S. Sardanelli, R. Kratochvil, and L.B. Gallagher. 2005. Agricultural innovations fact sheet: Cultural practices for root-knot and root-lesion nematode suppression in vegetable crop rotations. Sustainable Agriculture Research and Education. SARE Publication #06AGI2005. http://www.sare.org/publications/factsheet/0605.htm

11. Hazzard, R., A. Brown, and P. Westgate. 2008. Using IPM in the field: Sweet corn insect management field scouting guide (draft). University of Massachusetts Extension Vegetable Program.

Pesticide Management

12. Dill, J. & G. Koehler (Eds.). 2005. Agricultural pocket pesticide calibration guide. University of Maine Cooperative Extension & USDA. http://pronewengland.org/INFO/PROpubs/CalibrationGuide-small.pdf

13. Kovatch, J., C. Petzoldt, & J. Tette. A method to measure the environmental impact of pesticides. New York State Integrated Pest Management. Cornell University. http://nysipm.cornell.edu/publications/eiq/default.asp

14. Managing pest resistance to pesticides. 2008. Gemplers. http://www.gemplers.com/tech/ipm-resistance.htm

15. Windows pesticide screening tool Win-PST 3.0. Natural Resources Conservation Service. http://www.wsi.nrcs.usda.gov/products/W2Q/pest/winpst.html

General IPM Resources

16. Flint, M.L. and P. Gouveia. 2001. IPM in Practice: Principles and Methods of Integrated Pest Management. University of California. Publication 3418.

17. May, H.L. and M.B. Ryan. IPM and wildlife. 2004. NRCS. Fish and Wildlife Management Leaflet. No. 24. ftp://ftp-fc.sc.egov.usda.gov/WHMI/WEB/pdf/IPM_Wildlife.pdf

18. Vaughn, M., M. Shepherd, C. Kremen, and S.H. Black. 2007. Farming for Bees: Guidelines for Providing Native Bee Habitat on Farms. 2nd ed. Xerces Society for Invertebrate Conservation. Portland, OR. http://www.xerces.org/guidelines-farming-for-bees/

19. Tri-State Fertilizer Recommendations for Corn, Soybeans, Wheat and Alfalfa.2000. MSU Extension Bulletin E-2567 http://web2.msue.msu.edu/bulletins/Bulletin/PDF/E2567.pdf

20. Natural Enemies in Field Crops: A Guide to Biological Control. 2001. MSU Extension Bulletin 2721. http://web2.msue.msu.edu/bulletins/Bulletin/PDF/E2721.pdf

Forecasting Service Websites

21. Cucurbit downy mildew forecast homepage. 2008. http://www.ces.ncsu.edu/depts/pp/cucurbit/

22. Pest Watch. Penn State University. [A free internet-based insect and disease forecasting service for sweet corn and other crops. Based on in-season data from Maine and other NE states.].http://www.pestwatch.psu.edu/

23. Skybit.com. [Commercial weather service].http://www.skybit.com/

Pest Bulletins and News Letters

24. IPM Pest Monitoring Network. Univesity of Missouri http://ppp.missouri.edu/pestmonitoring/subscribe.htm

25. Wisconsin Pest Bulletin. Wisconsin Department of Agriculture Trade and Consumer Protection (DATCP) http://pestbulletin.wi.gov/

26. Minnesota Pest Report. Minnesota Department of Agriculture http://www.mda.state.mn.us/plants/pestmanagement/pestreports.htm

27. *Pest & Crop Newsletter* (Purdue University). http://extension.entm.purdue.edu/pestcrop/index.html

28. *Field Crop Advisory Team Alert Newsletter* (Michigan State University) http://ipmnews.msu.edu/fieldcrop/

29. *Integrated Crop Management News*. Iowa State University Extension http://www.extension.iastate.edu/cropnews

IPM Websites

30. National Sustainable Agriculture Information Service. 2007. [Source for IPM and organic guidelines for many pests and practices]. http://www.attra.ncat.org/pest.html

31. North Central IPM Center. http://www.ncipmc.org/index.cfm

32. Integrated Pest Management Resources at Iowa State University
http://www.ipm.iastate.edu/ipm/

33. Pest Management Guidelines. University of Missouri http://ppp.missouri.edu/pestguide/

34. Field Crop IPM Resources. University of Illinois
http://ipm.illinois.edu/fieldcrops/index.html

35. The IPM Institute of North America, Inc., http://www.ipminstitute.org/