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IPM Working Group Priorities Competitive Fund (IWG)

D3. IWG Literature Review, Previous Work, Related Experience

Access to insect and disease pest forecast and severity estimates is a priority expressed on every one the Northeast Center IPM Working Group priority lists (see attachment 8). New England stakeholders have expressed interest in the application of weather data for use in pest management decisions (Coli et al. 2001). Effective monitoring is the backbone IPM, but the time requirement for repeated pest monitoring sessions reduces its practicality and adoption. Optimum timing is essential for minimizing pesticide use with maximum effect. Funding for the New England Pest Management Network (NEPMNet) will allow us to leverage recent advances in meteorology, understanding of pest biology, and the widespread availability of computers and internet connections to facilitate IPM adoption, improve monitoring efficiency, and enhance efficacy of pesticides and other pest control tactics by identifying optimum timing for pest management decisions.

NEPMNet will provide access to pest and crop phenology model estimates in two ways. The first is in partnership with a private sector meteorological service (SkyBit Inc.). SkyBit will provide twice daily updates of hourly–resolution weather observations and forecasts for ten New England sites. SkyBit service has been evaluated in many pest management settings and found to be a valid, reliable and convenient source of weather data for pest phenology models (e.g. Caron and Richardson 2004). In addition to its use as input for pest and crop phenology models, the hourly weather forecasts will be published in chart and table form to provide easy access to weather information at a resolution required for efficient scheduling of field work. For examples see
http://pmo.umext.maine.edu/apple/AllModels/MEmodel/ME-Monmouth-HourChart.htm and
http://pmo.umext.maine.edu/apple/AllModels/MEmodel/ME-Monmouth-HourForecast.htm
Weather information is widely available, but not in a format tuned to the needs of farmers. This has been exacerbated by reduction in National Weather Service agricultural weather products.

An automated data management and web publication system that is already in operation (Koehler 2000) will translate the weather data into pest and crop forecast dates for key pest and crop events. It is beyond NEPMNet resources to develop new phenology models. Fortunately, models for many of the high priority pests in New England are available in the scientific and Extension literature (e.g. Agnello and Kain 2003, Bounds 2003, Childs et al. 2000, Dorman 2003, Hausbeck 2003, Herms 2002, Hoover 2002, Jyoti et al., Krause et al. 1975, Madden et al. 1978, Meyer et al. 2000, Petzoldt and Hoffmann 1999, Pitbaldo 1992.) In Year 1, we will implement existing crop and pest models for apples, woody ornamentals, and key vegetable pests. This will constitute the establishment of a New England Pest Forecast System.

Apple pests were selected because apples are an economically important crop grown in all six New England states with high reliance on pesticides, because a suite of apple pest models is already in operation and only requires linking up to the new weather sites, and because the diverse and challenging pest complex for apples makes phenology models a valuable tool for management assistance.

Woody ornamentals pests were selected because of the large and growing importance of the ornamental plant industry in New England, interest expressed by professional landscape managers for degree day guidance, the opportunity to serve a great number of "homeowner" backyard pesticide users, and increased interest in homeowner pesticide use.

The key vegetable pest models were selected on the basis of importance of the pest in New England, and the availability of an established weather-based pest management decision model that is part of IPM guidelines in New England and elsewhere.

In Years 2-4, existing models for additional vegetable pests and for weed seed germination and emergence will be considered for deployment, but only after the calculation and presentation of the Year 1 models have been finalized.

Links to the pest forecast web pages showing pest and crop forecasts will be given to Extension and University researchers as a resource for advising clients, creating newsletters and conducting field work. After an initial period of evaluation and adjustment, the decision whether to make the pest models available for direct public use will made by each state individually. This will allow the individual state Extension IPM programs to retain control of Land Grant University pest management information communicated to their state clientele. The state network project liaisons will be responsible for communicating with Extension IPM program leadership in their state to decide when to publicize the links for site(s) in their state for public access. When approved, links to the models for each state will be publicized on the PRONewEngland website.

The second way we will address stakeholder and IWG interest in pest forecasting is by affiliating NEPMNet with a regional pest forecast mapping system operated by Zedex Inc. Implementation of this system began in 2003 as a cooperative research project by Zedex, Cornell University, Iowa State University, Penn State University, University of Delaware, University of Maryland, and Rutgers University. An example of the model output format used can be seen online at http://www.agfleet.com/map/regional/region.php?region=3.

The mapping system has not been formally named yet, but last year used "Agfleet" as a working title. By becoming an affiliate, NEPMNet will allow New England states to benefit from the IPM decision making information published at the Agfleet website. As noted above for the locally generated pest forecast models, the state network project liaisons will be responsible for communicating with Extension IPM program leadership in their state to decide when to publicize links to the Agfleet regional pest forecast maps for public access. When approved, links to the models for each state will be publicized on the PRONewEngland website.

With ten sites spread across six states, we will not be offering a nearby site for all users. But even for users not close to one of the chosen sites, the pest forecasts can be used as general indicators. This is particularly true for simple degree day models that require only temperature data. Temperatures are consistent over relative wide areas, thus increasing the range over which forecasts made at a given site are useful to outlying locations. Users will also be able to compare

their own on-site weather data with the weather data entered for each pest forecast model site. This will help users adjust their interpretation of pest and crop estimates made at the nearest model sites in relation to their own location. The Agfleet products represent estimates as color-coded regional maps. Thus for the Agfleet products, interpretation between data points is addressed within the methodology used to produce the output.

The availability of real time pest and crop phenology estimates and forecasts will add a new dimension to IPM support in New England. Except for apple pest models which have been provided at a limited number of sites for orchardists in Maine and Rhode Island, these products are currently not available. As a regional project with a major web component, NEPMNet is perfectly suited to perform the centralized data management and web publication duties to make these tools available for New England pest management stakeholders.

In consultation with the project Advisory Committee in fall 2004, we will then consider how to move forward in this area. An objective of that meeting will be determining if there are user training needs, and if significant needs are identified, how to address them. One possibility is linkage between NEPMNet, IPM Extension programs, and IWGs to delivery such training as a component for the Year 2 NEPMNet proposal expected for submission in January 2005.

E3. IWG Objectives
Project Goal 4. Increase IPM adoption

Objective 4. Provide daily updates for pest and crop phenology forecasts for corn, tree fruit, vegetables, and woody ornamentals. Apply an existing automated system of weather data acquisition, processing, and web publication to provide IPM decision support information to pest managers. Provide Extension and research personnel, and eventually with state approval, public access to the "Agfleet" regional pest forecast models.

F3. IWG Procedures

Procedures for Objective 4.

The University of Maine Pest Management Office has the computer and network infrastructure required to operate the New England Pest Forecast System. In technical terms, the system will only require expansion of an existing system that NEPMNet co-director Glen Koehler has operated for the Maine Cooperative Extension Apple IPM Program since 1997. Koehler will be responsible for New England Pest Forecast System development and operations as an extension to his duties as PRONewEngland website webmaster.

Site locations will be chosen by consultation between Koehler and the state liaisons. State liaisons will in turn check with apple, ornamental, and vegetable specialists in their state to identify preferred location of the weather sites. Model sites will be distributed as follows: CT – 1, MA – 2, ME – 2, NH – 2, RI – 1, VT – 2.

Procedures for Objective 4 continued**.**

Pests important in New England and for which phenology models are available

Apples

Diseases

Apple scab ascospore maturity
Apple scab comprehensive infection potential rating
Apple scab inoculum load development and release
Apple scab lesion appearance dates
Apple scab infection period timing and severity
Apple scab respray guidelines
Flyspeck fungicide respray guidelines
Maryblyt fireblight blossom blight risk
Cougarblight fireblight blossom blight risk

Insect pests

Apple maggot monitoring and control period
Dogwood borer egg hatch dates
Codling moth beginning and peak flight dates, egg hatch dates: 1st and 2nd generation
European red mite key generation dates and resampling intervals
Lesser appleworm beginning and peak flight dates: 1st and 2nd generation
Mullein plant bug egg hatch
Plum curculio monitoring and control period
Redbanded leafroller beginning and peak flight dates: 1st and 2nd generation
Roundheaded apple tree borer egg hatch dates
San Jose Scale crawler emergence dates: 1st and 2nd generation
Spotted Tentiform leafminer key monitoring dates: 1st and 2nd generation
Tarnished plant bug overwintering adult activity
White apple leafhopper monitoring dates: 1st and 2nd generation

Key apple horticultural management dates

Apple bud stage dates
Apple thinning sensitivity
Apple maturity dates
Storage scald and preharvest drop sensitivity

Other tree fruit insect pests

Lesser peach tree borer beginning and peak flight dates
Peach tree borer beginning and peak flight dates
Pear psylla adult activity and egg hatch dates
Bud stage dates for peaches, pears, plums, and sweet cherries.

Vegetables

Diseases

Tom-Cast for tomato early blight, asparagus purple spot and carrot foliar blight.
Blitecast - Potato late blight forecast for potatoes.
Seasonal risk indicator for early Stewart's wilt of sweet corn

Insect pests
Cabbage maggot adult emergence dates
Colorado potato beetle larval development (potatoes, corn, peppers)
European corn borer flight, egg hatch, and larval tunneling dates for corn, potatoes, and peppers
Onion maggot peak flight dates: 1^{st} – 3^{rd} generations
Key horticultural management dates
Forage and sweet corn growth stages to time insect and weed management
Harvest dates estimates for forage corn varieties

Woody Ornamentals Insect Pests
Arborvitae leafminer
Azalea lace bug
Balsam twig aphid
Birch leafminer
Black vine weevil
Bronze birch borer
Cooley spruce gall aphid
Dogwood borer
Eastern spruce gall adelgid
Eastern tent caterpillar
Euonymous scale
European pine sawfly
European pine shoot moth
Fall cankerworm
Fall webworm
Forest tent caterpillar
Green peach aphid
Gypsy moth
Hawthorn lace bug
Hemlock wooly adelgid
Honey locust plant
Introduced pine sawfly
Japanese beetle
Lilac leafminer
Lilac borer
Locust leafminer
Mountain ash sawfly
Oak sawflies
Oak skeletonizer
Pine needle scale
Polydrusus weevil
Redheaded pine sawfly
Rhododendron borer
Rhododendron tip midge
Roundheaded apple tree borer
Snowball viburnum aphid

Spruce spider mite
"Spittlebug" (species not clarified)
Taxus mealybug
Twospotted spider mite
Viburnum leaf beetle
White pine aphid
White pine weevil

Starting dates:

State liaisons will report dates for a few key plant growth stages in their state to serve as biofixes. A biofix is an observation marker used to start accumulating values toward a target threshold. Biofixes are very useful for calibrating models developed outside of New England for use in New England. Experience with apple models developed in western New York and applied in Maine showed a bias for events to occur at a smaller total seasonal accumulation of degree days in Maine. But when McIntosh green tip was used as a biofix and all subsequent events were estimated by the number of degree days past green tip rather than by total seasonal accumulation, the forecast accuracy using the New York degree day values in Maine narrowed to within 0-3 days for events which could be confirmed by confirmatory observations.

The following biofix dates will be needed for each model site:
McIntosh Apple green tip
McIntosh Apple half inch green
McIntosh Apple first bloom
"Northern border" forsythia full bloom
Common lilac full bloom.
Beginning and ending dates for the majority of forage corn and sweet corn plantings.
Where potatoes are an important crop: First observation of Colorado potato beetle eggs

Helpful but optional:
First trap catch date for second generation spotted tentiform leafminer moths (apples)
First trap catch date for first generation European corn borer moths, cabbage maggot flies, and onion maggot flies (vegetables).

G3. IWG Literature Cited

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H3. IWG Probable Duration: 12 months
(Year 1 is covered by this proposal and budget, with plan to continue into Years 2 – 4 of the funding cycle)

I3. IWG Evaluation Plans

OBJECTIVES	**Performance Rating & Documentation**
Pest and crop forecasts, and detailed weather information.	Forecasts and weather information online for 2004 growing season.
Feedback from web site users.	Entries received through dialogue form on the PRONewEngland website.

Timeline for New England Pest Forecast System:
April 1
- Identification of weather data sites.
May 1
- Highest priority pest forecasts identified.
- Base system for handling weather data capture and analysis completed.
- Links to Agfleet pages distributed to state liaisons for distribution to interested Extension and research staff in their state.
June 1
- Base system cloned and operative for all sites.
- Crop forecasts published online with daily updates.
- User evaluation link present on PRONewEngland. Maine models will be publicly linked from the beginning, so there will be at least two sites which users can see to evaluate the information content and presentation of the pest forecasts.
September 30
- End of Year 1 pest forecasts and detailed weather updates.
November 30
- Summarize user feedback submitted through web site. Contact vegetable, apple, and woody ornamentals Extension specialists in all six New England states for feedback. Propose next steps for review by Advisory Committee.