

Managing Metalaxyl-Resistance in *Plasmopara halstedii* from a Chemical Company Perspective

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Its a pleasure to be invited to this symposium and I am looking forward to the discussions on metalaxyl resistance in sunflower. I am here to present an industry perspective on managing metalaxyl resistance in *P. halstedii*.

First some background issues :

Background

- Metalaxyl -since 1979 to date- has been the lead product for control of downy mildew and pythium.
- Brand name Apron Preferred globally for downy mildew control.
 - Apron -XL -the active isomer of metalaxyl will have an added advantage over just straight metalaxyl. Apron XL is an isomer of Apron. Apron (Metalaxyl) is actually a 50:50 mixture of two species called *stereoisomers*. Stereoisomers are compounds that are identical in every respect except that they are mirror images of one another. Your left and right hands are familiar examples of the same concept. Stereoisomers are simply the left handed and right handed versions of the same molecule.
 - Apron -XL is now our standard for control of fungi that belong to Oomycetes. It is classified as a reduced risk product and has a broad label including for control of downy mildew in sunflower. Because of the double level of active isomer the product is labelled for use at low use rates. It controls a wide range of pathogenic species of fungi that belong to oomycetes. The mode of action of Apron XL, like other members of the phenylamide class of chemistry, that inhibits RNA synthesis. This specific mode of action results in the prevention of spore production and the inhibition of mycelial growth of the fungus. Apron XL moves systemically into plants, providing more uniform distribution than is normally achieved with protectant seed treatments and making it less susceptible to removal by rainfall or binding to soil.
- Research is underway in Novartis to develop mixtures in view of a pro-active-anti resistance strategy.

Approach

Resistance management through integrated disease management concepts.

Present a basic framework for the development of adapted resistance management concepts.

Final strategies to be developed at the country level due to differences in agronomic conditions

With no reported incidence of sensitivity to metalaxyl from *P. halstedii* in the United-States, the 3 general guidelines we would like to address are :

- The no resistance issue at this given time.
The actions we need to take are :
 - Monitor the product performance closely.
 - Promote IPM practices.
 - Develop or identify mixing partners with metalaxyl.

- At the first sign of resistance :
 - Check if agronomic or environmental explanation can be found (loading, climatic seed quality).
 - Test for pathogen sensitivity from sites reported and map the incidence.
 - Reinforce IPM practices.
 - Recommend mixtures with different modes of action. We ask support from cooperative extension services, local press in documenting and disseminating accurate information pertaining to the report of resistance and only publish if confirmed through reliable sources.

- If resistance is confirmed,
our actions will be to :
 - Manage the issue to minimize the damage.
 - Seed quarantine.
 - Reinforce IPM principles.
 - Follow up surveillance of sensitivity and performance.

**Downy Mildew/Sunflower
Resistance Management concept PROCESSES**

Prevention

Indirect measures to reduce resistance risks :

- **PLANT RESISTANT VARIETIES**
- **IMPLEMENT CROP ROTATION**
 - Downy mildew soil contamination can last between 3 to 10 years
- **GOOD CROP MANAGEMENT**
 - Sowing under weather conditions allowing rapid emergence.
 - Avoid deep sowing.
- **REDUCE PATHOGEN SPREAD**
 - Avoid spread of infected seed.
 - Avoid transport of infected soil or plant material.
- **MANAGE SEED PRODUCTION**
 - No repeated use.

**Downy Mildew/Sunflower
Resistance Management Concept PROCESSES**

Observation

Decision Tools :

- **CROP MONITORING**
 - By farmers.
- **SENSITIVITY TESTING**
 - Use reliable lab methods.
- **SENSITIVITY MONITORING**
 - Determine frequency of strains with different sensitivity in overall population.

**Downy Mildew/Sunflower
Resistance Management Concept PROCESSES**

Intervention

Direct Measures :

- **UPROOT AND DESTROY INFECTED PLANTS**
 - Include volunteers
- **CHEMICAL CONTROL**
 - Seed treatment of all seeds.
 - Ensure correct loading rates.
 - Use partners in case of confirmed resistance to metalaxyl.

**Downy Mildew/Sunflower
Resistance Management Concept TECHNOLOGY**

Provided by industry

- **PRODUCTS WITH DIFFERENT MODES OF ACTION**
 - Evaluation of compounds is ongoing.
- **DEVELOPMENT OF MIXTURES PRODUCTS**
- **FORMULATE TECHNOLOGY**
 - Optimal seed loading.

**Downy Mildew/Sunflower
Resistance Management Concept SERVICES**

Provided by industry

- **PROMOTE AND ADOPT IPM STRATEGIES**
- **IMPLEMENT USE RECOMMENDATIONS**
- **GOOD APPLICATION TECHNOLOGY**
 - Optimal seed loading.
- **RESISTANCE RISK ASSESMENT**

**Downy Mildew/Sunflower
Resistance Management Concept SERVICES**

Public Research

- **DEVELOP AREA-WIDE DISEASE MANAGEMENT CONCEPTS**
- **MONITORING OF IMPACT OF PROGRAMS ON USER PRACTICES**
- **SENSITIVITY MONITORING**

**Downy Mildew/Sunflower
Resistance Management Concept SERVICES**

Education and Training

IPM Implementation :

- TARGET AUDIENCES
 - Industry.
 - Officials.
 - Distributors and dealers.
 - Extension Services.
 - GrowersIn Summary.

What is working for us in the United States is :

- 1 Apron and Apron XL continue to work well. Need to monitor resistance.
- 2 No reported resistance or sensitivity of *P. halstedii* in the U.S.
- 3 The exclusive use of these products as a seed treatment once in each sunflower production season reduces the opportunity for rapid development resistance.
- 4 The systemicity is a proven advantage of metalaxyl particularly to control pathogens in the oomycetes order.
- 5 The possibility of using an anti-resistant mixing partner exists.
- 6 Strong emphasis on IPM practices—Fungicide mixtures, resistant varieties, appropriate crop rotation and soil preparation can contribute to overcome the impending threat of resistance to chemical control of downy mildew in sunflower