Potentials For Improved Disease Control Through Integrated Interdisciplinary Research.

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Optimal Control of Plant Disease

- Controlling diseases is of critical importance for all vegetable crops, including tomato.
- Tomato is considered a model system to demonstrate the value of breeding for disease resistance.
- Potential exists for additional improvements in disease control through better integration of research in plant breeding and plant pathology.
- True interdisciplinary interaction, from the earliest stages of the programs, provides greater efficiency to accomplish goals and more opportunities for success than in separate uni-disciplinary programs.

Accomplishments of Uni-Disciplinary Approach of Plant Pathology?

- Test new control compounds to determine efficacy of control of disease on susceptible cultivars.
- Determine parameters to develop scouting protocols, time to spray on susceptible cultivars to minimize chemical use.
- Develop weather based forecast systems to time sprays on susceptible cultivars (Blitecast for late blight and TOM-CAST for early blight and Septoria leaf spot).

Risk / Unrealized Opportunity in Uni-Disciplinary Approach to Plant Pathology

- By using only susceptible varieties in trials, the methods and results obtained pertain only to susceptible varieties.
  - Strategies developed using only susceptible varieties are obsolete when resistant are adopted.
  - Agents cannot advise growers regarding scouting, thresholds, what sprays to use on the resistant varieties.
- Labels might require excessive levels of compound use.
- Control compounds that were too weak on susceptible varieties, could be effective on tolerant/resistant ones, but this was not determined.
  - Loss of possible use of mild control options with lower EIQ (environment impact quotient).

Accomplishments of Uni-Disciplinary Approach of Plant breeding

- Identify sources of strong resistance or tolerance to control disease, & transfer this resistance to cultivated tomato.
- Many examples of transfer of single gene resistance in tomato.

Risk / Unrealized Opportunity in Uni-Disciplinary Approach to Plant Breeding

- Limiting resistances used to only genes with conferring total disease control limits the pool of candidate genes.
  - Breeder might reject a source of tolerance/resistance that is considered to be too weak to stand alone.
  - This is lost opportunity if the resistance could actually give needed control in combination with a mild supplemental control.
- Resistant varieties are released without information to
  - Guide development of commercial varieties (homozygous or heterozygous for resistance gene),
  - Guide use of varieties (how to scout, type and numbers of supplemental sprays, threshold for spray, etc).

CONCLUSION

- A system that combines research in plant breeding and plant pathology more closely and earlier in the process could reduced risks, achieve greater gains.
- Case in point: Cooperative work on defoliating pathogens of tomato at Cornell University

Breeding (Mutschler)

Plant Pathology (Tom Zitter)

Control of Fungal Pathogens that Defoliate Tomato in NE US

- Three pathogens defoliate tomato in NE, reducing yield and fruit quality.
  - Early Blight (Alternaria tomatophila)
  - Late Blight (Phytothora infestans)
  - Septoria leaf spot (Septoria spp)
- This is a top disease control priority across NE.
- Must control all three diseases to be able to reduce total pesticide usage.
- Example of a situation in which target is overall protection of part of the plant (foliage) rather than focusing on one disease.

Perform Tests Of Deployment Issues On Resistance Lines While Breeding Was Proceeding

- Deployment Tests of Lines with genetic control of LB and EB revealed
  - the importance for using homozygous rather than heterozygous form of late blight resistance to control some pathogen isolates
  - the importance for using homozygous rather than heterozygous form of early blight tolerance to achieve optimal control under conditions favoring this disease.
- This information was provided to seed companies, agents when resistant germplasm was being released, empowering companies to make informed choices.

Perform Tests Of Deployment Issues On Resistance Lines While Breeding Was Proceeding

- Disease control of EB tolerance + minimal sprays of reduced risk compounds (coppers, biologicals), equals protection of intensive spray regime of high EIQ fungicides on susceptible tomatoes.
- Positive interaction between genetic and supplemental controls provides useful level of control using genetics tolerance and control compounds which, individually, do not provide desired levels of controls.
  - This increases the options for developing workable systems of disease control.

Interactive Trials Of Lines EB/LB Lines Demonstrated The Importance Of Controlling Septoria Leaf Spot

- **Triggered the breeding program to combine SLS resistance with genetic controls of LB and EB, before the issue was discovered on growers fields.**
- **Pyramiding genes to control different pathogens with similar impacts on plant (i.e. defoliation)**
- **Currently testing disease control with/without supplemental low EIQ fungicides with/without following TOM-CAST.**

Obstacles To Combining Breeding And Plant Pathology Efforts Earlier And More Interactively

- Cost
  - must fund both aspects of joint program
- Reduced number of active public plant breeders and field plant pathologists.
  - Not replacing researchers active in field work.
- To overcome these obstacles, we may need greater interaction of private researchers, public researchers, extension staff.