Can Management Strategies for *Rhizoctonia solani* of Sugar Beet in the US be Adopted in Europe?

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Outline

- Sugar beet in the US
- *Rhizoctonia solani*
- Research and practices - resistance management strategies
- Interpretation and utility of practices done in US
- Conclusion

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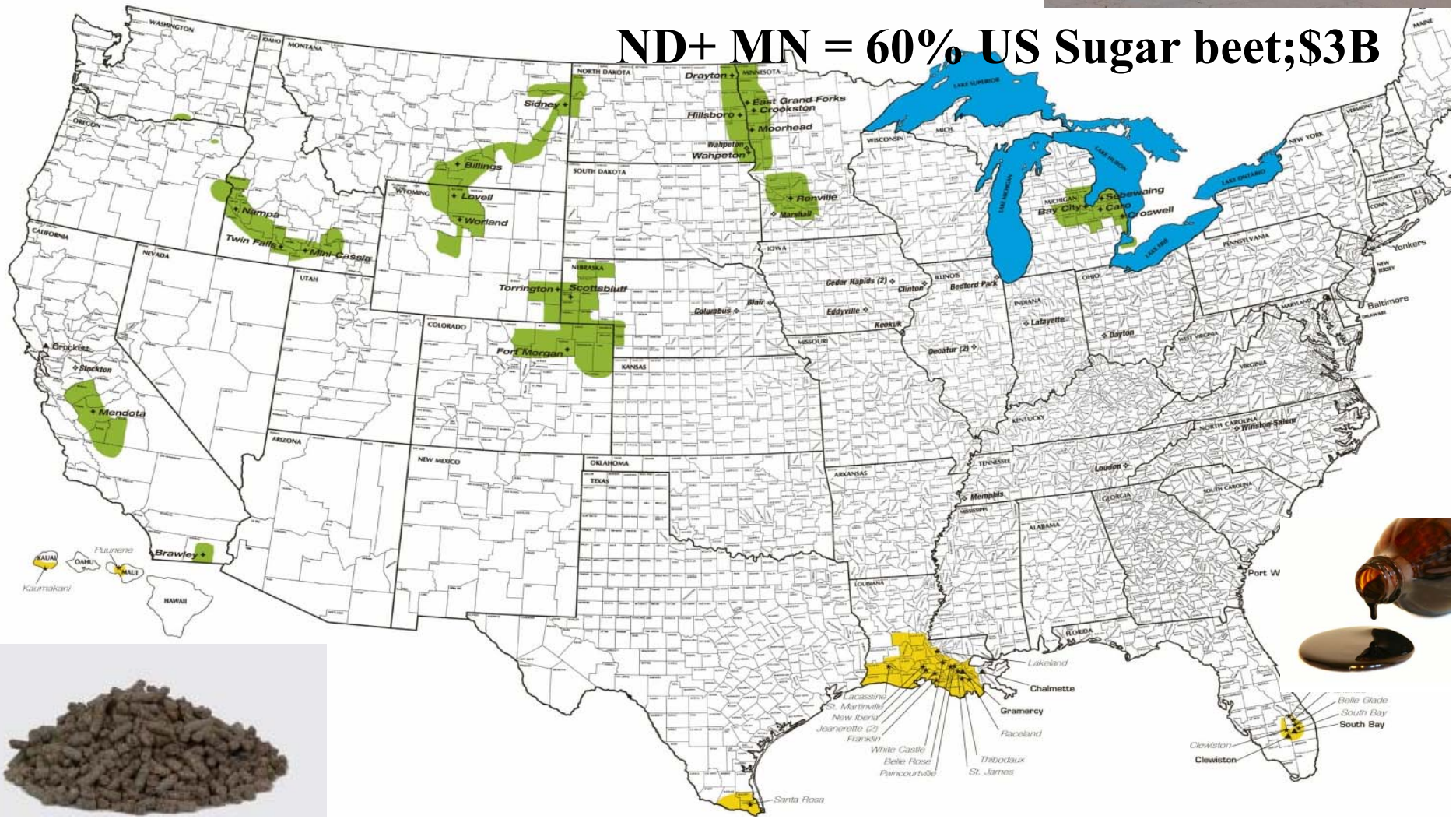
ND+ MN = 60% US Sugar beet;$3B



Rhizoctonia Damping-Off, Crown Rot and Root Rot

- **Causal agent – *R. solani*; AG-2-2 IV and AG-2-2 IIIB**
- **Infections are more severe in wet conditions.**

General Management Principles

- **Field selection – best fields; longer rotation with non-host crops such as wheat and barley**
- **Avoid planting *R. solani* host crops – beans, corn preceding sugar beet**
- **Control weeds – chenopods**
- **Improve drainage; do not throw infected dirt into crown**
- **Plant early in cool soils**
- **Use *Rhizoctonia solani* tolerant varieties**
- **Timely application of effective fungicides**

Damping-off, Crown and Root Rot







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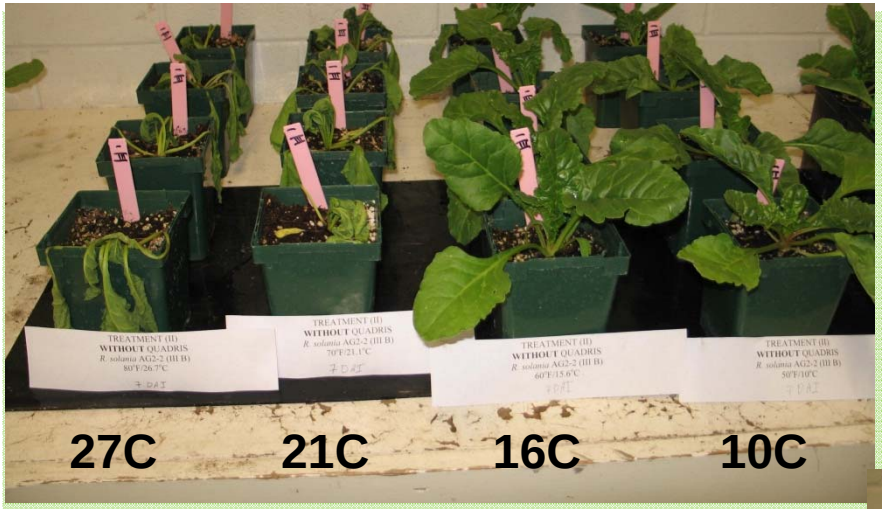
At What Soil Temperature is the Fungus Infective?



4-lf stage sugar beet inoculated with *R. solani* and kept at 27, 21, 16 and 10ºC

4-lf stage sugar beet treated with azoxystrobin, then inoculated with *R. solani* and kept at 27, 21, 16 and 10ºC

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At What Soil Temperature is the Fungus Infective?

- ***R. solani*** **will cause infection ≥18ºC temperatures in the soil at a 10 cm depth in the presence of adequate moisture.**

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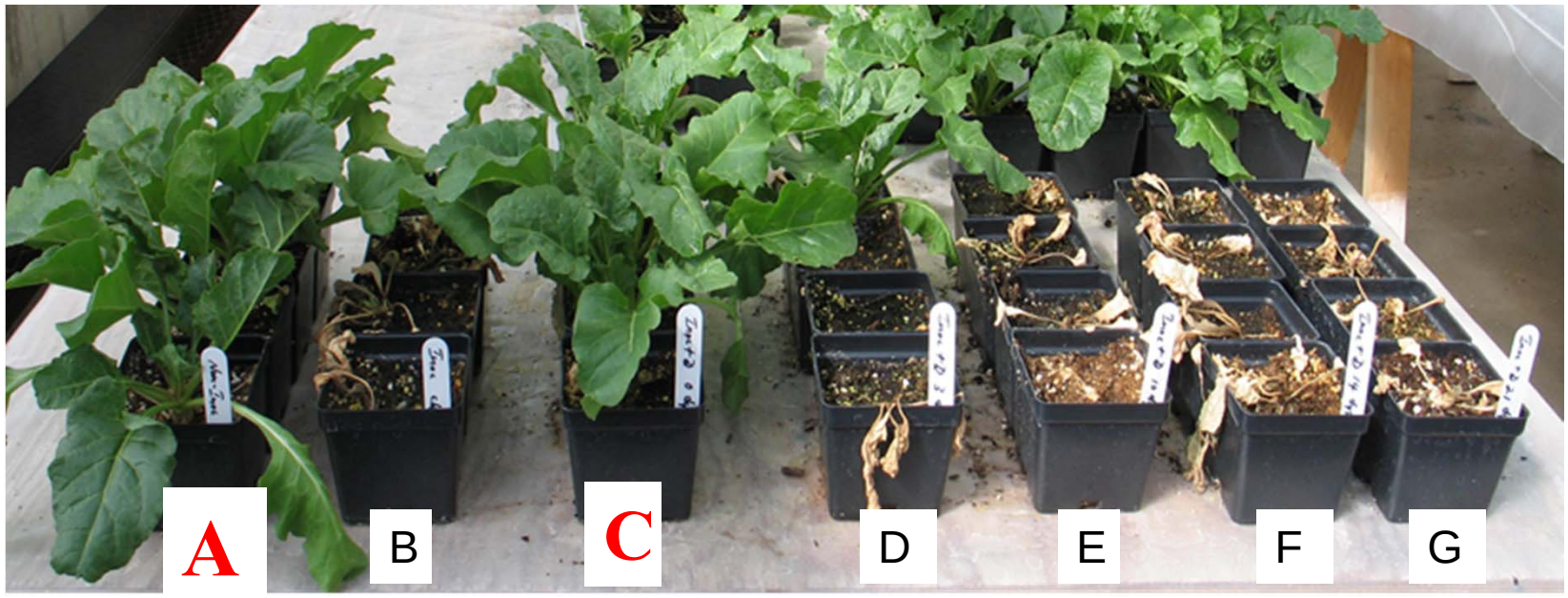
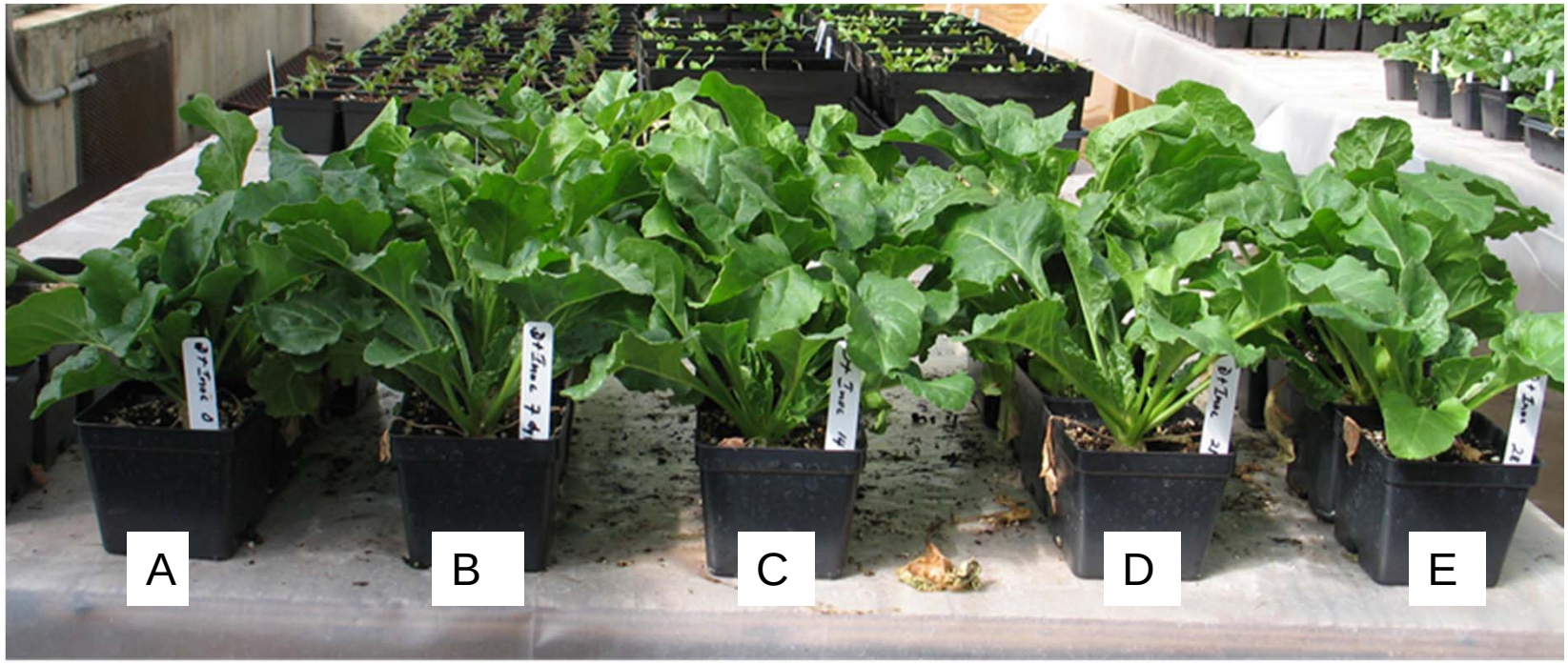
Effect of Azoxystrobin Applied at- or Post-Inoculation



Sugar beet plants inoculation with *R. solani* AG 2-2 IIIB followed by azoxystrobin application at different times. Non-inoculated control (A), Inoculated control (B), 0 days (C), 3 days (D), 10 days (E), 14 days (F), 21 days (G).

Effect of Azoxystrobin Application Pre-Inoculation



Sugar beet plants treated with azoxystrobin followed by inoculation with *R. solani* AG 2-2 IIIB at different times. 0 days (A), 7 days (B), 14 days (C), 21 days (D), and 28 days (E).

When is the Best Time to Apply Azoxystrobin to Control *R. solani*?

- **Azoxystrobin should be applied before infection takes place.**
- ***R. solani* will cause infection when the soil temperature at the 10 cm depth is ≥ 18ºC in the presence of adequate moisture**
  - ***Khan & Bradley, 2010 – Int. Sugar J.***

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Which Fungicides are effective at Controlling Rhizoctonia Root Rot in Field Conditions (*in a Normal Year*)?

Treatments:

-Non-treated check

-One application of a fungicide applied foliarly just before the average daily soil temperature at the 10 cm depth reaches 18ºC;

- As above and a second application 13 days after the first

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Growers Field in Foxhome, MN
Natural Inoculum; Non-treated Check

1 Application Azoxystrobin 0.7 liter/ha

1 Application Prothioconazole 0.4 liter/ha

Effect of Fungicide on Mortality

Treatments	*App. date*	*Mortality/30 m row*
Non-treated Check	-	37
Azoxystrobin	16 June	2
Azoxystrobin	16, 29 June	2
Prothioconazole	16 June	7
Prothioconazole	16, 29 June	5
LSD (0.05)		*12*

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Normal Year Recommendation

- **In a typical year – cool (10°C) at planting and soil temperature reaching 18°C in mid-June – one application of azoxystrobin (Strobilurin/Qoi, Syngenta) or prothioconazole (Triazole/DMI, Bayer) when the average daily soil temperature at the 10 cm depth is about 16°C will provide effective Rhizoctonia root rot control.**
- **Alternating a Qoi with a DMI will help to delay buildup of resistance in the pathogen to the fungicides.**

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Global Climate Change?

- **In the USA, particularly Minnesota and North Dakota, average daily soil temperature at the 10 cm soil depth reached 18ºC in mid-May in 2010, 2012 and early June in 2011; most fields were wet and thus conditions were favorable for damping-off and root rot infections either at planting, or earlier in the growing season.**

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Looks Good from Far…..

…..But Far From Good

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Will an In-furrow Application of Fungicide Control Rhizoctonia Root Rot?

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Glyndon, MN 2011 Results

Treatment	Rate Liter/ha	Rec. Sugar Kg & $/ha
1. Inoculated Check	-	3511/ 1,700
2. Azoxystrobin (*In-furrow*)	0.7	6866/ 3,235
3. Pyraclostrobin (*In-furrow*)	0.7	5080/ 2,371
LSD (0.05)		1486/ 719

Summary

Azoxystrobin effectively controlled *Rhizoctonia solani* when applied in-furrow in an inoculated soil where conditions were favorable for infection soon after planting and throughout the growing season.

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Is there any seed treatment that can be used to provide early season Rhizoctonia control?

Penthiopyrad – broad spectrum
Succinate dehydrogenase inhibitor (SDHI) – binds to ubiquinone binding pocket and inhibits mitochondrial activities

Managing *R. solani* with Penthiopyrad Seed Treatment 35 g a.i/ha + Azoxystrobin 0.7 liter/ha; 2010

Treatment	*Stand Count/30 m row*		*RSA (kg/ha)*
	Jun 9	*Oct 4*	
Inoculated Check	*146*	*96*	*5680*
Penthiopyrad 14 g a.i	**182**	**114**	**6487**
Azoxystrobin (2 June)	**158**	**102**	**7169**
Azoxy (If) /Azoxy (B)	***172***	***168***	***9412****
Penthiopyrad /Azoxy (B)	***182***	***146***	***9534****
LSD (P=0.05)	**24**	**30**	**2437**

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Inoculated Check

Resistant Variety: Azoxystrobin Foliar Application

Resistant Variety: Azoxystrobin In-furrow / Azoxystrobin Foliar

Resistant Variety: Penthiopyrad Seed Treatment

Resistant Variety: Penthiopyrad (Seed Trt) / Azoxystrobin Foliar Application

Summary

- **Penthiopyrad, as a seed treatment, provided good early season control against *R. solani* (but does not provide season long control).**
- **The combination of penthiopyrad as a seed treatment and a timely foliar application of azoxystrobin provided effective control of *Rhizoctonia solani* .**
- **Azoxystrobin used in-furrow followed by a foliar application is not encouraged; avoid development of fungicide resistant *R. solani* isolates.**

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Conclusions

- **Rhizoctonia root rot is becoming a problem in some European countries – Germany and Netherlands.**
- **In addition to the use of more tolerant varieties, azoxystrobin, a relatively benign product with a pre-harvest interval of 0 days may have a utility of controlling *R. solani*.**
- **The use of penthiopyrad at low rates as a seed treatment will be an effective alternating partner with azoxystrobin to delay fungicide resistance.**

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Future

- ✓ **Together, we have an important role to play in helping producers use science and technology to provide enough food, feed, fiber, fuel (flowers + fun for the Dutch) for an increasing and more discerning population,**
- ✓ **Using less arable land (0.21 ha now and 0.18 ha/person in 2025) and limited available water,**
- ✓ **While preserving our environment for future generations.**

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