Optimizing Metam Sodium Fumigation in Fine-Textured Soils

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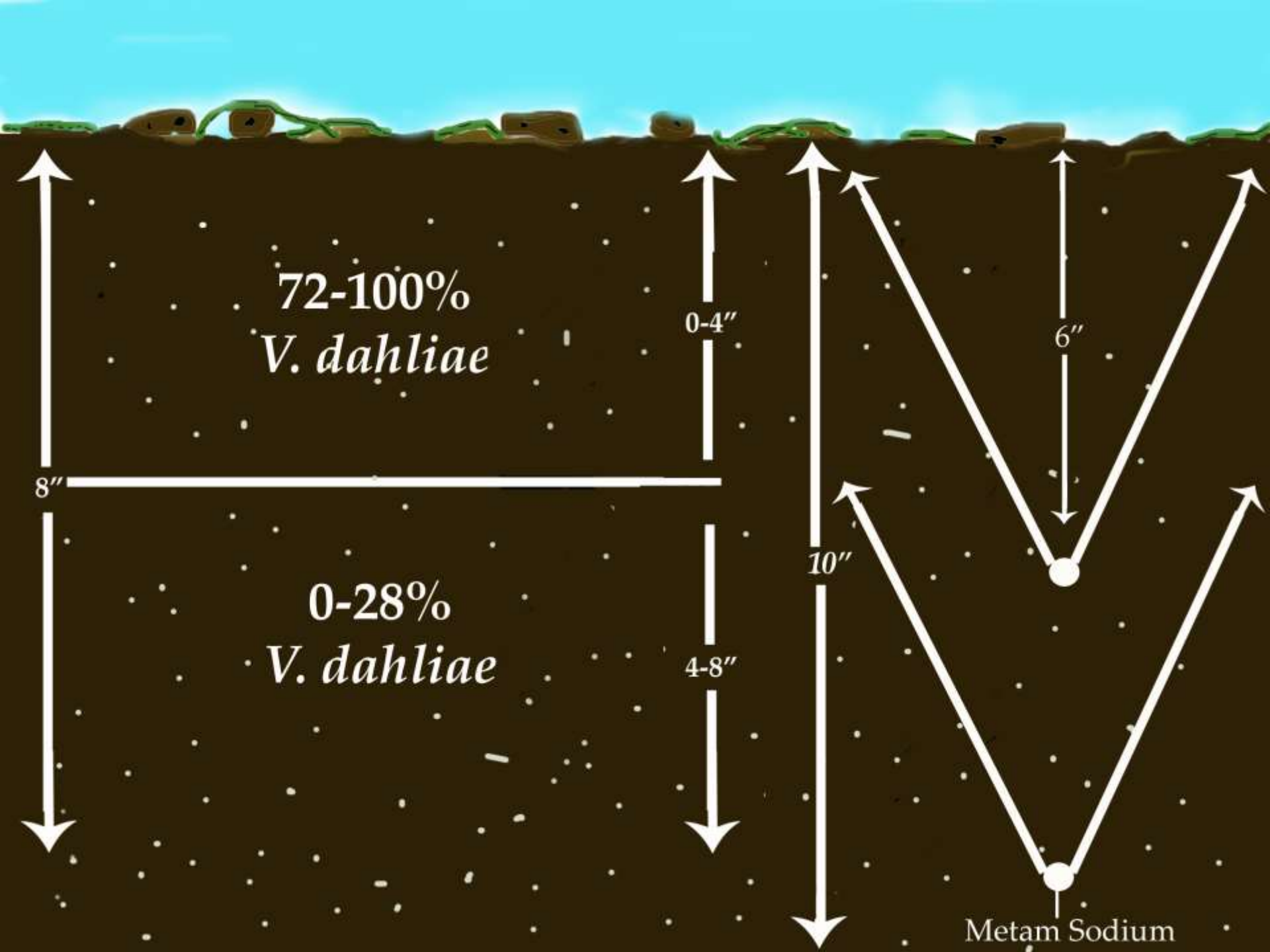
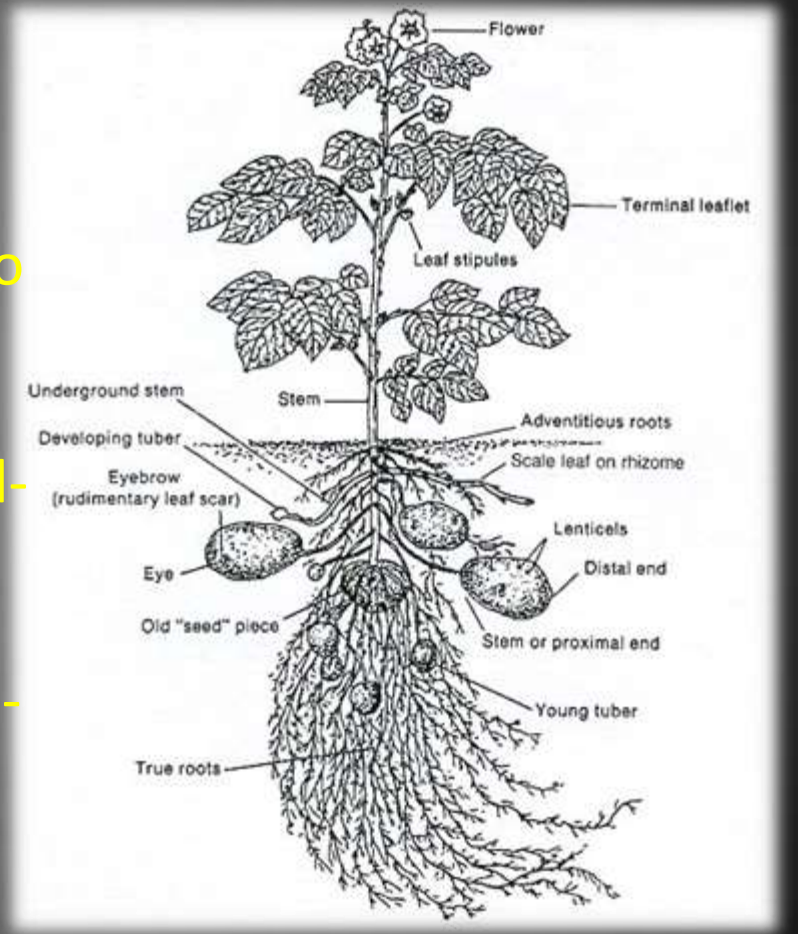
Early Dying

- Primary cause of early dying is *Verticillium dahliae*
- Primarily soil-borne, fungus survives as microsclerotia in the soil and on crop debris
- Microsclerotia are released into the soil from potato debris breakdown after 1.5 to 2 years
- *Vd* causes wilt of plant by blocking water conducting tissues
- Probably the most important cause of economic losses in potato industry in the U.S. today (cost of control + direct losses)


72-100%
V. dahliae
0-4″
8″
0-28%
V. dahliae
4-8″
10″
6″
Metam Sodium

V. dahliae – Potato Interaction

- Microsclerotia infect growing root tissue
- Must be in close proximity to roots, do not move within the soil
- Bulk of the root tissue below the seed-piece
- Despite lower inoculum potential at 4-8” depth, inoculum efficiency high



(Courtesy of Alberta, Food and Rural Development)

Vapam Trial-2011 & 2012

- The objective was to study interaction of soil temperature, injection depth, and rate of metam sodium on *Verticillium* wilt control
- Vapam applied at two temperature; early @59F, later @ 39F in 2011; 55F and 39F in 2012
- Vapam shanked in at 6” + 10” and at single 10” depth
- Vapam rates; 0, 40, 50, 60, & 70 gal/a
- Data included Vppg, weekly wilt readings, yield

Summary & Conclusions

- In most recent work, 60-70% *Verticillium* inoculum is in the top 4” of soil
- In most instances, fumigation at 39F significantly improved reduction Vppg, particularly at 0-4”
- Injection depth did not affect Vppg reduction
- Metam sodium rate did not affect Vppg reduction
- Fumigation at 39F significantly improved marketable yield compared to 55F
- Injection depth had no effect on marketable yield

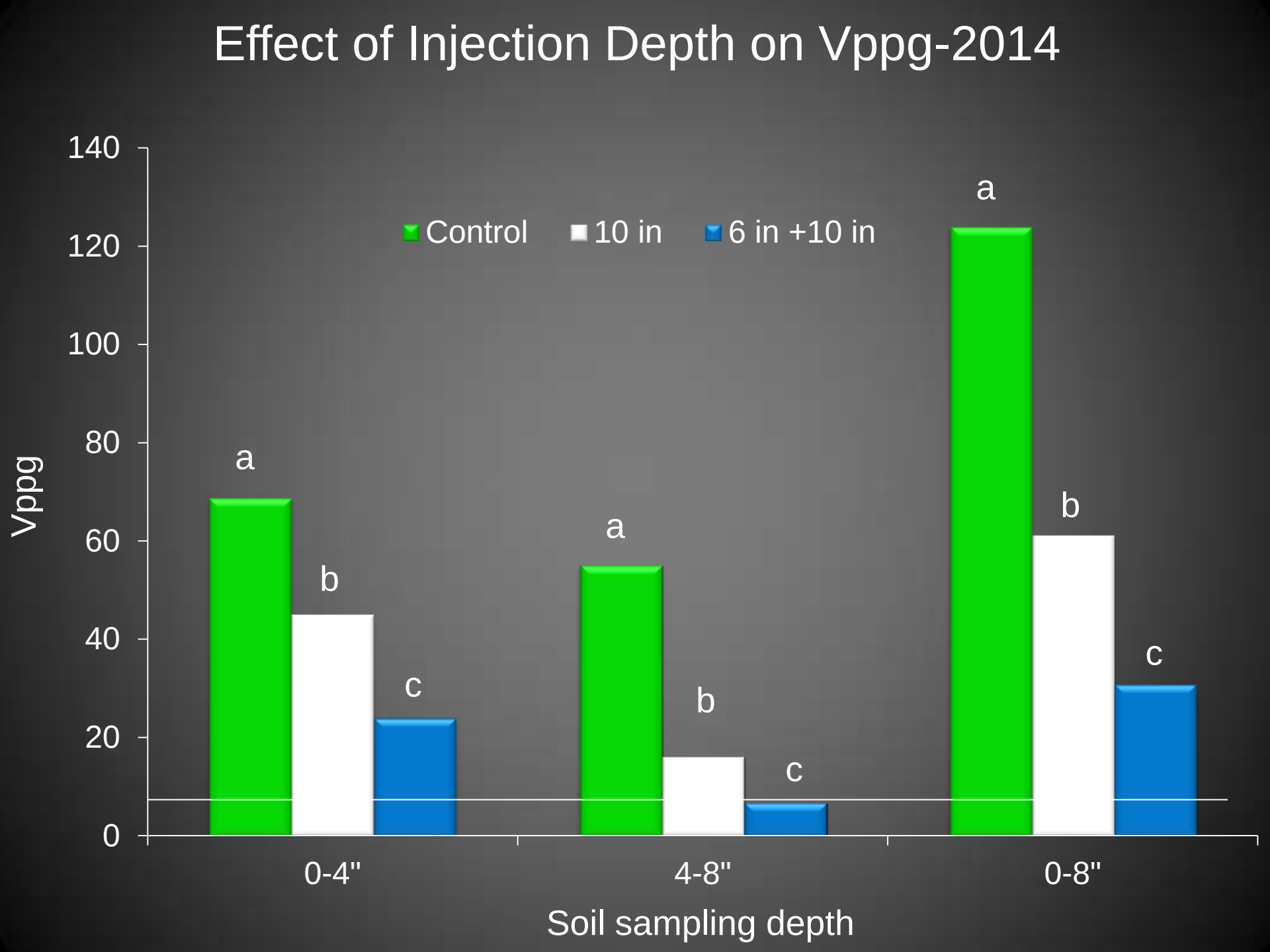
Recommendations

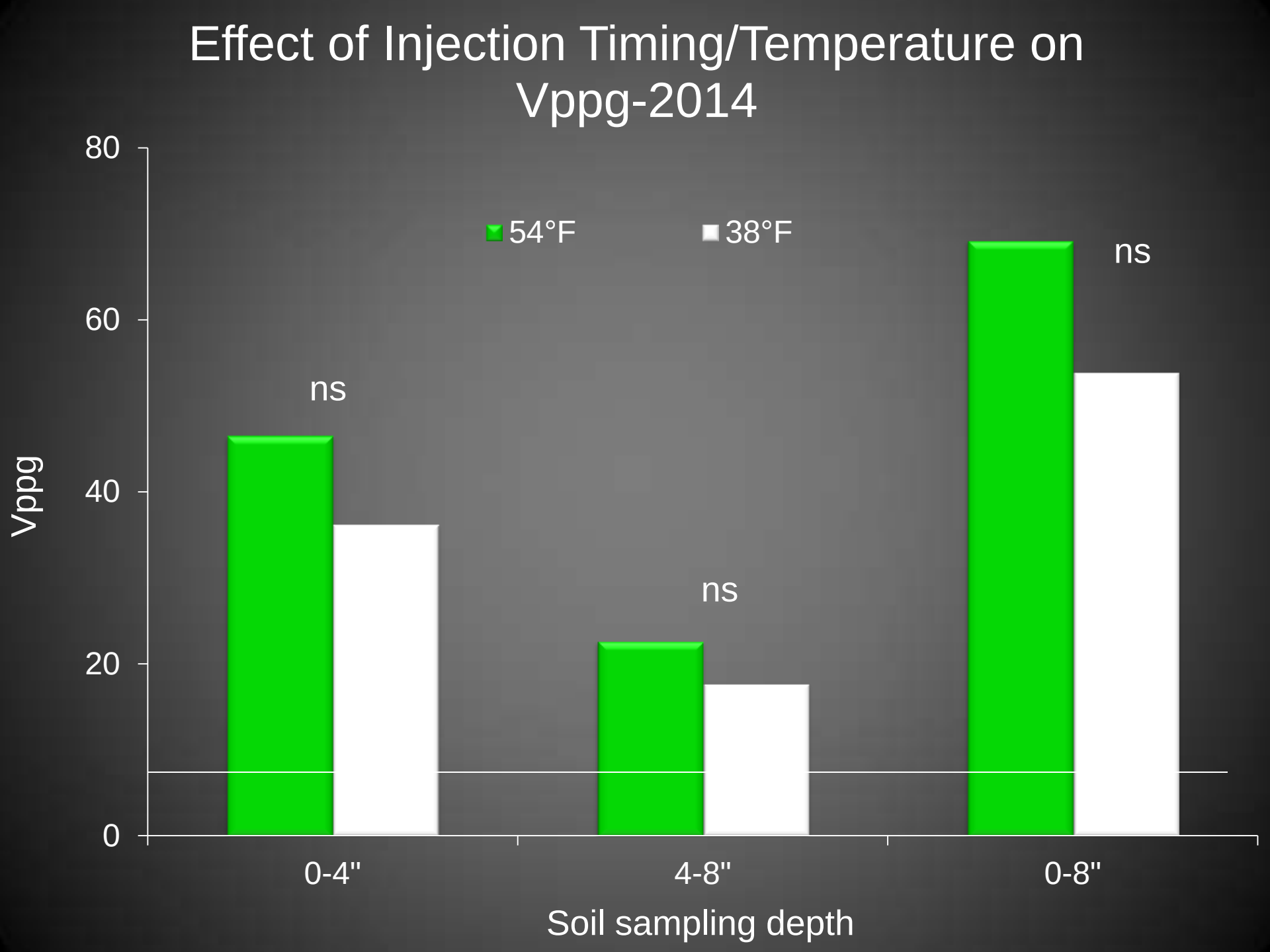
- Apply metam sodium when temperatures are <50F at 6” depth
- Very little evidence that metam sodium rates >40 gal/a provide greater reduction of Vert propagules
- A single injection depth of 10” provides equal or greater reduction of Vert propagules than split applications
- Continue to monitor soil populations; inoculum levels >40 Vppg (% reduction only fair) may require additional management tactics beyond metam sodium

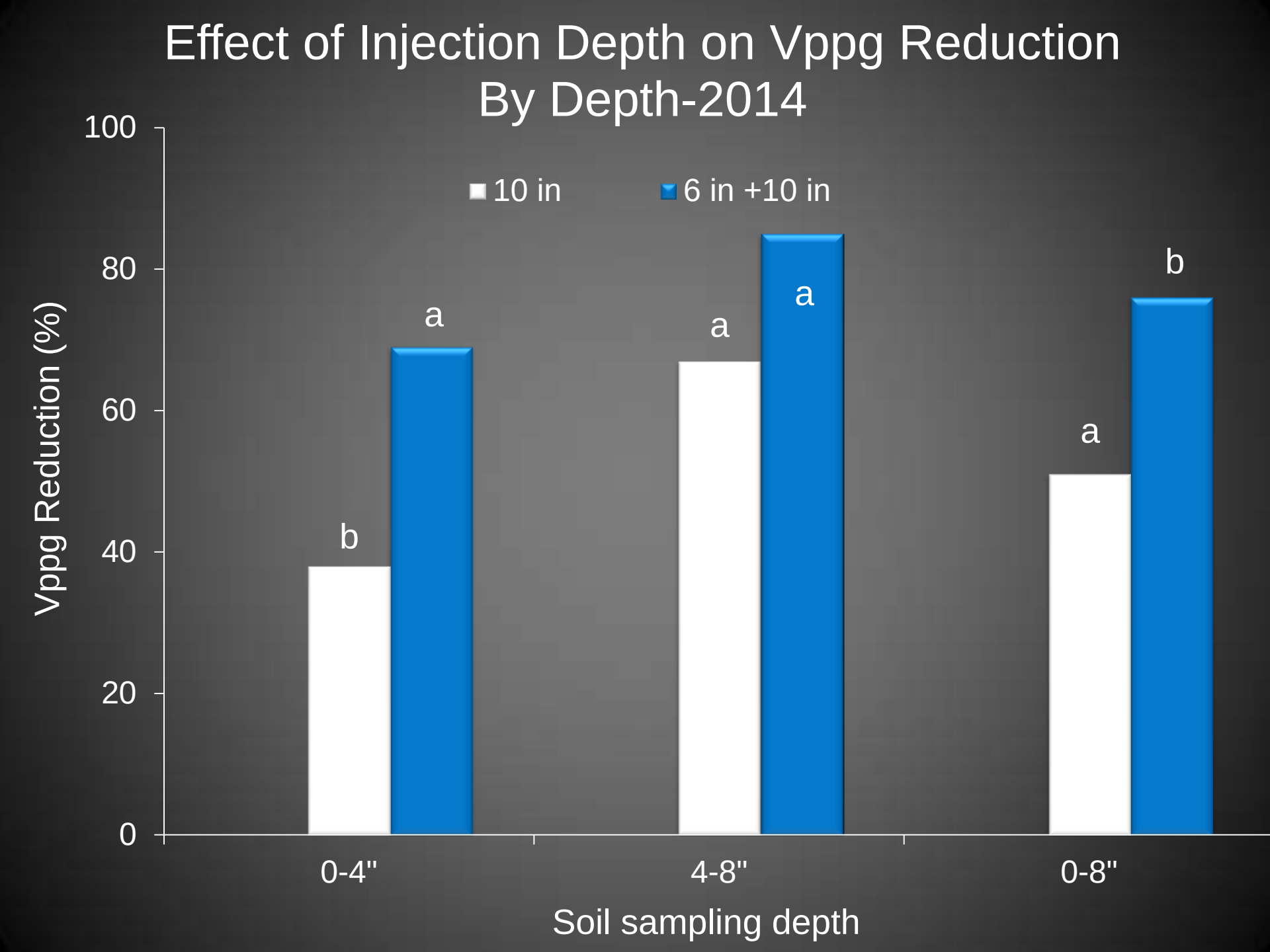
Unresolved Questions

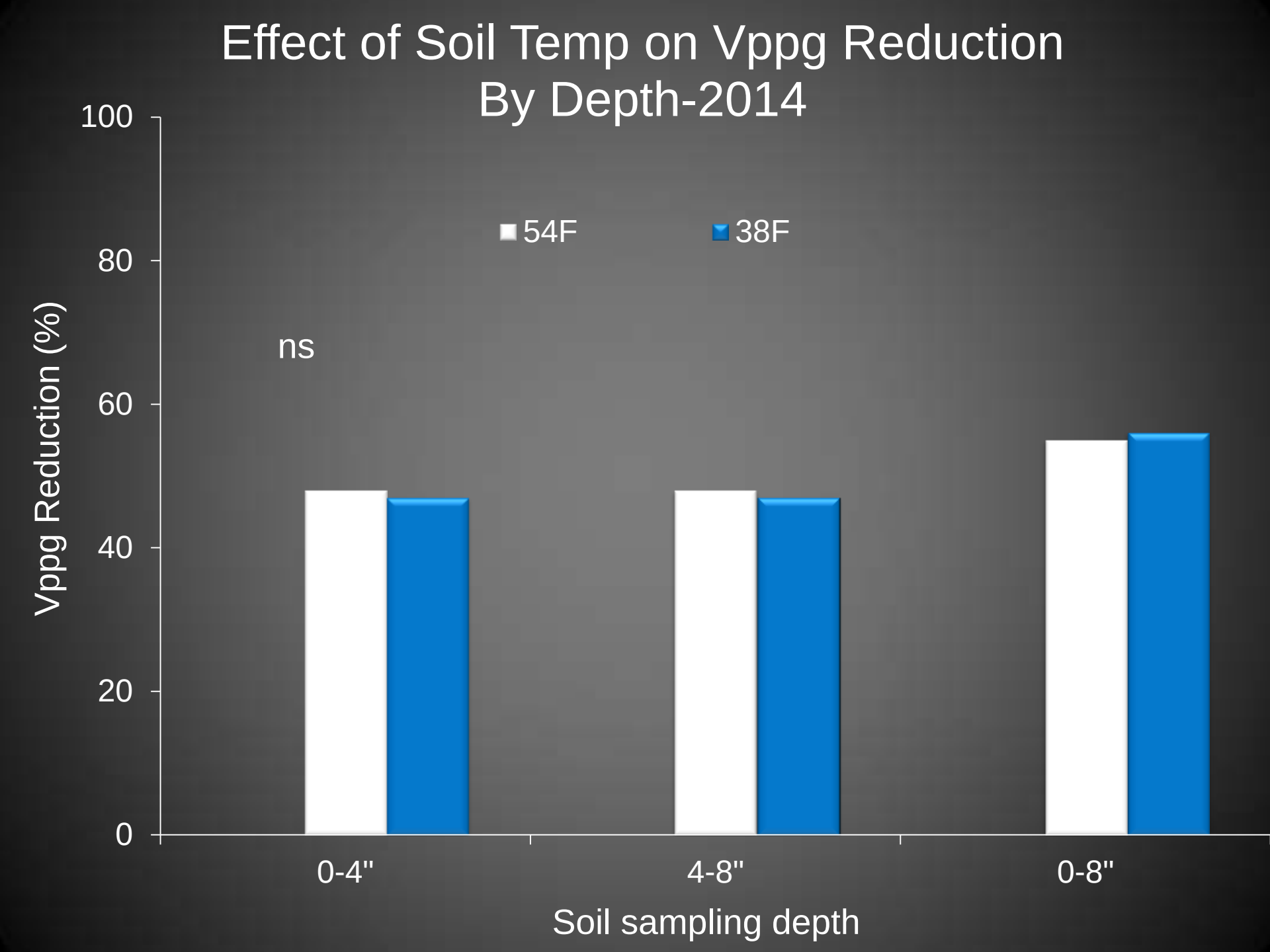
- All previous work on fumigation for Verticillium wilt management done in loamy sand soils with medium texture and OM <1.5%
- Questions asked by regional potato growers:
  - Can I expect the same results in my fine-textured silt loam soils?
  - What impact does OM have on metam sodium effectiveness?
- We repeated the aforementioned studies in a silt loam soil with 2.3% OM

2014

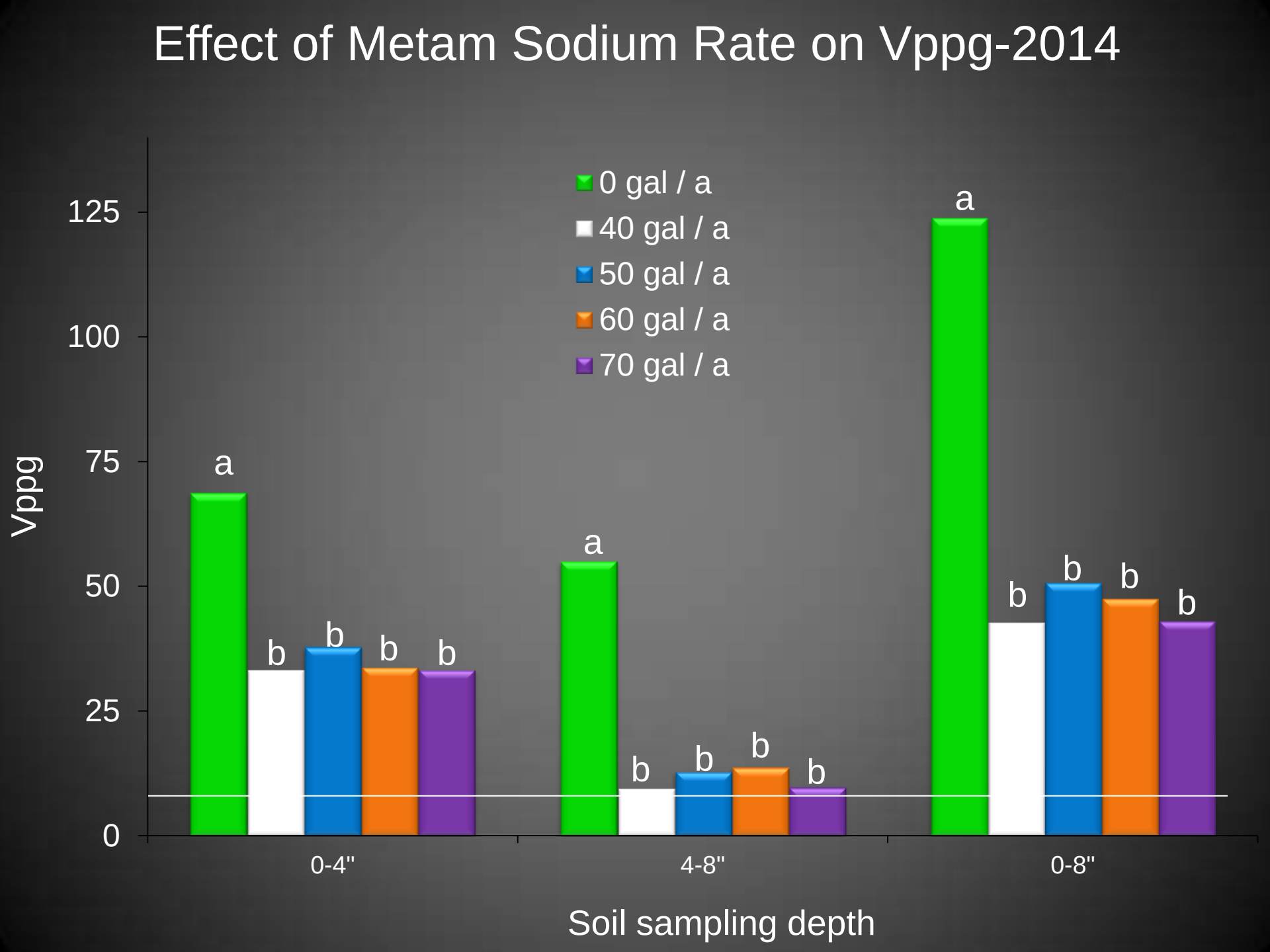

Effect of Injection Depth on Vppg-2014
140
120
100
80
60
40
20
0
Vppg
Control
10 in
6 in +10 in
a
b
c
a
b
c
a
b
c
0-4"
4-8"
0-8"
Soil sampling depth

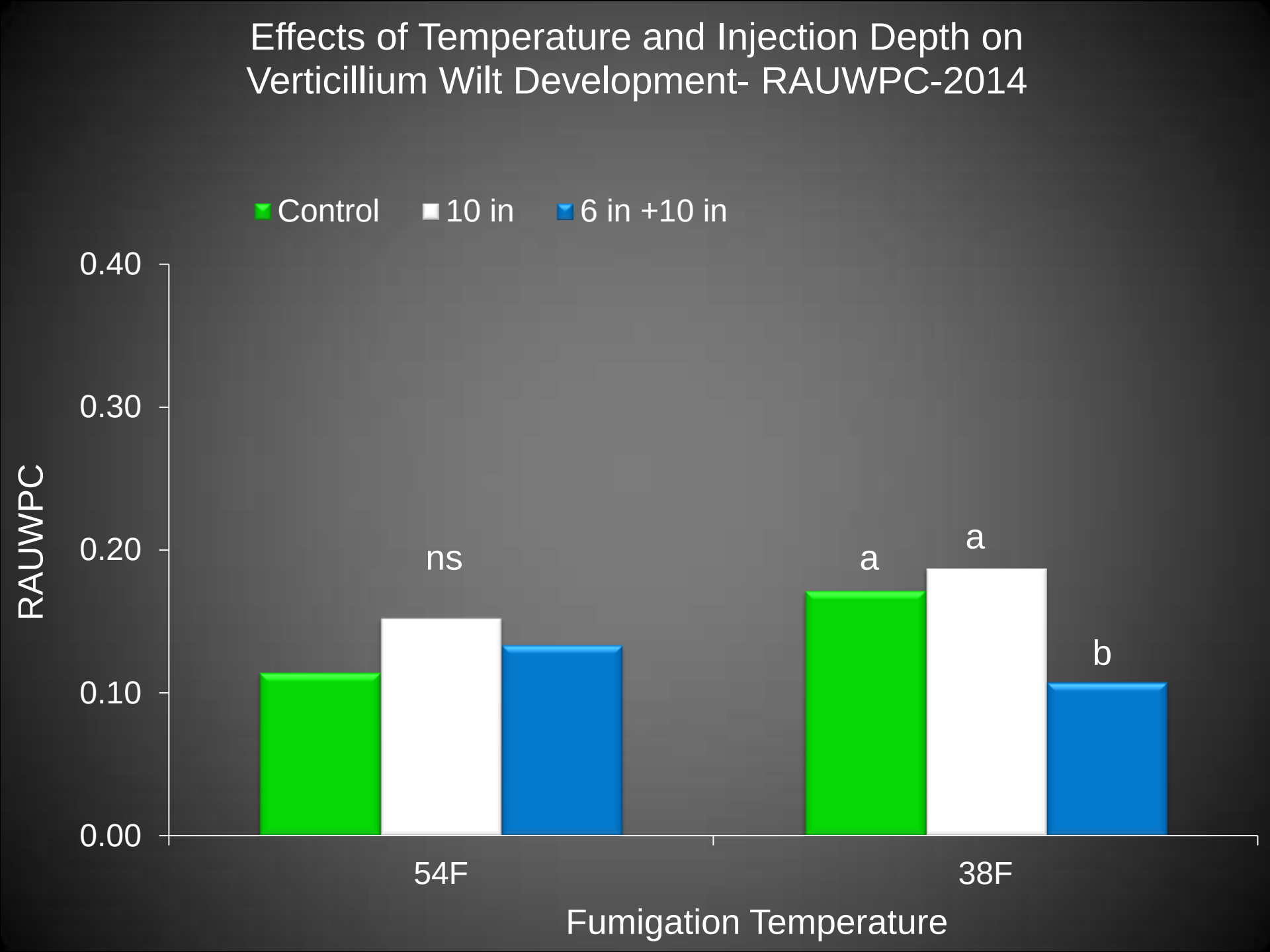

Effect of Injection Timing/Temperature on Vppg-2014
80
60
40
20
0
Vppg
54°F
38°F
ns
ns
ns
0-4"
4-8"
0-8"
Soil sampling depth

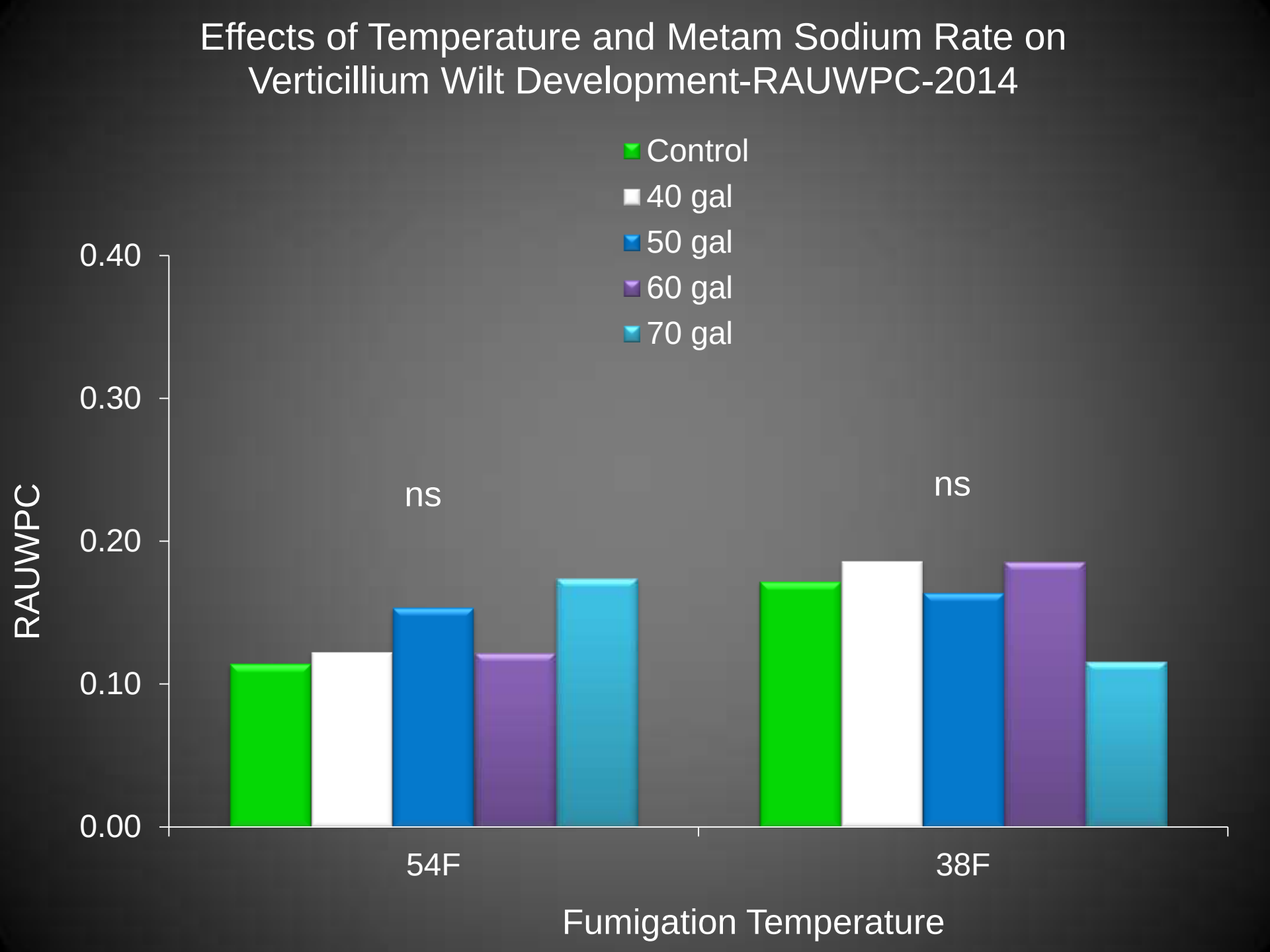

Effect of Injection Depth on Vppg Reduction By Depth-2014
100
80
60
40
20
0
Vppg Reduction (%)
10 in
6 in +10 in
b
a
a
a
a
b
0-4"
4-8"
0-8"
Soil sampling depth

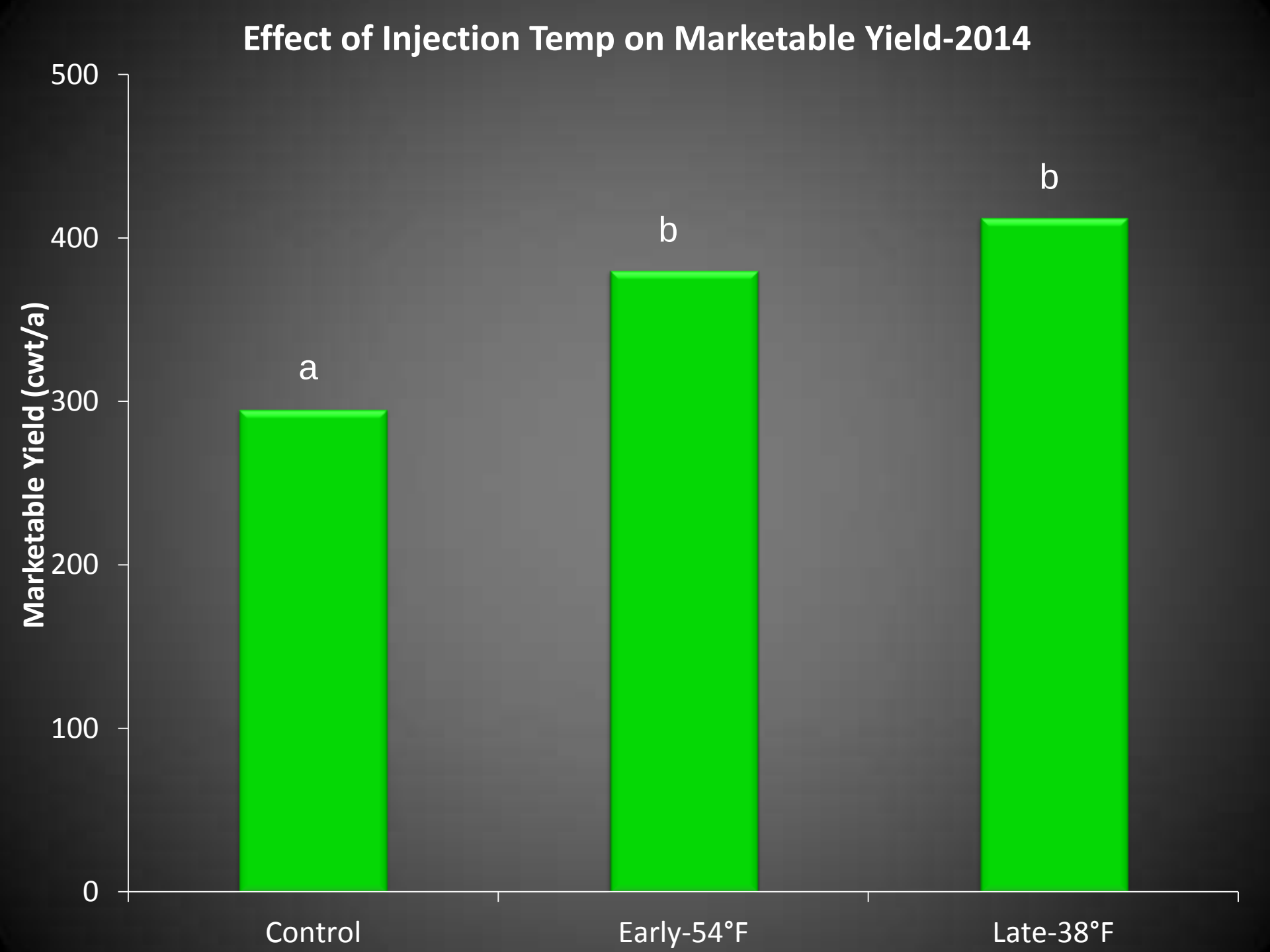

Effect of Soil Temp on Vppg Reduction By Depth-2014
100
80
60
40
20
0
Vppg Reduction (%)
54F
38F
ns
0-4"
4-8"
0-8"
Soil sampling depth

Effect of Metam Sodium Rate on Vppg-2014

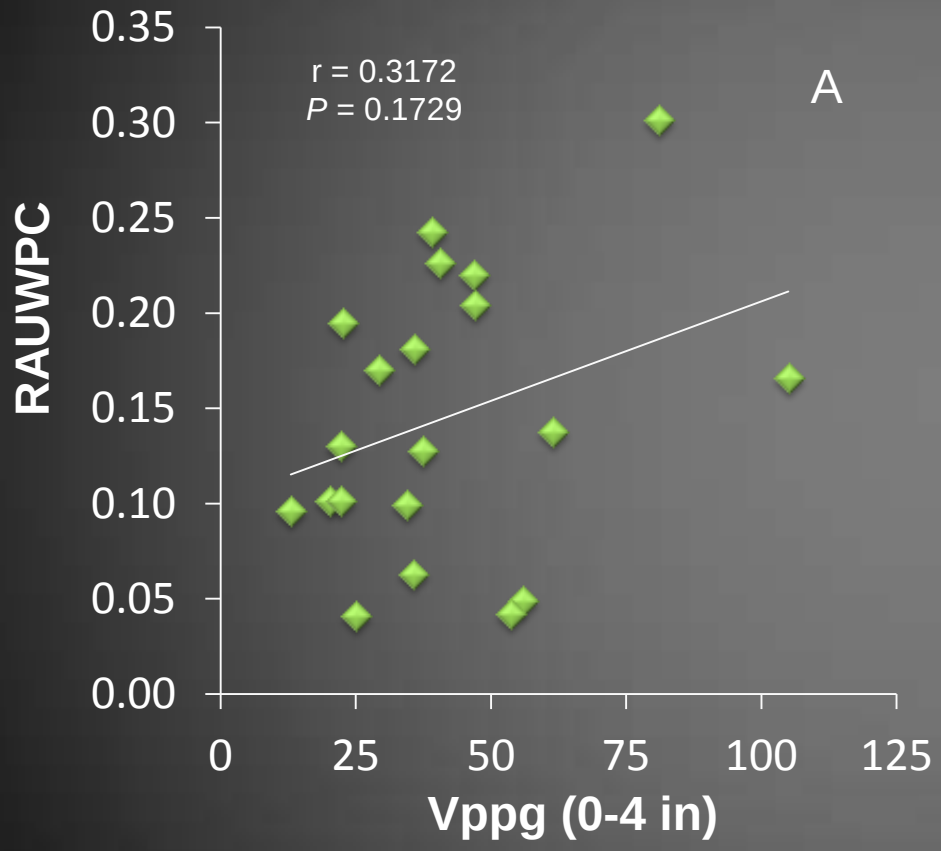


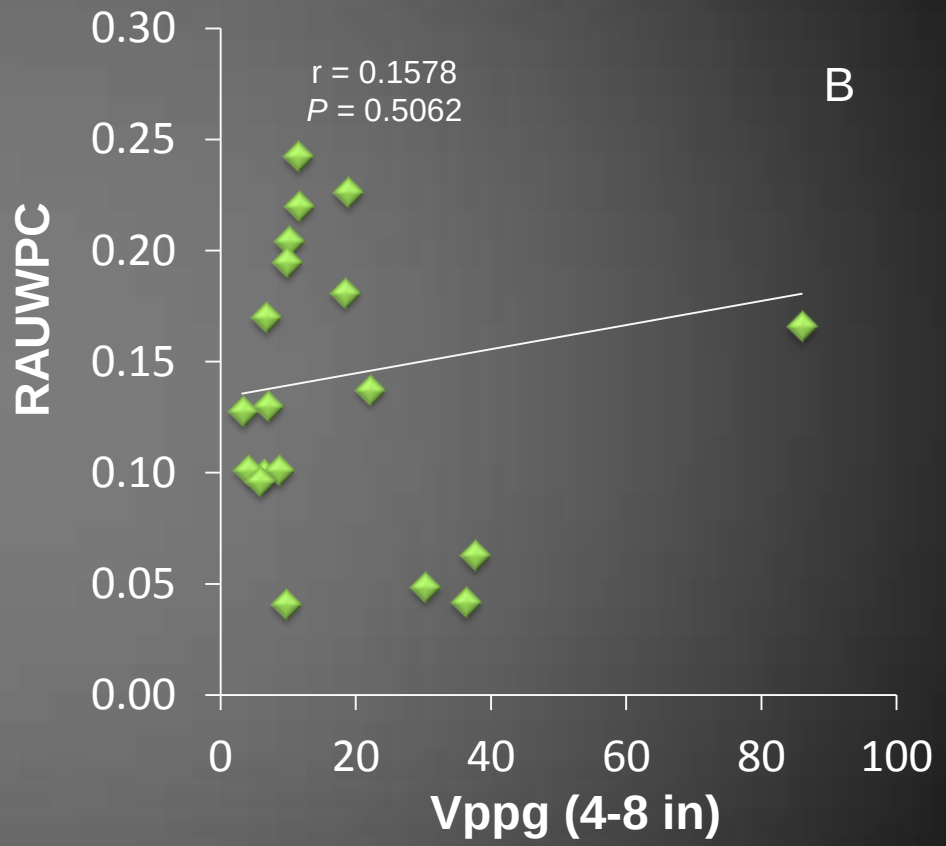

Effects of Temperature and Injection Depth on Verticillium Wilt Development- RAUWPC-2014
Control
10 in
6 in +10 in
0.40
0.30
0.20
0.10
0.00
RAUWPC
ns
a
a
b
54F
38F
Fumigation Temperature


Effects of Temperature and Metam Sodium Rate on Verticillium Wilt Development-RAUWPC-2014
Control
40 gal
50 gal
60 gal
70 gal
0.40
0.30
0.20
0.10
0.00
RAUWPC
ns
ns
54F
38F
Fumigation Temperature

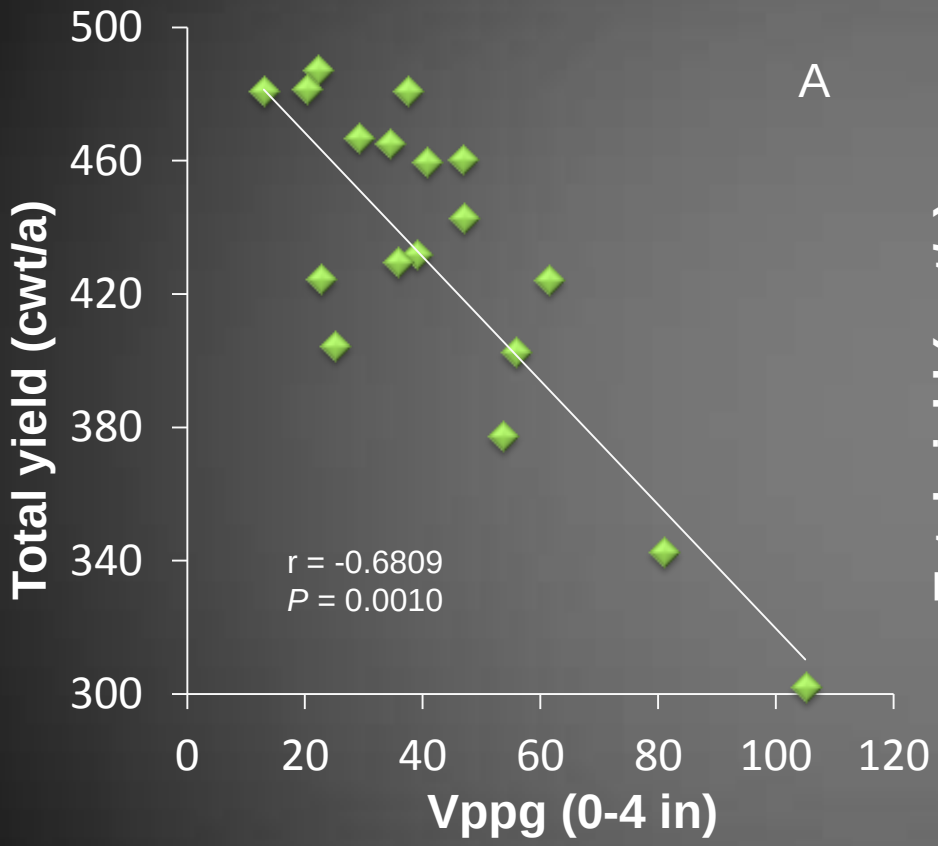

Effect of Injection Temp on Marketable Yield-2014
Marketable Yield (cwt/a)
500
400
300
200
100
0
a
b
b
Control
Early-54°F
Late-38°F

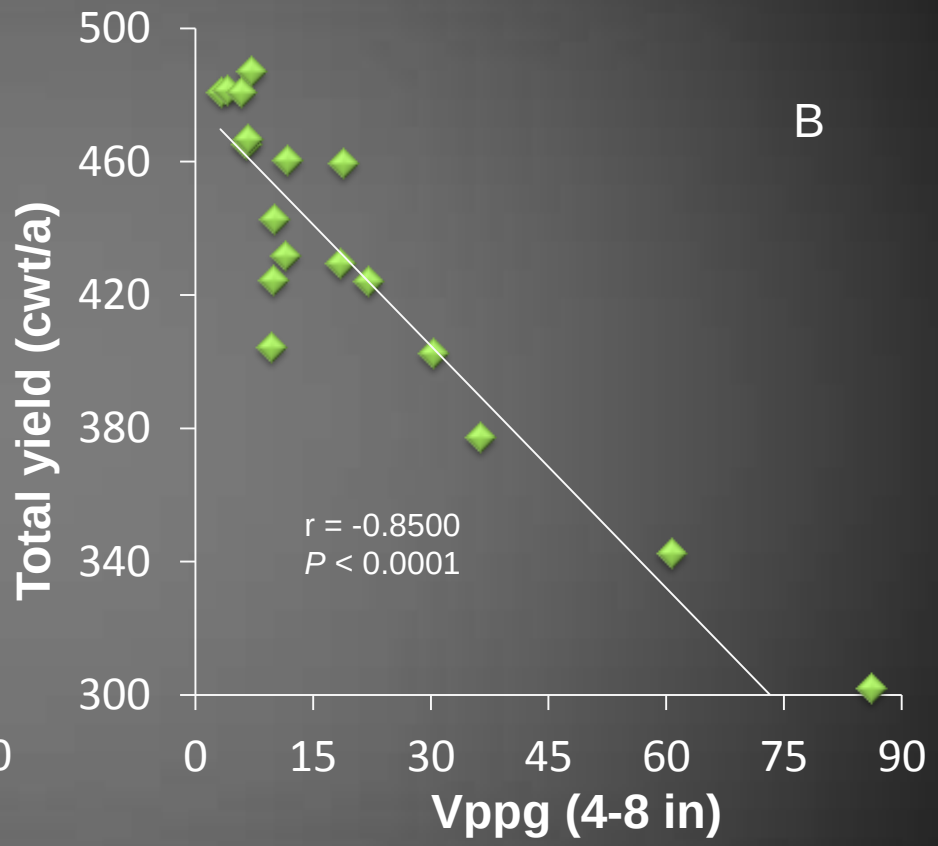
Relationship between Relative Area under the Wilt Progress Curve (RAUWPC) and Verticillium propagules per gram (Vppg) soil post-fumigation at 0-4” (A) and 4-8” (B)



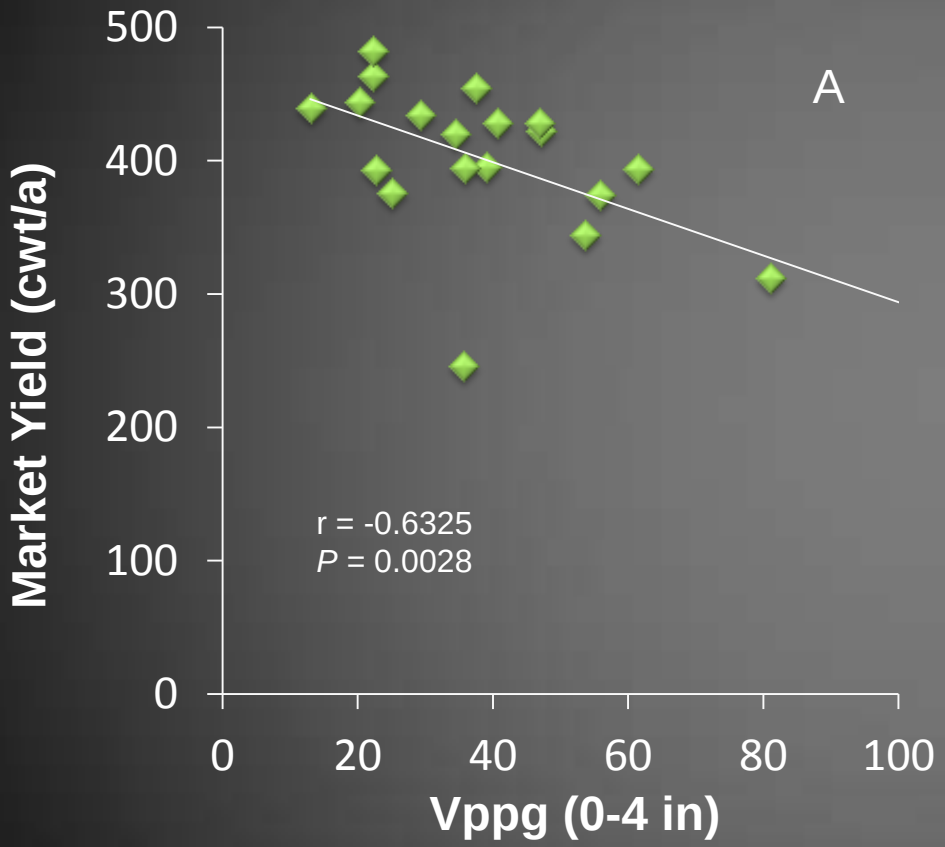


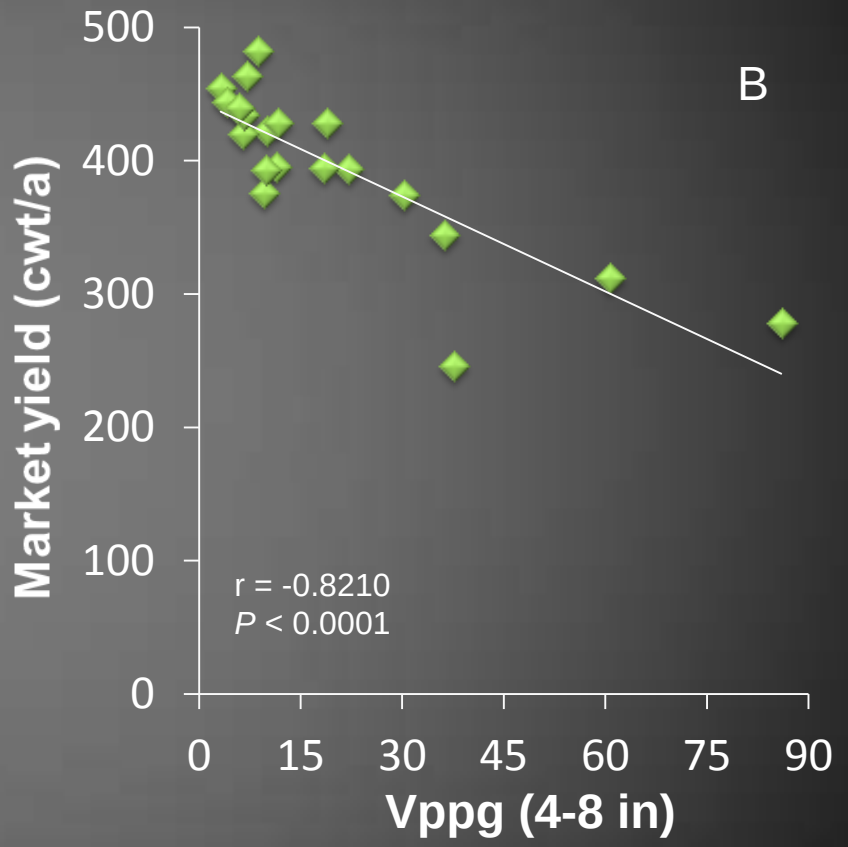
Relationship between Total Yield (cwt/a) and Verticillium propagules per gram (Vppg) soil post-fumigation at 0-4” (A) and 4-8” (B)





Relationship between Market Yield (cwt/a) and Verticillium propagules per gram (Vppg) soil post-fumigation at 0-4” (A) and 4-8” (B)





Summary

- The highest proportion of *Verticillium dahliae* inoculum is in the top 4” of soil.
- However, inoculum in 4-8” depth may be more efficient has a greater influence on wilt development and total/marketable yield.
- Results of fumigation trials in a fine-texured/ higher OM soil differ somewhat from those observed in medium-textured/low OM soil.

Summary

- Shank injection at two depths (6” & 10”) may be needed in a fine-textured soil and in soils with >2% OM to optimize efficacy.
- Temperature had less impact of fumigant efficacy in a fine-textured/higher OM soil than in a low OM loamy sand.
- Interestingly, despite the field trial, year of the study, and soil type, we have not observed and metam sodium rate response.

THANK YOU!
QUESTIONS?