



INSTITUTE ON THE ENVIRONMENT

UNIVERSITY OF MINNESOTA

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United States Department of Agriculture  
National Institute of Food and Agriculture

# Hazelnut Weed Control Trials

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## **Four Basic Methods of Weed Control in a factorial with Roundup**

- Cultivation (hoeing)
- Landscape Fabric
- Woodchip Mulch (+/- RU)
- Pre-emergent Herbicide (+/- RU)

## **Two Intensities of Control**

- “Divots” = 66 cm diameter circle (or square) around each plant
- “Full Plots” = 1 m wide bed, along length of row half way to next plant

## **Four Sites**

Rosemount “tilled”—following soybeans (planted spring 2013 w 6 reps)

Rosemount “sod”—brome grassland (spring 2013 w 7 reps)

Waseca “tilled”—following corn (spring 2013 w 5 reps)

Waseca “paired”—alfalfa hayfield (fall 2013 w 5 reps)

Hazels either planted directly into strips of RU-killed hay or planted into strips that were tilled following a RU burn-down

# Rosemount "Tilled" Weed Control Trial (followed soybeans)



Alleys mowed  
but no cross-  
mowing for first  
two years



# Rosemount "Tilled" Trial April 2015



Hoe, divot



Hoe, full plot



Fabric, divot



Fabric, full plot



Control, mowing only



Chip only, divot



Chip only, full plot



Chip + RU, divot



Chip + RU, full plot



Pre-emerge, divot



Pre-emerge, full plot



Pre + RU, divot



Pre + RU, full plot

Pre-emerge just sprayed, just hoed, RU not yet sprayed.

# Rosemount "Tilled" Trial June 2015 before mowing



Hoe, divot



Hoe, full plot



Fabric, divot



Fabric, full plot



Control, mowing only



Chip only, divot



Chip only, full plot



Chip + RU, divot



Chip + RU, full plot



Pre-emerge, divot



Pre-emerge, full plot



Pre + RU, divot



Pre + RU, full plot

Hoed twice and RU sprayed twice so far that season

# Rosemount "Tilled" Trial July 2015 after mowing



Hoe, divot



Hoe, full plot



Fabric, divot



Fabric, full plot



Control, mowing only



Chip only, divot



Chip only, full plot



Chip + RU, divot



Chip + RU, full plot



Pre-emerge, divot



Pre-emerge, full plot



Pre + RU, divot



Pre + RU, full plot

Hoed thrice and RU sprayed thrice so far that season





**Hoed**



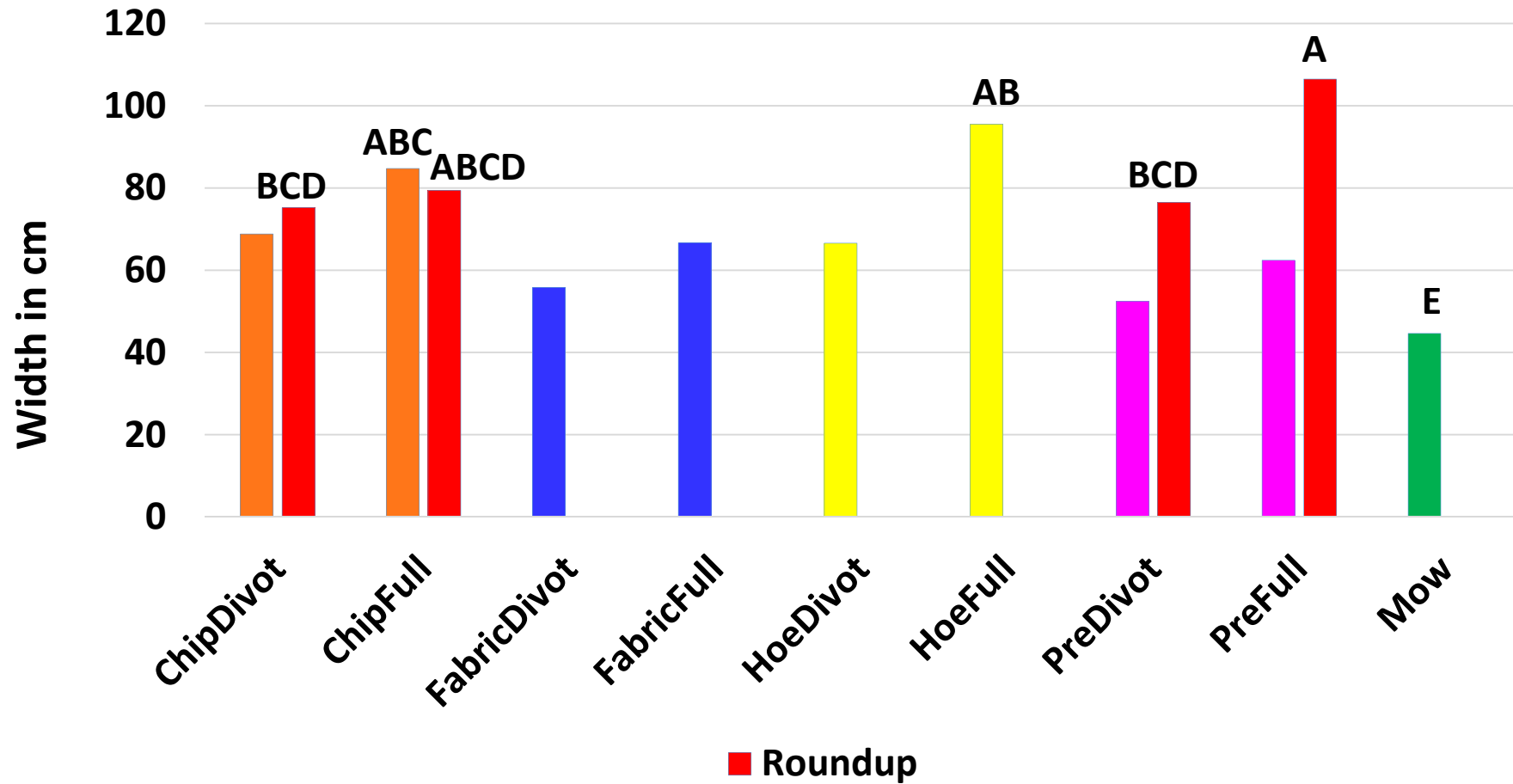
**Pre-emergent  
Herbicide  
+ Roundup**



**Control  
(Mowed Only)**

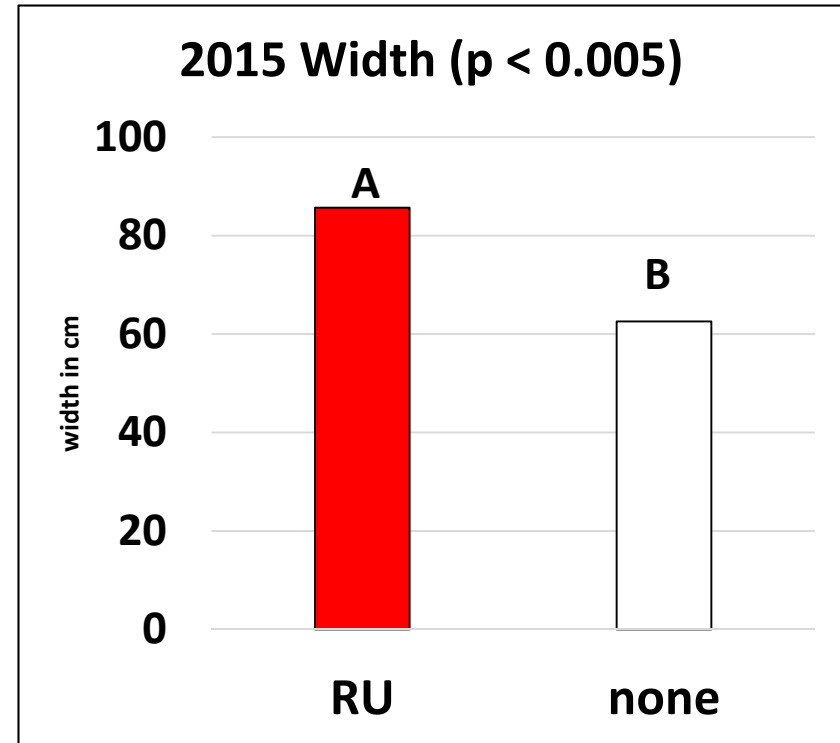
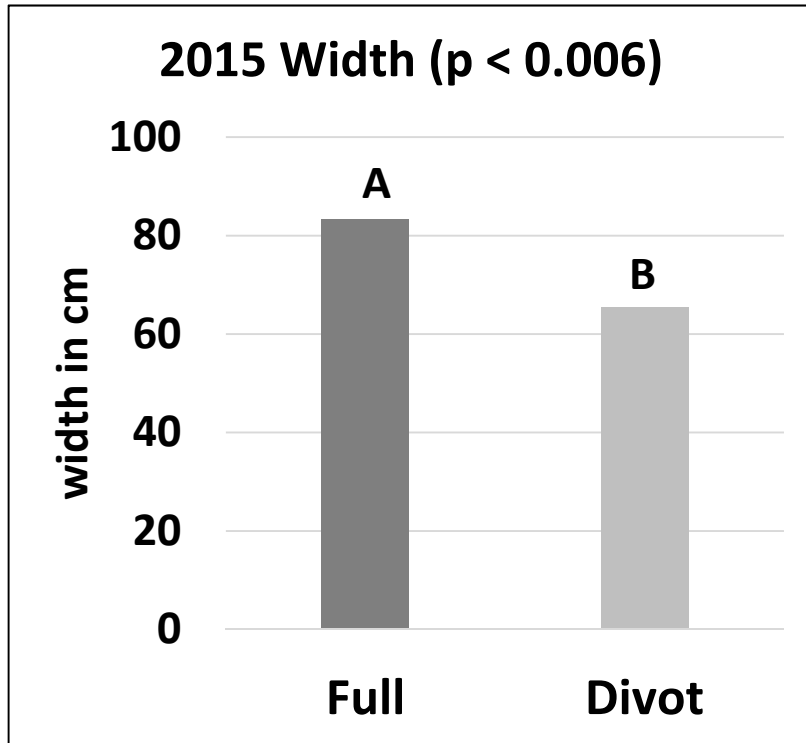
# Rosemount Tilled

2015 Bush Width ( $p = 0.0022$ )

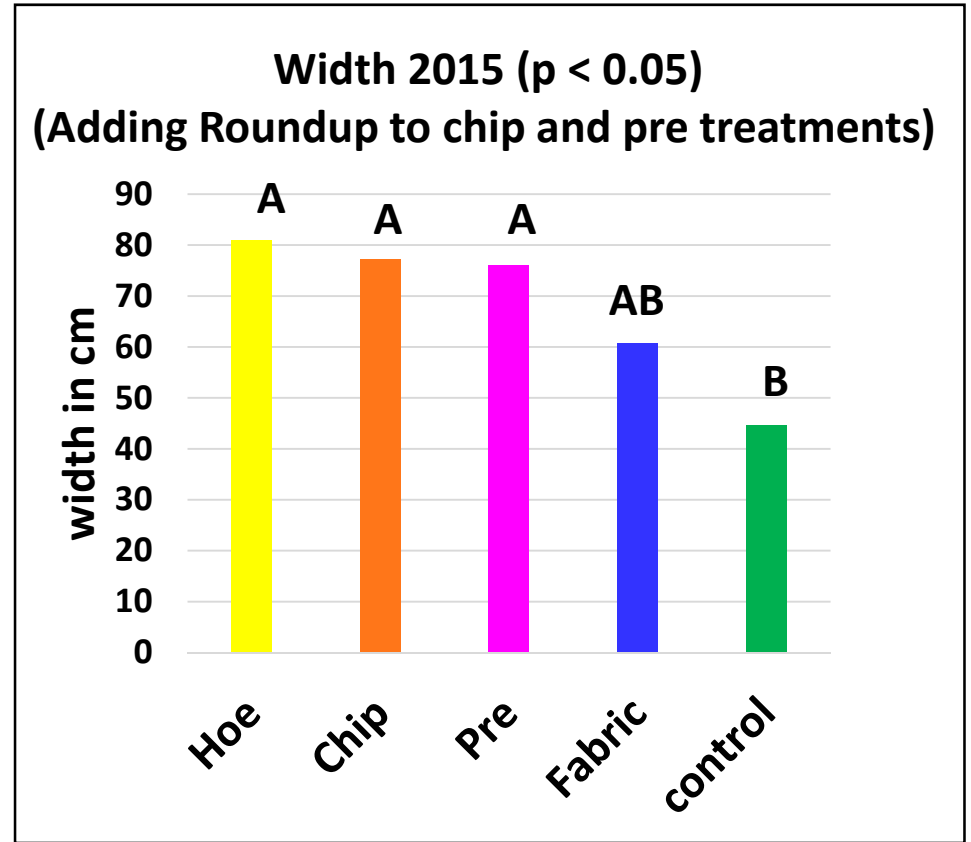
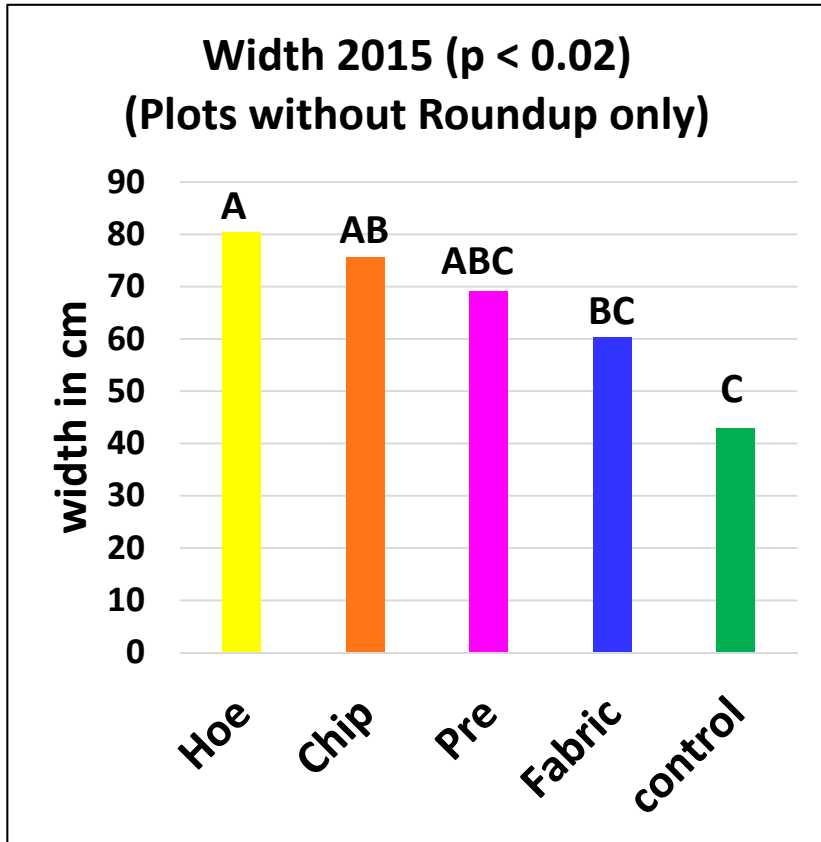


*If no letter is marked for a treatment, it is not significantly different than the control.  
Data are Least Squared Means, controlled for initial plant size.*

# Rosemount Tilled



# Rosemount Tilled

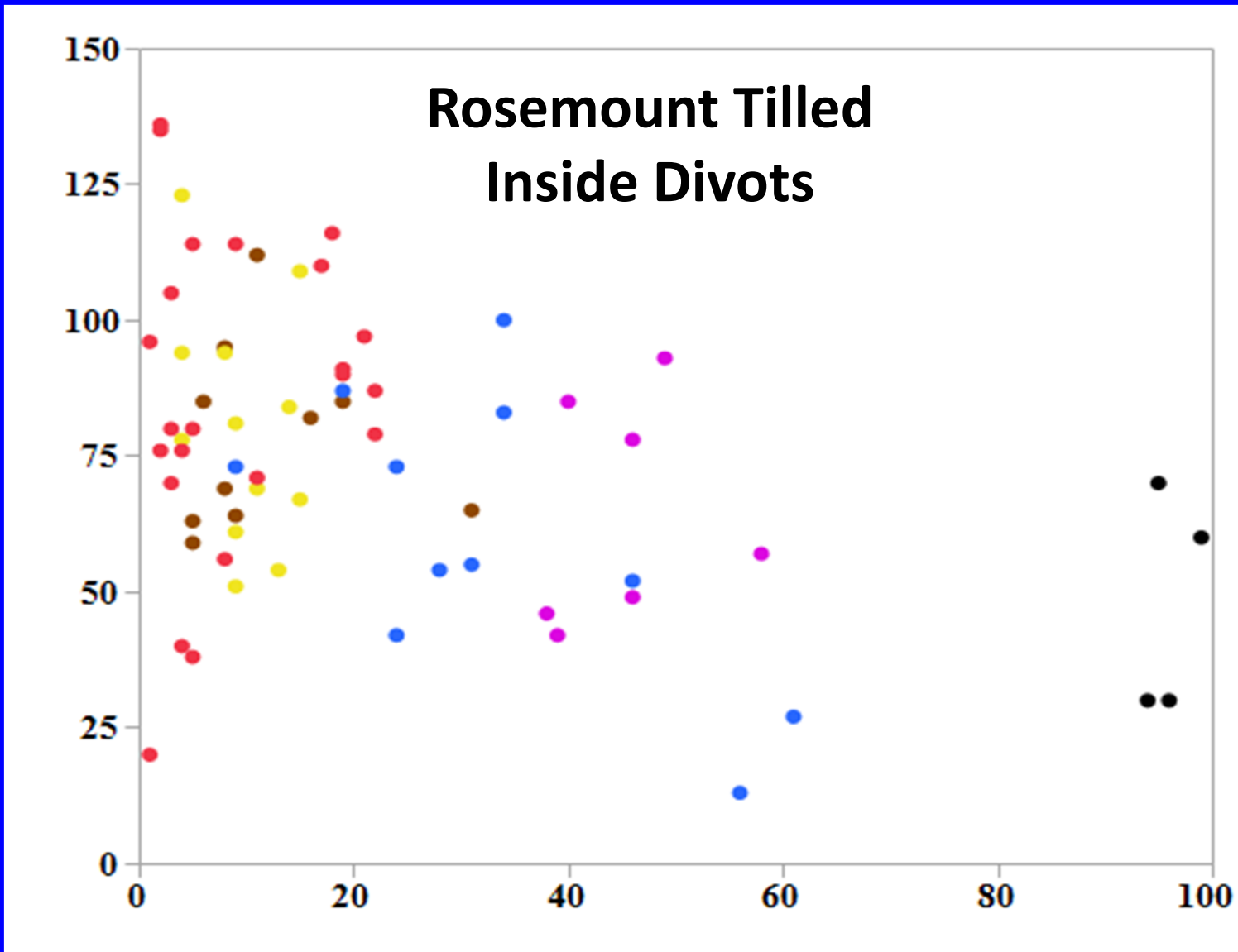




**Landscape Fabric**

# Effectiveness of Different Methods of Weed Control

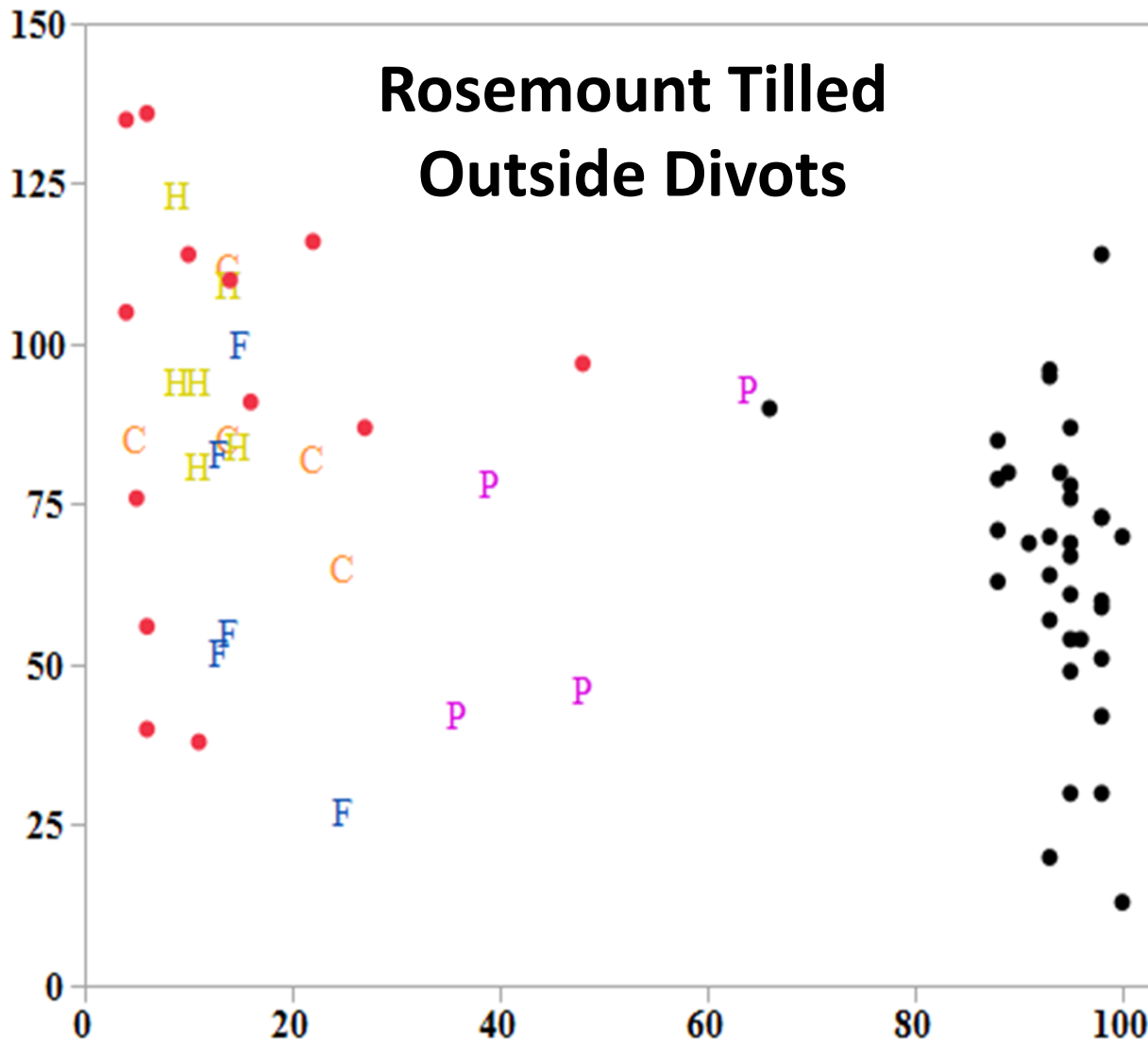
Hazelnut plant diameter



% Weed Cover Inside 1 1/2 Foot Diameter Divots

# Effectiveness of Different Methods of Weed Control

Hazelnut plant diameter



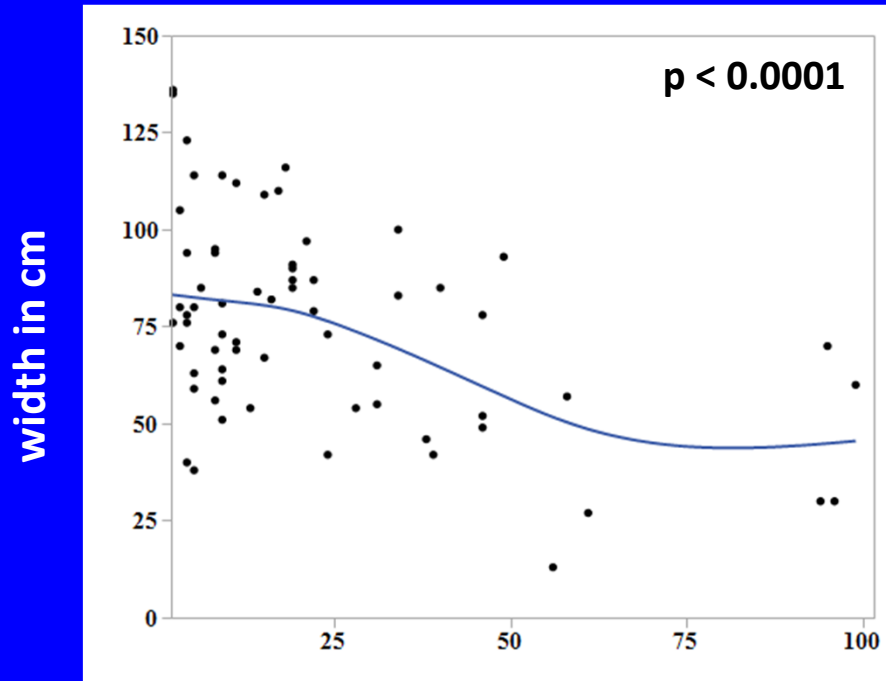
Red dots = Roundup  
H = Hoed  
C = Chips  
F = Fabric  
P = Pre-emerge  
Black dots = None

*“Divot only” treatments are treated as no weed control for this figure.*

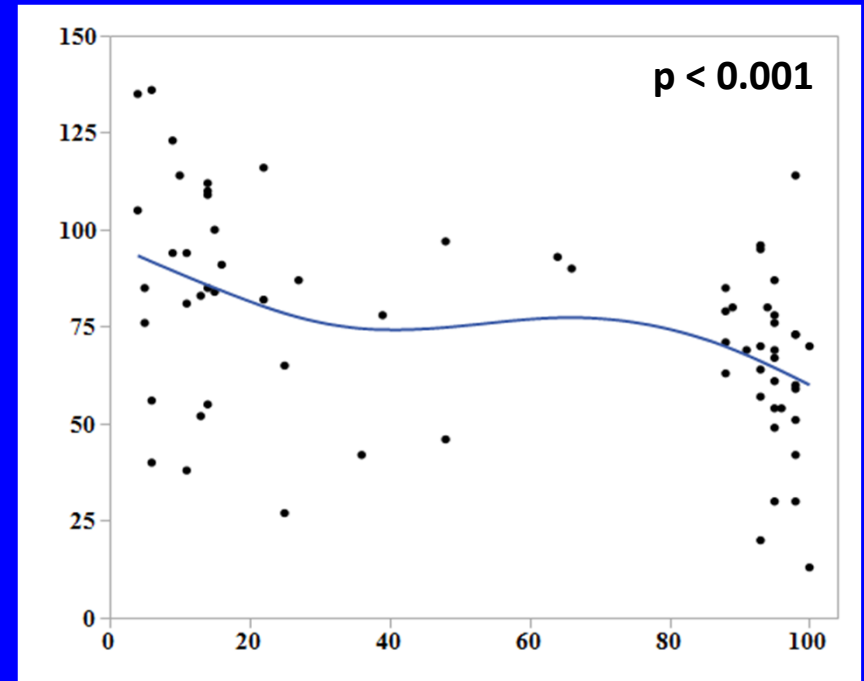
% Weed Cover Outside Divots

# Rosemount Tilled: Fall 2015

## Effect of Weed Pressure on Bush Width



% weed cover in divot



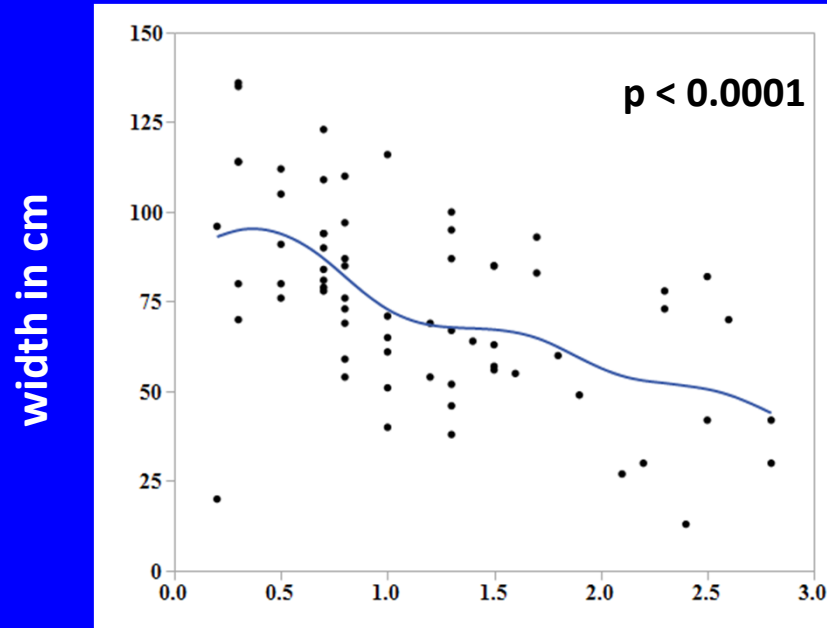
% weed cover in rest of plot  
(outside divot)

*Statistical models correct for initial plant size.*



# Rosemount Tilled: Fall 2015

## Effect of Weed Pressure on Bush Width



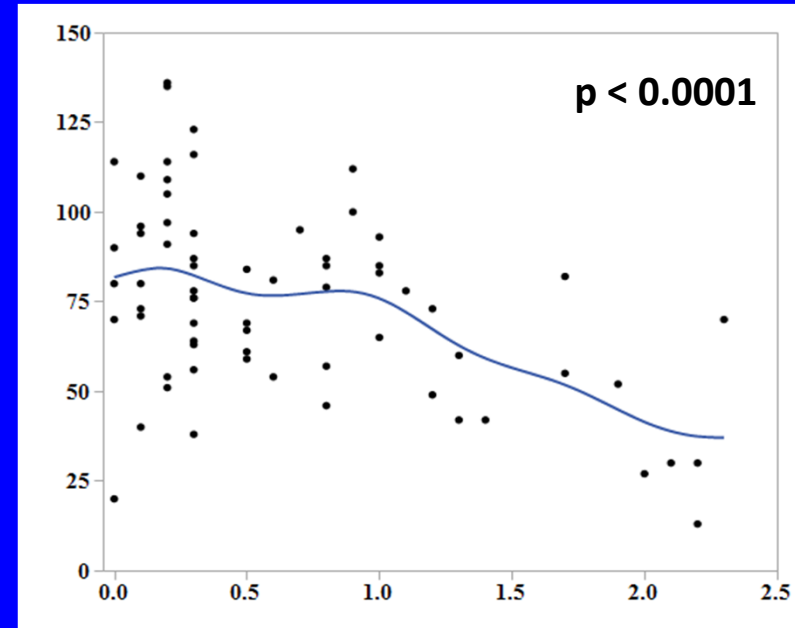
### Degree of Shading

0 = no weeds

1 = weeds half as tall as bush

2 = weeds as tall as bush

3 = weeds over the top of the bush



### Degree of Crowding

0 = no weeds

1 = moderate

2 = intense

3 = can't see the hazel bush

*Statistical models correct for initial plant size*

# Rosemount "Sod" Weed Control Trial



Planting strips killed with Roundup



Planting hole drilled with a 10-inch auger

Planted  
April 2013



Size of root system of  
mound layers

**Rosemount “sod”  
July 2015**



# Rosemount "Sod" Trial July 2015

*Hoeing not possible in sod*



*Not included.*



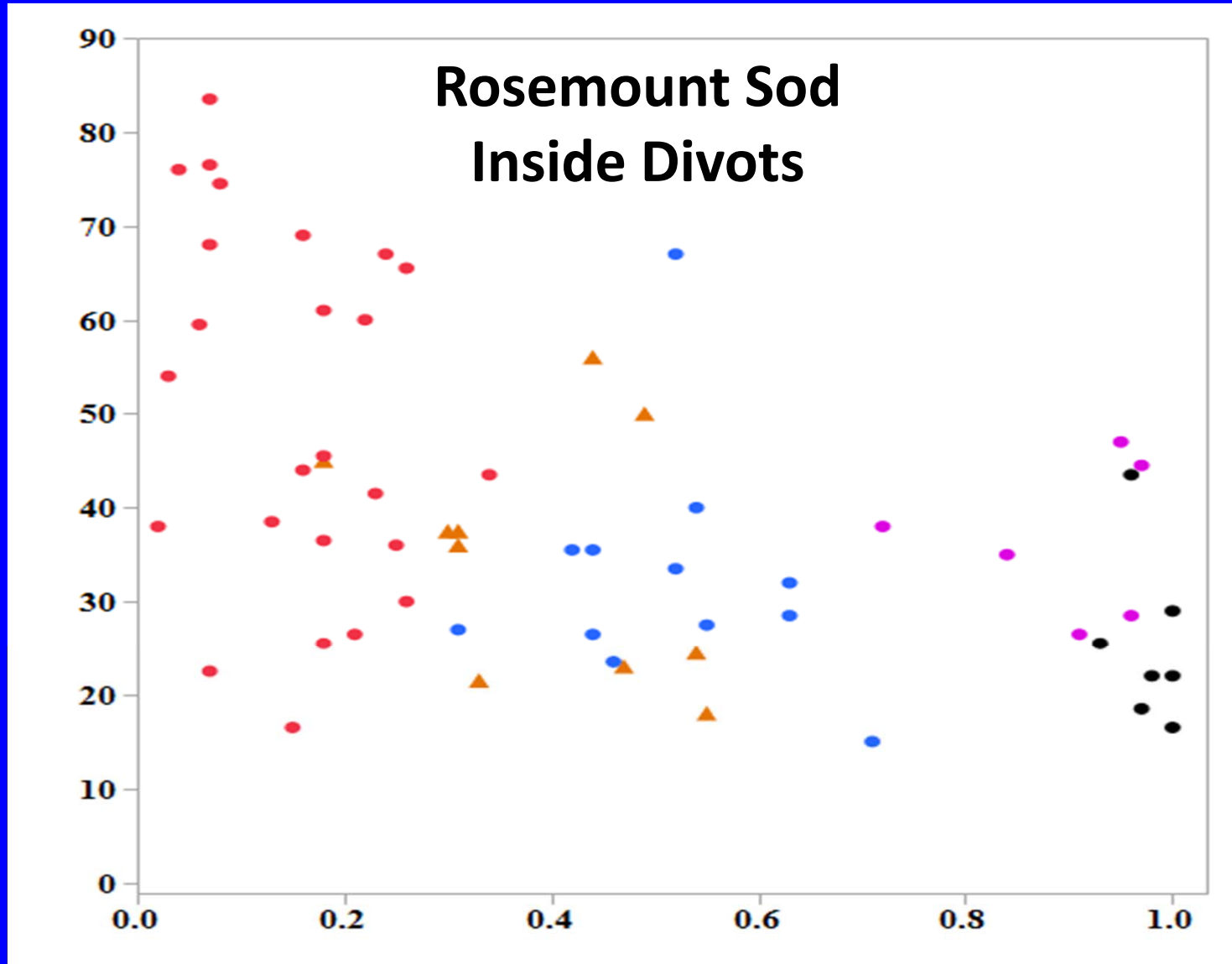
*Not included.*



**RU sprayed thrice so far that season**

# Effectiveness of Different Methods of Weed Control

Hazelnut plant diameter

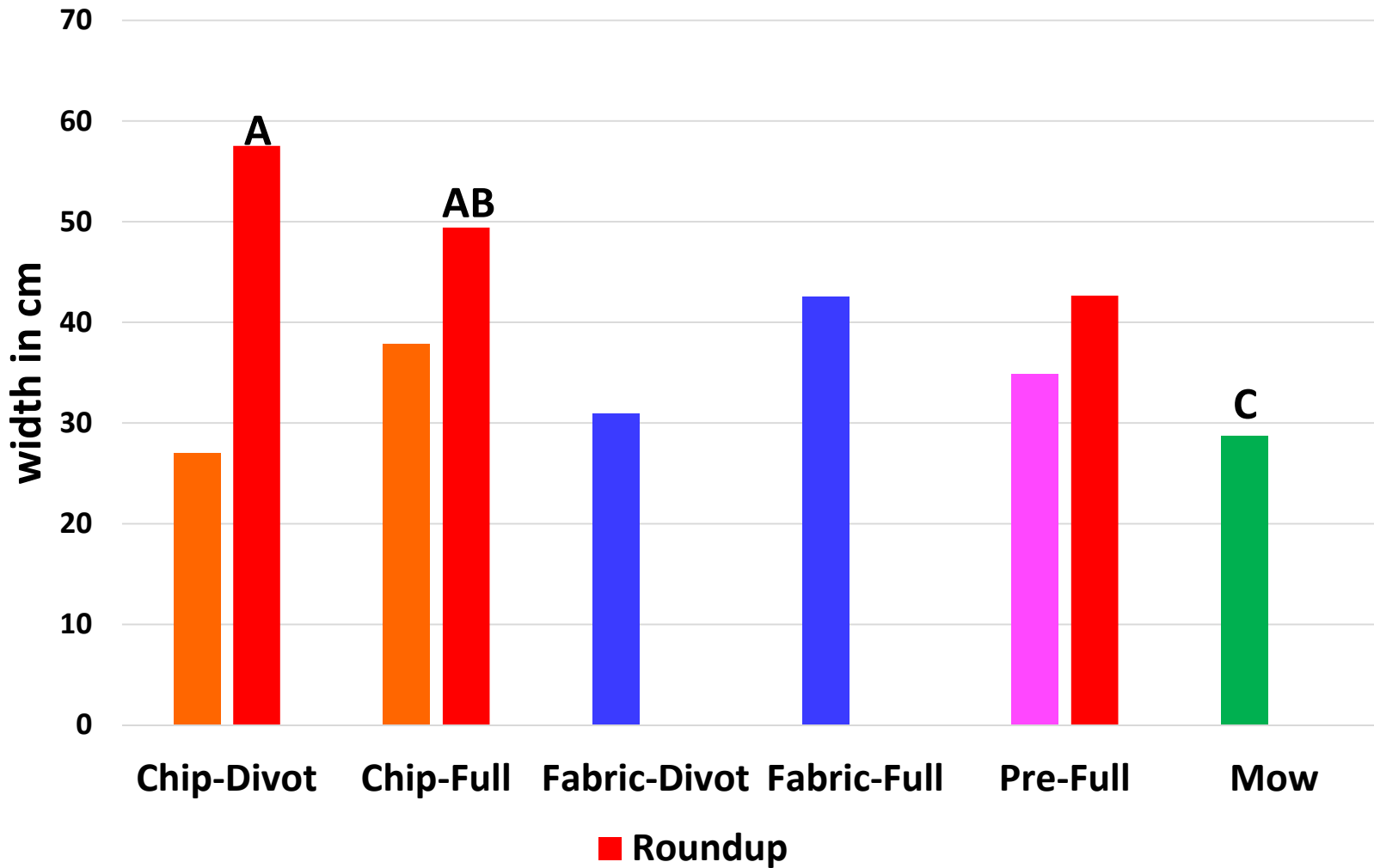


- Roundup
- Chips
- Fabric
- Pre-emerge
- None

Proportion Weed Cover Inside 1 1/2 Foot Diameter Divots

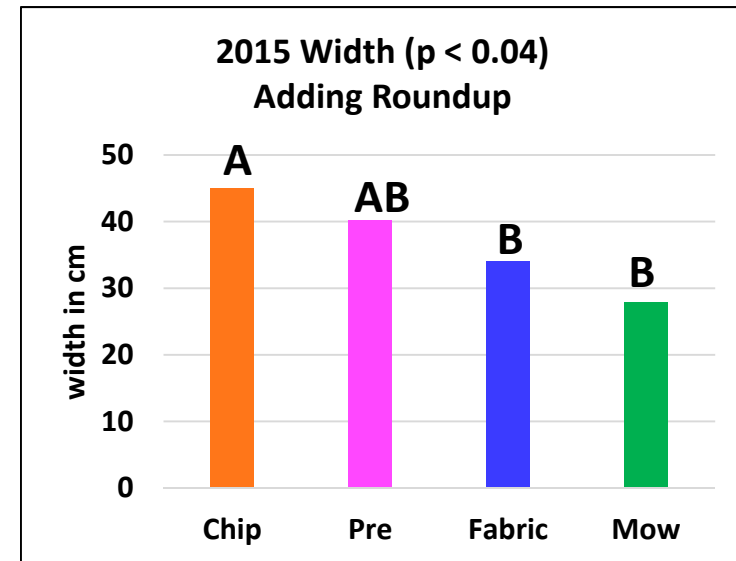
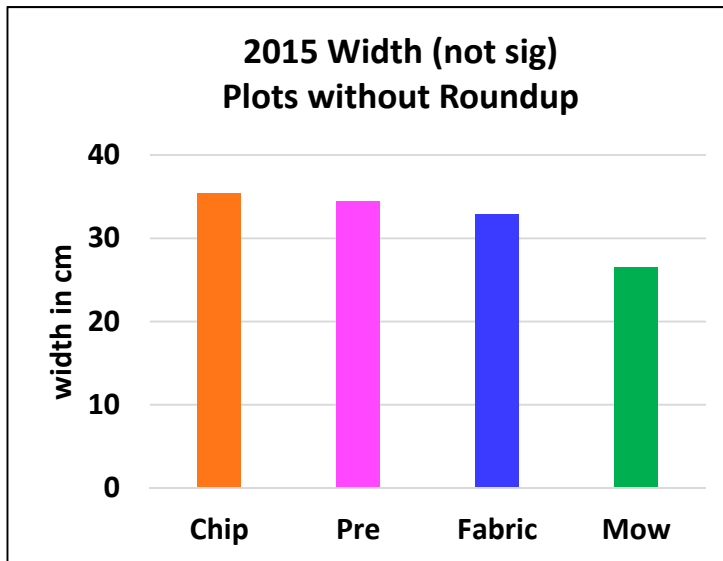
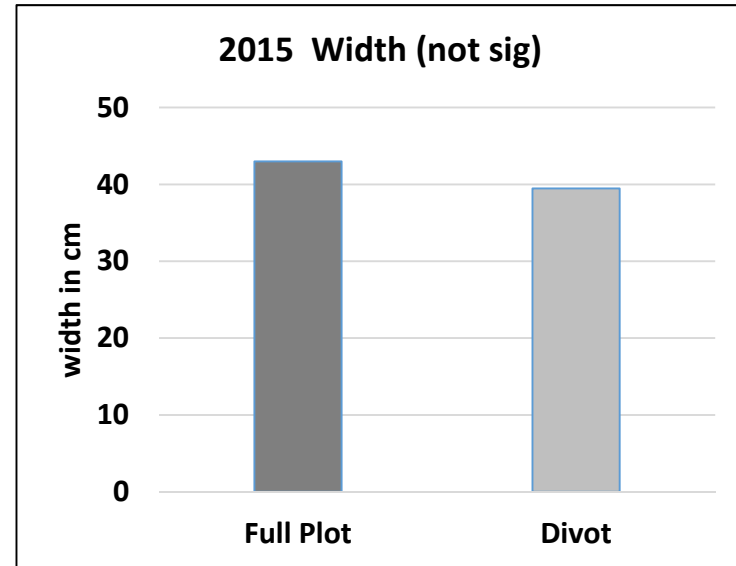
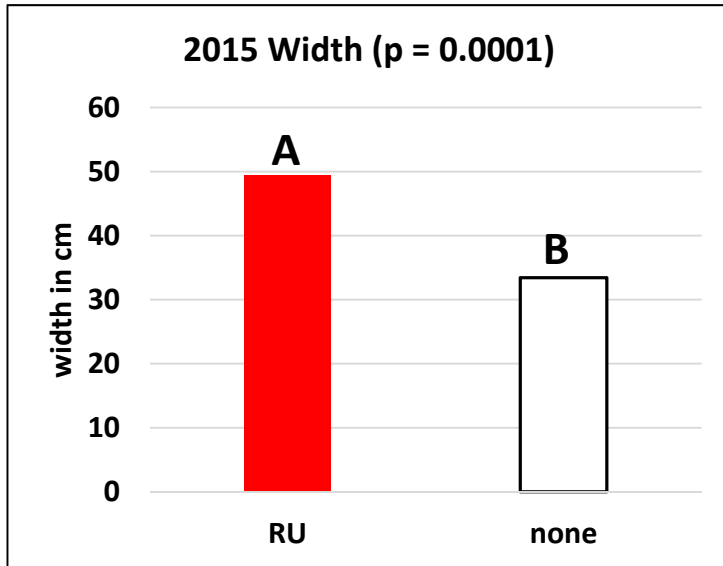
# Rosemount Sod

2015 Bush Width (p = 0.006)



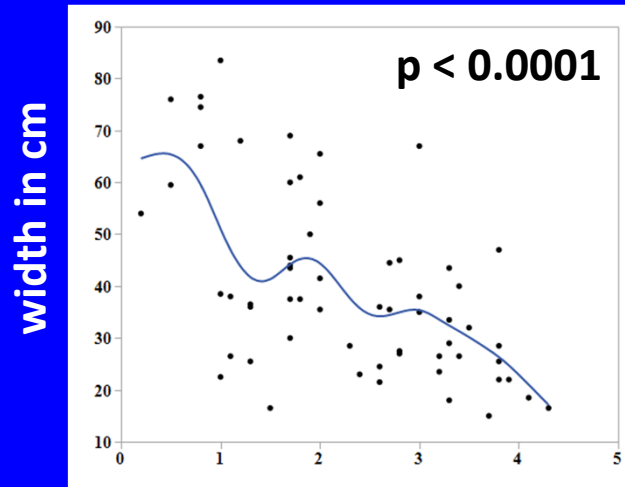
*If no letter is marked for a treatment, it is not significantly different than the control.  
Data are Least Squared Means, controlled for initial stem caliper.*

# Rosemount Sod



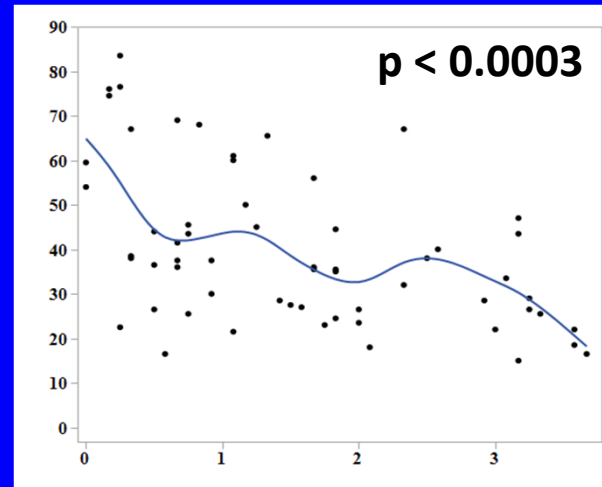
# Rosemount Sod: Effect of Weed Pressure on Bush Width

Fall  
2015



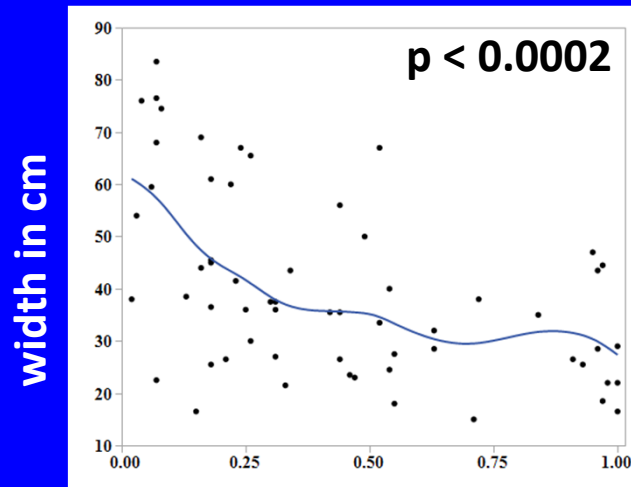
**Degree of Shading**

- 0 = no weeds
- 1 = weeds half as tall as bush
- 2 = weeds as tall as bush
- 3 = weeds over the top of the bush

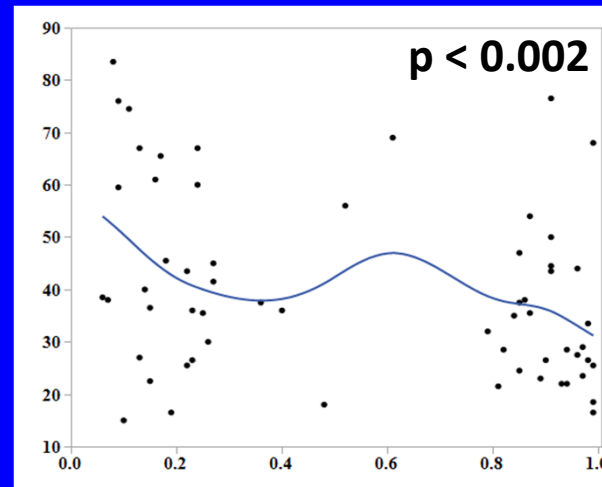


**Degree of Crowding**

- 0 = no weeds
- 1 = moderate
- 2 = intense
- 3 = can't see the hazel bush



**proportion weed cover in divot**



**proportion weed cover in rest of plot  
(outside divot)**

*Statistical models correct for initial plant size*





**June 2013**

## Waseca "Tilled" Trial (following corn)

**Beware of weed tree  
seeds in woodchips!**



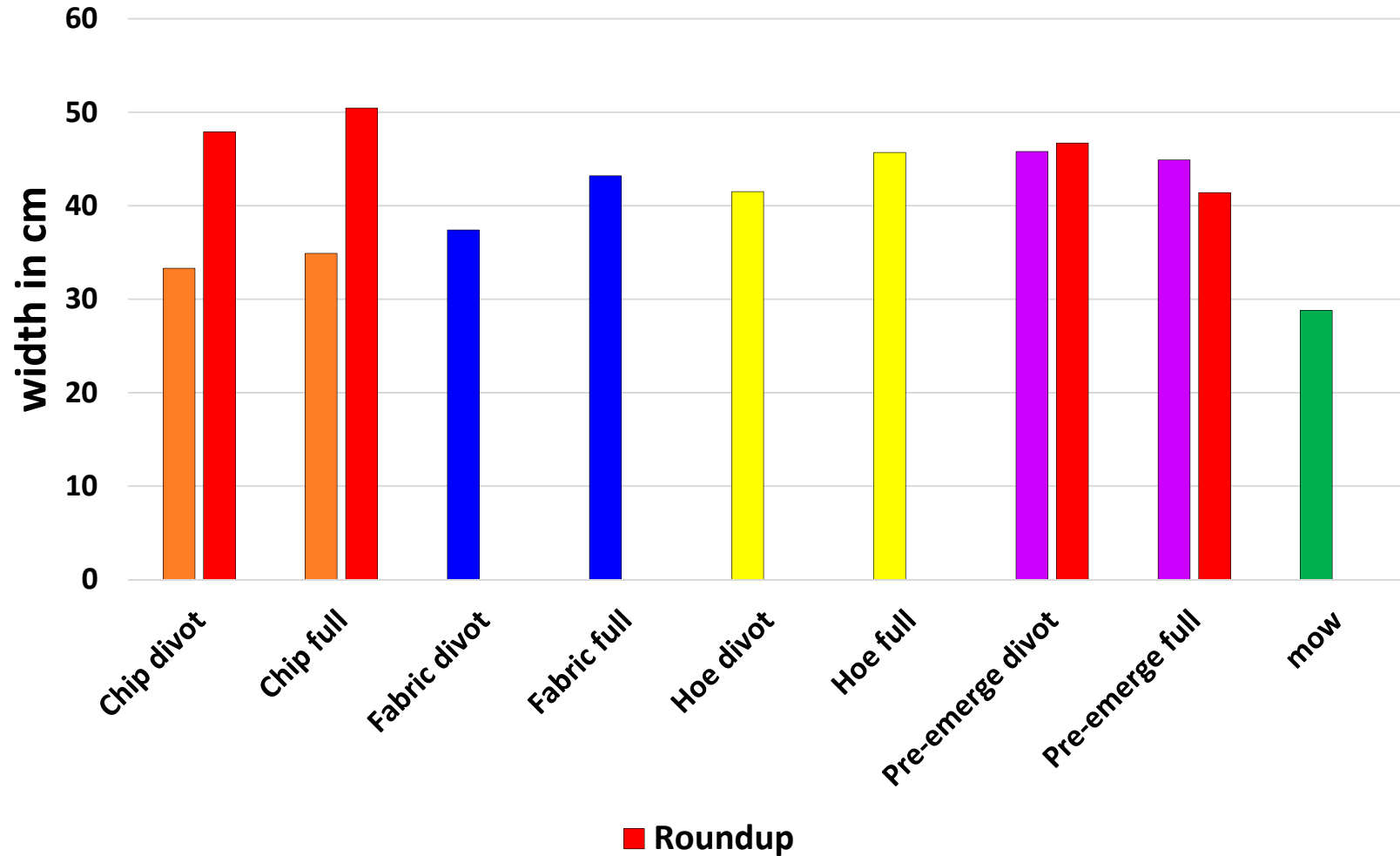
**July 2013**

**Waseca “tilled”  
July 2015**



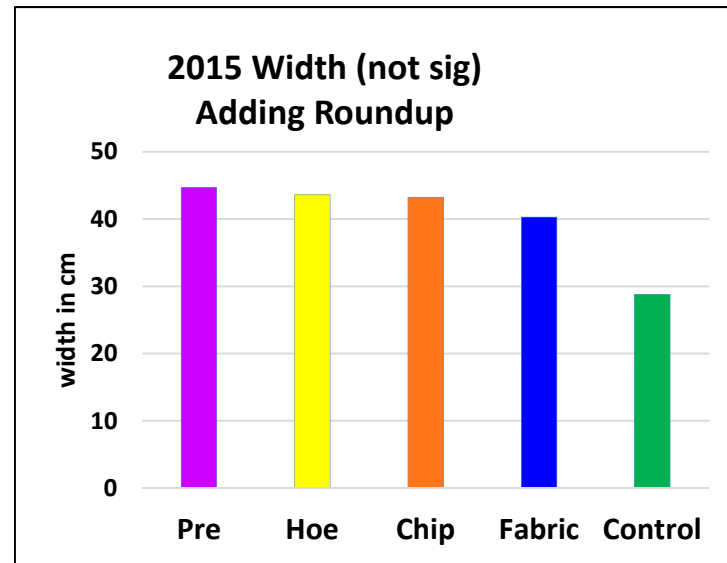
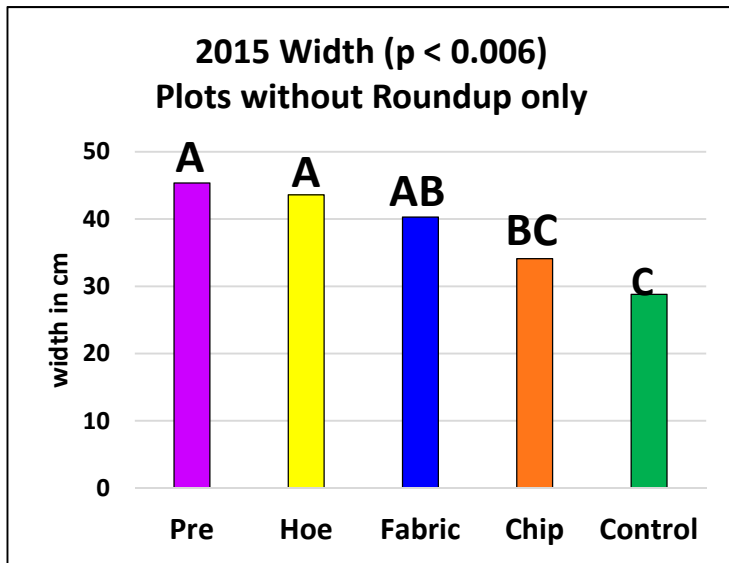
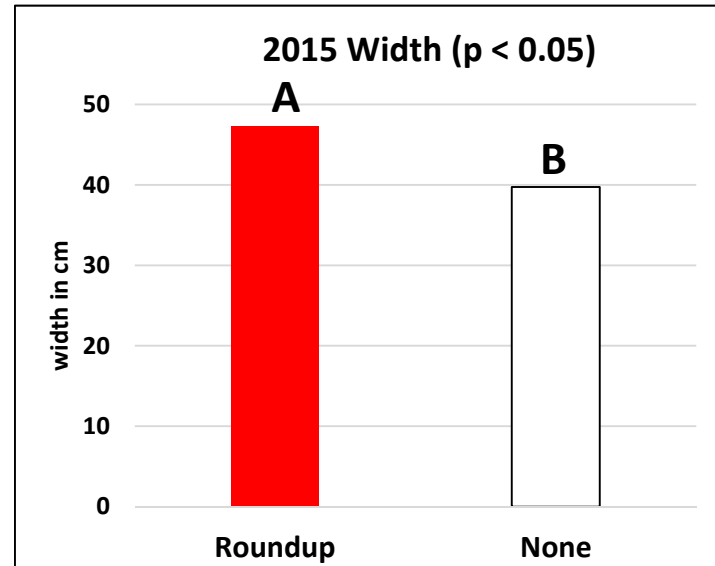
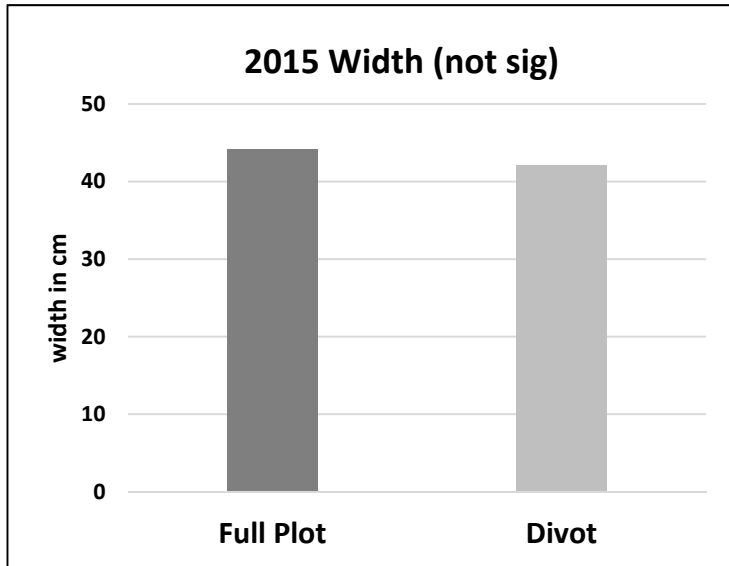
# Waseca Tilled

2015 Bush Width  
No significant differences ( $p < 0.10$ )



*If no letter is marked for a treatment, it is not significantly different than the control.  
Data are Least Squared Means, controlled for genotype.*

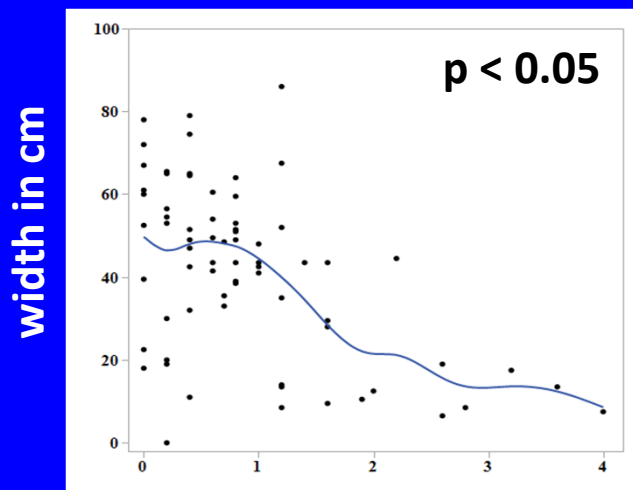
# Waseca Tilled



*Why is pre-emergent better than at Rosemount? Why are chips worse?*

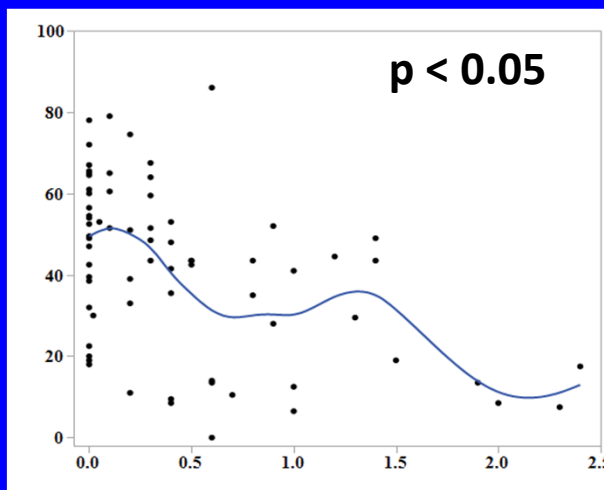
# Waseca Tilled: Effect of Weed Pressure on Bush Width

Fall 2015



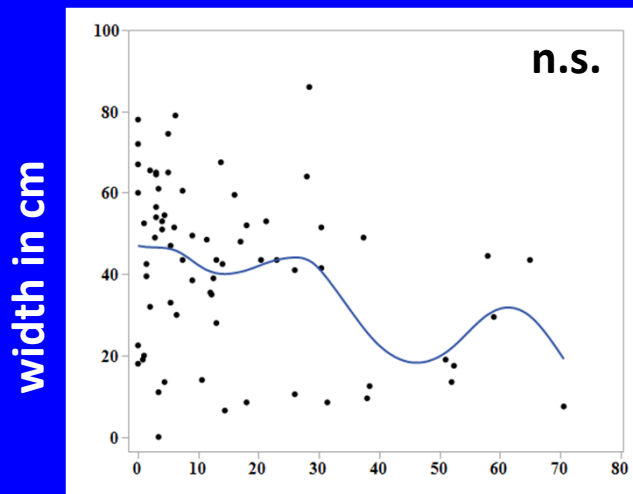
Degree of Shading

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- 1 = weeds half as tall as bush
- 2 = weeds as tall as bush
- 3 = weeds over the top of the bush

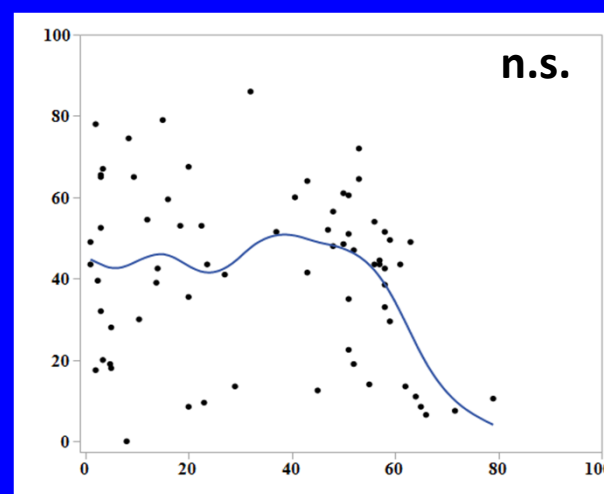


Degree of Crowding

- 0 = no weeds
- 1 = moderate
- 2 = intense
- 3 = can't see the hazel bush



% weed cover in divot



% weed cover in rest of plot  
(outside divot)

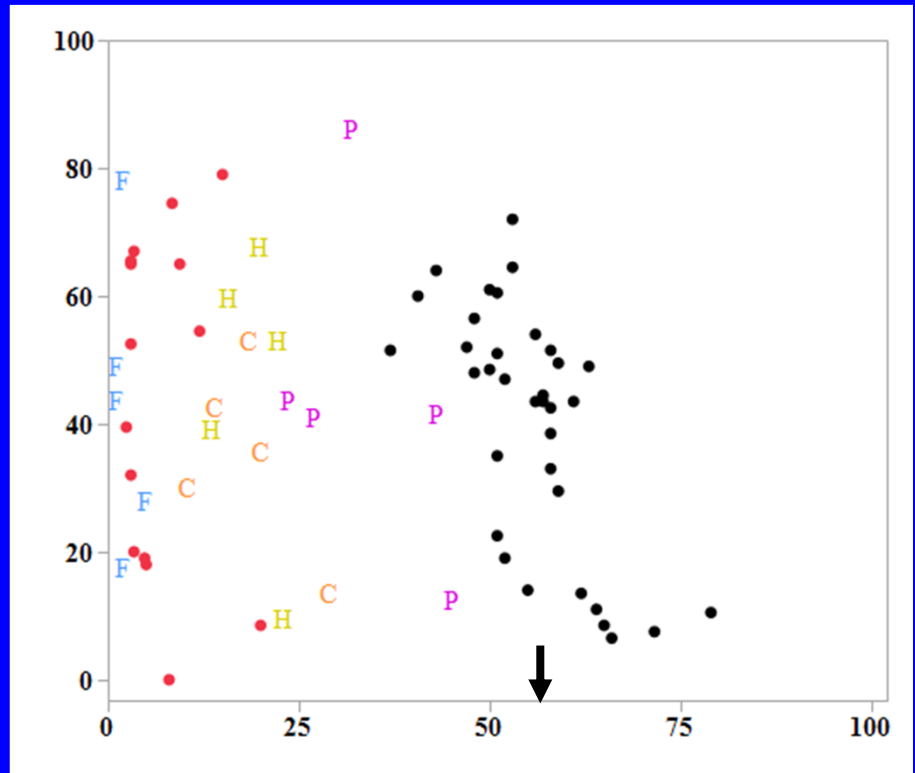
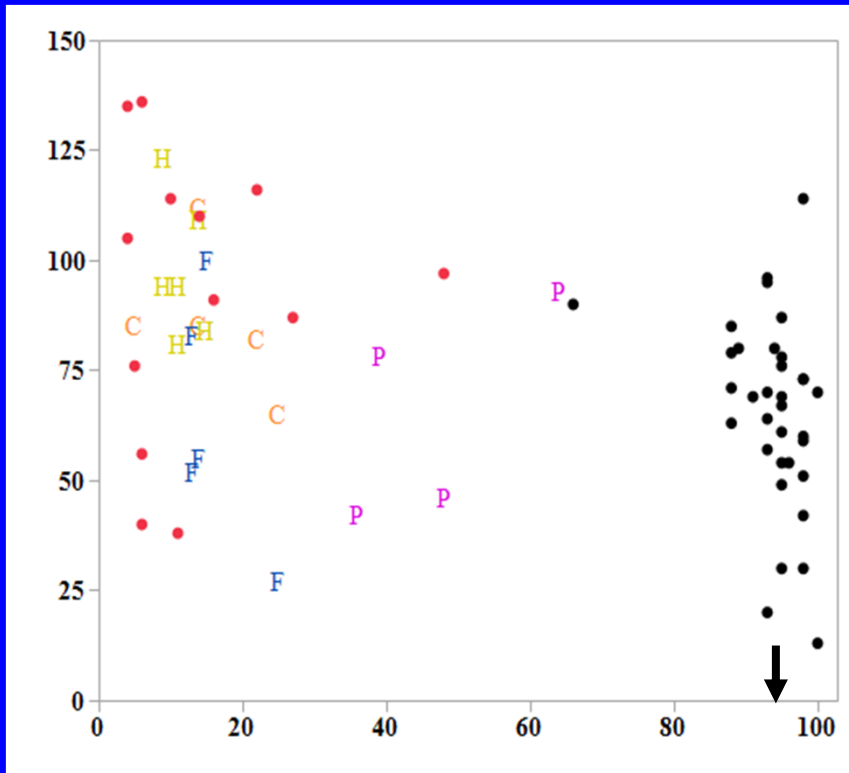
Statistical models correct for initial plant size

# Why the difference between Waseca tilled and Rosemount tilled?

Rosemount

Waseca

Vertical axis not relevant



% weed cover in plot outside of divot

Average % weed cover  
in un-weeded controls:

Rosemount tilled: 93%

Waseca tilled: 55%

- Red dots = Roundup
- Black dots = no control
- F = fabric
- C = woodchips
- H = hoed
- P = pre-emerge herbicide

# Waseca "Paired" Trial

Tilled: Roundup + Rototilling

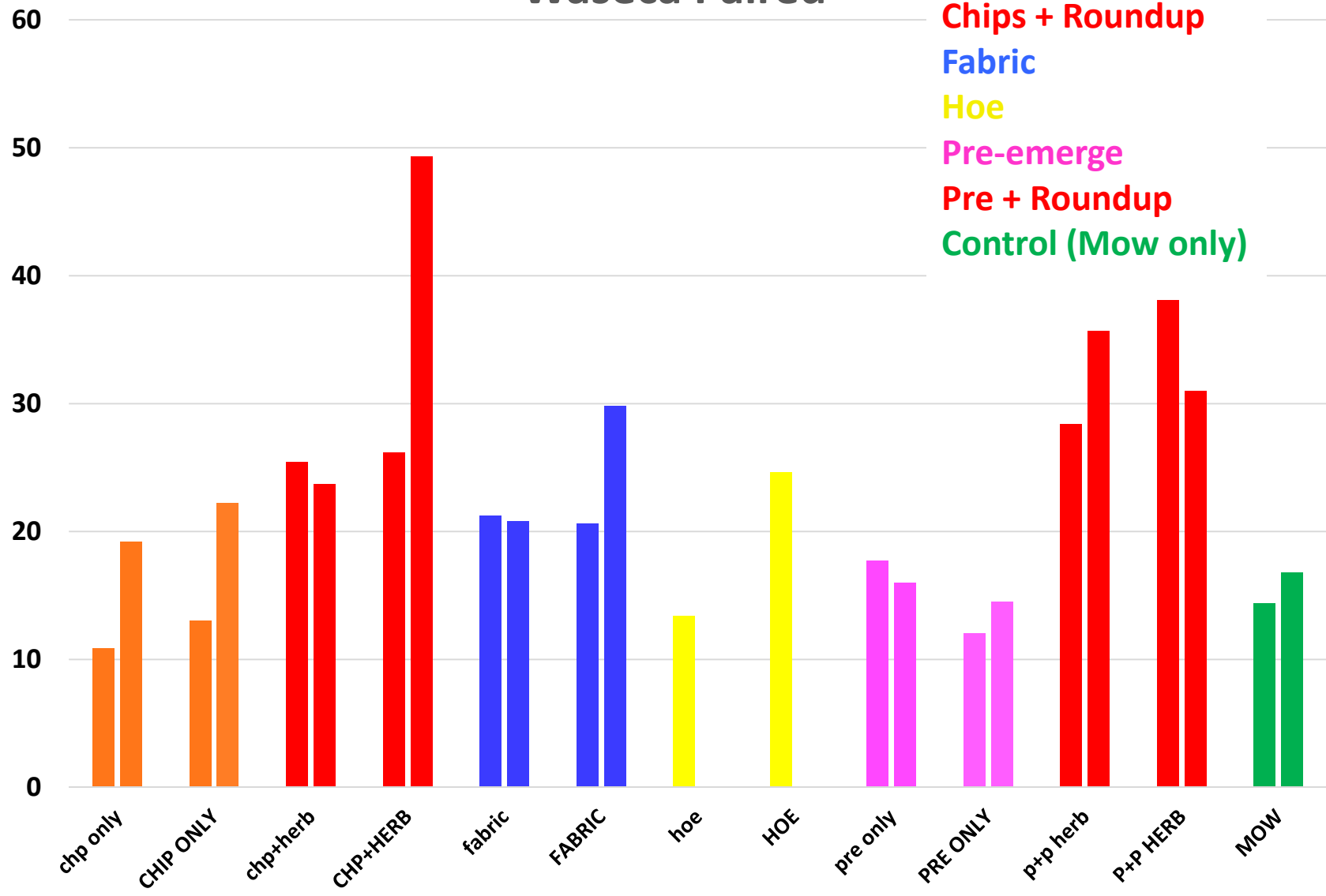
Untilled: Roundup Only

planted  
Oct 2013

# Waseca Paired

- Chips
- Chips + Roundup
- Fabric
- Hoe
- Pre-emerge
- Pre + Roundup
- Control (Mow only)

Width Fall 2015

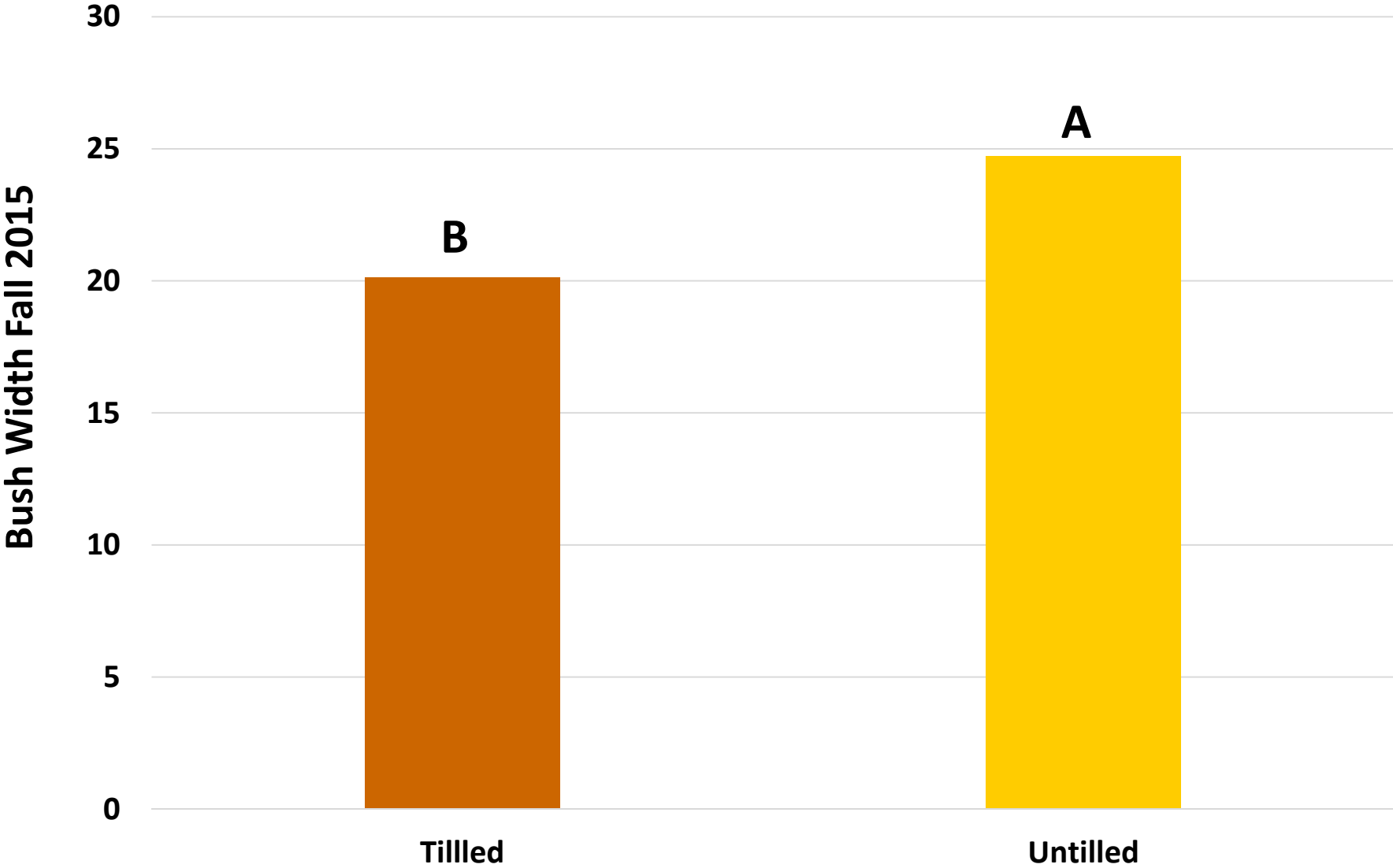


Tilled on left, untilled on right



**Waseca Paired  
Fall 2015 (after two years)**

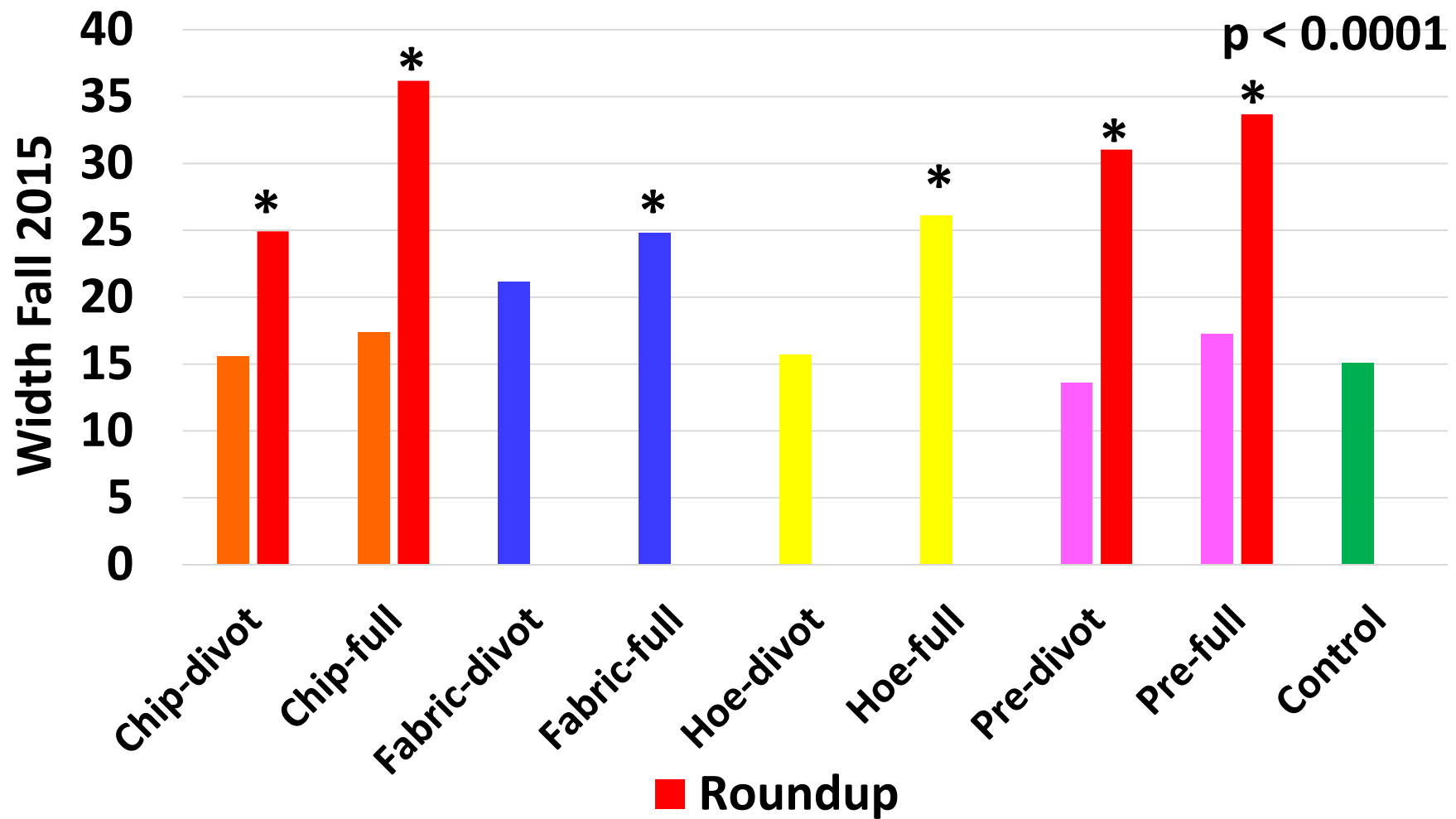
**p < 0.03**



# Waseca Paired

## Averages of Tilled and Untilled

(Fall 2015 after two years of weed control treatments)



\* = significantly better than the control

# Recommendations

## When planting into formerly tilled fields

- Most weeds likely to be annuals
- Annual weeds are relatively easy to control with any of the following:
  - Cultivation—start early and repeat often.
  - Woodchips must be applied thickly to effectively block out sunlight. They last two to three years.
  - Pre-emergent herbicides applied in early spring.
- If perennial weeds such as thistles and quackgrass are present they will need to be controlled with more intensive methods, such as Roundup or intensive cultivation.

# Recommendations

## When planting into sod:

- Digging and backfilling is challenging unless the ground is tilled first
- Perennial weeds will be a problem—eliminate them first!
- Woodchips provide moderate control but only in the first year.
- Pre-emergent herbicides are worthless against perennial weeds.

# Recommendations

- Spot applications of Roundup are an effective supplement to other methods.
- Apply Roundup with caution! It CAN KILL hazelnuts!
- Use personal protection with Roundup. We don't know how safe it really is.
- We also don't know the long-term effects of Roundup on the hazelnuts. Researchers in Canada are looking into whether it is translocated into the kernels.

# Landscape Fabric

- Is very effective against both annual and perennial weeds.
- It is essential to clip the weeds that grow through the planting hole.
- Buy good quality landscape fabric. It must block out all light.
- Do not ignore weed tree control in later years!
- In the long term, landscape fabric may restrict lateral growth of hazelnuts. More observation is needed to know whether this will be a problem.

# Take-home points

- Hazelnut growth is directly inhibited by weeds.
- The growth inhibition might take a few years to become apparent.
- Bush width is more inhibited than height.
- Both below-ground competition (for moisture and nutrients) and above-ground competition are important.
- Even weeds outside of the hazelnut drip-line make a difference.

# Future Plans for this Research

- Continue to apply treatments or merely continue to measure growth for next 2-3 years?
- Collect yield data for first 2-3 years of nut bearing to calculate economic return to management.
- Dig up several reps to evaluate root mass and morphology.