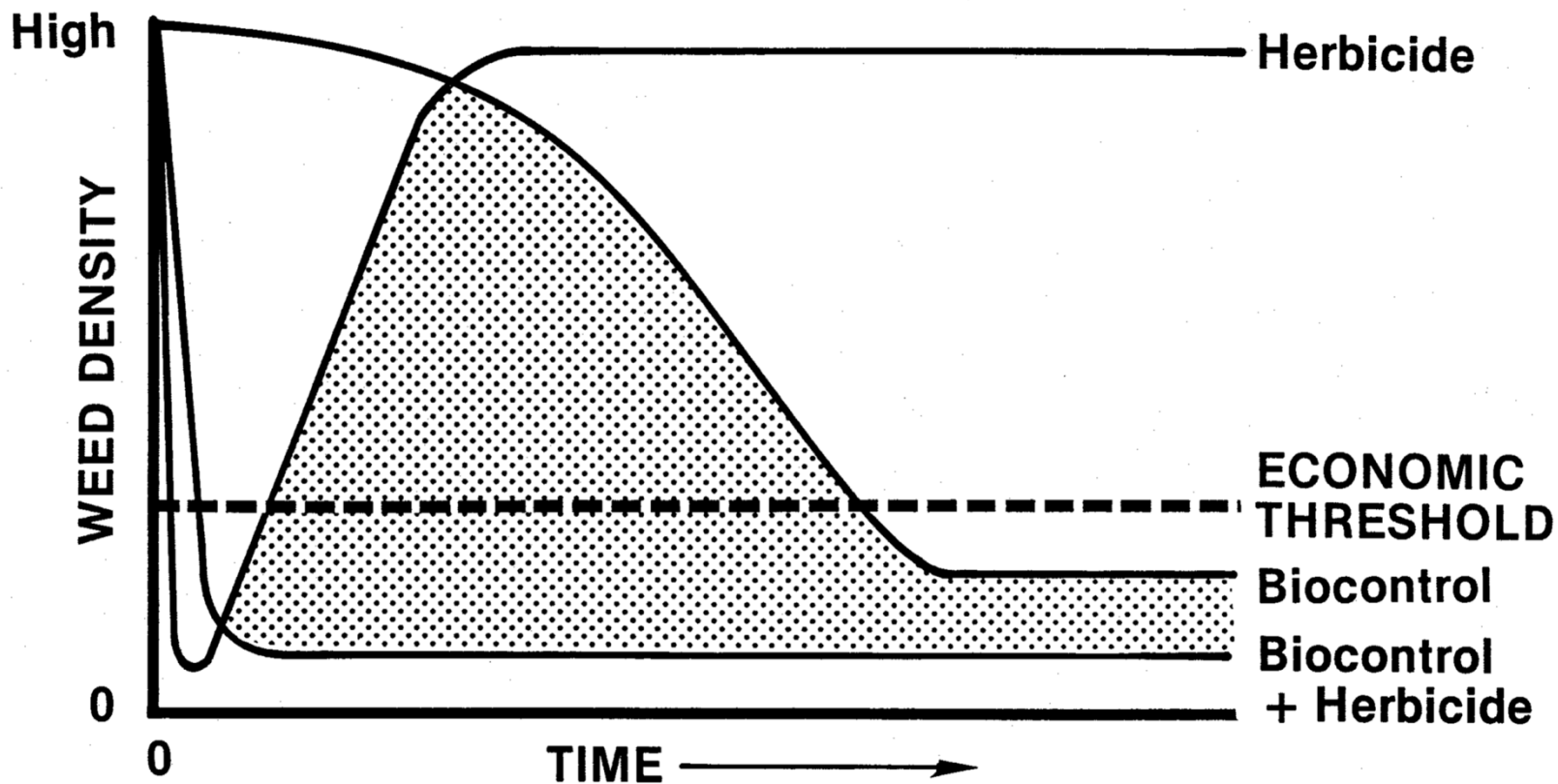


**INTEGRATION OF BIOLOGICAL
CONTROL AGENTS WITH HERBICIDES
AND GRAZING**

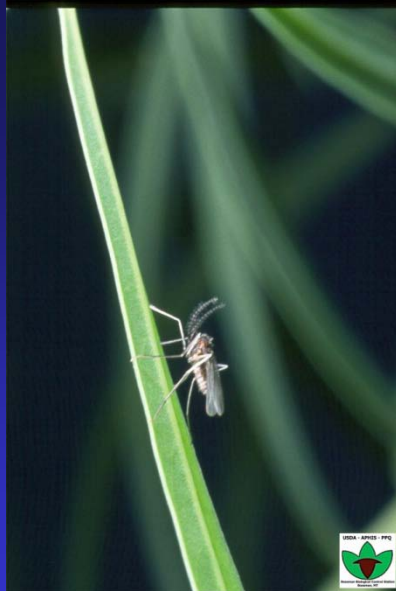
**ROD LYM
NORTH DAKOTA STATE UNIV.**

REASONS FOR IPM

- **REDUCE WEED DENSITY MORE QUICKLY**
- **INCREASE THE SUCCESS OF BIOCONTROL AGENTS, ONLY ABOUT 30% OF PROGRAMS ARE CONSIDERED SUCCESSFUL, MOST RELY ON ONE AGENT**
- **REDUCE THE USE OF A PESTICIDE OR THE NEED FOR MANY BIOCONTROL AGENTS**



From Messersmith and Adkins. 1995. Weed Technol. 9:199-208.



Gall midge (*Spurgia esula*)



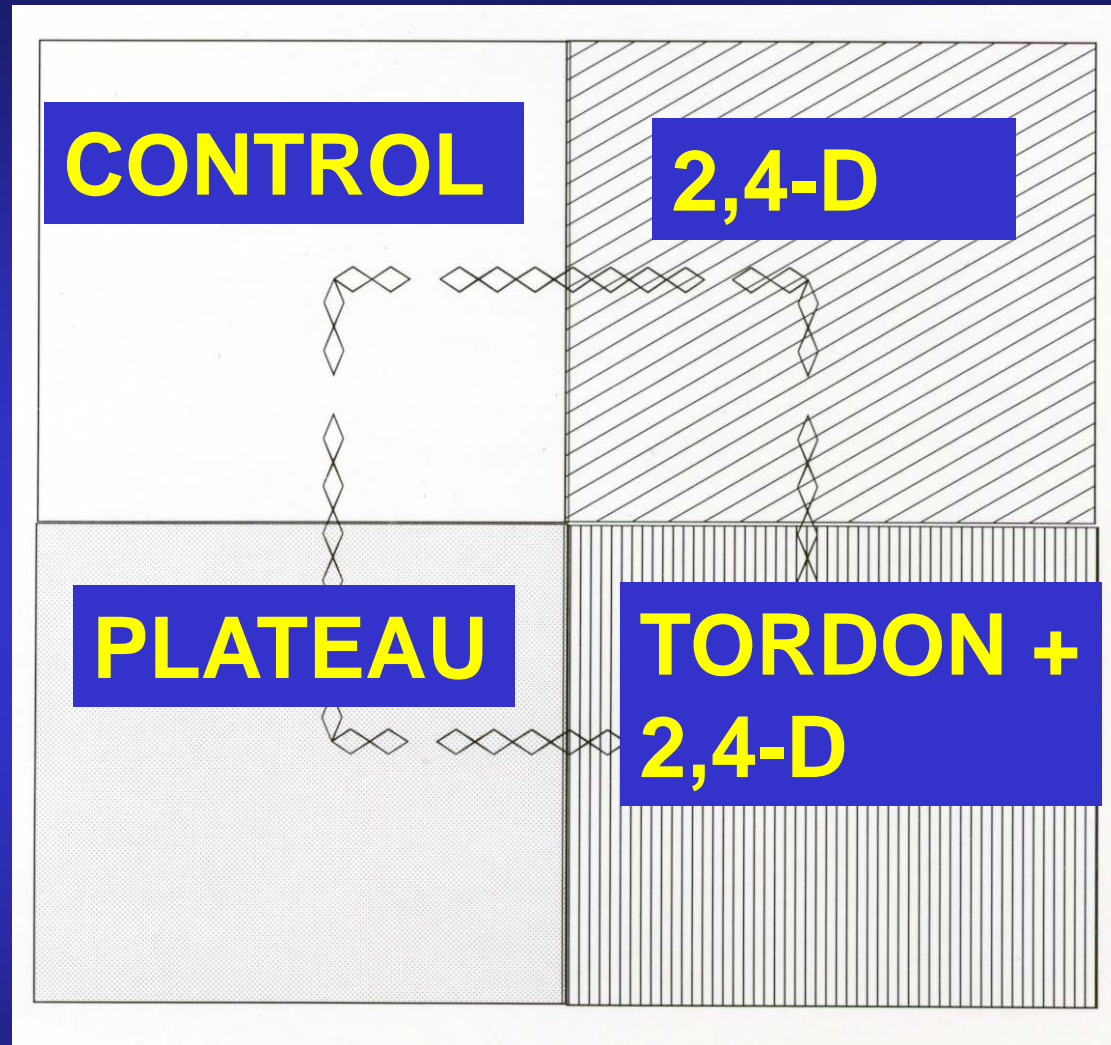
**Useful in wooded
and moist areas**



Prevents seed set



**WORKED
WELL AS
LONG AS
≈ 25% OF
LEAFY
SPURGE
WAS NOT
SPRAYED.**



Lym and Carlson. 1994. *Weed Technol.* 8:285-288.



A. FLAVA



A. NIGRISCUTIS

A. LACERTOSA







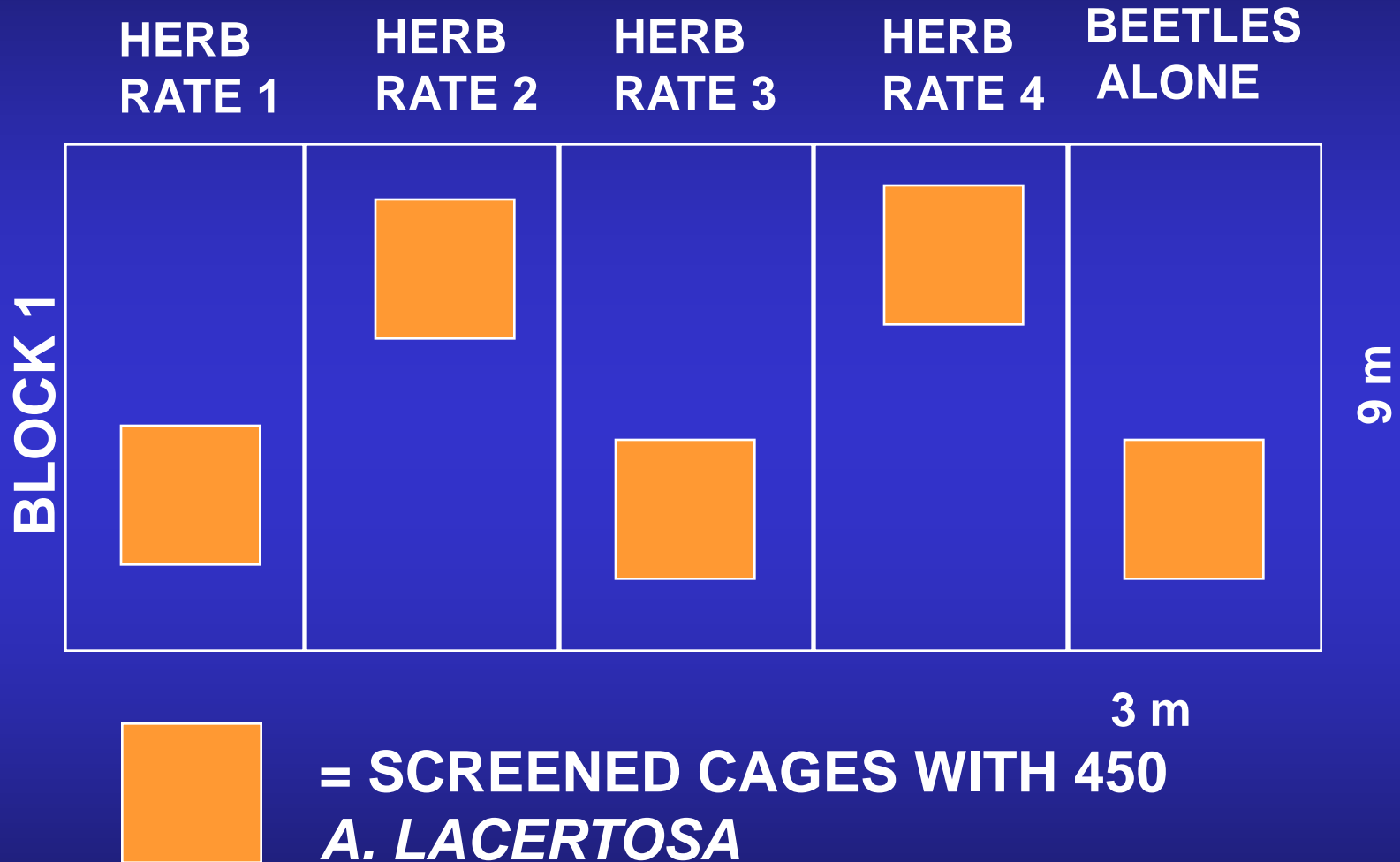
Aphanisoma insectary near Minot, ND.



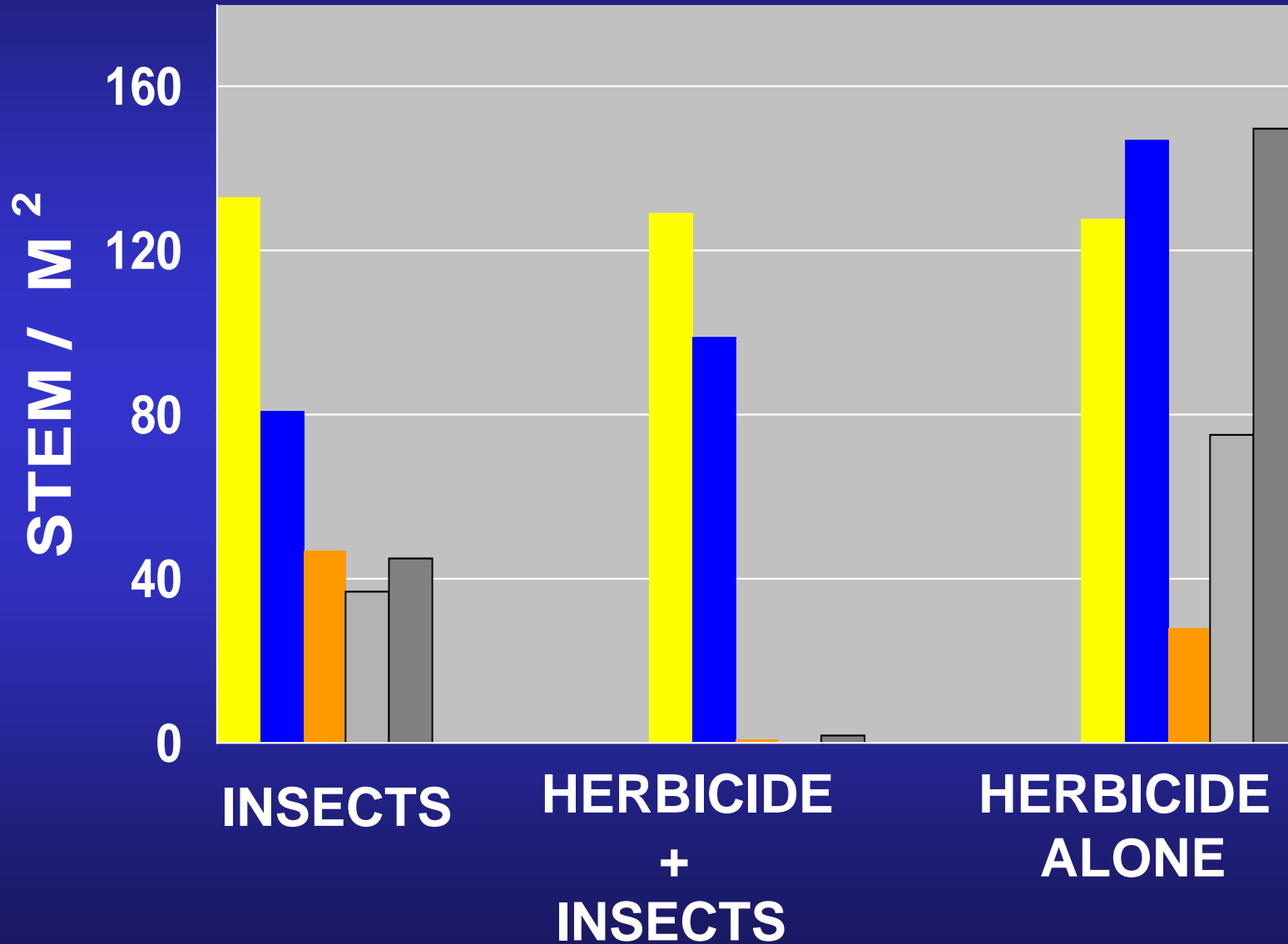
Helicopter was spraying leafy spurge in the area and came up over the hill.



HERBICIDES, *APHTHONA*, OR BOTH



LEAFY SPURGE CONTROL



HERBICIDES, *APHTHONA*, OR BOTH

- RESULTED IN MORE RAPID CONTROL, 3 TO 5 YEARS EARLIER THAN *APHTHONA* ALONE
- MOST SUCCESSFUL WHEN USED WITH ESTABLISHED *APHTHONA* POPULATIONS THAT WERE NOT INCREASING IN SIZE OR REDUCING LEAFY SPURGE DENSITY



Fall regrowth after *Aphthona* feeding.



Goats and sheep will graze leafy spurge.





A. NIGRISCUTIS COMBINED WITH SHEEP
GRAZING REDUCED LEAFY SPURGE STEMS
MORE THAN EITHER AGENT ALONE

Hansen. 1993. GPAC-14 Proceed. 47-48.



COMBINED HERBICIDES
WITH *GALLERUCELLA*
FOR LYTHRUM CONTROL

Lindgren et al. 1998. Bio. Cont. 12:14-19.



TRICLOPYR (GARLON) DID NOT
EFFECT *GALERUCELLA*
ADULTS, EGG MASSES, OR
LARVAE.

WORK WAS DONE WITH
POTTED PLANTS.

Integrating biological control with herbicides for Dalmatian toadflax control



Stephen Enloe, Andrew Norton, Tim Collier, Paul Meiman

Dalmatian toadflax invasion following fire





UGA1416019



UGA1416039

**Dalmation toadflax stem mining
Weevil *Mecinus janthinus* Germar.**



UGA1416009

Control of Dalmatian toadflax with herbicides

- A few herbicides are “effective”
 - Picloram
 - Imazapic
 - Chlorsulfuron
- Treatment at flowering provides variable control
- Fall treatment timing not well studied



Longmont, CO



Centennial, WY



Cheyenne, WY



Results 20 MAT

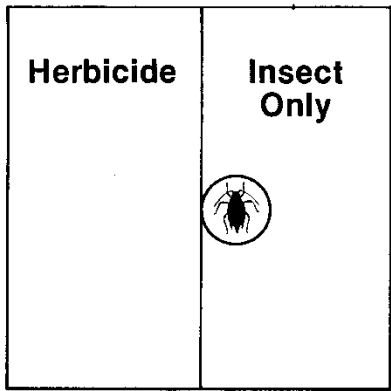
- Dalmatian toadflax control
 - **increased toadflax control with herbicide plus *Mecinus* only at Centennial**
 - ***Mecinus* not significant otherwise**

ADVERSE EFFECTS OF HERBICIDES ON AGENTS

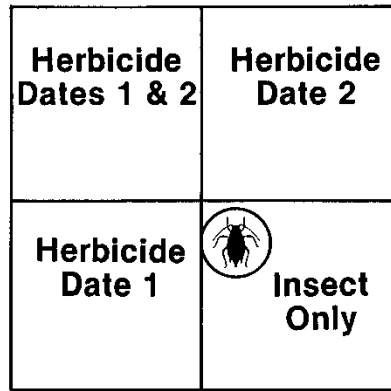
- *Rhinocyllus conicus* did not survive beyond 2nd instar when 2,4-D was applied within 48 h of oviposition (Tumble and Kok, 1979)
- Klein (1999) observed mass mortality of biocontrol agents on cactus following herbicide application.
- Herbicide did not kill insects, the timing of the application removed the food source at a critical time during the agents life cycle.

INTEGRATION WITH HERBICIDES

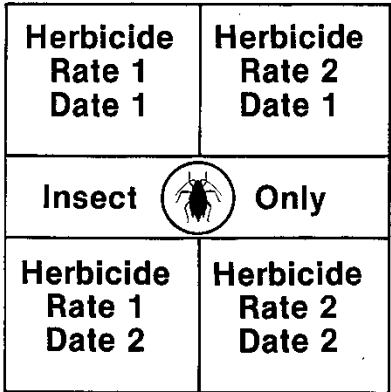
- **MUST BE SURE THAT**
 - **HERBICIDE DOES NOT DIRECTLY HARM AGENT**
 - **HERBICIDE DOES NOT REDUCE FOOD SOURCE BELOW A CRITICAL LEVEL**
 - **PREDATORY INSECTS ARE NOT INCREASED**



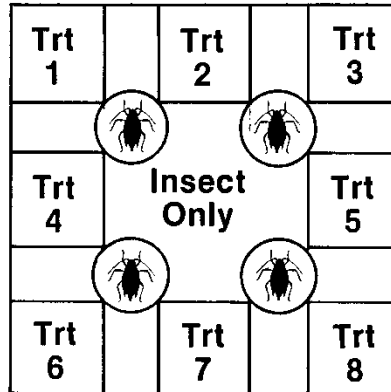
A



B



C



D



Insect release site

Trt = Treatment

**BESIDES HERBICIDES:
FERTILIZERS
MOWING
PATHOGENS
ETC.**

**BEST IF INSECT IS
MOBILE (NOT EGG OR
LARVAE)**

**TIME TO ADULT LIFE-
CYCLE**

SUMMARY

- **INTEGRATED SYSTEMS CAN RESULT IN MORE RAPID AND ECONOMICAL WEED CONTROL BUT ARE WEED SPP. DEPENDENT**
- **MORE COMPLETE CONTROL THAN ANY METHOD USED ALONE**
- **VERY DIFFICULT TO CONTROL INVASIVE SPECIES WITH ONE TOOL**

