Variable Rate Application of Preemergence Herbicides based on Weed Maps

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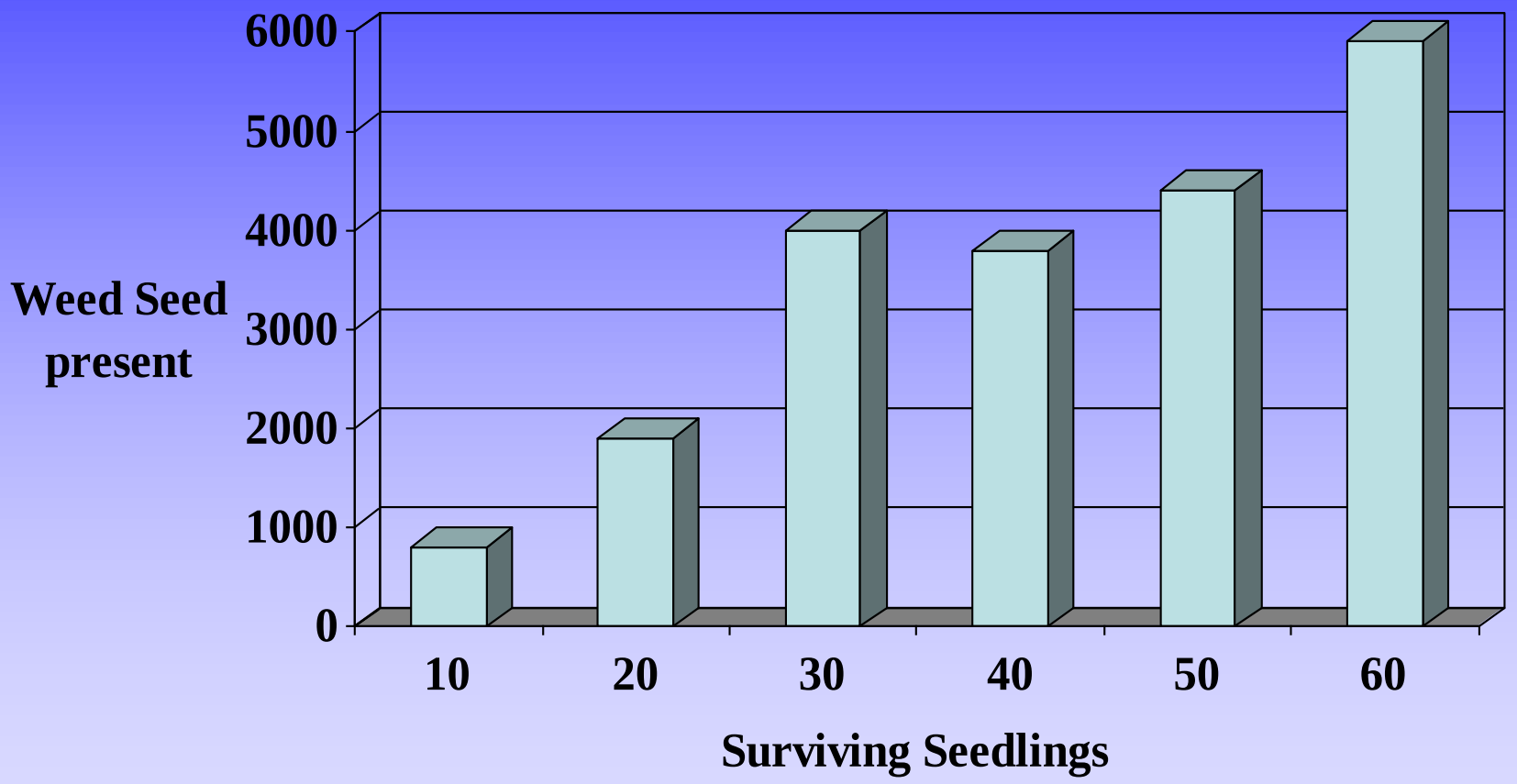
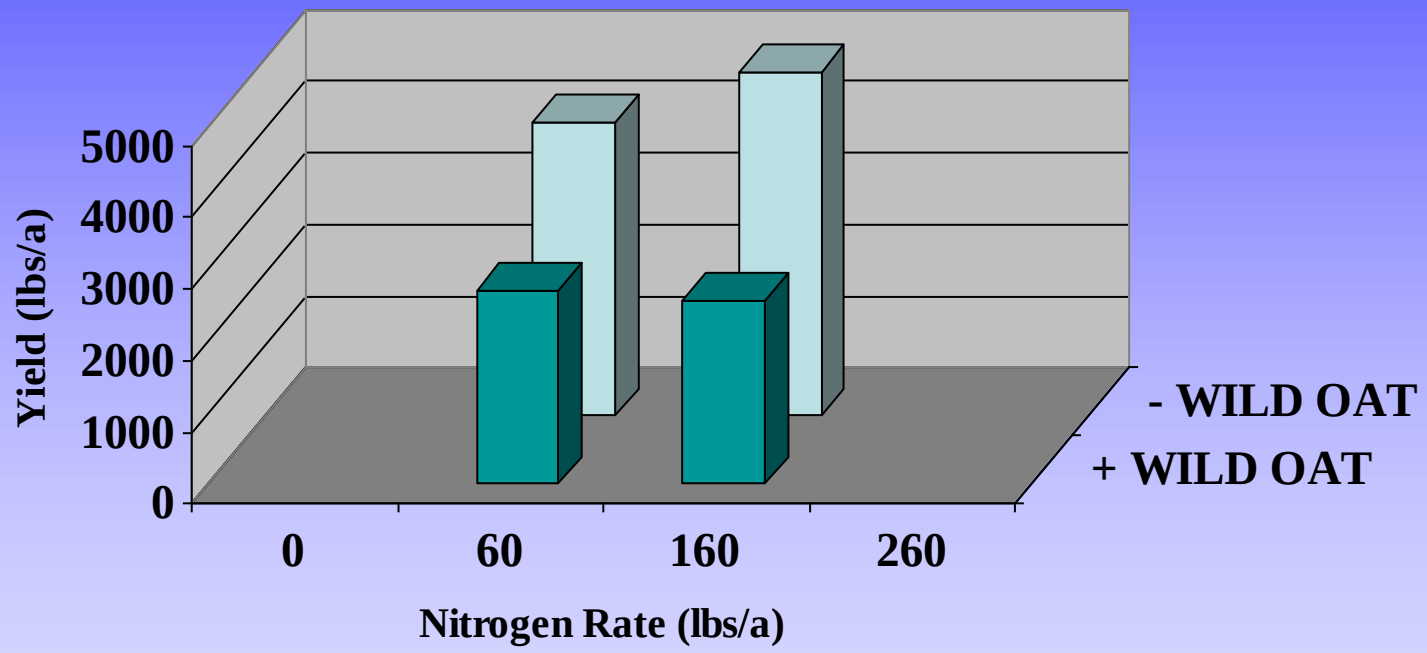
WEED DISTRIBUTION IN A FIELD

Surviving Sunflower Seedlings Relative to Initial Seed density



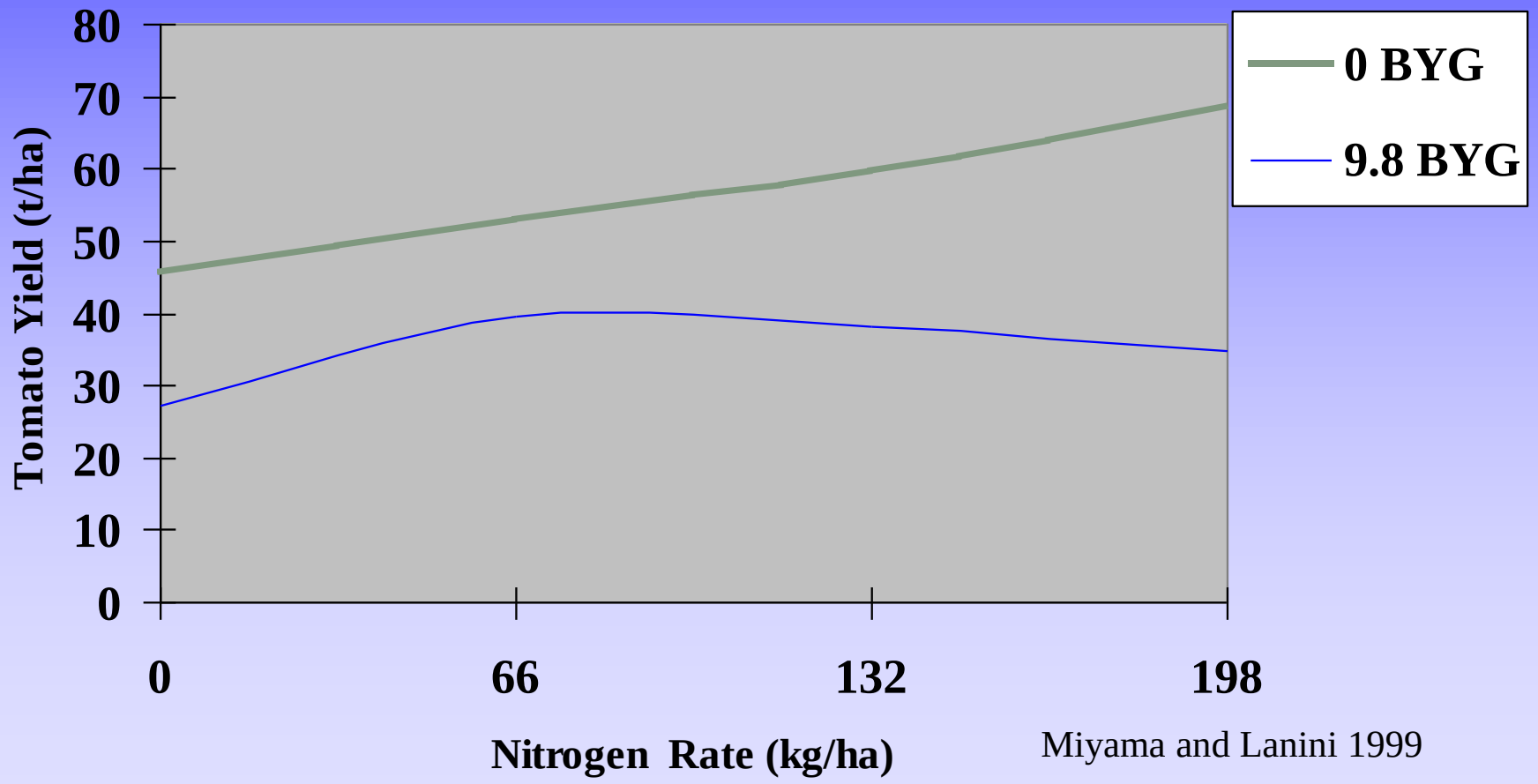
Dielman et al. 1999

Effect of Wild Oat release and Nitrogen Rate on Wheat Yield



Hill and Carlson 1985

Tomato Yield Relative to Nitrogen Rate and Barnyardgrass Density 1999



Miyama and Lanini 1999

Objectives

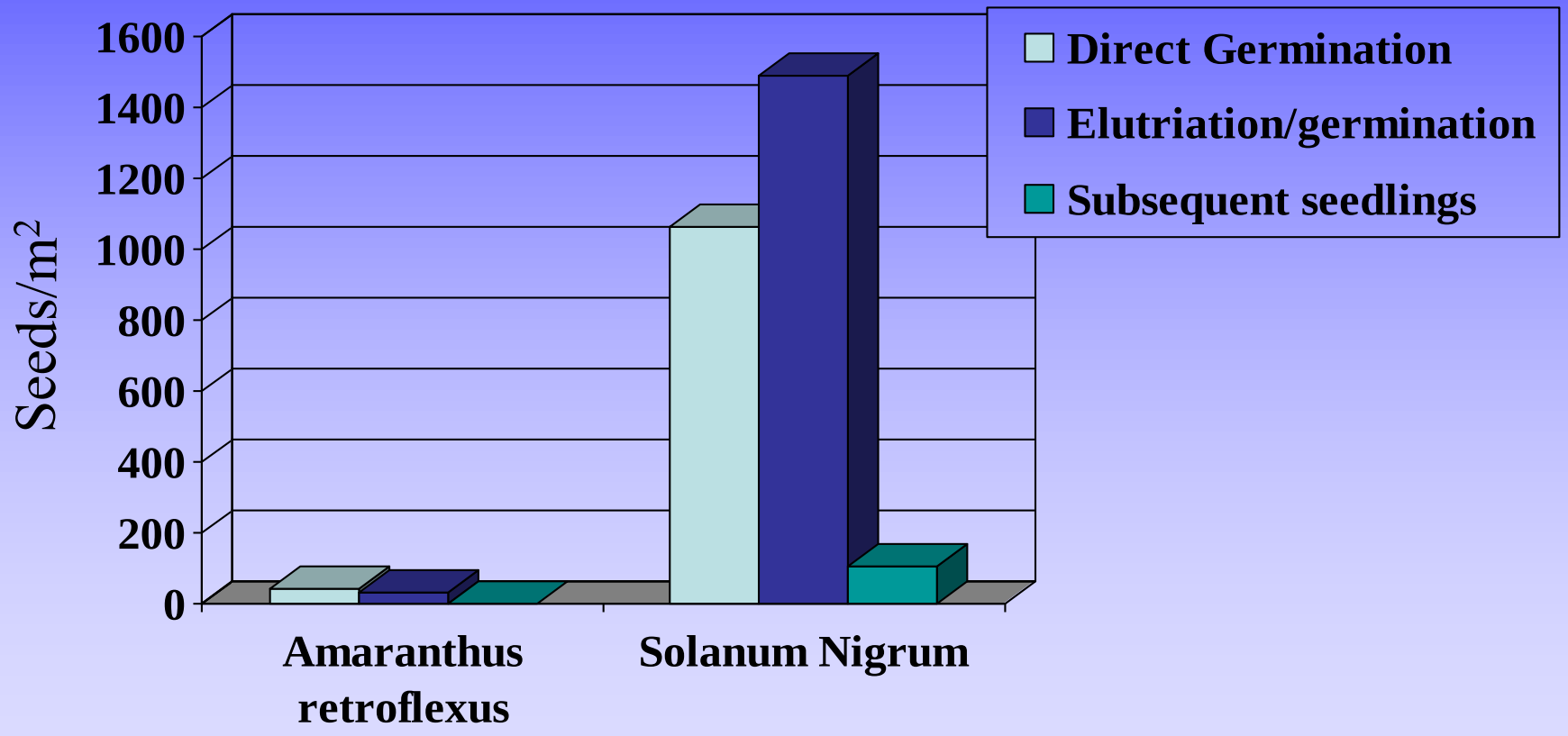
- Evaluate sampling methods for creating accurate weeds distribution maps
- Develop threshold criteria for variable rate herbicide applications
- Develop strategies for managing spatially heterogeneous weed populations

Seedbank Sampling Methods

- Separate seeds from soil by either potassium carbonate flotation (Buhler and Maxwell 1993) or elutriation (Gross and Renner 1989) and count resulting seeds
- Place soil sample in a greenhouse tray and count emerging seedlings (Forcella 1992).

Soil Core Sampling

Comparison of Seedbank Estimation Methods - 1997



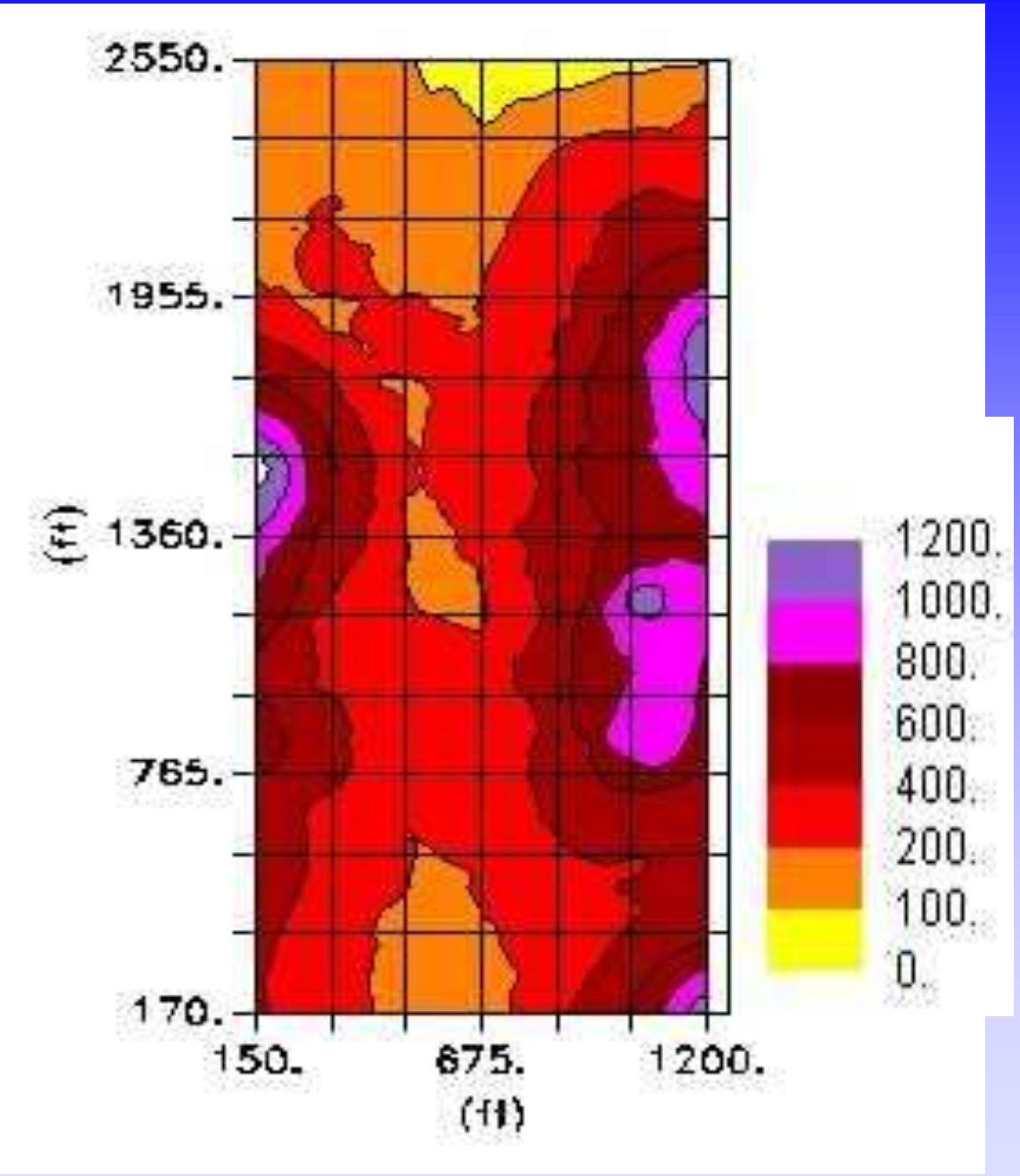
WEED SAMPLING AND MAPPING METHODS

- SEEDS - elutriation, greenhouse germination
- SEEDLINGS - ground based field counts during the season
- MATURE PLANTS - before the crop harvest, counts of plants with seeds

WEED MAPPING

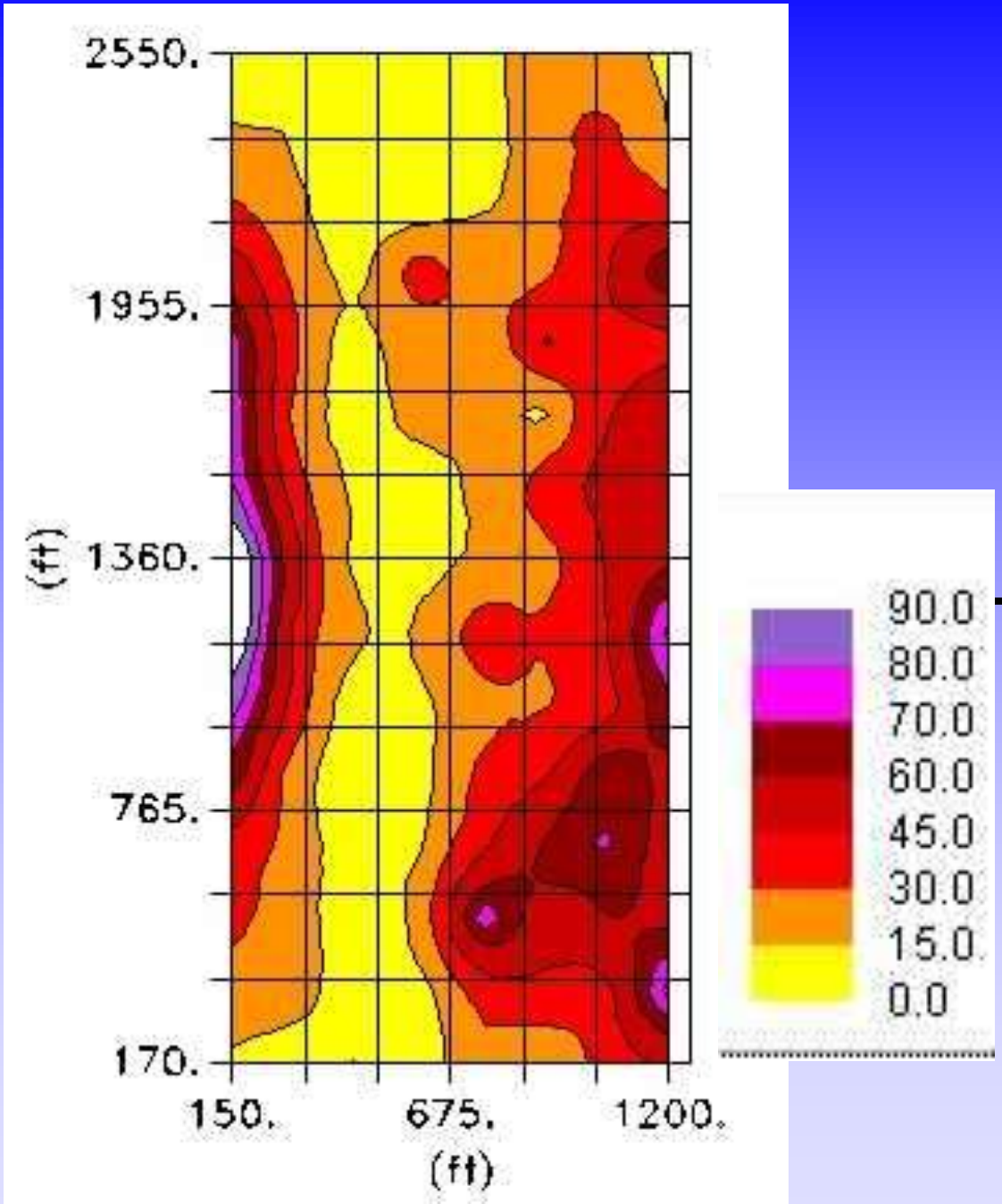
Portable GPS data logger

Quadrat method imposed on the whole field grid



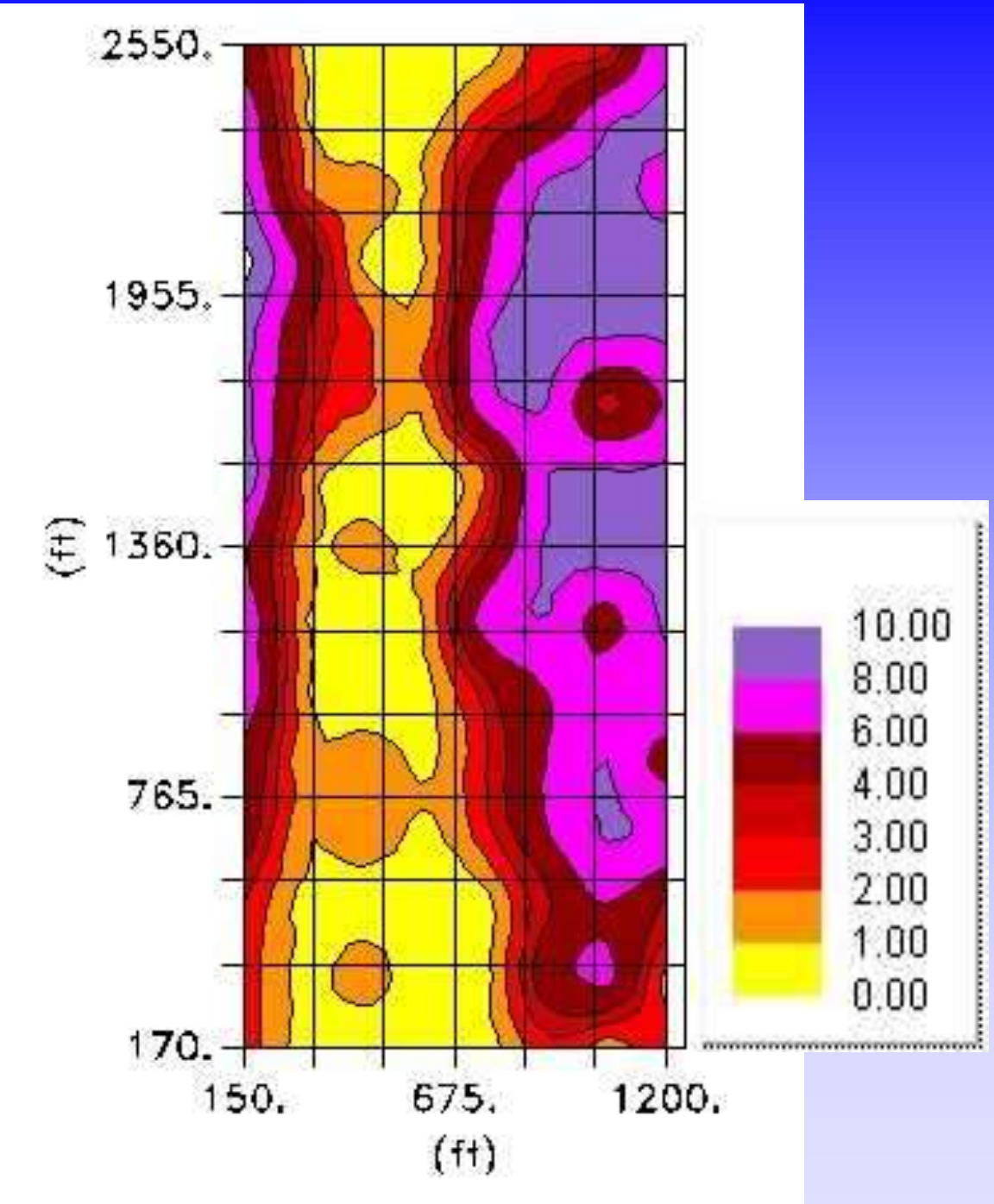
MAP BASED ON SEEDBANK ESTIMATION - *Solanum nigrum*

Turkovich field
Jan. 1999



MAP BASED ON SEEDLING COUNTS - *Solanum nigrum*

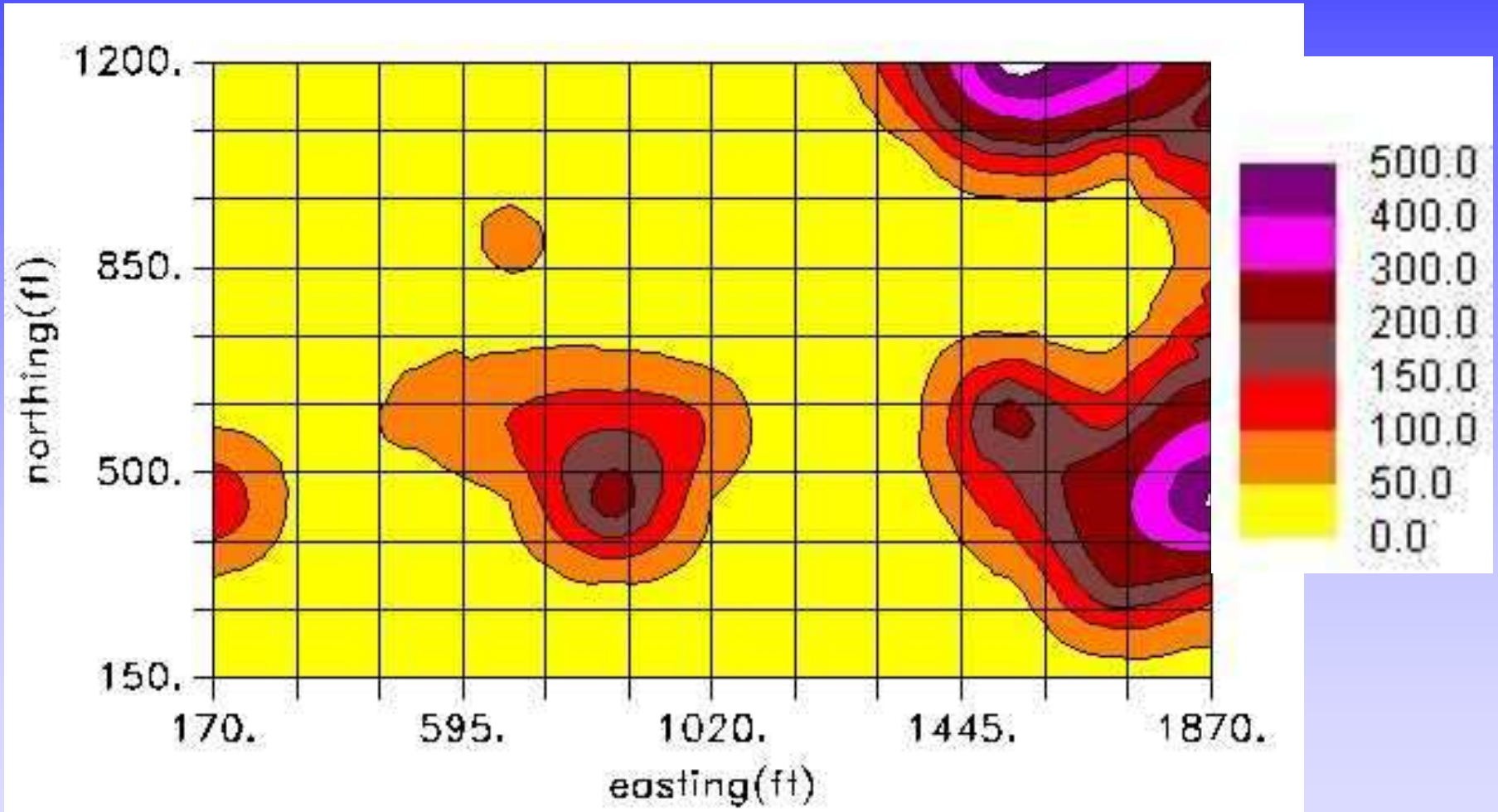
Turkovich field
Mar. – Jul. 1999



MAP BASED ON MATURE PLANT COUNTS - *Solanum nigrum*

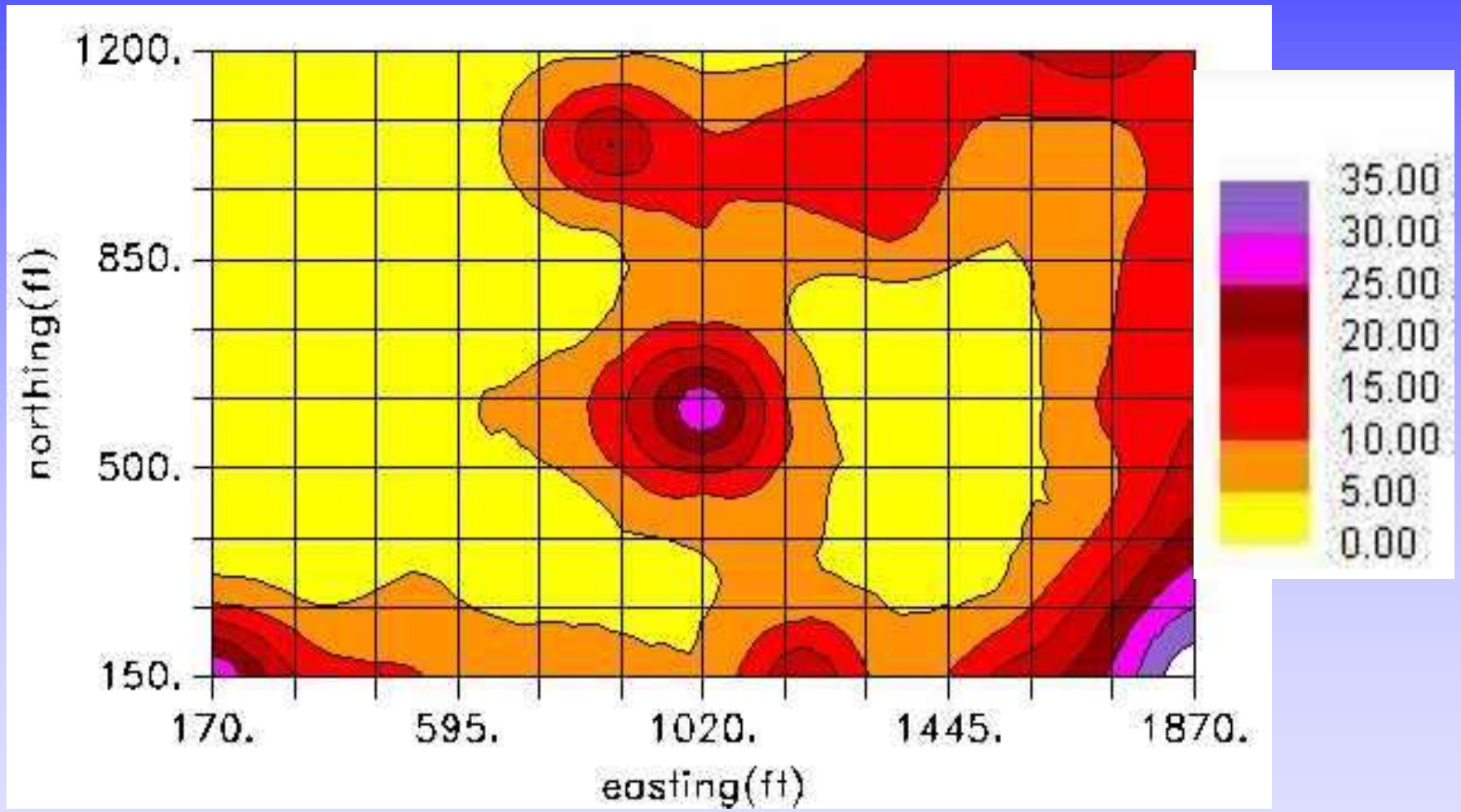
Turkovich field
Aug. 1999

MAP BASED ON SEEDBANK ESTIMATION - *Echinochloa crus-galli*



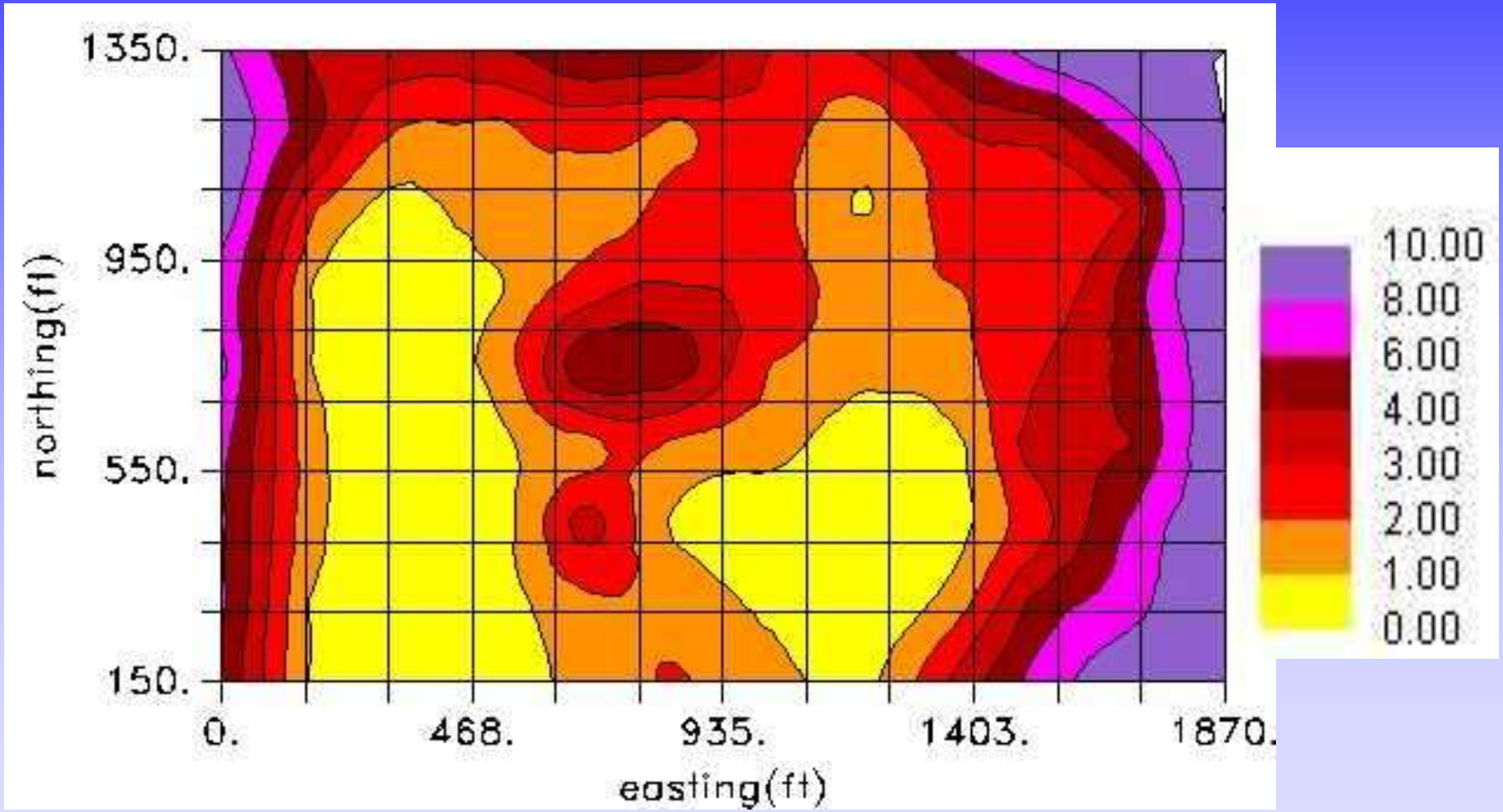
Rominger field, Jan. 1999

MAP BASED ON SEEDLING COUNTS - *Echinochloa crus-galli*



Rominger field, Mar. – Jul. 1999

MAP BASED ON MATURE PLANT COUNTS - *Echinochloa crus-galli*



Rominger field, Aug. 1999

VARIABLE RATE APPLICATOR

VARIABLE RATE APPLICATION EVALUATION EXPERIMENT

- Do the reduced rates give reliable weed control?
- What type of weed sampling gives the best information for the preemergent variable herbicide application?

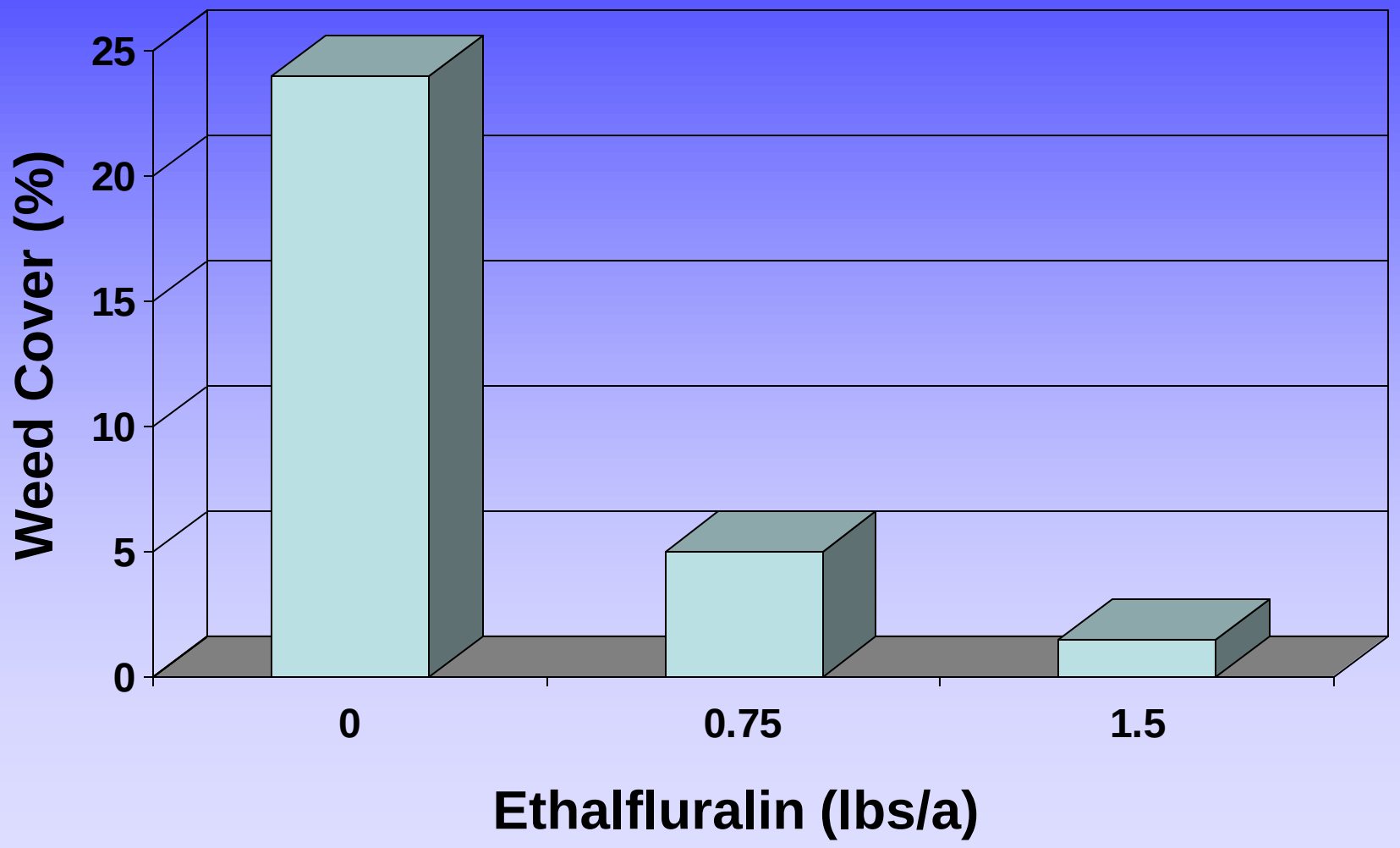
EXPERIMENTAL DESIGN

Split-plot design

Main plots - seedling map (S) or
mature plant map (M)

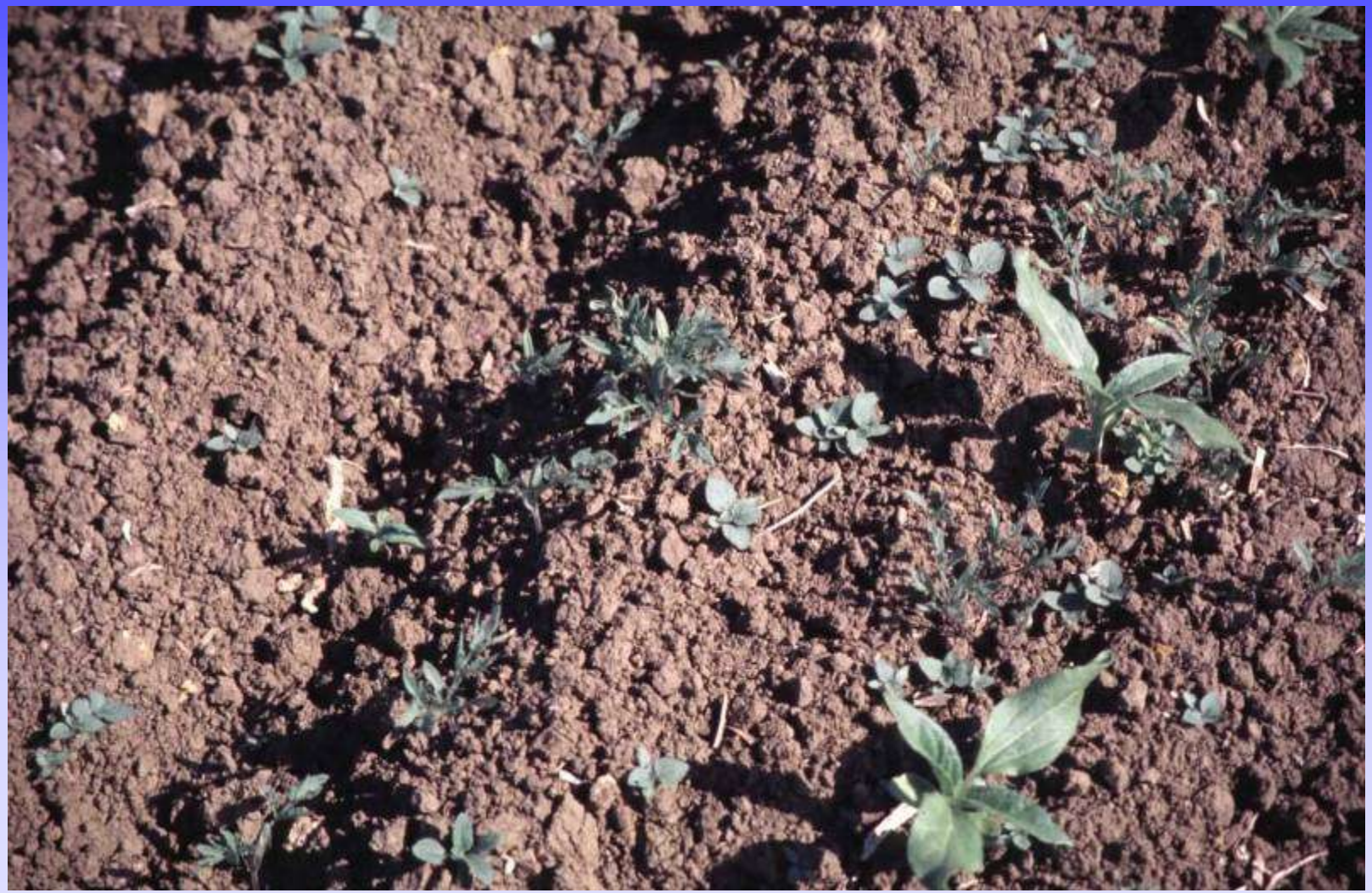
Subplot- - No herb. (0)
- medium rate (0.75 lb/a)
- high rate (1.50 lb/a)

Herbicide Rate Effect

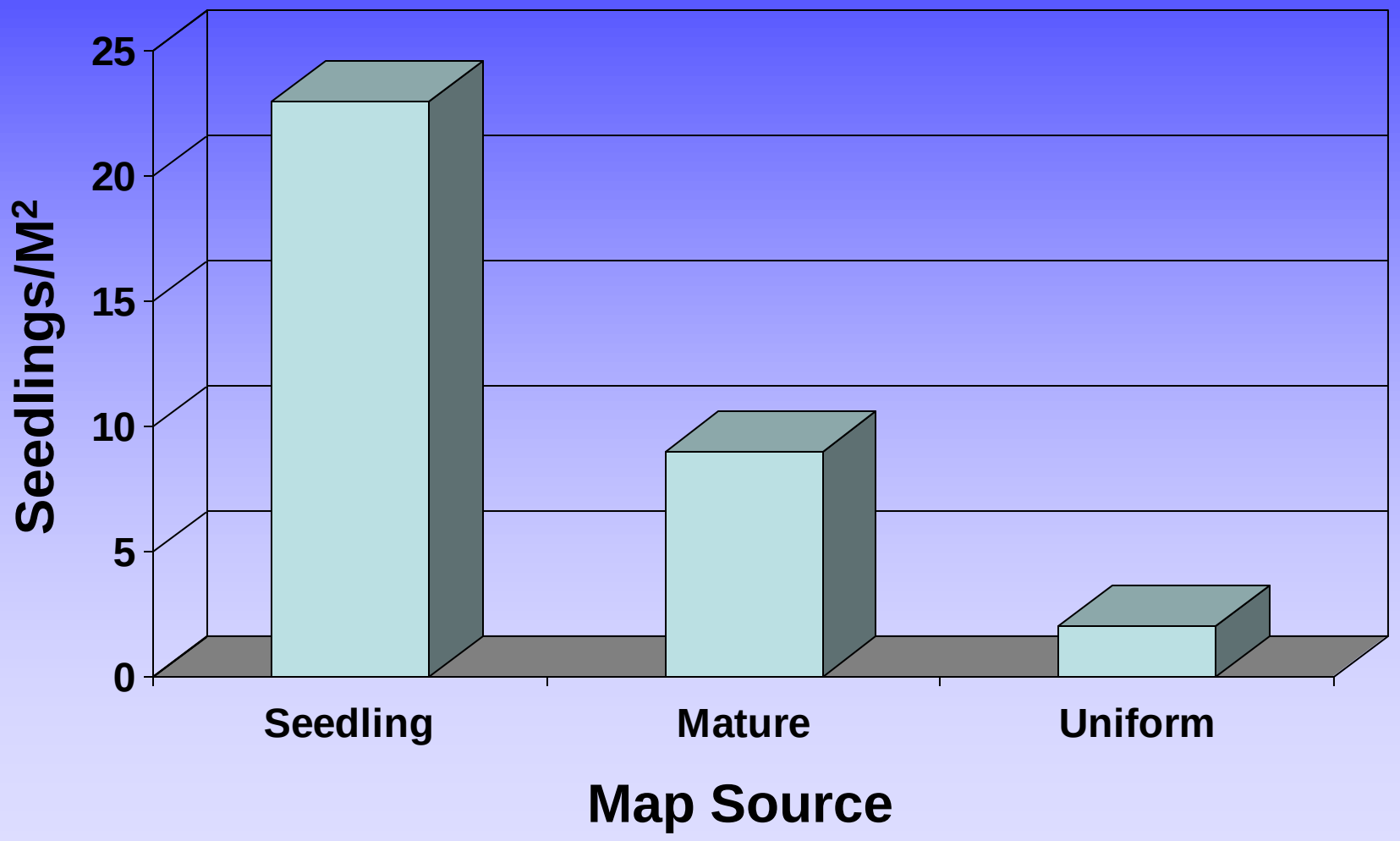


Variable Rate Treatments

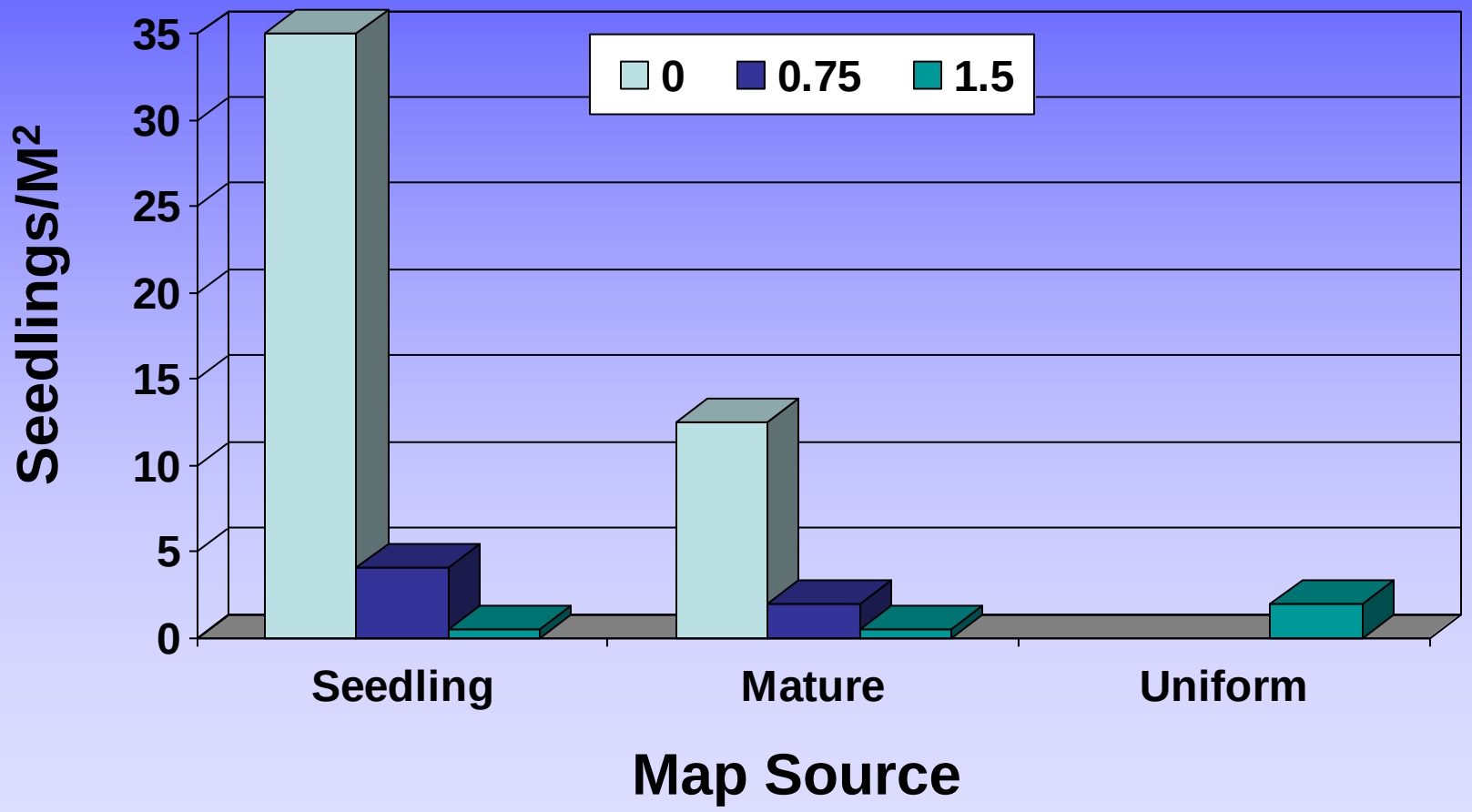
Seedling map – no herb.



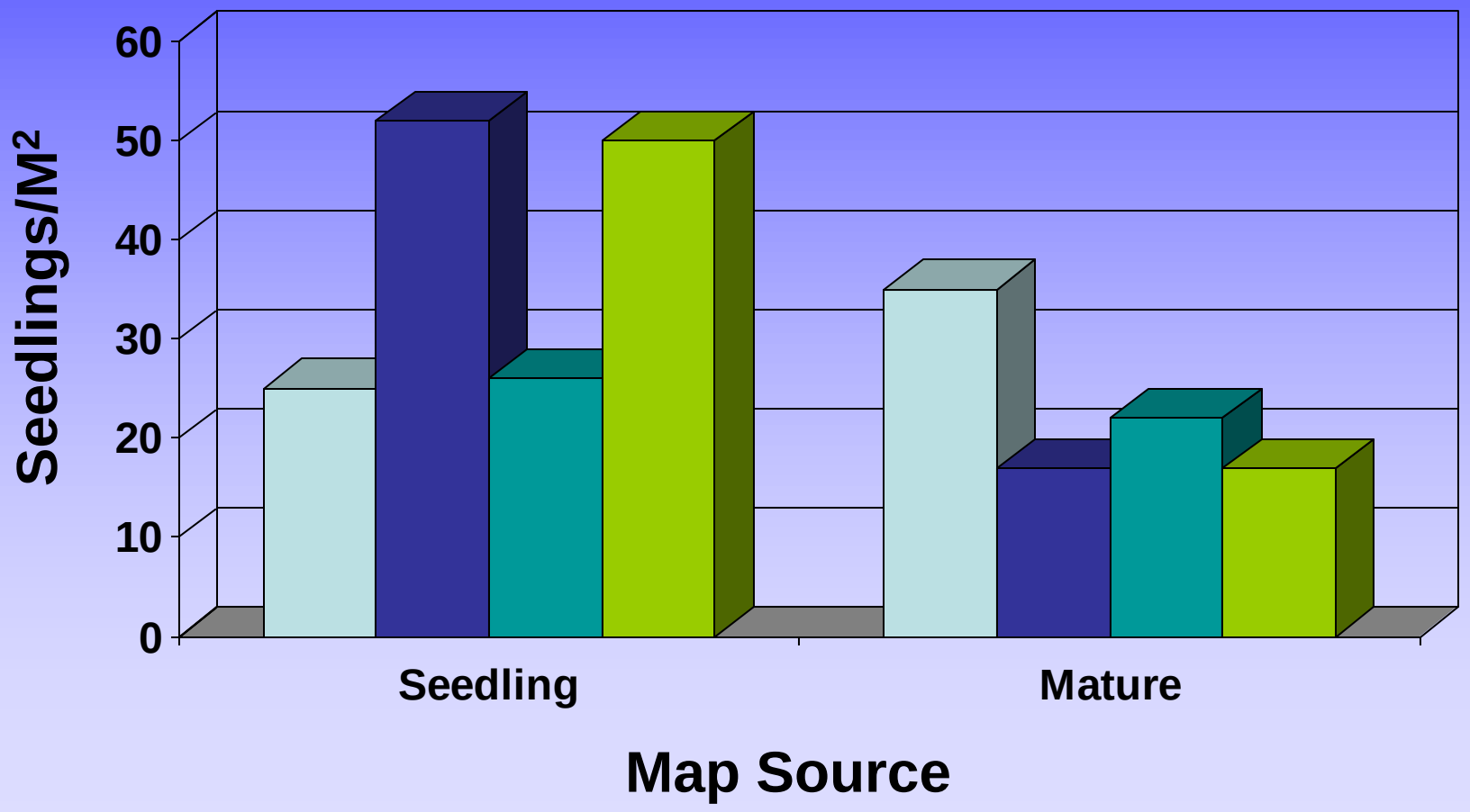
Effect of Map Source



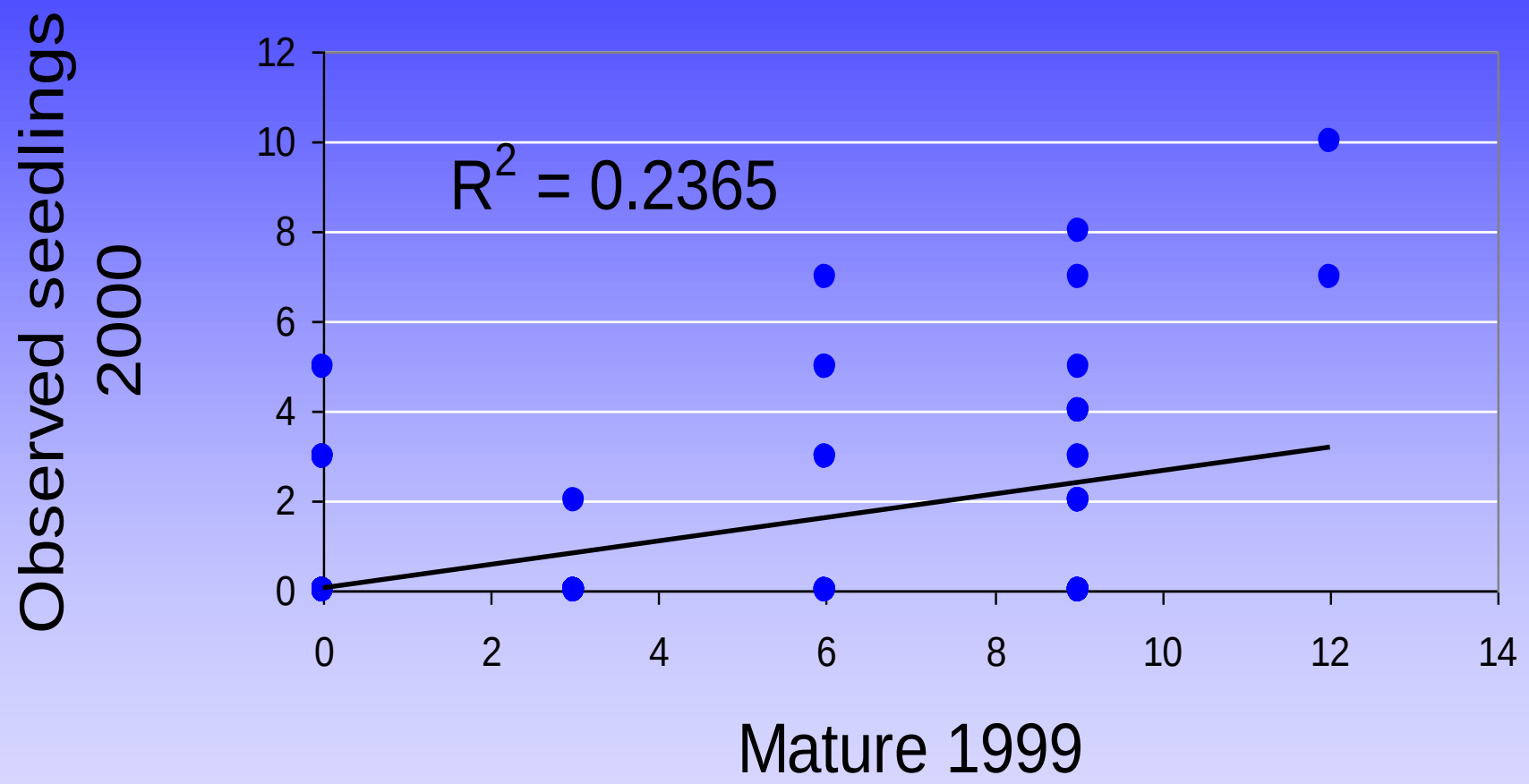
Effect of Map Source/ Herbicide Rate



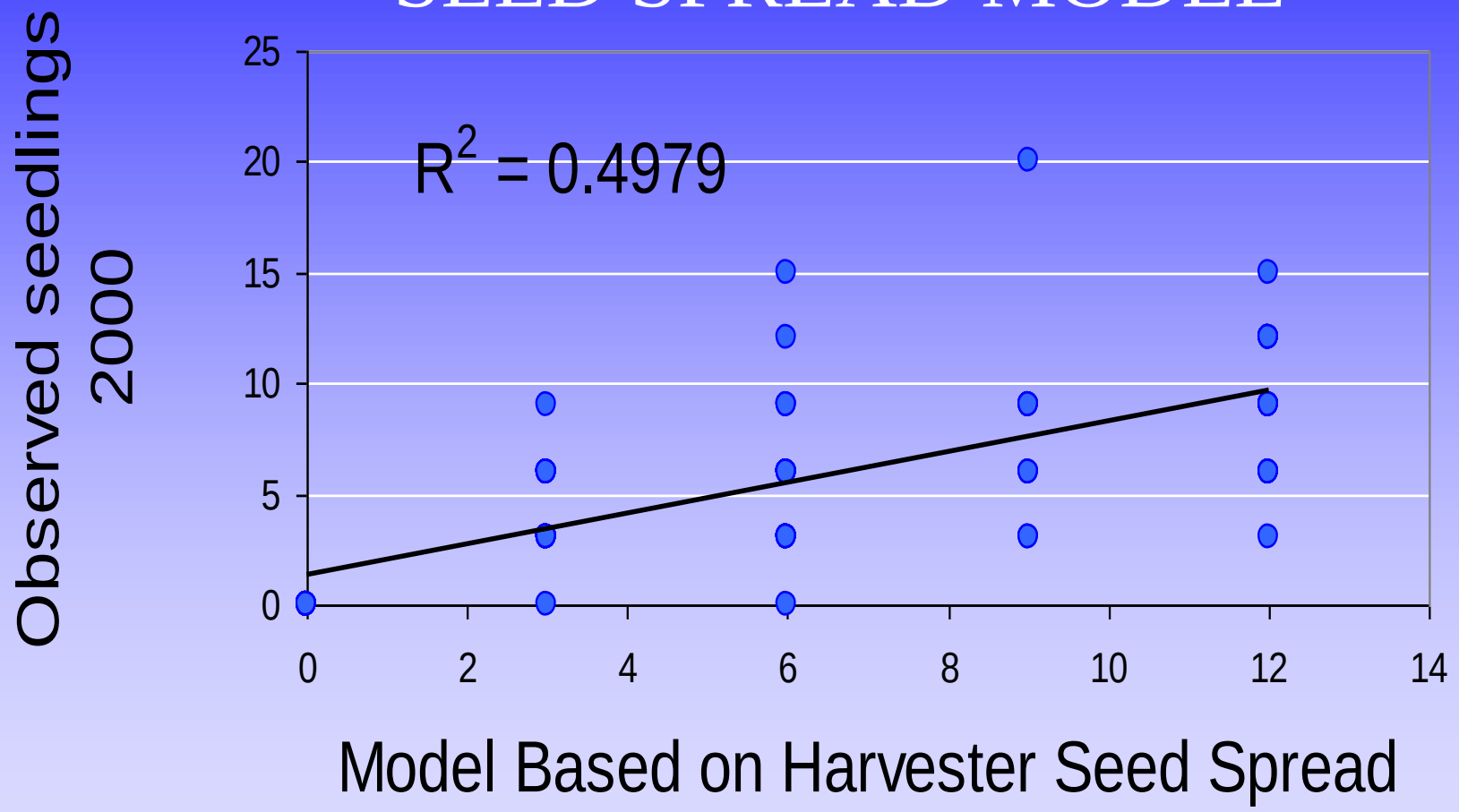
Effect of Map Source/ No Herbicide Plots



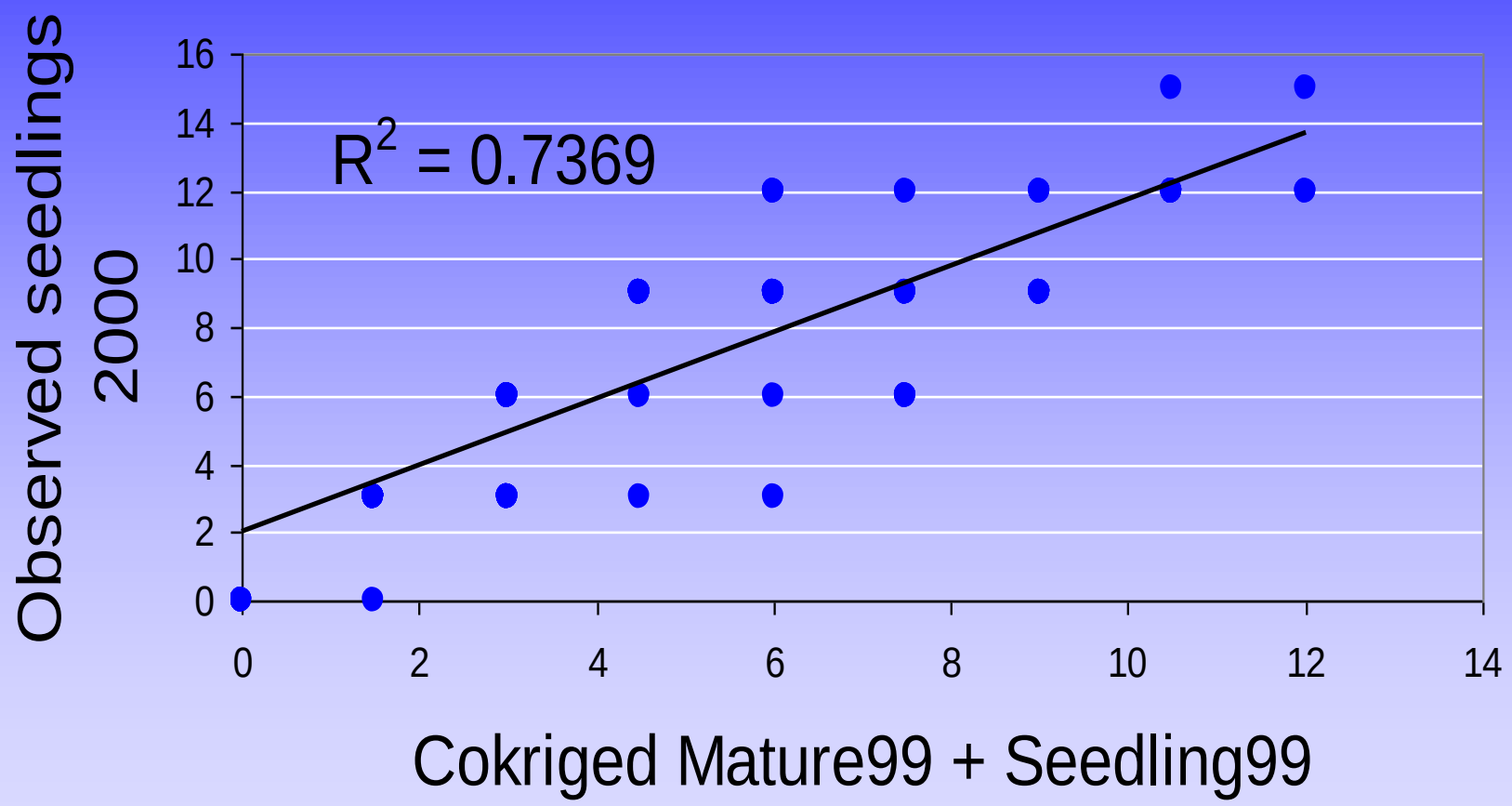
CORRELATION BETWEEN WEED COUNTS



ESTIMATION IMPROVED WITH SEED SPREAD MODEL



ESTIMATION IMPROVED WITH CO-KRIGING



Observations

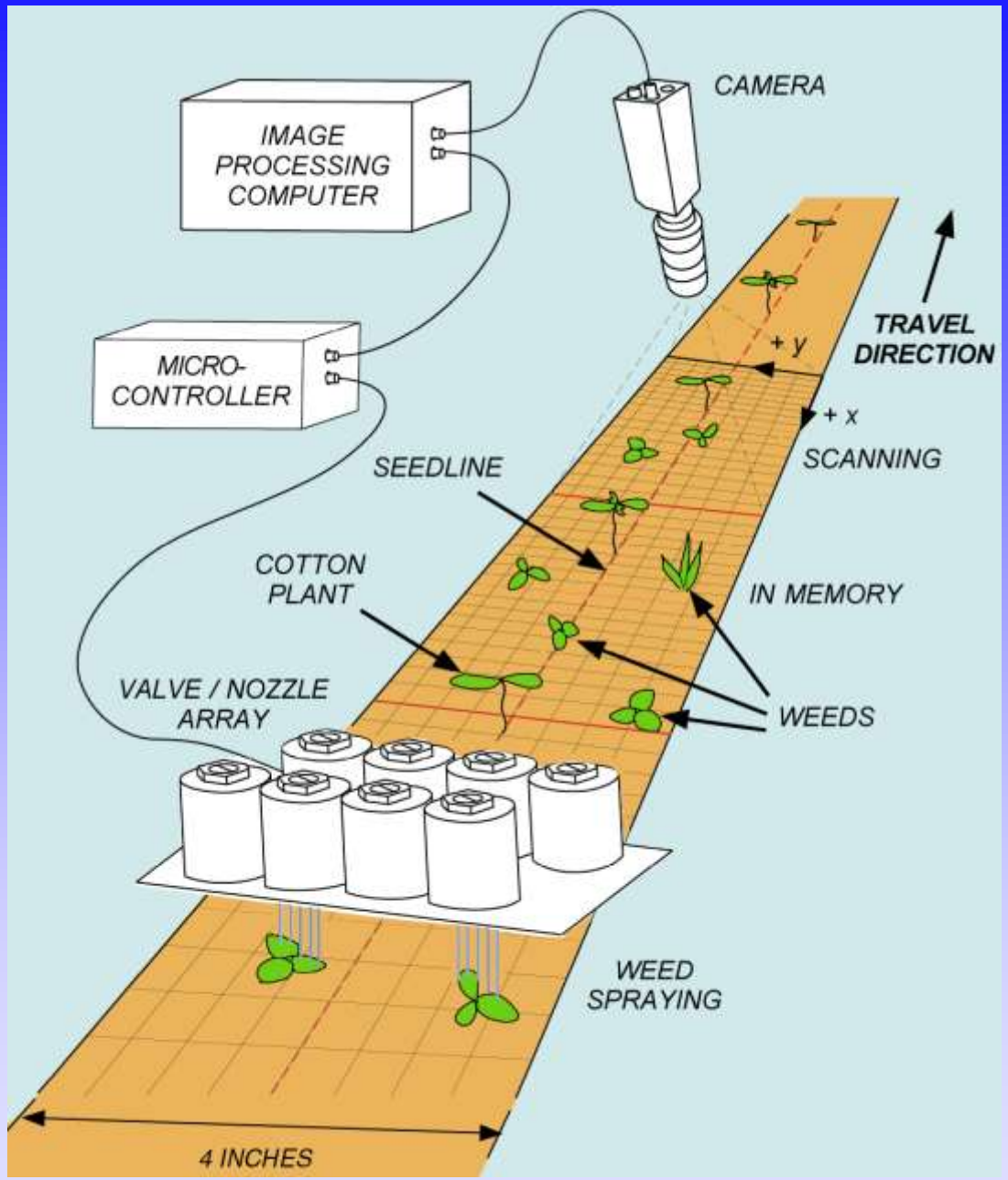
- Shape of weed patch is influenced by the field traffic
- Harvest operations are the main mean of seed spread
- Location of patches was stable over the period of the study with most changes occurring in the patch edges
- Field edges are usually most weedy

More Observations

- Sampling was most difficult for seedbank and easiest for seedlings and mature plants.
- Non-treated sites were not correctly predicted
- Medium herbicide rates gave sufficient weed control when the weed distribution was accurately predicted
- Weed control was significantly better when based on mature plant interpolated maps
- Creating accurate and reliable weed maps still remains a challenge

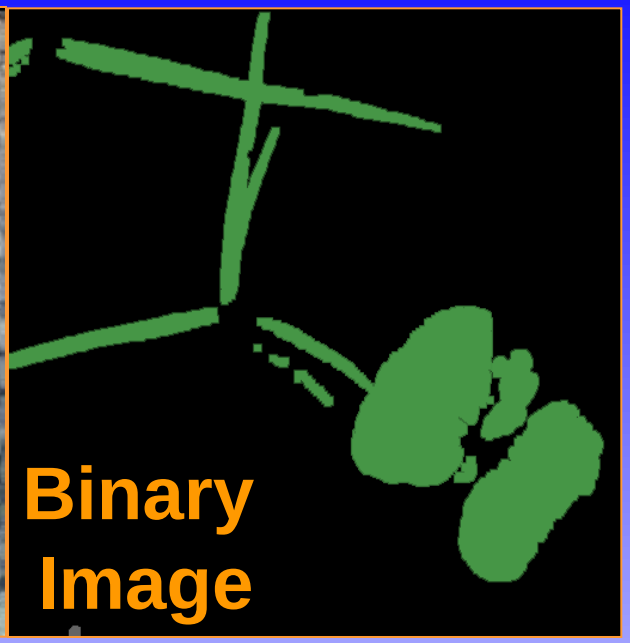
CURRENT DIRECTIONS

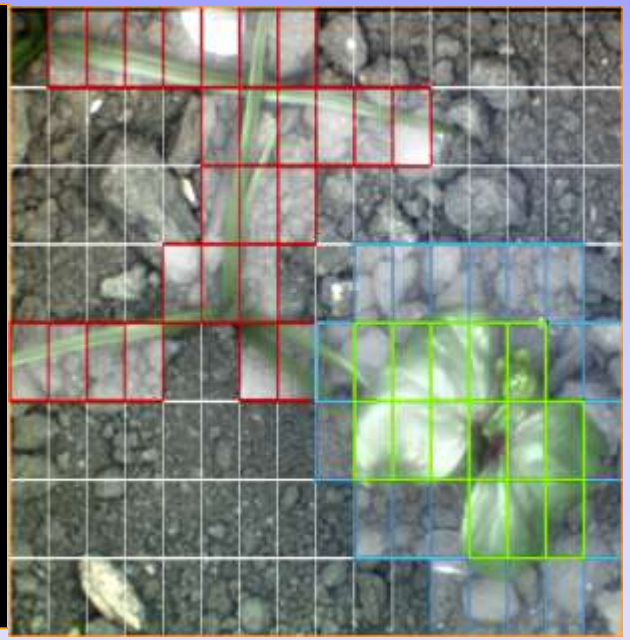
- Co-kriging of multiple year data
- More experiments on effectiveness at reduced rates
- Weed mapping - development toward weed sensing technology



The concept..

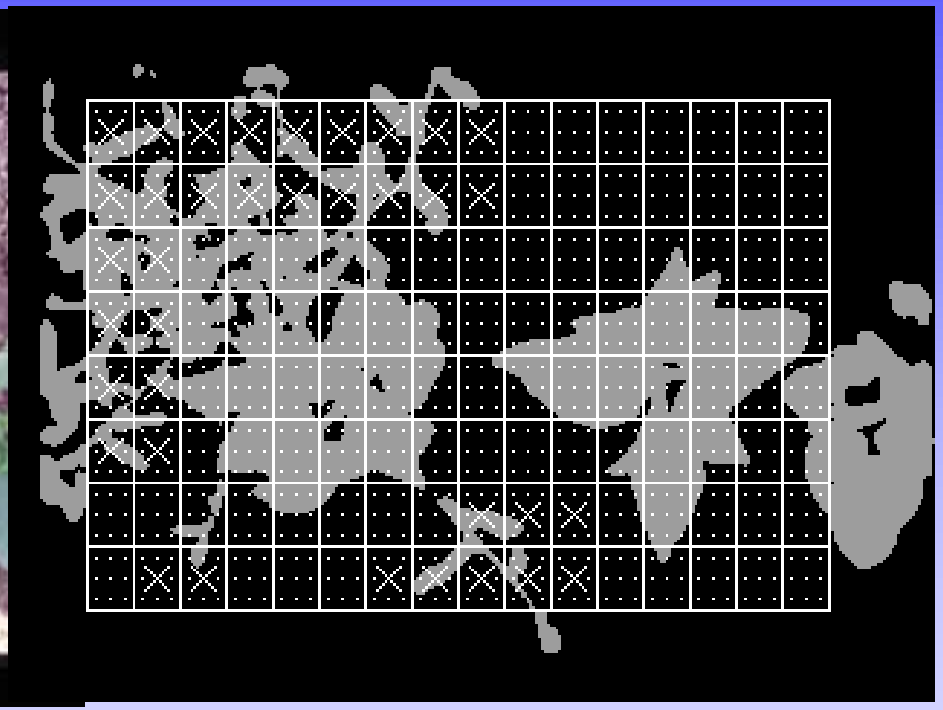
“Leaf-specific” agriculture



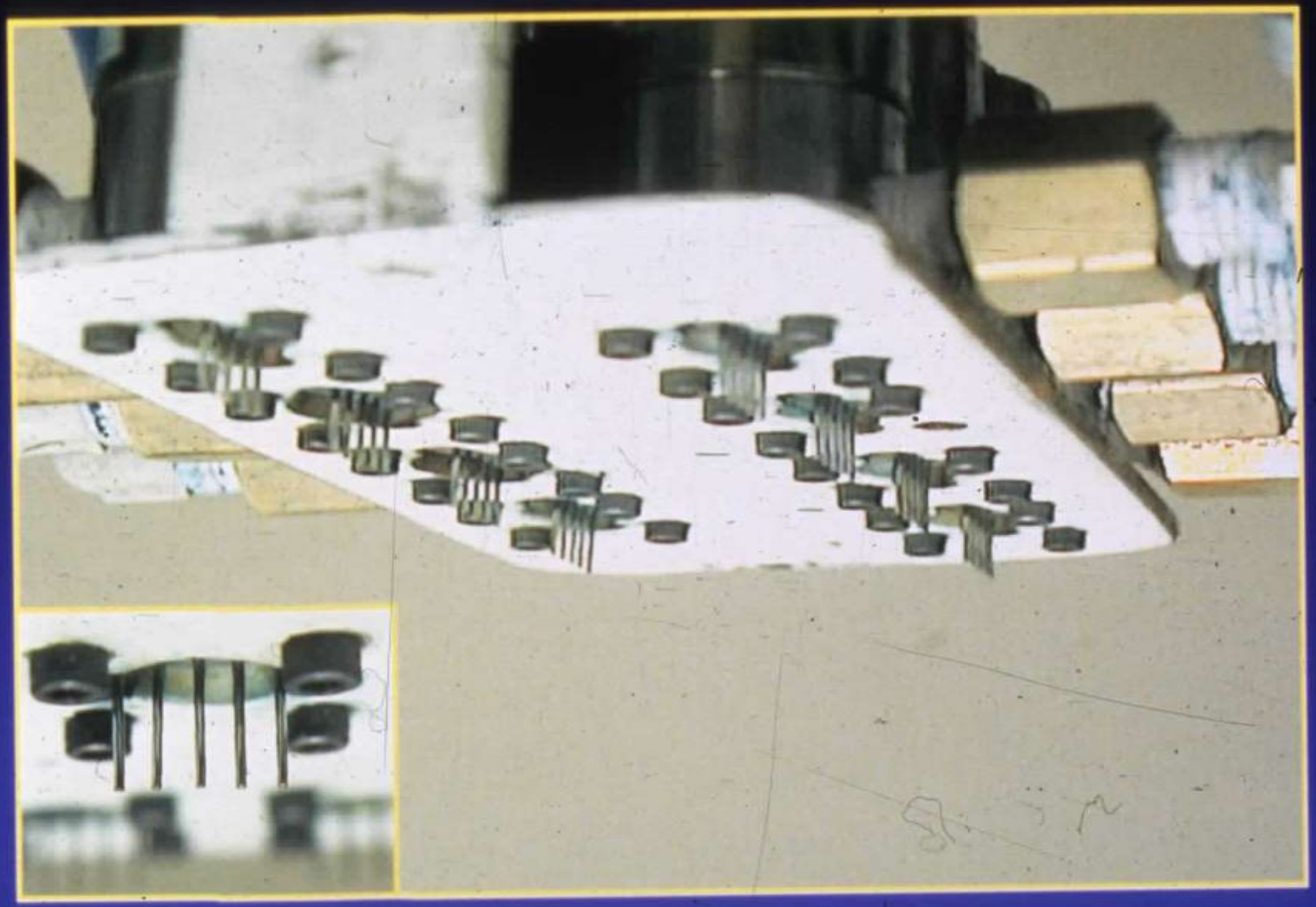


Spray Map
Green=Cotton
Blue=Protection Zone
Red=Weed

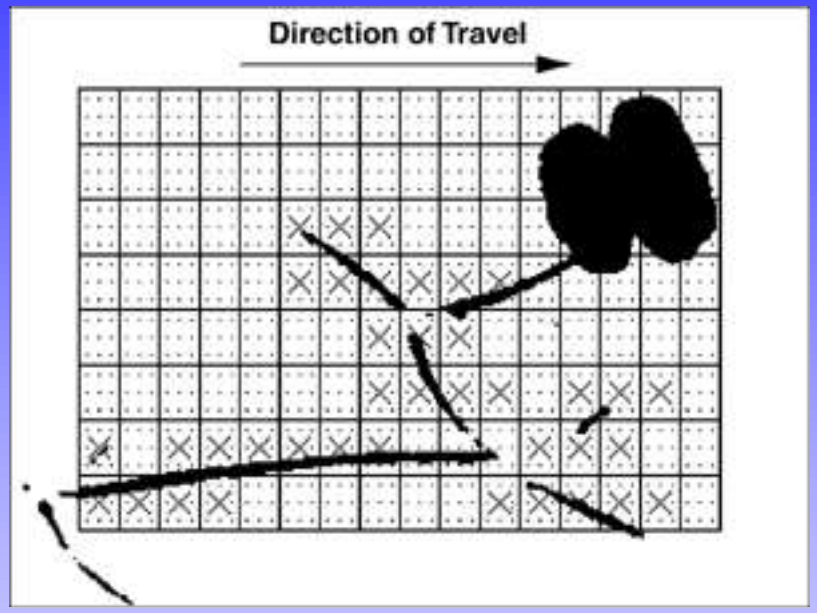
Beans & Field Bindweed



Micro-spray nozzles



Robotic Weed Control Results

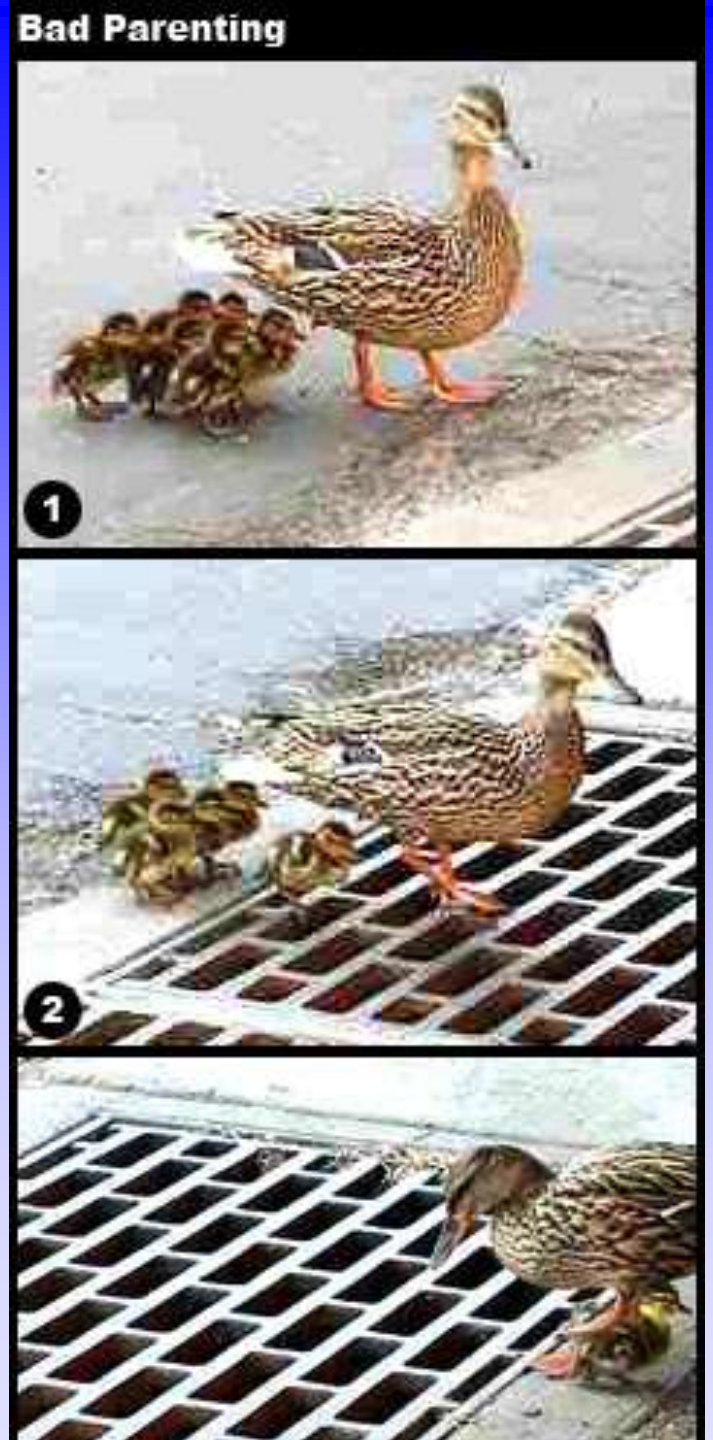


Observed Pesticide Savings

- Applied Pesticide reduced by 66 to 80%
- Non-target deposition on soil surface was reduced by 72 to 90%
- Spray drift reduced by 62 to 93%.

(Giles and Slaughter, 1997)

- Spray information can be captured for development of a weed distribution map



Questions?