How a Weed Scientists Sets up an Experiment to Provide Field Data

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Growers, scientists, consultants, industry personnel, etc…, all have original ideas about how to improve crop production.

The effectiveness of these ideas need to be tested under controlled conditions in the field.

Purpose of agricultural field experiments

Provide data to support existing knowledge.

Fill information gaps.

Develop new methodologies.

Ultimately, to assist in sustainability of the family farm!

Developing field experiments

- **Define objective**
- Site selection
- Design study
- Establish and maintain plots
- Collect/analyze data
- Report results

The objective

- **A desired goal or set of outcomes that are to be achieved by a project.**

- **For weed studies, there are many potential objectives which are often complex…….this determines the design, site selection, etc. of the experiment.**

Influence Herbicide Activity

- soil texture
- soil organic matter
- soil moisture
- soil ph
- water ph
- humidity
- temp
- spray pressure
- spray tips
- water volume
- droplet size
- tillage
- plant residue
- time of day when applied

Weed response to herbicides? Residual control? Foliar Control? Both?

Roundup UltraMax 1.6 pt

UltraMax 1.6 pt + Valor 1 oz

Crop response to foliar herbicides.

Untreated

Clearout 41 Plus

Wayne Co., 2003

Influence of soils on herbicide activity

Dual Magnum PRE

Can you truly determine weed response and crop response in the same study?

2 inch Palmer

5 inch Palmer

8 inch Palmer

Application Timing

Command/OP insecticide interaction on cotton

No OP

OP in-furrow

Di-Syston, Phorate, Thimate

Impact of tillage on herbicides

Understanding herbicide volatility?

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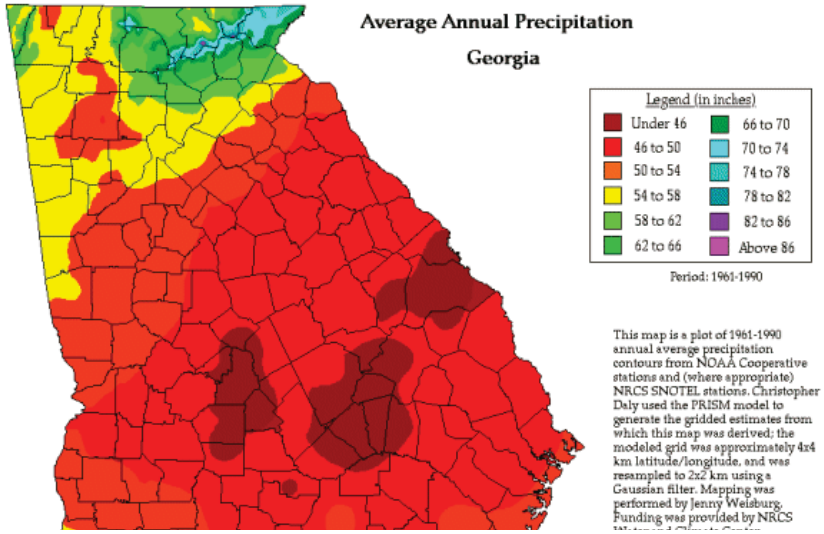
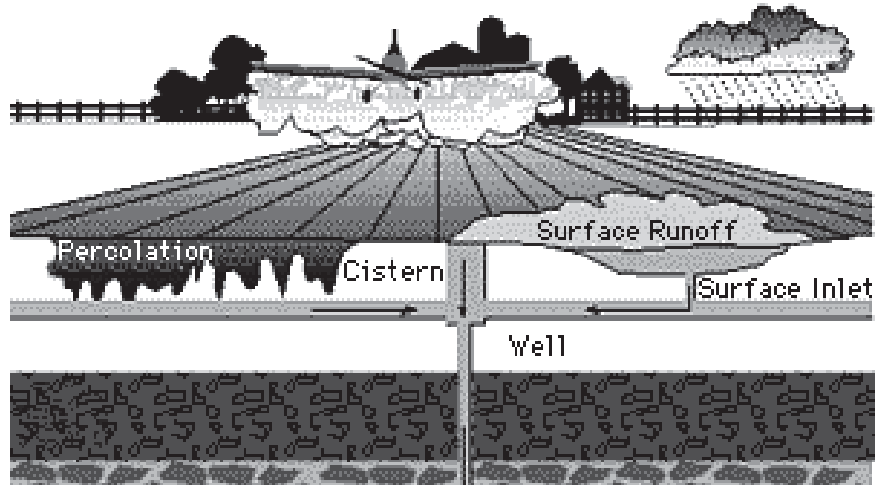




Extension.umn.edu

Variability will be observed within/among sites with respect to climate and soil characteristics.

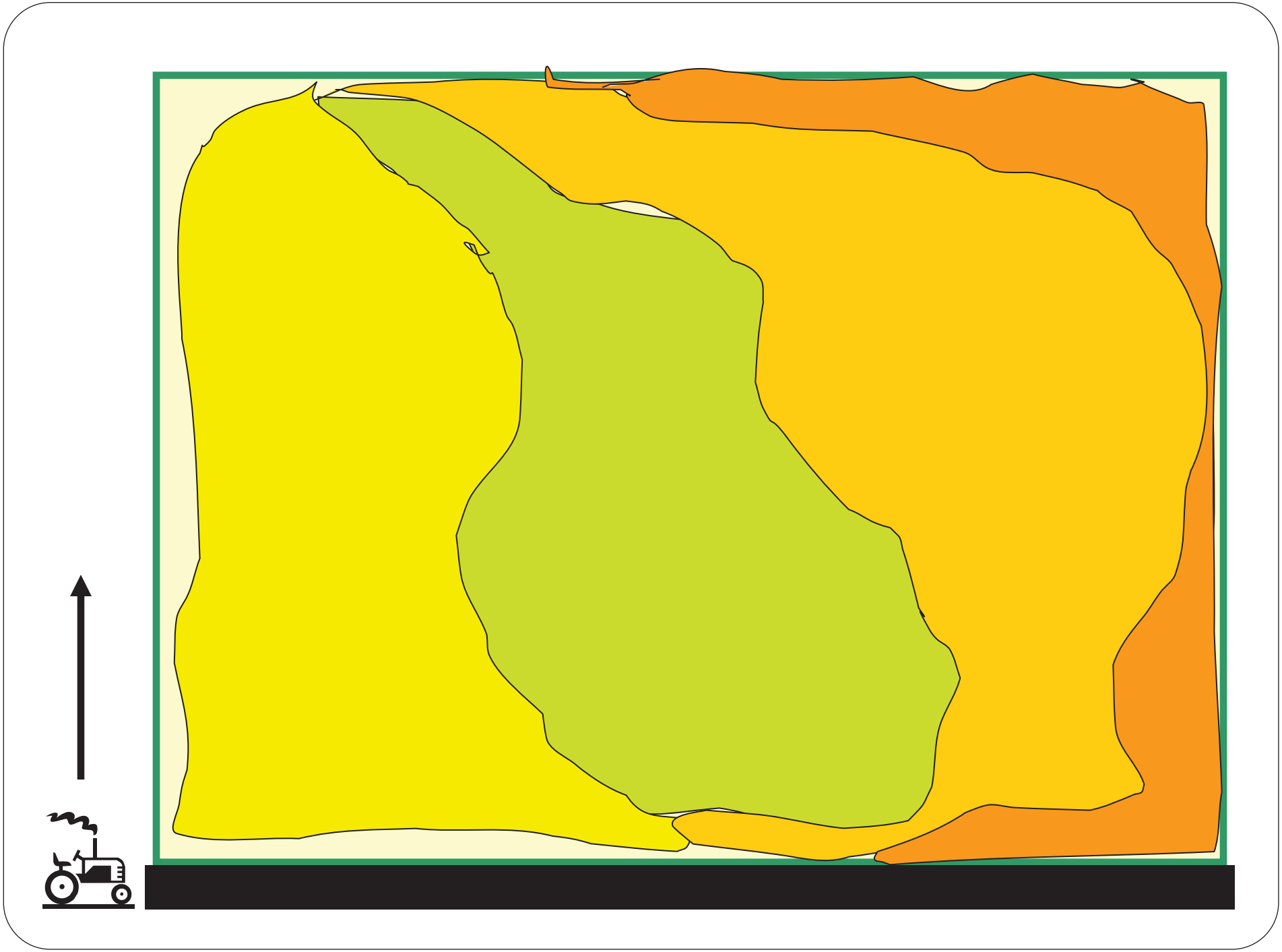
Precision-crop-protection.uni-bonne.de

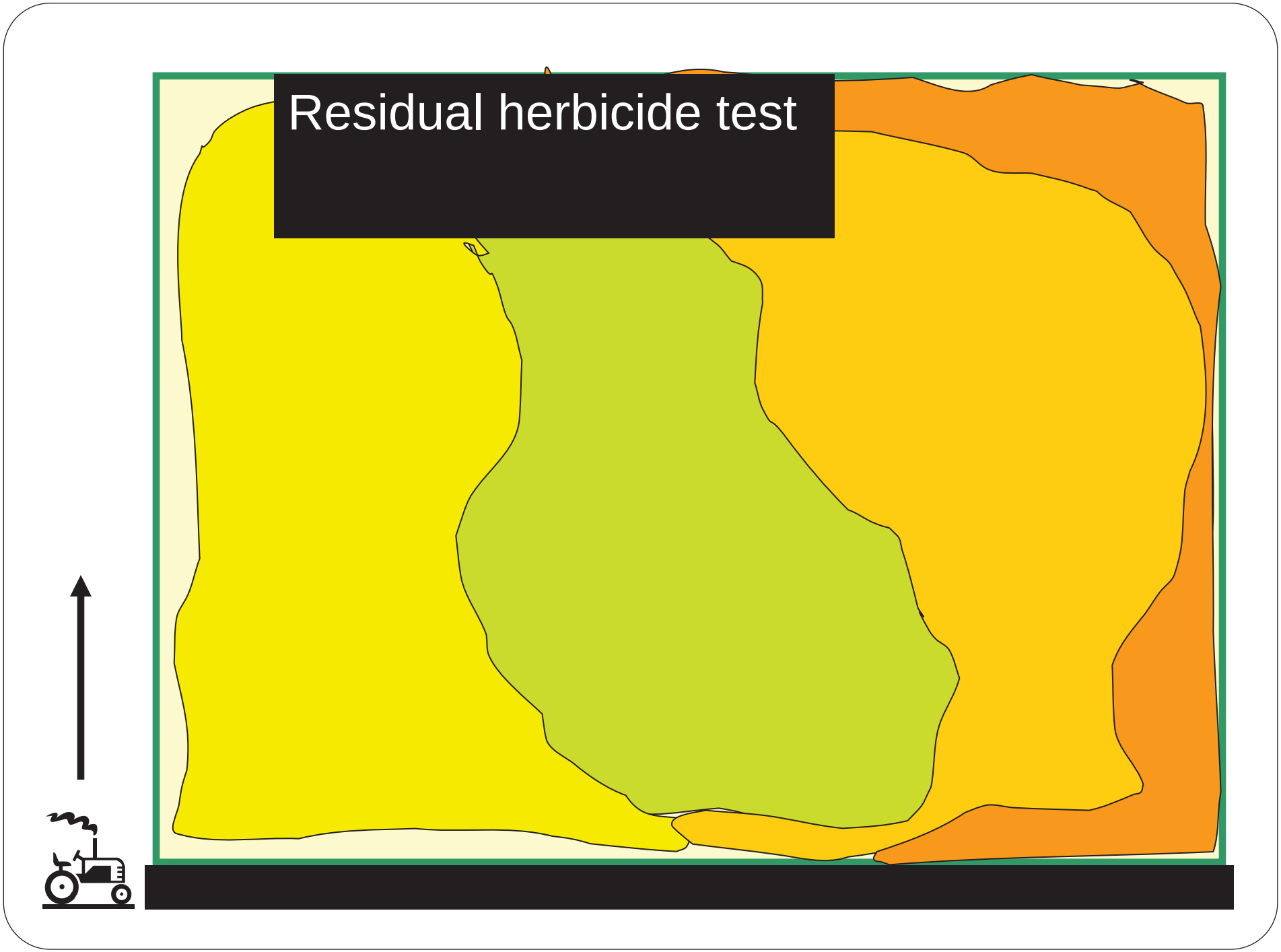
Picasaweb.google.com

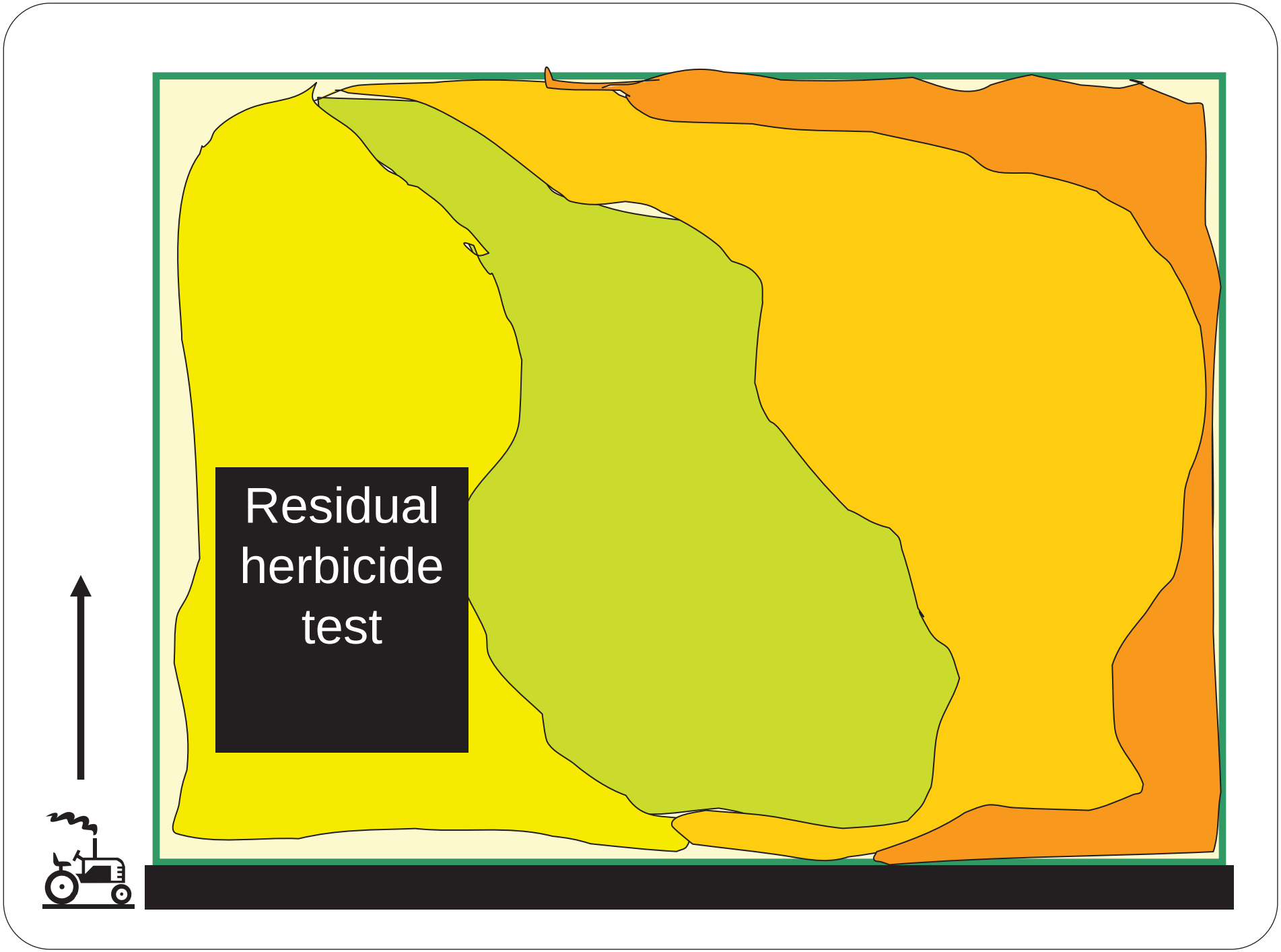
Site selection

- Having variation **between** sites is important if the **range** of circumstances over which the experimental results apply is important.

- Variability **within** a site is often less desirable, as it can obscure results.




Residual herbicide test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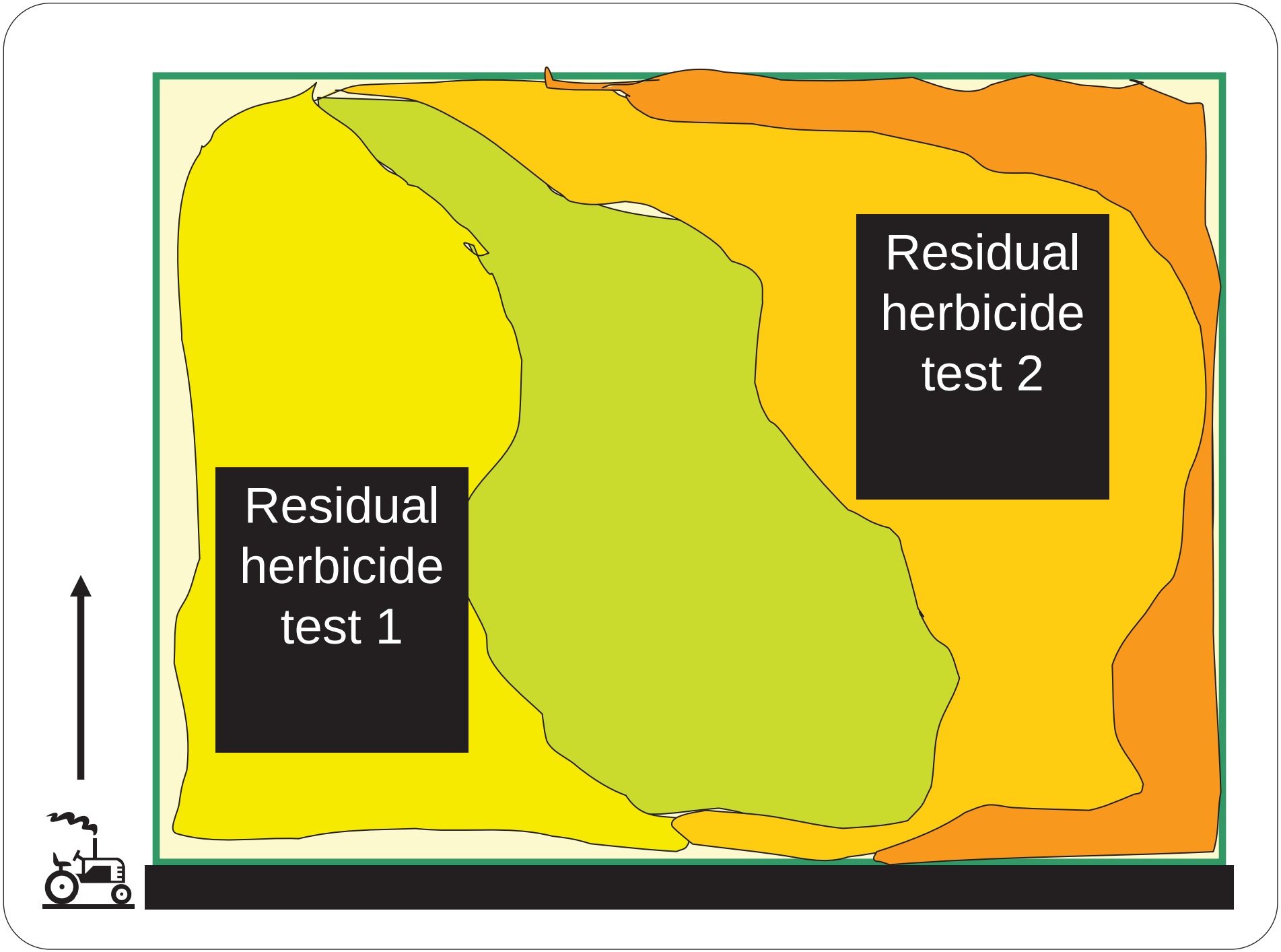
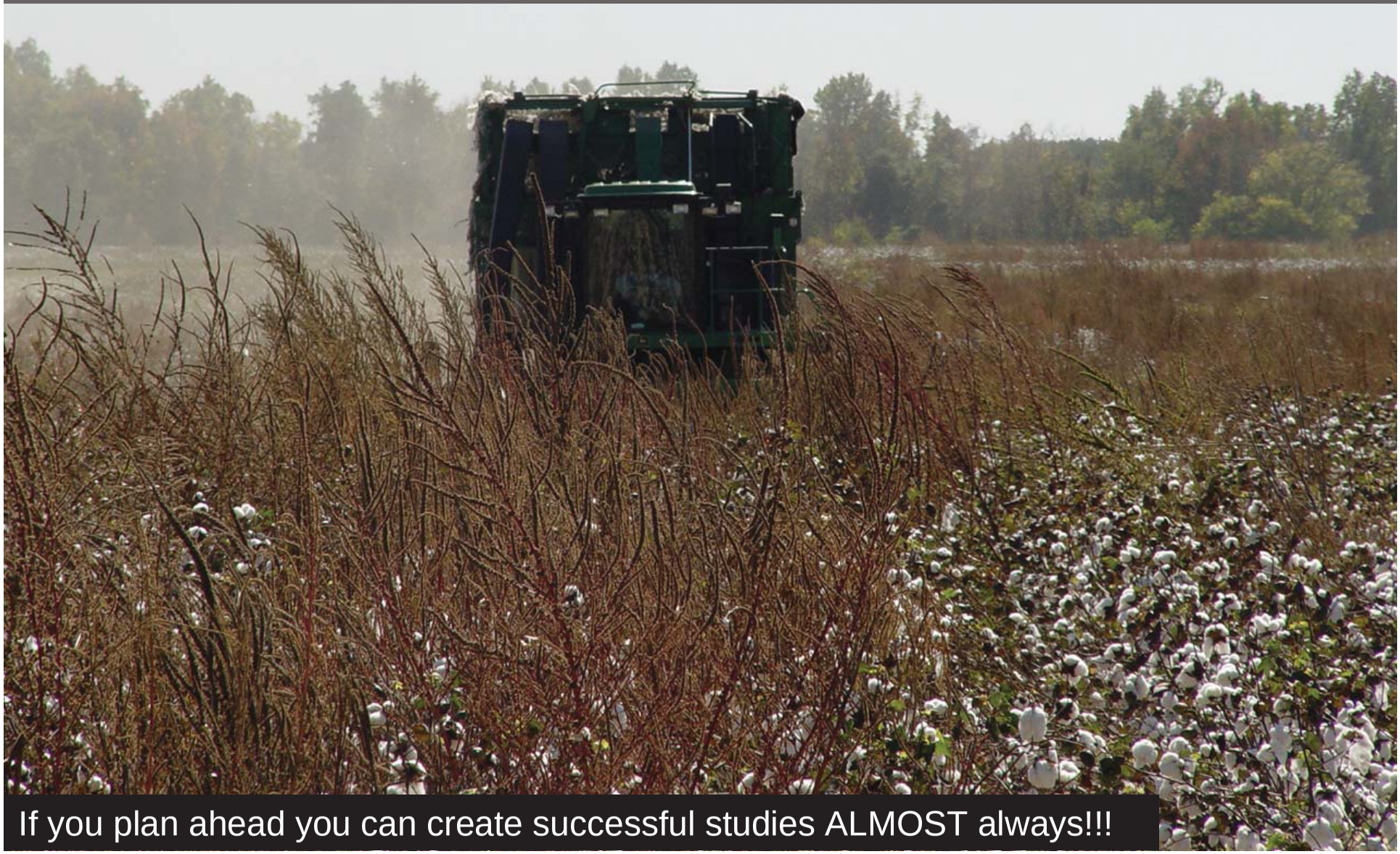

Residual herbicide test 2
Residual herbicide test 1

When selecting the site need to be observant in the previous year.



If you plan ahead you can create successful studies ALMOST always!!!

Overseeding of Weeds

- **Commonly used but must be careful**

  purchased seeds may not be compatible, may germinate at once, and you may get more than you are barging for!!!!

- **Better options:**

  1. Let the test areas over seed themselves

  2. Collect seed from your area and spread them immediately back in the test area

  3. Over seed a year ahead of study and let those plants produce a progeny

Site selection

- **If an individual site is non-uniform with respect to some local characteristic (soil texture, salinity, permeability, etc…), randomized and replicated field plots can help mitigate the inconsistency.**

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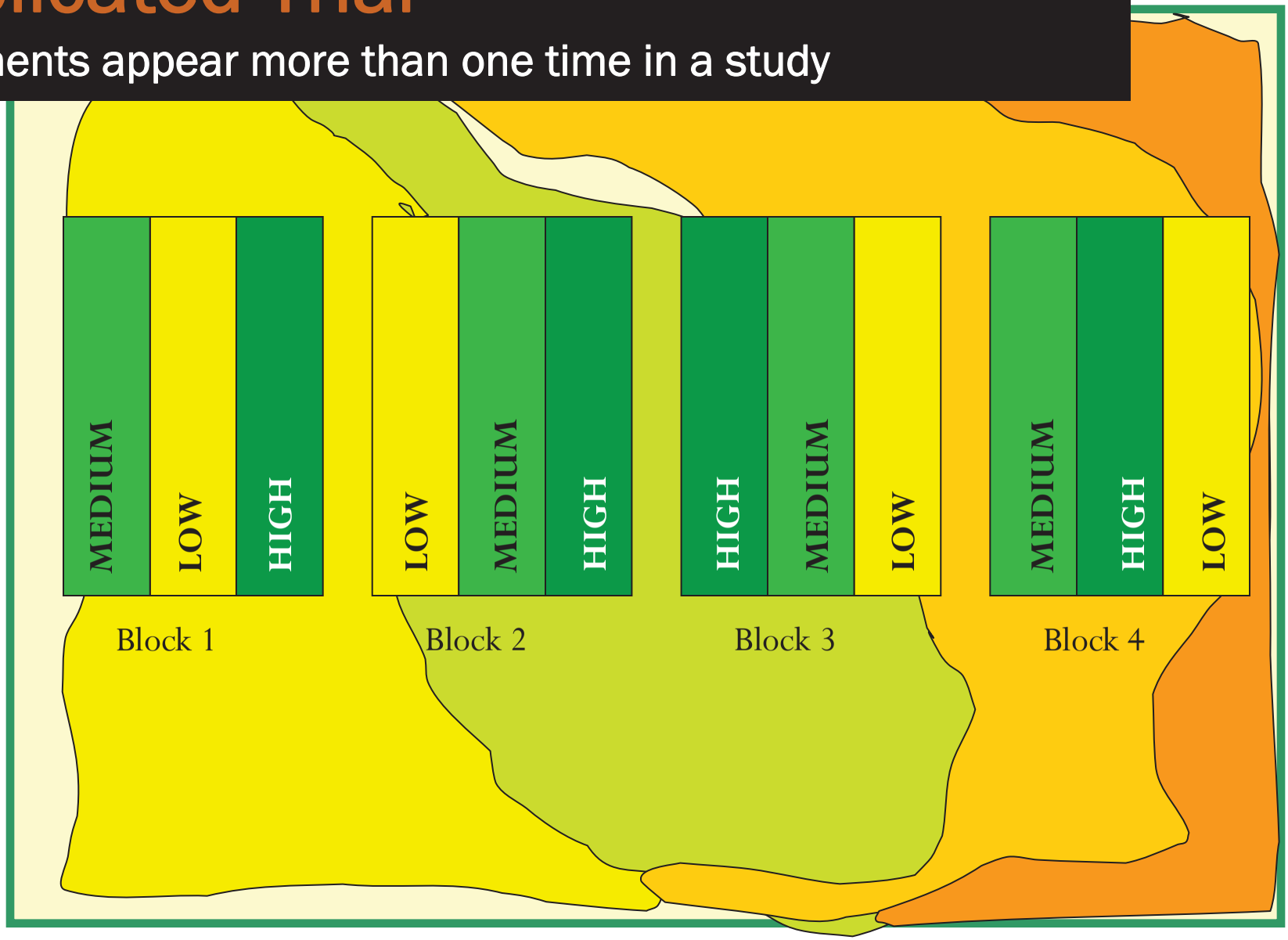
Replicated Trial

Treatments appear more than one time in a study



Replicated field plots

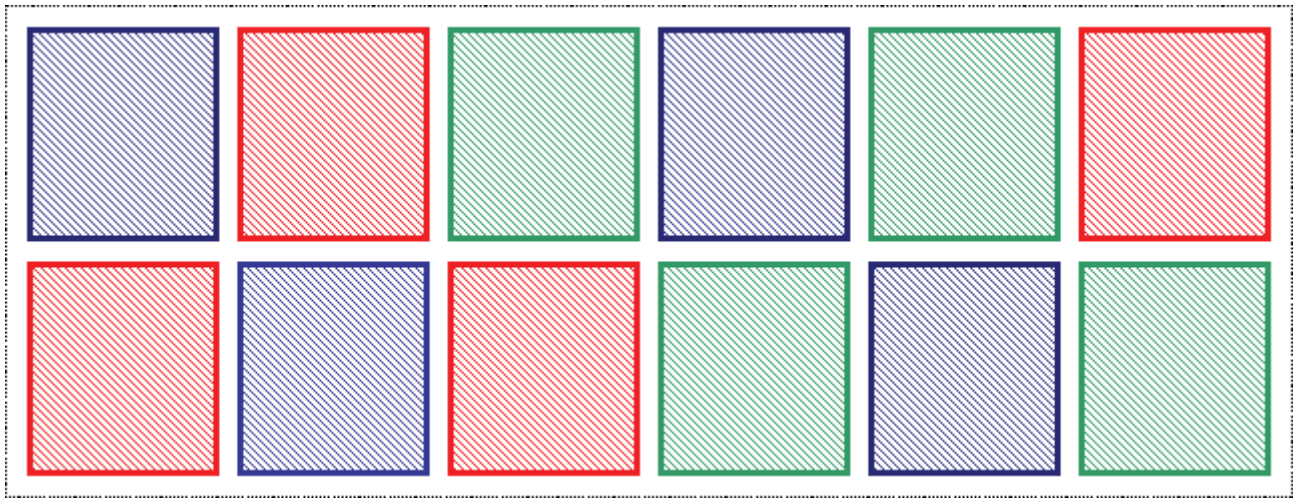
- **Advantages**
  - Replication allows us to make **statistical** comparisons between treatments.
  - Results that are recognized by scientific community.
  - Results suitable for making decisions.
  - To prevent unintentional bias

- **Disadvantages**
  - Can be complicated to conduct.

Some common types of replicated designs

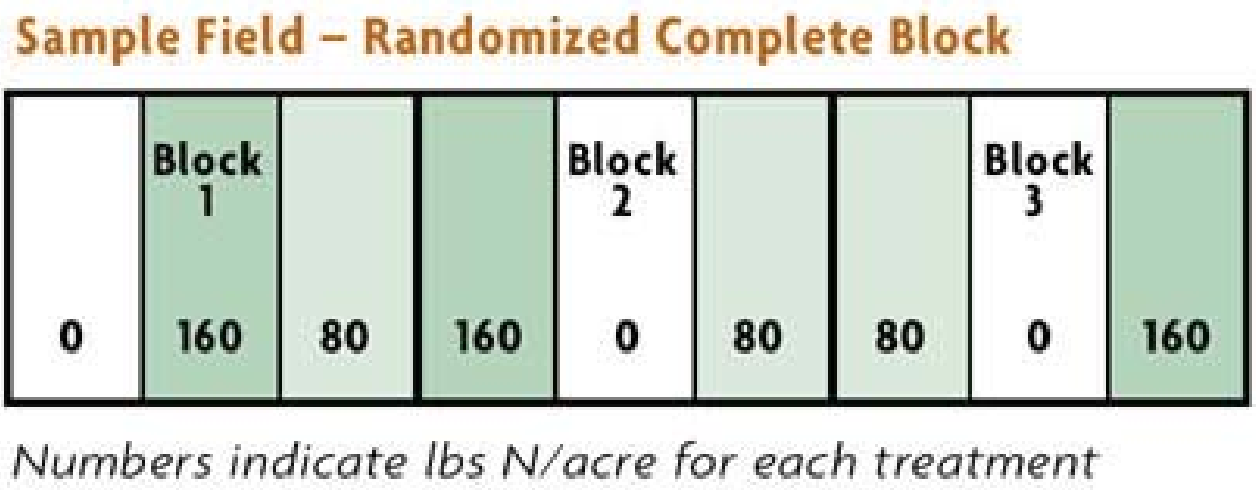
- CRD
  - Completely randomized design
- RCBD
  - Randomized complete block design
- SPD
  - Split plot design

Completely randomized design



Treatments are assigned to plots with no discernable pattern to the assignments

Randomized complete block



Each treatment occurs in each block

Treatments are randomly arranged WITHIN block

http://www.sare.org/publications/research/crops_research.htm

Split plot design

Sample Field – Split-Plot Design

Rep 1			Rep 2			Rep 3		
0	Vetch 80	160	160	No Vetch 80	0	80	No Vetch 0	160
160	No Vetch 0	80	80	Vetch 0	160	0	Vetch 160	80

Bold lines mark main treatments; light lines indicate split plots; numbers indicate lbs N/acre for each treatment

Tests multiple factors and how they interact

http://www.sare.org/publications/research/crops_research.htm


Whole plot = Ignite
Sub plot = cotton technology
LL Cotton
RR Cotton

How many replications are enough?

- Generally, the more, the better!
  - easier to differentiate similar means (statistics)
  - better assessment of variation within plot area

- But consider……
  - land constraints
  - time constraints
  - material constraints (chemical, plants, etc.)

  - Absolute minimum = 3
  - Preferred = 4 or 5

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Establish and maintain plots

- **Treatments**
  - Always include a **control/check and a standard** that you can compare your treatments of interest to (i.e. to measure effect).


Treatment
Non-treated control


MIDAS
MB

Establish and maintain plots

- **Treatments**

  - **ALWAYS TREAT EVERYTHING IN THE EXPERIMENT STUDY** EXACTLY **THE SAME EXCEPT THE VARIABLE YOU ARE EVALUATING!!!!!!!**

tillage, fertility, watering, fungicides, insecticides,

Establish and maintain plots

- **Plot size**
  - A 'plot' can be many things, from a single plant to several acres.
  - **As large as possible:**
    - How many treatments are in the study/what size area do you have to work in?
    - What size equipment will be needed to plant, maintain, and harvest the study?
    - How uniform is the area that you are studying?
    - How large a plot do you need to minimize the influence of one treatment on a neighboring treatment?

Establish and maintain plots

If the area available to work in is limiting, increase reps, not plot size!

- Plots should be equal in area
- Mark plots clearly
- Timely applications

Establish and maintain plots

- Plots should be equal in area
- Mark plots clearly
  - Especially regulated studies
- Timely applications
  - Document everything
- Keep up to date with changing regulations
  - Ex: chloropicrin, methyl bromide, metam
    - Medical exam, fit tests, respirators, SCBA
    - FMP

Establish and maintain plots

Must be capable of producing a crop similar to your growers to maximize the value of your data!!!!

Developing field experiments

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There is

- **GOOD DATA**
- **NO DATA**
- **BAD DATA**

There is

- GOOD DATA
- NO DATA
- ~~BAD DATA~~

Collect, analyze and report

- COLLECT MORE DATA THAN YOU NEED!
  - Visual estimates of control or injury will most often be the best data
    - POST: 1-5, 7-10, 14-18, 28, and 56 DAT
    - RESIDUAL: 7, 14, 21, 28, and 56 DAT
  - Crop or weed heights/widths (often 10 to 14 DAT)
  - Crop stand and weed densities (often 10 to 14 DAT)

Collect, analyze and report

- **Yield**
  - 1. harvest as much of plot as possible
  - 2. agronomic at least once depending on maturity
  - 3. vegetable……how many people do you have

    Bell pepper = 4 (grade them)

    Tomato, Eggplant = 5 to 7 (grade them)

    Cantaloupe = >7

    Squash = 12 to 20

    Cucumber = 4 to 6

    Watermelon = 3 to 5


SOUTHERN

Take pictures!

Pictures can say more to farmers that figures and numbers do!

Collect, analyze and report

- **Collect unbiased data. Remain objective.**
- **Conduct statistical analyses.**
- **Write up reports; include information about your objectives, methodologies, results and YOUR SUMMARIZED CONCLUSION.**

THINGS TO REMEMBER WITH HERBICIDES

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Tank cleanout!

THINGS TO REMEMBER WITH HERBICIDES

Cotton Response to Glyphosate + Dual*

heavy dew

no dew

*Application with dew applied 7 am. Application without dew applied 11 am.

SAFETY FIRST