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Designing In-field Demonstrations:

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Overview

Concept	Activity	Handouts
In-field demonstrations help farmers determine how new hybrids, products, and cropping practices compare to standard practices on their farms.	#1: How to Set Up Replications	A. *Demonstration Plot Worksheet* B. *Setting Up Replications* C. *Calculating Yields* (for field crop demos)
To compare the value of a new treatment with current practices, you need in-field trials that meet basic criteria for statistical validity.		
Keeping accurate data is essential to evaluating the results of in-field demonstrations.		
Farmers may not have a lot of room for demos, and generally lack powerful tools for analysis. Experiments need to be as simple as possible.		

Resources

Sustainable Agriculture Network, *How to Conduct Research on Your Farm or Ranch*

Kansas State University, *Establishing On-Farm Research and Demonstration Plots*

Washington State University, *On-farm Testing: A Grower's Guide; On-farm Testing—A Scientific Approach to Grower Evaluation of New Technologies*

University of Idaho, *Conduct Your Own Garden Research*

Manitoba Agriculture and Food, *On-Farm Testing*

Related Topics

All modules as they relate to the goals of the demo.

Set-up and scheduling considerations:

Beforehand:

Set this up with a host farmer who is innovative—but not prone to jump to conclusions before examining data. You'll be designing an actual farm trial which, presumably, your host will perform this season—and that all participants can observe over the course of the season.

If this involves a crop response, take a soil sample ahead of time.

Today, on site:

- Learn the reasons and criteria for setting up in-field demonstrations;
- Understand the external factors that can affect the outcome, and how to mitigate them;
- Learn how to establish baseline information and record your findings.

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Designing In-field Demonstrations

ACTIVITY #1: How to Set Up Replications

Setting	Time Required	Materials	Handouts
In a participant s home, before planting season. *Group size: 5 to 10*		*Flip chart or projector* *Clipboards and pencils*	*A.* Demonstration Plot Worksheet *B.* Setting Up Replications *C.* Calculating Yields *(for field crop demos)*

Q:	Pose a series of questions:	A:
Say a sales rep is excited about a new variety or product, or your Extension educator recommends a new tillage practice? How do you know if it will work on your farm? *Make a list (on flip chart or transparency) of specific new products, varieties, and cropping methods that participants have heard of and might like to try out.* *The list could include:* ♦ *new varieties or hybrids* ♦ *fertilizer sources or rates* ♦ *method of chemical application* ♦ *biocontrol of a difficult pest*		
What is the basic reason for setting up demonstration plots?	To see what the differences are between two different varieties, products, or techniques. One variety, product, or technique is new to you; the other is standard—something you're used to.	
When you demonstrate a new variety or technique, what is the most important principle you must consider?	The differences in yield or quality have to be the result of the treatment and not some other factor. Your results must be statistically valid.	
Take another look at the list. For each item, ask: What do we want to know? Why do we want to know this? How accurate do we want to be?	*Answers will vary* *For the first question, note that your answers are of three types:* ♦ *yes or no or either/or questions (more effective than? adverse effects?)* ♦ *quantitative questions (how long? what rate?)* ♦ *open questions (advantages and disadvantages? effects of ?)*	
The host farmer should select one of these treatments from the list. *Hand out the* Demonstration Plot Worksheet. *Fill in the header information.* ♦ *What is the hypothesis? It should be a variation on new treatment works better than standard practice.* *State your goal under Study objectives.*		

Q:	Continue your series of questions:	A:
Go back to the Demonstration Plot Worksheet *and fill in as much as possible for the host farm; continue on it throughout the discussion.* ♦ *If the weather is decent, walk outside and look over the fields where demonstrations will most likely take place.* *Now consider the following factors as they relate specifically to the chosen treatment, and record pertinent details on your clipboard or the flip chart.*		
For this hypothesis, what factors need to be measured?		*Answers will vary* Yield… quality…percent damage… plant populations… number of insects… amount of disease
What external factors could affect the statistical validity of a project?		Planting conditions need to be the same—or vary to the same degree!—for both treatments. Consider: ♦ rotational history ♦ location of drainage may cause warmth, dryness, etc. in one replication and not another ♦ fertilization and manure application history ♦ soil type and conditions (depth, texture, drainage, topography, weed infestations, close to hedgerow, runoff) ♦ equipment problems (planter cracking seed, hopper more or less full than others, depth adjustments, etc.) ♦ potential for animal damage (edge vs. mid-field) ♦ the weather
How can you statistically factor in the weather?		Repeating the experiment through several seasons is the best way to account for varying conditions from year to year. *And consider:* ♦ Will you have easy access to the field under all weather conditions?
How can you statistically factor in the farmer?		To control bias in commercial trials, the people who carry out or assess the trial don't know the specific treatment they're applying or evaluating. We probably don't have that luxury. To factor out our bias as much as possible, we can—at least—mark plots with codes or numbers. *Be sure plots are marked clearly on two sides. Brightly colored markers help. Be sure your markings won t wash out. Place backup markers in the headland(or some reasonably safe place) in case your main markers are accidentally destroyed. You could use GPS too, but always have a backup.*
How can you be sure we've designed a fair test for our hypothesis?		Except for the test itself, all other treatments need to be the same—*and done on the same schedule*—for the new treatment and the standard treatment. Such treatments may include: ♦ fertilizer placement ♦ the variety or hybrid ♦ planting date, rate, and conditions ♦ primary tillage methods

Q:	Carry on	A:
Hand out Setting up Replications *and discuss*		
How can we achieve statistical validity?	Both treatments need equal opportunity to produce the best they can. ♦ Do at least four REPLICATIONS (repetitions) of each treatment, and assign them to RANDOM plots (see next page). ♦ Select uniform fields OR: arrange treatment plots to include equivalent degrees of variation. ♦ Between each replication, keep at least one plant row free from treatments on neighboring plots… this helps prevent lateral seepage, drift, overspraying, etc. ♦ Only harvest the inner rows… you get an edge effect in the border rows.	
Plus, you need check strips What is a check strip? How do we include it?	A check strip is a control. Check strips help you account for variability within a field and provide a yardstick for comparing your results. (It might seem that the standard treatment is the control… but it's usually not.) ♦ *In a check strip, you do nothing related to your goal no treatment of any sort. If this is an herbicide trial, don t use herbicides.* If it s a fertilizer trial, don t use fertilizer.* ♦ *The check strip runs along each set of replications.* *Adapt to your situation. For example, if you're looking into post-emergence treatments, go ahead with a pre-emergence treatment. If you're testing a new variety, the standard treatment and the control are the same.)	
If your hypothesis concerns treatments for insects	Because check strips are bounded—often on two sides or more—by replications, treatments may artificially increase or decrease the number of pests in the check. What to do? ♦ Enlarge plot size. ♦ Assess only the central area of the plot.	
How can you minimize the extra hassle that setting up these demonstrations may entail?	♦ Measure the width of an up-and-back planting swath, then skip the total width of the number of rows you want to devote to the other treatment. ♦ Go up and back with one setting, then switch settings. ♦ Shut off the planter's single end unit.	
How do you determine plot size?	There are no hard and fast rules. But consider: *Row spacing width of equipment field length uniformity of land availability of labor hand or machine harvest* ♦ Do you have enough elbow room to work? You'll probably have visitors… do you have space for standing room and pathways? Bigger is better, but it has to be practical.	

Q:	Almost done	A:
What sorts of records should you keep on your crops?	♦ date of emergence or spring green-up (small grains) ♦ extent of tillering and grazing potential (small grains) ♦ height at 4- to 8-leaf stage (coarse grains and legumes) ♦ deficiency symptoms, diseases, insects ♦ date of silking, heading, or flowering; plant height ♦ date of maturity ♦ grain moisture at harvest ♦ yield / quantity / quality	
How do you randomize a treatment?	Assign a number or letter to each treatment (including the check strip), write the numbers on scraps of paper, and draw the numbers from a bag. Repeat for each replication. You can find random number generators on the internet.	
How do you account for variables during the growing season?	Record your observations of weather conditions, insects and diseases, persistent weeds, etc. Note date of infestation and extent of damage. Observe if there are any differences between treatments due to pests.	
On what basis can you make final production and economic comparisons between treatments?	On the basis of… cost vs. benefit… yield (total weight of test harvest)… quality…percent damage… plant populations… number of insects… amount of disease… life of stand…	
What considerations and techniques should you apply at harvest to protect the "equal opportunity" of each treatment?	♦ If plot areas are uniform, harvest the entire plot. ♦ If variable soil conditions occur to the same extent in all plots, harvest each entire plot. ♦ If non-uniform areas exist, harvest only areas that are the same size with similar soil conditions. ♦ Machine harvesting the middle rows from each treatment may reduce the edge (or border) effect. ♦ If you need to hand harvest, harvest the same length of two or more rows at two locations in each treatment. *See chart in* Setting up Replications *on how to measure 1/1000 of an acre for harvest.*	
What timing considerations do you need to assess the results?	**If you are testing varieties, harvest each at its peak of maturity to avoid artificial yield and quality differences.**	

Q:	***Done***	***A:***
What techniques can you use to evaluate the results of your harvest?	Your techniques will depend on the commodity and the goal of the test. You may need to send samples to a lab or set up a rating system.	
For field crops demos: Hand out the worksheet Calculating Yield.		
To accurately compare yields, you need to determine and compare crop weight and moisture content.	*If the farmer has equipment with a yield monitor, use it. Be sure it s calibrated using a weigh wagon or truck scale.* OR: *just use your weigh wagon, trucker scale, or farm scale.* ♦ *For small plots, use a milk scale on a tripod.* *Use the worksheet to calculate crop weight and moisture content.*	
Remember to ask yourself:	Are the results realistic for this growing season? What unusual factors may have tweaked the results?	
What uplifting advice do you need as you get underway?	♦ The ultimate objective is to find out what works. You can learn from "negative" results as well as positive results. ♦ Don't underestimate the value of unanticipated results.	
Anything else you need to know?	A project like this could take lots of time—plan for it.	
You may want to plan to have people come back, post harvest, to see what happened. ♦ Did the demo answer the questions? ♦ Were there problems with the study? ♦ How could it be improved? ♦ Do you need more than one growing season's data for your results to be meaningful? *You may wish to use the replicated data (results) to do a statistical analysis of variance or other measure of validity.* (Once you take the natural variation out of the results, you may find that your results aren't as impressive as they looked at first glance.) *Share this with class members and colleagues.* *Have everyone fill out an evaluation form, and remind them of the next class.*		

A. *Demonstration Plot Worksheet*

Worksheet for Activity 1: 3 pages

Name	Field ID
Address	Location in field
Demo goal	

Site characteristics	
Soil series	Soil texture
Soil test: N	pH
P	Organic matter
K	Micro-nutrients
Sample depth (inches)	

Cropping history: previous five years	***Fertilizers: rate/source***	***Chemicals: rate / type***	***Other***
1			
2			
3			
4			
5			

Weather summary during test:

Month	*Moisture: Rain*	*irrigation*	*Temperature: days above 90¡*	*Month*	*Moisture: Rain*	*irrigation*	*Temperature: days above 90¡*
January				July			
February				August			
March				September			
April				October			
May				November			
June				December			

A. *Demonstration Plot Worksheet*

Planting and cultural practices	
Preplant tillage	
Soil conditions at planting	
Residue cover at planting (%)	Planing depth
Planting date	Planting rate
Variety / hybrid	Plant population
Type of planter	Plants / row ft.
Fertilizer rates, dates, source	
Manure	
Herbicides: rate, compound	
Application method	Date
Insecticides: rate, compound	
Application method	Date
Cultivation: type, dates	
Other practices	
Other comments	

Plot diagram here:

A. *Demonstration Plot Worksheet*

List of treatments	*Emergence*	*Heading / flowering*		*Harvest*	*Yield*	*Other*
	Date	*Date*	*Height*	*Height*		
Check strip						

Plot description	
Plot length	Harvested length
Plot width	Harvested width
Number of rows	# rows harvested

Harvest criteria *(substitute your criteria as desired)*	Date
Harvest weight	Method of harvest
Harvest population	Grain moisture

Harvest criteria *(substitute your criteria as desired)*	Date
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Harvest criteria *(substitute your criteria as desired)*	Date
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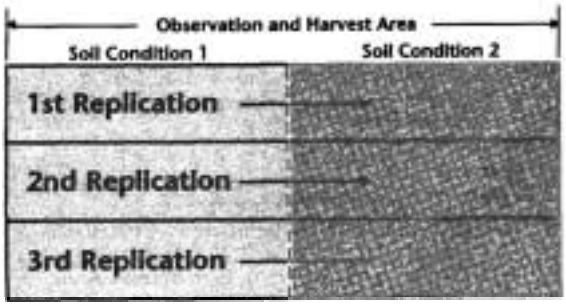
Adapted from J.L Havlin, J.P. Shroyer, and D.L. Devlin,Kansas State University Agriculture Research Center and Cooperative Extension Service.

B. *Setting Up Replications*

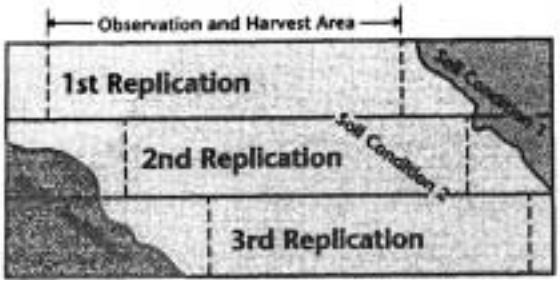
Handout for Activity 1

Randomize your treatment
After you pull numbers out of a hat, your planting strips might look like this:
C (check strip)
A
B
C (check strip)
B
A
A
C (check strip)
B

Examples of replications planted across three soil conditions.



Examples of replications planted perpendicular to direction of two soil conditions.



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C. *Calculating Yields*

Worksheet for Activity 1

Calculating grain yield per acre:

GW = grain weight per acre
TW = official grain test weight (pounds of grain per bushel see below)
GM = % grain moisture content at harvest

- *Use a grain moisture tester and consult the temperature correction factors provided with your tester.*

SCM = standard grain moisture content (see below)

$$\frac{GW}{TW} \times \frac{100 - GM}{100 - SGM} = \text{Bushels/acre}$$

Your yield:

____ x $\frac{100 - \_\_\_\_}{100}$ = _____ bu. ac.

	TW	SGM
Wheat	60	12.5
Grain sorghum	56	14
Soybean	60	13
Corn	56	15.5

Calculating silage yield per acre:

Calculate square feet of harvested strip:

Width x length = _____ sq ft

____ sq. ft. by 43,560 x 100 = _____ % ac

Net weight from strip: _____ lbs.

Multiply times: _____ % of acre

= _____ lbs. per acre

For yield in tons per acre:

Divide by 2000: _____ tons per acre

Correct for moisture:

- *Use a reliable, calibrated forage moisture tester (such as a Koster tester). Or microwave a 1000-gram sample. Weigh the sample, and continue drying and weighing until it no longer loses weight. Then calculate the percent moisture (or dry matter).*

Standardize your samples to zero percent moisture or to one standard moisture content. You may wish to check with your land grant college s forage crops extension specialist on how to do this.

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Module Feedback

Designing In-field Demonstrations

Modify this according to your needs.

Tell us a little about yourself:

I m a	*My commodity area is:*
♦ Farmer _____	♦ Dairy and field crops _____
♦ Crop advisor _____	♦ Vegetables _____
♦ Industry rep _____	♦ Fruits and berries _____
♦ Extension educator ____	♦ Greenhouse and nursery stock _____
♦ Other _____	♦ Other _____

Let us know what you think:

What part of the workshop was most interesting for you?
What part of the workshop was most valuable to you?
What two new ideas would you like to try on your farm or in your business?
Do you feel you understand IPM—and how to use it—better now?
What other information should be included in this module?
What other topics would you like us to cover in future modules?

Teachers, please fill out an evaluation as well. Photocopy and send all informative evaluations to:

NE-IPM Modules, NYS IPM Program, Box 28 Kennedy Hall, Cornell University, Ithaca NY 14853