UNIVERSITY OF DELAWARE
COLLEGE OF AGRICULTURE AND NATURAL RESOURCES
COOPERATIVE EXTENSION

# LARGE PLOT TEST-DEMONSTRATIONS FOR EVALUATING WEED CONTROL

**Weed Facts**
**WF-15**

Growers, consultants, and the agribusiness industry often ask if they can benefit from changes in their weed management practices, such as the use of a different herbicide, altering the rate of the existing herbicide, incorporating cover crops, or using a new type of cultivator. Comparing changes on separate farms, or even separating fields into halves, often can lead to erroneous conclusions because of the variations within and between fields. Weed species, soil characteristics, and many more factors vary from farm to farm. To determine if a change is beneficial or to truly compare different options, a replicated trial is needed. Often a new practice is compared to one or more standard practices. Some people use the term paired-comparison if a new practice is compared to one standard (two treatments). This type of test is conducted in actual use situations, using the producer's own equipment.

## PROCEDURES

Choose portions of the field with uniform soil and uniform weed infestations. Sometimes a few treatments are compared in large plots or strip trials. More commonly, a new practice is compared to a standard (paired comparison). Plots are replicated at each location. An untreated check plot is included to determine the type and number of weeds in the field, the variation in weed pressure throughout the field, and effect of treatments on the crop. If a large untreated area is not practical, small areas (only 15 to 20 feet long and the width of a spray boom) scattered throughout the observation area are needed. Weed infestations tend to be patchy so only a single small area will not be adequate for determining effectiveness of control.

Sometimes it is of interest to split large plots in order to compare the combined effect of two weed control practices. For example, what is the best herbicide program when both preemergence and postemergence herbicides are used? This type of test is more difficult to set up and analyze, but it allows the evaluation of a program approach to weed management.

Calibrate the equipment and make adjustments before applying treatments. Also, take extreme care in measuring the herbicide and water used for spraying.

Evaluations of efficacy involve determining weed control 2 to 6 weeks after treatment and again at harvest, in addition to crop stand, vigor, and crop yield. If treatments are not replicated at each location, the validity of observations for each site is difficult to interpret. If the site is not carefully chosen, variations in such features as weed infestation, soil fertility, soil moisture and drainage, soil texture and organic matter, seedbed preparation, planting depth, and disease infestations, may make assessment of weed management effects difficult. Sub-sampling procedures (at least four samples per plot) can be used to obtain an estimate of variation within each plot. A plot effect can be statistically demonstrated if the variation between plot treatments is significantly greater than the variation within plots. However, the cause of this difference is always questionable if the experimental area is not uniform.

Consequently, data from a single test site should be interpreted with care. Under normal conditions differences in crop yield of 10 to 20 percent between treatments would be required before statistical significance can be shown. To avoid conclusions based on invalid data, replicate the treatments and follow standard statistical procedures.

## OBTAINING DATA IN FIELD TESTING

Data to be obtained from the field validation of weed management will depend on the purpose of the test and the precision required.

Large-scale plots for weed control may require only a visual estimation of crop vigor and weed growth.

Ratings based on visual observations of symptoms are often used, particularly where many plots or plant species are involved and manpower is limited. To be effective, such systems depend on unbiased observations utilizing a rating system that is readily understandable and simple to use, yet gives data suitable for comparisons. Many different systems have been employed by weed scientists depending on the ultimate use of the data.

System One. The most common system currently employed is the 0 to 100 rating, which makes use of direct-percentage figures. The system is illustrated below. A rating is made individually for each weed species found in the untreated checks. The standard basis for comparison is an untreated weedy check. An effect on the weeds is first put into one of the five main categories. Final assessment is then made within the category (slight, moderate, or severe).

*Rating Systems for Weeds*

| Rating | Main categories | Detailed description of weed control |
|---|---|---|
| 0 | No effect | No weed control |
| 10 | | Very poor weed control |
| 20 | Slight | Poor weed control |
| 30 | | Poor to fair weed control |
| 40 | | Fair weed control |
| 50 | Moderate | Fair to moderate weed control |
| 60 | | Moderate weed control |
| 70 | | Weed control almost satisfactory |
| 80 | Severe | Satisfactory to good weed control |
| 90 | | Very good to excellent weed control |
| 100 | Complete | Complete weed control |

System Two. A less precise but quick method is to rate weeds by species and in relative abundance, and note average size or a developmental stage. An average size or developmental stage will provide information on partial control of the weeds.

Weed Abundance

Few: found occasionally without extensive searching

Common: easily found when searching

Abundant: found in large numbers

Extreme: very numerous, impresses the observer

Growth Stage

Grasses:

first, second leaf, etc.
tillering
early reproduction (head in sheath)
mid-reproduction (head open)
late reproduction (seed mature)

Broadleaf weeds:

cotyledon, seedling, number of leaves
early reproduction (bud)
mid-reproduction (flowering)
late reproduction (seed mature)

Winter annuals:

diameter of rosette
early reproduction (bud)
mid-reproduction (flowering)
late reproduction (seed mature)

System Three. A traditional method is species density, or weed counts. Counts of individual weed species may give a precise representation of both weed infestation and degree of control, particularly in experiments in which treatments are evaluated over a period of years. Counts are made on randomly selected areas (1 square foot to 1 square yard) of each experimental plot. The number and size of areas chosen will vary with the weed infestation and plot size; there must be enough, however, to provide a true sample. To facilitate counting, plots should be evaluated when weeds are small. The process is laborious and time-consuming, particularly if many plots or subsamples are involved. Counts are most useful where scattered infestations of weeds occur. Weed counts in untreated plot areas should be used as the basis for comparison of weed density. These data can be summarized as weed density (number of weeds/area) and distribution (percentage of each species present).

System Four. Weed harvests are useful in some cases. Weeds are either cut or pulled from uniform areas in the plots and weighed either fresh or after drying. This method is laborious but may provide very useful data, especially when trying to determine the ultimate result of an herbicide program, that is, biomass of weeds present at harvest and loss of potential crop yield. Biomass data can provide valuable information on the suppression of a given weed species that would not be observed with weed count data.

System Five. In certain crops, the time required to manually weed plots following standard control practices may serve as a useful
indicator of degree of weed control. These data are useful in situations where hand-weeding or hoeing are extensively used.

*Crop Response Data*

Weed management frequently affects the seedling establishment and survival of crop plants. Therefore, stand counts of treated and check plots maybe useful in determining injury. The standard basis for comparison is an untreated check. Typically, an entire row or a section of a row in each plot is counted (an area providing 50 to 100 plants is usually an adequate sample size).

Visual ratings usually are sensitive to stunting and other herbicide effects. Crop responses other than stunting include chlorosis, necrosis (death), deformed leaves, stand reduction, lodging, stunting, stem malformation, purpling, malformed roots (or brace roots), delayed flowering or maturity, or reduced quality. This type of information can be incorporated into the following table.

| Rating | Main categories | Crop response |
|---|---|---|
| 0 | No effect | No crop injury |
| 10 | | Slight crop discoloration or stunting |
| 20 | Slight | Some crop discoloration, stunting, distorted growth |
| 30 | | Crop injury more pronounce, but not lasting |
| 40 | | Moderate injury, crop usually recovers |
| 50 | Moderate | Crop injury more severe, recovery doubtful |
| 60 | | Lasting crop injury, no recovery |
| 70 | | Heavy crop injury, stand loss |
| 80 | Severe | Crop nearly destroyed, few surviving plants |
| 90 | | Only occasional live plants left |
| 100 | Complete | Complete crop destruction |

Early crop growth may be obtained by measuring plant height and observing date of seedling emergence (especially important for preemergence or preplant herbicide applications).

The most critical effect of weed management upon crop plants can be determined only if crop yields and quality are determined. If the early effects of weed management have been severe, yield represents the economic response of the crop to the treatment. The evaluator should be aware of the possibility that the crop can recover completely from early injury under good growing conditions; however, if drought, low fertility, insect, disease or nematode stress is present, recovery may not be possible. Therefore, if moderate to severe crop injury does not result in economic yield loss under good conditions, the significance of the potential injury should not be dismissed until evaluated in a stressed environment. A similar phenomenon accounts for the observation that crops may recover from early injury and yield normally if weeds are controlled; however, if weeds are not completely controlled and are allowed to remain in the crop after 4 to 6 weeks, yield loss response will be confounded by the weed competition stress.

The use of replicated strip trials is the best method to compare the benefits and value of any changes for an individual farmer. The replicated trial will give information as to the true benefit of the new practice. Conducting strip trials can be time-consuming, but to avoid problems assistance by Cooperative Extension personnel can be very helpful the first time a strip trial is conducted. And the information gained through a replicated trial will be of more value to the end user.

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Modified from: Research Methods in Weed Science. Third Edition. South. Weed Sci. Soc.



WF - 15 - 01/06
formerly WF-10