Journal of Extension
www.joe.org

December 2003 // Volume 41 // Number 6 // Ideas at Work // 6IAW3

A Farm Demonstrations Method for Estimating Cotton Yield in the Field for Use by Extension Agents and Specialists

Abstract
This article describes a programming possibility for Extension agricultural agents working in cotton production. It describes methods by which scientific estimates of cotton yields may be performed by agents in the field and educational opportunities that may arise as a result of the estimation process. These programs have been very popular and successful in Alabama.

Bob Goodman
Extension Economist
Internet Address: wgoodman@acesag.auburn.edu

C. Dale Monks
Extension Crop Scientist

Alabama Cooperative Extension System and Auburn University

Background

As cotton bolls start to open and talk in workshops and on farm tours centers around late season crop management and defoliation, farmers often are very interested in yield estimates. Often Extension agricultural agents in the Cotton Belt are asked to estimate cotton yields "in the field," before the cotton is picked. Usually, agents just look out over the field and develop an estimate based on the "look" of the field and their prior experience. The problem with such estimates is that they are almost invariably wrong, and agents making estimates based on such unscientific methods risk loss of credibility among their clientele.

Several "rules of thumb" exist for estimating such yields, for example "100 bolls per 10 feet of row equals one bale per acre" or "each individual lock per 10 row-feet equals 1 pound per acre lint". While these "rules of thumb" offer some improvement in accuracy, the interest in yield offer an excellent teaching opportunity for the agent.

While there is often a good bit of variation in any field, an agent who is willing to spend a few minutes sampling bolls can make a more accurate estimate and can use the opportunity to illustrate several important farm and cotton management principles. The accuracy of the resulting estimate depends on the agent's willingness to take the time to count and weigh a representative sample of bolls. The accuracy of the estimate directly depends on how much time is taken to develop the sample.

Factors Affecting Estimate Accuracy

It must be noted that the accuracy of yield estimates also depends, to a lesser extent, on assumptions regarding cotton picker efficiency and gin turnout. Efficiency of harvesting equipment may vary significantly, depending on age and condition of the pickers as well as field and environmental conditions. The proportion of the crop that ends up in the picker basket may vary between 75 95%. Under good conditions, pickers will be able to gather roughly 95% of the seed cotton, containing both lint and cottonseed, into the machine.

However, many common factors may significantly reduce that efficiency. Some cotton may be "strung out" of the bolls and fall to the ground. Some bolls may be "hard locked," a condition where the cotton lint fails to "fluff" so it is missed by the picker. Some bolls may not open in time to be picked. However, in the absence of extreme conditions 85 to 90% of the cotton will be harvested.

A second factor affecting yield estimate is gin turnout. Turnout refers to the ratio of cotton lint to cottonseed that together make up the seed cotton that is picked. Gin turnout is also affected by several factors such as cotton variety, cotton maturity, trash content, and general condition of the crop. Gin turnout may vary between 35 and 45% but is commonly in the lower end of that range (Glass, Monks, & Burmester, 2001) The tables in this study incorporate assumptions of 38% turnout and 87% picker efficiency for spindle-picked cotton.

Making the Estimate

The standard sample length for counting bolls to estimate yield is 10 row-feet. Bolls should be counted in several representative areas of the field. The agent should pick such a representative spot (or several) and count all the open bolls and bolls expected to open by harvest in 10 feet. Bolls unlikely to open or with visible signs of boll rot should not be included in the sample. Open bolls with "hard lock" should also be excluded from the total.

Typically, a "small" boll may weigh 2 grams (about .07oz), and a "large" boll may weigh 6 (about .21 oz), but if yield is to be estimated without weighing bolls, it may be assumed that the average boll at typical harvesting moisture content weighs 4 grams (.14 oz), and the "rule of thumb" is that it takes about 120 4-gram bolls per 10 feet of row on 38 inch rows to make a 480-pound bale of cotton. In other words, each boll counted per 10-foot of row represents about 4 pounds of lint per acre on 38-inch row cotton.

Lint yield may be estimated directly as the product of boll weight (in grams or ounces) multiplied by the number of boles in 10 row-feet times percent picker efficiency times gin turnout in percent divided by row spacing in inches multiplied by the factor 0.008685 (if your scale reads grams or .000306 if your scale reads ounces). An example is as follows:

{(Gms/Boll)*(No. Bolls)*(%Pckr Eff.)*(%Turnout)}/{(Row Spacing)*.008685}=lbs lint/acre
{4*120*.87*.38}/{38*.008685}=480 lbs lint/ac

{(Oz/Boll)*(No. Bolls)*(%Pckr Eff.)*(%Turnout)}/{(Row Spacing)*.000306}=lbs lint/acre
{.14*120*.87*.38}/{38*.000306}=478 lbs lint/ac

Table 1 depicts yield estimates using this method for various boll weights and counts. As shown in the table, it takes 16 3-gram bolls per foot of row to produce an estimate of 481 lbs. lint per acre on a field planted in 38-inch wide rows. On a field planted in 30-inch rows, each 4-gram boll per foot of row means about 50 pounds of estimated lint per acre, and thus it takes about 10 for each row-foot to represent a bale per acre. On 30-inch rows, for an average boll weight of 3 grams, 12 bolls per foot of row produces an estimate of 457 pounds per acre.

Table 1.
Estimated Lint Cotton Yield
38% Turnout, 87% Picker Efficiency, Pounds Lint per Acre

Bolls per Foot of Row, 38-Inch Rows								
Grams per boll	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**
2	160	200	240	280	321	361	401	441

2.5	200	250	301	351	401	451	501	551
3	240	301	361	421	481	541	601	661
3.5	280	351	421	491	561	631	701	771
4	321	401	481	561	641	721	801	881
4.5	361	451	541	631	721	811	902	992
5	401	501	601	701	801	902	1002	1102
5.5	441	551	661	771	881	992	1102	1212
6	481	601	721	841	962	1082	1202	1322
Bolls per Foot of Row, 30-Inch Rows								
Grams per boll	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**
2	203	254	305	355	406	457	508	558
2.5	254	317	381	444	508	571	634	698
3	305	381	457	533	609	685	761	837
3.5	355	444	533	622	711	799	888	977
4	406	508	609	711	812	914	1015	1117
4.5	457	571	685	799	914	1028	1142	1256
5	508	634	761	888	1015	1142	1269	1396
5.5	558	698	837	977	1117	1256	1396	1535
6	609	761	914	1066	1218	1370	1523	1675

Bolls must be weighed to make an accurate estimate. Again, there are many ways to scientifically estimate average boll weight. Any systematic sampling of boll weight and number will work. The choice depends on the scales available.

Postal-type scales that weigh in ounces will require samples that weigh several ounces, about 100 grams. This means you will need a sample of at least about 25-30 bolls. One may randomly select a sample of two or three plants and count and weigh every boll on those plants to get the average boll weight. There are about 28 grams in an ounce, so if you weighed a sample of 24 bolls and it weighed 3 ounces, it would convert to 3.5 grams per boll (Three ounces = 84 grams, 84grams/24bolls=3.5grams/boll). The only important principle is to sample bolls from many different areas in the field and from all parts of the cotton plants.

Additional Educational Opportunities

An interesting demonstration to perform while the agent is measuring these bolls is to show the value (and weight) of bolls from different parts of the plant. It is interesting for farmers to see the difference in value of a large first position boll near the middle of the plant and a small boll on the end of one of the upper fruiting branches. To calculate boll value, simply divide weight in grams by 454 grams per pound, and multiply by a current cotton lint price per pound, about $.55.

Another interesting demonstration while in the process of estimating yields is to show the wide variation between different areas of the field and between different plants. The farmers can see how the whole field might perform if the weaker areas of the field performed as well as the stronger areas.

Finally, doing these calculations gives farmers an idea of the value of a relatively small number of bolls per 10 row-feet. They can see that a late season insect control application or a boll-ripening treatment that opens just a few bolls every 10 feet will cover the cost of the material and application.

For example, it would require the chemical to open just 4.5 4-gram bolls per 10 row-feet to pay for a $10 per acre boll-ripening treatment. This represents less than half a boll per foot of row. With a normal plant population, that's about one boll on every sixth or eighth plant. One boll per row-foot on 38-inch rows equals 13,756 bolls per acre. While one 4-gram boll at $.55 per pound is worth less than two tenths of a cent, one 4-gram boll per foot of row is worth over $22 per acre.

In summary, demonstrations like these can be an interesting and important part of late-season cotton tours and field days and can provide the Extension agent ample opportunity to demonstrate area competence while providing farmers with useful cotton management information.

References

Cochran, M.J., Danforth, D., Bernhardt, J., Haney, J., Phillips, J. R., & Tugwell, N. P. (1990). Fiber properties and economic value of bolls as influenced by fruiting position. In D. M. Oosterhuis (ed.). *Proc. 1989 cotton research*. Univ. of Arkansas, Ark. Agri. Exp. Stn. Special Report 144:59-63.

Glass, K. M., Monks, C., & Burmester, C. (2001). *2000 Alabama cotton variety report*. Agronomy and Soils Department, Auburn University. Research Report Series no. 223.

Khalilian, A., Sullivan, M. J., & Mueller, J. D. (1999). Increasing picker efficiency by using a boll saver attachment. *The Journal of Cotton Science* 3:122-125.