Determining Yield Goals

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The nutrient requirement of a crop depends, among other factors, on the yield produced. For this reason, fertilization recommendations are generally based on the yield goal. The yield goal is the yield per acre the grower hopes to obtain [1]. Choosing realistic yield goals has economic as well as environmental implications [3]. Setting the yield goal too low may result in suboptimal nutrient availability and low yields, while too high yield goals result in over-application of fertilizers, which increases the costs of production without resulting in an increased yield [2]. Over-application of fertilizer may also result in losses which may cause environmental problems [3]. In addition, inadequate nutrient availability may affect the quality of the product.

Crop yield depends on many factors, including climate, crop species and variety, crop management (intensity as well as management skill level), and soil properties. Especially soil chemical and physical properties may vary considerably from field to field, or even within an individual field [3]. The yield goal should reflect what can be grown under the prevailing conditions of a specific field [2]. A number of methods have been used to set yield goals.

Methods to set a realistic yield goal

1. **Maximum yield**

   Using the maximum yield produced in the past on a specific field or a neighboring field with similar conditions. This approach does not take into account economics, environment, or crop profitability, and is not a responsible way to estimate realistic yield goals [3].

2. **Average yield**

   Using the average yield of the past 3 to 5 years realized on the field or a nearby field with similar conditions is a relatively easy method to use. If accurate farm records have been kept in the past, farm or field averages can be calculated [3]. However, using past yields may be too conservative a method as the yields of many crops tend to increase over the years due to new varieties or improved crop management [1]. Several approaches can be used to adjust past average yields:

   a. *Using a rolling average*

   This is the same procedure as described above. However, the average is calculated each year using the yield of the most recent five years [3]. With this approach, the yield goal is automatically adjusted each year taking into account changing factors, such as climatic conditions or yield potential of improved varieties. This is a good method, when the yields are close to the optimum. To prevent extreme under- or over-fertilization, the crop performance needs to be evaluated regularly (see below).

   b. *Adjusting the past average by a fixed percentage*

   This method uses the average of the last 3 to 5 years and increases it by 5-10%, with the higher yield becoming the yield goal [2, 3]. With this method, the average yield of fields should increase each year if not limited by stress conditions. If no yield increase is realized, the yield potential under the present conditions is likely reached and the adjustment should no longer be made unless new varieties are introduced or the crop management is improved.

c. *Adjusting the past average by dropping exceptional years*

Past averages can also be adjusted by dropping the lowest two yields of the previous five to ten years and using the average of the remaining years as the yield goal [3]. Likewise, exceptionally high yields may be dropped to calculate the average [2].

3. **Using yields from variety trials or county averages**

If no data from the field or neighboring fields with a similar soil type are available, average yields from crop variety trials or countywide averages can be used [2, 3]. The closer the soil and climatic conditions at the locations these yields were obtained resemble the conditions in the own fields, the better is the estimated yield goal. If desired, the average yields can be adjusted with one of the methods described above.

Evaluation of the yield goals

Independent of the method used to estimate the yield goal, it is important that the goal is compared to the yields realized each year and is adjusted if necessary.

- **Comparison with actual yield**

When the yield goals are reached or exceeded most years, they should be increased, as the yield potential may not be reached. I contrast, when the yield goals are not reached in most years, they should be corrected down, as too much fertilizer is applied. However, when the yields are constantly lower than expected, the grower should evaluate the crop management in general, including fertilization practices, pest and weed control, and irrigation.

- **Soil and plant analyses**

Mid-season plant tissue analyses reveal whether nutrient supply was adequate. Plant analyses can be used to supply nutrients to the current crop, as well as to correct the fertilization management for the following year. The determination of available nutrients left in the soil profile at the end of the season allows making corrections for the following year as well.

- **Economic analysis**

The evaluation of the yield potential needs to include an economic analysis. Aiming for the maximum yield is generally not the most profitable way to produce a crop. Fertilizer applied on top of the optimal rate does not lead to a yield increase high enough to cover the costs of this additional fertilizer [1, 2, 3].

References

1. Dahnke, W.C., Swenson, L.J., Goos, R.J., Leholm, A.G. 1988. Choosing a crop yield goal. North Dakota State University Extension Service. SF-822 (Revised). Available online at http://v1storm.lib.ndsu.nodak.edu/repository/bitstream/handle/10365/17617/SF-822-1988.PDF
2. Dobermann, A., Shapiro, C.A., 2004. G79-481 Setting a realistic corn yield goal. University of Nebraska Extension, Lincoln. Paper 1716. Available online at http://digitalcommons.unl.edu/extensionhist/1716
3. Taylor, R.W., 1998. Realistic yield goals for crops - considerations and suggestions. University of Delaware Cooperative Extension. Agronomy Facts AF-03. Available online at http://ag.udel.edu/extension/agnr/pdf/af-03.pdf

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