Yield Stability Zones

Introduction

Crop yield can vary from field to field, within fields, and from year to year. Yield monitor systems that record yield at 1-second intervals during harvest time generate yield maps that can be used for delineating management zones. Zoning is an effective method to group areas in the field that can be managed the same way. There are various methods to determine zones (see Agronomy Fact Sheet #108 to learn more about the benefits of zone-based field management). Here, the steps involved in developing yield stability zones are described.

What are Yield Stability Zones?

Yield stability zones are generated using both yield and yield variability over the years at the whole farm level. For humid areas and rainfed agriculture, it is important to develop zones that take into account the fact that yield can vary from year to year and that some areas are more consistent in yield than others. Areas that are consistently high yielding tend to be climate resilient areas.

Yield stability-based zone maps can be derived for each field that has at least three years of yield data for a specific crop. Each area on the farm is then classified as one of four zones: Q1 (zone that is consistently yielding higher than the farm average), Q2 (zone that also has higher yield than the average but is variable in yield across years); Q3 (zone that is variable and low yielding), and Q4 (zone that is consistently low yielding). When plotted on a map, as shown in Figure 1, zones are denoted as green (Q1), blue (Q2), yellow (Q3), and red (Q4). Note that yield stability zone maps are crop specific. For instance, corn grain fields may have different zone maps from corn silage or soybean fields.

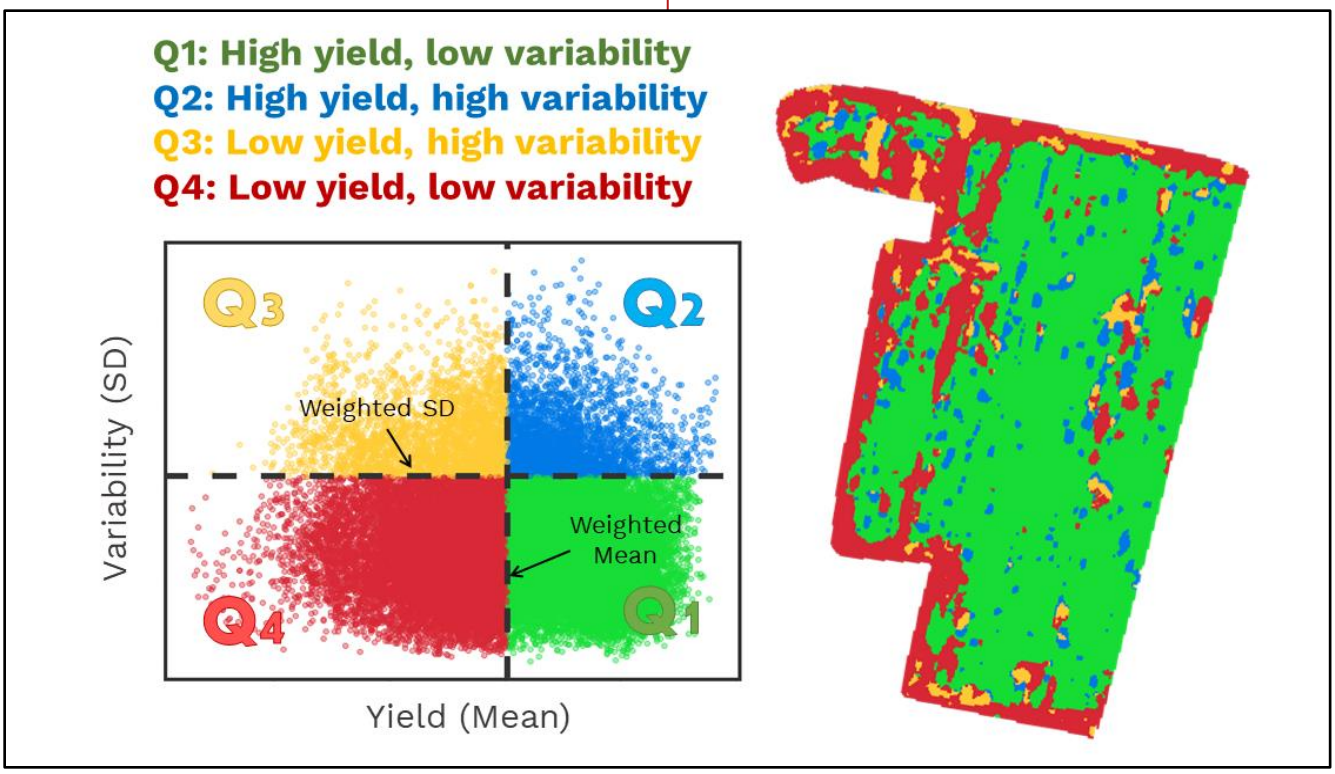

Figure 1. An example of the yield stability zones generated by delineating the farm weighted mean and standard deviation (SD) to create four quadrants (left). Map shows the grid location of the data points (right). Green (Q1) are zones that are consistently high yielding, blue (Q2) are variably high yielding, yellow (Q3) are variably low yielding, and red (Q4) are consistently low yielding.

Steps in Creating Yield Stability Zones

There are six main steps when developing yield stability zones and field maps.

1. *Collect at least three years of yield monitor data (whole-farm coverage).* Start with updated field boundary maps (Agronomy Fact Sheet #121). Ensure that harvester or chopper equipment is properly calibrated (Agronomy Fact Sheet #104, #105). After collecting the raw data, they need to be corrected for four delay values, namely mass flow, moisture, start pass, and end pass (Agronomy Fact Sheet #107). The quality of the zone maps is only as good as the quality of data.
2. *Generate a kriged map of each field.* To be able to overlay field yield maps from multiple years, the corrected datapoints from the yield monitor are kriged and converted into a raster format. Each rasterized yield map has a grid area of 6 x 6 ft^2, which is the ideal cell size to facilitate on-farm research using the single-strip spatial evaluation approach (SSEA; Agronomy Fact Sheet #124).
3. *Calculate the average yield of each grid cell across all years of data.* This grid cell average yield value is used to classify if the grid is higher or lower yielding than the whole-farm average.
4. *Calculate the standard deviation of each grid cell from fields with at least three years of yield data.* This grid value is used to separate consistently yielding areas from those that vary in yield depending on the weather that year.
5. *Determine the farm-weighted mean yield and farm-weighted standard deviation.* This is done by averaging all grid cells across all years of data to obtain the vertical (weighted mean, Figure 1) and horizontal (weighted standard deviation, Figure 1) cutoffs.
6. *Assign grids into specific zones.* Once the whole-farm cutoff between higher and lower yielding areas and the cutoff between stable and variable areas are known, we can assign a zone number to each 6 x 6 ft^2 area:

   - **Q1:** Above the average yield and below the average standard deviation.
   - **Q2:** Above the average yield and above the average standard deviation.
   - **Q3:** Below the average yield and above the average standard deviation.
   - **Q4:** Below the average yield and below the average standard deviation.

Years of Data Needed

Whole-farm average yield and standard deviation can be determined based on three years of data. However, if more years of quality data are available, it is recommended to include those years. Yield stability zones become more accurate with additional years of data. If a yield trend exists (e.g., yield increased over the past 5-10 years), limit zone delineation to the most recent five years.

Applications

Yield stability maps can (1) serve as a benchmark for troubleshooting problem areas; (2) offer insights into barriers to production; and (3) facilitate variable, zone-based, management. In addition, yield stability maps facilitate on-farm research using the single-strip spatial evaluation approach (SSEA). In this method (see Agronomy Fact Sheet #124 for more information), a strip covering the different yield zones is placed across the field to evaluate the effects of a management change (i.e., different rate of manure or fertilizer application, effect of biologicals or bio-stimulants, etc.).

Summary

Yield stability maps offer a practical and effective way of displaying and managing field variability, allow for zone-based management, and facilitate on-farm research.

Additional Resources

- Cornell Nutrient Management Spear Program Agronomy Fact Sheet Series. http://nmsp.cals.cornell.edu/guidelines/factsheets.html

Disclaimer

This fact sheet reflects the current authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this fact sheet does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of discharge levels from agricultural land.

For more information

Cornell University Cooperative Extension

Nutrient Management Spear Program
http://nmsp.cals.cornell.edu

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