

# Relationships between soil profile characteristic and soybean yields in 2010

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### Summary Points:

- Depth to limiting layer influences dryland soybean yields
- No one single item should be used to delineate management zones, consider use of yield data, soils maps, etc.

### Rationale:

*This summary is part of the Field-scale variability study initiated in 2010.* Various technics may be used to create management zones for precision management of soybean fields. Grid soil sampling, EC measurements, and yield maps are good tools that may be used to evaluate field level variability. Soil maps may also be useful but are often criticized for not being accurate enough for the creation of management zones. The purpose of the research presented here was to collect site specific soil profile data to that could explain some of the variability observed in soybeans that could not be explained by soil maps, grid soil sampling or EC measurement.

### Materials and Methods:

In January of 2011, soil cores were collected to the depth of bed rock or 43 inches from soybean fields located in Ottawa, Kay, and Washita Counties. Fields located in Ottawa and Kay counties were rain fed and the field located in Washita County was irrigated. Soil core collection locations were selected to provide a range in soybean yields so that profile characteristics could be used to evaluate yield variability. After collection, soil cores were transported back to Stillwater in plastic sleeves. Soil profile descriptions included the depth, texture, clay content, structure, consistency, and color of each horizon. This data allows for the determination of the depth to limiting layer, which was defined as the top of the first horizon containing a clay content greater than 35%, and redoximorphic features (grey masses intermixed with soil matrix, indicators of poor drainage or perennial water table)(Figure 1) at the Kay and Ottawa County locations. The texture of soils at the Washita County location ranged from sandy loams to sandy clay loams, therefore, it was assumed that clay content and drainage would not limit yield. In fact, because these soils were sandy it was assumed that whole profile clay content would be positively correlated with yield. The higher clay soils within this field were assumed to have greater water holding capacity and therefore greater yield potential.

### Results and Discussion:



Figure 1: Core showing grey and dark red redoximorphic features

The map presented in Figure 2 shows yield, the soil map and core collection location at the Ottawa County field. The whole field is mapped as a Taloka silt loam, therefore the NRCS soil map is not useful to delineate management zones for this field. The yields vary between 11 and 59 bushels per acre at this location and were regressed against the depth to limiting layer in Figure 3. Figure 3 shows that the yield is generally positively related to depth to limiting layer as expected. However, the weak relationship suggests that other variables influence yield. The core represented by the circled point in Figure 3 was collected from a drowned out area on the back side of a terrace. The three points above the cluster points falling on the line were collected from high yielding areas of the field and may result from elevated fertility in these areas.

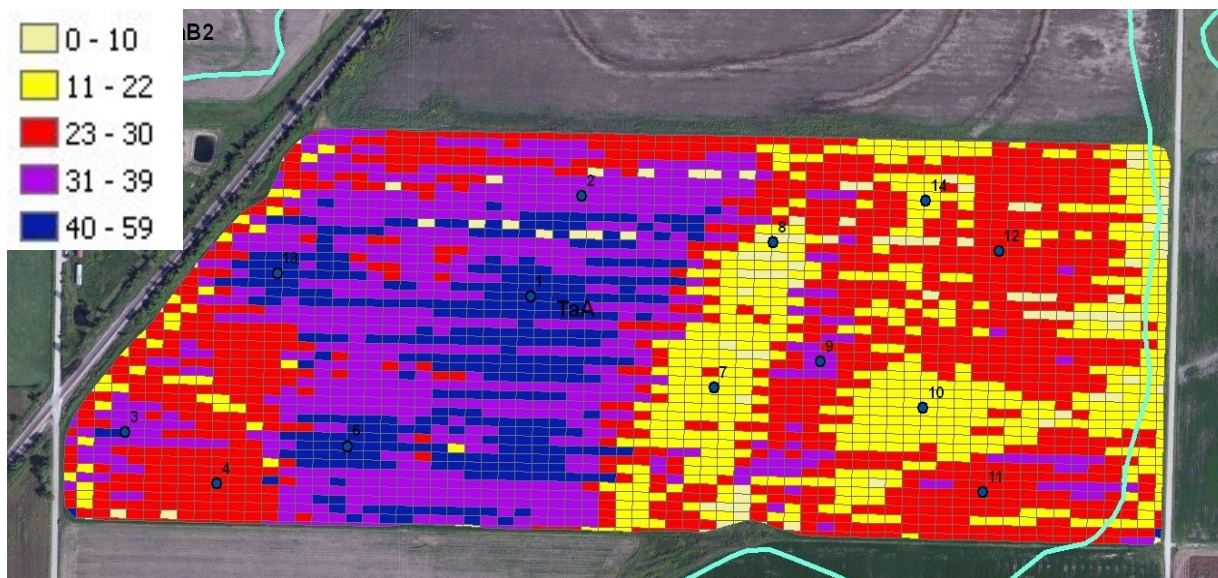


Figure 2: Soybean yields (yields shown in legend are in bushels per acre), NRCS soil mapping units and the location of soil core collection in Ottawa County near Miami.

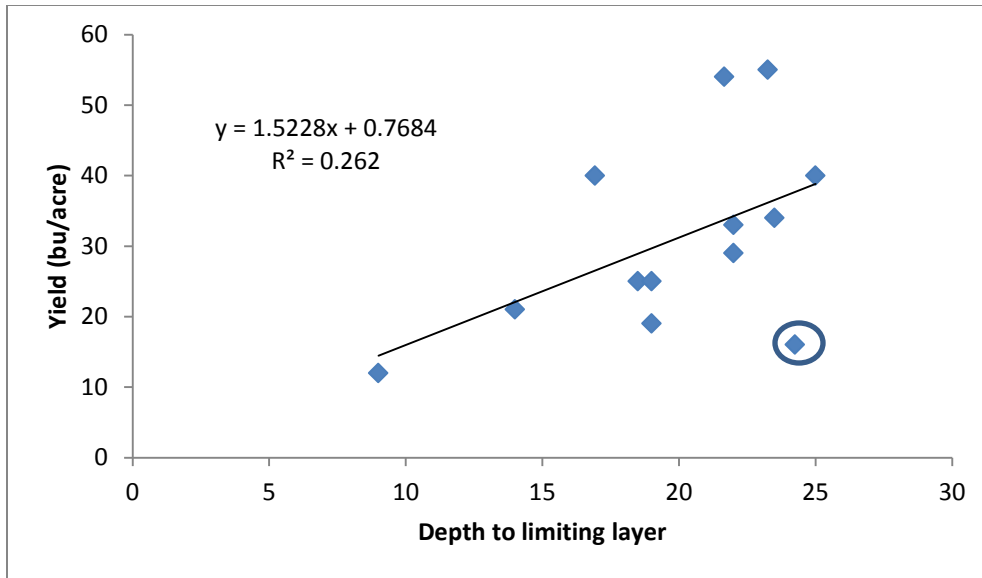


Figure 3: The relationship between soybean yield and depth to limiting layer observed in the field in Ottawa County near Miami.

The map presented in Figure 4 shows yield, the soil map and core collection locations at the Kay County field. Visual comparison of yield and the soil map demonstrates that the Port silt loam (Kc, on west side of field) is a highly productive soil. This is no surprise as it is a deep well drain soil with moderate texture and deep deposits of organic matter resulting from its recent formation in a flood plain. In contrast, Kirkland (KrB) and Tabler (TaA) soils can contain horizons with elevated clay content which restrict root growth and drainage. Figure 5 shows that depth to limiting layer was correlated with soybean yield. Therefore in this field soil profile characteristics play an important role in yield determination. Large differences, such as the differences in yield found on the Port the yield found on the Kirkland and Tabler soils can be delineated with the soil map. However, variation within the soil mapping units is also apparent in its impact on soybean yields.

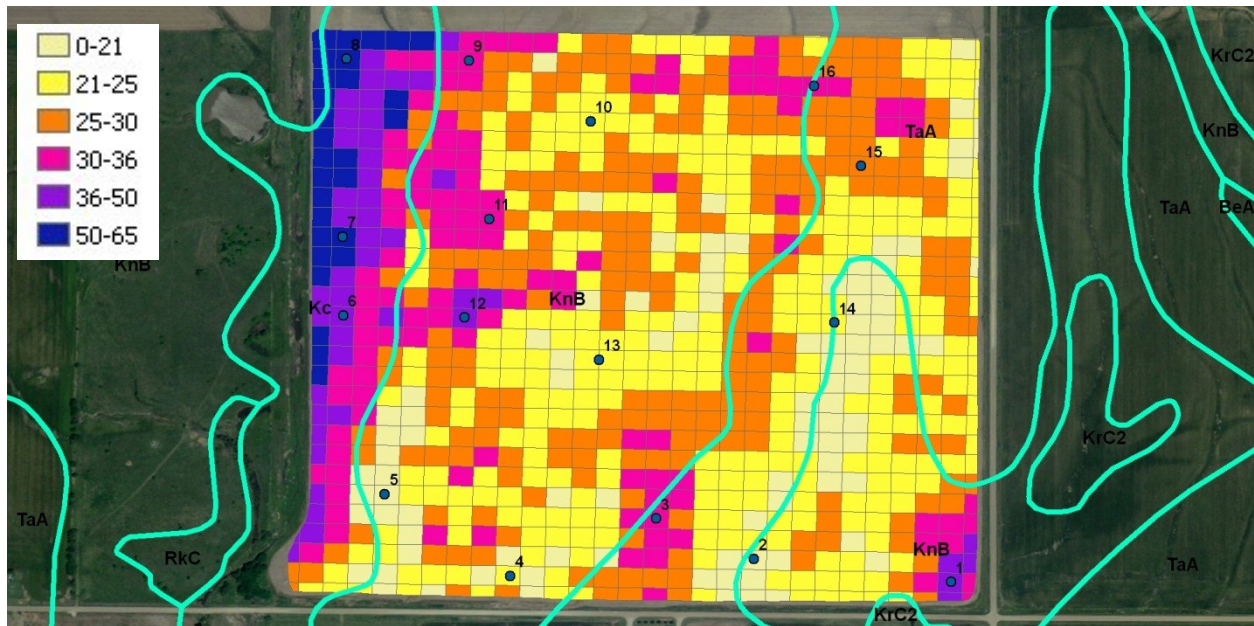


Figure 4: Soybean yields (yields shown in legend are in bushels per acre), NRCS soil mapping units and the location of soil core collection in Kay County near Ponca City.

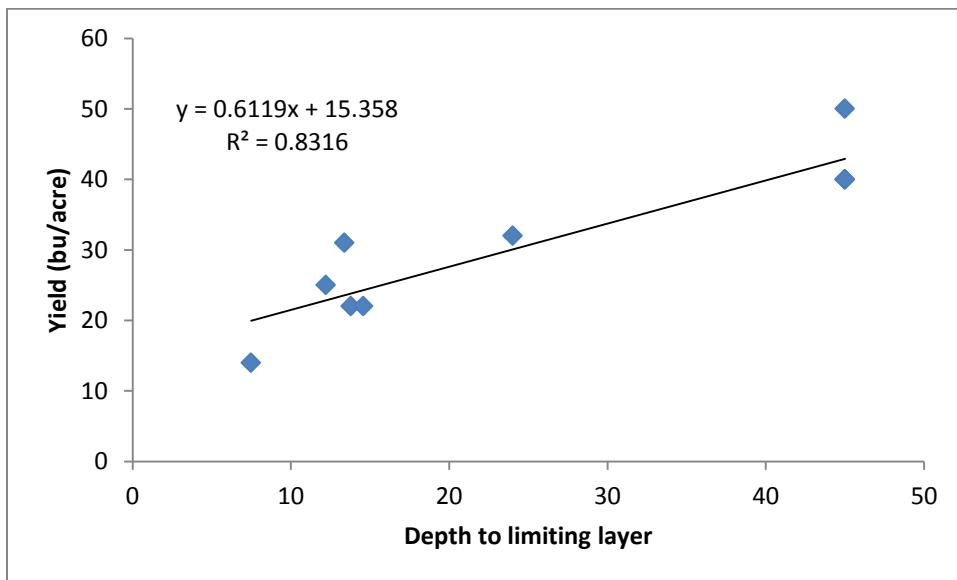


Figure 5: The relationship between soybean yield and depth to limiting layer observed in the field in Kay County near Ponca City.

The map in Figure 6 shows that the soil map provided little or no explanation of the variability in yield at the Washita County location. The low yielding areas (yellow and red) shown in Figure 6 correspond to the access road or terraces such as that observed in the SE corner and the NW corner. These areas were avoided during sampling therefore yields presented in Figure 7 range only from 60 to 80 bushels per acre. Figure 7 shows only a weak positive relationship between whole profile clay content and soybean yield. Irrigation likely reduces the impact of soil water holding capacity has on soybean yields therefore yields are generally high and uniform outside the areas of disturbance previously mentioned.

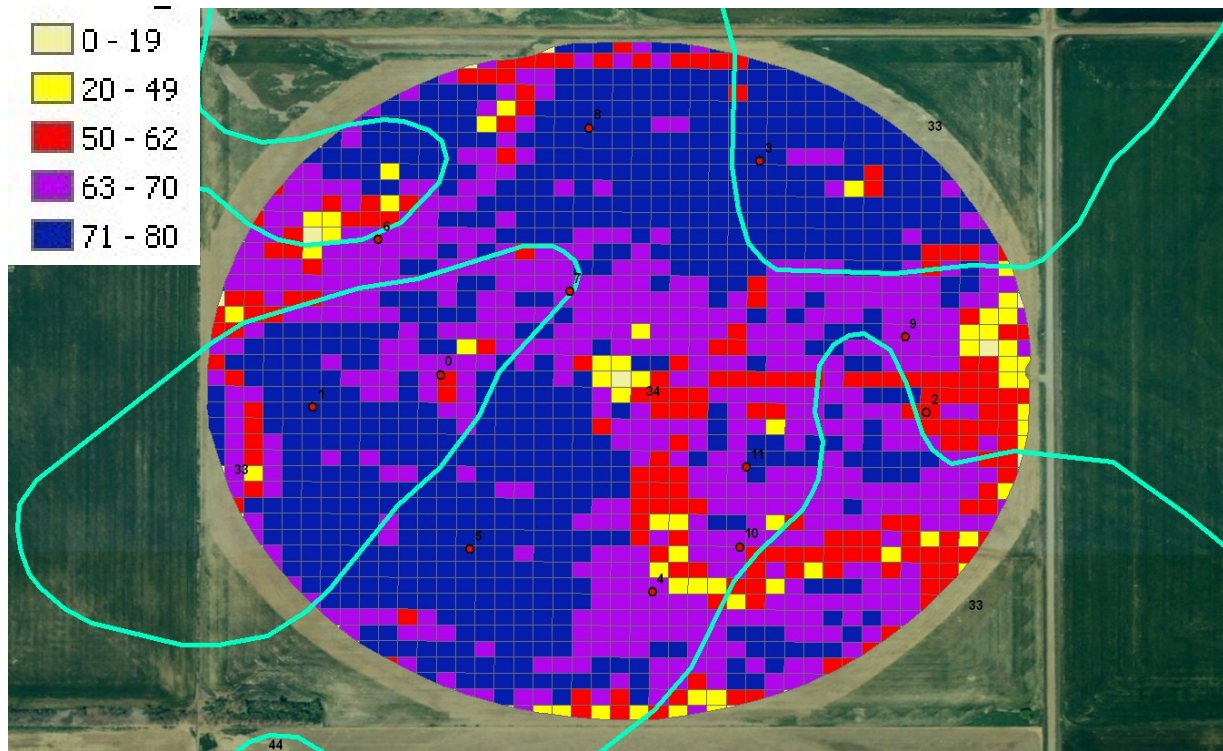


Figure 6: Soybean yields (yields shown in legend are in bushels per acre), NRCS soil mapping units and the location of soil core collection in SW Washita County.

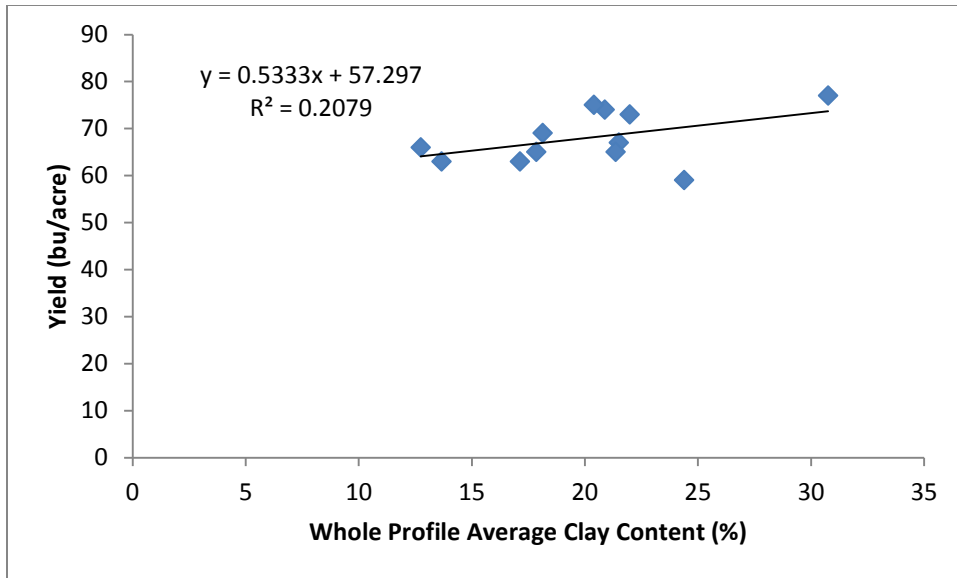


Figure 7: The relationship between soybean yield and the whole profile average clay content in the field in SW Washita County.

### Summary

In summary, depth to limiting layer appears to greatly affect dryland soybean yields in Oklahoma. Depth to limiting layer could be a useful tool in helping to delineate management zones. No single item should be used when creating management zones. Several of the following items should be considered: yield maps, soils map, fertility levels across the field, yield potential, depth to limiting layer across the field, etc.