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Short Communication

Using Variation in Soil Characteristics within Fields Provides a Minor Contribution to Prediction of Risk to Peanut *(Arachis hypogaea)* Yield in Reduced Tillage Systems

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Peanut (Arachis hypogaea L.) is generally grown on coarse-textured soils in the coastal plain of North Carolina and surrounding states in the United States. The majority of peanut is planted in conventional tillage systems. Digging peanut pods and inverting vines is the first of two steps involved in the harvesting process. Natural shedding of pods occurs with peanut and soil conditions present at the time of this operation can further exacerbate pod shed and subsequent yield and financial loss. Pod loss is greater on finer-textured soils than coarser-textured soils regardless of tillage system. Even though adoption of reduced tillage is positive for numerous reasons, this can be a difficult decision for peanut growers because of concerns of lower yields in reduced conservation tillage on finer-textured soils compared with yield on coarser-textured soils [1-3].

A risk index for transitioning from tillage to reduced tillage was developed in North Carolina to assist farmers in determining if the risk of yield being lower in reduced conventional tillage compared with yield in conventional tillage based on soil series and intensity of tillage (Table 1) [4]. The current risk index indicates that peanut yields are consistently higher on coarser-textured soils but response can vary depending on the intensity of tillage. For example, establishing raised beds after the previous crop is harvested and strip tilling into a desiccated cover crop or native vegetation on a finer-textured soil presents no more risk than no tilling into previous crop residue on a coarser-textured soil. However, a major challenge in using the risk tool and possibly affecting greater adoption of reduced tillage is that fields in the coastal plain of North Carolina are often mixed in terms of soil series and soil physical properties. In practice, it is implied that the risk tool assumes uniformity in soil characteristics across

Table 1: Risk to peanut yield for transitioning to conservation tillage from conventional tillage based on soil series and intensity of tillage. Adapted from [4].

[a]Pod loss on finer-textured soils, such as those on the Roanoke and Craven series, is often greater than on coarser-textured soils, such as Conetoe and Wanda series, regardless of tillage system. Difficulty in digging can increase when these soils become hard in the fall if rainfall is limited.

[b]Peanut response to reduced-tillage systems is invariably correlated with the degree of tillage. Efficient digging can be difficult when peanuts are planted in flat ground in reduced-tillage systems. Although fields may appear to be flat and uniformly level, often fields are more rugged than they appear, and setting up the digger to match unforeseen contours in the field can be difficult. Strip tillage into flat ground is a better alternative than no tillage into flat ground, although digging peanuts planted on flat ground can be more challenging regardless of the tillage system. Strip tillage into preformed beds often results in yields approaching those of conventional tillage.

[c]No till refers to planting into existing reside from the previous crop or a desiccated cover crop using an implement that does not disturb soil except for the narrow furrow where the seed is placed.

[d]Strip tillage refers to planting into an area disturbed with a tillage implement that covers the seeding area and approximately one-third of the row that the seed is planted into.

[e]The farmer determines the total number of points for each field based on soil series and tillage system. A higher score indicates that greater risk of yield being lower in reduced tillage is possible based on the soil series and the intensity of tillage selected.

Risk Factor	Points	Farmer Score
Soil series[a]		
Roanoke and Craven	40	___
Goldsboro and Lynchburg	20	___
Norfolk	10	___
Conetoe and Wanda	0	___
Tillage intensity[b]		
No tillage[c] into flat ground	35	___
Strip tillage[d] into flat ground	10	___
Strip tillage into stale seedbeds	0	___
Risk of yield being lower in reduced tillage than in conventional tillage[e]		
Low	35 or less	
Moderate	40 to 50	
High	55 or more	

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Table 2: Number of times a change in risk for each tillage system occurred when using percentages of soil series in each field rather than using only the dominant soil series in the risk tool.

Change in risk using Percentage of each Soil Series versus using the Dominant Soil Series only	Tillage System in Risk Tool			
	No till into flat ground	Strip till into flat ground	Strip till into stale seedbeds	No change in risk
Moderate to high	8	0	0	16
Low to moderate	0	0	0	24
High to moderate	0	3	0	21
Moderate to low	0	0	3	21
Low to high	0	0	0	24
High to low	0	0	0	24

fields in order to make the decision on transitioning to reduced tillage. This creates a challenge in terms of transitioning into reduced tillage, in part because some portion of a field's soil characteristics would place peanut at greater risk for lower yields if reduced tillage was implemented.

Methods

To gain a sense of the degree of risk due to variation in soil characteristics, soil maps for two research stations in North Carolina were examined to determine how much risk farmers would take if they adopted reduced tillage across the entire field based on the dominant soil series in the field rather than addressing variation in soil characteristics. Fields at these locations represent many of the soil series found in areas where peanut is produced and reflect the variation in soil characteristics that are often observed in farmer fields. Twelve fields at both research station were selected to determine how the risk to yield by adopting conservation tillage would change if the percentage of a specific soil series present in each field was used rather than the dominant soil series only. The percentages of soil series were adjusted for each level of tillage intensity in the risk tool based on soil series maps created for field units [5,6].

Results

In most instances, risk of peanut yield being lower in reduced tillage compared with conventional tillage did not change when using the major soil series in the field versus calculating risk due to variation in soil series (Table 2). However, in eight fields, the risk of yields being lower increased from moderate to high risk if peanut was planted no till into flat ground (Table 2). In contrast, risk of peanut yield being lower in reduced tillage decreased from high to moderate (3 fields) or moderate to low (3 fields) when peanut was strip tilled into flat ground or strip tilled into stale seedbeds, respectively. There were no instances where risk to yield either increased or decreased when considering low and high-risk category shifts.

This exercise using soil series variation in fields on research stations that are representative of variation often observed across the coastal plain of North Carolina indicate that the current risk tool does not capture risk completely when a single, dominant series is used as the predictor of risk. The shift was most often negative in the sense that growers might have lower yields than expected if they transitioned to reduced tillage because of inherent variation. However, this was only observed when peanut was planted no till into flat ground. The risk tool over-predicated yield loss in the transition to reduced tillage when strip tillage was involved. No till into flat ground is seldom recommended in North Carolina because of the perceived difficulty in digging pods and inverting vines at harvest [4]. These results indicate that adjusting the risk tool to capture variation in soil series would have a minor impact on the decision to transition to reduced tillage. However, growers interested in transitioning to no tillage in flat ground should consider variation in soil characteristics when making this decision.

The value of greater incorporation of soil characteristics in implementing production and pest management practices for peanut extends beyond tillage. Adjusting inputs such as fertilizer, lime for pH adjustment, and pest management inputs could benefit from greater precision which is often associated with soil characteristics. Warner et al. [7] reported that a precision peanut digger and vine inverter with depth adjustment could reduce pod loss. Soil moisture at the time of digging can impact pod loss during this operation, and adjustment based on soil moisture would likely be related in part to soil series and soil characteristics across fields. This approach would be of value in both reduced and conventional tillage systems.

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