Annual aboveground net primary productivity

**Objective:** Measure annual aboveground net primary productivity (ANPP) at the spatial scale of the fetch of the eddy-covariance towers located with business-as-usual (BAU) and aspirational (ASP) treatments at each LTAR. Here we focus on ground-based measurements of ANPP for the cropland LTAR sites. Cropland LTAR sites will usually harvest the entire fetch area, or at least a representative portion. A portion of ANPP will be removed as a crop (grain, lint, etc.) with the remainder left as residue. It is recommended that field-scale harvesting equipment be equipped with yield monitors and global positioning systems (GPS). Additional sampling will be required to quantify the residue component of ANPP, contribution of weed species if present, ANPP of cover crops where they are part of the production system, and edge-of-field buffer areas within the fetch area. Where relay cropping or double cropping is practiced multiple harvests will be needed. Where fallow is practiced ANPP will be annualized to reflect the fallow period. The primary objective is for each LTAR site to be able to report annual ANPP as dry biomass (kg ha-1).

We propose the ANPP measurements be separated as crop, residue, weeds, cover crop, and edge-of-field areas to capture productivity for the entire year.

**Protocol:** In cropland systems the crop is usually harvested during a single pass across the field. Harvesting with equipment that includes a yield monitor and GPS unit provide data that can be processed to produce a yield map (Sudduth and Drummond, 2007). The data provides information on spatial variability within the field and total production for the field. For crops having a harvest index (ratio of grain to residue) that is well documented and exhibits little variation reasonable estimates of residue can be calculated based on grain yield (Halvorson and Johnson, 2009; Varvel and Wilhelm, 2008). Additional sampling will be needed where weeds are present, a cover crop is part of the production system, where peak production is greater than at harvest and a harvest index is not well established, when edge-of-field areas are included in the fetch area, and when residue biomass samples are needed for nutrient analysis. Methods for this additional sample are provided below.

*Spatial Variation*

Agricultural fields exhibit spatial variability in productivity due to variation in soils, exposure, topography, etc. Strategies for sampling and managing spatially variable fields have been developed. These strategies involve using georeferenced data such as apparent electrical conductivity, digital elevation, crop yield and others to delineate like zones within the field (Johnson et al., 2003; Minasny and McBratney, 2003). Once management zones are delineated a stratified sampling strategy (number and location of sample sites) is used to estimate properties for the field.

*Temporal Variation*

Crops mature relatively uniformly and a single harvest should be adequate to measure ANPP. Where weeds contribute significantly to ANPP, sampling will have to account for life history (e.g. winter annual versus annual). Where cover crops are used multiple sampling dates will be needed to account for the contribution of the cover crop and the cash crop to ANPP. When edge-of-field buffer areas are included, multiple sampling dates may be needed to document plant species diversity in different seasons.

*Methods for Measuring Standing Plant Biomass*

Crop ANPP will be measured by sampling a reasonable area, length of row for row crops (corn, soybean, cotton, etc.) or quadrant for small grains (wheat, oats, etc.). Plants are clipped at crown level, dried, and separated into crop (grain, lint, etc.) and residue. Subsamples can be taken for nutrient analysis. Similar strategies can be used for weeds and cover crops when present and in edge-of-field areas.

**Literature Cited**

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