SAMPLING SOIL FOR FERTILITY AND NEMATODES

Sampling for Soil Fertility

Ensuring that soil nutrients are available to a growing crop is an important initial step for producing a profitable crop. Replenishing soil nutrients and ensuring optimum pH according to soil test results and recommendations will allow realization of the full yield potential of a healthy soybean crop.

Today's high yielding soybeans in the Midsouth are removing large amounts of nutrients from the soil. Data in the below Table 1 show the estimated amounts of nutrients that are removed from the soil by a soybean crop that yields 30 bu/acre (low yield environment) and 70 bu/acre (high yield environment). These values can be used to supplement soil test results to ensure that fertilizer additions at least replace the estimated amounts of nutrients that are removed with each crop harvest. Notice that a considerable amount of K and several of the micronutrients that are taken up by the crop remain in the field since a large percentage is contained in the stover which is returned to the field during harvest. As expected, P and K exhibit the largest removal from soil.

Table 1. Estimated nutrient removal in pounds/acre by monocropped soybeans with indicated seed yields.

	30 bu/acre yield		70 bu/acre yield	
Nutrient	**Grain**	**Stover**	**Grain**	**Stover**
P_2O_5 (P)	22 (9.5)	7 (3)	52 (22)	17 (7)
K_2O (K)	35.5 (29)	30 (25)	82.5 (68)	70 (58)
S	5.4	5.1	12.6	11.9
Mg	4.5	11	10.5	25.2
Ca	4.5	24	10.5	56.0
Cu	0.03	0.02	0.07	0.04
Mn	0.04	0.26	0.08	0.62
Zn	0.03	0.16	0.07	0.36
B	0.04	0.17	0.08	0.41
Fe	0.30	0.60	0.70	1.40

Sources: AgPhD, New Grain Phosphorus and Potassium Numbers, Univ. of Illinois, and Soybean Nutrition Requirements, Iowa State Univ. Extension. P_2O_5 removal rate in seed or grain based on 0.73-0.75 lb. per bushel of soybean seed yield, and K_2O removal rate in seed or grain based on 1.17-1.19 lb. per bushel of soybean seed yield. These values are lower than the 0.80 and 1.40 factors commonly used for P_2O_5 and K_2O removal rate per bushel of soybean yield, respectively.

Soil sampling and testing are the most important steps for successful determination of the amount of soil nutrients that have been depleted by a crop, and subsequently, what amount should be added to attain the desired level for anticipated yield of the following crop. Results from proper conduct of these two steps will serve as the most reliable indicator of how much of a particular nutrient is available to the crop. Use data below as a guide for determining the level of nutrient removal and replacement related to yield of corn and soybeans grown in a 1:1 biennial rotation (Table 2), and expected yield of soybeans at indicated soil test levels (Table 3).

Table 2. Estimated nutrient removal from a field cropped to a 1:1 corn:soybean rotation over a two-year period.

Corn:Soybean	Nutrient Removal			Fertilizer Replacement		
Yield	P_2O_5	K_2O	S	TSP*	MOP**	Value
bu/acre	*--lbs. across the 1:1 rotation--*			*----lbs. product----*		*$*
150:40	85-95	85-95	19	178	143	85.36
180:50	100-120	105-115	23	217	175	104.34
210:60	120-140	125-135	28	254	208	123.32
225:70	130-160	140-150	31	283	233	137.58
250:80	145-175	160-170	34	317	265	154.98

*Triple-super phosphate. **Muriate of potash.

Table 3. Expected yield of soybeans at various soil test levels of phosphorus and potassium expressed as a percentage of maximum yield.

	Expected yield without fertilizer		Fertilizer needed for maximum yield	
Soil test level	Phosphate	Potash	Phosphate (P_2O_5)	Potash (K_2O)
	----------% of maximum----------		*----------lbs./acre----------*	
Very low	35-80	50-80	120	120
Low	75-95	75-95	60	90
Medium	85-100	85-100	30	60
High	100	100	0	0
Very high	100	100	0	0

From Nutrient Management Guidelines for Agronomic Crops Grown in Mississippi, MSU Extension Service Publication 2647

An Aug. 10, 2017 article in Missouri Ruralist titled "Why fall is the best time for soil sampling" by Mindy Ward (quoting Missouri Agronomy Specialist Travis Harper) provides five reasons that fall vs. spring soil sampling may be best to manage for a following spring-planted crop. They are:

- Fall vs. spring weather conditions are usually more favorable for collecting the required number of soil samples from a given area or field.
- Applying lime in the fall according to soil test results will allow time for pH correction before spring planting.
- Fertilizer that is required according to soil test results can be purchased in the fall when prices may be lower.
- Turnaround time for results from a soil testing lab likely will be quicker for samples submitted in the fall.
- The availability of some fertilizer elements, e.g. phosphorus and potassium, for next year's crop will be enhanced with fall applications.

A soil testing program for nutrients consists of several steps.

- Use the correct soil sampling technique, which includes sampling when soil moisture conditions are suitable for tillage, using a soil map to delineate the areas with different textures so that zones with different textures (and thus different CECs) can be sampled and aggregated separately from each other, sampling from the top 6-8 inches of soil (or follow guidelines of the chosen testing lab), sampling between rows of the previous crop, and proper compositing of samples. Proper sampling protocol for soil fertility is provided by MSU Extension.
- Only composite samples from each distinct area (e.g. upland vs. lowland, sandy loam vs. silt loam vs. clay, light-colored vs. dark-colored, low- vs.

high-fertility as indicated by growth of the previous crop) in a field.
- The collected sample must represent only the area that is being tested.
- A representative sample from a distinct area should be composited from 15 to 20 soil cores.
- Soil cores that are to be composited should be gathered at random within each distinct area.
- Dry collected samples at room temperature, and thoroughly mix the soil in each composited sample.
- Collect one pint from each composited sample and place in a container that is available from or provided by the chosen testing laboratory.
- Each field or area should be sampled in the same month each year, preferably in the fall (see above summary from Missouri Ruralist article).
- Keep accurate records that include a sample identifier such as a number, and the location from which each labeled sample was collected each year.
- Sample each field at least every 3 years. More frequent sampling may be necessary in fields that do not have a history of soil test information (especially where high seed yields have been harvested), in fields that grow multiple crops or crops in rotation, and to determine and monitor trends in fertility levels.
- Identify CEC zones within a field so that divergent CEC zones can be sampled and aggregated separately from each other for nutrient testing (See CEC and soil sampling article).

Click here for instructions for submitting soil samples to the Mississippi State University Extension Soil Testing Laboratory. A soil test report should include pH, lime requirement, and cation exchange capacity (CEC–an indicator of soil texture), plus extractable levels of phosphorus, potassium, calcium, magnesium, sodium, and zinc. Organic matter and estimated reserve sulfur should also be reported.

Sampling for Nematodes

Soybean producers in the Midsouth must contend with nematode pests, several species of which may inhabit a single field. Significant yield losses caused by soybean cyst nematode (SCN), southern root-knot nematode (RKN), and reniform nematode (RN) can occur in Mississippi soybeans.

The change in cropping systems in Mississippi in recent years has led to increased concerns about nematode infestations of soybeans. The effect of these changes are:
- Increased acreage of corn that may be rotated with soybeans has led to heightened concern about soybeans being infested with RKN.
- Growing soybeans on sites once devoted to cotton has led to heightened concern about soybeans being infested with RN.

Because of these cropping system changes, the need to sample for nematodes has become even more important because of the added risk of infestations from RKN and RN, as well as SCN. Consider the below points.
- Properly collected and evaluated soil samples are the best tool for detecting the presence and species of nematodes in the soil. Proper sampling protocol for nematodes is provided by MSU Extension.
- To assess potential damage from nematodes in soybean fields, growers must determine which nematode or nematodes are present to make appropriate nematode management decisions.
- Accurate identification of the nematode species and population levels present in a field requires that soil samples be collected and sent to a diagnostic lab for evaluation.
- Properly analyzed samples will indicate where control practices are not needed, and conversely will indicate where control practices are needed to protect yield potential.
- Predictive sampling (sampling to determine if nematode problems are likely to affect a future crop) should be done when population densities are high to decrease the risk of not detecting the presence of a damaging species. Thus, the best time to sample is generally near or just after harvest. Sampling in the fall will allow enough time for analysis so that results can be used as a guide for variety selection or choosing an alternative crop for the next growing season.

Mississippi soybean producers may submit soil samples for nematode analysis to the Mississippi State University Extension Plant Pathology Lab. Instructions for sample submission and associated costs are contained on the laboratory site.

- If test results indicate that the above nematode species are not present in a field, care should be taken to prevent their introduction since nematodes can be moved from field to field by soil that is transported on field equipment.
- If test results indicate the presence of nematodes, the management goal is to use management practices that will keep the nematode population as low as possible since they are very difficult to eliminate (See Managing Nematode Pests in Midsouth Soybeans White Paper on this website).
- Soil texture affects movement of SCN in the soil and also may affect its reproduction and development. Basically, major damage to soybean by SCN infestation occurs when the crop is grown on medium- and coarse-textured soils. Apparently, damaging populations of SCN are not sustainable in soils series classified as clay.
- RKN tends to be associated with sandy soils on sites that have previously been devoted to cotton production in the Midsouth, where the combination of root damage and the reduced water-holding capacity of the soil can result in wilting of infected plants during the heat of the day.
- Determination of the density and race or type of SCN present in individual fields is required to prevent losses and determine management and control practices to apply. Determination of the race or type is especially important because the different SCN resistance sources convey differing levels of resistance against the varied races or types.
- Sampling for nematodes should be considered as important as sampling for soil fertility. This is especially true if there is no history of nematode sampling on either old or new soybean production sites. Once documentation of the absence or presence of nematodes is established for given fields, then management options outlined below can be adopted.

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