

## Natural Resources Conservation Service **Guidelines for Determining Herbaceous Stand Adequacy & Diversity** *Illinois Agronomy Technical Note No. 2*

After a grass/legume seeding, the question occasionally arises whether the stand is adequate for the intended purposes. This may include a determination of stand adequacy (density) and/or stand diversity. The purpose of Agronomy Technical Note IL-2 is to provide methodology that will be helpful in determining stand adequacy and plant diversity.

### **Assessing Stand Adequacy**

For a newly established stand to be deemed adequate, it must protect the soil resource, and achieve the planned purpose(s).

Protection of the soil resource is determined by the percentage of the soil surface that is protected by the vegetative cover.

Rapid establishment of dense stands is more important for plantings that will be used for forage production and stabilizing critical areas than for seedings used on non-erosive idle land for wildlife purposes.

Successful establishment is dependent on: weather (temperature and moisture), seedbed conditions, planting depth, seed soil contact, seeding rate, seed quality (germination and % purity), insects and diseases.

After emergence, grasses and legumes progress to a climax density. Monocultures of grasses or legumes often reach a climax density when mature. Management of monoculture seedings can influence the ultimate climax density. For example, stands of most grasses that are mowed 3 to 5 times a year will generally have a higher plant and stem density than a stand that is never mowed or mowed only once a year. Pure legume stands mowed 2 or 3 times per year are likely to have higher plant densities than when mowed less or more frequently than 2 or 3 times.

Mixtures of introduced grasses and legumes typically reach their climax densities within

two years and mixtures of native grasses and forbs within three years. Management and environmental conditions ultimately dictate stand density. Assuming an adequate job of seeding and optimal growing conditions, a much higher density of plants would be expected four to six months after seeding than one year after seeding. Likewise, expect fewer plants two years after seeding than one year.



Stands that are obviously adequate or inadequate by visual observation generally do not need a formal stand evaluation. Where visual observations cannot be conclusive and/or the stand determination is likely to be disputed, methods of determining stand emergence and/or establishment are needed to help make a decision whether a stand is adequate or needs to be reseeded and for documentation and reference purposes. Determining stand density can be done in an accurate manner and in a short period of time by using one of three methods described below.

Skill in correct plant identification at the various growth stages is necessary for this determination. Knowledge of the vegetative characteristics of species to be sampled is also essential. If the field is sampled soon after emergence, a plant can often be uprooted with the seed attached to aid in identification.

The time the sampling is done should be based on the purpose of the seeding. Initial verification of introduced cool season grasses and legume seedings can be evaluated as soon as 4-6 weeks after emergence. An evaluation after one full growing season or one year after seeding should give a good indication of what the final stand will be. Meaningful evaluations of diverse native species stands are often not possible until a year or two after the initial seeding.

If the stand is spotty and includes skip areas, then more samples than the minimum may be required. If a portion of the field has had a different cropping history, fertilization program or major differences in soil types or slopes, the sampling should be stratified and the average plant densities kept separate for the different areas. Tabular entries should be made after each frame count to ensure accuracy. Initial stand counts should be made before excessive plant growth makes frame alignment and the counting procedure more difficult.

**Table 1** provides some guidelines to help determine if a stand is adequate or inadequate based on species planted and the planned use. Using a frame size of one square foot, the number of seedlings counted per frame or the average of the samples taken on an area and compared to the values in Table 1 will indicate if a stand is adequate, or inadequate according to the numbers. If the count falls between adequate and inadequate then the stand is questionable. Questionable stands will need to be re-evaluated at a later time.

Weeds may also be inventoried during the sampling process; however, they should not be used to determine the adequacy of the stand.

If the stand is a mixture of species, all values in Table 1 should be reduced by the percentage of the ratio of each species planned in the mixture. For example, if the planned seeding is to result in a mixture of 50% orchardgrass and 50% alfalfa then the values in table 1 would be reduced by 50% for both components of the mixture. A sample form is included for your information and use. The information obtained from sampling plant density can be used as a reference point for making management decisions or evaluating seedings for program purposes. In some cases it may be determined that spot seeding is necessary because of a non-uniform stand. The sketch diagram indicating how the field is sampled should help define the areas needing reseeding. As the field is being sampled, the observer has the opportunity to spot weed infestations which may need to be controlled before they cause seedling mortality. The stand evaluation worksheet should be used as a management tool as well as a means of documenting stand establishment.

### Frame Method

A one square foot frame is easily constructed with a variety of materials and shapes. A circular frame will present the least edge to area ratio. Error due to sampling increases as the ratio of edge to area increases, and the smaller the sampling unit, the greater the edge error. A circular one square foot frame will have a circumference of approximately 42.5 inches. One can be constructed from 3/16 inch plastic covered cable. The ends can be joined with a short section (1 inch) of .25 outside diameter cooper tubing.

The number of samples required depends on factors such as stand uniformity and the number of species to be counted. Generally a minimum of 10 counts or samples per 10 acres or less of field size would result in a representative sample. An effort must be made to avoid end rows or turn around areas that may have been double seeded. The observer must not be biased by dense or sparse stands, but needs to sample equally in a systematic manner.

To begin a sampling transect, select a landmark on the horizon and walk towards it in a straight line. The sampling pattern should be such that a representative plant density is obtained. A pre-determined number of steps should be taken on a line that is diagonal or perpendicular to the drill rows or the direction the seeding was done. When the number or pre-determined steps have been taken, drop the frame at the toe of your shoe on the final step. Only those plants that are rooted within the frame will be counted and used in determining the stand density. Normally, only the crowns are counted as counting each tiller will overestimate the actual number of plants per square foot.

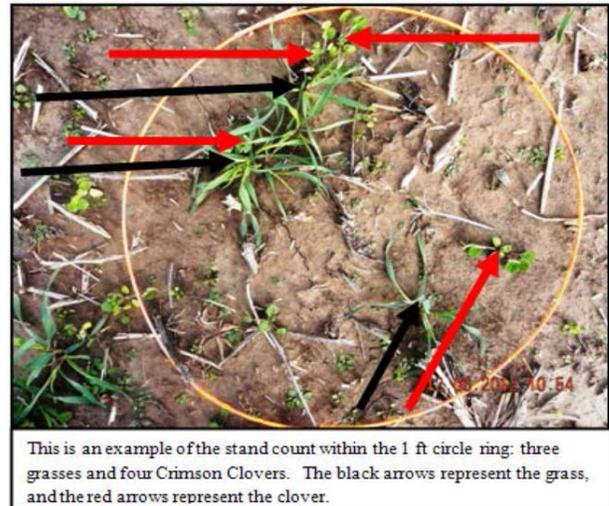
## Assessing Plant Diversity

Plant diversity is required for many different natural resource objectives. The desired plant diversity can only be obtained with a combination of proper seed mixture design and subsequent stand management. Absent any disturbance, natural succession usually leads to stands that are less diverse and thus less able to provide the desired plant community required by targeted wildlife and insect species. In many cases the acceptability of a plant stand is determined by a minimum number of plants per square foot. Additional criteria such as number of species of various types also need to be evaluated. Two additional methods for plant sampling are described below. With these two methods, planners can determine the species present and their frequency of occurrence. The information is

then used to gauge the adequacy of the stand for desired diversity objectives as well as determine conformance with specific conservation program requirements.

## Line Transect Method

A stand may be evaluated using the line transect method similar to the line transect



method used in measuring crop residue in row crops. A 50-100 foot cable, tape measure or cord that has 100 equally spaced beads, marks, or knots will be required. As with all sampling methods avoid areas that visually appear atypical. Stretch the line across the field as close to the ground as possible. The line may have to be manipulated to get past the canopy while not allowing the vegetation to shift the alignment of the line. The person doing the counts will need to stand in such a way that the eye is directly over the marks on the line. Sight on one **point** of the bead, mark, or knot. A point is considered the size of a pinpoint. Walk the entire line counting and recording the number of plants by plant species on the evaluation form. Record **basal** hits. Basal hits are live plants and should only be counted if the **crow**n is at or below a 1-inch height above the ground and intercepted by a point on the line. A minimum of 300 points (3 transects) per field should be taken. The tabulation of the percent occurrence of each species would be tallied the same as when measuring crop

residue. The total number of marks should then be divided into the number of desired species to determine percent of stand.



While completing the transect, count this as one plant (it contains multiple stems).

### Step Point Method

The step point method is similar to the line transect method. To estimate the percent occurrence of each species or species type, mark a point on the toe of each shoe at which to site. Select an area that is representative of the field and walk a straight line across the area by sighting at an object in the horizon. The line should be selected randomly and should be typical for the field or the portion of the field being evaluated. Walk along the line and stop at every third pace and site down at the point on the shoe. A point is considered the size

of a pinpoint. Record basal hits as described for the line transect method. Walk 300 paces recording the type and number of plants by species on the stand evaluation form. Counting weedy species is optional.

If it is obvious both visually and after 150 paces that the stand diversity is not adequate (i.e. the stand is all one species), take a photo of the field and enter a comment on the worksheet that the stand diversity is obviously not adequate. If the stand diversity on a field is somewhat questionable after one transect (300 paces), then complete one or two additional transects.

In general, the following guidelines will be used to determine acceptable diversity in plant stands.

	Frequency of Occurrence (%)
Legumes <sup>1</sup>	15% or more
For an individual plant species to be counted as adequate	10% or more
Total desirable species	60% or more

<sup>1</sup>Criteria would be used if presence of legumes is specified.



**TABLE 1 - PLANTS NEEDED PER SQUARE FOOT AT THE END OF SECOND  
GROWING SEASON FOR HERBACEOUS STAND EVALUATION 1/**

SPECIES	Forage Production		Critical Areas		Idle Land	
	Adequate	Inadequate	Adequate	Inadequate	Adequate	Inadequate
Big Bluestem	>2.0	<0.5	>3.0	<1.0	>1.0	<0.25
Indiangrass	>2.0	<0.5	>3.0	<1.0	>1.0	<0.25
Switchgrass	>2.0	<0.5	>3.0	<1.0	>1.0	<0.25
Little bluestem	>3.0	<0.75	>3.0	<1.0	>1.0	<0.25
Kentucky bluegrass	>5.0	<2.5	>8.0	<4.0	>4.0	<2.5
Orchardgrass	>5.0	<2.5	>8.0	<2.5	>4.0	<2.0
Redtop	>5.0	<2.5	>8.0	<4.0	>4.0	<1.5
Smooth brome	>4.0	<2.0	>8.0	<4.0	>4.0	<1.0
Tall Fescue	>5.0	<2.5	>8.0	<4.0	>4.0	<2.0
Timothy	>6.0	<3.0	> 8.0	<4.0	>4.0	<2.0
Alfalfa	>6.0	<3.0	>10.0	<5.0	>4.0	<2.0
Alsike clover	>6.0	<3.0	>10.0	<5.0	>4.0	<2.0
Birdsfoot trefoil	>6.0	<3.0	>10.0	<5.0	>4.0	<2.0
Crownvetch	>4.0	<2.0	>4.0	<2.0	>2.0	<1.0
Ladino clover	>6.0	<2.0	>8.0	<2.0	>4.0	<1.0
Red clover	>6.0	<3.0	>10.0	<5.0	>4.0	<2.0
Sweet clover	>6.0	<3.0	>10.0	<5.0	>4.0	<2.0
Korean Lespedeza	>6.0	<3.0	>10.0	<5.0	>4.0	<2.0

- > = greater than
- < = less than

1/ For stands less than one year old, multiply values by 2. For stands with one but less than two full growing seasons multiply values by 1.5.

**Example:** A pasture seeding was completed. A mixture of tall fescue was seeded at 8 lbs. PLS. /acre and birdsfoot trefoil at 5 lbs. PLS. /acre. A total of 13 PLS lbs. /acre of seed was used. Roughly 62% of the total seed was tall fescue and 38% of the total seed was birdsfoot trefoil. The seeding was evaluated 6 months after establishment using a one foot square frame. Based on Table 1,  $0.62 \times 10 = 6.2$  plants per square foot of tall fescue would be needed and  $0.38 \times 12 = 4.5$  plants per square foot of birdsfoot trefoil would be needed. The stand is adequate.

**EXAMPLE STAND ADEQUACY EVALUATION**

Conservationist: \_\_\_\_\_ Landowner: \_\_\_\_\_  
 Date: 10/15/2015 Program: EQIP  
 Tract/Field: T2500, Field 2 Practice Name: Forage and Biomass Planting Code 512

Plant Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total	Avg.
Tall Fescue	10	5	15	20	8	10	4	6	8	12																98	10
Birdsfoot trefoil	2	5	7	2	15	10	3	3	4	7																58	6
TOTAL PER COUNT*																											

Stand is \_\_\_X\_\_\_ Adequate \_\_\_\_\_ Questionable \_\_\_\_\_ Inadequate

### Stand Diversity Summary Line Transect or Step Point Method

Conservationist: \_\_\_\_\_ Landowner: \_\_\_\_\_  
 Date: \_\_\_\_\_ Program: \_\_\_\_\_  
 Tract/Field: \_\_\_\_\_ Practice Name: \_\_\_\_\_ Code: \_\_\_\_\_  
 Desired Species Diversity: \_\_\_\_\_

Species	% Occurrence Transect 1	% Occurrence Transect 2	% Occurrence Transect 3	Total % Occurrence	Average % Occurrence

**Instructions:** The stand diversity evaluation worksheet was developed to record observations for 100 points when using the line transect or step point method. At each point of the line or step, record the observed species and place a check mark in the box. Compute the total number of observations of each species and enter it into the summary table. Total desired species must equal at least 60%. Legume species must equal at least 15% and each desired individual grass species must equal at least 10% for the stand diversity to be adequate.

Stand is \_\_\_\_\_ Adequate \_\_\_\_\_ Questionable \_\_\_\_\_ Inadequate \_\_\_\_\_

Weed Competition \_\_\_\_\_  
 \_\_\_\_\_

Comments \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Recommendations to Cooperator \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



**Example:** A pasture originally seeded to Orchardgrass and Alfalfa has been grazed for several years and occasionally hayed. The pasture has been thinning due to grazing practices and dry weather with some weeds encroaching. In the spring, Red Clover was frost seeded and hayed in early summer. A transect was performed to evaluate the species composition and the success of the Red Clover establishment. Only the species of interest were tallied. Some points along the transect were void of pasture species and were observed to be bare ground or weeds.

STAND DIVERSITY EVALUATION WORKSHEET																											
	Sample Point																								Subtotal		
Plant Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
Red clover	*					*				*		*								*							5
Orchardgrass		*		*			*									*	*	*			*		*	*	*	10	
Tall Fescue								*	*				*	*	*							*				6	
Alfalfa					*														*							2	
	Sample Point																								Subtotal		
Plant Species	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50		
Red clover	*	*									*				*		*				*	*				7	
Orchardgrass				*	*							*	*	*		*		*						*	*	9	
Tall Fescue						*	*	*																		3	
Alfalfa										*									*	*			*			4	
	Sample Point																								Subtotal		
Plant Species	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75		
Red clover						*				*				*		*									*	5	
Orchardgrass	*	*			*		*	*		*					*							*	*	*		10	
Tall Fescue			*						*								*	*	*	*	*					7	
Alfalfa				*								*														2	
	Sample Point																								Subtotal		
Plant Species	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100		
Red clover	*										*		*			*	*				*					6	
Orchardgrass		*	*					*	*													*	*	*	*	8	
Tall Fescue										*				*	*											3	
Alfalfa				*		*	*												*							4	

**Example Stand Diversity Summary**

Species	Total % Occurrence
Red clover	23
Orchardgrass	34
Tall Fescue	19
Alfalfa	12

Summary: Only one step point transect was taken. Legumes are over 15% and each individual grass species is over 10%. The pasture consists of 35% legumes, 53% pasture grass species and 88% desirable species. The stand diversity is adequate.