TECHNICAL NOTE

USDA - Natural Resources Conservation Service
Boise, Idaho – Salt Lake City, Utah – Spokane, Washington

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REVISION

GUIDELINES FOR DETERMINING STAND ESTABLISHMENT ON PASTURE, RANGE AND CONSERVATION SEEDINGS

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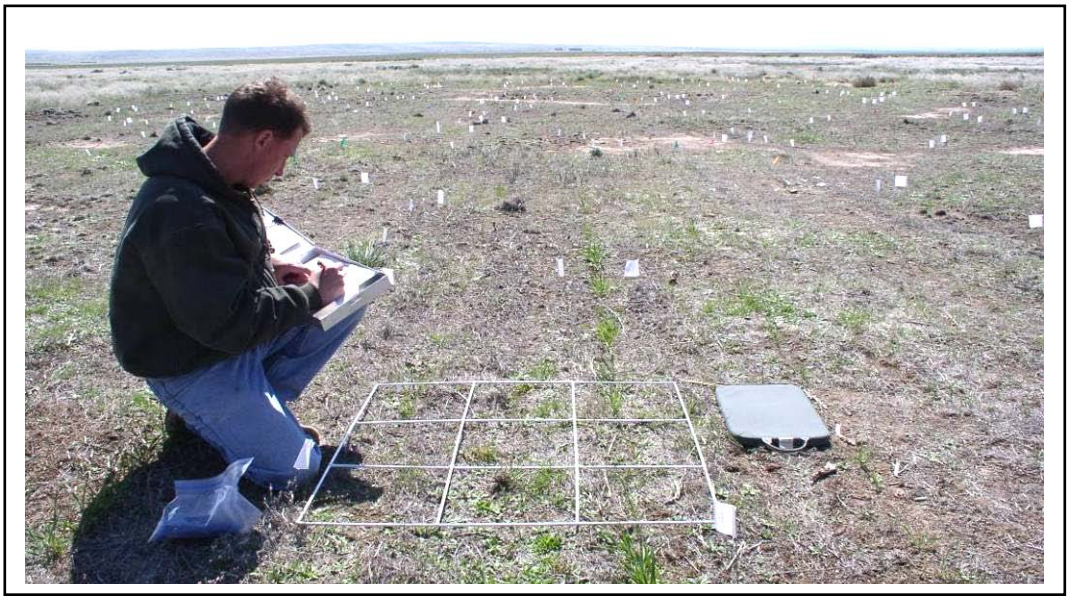
Judging the success of a new seeding is difficult, especially during the first season because the plants are small and difficult to identify. Inspect seedings periodically during the establishment period, since failures in stand establishment may still occur after initial seedling emergence.



Seeding Evaluation ***Photo by: Loren St. John***

The primary reasons for seeding failures are the lack of attention to planting practices including:

1. Elimination of competition – existing vegetation will out-compete seedlings trying to establish. Competition must be controlled to improve chance of establishing seeding.

2. Seedbed preparation – the cultural treatments needed to produce a suitable medium for seed germination, establishment and growth. A firm weed free seedbed is essential.

3. Seeding operation – placing the seed at the proper depth (seeding too deep is very common) with good seed-soil contact at the proper time to ensure timely germination and establishment.

4. Protection of planting from grazing and/or traffic following seeding is critical to allow adequate time for seedlings to establish. A good rule of thumb is when plants are producing seedheads, they are well established.

Other common causes for seeding failure include inadequate moisture and/or unfavorable soil conditions. Seed may germinate but fail to emerge due to a soil crust. After emergence, seedlings may die because of adverse climatic conditions or damage from pests. In some cases failure may occur during the second year under unusually dry weather conditions.

Seeding failure represents an expensive risk. When a failure occurs and is recognized early, reseeding is possible, salvaging a part of the seedbed preparation expense. Perhaps only a portion of a seeding will have to be replanted; and careful evaluation of seeding success will identify the areas that need to be reseeded.

Plantings should be inspected as soon as possible after plant emergence. If an obvious failure is recognized early there may be time to allow reseeding to capitalize on stored soil moisture. In the Intermountain West, reseeding should occur before May at lower elevations (valley bottoms) to no later than late May at higher mountain elevations. Refer to the Conservation Practice Standards and Specifications in the Field Office Technical Guide for timing of seeding practices. If adequate germination and emergence has occurred, the summer survival should be evaluated that fall. If failure is noted at that time, reseeding without complete seedbed preparation may still be possible as long as the site has few weeds.

Care must be used especially in evaluating dryland and rangeland seedings since first year results may be misleading unless closely examined. Often good seedling establishment is masked by heavy weed growth. Many such stands have been plowed up and reseeded, when another year of deferment and observation could have allowed the seeded perennials to become fully established and eliminate the weeds through competition. You may have to move the heavy weed cover or get down on your knees to identify seedlings that were included in the seed mixture.

The criteria for successful plantings should be based upon some quantitative measure of stand establishment. This might be seedlings per foot of seeded row or plants per unit area. The absolute values related to various success ratings will vary with site, year, species, and measurement method. Thus, a stand density which would be considered poor on a well drained, moist upland site might be excellent on a drier semi-desert site. For these reasons the criteria to be applied to any particular seeding should be based on local experience, observation and production potential of the site.

In addition to quantitative data on stand establishment, the examiner should note the kinds and amounts of weeds and desirable non-seeded perennials that have established. In some cases weed control may be necessary to allow seedling establishment.

A careful evaluation must be made before deciding to re-apply the practice or destroy a potential stand. The following factors should be considered when establishing guidelines for non-irrigated sites.

Plant Density

When examining seedings there are several things that should be observed. These include number of seedlings, uniformity of distribution of seedlings over the site and presence of undesirable weed species. The density of plants comprising a successful seeding will vary considerably from place to place, but if seedling plants are somewhat uniformly distributed with a minimum amount of undesirable species, the seeding probably is establishing successfully.

Some native species may be particularly slow to establish, so that full stands may not be present the first few years especially if a species is known to have dormant or hard seed. It is essential to watch and manage native seedings for two or more years before deciding whether they are successful. Similarly, most rapid-growing introduced species should establish a rather solid stand during the first year to year and a half after seeding. When evaluating the success of mixtures it is important to note the relative abundance of each species seeded. It is not uncommon for species such as fourwing saltbush, sagebrush and other shrubs to not even be observed in a 1 to 2 year old planting, but 4 years later a good plant population of the species exists in the stand.

Plant densities that produce successful stands vary from site to site. The objective of each seeding should be to achieve densities that normally are expected for key species in the ecological site description. A survey of the literature shows that a seeding will stabilize at a density typical for the native plant community of that site, with some qualifications.

1. A monoculture seeding of species such as crested wheatgrass, may establish at densities below potential, eventually producing large "wolf" plants with bare spaces between.

2. Diverse mixtures of grasses, forbs, legumes, and shrubs with varying rooting depths and plant phenologies will generally result in maximum densities because soil moisture use during the growing season is optimized.

Rule-of-thumb: *The target plant density for a seeding should be the total density of mature plants for the key species listed in the ecological site description.*

The following table of plant density data from seedings in the Intermountain West indicates that for most sites suitable for reseeding, plant densities will vary based on climate and soil quality.

PLANT DENSITY GUIDE

Mean Annual Precipitation	Ecological Site	Target Density plants/sq. feet
22"+	Loamy	3.0 - 4.0+
	Shallow, Gravelly, Stony, Eroded, etc.	2.0 - 3.5
16"-22"	Loamy	2.0 - 3.0
	Shallow, Gravelly, Stony, Eroded, etc.	1.0 - 2.5
12"-16"	Loamy	1.0 - 2.0
	Shallow, Gravelly, Stony, Eroded, etc.	0.8 - 1.5
10"-12"	Loamy	0.7 - 1.5
	Shallow, Gravelly, Stony, Eroded, etc.	0.5 - 1.0
<10"	Loamy	0.5 - 1.0
	Shallow, Gravelly, Saline, Calcareous, etc.	0.3 - 0.7

Hull and Holmgren (1964), found plant densities of well-established seedings to be relatively insensitive to seeding rates. Seeding rates exceeding 25 seeds/ft^2, generally produced the same plant densities as the seeding rate of 20- 25 seeds/ft^2 in the second or third growing season following planting. High seeding rates might be warranted on sites with very adverse conditions such as intense weed competition, soil crusting, and/or when seed quality is poor. Higher seeding rates may also be warranted with species with very small seed size and especially when seed is broadcast planted and a fairly high percentage of seed applied to the sight is not expected to find favorable sites for plant establishment.

In summary, target plant densities for most ecological sites in the Intermountain West are between approximately 0.5- 3.0 plants/ft^2. However, target densities are site specific. Adjust upward for higher precipitation, downward for lower precipitation and problem soils. Observation of similar ecological sites and reseeded areas will help establish target densities. Stand densities measured after the first growing season (or any subsequent season), should equal or exceed the target density for the site.

Photo by: Mark Stannard

Plant Vigor

Seedlings reaching the three-leaf stage (or beyond), and generally in healthy condition, have greater than a 90 percent chance of becoming established on most ecological sites suitable for seeding (Johnson 1986, White and Currie 1980).

Rule-of-thumb: *Stand counts should apply to seedlings with 3 or more true leaves, and in overall healthy condition. There should be none to slight evidence of insects, disease, or physical damage to the plants.*

Time of Evaluation

Stand counts at the end of the first growing season usually correlate strongly with seeding rates, and can often exceed the target density for the site. If the three-leaf stage and target density rules are being used, a planting can be evaluated at any time following seeding and is judged inadequate until there are a sufficient number of three-leaved seedlings to equal the target density. A reasonable time to check is at the end of the first growing season. If the mixture contains species with hard (or dormant) seed, and if stands are inadequate following the first growing season, evaluation can continue into the second growing season. Some native species may be particularly slow to establish, so that full stands may not be present the first few years. It is essential to watch and manage native seedings for two or more years before deciding whether they are successful. Only under exceptional circumstances (such as extended drought) should close evaluation need to continue past the second (introduced species) or third (native species) growing season.

> **Rule-of-thumb:** *A seeding may be evaluated any time before or at the end of the second growing season (third growing season for native species).*

Replanting Versus Natural Recruitment

Plant succession on abandoned cropland was documented in southern Idaho (Piemeisel 1938, 1951), and northeastern Colorado (Costello 1944). These classic fundamental studies can be used as a basis for making sound judgments as to whether to reseed a field with an inadequate stand.

In the Intermountain West, generally Russian thistle, *Salsola kali*; cheatgrass, *Bromus tectorum*; tumble mustard, *Sisymbrium altissimum*; and sometimes other species such as goatsbeard or salsify, *Tragopogon dubius* play an important role in succession on abandoned cropland fields. The year following abandonment, the greatest source of seed is provided by Russian thistle as the previous year's plants tumbled across the field depositing seed. These seeds germinate and grow into large individual plants, which often completely cover the field and produce enormous seed crops.

The second year is also dominated by Russian thistle, but plants are usually single-stemmed, stunted, and produce very little seed. The seed bank is replenished by mustard and cheatgrass invading from adjacent areas. The third year may be dominated by mustards (*Descurania* and *Sisymbrium* spp.), and sporadic, large patches of cheatgrass. However; for the next 15 to 20 years and often more, solid stands of cheatgrass dominate the field. In cheatgrass zones of the Columbia Basin, Great Basin and Snake River Plain, a sub-climax of cheatgrass may persist indefinitely. In other areas, perennial grasses may slowly increase in importance 15 to 30 years after the field is abandoned.

If a grass seeding is rated a failure after two growing seasons, a decision to reseed depends on the objectives of the land owner or land manager and the conservation program involved. If weedy plant cover is adequate based on knowledge of successional patterns, reseeding may not be required to control erosion. However, with conservation programs, failing to reseed may result in the increase of many additional acres of poor condition weed infested land, minimize future production potential and likely create an incentive to return the land to cropland. Successional data indicates that abandoned cropland will not return to at least fair condition before 25 to 30 years, if ever.

Rule-of-thumb: *Sites where stands are rated as failures should be reseeded unless natural succession is judged to result in at least fair condition rangeland after 10 years. Judgment should be based on the number of desirable perennial grass species present on the site and documented knowledge of successional patterns in the immediate area.*

Natural Recruitment

Natural recruitment of seed from seeded species is a factor to consider when sampling densities are less than adequate, and the conservationist must decide whether reseeding is necessary. Species such as crested wheatgrass and bluebunch wheatgrass recruit or reseed very poorly in most cases, whereas bluegrass and fescue species tend to reseed prolifically. Vegetative spread also should be considered, and is important for sod-forming species such as creeping foxtail, western wheatgrass, thickspike wheatgrass, streambank wheatgrass, intermediate wheatgrass and pubescent wheatgrass.

Sampling Methods

Stand evaluation methods can be employed with varying levels of complexity.

One practical method is:

1. Walk (or drive ATV) perpendicular or diagonally to the drill rows across the field and appraise the variability of the stand. Remember there will nearly always be more than one site-soil condition within a reseeded area, so appraise the stand based on the various soils and their inherent production potential.

2. On the way back, sample representative areas of the field using a pace transect. Record the number of three-leaved (or more) seedlings in a 9.6 square foot plot; (smaller plot frames may be used where the plant density is high); walk ten paces (or drive ATV an equivalent distance), and record again; repeat counting until 10 stops have been made. Divide the total number of plants counted by 96 to calculate the number of plants per square foot.

3. Complete at least three, 10-stop samples in each field, with more in larger fields as judged necessary (and based on site uniformity), by the conservationist. Two-out-of-three samples (67%), should fall within, or exceed, the target density range for the site.

4. Identify large areas of poor seedling establishment and judge whether those areas should be reseeded based on considerations addressed above, the land managers' objectives, and other factors.

An excel Job Sheet is attached and can be used to document your data collection. This sampling procedure may be necessary to meet conservation program support documentation when an appeal has been filed. Procedures should be tailored to the needs of each program. It is recommended that a State or Area Specialist be consulted in designing valid sampling procedures for program appeals.

Job sheet for Determining Stand Establishment on Pasture, Range, And Conservation Seedings (TN12)

Name:		Date Evaluated:	
Evaluator:		Date Planted:	
Soils/Site:		Contract No.:	
Precipitation		**Plot Size in Square Feet	

Transect 1

Species	1	2	3	4	5	6	7	8	9	10	11	12
Plant Symbol												
Plot 1												
Plot 2												
Plot 3												
Plot 4												
Plot 5												
Plot 6												
Plot 7												
Plot 8												
Plot 9												
Plot 10												
Total Count												
Percent by Species												

Plant Density :Seedlings/ft2 for Transect 1	

Transect 2

Species	1	2	3	4	5	6	7	8	9	10	11	12
Plant Symbol												
Plot 1												
Plot 2												
Plot 3												
Plot 4												
Plot 5												
Plot 6												
Plot 7												
Plot 8												
Plot 9												
Plot 10												
Total Count												
Percent by Species												

Plant Density :Seedlings/ft2 for Transect 2	

Transect 3

Species	1	2	3	4	5	6	7	8	9	10	11	12
Plant Symbol												
Plot 1												
Plot 2												
Plot 3												
Plot 4												
Plot 5												
Plot 6												
Plot 7												
Plot 8												
Plot 9												
Plot 10												
Total Count												
Percent by Species												

Plant Density :Seedlings/ft2 for Transect 3	

Plant Density : Avererage Number of Seedlings/ft2	

Percent stand by species												

Comments and Recommendations:

****Refer to Plant Materials Tech Note # 12 - GUIDELINES FOR DETERMINING STAND ESTABLISHMENT ON PASTURE, RANGE AND CONSERVATION SEEDINGS for further guidance.**

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