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State Grass of Texas

A PRACTICAL GUIDE TO THE ESTABLISHMENT OF VEGETATIVE COVER ON HIGHWAY RIGHTS-OF-WAY

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Texas Department of Transportation

A PRACTICAL GUIDE TO THE ESTABLISHMENT OF VEGETATIVE COVER ON HIGHWAY RIGHTS-OF-WAY

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INTRODUCTION:

The establishment of permanent, warm-season, perennial vegetative cover on highway rights-of-way is a complicated issue which involves the coordination of many items in order to achieve success.

Several specifications are involved, including topsoil, seeding, sodding, vegetative watering, etc.

Timing is especially critical because even if you perform all the right activities, but at the wrong time, you will not achieve your desired results.

This publication is an attempt to discuss and explain all the relevant issues, materials, techniques and tools currently available within the *1993 Standard Specifications for Construction of Highways, Streets and Bridges*, with the goal of helping designers, construction inspectors, maintenance personnel or anyone involved in the issue of establishing a permanent, warm-season perennial vegetative cover on our highway system.

IN THE BEGINNING:

It is logical to assume that the simplest way to grow vegetation is to start with an available seeding specification, apply the seed and hope for the best.

In reality, when planning for an ultimate cover of permanent, perennial warm-season vegetation, you have to start much earlier than that, and with items which, at first glance, appear to have little to do with growing vegetation.

Seedbed Preparation

In this publication the term "seedbed" is defined as that portion of the right-of-way on which you are trying to establish a vegetative cover. When you think about it, highway rights-of-way are some of the most inhospitable climates available with regard to the production of vegetation.

Steep slopes, lack of consistent water, vehicle emissions, poor organic matter and plant nutrients, and outside influences such as vehicles leaving the pavement, mowers rutting the slopes, and necessary rehabilitation/modification of the right of way makes it a tough place to grow grass!

And then, just when you feel you've achieved a good vegetative cover, a hazardous material spill occurs and wipes

out a large section of vegetation, or the local city government implements a water conservation plan because you're in one of our many "droughts" and you can't provide any supplemental water to an area you're trying to establish.

There are always going to be conditions which are beyond our control which make it difficult to grow a good stand of vegetative cover. However, the seedbed is something over which we have direct control.

For any vegetative matter to thrive, it must have several basic things:

✓ Sunlight (normally not a problem on roadway jobs);

✓ A seedbed which is not compacted and which will permit water, nutrient and oxygen penetration and exchange;

✓ Organic matter (often termed humus) - always found in good topsoil sources;

✓ Food (for plants, in the form of Nitrogen, Phosphorous and Potash); and

✓ Water (either natural or supplemental).

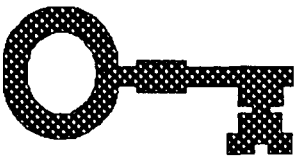
Sunlight

We won't address the sunlight issue other than mentioning that trying to grow a good stand of grass under a bridge structure which receives very little natural sunlight is similar to "pushing a rope." You can do it, but its frustrating, expensive and ultimately ineffective.

Compaction

The compaction of the seedbed is a critical issue. To insure the stability of fill slopes, the Department must specify a high compaction rate. This is great for embankments but disastrous for plant material. Without a topsoil plate, you are expecting vegetation to try to send roots down into what is almost like concrete. Some will make it, but the vast majority simply will not survive. Further, the more compact the soil, the less water, food and oxygen can penetrate the soil. Without those elements, you can't expect grass to germinate or establish.

So what do you do about the compaction issue?



Key Point!

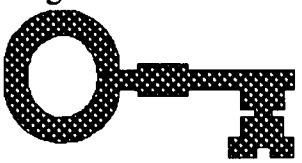
It is critical that the upper 4 inches of the seedbed be tilled and loosened.

Of course, if you haven't plated the area with a good topsoil which is rich in organic matter (humus), and you're tilling 4 inches of the embankment material itself, (which is often subsoil left over from a cut section on another part of the project), you're back to pushing the proverbial rope!

This compaction thing applies not only to a brand new area being constructed, but also to existing areas of right-of-way. If used as a parking lot for Contractor or construction equipment, the soil will become compact and the vegetation will die.

Organic Matter

The most appropriate method of satisfying both the "compaction" and the "organic matter" issue is to...



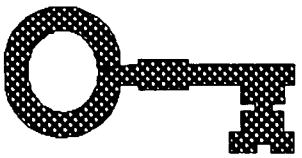
KEY POINT!

insure that you have an adequate topsoil plate over the entire area which is to be revegetated.

You might ask at this point ... "How do you expect me to put a topsoil plate on a 1:1 or steeper slope and expect it to stay and grow grass?"

My answer would be in the form of another question back to you..."Why are you trying to establish vegetation on a 1:1 or steeper slope in the first place, and if you're lucky enough to do so, how are you going to maintain this area in the future?"

Seriously, I do not recommend that you try the wholesale revegetation of a 1:1 or steeper slope. You can do it, by using some specialized tools which will be discussed later, but it may be more appropriate to evaluate the use of non-vegetative alternatives (concrete rip-rap for example).

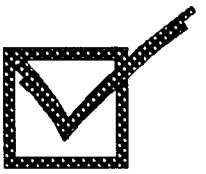


Key Point!

One of the best methods for securing good topsoil, is to strip, stockpile and reuse the existing topsoil.

(This assumes that you aren't working on the Moon and that you had a decent stand of vegetation growing on the project before you started!).

If, in fact, you **are** working on the Moon where there is no available topsoil, but yet you've been given the task of establishing a good vegetative cover, then your only option is to specify, purchase and install a topsoil plate on the areas to be revegetated.



Rule of Thumb!

As a rule of thumb, the more sand you have in a topsoil, the more erosion you can expect.

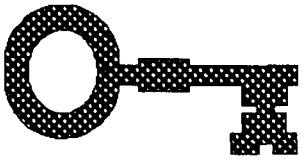
Try to find a good, dark, rich topsoil which is higher in the clay content. This topsoil will resist erosion and will provide a good medium for the establishment of the permanent perennial vegetative cover.

But finding and placing a good topsoil plate is not the only consideration; believe it or not, the actual surface treatment of the topsoil plate is also another critical factor.

In our Department, when plans call for an area to be constructed to a 3:1 grade, we insure that the Contractor does just that; grade and smooth that area or slope so that it is a smooth, precise 3:1 slope. That smooth slope might be "great looking," but it's a disaster when growing grass!

Consider this. The smoother the slope, the faster the water will move during a rainfall event. The faster the water moves, the more sediment you lose. And, if you've just finished seeding that good-looking smooth slope, guess what else is moving right along with your once-smooth topsoil? That's correct. Your seed is moving right along with your topsoil and into drainage ways, stock tanks, golf courses, etc. Lots of places which may not be particularly happy about receiving not only our sediment, but our seed mix as well. Now your slope is covered with rill and gully erosion, often exposing the underlying subsoil, and most of your seed is gone!

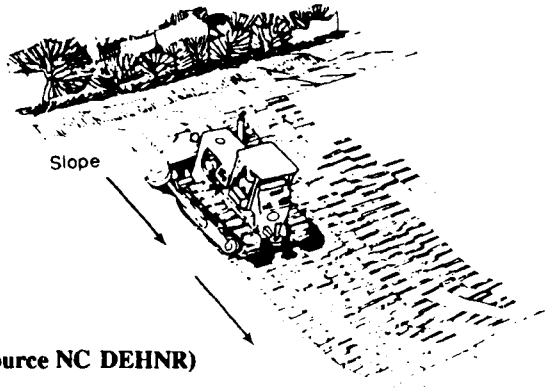
There is an effective way of preventing this action which is also cost-effective.



Key Point!

Consider leaving the slope "tracked."

Using a tracked vehicle to spread the topsoil plate will leave thousands upon thousands of depressions on the slope.



(Source NC DEHNR)

Each one of those track marks will act as a tiny "diversion dam" which will:

(1) slow the water velocity;

(2) retain moisture and nutrients; and

(3) help to provide an excellent home (microclimate) for those seeds to collect, germinate and flourish.

When the seed begin to germinate, you'll notice that they germinate within the track mark depressions. In a short time, their normal growth will have, hopefully, covered the entire area.

Even in the worst case, where, for whatever reason, you are not able to add organic matter and are required to try to grow vegetation on a poor area, the use of a tracked vehicle as described above will go a long way to helping you grow vegetation even on the poorest areas you have. You can use this technique on an area which has been previously seeded but is not doing well. Rather than disking the entire slope, try tracking the slope, then overseeding.

Food

When it comes to plants, food is primarily found in the form of three elements:

- ✓ **Nitrogen (N)**;
- ✓ **Phosphorus (P)**; and
- ✓ **Potash (K)**.

Just looking into the fertilizer issue will leave you baffled in a hurry, because you quickly get into the realm of the dreaded organic chemist! Rather than getting all tangled up in terms like nitrate versus urea, nonprotein organic versus inorganic,

or trying to figure out whether it is best to use a Calcium Cyanamide or a Superphosphate fertilizer, its safe to assume that most projects could use a little help in the food (fertilizer) area.

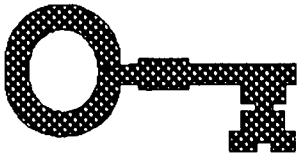
A walk through your local garden supply store will show you the bewildering number of different fertilizers, each with a different analysis, some with trace elements, some without, some with pesticides, some without, all making claims that, in effect, they could grow vegetation on a cue ball.

However, by just concentrating on the three key elements, you'll satisfy most of your fertilizer questions.

Nitrogen (N) is primarily responsible for the rich green color of vegetation.

Phosphorous (P) is primarily responsible for establishing a good root system.

Potassium (K) is primarily responsible for fruit and flower production.

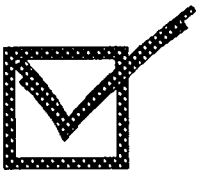


Key Point!

If adequate Nitrogen, Phosphorous and Potassium are available, right-of-way vegetation will typically do just fine without any of the other available trace elements, minerals or fancy formulations.

But, just as you don't feed an infant adult food, you don't apply the same rates of food (fertilizer) to an area which is newly seeded as you do to those areas on the right-of-way which already has a good stand of established vegetation.

High rates of Nitrogen will "burn" newly germinated seedlings. So on projects where you are seeding, you should apply a lower rate of N than you would on an area of established turf.



Rule of Thumb!

A good rule of thumb for determining fertilization requirements for newly seeded projects, is to plan for 100 pounds of N per Acre.

On established turf, a good rule of thumb for determining fertilization requirements is to plan for 150 pounds of N per Acre.

Well, you might mention, "That may be easy for you to say, but how do I figure all this out especially when you have different formulations of fertilizers?"

Fertilizers are commonly sold on the basis of a three-number designation, such as 10-20-0 or 10-10-10, etc. This type of designation indicates the amount (by weight) of Nitrogen (N), Phosphorous (P) and Potash (K) respectively which is contained within that bag of fertilizer.

For example, if you purchase a 100 pound bag of 10-20-10, each bag will contain 10 pounds of available Nitrogen, 20 pounds of available Phosphorous, and 10 pounds of available Potash.

"Hey! That only adds up to 40 pounds of fertilizer in this 100 pound bag. What makes up the other 60 pounds?"

Most of the remainder is inert material used as a "carrier" for the actual fertilizer nutrients of N-P-K itself. It's common to see the majority of the product (by wight) as inert materials.

So, on a seeding project, if you were trying to apply 100 pounds of N per acre, and you had 1.5 Acres to fertilize, you're going to need a total of 150 pounds of N for your project.

$$100 pounds \times 1.5 Ac = 150 lbsN$$

If you or the Contractor use 10-20-10, you're going to have to apply 15, 100-pound bags of 10-20-10 evenly over the entire area.

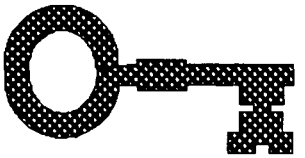
$$\frac{150(LbsN)}{10(Lbs/Bag)} = 15(100 LbBags)$$

In order to get 150 pounds of N using a 20-10-10 formulation, you would need to purchase 7.5, 100 pound bags. (Or 7, 100-pound bags and 1, 50 pound bag of 20-10-10).

$$\frac{150(LbsN)}{20(LbsN/Bag)} = 7.5(100 LbBags)$$

Of course, a logical question at this point would be "why did you use 10-20-10 in the first place? Why not 10-10-10?."

Although there are several resources available in your local area to recommend typical fertilizer requirements, including Department personnel who have worked in your local area trying to grow vegetation, **probably the best way to determine what fertilizer you actually need is to have a soil test performed.**



Key Point!

A soil test can usually be performed quickly and inexpensively and will give you a specific recommendation regarding the N-P-K needs of your project area.

To find out about what it takes to perform soil tests, give your local County Extension Agent a call and order a "Soil Test Kit." It will come with all the instructions necessary. (See Appendix A to see what the documents look like.)

But, if you don't have time to perform a soil test, if you just use the previous rule of thumb of applying 100 pounds of N per Acre for newly seeded areas, and 150 pounds of N per Acre for established turf, and use a complete fertilizer (one which has some combination of each of the three N-P-K elements), you won't be far off.

You also need to remember that nutrients will eventually be depleted from the soil or seedbed.

If your grass begins to look like the Texas National Guard has marched across it, when in fact, they haven't, and there are no other obvious reasons, you might consider applying a fertilizer.

Just as in doctoring yourself and trying to relieve a headache with aspirin, the old adage of "if one is good, five will be better" can also lead to disaster.

CAUTION!

If you apply too much fertilizer, you can easily "burn" the vegetation and do more harm than good. This is especially important in newly seeded areas.

Over-applications of fertilizer will be washed off the project and end up in drainage ways which often lead into reservoirs or into the underground aquifers. Not a good practice, especially in these environmentally-conscious times!

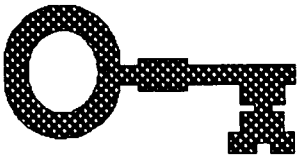
Water

And last, but certainly not least is the requirement for water to insure the successful germination and establishment of a vegetative area.

This is a tough issue because some of our projects are in areas which receive high amounts of natural rainfall, while other projects are in areas which receive very little natural rainfall.

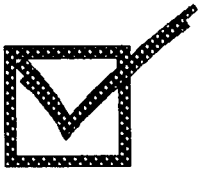
Sometimes those areas which receive ample rainfall experience periods of drought, while those arid regions often experience brief storms which dump tons of water onto your project in a very short time.

There's not much you can do about Mother Nature, but...



Key Point!

unless you receive adequate supplemental watering, you're simply not going to achieve the stand of vegetation you want.



Rule of Thumb!

A good rule of thumb for estimating the amount of water needed to establish a newly seeded area is to plan for ½ inch of water per acre per month during the establishment period.

"Alright," you say, "...but what does that mean in real language...and what is an 'establishment period' anyway?"

Let's address the amount of water issue first.

In order to figure how much ½ inch of water per acre is in gallons, you multiply the number of square feet in an acre (43,560), times the depth of water in feet, times 7.48 which is the conversion factor to convert cubic feet into gallons. Simple huh?

Really, it is. Let's take a "for example."

Suppose you have an area of 2.35 acres to be seeded. If you're trying to figure out how many gallons you would need to apply ½ inch of water you do the following calculations:

$$2.35(Ac)\times 43{,}560(SF/Ac)=102{,}366SF$$

...which gives you the total square footage (102,366 square feet).

Now, multiply this number by the decimal equivalent of ½ inch (.04) and you get the volume in cubic feet...

$$102{,}366(SF)\times .04(Ft)=4{,}094.64CF$$

Now, using the handy conversion factor we talked about earlier, you take the number of cubic feet and multiply it times 7.48 and you get the magic number of...

$$4{,}094.64(CF)\times 7.48(Gal/CF)=\underline{30{,}627.91}$$

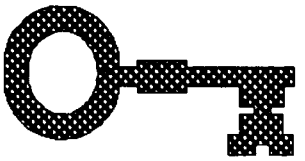
...gallons needed.

For our purposes, call it 31,000 gallons. Close enough for government work!

Whew! That's a lot of water! Yep, it is, but we're not through yet. Remember that earlier on I said that you have to provide for an adequate amount of supplemental water during the "establishment" period? You'll also remember I artfully ducked explaining what this "establishment period" was. Well, now's the time.

Relate this to trying to establish vegetation at your house. If you seed your front lawn, you're obviously going to want to water it to make sure that something grows. You can either pray for rain and take your chances, or "hedge your bet" by planning on watering it. Most of us would do the latter.

But you can't expect a newly seeded lawn to grow into what you expect if you dump the suggested ½ inch of water per Acre on the lawn, then retire to the living room to watch M*A*S*H reruns for a few weeks and expect a beautiful lawn to suddenly appear the next time you walk out of your front door.



Key Point!

Your newly planted seedbed is going to **require additional water for a 3-month period.**

After 3 months, your seeds should have germinated and grown to the point that you have a decent overall coverage.

So, in our example, you should take that magic number we determined earlier (which I believe was 31,000 gallons) and multiply that times the 3 months you'll be needing the water.

Now you get an even bigger number...

$$31{,}000(Gal)\times 3(Mo)=\underline{91{,}000}Gal$$

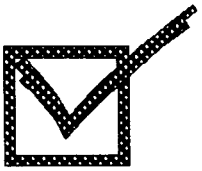
...total gallons of water needed to establish the vegetation.

There's more to consider, though.

If you say that you'll apply ½ inch of water per acre per month and you apply the first application on the 1st day of the month, then wait until the 1st day of each of the next two months to apply the rest, you've still shot yourself in the foot!

Obviously our precious water is going to have evaporated in a relatively short time, especially in our hot Texas climates.

While the previous formulas give you a decent estimate of the total amount of water you'll need during the establishment period, you need to adjust your application rates so that your seedbed stays moist for the longest period of time.



Better Rule of Thumb!

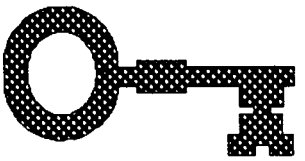
For the best chance of success, you should plan for applying ¼ inch of water per acre every two weeks for a 3-month period.

By timing your applications like this, you help your seedbed to remain moist and you'll be rewarded by consistent germination and decent establishment and growth of your vegetation.

"Good grief!," you say, "my area receives a ton of natural rainfall every year! Do I really need to plan for all this extra watering?"

The rules of thumb discussed above are meant to give you a guide as to what is going to be needed to establish a decent stand of vegetation. If you are in an area which is blessed with a lot of natural rainfall, great! You can use your professional judgement to adjust your supplemental watering needs accordingly.

But, can you truly guarantee that the area will be seeded at the right time, or that your natural rain will come when you need it? I'm not sure that I'd bet the ranch on it!



Key Point!

Without adequate moisture on your seedbed, you will never achieve the vegetation you're after!

Simply won't work.

Planning for supplemental watering is the best insurance policy you've got to insure you get what you want. If the rains come, you don't perform the supplemental watering (and you don't pay for it either).

CHOICES, CHOICES, CHOICES:

Okay, we've covered the basics of sunlight, compaction and seedbed preparation, organic matter, food and water. "You've beat the dead horse long enough" you might say.

Your next question might be "Then what method should I use? There's all kinds of options available in the spec book!"

I'll grant you that there are a lot of alternatives available to you and it gets

pretty confusing at times to select the most appropriate method.

But there are reasons for having the different alternatives available to you. One particular method simply won't work in every case. And, in some cases, one alternative might work just fine, but you probably could have achieved the same results by using a less expensive option.

Maybe the best way to address this whole "choice" issue would be to list all the available options, explain the "method to the madness" behind each alternative, and hopefully provide you with some guidelines that you can use to select the best method for your particular case.

There's lots of ways to "skin this cat," so...here goes!

Sodding versus Seeding

There are really only two major types of revegetation methods available in the spec book; sodding and seeding.

Sodding involves cutting blocks or rolls of established turf from an existing turfgrass field and placing those blocks or rolls onto your prepared seedbed. Normally sod is cut in such a manner that you have a turf blanket which includes at least 1 inch of the existing root system bound together with topsoil. Installation is relatively simple. Just "Green Side Up."

Seeding, on the other hand, involves distributing seed over your prepared seedbed which, after germination, establishes its own root system within the seedbed, and during establishment, spreads and covers the area in question.

The obvious advantages to sodding is that you start with established turf with a good root system. If placed "solid" over the entire area, you create an "instant" vegetative cover.

The primary disadvantage of sodding is primarily its higher cost.

A secondary disadvantage of sodding is that you create a "monoculture," (which is a four-bit word which simply means only one species of vegetation is planted).

"Well," you say, "what's wrong with planting only a single species?"

Nothing, provided it's your own front yard at home. But the Department has, by one estimate, over 750,000 acres of mowable right-of-way. While it may be appropriate to establish a "lawn look" at certain places on the right-of-way, we're not in the business of turning every acre of our right-of-way into a lush lawn.

Plus, if you've just gone to the expense of planting dozens of acres in solid St. Augustine sod, and, heaven forbid, the dreaded St. Augustine Eatum Beetle invades, (...don't laugh, could happen!), then you stand a good chance of losing the whole thing.

Also, a single species, especially St. Augustine, requires a high level of water and fertilizer to grow, and often cannot handle our standard herbicide formulations without extensive damage.

The standard seed mixtures, on the other hand, which have been formulated for all districts, and account not only for geographical differences, but urban versus rural considerations as well. They provide the primary advantages of: lower initial cost; species diversity which encourages "natural succession"; and lower long-term maintenance needs.

Don't get me wrong. There's nothing wrong with sodding. Some of the recent sods being marketed (Prairie Buffalograss for example), offer the advantage of drought-resistance and lower maintenance requirements. Sodding is an excellent alternative in **selected applications.**

Sodding for Erosion Control

Let's first concentrate on the various sodding alternatives available in the spec book and discuss each one.

Spot Sodding

Spot sodding is a method where block sod is cut into small squares (typically 3 inches square), and placed into furrows or shallow depressions along the right-of-way. The theory here is that the sod blocks will spread and fill out the bare areas between the blocks.

"How long does it take to fill out" you say? That obviously depends on how closely you place the blocks. The closer together, the quicker they join.

I know that sounds like an answer you might get from someone running for office, but I can't give you a precise time frame for it to occur because it depends a lot on some of the basic "bugaboos" we discussed earlier. (Remember ✓sunlight, ✓compaction & seedbed preparation, ✓organic matter, ✓food and ✓water?).

Block Sodding

This is just a "big brother" to spot sodding. In this application, you apply larger blocks, most often taking a large block or roll of sod and covering the entire area. You'll notice that the spec book says that if there is a danger of the sod sliding due to the height and slope of the surface, you may have to use things like wooden pegs to keep them where you want them.

You need to remember that for any newly sodded area, your sod cannot become established until it has had a chance to get its roots down into the seedbed. (Remember ✓seedbed preparation/organic matter?) Once your sod begins to grow and sinks roots down into the seedbed, then you begin to get an established turf which prevents the erosion of the seedbed and draws nutrients and water from the seedbed as well.

Grass Retards

You've probably seen grass retards used along drainage ditches or back slopes. Typically, long, rectangular blocks of sod are placed perpendicular to the flow of water in a drainage ditch. Of course it varies, but you often see these blocks placed every 25 feet or so.

I suppose the theory is that in time, these grass retards will grow and eventually cover the entire drainage ditch.

But think about it! That 12-inch band of sod is separated by 24 feet of unprotected soil. Couple this with a drainage ditch situation where you have concentrated flows of stormwater being directed over (and most often under, around and through), these retards, or you have high velocities of overland flow on back slopes and guess what's going to happen!

Given any significant rainfall event, your grass retards are not going to provide any significant erosion/sediment control capabilities, and usually, most of your carefully placed blocks are going to end up at the outflow end of your channel.

Guess you can tell that grass retards are not one of my favorite applications.

While they may be beneficial at the top of slopes or in selected locations, don't expect too much from them, especially in a drainage ditch situation.

Mulch Sodding

Mulch sodding is typically where an existing turf area is thoroughly disked leaving a chopped up collection of stems, stolons, roots and rhizomes all mixed into the topsoil. (Whoa! New words! "What's a stolon or a rhizome?" We'll discuss some of these terms later. Trust me.)

Then this mixture is placed or bladed out onto the area to be revegetated.

This isn't a particularly bad method, considering that when you place mulch sod onto a seed bed, you are going at least a little way in solving the ✓seedbed preparation/compaction, ✓organic matter issue.

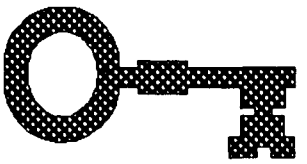
(Do you notice that a pattern of going back to the basics covered under "In the Beginning" is developing? Guess what? That pattern will continue for everything we discuss!)

Maybe you've also noticed another pattern developing; that this discussion follows the order of the standard specs for revegetation and addresses the differing revegetation techniques in the same order as they are written in the spec book.

Straw Mulch or Hay Mulch

"Hold on! You switched horses on me in the middle of a stream! Why a discussion about a mulch here? What does this have to do with sodding?"

Again, a good question, and one which needs addressing. Actually, I mention mulch at this point because it's simply the next item in the standard spec for sodding. Using my "no brainer" method of organizing this document, that means that I have no choice but to discuss mulches at this point.



Key Point!

The use of a mulch is probably one of the single most important elements in a successful revegetation project.

The purpose of any mulch is to provide a protective cover over your seedbed which:

✓ Reduces erosion caused by rainfall;

✓ Retains moisture and helps insure germination, root growth and establishment; and

✓ Moderates and controls the temperature along the surface of the seedbed itself.

But I digress from the subject!

Straw or hay mulch are excellent insurance policies to help your sodded area perform, especially if you elect to use spot sod or mulch sod. A mulch of some type is almost a necessity if you use grass retards or spot sod where you have lots of unprotected seedbed. Truly worth its weight in gold!

Seeding for Erosion Control

Now, lets switch from sodding and concentrate on the various seeding alternatives available in the spec book and discuss each one.

Broadcast Seeding

Broadcast seeding, while usually the simplest, is usually the least effective method of revegetating an area.

In its most basic form, it could simply consist of you and me finding a couple of 3-gallon coffee cans, filling them with seed, and scattering the seed while walking across the seedbed ("Johnny Appleseed" style).

Most often, broadcast seeding is performed by the use of a machine called a hydraulic seeder which sprays a water-seed slurry out onto the seedbed. Sometimes fertilizer is incorporated into the seeding process, and sometimes not.

The spec book says that after the seed has been applied to the seedbed, you should roll the area with a corrugated roller.

How come? Why roll the seed? Conventional Wisdom (the name of a well-known horticulture professor) said that rolling was necessary to insure "good seed/soil contact.

The reason that I state that broadcast seeding is probably the least effective method of revegetating an area is that this technique does not require the application of a mulch; only that the seed be rolled.

In a right-of-way situation, you can assume that unless you are prepared to constantly water an area on which seeds are lying on the top of the ground, you simply are not going to get much germination and establishment.

Further, broadcast seeding without the application of a mulch provides absolutely no initial erosion/sediment control. If you try this technique on any degree of slope, you are simply wasting your time and money! And if you use this technique on slopes without mulch, and try to do right by pouring the water to the slope, you are simply going to lose all the seed you placed on the area along with whatever topsoil plate you had to start with.

"Well, if this technique is so bad, why in the world is it in the spec book?"

This technique is OK on **level ground** which isn't influenced by concentrated overland flows. It's also OK if you bite the bullet and insure that the necessary supplemental water, food, etc. is being applied.

If you don't have those conditions, or are not willing or able to insure that degree of care, don't try it.

CAUTION!

Broadcast seeding is not recommended for revegetating any sloped area.

Straw or Hay Mulch Seeding

The major difference between straw or hay mulch seeding and broadcast seeding is that broadcast seeding doesn't require a mulch cover, while straw and hay mulch seeding doesn't require rolling.

Other than that, straw and hay mulch seeding is simply broadcast seeding with a mulch added to the process.

But the simple addition of a mulch makes this technique far superior to simple broadcast seeding!

In this technique, the seed (and hopefully fertilizer) is applied as a slurry to our prepared seedbed by a hydraulic seeder. (Remember the basics; you've got to do those first!).

Then, as a second step, a hay blower (straw blower?) comes along and blows a good, thick layer of the hay or straw mulch onto the seeded area.

"Hold it. What's the difference between hay and straw anyway?"

Hay is the term used when you harvest and bale grass species (such as Coastal Bermuda, Alfalfa, bermudagrass or other prairie grasses).

Straw, on the other hand, is the term used when you harvest and bale cereal grain species (such as wheat, oats or rice).

Don't worry about which one is best! Use what is locally available in your area. But be sure to try to get bales which are free of Johnsongrass if at all possible!

The specs talk about a "tacking agent" over the hay or straw. For those of you who have ever experienced trying to keep hay or straw on a slope in a windy area know why a tacking agent is required.

Without something to "glue" the hay or straw together, wind and rain will take your carefully applied hay or straw mulch and gleefully deposit it in the Mayor's driveway, the golf course water hazard, or some other unfortunate place.

Not only do you have an unhappy adjacent landowner, but you lose the mulching protection for the seeds.

By now, you know what you can reasonably expect without a mulch.

Historically, we have used asphalt emulsion as a tack to hay or straw. There is nothing wrong (or illegal at the time of this writing) with using asphalt emulsion to tack hay or straw. However, there seems to be a groundswell of environmental concerns relating to the use of any petroleum-based product.

Also, the fine emulsion mist created during the tacking process creates big problems if you're using this technique in urban areas. Here, you can expect complaints from folks about their car's paint jobs or from adjacent building occupants who can't get it off their windows.

Although there is not a lot of formal test data on organic tackifiers, there are a lot of these materials on the market. The Department will begin formal testing on tackifiers in the near future and will be able to provide you with some recommendations about their effectiveness. If you want to try an organic tackifier as an alternate to asphalt emulsion, call the folks in the Landscape Section in Austin and they can discuss what's currently available on the market.

We'll discuss this in the next session, but another alternative to asphalt emulsion as a tack over hay or straw mulch is to use any of the commercially produced "cellulose fiber mulches" as a tack.

Regardless of which tack you elect to use, always assume that you need to add a tack coat to a layer of hay or straw mulch if you expect it to stay where you want it and produce a decent stand of vegetation.

CAUTION!

Straw or Hay Mulch Seeding is not recommended for those areas of your project which have slopes of 3:1 or steeper.

Do the basics still apply here? You bet they do. You still need food, seedbed preparation, supplemental water, etc.

Cellulose Fiber Mulch Seeding

The major difference between cellulose fiber mulch seeding and hay or straw mulch seeding is in the type of mulch used.

In this technique, your seedbed is prepared (...basics, basics, basics...), then the seed (and hopefully fertilizer) slurry is applied to the seedbed by a hydraulic seeder. (So far, it's exactly the same as for straw or hay mulch seeding).

Now, rather than blowing hay or straw mulch onto the seedbed, a hydraulic seeder applies a water/commercial cellulose fiber mulch slurry onto the seeded area.

Cellulose fiber mulches (often termed hydraulic mulches) are bales of material manufactured either from virgin wood fiber (cutting down trees and producing a mulch), or from recycled or paper byproducts (waste products from paper mills, or recycled newsprint).

Unlike hay or straw mulches, there are big differences in the performance of the various hydraulic mulches.

The Department, through a formal testing program, has been evaluating the field performance of the various hydraulic mulches available on the market. As a result of this effort, (and as stated in the spec book), any hydraulic mulch used must have been pre-approved by the Division of Maintenance and Operations.

With hydraulic mulches, it is important to apply the specified amount of mulch. The rates are shown in the spec book.

Most of the hydraulic mulches contain a green dye which looks great when it's first sprayed out onto the seedbed. But it quickly fades. The dye is primarily there to help the operator see which areas have been covered, and to judge the application rate.

Hydraulic mulches do not require a tackifier as in the case of hay or straw mulches. Some of them have tacks already incorporated into the mulch. All cellulose fiber mulches typically hug the seedbed, forming a protective layer which retains moisture, protects the seedbed from the erosive effects of rainfall and moderates the temperature at the seedbed surface.

But remember, you gotta' have the basics covered in this technique too! Food, supplemental watering, compaction, etc., must be addressed.

CAUTION!

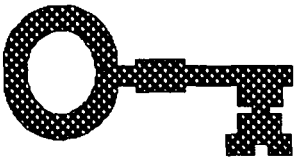
Cellulose Fiber Mulch Seeding is not recommended for those areas of your project which have slopes of 3:1 or steeper.

Drill Seeding

This technique differs from any of the previous techniques we've discussed as it involves a machine which looks like a "hog trough" on wheels pulled behind a tractor.

The seed drill itself is normally a rectangular box which has been separated into "bins," with each bin being able to hold and distribute seed. At the bottom of the gadget and in front of each bin are small knives or chisels which plow a small furrow in the seedbed. The bins also have a tube mechanism which allows the seed to drop out at a specified rate into the furrow which has just been created. Immediately behind the tube are small chains which rake topsoil back over the seed.

A seed drill does not require the application of a mulch because it literally plants the seed in a straight line in little furrows which are immediately filled with topsoil. The seed, therefore are "mulched" by the topsoil itself.



Key Point!

The use of a seed drill is an excellent technique to use in seeding areas.

It's limited, however to gentle slopes because they must be accessible by a tractor. Typically, you have good germination and relatively quick establishment.

But, does this mean that you can ignore the basics of supplemental water, food....

"Aaurrghhh! Enough already! We understand that you can't ignore them, so give us a break and stop going over them every time!"

OK, enough said about the basics. I won't say another word .....(Maybe!).

HAVE YOU ACTUALLY TRIED TO READ THE SEEDING SPEC?

I guess that means that you've tried to read the standard spec "Seeding for Erosion Control" and find it a tad confusing.

"Confusing? Man, with all those long-winded plant names, warm and cool season stuff, pure live nonsense, planting dates, temporary cool versus temporary warm, rural versus urban, dates to do this, dates to do that...calling it confusing is like saying that designing the Space Shuttle is 'challenging'."

OK, OK, maybe the spec is difficult to understand. However, one of the reasons the spec is difficult to understand is because of the peculiar terminology and language which is common to the seeding business.

The Tables at the back of this guide were designed to present the information in the standard specs in an easier-to-read format.

So let's take each of the major areas and try to discuss them.

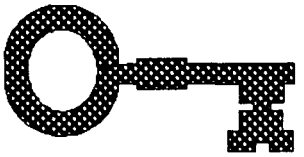
Seed Law

The Texas seed law requires that each bag of seed sold or furnished be labeled showing at the very least, the scientific name and type of the seed itself, the date of harvest, and data regarding the amount of extraneous material (anything which is not actual seed) present in the bag.

Just like medicine which has recommended shelf life, grass seed has a "shelf life" too. The older the seed, the fewer seed will actually germinate and grow.

If you are typical of 99.99% of the folks on this planet, you will have difficulties in recognizing the difference between Western Wheatgrass seed and Bufflegrass seed.

And it's not really important that you need to be able to do that.



Key Point!

What is important, however, is to inspect the seed tags which are furnished with every bag of seed ... to insure you are getting what you actually specified.

Pure Live Seed

All grass seeding rates are specified in terms of "pounds, pure live seed."

You'd assume that if you bought a pound of grass seed, and if it actually weighed 1 pound on your bathroom scales, that you've received a pound of pure, live grass seed.

Not!

This is not a reflection of shoddy business practices by the seed industry, but more a "nature of the beast" which can't be changed.

When seed is harvested, it is impossible to collect only the seed itself, especially as some of the seed is almost like dust. It's unavoidable to keep things like chaff, husks, pebbles and sometimes even weed seed from getting in with the seed you actually want. If we expected the seed industry to pick through every bag and remove anything which wasn't what we ordered, a one-pound bag of grass seed would probably cost us $1,000.

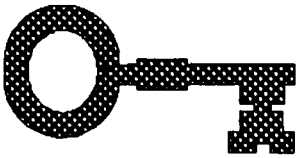
So as you can see, our one pound bag of grass seed is not **pure** seed.

To further complicate matters, out of the actual pure seed itself, not all of them are alive or viable. For whatever reason, some of the seed will never **germinate**.

The Texas Department of Agriculture requires each seed tag to show the **percent purity and percent germination** of that particular lot of seed.

The way, then, to figure the Pure Live Seed (PLS) is to multiply the percent purity shown on the tag by the percent germination shown on the tag.

This will tell you what percentage of that 1-pound bag of seed is actually pure, live seed.



Key Point!

Typically, you'll find that a 1-pound bag of seed will contain less than 1-pound of "pure live seed."

So in order to make sure that you are applying the seed at the appropriate rate (PLS), you'll have to increase the bulk poundage.

Confusing? Let's take a "for instance" and see if it helps.

Assume that you went to the store and bought a 1-pound bag of bermudagrass seed. After getting home, you carefully read the seed tag and discover the following information:

Purity: = 85%
Germination: = 75%.

To figure the amount of Pure Live Seed (PLS) you have, you use the following formula:

$$\%Purity \times \%Germination = \%PLS$$

OK, using that formula with our bag of bermudagrass, let's see what we've got:

$$0.85 \times 0.75 = 0.64 PLS$$

That means that your 1-pound bag of bermudagrass actually contains only 64% (or 0.64 pounds in our case), of pure, live seed. (It also means that 36% or 0.36 pounds of that 1-pound bag is just useless material!)

So, in order to get 1 pound of **pure live seed**, you need to set up your basic proportion equation which says ".64 pounds pure live seed is to one pound, as 1 pound is to x pounds pure-live-seed." Or in standard math notation...

$$0.64:1=1:x$$

Solving for "x," you get...

$$0.64x=1$$

...then finally...

$$x=\frac{1}{.64}=\underline{1.56(LbsBulk)}$$

...which means that you have to have 1.56 pounds of bulk seed in order to get 1.0 pound of **pure live seed** (with this percentage purity and germination).

Now, you say that the experts have recommended that you need to seed bermudagrass at 1.2 lbs PLS per acre and you have, magically, one acre to seed. How much of this stuff do we need?

$$1.56(LbsBulk)\times 1.2(LbsPLS/AC)=\underline{1.88}$$

... bulk pounds needed.

So you see you'll actually need to apply 1.88 pounds of bulk seed to achieve the desired planting rate of 1.2 lbs PLS on our hypothetical one-acre project.

In almost every case, you'll find that you need to apply more bulk pounds of seed per acre to get the specified rate of pure live seed (PLS) per acre. The amount you must increase depends, like we've said above, on that seed's percent purity and percent germination.

Definitions

Another confusing part of the seed spec is the bewildering number of grass species listed. And those names! Where did they come from?

Although you might impress someone at a party by casually dropping the term Buchloe dactyloides in a conversation, it is equally possible that you might be dropped by a right hook because they thought you were insulting them! By the time you explained that it was only the Latin name for Buffalograss, it's way too late.

Like I said, it's not important that you know (or even pronounce) the scientific names for each of the grasses in the seed spec.

But there are some terms which relate to the seed mix, which need some definition:

Scientific Name: A naming convention which uses Latin to assign a specific name to each plant species. Latin is used as it is a "dead" language, and it's not being changed daily. (Not like English where "bad" actually means "good," as in 'Man, that's a bad motorcycle!.")

When in doubt, always use the Scientific Name shown on the seed tag. Since only one plant species has that scientific name, you can be assured that you're getting what you specified.

Common Name: A generally worthless, but nonetheless widespread naming convention for plants. Basically, it's the name that is used most often for a typical plant. (Most plants are known by dozens of common names, depending upon the area of the country.)

Warm Season: Grass species which require consistently warm temperatures to germinate and grow. They typically turn brown and go dormant during the winter months.

Cool Season: Grass species which require consistently cool temperatures to germinate and grow. They are typically bright green during the winter months when everything else is brown.

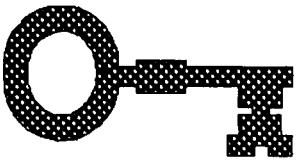
Native: A species which, in effect, has been around forever. (Something which was here when Great Grandpa came across the prairie in a covered wagon).

Introduced: A species which was brought in from other parts of the world and which, because it found the growing conditions so good, decided to stay, grow and spread.

Legume: (LAY-gume) A plant family which has the wonderful function of building good soil by fixing and releasing Nitrogen. Many are cool-season plants. **We recommend combining legumes each time you seed a temporary cool-season mix.**

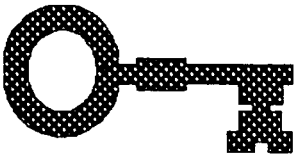
Perennial: A species which survives for more than two years. Typically, these species continually produce new seed and plants and remain from year to year. These are the plants we're trying to establish on the right-of-way!

Annual: A species which germinates, grows and dies within a single year or growing season. Most of our "temporary" seed mixtures are annuals.



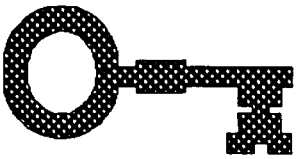
Key Point!

Planting Season: The "window" of time which is best suited for a particular seeding operation.



Key Point!

Seeding Mixture: The recommended planting mixture of several seed species designed for your specific area.



Key Point!

Seeding Rate: The amount of seed you should apply, in pounds pure live seed per Acre (PLS).

Stolon: (STO-lun) An above-ground runner which sends down roots and sprouts branches. (Bermudagrass spreads by stolons).

Rhizome: (RI-zome) A runner or rootstock which is below ground. (Johnsongrass spreads by rhizomes).

Turf Grass: Grasses which grow by sending out low growing runners, (typically stolons), which take root at the joints where new plants form. Since they spread by sending out runners, they are typically lower growing with shallower root systems. Examples include bermudagrass, St. Augustine, buffalograss and centipedegrass.

Bunch Grass: Grasses which spread by increasing the size of the actual leaf area (bunch) above ground. The root system does not spread from its original location and typically goes deep into the soil. Examples include K-R Bluestem, Green Sprangletop, etc.)

Stems: Basically, that portion of grass which is above ground. Leaves and fruit grow from these. (My apologies to any botanists out there, but an in-depth discussion regarding the names of all the plant parts isn't important here!).

Nurse Grass: A plant which germinates quickly and provides initial seedbed stability until the remaining species can germinate and establish. Green Sprangletop is used throughout our seed mix as a nurse grass.

Botanist: Someone who has been trained to be able to tell you anything you ever wanted to know about a plant, using some of the most bizarre names in the world.

As you can see from my clever use of cheap graphics, there are 3 key elements to seeding:

- ✓ Planting Dates;
- ✓ Seed Mixture; and
- ✓ Seed Rate.

If you lose control of any of these three items, you will not get what you want! So let's discuss each of these items:

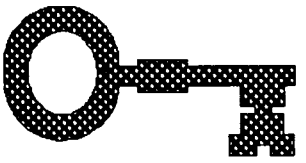
Planting Date

It is critical that seeding activities occur at the proper time. You cannot expect a "warm season" mixture to germinate in the middle of Winter any more than you can expect a "cool season" mixture to germinate in the dead of Summer.

"Well, good grief! Why do you have so many recommended planting dates in the first place?"

From past experience, it has been shown that areas to be seeded are seldom completed within the time window recommended for our warm-season, perennial seed mix. Further, even though an area is completed and ready to be seeded, the contractor (or the Department) is seldom ready or able to begin seeding operations.

Unfortunately, seeding operations are sometimes performed as one of the last items in a contract.



Key Point!

An area should be seeded or sodded as soon as it is brought to the final "lines and grades."

But what happens if an area is ready for seeding, but it's outside of the planting window for the Warm-Season Perennial seed mix?

Then use a "temporary" seed mixes, and/or use a Soil Retention Blanket. Remember, however, that the same area **must be reseeded with the warm-season perennial mix at the appropriate time.**

The planting dates shown in the standard spec are based upon average available natural rainfall and average temperature for the different areas of the state.

The planting dates for each type of seed mix in the standard spec for each District are shown on **TABLE 1**. (See page 29).

"These dates are pretty definite! Are you telling me that we have no latitude in planting either before or after the dates shown in **TABLE 1**?"

No, you have latitude to exercise your professional judgement to authorize exceptions to seeding operations which are outside of the recommended planting date windows. The standard spec says...

> "All planting shall be done between the dates specified for each highway district **except as specifically authorized in writing by the Engineer."**

Remember that the planting dates are based upon average conditions for your area. This list is saying that if you plant within the recommended windows, you will have an excellent chance in establishing the stand of grass you want. (That is if you've got the basics of topsoil, fertilizer,water, etc., covered ...Sorry, I know I promised not to go over the basics again, but I couldn't help it!)

The more variance you permit in the planting window, **the more care you are going to have to provide to insure adequate vegetation establishment!.**

For example, you could authorize seeding of warm-season perennials throughout our normally hot, dry summers **if you can assure adequate moisture will be placed on the seedbed.**

But remember that warm-season grass species **require** a certain temperature to germinate and establish. If you plant warm-season grasses in the middle of Winter, they simply will not germinate no matter how much water you pour onto the seedbed.

CAUTION!

Seeding the warm-season mix in the middle of winter in the hope that germination will occur during the spring is not recommended.

You'll get very poor germination (if any) of the seed which has been sitting idly during it's dormant period.

You may have also noticed in **TABLE 1** that there are dates during the Winter where seeding is not recommended.

A logical question would be "How come, and what do I do if I have an area ready to be seeded within this time frame?"

The "how come" part of the question can be answered by stating that the months of December through February are normally our coldest, driest months. Even cool season grasses won't stand much of a chance of germinating or establishing during this time.

The "what do I do" part of the question requires a lot of professional judgement and "Kentucky Windage."

If you find yourself with a seedbed which you must stabilize during this time period, probably the best tool to use would be the installation of a "Soil Retention Blanket" without the addition of any seed.

The Soil Retention Blanket will significantly reduce the surface erosion of your seedbed, and can be **overseeded with the warm-season mix at the appropriate time.**

Probably the most effective way to overseed would be to use a hydraulic seeder to spray the seed/fertilizer/water slurry directly onto the blankets.

If you chose not to use a soil retention blanket, you must plan on providing some sort of surface protection (mulch) to the seedbed until you're ready to perform your warm-season perennial seeding.

Some of the recommended methods to temporarily "mulch" a seedbed are:

✓ Apply straw or hay at the rate of 2,500 pounds per acre;

✓ Coat the seedbed with a layer of one of the currently approved commercial hydraulic mulch at the rate of 3,000 pounds per acre; or

✓ Coat the seedbed with an organic tackifier according to the manufacturer's recommendations. (Call the Landscape Section in Austin for recommendations).

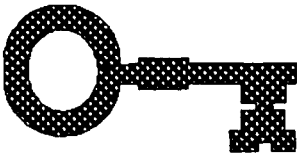
Are these methods foolproof? Nope! Even soil retention blankets, which are probably the best overall tool, may not work perfectly in every case. This certainly applies to the other techniques mentioned. However, any of the above techniques are far superior to simply allowing the seedbed to remain unprotected!

Seed Mixtures

Now let's discuss the various seed mixtures available to you through the standard spec.

One of the obvious things you'll notice is that it is a **mix** of several species of grass, and not a single species.

If you think about our rights-of-way at the scale of a grass seed, its apparent that there's lots of different conditions out there. There are sloped and flat areas, moderate to severe drainage ditches, different soils, different exposures, different nutrients available in soils, etc.



Key Point!

A single species of grass simply cannot be expected to survive and thrive in every situation.

Most of us are very familiar with wildflower season, and enjoy the color and beauty each spring. But think, for a moment about Bluebonnets.

Have you ever noticed Bluebonnets growing in a drainage ditch? If you haven't thought about it, check it out in your area next wildflower season. What you'll see is yellow flowers growing in the bottom of the drainage ditch and Bluebonnets growing higher up on the back slopes.

There will almost be a straight line where Bluebonnets stop and yellow flowers begin in a drainage ditch.

Bluebonnets simply cannot grow where their "feet are wet." They require good drainage. Many of the yellow flowers, however, thrive in the moist conditions within the drainage ditch itself.

The same concept holds true for our grass seeding mixture. The mixture was designed so that each individual species of grass could find its own "home" (sometimes called a "nitch") somewhere on the right-of-way. In combination, all of the seed work together to germinate, establish and cover the entire right-of-way regardless of the conditions.

Also, it should be recognized that the seed mix was developed based upon the Soil Conservation Service (SCS) recommendations for "Critical Area" seeding. The actual species are those the SCS has documented to occur most commonly in a particular county or geographic area.

The other factor which influenced the actual seed blend specified was the **commercial availability**. There's lots of excellent grass species, but not all of them are harvested commercially and commonly available. Given the quantity of seed the Department uses on an annual basis, commercial availability was an important factor.

While it's not important that you get tangled up with knowing scientific names or the individual growth characteristics of each of the grass species listed in our standard spec, TABLE 2 (which starts on page 31), was prepared to provide an overview for each of the grass species.

Seeding Rate

A common complaint you often hear about the rate specified in the standard spec is that it is too low. You'll notice that the total rate specified for the various districts in the standard spec varies from around 6 pounds pure live seed per acre to around 13 pounds pure live seed per acre.

A logical conclusion, considering that the actual cost of seed is a relatively minor cost item, would be to take the "if a little is good, then more will be better" approach and try to double or triple the seed rates.

Although it may seem logical, you only set yourself up for disaster if you follow this approach.

Think about it in terms of cows!

If you have ten acres of ground, (well fenced, hopefully), you could crowd 500 cows into the area.

You could also place 2 cows on that same ten-acre plot.

After a period of time, it's easy to see what you'll get.

The plot with 500 cows is going to require a ton of supplemental feed and water because each cow will be competing with every other cow for the available food and water. What might have been there originally will soon be depleted.

You'll have no choice but to provide supplemental food and water. In all probability, you'll still wind up with a bunch of skinny cows.

The plot with 2 cows is going to come out ahead. There's going to be plenty of food and water available for these 2 fortunate critters and, because they don't have the pressure of competition, they'll fatten up and grow nicely. You won't have to provide supplemental food or water either.

OK, corny analogy, but the same thing applies with grass seed.

Seed, like cows, are living, growing organisms which require a certain amount of food and water.

There's only a set, finite amount of food and water available on our seedbeds. The more seed you place on that seedbed, the more competition you create.

The recommended seeding rates were also based upon the Soil Conservation Service (SCS's) recommendations for "Critical Area" seeding.

They were also based upon trying to determine just how many seed would be placed on a 1-square foot area at a given rate to get a feel for the "competition" issue.

As noted in **TABLE 2**, some of the seeds are so small it takes 5 million to make a single pound. If we seeded with this particular seed alone at 1 pound to the acre, you would apply almost 115 seed to each square foot block. Since a square foot block contains 144 square inches, it also means that you would have almost one seed per square inch.

When you add in the remaining seed rates, you are provided with a realistic rate which will not create undue competition pressure, and gives you the best opportunity for the most thorough establishment of your vegetative cover.

You may have also noticed that Annual Rye was taken out of the seed mix. "How Come?" you ask.

Annual Rye proved to be more harmful than beneficial. Although it provides dense cover, it is highly competitive and crowds out most other species. If allowed to mature, it seriously interferes with efforts to establish permanent cover.

The substitutes of Foxtail Millet, Wheat, Oats and Barley, currently in the seed mix, still give you the quick growth, but do not persist and hinder efforts of establishing your subsequent permanent perennial warm-season cover.

Hopefully, this provides a good background on the seed mix and why;

- ✓ a certain species was selected;
- ✓ planting dates are important; and
- ✓ seeding rates were established.

TABLE 3 (which starts on page 36), shows the recommended seed mix and seed rate for all of the available seed types for each District.

SOIL RETENTION BLANKETS

Soil Retention Blankets are probably one of the most effective tools available when trying to revegetate sloped areas or areas which carry a concentrated flow of storm water.

The products are basically materials designed to be rolled out and secured to the area to be revegetated by stakes, staples or pins.

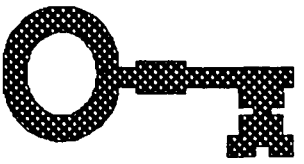
Soil Retention Blankets provide excellent seedbed protection from the erosive effects of rainfall events, resist the movement of sediment in a rainfall event, and perform the same function as a mulch.

Soil Retention Blankets are typically used in conjunction with Broadcast Seeding where a hydraulic seeding machine sprays the seed/fertilizer slurry onto the prepared seedbed, then the Soil Retention Blankets are secured to the area.

The Department has an extensive formal evaluation program and has developed a list of acceptable soil retention blankets for both "Slope Protection" applications and "Flexible Channel Liner" applications.

Further, the Department has issued Standard Plan sheets for Soil Retention Blankets (SRB) which show the Contractor or the Department exactly how a particular soil retention blanket is to be installed for the best results.

Each year, following the completion of the formal evaluation cycle, new products, which have met the Department's strict performance standards, will be added to the list available to Contractors and the Department.



Key Point!

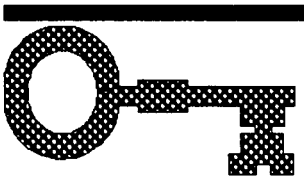
Soil Retention Blankets should always be used where you plan to seed an area 3:1 or steeper.

Soil Retention Blankets are also an effective tool to use when you are trying to stabilize an area which has been brought to "final lines and grades," but you're not in the planting window for the permanent, warm-season perennial seed mix.

The application of a Soil Retention Blanket will significantly reduce the amount of sediment which is lost from the area and may be overseeded at the appropriate time with your permanent seed mix.

For a handy discussion of how to use Item 169 "Soil Retention Blanket," call the Vegetation Management folks of the Construction and Maintenance Division and ask them to send you a copy of *Standard Specification Item 169 "Soil Retention Blanket," Guidelines for District Design and Construction Personnel."*

RESOURCES AVAILABLE:



Key Point!

Each District has a local Vegetation Manager.

Take the time to discuss your concerns with your local District Vegetation Manager. They can be a valuable resource in helping you solve and satisfy your revegetation problems.

Resources are available within the Vegetation Management Section of the Construction and Maintenance Division, as well as the Environmental Affairs Division.

AND IN CONCLUSION

As you can see, there are lots of ways to address the revegetation / sediment / erosion control issues you are faced with.

It is my hope that some of the items discussed in this guide will be given the opportunity to demonstrate their value to you on future projects. Most of all, I hope this guide will be viewed as a common-sense, "practical" aid to solving revegetation issues.

That was, after all, my original intent in writing the document.

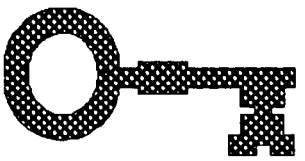
If the document is useful, please spread it around and share it with other folks involved in the same activities!

If you think that maybe it's not worth the paper it's written on, please give me call! Hopefully, I can revise it to include or reinforce some of the things you feel were left out.

On **TABLE 4**, (which starts on page 85), I've tried to pull everything into a single chart. On this Table, I make recommendations where I feel each of the various activities should be used and give an estimate of what the current costs should be.

And finally...

THE BOTTOM LINE



THE MASTER KEY!!!!

... is to establish a dense cover of permanent, warm season, perennial vegetation.

Through the consistent application of the tools, techniques and tips discussed in this document, you stand the best chance of achieving this goal.

TABLE 1

PLANTING DATES FOR AVAILABLE SEED MIXTURES
(Clarification to Item 164 "Seeding for Erosion Control")

TABLE 1
PLANTING DATES FOR AVAILABLE SEED MIXES

DIST	URBAN OR RURAL WARM[1]	TEMPORARY WARM	TEMPORARY COOL	LEGUMES	NO SEEDING
1	2/1 to 5/15	5/15 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 1/31
2	2/1 to 5/1	5/1 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 1/31
3	2/1 to 5/1	5/1 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 1/31
4	2/15 to 5/15	5/15 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 2/14
5	2/15 to 5/15	5/15 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 2/14
6	2/1 to 5/15	5/15 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 2/14
7	2/1 to 5/1	5/1 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 1/31
8	2/1 to 5/15	5/15 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 1/31
9	2/1 to 5/15	5/15 to 8/31	9/1 to 11/30	8/15 to 11/30	12/1 to 1/31
10	2/1 to 5/15	5/15 to 8/31	9/1 to 11/30	8/15 to 11/30	12/1 to 1/31
11	2/15 to 5/15	5/15 to 8/31	9/1 to 11/30	8/15 to 11/30	12/1 to 2/14
12	1/15 to 5/15	5/15 to 8/31	9/1 to 11/30	8/15 to 11/30	12/1 to 1/14
13	1/15 to 5/15	5/15 to 8/31	9/1 to 11/30	9/1 to 11/30	12/1 to 1/14
14	2/1 to 5/15	5/15 to 8/31	9/1 to 11/30	9/1 to 11/30	12/1 to 1/31
15	2/1 to 5/1	5/1 to 8/31	9/1 to 11/30	9/1 to 11/30	12/1 to 1/31
16	1/15 to 5/1	5/1 to 8/31	9/1 to 11/30	9/1 to 11/30	12/1 to 1/14
17	2/1 to 5/15	5/15 to 8/31	9/1 to 11/30	8/15 to 11/30	12/1 to 1/31
18	2/1 to 5/1	5/1 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 1/31
19	2/1 to 5/15	5/15 to 8/31	9/1 to 11/30	8/15 to 11/30	12/1 to 1/31
20	1/15 to 5/15	5/15 to 8/31	9/1 to 11/30	8/15 to 11/30	12/1 to 1/14
21	1/15 to 5/1	5/1 to 8/31	9/1 to 11/30	9/1 to 11/30	12/1 to 1/14
23	2/1 to 5/15	5/15 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 1/31
24	2/1 to 5/1	5/1 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 1/31
25	2/1 to 5/15	5/15 to 8/31	8/15 to 11/30	8/15 to 11/30	12/1 to 1/31

[1] Permanent, perennial seed mix necessary to satisfy requirements of NPDES.

TABLE 2

DISCUSSION OF AVAILABLE SEED SPECIES
(Clarification to Item 164 "Seeding for Erosion Control")

TABLE 2
DISCUSSION OF AVAILABLE SEED SPECIES

Scientific Name	Common Name	Comments
Agropyron smithii (Ag-ro-PIE-ron SMITH-e-i)	Western Wheatgrass	A **native, cool-season perennial bunch grass** which spreads through underground stems (rhizomes) and from seed. Typically produces a seedhead in June and goes dormant in mid-summer. This species does best on low areas of heavy soils where runoff water accumulates. It spreads slowly but cannot thrive under heavy mowing operations.
Andropogon hallii (An-dro-PO-gon HALL-e-i)	Sand Bluestem	A **native, warm-season perennial bunch grass** which spreads by seed and rhizomes. Typically produces a seedhead in August to October. It grows best on loamy to sandy soils. An excellent grass species for the more arid portions of the State. Can withstand closer mowing than some of the other bunch grasses.
Avena sativa (Ah-VEE-na Sah-TEE-vuh)	Oats	An **introduced, cool-season annual bunch grass** used for temporary erosion control.
Bothriochloa ischaemum (Both-ree-o-KLO-uh Ish-ee-mum)	K.R. Bluestem	A **native, warm-season perennial bunch grass** which is leafy and deep-rooted. It prefers medium fine-textured soils, but does well on sandy soils as well. Best sources indicate the species was introduced into California from China in 1917, but was not noticed until 1937 on the King Ranch (hence the name).
Bouteloua curtipendula (Boo-teh-LOU-uh Kur-teh-PEN-dew-luh)	Sideoats Grama	A **native, warm-season perennial bunch grass** which spreads from rhizomes. Typically produces a seedhead during June through September which is 18 to 36 inches in height. It grows on well drained areas, shallow ridges and rocky areas, but can be found on soils ranging from deep to very shallow. It will gradually decrease if mowed closer than 2 to 3 inches during the growing season. State grass of Texas!
Bouteloua eriopoda (Boo-teh-LOU-uh Ear-e-PO-duh)	Black Grama	A **native, warm-season perennial bunch grass** which produces a seedhead from June through October. Typically found from south-central Texas, into the Panhandle and into West Texas. Works well on dry slopes and plains.
Bouteloua gracilis (Boo-teh-LOU-uh GRASS-uh-lis)	Blue Grama	A **native, warm-season perennial bunch grass** which grows erect in definite bunches and reproduces only by seed. A short species which typically grows only from 10 to 20 inches high. The mature seedhead usually forms a curve which resembles the human eyebrow. Withstands extreme drought conditions. Will decrease when mowed below 3 inches during the growing season. Widely adapted to different soils types including alkaline soils.
Buchloe dactyloides (BOO-klo-uh Dak-tee-LOY-dees)	Buffalograss	A **native, warm-season, perennial, sod-forming (turf) grass** that reproduces by seed and vigorous surface runners (stolons). Low growing species seldom more than 5 inches tall. Withstands close mowing well, however it is more vigorous when mowed higher than 3 inches. An excellent species especially in those areas which are not sandy.

TABLE 2
DISCUSSION OF AVAILABLE SEED SPECIES

Scientific Name	Common Name	Comments
Cenchrus ciliaris (SIN-kruhs Sil-e-AIR-is)	Buffelgrass	An **introduced, warm-season, perennial bunch grass** common on sandy soils amd semi-disturbed sites in the South Texas Area. Produces seed from early spring till late autumn under favorable growing conditions.
Cynodon dactylon (SI-no-dun DAK-te-lawn)	Bermudagrass	An **introduced, warm-season, perennial sod-forming (turf) grass** which spreads primarily by above ground stems (stolons), but also by seed and by rhizomes. An excellent, all-around turfgrass which grows throughout Texas on any moderately well-drained soil, whether acid or alkaline, provided adequate moisture and food are present.
Eragrostis trichodes (Err-uh-GRAUS-tes Tri-KOY-dees)	Sand Lovegrass	A **native, warm-season, perennial bunch grass** which spreads by seed and sometimes by rooting at the nodes of the base stems. It is a tall plant with seedheads from 2 to 5 feet produced in the early fall. Produces a dense deep root system. Grows best on sandy soils but can often be found on heavier soils. This species decreases rapidly when mowed closer than 5 inches.
Festuca arundinaceae (Fes-TOO-kuh A-RUN-di-NAY-cee)	Tall Fescue	A **native, cool-season, agressive, perennial bunch grass** which grows to a typical height of 3 to 4 feet. It spreads by tillering (short shoot development) which develops a uniform thick sod. It has a heavy, fibrous root system which penetrates the soil as much as 5 feet.
Hordeum vulgare (HOR-de-um Vul-GAR-e)	Barley	An **introduced, cool-season annual bunch grass** used for temporary erosion control.
Leptochloa dubia (Lep-toe-KLO-uh DOO-be-uh)	Green Sprangletop	A **native, warm-season, tufted perennial bunchgrass** with a firm base but without stolons or rhizomes. Produces a seed head during May to November. A very important element in our seed mix because it serves as a **nurse grass** for all the other warm-season perennial seed species. It's primary purpose is to provide initial erosion-control stabilization and cover and to modify the seedbed so that the other species can grow and flourish. Normally exists for only two growing seasons.
Panicum virgatum (PAN-uh-kum Vur-GATE-um)	Switchgrass	A **native, warm-season, perennial bunchgrass** with vigorous roots which spreads from rhizomes and from seed. Best adapted to lower areas of moist soils, but is winter-hardy and drouth-resistant. It decreases under heavy mowing closer than 5 inches.
Paspalum notatum (Pas-PAY-lum No-TAUT-um)	Bahiagrass	An **introduced, warm-season, dense, tufted perennial bunchgrass** that grows from 1 to 2½ feet tall. Spreads by seed and also vegetatively by short, heavy runners. Forms a dense, heavy sod even on droughty, sandy soils. Adaptive to both heavy and sandy soils.
Schizachyrium scoparium (Shi-ZAH-uh-kree-um Sko-PAIR-e-um)	Little Bluestem	A **native, warm-season, perennial bunchgrass** which grows from 2-4 feet tall. Produces a seedhead from August to December. Decreases with heavy mowing. **Insure that seed furnished was of Texas origin only.**

TABLE 2
DISCUSSION OF AVAILABLE SEED SPECIES

Scientific Name	Common Name	Comments
Setaria italica (See-TAIR-e-uh I-TAL-i-kuh)	Foxtail Millet	An **introduced, warm-season annual bunchgrass** used for temporary erosion control.
Sorghastrum avenaceum (Sor-GAS-trum A-vee-NAY-ce-um)	Indiangrass	A **native, warm-season, perennial bunchgrass** which spreads both from seed and from short underground rhizomes. Produces tall (4-8 feet) seedheads. Decreases under mowing closer than 5 inches. May form patches of sod and may also occur in bunches. Readily establishes in disturbed sites.
Sporobolus cryptandrus (Spor-ROB-o-lus Krip-TAN-drus)	Sand Dropseed	A **native, warm-season perennial bunchgrass** that grows in rather small tufts or bunches. It spreads from seed and the old bunches spread by tillering. Growth begins in early spring and seed heads appear about September on stems 1 to 3 feet tall. Grows well on sandy, open soils. Moves in quickly on disturbed soils. Although it has very tiny seed (5,000,000+ per pound), many of the seed are "hardseed" and do not germinate well unless softened by acid or scarifying.
Triticum aestivum (TRIT-ih-kum Ess-TEE-vum)	Wheat	An **introduced, cool-season annual bunch grass** used for temporary erosion control.
Trifolium incarnatum (Tri-FO-le-um In-kar-NAY-tum)	Crimson Clover	An **introduced, cool-season legume** used for temporary erosion control. Provides the added benefit of beautiful red seedheads.
Melilotus officinalis (Mel-ih-LO-tus O-FISH-e-uh-nal-is)	Yellow Sweetclover	An **introduced, cool-season legume** used for temporary erosion control.
Chloris guyana (KLO-ris GUY-an-uh)	Rhodesgrass	An **introduced, warm-season perennial bunchgrass** with stems growing from a leafy base. Often spreads by long stolons which root at the leafy nodes. Grows on bottomlands.
Setaria macrostachya (See-TAIR-e-uh MAK-ro-STACH-ya)	Plains Bristlegrass	A **native, warm-season bunchgrass** which normally displays a pale green color. Grows in open, dry ground.
Vicia villosa (VEESH-e-uh Vih-LO-sa)	Hairy Vetch	An **introduced, cool-season legume** used for temporary erosion control.

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TABLE 3

STANDARD SEED MIXES, DATES AND RATES
(Clarification to Item 164 "Seeding for Erosion Control")
and
AVERAGE ANNUAL RAINFALL AND TEMPERATURE DATA

RURAL AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils				Mixture for Sandy Soils	
Dist	**Dates**	**(Eastern Sections)**		**(Western Sections)**		**(All Sections)**	
1	Feb 1 to May 15	Green Sprangletop Bermudagrass Little Bluestem Indiangrass (Lometa) **Total:**	0.9 1.2 1.7 2.3 === 6.1	Green Sprangletop Bermudagrass Little Bluestem Indiangrass (Lometa) Switchgrass (Alamo or Blackwell) === **Total:**	0.7 0.9 1.4 1.8 1.4 6.2	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) **Total:**	1.1 1.5 6.7 === 9.3

URBAN AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils		Mixture for Sandy Soils	
Dist	**Dates**	**(All Sections)**		**(All Sections)**	
1	Feb 1 to May 15	Green Sprangletop Bermudagrass === **Total:**	1.7 2.3 4.0	Green Sprangletop Bermudgrass === **Total:**	1.7 2.3 4.0

TEMPORARY COOL-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	**Dates**	**(All Sections)**	
1	Aug 15 to Nov 30	Tall Fescue Western Wheatgrass Wheat (Red, Winter) ==== **Total:**	4.0 5.0 30.0 39.0

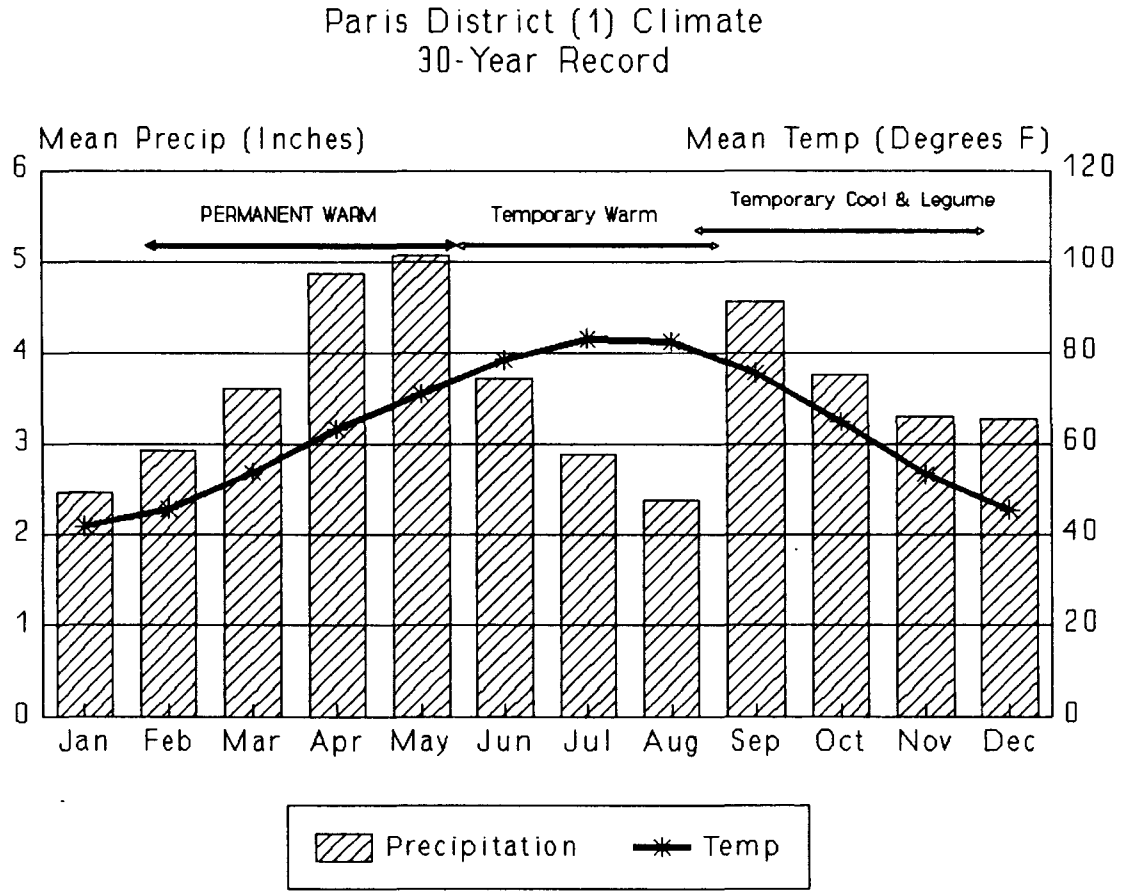
TEMPORARY COOL-SEASON LEGUME SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	**Dates**	**(All Sections)**	
1	Aug 15 to Nov 30	Crimson Clover === **Total:**	7.0 7.0

TEMPORARY WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
1	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils				Mixture for Sandy Soils	
Dist	**Dates**	**(Eastern Sections)**		**(Western Sections)**		**(All Sections)**	
2	Feb 1 to May 1	Green Sprangletop	0.6	Green Sprangletop	0.6	Green Sprangletop	0.7
		Sideoats Grama (El Reno)	1.8	Sideoats Grama (Haskell or El Reno)	1.8	Sideoats Grama (Haskell)	2.2
		Bermudagrass	0.8	Little Bluestem	1.1	Bermudagrass	0.9
		Little Bluestem	1.1	Indiangrass (Lometa or Cheyenne)	1.5	Little Bluestem	1.4
		K-R Bluestem	0.7	K-R Bluestem	0.7	Sand Dropseed	0.2
		Switchgrass	1.2	Switchgrass (Alamo or Blackwell)	1.2		
		Total:	6.2	**Total:**	6.9	**Total:**	5.4

URBAN AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils				Mixture for Sandy Soils	
Dist	**Dates**	**(Eastern Sections)**		**(Western Sections)**		**(All Sections)**	
2	Feb 1 to May 1	Green Sprangletop	0.9	Green Sprangletop	1.1	Green Sprangletop	1.1
		K-R Bluestem	1.0	K-R Bluestem	1.3	K-R Bluestem	1.3
		Bermudagrass	1.2	Buffalograss	10.7	Bermudagrass	1.5
		Buffalograss	8.0				
		Total:	11.1	**Total:**	13.1	**Total:**	3.9

TEMPORARY COOL-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	**Dates**	**(All Sections)**	
2	Aug 15 to Nov 30	Tall Fescue	4.0
		Western Wheatgrass	5.0
		Wheat (Red, Winter)	30.0
		Total:	39.0

TEMPORARY COOL-SEASON LEGUME SEEDING RATE: In Pounds, Pure Live Seed (PLS)

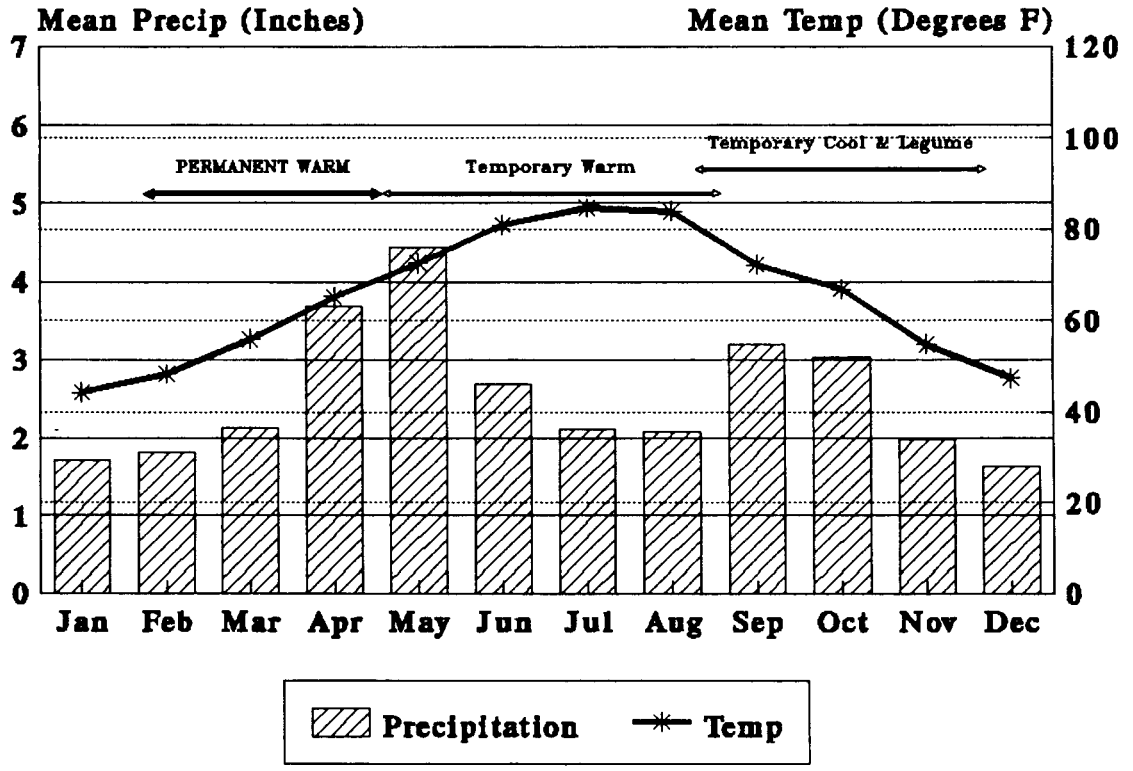
Dist	Dates	(All Sections)	
2	Aug 15 to Nov 30	Crimson Clover **Total:**	7.0 === 7.0

TEMPORARY WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
2	May 1 to Aug 31	Foxtail Millet **Total:**	30.0 === 30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.

Fort Worth District (2) Climate
30-Year Record



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils				Mixture for Sandy Soils	
Dist	**Dates**	**(Eastern Sections)**		**(Western Sections) (i.e. Clay Co. West)**		**(All Sections)**	
3	Feb 1 to May 1	Green Sprangletop	0.7	Green Sprangletop	0.7	Green Sprangletop	0.6
		Sideoats Grama (El Reno)	2.2	Sideoats Grama (El Reno)	2.2	Sideoats Grama (El Reno)	1.8
		Bermudagrass	0.9	Blue Grama (Lovington)	0.6	Bermudagrass	0.8
		Buffalograss	6.4	Buffalograss	6.4	Little Bluestem	1.1
		Western Wheatgrass*	2.8	Western Wheatgrass*	2.8	Sand Dropseed	0.2
						Sand Bluestem*	0.2
		Total:	13.0	**Total:**	12.7	**Total:**	4.7

* Seed Western Wheatgrass between September 1 and February 28.
Use "Woodward" variety of Sand Bluestem in the Rolling Plans (including the Canadian River Valley) and "Elida" variety of Sand Bluestem in the High Plains.

URBAN AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils				Mixture for Sandy Soils	
Dist	**Dates**	**(Eastern Sections)**		**(Western Sections)**		**(All Sections)**	
3	Feb 1 to May 1	Green Sprangletop	1.1	Green Sprangletop	0.9	Green Sprangletop	1.1
		Bermudagrass	1.5	Sideoats Grama (El Reno)	2.8	Bermudagrass	1.5
		Buffalograss	10.7	Western Wheatgrass	3.5	Sand Dropseed	0.4
				Buffalograss	8.0		
		Total:	13.3	**Total:**	15.2	**Total:**	3.0

TEMPORARY COOL-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	**Dates**	**(All Sections)**	
3	Aug 15 to Nov 30	Tall Fescue	4.0
		Western Wheatgrass	5.0
		Wheat (Red, Winter)	30.0
		Total:	39.0

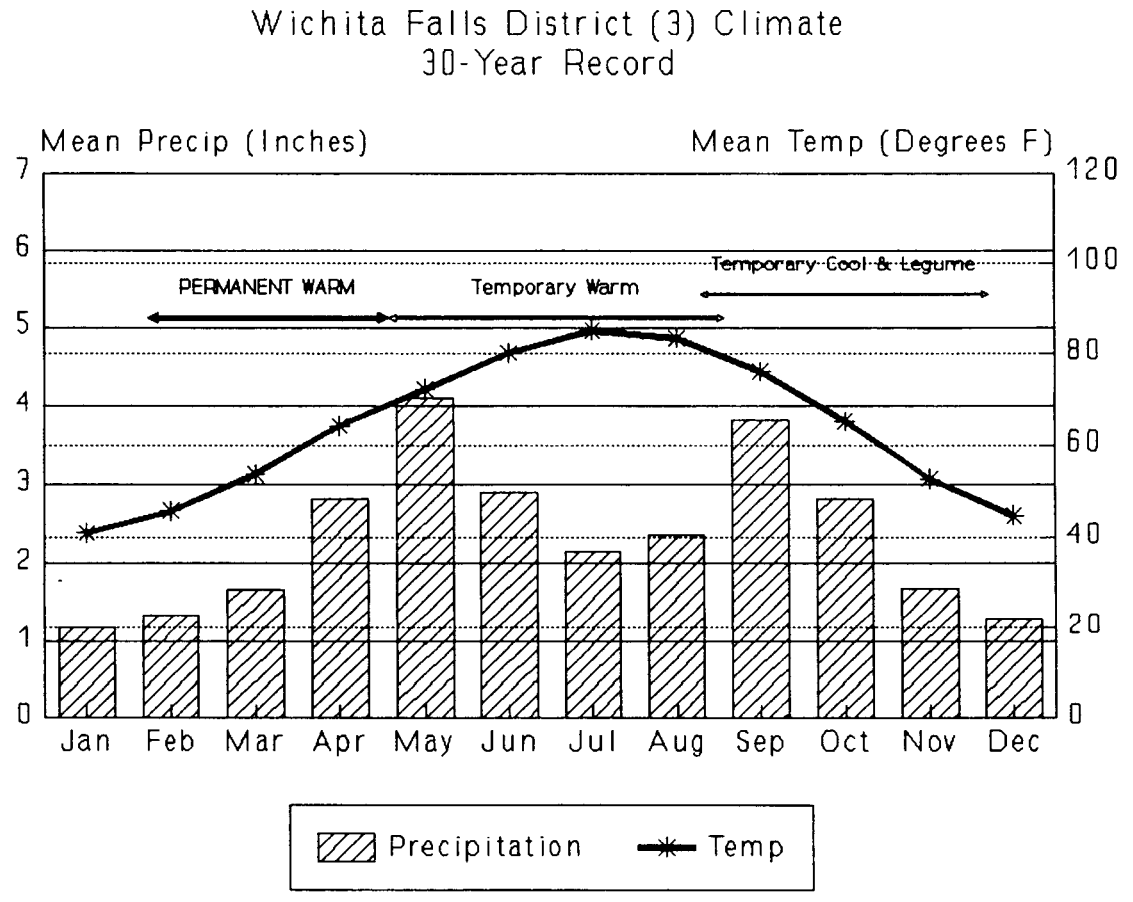
TEMPORARY COOL-SEASON LEGUME SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
3	Aug 15 to Nov 30	Crimson Clover	7.0
		Total:	7.0

TEMPORARY WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
3	May 1 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils		Mixture for Sandy Soils	
Dist	**Dates**	**(All Sections)**		**(All Sections)**	
4	Feb 15 to May 15	Green Sprangletop	0.9	Green Sprangletop	0.7
		Sideoats Grama (El Reno)	2.8	Sideoats Grama (El Reno)	2.2
		Blue Grama (Lovington)	0.8	Blue Grama (Lovington)	0.6
		Buffalograss	8.0	Sand Dropseed	0.2
			===	Sand Bluestem*	0.2
					===
		Total:	12.5	**Total:**	3.9

* Use "Woodward" variety of Sand Bluestem in the Rolling Plans (including the Canadian River Valley), and "Elida" variety of Sand Bluestem in the High Plains.

URBAN AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils		Mixture for Sandy Soils	
Dist	**Dates**	**(All Sections)**		**(All Sections)**	
4	Feb 15 to May 15	Green Sprangletop	0.9	Green Sprangletop	0.9
		Sideoats Grama (El Reno)	2.8	Sideoats Grama (El Reno)	2.8
		Blue Grama (Lovington)	0.8	Blue Grama (Lovington)	0.8
		Buffalograss	8.0	Sand Dropseed	0.3
			====		===
		Total:	12.5	**Total:**	4.8

TEMPORARY COOL-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	**Dates**	**(All Sections)**	
4	Aug 15 to Nov 30	Tall Fescue	4.0
		Western Wheatgrass	5.0
		Wheat (Red, Winter)	30.0
			====
			39.0

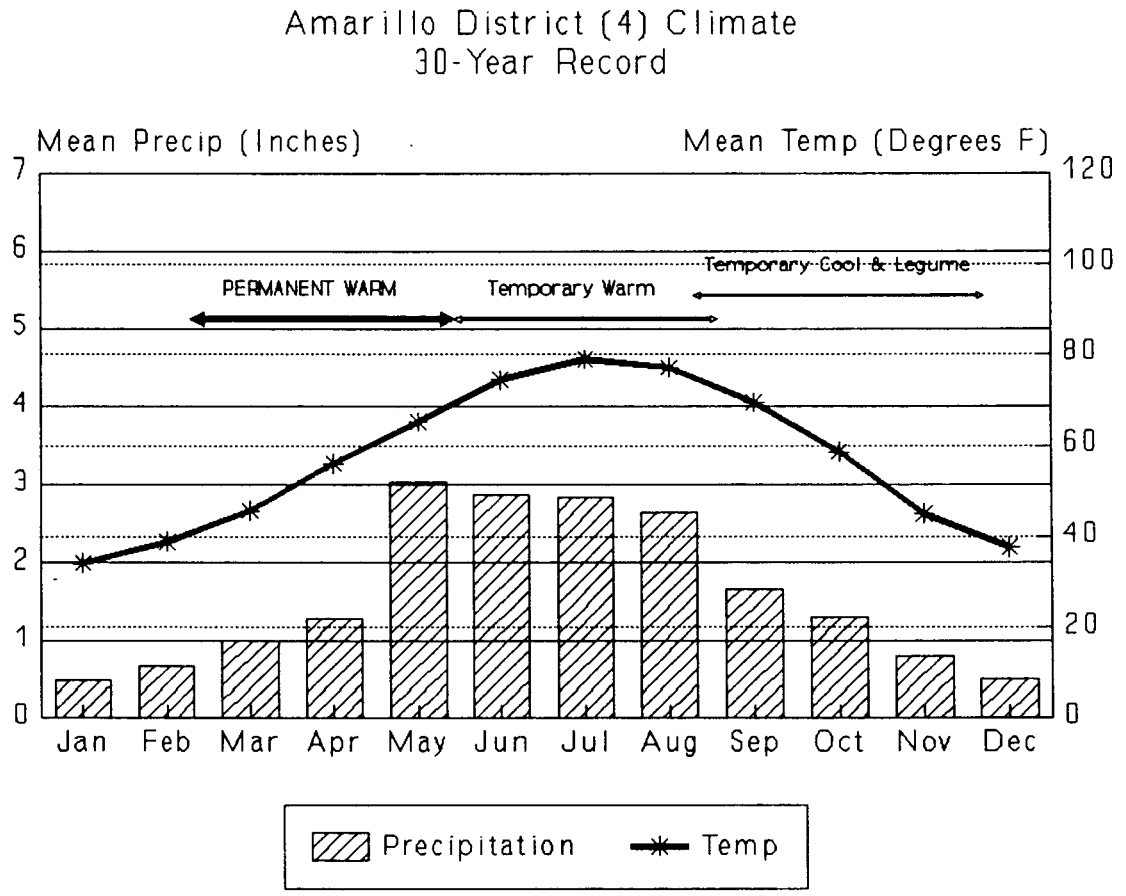
TEMPORARY COOL-SEASON LEGUME SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
4	Aug 15 to Nov 30	Yellow Sweetclover	4.0
		Total:	4.0

TEMPORARY WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
4	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils				Mixture for Sandy Soils	
Dist	**Dates**	**(East of IH 27)**		**(West of IH 27)**		**(All Sections)**	
5	Feb 15 to May 15	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Lovington) Buffalograss **Total:**	0.9 2.8 0.8 8.0 === 12.5	Green Sprangletop Sideoats Grama (Coronado) Blue Grama (Lovington) Buffalograss **Total:**	0.9 2.8 0.8 8.0 ==== 12.5	Green Sprangletop Sideoats Grama (Coronado) Blue Grama (Lovington) Sand Dropseed Sand Bluestem* **Total:**	0.7 2.2 0.6 0.2 0.2 === 3.9

* Use "Woodward" variety of Sand Bluestem in the Rolling Plains (including the Canadian River Valley) and "Elida" variety of Sand Bluestem in the High Plains.

URBAN AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils		Mixture for Sandy Soils	
Dist	**Dates**	**(All Sections)**		**(All Sections)**	
5	Feb 15 to May 15	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Lovington) Buffalograss **Total:**	0.9 2.8 0.8 8.0 ==== 12.5	Green Sprangletop Sideoats Grama (Coronado) Blue Grama (Lovington) Sand Dropseed **Total:**	0.9 2.8 0.8 0.3 === 4.8

TEMPORARY COOL-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	**Dates**	**(All Sections)**	
5	Aug 15 to Nov 30	Tall Fescue Western Wheatgrass Wheat (Red, Winter) **Total:**	4.0 5.0 30.0 ==== 39.0

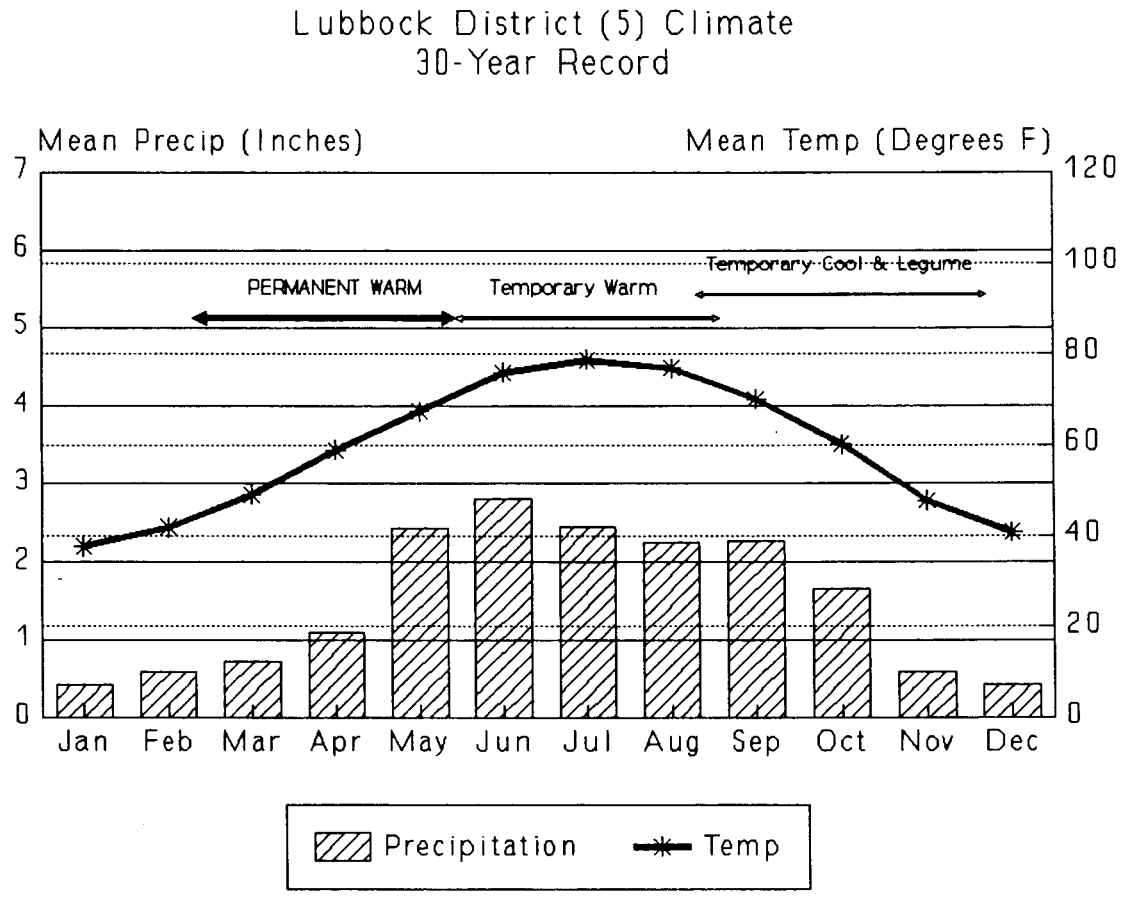
TEMPORARY COOL-SEASON LEGUME SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
5	Aug 15 to Nov 30	Yellow Sweetclover	4.0
		Total:	4.0

TEMPORARY WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
5	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils				Mixture for Sandy Soils	
Dist	**Dates**	**(North of Pecos River)**		**(South of Pecos River)**		**(All Sections)**	
6	Feb 1 to May 15	Green Sprangletop	0.7	Green Sprangletop	0.9	Green Sprangletop	0.6
		Sideoats Grama (Premier or Uvalde)	2.2	Sideoats Grama (Premier or Tucson)	2.8	Black Grama	0.3
		Black Grama	0.4	Black Grama	0.5	Blue Grama (Hachita)	0.5
		Blue Grama (Hachita)	0.6	Blue Grama	0.8	Little Bluestem	1.1
		Little Bluestem	1.4		====	Sand Dropseed	0.2
			===			Sand Bluestem	0.2
		Total:	5.3	**Total:**	5.0		===
						Total:	2.9

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed (PLS)

		Mixture for Clay or Tight Soils		Mixture for Sandy Soils	
Dist	**Dates**	**(All Sections)**		**(All Sections)**	
6	Feb 1 to May 15	Green Sprangletop	0.9	Green Sprangletop	0.9
		Black Grama	0.5	Black Grama	0.5
		Blue Grama (Hachita)	0.8	Blue Grama (Hachita)	0.8
		Sideoats Grama*	2.8	Sand Dropseed	0.3
			====		===
		Total:	5.0	**Total:**	4.8

* North of the Pecos River, use either "Premier" or "Uvalde" varieties of Sideoats Grama. South of the Pecos River use either "Premier" or ""Tucson" varieties.

TEMPORARY COOL-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	**Dates**	**(All Sections)**	
6	Aug 15 to Nov 30	Western Wheatgrass	7.5
		Wheat (Red, Winter)	45.0
			====
			52.5

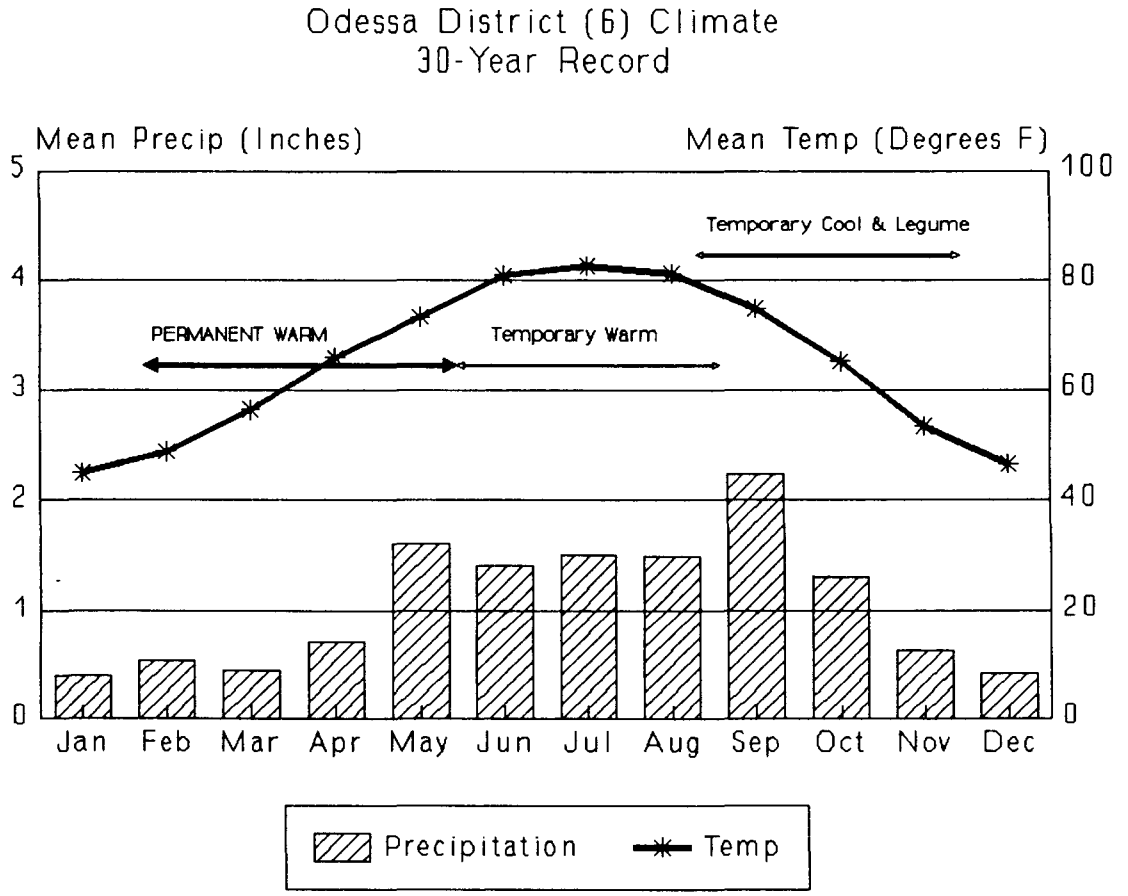
TEMPORARY COOL-SEASON LEGUME SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
6	Aug 15 to Nov 30	Yellow Sweetclover	4.0
		Total:	4.0

TEMPORARY WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
6	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
7	Feb 1 to May 1	Green Sprangletop	0.7	Green Sprangletop	0.7
		Sideoats Grama (Haskell)	2.2	Sideoats Grama (Haskell)	2.2
		Buffalograss	6.4		
		Little Bluestem	1.4	Little Bluestem	1.4
		K-R Bluestem	0.8	K-R Bluestem	0.8
			====	Sand Dropseed	0.2
					===
		Total:	11.5	**Total:**	5.3

URBAN AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
7	Feb 1 to May 1	Green Sprangletop	0.9	Green Sprangletop	0.9
		Buffalograss	8.0	K-R Bluestem	1.0
		K-R Bluestem	1.0	Sand Dropseed	0.3
		Sideoats Grama (Haskell)	2.8	Sideoats Grama (Haskell)	2.8
			====		===
		Total:	12.7	**Total:**	4.7

TEMPORARY COOL-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
7	Aug 15 to Nov 30	Western Wheatgrass	7.5
		Wheat (Red, Winter)	45.0
			====
			52.5

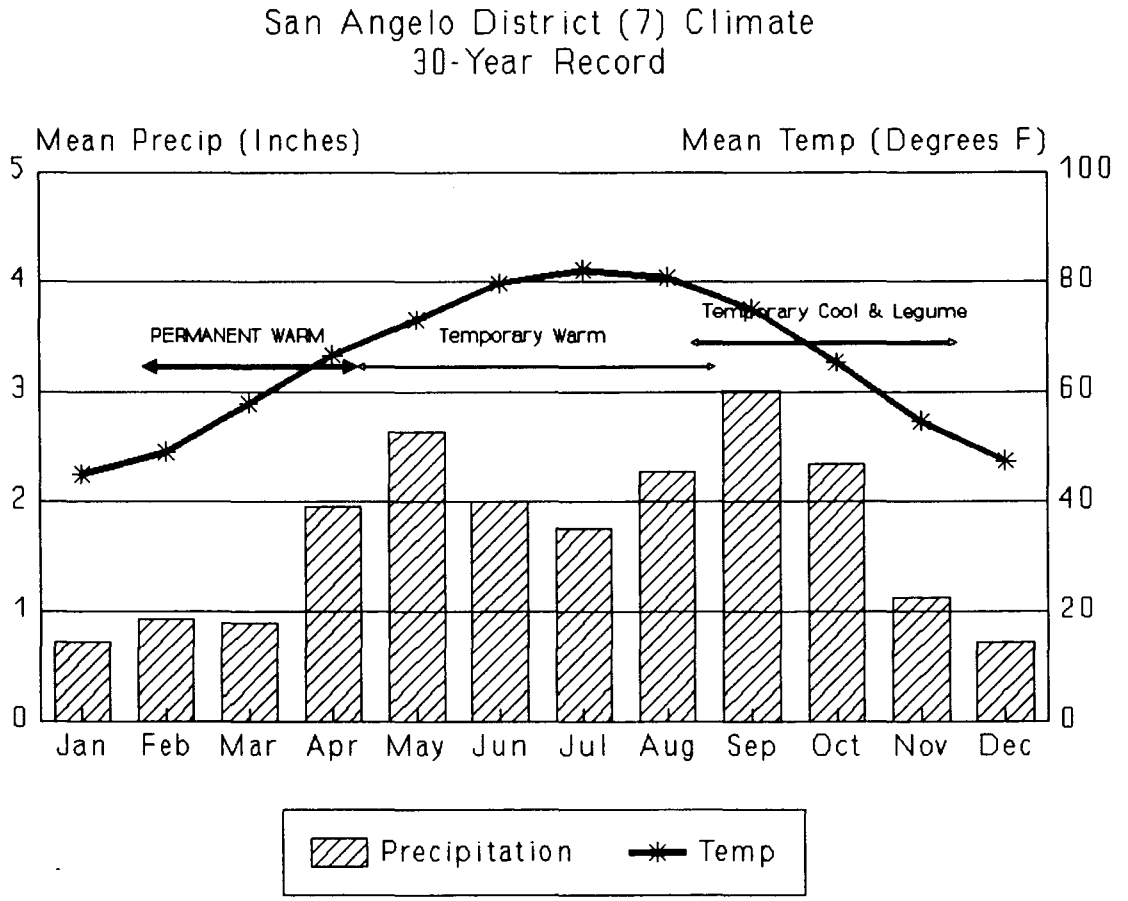
TEMPORARY COOL-SEASON LEGUME SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
7	Aug 15 to Nov 30	Yellow Sweetclover	4.0
			===
		Total:	4.0

TEMPORARY WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
7	May 1 to Aug 31	Foxtail Millet	30.0
			====
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	Mixture for Clay or Tight Soils (N., W. & E of and Including Fisher Co.)		Mixture for Clay or Tight Soils (South of Fisher County)		Mixture for Sandy Soils (All Sections)	
8	Feb 1 to May 15	Green Sprangletop	0.9	Green Sprangletop	0.9	Green Sprangletop	0.7
		Sideoats Grama (Haskell)	2.8	Sideoats Grama (Haskell)	2.8	Sideoats Grama (Haskell)	2.2
		Buffalograss	8.0	Buffalograss	8.0	K-R Bluestem	0.8
		Blue Grama (Hachita)	0.8	Little Bluestem	1.7	Sand Dropseed	0.2
			====		====	Sand Bluestem*	0.2
							====
		Total:	12.5	Total:	13.4	Total:	4.1

* Use "Woodward" variety of Sand Bluestem in the Rolling Plains (including the Canadian River Valley) and "Elida" variety of Sand Bluestem in the High Plains.

URBAN AREA WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
8	Feb 1 to May 15	Green Sprangletop	0.7	Green Sprangletop	0.9
		Buffalograss	6.4	Sand Dropseed	0.3
		Sideoats Grama (Haskell)	2.2	Sideoats Grama (Haskell)	2.8
		K-R Bluestem	0.8	K-R Bluestem	1.0
		Blue Grama (Hachita)	0.6		===
			====		
		Total:	10.7	Total:	5.0

TEMPORARY COOL-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
8	Aug 15 to Nov 30	Tall Fescue	4.0
		Western Wheatgrass	5.0
		Wheat (Red, Winter)	30.0
			====
			39.0

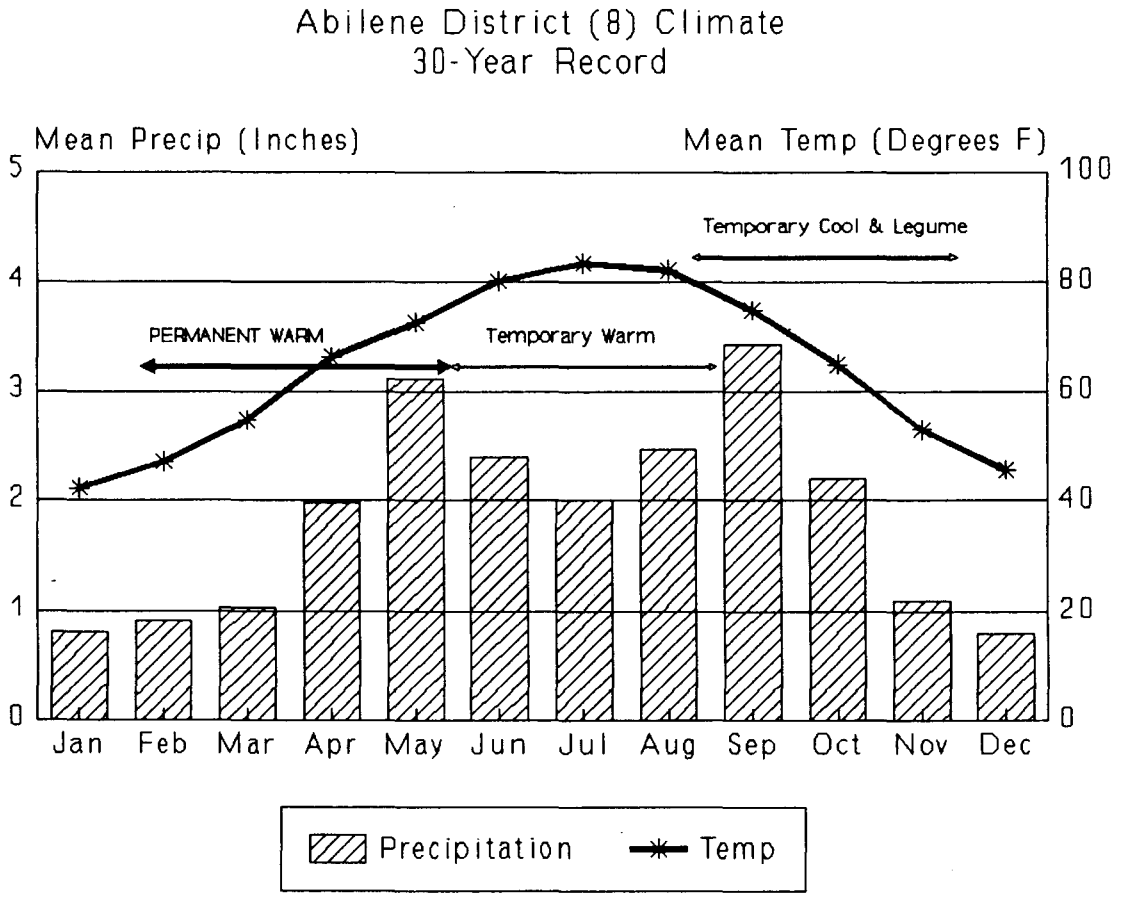
TEMPORARY COOL-SEASON LEGUME SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
8	Aug 15 to Nov 30	Yellow Sweetclover	4.0
		Total:	4.0

TEMPORARY WARM-SEASON SEEDING RATE: In Pounds, Pure Live Seed (PLS)

Dist	Dates	(All Sections)	
8	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (East of IH 35)		Mixture for Clay or Tight Soils (West of IH 35)		Mixture for Sandy Soils (All Sections)	
9	Feb 1 to May 15	Green Sprangletop	0.6	Green Sprangletop	0.6	Green Sprangletop	0.9
		Bermudagrass	0.8	Sideoats Grama	1.8	Bermudagrass	1.2
		Little Bluestem	1.1	(Haskell or Premier)		K-R Bluestem	1.0
		Indiangrass	1.5	Buffalograss	5.3	Sand Dropseed	0.3
		(Lometa)		Little Bluestem	1.1		====
		K-R Bluestem	0.7	K-R Bluestem	0.7		
		Switchgrass	1.2	Switchgrass	1.2		
		(Alamo)	====	(Alamo)	====		
		Total:	5.9	**Total:**	10.7	**Total:**	3.4

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (East of IH 35)		Mixture for Clay or Tight Soils (West of IH 35)		Mixture for Sandy Soils (All Sections)	
9	Feb 1 to May 15	Green Sprangletop	0.9	Green Sprangletop	0.9	Green Sprangletop	0.7
		Bermudagrass	1.2	Sideoats Grama	2.8	Bermudagrass	0.9
		K-R Bluestem	1.0	(Premier or Haskell)		Sideoats Grama	2.2
		Buffalograss	8.0	K-R Bluestem	1.0	(Premier or Haskell)	
			====	Buffalograss	8.0	K-R Bluestem	0.8
					====	Sand Dropseed:	0.2
							====
		Total:	11.1	**Total:**	12.7	**Total:**	4.8

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
9	Sep 1 to Nov 30	Tall Fescue	4.0
		Oats*	21.0
		Wheat (Red, Winter)	30.0
			====
			55.0

* May substitute Barley at 72.0 lb./acre divided by the number of species in the mix.

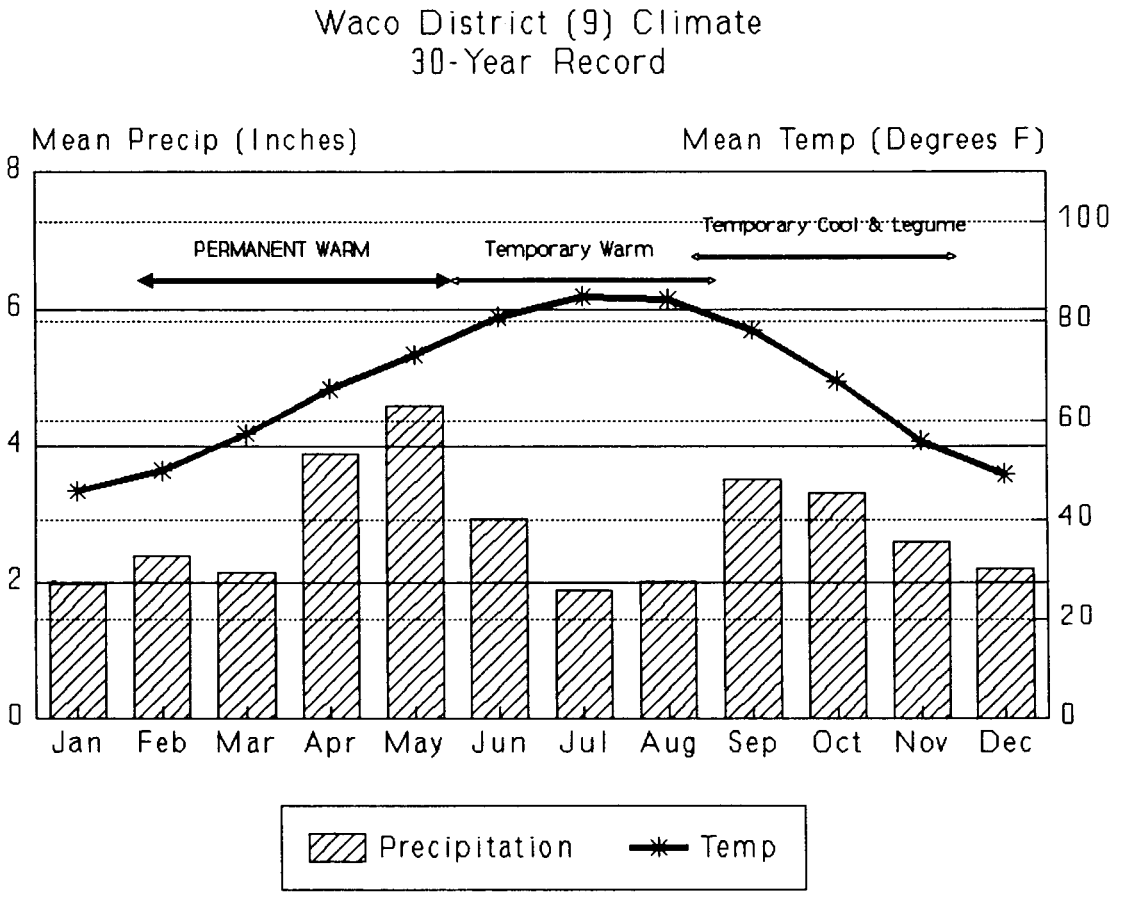
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
9	Aug 15 to Nov 30	Crimson Clover	7.0
		Total:	7.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
9	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
10	Feb 1 to May 15	Green Sprangletop	0.7	Green Sprangletop	1.7
		Bermudagrass	0.9	Bermudagrass	2.3
		Little Bluestem	1.4		====
		Indiangrass (Lometa)	1.8		
		Switchgrass (Alamo)	1.4		
			====		
		Total:	6.2	**Total:**	4.0

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
10	Feb 1 to May 15	Green Sprangletop	1.7	Green Sprangletop	1.7
		Bermudagrass	2.3	Bermudagrass	2.3
			====		====
		Total:	4.0	**Total:**	4.0

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
10	Sep 1 to Nov 30	Tall Fescue	4.0
		Oats *	21.0
		Wheat (Red, Winter)	30.0
		* (May substitute Barley at 72.0 lb/acre divided by the number of species in the mix)	====
		Total:	55.0

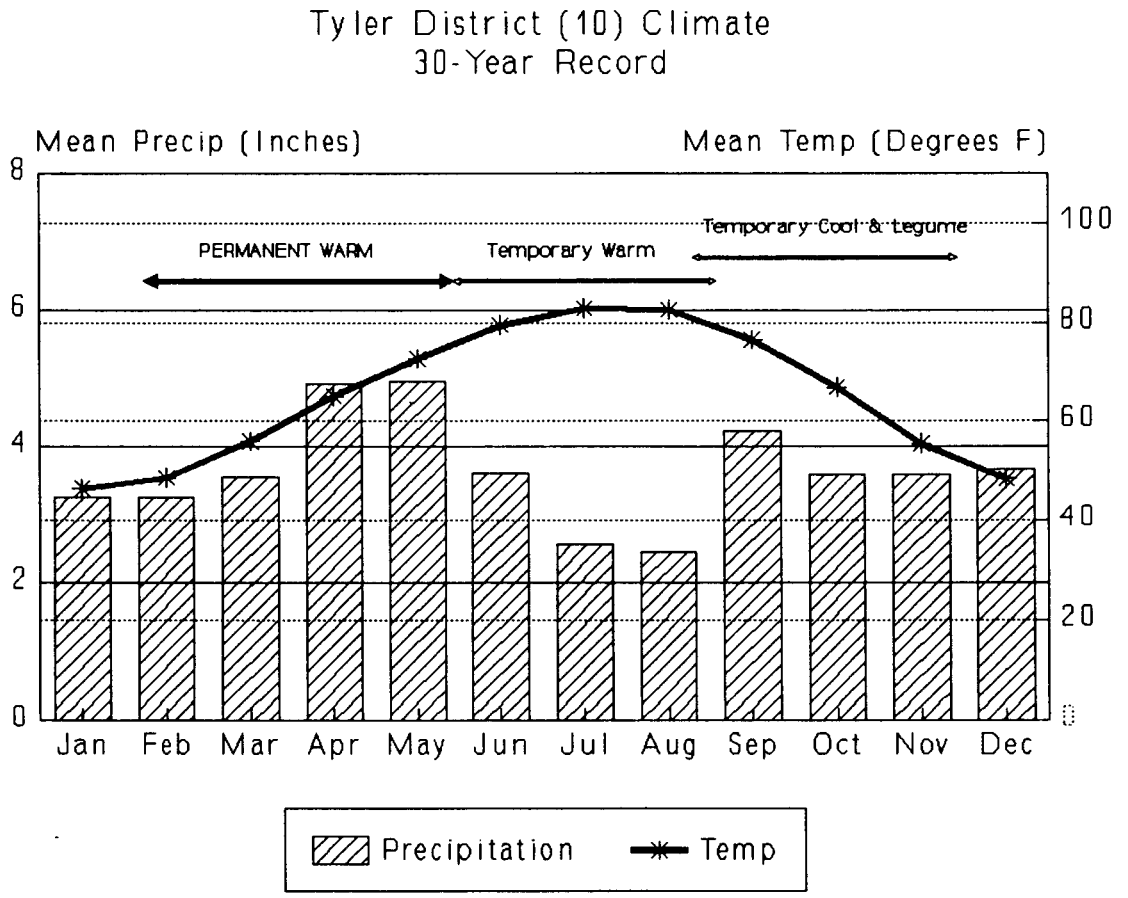
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
10	Aug 15 to Nov 30	Crimson Clover	7.0
			===
		Total:	7.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
10	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
11	Feb 1 to May 15	Green Sprangletop	0.7	Green Sprangletop	1.7
		Bermudagrass	0.9	Bermudagrass	2.3
		Little Bluestem	1.4		====
		Indiangrass (Lometa)	1.8		
		Switchgrass (Alamo)	1.4		
			====		
		Total:	6.2	**Total:**	4.0

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
11	Feb 1 to May 15	Green Sprangletop	1.7	Green Sprangletop	1.7
		Bermudagrass	2.3	Bermudagrass	2.3
			====		====
		Total:	4.0	**Total:**	4.0

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
11	Sep 1 to Nov 30	Tall Fescue	4.0
		Oats *	21.0
		Wheat (Red, Winter)	30.0
		* (May substitute Barley at 72.0 lb/acre divided by the number of species in the mix)	====
		Total:	55.0

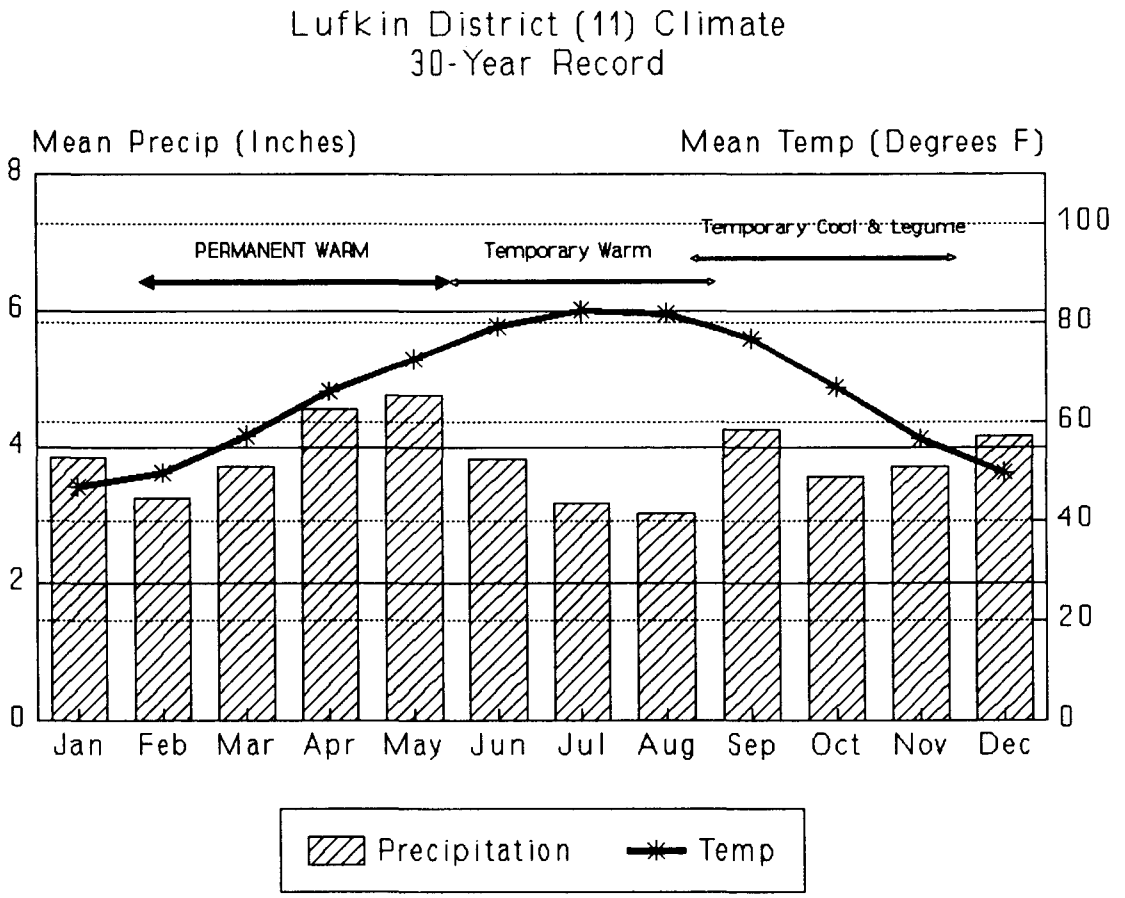
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
11	Aug 15 to Nov 30	Crimson Clover	7.0
			===
		Total:	7.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
11	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
12	Jan 15 to May 15	Green Sprangletop	0.6	Green Sprangletop	0.9
		Bermudagrass	0.8	Bermudagrass	1.2
		Little Bluestem	1.1	Bahiagrass (Pensacola)	5.0
		Indiangrass (Lometa)	1.5		
		K-R Bluestem	0.7	K-R Bluestem	1.0
		Switchgrass (Alamo)	1.2		
			====		====
		Total:	5.9	**Total:**	8.1

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
12	Jan 15 to May 15	Green Sprangletop	1.1	Green Sprangletop	1.1
		Bermudagrass	1.5	Bermudagrass	1.5
		K-R Bluestem	1.3	K-R Bluestem	1.3
			====		====
		Total:	3.9	**Total:**	3.9

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
12	Sep 1 to Nov 30	Oats *	64.0
		* (May substitute Barley at 72.0 lb/acre)	====
		Total:	64.0

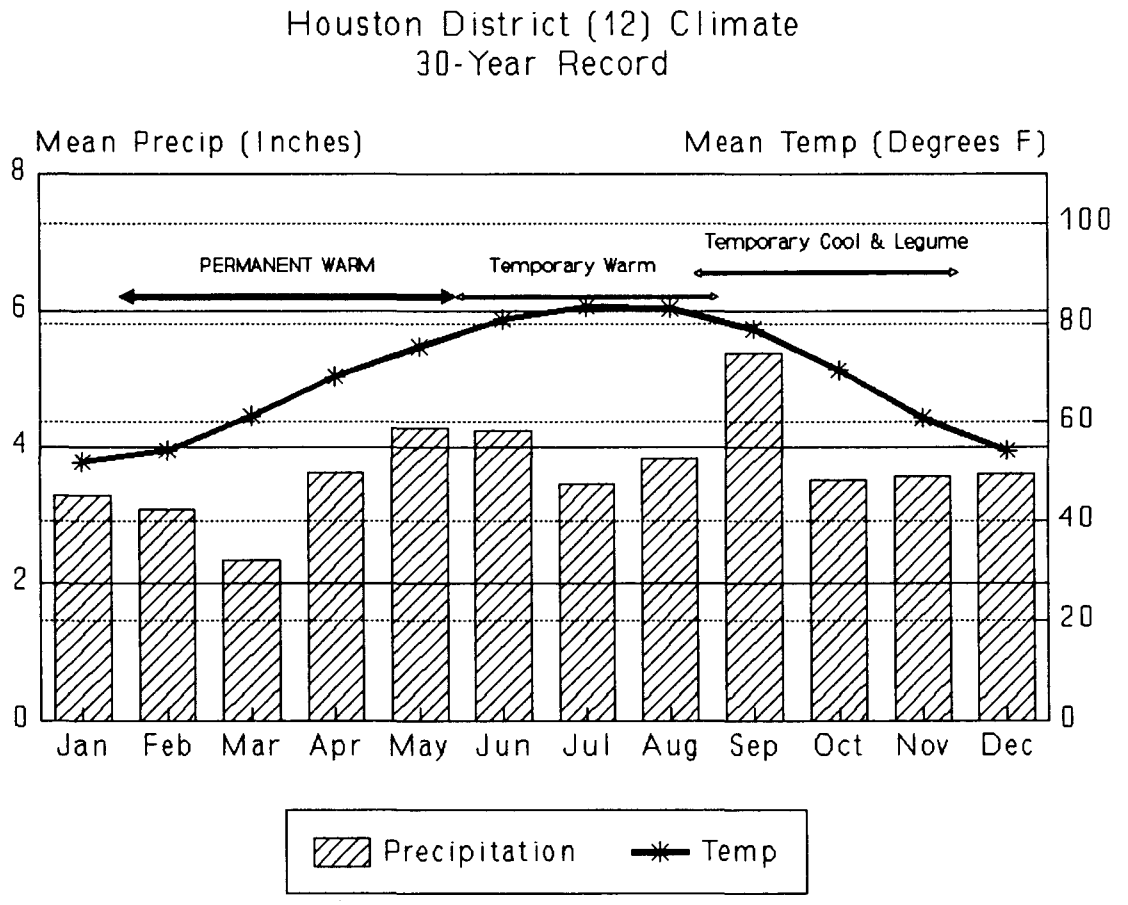
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
12	Aug 15 to Nov 30	Crimson Clover	7.0
			===
		Total:	7.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
12	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (Wharton and Matagorda Counties)		Mixture for Clay or Tight Soils (All other Sections)		Mixture for Sandy Soils (All Sections)	
13	Jan 15 to May 15	Green Sprangletop	0.9	Green Sprangletop	0.6	Green Sprangletop	0.7
		Bermudagrass	1.2	Bermudagrass	0.8	Bermudagrass	0.9
		Little Bluestem	1.7	Little Bluestem	1.1	Bahiagrass (Pensacola)	4.0
		K-R Bluestem	1.0	Indiangrass (Lometa)	1.5		
			====	K-R Bluestem	0.7	Little Bluestem	1.4
				Switchgrass (Alamo)	1.2	K-R Bluestem	0.8
					====		====
		Total:	4.8	**Total:**	5.9	**Total:**	7.8

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
13	Jan 15 to May 15	Green Sprangletop	1.1	Green Sprangletop	1.1
		Bermudagrass	1.5	Bermudagrass	1.5
		K-R Bluestem	1.3	K-R Bluestem	1.3
			====		====
		Total:	3.9	**Total:**	3.9

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
13	Sep 1 to Nov 30	Oats *	64.0
		* (May substitute Barley at 72.0 lb/ac)	====
			64.0

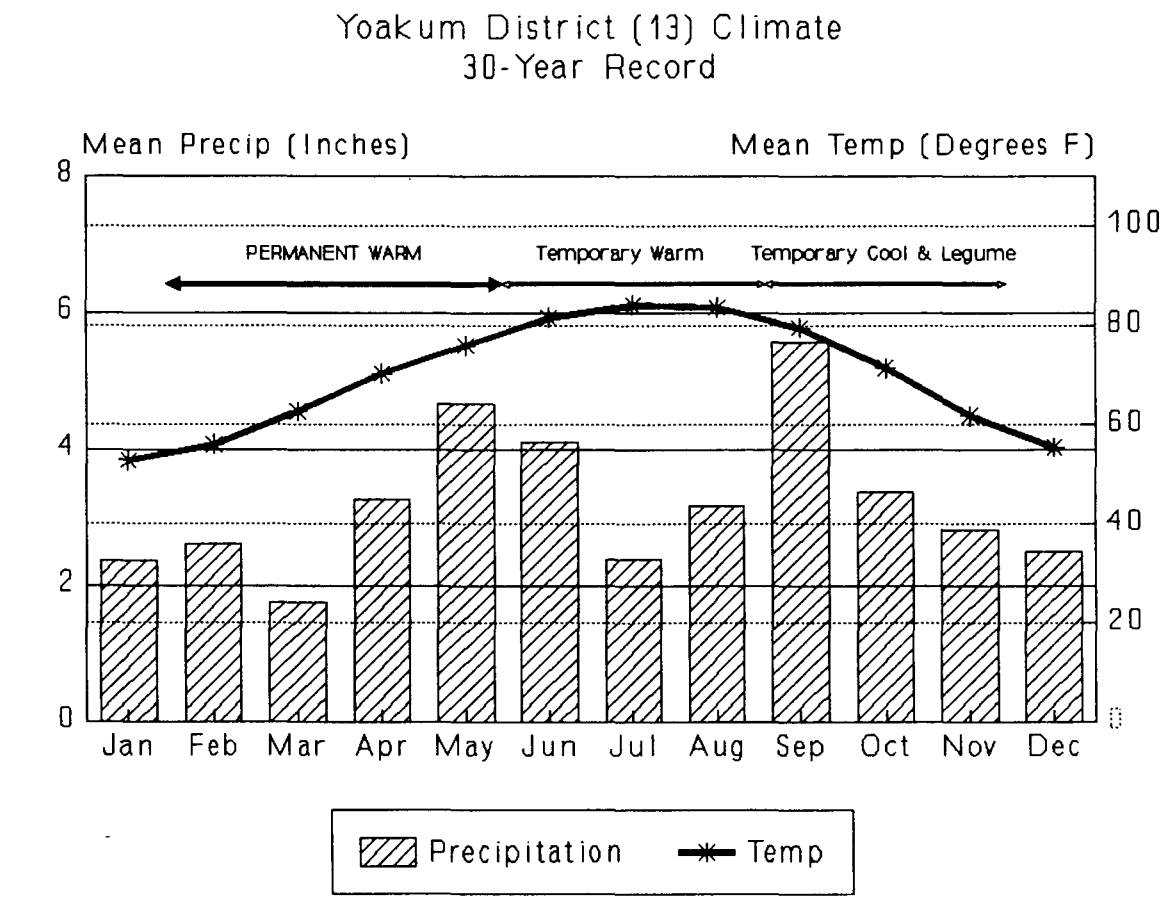
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
13	Sep 1 to Nov 30	Hairy Vetch	8.0
			===
		Total:	8.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
13	May 15 to Aug 31	Foxtail Millet	30.0
			====
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

		Mixture for Clay or Tight Soils		Mixture for Sandy Soils
Dist	**Dates**	**(East of IH 35)**	**(West of IH 35)**	**(All Sections)**
14	Feb 1 to May 15	Green Sprangletop 0.6 Bermudagrass 0.8 Little Bluestem 1.1 Indiangrass 1.5 (Lometa) Buffalograss 5.3 Sideoats Grama 1.8 (Haskell or Uvalde) ==== **Total:** 11.1	Green Sprangletop 0.6 Little Bluestem 1.1 Indiangrass 1.5 (Lometa) Buffalograss 5.3 Sideoats Grama 1.8 (Haskell or Uvalde) Switchgrass 1.2 (Alamo) ==== **Total:** 11.5	Green Sprangletop 0.9 Bermudagrass 1.2 Sand Lovegrass 0.8 K-R Bluestem 1.0 ==== **Total:** 3.9

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

		Mixture for Clay or Tight Soils		Mixture for Sandy Soils
Dist	**Dates**	**(East of IH 35)**	**(West of IH 35)**	**(All Sections)**
14	Feb 1 to May 15	Green Sprangletop 0.9 Bermudagrass 1.2 Buffalograss 8.0 Sideoats Grama 2.8 (Haskell) ==== **Total:** 12.9	Green Sprangletop 0.9 Buffalograss 8.0 K-R Bluestem 1.0 Sideoats Grama 2.8 (Haskell or Uvalde) ==== **Total:** 12.7	Green Sprangletop 0.9 K-R Bluestem 1.0 Bermudagrass 1.2 Sand Lovegrass 0.8 ==== **Total:** 3.9

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	**Dates**	**(All Sections)**
14	Sep 1 to Nov 30	Tall Fescue 4.0 Oats * 21.0 Wheat (Red, Winter) 30.0 * (May substitute Barley at 72.0 lb/ac divided by the number of species in the mix) ==== 55.0

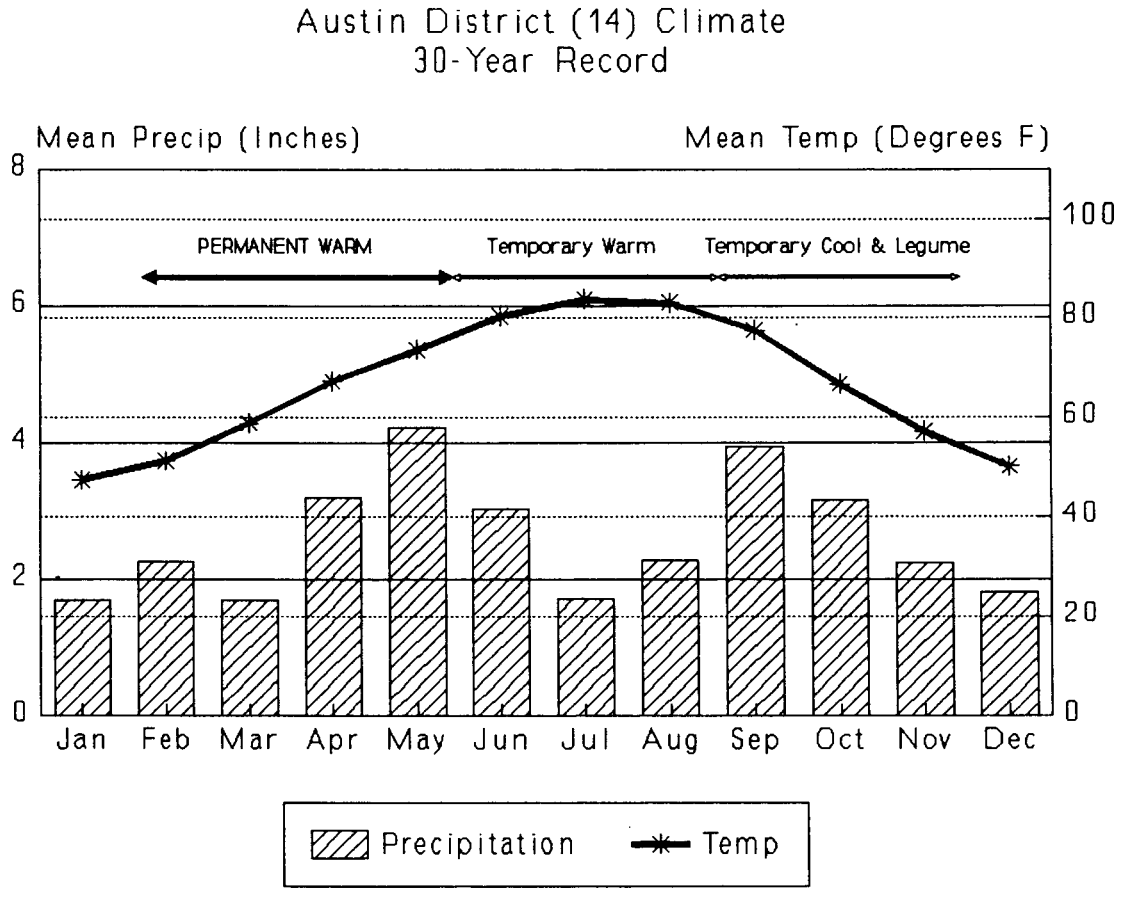
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
14	Sep 1 to Nov 30	Hairy Vetch	8.0
		Total:	8.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
14	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (Uvalde, Frio and Atascosa Counties, N.E.)		Mixture for Clay or Tight Soils (Zavalla, LaSalle and McMullen Counties, S.W.)		Mixture for Sandy Soils (All Sections)	
15	Feb 1 to May 1	Green Sprangletop	0.6	Green Sprangletop	0.6	Green Sprangletop	0.9
		Sideoats Grama (Haskell or Uvalde)	1.8	Sideoats Grama (Haskell or Uvalde)	1.8	Bermudagrass	1.2
		Little Bluestem	1.1	Buffalograss	5.3	Buffelgrass	2.0
		Bermudagrass	0.8	Plains Bristlegrass	1.0	K-R Bluestem	1.0
		Buffalograss	5.3	K-R Bluestem	0.7		====
		K-R Bluestem	0.7	Bermudagrass	0.8		
			====		====		
		Total:	10.3	**Total:**	10.2	**Total:**	5.1

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (East of US 281)		Mixture for Clay or Tight Soils (West of US 281)		Mixture for Sandy Soils (All Sections)	
15	Feb 1 to May 1	Green Sprangletop	1.1	Green Sprangletop	0.9	Green Sprangletop	1.1
		Buffalograss	10.7	Sideoats Grama (Haskell or Uvalde)	2.8	Bermudagrass	1.5
		Bermudagrass	1.5	Buffalograss	8.0	Sideoats Grama (Haskell or Uvalde)	3.7
			====	Bermudagrass	1.2		===
					====		
		Total:	13.3	**Total:**	12.9	**Total:**	6.3

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
15	Sep 1 to Nov 30	Tall Fescue	4.0
		Oats *	21.0
		Wheat (Red, Winter)	30.0
		* (May substitute Barley at 72.0 lb/ac divided by the number of species in the mix)	==== 55.0

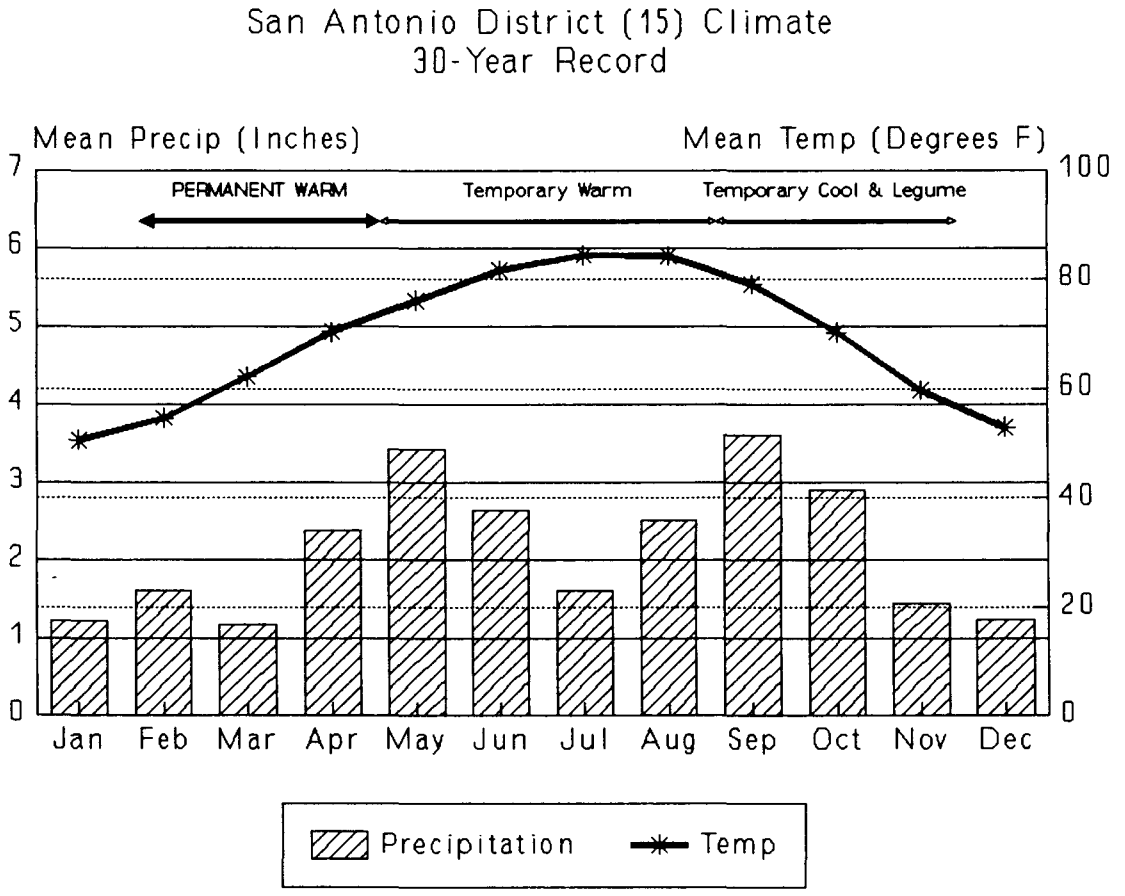
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
15	Sep 1 to Nov 30	Hairy Vetch	8.0
		Total:	8.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
15	May 1 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

		Mixture for Clay or Tight Soils				Mixture for Sandy Soils	
Dist	Dates	(East of U.S. 77)		(West of U.S. 77)		(All Sections)	
16	Jan 15 to May 1	Green Sprangletop	0.7	Green Sprangletop	0.7	Green Sprangletop	0.9
		Bermudagrass	0.9	Rhodesgrass	0.4	Bermudagrass	1.2
		Sideoats Grama (Haskell or Uvalde)	2.2	Plains Bristlegrass	1.2	Buffelgrass	2.0
				Buffalograss	6.4	K-R Bluestem	1.0
		Little Bluestem	1.4	K-R Bluestem	0.8		====
		K-R Bluestem	0.8		====		
			====				
		Total:	6.0	**Total:**	9.5	**Total:**	5.1

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

		Mixture for Clay or Tight Soils				Mixture for Sandy Soils	
Dist	Dates	(East of U.S. 77)		(West of U.S. 77)		(All Sections)	
16	Jan 15 to May 1	Green Sprangletop	1.1	Green Sprangletop	0.9	Green Sprangletop	0.9
		Bermudagrass	1.5	K-R Bluestem	1.0	Bermudagrass	1.2
		K-R Bluestem	1.3	Buffalograss	8.0	K-R Bluestem	1.0
			====	Bermudagrass	1.2	Sand Dropseed	0.3
					====		====
		Total:	3.9	**Total:**	11.1	**Total:**	3.4

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
16	Sep 1 to Nov 30	Oats *	64.0
		* (May substitute Barley at 72.0 lb/ac)	====
			64.0

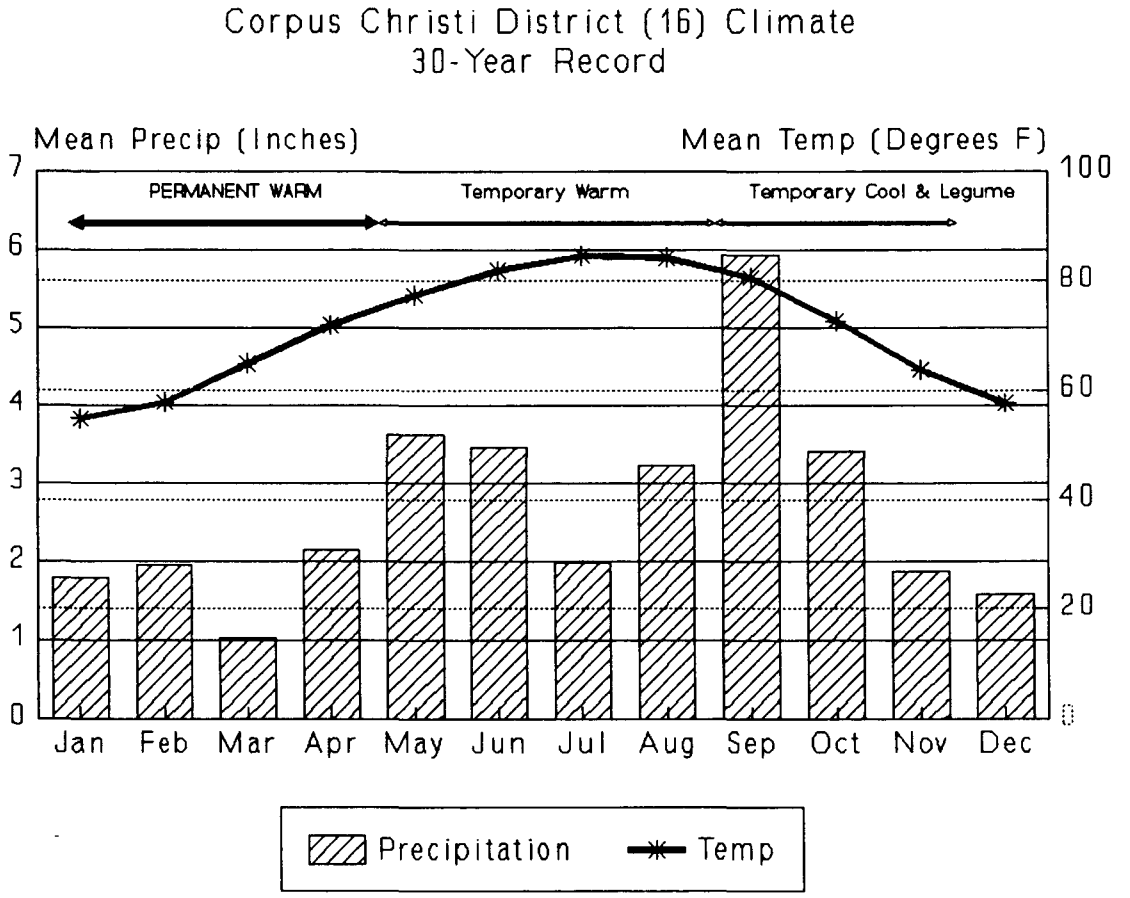
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
16	Sep 1 to Nov 30	Hairy Vetch	8.0
			===
		Total:	8.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
16	May 1 to Aug 31	Foxtail Millet	30.0
			====
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
17	Feb 1 to May 15	Green Sprangletop	0.6	Green Sprangletop	1.1
		Bermudagrass	0.8	Bermudagrass	1.5
		Little Bluestem	1.1	Bahiagrass	6.7
		Indiangrass (Lometa)	1.5	(Pensacola)	====
		K-R Bluestem	0.7		
		Switchgrass (Alamo)	1.2		
			====		
		Total:	5.9	**Total:**	9.3

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
17	Feb 1 to May 15	Green Sprangletop	1.1	Green Sprangletop	1.1
		Bermudagrass	1.5	Bermudagrass	1.5
		K-R Bluestem	1.3	K-R Bluestem	1.3
			====		====
		Total:	3.9	**Total:**	3.9

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
17	Sep 1 to Nov 30	Tall Fescue	4.0
		Oats *	21.0
		Wheat (Red, Winter)	30.0
		* (May substitute Barley at 72.0 lb/ac	====
		divided by number of species in the mix)	55.0

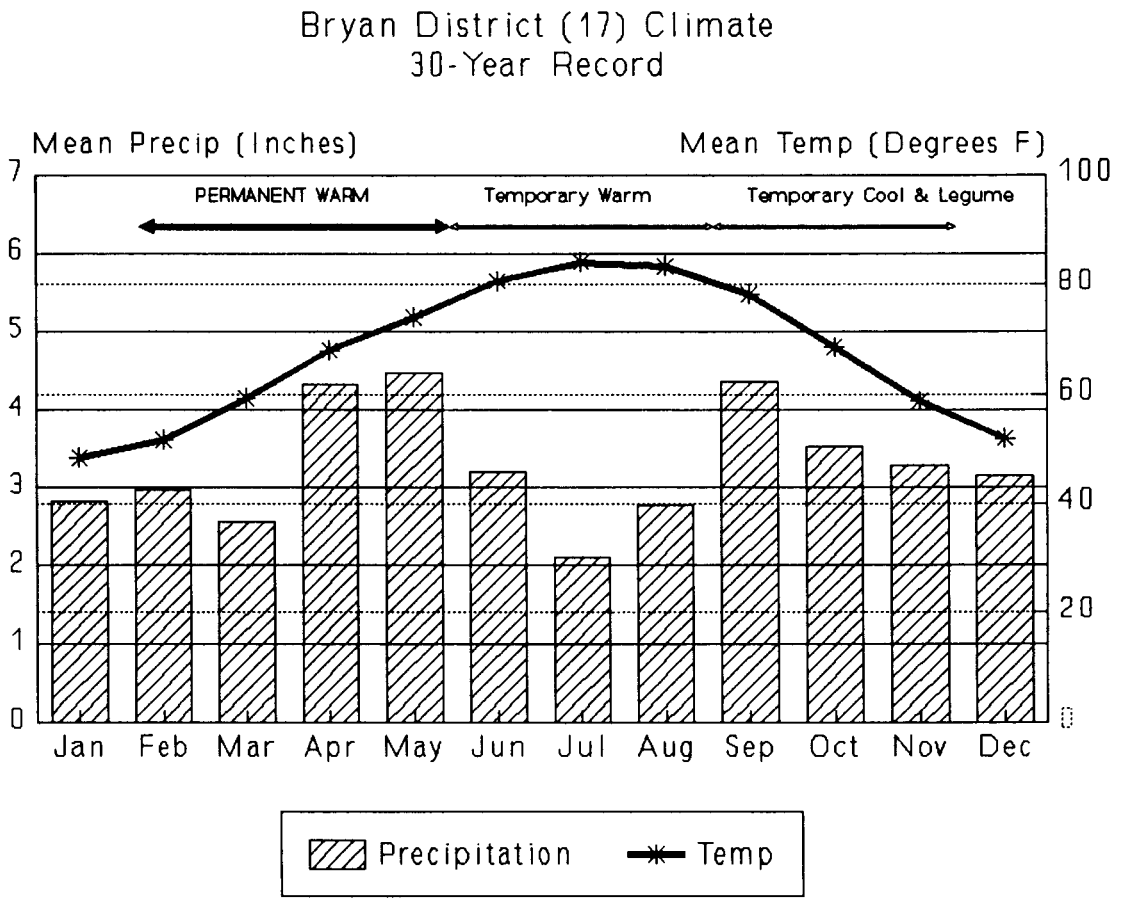
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
17	Aug 15 to Nov 30	Crimson Clover	7.0
			===
		Total:	7.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
17	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

		Mixture for Clay or Tight Soils				Mixture for Sandy Soils	
Dist	**Dates**	**(East of U.S. 75)**		**(West of U.S. 75)**		**(All Sections)**	
18	Feb 1 to May 1	Green Sprangletop	0.6	Green Sprangletop	0.7	Green Sprangletop	1.1
		Bermudagrass	0.8	Bermudagrass	0.9	Bermudagrass	1.5
		Little Bluestem	1.1	Sideoats Grama (El Reno)	2.2	Sand Dropseed	0.4
		Indiangrass (Lometa or Cheyenne)	1.5	Little Bluestem	1.4		====
		Buffalograss	5.3	Indiangrass (Lometa or Cheyenne)	1.8		
		Switchgrass (Alamo or Blackwell)	1.2		====		
			====				
		Total:	10.5	**Total:**	7.0	**Total:**	3.0

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

		Mixture for Clay or Tight Soils		Mixture for Sandy Soils	
Dist	**Dates**	**(All Sections)**		**(All Sections)**	
18	Feb 1 to May 1	Green Sprangletop	1.1	Green Sprangletop	1.1
		Bermudagrass	1.5	Bermudagrass	1.5
		Buffalograss	10.7	Sand Dropseed	0.4
			====		====
		Total:	13.3	**Total:**	3.0

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	**Dates**	**(All Sections)**	
18	Aug 15 to Nov 30	Tall Fescue	4.0
		Western Wheatgrass	5.0
		Wheat (Red, Winter)	30.0
			====
			39.0

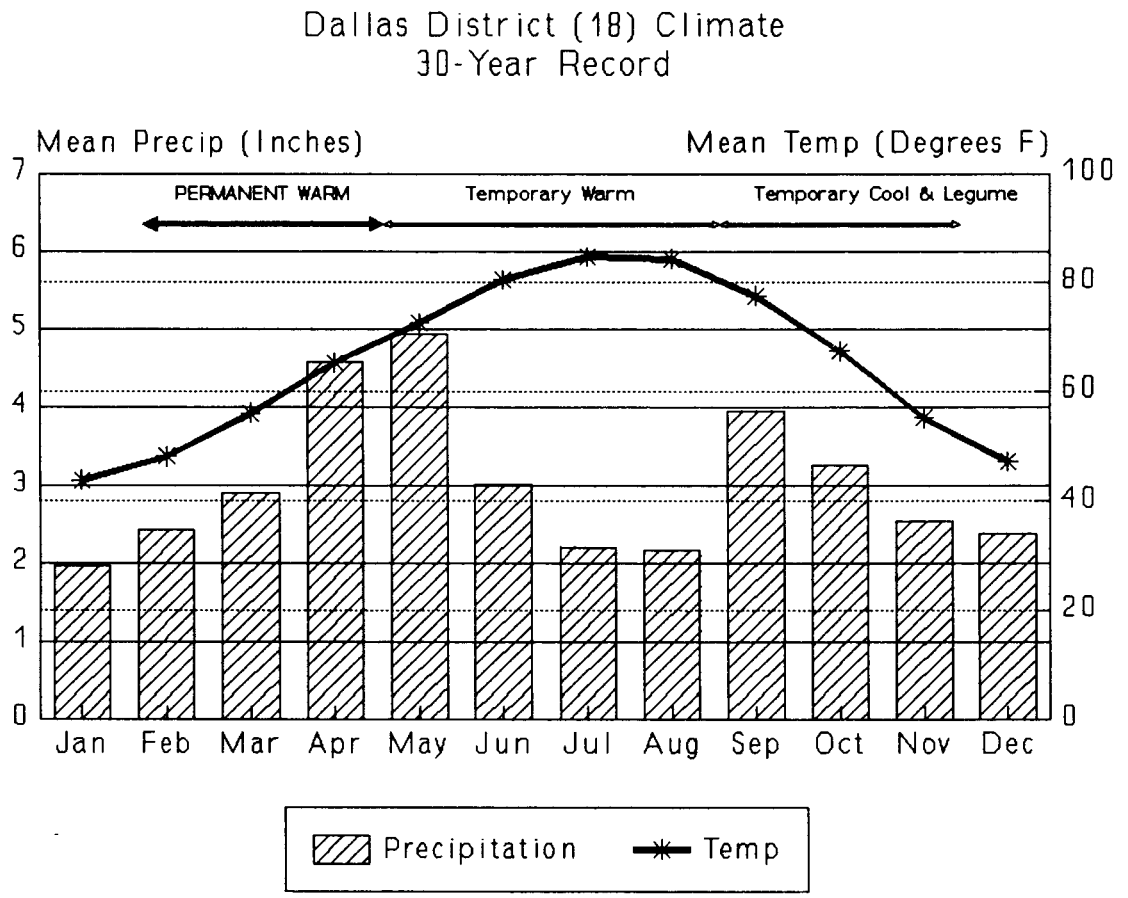
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	**Dates**	**(All Sections)**	
18	Aug 15 to Nov 30	Crimson Clover	7.0
			===
		Total:	7.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
18	May 1 to Aug 31	Foxtail Millet	30.0
			====
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
19	Feb 1 to May 15	Green Sprangletop	0.6	Green Sprangletop	1.1
		Bermudagrass	0.8	Bermudagrass	1.5
		Little Bluestem	1.1	Bahiagrass	6.7
		Indiangrass (Lometa or Cheyenne)	1.5	(Pensacola)	====
		Switchgrass (Alamo)	1.2		
		Bahiagrass (Pensacola)	3.3		
			====		
		Total:	8.5	**Total:**	9.3

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
19	Feb 1 to May 15	Green Sprangletop	1.7	Green Sprangletop	1.7
		Bermudagrass	2.3	Bermudagrass	2.3
			====		====
		Total:	4.0	**Total:**	4.0

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
19	Sep 1 to Nov 30	Tall Fescue	4.0
		Oats *	21.0
		Wheat (Red, Winter)	30.0
		* (May substitute Barley at 72.0 lb/ac divided by number of species in the mix)	==== 55.0

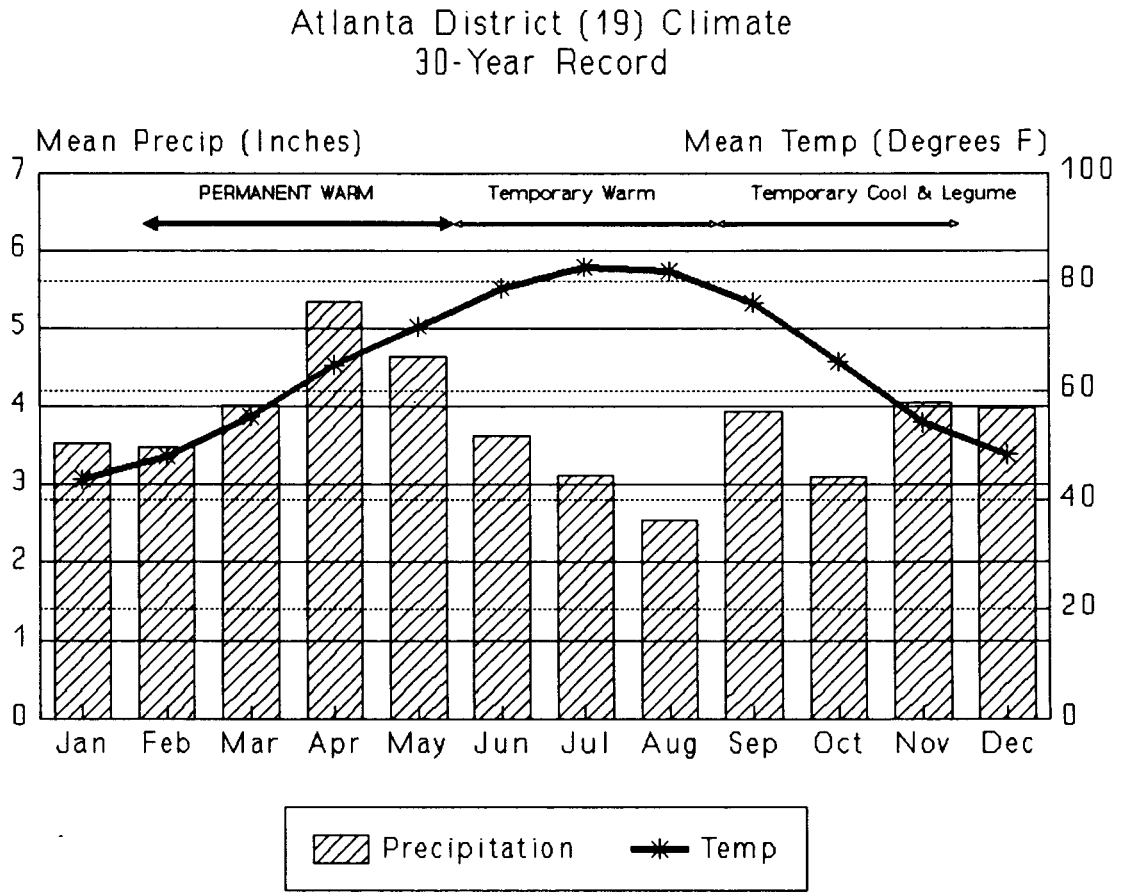
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
19	Aug 15 to Nov 30	Crimson Clover	7.0
			===
		Total:	7.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
19	May 15 to Aug 31	Foxtail Millet	30.0
			====
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
20	Jan 15 to May 15	Green Sprangletop	0.7	Green Sprangletop	1.1
		Bermudagrass	0.9	Bermudagrass	1.5
		Little Bluestem	1.4	Bahiagrass	6.7
		Indiangrass (Lometa)	1.8	(Pensacola)	====
		Switchgrass (Alamo)	1.4		
			====		
		Total:	6.2	**Total:**	9.3

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
20	Jan 15 to May 15	Green Sprangletop	1.5	Green Sprangletop	1.5
		Bermudagrass	1.2	Bermudagrass	1.2
			====		====
		Total:	2.7	**Total:**	2.7

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
20	Sep 1 to Nov 30	Oats	64.0
		* (May substitute Barley at 72.0 lbs/ac)	====
			64.0

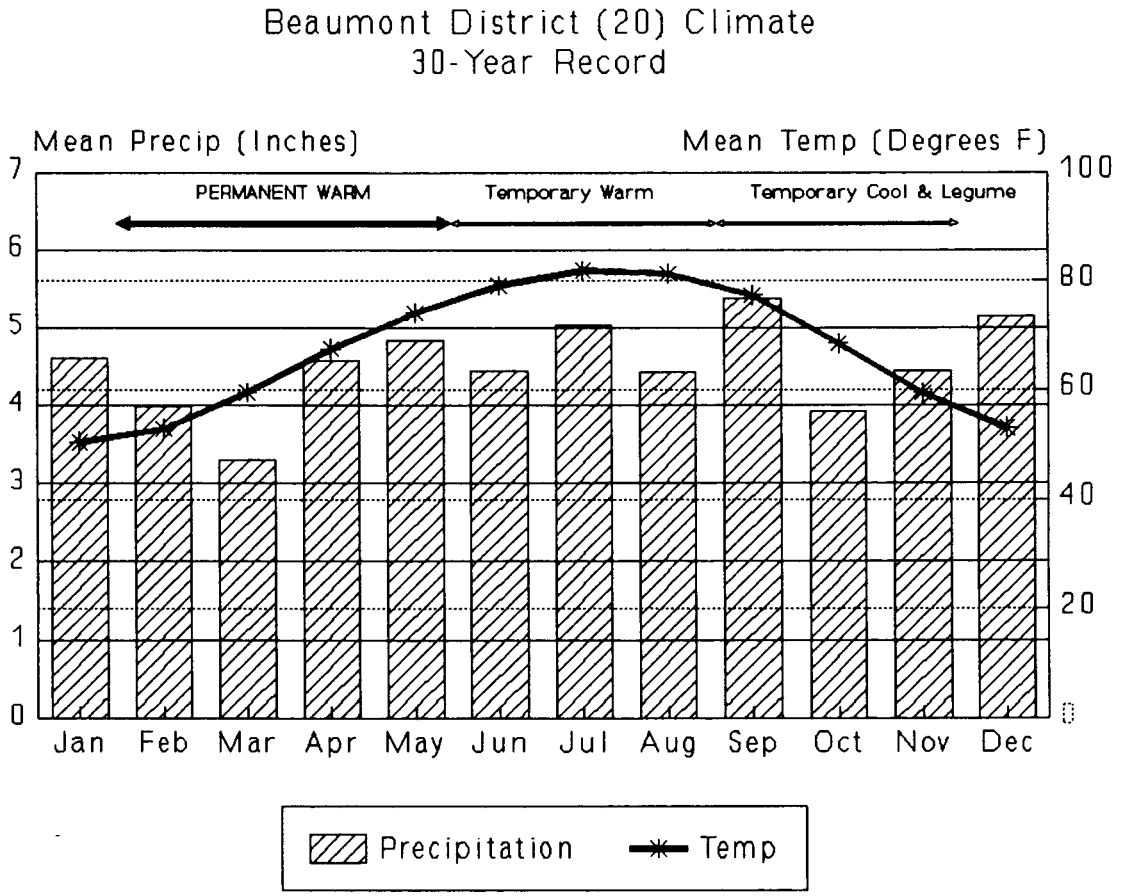
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
20	Aug 15 to Nov 30	Crimson Clover	7.0
			===
		Total:	7.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
20	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
21	Jan 15 to May 1	Green Sprangletop	0.7	Green Sprangletop	0.7
		Rhodesgrass	0.4	Bermudagrass	0.9
		Plains Bristlegrass	1.2	Rhodesgrass	0.4
		Buffalograss	6.4	Buffelgrass	1.2
		K-R Bluestem	0.8	Sand Dropseed	0.2
			====		====
		Total:	9.5	**Total:**	3.4

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (East of U.S. 281)		Mixture for Clay or Tight Soils (West of U.S. 281)		Mixture for Sandy Soils (All Sections)	
21	Jan 15 to May 1	Green Sprangletop	0.9	Green Sprangletop	0.9	Green Sprangletop	0.9
		Bermudagrass	1.2	Sideoats Grama	2.8	Bermudagrass	1.2
		K-R Bluestem	1.0	(Premier or Uvalde)		K-R Bluestem	1.0
		Buffalograss	8.0	K-R Bluestem	1.0	Sand Dropseed	0.3
			====	Buffalograss	8.0		====
					====		
		Total:	11.1	**Total:**	12.7	**Total:**	3.4

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
21	Sep 1 to Nov 30	Oats	64.0
		* (May substitute Barley at 72.0 lbs/ac)	====
			64.0

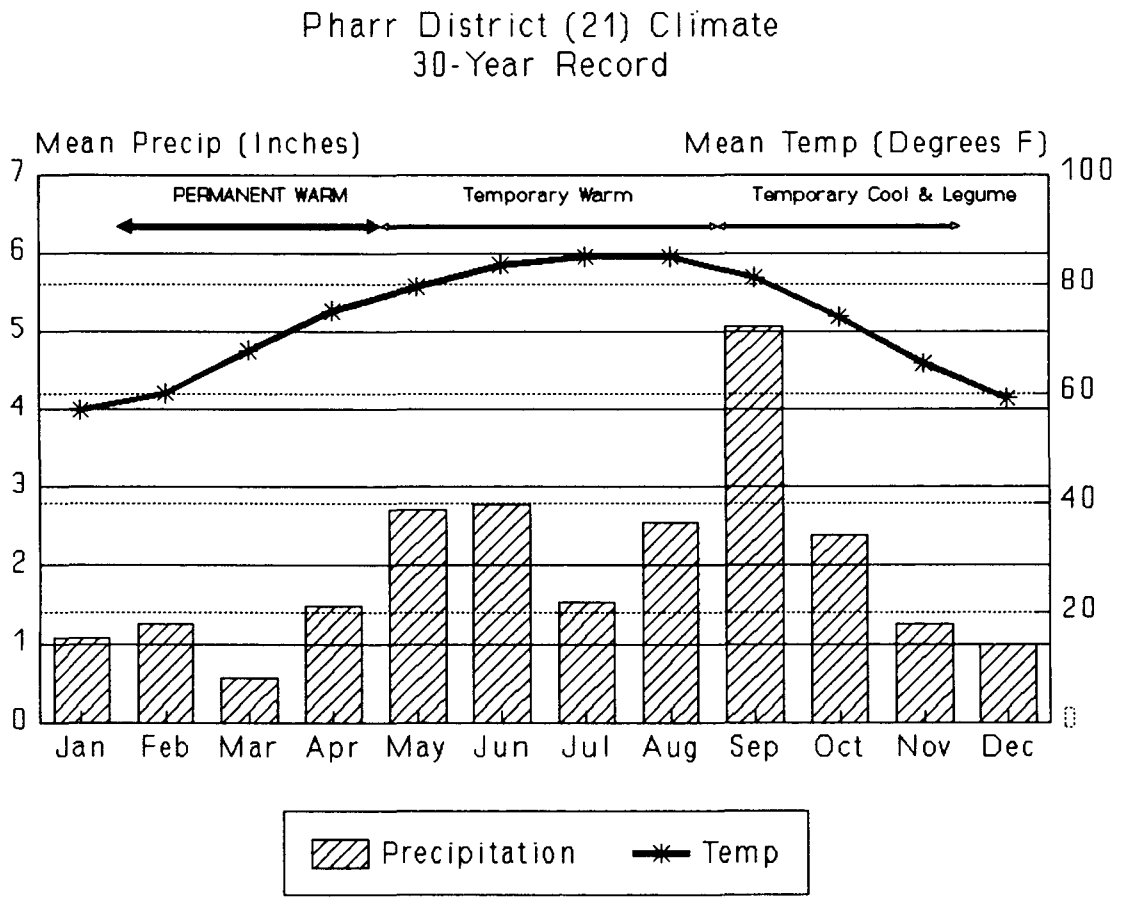
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
21	Sep 1 to Nov 30	Hairy Vetch	8.0
			===
		Total:	8.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
21	May 1 to Aug 31	Foxtail Millet	30.0
			====
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
23	Feb 1 to May 15	Green Sprangletop	0.7	Green Sprangletop	0.6
		Little Bluestem	1.4	Little Bluestem	1.1
		Sideoats Grama (Haskell)	2.2	Sideoats Grama (Haskell)	1.8
		Buffalograss	6.4	Bermudagrass	0.8
		K-R Bluestem	0.8	Sand Lovegrass	0.5
			====	Sand Dropseed	0.2
					====
		Total:	11.5	**Total:**	5.0

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
23	Feb 1 to May 15	Green Sprangletop	0.7	Green Sprangletop	0.7
		Buffalograss	6.4	K-R Bluestem	0.8
		K-R Bluestem	0.8	Bermudagrass	0.9
		Sideoats Grama (Haskell)	2.2	Sideoats Grama (Haskell)	2.2
		Bermudagrass	0.9	Sand Dropseed	0.2
			====		====
		Total:	11.0	**Total:**	4.8

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
23	Aug 15 to Nov 30	Tall Fescue	4.0
		Western Wheatgrass	5.0
		Wheat (Red, Winter)	30.0
			====
		Total:	39.0

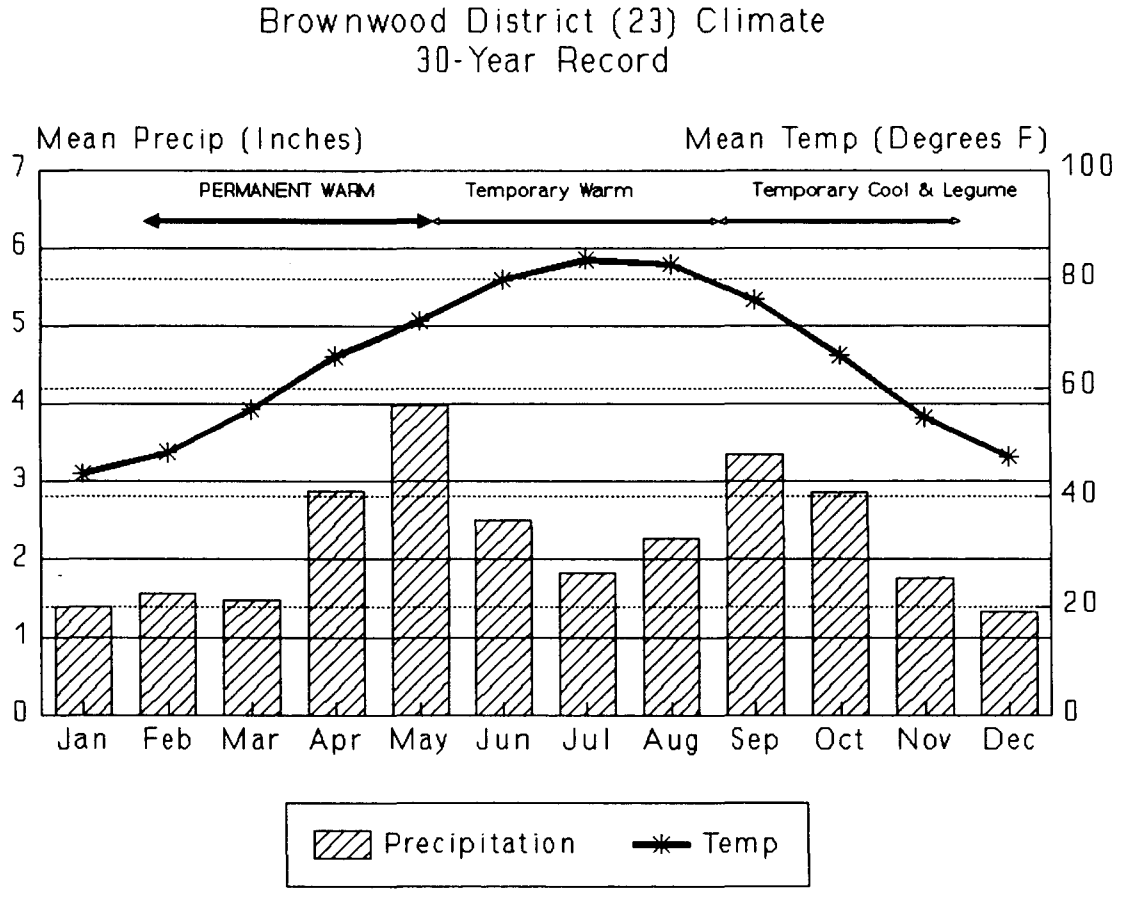
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
23	Aug 15 to Nov 30	Yellow Sweetclover	4.0
		Total:	4.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
23	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
24	Feb 1 to May 1	Green Sprangletop	0.7	Green Sprangletop	0.9
		Black Grama	0.4	Black Grama	0.5
		Blue Grama (Hachita)	0.6	Blue Grama (Hachita)	0.8
		Sideoats Grama* (Tucson)	2.2		
		Sand Dropseed	0.2	Sand Dropseed	0.3
			====		====
		Total:	4.1	**Total:**	2.5

* Substitute "Premier" variety of Sideoats Grama in Eastern Brewster County.

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
24	Feb 1 to May 1	Green Sprangletop	0.7	Green Sprangletop	0.9
		Black Grama	0.4	Black Grama	0.5
		Blue Grama	0.6	Blue Grama	0.8
		Sideoats Grama * (Tucson)	2.2	Sand Dropseed	0.3
		Sand Dropseed	0.2		====
			====		
		Total:	4.1	**Total:**	2.5

* Substitute "Premier variety of Sideoats Grama in Eastern Brewster County.

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
24	Aug 15 to Nov 30	Western Wheatgrass	7.5
		Wheat (Red, Winter)	45.0
			====
		Total:	52.5

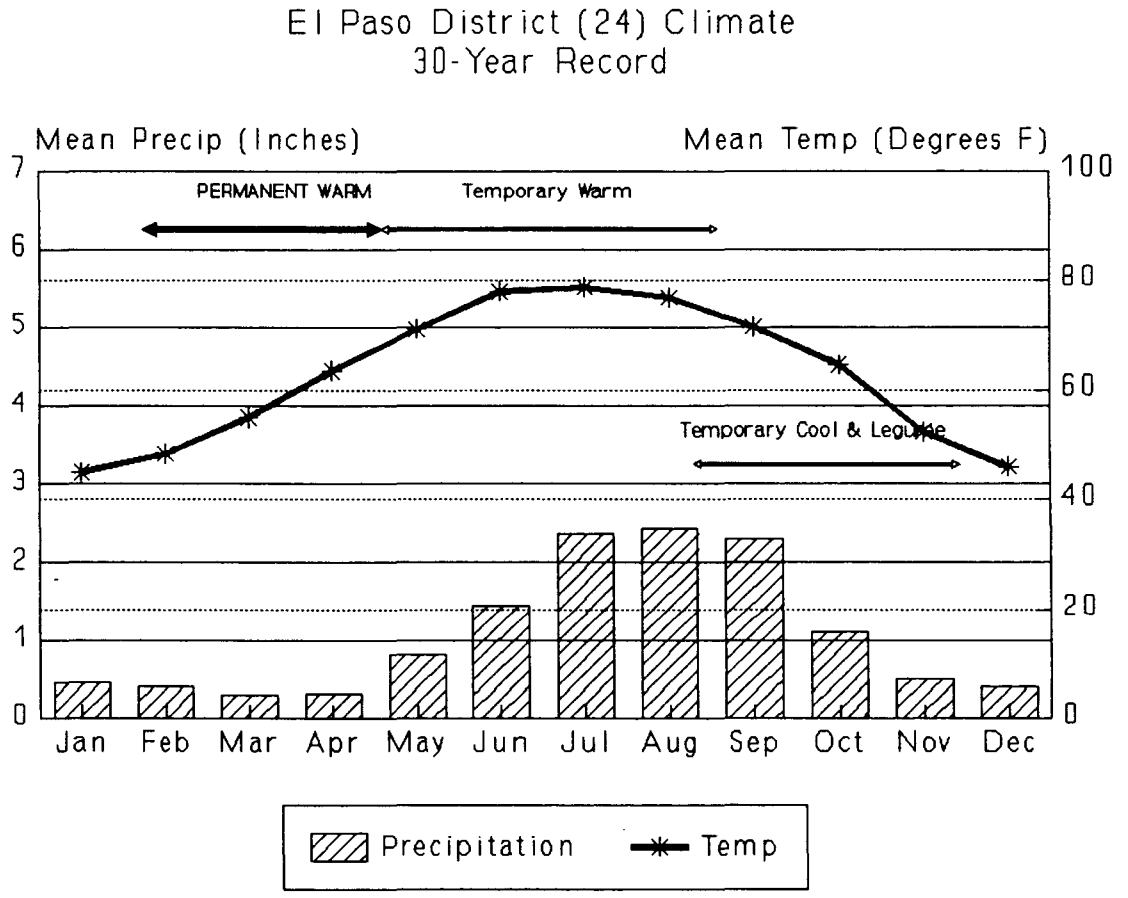
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
24	Aug 15 to Nov 30	Yellow Sweetclover	4.0
		Total:	4.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
24	May 1 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

RURAL AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
25	Feb 1 to May 15	Green Sprangletop	0.7	Green Sprangletop	0.7
		Sideoats Grama (El Reno)	2.2	Sideoats Grama (El Reno)	2.2
		Blue Grama (Lovington)	0.6	Blue Grama (Lovington)	0.6
		Buffalograss	6.4	Little Bluestem	1.4
		Western Wheatgrass *	2.8	Sand Dropseed	0.2
			====		====
		Total:	12.7	**Total:**	5.1

* Western Wheatgrass must be sown between September 1 and February 28.

URBAN AREA WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	Mixture for Clay or Tight Soils (All Sections)		Mixture for Sandy Soils (All Sections)	
25	Feb 1 to May 15	Green Sprangletop	0.7	Green Sprangletop	0.7
		Sideoats Grama (El Reno)	2.2	Sideoats Grama (El Reno)	2.2
		Blue Grama (Lovington)	0.6	Blue Grama (Lovington)	0.6
		Western Wheatgrass *	2.8	Western Wheatgrass	2.8
		Buffalograss	6.4	Sand Dropseed	0.2
			====		====
		Total:	12.7	**Total:**	6.5

* Western Wheatgrass must be sown between September 1 and February 28.

TEMPORARY COOL-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
25	Aug 15 to Nov 30	Tall Fescue	4.0
		Western Wheatgrass	5.0
		Wheat (Red, Winter)	30.0
			====
		Total:	39.0

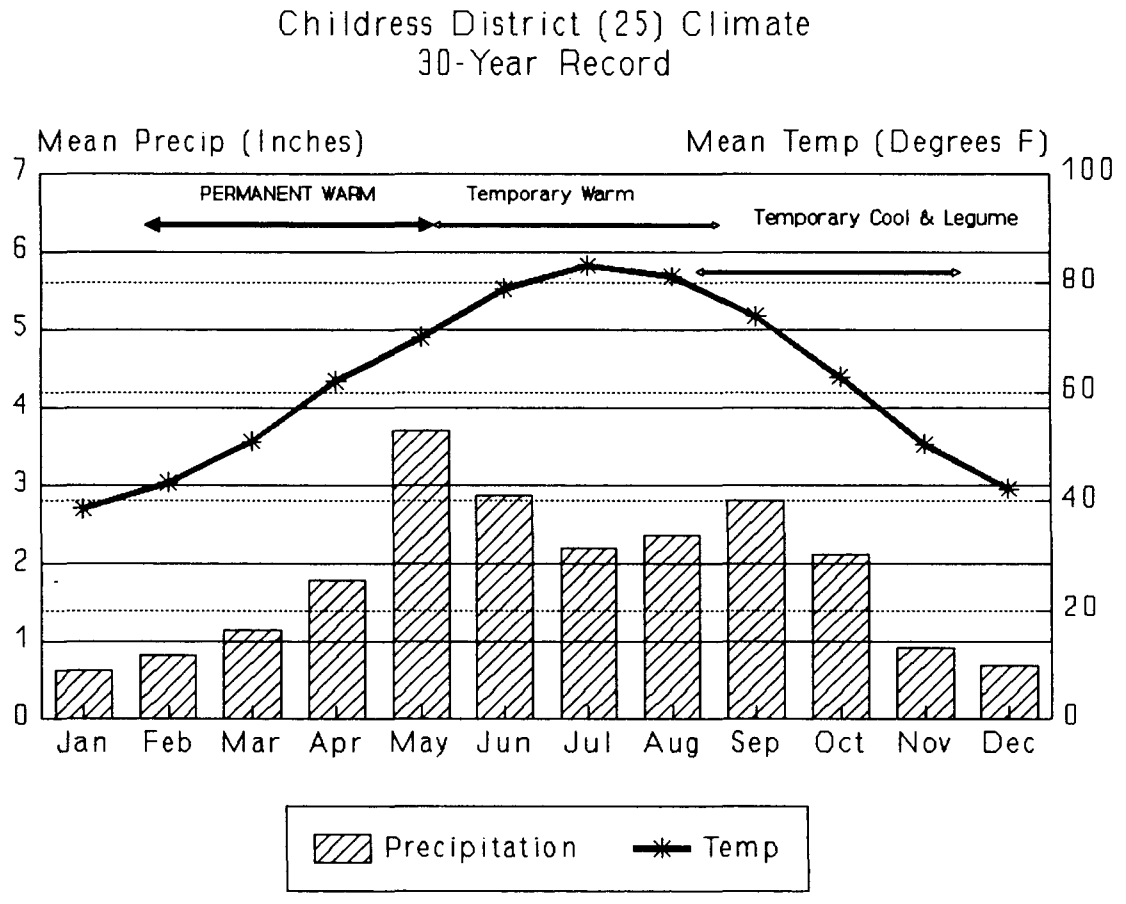
TEMPORARY COOL-SEASON LEGUME SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
25	Aug 15 to Nov 30	Yellow Sweetclover	4.0
		Total:	4.0

TEMPORARY WARM-SEASON SEEDING RATES: In Pounds, Pure Live Seed

Dist	Dates	(All Sections)	
25	May 15 to Aug 31	Foxtail Millet	30.0
		Total:	30.0

Note: Names in parenthesis ( ) represent "improved" varieties of the species shown.



Source: Climate of Texas Counties

TABLE 4

RECOMMENDED REVEGETATION APPLICATIONS AND ESTIMATED COSTS

Clarification to Items
162 - "Sodding for Erosion Control"
164 - "Seeding For Erosion Control"
166 - "Fertilizer"
168 - "Vegetative Watering", and
169 - "Soil Retention Blanket"

TABLE 4
RECOMMENDED REVEGETATION APPLICATIONS AND ESTIMATED COSTS

Application Method	Pay Item	Flat		Est. Cost	Slopes Flatter than 3:1		Est. Cost	Slopes 3:1 or Steeper [4]		Est. Cost	Drainage Channels		Est. Cost
		Sand	Clay		Sand	Clay		Sand	Clay		Shear Stress Less Than 2.0	Shear Stress 2.0 or More	
Standard Specification Item 162 "Sodding for Erosion Control"													
Grass Retards [1]	162	N/R	✓	$3.50 to $4.00 per SY	N/R	N/R	N/A	N/R	N/R	N/A	N/R	N/R	N/A
Spot Sodding [1]	162	N/R	✓	$0.50 to $0.75 per SY	N/R	N/R	N/A	N/R	N/R	N/A	N/R	N/R	N/A
Mulch Sodding [3]	162	✓	✓	$6.50 to $7.50 per CY	✓	✓	$6.50 to $7.50 per CY	N/R	N/R	N/A	N/R	N/R	N/A
Block Sodding	162	✓	✓	$2.25 to $2.75 per SY	✓	✓	$2.25 to $2.75 per SY	✓	✓	$2.25 to $2.75 per SY	✓	N/R	$2.25 to $2.75 per SY
Straw or Hay Mulching	162	✓	✓	$0.05 to $0.10 per SY	✓	✓	$0.05 to $0.10 per SY	N/R	N/R	N/A	N/R	N/R	N/A

LEGEND:
N/R = NOT RECOMMENDED ✓ = ACCEPTABLE N/A = NOT APPLICABLE SY = Square Yard

[1] If Grass Retards or Spot Sodding is used, cover unprotected seedbed with either Straw or Hay Mulch, Straw or Hay Mulch Seeding or Cellulose Fiber Mulch Seeding
[4] Soil Retention Blankets should be used on slopes 3:1 or steeper, except where solid block sod is specified.
[3] If Mulch Sodding is used on slopes 3:1 or steeper, or in drainage channels, the addition of a Soil Retention Blanket is strongly recommended.

TABLE 4
RECOMMENDED REVEGETATION APPLICATIONS AND ESTIMATED COSTS

Application Method	Pay Item	Flat		Est. Cost	Slopes Flatter than 3:1		Est. Cost	Slopes 3:1 or Steeper [4]		Est. Cost	Drainage Channels		Est. Cost
		Sand	Clay		Sand	Clay		Sand	Clay		Shear Stress Less Than 2.0	Shear Stress 2.0 or More	
Standard Specification Item 164 "Seeding for Erosion Control"													
Broadcast Seeding [1]	164	✓	✓	$0.06 to $0.15 per SY	N/R	N/R	N/A	N/R	N/R	N/A	N/R	N/R	N/A
Straw or Hay Mulch Seeding [2]	164	✓	✓	$0.20 to $0.30 per SY	✓	✓	$0.20 to $0.30 per SY	N/R	N/R	N/A	N/R	N/R	N/A
Cellulose Fiber Mulch Seeding [3]	164	✓	✓	$0.20 to $0.30 per SY	✓	✓	$0.20 to $0.30 per SY	N/R	N/R	N/A	N/R	N/R	N/A
Drill Seeding	164	✓	✓	$0.35 to $0.55 per SY	✓	✓	$0.35 to $0.55 per SY	N/R	N/R	N/A	N/R	N/R	N/A

LEGEND:
N/R = NOT RECOMMENDED ✓ = ACCEPTABLE N/A = NOT APPLICABLE SY = Square Yards

[1] Broadcast seeding should be used on flat areas only.
[2] Straw or Hay Mulch Seeding should not be used on slopes 3:1 or steeper.
[3] Cellulose Fiber Mulch Seeding should not be used on slopes 3:1 or steeper.
[4] Soil Retention Blankets should be used on all areas to be seeded if slopes are 3:1 or steeper.

TABLE 4
RECOMMENDED REVEGETATION APPLICATIONS AND ESTIMATED COSTS

Application Method	Pay Item	Flat		Est. Cost	Slopes Flatter than 3:1		Est. Cost	Slopes 3:1 or Steeper [4]		Est. Cost	Drainage Channels		Est. Cost
		Sand	Clay		Sand	Clay		Sand	Clay		Shear Stress Less Than 2.0	Shear Stress 2.0 or More	
Miscellaneous Support Specifications													
Fertilizer [1]	166	✓	✓	$250 to $400 per TON	✓	✓	$250 to $400 per TON	✓	✓	$250 to $400 per TON	✓	✓	$250 to $400 per TON
Vegetative Watering [2]	168	✓	✓	$35 to $55 per MG	✓	✓	$35 to $55 per MG	✓	✓	$35 to $55 per MG	✓	✓	$35 to $55 per MG
Soil Retention Blankets [4]	169	✓	✓	$2.00 to $2.50 per SY	✓	✓	$2.00 to $2.50 per SY	✓	✓	$2.50 to $3.50 per SY	✓	✓	$4.00 to $6.00 per SY

LEGEND:
✓ = RECOMMENDED SY = Square Yard MG = Thousand Gallons

[1] Fertilizer should be included with all new sodding or seeding projects at a rate of 100 lbs Nitrogen (N) per Acre.
[2] Vegetative Watering should be included in all new sodding or seeding projects at the rate of 1/4 inch of water per acre every two weeks for a 3-month period.
[4] Soil Retention Blankets should be included on all seeding projects with slopes of 3:1 or steeper.

APPENDIX A

SAMPLES OF SOIL TEST KIT DOCUMENTS TEXAS AGRICULTURAL EXTENSION SERVICE

TEXAS AGRICULTURAL EXTENSION SERVICE
THE TEXAS A&M UNIVERSITY SYSTEM
Soil, Water, and Forage Testing Laboratory

SOIL SAMPLE INFORMATION FORM

Please submit this completed form and payment with your soil samples. Mark each soil sample bag with your sample identification which should correspond with the sample identification written on this form. See mailing instructions under Step 4 on the back of this form (Please Do Not Send Cash).

SUBMITTED BY: Results will be mailed to this address.

Name _____ County _____

Address _____ Phone _____

City _____ State _____ Zip _____

FOR: (Optional)

Name _____

Address _____

City _____ State _____ Zip _____

SAMPLE I.D.		PLANT INFORMATION			
Laboratory # (For Lab Use)	Your Sample I.D.	To Be Irrigated	Previous Lime Or Fertilizer	Intended Plant To Be Fertilized	Yield Goal

Circle Requested Analyses

	Cost Per Sample
Complete Analysis (Routine Analysis + Micronutrients, Boron and Lime Requirement.)	$ 25.00
Routine Analysis (pH, NO_3, P, K, Ca, Mg, Na, S, & Salinity)	$ 10.00
Routine + Micronutrients (Zn, Fe, Cu, Mn)	$ 14.00
Salinity (Detailed Analysis)	$ 15.00
Boron	$ 5.00
Potting Media (Non-Soil Mixes) Saturation Extract Analysis	$ 15.00
Organic Matter Analysis	$ 5.00
Soil Texture Analysis	$ 10.00

How Is Forage Used?

Grazing Only _____

Hay Only _____

Grazing and Hay _____

New Establishment _____

Minimum Requirement Est. _____

Describe any problems _____

_____

_____

TEXAS AGRICULTURAL EXTENSION SERVICE
THE TEXAS A&M UNIVERSITY SYSTEM
Soil Testing Laboratory

SOIL SAMPLE INFORMATION SHEET FOR LAWNS, GARDENS AND FLOWER BEDS

Fill in the following information sheet as complete as possible and submit with your soil samples. Mark each soil sample with your name and sample number which should correspond with the information furnished on this sheet.

NAME _____ COUNTY _____

ADDRESS _____ ZIP _____

Sample Site Zip Code (if different) _____

EXTRA COPY TO: Name _____

Address _____ Zip _____

SAMPLE MANAGEMENT				
Lab #	**Your Sample Number**	**Plants To Be Grown**	**Previous Lime Or Fertilizer**	**Remarks**

Circle Requested Analyses

	Fee Per Sample
Complete Analysis (Regular Analysis + Micronutrients, Boron and Lime Requirement.)	*$25.00*
Regular Analysis (pH, N, P, K Ca, Mg, Na, S, & Salinity)	*$10.00*
Regular + Micronutrients (Zn, Fe, Cu, Mn)	*$14.00*
Nitrates Only	*$ 2.00*
Salinity (Detailed Analysis)	*$15.00*
Boron	*$ 5.00*
Lime Requirement (Cation Exchange Capacity and Exchangeable Aluminum)	*$10.00*
Potting Media (Non-Soil Mixes) Saturation Extract Analysis	*$15.00*
Organic Matter Analysis	*$ 5.00*
Soil Texture Analysis	*$10.00*

Give any additional information regarding any problems encountered:

_____

_____

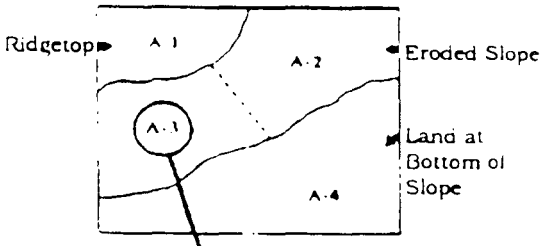
_____

See mailing instructions under step 4 on the back of this sheet.. (PLEASE DO NOT SEND CASH)

Procedure For Taking Soil Samples

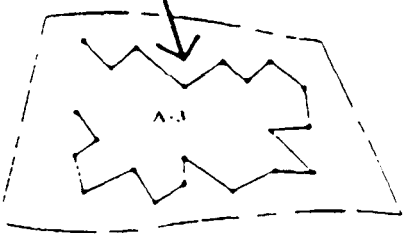
Soil tests can be only as accurate as the samples on which they are made. Proper collection of soil samples is extremely important. Chemical tests of poorly taken samples may actually be misleading because they do not represent the area to be cropped.

Step 1.



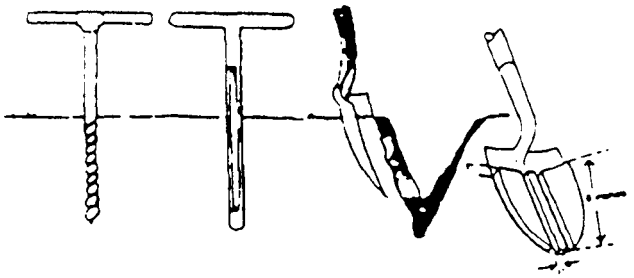
Take one composite soil sample from each uniform area of 10 to 40 acres in a field. In areas such as East Texas, one sample should represent only 10 to 20 acres; whereas, in areas where soils are more uniform, one sample can represent up to 40 acres.

Step 2.



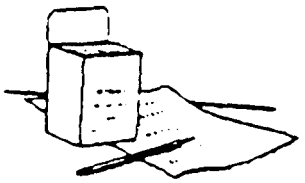
The composite sample should be taken from each area. This can be done by taking small cores or slices from 10 to 15 different places. Place these in a clean container (plastic bucket, paper sack, etc.), mix thoroughly and take out approximately 1 pint for the composite sample.

Step 3.



When taking soil samples, use a spade, soil auger or soil sampling tube as illustrated. Scrape the litter from the surface. Make the core or boring 6 inches deep in the soil. (For permanent sod, sample to a depth of 3 to 4 inches) To use a spade, dig a V-shaped hole and take a 1 inch slice of soil from the smooth side of the hole. Then take a 1 X 1 inch core from the center of the shovel slice as illustrated. Repeat in 10 to 15 different places, put in a clean plastic bucket, thoroughly mix and remove a pint as a composite sample representing the field or area.

Step 4.



Complete the information form on the opposite side. Enclose the completed information form and ***payment*** *inside the package containing samples. Make check payable to Soil Testing. DO NOT SEND CASH. Address the letter and package to one of the following addresses:*

Extension Soil, Water, and Forage Testing Laboratory
Texas A&M University - Soil & Crop Sciences
College Station, Texas 77843-2474
Phone 409/845-4816

Soil Testing Laboratory
Texas Agricultural Extension Service
Lubbock, Texas 79401-9746
Phone 806/746-6101

Precautions

1. Avoid sampling spots in the field such as small gullies, slight field depressions, terrace waterways and unusual spots.
2. When sampling fertilized fields, avoid sampling directly in fertilized band.
3. Do not use old vegetable cans, tobacco cans, match boxes, etc., to submit samples.
4. Do not use heat to dry samples.
5. Be sure to keep a record for yourself as to the area represented by each sample.
6. Be sure sample numbers on the boxes correspond with sample numbers on the information sheet.

For Further Details Consult Your County Extension Agent

D-592

Texas Agricultural Extension Service

SOIL TESTING LABORATORY
TEXAS AGRICULTURAL EXTENSION SERVICE
THE TEXAS A&M UNIVERSITY SYSTEM

This carefully collected soil sample is the first step in the development of profitable fertilization and liming practices. See instructions on the back of the bag.

Sample number _____

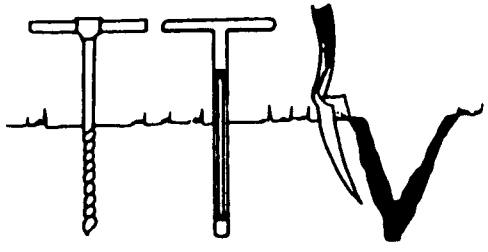
Name _____

Address _____

Soil Sample Bag

HOW TO GET A GOOD SOIL SAMPLE
(See information sheet for details)

1. Take 10 to 20 thin slices or cores at random, put in a clean plastic bucket, mix thoroughly, then fill bag.



2. Collect soil to plow depth for cultivated fields and to 3 to 4 inches for turf, pasture and hay fields.
3. Use spade, shovel sampling tube or other suitable tool. The most important requirement is to cut a thin slice or core of soil to the desired depth.
4. Complete information sheet, check which tests are desired, make check payable to the Texas Agricultural Extension Service (do not send cash), put in envelope with stamp and attach to sample package or mail separately.
5. Use self-addressed mailing carton. See instructions on information sheet.