TECHNICAL NOTES

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MICHIGAN

AGRONOMY #6
SUBJECT: Identification of Common Grasses
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To: All Offices

The following information and pictures show prime characteristics in identification of common grasses from seedling to maturity:

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GRASSES CLASSIFIED ACCORDING TO PRACTICAL CONSIDERATIONS

1. Especially tolerant to soil acidity - red top.

2. Quick starting (may be used to hold soil until slower starting species become established) timothy, red top, rye-grass.

3. More than average tolerant of dry conditions - brome grass, orchard grass, red fescue.

4. More than average tolerant of wet conditions - Reed canary grass, red top, meadow fescue, rye-grasses, tall fescue.

5. Bunch grasses (do not creep by means of rhizomes or stolons) - timothy, orchard grass, meadow fescue, tall fescue, red fescue, poverty grass.

6. Creeping grasses - brome grass, Kentucky bluegrass, Canada bluegrass, red top, creeping red fescue, quack grass.

7. Shade Tolerance (listed in order from 'dry' shade to 'wet' shade) - orchard grass, meadow fescue.

8. Especially responsive to high fertility - brome grass, Kentucky bluegrass, timothy, rye-grass, orchard grass.

9. Less exacting as regards fertility - red top, Canada bluegrass.

10. Sometimes kill under low temperatures - orchard grass, rye-grasses.

11. Grow late in autumn and start early in spring - orchard grass, rye-grasses, meadow fescue, tall fescue.

12. Tolerate close grazing well (high percentage of leaf area below the close grazing bite level) Kentucky bluegrass, Canada bluegrass, rye-grass, red fescue.

13. Require skillful management in grazing (low percentage of leaf area below the close grazing bit level and therefore may be seriously denuded of food manufacturing leaf area by prolonged close grazing) - timothy, Reed canary grass, red top, brome grass, meadow fescue, tall fescue, orchard grass.

14. Heaving may be serious (corms lifted out of the ground by alternate freezing and thawing in somewhat the same way that fence posts are heaved) - timothy.

15. Make numerous sterile shoots - meadow fescue (see drawing), tall fescue.

16. Grasses with low acre seed costs (on basis of retail prices over last decade - lowest first) timothy, red top, domestic rye-grass.

17. Laxative effect - all succulent young grasses. Meadow and tall fescue at all stages are reported to be laxative to horses.

18. Palatability - Every grass is more palatable when young than when mature and high in fiber. Therefore, management influences palatabilty. Brome grass is widely recognized as very palatable.

19. For soil binding - creeping species are more effective than bunch grasses. Quick starters have definitive advantage. Only well adapted species are efficient.

THE READER WILL FIND DEFINITIONS OF COMMONLY USED GRASS TERMS ON THE LAST PAGE

SUGGESTIONS FOR USING THE ILLUSTRATIONS

Grasses are like people in that all members of the same family are not identical. However, in both humans and grasses there are certain traits held in common by very closely related individuals. Such traits are used in separating species and varieties. Just as an occasional blond appears in a family of brunettes, so an occasional unusual specimen occurs in grasses. The sketches on the following pages depict the characters least likely to change and the shapes most commonly found. Bear in mind that there will always be more or less deviation from the most common shape which has been sketched. One who examines a population of reasonable size in any species or variety should find that the sketches serve their intended purpose. Terms not made clear on these 2 pages or in the drawings are defined on the last page.

To identify grasses from the characteristics of their heads — observe:

- **Type of inflorescence** — Panicles, like oat heads, found in most grasses; Spikes which are borne by quack-grass plants; or Spikelike panicles e. g. timothy.
- **Flowers per spikelet. (Between each pair outer glumes)** — Varies from:- one in timothy; up to a maximum of 11 in brome grass. Most species have a variable number which usually falls within rather definite minimum & maximum limits, the latter given in the illustrations.
- **The seeds** — See below

To identify grasses by means of their seeds — observe:

- **The relative size of the seeds** — The size figures given in the sketches are averages. Every species will have some seeds smaller and some larger. All seed measurements are given in millimeters (m.m.). To give accurate data in inches would require measurements to 1/64 inch which is not found on most rules.
- **Basal hairs** — Seeds like those of red top & Reed canary grass have hairs at their bases. This is invariably true if examined before harvest. Threshed samples that have passed thru commercial channels may have more or less of these hairs rubbed off.
- **Awns** — Some species have lemmas with awns attached.
- **Shape of lemma and palea** — Some lemmas are curved - like orchard grass. Some have characteristic "broadest areas" like Canada bluegrass and Kentucky bluegrass.
- **Nerves or veins on lemmas** — Lemmas like those of Canada bluegrass have few nerves or veins on them. Kentucky bluegrass lemmas have more numerous nerves or veins.

Utilizing culm characters in grass identification — observe:

- **X-sectional shape of culm or stem** — Flat in Canada bluegrass. Rounded in most species. The rounded shape is modified by slightly keeled leaf sheaths as in brome grass, for example.
- **Habit of leaves on the culm** — Leaves are strikingly ascending in Canada bluegrass. In most other species they are less erect.
- **Roughness** — Found just below panicles in rough stalk meadow grass and a few other species.

To identify in the vegetative stage such as young pasture or lawn grasses.

Warning!! Such plant material becomes distorted when dried -hence should only be used for study when young and succulent

observe

- **Leaves rolled or folded in bud shoot** — Bud shoots are present in very young grasses before they develop culms (stems). Every leaf, before it appears, is either rolled or folded up in this bud shoot. The easiest way to observe is to cut squarely across the shoot with a razor blade. Examples: rolled in timothy; folded in bluegrasses.
- **Shape of ligule** — The ligule is the very thin, membranous, upright structure located on the collar between leaf blade & leaf sheath. No two species have perfectly identical ligules. For contrast see sketches of red top and timothy. Note: Ligules often become torn and distorted as maturity approaches.
- **Presence or absence of auricles** — Auricles are extensions of the collar. They may be prong-like as in quack grass. They may be blunt as in meadow fescue. They may be lacking as in timothy.
- **Shape of leaf blade in cross-section** — Grasses either have flat blades such as those found in timothy; or V-shaped as those found in the bluegrasses and orchard grass; or closed such as the blades of creeping red fescue & sheep fescue.
- **Shape of tip of blade** — Some grasses have blades which are boat shaped at the tip or outer end e.g. the bluegrasses and orchard grass. Most species have blade tips which are not boat shaped. Examples: timothy and red top.
- **Blade markings & marginal constriction** — These can be misleading unless used with caution and in conjunction with other more dependable characters. Quack grass and some other species have a constriction at about 1 to 4 inches from the tip end. Brome grass has a constriction at about midway between tip and collar plus a peculiar marking on the under side of the leaf at the point of constriction. The marginal constriction in Reed canary grass is not similarly located. The bluegrasses have thin lines (median lines) on each side of the mid-rib visible when blade is held against a strong light.
- **Sheaths** — Keeled in Canada bluegrass; not keeled in timothy.
- **Habit of growth** — This does not apply to grasses much less than a year old. Species like orchard grass are true bunch grasses. They do not spread to make a continuous sod. Contrast with Ky. bluegrass which produces underground creeping stems called rhizomes or rootstocks. Rough stalk meadow grass makes above-ground creeping branches called stolons. The length of internodes, or distance apart of nodes, influences the density of the sod. Number and overall length of rhizomes or stolons also affects sod density.
- **Basal leaf habit** — Grasses like the bluegrasses, which have a high proportion of their total leaf area close to the soil, are difficult to injure by heavy grazing. Close grazing of species like timothy may remove too large a proportion of their total leaf area & may shorten life as well as seriously reduce yield.

CANADA BLUEGRASS

2,500,000 to 2,700,000 seeds per pound.

Bushel weight range:- 12 to 24 lbs. Usual standard weight 14 pounds.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	18.25%	12.75%	9.67%	6.88%

For over a century Canada bluegrass has been common in the Northeastern states of the Union and in some provinces of Canada, but this species is actually of old world origin. Farmers who have expected too much of it may have viewed the slender, sparsely leaved culms with unjustly critical eyes & called it "wire-grass", but this disparaging name is rarely applied by those who have learned to graze it properly. It is distinctive since it is the only bluegrass with so much as a faint suggestion of blue in its glaucous green color.

Canada bluegrass is known to thrive at lower fertility but higher lime levels than Kentucky bluegrass (see development of this point on Ky. bluegrass page). Canada bluegrass is the dominant permanent pasture grass in New York counties where soils are heavier than average and rainfall below the mean for the State.

At the Churchville experimental field (near Rochester) areas undisturbed by the plow for close to a decade, produced the following natural responses: (1) A high proportion of Canada bluegrass on the heavy, undrained part where water stands for days in late winter and early spring, followed by drying, baking and cracking open during the heat of summer. (2) A high proportion of Kentucky bluebrass on areas affected by a tile drainage system. Here water did not stand and the soil was less inclined to bake and crack open in summer. Exposed limey subsoils, devoid of organic matter, such as one finds in road cuts often support the growth of Canada bluegrass. One of the best illustrations of the plant's ability to "get-along-with-little" is a dry stone wall on the campus of Cornell University. On top of this wall is not more than 2 inches of soil, and a pure volunteer stand of Canada bluegrass. Also, no permanent grass will perform better where extremes from wet to dry occur each year.

Canada bluegrass is primarily a permanent pasture grass. It flowers and sets seed about 10 to 14 days later than the Kentucky species, but its culms and leaves remain green more than 14 days later in summer than those of the Kentucky bluegrass. It does, however, eventually succumb to summer heat and drought.

Because of the high proportion of basal leaves and high percentage of leaf area below the close grazing bite level, it is difficult to overgraze. Canada bluegrass sods are called tough but they are not dense. As one looks downward he will see more of the ground thru a Canada bluegrass sod than thru a Kentucky bluegrass sod. Rhizomes (or rootstocks) are fairly numerous but internodes are too long to produce a sward with the effect of a good thick rug.

As a hay plant it is far excelled, in both quantity & quality produced, by the taller growing, more leafy species possessing characteristics like those of timothy. Culm leaves are few and small. This means that the hay is stemmy. Almost none is grown primarily for hay and relatively little is cut for hay. As a short-term pasture crop it has the handicap of being slow to become established. Further, the big bite species, like orchard grass and brome grass, will greatly out-yield it and they should prove more palatable to livestock if properly managed.

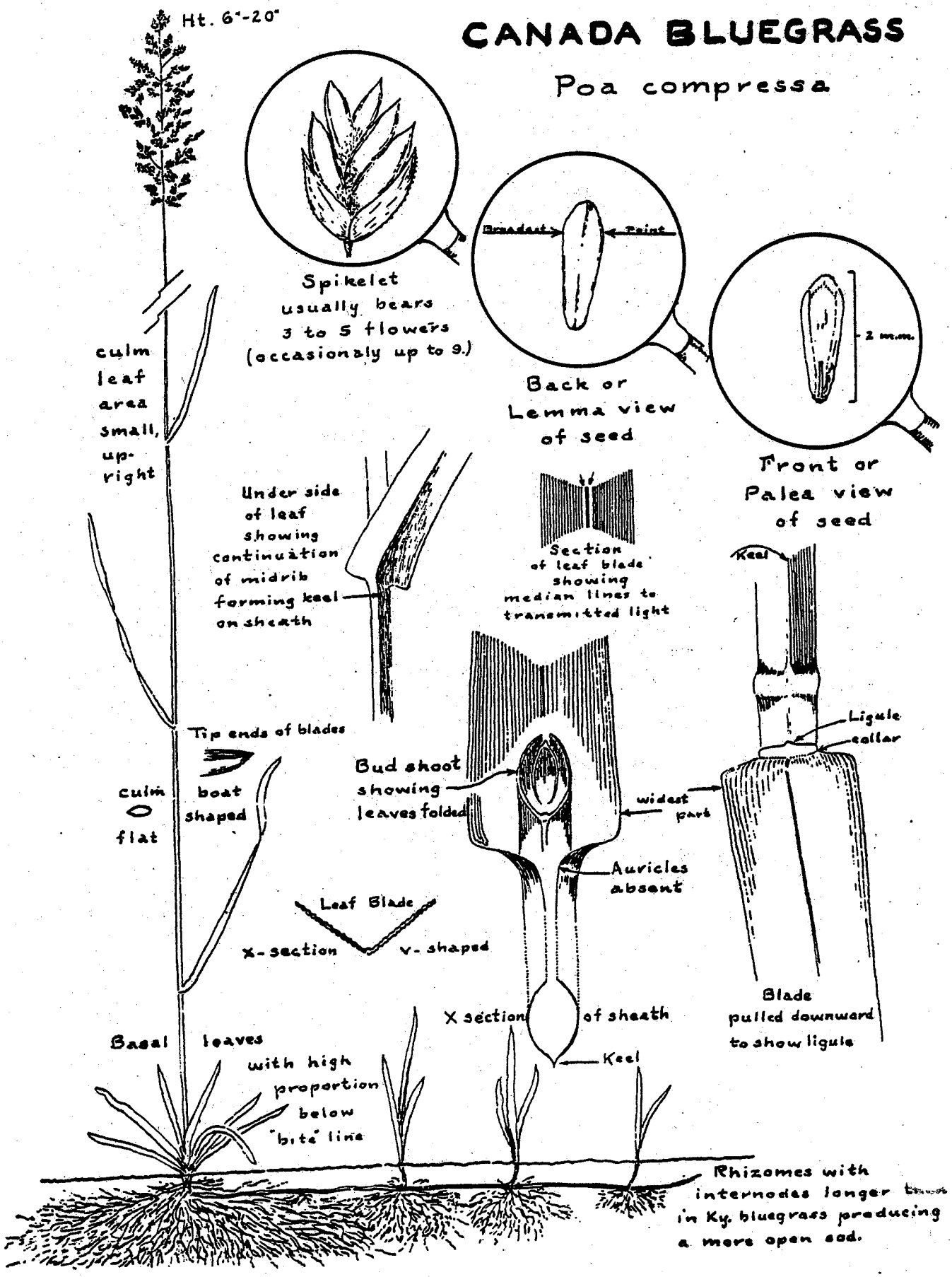
Canada bluegrass is not shade tolerant and should not be seeded in combination with taller species. It is occasionally found growing in dry soil beneath a high-headed tree which competes with it for water and nutrients but not for light.

Except in an unusual year Canada bluegrass seed sells for enough less than Kentucky bluegrass to present a temptation to the unscrupulous seedsman who knows that few farmers have learned to differentiate seed of one species from the other. Separation is actually not difficult (see drawings).- Canada bluegrass seed is sown efficiently thru practically all farm seeding equipment, no mechanical problem.

It has been said that if conditions for its growth are favorable there is no need to sow Canada bluegrass (or even Kentucky bluegrass) seed; and if conditions are not favorable there is nothing gained from sowing it. There is truth in such a statement because Canada bluegrass does readily volunteer. Stands that appear voluntarily usually are not established uniformly over a field and they are commonly not quite quick enough in taking over the land to compete effectively with weeds. Volunteer establishment may be speeded up a little by sowing an adapted hay legume and allowing nature's Canada bluegrass to take possession of the land as the seeded species gradually "run out". Direct seeding may be faster provided a quick starting grass and pasture legume is sown to hold the soil and provide grazing until the bluegrass is established. Use of basic mixtures like those proposed for Kentucky bluegrass might be helpful in developing the proper combination. In these substitute Canada for Kentucky.

CANADA BLUEGRASS

Poa compressa



KENTUCKY BLUEGRASS

2,175,000 to 2,225,000 seeds per pound.
Bushel weight range:- 12 to 24 lbs. Usual standard weight 14 pounds.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	18.70%	11.51%	9.75%	7.75%

Despite all that one reads & hears about the famous pastures of Kentucky, the bluegrass bearing the name of that state originated in Europe. It did, of course, gain a favorable reputation in Kentucky.

That this grass requires a high fertility level is strongly suggested by the results of a chemical study of soils taken from beneath that species as it occurred in 39 New York pastures. These soils were higher in nitrogen, phosphorus & potash than soils taken from beneath Canada bluegrass in the same pastures. Part of what has been written crediting the limestone in the soils of Kentucky with the maintenance of Kentucky bluegrass may be subject to question, since more lime was found under Canada bluegrass than under the Kentucky species in New York pastures. This was not generally true in Ohio. Lime enough to maintain associated legumes which contribute the much needed nitrogen could be a factor, however.

Kentucky bluegrass is much more tolerant of cold than of heat. A serious indictment against bluegrass pastures is that they "dry up in summer". That lack of moisture contributes no little to this dormant condition may be verified by any person who has a lawn, a hose and a good water supply. The cooling effect of evaporating water may reduce soil temperature and this may be more important to the plant than air temperature. Because of its recuperative ability following a dormant summer period, Kentucky bluegrass is productive farther south than timothy.

The usefulness of Kentucky bluegrass in lawns & pastures is enhanced by its ability to start growth early in the spring & remain vegetative later in the fall than most species. However, recent evidence indicates that the amount of growth made in the fall weighs less than one would estimate from its appearance.

Kentucky bluegrass prefers (as does every grass) well-drained, moisture retentive loams but it thrives better on clay loams than on sandy soils. This species is sensitive to conditions that exist where water stands for any considerable period of time. It is replaced by Canada bluegrass on soils which are wet in spring & excessively dry in summer. Kentucky bluegrass is more sensitive to shade than Canada bluegrass.

All classes of livestock, including poultry, find it palatable as a pasture plant. Kentucky bluegrass is less desirable as a hay plant because it does not yield as well as the taller grasses & its culms are not as leafy. It is also less desirable than the taller species for short-term pastures where grazing management for the latter is proper. A high proportion of the total leaf area of Kentucky bluegrass is at the base of the culm & enough of this is below the bite level so that it is able to persist even with uncontrolled grazing. In fact, some bluegrass rotation grazing experiments have (before the era of the electric fence) made extra fencing look like a questionable investment. At present, however, it appears that dividing pastures reduces the amount of herbage unnecessarily tramped down & cuts wastage due to stock neglecting to graze some parts of each paddock.

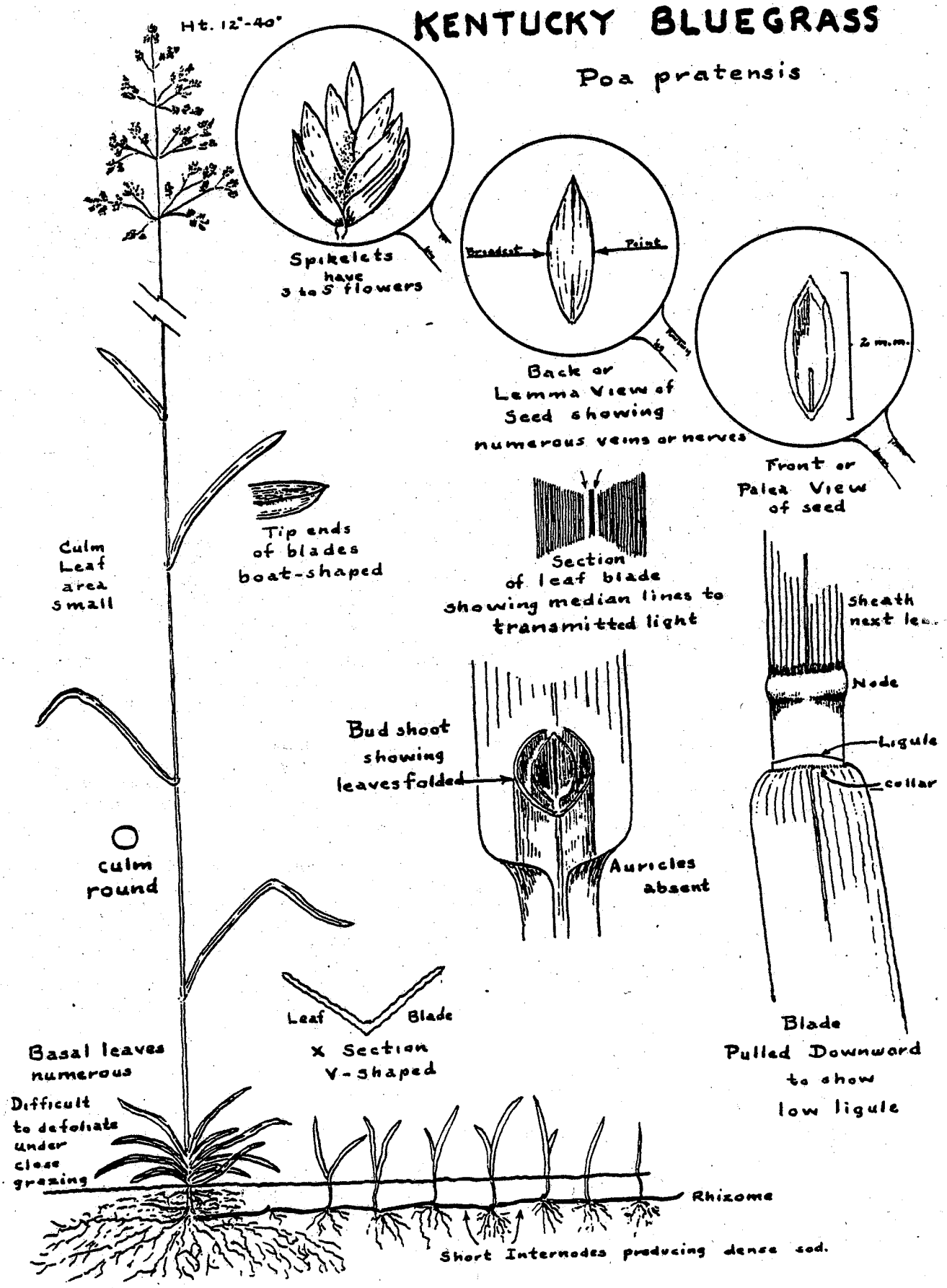
Kentucky bluegrass makes a more dense sod than Canada bluegrass, but not so close a sod as Rhode Island bent grass. Rhizomes are fairly long & numerous & their internodes are relatively short. Altho the sod is reputed to stand tramping & grazing well, turning out livestock in the spring before the ground is firm may lead to serious "punching". In the best interest of the sod the date of turning out should be determined more by the firmness of the land than by the height of the grass.

Kentucky bluegrass should be regarded as a permanent pasture grass. Because of this, association with wild white clover - a long lived perennial may be preferable to the shorter lived Ladino clover. Bluegrass seeds do not present mechanical problems in sowing. The seed is slow to germinate and the plant slow to establish itself. Seed is relatively expensive both on the pound and on the acre basis. Germination is characteristically low - 70% being considered good. One of the simplest & easiest means of establishing a stand is to sow an adapted legume & allow the bluegrass to "come in" voluntarily as the legume & other grasses "go out" under grazing. See section on seeding on timothy page.

A common mistake made in compounding seed mixtures is to sow Kentucky bluegrass with o quick-starting grass to hold the soil & provide grazing during the long period of establishment. One or two bases for mixture-making follow: Rarely can one justify sowing over 20 lbs. of total seed per acre - 1/3 of total should consist of a fast-starting species like timothy or red top. One or two lbs. of white clover are enough.

KENTUCKY BLUEGRASS

Poa pratensis



MEADOW FESCUE AND TALL FESCUES

225,000 to 255,000 seeds per pound.
Bushel weight range: - 15 to 30 pounds.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	19.63%	12.56%	8.38%	5.25%

Sometimes this species is called English bluegrass, a name which is misleading because it does not belong to the bluegrass genus. The widely accepted American name is meadow fescue altho it has been called Randall's Grass in the South. A variety of meadow fescue, long since established, is the so-called tall fescue, which differs from meadow fescue in being from 4 to 12 inches taller and somewhat coarser. Alta Fescue is a selection from tall fescue developed at the Oregon Experiment Station. Kentucky 31 (Suiter's Grass) at times reported in the popular press to be "something unlike any other known grass" appears to be merely a selection from tall fescue.

Because the principal physical difference between the fescues is height and because meadow fescue is the most common form, making up much of that which volunteers, it is the subject of the sketches. Height figures given in the sketches include the range of meadow and tall fescue and the selections mentioned. Under surfaces of the coarse, harsh leaves are more conspicuously shiny than upper surfaces.

Meadow and tall fescues are bunch grasses having no creeping stems such as rhizomes or stolons to produce a continuous sod. Most investigators state that these fescues are less conspicuously bunchy than orchard grass or tall oat grass. That seems to be true in the Cornell experimental plats where seeding was fairly liberal but it is not true of most volunteer stands observed in New York State.

Except where it is very closely grazed or treated like bluegrass, meadow fescue is a long lived perennial. An unusual characteristic of the plant is that it makes numerous sterile shoots (see sketch). These add to the forage produced but do not contribute to seed yields. Sterile shoots, being more numerous in tall fescues than in meadow fescue, may account for the fact that seed yields of tall fescues are lower and prices higher. In the South tall fescues remain green thru early winter.

Meadow and tall fescues are used for both hay and pasture. They have not and probably will not attain the importance of the more palatable timothy. Sizeable acreages of meadow fescue have voluntarily appeared in the Mohawk Valley and lesser acreages in several other parts of New York State. Tall fescue is coarser and less palatable than meadow fescue.

As hay plants meadow and tall fescue suffer by comparison with the finer stemmed timothy. They will probably outyield timothy on wet soils (where water doesn't actually stand), but timothy is a superior hay species for most situations. Hay of these fescues is somewhat laxative and because of this is discriminated against as horse feed. They approach, but do not equal orchard grass in shade tolerance. This makes it feasible to sow meadow fescue with a taller growing species if that seems desirable. They tolerate drought somewhat less well than brome and orchard grass. Seed costs place the fescues at a disadvantage to some other grasses. There are no problems in the mechanics of seeding similar to those presented by orchard and brome grass.

Meadow and tall fescues are better suited for pasture where grazing is not so close as is the rule with Kentucky bluegrass and wild white clover. In other words, they require the same sort of management as pastures which support the growth of orchard or brome grass. Their lesser drouth tolerance and lack of palatability (noted above) makes these fescues not so well suited for short-term big bite pastures as orchard or brome grass. The proportion of basal leaf area below the close grazing bite level is not so small as in timothy, but is small when compared to the bluegrasses. Meadow and tall fescue have withstood the close mowing treatment which in experimental plats was intended to simulate close grazing, better than one would expect and better than they have withstood actual close grazing in New York pastures. Fertility level may contribute to the explanation. It appears that rotational grazing with the control that it affords is the best way to maintain these fescues in pasture.

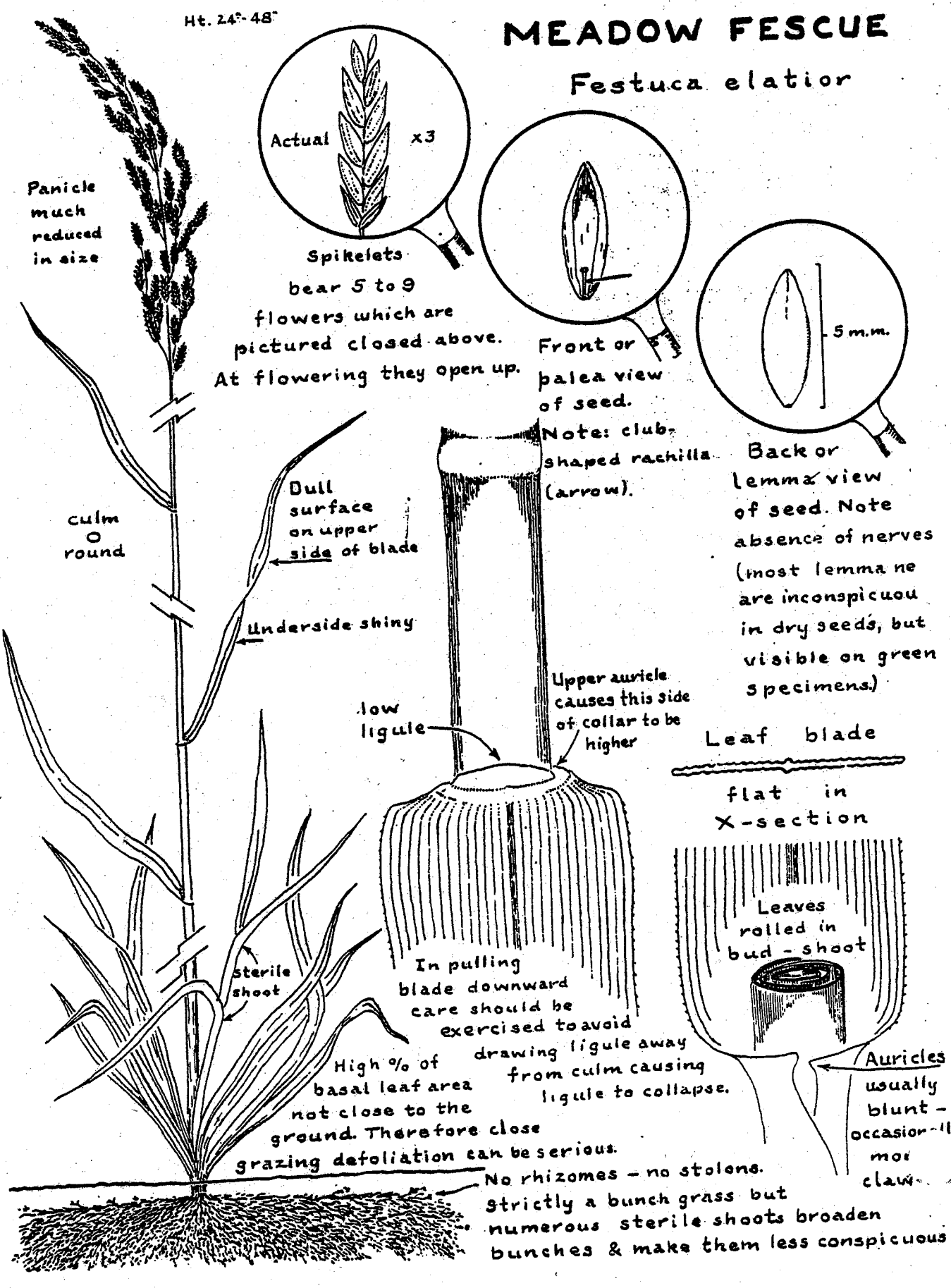
Meadow and tall fescue do not germinate quite so rapidly as timothy or red top but they are fairly quick to establish themselves. Fall seeding with winter grain would be satisfactory if they were grown in an area where such grains were a part of the rotation. Seeding with spring grains is more common and is most satisfactory.

Before seeding meadow or tall fescue one should ask himself what these grasses will do for him that species like timothy, orchard grass or brome will not do better and at lower seed cost. However, in event that the land is slightly wet and red top not wanted, then the suggestion listed below might well serve as a base or starting point for modification in developing seeds mixtures for specific situations.

A maximum total of 14 pounds of seed per acre; of which over half should be alsike or alsike and Ladino clover - the balance one of the above fescues. With 1 or 2 lbs. of Ladino (creeping legume) 6 to 8 lbs. of fescue are probably enough.

MEADOW FESCUE

Festuca elatior



ORCHARD GRASS

510,000 to 600,000 seeds per pound.
Bushel weight range:- 12 to 22 lbs. Usual standard weight 14 lbs.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	19.20%	13.13%	9.75%	5.19%

The most outstanding characteristic of orchard grass is its ability to tolerate shade. It thrives better than most grasses when overshadowed by taller growing species which seem to harm it very little unless they deprive it of soil moisture. Like most grasses it makes its best growth at a high fertility level, but seems not to be so exacting as brome grass in this respect. Orchard grass thrives on a wide range of soils but seems to be at a disadvantage on sands, mucks and very wet land.

It is not the most winter-hardy of grasses. This is probably due to the fact that it never develops specialized storage organs such as rhizomes, stolons or corms. Some evidence has recently been offered to prove that reserve foods are stored in those parts of culms and leaf sheaths just above the ground, and of course to a degree in the roots. Nevertheless, orchard grass is of dubious practical value at latitudes north of the northern limits of New York State. In fact a few cases of its winter-killing have been reported in some northern New York counties.

Probably because of its relatively low supply of reserve foods and tendency to be awakened from dormancy too early, it thrives best where winters are not long & severe. It continues growth late in the fall & begins growth early in spring, having a shorter rest period than many other species better fortified with reserve food. E. W. Leland of Cornell has evidence that it does not out-yield other species in dry matter during the first weeks of spring, but by mid-May orchard grass is growing at a more rapid rate than most grasses. An explanation for this could be that orchard grass, being a typical bunch grass, does not so completely occupy the ground as creeping species which do not start to grow so early as it does in the spring; or the explanation could be winter depletion of food reserves.

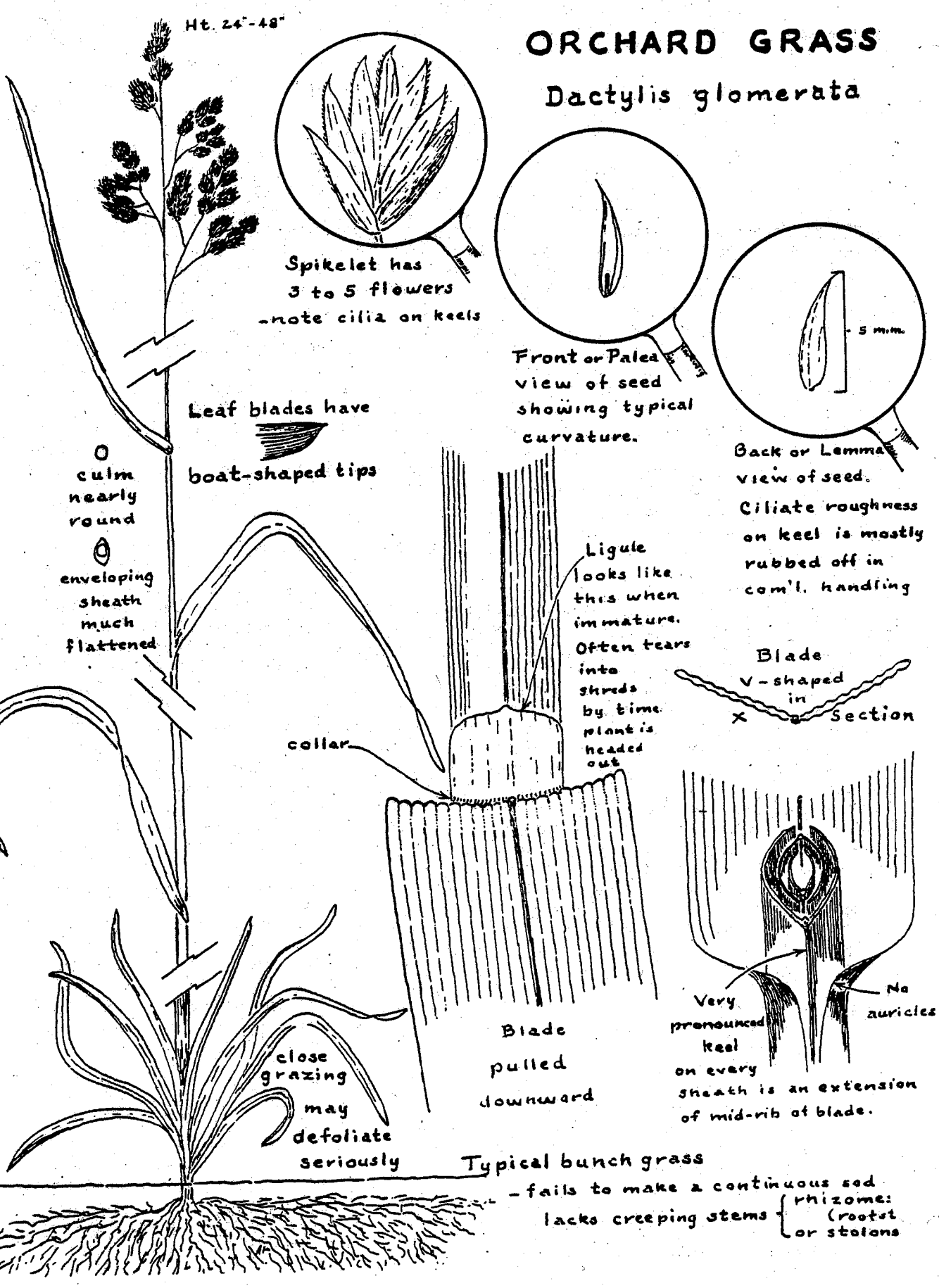
Orchard grass is more drought tolerant than timothy but probably not quite so able to withstand dryness as brome. Altho better adapted to pasturing or ensiling, in two Cornell hay-experiments it produced more late summer growth than brome grass when each was associated with alfalfa. Some livestock men dislike orchard grass because of its reputed lack of palatability. This is most likely due to its early maturity during which it becomes woody very rapidly. It could also be related to the harshness of its leaves. Despite this handicap it is gaining popularity in combination with legumes like Ladino clover and alfalfa. With either mixture grazing management is extremely important. Allowing the orchard grass to overshadow Ladino for very long at least reduces the proportion of that legume. The maintenance of alfalfa calls for allowing it to reach full bloom once a year and avoiding the removal of top-growth when it is building reserves for winter. Thus, preventing orchard grass from becoming woody without weakening alfalfa, presents a challenge to the person responsible for the grazing management. This is best met under conditions of rotational grazing which affords the control needed. Orchard grass often does not persist for long under the close grazing which is customary on permanent pastures consisting of bluegrass and wild white clover. The reason for this is evident from the sketches which reveal the fact that a high proportion of the leaf area of the bluegrasses is below the close grazing bite level. That is not true of orchard grass. Except in very favorable situations it cannot be grazed so closely nor so continuously if it is to build the food reserves necessary to keep it alive.

Some farmers object to the patchy appearance of fields in which orchard grass is growing. It is a true bunch grass and never makes a continuous sod. One way to meet this objection is to make sure that the mixture sown and the management given does not result in orchard grass alone. In some cases it may help to sow a little more orchard grass seed than some have sown - but not so much as to crowd out the associated legume which should predominate.

Orchard grass has been sown with success in spring, summer and fall. Fall seeding is practical only where the grass is well established before heavy frosts. When sown without a companion crop it does not start so rapidly nor hold the ground against erosion so well as red top, or even timothy. With existing farm seeding equipment, the large fluffy seeds present a mechanical problem like that involved in sowing brome grass seed. (See comments on sowing brome and timothy) Suggested starting points for tailoring mixtures to fit specific situations are:- Make 18 lbs. per acre of orchard grass and alfalfa the maximum - always over half alfalfa. Sow up to 10 lbs. per acre of orchard grass and Ladino - 1 to 2 lbs. of the latter (creeping).

ORCHARD GRASS

Dactylis glomerata



POVERTY GRASS

560,000 to 750,000 seeds per pound.
Bushel weight range:-4 to 6 pounds.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	17.06%	13.50%	7.81%	4.75%

This is a native species with many names - none of which are quite as accurately descriptive as poverty grass, Others sometimes heard are white top, old fog, wire grass, wild oat grass, white horse, bonnet grass, hillbilly grass, turkey strip and a host of others that are not used in polite society.

Poverty grass has been designated as a weed grass but it lacks certain attributes of plants ordinarily called weeds. For example, it is very feebly competitive - probably only gains a "foothold" after more desirable species have failed to survive or are in the process of failing to survive. The weeds that are associated with it are those which do not compete successfully with well-managed and well-fertilized crop plants. Examples:- Devil's Paintbrush or Orange Hawkweed (Heiracium aurantiacum) and Clammy Everlasting (Gnapphalium decurrans).

The presence of this "grass of the hills" implies low fertility level and almost invariably high acidity. Even in the earlier stages of its culm development it appears to reflect the deficiencies of the land on which it is grown for it loses its succulence and becomes somewhat dry before maturity. The culms are wiry in appearance but more often hard and brittle than tough. Leaf area on the culm is typically small. The spike-like panicles develop a poorly-nourished appearance and bear only a few seeds, part of which shatter before all are ripe leaving wasted-looking empty glumes.

The stand is rarely uniformly thick because it is a typical bunch grass with no rhizomes or stolons. As they mature the lower leaves curl and become brittle (see sketch). The root system is much restricted and weak so that grazing animals often pull an appreciable number of little clumps which litter up the sward. When powerful forces of erosion are at work it quickly gives way, leaving bare streaks on steep hillsides. In less steep situations its appearance represents one of nature's more or less effective ways of reclaiming worn-out lands. (See last paragraph)

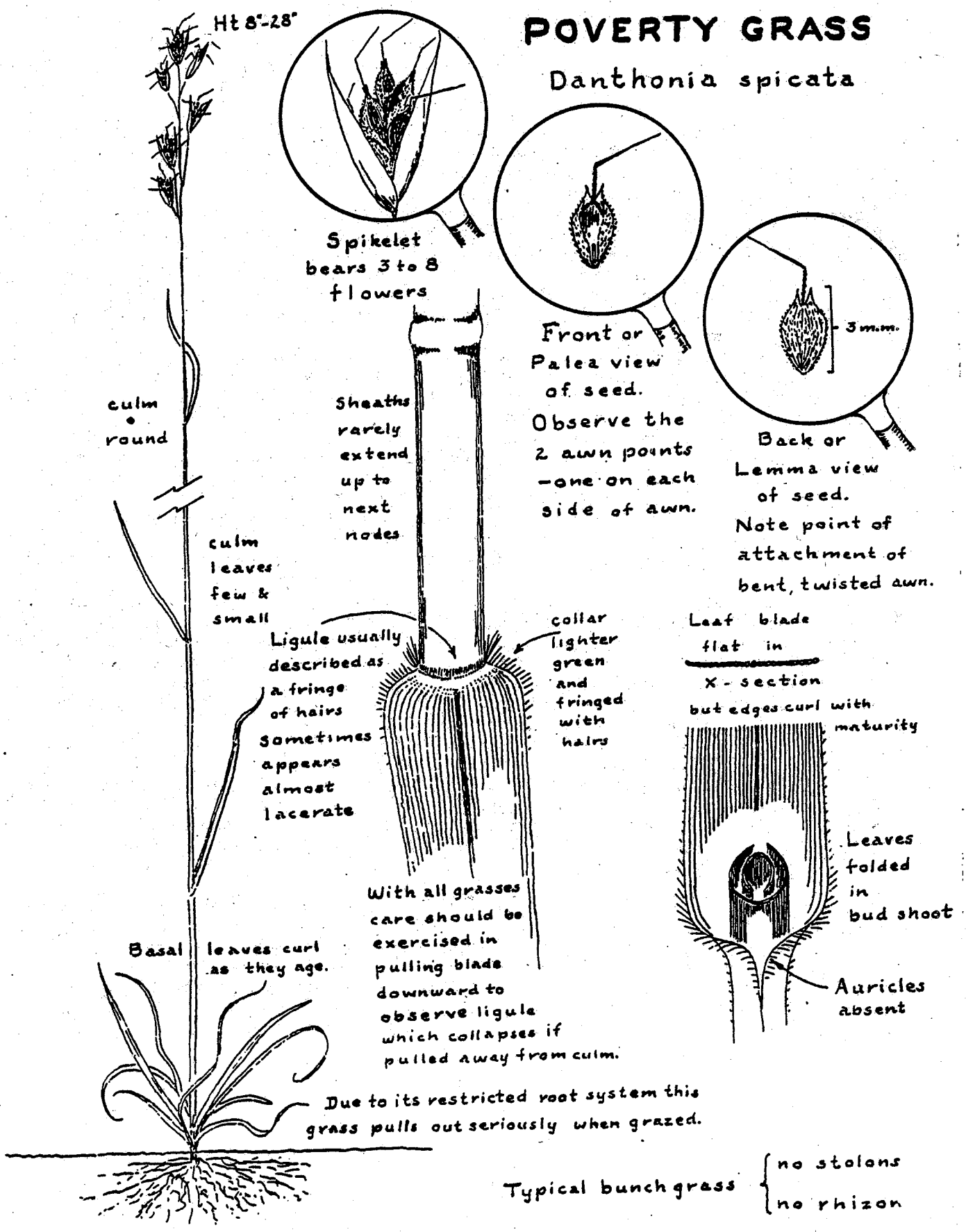
Livestock grazing on poverty grass pastures is likely to look under-nourished in the presence of uneaten herbage - mute testimony to low nutritive value and lack of palatability. Farmers comment that "there is not much milk in it." Thousands of acres of it (sometimes interspersed with sweet vernal grass and quite regularly blended with weeds) are cut each year for hay and bedding. Yields are low and hay quality usually very low. More should be used for bedding and less for hay despite the fact that livestock men deplore its low absorptive capacity for liquid excrement.

The better-drained land which supports the growth of poverty grass may be reclaimed through the use of lime, manure and commercial fertilizer. Manure is often difficult to apply to steep hillsides and erosion has carried away the thin mantle of surface soil from these sloping areas. For such land and for the wet, shallow, hard-pan soils which support poverty grass, the New York State program of reforestation seems most logical.

Dr. H. P. Cooper, formerly of Cornell, (now Dean at South Carolina) collected abundant evidence which indicated that nature's most common way of dealing with depleted soils covered with poverty grass is to gradually reseed evergreen tree species. He had hundreds of photographs taken in New York State showing natural evergreen encroachment in hill pastures and hay fields. In such situations the feeble poverty grass did not prevent tree establishment, as have some of the taller, fast-growing, cultivated grass species elsewhere through effective competition.

POVERTY GRASS

Danthonia spicata



Typical bunch grass { no stolons / no rhizon

160,000 to 200,000 seeds per pound.
Bushel weight range:- 11 to 13 pounds.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	19.00%	13.10%	8.25%	5.13%

One distinction which can be claimed for quack grass is that it has earned for itself more names, printable and unprintable, than any other grass including poverty grass. Some of the former kind follow: Witch grass, Quitch grass, Switch grass, Twitch grass, (there are 2 unprintables that rhyme with these), Dog grass, Devil grass, Scutch grass, Couch grass and Wheat grass.

Another dubious distinction is that it has stimulated more "dark thoughts" in the minds of persons working with hoes or cultivators than any other temperate climate member of the great grass family. It undoubtedly deserves the rating 'noxious'.

Some farmers are able to derive small consolation from the fact that quack grass usually thrives at high fertility levels on dairy farms where there is an abundance of manure. The writer, during nearly 9 years of visiting New York farms as an extension agronomist, never found quack grass growing in association with poverty grass, 41% of 952 hay samples collected in 3 typical New York dairy counties and examined by the writer contained quack grass.

Quack grass is not difficult to identify (see sketches). The grass most readily confused with it is rye grass when both are in head. The spikelets in the spike of quack grass have their broad sides against the rachis (or axis of the spike) while those of rye grass bear spikelets the edges of which are toward the rachis.

The characteristic which makes quack grass so obnoxious is its persistency. Were it not for this trait it could well rank with timothy, brome and orchard grass. The persistency of quack grass is not due to its root system but rather to the network of rhizomes (or rootstocks) which it produces. These are fleshy, storage organs containing reserve foods which are held in readiness to nourish the new shoots which so spontaneously arise from the nodes beneath the ground level.

Eradication should be directed at the weak point in the life cycle of any weed. One of the weakest points in the life cycle of quack grass on land where it had not previously appeared, is the first 50 to 60 days after germination. Until the seedling plant is close to 2 months old it does not develop rhizomes. In that period it is just as easy to kill by uprooting as any non-creeping grass.

Once the rhizomes develop the problem becomes more complicated. Disk harrows cut the rhizomes into short pieces, making it more difficult to pull them out of the ground where the sun can dry them out and thus contribute to their extinction. Spring toothed harrows pull the rhizomes out of the ground, but drag and scatter them over the land. Burying deeply is usually a mistake. Freezing kills few rhizomes.

There are many ways of combating this pest. Selective chemical means are receiving much research attention. One of the best practical mechanical means which does not sacrifice the use of the land in the process is as follows:

(1) Quack is one of the few grasses which will weaken itself by becoming sodbound. Grazing for a year or two if practical increases sod-binding and brings the rhizomes closer to the surface of the ground where they may be dragged out. Plow shallow so that the rhizomes will not be mixed throughout the furrow slice.

(2) Harrow at intervals throughout the spring months and often enough to prevent more than an inch or two of green growth. This exhausts reserve food in the rhizomes.

(3) If each succeeding recovery appears weaker and the quack seems to be getting quite feeble, then a smother crop of tall varieties of buckwheat such as Tartary or Japanese may be sown in early July. Buckwheat is effective as a smother crop only after the quack has been repeatedly and effectively weakened as suggested above, so that the quick-starting buckwheat will provide a complete canopy over the feeble quack plants and continue the starving process by shutting off the light.

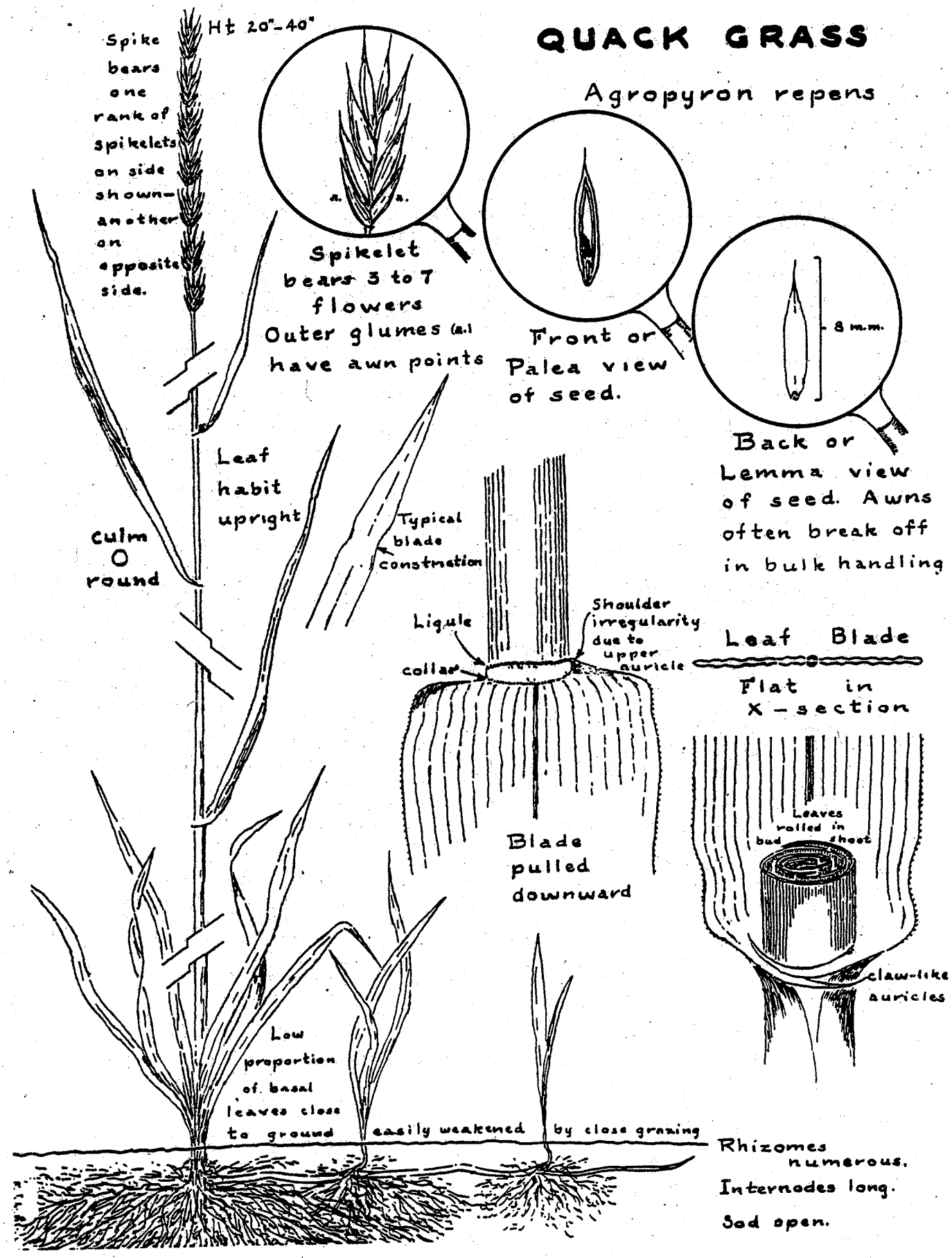
(4) If any quack grass remains after buckwheat harvest, a choice of procedures is offered:- (a) Where slope is slight and erosion not a problem, plow and continue the harrowing during the fall months. This may complete the job of eradication.

(b) Where erosion is a problem, defer plowing until spring at which time the same procedure as that outlined above may be repeated.

Such procedures are only as good as the faithfulness of the farmer and depend somewhat on the weather. Each time one allows the quack to reach a height of 6 inches he has undone the weakening effects accomplished in at least two cultivations.

QUACK GRASS

Agropyron repens



500,000 to 600,000 seeds per pound.
Bushel weight range:- 10 to 30 pounds.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	18.70%	14.50%	6.13%	5.88%

It is possible that red fescue was so named because of the presence of a reddish tinge on the sheaths at the base of the plant. This reddish or purplish-red coloration is present on most but not all plants. A very few appear never to develop the red and a few more change in color from reddish to a weathered brown. It is also possible that the name, red fescue, was applied because some of the outer glumes and lemmas in the panicle take on a reddish hue.

Red fescues are of two habits - the intravaginal or bunch (tufted) habit and the extravaginal or creeping habit. The latter bears short heavily scaled rhizomes. Most of what is sold under the name of red fescue (unless specified as creeping) does not creep. The non-creeping form is the subject of the sketches (which see).

The tufted or non-creeping red fescue bears leaves which are similar in shape but very slightly larger in size than those of sheep's fescue. They are deep green and either not glaucous or only slightly so, in contrast to the distinctly glaucous (bluish) green leaves of sheep's fescue.

The creeping form makes two types of top growth. Plants which arise directly from seeds shoot up straight, but plants produced vegetatively on the short scaley rhizomes show a very distinct curvature at their bases. This curvature is such as to suggest that the plant started out to creep and then "gave up the plan" and grew upright. The leaves of the creeping form are lighter green than those of the non-creeping form and are less likely to be covered with a "bloom". Creeping red fescue leaves are commonly reported to be folded rather than closed (rolled) in the normal condition, but are observed to roll or close in the face of deficient moisture. As the creeping form occurs in the Champlain Valley, many of the leaves are folded and of such appearance as to suggest bluegrass at a first quick glance. When seeds of these Champlain Valley plants were sown at Ithaca they gave rise to plants many of which were permanently closed. This anomally, together with the aberrations found in sheep's fescue make the fine-leaved fescues difficult to classify and identify.

Red fescues, because of their drought tolerance, are especially adapted to dry sandy or gravelly soils. Their ability to remain green and vegetative under close grazing during the hot summer months has caused them to be investigated as permanent pasture plants. In Cornell tests the red fescues have ranked very high in total dry matter yield. Appearances have not always correlated with yields because these grasses have been relatively low in moisture content. Creeping red fescues seem to come nearer to producing a fair yield of dry matter during the summer months than any other permanent pasture species.

The few palatability data that are available indicate that one of the weaknesses of red fescues is that they are not the most palatable, although probably more palatable to several classes of livestock than sheep's fescue. Wild white clover appears to do a little less well with creeping red fescue than with Kentucky bluegrass. This might be due to competition.

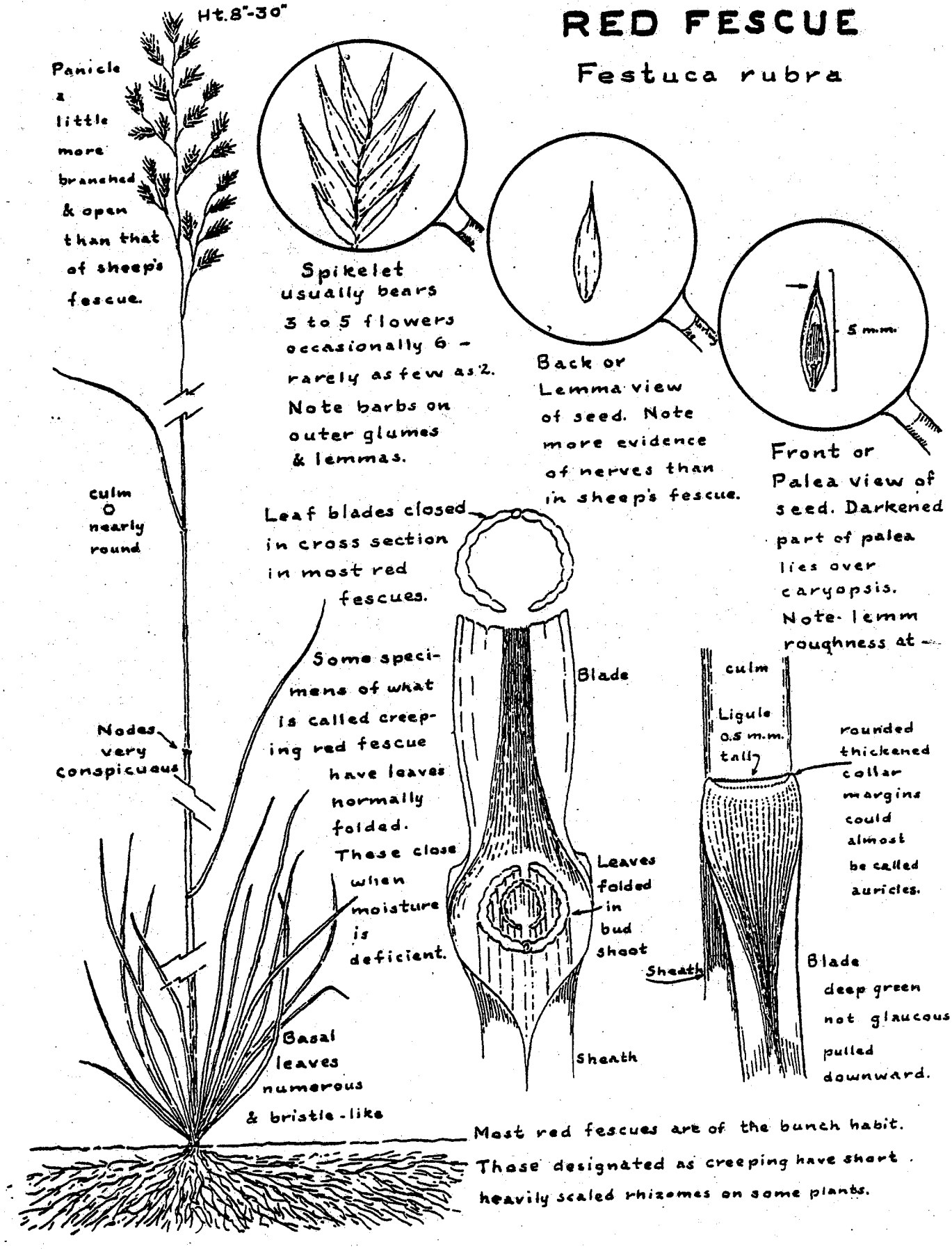
Creeping red fescue volunteers and develops numerous relatively pure stands thruout the Champlain Valley of New York and Vermont. This area of spontaneously occurring creeping red fescue extends up into the Province of Quebec. Every effort should be made to encourage the species in these places because it is doubtless more valuable, at least under these conditions, than Kentucky bluegrass. In other parts of New York the non-creeping form volunteers but it never makes up such a high proportion of the total pasture herbage as the creeping form. Red fescues are no more valuable as hay plants than Kentucky bluegrass.

Man-established stands are not likely to be numerous because of the fact that seed costs are almost prohibitive to the farmer with the ordinary amount of working capital. Some of the varieties of creeping red fescues that are difficult to obtain are:- Olds, Oregon, Illihee and S-59. Seed of Chewing's fescue or New Zealand fescue is a commercial commodity but it is usually a mixture of creeping and non-creeping forms.

If one is able to justify seeding red fescue as a long-term investment, it should be sown along with some grass which germinates more rapidly and grows fast to hold the ground. Suggested bases for modification in mixture making are: A maximum total of 22 lbs. of seed per acre made up of 2/3 red fescue and 1/3 either timothy or redtop or both, plus 1-2 lbs. of white clover (creeping legume - see timothy).

RED FESCUE

Festuca rubra



RED TOP

4,200,000 to 5,000,000 seeds per pound.

Bushel weight range:- 12 to 40 lbs. Usual standard weight 14 pounds.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	18.31%	12.07%	8.21%	5.81%

Red top is adapted over a wider range of soil and climatic conditions than is timothy. It tolerates more heat than timothy and probably as much cold. It is capable of thriving in situations much too wet for timothy and, paradoxically in environments a little too dry for timothy. No other grass will give as good account of itself where soil acidity is excessive. No other widely used grass will produce as many pounds of dry matter at low fertility levels as will red top. Despite this best yields are produced where fertility is abundant. Heavy soils are preferred to light ones, but there are few economic grasses as well suited to light sandy soils as red top.

This is one of the most rapid germinating grasses and because of that fact and the fact that it grows rapidly in early stages, it may be justified as a temporary or short term ingredient in mixtures with slow starting species like the bluegrasses - especially in situations where the land slopes and where erosion may become a problem. Acre seed costs for red top are lower than for any grass except timothy.

It flowers about ten days later than commercial timothy. This characteristic makes it easier to cure into hay of good appearance, but there is market prejudice against red top hay in many areas. When grown in mixture and cut as the timothy is beginning to bloom, red top will usually not have advanced beyond the "boot" stage (just beginning to emerge from the upper leaf sheaths).

Unhappily, with all these virtues, red top has some serious shortcomings. Not the least of these is its relatively low feeding value which includes a lack of palatability.

It is much better suited for hay than for grazing despite the fact that New York surveys have shown it to be present in small amounts in a high percentage of pastures. Lack of numerous close-to-the-ground leaves (and little leaf area below the close-grazing bite level) make it vulnerable to grazing such as that practiced in good bluegrass-white clover pastures. Although it creeps by means of rhizomes, the nodes are so far apart (or the internodes so long) that it does not make a dense sod. However it is a better soil binder than most bunch grasses.

In situations favorable for timothy it rarely equals that crop in yield. Red top should not be seeded in combination with taller growing species because long continued shade seriously reduces its yield.

One Cornell test of grass-legume mixtures has led to the suggestion that at high fertility level most legumes find other grasses more compatible than red top. This test, however, did not include red top at various rates of seeding, and it is possible that too much seed of that species was used. The word "incompatible" would not apply to red top in situations especially suited to alsike clover.

Red top does not present mechanical seeding problems, because most farm seeding machinery will, with proper adjustment, sow it in combination with the common legumes and with other small seeded grasses like timothy and the bluegrasses.

Red top has not been widely tested in combination with Ladino clover, because this legume is conceded to require a high fertility level at which the more palatable and nutritious grasses are not only possible but decidedly preferable.

On poor hill soils where mammoth red clover is superior to medium red clover there may be some justification for red top but for most situations a good rule to follow is: "NEVER SOW RED TOP WHERE TIMOTHY CAN BE GROWN WELL".

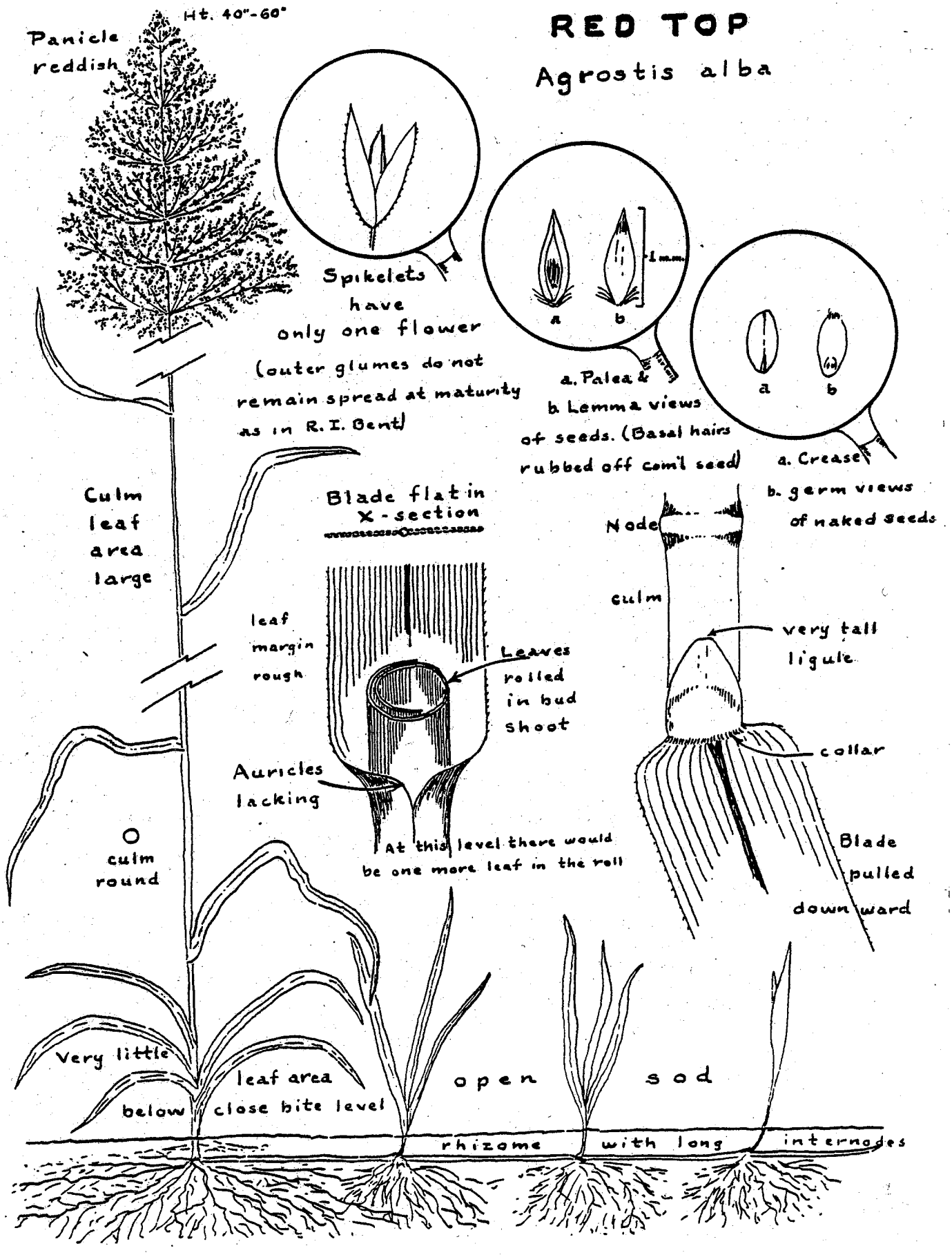
Some soils that are too wet for the red clovers will support the growth of alsike clover. Much land in this category heaves so badly in late winter and early spring that timothy corms are lifted out of the soil and death follows. Under such conditions red top has particular merit. See seeding section on timothy page.

From the above it should be apparent that there are here and there conditions under which the advantages of red top out-weigh the disadvantages. To get maximum yields in such locations it is unwise to sow ready mixed seeds or to follow standard mixture prescriptions if one will study each situation and adjust the mixture to fit the specific environmental conditions. The following are suggested as starting points:

The maximum total seed of red top and alsike or red top and alsike and Ladino should be 10 lbs. per acre. For red top and timothy a 12 lb. maximum (including the same legumes). In either mixture include over 50% legume seed. Light weight (or chaffy) red top seed is not a good buy because the chaff consists largely of outer (sterile) glumes.

RED TOP

Agrostis alba



REED CANARY GRASS

530,000 to 550,000 seeds per pound.
Bushel weight range: - 44 to 48 pounds.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	18.03%	14.38%	9.93%	3.88%

Reed canary grass has at least one interesting colloquial name. The Pennsylvania Dutch call it "must essen" which translated from their unique mixed language to everyday English means "must eat". The derivation of this unusual name is traced to the fact that the leaf margins are so rough that once an animal gathers up a mouthful she cannot change her mind and reject it because the rough edged blades resist ordinary ejection. The late Dr. Jenkin, able plant breeder of the Welch Plant Breeding Station at Aberystwyth, Wales, devoted considerable time in an effort to "breed the rough leaf margins off" of this species. If his efforts were fruitful, no new strain of the sort he undertook to develop is as yet available to the American farmer.

Interest in Reed canary grass has been increasing in the past decade. Two factors have contributed to this increase. The first has been the rediscovery of the fact that Reed canary grass is not only well adapted to lands that are inundated from a part to most of the time, such as swamps and bogs, but also thrives on well-drained upland soils. (Salt water marshes are not suitable for Reed canary grass nor are areas of high alkali content.) The second factor is that it isn't necessary to sow as much as 20 to 25 pounds of the expensive seed per acre (formerly believed desirable).

There are factors which will retard the acceptance of Reed canary grass as a hay plant. Most serious among these is the fact that the grass is so tall that no ordinary legume will tolerate its shade. Another is that no legume is able to survive the degree of inundation in which Reed canary grass often thrives. Alsike clover comes nearest to being able to grow in standing water, but such an environment is somewhat less than ideal for alsike. For land where water does not stand on the surface more than a few days it must compete with meadow and tall fescue, meadow foxtail, and even red top; all of which are more compatible to associated legumes.

Reed canary grass can be handled as a pasture species on moderately drained to well drained land where legumes may be grown with it, but grazing cannot begin early enough on water-logged land to prevent the legume from being "shaded out" by the grass. Where Reed canary grass can be kept less than a foot tall, Ladino clover may well serve as the legume. Very close continued grazing drives Reed canary grass out by starvation since it has a very low percentage of leaf area within an inch or two of the ground. This emphasizes the importance of controlled rotational grazing.

Reed canary grass is usually described as a coarse, tall-growing species which reproduces vegetatively by creeping underground stems called rhizomes (or rootstocks). It reproduces sexually by means of seeds, the yields of which are not high, and they are further reduced by early shattering and the ravages of birds at harvest time. Except under continuous close grazing Reed canary grass is a long lived perennial.

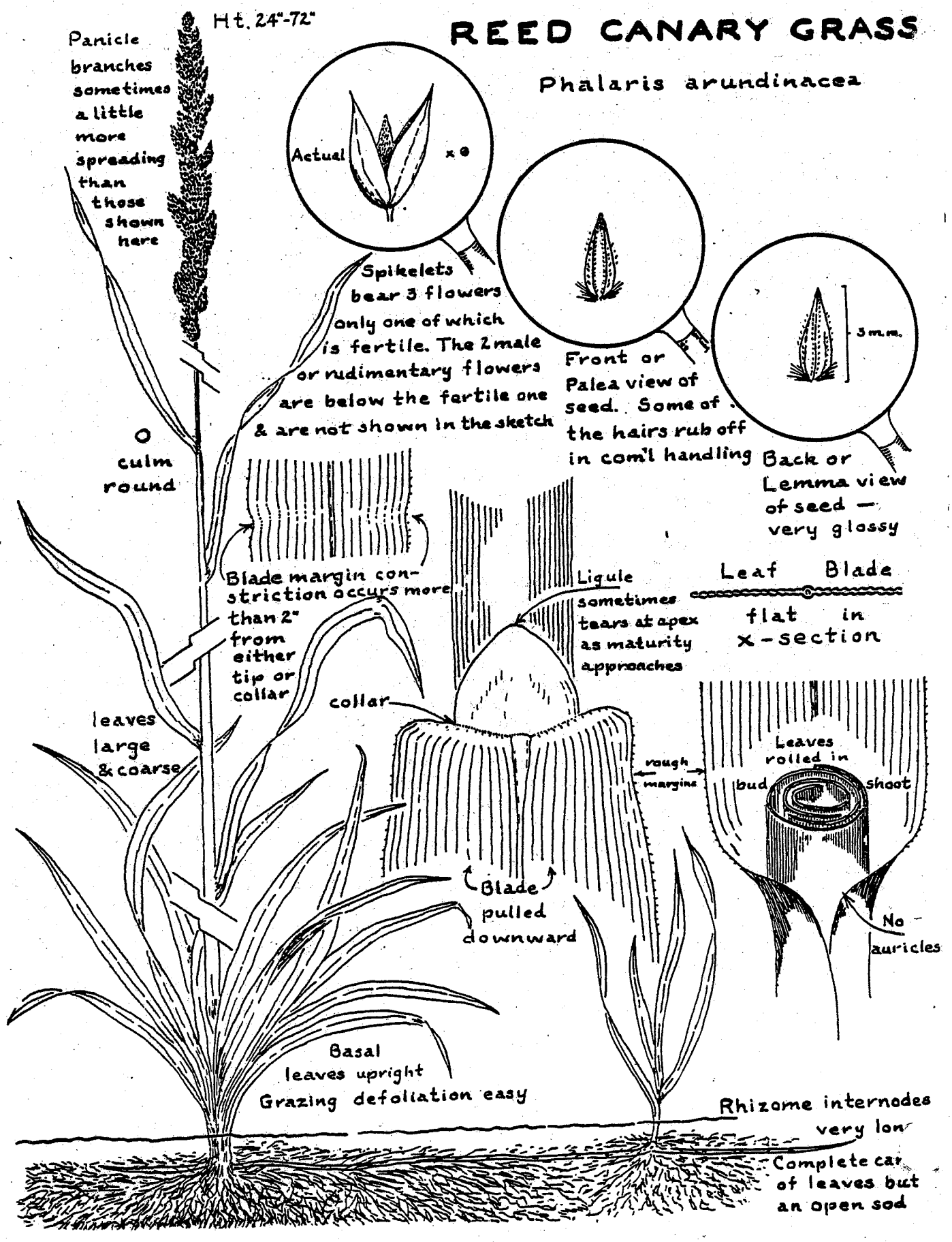
Some writers make the point that it does not thrive on peaty soils. This could be due to deficient nitrogen for in such soils decomposition and nitrogen release could be slow. One of the best stands of Reed canary grass in New York State is on land that would be classified as muck ($3\frac{1}{2}$ feet deep). Nitrogen in this case probably is carried to the muck area in the form of drainage water from the higher ground which lies on all sides. An amazingly good stand occurs in another part of New York on a sandy stream-bed where water moves quite rapidly part of the time. These observations prove nothing but suggest that nutrition may be more important than soil class.

The following suggestions (along with those in the timothy section) are offered for the guidance of mixture makers;- Seeding should be alone (no legume) on land under water until mid- or late June. (Grass hay to be cut when machinery can be used in July). Sow not less than 6 nor over 12 lbs. per acre thru all shoes of the drill on a well-worked seed-bed in late summer. Seeding should not be so late that the stand will fail to be well established before fall floods. (August probably better than September).

On land that can be grazed at heights not to exceed 12 inches beginning not later than late May or early June, sow from spring to August a maximum total of 8 lbs. per acre of Reed canary grass and Ladino clover - 1 or 2 lbs. of the latter (creeping). If the legumes are to consist of alsike and Ladino, make the maximum total 12 lbs. and provide over half legume seed.

REED CANARY GRASS

Phalaris arundinacea



RYE-GRASSES

Seeds per pound:- Perennial 320,000 to 340,000; Italian 270,000 to 290,000.
Bushel weight range:- 12 to 28 lbs. Usual standard weight:- Per. 24# Ital. 20#.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	18.60%	12.81%	6.24%	5.03% Peren.
	18.70%	11.19%	6.30%	4.91% Ital.

The ryegrasses do not owe their name to any close botanical relationship to the cereal rye - nor to any great similarity to it. Probably of Asiatic origin, they were introduced into the United States from Europe. On the latter continent the perennial form became the first cultivated grass, and there it continues to be of far greater importance than in America. Their failure to win prominence in America may be due to lack of cold, heat and drouth tolerance of existing ryegrass varieties. They tolerate excessive soil moisture nearly as well as meadow and tall fescue, but not so well as Reed canary grass or red top. The ryegrasses respond well to fertility but are not so exacting as bromegrass. They will not tolerate shade over long periods of time and therefore should not be sown with taller species, except for temporary effect.

Perennial ryegrass may be differentiated from the Italian form by means of characters shown in the drawings. The habit of calling the perennial form "common darnel" has led to its confusion with the so-called "poison darnel". The latter (not illustrated) may be separated by means of its conspicuous lower outer glume which exceeds the length of the entire spikelet.

In the northeast, the term perennial as applied to the longer lived of the two species is sometimes misleading. Commercial seed of perennial ryegrass has never proved consistently winter-hardy on farms in the latitude of Ithaca, New York, although scattered plants may persist. This non-hardiness may be related to its late fall and early spring growth (or short dormant period) which somewhat resembles that of orchard grass. There are several European varieties of perennial ryegrass. Two of these, the Svalof Victoria and the Norwegian Jaederisk, have been somewhat more winter hardy than commercial at the high fertility level in the experiment station at Ithaca, New York, but very little if any more winter hardy on nearby dairy farms. Both fertility level and thickness of planting probably influence winter hardiness. In temperate climates with mild winters and cool summers perennial ryegrass may prove satisfactory in association with wild white clover, because the close grazing necessary to maintain the latter helps prevent the development of the tough wiry culms of ryegrass. Mowing is usually important. Due to its quick germination, it may be used as a temporary ingredient in some pasture seeds mixtures. In amounts up to 4 (or even 6) pounds per acre it may help hold soil against erosion until the longer lived, more desirable and slower starting species become established. For this purpose timothy or even red top are probably better. Danish E. F. #79 is probably the best perennial ryegrass.

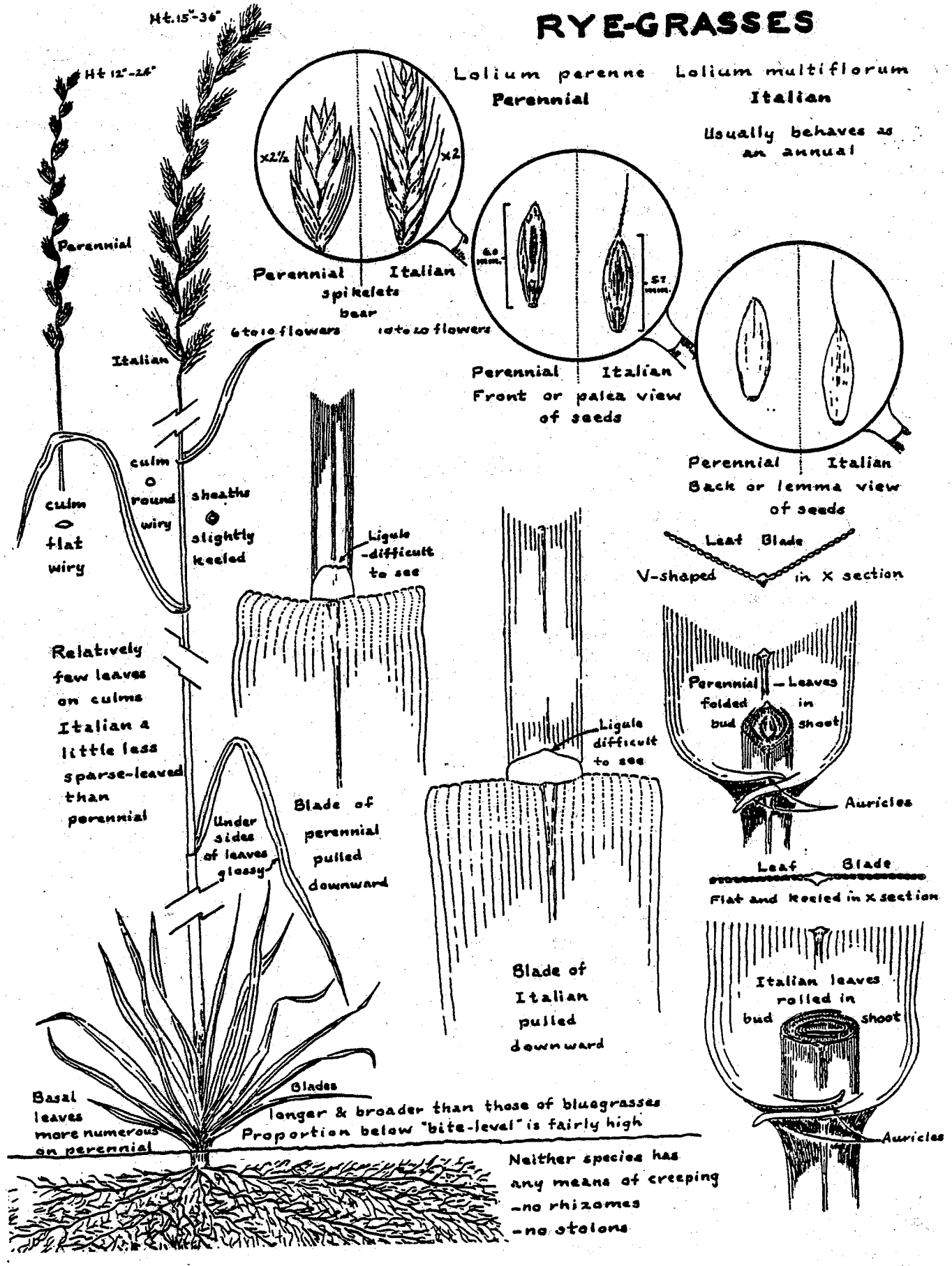
Italian ryegrass, variously regarded as annual, biennial and short lived perennial in Europe, usually winter-kills close to 100% in most parts of New York State. There are several European varieties of it. One of these, the Westernwolth, yielded very poorly when spring-sown as an emergency hay crop in the Cornell Experiment Station. The high temperature of early summers seemed to have arrested its growth.

Most of what is called "domestic" or "American-grown" is a mixture of perennial and Italian with the latter predominating. Despite the fact that ryegrasses are almost wholly self-pollinated, there is always a small percentage of cross fertilization between the two species which results in some intermediate types which are not shown in the drawings. Most seed is produced in the mild climate of the Pacific Northwest.

In the U. S. the demand for domestic ryegrass seed far exceeds that for the perennial. Most of the "domestic" is sown for cover crop and green manure purposes. As such it sometimes provides late fall and early spring pasturage on land that will tolerate treading. For these purposes capital is made of its ability to grow during the latter part of the season when weather is cool and moisture not lacking. A practice which is gaining in popularity in some parts of the northeast is that of sowing the seed at the time of last cultivation of inter-tilled crops. Some farmers credit the ryegrass with holding up the mechanical corn picker in a wet season.

Altho ryegrasses are strictly bunch grasses with no means of creeping, they excel as green manure crops, not because they make a heavy top growth, but because the proportion of roots to top is greater than in most grasses. The sowing of 10 to 24 pounds of seed per acre have been suggested. The higher rates may prove more satisfactory if the cover crop is to be grazed. Lighter rates probably favor winter survival altho experimental data on this point are lacking.

RYE-GRASSES


Ht. 15"-36"
Ht 12"-24"
Perennial
Italian
Lolium perenne
Perennial
Lolium multiflorum
Italian
Usually behaves as an annual
x2½
x2
Perennial
Italian
spikelets bear
6 to 10 flowers
10 to 20 flowers
6.0 mm.
5.7 mm.
Perennial
Italian
Front or palea view of seeds
Perennial
Italian
Back or lemma view of seeds
culm
flat
wiry
culm
round
wiry
sheaths
slightly keeled
Ligule
difficult to see
Leaf Blade
V-shaped
in X section
Relatively few leaves on culms
Italian a little less sparse-leaved than perennial
Blade of perennial pulled downward
Ligule
difficult to see
Perennial
Leaves folded in bud
shoot
Auricles
Under sides of leaves glossy
Leaf Blade
Flat and keeled in X section
Blade of Italian pulled downward
Italian leaves rolled in bud
shoot
Auricles
Basal leaves more numerous on perennial
Blades
longer & broader than those of bluegrasses
Proportion below "bite-level" is fairly high
Neither species has any means of creeping
-no rhizomes
-no stolons

SMOOTH BROME GRASS

135,000 to 190,000 seeds per pound.

Bushel weight range:- 10 to 20 lbs. Usual standard weight 14 lbs.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	19.84%	15.50%	11.06%	6.25%

Brome grass has commanded a great amount of attention in the Middle-west during the past decade & interest is increasing in the East. Few persons who know the grass will deny that it is one of the most palatable grasses & that it remains green in color longer than does timothy except where leaf-spot (disease) is present.

Brome is decidedly a high fertility level grass. It appears to thrive best where conditions are satisfactory for alfalfa and when grown in combination with alfalfa. The drought tolerance of brome grass is widely appreciated, but its poor performance under conditions of very heavy rainfall is less widely known. An explanation for the latter may be that heavy rainfall has leached the nutrients so important to brome grass from such soils. This species is not shade tolerant.

Despite its merits, the man whom the writer considers to be the leading forage crop expert in America declines to recommend brome grass to farmers because of the mechanical difficulties involved in seeding the very large chaffy seeds. Brome seeds will not flow thru standard farm grass seeding machinery unless opened so wide as to cause too rapid passage of ordinary legume seeds which are smaller, weigh 60 lbs. per bushel, & which very readily separate out of a mixture with brome grass seeds. It is often suggested that brome be sown either mixed with the small grain or mixed with the fertilizer. That of course, involves some compromises, for either the brome must be sown too deep (at small grain seed depth) - or the small grain must be sown too shallow (at brome grass seed depth). The development of new machinery which will solve such problems is currently receiving attention, but time will be required to replace existing seeding machines on farms. Mixing with fertilizer may cause "burning" of seedling plants.

Brome grass rarely reaches peak production during the first haying year. In two Cornell experiments brome thickened as the alfalfa thinned during the latter years of the stands. It costs considerably more to seed an acre to brome grass than to seed an acre to timothy. Brome recovers more slowly after cutting than orchard grass.

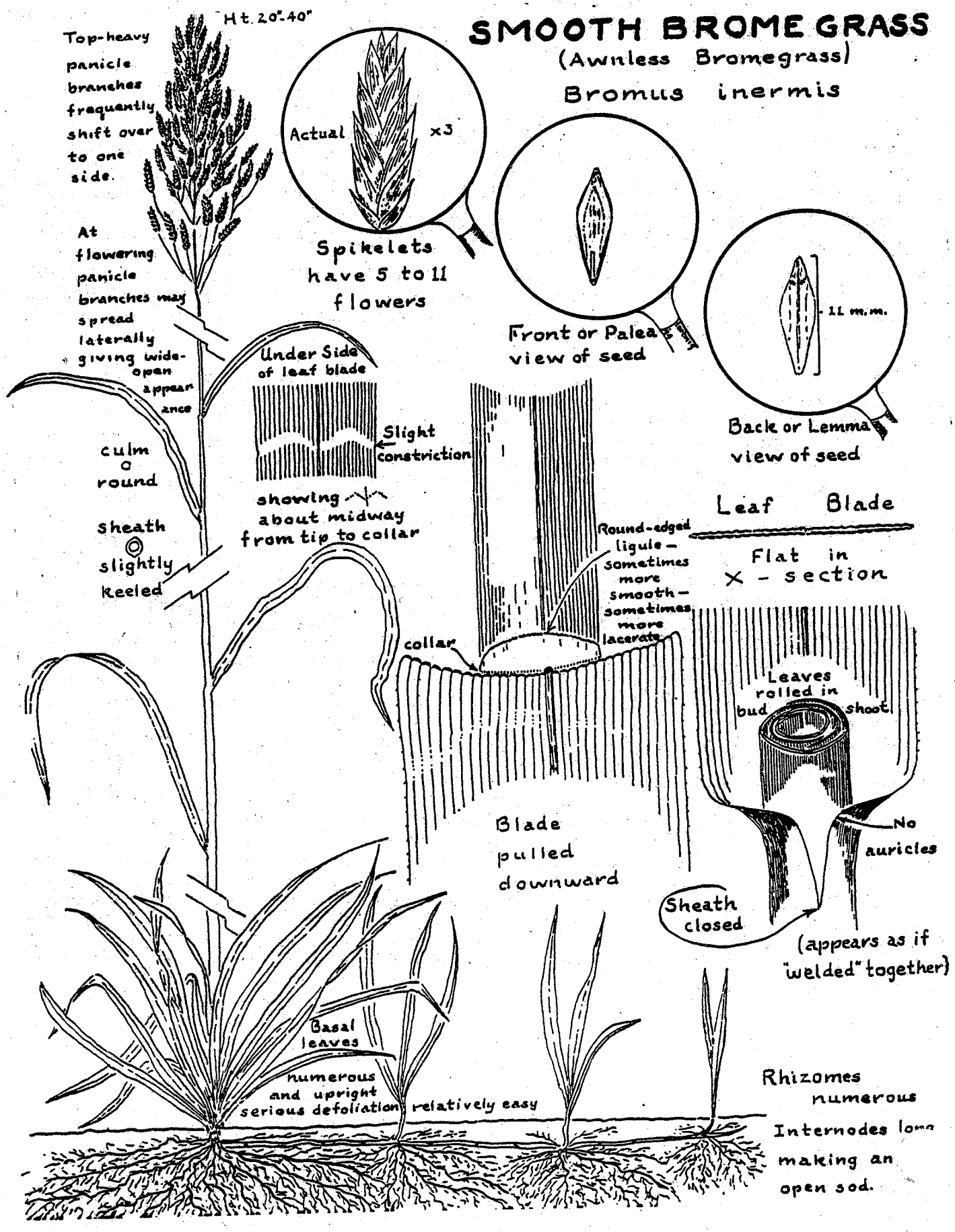
As a pasture plant brome grass excels timothy because it makes more growth during the heat of summer when most permanent pastures are dry & unproductive. The hot weather growth frequently does not weigh as heavily as appearances would lead one to estimate however. Grazing management must be very different than for Kentucky bluegrass & wild white clover because only a very small proportion of the total leaf area of brome grass is below the level of the "bite" of the grazing animal & thus serious defoliation may occur to reduce yields & length of life. Rotational grazing is more important with pastures which contain this grass than with bluegrass and wild white clover. The reason for this is that over-grazing can better be prevented under rotational grazing than where grazing is indiscriminate.

Altho brome is regarded as a long-lived perennial, hayfields & pastures containing that species should not be regarded as permanent. One factor which contributes to shorten the life of the plant is its tendency to become sod-bound. The sod-bound condition is attributed to the accumulation of dead rhizomes and roots, both of which are shorter lived than most people realize. Rhizomes & roots are continually dying & being replaced by new ones. The number of rhizomes in brome is greater than in most grass species & its root system is more extensive than that of most other grasses. This dead fibrous material widens the carbon-nitrogen ratio in the soil, and causes a nitrogen shortage to the living plants. New York farmers were among the first to discover that the sod-bound condition could be relieved by stirring the soil on which the crop was growing. It is a well-known fact that stirring the soil stimulates decay & decay releases nitrogen. A more recently discovered treatment for the sod-bound condition involves the use of commercial fertilizer nitrogen to narrow the carbon-nitrogen ratio. Brome grass is less likely to become sod-bound if grown in association with a legume. For the Northeast, seed of southern strains of brome grass such as Achenbach, Lincoln, Fisher & Elsberry is preferred to seed of the northern strains. The following (see timothy seeding) are suggested as bases for formulating & adjusting seeding mixtures to varying field conditions as they exist:- Sow a maximum of 18 lbs. per acre of bromegrass and alfalfa - always over half alfalfa, or up to 10 lbs. per acre of brome grass and Ladino - 1 to 2 lbs. of the latter (a creeping legume) being ample.

SMOOTH BROME GRASS

(Awnless Bromegrass)

Bromus inermis



TIMOTHY

1,190,000 to 1,240,000 seeds per pound.
Bushel weight range:- 42 to 60 lbs. Usual standard weight 45 pounds.

Stage of growth:-	4" tall	Before heading	In bloom	Seeds plump
Total crude protein (dry):-	19.50%	12.46%	7.87%	5.49%

Timothy is by far the most important hay grass in the Northeast. It excels when measured by Piper's four criteria:

1. Reproductive: - Seed is cheap - acre costs of seeding are low.
2. High Feeding Value: - Compared to other grasses is palatable & nutritious.
3. Yields Well: - Ranks among the heaviest yielding hay grasses.
4. Persistent: Enough to maintain itself under conditions of cultivation, but not so persistent as to become a weed.

Timothy seed can be sown in combination with all common legumes thru the grass seeding equipment that exists on the farm. It is not too adversely affected by the pH which is best for any of the common legumes. It thrives on the heavy, moisture retentive soils that are prevalent in the Northeast, but is excelled by red top, Reed canary grass & possibly by meadow & tall fescue on soils that are wet. Timothy matures later than medium red clover, but at about the same time as mammoth red clover.

This grass makes its best growth where the fertility level is high. However, its desirable characteristics are numerous enough so that it still provides some advantage under conditions of less favorable fertility & soil moisture. It does, however, lack drought resistance & on very wet soil freezing & thawing causes the corms to heave out & shorten its useful life. It tolerates shade rather poorly.

Timothy is somewhat less satisfactory than either brome grass or orchard grass for grazing purposes because it grows less well than they do during the heat of summer. Like orchard & brome grass it can be easily overgrazed because only a small part of its total leaf area is below the close grazing bite level. That means injurious defoliation is possible unless pasture management is just right. Such defoliation prevents the storage of reserve foods in the corms at the base of the plant & lack of reserve foods influences both yield & length of life.

About 3 decades ago Cornell plant breeders developed 2 very superior strains of timothy - #1777 & #4059. Despite the distinct yield advantages of these 2 strains, farmers could not be persuaded to pay a reasonable premium price for seed. More recently, M. W. Evans, U.S.D.A. timothy specialist working in Ohio, has produced a new very late variety called Hopkins. This makes possible a sequence of varieties from early to very late as follows: Marietta, commercial, Lorain & Hopkins.

There are no principles for the compounding of hayfield & pasture seeds mixtures that are based on a body of real experimental evidence. This lack of basic knowledge upon which to base seeding mixtures is reflected in the wide differences between those recommended by various state colleges. It is this writer's opinion that yields may easily be increased by as much as 10% by carefully compounding a seeds mixture to fit the conditions of any one field rather than sowing some standard mixture that is oversimplified to make memorization easy or one that represents the compromise of a group called a "Seeds Committee".

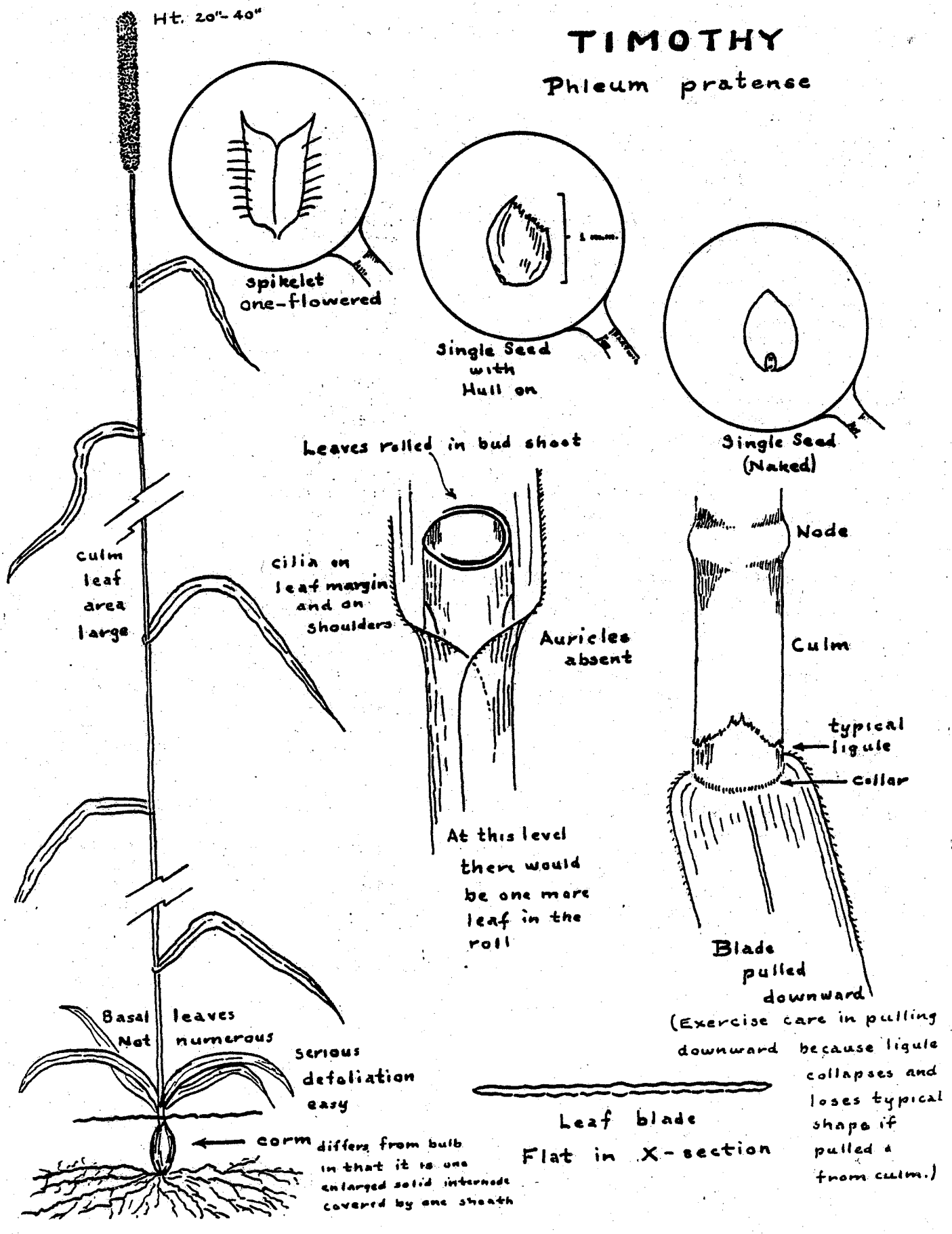
The late Professor J. H. Barron, as a result of numerous farm demonstrations, concluded that legumes could easily be "smothered" by sowing too much grass with them. This led to the proposal that more pounds of legume seeds be sown per acre than of grass seed - except where a creeping legume is used. Seeds should be mixed before putting them in seeding machinery. Legumes should be inoculated before such mixing.

During the legume campaigns which were conducted in most counties of New York State, hundreds of observations were made on farms where many different seed mixtures had been prescribed. What was learned from this experience was never organized into a body of principles but it has led to the following suggestions, in addition to those above, for "tailoring" seeding mixtures to fit specific situations:-

Probably the upper limit should be 16 or 18 lbs. per acre of total seed in a mixture of timothy with medium or mammoth red clover or alfalfa. The total may be reduced on well prepared seedbeds or where likelihood of too deep coverage is less or by efficient seeding procedures. Sowing timothy seed (not legume seeds) in the fall with winter grain justifies reducing timothy by 1/3 to 1/2. Replacing part of the above legumes with smaller seeded species like Ladino, alsike or birdsfoot trefoil justifies a reduced total as would partial replacement of timothy with small seeded redtop. Cold late soils, old seed, or unscarified legumes (over 50% hard seed) suggest increases.

TIMOTHY

Phleum pratense



DEFINITIONS OF COMMONLY USED GRASS TERMS

AWN	The "beard". A long, slender, needle-like, usually barbed, sometimes bent extension of the mid-nerve of the lemma - rarely found on an outer glume.
AURICLE	A lateral extension of the collar, Occurs in pairs - one from each side of the collar. Project more or less around the culm (see quack grass).
CARYOPSIS	The naked seed or kernel of any grass (with lemma and palea removed).
CILIATE	Having hair at edges or margins like miniature eye-lashes. When very short may approach saw teeth in the shape and be stiff enough to cut the human lip.
COLLAR	Thickened, hingelike part serving as a joint between blade and sheath.
CORM	An enlarged, solid, more or less elliptical-shaped internode, formed at the base of the culm and covered by a single leaf-sheath (as in timothy). Important organ for storage of reserve food. From it arise new shoots and leaves. Should not be confused with a bulb which consists of a series of overlapping leaf-sheaths, covered not by one sheath but by several.
CULM	The upright, more or less hollow stems of the smaller members of the grass family. Characterized by the presence of nodes and internodes.
EMBRYO	The miniature plant within the seed. In popular usage, the "germ".
ENDOSPERM	The larger part of the caryopsis or seed which provides protection and supplies nourishment for the new seedling that sprouts from the embryo.
FLOWER (floret)	- Popularly consists of lemma and palea with those sexual parts which lie between them. Strictly, a floret is the above and a flower the sexual parts only.
GLAUCOUS	Appearing as if covered with a fine powdery wax which may be rubbed off with the finger as in the case of that on the fruit of the grape.
KEELED	Having a sharp fold resembling the keel of a boat.
LACERATE	Having margins irregularly torn or cleft in appearance.
LEAF-BLADE	The conspicuous part of the leaf which in grasses departs from the culm at more or less of an angle as it develops.
LEAF-SHEATH	The part of the grass leaf which originates at a node and envelopes the culm up toward, and in some cases even beyond, the next node.
LEMMA	The larger part of the two somewhat chaffy parts which first surround and protect the sexual parts and later the caryopsis of perfect flowers. Originates below and opposite the palea and always above the two outer glumes. (See red top seed drawing - middle circle).
LIGULE	Small, thin, papery, upright structure flush with the culm and seated on the collar where blade joins sheath. Farmer's term: "rainguard"
NODE (S)	The somewhat regularly spaced enlargements of the culm, rhizome, or stolon from the buds of which arise leaves, shoots, (branches), or roots.
OUTER GLUME	Chaffy modified leaf, usually one of a pair located at the base of spikelet. Rarely adheres as closely as lemma and palea to the caryopsis. (See spikelet drawing of sweet vernal grass).
PALEA	The smaller, inner member of the chaff-like parts which closely envelope the sexual parts or caryopsis. Always originates opposite and slightly above the point of origin of the lemma. (See seed drawings).
PANICLE	A head containing branches (sometimes re-branched) with pedicels (enlarged tipped branches) supporting spikelets, (See Kentucky bluegrass).
RACHIS	The noded or zig-zag shaped terminal part of the culm which makes up the central framework ("backbone") of the head (spike or panicle).
RACHILLA	The little rachis within the spikelet on which are borne all but the first or sessile flower - the latter being borne directly on the rachis.
RHIZOME	Same as a rootstock. A below-ground branch running horizontally. Its nodes give rise to new shoots and roots. May not live long after the establishment of new plants, which is its life function.
SPIKE	A type of head with each spikelet attached directly (sessile) to a rachis joint and having no intervening branch or pedicel. (See quack grass).
SPIKELET	Two outer glumes with all parts lying in between or above them. This usually includes one to several flowers and, in the latter case, a rachilla.
STERILE SHOOT	A vegetative culm which is valuable because of its leaf area but which never heads, flowers or fruits. (See drawing of meadow fescue).
TILLERING	"Stooling" to the farmer It consists of the production of upright branches or culms which are called tillers.
STOLON	A prostrate, above-ground branch which produces buts at nodes from which originate new shoots and roots. Not longer lived than a rhizome.