NEW HOLLAND

Haymaker's

Handbook

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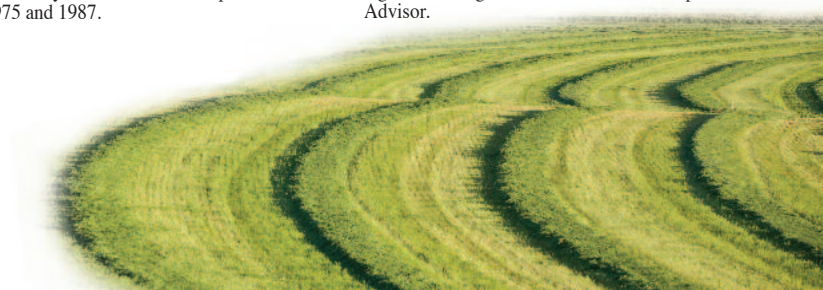

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Preface

Throughout its 115 year history, New Holland has always pursued a goal of finding innovative ways to simplify farmers' labors, making their lives less fatiguing, more pleasurable and more productive. From its freeze-proof engines of the early days to the world's first automatic pickup baler of the early '40's to the first Haybine® mower-conditioner in the '60's to the first Twin Rotor® combine and beyond, New Holland has reached its goal many times over.

With the addition of balers and forage harvesters to the New Holland product line began a focus on hay and forage production. Since then, New Holland has cultivated a passionate interest in the crops, their regional production methods, and the machines designed to handle them. Through a complete knowledge of these crops, methods and producers, the company has excelled in creating, manufacturing and servicing the machines needed for their harvest.

Early on, New Holland adopted several slogans to tie the company closely to hay and forage production in a way that went far beyond designing and building machines.

Slogans like "First in Grassland Farming," "Eat More Meat, Drink More Milk for a Healthy Agriculture," and "Hay in a Day" became synonymous with the name New Holland and established the firm as a leader in the field.

At the same time, the company became deeply involved with college and university agricultural departments and was very active in The American Forage and Grassland Council. Convinced that the pursuit of quality hay and forage production as it related to equipment was an important part of its mission, New Holland published a booklet in 1975 entitled *Haymaker's Handbook*, a small, abbreviated "how-to" guide book drawing together relevant university research, farmer know-how and company expertise to help both novices and well established farms understand the latest techniques and to improve upon hay and forage production. This booklet was so popular that it was revised and re-printed in 1987. Since then, it has successfully guided hundreds of forward-thinking producers around the world.

Although time has passed, many of the original messages contained within the early editions of *Haymaker's Handbook* remain valid despite the many landmark industry developments that have occurred. Today's renaissance in quality and focus on improved varieties and yields have driven this third edition of the popular handbook. Modern hay and forage crops are distinguished as valuable farm commodities and indispensable livestock feedstuffs. In reading this latest edition, a new generation of producers may discover the knowledge of prior generations and heed today's advanced production methods, learning to balance farm tradition with modern practices.

CHAPTER 7

Growing

Get Stands Off to a Good Start

It's no secret that if you want top forage yields you must start with good stands.

If asked why your seeding failed, you may say, "poor quality seed," "dry soil," or perhaps "too many weeds." All of which point to the fact that successful seedling establishment of small seeded hay crops is governed by many factors – quality seed, proper seedbed, adequate lime and fertilizer, seeding at the right time, the best crop sequence, good seeding techniques, and satisfactory control of troublesome weeds and insects.

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Moisture, Temperature, and Light

Other factors are important, too. Forage seeds require moisture, oxygen and some warmth to germinate and grow. The seeds are small and must be planted close to the soil surface. One-quarter to three-eighths-inch planting depths are optimum under most conditions.

Too much or too little water may harm the seeds and seedlings. In wet soils, oxygen may be lacking while temperatures may be too cool for germination and seedling growth. Then, too, some seeds can absorb water and start to germinate in soils too dry for survival of small seedlings.

Light, both intensity and day length, has a big influence on the early development of forage plants. Reduced light intensities, due either to excessive cloudiness or competition from crops or weeds, may be responsible for many seeding failures of both legumes and grasses.

Greenhouse studies at Penn State University show how important light is. Under controlled conditions, top growth of bird's-foot trefoil was reduced about 90% by reduced light

intensities due to shading. Root growth was affected more severely than top growth.

Plants growing together may shade one another to almost the same degree. Under the dense stand of an oats crop, for example, light levels may be reduced by 95% or more. Such levels may be too low for the seedling to survive.

Some forage seedlings are more shade tolerant than others. But three words, "legumes like light," pretty well tell the story, regardless of species or variety.

We talk a lot about competition, but other factors may be working, too, one of which is called allelopathy. Allelopathy is any direct or indirect harmful effect by one plant or another through the production of chemical compounds that escape into the environment. A very important point concerning allelopathy or autotoxicity is that its effect depends on a chemical being added to the environment, thus separating it from the competition effects noted earlier.

While not all researchers agree, there is plenty of evidence to suggest that alfalfa yields and stand densities are greater when alfalfa is rotated with soybeans, corn, or grasses, compared to growing alfalfa after alfalfa. This is supported by the research shown in Figure 7-1.

The University of Illinois concludes that there is a problem when alfalfa is seeded directly back into an old alfalfa stand, especially if the old stand is around 50% or more alfalfa.

How Many Plants per Acre?

Plant populations and hay yields usually decline as stands get older, especially with legumes. So what makes a productive forage stand? That may depend on where you farm, the crop you grow, and the age of stand. For example, in South Dakota, specialists consider 300,000 legume plants per acre (7 plants per square foot) as nearly ideal under most conditions in that area. A field with 300,000 plants per acre would produce as much hay in a drought year as a field with 150,000 plants, they report, but would yield more in a favorable season.

In North Dakota studies, alfalfa hay yields in the establishment year increased with increasing plant density, up to a point, but by the second production year, yields began to level out. Workers in that state concluded that under their growing conditions, near maximum

FIGURE 7-1

The Effects of Various Crop Sequences on Alfalfa Yields and Stand Count after 6 Years (Illinois data)

Cropping Sequence	Tons DM/Acre	Square Foot
Corn - alfalfa	3.8	4.6
Corn - soybeans - alfalfa	3.5	3.8
Alfalfa	1.9	2.0

Sources: University of Illinois

alfalfa yields can be produced with seeding rates that establish ten evenly distributed plants per square foot by the fall of the seeding year. Most researchers suggest a decline in alfalfa stand density has little direct effect on forage quality.

Minnesota authorities point out that just one pound of alfalfa seed per acre equals five seeds per square foot. Sow eight pounds of alfalfa and six pounds of bromegrass and you have 58 plants per square foot – if every seed germinated.

Everything considered, a good rule of thumb rule for legumes is about 500,000 strong seedlings per acre, or twelve plants per square foot. Somewhat more grass seedlings per square foot, especially for bunch grasses, may be desirable.

But you'll generally need to sow more seeds per acre to assure a good stand. It's not unusual for legume populations to drop to only five to ten plants per square foot within a short time after seeding. And, as plants reach full size, natural competition thins them out even more.

Thus, don't skimp on seed. But don't be extravagant either. Check on seeding rate recommendations with local authorities and be sure you're planting the right amount of seed to end up with high producing stands.

Remember, too, that seeding rate is related to seeding method. With precision seeding techniques and no-till seedings, for example, rates can safely be reduced by 15%-20% compared to broadcasting.

FIGURE 7-2

The Approximate Seeds Per Pound of Several Forage Crop Species Together with the Theoretical Number of Seeds Per Square Foot at Various Rates

Crop	Approximate Seeds/Pound	Seeds/Square Foot at Seeding rate per acre of			
		1 lb.	2 lb.	5 lb.	10 lb.
Alfalfa	221,000	5	10	26	51
Bluegrass, Kentucky	2,000,000	46	92	230	460
Brome, Smooth	137,000	3	6	16	31
Clover, Ladino	754,000	17	35	87	173
Clover, Red	293,000	7	13	34	67
Crown vetch	120,000	3	6	14	27
Fescue, Tall	246,000	6	11	28	56
Orchard grass	468,000	11	21	54	107
Redtop	5,605,000	129	257	644	1287
Reed Canary grass	660,000	15	30	61	152
Ryegrass	280,000	6	13	32	64
Sudangrass	55,000	1	3	7	13
Timothy	1,260,000	29	58	145	289
Trefoil, Bird's-foot	414,000	10	19	48	95

But, regardless of your intended seed rate or seeding technique, remember to calibrate your seeder before going into the field. Intended seeding rates and/or seeding depths are often quite different from what is actually done because the equipment is not properly adjusted or calibrated.

When to Seed

In some areas, it's possible to make a successful seeding almost any month of the growing season.

In general, seedings made prior to prolonged cool and moist weather are more successful than those made when it's hot and dry.

During the winter and early spring months, soil moisture has built up and spring moisture is generally good. Evaporation is less during the spring and soil moisture is retained longer during the establishment period.

To take advantage of the "ideal" conditions at this season of the year, including better moisture and less competition from weeds, spring seedings of most species should be made as early as a proper seedbed can be prepared. Seed alfalfa in early April without a companion crop and harvest your first hay crop in about 70 days. Exceptions to this "early as possible" rule are bird's-foot trefoil and crown vetch, which should not be seeded until soil temperatures reach the upper 50's.

Seeding in the late summer is also popular in some areas, and is considered especially ideal for many cool-season grasses because of cool nights, adequate rainfall, and warm soil. In general, grasses sown in the late summer or early fall root more deeply because the slower top growth is conducive to better root formation. However, some grass species, such as orchard grass, are relatively nonhardy in the seedling stage, while others, such as bromegrass and reed canary grass lack seedling vigor. Thus, these species must be seeded relatively early in the season to assure good winter survival. Success is most often achieved where at least 8 to 10 weeks of good growing weather precede winter dormancy.

FIGURE 7-3

The Percent Seedling Emergence of Several Forage Crops When Seeded at 4 Depths.

Crop	Seedling Depth in inches			
	1/2	1	1 1/2	2
Alfalfa	64	53	45	19
Clover, Alsike	53	49	9	4
Clover, Ladino	47	28	2	0
Clover, Red	56	62	22	14
Bluegrass, Kentucky	43	27	4	0
Bromegrass	78	69	51	24
Timothy	89	81	39	12
Redtop	64	33	2	0

Depth of Seeding

Hay legume and grass seeds are small and can easily be placed too deeply. The optimum depth for small forage seeds is one-quarter to three-eighths inch on heavy soils and one-half to three-quarters inch on light soils. These facts have been confirmed by research throughout the U.S. One look at Figure 7-3 will tell you how seedlings of several crops emerged when planted at different depths.

The Ideal Seedbed

Firm, fine, and mellow on the surface is one way to describe the ideal forage seedbed.

If the seedbed is not firm, tiny legume and grass roots will grow into air pockets between soil particles and die. That firm, fine, and mellow seedbed is also essential to permit uniform, shallow coverage of seed.

For the prepared seedbed, early plowing, followed by an occasional disking or harrowing, will aid in firming the soil in the seeding zone. Cultipacking before seeding is additional assurance of a firm seedbed.

A fine, firm seedbed improves chances of a successful forage stand. If the seedbed is too loose, tender legume and grass roots dry out and may die.

But whatever plan you follow, a seedbed firm enough for a man to walk across without sinking more than a quarter inch into the soil is a good rule to follow.

Inoculate Legumes

Rutgers University scientists pointed out many years ago that every acre is "covered" with 35,000 tons of free nitrogen in the atmosphere. Out of this vast nitrogen supply, only a tiny portion is taken by legumes. However, this nitrogen can be an important factor in cutting the amount of commercial nitrogen needed for the following crop. But legumes salvage nitrogen only if efficient legume bacteria (rhizobia) are present. And as pointed out by the late Dr. O. N. Allen, rhizobiologist at the University of Wisconsin, "Only 25% of all rhizobia found naturally in the soil are highly beneficial."

Legumes and bacteria establish a working relationship called symbiosis. The plant furnishes sugar, energy, and nodules formed by bacteria. The bacteria use energy to change free nitrogen from the air into a form used by the plants. Not all soils contain nitrogen-fixing bacteria of either the right kind for a specific crop or in sufficient quantity. Rhizobia content of soils varies according to geographical area, cropping history, and the soil itself. That's why it's important to inoculate legume seeds and with the proper strain of bacteria.

When and Why of Inoculation

Under favorable conditions and a

continuous legume cropping history, the right kind and adequate amount of bacteria may be present in the soil horizon. However, in cases of low pH or low fertility, drought, high soil temperature, or persistent rains, the number of bacteria may be greatly diminished. Under such conditions, and especially when planting legumes for the first time on new land, or if four or five years have elapsed since the previous legume crop, seed definitely should be inoculated. A good rule of thumb is "when in doubt, inoculate."

Inoculation adds a fresh culture of effective rhizobia strains to seed and soil. Thus, rhizobia can begin working as the seed germinates and the plant starts growing. Since protein content in legumes is directly related to nitrogen content, effective inoculation is a major key to improving yield and quality.

Benefits of Inoculation

Research shows the more effective strains of legume bacteria can increase yield or protein content of legumes as much as 20%, on the average, over natural legume bacteria in the soil.

Without legume bacteria in the soil, legumes can't take nitrogen from the air. So inoculation is essential to give legumes the chance they need to reach full potential.

The amount of nitrogen legumes can fix varies widely, depending on many factors. Of these factors, the five most important are: (1) type of legume, (2) how well seeds are inoculated and effectiveness of inoculating bacteria, (3) soil type and fertility level, (4) soil pH, and (5) climatic conditions.

When conditions are favorable, a stand of alfalfa may fix nearly 200 pounds of nitrogen per acre. On the other hand, annual legumes such as soybeans will fix about 40 to 60 pounds.

Pre-inoculation

Seed can be hand inoculated with a fresh culture of the proper strain of bacteria just prior to sowing. However, much of the alfalfa and clover seed currently marketed is already pre-inoculated with the proper strain. Newer pre-inoculated techniques, such as the clay-based Dormal process, have proven highly effective and have extended the shelf life over conventional humus-based pre-inoculants. Nevertheless, pre-inoculated seed carried over from spring for summer or fall seedlings should normally be reinoculated prior to seeding.

Seed Treatments

Other newer seed treatments are also available to help get new seedings off to a good start. Studies in several states have shown that treating seed of several species with the systemic fungicide metalaxyl, marketed under the trade name *Apron*, provides good protection against present strains of the pythium and phytophthora seed and root-rot organisms. Treated seed lots frequently resulted in initial stands 20% to 40% better than untreated controls. Based on current information, *Apron* can be used successfully with both clay-based and humus-based pre-inoculants if directions

are followed carefully.

Lime coating of legume seeds has also been accepted in some states as an aid to better stands. Newer lime coating processes seem to work well with both pre-inoculated and *Apron* treated seed.

Seeding Tools

Good hay-crop stands can be obtained by using a variety of techniques. Some are more successful than others, depending on local soil and climatic conditions.

Seeding equipment commonly used for grasses and legumes on a prepared seedbed include:

(1) *Cultipacker Seeder.* This machine works well for seeding legumes or small-seeded grasses on areas free of crop residue. Light-weight seeds – smooth bromegrass or wheatgrass – may not be well covered and smaller seeds may not be covered with the cultipacker seeder on areas having heavy crop residues.

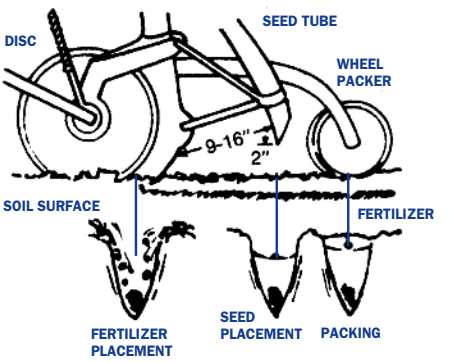
(2) *Press Drill.* A drill which has press wheels following the seed tubes is best on fields with crop residue. A press drill also shows excellent results on plowed or clean, fallowed land if a uniform shallow seeding is made. They warn that lightweight grass seeds may "bridge over" in the drill box and not feed down the spouts.

(3) *Grain Drill.* On plowed or clean, fallowed land, a grain drill can be used without press wheels. Pack the field after seeding, but remember that packing can lead to erosion, under some conditions. "Bridging over" is also a problem.

(4) *Broadcast Seeder.* A broadcaster can be used for seeding forage legumes on plowed or clean fallowed land if seed is harrowed in, or gone over with a corrugated roller. In some areas, early spring broadcasting without covering is the accepted method for seeding red clover in fall-sown wheat.

Fluid or suspension seeding is a relatively new, but very effective, custom way of broadcasting seed uniformly over large acreages in a short time. However, cultipacking before and after seeding is a must with this type of seeding. Authorities generally agree that if seeding occurs immediately after the inoculated seeds are added to the suspension, there's no injury to the rhizobia.

Band Seeding Most Reliable



No-Till Seedings Gaining Favor

In many areas, seeding alfalfa or other legumes the no-till way either in small grain or corn stubble, or in sod, has gained momentum in recent years.

Several requirements for successful no-till establishment include:

(1) Competition from other plants

must be eliminated.

(2) Heavy thatch and plant growth tall enough to shade the soil surface must be removed.

(3) Protect the seedlings from insects, especially when seeding in sod.

(4) Soil fertility must be medium to high with pH about 6.5.

(5) Seed at the proper time.

(6) Use proper, well maintained equipment.

Seeding Forages with a Companion Crop

Small grain companion crops are among the oldest methods of getting weed-free forage the seeding year. However, recent research shows small grain crops compete with young seedlings for light, moisture, and nutrients.

Where oats or other spring grains are used as a companion crop, all forage experts advise using a variety that is short, early maturing, stiff-strawed, and non-lodging. Then reduce its seeding rate by one-half. Lodging resistance is of greatest importance. Many seedings are thinned or lost when lodged grain forms a tight canopy over the legume, sealing out light. Barley is especially susceptible to lodging and is not usually recommended as a companion crop. For best results where oats is used, remove as green chop, silage, or hay, just as the heads emerge from the boot. After harvesting oats, close clipping of stubble can markedly improve the legume seeding. Careful management after the oat crop is removed is also important. Red clover can be improved more than alfalfa by clipping. Trash should be removed from fields after clipping. Delaying clipping until late August is beneficial only if you have good rainfall and soil moisture.

Weeds develop quickly in unclipped fields. Heavy weed growth almost always reduces vigor and density of new legume stands, as well as reducing hay yields the following spring.

Ohio tests indicate stands usually are better when alfalfa is seeded in oats instead of in wheat. But for fall seeding, wheat is better than barley or rye. Wheat is sometimes superior to oats as a companion crop for red clover.

Eliminate That Companion Crop

Recently many hay growers throughout the country have turned to spring seedings without a grain crop, especially with legumes. Except where weeds have been a serious problem, this practice has meant from 4 to 5 or more tons the seeding year.

Researchers in Illinois, Michigan, Iowa, and Ontario found proper herbicides applied when alfalfa is a few inches high do a good job of controlling broadleaf weeds. This gets legumes off to a good start, eliminates the need for a companion crop, and gives 4 or more tons of top-quality forage the seeding year.

Forage stands established without companion crops are usually better and more productive in following

years. When legumes are seeded without a companion crop, weeds are a problem and some means of control is necessary.

Good Weed Control Critical

Thus, good weed control with herbicides at establishment is critical to getting good hay stands.

Herbicides used for hay stand establishment can generally be classified as either pre-plant or post-emergence materials.

EPIC and benefin are pre-plant incorporated herbicides. That is, they are applied before planting and incorporated within the soil to a depth of 1 to 2 inches. If used at the proper rate and thoroughly mixed with the soil, these herbicides will control most of the annual grasses and many broadleaf weeds found in new legume seedings. Eptam also does an excellent job of controlling nutsedge.

Since these herbicides will severely injure seedling forage grasses, weed specialists stress they cannot be used in mixtures with forage grasses. Where grass-legume mixtures are to be made, you must rely on a spot emergence application of 2,4-DB for control of the broadleaf weeds but the grass weeds will be missed. However, for effective control, these materials must be applied when the weeds are small and the forage legumes are in the second to third trifoliate leaf stage.

Weed authorities further emphasize that forage legumes differ in their susceptibility to many of the herbicides mentioned. Alfalfa and bird's-foot trefoil, for example, are tolerant to treatments of EPIC, benefin, and 2,4-DB, but sweet clover and crown vetch are susceptible.

Before using herbicides on new seedings, be sure to check with local authorities for specific recommendations.

One final word: many new seedings have been severely damaged from herbicide residues, particularly triazines. Thus, plan your herbicide program for all of the crops in the rotation, not just the immediate seeding.

Manage Those New Seedings

Seeding year management can be important to the successful establishment of a new seeding, too. This includes insect control.

One excellent approach to a successful spring seeding is to seed on a prepared seedbed, eliminate the companion crop, control weeds and insects with chemicals, and remove the first hay crop the seeding year when the legume reaches the late bud to early bloom stage of growth. Normally with this program, three or more harvests may be made the year of seeding, depending on the length of the growing season.

In many areas of the U.S., potato leafhoppers can be very destructive on new spring seedings of alfalfa and other legumes. If leafhopper populations build up, there are several approved insecticides available to effectively control this pest on new seedings. However, daily inspections of the fields are necessary to detect

its presence.

When weeds are a problem in spring seedings made without a companion crop, wait until the alfalfa is at the proper stage, second trifoliate, and apply post-emerge herbicides for best controls.

Establishing Bermuda Grass

Bermuda grass and other vegetatively propagated species require special attention for establishing stands. When preparing a seedbed, two factors are important: (1) sprigs (portion of stem or root used for transplanting) should be planted only in moist soil, and (2) the seedbed should be weed-free or weeds controlled immediately with herbicides after planting.

Planting should be fairly deep to insure continued soil moisture, but tops should be above ground. However, planting too deep may delay emergence and seems to increase spring damage by soil microbes.

Fertilizing as soon as stolons appear will help to hasten development and ground cover.

More Bermuda grass is propagated by planting sprigs than by seeding. Farmers generally have better success with this method. Poor seeding habits of coastal hybrid forage varieties such as Midland and Teft-44 types make it mandatory they be established from sprigs. Some farmers maintain on-farm Bermuda grass nurseries to insure having fresh planting material available.

Bermuda grass specialists say there are three major reasons for stand failures: (1) planting on areas that have stands of other grasses, (2) using dried out sprigs, and (3) grazing before grass is established. They suggest planting sprigs on a clean, moist seedbed free of other growing grasses. Use fresh sprigs with at least 3 nodes or joints. Plant sprigs the same day they are dug, or better still, the same half day. If not planted almost immediately,

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