

LADINO CLOVER FOR OHIO FARMS



OHIO AGRICULTURAL EXPERIMENT STATION

Wooster, Ohio

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LADINO CLOVER FOR OHIO FARMS

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Ladino clover is rapidly being accepted by Ohio farmers as a valuable plant for pasture, soil improvement, hay, and silage. Its contribution to the success of a pasture program (its major contribution) has not been equalled since the introduction of Sudan grass as a midsummer pasture crop 35 years ago.

The amount of Ladino seeded annually in Ohio is estimated between 50,000 and 75,000 pounds. Most of this was probably used in a meadow mixture where the crop is to be used for pasture or for hay and pasture. However, many thousands of pounds have also been used for the introduction of Ladino into permanent bluegrass pastures. Ladino is probably more to be recommended in rotation pasture than in permanent pasture, since much more careful management is required to maintain it in the latter.

The virtues of Ladino clover are (1) high nutritive value as indicated by its large content of protein, minerals, and vitamins; (2) high palatability to all classes of livestock; (3) rapid recovery after mowing and grazing; (4) persistence with good management; (5) ability to withstand grazing; (6) spreading habit of growth; (7) nitrogen-fixing ability; (8) relative freedom from disease; and (9) ease of establishment from seed.

THE PLANT

Ladino clover (*Trifolium repens*, var. *latum*) is a variety of white clover. It has larger leaves, stems, and flowers than common white clover and is therefore called giant white clover. It is 1 week to 10 days later in coming into first bloom than white clover. If growing conditions are favorable it may reach a height of 12 to 18 inches. Ladino clover and common white clover plants of equal size cannot be distinguished by any dependable marks. However, the presence of any considerable amount of Ladino in a mixture with common white can be determined by the larger, lighter-colored leaves, frequently with a crepe or crinkled surface (fig. 1).

ACKNOWLEDGMENT.—The authors are indebted to C. F. Monroe, Associate in Dairy Industry, D. S. Bell, Associate in Animal Science (sheep), and to D. C. Kennard, Associate chairman in Poultry Science at the Ohio Agricultural Experiment Station, for permission to quote the results of pasture experiments conducted in cooperation with these departments.

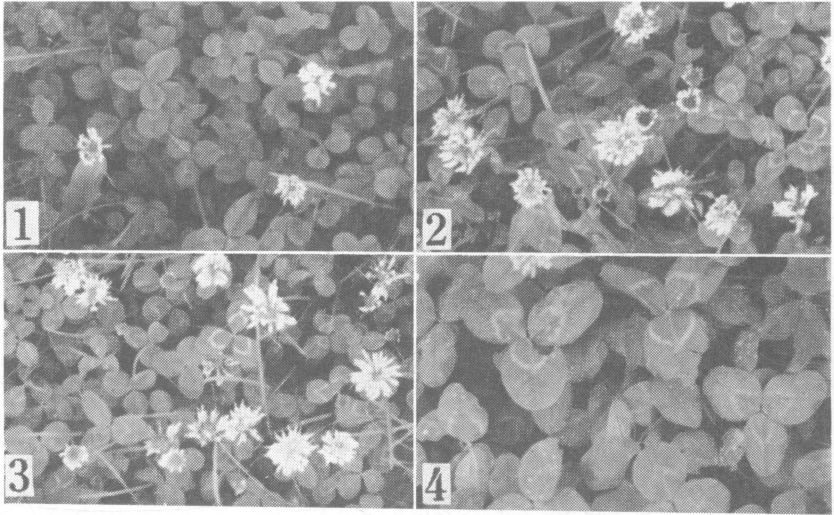


Fig. 1—Four varieties of White Clover—June 12—Columbus, Ohio.
 Kent (top left)—leaves small; few blossoms showing.
 Louisiana (top right)—leaves longer than Kent, many blossoms showing.
 Cornbelt (bottom left)—much like Louisiana, but slightly less vigorous.
 Ladino (bottom right)—large leaves, vigorous growth and later coming into bloom.

The upright growth of Ladino clover consists entirely of unbranched leaf and flower stalks which grow directly from the crown of the plant or from the nodes of the prostrate stem. The leaves and stems of Ladino clover are free from hairs and the undersides of the leaflets commonly have a waxy or shiny appearance.

MEANS OF SPREAD

The Ladino clover seedling develops into a well-rooted plant which soon sends out one or more prostrate stems from its crown, which grow along the ground. At frequent intervals, these creeping stems or runners form joints or nodes which develop roots where they touch the ground. The nodes also form buds, send up leaves and flowers, and develop new runners, thus developing a potential new plant. A single mother plant may form a clump 3 feet or more in diameter by the end of the second season. In the course of a year or two, many of the runners are broken by livestock, insects, or winter injury, thus establishing many new plants from the one old one.

This ability to spread by means of the prostrate stem and nodal plant enables Ladino clover to survive and increase its stand under competitive conditions where it would not spread if dependent on seed alone (figs. 2 and 3). A close inspection of almost

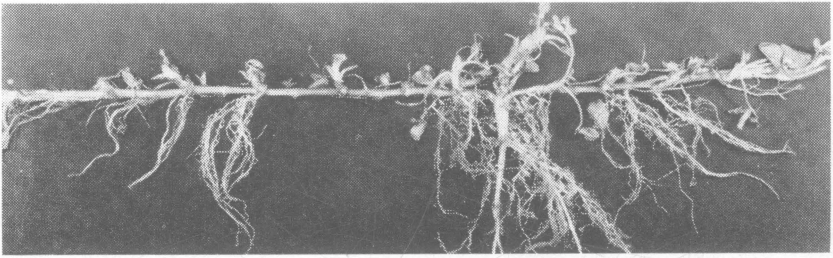


Fig. 2—Ladino clover mother plant with creeping stems, nodal roots and sprouts.

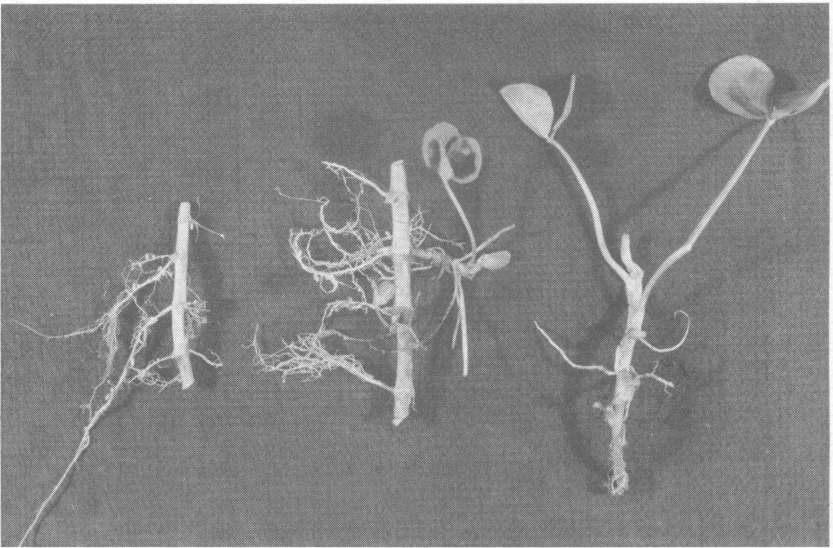


Fig. 3—Sections of Ladino clover creeping stem. Right—tip of runner. Middle—mid-section with nodal sprout starting. Left—nodal roots but no shoots.

any well-established Ladino clover-grass mixture will show that runners have grown through or around thick clumps of grass until they reached an open spot beyond, where they have established nodal plants. Leaves are suppressed at the nodes if the light has been reduced too much by the shading of dense over-growing vegetation, but roots may be formed if the moisture is favorable.

If the runners which connect the nodal plants with the mother plant are intact, the small plants will be supplied with extra moisture and nutrients until they are large enough to shift for themselves. If the connecting runner is broken before the nodal plants

are well developed, they are likely to die, especially in hot, dry weather.

PLANT REQUIREMENTS

Climate.—Ladino clover has been tested in all parts of the state and appears to be well adapted to all variations of climate in Ohio. It is, however, less winter-hardy than alfalfa, red clover, alsike, and common white clover and is less drought-resistant than alfalfa.

Soil types.—Ladino clover has a wide soil adaptation, but soon disappears on dry hillsides where the soil is shallow. It does best on fairly productive soil having a physical condition and location suitable for the maintenance of a good moisture content throughout the season. While it cannot be regarded as a wet land plant, it does well on areas that are too wet for common cultivated crops.

Lime.—Ladino clover has about the same lime requirement as red clover. In numerous trials in all sections of Ohio the stand and growth have been entirely unsatisfactory where the soils were highly acid.

Fertilizer.—In many cooperative trials with farmers and in Ohio Experiment Station tests, Ladino has been quite responsive to applications of phosphate or phosphate and potash where the latter is needed. Five hundred pounds of 0-20-0, or 0-12-12 (or their equivalent) at time of establishment and every 2 or 3 years thereafter may be expected to give a profitable response.

SEEDING LADINO CLOVER

The seedling stage of the Ladino clover plant is a critical one in its establishment. Too much shade at this time or excessive competition for moisture and nutrients by larger plants frequently results in a loss of stand. However, if given an even start in a mixture and a favorable growing season, it frequently dominates or smothers its associates.

Inoculation.—Ladino clover is inoculated by the same strain of bacteria that inoculates common white clover, red clover, and alsike. If Ladino clover is to be sown on a field that has produced a well-inoculated crop of any one of the true clovers within the last 5 years, the chances are good that the inoculating bacteria for Ladino are in the soil. However, the strain present may not be the most efficient one; and since legume cultures are inexpensive, it is always advisable to inoculate the seed. Particularly should inoculated seed be used when newly-treated pastures are seeded, because

the previously acid and infertile soil may have had but few plants of true clovers growing in it. Legume bacteria do not live long under such conditions.

The date of expiration of effectiveness of legume inoculants on sale in Ohio will be found on the package and should be noted before using.

Rates of seeding.—The recommended rates of seeding of Ladino clover are from $\frac{1}{2}$ to 2 pounds to the acre, if sown in addition to other forage crop seeds, or 2 to 4 pounds to the acre if sown alone. The low rates are sufficient because of the small size of the seed and the spreading habit of the plant.

When Ladino clover is sown alone at the rates recommended it is difficult to get an even distribution of the seed because of its small bulk. Ease and accuracy of seeding are increased if coarse corn meal or some other granular material is added to the seed to increase its bulk to 3 or 4 quarts to the acre.

Date of seeding.—Midsummer seedings of Ladino clover often fail because seed germination and seedling establishment are depressed by high soil temperatures. At Wooster, midsummer seedings made under seemingly favorable soil and moisture conditions have been less successful than spring seedings. Cooperative test seedings with Ohio farmers have also generally resulted in unsatisfactory stands when seeded in midsummer. However, some successful establishments with midsummer seedings of Ladino clover have been obtained. Success depends upon the temperatures during the period of seed germination and seedling establishment.

SEED CHARACTERISTICS

Color and Size.—The seeds of Ladino clover and those of the other varieties of white clover are indistinguishable. The natural color of Ladino seeds is yellow, but weathering may turn some of the seed coats to brownish. However, if the seeds are plump and the germination satisfactory, discolored seeds may be sown with good results.

There are about 700,000 seeds in a pound of Ladino clover seed, or slightly more than the number in a pound of alsike, two and one-half times as many as in a pound of red clover, and three times as many as in a pound of alfalfa seed. A seeding of 1 pound of Ladino clover seed on an acre, if evenly distributed, will give about 16 seeds per square foot, or one seed in a space of 3 inches square. If only one-fourth of the seeds produced established plants, the stand would average one for every 6 by 6 inch spacing, which is ample for a good stand.

Certified seed.—The purchase of certified seed is recommended because such seed is harvested from fields that have passed inspection for varietal purity before harvest. Seed merchants with an established reputation for dependability make every effort to supply their trade with seeds of known varietal purity and many of them handle certified seed.

Hard seeds.—Ladino clover seed includes some seeds which are “hard,” or relatively impermeable to the absorption of water. This delays germination. The label or tag which the seed law requires be attached to the seed container may indicate the percentage of hard seeds, but this cannot be added to the percentage of germination. Hard or impermeable seeds will germinate in time. Some will germinate in a few days beyond the time period of the official germination test, some in a few weeks or months, and some will still be impermeable at the end of 1 year or more.

Some hard seeds are made permeable by frost action if sown before the end of the period of freezing and thawing weather in the spring, and many of them may germinate almost as promptly as the permeable seeds sown at the same time. The presence of some hard seeds is probably desirable because the germinating

period is stretched out and thus weather conditions unfavorable to seedling establishment may be missed by enough seeds to produce a good stand later on.

Many hard seeds are rubbed or scarified in threshing, that is, the seed coats are scratched and so water is permitted to enter. Consequently that seed which is returned to the soil directly from ripened seed heads in meadows and pastures has a higher proportion of hard seeds than has threshed seed. Some seed heads carefully rubbed out by hand have had as high as 70 to 90 percent of hard seeds. These hard seeds are a source of volunteer stands at future dates. At Wooster on the Dairy Pas-

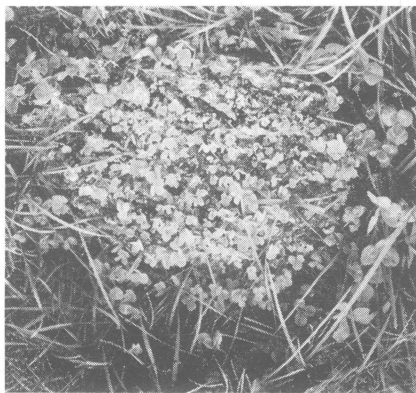


Fig. 4—Ladino clover seedlings, May 20, 1947 growing in cow dung dropped in the summer of 1946. The impermeable seeds in the manure were made permeable by freezing over winter and germinated during the continued wet weather of the spring. A total of 1920 seedlings and sprouted seeds were counted in this one dropping. (Dairy Pasture Research Farm, Wooster, Ohio.)

ture Research Farm, a good volunteer stand of Ladino clover in wheat was obtained from seed which had shattered when the field was in pasture 2 years previous. The sod was plowed for corn, and the corn stubble plowed for wheat. This tendency to maintain stands from shattered seed is comparable to alsike clover.

Many hard seeds pass through the digestive tract of animals grazing on Ladino clover, or fed hay containing Ladino clover seeds, and are a source of volunteer Ladino clover when the manure is spread (fig. 4).

LADINO CLOVER FOR PASTURE

Palatability.—Ladino clover is assuming considerable importance on Ohio farms as pasture for all classes of livestock (fig. 5). It is one of the most palatable of the legumes. Both cattle and sheep find it a little more palatable than red and alsike clovers when grazing in a mixed seeding. Ladino clover and common white clover seem to be about equally palatable at equal stages of development. The Ladino, however, grows taller and can be more easily grazed at a younger stage of growth. It has been frequently observed on the Dairy Pasture Research Farm and elsewhere that the Ladino clover is eaten in preference to the ordinary white clover when they grow in the same pasture.

Samples of the clover plucked from the pastures at Wooster to stimulate grazing have ranged from 17 to 28 percent crude pro-

Fig. 5A—Ladino clover alone or in mixture is relished by all classes of livestock.



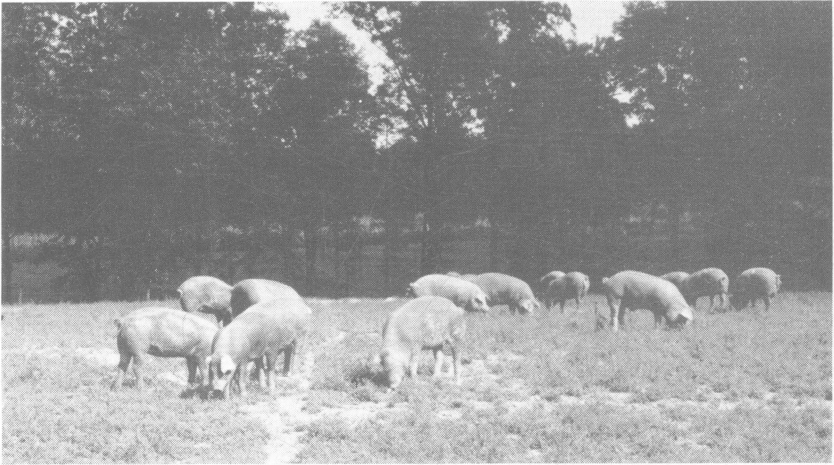


Fig. 5B—Ladino mixtures lower the cost of producing meat.



Fig. 5C—Sheep relish Ladino mixtures.

tein (N x 6.25) on a moisture-free basis. The lower protein samples represented clover that contained some ripe heads or leaves damaged by leaf-hopper attack: the higher protein samples represented rapidly-growing green leaves. The average crude protein content of Ladino clover for the grazing season is about 20 percent on a dry basis.



Fig. 5D—Ladino clover mixtures makes good pasture for chickens.

Habit of growth and grazing.—The growth habit of Ladino clover is favorable for its survival under grazing and its quick recovery thereafter. The nodes and growing point of the creeping stem lie close to the ground and are thus well protected from being grazed off, even by sheep, notably close grazers. Chickens, if too numerous, will pick out and destroy many of the growing points and retard recovery; however, unless the nodes are completely killed they are capable of sprouting new branches if protected for a little while, thus re-establishing the stand (fig. 6).

A pure or nearly pure Ladino clover pasture may cause cattle and sheep to scour badly. Hence, a mixed seeding with less succulent grasses and legumes is desirable. This mixed seeding is also less likely to cause cattle and sheep to bloat. For hogs and poultry, a pure or nearly pure stand is desirable because a succulent low crude fiber forage is better suited to these animals.

Pasture management.—The best returns from Ladino clover pasture are usually obtained by dividing the pasture into two or more sections that can be grazed in rotation. Sufficient livestock should be put on a section to graze it down in 2 to 4 weeks, depending upon the rapidity of the growth and the season of the year. The livestock then should be removed to another section while the one last grazed is making new growth. Ladino clover will make remarkable recovery in 2 to 3 weeks.

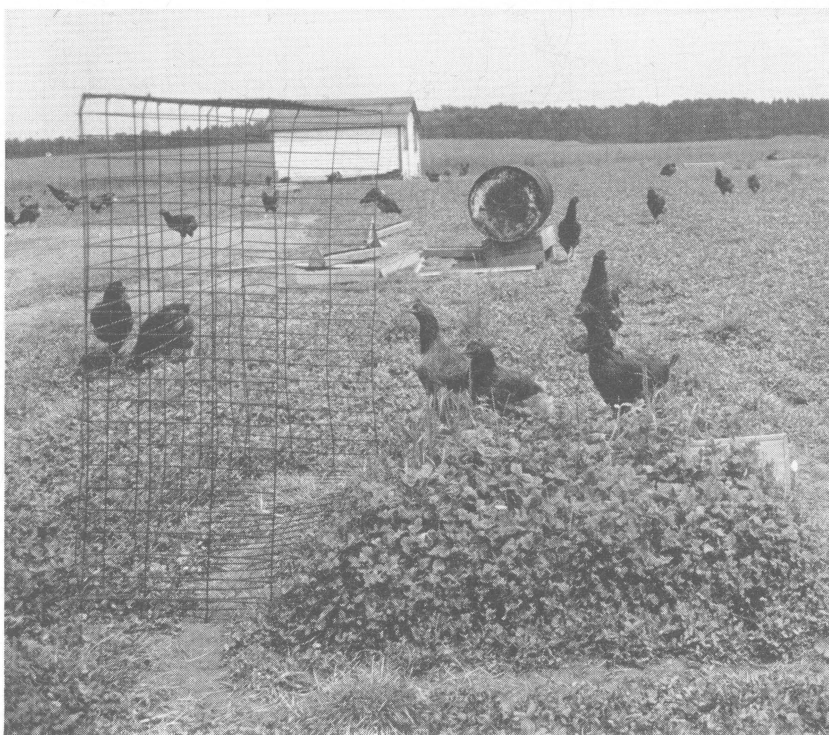


Fig. 6—Two weeks growth of Ladino clover made under the cage in a poultry paddock. (Poultry Research Paddocks, Wooster, Ohio.)

Too close grazing and regrazing before the new growth is well started will quickly thin the stand and curtail production. If grazed continuously, Ladino clover should not be grazed too short: a top growth of 3 to 5 inches will be sufficient to maintain the stand.

Late fall grazing is responsible for the failure of many pastures to "come back" quickly in the spring, and is the cause of many weedy pastures. Winter manuring is helpful in reducing winter injury. Fertilizing aids in starting spring growth, thus modifying to some extent the effect of late grazing.

In contrast to many forage plants, Ladino clover can be permitted to stand and accumulate considerable top growth without materially losing palatability. It does not mature all at once and become woody, as is the habit of red clover, but continues to grow so long as weather conditions are favorable, sending up new leaves and flower stalks as the old ones mature.

In the management of pasture mixtures of timothy or smooth brome grass with Ladino clover and alfalfa in which the paddocks were grazed in rotation, it was observed that quicker recovery of the herbage was obtained if the livestock were removed before the pasture was grazed below 3 inches, with some taller uneaten bunches being left (fig. 7). This was plainly evident when the new growth of grass and Ladino in the pasture was compared with the growth inside wire cages, set up at several places in the pastures.

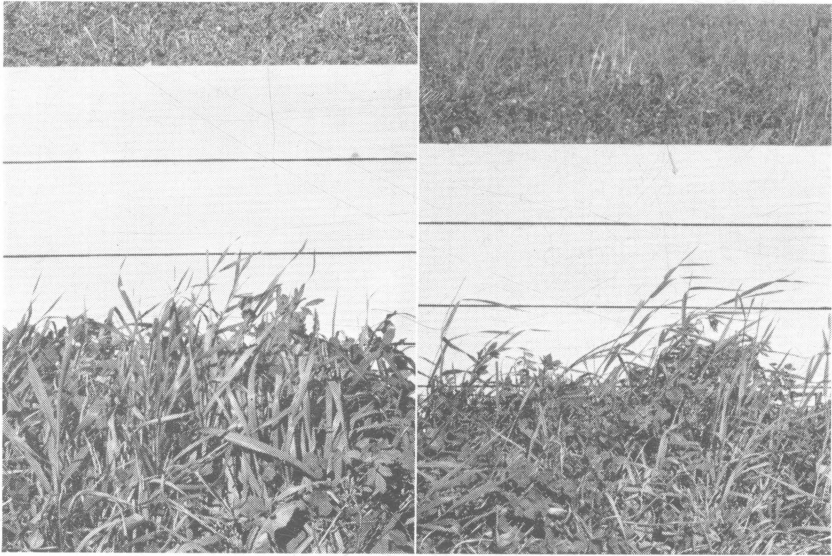


Fig. 7—Meadow-pasture mixtures ready for second grazing. Four to six inch stubble left after first grazing. Lines on screen six inches apart. Left—Timothy-alfalfa-Ladino clover. Right—Bromegrass-alfalfa-Ladino clover. (Dairy Pasture Research Farm, Wooster, Ohio.)

The herbage inside these cages was clipped within an inch or two of the ground at the time the cattle were moved to fresh pasture. The recovery of growth within the cages was slow, in fact, almost negligible during the midsummer season. This same sort of response has been observed in grazing tests in cooperation with Ohio farmers.

The reason for this effect may be explained in part by some work of the United States Regional Pasture Research Laboratory (1) on the location of the storage reserve food in many of the grasses. It has been shown that the sugar and fructosan are stored in the lower stalks and roots, and that the larger proportion of

(1)—“Improving Pastures and Grasslands for the Northeastern States” U.S.D.A. Misc. Pub. 590, February 1946.

the stored food is not in the roots, but in the stubble and lower portion of the leaves. The amount increased progressively from the leaf tip back to the soil surface.

There is probably no advantage in mowing a Ladino clover-grass pasture unless rank patches of ungrazed grass are developing in which the clover is being smothered or weeds are becoming a problem.

ESTABLISHING LADINO CLOVER IN PERMANENT SODS

Many trials have been conducted in various sections of the state upon methods of establishing Ladino clover in permanent pods. Data were obtained on 50 such trials at the close of the 1944 pasture season (2). Where no soil preparation was made and neither lime nor fertilizer applied, only 10 percent of the trials were successful in producing a good stand of Ladino clover. Where lime and fertilizer were applied, but no soil preparation was made, 23 percent of the trials were successful. Where lime and fertilizer were applied and the ground was disked, 41 percent were successful. In 1945, 33 percent of the seedings on limed and fertilized land, without soil disking were successful, while where disking accompanied the liming and fertilizing, 53 percent were successful in establishing good stands.

Twenty-six tests established in 1945 and 1946 were checked in the fall of 1946. Where the land had been limed and fertilized and disked, only 8 of the 26 were failures, and these were explained by too little soil preparation, unfavorable weather, late seeding, or over-pasturing. The 18 tests showing good establishment of Ladino clover had an average of 86 percent stand. This contrasts with the other legumes and grasses as shown in Table 1.

The few successful stands obtained where neither lime nor fertilizer was used were doubtless better than average soils in lime content and soil productivity. Many of the tests established in earlier years and not included with the "good" stands at the close of the first season developed excellent stands from the natural spreading of existing plants in later years. In general, these and other tests show that the greatest degree of success in establishing Ladino clover in permanent sods has been obtained when the old vegetation has been subdued by close fall grazing or by working up the soil otherwise, followed by severe disking and seeding early in the spring.

(2)—State Project 39, Hot Weather Legumes for Permanent Pasture, D. R. Dodd and M. A. Bachtell.

Table 1—Establishment of legumes and grasses in 18 cooperative tests on Ohio farms.

Crops	Percent of perfect stand	Percent showing good or excellent growth at the end of the first season
Legumes:		
Ladino clover	86	78
Alfalfa	67	61
Sweet clover	65	63
Birdsfoot trefoil	51	33
Lespedeza sericea	35	none
Grasses:		
Orchard grass	71	83
Alta fescue	56	50
Marietta timothy	54	39
Bromegrass	43	44

However, a surprising degree of success has been obtained from early March seeding without soil preparation, provided close fall grazing is followed by spring application of lime and fertilizer disked or cut into the soil $\frac{1}{4}$ to 2 inches deep. Grazing should be light or discontinued entirely while the Ladino clover is becoming established.

SEEDING LADINO CLOVER ON RENOVATED PASTURES

Many permanent pastures may be improved in carrying capacity, nutritive value, and uniformity of production by *renovation*, a process which involves some seedbed preparation to partly or completely eliminate the existing vegetation, to incorporate fertilizer and lime (if needed) into the soil and to provide favorable conditions for a new seeding of forage legumes and grasses.

Renovation is especially desirable on farms where there is not sufficient level rotation land to provide for midsummer grazing of meadow-pastures and where it is desirable to establish an alfalfa-Ladino-grass or Ladino-grass seeding on a part of the old permanent pasture area. When herbage production decreases because of the thinning out of the Ladino clover and other desirable species, re-renovation is called for. For a period of 3 to 4 years, renovated pastures may be expected to produce 25 to 40 percent more than the maximum obtained at the end of such a period by treatment without renovation. There will, however, be a tendency for the two areas to approach the same level after this period of time.

In renovating an old pasture, the sod may be worked up into a seedbed by disking or other type of surface working. Such methods of preparation have the advantage of keeping the sod on or near the surface where it has the beneficial effect of a mulch (3). On sloping land, soil erosion is more likely to occur if the land is plowed. If the sod is heavy, the time and labor of preparing a good seedbed by this process are usually more than if the land is plowed. On many farms, field cultivators are being used instead of or to supplement the disk in preparing "trash mulch" seedbeds.

There are many permanent grass pastures on level or gently rolling land that can be re-established successfully by plowing the sod, planting it to corn, and following with a small grain crop as a companion crop in which the new pasture mixture is seeded. There are certain advantages in this procedure:

1. It permits placing the lime and fertilizer in the rootbed of the soil; lime and phosphate act more promptly and effectively when placed there than when applied as top-dressings to the soil surface only.
2. It gives an opportunity to apply and plow down liberal amounts of manure, a practice that is helpful on soils low in organic matter. However, in establishing seedlings on thin land, an application of manure as a top-dressing on the small grain companion crop in which the seedlings are made is more effective than plowing all the manure under.
3. It facilitates the control of some perennial weeds which may not be completely eradicated by disking and direct seeding.
4. It makes it possible to fill up holes and level the surface so that the mowing machine can be used more effectively in clipping the pastures.

There are also some disadvantages to the procedure: It exposes sloping land to greater erosion hazards, it retires the land from the use as pasture during the corn crop year and for much of the small grain crop year.

ESTABLISHING LADINO CLOVER IN COMPANION CROPS

Ladino clover may be successfully established by sowing it in a companion crop of small grain, either alone or as a part of

(3)—For a detailed discussion of the advantages of a mulch in establishing a new meadow or pasture seedings, see "The Trash Mulch Method of Reclaiming Broomsedge and Povertygrass Lands with Alfalfa", H. L. Borst and R. E. Yoder, Ohio Agricultural Experiment Station Bimonthly Bulletin May-June, 1943, Vol. XXVII, No. 222.

a meadow or pasture seed mixture. Broadcasting the seed on the winter grain in March when the soil is freezing and thawing results in shallow covering of the seed and good seedling establishment. If sown later, after the freezing and thawing period is past, the seed should be drilled in or broadcast and covered lightly with a harrow or rotary hoe.

When sowing Ladino clover seed or mixture with the grass-seed attachment of the grain drill in a companion crop of spring-sown small grain, care should be taken to keep the seed from being covered too deep since this results in a poor stand. Adjusting the grass seed delivery tubes to drop the seed back to the drill disks or hoes helps to overcome this difficulty.

A good method of seeding with spring-sown small grains is to sow the Ladino clover and other seeds broadcast (wheelbarrow, knapsack, horn seeder, or other means) immediately after the small grain has been sown. Covering the seed thus sown in the spring is seldom necessary; the first good rain will do the job.

The most successful seeding method with spring-sown small grain is commonly known as the "cultipacker method." It consists of using the cultipacker immediately after sowing the small grain, broadcasting the seed (much of which will collect in the cultipacker furrows) and permitting the first rain to cover it. Prompt emergence and uniform stands are the rule with this method. More details about the method are given in the Ohio Agricultural Extension Service Bulletin 261, *Choosing and Sowing Meadow and Pasture Seedings*.

A good stand of Ladino clover may be lost by mismanagement of the grain crop at harvest time. If harvested with a combine and a heavy crop of straw is left on the field, the stand of Ladino clover and other legumes may be seriously reduced that fall and early winter. In tests at the Ohio Agricultural Experiment Station, removing a part or all of the straw and stubble has prevented this loss.

On the Sheep Research and the Dairy Pasture Research Farms, it is a common practice to graze off the companion crop of wheat or oats in which the forage seedings have been made. It has been demonstrated that this practice improves the stand of the meadow or pasture seeding, and that under fairly close grazing it survives in a meadow-pasture mixture if the alsike is omitted and the red clover is reduced in the seed mixture. One of the successful mixtures now being used in a 4-year rotation of corn, small grain, and 2

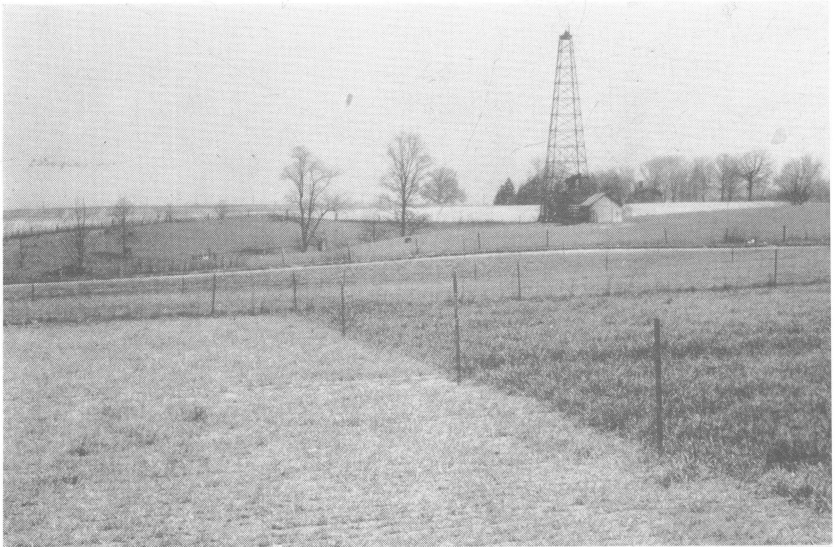




Fig. 9—Left: sheep grazing off companion crop of oats in which smooth brome-grass, alfalfa and Ladino clover have been seeded. Right: close-up, showing how oats have been grazed off. (July 5, 1945, Sheep Research Farm, Wooster, Ohio.)

years of meadow-pasture is made up of 7 pounds alfalfa, 3 pounds red clover, and 1 pound of Ladino clover to the acre seeded in the spring. In addition, 3 pounds of timothy are sown in the fall on wheat, or 6 pounds with oats in the spring. Alfalfa is not as strongly competitive as red and alsike clover.

The strongly competitive effect of a component of a mixed seeding can be controlled in large measure by grazing off the excessive growth before it gets too rank. A lush growth of the mixed herbage in the stubble fields can be grazed in August and early September, usually with beneficial results to the Ladino clover (figs. 8 and 9).

EFFECT OF TIME OF CUTTING HAY ON SURVIVAL

The time of cutting the first crop of hay also has an influence on the survival of Ladino clover in the mixture. A good survival is more likely if the hay is cut early. At Wooster, Ladino clover survived well on that part of a mixed alfalfa-red clover-Ladino clover-timothy meadow which was cut for grass silage June 10, but was badly thinned out on the rest of the field which was not cut for hay until June 25. Grazing off the first crop of hay (starting about May 25 at Wooster) gave a good survival of Ladino clover.

LEFT: Fig. 8—Grazing off the wheat companion crop. Top—closely grazed wheat, left of fence. Middle—June 20. Closeup of wheat row showing small legume and grass plants. Bottom—view of above, Sept. 17. (Sheep Research Farm, Wooster, Ohio.)

SEED MIXTURES FOR DIFFERENT SOIL CONDITIONS

The success of a seeding depends in large measure upon the adaptation of the seed sown to the soil conditions of the area. The lime content of the soil and soil drainage are especially important in this regard.

In general, a simple seed mixture will meet the requirement of any specific soil condition. For most situations this will be one or two legumes and one grass, or seldom more than three legumes and two grasses. Some fields are so mixed in soil type and drainage that it becomes desirable to sow a somewhat complex seed mixture in order to have something adapted to each specific area. However, the use of "shotgun" seed mixtures, for the most part, results from a failure to recognize the relationship between soil conditions and crop adaptation.

When any meadow mixture is intended in part for pasture, add $\frac{1}{2}$ to 1 pound of Ladino clover to the hay mixture, or replace the alsike clover in the mixture with 1 pound of Ladino. When the seedings are primarily for permanent pasture, add 3 to 5 pounds of Kentucky bluegrass and $\frac{1}{2}$ to 1 pound each of Ladino and Louisiana white clovers to any hay mixture adapted to the situation.

See tables 2 and 3, Ohio Agricultural Extension Service Bulletin 261, "Choosing and Sowing Meadow and Pasture Seedings" for more detailed recommendations (4).

Timothy and Ladino clover.—The addition of Ladino clover to timothy or a timothy mixture improves its usefulness for pasture. Ladino makes good midsummer growth unless the weather is too dry and so makes up somewhat for the smaller midsummer growth of timothy. If properly managed, the mixture can be maintained for several years.

A mixture of timothy and Ladino clover makes a good combination for the establishment of Ladino clover pasture for chickens, where much clover and little grass are wanted (fig. 10—see fig. 5D on page 11). The mixture may be seeded in the usual way with a companion crop of small grain. In the spring of the following year, clipping back the growth two or more times when it gets to be 6 to 8 inches tall will discourage the timothy and encourage the Ladino clover. Most poultrymen make a practice of mowing the poultry paddocks frequently in order to keep the herbage short and

(4)—This bulletin can be obtained from the office of the County Agricultural Agent; from the Agricultural Extension Service of the Ohio State University, Columbus; or from the Ohio Agricultural Experiment Station, Wooster, Ohio.

succulent. This practice results in a final stand of almost pure Ladino clover in a year or two, even though alfalfa, red clover, and timothy were included in the seed mixture. Orchard grass, brome-grass, and Kentucky bluegrass may be expected to last longer than timothy under such treatment.

Smooth brome-grass and Ladino clover.—A mixture of smooth brome-grass and Ladino clover (including alfalfa in favorable situations) is, in many ways, an ideal pasture or meadow-pasture mixture (5). It is highly nutritious and retains its nutritive property with advancing maturity somewhat better than mixtures containing orchard grass or timothy. It makes good quality hay, its recovery after hay harvest is prompt, and its growth for mid-summer pasture larger than the aftermath of timothy.

Orchard grass and Ladino clover.—Orchard grass in a fairly thick stand is one of the most competitive of the tall grasses, and if the grass is permitted free growth the Ladino clover seeded with it is soon crowded out. If the rate of seeding the orchard grass is limited to 3 to 4 pounds to the acre, the Ladino clover will have little difficulty in competing.

Grazing of the orchard grass-Ladino clover mixture or the removal of a hay crop early in the season retards the growth of the orchard grass and gives the Ladino clover a better chance to get well started.

On the Dairy Pasture Research Farm, Ladino clover in an orchard grass-alfalfa-Ladino clover mixture made up about 20 percent of the herbage the first season, then because of the early growth of the orchard grass hay in the second and third years, it dropped to about 3.5 to 5 percent, but was restored to a satisfactory proportion, 17.5 percent, in the summer of the fourth year by a period of early grazing from April 6 to May 3, followed by a hay harvest on June 17. Because of its vigorous growth after grazing, orchard grass should be grazed closer than timothy or smooth brome-grass in order to avoid crowding out the Ladino clover in the mixture (figs. 11 and 12).

Kentucky bluegrass and Ladino clover.—Ladino clover is a valuable addition to Kentucky bluegrass pasture. Under rotational grazing and proper management it contributes more to the herbage yield than does the common white clover (fig. 13).

(5)—Brome-grass—Use and Culture on Ohio Farms, C. J. Willard, Ohio Agricultural Extension Service Bulletin 290.



Fig. 11—Orchardgrass-alfalfa and Ladino clover pasture in June. Height of grass about 4 inches. (Dairy Pasture Research Farm, Wooster, Ohio.)

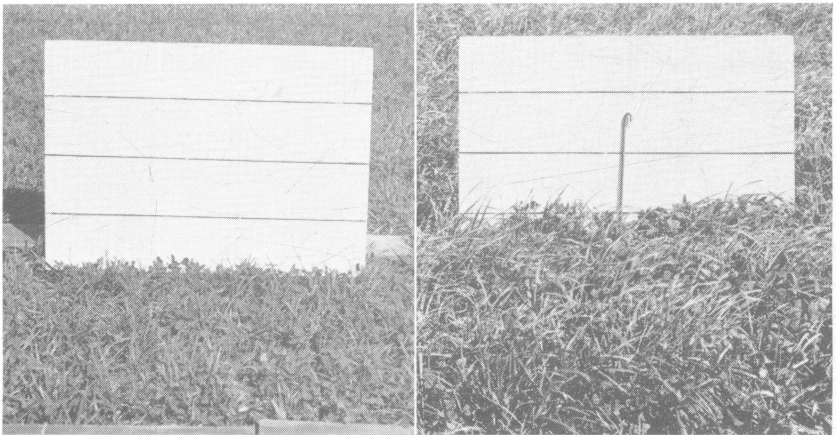


Fig. 12—Orchardgrass-Ladino clover sheep pasture. Lines on screen 6 inches apart. Left—at the close of a pasture period. Growth left about 3 inches tall. Right—regrowth 18 days later. Height 6 to 8 inches tall. (Sheep Research Farm, Wooster, Ohio.)

It is difficult to maintain a good stand of Ladino clover in a dense, closely grazed or over-grown sod of Kentucky bluegrass. The maintenance of a satisfactory Ladino content is dependent upon an intermediate type of management such as is commonly associated with rotational grazing and mowing at the end of each grazing period.

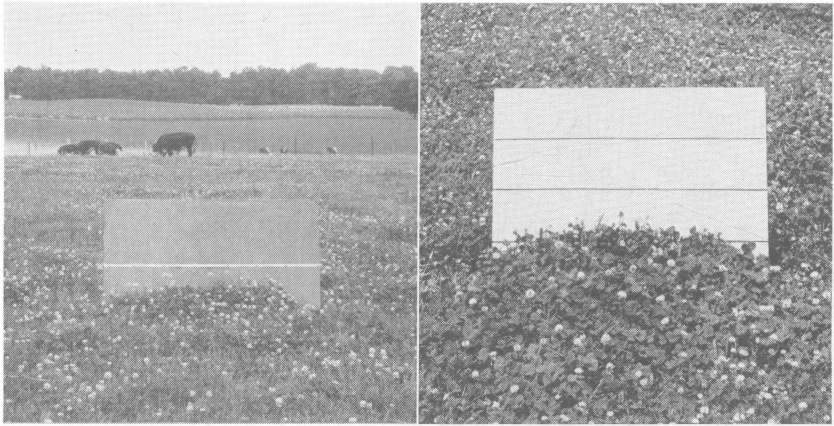


Fig. 13—Left—Photo July 6, 1939. Ladino clover showing up in Kentucky bluegrass—white clover—Ladino clover pasture 3 years after establishment. Photo July 20, 1947. Same pasture during wet season of 1947. Ladino clover was not so noticeable during intervening years of normal to dry seasons. (Dairy Pasture Research Farm, Wooster, Ohio.)

MISCELLANEOUS USES FOR LADINO CLOVER

Ladino clover for hay.—Because of its succulence, prostrate habit of growth, and relatively low crude fiber content when grown alone, Ladino clover is less satisfactory for hay than the more common meadow legumes. When grown in a pure stand the difficulties of curing are great.

The Agronomy Department first attempted to make pure Ladino clover hay in 1929. The results are given in table 2.

Table 2.—Yields of Ladino Clover Hay—Wooster, 1929

Cutting	Yield per acre	Percent crude protein	Yield of crude protein per acre
	Pounds		Pounds
May 27	2,565	18.3	470
July 15	2,160	19.7	425
August 19	1,440	18.7	270
Total	6,165		1,165

The plants contained about 90 percent water when freshly cut. Hay yields were calculated on the basis of 15 percent moisture. The mowed clover was soft and tended to pack tightly in the windrow and cock, and so was difficult to cure. Even when it seemed sufficiently dry to put into the mow, some of it spoiled in storage.

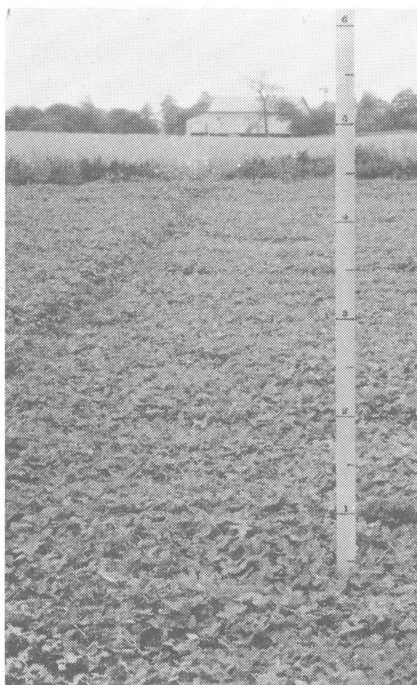


Fig. 14—Photo June 12, 1929. Six inches of growth made by Ladino clover in 16 days after cutting for hay.

The season was exceedingly favorable for a good growth of Ladino clover; the rainfall for the 5-month period of April to August inclusive was 4.17 inches above normal. The Ladino clover was mowed when the plants were showing much bloom. It made a remarkably quick recovery after cutting (fig. 14).

At Columbus, Ladino clover for hay during a 5-to 8-year period yielded less at the first cutting than alsike or red clover. The second cutting of Ladino clover was more than that of alsike, (which normally produces a poor aftermath), and less than red clover. The total production of Ladino clover was less than that of either alsike or red clover. Ladino clover makes its greatest production when harvested more frequently than twice per season.

Ladino clover is more promising for hay in mixtures. In a tall grass mixed meadow it may not contribute as much to the yield of hay as its appearance in the mixture would indicate; because of its high moisture content its dry hay yield is reduced in comparison with grasses and other legumes. At Wooster in mixed seedings, Ladino has seldom contributed as much as 20 percent to the dry hay yields. However, its high protein content adds considerably to the feeding value of the hay.

Seed Production.—Many Ohio farmers have expressed an interest in Ladino clover seed production as a possible sideline, largely because of the high prices quoted for seed during the past several years. Ladino clover sets seed abundantly in Ohio during dry, sunny weather if the blossoms are well cross-pollinated by bees and other insects. Harvesting difficulties have been the major handicap to a successful seed production enterprise.

One of the problems in seed production is uneven ripening of seed heads during periods of good growing weather and continuous growth of green leaves during the seed ripening period. When some heads are ripe others will be in all stages of development from buds to ripe heads. It is only during periods of dry sunny weather which stop growth that the proportion of ripe heads is dominant.

Another difficulty is that the stems of the ripe seed heads crinkle down on or near the ground so that many heads are missed by ordinary harvesting machinery. Attempts to develop special harvesters have met with some success. The sections of Farm Crops and Agricultural Engineering of the Michigan Agricultural Experiment Station (6) are developing an experimental vacuum type harvester that is meeting with considerable success. Seed recoveries of 5 to 10 times that obtained with the ordinary combine harvester have been obtained.

Mr. A. A. Fishbaugh, a grower of certified seed in Mercer County, Ohio, has developed a method of harvesting Ladino clover seed that has met with considerable success. In 1948, he harvested a ton of seed from 22 acres. He does not pasture or make hay from the Ladino intended for seed but permits it to produce a succession of blossoms and ripe heads until time to harvest during favorable weather in late summer. He prefers a pure stand of Ladino. The secret of his success lies in a special type cutterbar which he devised by making certain changes in the standard cutterbar of the mower. It permits very close cutting, freedom from clogging and perfect operation of the windrow attachment. The guards have been cut down to remove all resistance to passage through the clover and lifting fingers have been added so that matted material can readily come in contact with the sickle. The viny material on the ground forces the cut material off the cutterbar onto the side buncher. The windrow is permitted to become thoroughly dry and is then threshed with the combine.

Direct harvesting with the combine is not practicable because too much green and wet material is threshed with the seed, causing it to heat and spoil. Ladino clover mowed for seed sometimes makes a new growth quickly and pushes up through the swath before it

(6)—“Vacuum Type Harvester for White Clover Seed”, S. T. Dexter and E. G. McKibben, Michigan Agr. Expt. Station, Quarterly Bulletin, Vol. 27, No. 3, Feb. 1945. “The Vacuum Harvester for Clover Seed”, S. T. Dexter and W. H. Sheldon, Michigan Agr. Expt. Station, Quarterly Bulletin Vol. 29, No. 4, May 1947.



Fig. 15—Ladino clover is not easily smothered. Here it has pushed up through a swath of bromegrass and Ladino clover, mowed but not raked. Border cut away to show swath.

is ready to thresh (fig. 15). Windrow curing is difficult, too, at times because the clover may mat down tightly and be difficult to maintain in a loose fluffy condition for satisfactory drying.

Everything considered, it is probable that little Ladino clover seed will be harvested in Ohio until improved harvesting machinery and methods become more prevalent.

The greater part of the domestic Ladino seed crop of the United States is produced in western states under irrigation. Yields up to 400 pounds to the acre are occasionally obtained in that section, but 150 pounds is considered satisfactory. Under irrigation a good seed crop can be expected year after year almost without fail.

Ladino clover for soil improvement. Ladino clover is valuable in maintaining or increasing soil productivity because of its nitrogen-fixing power, the high nitrogen contents of its residues, and its perennial habit. Ladino clover sods add high quality organic matter to the soil. The common clover-timothy mixture can be greatly improved in its soil-building power by adding a half-pound of Ladino clover seed per acre. The Ladino clover will persist after red clover and alsike have largely disappeared in the second year of harvest, thus changing the sod from a low-nitrogen to a high-nitrogen residue.

Ladino clover alone probably is not equal to sweet clover as a green manure crop to be seeded in small grain and plowed down

the following spring for corn. However, a combination of the two may have advantages. Its use as a cover crop to be seeded in corn at the last cultivation is still under study, but the failures to obtain good stands are still numerous.

Ladino clover in orchards.—Ladino clover is being used with excellent results as a cover crop in orchards. It produces a dense mat of low-growing, highly nitrogenous material that protects the soil and conserves moisture. Its perennial habit of growth and abundant seed production make it easy to maintain even though the orchard may be disked or otherwise cultivated every year or two. It may be used alone or in combination with a grass. A good combination consists of 2 to 3 pounds of Ladino and 4 to 6 pounds of timothy or Kentucky bluegrass as an early spring seeding. Once such a seeding has been established, the sod may be mown as frequently as desired to supply mulch and reduce competition with trees, without serious damage to the sod. Both the Ladino and the grass come back quickly with favorable weather following cultivation, which may become necessary if too dense a grass sod should develop.

Ladino is superior to alfalfa and sweet clover in the orchard since it has a more shallow root system which prevents its competing in dry periods with the trees for moisture at greater depths. During such periods, the Ladino provides a mat of dead or dormant material that prevents evaporation of the moisture from the surface of the soil.

INSECT DAMAGE

The potato leafhopper, *Empoasca fabae* (Barr.), attacks Ladino clover, causing the leaves to turn yellow or reddish purple. The extent of the damage is difficult to estimate during the period of vigorous growth when new leaves are developing rapidly. Many leafhopper eggs and nymphs are destroyed by grazing animals. The growth of seedlings may be retarded and many of them killed by attacks of leafhopper.

Some seasons the clover leaf weevil, *Hypera punctata* (Fab.), does considerable damage to Ladino clover in May. It feeds on the leaves and may completely defoliate small plants.

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