

A LEGUME PROGRAM FOR ORCHARDS ON LOAMY SOILS

By *Carter M. Harrison and Newton L. Partridge*

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By *Carter M. Harrison and Newton L. Partridge*
Departments of Farm Crops and Horticulture

The supply of nitrogen fertilizers may be limited for the duration of the war. Experience already has shown that dislocation of transportation and distribution is likely to be as effective in reducing available supplies as is actual shortage of materials. Supplying a large proportion of the nitrogen needed by our orchards through the growth of legumes will be wise insurance against a lack of chemical nitrogenous fertilizer during the period of the war. The soil-building program for orchards on loamy soils is somewhat different from that best suited for sandy soils and should be considered separately.

Most deep, well-drained loamy soils are able to supply sufficient amounts of moisture to meet the needs of orchard fruits and, in addition, those of plants used for permanent sods in orchards. By the judicious selection of clover and grass species, the proper use of lime and fertilizers, and mowing at suitable times, it is possible to obtain an orchard cover which will supply considerable amounts of nitrogen for the use of the fruit trees without injurious competition.

Data collected over a considerable period of years at the Graham Horticultural Experiment Station near Grand Rapids show that the average cost of maintaining an acre of orchard under a clean cultivation-cover crop system of management—including disking, dragging, purchase of seed and seeding the cover crop—is approximately \$10 annually. This expenditure is largely for labor. Corresponding labor costs—including mowing, raking and spreading the grass—in a sod mulch orchard were less than \$5 per acre. This is a difference of about \$5 per acre, a sizable sum for a large orchard. At present labor prices, the difference might well be nearly twice that amount. In view of present and prospective costs and the difficulty or impossibility of obtaining new mechanical equipment and repairs for all farm machinery, the benefits may be greater than the figures imply.

When all these facts, coupled with the demonstrated better long-term performance of most deciduous tree fruits under a suitable sod mulch culture, are compared with a system of clean cultivation-cover crop soil management, the conclusion is evident that many cultivated Michigan orchards set on loamy soils should be seeded down in 1943. This publication is intended to

point out how successful seedings may be made and what combinations of grasses and legumes are most likely to succeed.

WHAT ORCHARDS TO SEED

Most apple, pear, plum and cherry orchards will grow and produce as well or better over a term of years when seeded down as they will under the cultivation-cover crop system of management. On deep loam soils suited to these fruits, supplies of moisture are present in sufficient quantities for both trees and the grass-clover sod. Trees grown under cultivation-cover



Fig. 1. Baldwin tree grown 22 years under cultivation-cover crop at the Graham Horticultural Experiment Station. Photographed by Toenjes Jan. 17, 1942. Trunk circumference, 36¾ inches; height of pole, 20 feet. Compare with Fig. 2.



Fig. 2. Baldwin tree grown on a plot seeded down the year following setting. The sod-mulch system of management has been followed for 21 years. Photographed by Toenjes Jan. 17, 1942. Trunk circumference, 40½ inches; height of pole, 20 feet. Compare with Fig. 1.

crop and grass sod at the Graham Horticultural Experiment Station are illustrated in Figs. 1 and 2, and similar or more striking results may be observed when clover is grown with grass on such soils. On eroding hillsides, a permanent sod cover will conserve the fertile surface soil, prevent wasteful erosion losses of soil organic matter and increase the permeability of the soil and the penetration of moisture into it. The amount of erosion that occurred in an orchard on a gentle slope when the soil was cultivated is shown in Fig. 3. A good sod cover aids in holding the snow and is of great value in preventing root killing during exceptionally severe winter cold spells. Trees, grown in sod, mature wood and crop earlier and the



Fig. 3. Baldwin tree grown on cultivation-cover crop plot, illustrating extent of soil loss by erosion. Such exposed roots are subject to injury by cultural equipment and are subject to winter injury.

fruit usually has better color and finish than when the variety is produced in cultivated orchards.

Peach trees are less tolerant of sod cover than are the fruits previously mentioned. Nevertheless, where peach orchards are set on rapidly eroding hillsides, the trees are just as productive after one or two years under sod as they are under a cultivation-cover crop method. When such sod-grown trees are mulched with leguminous materials and fertilized with chemical nitrogen fertilizers, they are often more productive than cultivated trees grown on similar sites.

KINDS OF MIXTURES TO SEED

The selection of the mixture will depend on the nature of the soil and site. To make a successful cover, the plants must survive and make at least a moderate growth. Furthermore, except on sites where the loam is especially deep and well supplied with moisture, the mixture must not offer too great competition to the trees for soil moisture and nutrients.

Canada bluegrass is found throughout Michigan, growing on sites and soils adjacent to many of our orchards, particularly those set on clay soils or slopes which have been eroded to some extent. Although not particularly

vigorous, this species, when once established, provides sufficient protection against erosion on most slopes which make practical orchard sites. It does not form a quick cover and should always be sown in a mixture with some other grass which will provide a cover more quickly, such as timothy.

Kentucky bluegrass does better than Canadian bluegrass on the more fertile soils which are abundantly supplied with soil organic matter. It should always be sown in mixture with timothy.

Timothy usually will not provide a permanent sod cover on most orchard soils. However, it will give a quick cover and is valuable for use with grasses which form a cover more slowly such as the bluegrasses.

Grasses which remain green and succulent well into drouth periods such as smooth brome, orchard and reed canary should not be sown in orchards since they offer too much competition to the trees and to the clover.

White clover is widely distributed throughout the fruit area and is found adjacent to many of our orchards, especially those on hillsides. It is a low-growing plant and will not survive the competition of vigorous grass sods, but it will survive in areas where the growth of the grass is less, particularly on clay or heavy loam soils. This clover is often found on eroded hillsides growing with Canadian bluegrass.

Alsike clover is also widely distributed and is often found growing on the more sandy loams, where other clovers are found less frequently.

Red clover is more vigorous and grows taller than those already mentioned and is usually found on the more fertile soils such as those which support a good growth of *Kentucky bluegrass*.



Fig. 4. Character of the cover maintained on the sod-mulch plot. No erosion takes place here and the roots are sheltered from winter freezes by the mulch and grass.

Alfalfa is usually a vigorously growing plant whose roots penetrate deeply into the soil and exploit the same soil horizons as do the fruit tree roots. Consequently, it offers much more competition to the trees than do the clovers mentioned above whose roots do not enter the soil so deeply. Alfalfa is likely to check the growth of fruit trees in dry seasons because it removes so much water from the subsoil. As a result, we do not recommend that it be sown in orchards.

Sweet clover is a biennial which is often of value as a soil builder. However, it does not often maintain its stand when grown with grass hence it does not make a successful legume to use in a mixture.

On fertile, level, loamy sites a mixture of 10 pounds of Kentucky bluegrass, 5 pounds of timothy and 5 pounds of red clover per acre may be sown.

On soils medium in fertility, a mixture of 5 pounds of Kentucky bluegrass, 5 pounds of Canadian bluegrass, 3 pounds of timothy, 3 pounds of red clover, and 2 pounds of alsike should be sown.

Less-fertile soils which are eroded and low in organic matter should be sown with a mixture of 10 pounds of Canadian bluegrass and 5 pounds of timothy per acre of land covered or a mixture of 10 pounds of Chewings fescue and 5 pounds of sheep's fescue per acre when seed is available. White clover seed at the rate of 2 pounds per acre should be added to these mixtures of grass.

WHEN TO SEED

Grass seedings may be made successfully at two times: in the late summer before the fall rains begin, that is from about August 15 to September 15; and in the early spring from the time the surface thaws until May 1. Late summer seedings are preferable to those made in the spring. Late spring seedings, after May 1, generally result in poor stands or complete failure of the grass. The clover may be sown with the grass, provided it is seeded at the times mentioned. When the grass has been seeded in the fall, clover may also be sown later on the snow in March or April.

USE OF MANURES, MULCHES, LIME AND FERTILIZERS

The soil should be tested for its lime requirement by the use of Soiltex (which may be obtained from your county agricultural agent) and the amount of lime needed applied. Lime should be applied a couple of months previous to seeding, if possible, and worked into the soil thoroughly. When the soil is low in fertility, in poor tilt, or the land to be seeded is subject to erosion, it is necessary to help the seedlings establish themselves. A very light application of strawy manure may be made or a very thin mulch of

straw may be spread after sowing the seed. The ground should be visible through the mulch which should not be more than "two straws" thick. An application of ammonium sulfate at the rate of 150 to 200 pounds per acre of land covered, will also help in hastening the development of the cover, but it may be difficult to obtain at this time. An application of 300 pounds of a high-analysis fertilizer, such as 0-20-20, 0-14-14, or other formula containing large quantities of phosphate and potash should be applied before seeding.

PREPARING THE SEEDBED

A seedbed for grass and clover should be fine and well firmed before seeding. After a thorough working of the soil, the use of a cultipacker in firming the soil prior to sowing will aid materially in obtaining a cover.

SOWING THE SEED

Following the cultipacking, the grass and clover seed may be broadcast with any common hand-operated seeder or from the seeder attachment of the drill. Care should be exercised not to sow the seed deeply if a drill is used. After seeding, cultipacking will suffice to cover and firm the soil around the seed.

CARE OF THE GRASS-CLOVER SOD

After the sod has been established it does not require much care. The grass should be cut when the heads begin to appear, since cutting at this time will tend to weaken its growth somewhat and reduce competition with the clover. A light growth may be left as it falls when cut. In young orchards, or where the grass grows vigorously, the cuttings should be raked and put under the trees to serve as mulch, since the material will contain considerable amounts of nitrogen which will serve to replace some of the chemical nitrogen fertilizers that are used for the trees customarily. One cutting usually will be obtained, but additional cuttings may be made where the grass-clover mixture grows vigorously. These extra cuttings should be made only when the cover is bulky enough to make the labor of working it under the trees worthwhile. In some instances, when the clover is not making a satisfactory growth, it may be strengthened by the application of fertilizers containing phosphate and potash at the same rate as suggested for application before seeding.

USE OF FERTILIZERS AND MULCHES FOR THE FRUIT TREES

When orchards are first seeded, the trees will not be able to obtain sufficient nitrogen for growth as they did while they were being cultivated. After they become adjusted to the sod and the grass has improved the porosity

and penetrability of the soil, the trees will usually require less nitrogen fertilizer than they did before the orchard was seeded. Where the clover is abundant and vigorous and considerable quantities of cuttings can be placed around the trees, the amount of nitrogen fertilizer should be reduced proportionately to the amount of mulching material added. In some instances, after the mulch begins to release considerable quantities of nitrogen, the trees will require proportionately smaller amounts than mature apple trees, from the decaying plant material.

When the orchard is first seeded, there will be no mulching material produced in it at first. For a year or two, the need for nitrogen for the trees is likely to be greater than before. Most mature apple trees should each receive increased applications of ammonium sulfate after seeding, ranging up to 2 pounds more than they had been receiving previously if their growth is to be as vigorous and their production as large as it was under cultivation. This is only a temporary condition, however, and in case no extra nitrogen fertilizer can be obtained, the trees usually will only receive a temporary check. In case straw for mulch around the trees is applied before cuttings are available, about the same amount of additional nitrogen will be needed by the trees. Other kinds of fruit trees and young apple trees will require proportionately smaller amounts than mature apple trees. The amount of nitrogen that should be added as fertilizer will be indicated by the growth of the trees and the color of the foliage and fruit. If insufficient nitrogen is available for the trees, the terminal shoots will be short and thin and the leaves yellowish green. When too much nitrogen is present, the terminal shoots will be long, the leaves dark green, and the fruit will mature late and be poorly colored. An intermediate type of growth is best. The amount of the application should be adjusted to correct the conditions as necessary.

The use of mulch under the spread of the branches will reduce the severity of the competition between tree and cover and reserve this soil for the exclusive use of the tree roots. In addition, mulched trees will receive sufficient amounts of potash, phosphate and the minor elements to meet any deficiencies likely to be found in Michigan fruit soils. In those orchards where the amount of cuttings produced will not supply sufficient material to maintain the mulch, or during the time before the clover-grass sod is well established, additional material should be brought in from outside the orchard, if possible. Under the more-or-less limited supply of nitrogen fertilizer available at present, legume hay will probably be more satisfactory for use as a mulch since it will add to the supply of nitrogen available to the trees more quickly. When trees are first mulched with straw, the amount of nitrogen fertilizer applied should be increased, as mentioned above. When legume hay is used, the amount of nitrogen applied previously may be decreased somewhat and the same growth rate probably will be maintained.

As the mulch decays, no matter what its nature, eventually it will release nitrogen to the tree roots and the amount of fertilizer applied should be reduced.

TREATMENT OF ORCHARDS ALREADY IN GRASS SOD

It is usually unnecessary to break up a grass sod cover in order to substitute a grass-clover mixture for it. The use of sufficient lime to satisfy the lime requirement as indicated by the Soiltest test together with the application of fertilizers high in phosphate and potash, as suggested above for new seedings, will usually increase materially the growth of clover plants already established though making very little growth in the sod. The clover will have a better chance to grow when the grass is mowed early and rather close as suggested in a previous paragraph. If desired, a light seeding of clover may be made on a late snow, but this is usually not needed to secure a satisfactory stand.

BEWARE OF RABBITS AND MICE

Rodents are likely to cause occasional damage in any orchard. No mulch should be piled against the tree trunk, nor should grass and weeds be permitted to grow within 8 or 10 inches of the tree. Directions regarding the protection of trees against rodents are given in Extension Bulletin 196, "*A Fruit Tree Coating Effective Against Cottontails*," and in an article reprinted from the Michigan Agricultural Experiment Station Quarterly Bulletin, Vol. 24, No. 1. Copies of these reports will be mailed on request to the Director, Michigan Agricultural Experiment Station, East Lansing.

FIRE LANES REDUCE FIRE HAZARD

Fires occasionally burn across orchards in sod; therefore it is a good policy to divide the orchard into sections by fire lanes so that the fire may be confined more easily. These lanes are made with a disk and are so located that they do not run up and down steep slopes where severe erosion might occur. It is not necessary to keep weeds from growing on them, provided they are disked into the soil whenever they become dry. In dry weather it is a good precaution to keep the sprayer full of water. Spray rigs have been found to be a very effective piece of fire fighting equipment.

