Pasture Improvement and Management

D. B. Johnstone-Wallace

CORNELL EXTENSION BULLETIN
Published by the New York State College of Agriculture
at Cornell University. Ithaca, N.Y.
L. R. Simons, Director of Extension Service

CONTENTS

PASTURE IMPROVEMENT AND MANAGEMENT

D. B. JOHNSTONE-WALLACE

"THE GREATEST agricultural resource of New York is its exceptional adaptation for the growth of grass. Yet the hay crop has received little attention and pastures have rarely received any care . . . . . It would certainly seem good policy to consider means of increasing the efficiency of our pastures."

This statement, made by the late Doctor G. F. Warren, appears in Cornell University Agricultural Experiment Station Bulletin 280, published in 1910.

As a result of research commenced in 1931 it is now possible to make recommendations concerning methods of fertilization and grazing management that will increase the efficiency of New York pastures. These recommendations are discussed in this bulletin.

THE TYPE OF PASTURE TO IMPROVE

AT CORNELL University good pastures are yielding annually from 4000 to 6000 pounds of dry matter to the acre, containing from 20 to 30 per cent of protein. Such yields are sufficient to justify the use of good land for pasture.

In the selection of fields for improvement, consideration should be given to their distance from the farm buildings, their accessibility to drinking water, and their adaptation for division into smaller fields to permit the adoption of a system of alternate grazing. Whenever possible fields should be selected that are sufficiently free from stones, stumps, and hummocks to permit close mowing.

Moderately level fields are desirable, and those sloping to the north and east are more productive during the hot summer months than are those sloping to the south and west, because lower soil temperatures are maintained. The best pasture land should be improved first, for after improvement has taken place much of the poorer land may not be needed.

Medium to heavy soils well supplied with moisture are better for pasture purposes than are the lighter and dryer soils.

Because of the importance of good grazing management involving periodical close grazing, it is essential to restrict improvement to an area that can be properly grazed with the stock available. As a rule, one acre

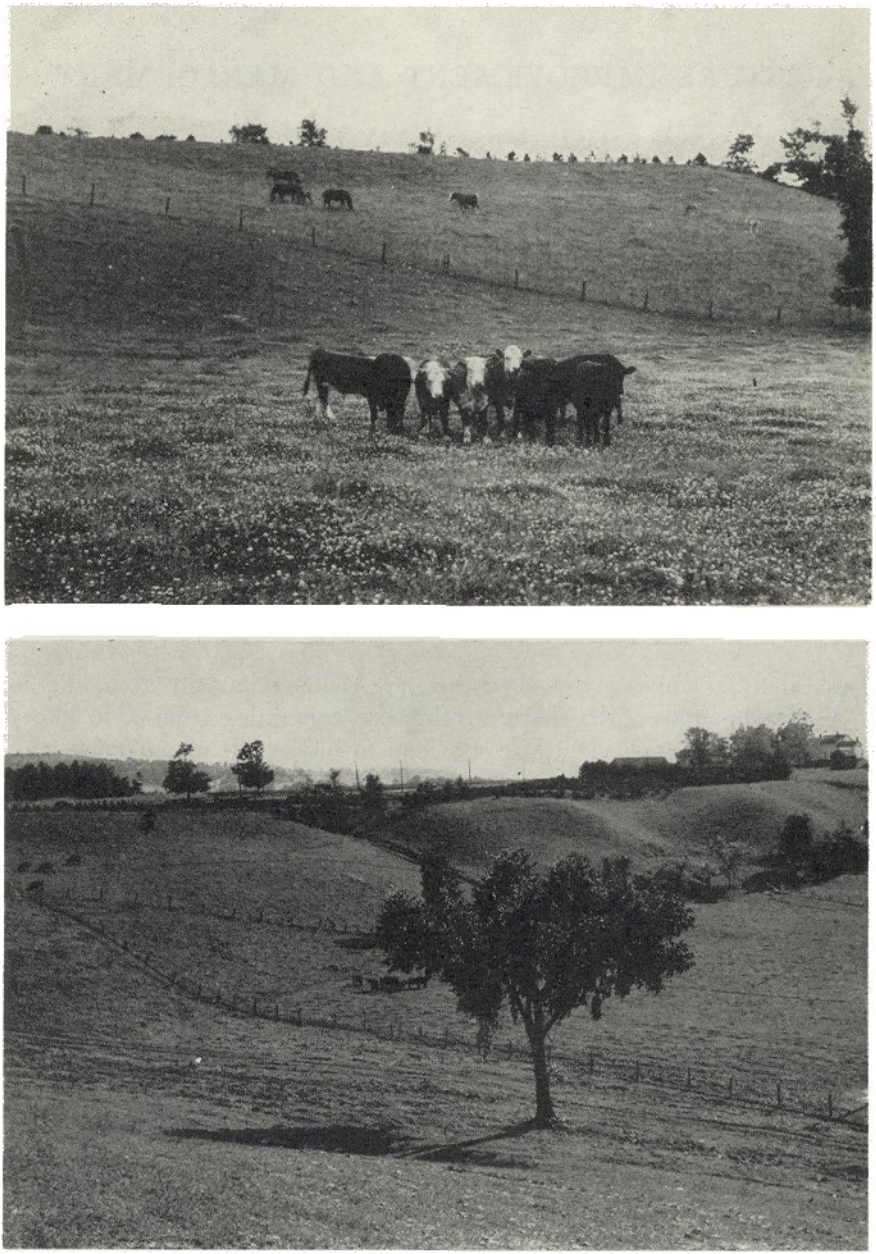

FIGURE 1. BEEF-CATTLE PASTURE AT CORNELL UNIVERSITY

The pasture has been improved by fertilization with superphosphate and by good grazing management. No plowing or seeding has been needed. This pasture carries the equivalent of one Aberdeen Angus cow and her calf per acre without supplementary feed during the grazing season of approximately six months

FIGURE 2. SWARD OF THE PASTURE SHOWN IN FIGURE 1

The herbage is at the ideal height for grazing. A botanical analysis of the herbage showed, by weight, Kentucky bluegrass 40 per cent, wild white clover 40 per cent, bent grasses 6 per cent, rough-stalked meadow grass 3 per cent, timothy 2 per cent, and weeds 10 per cent

of improved pasture is adequate for one cow or its equivalent during a grazing season of from five to six months.

Pasture improvement is not expensive, and on most New York farms the annual cost of fertilizer treatment need seldom exceed $2 for each cow or its equivalent maintained on the farm.

PASTURE FERTILIZATION

The need for phosphorus

THE FIRST essential in the improvement of pastures on all soils in New York State is an adequate application of available phosphorus. This can be supplied most economically at the present time in the form of superphosphate, but other effective forms of phosphorus may be used when obtainable at competitive prices.

The first application of phosphorus must be large enough to produce a vigorous growth of wild white clover and other pasture legumes, which play an extremely important part in pasture improvement. The application recommended is from 600 to 800 pounds of 20-per-cent superphosphate to the acre, or an equivalent quantity of any other grade. This should be repeated at intervals of about four years.

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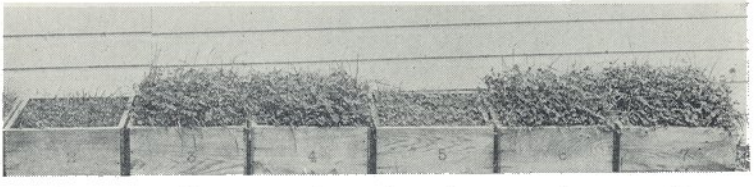


1 2 3 4 5 6

FIGURE 3. RESPONSE OF ONTARIO LOAM TO FERTILIZER TREATMENT

Top: A poverty-grass (*Danthonia spicata*) pasture in Herkimer County, on Ontario loam testing pH 6.4, that shows response to treatment when seeded with a non-legume, cultivated white mustard, and when seeded with a mixture of grasses and wild white clover

Center and bottom: 1, untreated; 2, complete treatment with nitrogen, phosphorus, potash, and lime; 3, complete except no potash; 4, complete except no phosphorus; 5, complete except no nitrogen; 6, complete except no lime

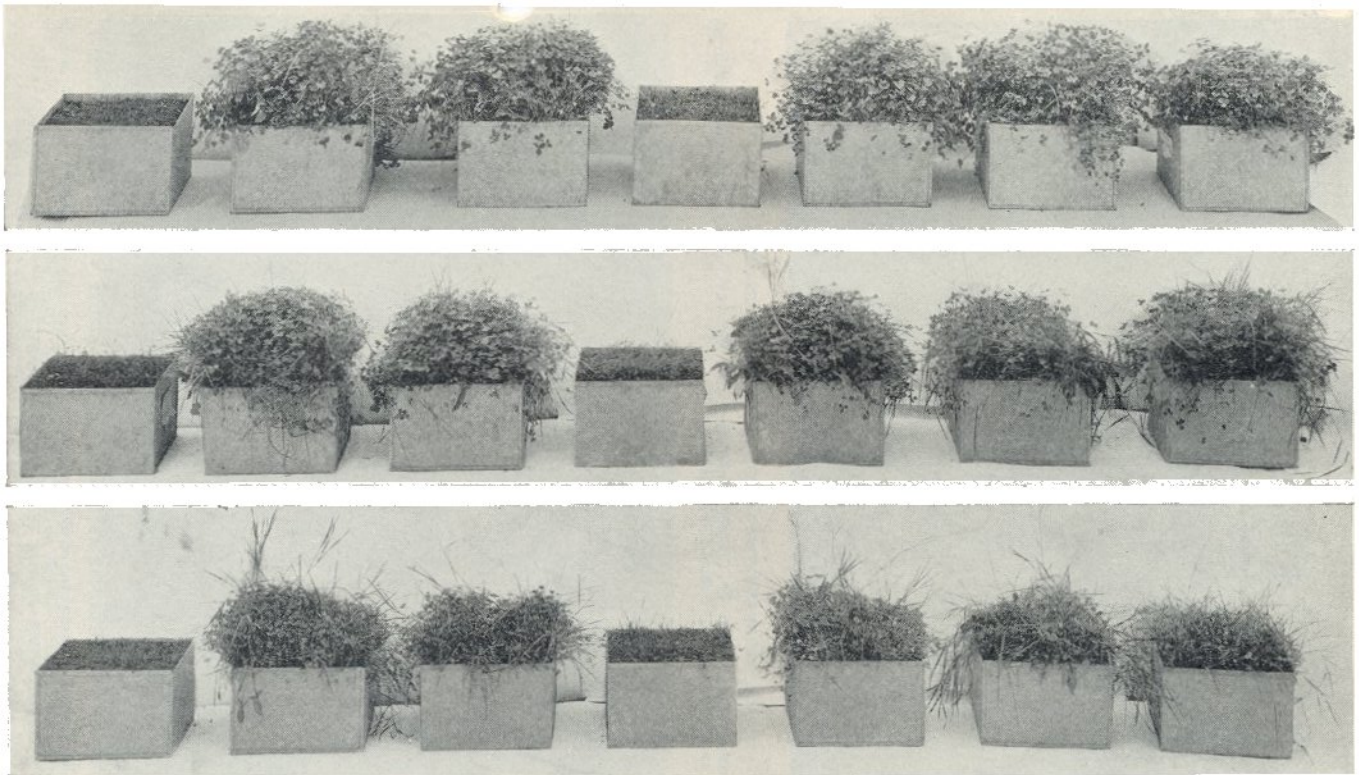


FIGURE 4. RESPONSE OF LANGFORD, WALTON, AND LACKAWANNA SILT LOAMS TO FERTILIZATION

The soils used in this experiment, reading from top of page to bottom, are Langford silt loam testing pH 5.5, Walton silt loam testing pH 5.2, and Lackawanna silt loam testing pH 4.8. Each box was seeded with a mixture of grasses and wild white clover. The treatments from left to right were:—1, untreated; 2, complete treatment with nitrogen, phosphorus, potash, and lime; 3, complete except no potash; 4, complete except no phosphorus; 5, complete except no nitrogen; 6, complete except no lime; 7, phosphorus only

FIGURE 5. A PASTURE BEFORE IMPROVEMENT

An untreated pasture plot at Cornell University that consists largely of devils paintbrush (*Hieracium aurantiacum*) and redtop (*Agrostis alba*)

FIGURE 6. THE SAME PASTURE AS THAT SHOWN IN FIGURE 5 AFTER FERTILIZATION

The fertilizer treatment consisted of 800 pounds of 16-per-cent superphosphate and 3000 pounds of ground limestone per acre, spread on the surface without either plowing or seeding. Note the development of New York white clover (*Trifolium repens* var.)

FIGURE 7. RESULT OF SEEDING WITHOUT FERTILIZER TREATMENT

This is the same pasture as that shown in figure 4. Poor results were obtained by plowing and seeding with the Cornell pasture mixture without any fertilizer treatment

FIGURE 8. RESULT OF SEEDING AND FERTILIZER TREATMENT

This is the same pasture as that shown in figure 7 after plowing, treatment with 800 pounds of 16-per-cent superphosphate and 3000 pounds of ground limestone per acre, and seeding with the Cornell pasture mixture

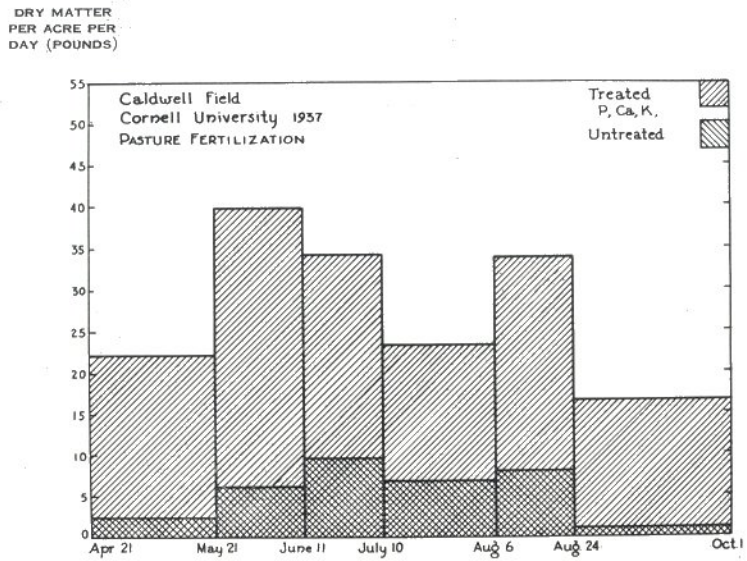


FIGURE 9. INFLUENCE OF FERTILIZER TREATMENT ON SEASONAL PRODUCTION OF PASTURE HERBAGE

This is a comparison of the seasonal productivity of treated and untreated pastures at Cornell University in 1937. The total column represents the yield of dry matter per acre per day during each period of a pasture treated with superphosphate, muriate of potash, and ground limestone, while the darkly shaded portion at the bottom of each column represents the yield from the untreated pasture

FIGURE 10. PASTURE IMPROVEMENT AND EROSION CONTROL

Right: An untreated pasture plot at Cornell University that shows thin sward which results in erosion and loss of water by runoff from the surface.

Left: A plot treated with superphosphate and lime that shows a development of protective sward of wild white clover. The rapid absorption of water by this plot resulted from the increased porosity of the soil brought about by the growth of roots and the activities of earthworms. The treated plot contained four times as many earthworms as did the untreated plot

Early fall applications are considered most satisfactory, but late fall and early spring applications are also successful.

The need for lime

Lime is second in importance to phosphorus in the treatment of New York pastures. The best condition for pasture growth is a soil that tests between pH 6 and pH 7. It is recommended that soils testing between pH 5 and pH 6 should receive an application of 2000 pounds of ground limestone to the acre, and that those testing below pH 5 should receive 3000 pounds. County agricultural agents in the State make such soil tests free of charge if requested to do so. Applications of limestone should be repeated usually at intervals of from four to eight years if further tests indicate the need.

The need for potash

New York pastures respond to potash less frequently than they do to phosphorus and lime. Potash deficiencies have been found most often on light sandy and gravelly soils and in fields that have been depleted in fertility by the removal of hay and other crops without adequate applications of manure or fertilizers containing potash. When potash is needed, it should be applied in the form of muriate of potash at the rate of about 100 pounds to the acre. This application may be repeated at intervals of about four years.

The need for nitrogen

The need for nitrogen in the improvement of New York pastures is usually as great as is the need for phosphorus. Fortunately, the nitrogen required can be supplied under New York conditions by encouraging the growth of pasture legumes by suitable fertilization and periodical close grazing. The most valuable legumes in New York pastures are wild white clover (*Trifolium repens* var.), wild birdsfoot trefoil (*Lotus corniculatus* var.), and yellow trefoil (*Medicago lupulina*). Of these, wild white clover is the most widely distributed and the most valuable. It is a wild form of the commercial white Dutch clover from which it differs by possessing smaller leaves and flowers, by flowering later, and, what is of greatest practical importance, by being a true perennial that remains permanently in the pasture sward; whereas plants produced from seed of commercial white Dutch clover behave like medium red clover and seldom survive more than two years.

Some extremely poor pastures contain no wild white clover or contain less than an average of one plant to the square yard evenly distributed. In these pastures it is advisable to introduce wild white clover into the sward by sowing 1 pound of seed to the acre in late March or early April.

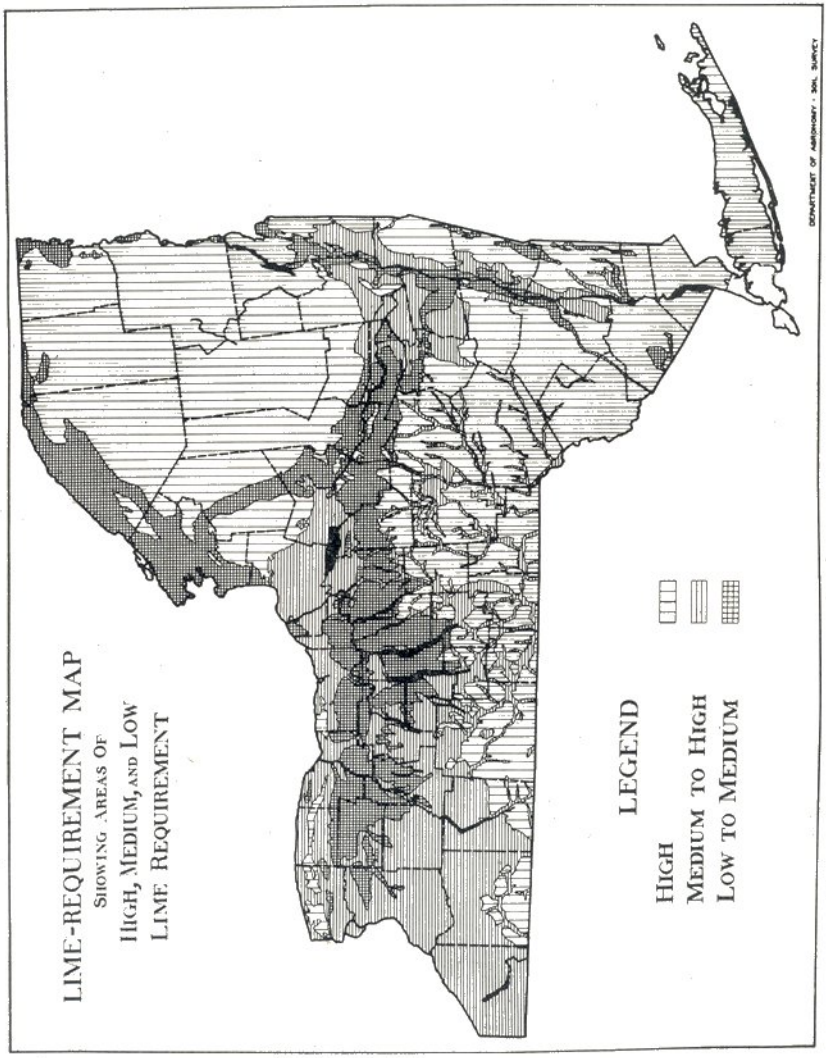


FIGURE 11. LIME REQUIREMENT OF SOILS IN DIFFERENT PARTS OF NEW YORK

The seed may be mixed with sand, soil, or granulated superphosphate to facilitate even distribution over the surface of the pasture, and sown from a wheelbarrow or cyclone type of seeder. If the seed is sown sufficiently early, harrowing is unnecessary; but the field may be rolled to advantage. The seed should be inoculated with the type of culture used for red clover.

Some pastures may be improved most effectively by plowing or harrowing, fertilizing, and reseeding as described under the establishment of new pastures by seeding (page 30).

The importance of wild white clover in New York pastures is indicated by the results of experiments at Cornell University, which have shown that the addition of 2 pounds to the acre of wild white clover to a seeding of 24 pounds to the acre of Kentucky bluegrass has frequently increased the yield of dry matter by more than 500 per cent, while the content of protein and lime in the herbage has also been raised considerably. The amount of nitrogen supplied by the growth of wild white clover is so great that the herbage removed from an acre of good pasture at Cornell University in a grazing season usually contains nitrogen equivalent to from 1000 to 1500 pounds of sulfate of ammonia to the acre.

In addition to supplying nitrogen, wild white clover, because of the dense sward produced, results in lower and more uniform soil temperatures during the summer months than those in pastures with no clover. This leads to greater productivity. The dense sward also prevents erosion and loss of water by runoff from the surface during heavy rains. Wild white clover is so palatable that the pastures are grazed close and uniformly and weeds are suppressed.

New York wild birdsfoot trefoil is a highly productive perennial legume with a deep taproot. Attention was first directed to the value of this plant for pasture purposes as a result of its discovery by the author near Claverack in Columbia County during a pasture survey made in 1934. Since then it has been found in other extensive areas in the State, especially in Albany, Schenectady, Schoharie, Saratoga, Montgomery, Ulster, and Washington Counties. It frequently contributes more than 50 per cent of the herbage, and is valuable because of its productivity, palatability, and drought resistance.

Experiments with wild birdsfoot trefoil at Cornell University are giving promising results, and it has been found especially valuable because of its ability to continue rapid growth during periods of hot dry weather.

The New York wild variety has been found to differ considerably in habit of growth from the European cultivated variety and the English wild variety, both of which have been obtainable commercially. Because

FIGURE 12. AN UNTREATED POVERTY-GRASS PASTURE ON VOLUSIA SILT LOAM AT THE VIRGIL EXPERIMENTAL FIELD IN CORTLAND COUNTY

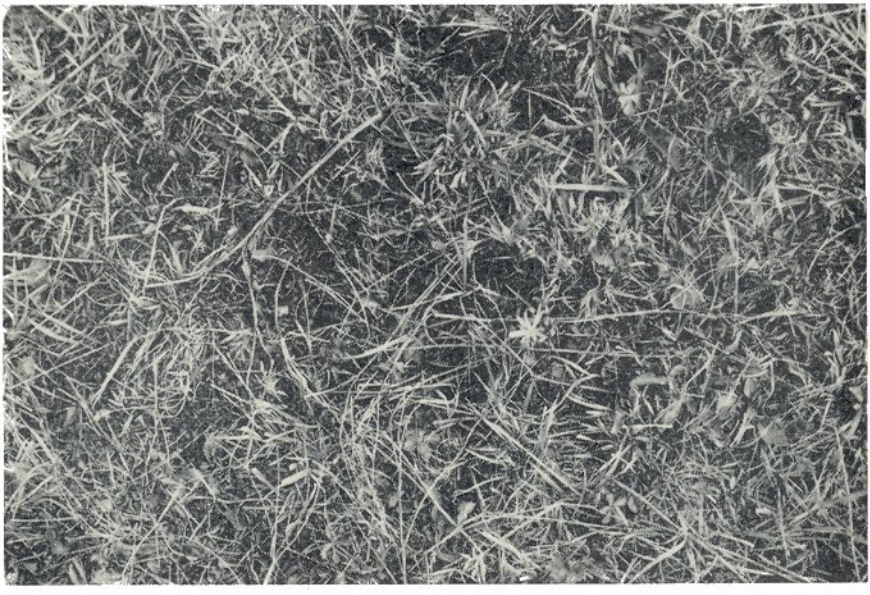


FIGURE 13. THE SAME PASTURE AS THAT SHOWN IN FIGURE 12 AFTER FERTILIZATION WITH SUPERPHOSPHATE
This pasture showed no response to superphosphate

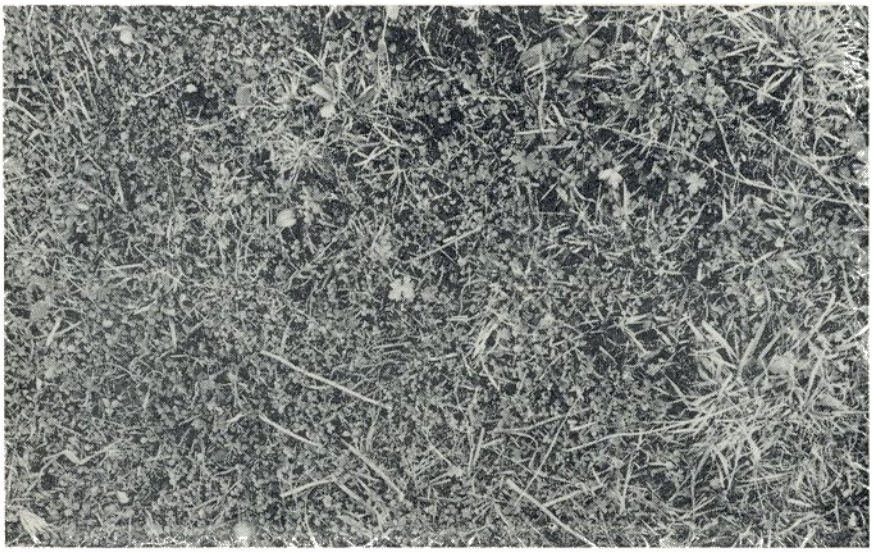


FIGURE 14. THE SAME PASTURE AS THAT SHOWN IN FIGURE 12 AFTER FERTILIZATION WITH SUPERPHOSPHATE AND A SEEDING OF WILD WHITE CLOVER
Wild white clover was sown on the surface in early spring at the rate of 1 pound of seed to the acre

of the superiority of the New York variety, farmers in the State have been advised to harvest supplies of seed. A considerable amount has been produced in Albany County.

Yellow trefoil, although less valuable than wild white clover and birdsfoot trefoil, is a useful constituent of many New York pastures. It maintains itself in the pasture sward by seeding profusely even under close grazing conditions.

If the nitrogen required by New York pastures is not supplied through pasture legumes, the only alternative is to use fertilizers containing nitrogen or to make applications of manure. It is only under very exceptional circumstances that the high cost of the annual applications of nitrogenous fertilizers required when insufficient legumes are available, can be justified under New York conditions.

The need for manure

Applications of manure are especially beneficial to those pastures with thin swards that are on soils deficient in organic matter. Unfortunately, manure discourages stock from grazing pasture herbage, and unless precautions are taken more harm than good may result. In order to use manure to advantage, light dressings of from 8 to 10 tons to the acre should be applied in the fall to the whole of one field rather than to part

FIGURE 15. A SINGLE PLANT OF WILD WHITE CLOVER, SHOWING TAPROOT, CREEPING STEMS ROOTING AT NODES, AND NODULES

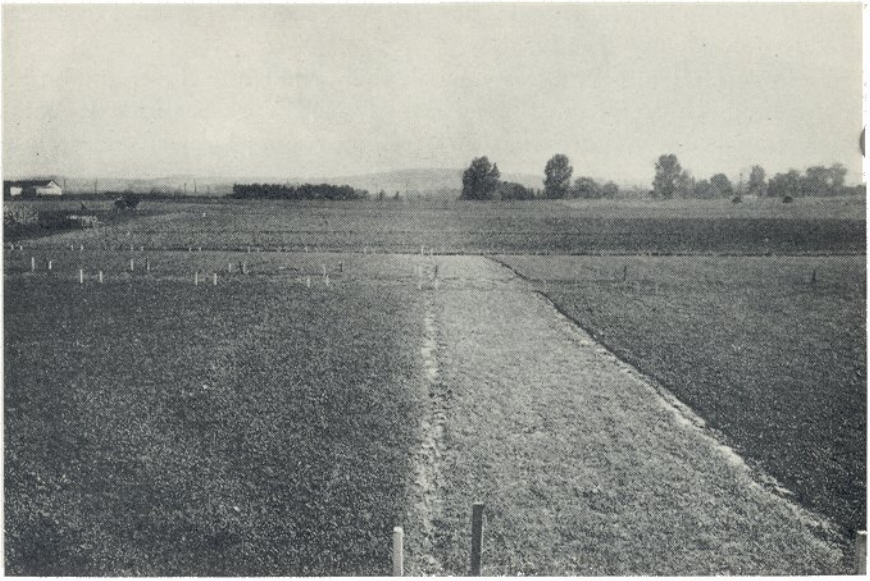


FIGURE 16. KENTUCKY BLUEGRASS AND WILD WHITE CLOVER

Left: A plot of Kentucky bluegrass and wild white clover grown together. Right: A plot of Kentucky bluegrass grown alone. Note the difference in color and in amount of herbage

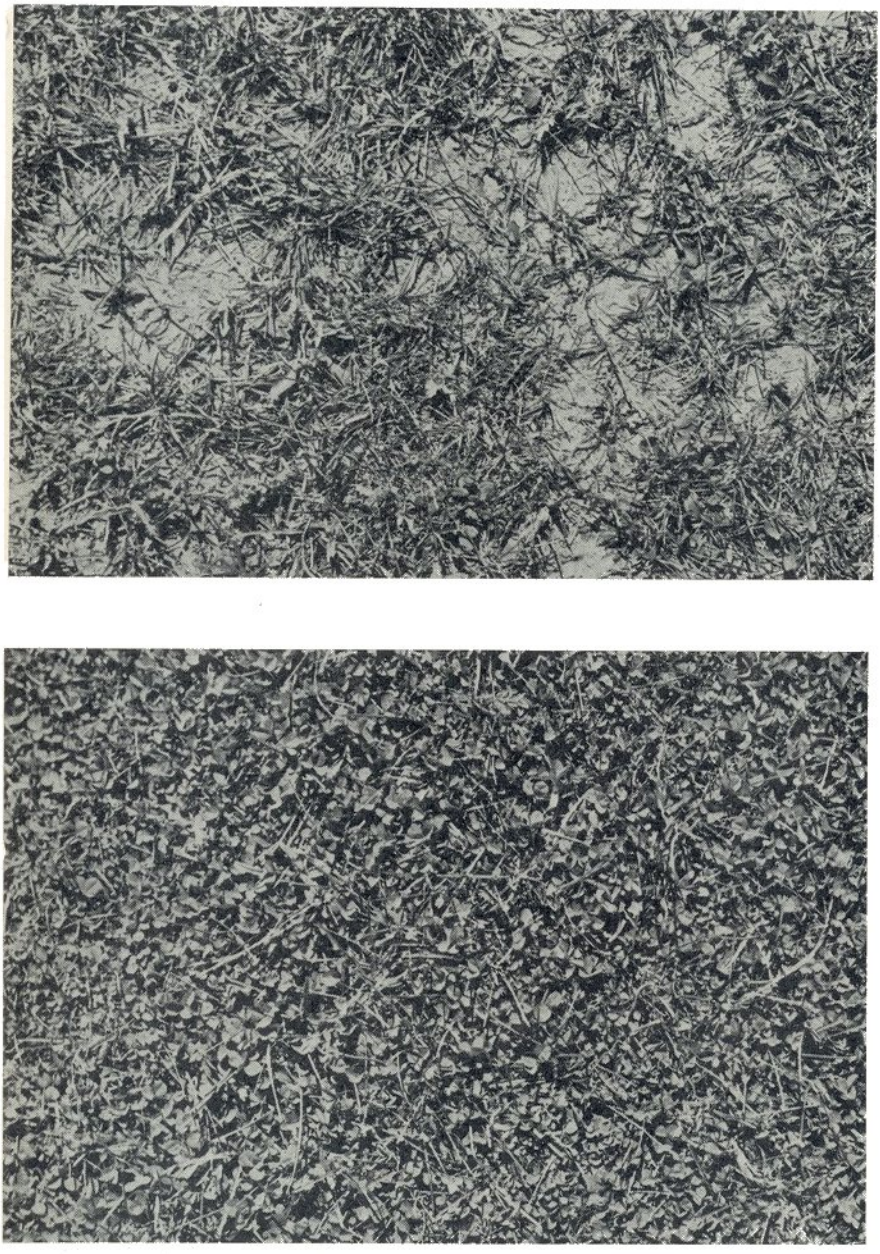


FIGURE 17. INFLUENCE OF WILD WHITE CLOVER ON KENTUCKY BLUEGRASS

Top: A thin sward of Kentucky bluegrass grown alone, showing pale color, bare soil, and encroachment of weeds

Bottom: A dense sward of Kentucky bluegrass and wild white clover, showing dark color, due to nitrogen, and thick cover which influences soil temperatures and water absorption

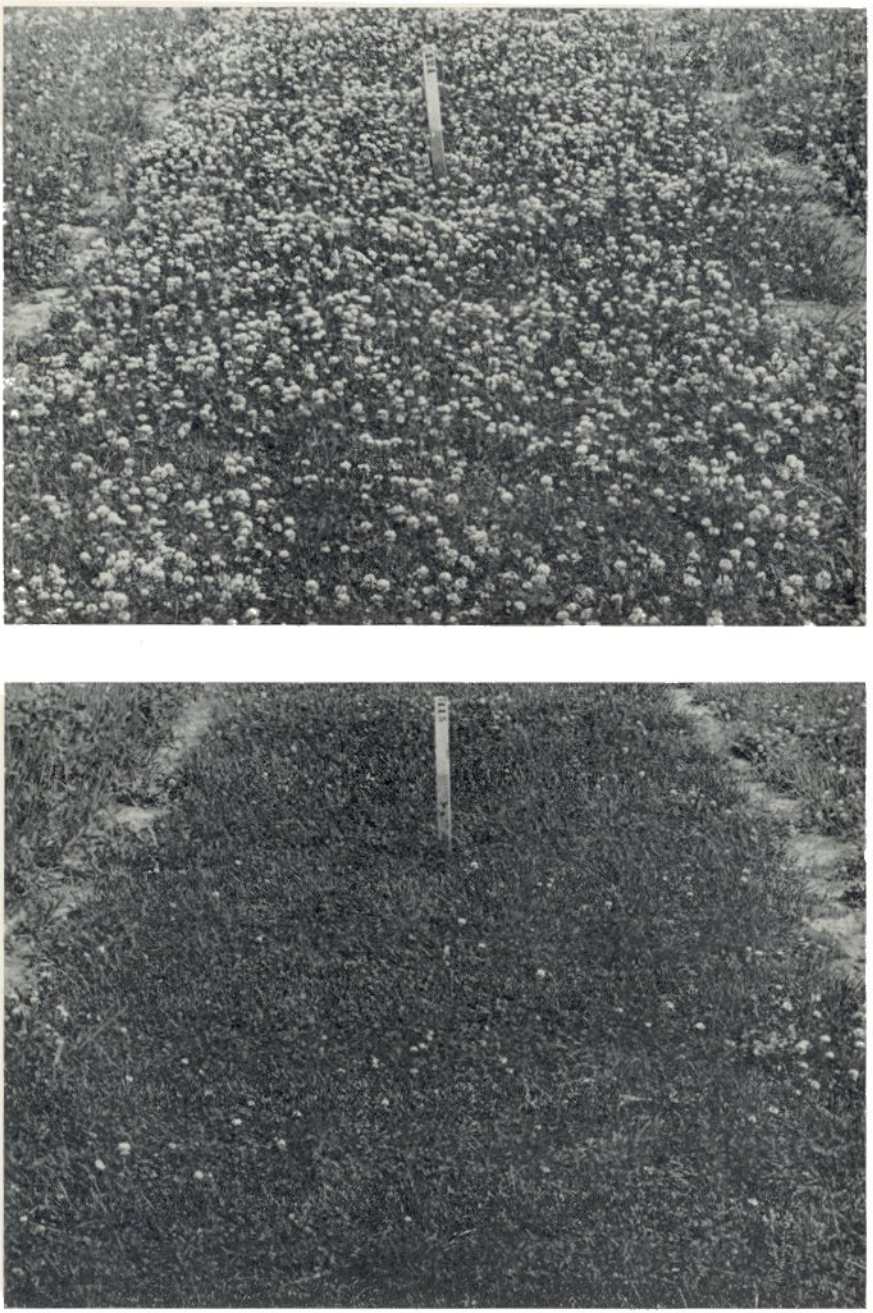


FIGURE 18. WHITE DUTCH CLOVER AND WILD WHITE CLOVER

Top: White Dutch clover, first year. Note the early flowering habit and the large leaves and flowers

Bottom: Kent wild white clover, first year. Note the late flowering habit and the small leaves and flowers

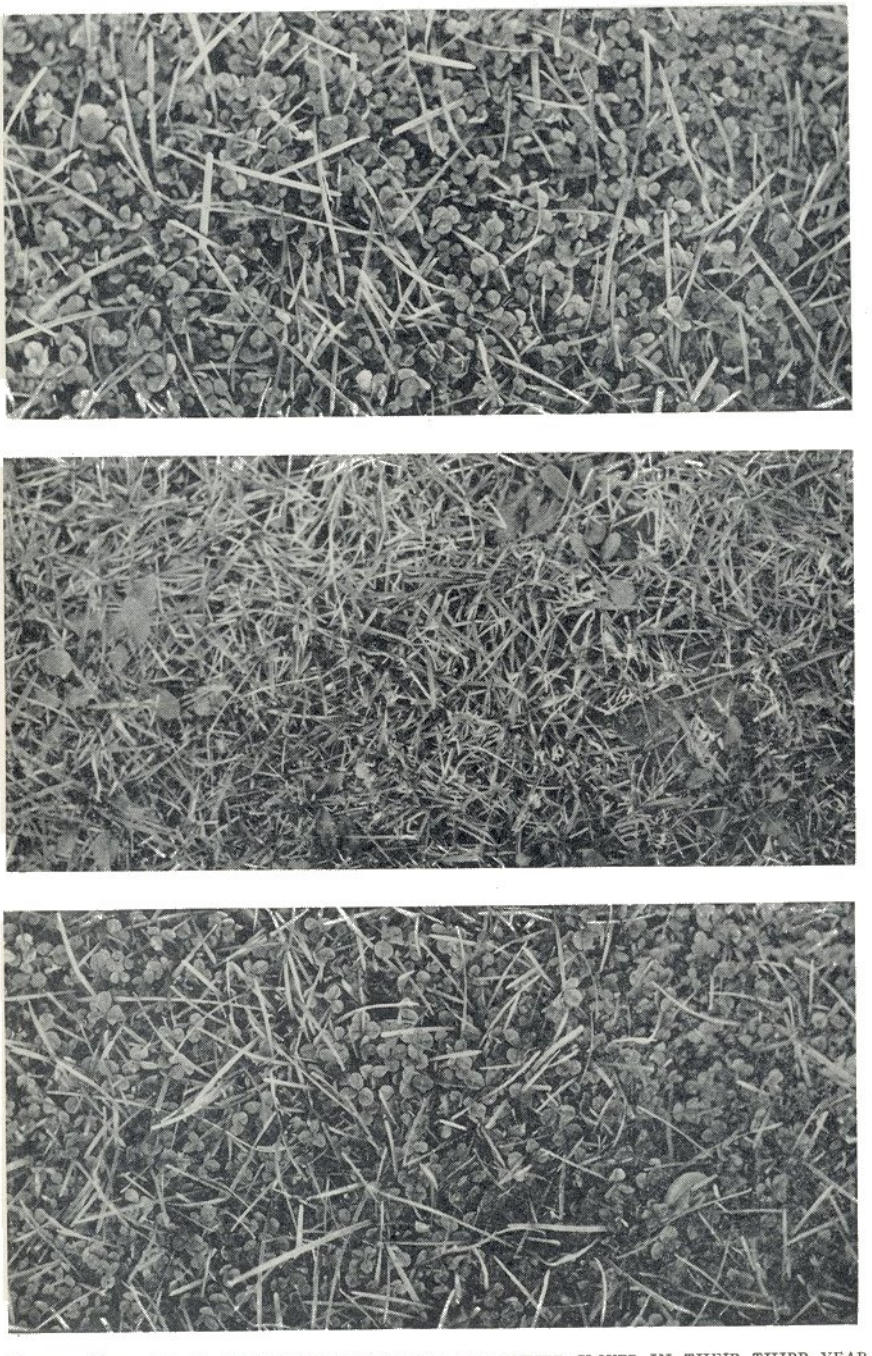
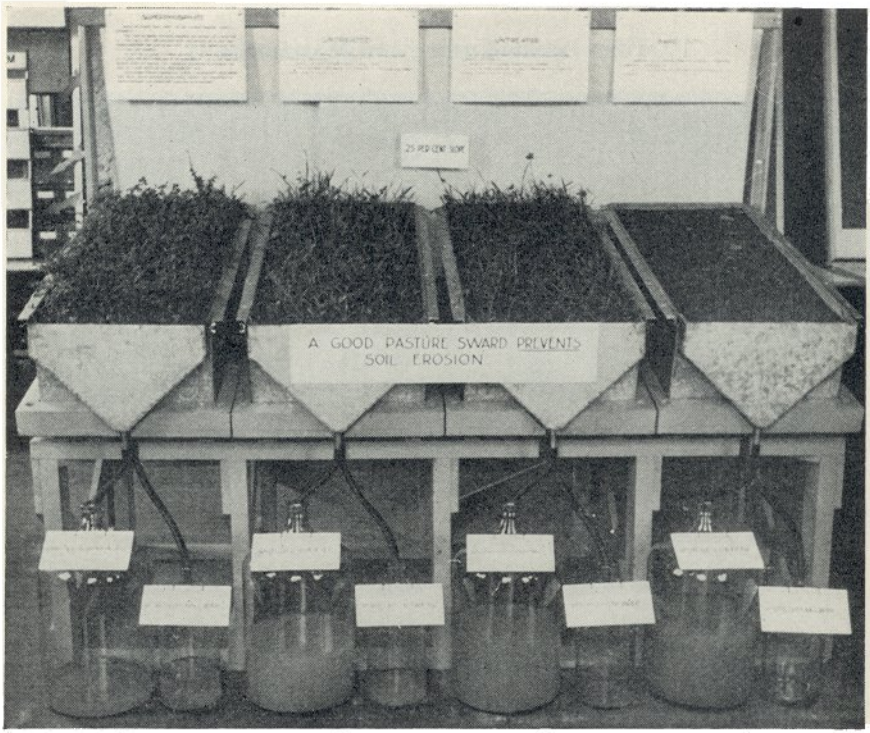


FIGURE 19. PLOTS OF KENTUCKY BLUEGRASS AND WHITE CLOVER IN THEIR THIRD YEAR
Top: Kent wild white clover
Center: Commercial white Dutch clover
Bottom: New York wild white clover
Note the persistance of wild white clover in comparison with white Dutch clover



1 2 3 4

FIGURE 20. EFFECT OF PASTURE IMPROVEMENT IN PREVENTING SOIL EROSION AND IN INCREASING ABSORPTION OF WATER BY THE SOIL

1, Pasture treated with superphosphate; 2 and 3, pasture untreated; 4, soil from same field but without protective turf

This exhibit, staged during Cornell Farm and Home Week in February 1935, shows the loss of water and soil by runoff from the surface (large bottle) and by percolation (small bottle) after the application of water equivalent to ½ inch of rain per day for 5 days, on a 25-per-cent slope

FIGURE 21. METHOD OF DETERMINING LOSS OF WATER BY RUNOFF FROM THE SURFACE

These are the pasture experimental plots at the Soil Conservation Service Experiment Station in the Arnot Forest near Ithaca, New York

FIGURE 22. A NEW YORK WILD-BIRDSFOOT-TREFOIL PASTURE ON HUDSON SILT LOAM IN COLUMBIA COUNTY

New York wild birdsfoot trefoil (*Lotus corniculatus* var.) is of value because of its perennial character and its drought resistance

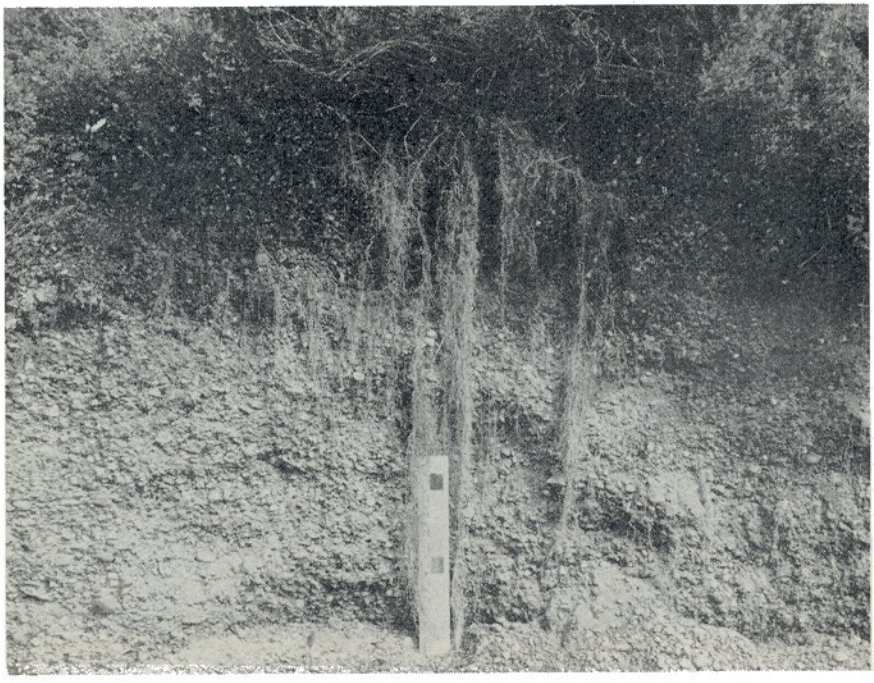


FIGURE 23. THE ROOT SYSTEM OF NEW YORK WILD BIRDSFOOT TREFOIL
This wild birdsfoot trefoil, growing on the edge of a gravel pit in Albany County, New York, shows the extensive root system that makes the legume resistant to drought

only. The manure should be supplemented with superphosphate, and any herbage left ungrazed in late May or early June should be cut as closely as possible with a mowing machine.

PASTURE MANAGEMENT

Grazing

GOOD PASTURE management means a system of fertilization and grazing that makes it possible for an animal to consume, during *each day of the grazing season*, the maximum amount of feed of a chemical composition suitable for the maintenance of health and conditions and for the production of milk, meat, wool, bone, or other product desired.

A good cow under the most favorable conditions is able to consume about 150 pounds of green pasture herbage in a day. This task must be accomplished with a "mowing" apparatus about 3 inches in width. Cows spend only about 8 of the 24 hours in actual grazing, the remaining 16 hours are spent resting and chewing the cud.

A heap containing 150 pounds of green grass covers a circle nearly 6

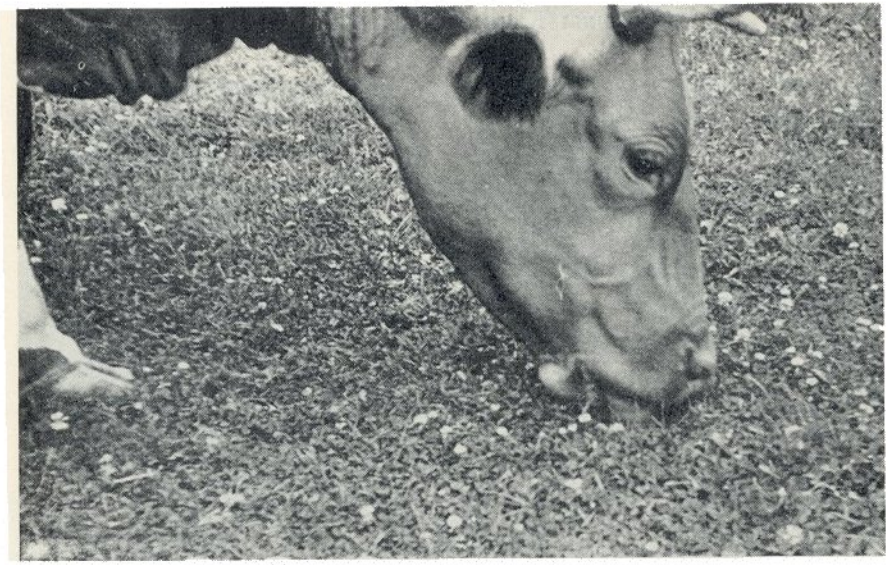


FIGURE 24. A COW GRAZING ON AN IMPROVED PASTURE

The nose of a good cow in a good pasture tells much about grazing management. Grazing management is as important as fertilization in pasture improvement

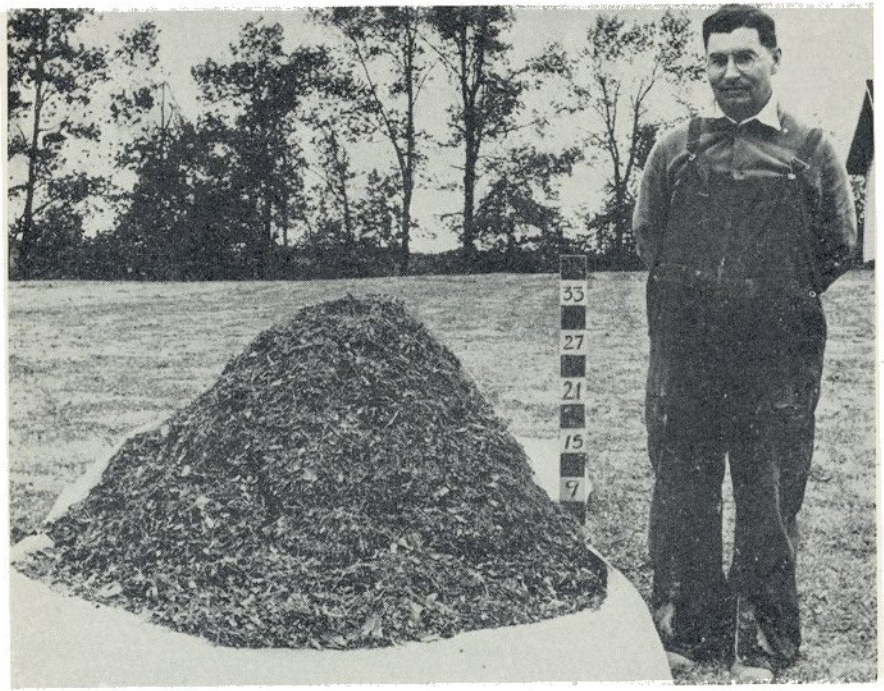


FIGURE 25. AMOUNT OF PASTURE HERBAGE GRAZED IN A DAY BY ONE COW

A good cow in a good pasture under ideal conditions may consume in a day about 150 pounds of green herbage containing about 30 pounds of dry matter. This is enough to maintain a cow in good condition while producing from 30 to 50 pounds of milk a day. The gathering of this amount of grass with a mowing apparatus approximately 3 inches in width, in a working day of 8 hours, is only possible in pastures similar to those shown in figures 2, 6, 8, 26, and 35. It is not possible in pastures similar to those shown in figures 5, 7, and 27

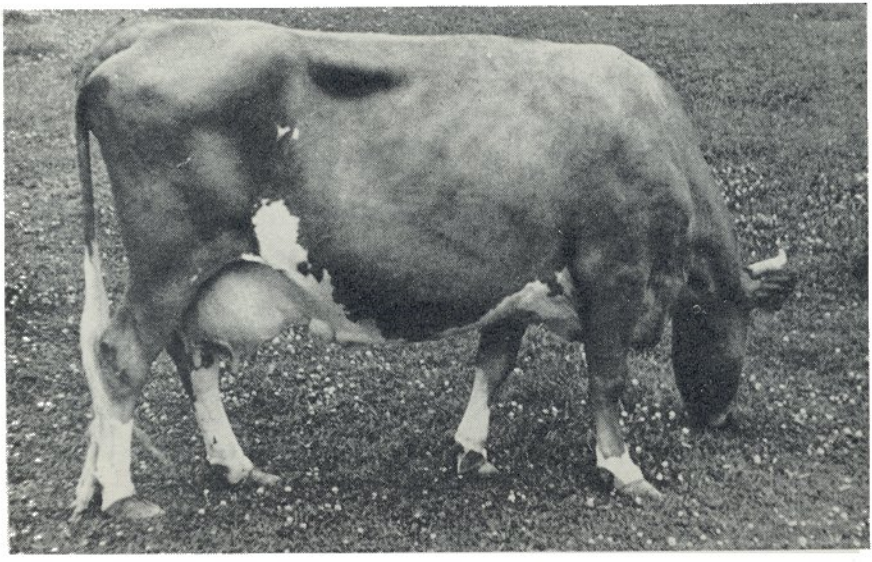


FIGURE 26. A COW GATHERING HERBAGE

Cows select short, leafy, pasture herbage high in protein and low in indigestible fiber in preference to old tall herbage. Under ideal conditions the herbage is gathered rapidly as the animal walks slowly forward with her head moving from side to side. About one third of the day is spent in actual grazing and two thirds in resting and chewing the cud. As much grazing is done during the night as during the day

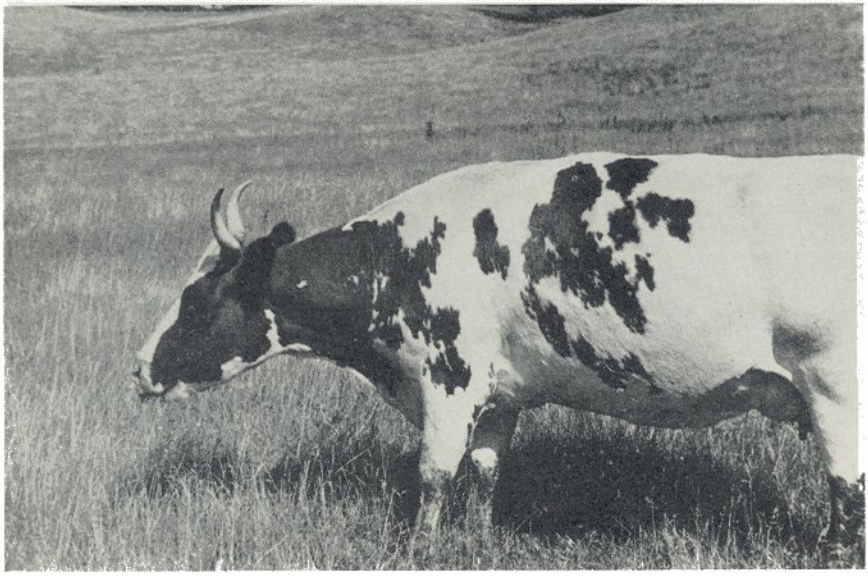


FIGURE 27. A COW GRAZING IN A POOR PASTURE

A typical badly managed pasture showing how difficult it is for a cow to gather the herbage required. Compare this method of grazing with that shown in figure 26

feet in diameter and 3 feet high in the center. It is evident that such a quantity of herbage can be gathered by a cow in 8 hours only when the sward is dense and at a height that permits rapid collection. Observations made of grazing cattle indicate that a height of about 4 inches closely approaches the ideal.

Since cattle spend as much time in grazing during the night as during the day, equally good pasture should be provided for each period.

As an aid to good grazing management, the pasture area should be divided into from three to eight enclosures, each with independent access to drinking water. These enclosures should be grazed alternately. The cost of fencing may be reduced to a minimum by the use of a safe type of electric fence.

FIGURE 28. SELECTIVE GRAZING

Cattle refuse to graze luxuriant herbage growing where droppings have fallen, but they will eat the herbage if it is handed to them or placed on the ground a short distance from the place on which it grew. The odor associated with the droppings appears to be the cause for this. Horses will graze much of the herbage left by the cattle under a system of alternate grazing

On dairy farms, the most satisfactory procedure is to turn the stock out to pasture early in the grazing season as soon as the herbage has reached a height of about 3 inches, provided the ground is sufficiently dry to prevent excessive injury to the turf and provided weather conditions are favorable. In most of New York in a normal season this means during the first week in May. When a system of alternate grazing is followed, the milch cows should be allowed access to the first field and should remain there as long as the herbage is sufficient for them to consume nearly the maximum amount each day. The milch cows should next be removed into the second field, and the dry cows and the young stock should be allowed to graze the first field as closely as possible. This procedure should be followed with each field.

Mowing

When the dry cows and the young stock are removed, the herbage growing where droppings were deposited during the previous year or earlier in the season, is usually still ungrazed. Horses may be turned into the field for a short time as they will graze much of the herbage left by the cattle. If there are no horses, the ungrazed herbage should be cut as closely as possible with a mowing machine. Mowing is particularly important in late May or early June. In well-managed pastures, one mowing a year is usually sufficient; but in some, several mowings are

FIGURE 29. MOWING THE PASTURE

The mowing machine is the most important aid to good grazing management. Pastures should be mowed closely in early June and again later if necessary

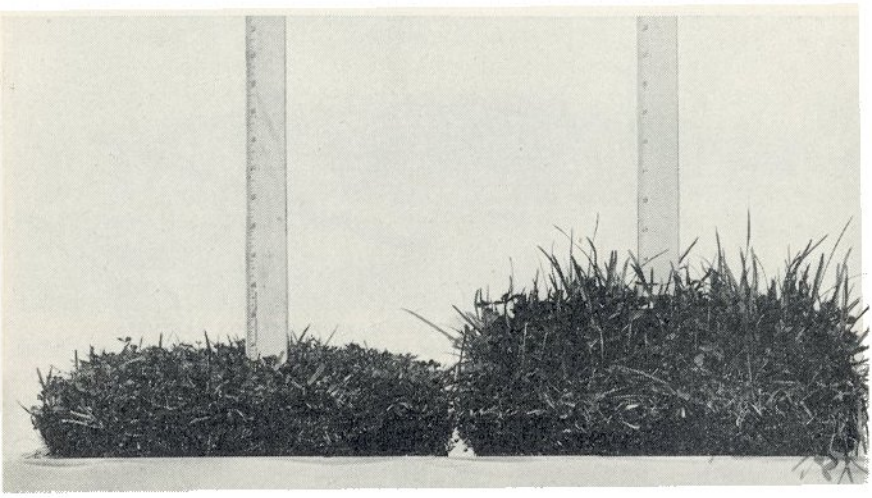


FIGURE 30. TURF FROM A PASTURE THAT IS GRAZED UNDER A SYSTEM OF ALTERNATE GRAZING

Right: Condition of herbage when the cattle are turned in the pasture. The herbage is approximately 4 inches high

Left: Condition of herbage when grazing is completed and a rest period is commencing. The herbage has been grazed to a height of about ½ inch. Approximately one week of grazing is followed by a rest period of three or four weeks

required. Mowing should be done while the livestock still occupy the pasture, as the herbage when moved away from the place on which it grew is usually eaten readily. Failure to graze where droppings have been deposited appears to be associated with the odor. Grazing animals seldom consume herbage growing where droppings from their own kind have fallen, but they may graze readily when the droppings are from other kinds of grazing animals. It is largely for this reason that mixed grazing leads to the more efficient use of pasture.

After each field has been closely grazed, and mowed when necessary, the average height of the herbage should be little more than ½ inch. When this stage has been reached, the field should "rest" until the herbage has again reached a desirable grazing height; this period is usually from two to four weeks.

Harrowing

The use of a flexible grass harrow at least once during the grazing season is helpful, for it scatters the cattle droppings so that they are beneficial over a large area rather than harmful on a small area. At the same time more even grazing results, and the need for mowing is reduced. Under a system of alternate grazing, droppings may be scattered with advantage after each field has been grazed, but considerations of the

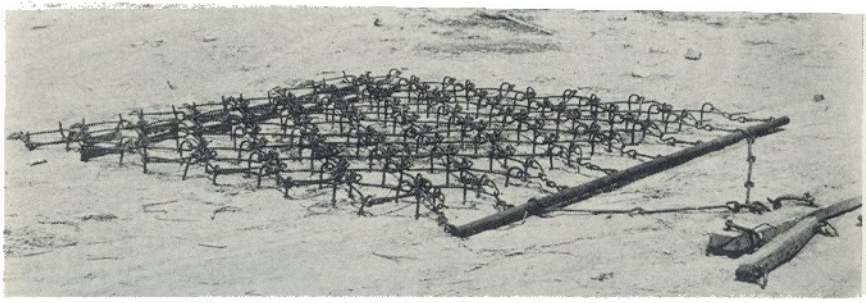


FIGURE 31. A SPECIAL FLEXIBLE GRASS HARROW USED ON PASTURES
The scattering of droppings periodically is an aid to good pasture management. A special flexible grass harrow similar to that shown does the work most effectively

FIGURE 32. A HOMEMADE GRASS HARROW
A good substitute for a flexible grass harrow can be made from discarded automobile rims

expense involved may make it advisable to harrow only once during the grazing season. September is the most suitable time for this operation. Under New York conditions harrowing in early spring brings stones to the surface and pulls out valuable plants that have been partially heaved out during the winter.

Rolling

The use of a smooth roller very early in the spring is helpful. It reduces injury caused by heaving, presses back stones, and makes the ground more even so that close grazing and mowing are possible. A tractor fitted with broad wood-covered wheels has been found useful for this purpose at Cornell University.

Although pasture does grow during most of October, the rate of growth slows up rapidly during the month. In order to reduce winter injury and to provide conditions favorable for early spring growth, it is

advisable in early October to stop grazing pastures that have been closely grazed, so that a growth of about 3 inches may be made and root reserves stored before winter. Pastures that have not been grazed closely may be stocked considerably later than closely grazed pastures, as it is advantageous to remove as much of the old herbage as possible after growth has ceased in order to provide more favorable conditions for grazing in the following year.

Control of thornbush encroachments

Encroachments of wild thorn, wild apple, brier rose, blackberry, hardhack, and other trees and shrubs, are usually associated with a low level of fertility and with bad grazing management. Effective control measures consist of cutting the bushes to ground level or pulling them out, and fertilizing and grazing the pasture as previously suggested (pages 5 and 25). Stock will graze the young shoots along with the other herbage, and the plants are soon destroyed by this treatment.

Drainage of pastures

The expense of tile draining can seldom be justified in New York pastures. Improvement in the drainage may be made by opening existing water courses and by using tile in the excessively wet spots. Increasing

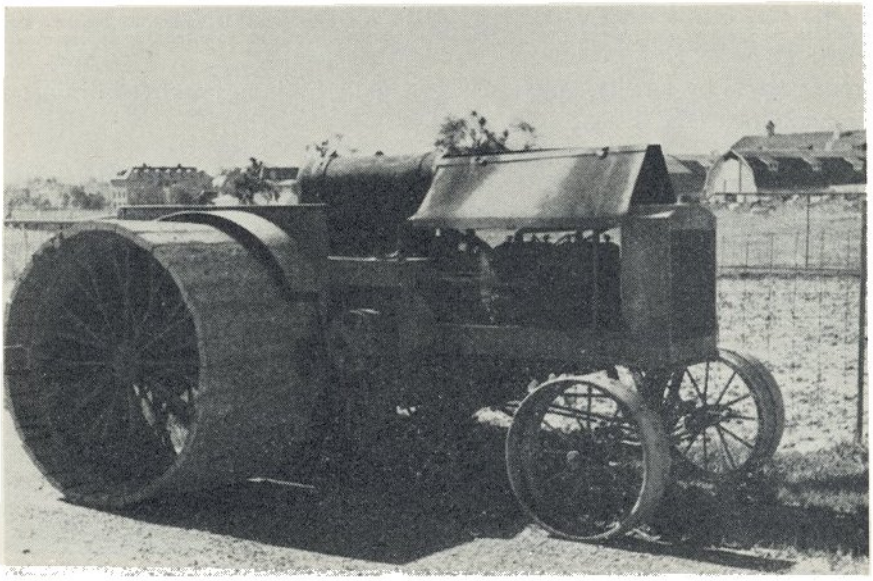


FIGURE 33. ROLLING A PASTURE

Rolling is an aid to good grazing management if done very early in the spring. It reduces the injury caused by winter heaving, presses in stones and hummocks, and facilitates close mowing and even grazing. A tractor fitted with broad wood-covered wheels, as shown, permits rolling to be done in early April when the ground is still soft

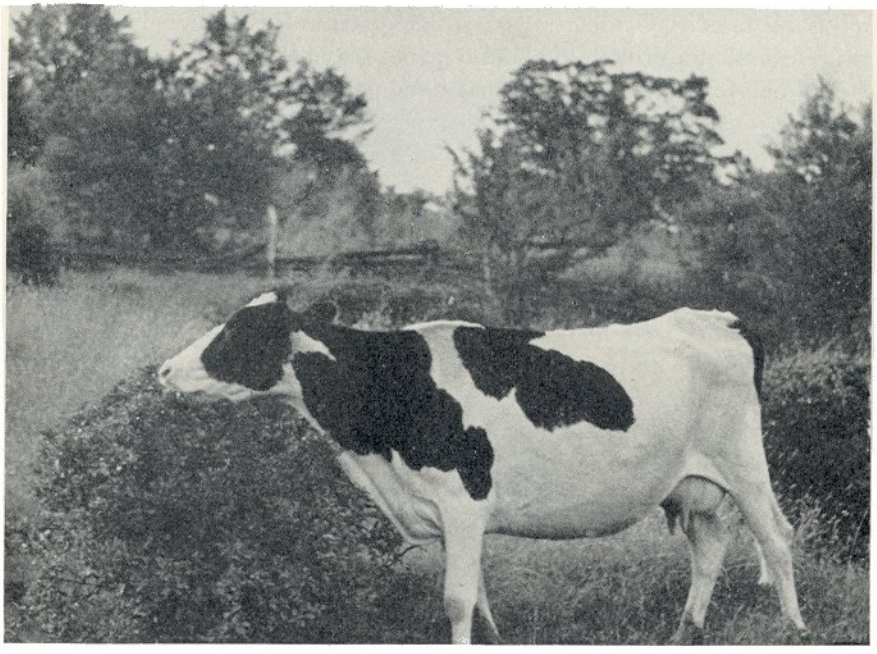


FIGURE 34. CONTROLLING THORNBUSHES

The young shoots of thornbushes and wild apple are grazed by cattle. If bushes are removed and pastures are properly fertilized and grazed, the young shoots are eaten soon after they appear above-ground and the plants are thus destroyed

root growth by fertilizer treatment gradually leads to improved drainage in many fields.

ESTABLISHMENT OF NEW PASTURES BY SEEDING

PASTURE improvement can usually be accomplished satisfactorily and with least expense by the fertilization of the existing sward without plowing or seeding, and by good grazing management.

In order to establish the most productive type of pasture and to improve exceptionally poor pastures, however, the combination of plowing or harrowing, fertilizer and lime treatment, seeding with a suitable seed mixture, and good grazing management, is recommended.

The fine tilth and firm seedbed required can usually be prepared most satisfactorily by plowing in the fall and harrowing in the spring. Sometimes it is advisable to crop old pasture land for a year or more previous to seeding. Very poor pastures on thin soils may give better results if the seedbed is prepared by harrowing only, to prevent bringing the subsoil to the surface.

Fertilizer treatment is essential, and the recommendations previously made (page 5) should be followed. Poor soils deficient in organic

matter may also receive an application of manure. If this is not available, an application of nitrate of soda at the rate of 100 pounds to the acre helps to establish the seedlings rapidly.

Seeding should be done as early as possible in April or May, and the best results are obtained when no nurse crop is used. A fine tilth should be prepared by harrowing. The field may then be rolled with a cultipacker and the seed sown evenly over the surface with a suitable wheelbarrow seeder. The ideal depth of cover for the seeds is about ¼ inch, so the field should be lightly harrowed with a flexible grass harrow or worked with a plank drag or weeder. Covering seed too deeply often causes failure. It is important to control weeds by mowing when necessary between May and July. By this time the growth should be sufficient to permit occasional grazing during the remainder of the season. This treatment encourages the development of a dense sward of wild white clover. If seeding cannot be done before the end of May, it is advisable to postpone it until late

FIGURE 35. A DENSE LEAFY SWARD—THE OBJECT OF PASTURE IMPROVEMENT

The ideal at which to aim is a dense leafy sward about 4 inches in height and consisting of wild white clover and pasture strains of the most valuable grasses. Under good grazing management such a pasture should enable a grazing animal to consume the maximum amount of herbage during each day of the grazing season. The sward shown was produced at Cornell University with the aid of the Cornell pasture mixture

August. Grasses usually do well when seeded at this time, but clovers are sometimes injured during the winter.

The Cornell pasture mixture has been developed as a result of experiments at Cornell University and of experience obtained throughout the State. It has been designed with the object of producing a uniformly high yield of nutritious herbage throughout a grazing season of about six months. It is adapted only for soils adequately supplied with fertilizer and lime and for fields that will be properly grazed.

The Cornell pasture mixture for 1938[1]

	Pounds to the acre
Kentucky bluegrass (*Poa pratensis*)	8
Canada bluegrass (*Poa compressa*)	2
Rough-stalked meadow grass (*Poa trivialis*)	1
Timothy (*Phleum pratense*)	6
Perennial ryegrass (*Lolium perenne*)	5
Yellow trefoil (*Medicago lupulina*)	2
Wild white clover (*Trifolium repens* var.)	1
Total	25

It is recommended that seed of New York wild birdsfoot trefoil (*Lotus corniculatus* var.) should be substituted for all or part of the yellow trefoil, especially in fields subject to drought, provided conditions justify the increased cost of the mixture.

The selection of the strains of each constituent used in the mixture is of great importance, and the following are suggested in order of preference, based on experiments at Cornell University. The use of several strains of each constituent helps to provide uniform growth throughout the grazing season.

Perennial ryegrass

Swedish Svalof Victoria
Norwegian Jaedersk
Danish E. F. 79

These varieties have been found to be sufficiently winter hardy and truly perennial under Cornell University conditions.

Timothy

Aberystwyth pasture S. 50

[1]One should consult his county agricultural agent concerning changes which may be made in this mixture in the future as a result of experimental work in progress and for sources of the seeds specified.
Information concerning mixtures adapted to special local conditions may be obtained from the Department of Agronomy, at Cornell University, Ithaca, New York.

Corstorphine pasture C. B. 191
Aberystwyth pasture-hay S. 48
Cornell hay 1777

The two pasture types (Aberystwyth pasture S. 50 and Corstorphine pasture C. B. 191) are of special value because of their creeping habit of growth, which results in the production of a close sward and in the persistence of the plants under grazing conditions. Unfortunately, seed supplies are not plentiful. If improved strains are unobtainable, commercial timothy should be used.

Wild white clover

Kent old pasture
New York old pasture

Seed of these strains grown in New York should be certified by the New York Seed Improvement Association. Seed grown in England should be certified as Grade A or Grade B by the Ministry of Agriculture. Uncertified seed should only be accepted if it has been examined and approved by the Division of Seed Investigations, at Geneva, New York. This applies also to seed of strains of perennial ryegrass, timothy, and birdsfoot trefoil.

Other constituents

Commercial strains of Kentucky bluegrass, Canada bluegrass, rough-stalked meadow grass, and yellow trefoil should be used, as improved strains are not yet available.

Inoculation

The legume seeds included in the Cornell pasture mixture should be inoculated when sown in fields that have not grown similar legumes previously. The inoculation culture required for wild white clover is the same as that used for red clover. Yellow trefoil requires the same type of culture as that used for alfalfa. Birdsfoot trefoil requires a special culture obtainable from the Department of Agronomy at Cornell University. It should not be sown without inoculation.

PROVISION FOR ADDITIONAL GRAZING IN JULY, AUGUST, SEPTEMBER, AND OCTOBER

THE PASTURE growing season in most of New York is from about April 1 to November 1. In a normal season, good improved pastures when grazed alternately may provide grazing from about May 1 to October 15.

Usually pasture growth is most rapid in late May and early September when soil temperature and moisture conditions are most favorable. The period of least growth is between June 15 and August 15. Slow growth also occurs in October. The development of a dense sward of wild white clover, by improving soil temperature and soil moisture conditions, leads

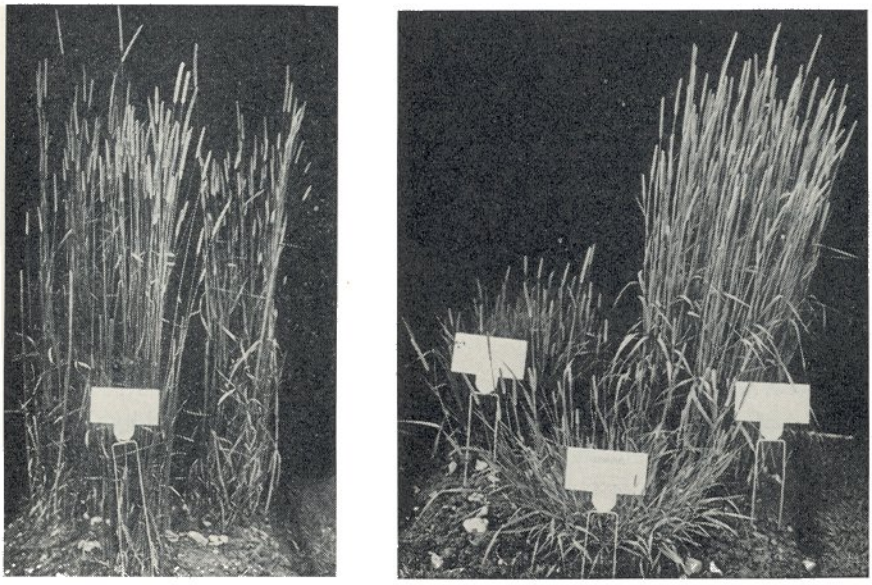


FIGURE 36. VARIETIES OF TIMOTHY
Left: Single plants of commercial timothy
Right: Single plants of selected pasture and hay types

to greater production during the hot summer months. Meadow aftermaths produced from the usual type of meadow mixtures, containing in addition 1 pound to the acre of wild white clover or Ladino white clover, are especially valuable as supplementary pastures during this period. In establishing long-term meadows to be used at first for a combination of hay and pasture and subsequently for pasture only, a mixture such as the following may be used.

The Cornell hay-pasture mixture for 1938[2]

	Pounds to the acre
Kentucky bluegrass (*Poa pratensis*)	4
Canada bluegrass (*Poa compressa*)	2
Rough-stalked meadow grass (*Poa trivialis*)	1
Timothy (*Phleum pratense*)	6
Perennial ryegrass (*Lolium perenne*)	4
Red clover (*Trifolium pratense*)	3
Alsike (*Trifolium hybridum*)	2
Yellow trefoil (*Medicago lupulina*)	2
Wild white clover (*Trifolium repens* var.)	1
Total	25

[2]One should consult his county agricultural agent concerning changes made in this mixture as a result of experimental work in progress and for sources of the seeds specified.
Information concerning mixtures adapted to special local conditions may be obtained from the Department of Agronomy, at Cornell University, Ithaca, New York.

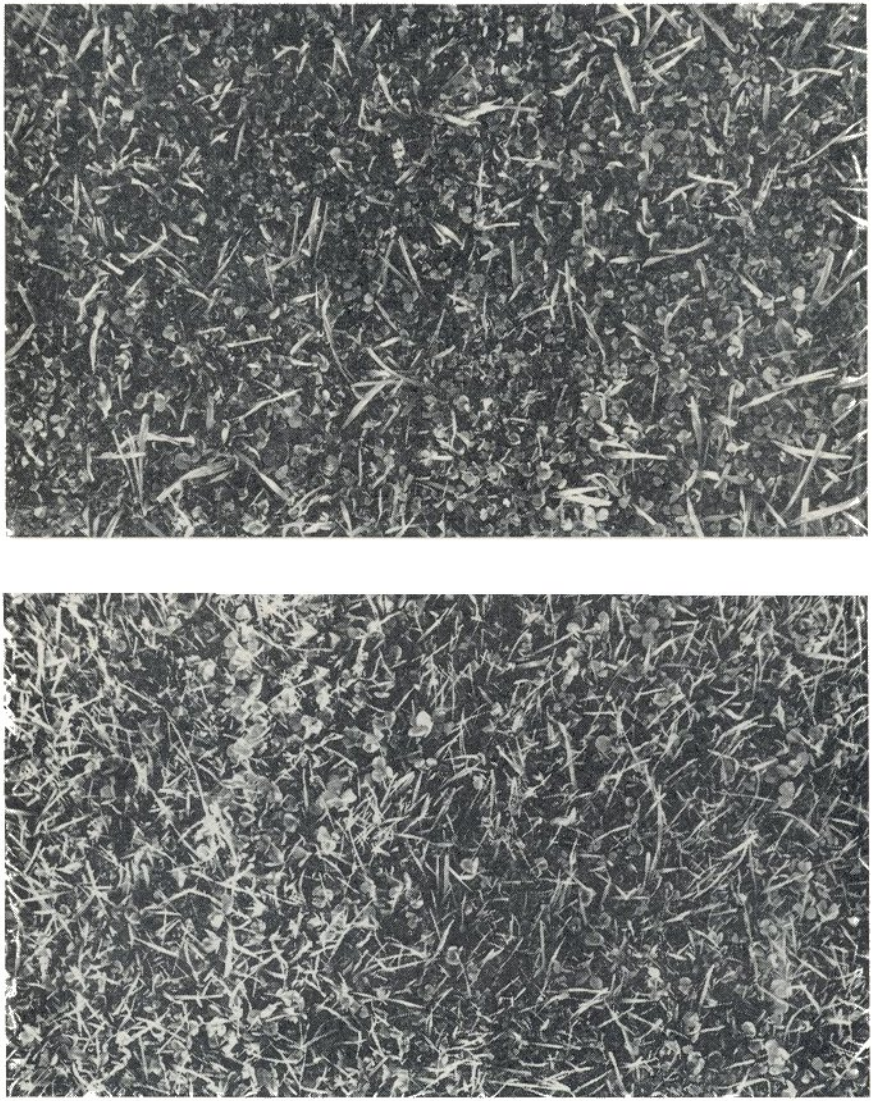


FIGURE 37. SWARD OF TIMOTHY AND WILD WHITE CLOVER

Top: Commercial timothy and wild white clover, third year. Note the broad leaves of timothy and the small number of surviving plants.

Bottom: Aberystwyth pasture timothy No. S. 50 and wild white clover, third year. Note the narrow leaves of timothy and the large number of surviving plants forming a dense sward. This is a dwarf leafy type of the timothy shown in figure 24 and has a creeping habit of growth. It is able to persist under close grazing conditions

The varieties selected should be the same as those suggested for the Cornell pasture mixture (page 32), and the substitution of New York wild birdsfoot trefoil for all or part of the yellow trefoil is recommended. Ladino white clover may replace wild white clover if the mixture is intended primarily for hay and aftermath grazing.

Alfalfa

The use of alfalfa as supplementary pasture is justified on soils well adapted to this crop. The value of such fields for pasture purposes may be increased by seeding a mixture of alfalfa and timothy, orchard grass, or smooth brome grass. In grazing alfalfa, precautions must be taken against bloat in grazing animals. In order to maintain a good stand of alfalfa, close grazing must be prevented.

Sudan grass

A special pasture crop that is helpful during the hot summer months is Sudan grass. Sudan grass may be seeded with a grain drill, at the rate of 25 pounds to the acre, in late May or early June to provide grazing in July, August, and September. Precautions must be taken against cyanide poisoning. There appears to be little risk when all the plants are allowed to reach a height of above 2 feet before they are grazed.

FIGURE 38. SUDAN GRASS AS A SUPPLEMENTARY PASTURE CROP
Sudan grass is used as a supplementary pasture crop and is of special value in July and August

Sweet clover

Biennial white blossom sweet clover, seeded at the rate of 18 pounds of scarified seed to the acre in early spring, provides useful grazing in August and September of the same year and from May to August in the following year. It is more valuable as a substitute for permanent pasture than as supplementary pasture, for it makes its best growth at the same time as permanent pastures.

Marrow-stem kale

Few crops are available to provide additional feed in October, a time when it is often of great value. Marrow-stem kale is useful for this purpose. It is a cross between Kohlrabi and thousand-headed-kale and derives its name from the tall thick stem which contains a marrow-like pith. It is one of the most productive green crops available and is unusually high in carotin. Seed may be sown at the rate of about 3 pounds to the acre in April or May, in rows about 28 inches apart, and the best growth is made when the plants are thinned to from 6 to 9 inches apart. The crop may be cut and fed to stock on pasture or indoors. Marrow-stem kale is resistant to injury by frost, and usually remains in good condition for feeding until severe frosts in November.

FIGURE 39. MARROW-STEM KALE

Marrow-stem kale is of special value as a supplementary feed on pasture in September and October. This crop was grown at Cornell University

Grass silage

Under a system of alternate grazing, all the fields need not be used during May and June when growth is most plentiful. The fields not grazed may be allowed to make a growth of from 6 to 8 inches before the sward is cut for silage. Cutting can be done conveniently with an ordinary mowing machine fitted with a windrower or a buncher. The herbage may be collected by a hay loader. In order to preserve the silage most effectively, from 16 to 20 pounds of food grade 68 per cent liquid phosphoric acid of sufficiently low fluorine content should be mixed with each ton of herbage as it is put into the silo. As an alternative, from 60 to 80 pounds of molasses may be used in the same way. The silage produced may be fed during the summer months if it is needed or it may be used for winter feed.

Preliminary trials indicate that a good type of long-term mixture to use for the production of grass and legume silage and for supplementary summer grazing is the following:

	Pounds to the acre
Orchard grass (*Dactylishglomerata*)	10
Timothy (*Phleum pratense*)	5
Perennial ryegrass (*Lolium perenne*)	5
New York wild birdsfoot trefoil (*Lotus corniculatus* var.)	2
Yellow trefoil (*Medicago lupulina*)	1
Ladino white clover (*Trifolium repens* var.)	2
	25

The strains used should be those suggested for the Cornell pasture mixture (page 32). Leafy pasture types of orchard grass are preferable to the commercial hay types. Suitable strains are Svalof Brage, Aberystwyth S143, S37 and S26, and New Zealand Akaroa. Of these, the Svalof Brage strain is the most winter-hardy.

FEEDING VALUE OF PASTURE HERBAGE

Good pasture herbage has a feeding value that is somewhat similar to milk. Because of selective grazing, by which animals eat short leafy herbage in preference to tall stemmy material, the herbage actually consumed by the stock is usually higher in protein content and in minerals than is the average of the herbage in the pasture. The herbage consumed from excellent pastures frequently contains in the dry matter as much as 30 per cent of protein, 1.5 per cent of phosphoric acid, and 1.5 per cent of lime.

The digestibility of young leafy pasture herbage is high in comparison with other feeds, and the fibre present is almost as digestible as are the carbohydrates. The ample supply of minerals, vitamins, and carotin present contribute to make good pasture the most valuable feed for stock.

The composition of the herbage from poor pastures differs widely from that of good pastures. The protein content is frequently less than 4 per cent, while the content of phosphoric acid and lime may fall below 0.25 per cent. Stock grazing such pastures make poor growth and sometimes suffer from mineral-deficiency diseases.

A good cow in a good pasture may consume enough herbage to maintain herself in condition while producing from 30 to 50 pounds of milk a day. Because of the high protein content of good pasture herbage, it is advisable to feed high-yielding cows supplementary grain feed that is comparatively low in protein when they are on good pasture.

PASTURES FOR LIVESTOCK OTHER THAN DAIRY CATTLE

Beef cattle

BEEF CATTLE require the same type of pasture as that needed by dairy cattle; therefore, similar methods of fertilization and grazing management should be followed. For cattle to be fattened on pasture without the aid of grain feed, the pastures must be of excellent quality.

FIGURE 40. A SHEEP PASTURE

Sheep do best on pastures with a dense sward of short leafy herbage. The pasture shown consists of Kentucky bluegrass, wild white clover, and wild birdsfoot trefoil. It is in Schenectady County, and is the result of treatment with superphosphate and good grazing management with the aid of both sheep and cattle

Sheep

Since sheep require an abundance of short leafy pasture herbage for best results, under New York conditions it is advantageous to have cattle grazing in the same field with the sheep. By mixed grazing: the liveweight gains per acre are increased; the pastures are kept in better condition by the removal of much of the taller herbage by the cattle; and some protection against dogs is provided. When mixed grazing cannot be practiced, the mowing machine should be used frequently to maintain the pasture in a suitable condition for sheep grazing.

Horses

Horses and sheep require a similar type of pasture, and mixed grazing with horses and sheep is not desirable. Cattle in the same field with horses help to provide better grazing for the horses. If there are no cattle, the pastures must be closely mowed frequently during the grazing season, and droppings, which are usually confined to selected parts of the field, should be scattered periodically.

Swine

Swine are able to obtain a considerable amount of feed from good pasture if the herbage is maintained in a short leafy condition. The frequent use

FIGURE 41. A HORSE PASTURE

Horses graze extremely closely and select the youngest and tenderest herbage only in certain parts of the field. Grazing cattle with horses and the frequent use of the mowing machine and grass harrow are aids to good grazing management in pastures primarily intended for horses

FIGURE 42. UNDERGRAZING AND OVERGRAZING

A pasture may be undergrazed and overgrazed at the same time. In the pasture shown this condition has been caused by delayed grazing in the spring and by mixed grazing with horses and sheep

of a mowing machine is helpful and pastures should be fertilized as previously suggested (page 5). Alfalfa pastures also may be used.

Poultry

The Cornell pasture mixture is well adapted for the production of permanent poultry pastures, especially when the pasture types of timothy are used. Investigations in progress indicate that Ladino white clover and rough-stalked meadow grass are of special value in poultry pastures because of the readiness with which they are eaten. Until further experimental results justify a special mixture for poultry pasturing, it is suggested that the Cornell Pasture Mixture be used. The mixture may be modified by the addition of 1 pound of Ladino white clover and 2 pounds of rough-stalked meadow grass to the acre.

It is important to keep poultry pastures in short leafy condition by periodical close mowing.

FIGURE 43. A POULTRY PASTURE

This pasture on Long Island was produced by seeding with the Cornell pasture mixture and is used for poultry

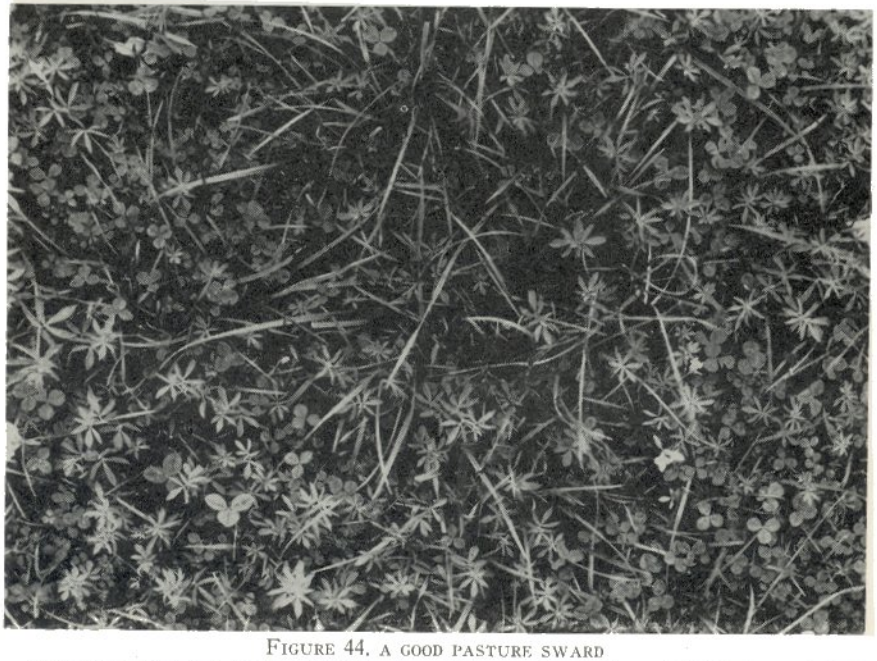


FIGURE 44. A GOOD PASTURE SWARD

This sward, produced by the Cornell pasture mixture and containing wild birdsfoot trefoil, is suitable for the requirements of dairy cattle, beef cattle, sheep, horses, swine, and poultry

A Lot Depends on Pastures

LITERALLY and figuratively, good pastures furnish the basis of the dairy industry.

To make pastures productive and to maintain them in the best condition should be the aim of the dairy farmer. Helps toward producing feed for dairy cattle are given in a number of Cornell bulletins. Among these are:

P 634 Combination of corn and soybeans for silage. *Wiggans*

P 694 Early-cut, nitrogen-fertilized timothy hay as compared with alfalfa hay for feeding dairy cows. *Salisbury and Morrison*

E 181 Meadow improvement through seeding, fertilization, and management. *Gustafson*

E 183 Drainage, plowing, seedbed preparation, and cultivation. *Gustafson*

If you want any of these, just drop a penny post card in the mail-box, with your name and address on it, and the number of the bulletin you desire. Send it to

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