

Cover Ch.

THE NEW JERSEY STATE AGRICULTURAL COLLEGE

Division of Extension

Extension Circular 1

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MAINTAINING SOIL FERTILITY BY THE USE OF COVER CROPS

The most successful farmers use cover crops.

Profitable production depends largely on an ample supply of organic matter and nitrogen in the soil.

Because of the increasing scarcity and high price of stable manure, and high-grade fertilizers, some other sources of nitrogen and organic matter *must* be provided if maximum production is to be continued economically.

Both nitrogen and organic matter *can* be secured cheaply by growing legume cover crops.

A good cover crop plowed under will provide as much (or more) organic matter in the roots and tops, per acre, as 8 tons of manure.

A good *legume* cover crop may take from the air and put into the soil as much nitrogen per acre as is contained in 8 tons of manure or 500 pounds of nitrate of soda. Although not as quick-acting as nitrate, most of the nitrogen in a cover crop will eventually become available.

On light soils cover crops, even non-legumes, will prevent the loss through leaching, blowing and washing of many dollars' worth of soluble plant-food.

The use of cover crops can usually be combined with the growing of a cash crop, thus maintaining the fertility of the soil without interfering with the cash income.

Maximum production *can* be maintained without manure and with fertilizers containing comparatively little nitrogen (and therefore less expensive), if legume cover crops are systematically grown, as suggested in the following outline.

OUTLINE FOR COVER CROPS

ONIONS (from sets) followed GARDEN PEAS followed EARLY SWEET CORN interplanted ASPARAGUS interplanted RYE or WHEAT stubble seeded (if moist)	}	in JULY with	{	1. Cowpeas* (5 to 6 pecks) or 2. Soybeans* (5 to 6 pecks)
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* Cowpeas and Soybeans are killed by frost, and may be plowed under or disked in for rye or rye and vetch, if desired.

EARLY CABBAGE followed EARLY STRING BEANS followed EARLY TOMATOES followed POTATOES followed FIELD CORN interplanted in JULY or	}	in AUGUST with	{	A Clover or a Mixture of Clovers*, with Winter Vetch (10 to 15 lbs.), and Turnips (3 ounces).
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CANTALOUPE CUCUMBERS EGGPLANTS PEPPERS LATE TOMATOES WATERMELONS	}	Broadcast at last cultivation in AUGUST with	{	A Clover or a Mixture of Clovers*, with Timothy (10 to 12 pounds), and Turnips (2 ounces).
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* In sowing red, mammoth or sweet clover or alfalfa, use 10 to 12 pounds of seed per acre. For alsike use 5 to 8 pounds, and for crimson clover, 15 to 18 pounds. After August 15, add ½ bushel of rye or wheat to clover mixtures where timothy is not sown. North of Trenton and New Brunswick clovers should be sown *before* August 15, and crimson clover should not be used.

Timothy, alsike and the smaller clover seeds need not necessarily be cultivated in.

BEANS CABBAGE PEPPERS CORN STUBBLE POTATOES CANTALOUPE CUCUMBERS ONIONS EGGPLANTS TOMATOES	}	Interplanted or followed	}	in SEPTEMBER with	{	1. Rye or Wheat (5 pecks), and Winter Vetch (15 to 20 lbs.), or 2. Rye or Wheat (6 pecks).
				in OCTOBER or NOVEMBER	}	with Rye (6 to 8 pecks).

Sweet clover and alfalfa are excellent cover crops and start to grow early in the spring, but should not be sown unless the soil has been well limed. If the land is too sour for red clover, alsike may succeed. Clover failures are often due to lack of lime.

Vetch, soybeans, sweet clover and alfalfa should *always* be *inoculated* unless the field has grown them before successfully; cowpeas should be inoculated in North Jersey.

(OVER)

Practical Suggestions Regarding Cover Crops

The heavier the seeding the better will be the stand, but good live seed, timely sowing, a moist soil and careful covering give good stands with moderate amounts of seed. Lighter seedings keep down the expense and leave seed for the other fellow.

Drills save seed through better and more even covering. Where a drill is used the amount of seed recommended may be reduced one-quarter. A one-horse drill which will go between the rows of corn or truck, will soon pay for itself in the seed saved.

Unless corn blows down it is never too late to cultivate the middles *lightly* to cover seed. If the season is dry and the corn heavy, it may be better to cut the corn early and sow rye and vetch than to seed in the corn in August.

Legume seeds should be sown as early as possible to secure maximum fall growth and consequent resistance to winter killing, but it is better to wait until *after* a good rain than to sow on very dry ground.

Liberal *broadcast* fertilization and side-dressings return good profits in the crop to which applied and help materially to insure the success of the cover crop; a soil must be well fed to produce a money crop and a cover crop the same season.

If time can be allowed for spring growth of the cover crop, preference should be given to the legumes. Crimson clover, sweet clover and alfalfa make the earliest start.

Too large a spring growth, especially of rye, will dry out the soil excessively, and form too thick a mat when plowed under. By disking thoroughly before plowing a heavy growth can be turned under to better advantage and an injurious layer of green material in the bottom of the furrow will be avoided.

Use nitrogen in fertilizers primarily as a stimulant to crops, depending on legumes and stable manure, if available, for the main nitrogen supply.

Acid phosphate is still comparatively cheap and abundant. Use it freely.

Order cover crop seeds early and make inquiry as to their purity and germination.

For further information and more detailed discussion of cover crops ask for Circular 85, of the New Jersey Agricultural Experiment Station, New Brunswick, N. J.

Cover Crops and Green Manure

THE use of green crops as manures and cover crops has yearly become a greater factor in maintaining the fertility of land, where extensive agriculture is practised. On high-priced land near cities, where an abundant supply of manure is available, green cropping is not practised. However, on garden and general farms, remote from cities and transportation, green manures are indispensable and should be in every rotation.

These crops may be divided into five heads, depending upon their use:

- (a) Catch crop.
- (b) Cover crop.
- (c) Green manures.
- (d) Nurse crop.
- (e) Soiling crop.

(a) **CATCH CROPS** are those crops that occupy the ground for short intervals between the growing of other crops, in order to secure more products within a given time. As a rule, they are relatively quick-growing plants that can be used for emergency crops. Their chief uses are to replace a crop that has failed, early in the season, (2) to fill the gap between an early maturing crop and the sowing of a late crop, (3) to take the place of a summer fallow in controlling weeds.

(b) A **COVER CROP** is a temporary green crop grown for the purpose of improving the soil, either by protection or by being turned under for its manurial value. In general there are five purposes for which these crops are grown:

- (1) To prevent the loss of soluble foods during late fall and winter.
- (2) To prevent erosion on hillsides and slopes in the winter.
- (3) To prevent root injury on orchard lands.
- (4) To supply humus.
- (5) To improve the physical condition of the land.

As a rule, these crops are sown late in summer or early in fall, so that they make sufficient growth to cover and protect the ground before severe frosts come. By so doing the cover crop will use the plant food late, after the trees or other crops have completed their growth, and they will prevent the soil from freezing as early and as deeply as it otherwise would.

(c) A **GREEN MANURE** consists of immature crops which are plowed under to supply humus, fertilizer, and organic material. All cover crops may be used as green manures, but all green manures are not cover crops. Green manuring is a very general practice, both in extensive vegetable growing and general farming. There are three general uses of green manure crops:

- (1) To maintain the necessary amount of vegetable matter.
- (2) To keep the soil in the proper sanitary condition.
- (3) To increase the fertility of the soil.

The decaying of the manurial plants liberates the plant food they contain, as well as organic acids which dissolve the unavailable mineral elements for future crops.

(d) In sowing grass or clover seeds it is a very common practice to sow in or with them a small grain, which in such a case is known as a **NURSE CROP**. This practice has distinct advantages as well as disadvantages. Among the former we have:

- (1) A greater return from the land the first year.
- (2) Economizing with labor by using one seed-bed for two crops.
- (3) To check weeds.
- (4) To prevent washing of the land, while the slower growing crop is getting established.

As opposed to these we have the following disadvantages:

- (1) The grass or clover crop is apt to be weakened by shading.
- (2) The grass may be injured by having the nurse crop use excessive amounts of moisture.

The crops most commonly used are wheat, rye, barley, and oats, in the order named. Oats shade the ground more than barley, while barley shades more than wheat or rye. These crops can be arranged according to their moisture requirements as follows: Wheat, barley, oats, and rye.

The time at which a nurse crop is harvested is important, for the sudden removal of such a crop is apt to cause the grass crop to suffer materially from heat and drought.

(e) **SOILING** is the feeding of green harvested forage directly from the field to the stock. Occasionally it refers to a species of pasturing where movable fences are used to confine the cattle, in a green crop. At the present time it is largely used with dairy cattle to increase milk production. It requires very careful planning of a succession of crops so that there will be an ample supply as needed. However, serious loss is apt to result by the increase in labor for the daily hauling and cutting of these crops.

The plants used for these five purposes may be classified as—

(a) Non-leguminous; (b) leguminous, while each of these heads may be subdivided into hardy crops and non-hardy crops. By non-leguminous crops we mean those crops which depend upon the soil for their nitrogen supply. By leguminous crops we mean those crops which are able to take nitrogen from the air, by means of nitrogen-fixing bacteria which live in nodules on the roots of these crops. Nodules are small irregular knots which appear as offsets on the roots of the leguminous plants.

Leguminous plants are soil improvers, while the non-leguminous plants reduce the fertility of the soil, except as they are returned to the soil as green manures.

The following table gives the classification of the crops that may be considered under the five subdivisions:

I. Non-leguminous Crops		II. Leguminous Crops	
(a) HARDY:	(b) NON-HARDY:	(a) HARDY:	(b) NON-HARDY:
(1) Rye.	(1) Barley.	The Clovers.	Cow-pea.
(2) Wheat.	(2) Buckwheat.	(1) Alsike.	Field pea.
(3) Winter turf oats.	(3) Millets.	(2) Crimson.	Soy bean.
	(4) Oats.	(3) Mammoth.	Common vetch.
	(5) Rape.	(4) Red.	Velvet bean.
	(6) Turnip.	(5) Sweet or Bokhara.	
		(6) White Dutch.	
		(7) Burr.	
		Hairy vetch.	

Rye (*Secale cereale*)

Rye is a hardy, annual, non-leguminous plant, and is adapted to a wide range of soil and climatic conditions. While it prefers the lighter loams and sandy soils, it will do well on clay soils. Rye will yield better crops on poor, sandy, exposed, or acid soils than will wheat. When sown after a cultivated crop, disc and harrow the land. Otherwise plow six or seven inches deep and thoroughly fit the seed-bed.

While rye is a poor land crop, it responds readily to the application of fertilizer, especially the phosphates. Two to four tons of manure, supplemented with 40 to 50 pounds of acid phosphate gives good results. One hundred and fifty to 250 pounds of acid phosphate, as well as 150 to 250 pounds of a 3:10:3 fertilizer are recommended by various writers.

Rye may be sown $\frac{1}{2}$ to 2 inches deep, broadcast or in drills 6 to 8 inches apart. In the south it is generally sown from October 15 to the latter part of November, while in the north the customary dates are from September 15 to October 15. When drilled, 42 to 56 pounds are used to an acre, but for broadcasting 84 to 112 pounds are sown to an acre. Rye as a green manure should be turned under when about knee high, while for soiling the plant should be cut when in full bloom. Rye may also be used as a catch crop, a nurse crop, while it is an ideal cover crop because of its quick growth and wide-spreading root system.

Wheat (*Triticum spp.*)

Wheat, like rye, can be classified as a hardy, annual cereal, being grown chiefly for its grain and straw, although it is the most important nurse crop of the small grains. Wheat thrives best in cool climates and upon well-drained loams and sandy loams, although it does well on some clay soils if they are well drained. Wheat will withstand considerable surface moisture, but water-soaked areas should be avoided.

As to its fertility, wheat requires a large amount of humus, but the soil should never be acid. One hundred and fifty to 250 pounds of a 3:10:3 fertilizer is recommended for the richer soils, while for the poorer soils 250 to 350 pounds of fertilizer is necessary. Very beneficial results are obtained by the additional application of 1000 to 1400 pounds of ground limestone two or three weeks before sowing wheat.

The soil should be fitted the same as for rye, after which the seeds should be planted $1\frac{1}{2}$ inches deep in drills 6 to 8 inches apart or broadcast. In drills 60 to 75 pounds of seed are used, while broadcasting requires 105 to 120 pounds. In the south wheat is commonly sown from October 1 to November 15; however, in the north wheat is generally sown during the month of September.

The prime uses of wheat are as—(1) a nurse crop with the grasses and clovers; (2) a cover crop.

It is seldom grown as a catch crop, green manure, or soiling crop because of the high price the grain and straw bring on the open market.

Barley (*Hordeum spp.*)

Barley in its general appearance is quite similar to wheat and rye, although not as tall. The leaves are grayish green and somewhat broader than the other grains. The head is a spike, with the spikelets set alternately on a zigzag central stem. Six-rowed barley is formed by each of the three spikelets being fertile, while with two-rowed barley only the central spikelet is fertile.

Barley requires a richer soil than wheat. It does best on a porous, well-drained loam. An abundance of humus, as well as good physical conditions, are necessary. Barley is shallow rooted, hence it is very apt to be injured by heaving, where sown as a winter crop. Barnyard manure is the best fertilizer, but occasionally additional applications of 200 pound of acid phosphate plus 75 pounds of muriate of potash are made. Manure supplemented with raw rock phosphate gives good results. If the soils are at all acid, the addition of 30 to 40 bushels of lime to an acre will aid materially.

It is desirable to fall plow a considerable time before sowing. Leave the soil in the rough for the winter and disc the following spring. Since the winter crop generally follows a cultivated crop, discing is sufficient to fit the soil. Barley is generally sown 2 to 3 inches deep in drills 6 to 8

inches apart. Although occasionally broadcast, drilling is preferred because the plants withstand drought better. They produce a deeper root system and they get more air and sunlight. Forty-eight to 72 pounds is the customary rate of sowing. In the north barley is sown from April 1 to May 15; central states March 1 to middle of April. In the south and central states barley is sown from September 15 to October 15.

While barley is grown primarily for its grain, it makes an excellent nurse crop for grasses and a good cover crop. When used as a soiling crop, it should be cut before it reaches the milk stage. The true winter types are more hardy than oats, but less hardy than winter wheat.

Buckwheat (*Fagopyrum esculentum*)

Buckwheat is an annual of erect habit of growth, generally growing about three feet high. Its total root system, consisting of a primary root and several branches is small and shallow. Its stems vary from $\frac{1}{4}$ to $\frac{5}{8}$ inch in diameter, being green to purplish red when fresh, and brown at maturity. While it does not tiller, buckwheat branches readily to form a very dense mat.

This crop thrives in a cool climate, although the seedlings will stand considerable heat in the early stages. High temperatures are disastrous after showers and during seed formation, because of the blasting of the flowers. Since buckwheat will mature in 8 to 10 weeks it adapts itself to a wide range of latitude. Any well-drained soil will produce an excellent crop of buckwheat, but if too rich, the plants are very apt to lodge and mat. Buckwheat will grow on soils that will not produce any other crop.

The soil should be plowed early and harrowed several times before planting. While this crop will do well without fertilizer, the application of ten tons of manure or 200 to 300 pounds of a 1:10:2 or 2:12:4 fertilizer materially increases the yields. It is customary to sow buckwheat $1\frac{1}{2}$ to 2 inches deep at the rate of 36 to 60 pounds with a grain drill, in drills 6 to 8 inches apart. In the north buckwheat is sown during the last week of June and the first week of July, while in the south it is sown approximately a month later.

Buckwheat is an ideal green manure crop, because it thrives on poor soils. It grows rapidly, it smothers out weeds, it leaves the soil mellow, and it decays rapidly. It is also an excellent catch crop with rye. Buckwheat outgrows the rye and may be fall cut, after which the rye springs up, grows during the fall and winter, and is plowed under in the spring.

Millets (*Chaetochloa* spp.; *Panicum* spp.)

The millets are half-hardy, rank-growing, grass-like plants. They should not be grown as a main crop, but rather as a catch crop. It makes a very good substitute to use after a crop of frosted corn, so that the land is used during the growing season. Millet can also be grown where corn is not easily grown or on a piece of land that otherwise would lie idle. Millets are also excellent to use in short rotation, especially on foul land to get rid of weeds.

The millets are surface feeders, hence the soil should be a fertile mellow loam with but little clay. The application of 4 to 5 tons of manure before plowing, supplemented by top dressings of commercial fertilizer just before sowing, is desirable. When sown as a second or catch crop, thorough fitting is not necessary—discing will be sufficient.

Millets are ordinarily sown $1\frac{1}{2}$ to 2 inches deep in drills, or broadcast at the rate of $12\frac{1}{2}$ to $37\frac{1}{2}$ pounds, depending upon the type of millet used. The seeds are sown during May and June in the north, but as a soiling crop millets can be sown every two or three weeks from the tenth of May to the last of July. When cut for hay, the crop should be harvested when completely headed. If allowed to grow too long, millets will not cure well because of the succulence of the stems. For soiling purposes cut as soon as the crop heads, otherwise it will become over-ripe and will not be relished by the cattle. As a green manure, plow under when they are approximately knee high.

Oats (*Avena sativa*)

Oats rank next to corn and wheat in acreage and value in the United States. Proper cultural and climatic conditions are far more important than fertility of the soil. Since more water is necessary to produce a pound of dry weight with oats than with any of the other grains, the water-holding soils as loams and clays are preferred provided drainage is good.

It is not advisable to apply manure just before sowing, but rather upon the preceding crop. However, early applications of small amounts of nitrate give satisfactory results because oats make most of their growth early before the soil nitrogen is available. It is a common practice to apply the potash and phosphate to the previous crop.

While oats are grown in the north primarily as a spring crop, except the winter turf oats, they are grown to considerable extent in the south as a winter crop. In the south oats are used as a grain crop, soiling crop, cover crop, green manure, nurse crop, and for winter pasture. On fertile soils it is advisable to apply 100 to 125 pounds of phosphoric acid and 30 pounds of potash, while on the poorer soils 200 to 250 pounds of acid phosphate and 60 pounds of muriate of potash are applied—adding a top dressing of 25 pounds of nitrate of soda in the spring as growth starts.

Winter oats in the south are generally sown from September to November, 2 inches deep, at the rate of 80 to 96 pounds to an acre. Ordinarily oats are sown in drills 6 to 8 inches apart, although broadcasting and the open furrow method are used.

In the north for spring oats, fit the land as soon as possible in the spring and sow the oats the

latter part of April or early May. As a spring crop in the south oats are sown the latter part of January or early February.

While grown primarily for its grain and straw, oats are excellent as a nurse crop, cover crop, and for soiling. They may also be used as a spring catch crop and for green manuring.

Rape (*Brassica napus*)

Rape most closely resembles the ruta bagas in its general appearance and habit of growth. Although as a wild plant it is an annual, when cultivated, rape may be either an annual or a biennial. Rape is not particular in its requirements, but a cool season and a well-drained sandy loam are preferred.

In the north rape is sown from the first of May to the end of July, while in the south plantings are made during the cooler fall months. In Canada rape does best if sown on or about June 15. Rape can be sown $\frac{1}{2}$ inch deep, either in cultivated rows, drills, or broadcast at the rate of 4 to 5 pounds to an acre. The common spacing between drills is 6 to 8 inches, while cultivated rows are generally spaced 24 to 28 inches, although spacing from 18 to 36 inches is used. When sown with a grain, rape should be broadcast when the grain is 2 to 3 inches high. If planted in corn, sow at the last cultivation.

Rape may be used for pasturing, as a cover crop, as a soiling crop, as a catch crop, and as a green manure.

Turnips (*Brassica rapa*)

While not strictly a cover or green manure crop, turnips are often used as such with grains and clover. However, in some instances in the south they are sown as a manurial crop during the fall. As with the other root crops, turnips do best during the cool seasons and upon a light sandy loam. Nevertheless, they will succeed over a wide range of soil, especially if grown in combination with other crops.

Turnips are sown $\frac{1}{2}$ inch deep, at the rate of 3 to 4 pounds when broadcast. Since they will mature in six to eight weeks, turnips should be sown in the north during August. In the south they may be sown from the latter part of July to the middle of November. The larger roots can be saved for cattle feed, while the rest and the roughage can be plowed under or used as a cover crop. Turnips also make a good catch crop, and they are especially good as a soiling crop for hogs.

Alsike Clover (*Trifolium hybridum*)

(Swedish Clover)

Alsike clover is a long-lived perennial, producing a good stand for four to six years. When the plants are crowded, the stems are erect, but isolated specimens are spreading, often measuring 12 inches in diameter. The herbage is smooth, with more leaves than red clover. It is easily distinguished from other clovers by its pink blossom.

Alsike is adapted to a wider range of climatic and soil conditions than is red clover, though not as diverse as white Dutch clover. It prefers a cool, moist climate, rarely winter killing; besides, it will withstand considerable heat and drought. This clover thrives on clays, clay loam, sandy loams, and muck. It will do better on moist and acid soil than almost any of the other clovers.

Alsike may be sown alone or with a nurse crop either in the spring or in fall, $\frac{1}{2}$ inch deep, at the rate of 8 to 12 pounds to an acre. Although good stands may be obtained for four to five years, the second season is generally the best. Since there are few hard seeds in alsike and they germinate in two to six days, a good stand should be obtained at the above rates of sowing.

Like the other clovers, the main use of Alsike clover is for hay, upon moist lands. However, all the clovers make excellent cover crops, and as green manures they cannot be excelled. Good results are obtained by sowing the clovers in the spring on fall-sown grains. Clover may be plowed under the first fall as a green manure, or it may be left as a cover crop and cut the next season. The second cutting can then be plowed under for green manure. The clovers may also be used as soiling crops, although it is not a common practice.

Crimson Clover (*Trifolium incarnatum*)

(Scarlet Clover; Carnation Clover; Incarnate Clover)

Crimson clover is an annual, growing approximately three feet high. When isolated, the individual plants are decidedly spreading, but in the field the plants are generally erect. As a rule, the young plants of fall-sown seed have single stems, but they may develop as many as 20 stems and 50 flowers. The flowers are brilliant crimson, rarely white, yellowish, rose, or variegated.

Crimson clover will not withstand extreme cold, so that it is apt to winter kill north of New Jersey and west of the Alleghany mountains. This clover succeeds well on sandy and clay soil which have a relatively high humus content; however, crimson clover will not succeed on poor sandy soils or muck. It is adapted to growing in the shade and it does not seem to be affected by clover sickness.

Crimson clover is generally sown one inch deep in sandy soils and one half inch deep in clay soils at the rate of 12 to 20 pounds when drilled and 22 to 40 pounds when broadcast. In the north it is generally sown in mid-summer, while in the south it may be sown through October. If sown

too early crimson clover is apt to be injured by the heat while late plantings are apt to winter well. Ordinarily crimson clover is sown in a nurse crop, or a tilled crop, as corn, cotton, soy beans, tobacco, and cantaloupes.

Crimson clover may be used as a cover crop in the south, as a soiling crop, and as a green manure.

Red Clover (*Trifolium pratense*)

(Ordinary Clover; Medium Clover)

Red clover is by far the most important leguminous forage crop grown in the United States. Its acreage is five times that of alfalfa. Red and mammoth clover are quite similar; in fact, the latter is supposed to be variety of red clover. If sown alone, red clover generally yields but one good crop; however, when sown in combination with other clovers and grasses, it produces a fair crop the second season.

Red clover is hardy, but it prefers humid regions without excessive heat or cold. While it is not exacting in its soil requirements, it prefers a well-drained soil with a good humus content. Red clover thrives better on clay than on loams, but higher yields are obtained on loams than on sandy soils. Red clover will not do well in the shade; hence it is of little value as a cover crop in an orchard.

Red clover is sown one inch deep on clay soils and one and a half inches deep on sandy soils, at the rate of eight pounds to an acre. In the south it is generally sown during the late fall, while in the north spring sowing is preferred to avoid serious winter killing. It is customary to sow red clover with or in a crop of small grain.

Red clover may be used as a cover crop, a soiling crop, and for green manure.

Mammoth Clover (*Trifolium pratense perenne*)

(Sapling Clover; Bull Clover; Pea Vine Clover)

Mammoth clover was derived from red clover, but it is often confused with *Trifolium medium*, the zigzag clover. Its general requirements are the same as those of red clover, but mammoth clover does better than red clover on poor or sandy soils. Like alsike, mammoth clover does fairly well on acid soils. Mammoth clover is preferred to red clover in combinations, especially when timothy is used in the mixture. Red and mammoth clovers can be compared as follows:

MAMMOTH CLOVER
Blooms with timothy
Stems are solid
Plants live three or more years
Tap root branches
Heads are seldom in pairs
Pedicels long and bent

RED CLOVER
Blooms two weeks earlier than timothy
Stems hollow
Plants live two years
Tap root branches little
Heads often in pairs
Pedicels short, straight

Sweet Clover (*Melilotus alba*)

(Bokhara Clover; White Melilot; Siberian Melilot; Honey Clover)

Sweet or Bokhara clover is a biennial. The seedlings appear early in the spring, growing slowly during the summer, but often reaching a height of three or four feet by fall. The root system may reach a depth of six feet the first season. The second year the plants start early, soon growing to a height of 6 to 12 feet. The flowers are white, scented, and in rather dense clusters.

Sweet clover does equally well in humid and semi-arid regions, growing well from southern Canada to the Gulf of Mexico. It will grow on all types of soil from cemented clay to sand, but it prefers soils with an abundance of lime. Sweet clover should be used where alfalfa and red clover will not grow, because it withstands drought and excessive moisture.

It is essential that sweet clover have a very firm seed-bed, which has been well inoculated, provided such a crop has not been previously grown on the land. It may be sown 1½ to 2 inches deep, either in drills or broadcast at the rate of 20 to 30 pounds of hulled seed for broadcasting and 10 to 15 pounds of hulled seed in drills. Sweet clover may be sown either in the early fall or early spring, the latter being preferred.

As a soiling crop it is relished by hogs, but cattle do not take to it, at first, until they have become accustomed to the pungent, bitter flavor. Sweet clover may also be used for green manure if it is plowed under early. If allowed to grow for any length of time, the stems become hard and woody, so that they will not readily decay when plowed under. It is seldom used as a cover crop.

White Clover (*Trifolium repens*)

(Dutch Clover; White Trefoil; White Dutch Clover)

White Dutch clover is a long-lived but shallow-rooted perennial. It differs from red and Alsike clovers in that it has a solid stem which creeps on the ground and readily roots at the nodes. A single plant will often be a foot or more in diameter.

Although white clover prefers cool, moist climates, it persists through the hot summer weather in the south. It is also used in the south largely for winter pastures. Since it grows well in shady places and is procumbent, it is highly prized as a cover crop in orchards in both the north and the south. Although it will grow on a wide range of soils, white clover prefers a well-drained loam or clay loam with a high humus content.

White clover is generally used in mixtures with other clovers and grasses, being very seldom sown alone. It is generally sown about two inches deep at the rate of 9 to 13 pounds to an acre. Clovers and grasses generally receive their fertilizer from the residue of a previous crop, especially when sown with a nurse crop. A top dressing of manure late in the fall or early in the spring will aid the crop materially, especially if it is to be left for more than one season.

Burr Clover (*Medicago* spp.)

There are about 40 species of burr clover which are used primarily in the south and far west for hay, and as a soiling crop. They are half-hardy annuals which start into growth in the fall, maturing early the following summer. The plants are prostrate when isolated, but under field culture they produce herbage 8 to 18 inches deep. They may be easily distinguished by their burr-like pods which are entirely different from the pods of any other clover. The two species most commonly grown in this country are toothed burr clover, *Medicago hispida*, and the spotted burr clover, *Medicago arabica*. The first is used in California, while the latter is largely grown in the south.

Burr clovers are sown any time from August to November in the south, approximately two inches deep. If hulled seed is used, 15 pounds are sown to an acre. In the burrs the seed weighs 10 pounds to a bushel and two bushels are sown to an acre. After sowing the seed, the ground should be lightly harrowed, so that the seeds are well covered. Burr clovers are not cold resistant, so that below 15° F. they are apt to winter kill.

Hairy Vetch (*Vicia villosa*)

(Sand Vetch; Russian Vetch; Winter Vetch)

Hairy vetch is a hardy annual, but it often behaves like a biennial. Its stems are slender, growing up to 12 feet long, but seldom exceeding four feet. The herbage is composed of 11 to 17 leaflets to a leaf, which are always hairy and somewhat silvery. The flowers are violet blue, rarely white, being borne in dense, one-sided clusters of about 20 flowers each. The pods are pale green, smooth, containing 2 to 8 small globose, nearly black seeds.

Hairy vetch is grown primarily in cool, temperature climates, hence it does particularly well in the north. It will grow on a wide variety of soils, preferring sand or sandy loams rich in lime, although vetch will do well on clay, if well drained. Vetch is also quite resistant to alkali. In the north, spring sowings will produce flowers, but rarely pods the first year, generally maturing the second season. In the south, fall plantings are necessary.

Best results are obtained by sowing vetch in the fall, either in the north or in the south. Vetch may be sown alone 1½ inches deep, at the rate of 40 to 60 pounds to an acre. However, it is commonly sown with small grains at the rate of 20 to 25 pounds to an acre, with the usual amounts of the grains. To obtain a successful catch of vetch it is necessary to inoculate the field, preferably with soil, from a field where vetch has been grown.

Vetch makes an ideal cover crop, because of its deep root system and the dense mat which it makes on the soil. As a green manure it is excellent because it makes a dense growth, as well as being a legume. Vetch is one of the best soil improvers that can be grown on poor soils, but at the present time winter vetch is used very little.

Cow-peas (*Vigna sinensis*)

The cow-pea is really not a pea at all, but a bean. While they are used particularly as a forage and restoration crop, in the south the white-seeded varieties are used for food. The plants are bushy, more or less upright, with typical bean leaves, and the pods are long, slender, and cylindrical. They are hardy annuals, maturing in approximately seventy-five days.

Cow-peas require the same climate as corn, but they can withstand more heat because cow-peas are quite drought resistant. They will do well on any well-drained soil. While cow-peas will withstand a moderate amount of shade, they will not survive spring or fall frosts.

Inoculation is not ordinarily necessary to get a good stand, but on poorer soils it is advisable. They may be broadcast at the rate of 60 to 120 pounds, or drilled at the rate of 75 pounds to an acre, or in three-foot rows at the rate of 15 to 20 pounds to an acre. The early varieties mature in seventy to ninety days, medium varieties ninety to one hundred days. The growth of cow-peas is very slow until the hot weather comes, so that they should never be sown before corn, and two weeks later is preferred. They may then be sown any time up to ninety days before frost. Early sowings are not desirable because of the tendency of the seeds to decay in the soil.

For soiling or hay, two crops of cow-peas may be grown from a single seeding, because after the first cutting they sprout and throw up a vigorous second growth. They may also be used as a catch crop and as a green manure.

Field Pea (*Pisum arvense*)

(Canada Field Pea; Canada Pea)

The field and garden peas intergrade when used for green manures and cover crop. As a rule, field peas may be distinguished by angular, brown to black, or speckled seeds and colored flowers, while garden peas have round, yellow, or green seeds; flowers white. However, many varieties of garden peas are used for forage purposes.

Field peas are annual plants with hollow stems, generally growing to a height of 1½ to 10 feet. The herbage is composed of pinnate leaves with one to three pairs of leaflets and tendrils at the top of the rachis. One to three flowers are borne on each stem, which later form green pods.

Field peas are adapted to moderate temperatures. While they will withstand considerable frost, they readily succumb to high temperature and humidity. In the north they are grown as a summer crop. Where temperatures rarely go below freezing, they are grown as a winter crop, and in the intermediate areas they are sown either in fall or spring. Field peas require an abundance of lime, and they prefer loams or clay loams.

Field peas may be broadcast or drilled 1½ to 3 inches deep at the rate of 90 pounds to an acre for the small-seeded sorts, and 180 pounds for the large-seeded varieties. Most growers prefer to sow field peas in drills because of the more even germination. While peas are sown alone, they are commonly sown in combination with other crops, particularly oats. When peas and oats are sown together, 60 to 120 pounds of peas plus 32 to 64 pounds of oats are sown to an acre. If they are to be used for hay, cut when the oats are in the dough stage. Field peas make an excellent catch crop as well as a green manure and soiling crop. Peas should be fed in moderation to stock, particularly to cattle.

Soy Beans (*Soja max*)

(Soja beans)

The soy bean is an erect, branching annual with stout stems and a well-defined main axis. They grow from six inches to six feet in length, depending upon the variety. All plants are hairy, and they may be either gray or tawny in color. Tawny plants are generally associated with dark-colored pods and usually purple flowers. The leaves vary considerably in size, shape, and color, generally turning yellow as the pods mature.

They will make a satisfactory growth on poor soils; if inoculated, however, soy beans do best on loams and clays. While not sensitive to moisture, soy beans will not do well where water stands for any length of time. Soy beans are more drought resistant than are cow-peas. Although soy beans will withstand a temperature as low as 27° F., they will not stand the extreme heat of the south.

Soy beans may be sown any time after danger from severe frosts is past at the rate of 60 to 90 pounds to an acre for broadcasting, or 20 to 30 pounds to an acre when placed in rows 24 to 36 inches apart. Most of the larger varieties are planted in rows 36 inches apart, with 2 to 3 inches between plants, while the smaller varieties are placed in rows 18 inches apart. Grain drills and corn planters are also used, but they should never be set to cover the seed more than two inches deep.

While soy beans are most commonly sown alone, they are frequently sown in corn or with cow-peas. When sown with cow-peas, soy beans aid materially at harvest time, for they keep the cow-peas erect and prevent lodging. In this combination one bushel of soy beans is sown with ½ bushel of cow-peas if broadcasted, while one-half of this amount will be sufficient if sown in three-foot rows. Soy beans are not as desirable as cow-peas as a green manure and soil improver, but they are excellent as a catch crop or for soiling purposes.

Common Vetch (*Vicia sativa*)

(Tares; Smooth Vetch)

Common vetch is strictly an annual having much the same habit of growth as garden peas. The stems are slender, growing from 3 to 5 feet high. The foliage is composed of pinnate leaves, each with seven pairs of leaflets surmounted by a tendril. The flowers generally grow in pairs, being violet purple and rarely white. The brown pods contain 4 or 5 gray or marbled seeds which are discharged as the pod coils at maturity.

Common vetch requires a cool season to make an ideal growth. It will withstand a temperature of 10°, but at zero vetch is apt to badly winter kill. Vetch thrives on any well-drained soil from a loam to gravel; besides, it is an excellent soil improver on soils which have been inoculated.

The fitting of the land varies considerably in different sections; in any case the seed-bed should be firm. In the west vetch is sown early in the fall on the stubble of spring-sown grain, while in the south special preparation is necessary. Vetch may be drilled, but the more common practice is to broadcast: with or without a supporting crop. In the south it is sown from October to the middle of December, while in the west it is sown during September and October. Where winters are severe, common vetch is seldom sown, but when grown, it must be sown in the spring. The usual rate of sowing is 60 pounds to an acre, or with oats at the rate of 30 pounds of vetch plus 20 pounds of oats. On wet soils 70 to 120 pounds are necessary or 60 pounds of vetch plus 40 pounds of oats.

This crop is grown chiefly as a green manure or a hay crop, although it can be used as a cover crop in the south and the moderate sections of the west.

Velvet Bean (*Stizolobum deeringianum*)

(The Florida Velvet Bean)

This crop is a vigorous, bean-like plant which may grow 30 to 50 feet long, but ordinarily about half this length. The leaves are trifoliate, with large membranous leaflets. The flowers are dark purple, in long, pendant clusters. The pods are two inches long, watery, and generally constricted between the 3 to 5 marbled brown or gray seeds.

This crop is used mainly for pasture after the pods have been harvested. It is advisable to grow velvet bean with another crop to support it. When planted alone, the seeds are dropped in hills 5 feet apart each way, which requires 12 pounds of seed to an acre. By discing the vines, they may be turned under as a green manure.

Various combinations of crops are recommended by various writers for different purpose cover crops.

1	{	Mammoth clover.....	6 pounds
		Alfalfa.....	10 pounds
		Turnip.....	2 to 3 ounces
2	{	Alfalfa.....	6 pounds
		Crimson clover.....	6 pounds
		Alsike.....	3 pounds
		Strap-leaf turnip.....	2 to 3 ounces
3	{	Clover, red or mammoth.....	10 pounds
		Winter vetch.....	15 pounds
		Oats.....	$\frac{1}{2}$ bushel
		Cowhorn turnips.....	$\frac{1}{2}$ pound
4	{	Buckwheat.....	$\frac{1}{2}$ bushel
		Oats.....	1 bushel
		Rye.....	1 bushel
5	{	Oats.....	$1\frac{1}{2}$ bushels
		Clover.....	15 pounds
6	{	Buckwheat.....	$\frac{3}{4}$ bushel
		Oats.....	1 bushel
7	{	Oats.....	$1\frac{1}{2}$ bushels
		Rye.....	1 bushel

SOILING CROPS

<i>Crop</i>	<i>Time of Seeding</i>	<i>Time of Feeding</i>
Rye.....	Sept. 1	May 10-20
Wheat.....	Sept. 5-10	May 20-June 5
Red clover.....	July 20-30	June 5-15
Oats and peas.....	April 10	June 25-July 10
Oats and peas.....	April 20	July 10-July 20
Oats and peas.....	April 30	July 20-Aug. 1
Cow-peas.....	June 5-10	Sept. 5-20
Barley and peas.....	Aug. 5-10	Oct. 1-30

SOILING SYSTEM FOR 10 COWS

<i>Crop</i>	<i>Area</i>	<i>When to Feed</i>
Rye.....	$\frac{1}{2}$ acre	May 15-June 1
Alfalfa.....	2 acres	June 1-12
Clover and timothy.....	$\frac{3}{4}$ acre	June 12-24
Peas and oats.....	1 "	June 24-July 15
Alfalfa (2d crop).....	2 acres	July 15-Aug. 11
Sorghum and cow-peas (after rye).....	$\frac{1}{2}$ acre	Aug. 11-28
Cow-peas (after peas and oats).....	1 "	Aug. 28-Sept. 30

Clovers with various nurse crops:

- (1) Winter, spring, or fall sown wheat or rye.
- (2) Spring with wheat, barley, or oats.
- (3) Corn at the last cultivation.
- (4) Rape or turnip in the late summer.

W. ATLEE BURPEE CO.

Seed Growers

Philadelphia

Lester C. S.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DEPARTMENT CIRCULAR 43.

Contribution from the Bureau of Plant Industry.

(Forage-Crop Investigations).

WM. A. TAYLOR, Chief.

REDTOP (*Agrostis alba*).

Redtop is the only grass of much prominence as a hay plant among the many grasses belonging to the genus *Agrostis*. It was early introduced into the American Colonies. This grass has been known under many common names, such as whitetop, fiorin, white bent, and herd's grass. As these names belong more properly to other grasses, all of them should be dropped and the term redtop, by which it is most commonly known, used exclusively. It is a perennial grass, with a creeping habit of growth, which makes a coarse, loose turf. It matures at about the same time as timothy. The leaves are about one-fourth of an inch wide, and the stems small and wiry. The hay is inclined to be tough and is generally unpopular on the market.

VALUE.

No grass will grow under a greater variety of conditions than redtop. It is the best wet-land grass among the tame species. It will grow on soils so deficient in lime that most other grasses fail. It is strongly drought resistant and is often used for holding banks to prevent erosion. Redtop is second only to bluegrass as a pasture plant in the northeastern part of the country. It is a vigorous grower and will serve in a short time where a turf is desired. It will thrive from Canada to the Gulf of Mexico and from New York to California. Though often used in lawn mixtures, its use by itself for that purpose is not to be recommended. The turf is unsightly after the first year, and it tends to keep out more desirable species. It will add to the yield of a timothy and clover hay crop, but is considered objectionable by buyers of market hay.

USES.

The chief uses of this grass are (1) as a wet-land or sour-land hay crop; (2) as a part of pasture mixtures under humid conditions,

especially on soils other than limestone; (3) as a soil binder; and (4) as an ingredient in all hay mixtures which are to be fed at home.

It may be used for lawn purposes, especially on poor soils when the finer species of *Agrostis* can not be obtained. It is not a competitor of bluegrass for lawns, as the latter should be used on fertile limestone soils. Redtop is a valuable grass when used for the purposes mentioned.

SEED.

Most of the seed of redtop is produced in southern Illinois. The seed is smaller than that of any other commercial grass, and for that reason should be comparatively free from impurities, as it is easily separated from other seeds by screening. It is sold in two grades, known as "chaffy" and "re-cleaned." The latter should be purchased, as it is more economical and there is less danger of its containing noxious weed seeds. Redtop seed weighs about 14 pounds to the bushel in the chaff, while the re-cleaned seed should weigh about 36 pounds.

SOILS AND CLIMATE.

Redtop is not only tolerant of a sour soil, but seems to prefer a soil deficient in lime. It grows to perfection in the part of southern Illinois known locally as "Egypt," where many soils are very "sour" and poorly drained, with impervious hardpan subsoils. In New England it is the principal hay plant that is seeded, but it is frequently crowded out of meadows by quack-grass and Rhode Island bent. As previously stated, it is not particular in regard to climatic conditions, but thrives best with an abundance of moisture. Lands which are too wet for redtop are unsuited for nearly all other tame grasses.

CULTURE.

On account of its small seed redtop should have a fine, mellow seed bed, and care should be taken to prevent covering it too deeply in the soil. It may be seeded either in early spring or late summer. When seeded alone 10 pounds of good seed to the acre will insure a stand. From 4 to 5 pounds are sufficient when used with other grasses for hay, and 2 to 3 pounds are enough to use in pasture mixtures, as it spreads quite readily under favorable conditions.

LYMAN CARRIER,

Agronomist.

WASHINGTON, D. C., *May 31, 1919.*

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UNITED STATES DEPARTMENT OF AGRICULTURE,

DEPARTMENT CIRCULAR 44,

Contribution from the Bureau of Plant Industry
(Forage-Crop Investigations).

WM. A. TAYLOR, Chief.

ITALIAN RYE-GRASS (*Lolium multiflorum*).

Few grasses have been more exploited than Italian rye-grass. It is closely related to perennial rye-grass and much resembles it in general appearance. It grows to a height of from 1½ to 3 feet. In the moist climate of England it has been very popular as a hay plant and is said to yield four to eight cuttings there when watered with liquid manure. The under surface of the long, narrow leaves has a bright, glossy color, which makes it an attractive lawn grass. Italian rye-grass is an annual plant; yet it sometimes lives more than one year, though seldom more than two years.

VALUE.

The chief value of Italian rye-grass is for an annual hay crop, for temporary lawns, and for winter grazing in the South. The seed usually germinates well, and the grass makes a vigorous growth. This is one of the few grasses that will produce a crop of hay the same season it is sown. It is especially useful to produce a turf quickly and often forms a prominent part of lawn mixtures. Italian rye-grass is more drought resistant than perennial rye-grass and has been used to some extent under dry-land conditions, especially in California.

USES.

This grass is used to some extent in the South to produce winter grazing on Bermuda-grass sod. As an annual hay plant it does not yield the quantity that millet or Sudan grass will produce and so is not commonly grown for hay. It is an excellent grass to include in mixtures for both pastures and lawns. The rye-grass will make an early growth and then give way to the slower growing perennials. The increased yield the first season will usually more than pay for the extra expense of seeding. If seeded early in the fall in the South Atlantic States it will produce a crop of hay the following spring in time to allow the seeding of a crop of soy beans or cowpeas on the same land.

SOIL AND CLIMATE.

Italian rye-grass will grow under a great variety of soil and climatic conditions. In the East it does best with an abundance of moisture. It is used on the irrigated lands of the West with excellent results. A rich, moist loam is best suited to its culture.

SEED.

The seed of Italian rye-grass weighs about 24 pounds to the bushel. Most of it is imported from England. The seed usually sells at a reasonable price and generally may be depended upon to be of good quality.

CULTURE.

A firm subsoil with a fine, mellow seed bed is desirable for seeding. When used on Bermuda-grass sod the old turf should be harrowed, preferably both before and after seeding. Good results are often obtained by seeding with a disk drill, which cuts the turf and covers the seed. When seeded alone it requires from 25 to 30 pounds of seed to the acre to give a full stand. A smaller quantity is sufficient on a well-prepared seed bed if care is taken to give an even seeding. In mixtures with other grasses and clovers, 8 to 10 pounds of seed to the acre will be sufficient.

LYMAN CARRIER,
Agronomist.

WASHINGTON, D. C., *May 31, 1919.*