



Growing
BIRDSFOOT
TREFOIL

in Illinois

By J. J. PIERRE and
J. A. JACKOBS

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ABOUT THE COVER: Typical of birdsfoot trefoil are the yellow sweet pea-like flowers at the top of the stem, the seed pods resembling a bird's foot, and the five leaflets (see plant description, page 3).

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GROWING BIRDSFOOT TREFOIL IN ILLINOIS

By J. J. PIERRE and J. A. JACKOBS¹

BIRDSFOOT TREFOIL is a perennial legume more drouth-resistant than red clover and less sensitive to poor drainage than alfalfa. In addition, the New York broadleaf type will persist under grazing for many years; it remains green and palatable throughout the summer; it will grow throughout Illinois on many types of soil; and it can be grazed by livestock with little or no danger of bloat.

A comparative newcomer to Illinois,² it is arousing a great deal of interest because of these characteristics. This circular has therefore been written to answer some of the questions that are being asked about the uses, establishment, and management of birdsfoot trefoil on Illinois farms.

DESCRIPTION, SPECIES, AND VARIETIES

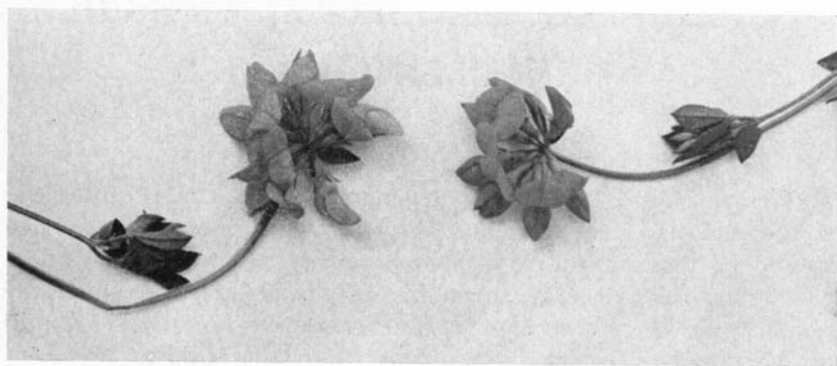
Plant Description

When birdsfoot trefoil starts to grow it has only one stem, but later it develops a branching crown, somewhat like that of alfalfa, with many fine leafy stems. It develops a deep, branching taproot intermediate in size between that of alfalfa and that of red clover. The leaves have five leaflets instead of the three typical of clover and alfalfa. Three of the five leaflets are borne at the end of the petiole and the other two at its base.

The flowers are yellow and shaped like sweet pea flowers (Fig. 1). About four to eight are borne in a cluster at the top of long seed branches. The plants are self-sterile, so that pollination must be done by bees or other insects. When ripe, the seed pods are long, cylindrical, and brown, extending outward at an angle from the tip of the flower stem to give the appearance of a bird's foot. They contain, on the average, 16 to 20 seeds arranged in a straight line as in a bean pod. The pods shatter very easily, opening into two twisted halves to throw out the seed. The seed is about halfway in size between that of red

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² See historical note, page 14.



The yellow flowers of birdsfoot trefoil are shaped like sweet pea flowers and are borne in clusters at the tips of the seed branches. (Fig. 1)

clover and that of alsike clover. A bushel weighs 60 pounds, and there are about 400,000 seeds to a pound.

Species and Varieties

Of several species tested in Illinois, the broadleaf (*Lotus corniculatus* L.) has proved to be the best. The narrowleaf (*L. tenuis* Gaud.) and big trefoil (*L. uliginosus* Schk.) are not as productive and apparently have no advantages over the broadleaf species.

Two types of the broadleaf species are generally recognized — one is commonly known as the New York, and the other as the Italian or French broadleaf. The Italian has more seedling vigor, blooms earlier in the spring, recovers more quickly after cutting for hay, and grows more upright than the New York. However, the New York can survive more severe grazing and for this reason it is longer-lived, remaining in pastures longer than the Italian. Therefore, the New York is recommended for use in perennial pastures. The Italian is satisfactory for meadows that will be cut for hay.

Several new varieties have been developed. Empire, an improved variety of New York broadleaf selected by the Cornell Agricultural Experiment Station, is an excellent variety for perennial pastures in Illinois. Viking, also selected by Cornell, was derived from the Italian broadleaf, but little is known about this variety because no seed has been available for testing. Other varieties of Italian origin are Cascade and Granger, both selected in the Northwest. In tests to date Granger and Cascade appear to be very good varieties of the Italian broadleaf type.

USES OF BIRDSFOOT TREFOIL

Pastures

The main use of the New York variety is in perennial pastures, for the reasons already mentioned — its resistance to drouth and poor drainage, its survival under grazing, its production of green, palatable forage throughout the summer, and its general adaptability to Illinois conditions, plus the fact that it doesn't cause bloat. The Italian variety may be used in perennial pasture also, but it is less able to survive grazing than the New York variety. Because birdsfoot trefoil is slow in becoming established, it is not recommended for rotation pasture.

Hay and Silage

Both the New York and Italian varieties can be grown as perennial hay or silage crops. Since birdsfoot will grow on soils which are too shallow or too wet for alfalfa, it may prove to be a valuable hay legume where alfalfa is not adapted. Where both are grown, the haying season can be prolonged, for birdsfoot reaches the hay stage later than alfalfa. Birdsfoot can be cut and cured as easily as alfalfa or red clover.

One of the first to use birdsfoot for hay in Illinois was Nick Mueller, of Edgington, who harvested 30 acres in 1949. He was well pleased with the quality of hay and fed it to his calves because of its leafiness, fine stems, and palatability. Others have been well pleased with birdsfoot as a hay or grass silage crop.

HOW TO GET A GOOD STAND STARTED

Birdsfoot trefoil grows slowly in the seeding year; so the following precautions must be taken to establish good stands.

Inoculate With the Right Kind of Bacteria

The bacteria that form nodules on birdsfoot roots are different from those found on other legumes commonly grown in Illinois. It is important therefore that the plants be inoculated with a good culture of the right kind of bacteria. The inoculant may have to be ordered several weeks in advance.

It is difficult to obtain good nodulation. This may be because birdsfoot seed is smooth and consequently the bacterial culture does not adhere well. Good results have been obtained by wetting the seed

with water to which corn sirup has been added, at the rate of 2 tablespoonfuls per quart, and then using nearly twice as much of the proper inoculant as on other legumes.

Lime and Fertilize as Necessary

Although birdsfoot will grow on soils rather low in fertility, it will become established faster and yield better on more fertile soils. It is therefore well to test the soil, and apply the amounts of lime and fertilizer that are recommended for alfalfa on the basis of the tests. The lime should be applied and mixed thoroughly with the soil several months before seeding, but the fertilizer, such as phosphorus and potash, can be applied at any time before or at the same time as seeding. On badly eroded soils and soils low in organic matter and fertility, a complete fertilizer containing nitrogen, such as 10-10-10, will give the plants a faster start. Barnyard manure is valuable when applied at seeding time on low-organic-matter soils. It not only furnishes nitrogen and other elements but also acts as a mulch to protect the plants from drouth and beating rains.

Prepare Seedbed Early

Preparation of the seedbed should be started several months before it is time to seed. Shallow plowing on the contour plus repeated cultivations for several months will help kill a grass sod or weeds that might otherwise compete with the small birdsfoot seedlings. These cultivations will also firm the seedbed and permit moisture to accumulate. Shallow plowing is better than deep plowing because it leaves more of the grass roots and stems near the surface to act as a mulch and thus more water soaks into the soil instead of running off.

Seed in Summer or Early Spring

Because birdsfoot trefoil starts out more slowly than alfalfa it should be given as much time as possible to get established before summer drouths or winter frosts. September seedings are not recommended because the plants are usually too small to survive the winter. Late July or early August seedings have been successful, especially in the southern part of the state. Weed competition is usually less severe on summer than on spring seedings.

In northern Illinois early spring seedings on a seedbed that was partly prepared the previous fall have given the best results. With spring seedings, oats can be used as a companion crop to reduce weed growth and soil erosion, but it should be planted at a rate of less than

1 bushel per acre and grazed down when 6 to 8 inches high. Rye and wheat should not be used as companion crops because they are often too competitive. This is true even when attempts are made to graze the rye or wheat, since the ground is usually too wet or soft for grazing in the spring until after the grain has made considerable growth.

Seed at Proper Depth With Roller or Drill

Seeding can be done with either a corrugated-roller type seeder or a small-grain drill with a grass seed attachment. The ideal depth of seeding is about $\frac{1}{4}$ inch. When seeding is done with a drill, the seed can be placed at the proper depth (and about 1 inch above a band of fertilizer) by adjusting the spouts so that those dropping the seed will be 10 inches behind the ones dropping the fertilizer. The field should then be rolled unless the soil is too wet.

Use Proper Seeding Rates and Mixtures

If birdsfoot is seeded alone, the rate should be about 6 pounds to the acre. However, since it is slow in getting started and is also inclined to lodge when grown alone, it is best grown with a grass.

A seeding mixture which has been used with success is 5 pounds of birdsfoot trefoil per acre, 2 pounds of red clover, and 4 pounds of brome grass. Other grasses such as orchard grass, timothy, or tall oat-grass, at rates of 6, 4, and 10 pounds per acre respectively, can be substituted for brome grass where they are better adapted.

Birdsfoot should not be seeded with "shotgun" mixtures of other legumes and grasses. It is not compatible with lespedeza, and it will not survive the seeding year if there is too much competition from other species such as clover or alfalfa.

Protect Seedlings

A new seeding should be grazed and mowed during the first year to protect the birdsfoot seedlings from shading and competition from other species. Such vegetative competition from other plants has killed more new stands of birdsfoot trefoil than any other single factor.

MANAGEMENT OF ESTABLISHED STANDS

Once birdsfoot trefoil is established, proper management will depend on whether the New York or the Italian strain was seeded and whether the stand is to be used for hay or pasture.

When the New York strain is used for pasture little attention to management is needed except to see that the pasture is not extremely overgrazed or undergrazed. The prostrate growth habit of the New York strain enables it to maintain its vigor and even reseed itself under fairly close grazing.

The Italian strain should be managed about the same as alfalfa. When pastured, it should be rotationally grazed rather than continuously grazed, and should have at least a month to recover between grazings.

When used as hay, both types should be cut between the 1/10 and 1/2 bloom stage. They should not be cut after September 15 in southern Illinois or September 1 in northern Illinois.

MANAGEMENT STUDIES

To find out more about the use and management of birdsfoot trefoil and to compare the New York and Italian varieties, a study was started at the University South Farm in 1949. These four field seedings were made without a companion crop on April 19: (1) New York Empire broadleaf alone; (2) Italian broadleaf alone; (3) Italian broadleaf with Lincoln brome grass; and (4) Italian broadleaf with Kentucky bluegrass.

The entire area was grazed with ewes and lambs from July to September and clipped three times during the same period. In 1950 and 1951, part of each seeding was grazed by yearling lambs. The remaining portion of each seeding was divided into 12 plots, with a different kind of cutting treatment being tried on each plot. Some of the plots were cut frequently and closely to give the same effect as grazing; others were cut as though for haying. The same cutting treatments were used on all four seedings.

In 1952 the plots that had been cut the previous two years were harvested for hay in the first part of June, early in July, and again early in September. The yield data obtained were used to measure the residual effects from the cutting treatments followed during 1950 and 1951.

Results of Different Kinds of Cuttings

Plant survival. New York birdsfoot trefoil maintained a very good stand after every cutting treatment except one: A stand that had rated very good was reduced to only a fair stand by cutting after the seed had ripened in 1951.



A general view of the management study on the University of Illinois South Farm. The New York Empire variety survived the effects of close, frequent, and late fall cutting better than the Italian birdsfoot. (Fig. 2)

Italian birdsfoot was reduced in stand after close and frequent cuttings, especially when the cuttings were continued until October instead of September 1. No reduction was observed in a stand that was cut every 3 weeks at a height of 4 inches until September 1; or in a stand that was cut at prebloom, 1/10 bloom, full bloom, and maturity.

These results indicate that New York is better for pasture than Italian.

Root weights. The root weights of New York broadleaf were not significantly different as a result of the various cutting treatments. The highest average weight of roots was found when cutting was deferred until plants reached the hay stage.

Italian broadleaf roots were heavier when the plants were not cut after September 1 and when they were cut at a height of 4 inches instead of 1 inch. The lowest root weights were found on plants that were cut closely, frequently, and until October. Plants cut at maturity had significantly higher root weights than any of the others except those that were cut at full bloom.



A plot of New York birds-foot before harvesting at the mature stage. Note numerous flowers and seed pods and the heavy, leafy growth of vegetation. (Fig. 3)

Yields. Each of the four seedings responded similarly to the different cutting treatments. Table 1 shows the results from three of the cutting treatments—the first two being similar to grazing and the last one similar to haying. In general, the lowest yields were obtained from cutting when the plants were 3 inches tall; and the highest from cutting twice at full bloom and once in September. Close cutting reduced the yield of the Italian seedings more than the New York. This indicates again the superior ability of the New York variety to survive grazing.

Table 1. — Yield of Dry Matter from Italian and New York Birdsfoot Trefoil as a Result of Different Cutting Treatments, Urbana, 1950-1952 (Tons per acre)

Year	New York birdsfoot	Italian birdsfoot	Italian birdsfoot with bromegrass	Italian birdsfoot with bluegrass
Cutting every 3 weeks until October in 1950 and 1951				
1950.....	2.33	1.70	1.63	1.52
1951.....	2.49	1.45	2.08	1.78
1952 ^a	2.53	2.05	2.26	2.00
Cutting to 1 inch when plants were 3 inches high until October in 1950 and 1951				
1950.....	1.75	1.28	1.18	1.07
1951.....	1.92	.96	1.54	1.21
1952 ^a	3.08	1.84	2.34	1.97
Cutting twice at full bloom and again on September 1 in 1950 and 1951				
1950.....	2.67	2.14	2.07	2.12
1951.....	3.74	3.56	4.36	4.04
1952 ^a	3.48	4.00	4.18	4.42
Difference necessary for significance at the 5 percent level				
1950.....	.21	.29	.27	.33
1951.....	.33	.46	.94	.35
1952.....	.55	.55	.41	.58

^a In 1952 all plots were harvested three times for hay.

Quality. Both the New York and the Italian types were about the same in chemical content, and they were also similar in this respect to red clover and alfalfa. The percentages of protein, phosphorus, potassium, and calcium were usually lower when the birdsfoot plants were harvested at maturity than when they were harvested at the more immature stages. Table 2 shows the percentage of each when the plants were cut at several different stages.

Results From Grazing

Forage and mutton yields. On each of the plots that were grazed, a small section was fenced off from the animals, so that the amount of forage grown could be measured. The amount of forage harvested from these small fenced-off areas, or pasture cages, was about equal to the amount obtained from the plots cut at the full-bloom stage.

The average yield from the pasture cages increased from 2.25 tons of dry matter per acre in 1950 to 4.09 tons in 1951. This increase of 85 percent was not reflected in the pounds of animal gains, which increased by only 8 percent — from 214 pounds in 1950 to 232

Table 2. — Chemical Composition of New York and Italian Birdsfoot Trefoil Given Different Cutting Treatments, Urbana, 1950-1951 (Percent)

Year	Crude protein		Phosphorus		Potassium		Calcium	
	N.Y.	Italian	N.Y.	Italian	N.Y.	Italian	N.Y.	Italian
Cutting every 3 weeks until October								
1950.....	26.1	27.1	.45	.46	2.2	2.2	1.5	1.5
1951.....	31.5	29.7	.45	.49	2.0	1.9	1.8	1.9
Cutting back to 1 inch when plants were 3 inches high until October								
1950.....	27.4	28.4	.43	.44	2.2	2.2	1.5	1.4
1951.....	22.5	29.7	.49	.51	2.4	2.0	1.8	1.7
Cutting twice at full bloom and again on September 1								
1950.....	20.2	16.3	.28	.36	1.8	1.6	1.1	1.2
1951.....	22.7	19.7	.41	.38	1.8	1.6	1.4	1.3

pounds in 1951. However, the sheep days of grazing per acre increased from 684 days in 1950 to 1,251 days in 1951, or nearly 83 percent.

Plant survival. No changes were observed in the stand of New York birdsfoot as a result of grazing. The Italian, however, showed a slight decrease in stand.

Results of Seeding With Grass

Neither bromegrass nor bluegrass had any depressing effects on the yield and vigor of Italian birdsfoot trefoil. Nor did volunteer bluegrass affect New York birdsfoot.

Grass not only has no adverse effects, but it keeps the birdsfoot from lodging and also protects it from heaving. An example of what often happens when birdsfoot is sown without grass occurred at Dixon Springs during the winter of 1951-52. At that time a seeding of birdsfoot alone suffered considerable heaving and a reduction of stand after it had been grazed closely by sheep in the fall of 1951.

SEED PRODUCTION

Birdsfoot trefoil is a prolific seed producer but the seed is difficult to harvest. For one thing, the seed is produced over a period of time, and a plant may have thoroughly ripe pods and new flowers at the

same time. For another, when the pods become ripe and dry they shatter rather easily so that considerable loss of seed is inevitable even with the best management and harvesting techniques.

Yields

The first crop of the season is usually the one that produces the highest yields. Even so, few of the seed yields obtained in Illinois have been higher than 50 pounds per acre. A 10-acre field of New York birdsfoot trefoil was harvested for seed at the Dixon Springs Station in 1952 and 1953, after having been grazed for about a month early in the spring. The seed was combined from the swath and yields have averaged about 30 pounds per acre each year.

At the Albia Pasture Improvement Farm in Iowa, however, Iowa State College harvested three crops of seed in as many years, and obtained yields of 171, 119, and 243 pounds per acre on a field basis.

Hormones Found Ineffective

The possibilities of using hormone treatments to either promote more uniform ripening of seed or to prevent seed shattering were studied at Urbana. Two hormones, Indole-3-acetic and alpha-naphthalene-acetic acids, were sprayed directly on the flowers of birdsfoot trefoil on different dates. Both were tried in concentrations of 10 and 100 p.p.m. Neither hormone, however, had any significant effect on the percentage of flowers developing into pods. Nor — when the seeds were harvested on several different dates after treatment — was there any difference in the number of pods not shattered.

Effects of Mowing

Different field plots at Urbana were mowed on May 15, May 30, and June 10, and seed yields were compared with yields from plots that had not been mowed at all before harvest. Mowing in June reduced yields, but mowing in May had no adverse effect. Apparently mowing or grazing old vigorous stands in May reduces the amount of vegetation that needs to go through the combine without reducing seed yields to any large extent.

Methods of Harvesting

Probably as good a harvesting method as any is to mow with a windrower attachment on the mower and then combine directly from the swath as soon as the forage is dry enough to go through the combines.

Other methods tried have varied from combining the standing crop to placing the partly dried forage from the windrow in small cocks, a stack, or round bales, and then, after further drying, threshing with a clover huller or combine.

INSECTS AND DISEASES

At the present time birdsfoot trefoil is less affected by diseases and insect pests than are most legumes. Grasshoppers, leafhoppers, and the spittlebugs will cause damage similar to that which they inflict on alfalfa; but so far they have not been known to seriously injure a well-established stand.

Two root rots, caused by *Rhizoctonia solani* and *Sclerotinia trifolium*, have been observed, but they have not caused heavy damage on pastured fields in Illinois.

HISTORICAL NOTE

Like other legumes in common use, birdsfoot trefoil came from Europe; it is believed that the seed was introduced with ballast materials from England. Although it was first reported in New York in 1875, it was not recognized as a plant of much economic importance in this country until 1934, when agronomists from Cornell University found it growing extensively on run-down farms in the New York Hudson valley. Farmers didn't know where it came from, but they knew that all kinds of stock liked it and that it had persisted and spread in their pastures for 20 years or longer. When the soil was treated with lime and fertilizer, they found that the yields of forage were very good.

H. A. MacDonald, of Cornell University, started intensive studies on this legume in 1934 to determine its habits, its soil and fertilizer needs, and its value. In 1937, the first commercial quantities of seed produced in the state were harvested. Since then broad-leaf birdsfoot trefoil has been recognized as a valuable legume in New York, Illinois, Iowa, Indiana, and several other states.

In Illinois, a small planting had been established on the University South Farm at Urbana as far back as 1929. Several years later that area was converted into a bluegrass border along a new roadway. Although it has been mowed repeatedly for more than 20 years, many birdsfoot plants can still be found with the bluegrass.

In the spring of 1942 a trial pasture planting of New York birdsfoot was established on an eroded Clarence silt loam soil near Pontiac. Besides maintaining an excellent stand for the past 11 years, this planting has been spreading into the bluegrass next to it. At the Dixon Springs Experiment Station, New York birdsfoot was seeded alone in 1944. From 1946 to 1950 inclusive the yield of dry matter averaged 5,106 pounds per acre per year. At the end of this period 70 percent of the forage consisted of birdsfoot trefoil. Since 1946, numerous other trial plantings have been made co-operatively throughout the state by members of the Agricultural Experiment Station, the Soil Conservation Service, and the Extension Service, as well as by interested farmers. The main object has been to determine the adaptation of birdsfoot to different soils and climatic areas and to observe the cultural and management practices that are favorable to it. Some of the plantings compared birdsfoot trefoil grown with different grasses to alfalfa, Ladino clover, and other legumes in association with these same grasses.

In Iowa, the first known seedings of birdsfoot trefoil were made in 1938. One planting near Atlantic was seeded with timothy for hay, while another near Centerville was seeded with bluegrass for pasture. Both have maintained good stands to this date. Other pasture seedings made in 1941 and 1942 at the Albia Pasture Improvement Farm have also continued with a vigorous stand and growth.

Similarly, results in Indiana have been very good. A 1941 seeding with bluegrass at the Miller-Purdue farm has maintained an excellent stand and has consistently produced as much beef per acre as any other grass-legume combination — if not more. From 1948 through 1950 the average gains of beef per acre were 342 pounds each year. The soils at this station are not good alfalfa soils, since they are heavy in texture, and have impervious subsoils and poor internal drainage. In 1953, the Purdue Station reported that birdsfoot trefoil in combination with bluegrass gave a greater increase in beef production on permanent pastures than an annual application of 120 pounds of nitrogen per acre.

Birdsfoot Trefoil Has Many Advantages . . .

It will withstand grazing, set seed even when grazed, and maintain a good stand for many years.

It is winter-hardy, and also survives heat and drouth very well. It will grow on a wide range of soils with varying fertility.

When properly fertilized and managed, it yields well, producing a palatable, nutritious feed either as pasture, hay, or silage.

No cases of bloat have ever been reported in animals grazing birdsfoot trefoil.

But It Has Disadvantages, Too . . .

For one thing, birdsfoot doesn't become established quickly or easily. For another, seed is expensive.

Stems are weak, often lodging if the plant is not grown with a grass.

A special inoculant is essential, and it may have to be ordered several weeks before seeding.