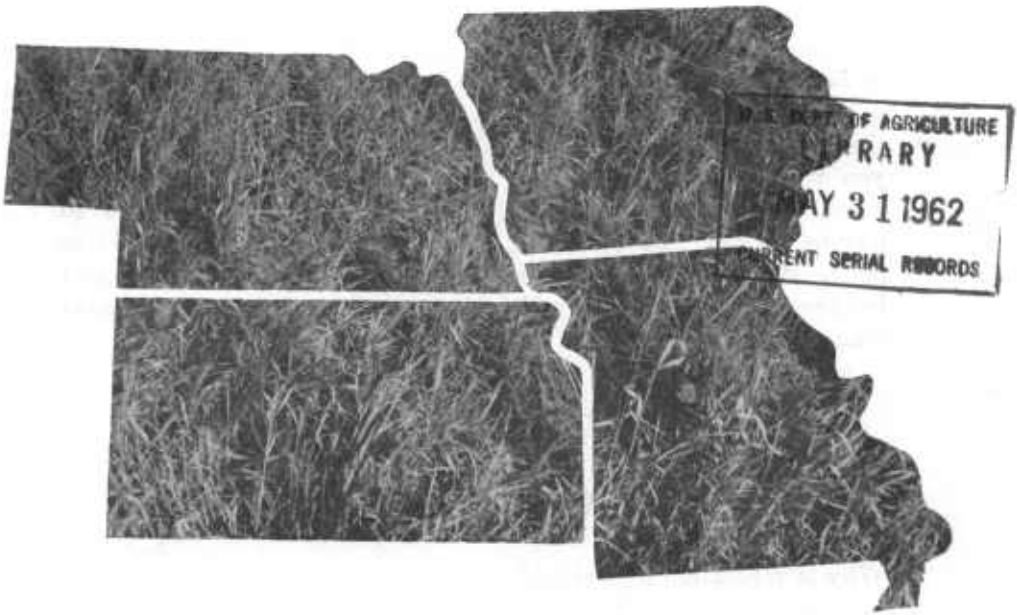
ESTABLISHING VEGETATION ON EXPOSED SUBSOIL IN THE MONONA-IDA-HAMBURG SOIL ASSOCIATION AREA

OF KANSAS, IOWA, MISSOURI, AND NEBRASKA



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Iowa Agriculture and Home Economics Experiment Station

POINTS TO REMEMBER

1. Fertilize Properly. Use 50 pounds of N and 200 pounds of P_2O_5 on most subsoil cuts of Monona - Ida - Hamburg soil association.
2. Seed at the Proper Time. In the spring seed before May 15. Don't waste seed by seeding later than this date. Seed fall seedings between August 15 and September 15. Use 5 pounds of alfalfa and 8 pounds of brome per acre.
3. Use a Legume. Use a legume in the initial seeding even though you wish to end up with a grass. Alfalfa is the best legume to use. To obtain a good stand, inoculate the legume seed. Bromegrass will take over within 2 years.
4. Plant the Right Variety. Plant varieties of brome and alfalfa adapted to western Iowa—Auchenbach or Lincoln brome; Vernal or Ranger alfalfa.
5. Mulch is not Necessary. It is expensive to obtain and to apply; it is cheaper to reseed several times than to use a mulch.
6. Native Grasses are Slow. If you prefer native grasses, use sideoats grama, little bluestem, switchgrass, or sand lovegrass—in that order of suitability. Be prepared to spend more money for native grass seed than for brome and to wait 3 to 5 years for good stands.

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WHY IS VEGETATION IMPORTANT?

Erosion of exposed subsoil is a serious problem on basin terraces, cut slopes, borrow areas, earth fills, highway backslopes, and similar areas. On a highly erodible subsoil, as that found in the Monona-Ida-Hamburg soil association area of Iowa (fig. 1),[1] silt eroded from exposed subsoils in one year can drastically reduce the capacity of a road ditch or a basin terrace for conducting or storing water (fig. 2).

With stepped-up highway construction and with increased watershed work, both in the Little Sioux watershed and under Public Law 566, more and more acres of subsoil are being exposed each year (fig. 3). Since the areas exposed in watershed development and highway construction (fig. 4) and the costs of building these structures are great, it is very important that the subsoils be stabilized as quickly as possible.

At present, the most practical method of stabilizing subsoil areas is to establish a vegetative cover. Fortunately, the Monona-Ida-Hamburg subsoils are friable and easy to work. A seedbed can be prepared easily. The subsoils are, however, very low in nitrogen and available phosphorus and are highly erodible (figs. 5 and 6). Thus, erosion is often excessive during the period when seedlings are too small to give adequate protection. The cost of establishing vegetation on these sites is justified to a large extent as protection for costly structures. When compared with an alternative such as sodding, the cost of seed and fertilizer is not excessive.

[1] The Monona-Ida-Hamburg soil association (MIH) consists of soils developed in deep, wind-deposited material adjacent to the Missouri River bottom lands. The Hamburg and Ida soils and, sometimes, the Monona occur on steep slopes. The Ida soil contains lime in the surface and is low in available phosphorus.

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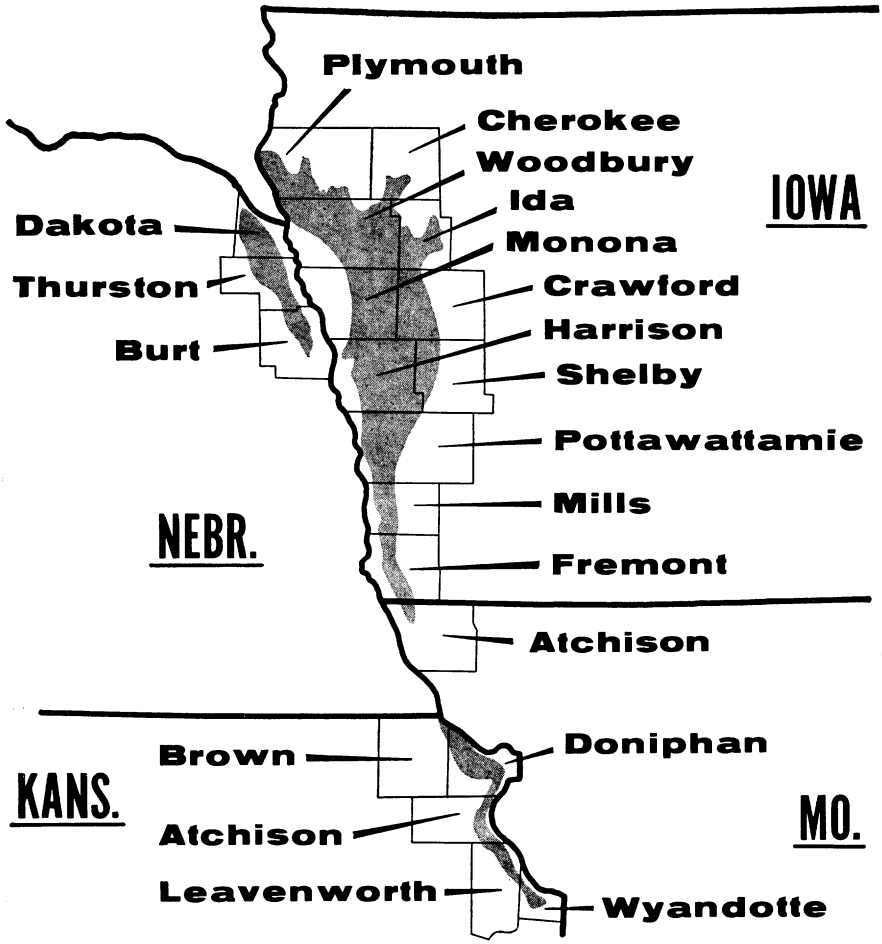

Monona-Ida-Hamburg soil association area

Figure 1.—Monona-Ida-Hamburg soil association area in Iowa, Nebraska, Kansas, and Missouri.

HOW MUCH FERTILIZER IS NEEDED?

Phosphorus is the key to the successful establishment of legume or grass–legume seedings. Nitrogen and phosphorus must be used when grass is seeded alone. Table 1 illustrates yield differences found in several experiments and many field trials. Highest yields of an alfalfa–brome mixture were the result of the highest phosphate application (240 pounds per acre). The quantity of nitrogen had little effect on these yields, which were taken in the fall of the seeding year.

Figure 2.—Silt deposition in the channel of a basin terrace caused by erosion of the cut slope above.

TABLE 1.—*Effects of fertilizer treatments on the yields of alfalfa–brome on Ida silt loam subsoil*

Treatment (lb. per acre)			Yield at 12-percent moisture
N	P_2O_5	K_2O	
			Pounds per acre
120	0	0	12
0	0	0	36
80	80	0	325
40	80	0	432
120	80	0	503
40	160	0	509
0	240	0	891
40	240	0	947

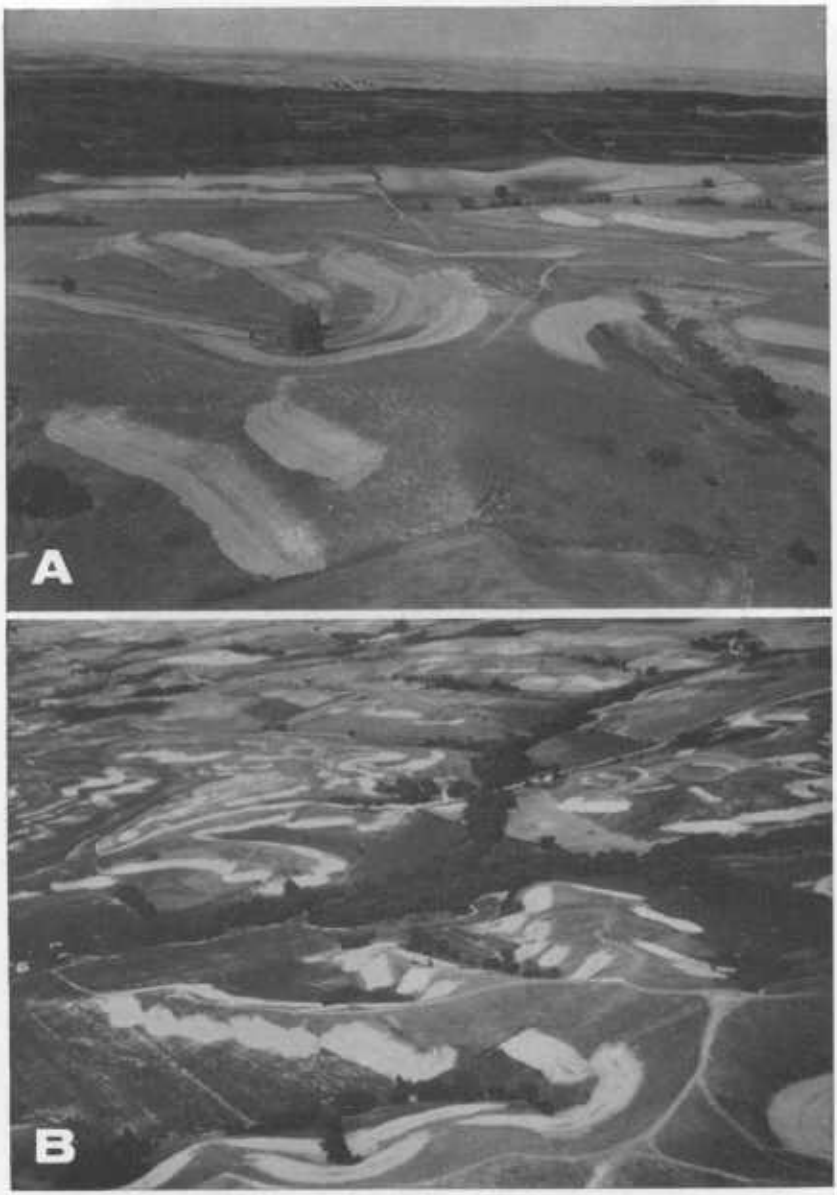

Figure 3.—Light-colored areas are basin terraces to be vegetated in Woodbury County, Iowa: *A*, Lum Hollow watershed; and *B*, Davis watershed.

Figure 4.—Basin terraces protect more nearly level areas from runoff water from steep areas above.

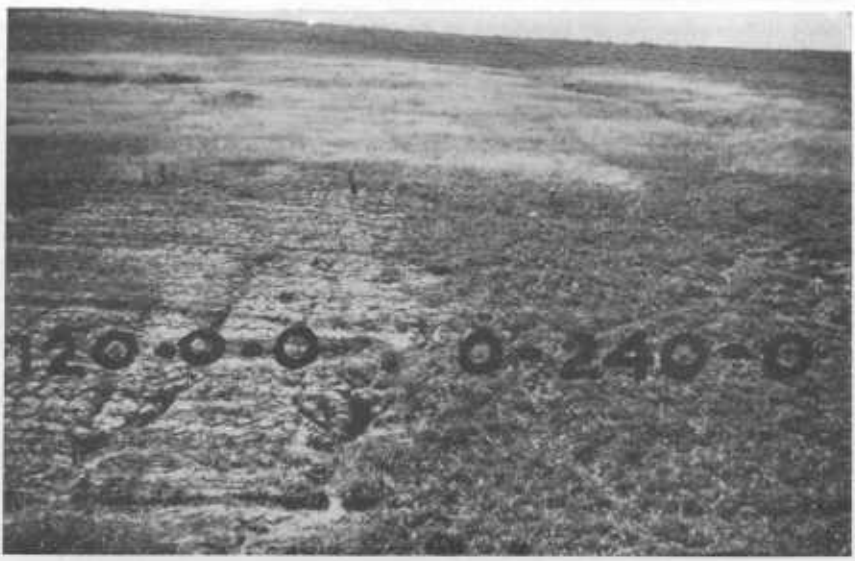

Figure 5.—Neither brome nor alfalfa can be established without phosphorus. Vegetation was established on the plot at right where 240 pounds per acre of P_2O_5 was applied, but vegetation was sparse on the plot at left where 120 pounds N was the only nutrient supplied.

Some nitrogen does help the grasses in the grass–legume mixture to get off to a good start, however. Table 2 shows that 25 pounds of nitrogen gave an increase in the number of brome plants. From studies of many seedings in the Monona-Ida-Hamburg soil association area, it has been found most subsoils are less fertile than at the

Figure 6.—Vegetation was not established on the unfertilized area between two high-phosphate experimental plots.

Figure 7.—A year-old stand of alfalfa and brome established on a basin terrace. Fertilizer treatment was at the rate of 600 pounds of 8–32–0 per acre.

experimental site (3 miles east of Castana, Iowa). The recommended application for the brome–alfalfa mixture over the entire area, therefore, is 50 pounds of N and 200 pounds of P_2O_5 per acre (fig. 7). A soil test will indicate whether or not the maximum P_2O_5 application is needed, if there is time to have the soil tested prior to seeding. Figure 8, *B*, shows that a nitrogen application is not absolutely necessary when alfalfa is seeded with brome. When brome is seeded without a legume, however, nitrogen is essential at seeding time, and annual applications of nitrogen are necessary to keep the stand vigorous. Brome cover was not nearly so good as that obtained when alfalfa was used in the seeding, partly because stands were reduced by erosion during the seeding year, but mainly because of the need for nitrogen, which is supplied by alfalfa (figs. 8 and 9).

Barnyard manure is a very effective fertilizer, but it must be supple-

TABLE 2.—*Brome stand and cover, as influenced by fertilizer treatment and oats and alfalfa companion crops, Ida silt loam subsoil*

Crop and fertilizer treatment (N–P_2O_5–K_2O) in pounds per acre	Brome plants per square foot [1]	Evaluation of brome cover year following seeding
	Number	
Brome with oats:		
0–200–0	11	Poor.
25–200–0	14	Fair.
50–200–0	19	Do.
Average	15	
Brome with alfalfa and oats:		
0–200–0	10	Excellent.
25–200–0	23	Do.
50–200–0	16	Do.
Average	16	
Brome only:		
0–200–0	14	Poor.
25–200–0	21	Poor to fair.
50–200–0	25	Fair to good.
Average	20	
Brome with alfalfa:		
0–200–0	20	Very good to excellent.
25–200–0	26	Excellent.
50–200–0	25	Do.
Average	24	
All crop treatments (average):		
0–200–0	14	
25–200–0	21	
50–200–0	21	

[1] Counts made in the fall of the seeding year.

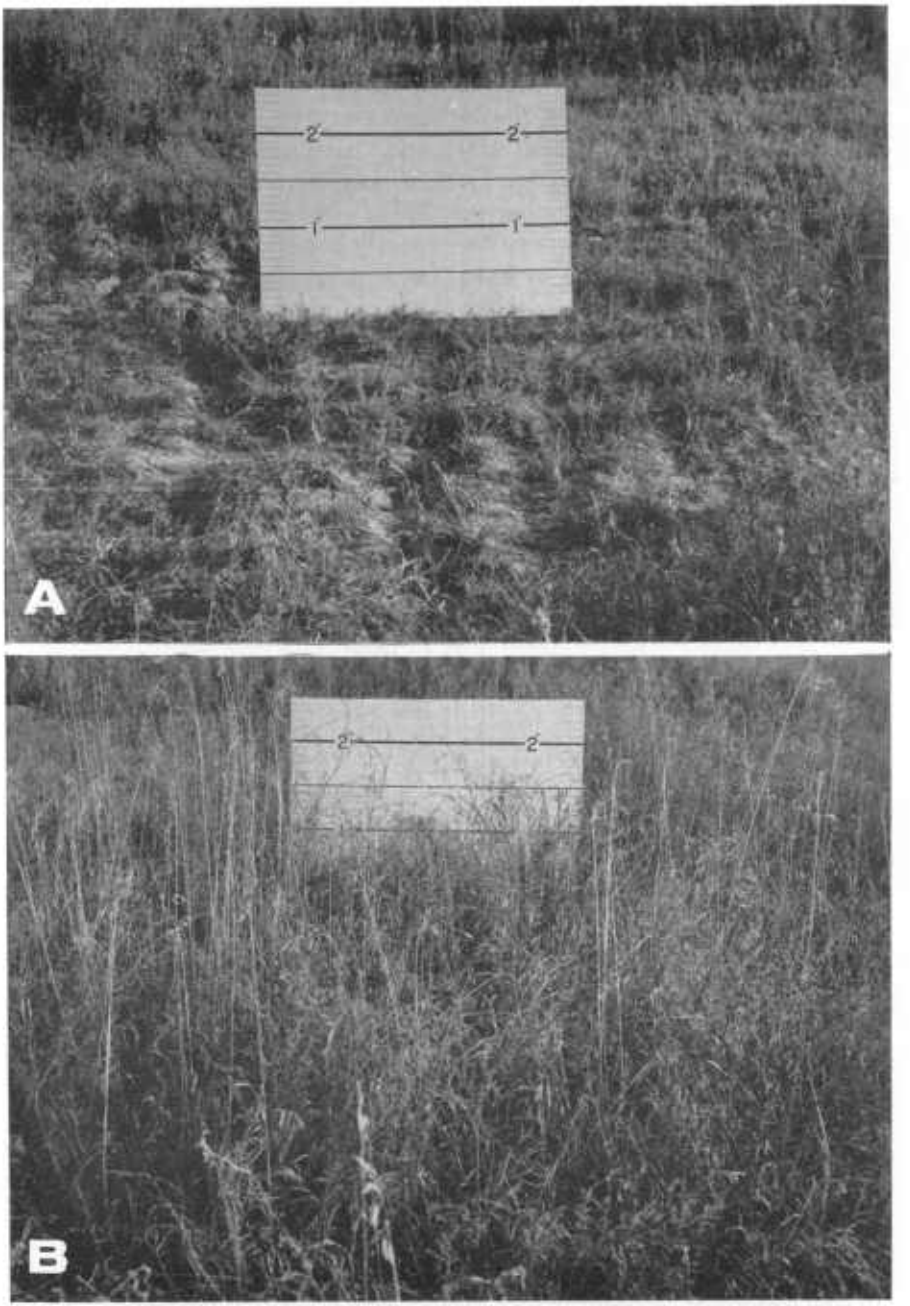

Figure 8.—Establishment of brome cover when 200 pounds of P_2O_5 per acre is added to subsoils: *A*, Cover very poor on brome seeding; 8, cover excellent on a brome–alfalfa seeding.

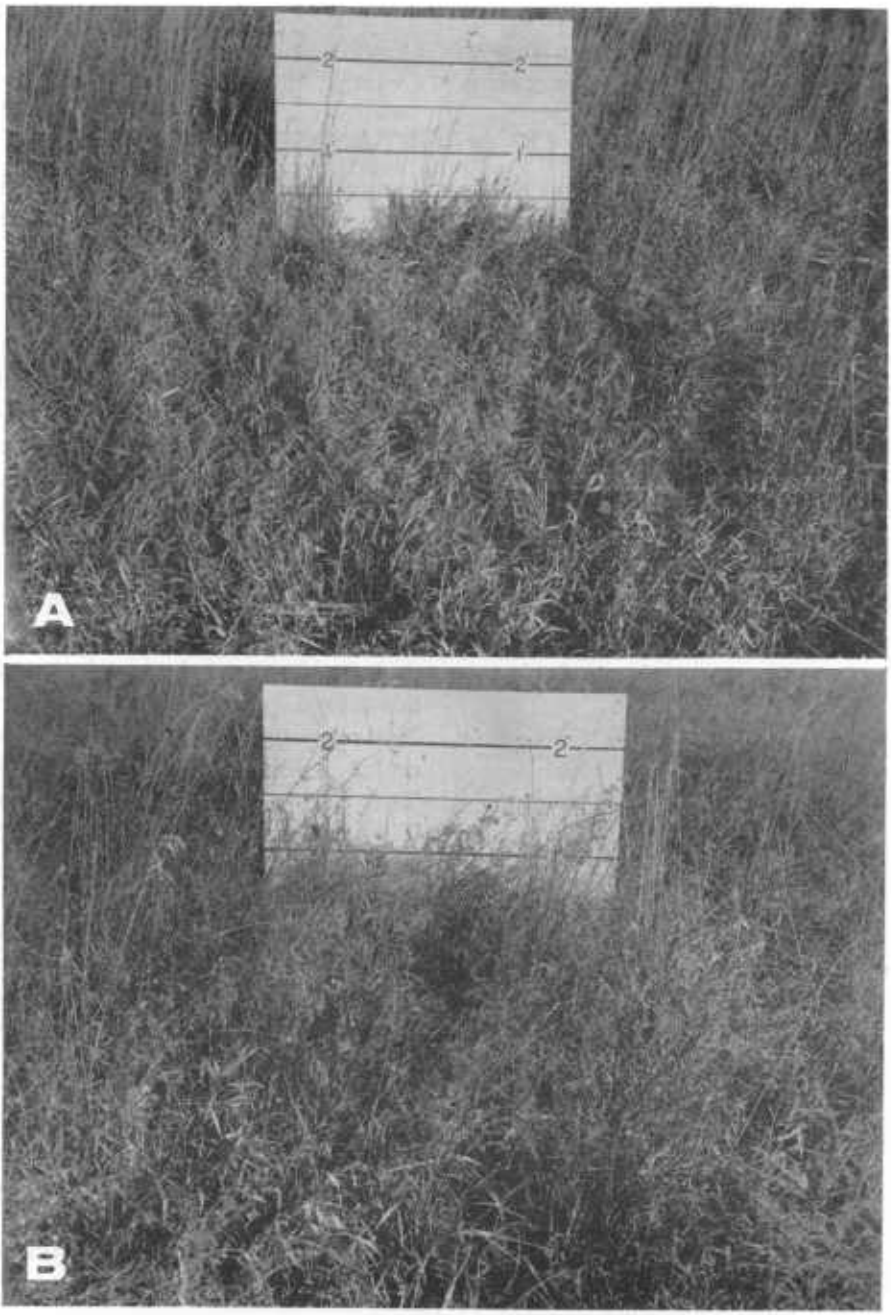

Figure 9.—Establishment of brome cover when 50 pounds of N and 200 pounds of P_2O_5 per acre are added to subsoils: *A*, Cover good on brome seeding; *B*, cover excellent on a brome–alfalfa seeding (alfalfa has been frosted).

mented with phosphate. It should be worked into the soil surface to some extent with a disk or spring-tooth harrow. It will also act as an effective mulch to keep down erosion.

WHAT TYPE OF VEGETATION IS BEST?

A mixture of alfalfa and brome has given excellent results on subsoils in the Ida-Monona-Hamburg area. In areas that are neither grazed nor mowed, brome will crowd out the alfalfa within 2 years. In such areas the effect of the alfalfa on the vigor of the brome is pronounced, and this effect will remain for several years after the alfalfa is gone. Brome seeded alone with nitrogen fertilizer in quantities up to 50 pounds per acre was in need of another nitrogen application the following spring. An oats companion crop reduced the brome stand (table 2).

In a pasture where alfalfa is not wanted because of the bloat hazard to livestock, however, the alternative is to seed brome with oats. These stands are usually less vigorous. Sufficient nitrogen (75 to 100 pounds per acre) should be added to replace that furnished by alfalfa. Nevertheless, it is more economical to use alfalfa in getting the grass started if care is observed in grazing the mixture. Alfalfa will reduce the quantity of nitrogen necessary to keep the brome vigorous during the establishment period. As alfalfa grows rapidly, it will serve as a cover crop if seeded early enough. Alfalfa then will generally be gone at the end of the second year if the mixture is not grazed or mowed.

Vernal, Ranger, Buffalo, or Atlantic alfalfa varieties and Auchenbach, Lincoln, or Fisher brome varieties are recommended in that order of desirability for the Ida-Monona-Hamburg soil association area. Alfalfa should always be inoculated, as the subsoil material is almost certainly without a source of bacteria.

Native grasses such as sideoats grama, little bluestem, switchgrass, and sand lovegrass have at least one advantage over smooth brome. Native grasses will remain vigorous on less fertile soils than will brome. They also have disadvantages. They don't compete nearly so well with alfalfa as does brome. Higher seeding rates are necessary in native grass seedings (table 3), and seed is expensive. (See "How Much Native Grass Seed.") Native grasses develop much more slowly than bromegrass. Seeding with alfalfa is even more important with native grasses than with brome because of the need for cover during the establishment period. The warm season native grasses, e.g., sideoats grama and switchgrass, should be seeded only in the spring.

WHEN AND HOW SHOULD SEEDING BE DONE?

Seed grasses and legumes (except warm-season native grasses) between April 1 and May 15 or between August 15 and September 15.

TABLE 3.—*Effect of different seeding rates of grasses and alfalfa on grass stands the second year on exposed Ida silt loam subsoil*

Species	Grass plants per square foot if live seed were planted at the rate of [1]—		
	10	20	40
	Number	*Number*	*Number*
Smooth brome	[2] 13	19	22
Little bluestem–sideoats grama mixture	4	5	13
Switchgrass–sand lovegrass mixture	3	6	11
Canada wildrye–indiangrass mixture	1	2	4
Western wheatgrass	0	0	1

[1] Alfalfa was seeded at the rate of 5 pounds per acre on one-half the area and at 10 pounds on the other half. Since the rate of alfalfa seeding had no significant effect on the grass stands, the data are averages from the entire experiment regardless of alfalfa seeding rate.

[2] By the second year the brome plants had begun to spread, causing the stand count to be higher than the seeding rate in some cases.

HOW MUCH NATIVE GRASS SEED?

When buying native grass seed, check germination and purity. These may be very low with "trashy" seed. Multiply the percentage of germination times the percentage of purity to obtain the percentage of live native grass seed. After the approximate number of live seed per pound of native grass is determined, check the number of seed per pound—sideoats grama, 191,000; little bluestem, 260,000; switchgrass, 389,000; sand lovegrass, 1,400,000—to obtain the number of pounds that must be seeded per acre for a certain stand per square foot. (The number of seed per pound of other native grasses may be obtained from your county agent or SCS technician.)

SAMPLE PROBLEM: Little bluestem is to be seeded. To obtain the best possible emergence, 40 live-seed-per-square-foot rate is decided upon. The seed to be purchased has a purity of 50 percent and a germination of 60 percent.

$0.50 \times 0.60 = 30$ percent little bluestem live seed.

The average number of seed per pound of little bluestem is 260,000. With only 30 percent live seed in a pound, 78,000 seed should sprout. As there are 43,560 square feet in an acre, each pound will furnish only

$$\frac{78{,}000}{43{,}560} = 1.8$$ little bluestem live seed per square foot.

Thus, to get 40 little bluestem live seed per square foot, 22 pounds of seed per acre must be sown.

An optimum number of seedlings per square foot has not been determined, but cover is obtained more quickly as the number increases.

Usually the young seedings are safe from a killing frost after April 1. If seeding cannot be done before May 15, it is much better to wait and make a fall seeding for brome and alfalfa. Seedlings usually cannot survive high midsummer temperatures.

Spring seeding is preferred, especially for warm-weather native grasses. In this area, long dry periods in the fall happen much more frequently than dry periods of similar length in the spring. If the

fall is too dry for seedings to get started, melting snow and early spring rains usually ruin the seedbed and seeding must be done again in the spring.

The seedbed can be made with a disk or a springtooth harrow. Till to a minimum depth of 3 inches. Fill all rills and gullies and make the seedbed as smooth as possible. If there are rills in the area to be seeded, disk it before the fertilizer is applied. After disking, harrow until the seedbed is smooth. Broadcast the seed or plant it with a drill. Cover broadcast seed with a harrow or roller. If a small grain is used as a companion crop, disk it in and harrow before seeding the grass and legume.

If an exceptionally severe erosion hazard exists and spring seeding was not successful, use a temporary seeding of sudangrass or forage sorghum for late spring and summer. Disk this cover when 15 to 20 inches tall and make the permanent seeding of brome and alfalfa in mid-August.

IS A SMALL-GRAIN COMPANION CROP NECESSARY?

Under favorable conditions, if alfalfa is seeded before April 10, it will have made enough growth by June 1 to protect the subsoil from erosion. Data from studies at the Western Iowa Experiment Farm show that in 8 of the 13 years, 1948–60, heavy spring rains did not occur until after June 1. Thus, it has been concluded that a companion crop other than alfalfa for the grass seeding is not necessary. If the seeding cannot be made before April 10, a small grain should be seeded with the grass and legume to furnish protection against erosion. Mow the small-grain crop in late June to keep it from excessively shading the seeding. Because subsoil areas have few, if any, weed seeds, a companion crop is not essential to keep weeds down.

WHAT ABOUT MULCHES?

Mulching or a soil-stabilizer material is desirable on steep subsoil areas of the Monona-Ida-Hamburg soil association only to keep down erosion while seedings are being established. Undesirable physical conditions, such as hard clods, are not a problem on this subsoil. A satisfactory seedbed can be prepared and seedings will grow well without a mulch.

Clear, 2-mil (0.002 inch) polyethylene film, SS–1 asphalt spray (0.2 gal. per sq. yd.) (fig. 10), and straw (1.5 tons per acre) have been used in several experiments in the area. All these decreased erosion during the establishment period, which is very desirable, but all had some disadvantages.

All the mulching materials used may reduce the stand of brome and alfalfa (table 4). They are all expensive and difficult to apply. Since runoff and erosion data from the Western Iowa Experiment

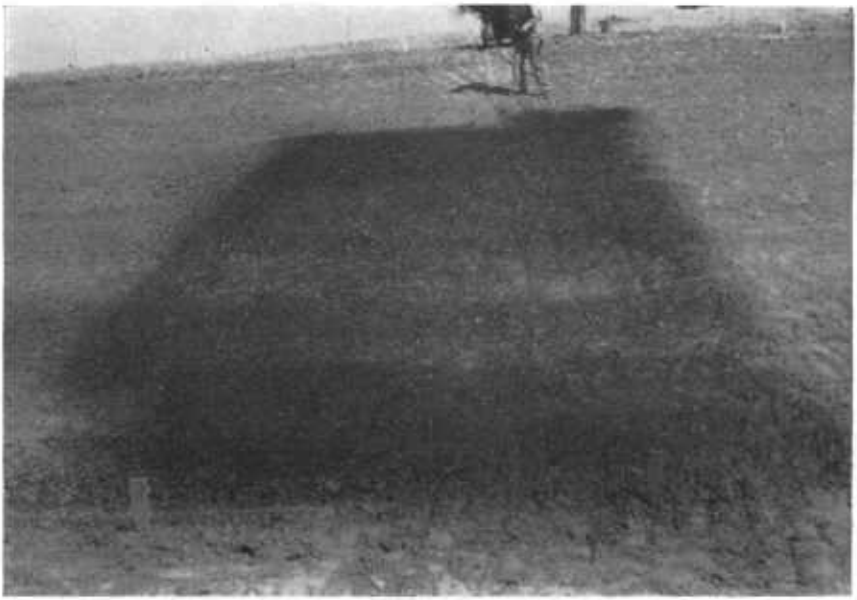

Figure 10.—Spraying asphalt film on an experimental plot located on a basin-terrace cut slope.

Farm show that a mulch in 8 of 13 years would not have been necessary to prevent excessive erosion, it is better to reseed than to put on an expensive covering material.

In addition to those mentioned, several other types of soil stabilizing or mulching materials have been tested by the Iowa State University in cooperation with the

TABLE 4.—*Effect of mulching or covering material or small-grain companion crop on establishment of a brome–alfalfa cover*

Mulch material or companion crop	Fall seeding			Spring seeding		
	Plants per square foot	Brome	Alfalfa	Plants per square foot	Brome	Alfalfa
	Number	*Percent*	*Percent*	*Number*	*Percent*	*Percent*
Polyethylene film	3	6	94	0		
Asphalt spray	(1)	(1)	(1)	8	22	78
Straw	10	30	70	14	19	81
Companion crop (rye with fall seeding; oats with spring seeding)	15	20	80	13	45	55
No cover or companion crop	20	30	70	16	28	72

[1] No asphalt sprayed on fall seeding.

Iowa Highway Commission. Detergents, latex compounds, water emulsions of waste fats, liquid plastics, and starch are among the types of compounds that have been tested. Some of these materials reduce erosion, but in experimental work to date (1961) they appear less effective in this regard than straw or strawy manure mulches, and they are more expensive.

Advantages and disadvantages of the mulches are given below:

Mulching material:	*Advantages*	*Disadvantages*
Polyethylene film.	Controls erosion completely. Increases soil temperature to give seedlings a faster start.	Costs over $200 per acre. Must be ventilated or removed before hot weather. Difficult to tie down and tears very easily in the wind. Restricts emergence of brome.
Asphalt spray	Does a good job of controlling erosion. If a machine is available, application can be made quickly and easily. Increases soil temperature to give seedlings a quicker start. Seedlings grow up through mulch.	Costs nearly $200 per acre for material and requires a special machine for spraying. In late spring seedings high temperatures caused by the asphalt damages the seedlings. Not so effective as polyethylene film in controlling erosion.
Straw	Available on the farm or neighboring farms in many instances. Relatively inexpensive if available. Controls erosion partly.	Lowers soil temperature in the spring and retards seedling germination and growth. Creates a fire hazard along roads. Oat straw contains many oat seeds. A thick stand cuts down grass and legume establishment. Wheat straw contains comparatively few wheat seeds. Wind tends to bunch straw. During storms, it tends to form dams that pond water. Breaking of these straw dams may start rilling. Should be spread by hand to obtain even application; this is laborious. Less effective in controlling erosion than either polyethylene film or asphalt spray.
Manure	Doubles as a mulch and is excellent source of nutrients and organic matter; however, addition of P_2O_5 is needed to supply adequate quantities of phosphorus. Is available on most farms.	Lowers soil temperature, but not as much as straw.

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