Aerial Seeding

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ABSTRACT

Spring seeding of permanent grasses in a temperate zone can be subjected to many delays. Waiting for the soil to firm after frost and waiting for it to dry after spring rains can consume much of the available and valuable time needed for spring seeding. When complete seedbed preparation is required, along with the application of fertilizer and seed and the application of mulch, a contractor will find it difficult to complete 30 acres per day. Applying seed by aerial means when the ground is loose and friable from frost action, usually during the month of March, is cost effective. Seeding proceeds at the rate of 50 acres per hour. Average annual savings for a 15-year period of use is in excess of $0.5 million per year. Excellent results have been achieved in the establishment of turf because this method permits the seed to start to grow as soon as soil conditions are favorable in the spring. As a part of the grading operation, the roadsides are fertilized and seeded with a stabilizing crop seed. This crop residue then becomes the mulch to be used the following year for the permanent seed. This preparation is necessary for aerial seeding to be successful.

Aerial seeding is one way of applying seed by the overseeding method. Other equipment that will qualify for use in overseeding are (a) broadcast seeder, (b) field cyclone seeder, (c) hand cyclone seeder, and (d) hydraulic seeder. Since 1971, erosion control contractors have chosen to use aerial seeding equipment as a means of overseeding on more than 32,749 acres of highway right-of-way.

Seeding by air is not a new technique. Iowa's first attempt at aerial seeding of highway right-of-way was made in the spring of 1962 using a fixed-wing aircraft.

Two major factors make overseeding a practical method for permanent seeding of highway rights-of-way: (a) major savings in permanent seeding cost, and (b) excellent results in the establishment of turf because this method permits the seed to start to grow as soon as soil conditions are favorable in the spring.

Overseeding should be done when the soil is loose and friable from frost action. This practice allows a growing season approximately 6 to 8 weeks longer than when complete preparation of seedbed is performed.

Total estimated savings achieved from overseeding 32,749 acres has been $8,458,075 for the 15-year period. Table 1 gives the number of miles, acres of overseeding and fertilizing for 1971 through 1985, and includes other bid items relating to permanent seeding.

Table 2 gives the estimated savings achieved from performing aerial seeding. The savings resulting from the elimination of seedbed preparation is the difference between overseeding and fertilizing and seeding and fertilizing, which requires complete seedbed preparation. The estimated savings resulting from the existing drop residue serving as mulch is based on the bid item for mulching when it is done by normal seeding methods. In studying Table 2, it can be seen that extensive savings are achieved by using the aerial seeding method. Aerial seeding includes the application of the seed into existing stabilizing crop residue in early spring without additional soil preparation or mulching and when soil conditions are subject to frost action. The following table gives the estimated savings from 1971 through 1985.

Year	Savings ($)	Year	Savings ($)
1971	230,184	1979	943,400
1972	403,200	1980	433,596
1973	816,060	1981	329,474
1974	465,840	1982	117,521
1975	852,048	1983	365,862
1976	1,119,581	1984	400,140
1977	707,728	1985	703,171
1978	569,910		

Figure 1 shows Plate 1, which provides an analysis of all projects. Significant advances have been made in the seeding operation for the application of the permanent seed for erosion control on Iowa highways. There is, of course, a certain amount of each project that cannot be seeded or is not practical to be seeded, by overseeding methods. Because of the construction scheduling in paving contracts and the shouldering and shaping of the final foreslope, it may be necessary to prepare the seedbed in a normal manner. For both divided and dual-lane highways, the top 12 to 15 ft of the upper portion of the foreslope, as well as the entire median area for divided highways, may require seedbed preparation, seeding, fertilizing, and mulching.

Overseeding is not a new practice. It was used many years in Iowa before the practice of aerial seeding primarily for the seeding of legumes on projects in which the permanent grasses were seeded in the fall. Usually this seeding is done with a hand cyclone seeder or regular field equipment if the ground is dry enough to permit this type of operation.

SOIL CONDITIONING

The stabilizing crop seeding and fertilizing included in the grading contracts provide the general condi-

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TABLE 1 Average Bid Price for Permanent Seeding and Erosion Control, 1971-1983

Year	Activity	No. of Miles	No. of Acres	Average Bid Price ($)
1971[a]	Overseeding and fertilizing	59	1,656	74.00
	Seeding and fertilizing		1,474	103.00
	Seeding, fertilizing, and mulching		1,503	217.00
	Mulching		1,462	110.00
	Mowing (3)		8,304	5.00
1972[a]	Overseeding and fertilizing	103	3,200	85.00
	Seeding and fertilizing		1,900	116.00
	Seeding, fertilizing, and mulching		662	229.00
	Mulching		1,812	95.00
	Mowing (3)		14,667	6.00
1973[a]	Overseeding and fertilizing	108	2,814	120.00
	Seeding and fertilizing		1,013	245.00
	Seeding, fertilizing, and mulching		629	332.00
	Mulching		1,346	165.00
	Mowing (3)		9,322	11.00
1974[a]	Overseeding and fertilizing	82	1,941	175.00
	Seeding and fertilizing		60	250.00
	Seeding, fertilizing, and mulching		187	391.00
	Mulching		29	170.00
	Mowing (3)		6,329	12.50
1975[a]	Overseeding and fertilizing	87	2,928	179.00
	Seeding and fertilizing		436	317.00
	Seeding, fertilizing, and mulching		212	470.00
	Mulching		1,023	229.00
	Mowing (3)		10,487	12.00
1976[a]	Overseeding and fertilizing	206	4,889	179.00
	Seeding and fertilizing		993	275.00
	Seeding, fertilizing, and mulching		144	408.00
	Mulching		1,218	232.00
	Mowing (3)		14,749	12.00
1977[a]	Overseeding and fertilizing	82.5	2,492	168.00
	Seeding and fertilizing		948	282.00
	Seeding, fertilizing, and mulching		115	452.00
	Mulching		1,051	192.00
	Mowing (3)		7,956	10.00
1978[a]	Overseeding and fertilizing	70.2	1,727	190.00
	Seeding and fertilizing		721	287.00
	Seeding, fertilizing, and mulching		58	707.00
	Mulching		734	233.00
	Mowing (3)		5,321	10.00
1979[a]	Overseeding and fertilizing	93	2,650	205.00
	Seeding and fertilizing		894	286.00
	Seeding, fertilizing, and mulching		119	663.00
	Mulching		727	275.00
	Mowing (3)		7,986	12.00
1980[a]	Overseeding and fertilizing	68	1,682	225.00
	Seeding and fertilizing		426	248.00
	Seeding, fertilizing, and mulching		240	514.00
	Mulching		661	235.00
	Mowing (3)		5,082	13.00
1981	Overseeding and fertilizing	77	1,282	216.00
	Seeding and fertilizing		809	234.00
	Seeding, fertilizing, and mulching		2,128	550.00
	Mulching		491	239.00
	Mowing (3)		3,861	12.00
1982	Overseeding and fertilizing	24	527	262.00
	Seeding and fertilizing		306	268.00
	Seeding, fertilizing, and mulching		168	595.00
	Mulching		715	217.00
	Mowing (3)		2,039	16.00
1983	Overseeding and fertilizing	36	1,302	253.00
	Seeding and fertilizing		370	287.00
	Seeding, fertilizing, and mulching		64	585.00
	Mulching		723	247.00
	Mowing (3)		4,737	16.00
1984	Overseeding and fertilizing	45	1,482	227.00
	Seeding and fertilizing		103	247.00
	Seeding, fertilizing, and mulching		206	497.00
	Mulching		103	250.00
	Mowing (3)		4,514	14.00
1985	Overseeding and fertilizing	72	2,177	228.00
	Seeding and fertilizing		177	283.00
	Mulching		171	268.00
	Mowing (3)		6,531	15.00

[a]Based on summary of awarded contracts for the calendar year.

TABLE 2 Overseeding (Aerial Seeding), Estimated Savings for Permanent Seeding and Erosion Control, 1971-1985

Year	Miles Seeded	Acres Seeded	Averaged Bid Overseeding and Fertilizing Per Acre ($)	Additional Cost for Seedbed Preparation Per Acre ($)	Additional Cost for Mulching Per Acre ($)	Estimated Savings, No Seedbed Preparation Required ($)	Estimated Savings, No Mulch Required ($)	Total Savings by Overseeding ($)
1971[a]	59	1,656	74	29	110	48,024	182,160	230,184
1972[a]	103	3,200	85	31	95	99,200	304,000	403,200
1973[a]	108	2,814	120	125	165	351,750	464,310	816,060
1974[a]	82	1,941	175	70	170	135,870	329,970	465,840
1975[a]	87	2,928	179	138	153	404,064	447,984	852,048
1976[a]	206	4,889	179	96	133	469,344	650,237	1,119,581
1977[a]	82	2,492	168	114	170	284,088	423,640	707,728
1978[a]		1,727	190	97	233	167,519	402,391	569,910
1979[a]		2,650	205	81	275	214,650	728,750	943,400
1980[a]		1,682	225	23	235	38,686	395,270	433,956
1981	77	1,282	216	18	239	23,076	306,398	329,474
1982	24	527	262	6	217	3,162	114,359	117,521
1983	37	1,302	253	34	247	44,268	321,594	365,862
1984	45	1,482	227	20	250	29,640	370,500	400,140
1985	72	2,177	228	55	268	119,735	583,436	703,171

[a]Based on summary of awarded contracts for the calendar year.

PLATE No. 1
Permanent Seeding Fiscal 1985
Low Bid Costs

Projects: 17
Acres: 2,177.0

Total Miles: 72.1
Total Contract Cost: $1,387,720

Project		Miles	Acres	Bid Price (per acre)	Total Overseeding and Fertilizing	Seedbed Preparation, Seeding and Fertilizing (per acre)	Mulch (per acre)	Wildflower Seeding (lb)	Native Grass (acres)	Total Project Cost
Black Hawk (11)	520	1.0	70	$230	$ 16,790	$260	$250	68		$ 47,184
Black Hawk (29)	380	3.1	151	230	34,730	260	250	20.6		78,801
Black Hawk (27)	380	3.0	302	240	72,480	280	250	7		132,490
Black Hawk (63)	380	1.6	60	240	14,400	280	250	11		43,258
Wapello	1	5.5	90	200	18,000	325	325	16	3.7	51,605
Poweshiek	146	2.4	22	325	7,280	350	350	4		27,764
Muscatine (34)	61	3.5	67	196	20,171	222	200	12	67.2	61,594
Muscatine (42)	61	4.3	106	196	20,776	222	200	24	126	73,566
Chickasaw (10)	63	4.4	50	240	12,000	300	300	6.2		22,524
Chickasaw (26)	63	4.9	47	240	11,280	300	300	5.8		20,192
Bremer	63	13.0	141	240	33,840	300	300	17		68,334
Polk	35	4.0	130	237	30,755	282	282	27.5		221,192
Benton	380	4.0	280	205	57,400	280	300	23.6		160,918
Linn (72)	380	4.9	239	230	55,085	280	250	23.6		128,536
Linn (75)	380	6.9	268	230	61,755	280	300	23.6		135,340
Linn (78)	380	2.3	100	205	20,500	280	300	11.8		59,788
Scott	61	3.3	51	340	17,340	520	340			54,635
Total		72.1	2,177	Ave. 228	$497,582	Ave. 283	Ave. 268	301.7	196.9	$1,387,720

Average cost overseeding and fertilizing	$228/acre
Average cost seedbed preparation, seeding, fertilizing and mulching	$551/acre
Savings (no seedbed preparation or mulch)	$323/acre
Total savings 2177 acres x $323	$703,171

*Total project includes all seeding, sodding, special ditch control, mowing, water for ditch control, traffic control, and mobilization.

FIGURE 1 Analysis of all seeding projects.

tioning of the soil. The abundant vegetation cover, basically weed-free, together with the root structure to bind the soil particles, minimizes erosion.

The seed mixture consists of the following: winter rye, sudangrass (piper) fescue, Ky. 31, and alfalfa (ranger or vernal) for early spring; sudangrass (piper), fescue Ky. 31, and alfalfa (ranger or vernal) during the summer; and winter rye, fescue Ky. 31, and alfalfa (ranger or vernal) for the fall schedule. All areas that are not seeded by September 30 are to be rough-finished. The more critical areas may be scarified, fertilized, and mulched with the mulch to be anchored with the mulch tiller. This practice provided a natural environment to use the overseeding technique by aerial or other adaptable equipment.

PERFORMANCE

The first two projects in 1971 consisted of more than 600 acres. The seeding was done between the first of March and the first of April. The standard specifications require that the seed be applied when the ground is loose and friable from frost action. Overseeding techniques are used only in the early spring and are not practical for fall seeding when complete seedbed preparation is required. In all cases, establishment of the vegetation has been considered excellent when compared with seeding done by the standard procedures, which are usually carried out during the end of the spring seeding period.

By using a helicopter, enough seed can be carried to seed 8 acres. A small airplane can carry enough

seed for 8 acres whereas a larger airplane can carry enough seed for 12 to 24 acres. It is necessary for the pilot to use a good deal of judgment in order to get the seed applied at the proper rate.

In order to calibrate the seeding equipment, one or two test plots are staked out based on the capacity of the equipment. It is the contractor's obligation to see that the seed is applied at a uniform rate. It then becomes the pilot's obligation to secure a uniform distribution of seed. To achieve this, a minimum of two passes are made over a given area. By seeding at one-half rate, a uniform distribution of seed is achieved.

The contractor makes his own arrangements with an aerial seeding firm. The aerial seeding firm may furnish all related equipment, the pilots as well as necessary ground personnel, which usually consists of one man and two-way radios so there can be ground-to-air communication in order to monitor and control the seed application.

The rate of seed application varies from 30 to 50 acres per hour with wind conditions calm or less than 10 mph. Gusty wind causes poor seed distribution and an unsafe condition for the control of the aerial seeding equipment. Uniform application of seed has been obtained with the air speed of 40 to 45 mph for the helicopter at an altitude of 30 to 45 ft. The width of the swath being seeded varies from 40 to 45 ft.

SUMMARY

The helicopter, which has the side-mounted seed hoppers and all seeding apparatus within the confines of the helicopter, makes a compact unit that is easy to maneuver. The unit with the suspended seed hopper has the advantage of being able to reach into tight corners; however, it has the disadvantage of being more unwieldly to handle. The airplane does an excellent job during low-wind conditions and when few obstacles exist on the highway right-of-way and the right of way is of uniform width.

The following data and dimensions are provided for aircraft used for overseeding.

	Helicopter with Suspended Bucket	Helicopter with Side Mounts	Airplane
Size of batch, acres	8	8	8-20
Air speed, mph	40-45	40-45	90
Altitude, height	40-45	25-30	50-60
Swath spread, width	45-50	40-45	45-55

In the operations in Iowa, the erosion-control contractor furnishes the seed, the fungicide, the inoculant, and sufficient ground personnel to handle processing of the seed. Because a large volume of seed can be used in a very short period of time and because of the effectiveness of this type of seeding, efficiency is one of the keys for economy. The contractors have streamlined their own operation in order to provide fast service with a minimum of unproductive time for the helicopter. Probably the most satisfactory service has been obtained when a large-capacity mixing unit, such as that used in the livestock industry, was used for mixing the seed. The appropriate proportions are put in the mixing unit. After it is thoroughly mixed, the seed can be augered into containers and weighed on a platform scale to determine proper quantity of seed to use for the project. While the pilot is applying a load of seed, ground personnel are preparing for the next load. For an 8-acre load, four containers of seed are prepared to empty into the hopper when the pilot returns for seed. This results in a minimum of downtime.

Under most conditions, the fertilizer is applied at a later date when the ground is firm and can support normal field spreaders with flotation tires. On some projects the helicopter has been used to spread the fertilizer. This method of application may be used because of extremely unstable and wet soil conditions. During fiscal year 1985, some contractors used the helicopter for the second or fall application of fertilizer.

In 1971 aerial seeding firms charged the contractor $1.50 to $2.00 an acre for the application of seed. This varied somewhat, depending on the size of the job. For fiscal year 1985, the average cost was approximately $8.00 per acre for applying seed and $14.00 per acre for applying fertilizer. This type of work is attractive to the aerial applicators because it is required during the last part of February and the month of March. This time of year is extremely slack for other aerial application work.

This brief description of aerial seeding is intended to provide information about a practical, proven, and economical method of permanent seeding for highway use.

Publication of this paper sponsored by Committee on Landscape and Environmental Design.