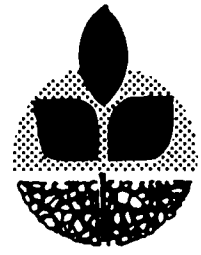
# Field Sanitation Costs for Willamette Valley Grass Seed Producers

Circular of Information 703
April 1989



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ACKNOWLEDGMENTS: A number of persons contributed their time to the project. They include seed growers Mike Coon, Shedd; Don Estergard, Harrisburg; Dennis Glaser, Tangent; Bob Lindsay, Shedd; Jerry Mullen, St. Paul, Jim Vanleeuwen, Halsey; and Dave Nelson, Executive Secretary of the Oregon Seed Council. Dave Bender, Albany, Greg Loe and Ron Rowe, Corvallis, and Bob Rear, Eugene, provided machinery and equipment information for the study. The research was financed under Contract 14-89 between the Department of Environmental Quality and Oregon State University.



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# FIELD SANITATION COSTS FOR WILLAMETTE VALLEY GRASS SEED PRODUCERS

T.L. Cross and R. Mason

## INTRODUCTION

Grass seed production, processing, and marketing accounts for a large share of Oregon's agriculture industry. In 1988, Oregon growers harvested approximately 360,000 acres of grass seed with an estimated farm gate sale value of $211 million [Miles].

Field sanitation is a critical component of grass seed production. Historically, open field burning has been used to remove straw residue and provide disease, weed, and volunteer crop seedling control. Alternative methods of field sanitation are available, but little is known about their cost or long-term effectiveness. The two alternatives used most often by growers are propane burning and nonthermal sanitation with or without straw removal.

This study will focus on the costs of three field sanitation methods in the Willamette Valley for 1988. The objectives of the study are:

1. To estimate the average cost per acre of sanitizing grass seed fields using propane burners;

2. To estimate the average cost per acre of sanitizing grass seed fields using traditional open field burning; and

3. To estimate the average cost per acre of sanitizing unburned grass seed fields using other chemical and tillage methods.

The study was initiated in July 1988 to coincide with grass seed harvest and field sanitation. A unique aspect of this research is that it is based on actual experiences of a large cross-section of grass seed growers.

A survey was used to collect data from growers to estimate sanitation costs per acre. The three-part survey was administered to a randomly selected group of growers by telephone.[1]

Names, addresses, and telephone numbers of 786 growers who had registered grass seed acres with the Department of Environmental Quality for 1988 were used as the sample frame. Growers who had recorded less than 50 acres and duplicate names were deleted from the sample, leaving 628 names in the population. A random 50 percent sample of 314 growers was selected for interview by telephone. Interviews were attempted between September 25 and November 10, 1988, after the burning season.

The results of the telephone contact are shown in table 1. An adjusted completion rate of 94 percent was achieved, after nongrowers were subtracted from the sample base. The response is considered quite high, providing confidence that the data will not be affected appreciably by nonresponse effects. The unusually high response rate indicates that growers were both interested and willing to cooperate in the study.

Table 1. Summary of Telephone Contacts for the Survey

| | |
|---|---|
| Completed | 282 |
| Refused | 14 |
| Not at home | 4 |
| No longer raising grass seed | 14 |
| TOTAL | 314 |

**Study Approach**

Field sanitation practices vary widely among growers due to a number of factors, including location of fields, species and variety of grass crops grown,

[1] A copy of the interview schedule is available on request.

machinery and equipment available, personal preferences, and institutional restrictions. The approach taken in this study is to first determine the cultural operations performed and the resources used by each grower surveyed. Next, the costs associated with the various cultural operations and resources used are estimated using enterprise budgeting techniques. Finally, the estimated operation costs are summed for each grower to arrive at individual costs per acre, which are then averaged to give the average costs per acre for each alternative field sanitation practice.

To illustrate this approach, consider baling straw on a field which will be propane burned. Growers were asked how many tons of straw they baled, what type of baler they used, the horsepower of the power unit for the baler, and the type of bales they put up. The responses to these questions established the cultural operations performed and the resources used by each grower. The next step was to estimate the typical baling costs per ton for a variety of sizes and types of balers and power units. For example, the cost of baling using a square baler pulled by a 120 horsepower tractor was estimated to be $8.78 per ton. These typical costs of baling were then used to calculate each grower's baling cost per acre, based on the size and type of baler and the tons of straw each grower baled.

Please note that the approach we have used considers only those costs of field sanitation which were paid in 1988. We have not estimated the potential decreases in yields of propane burned or unburned grass seed acreage relative to open field burning. Thus, we have ignored a potential cost associated with propane burned and unburned acreage, due to our limited one-year data set.

During the pre-test of the survey, we found that operations and resources used by growers varied among their individual fields and varieties of grass seed. In order to collect the information we needed, we asked growers to respond to the propane burning, open field burning, and nonburning sections of the survey for the largest field they sanitized using each method. This allowed growers to relate the survey to individual fields, and provided the study with the largest feasible

acreage base upon which cost estimates could be made. It also provided a consistent means of collecting data from growers.

A potential problem with using cost information from grower's largest fields is that average costs per acre may be understated if larger fields can be more efficiently sanitized than smaller fields. To overcome this problem, we calculated weighted average costs per acre using field size as the weighing mechanism. The resulting weighted average costs are compared to the unweighted costs to determine the effect of field size on costs per acre.

**Assumptions**

A number of assumptions must be made to estimate typical costs of operations and resources. The major assumptions made in this study and the methods used to calculate costs are discussed below.

*Labor* All labor used in field sanitation is valued at $7.00 per hour. This wage rate may be thought of as the net cost to growers for hired labor which is paid a cash wage of $5.00 per hour, with an additional $2.00 per hour for payroll expenses (withholding taxes, record keeping, preparing W-2 forms, etc.). Alternatively, this wage rate can represent the opportunity cost of labor provided by the owner/operator. The individuals performing field sanitation could have been employed elsewhere for $7.00 per hour. In either case, labor is a resource used and must be paid.

*Interest Rate* An interest rate of 6 percent is used to calculate machinery and equipment ownership costs. This interest rate reflects the <u>real</u> rate of interest, which is the difference between the nominal interest rate and the rate of inflation. In other words, a real interest rate is adjusted for inflation.

Current lending rates for intermediate capital range from 10 to 13 percent [McKinnon, Meyer]. Table 2 shows that inflation has ranged from 2 to 13 percent over the last 20 years with an average of 6 percent [Bureau of Labor Statistics]. This results in a real interest rate of approximately 6 percent.

*Machinery and Equipment*

Table 3 contains a summary of estimated machinery and equipment costs for agricultural operations related to grass seed field sanitation. Appendix A reports the detailed machinery cost estimates.

*Inputs*

Purchase prices, salvage values, useful lives, annual hours of use, and field capacities were obtained from machinery dealers, growers, Extension agents, and other farm professionals.

*Parameters*

Lube, insurance, fuel, and repair multipliers were obtained from agricultural engineering studies. Interest rates and labor rates were assumed as discussed above. Current capital values of machinery and equipment are calculated as average values, using the following equation:

$$\text{Current Value} = \frac{\text{Purchase Price} + \text{Salvage Value}}{2}$$

Remaining lives are one half of the total useful lives.

Average capital values assume that machinery is half used up, which impute machinery and equipment costs over time as average costs. Obviously, some growers use new machinery, while others use quite old machinery. Our costs reflect the

Table 2. Consumer Price Index for All Items and Annual Percentage Change, 1967=100

| Year | CPI - All Items | % Change |
|---|---|---|
| 1967 | 100.0 | |
| 1968 | 104.2 | 4.20 |
| 1969 | 109.8 | 5.37 |
| 1970 | 116.3 | 5.92 |
| 1971 | 121.3 | 4.30 |
| 1972 | 125.3 | 3.30 |
| 1973 | 133.1 | 6.23 |
| 1974 | 147.7 | 10.97 |
| 1975 | 161.2 | 9.14 |
| 1976 | 170.5 | 5.77 |
| 1977 | 181.5 | 6.45 |
| 1978 | 195.4 | 7.66 |
| 1979 | 217.4 | 11.26 |
| 1980 | 246.8 | 13.52 |
| 1981 | 272.4 | 10.37 |
| 1982 | 289.1 | 6.13 |
| 1983 | 298.4 | 3.22 |
| 1984 | 311.1 | 4.26 |
| 1985 | 322.2 | 3.57 |
| 1986 | 328.4 | 1.92 |
| 1987 | 340.4 | 3.65 |
| Average | | 6.36 |

Table 3. Machinery Costs per Acre for Grass Seed Field Sanitation Operations

| INPUTS | Units | Self-Propelled Swather | —BALE— 75 hp Tractor Square Bales | —BALE— 120 hp Tractor Square Bales | —BALE— 190 hp Tractor Square Bales | —BALE— 120 hp Tractor Round Bales | —STACK— Bale Wagon | —STACK— 75 hp Tractor and Loader | —STACK— 120 hp Tractor and Loader | —STACK— 190 hp Tractor and Loader | —CHOP— 75 hp Tractor Flail Chop |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Machine | | | | | | | | | | | |
| Size | hp | 90 | 75 | 120 | 190 | 120 | 90 | 75 | 120 | 190 | 75 |
| Fuel type | G or D | D | D | D | D | D | D | D | D | D | D |
| Purchase price | $ | 45000 | 32000 | 52000 | 80000 | 52000 | 70000 | 32000 | 52000 | 80000 | 32000 |
| Salvage value | $ | 10000 | 9600 | 15600 | 24000 | 15600 | 25000 | 9600 | 15600 | 24000 | 9600 |
| Life | hrs | 3000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 |
| Annual use | hrs | 300 | 450 | 450 | 450 | 450 | 600 | 450 | 450 | 450 | 450 |
| Implement | | | | | | | | | | | |
| Size | ft | none | motor | pto | pto | 1.5 ton | none | | | | 14 |
| Purchase price | $ | | 33000 | 25000 | 25000 | 18000 | 14000 | 14000 | 14000 | 8500 | |
| Salvage value | $ | | 7000 | 7000 | 7000 | 5400 | | 1400 | 1400 | 1400 | 1275 |
| Life | hrs | | 3000 | 3000 | 3000 | 3000 | | 3000 | 3000 | 3000 | 2500 |
| Annual use | hrs | | 300 | 300 | 300 | 300 | | 300 | 300 | 300 | 200 |
| Capacity | acres/hr | 6 | 4 | 4 | 4 | 4 | 5 | 3 | 3 | 3 | 5 |
| Input costs | $/yr | | 7800 | 6750 | 6750 | 600 | | | | | |
| Operation | | | | | | | | | | | |
| Cost per hour | | 52.29 | 69.50 | 70.28 | 82.35 | 42.71 | 64.55 | 30.84 | 38.63 | 50.70 | 29.54 |
| Cost per acre | | 8.71 | 17.38 | 17.57 | 20.59 | 10.68 | 12.91 | 10.28 | 12.88 | 16.90 | 5.91 |
| Cost per ton | | 4.36 | 8.69 | 8.78 | 10.29 | 5.34 | 6.45 | 5.14 | 6.44 | 8.45 | NA* |

| INPUTS | Units | —CHOP— 120 hp Tractor Flail Chop | —CHOP— 190 hp Tractor Flail Chop | —LOAF— 120 hp Tractor Flail & Loaf | -HARROW- 75 hp Tractor Pasture Harrow | -HARROW- 120 hp Tractor Pasture Harrow | -HARROW- 190 hp Tractor Pasture Harrow | --FLUFF-- 75 hp Tractor Fluff | —BURN— 75 hp Tractor Propane Burn | --BURN-- 120 hp Tractor Propane Burn | --BURN- 190 hp Tractor Propane Burn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Machine | | | | | | | | | | | |
| Size | hp | 120 | 190 | 120 | 75 | 120 | 190 | 75 | 75 | 120 | 190 |
| Fuel type | G or D | D | D | D | D | D | D | D | D | D | D |
| Purchase price | $ | 52000 | 80000 | 52000 | 32000 | 52000 | 80000 | 32000 | 32000 | 52000 | 80000 |
| Salvage value | $ | 15600 | 24000 | 15600 | 9600 | 15600 | 24000 | 9600 | 9600 | 15600 | 24000 |
| Life | hrs | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 |
| Annual use | hrs | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| Implement | | | | | | | | | | | |
| Size | ft | 14 | 14 | 14 | 10 | 10 | 10 | 10 | 30 | 30 | 30 |
| Purchase price | $ | 8500 | 8500 | 37000 | 600 | 600 | 600 | 4000 | 7200 | 7200 | 7200 |
| Salvage value | $ | 1275 | 1275 | 7400 | 50 | 50 | 50 | 400 | 720 | 720 | 720 |
| Life | hrs | 2500 | 2500 | 2500 | 2000 | 2000 | 2000 | 2000 | 1500 | 1500 | 1500 |
| Annual use | hrs | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 150 | 150 | 150 |
| Capacity | acres/hr | 6 | 7 | 5 | 7 | 7 | 7 | 7 | 10 | 10 | 10 |
| Input costs | $/yr | | | | | | | | | | |
| Operation | | | | | | | | | | | |
| Cost per hour | | 37.33 | 49.40 | 65.74 | 21.62 | 29.41 | 41.48 | 25.41 | 30.20 | 37.99 | 50.06 |
| Cost per acre | | 6.22 | 7.06 | 13.15 | 3.09 | 4.20 | 5.93 | 3.63 | 3.02 | 3.80 | 5.01 |

*NA = Not Applicable.

Table 3. Machinery Costs per Acre for Grass Seed Field Sanitation Operations (continued)

| INPUTS | Units | Buggy Fert. Appl. | Buggy Chem. Appl. | --WATER-- Tractor & Small Water Tank | --WATER-- Tractor & Large Water Tank | --TILL-- 120 hp Tractor Disc or Plow | --TILL-- 190 hp Tractor Disc or Plow | --TILL-- 260 hp Tractor Disc or Plow |
|---|---|---|---|---|---|---|---|---|
| Machine | | | | | | | | |
| Size | hp | 125 | 125 | 75 | 75 | 120 | 190 | 260 |
| Fuel type | G or D | G | G | D | D | D | D | D |
| Purchase price | $ | 35200 | 35200 | 32000 | 32000 | 52000 | 80000 | 115000 |
| Salvage value | $ | 3520 | 3520 | 9600 | 9600 | 15600 | 24000 | 34500 |
| Life | hrs | 5000 | 5000 | 8000 | 8000 | 8000 | 8000 | 8000 |
| Annual use | hrs | 400 | 400 | 450 | 450 | 450 | 450 | 450 |
| Implement | | | | | | | | |
| Size | ft | 3-ton | 500 gal | 500 gal | 1000 gal | 13 | 15 | 15 |
| Purchase price | $ | 5400 | 7900 | 4300 | 5300 | 12400 | 14900 | 14900 |
| Salvage value | $ | 540 | 790 | 430 | 530 | 1240 | 1490 | 1490 |
| Life | hrs | 1500 | 1500 | 1000 | 1000 | 2500 | 2500 | 2500 |
| Annual use | hrs | 100 | 100 | 50 | 50 | 250 | 250 | 250 |
| Capacity | acres/hr | 20 | 20 | 50 | 50 | 6 | 7 | 8 |
| Input costs | $/yr | | | | | | | |
| Operation | | | | | | | | |
| Cost per hour | | 43.43 | 42.47 | 24.63 | 27.11 | 41.43 | 56.06 | 69.95 |
| Cost per acre | | 2.17 | 2.12 | 0.49 | 0.54 | 6.90 | 8.01 | 8.74 |

average between these extremes. This method also recognizes that machinery and equipment must be replaced over time.

*Costs per hour* Fuel is calculated based on agricultural engineering estimates [McGrann] and the type of fuel used (gas or diesel). Lubrication cost is calculated as fifteen percent of fuel costs [Bauscher]. Repairs are based on agricultural engineering estimates [McGrann]. Insurance costs are calculated as one percent of current value.

Depreciation costs reflect the actual decline in value of the machinery and implements using the straight-line depreciation method. Depreciation for the current year is dependent on the portion of the remaining life used in the current year and on the current market value adjusted for salvage value [McGrann]. Costs per acre are calculated by dividing total cost per hour by acres per hour. For hay operations, cost per acre is divided by two tons per acre to calculate cost per ton.

*Propane costs* During the summer of 1988, propane cost $0.729 per gallon in 1,000 gallon tanks. Delivery and set up of the tanks cost $35.00 per hour, and we assumed a maximum charge of $70.00 per tank for this service. The total cost of propane used in this study is $0.799 per gallon.

*Chemical costs* For unburned acreage, growers were asked to identify the additional chemicals they intended to spray as a result of not burning their fields, the rates at which they would spray, and the total number of applications required. Table 4 shows the most common sprays used and their costs, based on prices provided by chemical dealers.

Many of these chemicals are used on fields which are open or propane burned as spring applications. However, nonthermal sanitation may also require one or more additional fall applications of these chemicals, and these added applications are included in calculating nonthermal sanitation costs.

Table 4. Common Chemicals Applied to Unburned Grass Seed Fields; Application Rates and Prices[2]

| Chemical | Typical Rate per acre | Price |
|---|---|---|
| Karmex | 2 - 3 pounds | $ 3.80/pound |
| Nortron | 2/3 gallon | $47.00/gallon |
| Simazine | 2 pounds | $ 2.95/pound |
| Banvel | 1/2 pint | $59.00/gallon |
| 2,4-D Amine | 1 quart | $ 8.00/gallon |
| Atrazine | 1/2 - 3 pounds | $ 2.40/pound |
| Enquik | 15 gallons | $ 2.00/gallon |

[2]Mention of trade name products does not mean any endorsement of these products by Oregon State University, and the fact that other products are not mentioned does not mean any discrimination against them. Substitute other formulations, as appropriate, for those included in this study.

*Straw storage*

Straw storage costs are based on estimates from a publication by Doran and Ford. They estimate that it cost $9.72 per ton to store hay in a pole shed in 1978, and $10.46 per ton to store hay in a metal shed in 1978.

These costs are adjusted using an agricultural building index [USDA] to obtain 1988 storage costs of $13.22 per ton in a pole shed and $14.23 per ton in a metal shed. A building index was used to adjust costs because construction costs are the major component of straw storage costs. Other costs include interest on stored straw, repairs, insurance, high stacking straw, and weight loss of 5 percent of the straw. The storage costs reflect 6 months of straw storage per year.

## RESULTS

### Acreage Results

Table 5 summarizes the acreage of grass seed represented by the survey sample. The 282 respondents farmed a total of 242,464 acres of cropland. The smallest farm in the sample is 60 acres, and the largest farm is 8,000 acres. Average farm size for the sample is 866 acres. These farms harvested 185,019 acres of grass seed in 1988. The least amount of grass seed harvested is 18 acres, and the largest is 7,200 acres. On the average, these 282 farms harvested 656 acres of grass seed.

Table 5. Acreage Results for the Survey Sample

| | | | Grass Seed | | | |
|---|---|---|---|---|---|---|
| | Growers | Acres Farmed | Total Acres Harvested | Perennial Acres Harvested | Annual Acres Harvested | Acres Unharvested |
| Total | 282 | 242,464 | 185,019 | 119,427 | 63,118 | 3,642 |
| Minimum | | 60 | 18 | 0 | 0 | 0 |
| Maximum | | 8,000 | 7,200 | 5,500 | 3,000 | 480 |
| Average | | 866 | 656 | 424 | 224 | 13 |

Perennial grass seed acreage totaled 119,427 acres in the sample, and averaged 424 acres per farm. Annual grass seed acreage totaled 63,118 acres in the sample, and averaged 224 acres per farm. Growers reported that 3,642 acres of grass seed was left unharvested in 1988, which was two percent of total grass seed acres surveyed. These unharvested acres were likely newly established stands, or old stands which were no longer economically viable. The perennial and annual acres do not add up to total grass seed acres due to rounding and approximation errors by respondents, but the difference is just over one percent.

The Department of Environmental Quality reports that 342,559 acres of grass seed were registered in the Willamette Valley in 1988. If we assume that this figure represents total valley grass seed acreage, then we can calculate a multiplier to be used to aggregate our sample average totals to total values for the entire Willamette Valley, using the following equation.

$$\text{Multiplier} = \frac{\text{Total acres}}{\text{Sample acres}} = \frac{342{,}559}{185{,}019} = 1.85$$

Using this multiplier, we estimate that 220,940 acres of perennial and 116,768 acres of annual grass seed were harvested in the Willamette Valley in 1988. This multiplier is also used to project propane burned, open field burned, and unburned grass seed acres for the Willamette Valley in 1988.

Open field burning was practiced by over 90 percent of growers surveyed on some of their acreage in 1988. The total acres open field burned by survey respondents was 81,450. The smallest number of acres open field burned by a single grower was 15, and the largest was 3,800. The average number of acres open field burned was 321 for the 254 growers who utilized some open field burning. These results are summarized in table 6.

Table 6. Open Field Burned Acreage

| | Growers | Total open field burned acres | Acres in largest open burned field |
|---|---|---|---|
| Total | 254 | 81,450 | 21,526 |
| Minimum | | 15 | 14 |
| Maximum | | 3,800 | 600 |
| Average | | 321 | 85 |

To estimate total open field burned acreage, we use the acreage multiplier derived above. The total estimated open field burned acreage in the Willamette Valley for 1988 is

$$1.85 * 81,450 = 150,683 \text{ acres}$$

This compares to 168,475 acres reported burned by DEQ, and shows that our acreage estimate is only 12 percent different than the true value. There is good reason to expect expanded sample values to be slightly lower than DEQ burning totals. A few growers registered their acres after our sample was drawn and that raised the total number of acres burned by survey respondents, which in turn would increase our estimated open field burned acreage.

Of the 282 growers surveyed, 128, or 45 percent, used propane burners to perform field sanitation on some or all of their grass seed acreage. The total acreage propane burned in the survey was 29,801 acres. The smallest number of acres propane burned by a single grower was 14, and the largest was 3,000. The average amount of acreage propane burned for those growers who propane burned more than 0 acres was 233 acres. These results are summarized in table 7.

Table 7. Propane Burned Acreage for the Survey Sample

| | Growers | Total propane burned acres | Acres in largest field propane burned |
|---|---|---|---|
| Total | 128 | 29,801 | 9,292 |
| Minimum | | 14 | 14 |
| Maximum | | 3,000 | 600 |
| Average | | 233 | 73 |

To estimate total propane burned acreage, we can use the multiplier derived previously. Total estimated propane burned acreage in the Willamette Valley for 1988 is

1.85 * 29,801 = 55,132 acres

Table 5 also contains the results for the largest field propane burned by each grower. The total acreage accounted for by each grower's largest field is 9,292, or approximately one-third of the total acreage reported propane burned in the survey. Estimated propane burning costs per acre are based on the operations and resource growers used on these largest fields. Since these largest fields represent a high percentage of the total acres propane burned, we feel confident that our estimated costs are representative of those paid by growers.

Of the 282 growers surveyed, 204 had at least some acreage which they harvested but didn't burn. This leaves 78 growers that burned all of their

harvested acreage, using propane and/or open field burning. A total of 69,469 acres were not burned by survey respondents, with an average of 341 acres per grower. Using our acreage multiplier, we estimate that total unburned, harvested acreage in the Willamette Valley is

1.85 * 69,469 = 128,518 acres

Table 8 reports totals and values from grower's largest unburned, harvested fields. The total acres in grower's largest fields represent 23 percent of the total unburned acres. As in the propane and open field burning sections, the data from grower's largest unburned fields is used to calculate average costs per acre.

Table 8. Unburned, Harvested Grass Seed Acreage

| | Growers | Total unburned acres | Acres in largest unburned field |
|---|---|---|---|
| Total | 204 | 69,469 | 15,999 |
| Minimum | | 10 | 5 |
| Maximum | | 3,000 | 410 |
| Average | | 341 | 78 |

**Open Field Burning Results**

Open field burning costs were estimated using information gathered from grower's largest open burned field. Total acreage from these largest fields accounts for 25 percent of the open burned acres in the survey. The average largest field size for open burning is 85 acres, (from table 6) compared to 73 acres (from table 7) for propane burning. This implies that propane burning tends to be performed on smaller fields, while larger fields tend to be open burned.

Cost information for open field burning is summarized in table 9. The number of growers and average costs are shown only for those growers who

incurred each type of expense. Incomes are treated as negative values, since they offset the expenses of field sanitation.

The primary costs of open field burning include labor, water tanks, border preparation, and burning fees. A few growers baled, stacked, and stored straw prior to burning their fields, while the majority of growers used burning as a means of disposing of their straw. Field burning rules established by the State Fire Marshal do not require straw removal prior to open field burning [Greene]. However, the rules do specify that "all fields, prior to burning, shall be prepared by removing all straw that lies within a 20-foot strip on the perimeter of the field." The required border preparation could be performed by various methods, including baling, plowing, and discing.

The average cost per acre for open field burned grass seed acreage is $8.86. Individual costs ranged from a low of -$9.83 per acre to a high of $35.55 per acre. The average cost is calculated by multiplying the number of growers who performed each operation by the average cost per acre, summing the total costs of the operations, and dividing the sum by 254 (the number of growers who open field burned.

To examine the relationship between field size and cost per acre, we weighted individual costs per acre by grower's field sizes. The weighted average cost of open field burning was calculated to be $7.97 per acre. Based on the difference of only ten percent between the unweighted average and the weighted average cost per acre, we conclude that our data exhibits no indication of economies of size in open field burning, and therefore our methods have not underestimated actual costs. Assuming that open field burning cost is a normally distributed random variable, we construct a 95 percent confidence interval for our estimated average open field burning cost. We calculate that

$$\text{PROB}[\$8.31 \leq \text{True Average Cost} \leq \$9.41] = 95 \text{ percent}$$

Table 9. Costs per Acre Calculated for Open Field Burned Acreage, by Operation or Resource[4]

| Operation or Resource | Number of Growers | Average Cost per Acre |
|---|---|---|
| | | $ |
| Swathing or Windrowing | | |
| Owner/operator | 23 | 10.22 |
| Custom | 0 | |
| Baling | | |
| Owner/operator, square bales | 11 | 3.45 |
| Owner/operator, round bales | 1 | 0.53 |
| Custom | 3 | 7.77 |
| Trade straw | 2 | 0 |
| Stacking Bales | | |
| Owner/operator, tractor | 2 | 0.39 |
| Owner/operator, bale wagon | 1 | 0.21 |
| Custom | 3 | 2.65 |
| Burning Stacks | | |
| Labor | 5 | 0.14 |
| Water tanks | 5 | 0.31 |
| Straw Sales | | |
| Storage expense, pole shed | 0 | |
| Storage expense, metal shed | 20 | 0.51 |
| Storage expense, rented shed | 1 | 2.44 |
| Straw sales | 3 | -9.01 |
| Expected straw sales | 2 | -25.16 |
| Field Burning | | |
| Labor | 254 | 0.91 |
| Water tanks | 254 | 2.05 |
| Fee | 254 | 3.50 |
| Border preparation | 254 | 1.50 |
| AVERAGE TOTAL COST PER ACRE | 254 | 8.86 |
| CONFIDENCE INTERVAL | | 8.31 - 9.41 |

[4]Average costs are based on the number of growers reported for each operation or resource.

This means we are 95 percent certain that the true average cost per acre for open field burning in the Willamette Valley in 1988 lies in the interval between $8.31 and $9.41.

As we will demonstrate in the next two sections, a major factor influencing the cost of propane burning and nonthermal field sanitation is the ability of growers to dispose of the straw. The two primary methods of disposing of straw according to our survey are: 1) bale the straw and burn it or let it decompose in stacks; and

2) bale the straw and sell it or trade the straw to someone in return for baling and removal services. Growers who have a market for their straw would likely sell it or trade it, while those with no market would tend to burn it or let it decompose.

Straw sales or trades had very little effect on the average cost per acre of open field burning. Only seven growers sold or traded straw from their largest open burned field, and their average cost of burning was $5.49 per acre. A 95 percent confidence interval for this estimate ranges from -$1.58 to $12.56 per acre.

The average cost for the 247 growers who open burned but did not sell or trade straw from their largest fields is $8.96 per acre, with a 95 percent confidence interval of $8.42 to $9.49 per acre. This average confidence interval is almost identical to our total average confidence interval, again leading us to conclude that straw markets do not influence the average cost per acre of open field burning.

While the average cost of $5.49 for growers who traded or sold straw is different from our overall average, the difference is small and shows that straw markets have little impact on the cost of open field burning.

**Propane Burning Results**

The cost of propane burning is summarized in table 10, which shows the number of growers who incurred each type of expense at a nonzero level and the average costs of each operation or resource. All values in table 10 are on a per-acre basis. Incomes received from straw storage or sales are reported as negative values, since they offset the expenses of field sanitation.

Several alternative scenarios of field practices were identified by survey respondents. Many growers gave the straw to individuals in return for baling, stacking, and removal, followed by propane burning. Other growers flail chopped the straw into loafs, burned the loafs, then propane burned their fields. Still

others baled and stacked their straw, burned their stacks, then propane burned their fields. Thirty-six growers propane burned their fields twice. The variety of practices used indicates that growers are still experimenting with propane burning to determine the optimum practices for their fields.

The average cost for propane burned grass seed acreage is $37.79 per acre. Individual costs ranged from a low of $0.97 to a high of $104.79 per acre. The average cost is calculated by multiplying the number of growers who performed each operation by the average cost per acre, summing the total costs of the operations, and dividing the sum by 128 (the number of growers who propane burned). To examine the effect of field size on average cost, individual growers costs per acre were weighted by the acres in their largest field. The weighted average cost of propane burned acreage is $37.01, which is not significantly different than our unweighted average of $37.79.

Table 10. Costs per Acre Calculated for Propane Burned Acreage, by Operation or Resource[3]

| Operation or Resource | Number of Growers | Average Cost per Acre |
|---|---|---|
| | | $ |
| Swathing or Windrowing | | |
| Owner/operator | 39 | 10.72 |
| Custom | 0 | |
| Baling | | |
| Owner/operator, square bales | 15 | 19.59 |
| Owner/operator, round bales | 5 | 12.77 |
| Custom | 20 | 22.73 |
| Trade straw | 69 | 0 |
| Straw Storage | | |
| Storage expense, pole shed | 1 | 14.50 |
| Storage expense, metal shed | 0 | |
| Income from storage | 4 | -14.20 |
| Stacking Bales | | |
| Owner/operator, tractor | 7 | 18.63 |
| Owner/operator, bale wagon | 1 | 16.14 |
| Custom | 13 | 13.87 |
| Burning Stacks | | |
| Labor | 19 | 1.16 |
| Water tanks | 19 | 1.38 |
| Straw Sales | | |
| Storage expense, pole shed | 4 | 13.68 |
| Storage expense, metal shed | 6 | 28.31 |
| Storage expense, rented shed | 0 | |
| Straw sales | 7 | -21.09 |
| Expected straw sales | 4 | -19.62 |
| Flail Chopping | | |
| Owner/operator, flail only | 19 | 7.68 |
| Owner/operator, flail & loaf | 20 | 15.78 |
| Custom | 5 | 16.19 |
| Burn Loafs | | |
| Labor | 17 | 0.79 |
| Water tanks | 17 | 1.06 |
| 1st Propane Burning | | |
| Up to 120 hp tractor & burner | 54 | 2.67 |
| 120 hp to 190 hp tractor & burner | 73 | 2.92 |
| Over 190 hp tractor & burner | 1 | 7.25 |
| Gas | 128 | 9.85 |
| Water tanks | 128 | 2.03 |
| Custom | 8 | 12.92 |
| 2nd Propane Burning | | |
| Up to 120 hp tractor & burner | 12 | 2.38 |
| 120 hp to 190 hp tractor & burner | 23 | 2.49 |

Table 10. Costs per Acre Calculated for Propane Burned Acreage, by Operation or Resource[3] (continued)

| Operation or Resource | Number of Growers | Average Cost per Acre |
|---|---|---|
| | | $ |
| Over 190 hp tractor & burner | 1 | 3.62 |
| Gas | 36 | 8.62 |
| Water tanks | 36 | 1.73 |
| Custom | 1 | 16.00 |
| Pasture harrow between burnings | 20 | 3.60 |
| Additional Fertilizer Expense | | |
| Potash | 17 | 3.57 |
| Phosphate | 14 | 6.46 |
| Extra application | 6 | 2.17 |
| AVERAGE TOTAL COST PER ACRE | 128 | 37.79 |
| CONFIDENCE INTERVAL | | 33.85 - 41.74 |

[3]Average costs are based on the number of growers reported for each operation or resource.

By assuming that individual propane burning costs form a random sample from a normally distributed random variable, we can construct a confidence interval for our estimated average cost. The confidence interval for average propane burning cost per acre is:

$$\text{PROB}[\$33.85 \leq \text{True Average Cost} \leq \$41.74] = 95 \text{ percent}$$

In other words, we are 95 percent certain that the true average cost per acre for propane burning in the Willamette Valley in 1988 lies in the interval between $33.85 and $41.74.

The estimated average cost of propane burning for growers who sold or traded their straw is $29.98 per acre. The 95% confidence interval for this estimate is $25.73 to $34.24 per acre. The estimated average cost of propane burning for growers who did not sell or trade their straw is $50.80 per acre, with a 95 percent confidence interval of $44.56 to $57.04 per acre. Of the 128 growers who propane burned, 80 sold or traded straw and 48 did not sell or trade straw.

This analysis highlights the importance of the existence of a straw market in determining growers' costs. Growers with no market for their straw paid an average of an additional $20.82 per acre to sanitize their fields using propane burning compared to growers who were able to sell or trade their straw. The difference in costs paid by growers with no market for their straw can likely be attributed to the costs of removing the straw.

**Results for Nonthermal Sanitation**

Cost information for unburned, harvested acreage is summarized in table 11. This table shows the number of growers and average costs for the operations performed and resources used on grower's largest harvested, unburned grass seed fields. Average values are based only on those growers values who incurred the respective expenses.

As in propane burning, growers exhibited large variability in the field practices they performed for nonthermal sanitation. Most growers chopped their straw, used tillage to work up the soil, and applied one or more chemicals in the fall for disease and volunteer seedling control. Other growers traded their straw in return for baling, stacking, and removal, then used tillage and chemical applications on their fields.

The estimated average field sanitation cost for harvested, unburned grass seed acreage is $35.41 per acre. The minimum value for an individual grower is -$8.50 per acre, and the maximum value is $108.52 per acre.

The weighted average cost of unburned, harvested acreage is $38.24 per acre. Since the weighted cost is greater than the unweighted cost per acre, economies of field size may be present in our data. Adjusting for field size shows that our costs may underestimate true costs for unburned, harvested acreage. However, the difference in the two averages is small (less than 10 percent) indicating that our methods are valid even for the unburned acreage. A confidence interval for the average cost per acre is calculated to be

PROB[$32.00 ≤ True Average Cost ≤ $38.81] = 95 percent

We are 95 percent sure that the true average cost per acre for unburned acreage lies in the range from $32.00 to $38.81.

The average cost for the 47 growers who sold or traded straw from their largest unburned, harvested field is $28.57 per acre. The 95 percent confidence interval for this estimate ranges from $21.80 to $35.33 per acre. This is a large interval, indicating a large amount of variability in cost per acre among these 47 growers.

For the 157 growers who did not trade or sell straw from their largest unburned, harvested field, the average cost is $37.40 per acre, with a 95 percent confidence interval of $33.51 to $41.30 per acre. Average cost per acre for unburned acreage does appear to be related to the existence of a straw market although the economic impact in this case is not as great as for propane burning. This could be due to the fact that annual ryegrass is often not burned, and there is very little demand for ryegrass straw. Seventy-nine annual ryegrass fields were among the 204 fields left unburned.

Table 11. Costs per Acre for Nonthermal Sanitation of Grass Seed Fields, by Operation or Resource[5]

| Operation or Resource | Number of Growers | Average Cost per Acre $ |
|---|---|---|
| Swathing or Windrowing | | |
| Owner/operator | 36 | 10.16 |
| Custom | 0 | 3.00 |
| Baling | | |
| Owner/operator, square bales | 18 | 7.73 |
| Owner/operator, round bales | 5 | 15.63 |
| Custom | 17 | 19.04 |
| Traded straw | 36 | 0 |
| Straw Storage | | |
| Storage expense, pole shed | 3 | 8.66 |
| Storage expense, metal shed | 0 | |
| Income from storage | 1 | -14.00 |
| Stacking Bales | | |
| Owner/operator, tractor | 12 | 14.76 |
| Owner/operator, bale wagon | 1 | 9.68 |
| Custom | 7 | 11.95 |
| Burning Stacks | | |
| Labor | 18 | 1.00 |
| Water tanks | 18 | 2.70 |
| Straw Sales | | |
| Storage expense, pole shed | 2 | 13.82 |
| Storage expense, metal shed | 5 | 27.32 |
| Storage expense, rented shed | 0 | |
| Straw sales | 9 | -23.05 |
| Expected straw sales | 2 | -16.11 |
| Flail Chopping | | |
| Owner/operator, flail only | 84 | 9.25 |
| Owner/operator, flail & loaf | 32 | 15.20 |
| Custom | 12 | 4.31 |
| Burn Loafs | | |
| Labor | 25 | 1.12 |
| Water tanks | 25 | 2.75 |
| Tillage | | |
| Owner/operator | 98 | 8.18 |
| Custom | 4 | 6.77 |
| Chemicals | | |
| Chemical costs | 142 | 23.28 |
| Application | 142 | 3.36 |
| AVERAGE TOTAL COST PER ACRE | 204 | 35.41 |
| CONFIDENCE INTERVAL | | 32.00 - 38.81 |

[5]Average costs are based on the number of growers reported for each operation or resource.

## SUMMARY AND CONCLUSIONS

Table 12 summarizes the estimated costs for sanitizing grass seed fields using alternative methods. Open field burning is the least expensive alternative, with propane burning and nonthermal sanitation costing approximately four times more than open field burning. The confidence intervals for all three methods are fairly small, given the variability in practices performed by growers.

Table 12. Summary of Estimated Field Sanitation Costs, 1988

| Field Sanitation Method | Number of Growers | Average Cost per Acre | 95% Confidence Interval | |
|---|---|---|---|---|
| | | | Lower Bound | Upper Bound |
| Open field burning | 254 | 8.86 | 8.31 | 9.41 |
| Straw sold or traded | 7 | 5.49 | -1.58 | 12.56 |
| No straw sold or traded | 247 | 8.96 | 8.42 | 9.49 |
| Propane burning | 128 | $37.79 | $33.85 | $41.74 |
| Straw sold or traded | 80 | 29.98 | 25.73 | 34.24 |
| No straw sold or traded | 48 | 50.80 | 44.56 | 57.04 |
| No burning | 204 | 35.41 | 32.00 | 38.81 |
| Straw sold or traded | 47 | 28.57 | 21.80 | 35.33 |
| No straw sold or traded | 157 | 37.40 | 33.51 | 41.30 |

Since open field burning is by far the least expensive sanitation method, we would expect it to be the preferred method used by growers. Why do growers use propane burning and nonthermal sanitation on their fields, given these circumstances? Obviously, noneconomic factors must play a role in determining field sanitation methods.

The most important factor related to field sanitation is undoubtedly approval to burn. Grower's fields are allowed to burn only when weather conditions are appropriate, as determined through the DEQ smoke management program, the State Fire Marshal, and the local fire district. We pointed out in the acreage results section that 78 of 282 growers surveyed, or 28 percent, burned all of their harvested grass seed fields. This means that 72 percent of growers surveyed were not able to burn all their fields for one or more reasons.

Another factor related to the ability to burn is location. Fields located within one-half mile of interstate highways and one-fourth mile of other designated roadways in the Willamette Valley are restricted from burning unless large safety buffer zones are observed. Thus, many growers must use propane burning or nonthermal sanitation on fields because of their close proximity to roadways. Others may not burn out of concern for neighbors and nearby communities.

The variety of grass seed grown may dictate the sanitation methods chosen by growers. Increased production of proprietary varieties has been accompanied by contracts requiring shorter rotations [Conklin, et.al.]. With shorter rotations, many growers may feel that propane burning or nonthermal sanitation provide adequate disease protection on those fields which are not open field burned. Also, some varieties of grass seed may be sensitive to thermal sanitation, and require nonthermal sanitation. This may partially explain the fact that 204 growers used nonthermal sanitation, while only 128 growers used propane burning.

Machinery and equipment availability certainly has a bearing on sanitation methods. In order to propane burn, growers require the services of straw removal equipment (balers, stackers, choppers, loafers, etc.) and propane burning equipment. Nonthermal sanitation, on the other hand, makes use of equipment used in other grass seed field operations (disks, plows, sprayers, etc.).

The difference in cost depending on whether the straw is sold or traded is an important aspect of this study's findings. Growers who had a market for their straw incurred lower costs to sanitize their fields under all three sanitation methods studied. Straw sales or trades had the greatest impact on propane burned acreage. Open field burning was the method least affected by straw markets.

Examination of weighted average costs showed that the procedures used in this study did not significantly bias the estimates due to economies of field size. The fact that the estimated costs per acre were generated from data on growers'

largest fields did not appear to affect the estimates. However, the estimates should be viewed as conservative, since economies of size may indeed exist, but were not detectable in the data set.

Finally, remember that these estimates were obtained from only one year of data. Field sanitation impacts on future yields were ignored due to a lack of research in this area. Further studies are needed to estimate long run average costs for field sanitation methods. Further research is also needed on the impacts of shorter stand life, the effects of thermal and nonthermal sanitation on proprietary varieties, and the status and outlook for straw markets.

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# APPENDIX A. DETAILED MACHINERY COST WORKSHEET

## Appendix Table A1. Machinery Costs per Acre for Grass Seed Field Sanitation Operations

| INPUTS | Units | Self-Propelled Swather | –BALE– 75 hp Tractor Square Bales | –BALE– 120 hp Tractor Square Bales | –BALE– 190 hp Tractor Square Bales | –BALE– 120 hp Tractor Round Bales | –STACK– Bale Wagon | –STACK– 75 hp Tractor and Loader | –STACK– 120 hp Tractor and Loader | –STACK– 190 hp Tractor and Loader | -CHOP- 75 hp Tractor Flail Chop |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Machine | | | | | | | | | | | |
| Size | hp | 90 | 75 | 120 | 190 | 120 | 90 | 75 | 120 | 190 | 75 |
| Fuel type | G or D | D | D | D | D | D | D | D | D | D | D |
| Purchase price | $ | 45000 | 32000 | 52000 | 80000 | 52000 | 70000 | 32000 | 52000 | 80000 | 32000 |
| Salvage value | $ | 10000 | 9600 | 15600 | 24000 | 15600 | 25000 | 9600 | 15600 | 24000 | 9600 |
| Life | hrs | 3000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 |
| Annual use | hrs | 300 | 450 | 450 | 450 | 450 | 600 | 450 | 450 | 450 | 450 |
| Implement | | | | | | | | | | | |
| Size | ft | none | motor | pto | pto | 1.5 ton | none | | | | 14 |
| Purchase price | $ | | 33000 | 25000 | 25000 | 18000 | | 14000 | 14000 | 14000 | 8500 |
| Salvage value | $ | | 7000 | 7000 | 7000 | 5400 | | 1400 | 1400 | 1400 | 1275 |
| Life | hrs | | 3000 | 3000 | 3000 | 3000 | | 3000 | 3000 | 3000 | 2500 |
| Annual use | hrs | | 300 | 300 | 300 | 300 | | 300 | 300 | 300 | 200 |
| Capacity | acres/hr | 6 | 4 | 4 | 4 | 4 | 5 | 3 | 3 | 3 | 5 |
| Input costs | $/yr | | 7800 | 6750 | 6750 | 600 | | | | | |
| PARAMETERS | | | | | | | | | | | |
| General | | | | | | | | | | | |
| Lube multiplier | AgEng | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Insur. multiplier | AgEng | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Interest rate | % | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% |
| Labor | $/hr | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 |
| Machine | | | | | | | | | | | |
| Gas cost | $/gal | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Diesel cost | $/gal | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 |
| Fuel multiplier | AgEng | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 |
| Current value | Calc | 27500 | 20800 | 33800 | 52000 | 33800 | 47500 | 20800 | 33800 | 52000 | 20800 |
| Remaining life | Calc | 1500 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 |
| Repair Factor #1 | AgEng | 0.278 | 0.029 | 0.024 | 0.024 | 0.024 | 0.230 | 0.024 | 0.024 | 0.024 | 0.029 |
| Repair Factor #2 | AgEng | 1.400 | 1.500 | 1.500 | 1.500 | 1.500 | 1.400 | 1.500 | 1.500 | 1.500 | 1.500 |
| Implement | | | | | | | | | | | |
| Current value | Calc | | 20000 | 16000 | 16000 | 11700 | | 7700 | 7700 | 7700 | 4888 |
| Remaining life | Calc | | 1500 | 1500 | 1500 | 1500 | | 1500 | 1500 | 1500 | 1250 |
| Repair Factor #1 | AgEng | | 0.168 | 0.222 | 0.222 | 0.168 | | 0.168 | 0.168 | 0.168 | 0.304 |
| Repair Factor #2 | AgEng | | 1.400 | 1.400 | 1.400 | 1.400 | | 1.400 | 1.400 | 1.400 | 1.400 |
| COSTS PER HOUR | | | | | | | | | | | |
| Machine | | | | | | | | | | | |
| Fuel | | 5.36 | 4.47 | 7.14 | 11.31 | 7.14 | 5.36 | 4.47 | 7.14 | 11.31 | 4.47 |
| Lube | | 0.80 | 0.67 | 1.07 | 1.70 | 1.07 | 0.80 | 0.67 | 1.07 | 1.70 | 0.67 |
| Repairs | | 21.39 | 2.86 | 3.85 | 5.92 | 3.85 | 40.39 | 2.86 | 3.85 | 5.92 | 2.86 |
| Labor | | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 |
| Insurance | | 0.92 | 0.46 | 0.75 | 1.16 | 0.75 | 0.79 | 0.46 | 0.75 | 1.16 | 0.46 |
| Depreciation | | 11.67 | 2.80 | 4.55 | 7.00 | 4.55 | 5.63 | 2.80 | 4.55 | 7.00 | 2.80 |
| Interest | | 5.15 | 2.69 | 4.37 | 6.72 | 4.37 | 4.58 | 2.69 | 4.37 | 6.72 | 2.69 |
| Total | | 52.29 | 20.95 | 28.73 | 40.81 | 28.73 | 64.55 | 20.95 | 28.73 | 40.81 | 20.95 |
| Implement | | | | | | | | | | | |
| Repair | | | 9.48 | 9.49 | 9.49 | 5.17 | | 4.02 | 4.02 | 4.02 | 4.08 |
| Inputs | | | 26.00 | 22.50 | 22.50 | 2.00 | | | | | |
| Insurance | | | 0.67 | 0.53 | 0.53 | 0.39 | | 0.26 | 0.26 | 0.26 | 0.24 |
| Depreciation | | | 8.67 | 6.00 | 6.00 | 4.20 | | 4.20 | 4.20 | 4.20 | 2.89 |
| Interest | | | 3.74 | 3.02 | 3.02 | 2.21 | | 1.41 | 1.41 | 1.41 | 1.38 |
| Total | | | 48.55 | 41.54 | 41.54 | 13.97 | | 9.89 | 9.89 | 9.89 | 8.59 |
| Operation | | | | | | | | | | | |
| Cost per hour | | 52.29 | 69.50 | 70.28 | 82.35 | 42.71 | 64.55 | 30.84 | 38.63 | 50.70 | 29.54 |
| Cost per acre | | 8.71 | 17.38 | 17.57 | 20.59 | 10.68 | 12.91 | 10.28 | 12.88 | 16.90 | 5.91 |
| Cost per ton | | 4.36 | 8.69 | 8.78 | 10.29 | 5.34 | 6.45 | 5.14 | 6.44 | 8.45 | NA* |

*NA = Not Applicable.

# Appendix Table A1. Machinery Costs per Acre for Grass Seed Field Sanitation Operations (continued)

| INPUTS | Units | —CHOP— 120 hp Tractor Flail Chop | —CHOP— 190 hp Tractor Flail Chop | —LOAF— 120 hp Tractor Flail & Loaf | —HARROW— 75 hp Tractor Pasture Harrow | —HARROW— 120 hp Tractor Pasture Harrow | —HARROW— 190 hp Tractor Pasture Harrow | —FLUFF— 75 hp Tractor Fluff | —BURN— 75 hp Tractor Propane Burn | —BURN— 120 hp Tractor Propane Burn | —BURN— 190 hp Tractor Propane Burn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Machine | | | | | | | | | | | |
| Size | hp | 120 | 190 | 120 | 75 | 120 | 190 | 75 | 75 | 120 | 190 |
| Fuel type | G or D | D | D | D | D | D | D | D | D | D | D |
| Purchase price | $ | 52000 | 80000 | 52000 | 32000 | 52000 | 80000 | 32000 | 32000 | 52000 | 80000 |
| Salvage value | $ | 15600 | 24000 | 15600 | 9600 | 15600 | 24000 | 9600 | 9600 | 15600 | 24000 |
| Life | hrs | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 | 8000 |
| Annual use | hrs | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| Implement | | | | | | | | | | | |
| Size | ft | 14 | 14 | 14 | 10 | 10 | 10 | 10 | 30 | 30 | 30 |
| Purchase price | $ | 8500 | 8500 | 37000 | 600 | 600 | 600 | 4000 | 7200 | 7200 | 7200 |
| Salvage value | $ | 1275 | 1275 | 7400 | 50 | 50 | 50 | 400 | 720 | 720 | 720 |
| Life | hrs | 2500 | 2500 | 2500 | 2000 | 2000 | 2000 | 2000 | 1500 | 1500 | 1500 |
| Annual use | hrs | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 150 | 150 | 150 |
| Capacity | acres/hr | 6 | 7 | 5 | 7 | 7 | 7 | 7 | 10 | 10 | 10 |
| Input costs | $/yr | | | | | | | | | | |
| PARAMETERS | | | | | | | | | | | |
| General | | | | | | | | | | | |
| Lube multiplier | AgEng | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Insur. multiplier | AgEng | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Interest rate | % | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% | 6% |
| Labor | $/hr | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 |
| Machine | | | | | | | | | | | |
| Gas cost | $/gal | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Diesel cost | $/gal | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 |
| Fuel multiplier | AgEng | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 |
| Current value | Calc | 33800 | 52000 | 33800 | 20800 | 33800 | 52000 | 20800 | 20800 | 33800 | 52000 |
| Remaining life | Calc | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 |
| Repair Factor #1 | AgEng | 0.024 | 0.024 | 0.024 | 0.029 | 0.024 | 0.024 | 0.029 | 0.029 | 0.024 | 0.024 |
| Repair Factor #2 | AgEng | 1.500 | 1.500 | 1.500 | 1.500 | 1.500 | 1.500 | 1.500 | 1.500 | 1.500 | 1.500 |
| Implement | | | | | | | | | | | |
| Current value | Calc | 4888 | 4888 | 22200 | 325 | 325 | 325 | 2200 | 3960 | 3960 | 3960 |
| Remaining life | Calc | 1250 | 1250 | 1250 | 1000 | 1000 | 1000 | 1000 | 750 | 750 | 750 |
| Repair Factor #1 | AgEng | 0.304 | 0.304 | 0.304 | 0.364 | 0.364 | 0.364 | 0.364 | 0.364 | 0.364 | 0.364 |
| Repair Factor #2 | AgEng | 1.400 | 1.400 | 1.400 | 1.300 | 1.300 | 1.300 | 1.300 | 1.300 | 1.300 | 1.300 |
| COSTS PER HOUR | | | | | | | | | | | |
| Machine | | | | | | | | | | | |
| Fuel | | 7.14 | 11.31 | 7.14 | 4.47 | 7.14 | 11.31 | 4.47 | 4.47 | 7.14 | 11.31 |
| Lube | | 1.07 | 1.70 | 1.07 | 0.67 | 1.07 | 1.70 | 0.67 | 0.67 | 1.07 | 1.70 |
| Repairs | | 3.85 | 5.92 | 3.85 | 2.86 | 3.85 | 5.92 | 2.86 | 2.86 | 3.85 | 5.92 |
| Labor | | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 |
| Insurance | | 0.75 | 1.16 | 0.75 | 0.46 | 0.75 | 1.16 | 0.46 | 0.46 | 0.75 | 1.16 |
| Depreciation | | 4.55 | 7.00 | 4.55 | 2.80 | 4.55 | 7.00 | 2.80 | 2.80 | 4.55 | 7.00 |
| Interest | | 4.37 | 6.72 | 4.37 | 2.69 | 4.37 | 6.72 | 2.69 | 2.69 | 4.37 | 6.72 |
| Total | | 28.73 | 40.81 | 28.73 | 20.95 | 28.73 | 40.81 | 20.95 | 20.95 | 28.73 | 40.81 |
| Implement | | | | | | | | | | | |
| Repairs | | 4.08 | 4.08 | 17.75 | 0.29 | 0.29 | 0.29 | 1.95 | 3.22 | 3.22 | 3.22 |
| Inputs | | | | | | | | | | | |
| Insurance | | 0.24 | 0.24 | 1.11 | 0.02 | 0.02 | 0.02 | 0.11 | 0.26 | 0.26 | 0.26 |
| Depreciation | | 2.89 | 2.89 | 11.84 | 0.28 | 0.28 | 0.28 | 1.80 | 4.32 | 4.32 | 4.32 |
| Interest | | 1.38 | 1.38 | 6.30 | 0.09 | 0.09 | 0.09 | 0.61 | 1.45 | 1.45 | 1.45 |
| Total | | 8.59 | 8.59 | 37.01 | 0.67 | 0.67 | 0.67 | 4.46 | 9.25 | 9.25 | 9.25 |
| Operation | | | | | | | | | | | |
| Cost per hour | | 37.33 | 49.40 | 65.74 | 21.62 | 29.41 | 41.48 | 25.41 | 30.20 | 37.99 | 50.06 |
| Cost per acre | | 6.22 | 7.06 | 13.15 | 3.09 | 4.20 | 5.93 | 3.63 | 3.02 | 3.80 | 5.01 |

Appendix Table A1. Machinery Costs per Acre for Grass Seed Field Sanitation Operations (continued)

| INPUTS | Units | Buggy Fert. Appl. | Buggy Chem. Appl. | -WATER- Tractor & Small Water Tank | -WATER- Tractor & Large Water Tank | —TILL— 120 hp Tractor Disc or Plow | —TILL— 190 hp Tractor Disc or Plow | —TILL— 260 hp Tractor Disc or Plow |
|---|---|---|---|---|---|---|---|---|
| Machine | | | | | | | | |
| Size | hp | 125 | 125 | 75 | 75 | 120 | 190 | 260 |
| Fuel type | G or D | G | G | D | D | D | D | D |
| Purchase price | $ | 35200 | 35200 | 32000 | 32000 | 52000 | 80000 | 115000 |
| Salvage value | $ | 3520 | 3520 | 9600 | 9600 | 15600 | 24000 | 34500 |
| Life | hrs | 5000 | 5000 | 8000 | 8000 | 8000 | 8000 | 8000 |
| Annual use | hrs | 400 | 400 | 450 | 450 | 450 | 450 | 450 |
| Implement | | | | | | | | |
| Size | ft | 3-ton | 500 gal | 500 gal | 1000 gal | 13 | 15 | 15 |
| Purchase price | $ | 5400 | 7900 | 4300 | 5300 | 12400 | 14900 | 14900 |
| Salvage value | $ | 540 | 790 | 430 | 530 | 1240 | 1490 | 1490 |
| Life | hrs | 1500 | 1500 | 1000 | 1000 | 2500 | 2500 | 2500 |
| Annual use | hrs | 100 | 100 | 50 | 50 | 250 | 250 | 250 |
| Capacity | acres/hr | 20 | 20 | 50 | 50 | 6 | 7 | 8 |
| Input costs | $/yr | | | | | | | |
| PARAMETERS | | | | | | | | |
| General | | | | | | | | |
| Lube multiplier | AgEng | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Insur. multiplier | AgEng | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Interest rate | % | 6% | 6% | 6% | 6% | 6% | 6% | 6% |
| Labor | $/hr | 7.00 | 7.00 | | | 7.00 | 7.00 | 7.00 |
| Machine | | | | | | | | |
| Gas cost | $/gal | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| Diesel cost | $/gal | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 | 0.72 |
| Fuel multiplier | AgEng | 0.104 | 0.104 | 0.083 | 0.083 | 0.083 | 0.083 | 0.083 |
| Current value | Calc | 19360 | 19360 | 20800 | 20800 | 33800 | 52000 | 74750 |
| Remaining life | Calc | 2500 | 2500 | 4000 | 4000 | 4000 | 4000 | 4000 |
| Repair Factor #1 | AgEng | 0.029 | 0.029 | 0.029 | 0.029 | 0.024 | 0.024 | 0.024 |
| Repair Factor #2 | AgEng | 1.500 | 1.500 | 1.500 | 1.500 | 1.500 | 1.500 | 1.500 |
| Implement | | | | | | | | |
| Current value | Calc | 2970 | 4345 | 2365 | 2915 | 6820 | 8195 | 8195 |
| Remaining life | Calc | 750 | 750 | 500 | 500 | 1250 | 1250 | 1250 |
| Repair Factor #1 | AgEng | 0.934 | 0.304 | 0.777 | 0.777 | 0.364 | 0.364 | 0.364 |
| Repair Factor #2 | AgEng | 1.400 | 1.400 | 1.400 | 1.400 | 1.300 | 1.300 | 1.300 |
| COSTS PER HOUR | | | | | | | | |
| Machine | | | | | | | | |
| Fuel | | 11.05 | 11.05 | 4.47 | 4.47 | 7.14 | 11.31 | 15.48 |
| Lube | | 1.66 | 1.66 | 0.67 | 0.67 | 1.07 | 1.70 | 2.32 |
| Repair | | 2.52 | 2.52 | 2.86 | 2.86 | 3.85 | 5.92 | 8.51 |
| Labor | | 7.00 | 7.00 | | | 7.00 | 7.00 | 7.00 |
| Insurance | | 0.48 | 0.48 | 0.46 | 0.46 | 0.75 | 1.16 | 1.66 |
| Depreciation | | 6.34 | 6.34 | 2.80 | 2.80 | 4.55 | 7.00 | 10.06 |
| Interest | | 2.71 | 2.71 | 2.69 | 2.69 | 4.37 | 6.72 | 9.66 |
| Total | | 31.75 | 31.75 | 13.95 | 13.95 | 28.73 | 40.81 | 54.70 |
| Implement | | | | | | | | |
| Repairs | | 6.46 | 3.07 | 3.61 | 4.46 | 6.45 | 7.76 | 7.76 |
| Inputs | | | | | | | | |
| Insurance | | 0.30 | 0.43 | 0.47 | 0.58 | 0.27 | 0.33 | 0.33 |
| Depreciation | | 3.24 | 4.74 | 3.87 | 4.77 | 4.46 | 5.36 | 5.36 |
| Interest | | 1.68 | 2.46 | 2.72 | 3.35 | 1.50 | 1.81 | 1.81 |
| Total | | 11.68 | 10.71 | 10.68 | 13.16 | 12.69 | 15.25 | 15.25 |
| Operation | | | | | | | | |
| Cost per hour | | 43.43 | 42.47 | 24.63 | 27.11 | 41.43 | 56.06 | 69.95 |
| Cost per acre | | 2.17 | 2.12 | 0.49 | 0.54 | 6.90 | 8.01 | 8.74 |