Seed Processing in the Willamette Valley

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This report deals with processing of forage, turf, and cover crop seeds in the Willamette Valley, Oregon. The following are highlights of the contents.

* There are about 350 seed cleaning plants in the Willamette Valley. Approximately 65 percent of these are located on farms - the remainder are commercial plants.
* Seed cleaning in the Willamette Valley is characterized by a small number of plants doing the major part of the cleaning.
* More common ryegrass was cleaned than any other seed in all three types of plants.
* Large amounts of unused capacity exist in the sample plants.
* Mechanization in the handling of seeds has not kept up with the shift to bulk receiving and storage.
* The most conspicuous characteristic of the cleaning plants in the survey was the wide variety of methods and equipment in use.
* There are many different equipment combinations in use, but there are only a few which are used widely.
* Hourly cleaning capacities vary widely among the survey plants.
* Docks and sorrels were reported to be the most usual contaminants.
* Commercial and semi-commerical processors used three methods of charging for seed cleaning - by the hour, on the inweight, and on the clean weight.
* Sales to local dealers are the most important method of selling clean seed.

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C. H. Greene and G. B. Davis*

Introduction

In 1957, Oregon produced 184 million pounds of grass and legume seeds, more than one-fifth of the total production in the United States. The 1957 crop contributed nearly 17 million dollars to farm income, and uncounted other income generated through processing, transportation, and other marketing activities.

Rising transportation costs to major markets in the south and east reduced prices for many western seed crops, and increasingly higher quality requirements for interstate seed shipments are making it necessary to examine all possibilities for reducing marketing costs. Seed cleaning plants appear to offer an approach to this problem. There are well over 400 seed cleaning plants in the State, and at least 350 are located in the Willamette Valley. Of these, approximately 250 are farmer-operated and 100 are commercial. The plants vary widely in their operating season, size, equipment, and methods employed. These differences raise questions relative to their efficiency.

A marketing research program dealing with the seed industry will investigate these questions. It will consist of two parts:

a. A survey of the industry to obtain information on physical layout of buildings and equipment, season's volume, kinds of seeds cleaned, length of season, hourly capacity, labor requirements, equipment and methods being used and other information describing the plants and their cleaning operations. This report is concerned with results of this survey.

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b. Results obtained in the first phase will be used as a basis for selecting particular plants for an intensive study of their costs and efficiencies. Industrial engineering techniques will be used.

RESULTS

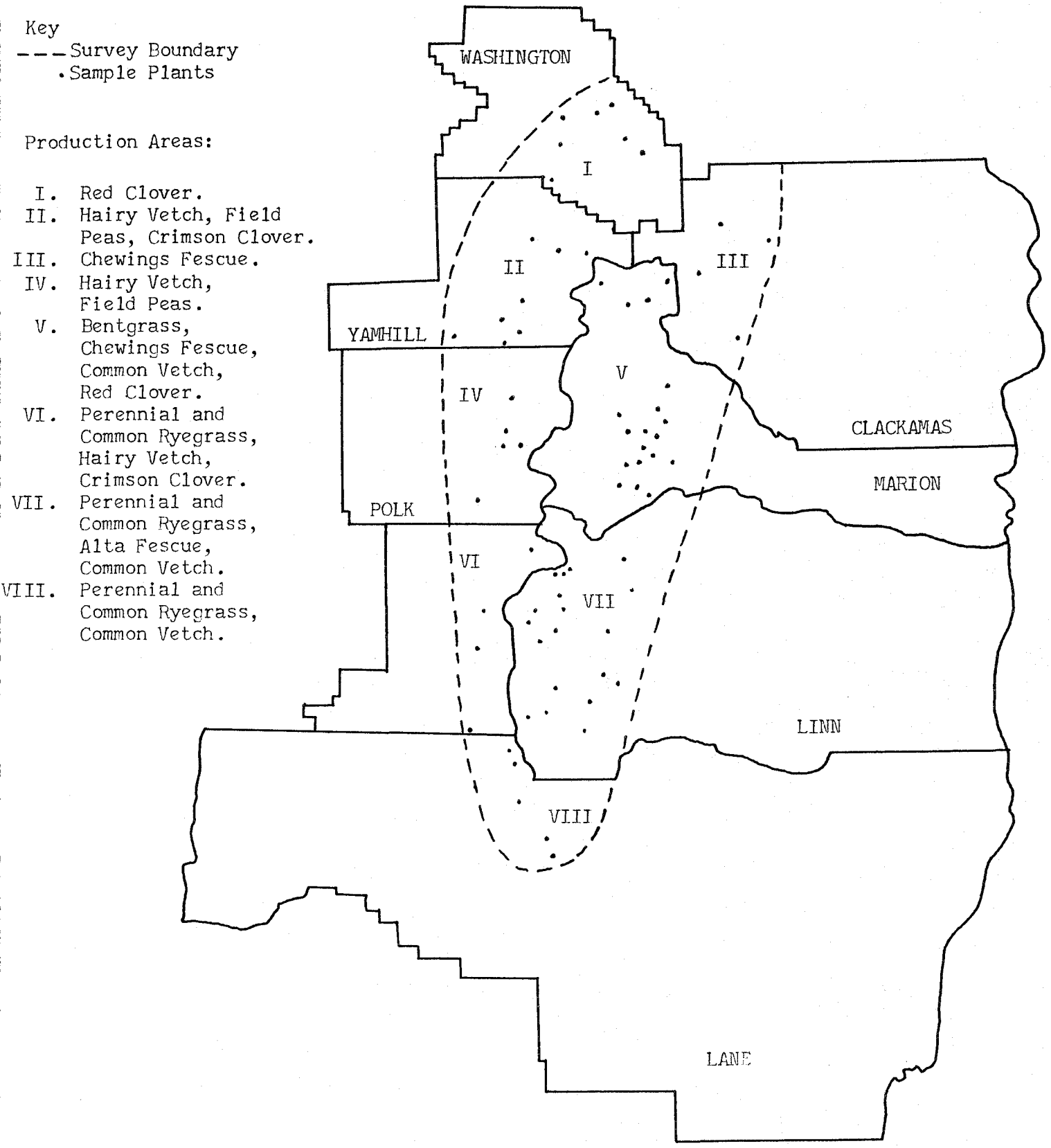
Of the 70 seed cleaning plants included in the survey, 32 were classified as farm plants, 13 as semi-commercial, and 25 as commercial. These plants were selected at random from the approximate 350 plants located in the Willamette Valley (Figure 1).

Farm plants were located on farms and were used to clean only seed grown by the owner, or to clean small lots of seed for other growers without charge. The semi-commercial plants, also located on farms, cleaned seed for other growers on a fee basis (custom cleaning). In some of these plants, custom cleaned seed amounted to less than 10 percent of the total season's volume, while in others custom cleaning was the major part of their volume. The commercial plants cleaned strictly on a custom basis, or in a few instances, bought seed in the dirt to clean on their own account. Cooperatives were included as commercial plants.

Size of Plants

Seed cleaning in the Willamette Valley is characterized by a small number of plants doing the major part of the cleaning. The top 25 percent of the farm, semi-commercial, and commercial plants cleaned out 68 percent, 49 percent, and 56 percent, respectively, of the total volume cleaned by these plants (Table 1).

Figure 1. Willamette Valley Counties, Showing Survey Area, Approximate Location of Sample Plants, and Major Production of Specified Seed Crops by Counties.



The largest group of farm plants were those with less than 50,000 pounds of clean seed, but they accounted for only 4 percent of the seed processed by farm plants. (Table 2) The average volume for farm plants was 199,344 pounds, ranging from 10,000 to 1,020,000 pounds.

Table 1. Percentage of combined output represented by various percentages of the sample plants, Willamette Valley, Oregon, 1957.

Percentage of Plants	Percentage of Total Volume		
	Farm	Semi-Commercial	Commercial
25	68	49	56
50	89	77	83
75	98	93	97
100	100	100	100

Semi-commercial plants had an average volume of 442,862 pounds and ranged in size from 44,500 pounds to 1,171,500. The greatest number of these plants fell into two classes, with four plants in each group. One group of four -- those in the 200,001- to 500,000-pound range-processed 24 percent of the seed processed by semi-commercial plants, but the other group -- those in the 500,001- to 1,000,000-pound range -- processed nearly 49 percent.

The largest grouping of commercial plants fell in the range of 1,000,001 to 2,000,000 pounds, though these eight plants processed only 29 percent of the total processed by commercial plants. The next largest group, seven plants, processed nearly 63 percent of the commercial plant total. The average volume for commercial plants was 1,597,008 pounds, ranging from 10,000 to 5,210,800 pounds.

Table 2. Numbers of Plants and Volume of Clean Seed Processed, by Specified Volumes, 1957 Crop Year

Season's Volume (pounds)	Farm Plants		Semi-Commercial Plants		Commercial Plants	
	Plants (number)	Volume (1,000 pounds)	Plants (number)	Volume (1,000 pounds)	Plants (number)	Volume (1,000 pounds)
Under 50,000	10	258	1	45	2	26
50,001- 100,000	5	329	1	65	-	-
100,001- 200,000	7	974	2	271	2	279
200,001- 500,000	7	2,198	4	1,396	4	1,513
500,001-1,000,000	2	1,600	4	2,810	2	1,454
1,000,001-2,000,000	1	1,020	1	1,172	8	11,617
Over 2,000,000	-	-	-	-	7	25,036
Total	32	6,379	13	5,757	25	39,925

Percentages of Totals

Season's Volume	Farm Plants		Semi-Commercial Plants		Commercial Plants	
	Plants (percent)	Volume (percent)	Plants (percent)	Volume (percent)	Plants (percent)	Volume (percent)
Under 50,000	31	4	8	1	8	*
50,001- 100,000	16	5	8	1	-	-
100,001- 200,000	22	15	15	5	8	1
200,001- 500,000	22	35	31	24	16	4
500,001-1,000,000	6	25	31	49	8	4
1,000,001-2,000,000	3	16	8	20	32	29
Over 2,000,000	-	-	-	-	28	63
Total	100	100	100	100	100	100

* Less than .5 percent.

Kinds of Seed Cleaned

More common ryegrass was cleaned than any other seed in all three types of plants. It constituted 41 percent of the seed cleaned in farm and commercial plants, and 51 percent in semi-commercial plants. (Table 3). The next most important crop, except in semi-commercial plants, was perennial ryegrass.

The second most important crop for the semi-commercial cleaners was chewings fescue. They cleaned out nearly a million pounds. Bentgrass was third in importance in these plants and in the farm plants, but was eleventh for the commercial plants. Hairy vetch was third over-all in volume, and third in the commercial plants. The other crops cleaned are listed in Table 2, which shows their relative importance in 1957.

One significant feature of the sample plants was the variety of seeds cleaned in any one plant. Some plants cleaned only one or two different kinds of seed, while others cleaned as many as fifteen. Thirty-one of the plants cleaned only grass seed, and five cleaned only legume seeds. Thirty-four cleaned both types. There appeared to be no relationship between seasons' volume and the amount of specialization or lack of it as regards types of seed cleaned. The only exception to this was that four of the five plants cleaning only legume seeds had less than 50,000 pounds annual volume, and the other had less than 200,000 pounds. There was also no evident relationship between the number of different kinds of seed cleaned and a plant's annual volume, though the commercial plants as a group tended to have the greatest variety. Geographical location within the valley appeared to be the only factor which had any bearing on either the kinds of seeds or the types of seeds which a plant cleaned. Major

Table 3. Numbers of Plants Processing Each Kind of Seed with Total Volume Processed, 1957

Kind of Seed	32 Farm Plants		13 Semi-Commercial Plants		25 Commercial Plants	
	Number Cleaning	Volume1/	Number Cleaning	Volume1/	Number Cleaning	Volume1/
		1000 lbs		1000 lbs		1000 lbs
Common ryegrass	14	2,603	7	2,933	20	16,396
Perennial ryegrass	7	1,826	4	663	10	8,844
Hairy vetch	10	471	2	35	13	4,622
Common vetch	6	103	1	20	14	2,173
Aus. winter peas	4	25	-	-	8	2,019
Chewings fescue	9	331	8	1,019	8	713
Bentgrass	7	496	5	804	7	508
Crimson clover	6	99	1	5	14	1,392
Red clover	2	11	-	-	15	1,355
Alta fescue	5	109	4	107	15	883
Creeping red fescue	3	93	3	44	9	562
Merion bluegrass	2	25	3	103	1	162
White clover	-	-	-	-	2	75
Alfalfa	-	-	-	-	2	67
Sudan grass	1	50	-	-	1	10
Meadow foxtail	2	3	-	-	3	56
Orchard grass	2	16	-	-	1	21
Lotus	-	-	-	-	2	279
Sub-clover	-	-	2	25	-	-
Reeds canary grass	-	-	-	-	1	19
Alsike clover	-	-	-	-	3	10
Cheat	-	-	-	-	1	9
Ladino clover	-	-	-	-	2	3
Total pounds processed		6,379		5,757		39,925

1/ Total pounds of clean seed processed by all the plants cleaning each seed.

production of most of the seed crops tends to be localized (Figure 1). That is, the production of the major portion of a particular seed tends to be contributed by one or two counties, even though the crop may be grown in all parts of the valley.

Cleaning Season and Labor Requirements

Large amounts of unused capacity exist in the sample plants. Seed cleaning is seasonal work for most of the plants. In fact, only four of the seventy plants in the survey cleaned seed year-round. In addition, there are wide variations in number of hours operated, as shown below.

Type of Plant	Days of Season1/		Hours Operated2/	
	Range	Average	Range	Average
Farm	10-185	94	20-1200	319
Semi-commercial	60-200	132	117-3158	830
Commercial	80-300	207	96-2314	1287

1/ From first day to last.

2/ Derived from data on volume cleaned and cleaners' estimates of hourly output for each plant.

One reason for the wide variation in days of season is the manner in which the cleaning is done. Most plants started at harvest time, but only nine farm plants cleaned their entire volume during the harvest period. Eighteen other farm plants cleaned during the harvest period, and then finished up during the winter months. Five waited until winter to do all their cleaning. The commercial and semi-commercial plants cleaned straight through from harvest till they were done. Most of the cleaning is finished by late February or early March.

From data on seed volume and hourly capacity for each seed, it was possible to derive the hours operated shown above. This figure contains no allowance for time lost between lots or for breakdowns. Yet it indicates that seed cleaning equipment in these plants is not being used to full capacity.

It should be noted here that the time spent by many of the farm cleaners in cleaning grains was not included in the operating season. For this reason, the extent of the excess capacity in farm plants is not quite as great as the short seasons would indicate. Excess capacity does exist, however. Perhaps the best reason for the existence of excess capacity is that many of the farm seed cleaning plants utilize off-season labor which would otherwise be idle. The question arises, however, as to whether seed cleaning is the best use of this off-season labor. Undoubtedly there are aspects of convenience associated with cleaning one's own seed. Yet the fact that seed cleaning is an enterprise with a high proportion of fixed costs in relation to variable costs means that costs per unit of output are lowered in a given plant only through increases in number of hours operated and thus in total output. If the real cost of operation of a farm seed cleaning plant were known, some cleaners might discover there are better uses for their off-season labor than seed-cleaning. The question of costs of operation will be the subject of further research.

Seed cleaning is not an operation that requires a large amount of labor (Table 4). Well over two-thirds of the plants used only one man per shift. Labor required depends to some extent on plant volume, but

Table 4. Labor requirements of the sample plants
Willamette Valley, Oregon, 1957

	32 Farm Plants	13 Semi-Commercial Plants	25 Commercial Plants
Plants using 1 man per shift	32	10	10
" " 2 men " "	-	2	4
" " 3 " " "	-	1	3
" " 4 " " "	-	-	5
" " 5 " " "	-	-	1
" " 6 " " "	-	-	2
Plants with only one shift	25	6	-
Plants with more than one shift			
At harvest	7	6	21
Rest of season	-	1	4
Plants using extra men during receiving period	3	5	25

more often it depends on the cleaning and handling methods employed. This is particularly true at harvest time when the plants are receiving the seed. The labor requirements in the farm plants were furnished by the operator or his family, or by a farm hand already hired on a year-round basis. Only two semi-commercial plants used labor hired exclusively for cleaning.

Shift length varied only slightly. It was usually between 8 to 12 hours: mostly 10 to 12 hours during the peak receiving season and 8-10 during the rest of the cleaning period.

In order to more fully utilize their labor and equipment, all the commercial plants surveyed had one or more other enterprises in addition to seed cleaning. In fact, the four smallest plants -- those with less than 200,000 pounds of clean seed for the season -- did cleaning more as a sideline to a feed and fertilizer business or farm supply. Grain cleaning was carried on by all but five of the plants. Some plants bought and sold seeds cleaned by other plants; most had a fertilizer and farm supply business; about fifty percent mixed and sold feeds. Even though these enterprises allowed the commercial plants to employ a certain number of men on a permanent basis, part or all of their cleaning equipment lies idle much of the time. This is especially true for specialized machines such as specific gravity separators.

Handling Methods and Storage Facilities

Mechanization in the handling of seeds has not fully kept up with the shift to bulk receiving and storage (Table 5). Although over 80 percent of

Table 5. Seed Handling Methods Used by the Survey Plants: Percentages of Plants Using Each Method, Willamette Valley, Oregon, 1957

	32 Farm Plants	13 Semi-Commercial Plants	25 Commercial Plants
	%	%	%
1. Both field run and clean seed handled in sacks moved by hand truck.	25	15	12
2. Field run seed stored in bins, moved to line by conveyors & gravity flow; sacks of clean seed moved by hand truck.	60	39	40
3. Field run seed stored in bins, removed by gravity or conveyor into hand cart and thence to line; sacks of clean seed moved by hand truck.	9	15	16
4. Field run seed stored in boxes, moved to line by fork-lift truck; sacks of clean seed moved by hand truck and fork-lift truck.	-	8	16
5. Part of field run seed stored in bins, part stored in boxes; moved to line by gravity flow and conveyors, and by fork-lift truck. Clean seed moved by hand truck and fork-lift truck.	-	15	8
6. All seed handled in bulk: both field run seed and clean seed stored in bins and moved by conveyors and gravity.	6	-	-
7. Same as (3) above, except sacks of clean seed moved by fork-lift truck.	-	-	4
8. Field run seed stored in large wheeled boxes movable to line by one man. Sacks of clean seed moved by hand truck.	-	8	-
9. Same as (2) above, except sacks of clean seed moved by fork-lift truck.	-	-	4
	100	100	100

the survey plants stored field run seed in bulk storage bins or boxes, over one-third of the plants used handling methods which required manual handling of the field run seed either into or out of storage. Only about 15 percent of the plants were using mechanized handling methods on the clean seed. Size of plant (annual volume) and type of plant -- farm, semi-commercial, or commercial -- had no discernible bearing on seed handling methods, except the farm group had a lower percentage of plants using fork-lift trucks, and none using boxes as storage.

Storage space was often a problem. Whereas the average of all plants was sufficient for the 1957 crop, over half of the plants in the survey did not have enough storage space for their total volume. Many were particularly short of space for field run seed during the peak receiving season. Inasmuch as the peak marketing season for much of the seed coincides with the peak receiving season, storage space for clean seed was not as much of a problem.

The disposal of screenings is a problem faced by all seed cleaners. Most commercial plants make an accounting to growers for their screenings and either buy them to grind for feed or return them to the grower. In the commercial and semi-commercial plants the screenings are usually sacked. This requires quite a bit of labor. The problem is a little simpler for farm plants. They usually sack only those screenings which they intend to reclean or grind for feed. Mostly they haul the others off in the bulk to a dumping or burning place. One plant visited used a pneumatic conveyor to transfer screenings into a burner similar to those used by sawmills to burn waste by-products.

Seventy percent of the farm plants realized some value through selling or feeding at least a portion of their screenings. Nearly 50 percent of the commercial and semi-commercial plants ground screenings for their customers, and about half the commercial plants bought screenings to grind for feed. The cleaners indicated they ground no screenings for feed if they contained noxious weed seeds or seeds of weeds which were locally a serious problem.

Cleaning and Handling Equipment

The most conspicuous characteristic of the cleaning plants in the survey was the wide variety of methods and equipment in use (Table 6). Commercial plants tended to have the most equipment, both in number of different items and quantities of most items. This is only logical in view of their greater average volume and the greater variety of seeds cleaned. The same was true of the semi-commercial plants in relation to the farm plants. Yet, within the group of farm plants, and within the group of semi-commercial plants, size, or annual volume, appeared to bear no relationship to the number or variety of different equipment items in a plant. There was such a relationship among the commercial plants, however. This suggests that for the range in size occurring in the farm and semi-commercial plants, the kind of seed cleaned and the number of different kinds cleaned are more important than total volume in determining the equipment needs of the plant. However, an analysis of equipment sizes would probably reveal that the larger items were usually in the larger plants.

Table 6. Percentages of Cleaning Plants Having Specified Equipment Items, Willamette Valley, Oregon, 1957

Item and Quantity	Farm Plants	Semi-Commercial Plants	Commercial Plants
	(percent)	(percent)	(percent)
A. Cleaning and Separating			
1. Cleaners 1	72	23	20
2	25	54	28
3	3	15	4
4	-	8	28
5	-	-	8
6	-	-	8
7	-	-	4
2. Discs 1	28	23	16
2	9	31	8
3	-	8	8
3. Disc-Cylinders 1	41	46	56
2	-	-	12
3	-	-	4
4. Indent Cylinders			
Single Barrel	9	39	16
Multiple Barrel	6	15	16
5. Spiral Separator (1 or more)	34	15	64
6. Doghair Reel	16	39	28
7. Spec. Gravity Separator 1	6	15	24
2	-	-	12
8. Draper	3	-	24
9. Dodder Rolls	-	-	16
10. Buckhorn Sawdust Mill	-	-	12
11. Electromagnetic Separator	-	-	8
12. Electrostatic Separator	-	-	4
13. Perforated Grader Cylinder	-	-	12
14. Debearder of Huller	31	31	20
B. Handling Equipment			
1. Belt-and-Cup Elevators			
none	6	-	4
1-3	91	69	24
4-6	3	31	36
7-9	-	-	16
10-12	-	-	8
over 12	-	-	12
2. Pneumatic Conveyor	3	-	4
3. Augurs	28	39	24
4. Horizontal Conveyor (Belt or Dragchain)	6	23	16
5. Hand Cart 1 or 2	9	8	20
3 or 4	-	8	4
6. Sack Piler	3	8	28
7. Fork-Lift Truck 1	-	23	12
2	-	-	12

In the discussion that follows, a "cleaner" is any air-screen machine, whether used for scalping, cleaning, or finishing work. The word "disc" refers to a separating machine using indent discs, and "cylinder" is a machine in which the separation takes place in an indented cylinder. A "disc-cylinder" is a separator with both a cylinder and a series of discs.

Special purpose machines were especially common in the commercial plants. Spiral separators were present in almost all plants cleaning vetches. Doghair reels were also quite common in plants cleaning large amounts of ryegrass. Specific gravity separators were more numerous in the commercial plants. Debearders, including seed polishers and hullers (and hammermills used for this purpose) were present in over one-fourth of the plants. Inclined drapers were found in nearly one-fourth of the commercial plants, but only 3 percent of the farm plants had a draper, and none were present in semi-commercial plants.

Such items as buckhorn mills, electromagnetic separators, electrostatic separators, dodder rolls, and perforated cylinders were found only in a few of the commercial plants.

Seed handling equipment also varied in number of items and variety of sizes and models. All but 4 percent of the total number of plants used belt-and-cup elevators to lift loose seed. One farm plant and one commercial plant had airlifts or pneumatic conveyors. One farm plant used only augurs for moving and lifting loose seed. Nearly all the farm plants and most of the semi-commercial plants had 1 to 3 elevators, whereas the largest percentage of commercial plants had 4 to 6 elevators.

Nearly one-fourth of the commercial and semi-commercial processors had fork-lift trucks; but none were present in the farm plants. Mechanical aids to sack stacking were found in 28 percent of the commercial plants, only 8 percent of the semi-commercial, and only 3 percent of the farm plants.

Equipment Combinations and Cleaning Methods

There are many different equipment combinations in use; yet there are only a few which are used widely (Table 7). It will be noted from the table that the cleaning lines were mostly composed of only two or three machines. The more complicated lines (included in "16 other combinations" in Table 7) are presented in more detail in appendix Table 1. The cleaning lines, or equipment combinations, are presented in the tables according to the order in which each machine appeared in the line. For example, the combination "cleaner plus disc-cylinder plus cleaner" shows that the seed was first run over an air-screen cleaner, then through a disc-cylinder machine, and finally through another air-screen cleaner.

As regards the "associated equipment," these were specialized items. They were sometimes incorporated into the cleaning line, as, for instance, a doghair reel used to remove rat-tail fescue from ryegrass. Most often, though, they were not a part of the regular line, but were used to effect a particular separation on some lots (the use of an electrostatic separator is a good example of this). Or, they were used to do a particular job to facilitate the cleaning and separating of the seed in the regular line (such as hammermills or debearders used to break up "doubles" in some seeds or to remove awns or otherwise change the physical properties

Table 7. Most Common Equipment Combinations Used to Clean Specified Turf, Forage, and Cover Crop Seeds in the Willamette Valley, Oregon, 1957

Cleaning line	Perennial & Common Ryegrass	Alta Fescue	Chewings & Creeping Red Fescue	Bent-grass	Hairy & Common Vetch	Crimson Clover	Red Clover	Other Crops/1	Plants Using Each/2
	Percentages of the total number of plants cleaning each specified seed								
Cleaner plus disc cylinder	26	25	22	7	31	7	-	21	20
Cleaner plus disc cylinder plus cleaner	21	25	24	20	13	13	20	25	15
One cleaner	2	-	3	20	11	27	20	4	10
Cleaner plus disk	8	4	-	-	9	7	10	9	10
Cleaner plus cylinder	6	8	8	13	7	7	-	8	7
Two cleaners	-	-	3	20	2	13	20	4	6
16 other combinations/3	37	38	40	20	27	26	30	29	32
Totals	100	100	100	100	100	100	100	100	100
Associated equipment/4									
Doghair reel	45	4	-	-	-	-	-	-	17
Gravity separator	5	4	3	-	11	33	30	29	9
Spiral separator	-	-	-	-	67	-	-	-	22
Draper	-	-	-	-	16	7	30	13	6
Buckhorn sawdust mill	-	-	-	-	-	20	-	-	3
Debearder/5	2	-	22	47	-	-	-	13	14
Electromagnetic separator	-	-	-	-	-	-	20	-	2
Electrostatic separator	-	-	-	-	-	7	10	-	1
Number of plants cleaning each crop	62	24	37	15	45	15	10	24	107

/1 Includes meadow foxtail, orchard grass, alsike clover, merion bluegrass, and dry field peas.

/2 Relative importance of each combination, taken as a percentage of the column total. This is not equal to the number of plants (70) in the survey because several plants used their equipment in more than one combination for different crops. Figures in this column are also not strictly comparable to values in the same rows in other columns because most plants used a given combination on more than one seed.

/3 Shown in Appendix Table 1.

/4 Usage is expressed as a percentage of the total number of plants cleaning each crop. These items were used in addition to or as part of the cleaning lines.

/5 Debearders, hullers, seed polishers, and hammermills used in the cleaning process.

of the seed). Or, as in the case of the spiral separator, some are used to make a specific separation, as vetch from oats.

Doghair reels were most often used to remove rat-tail fescue from ryegrass tailings out of a disc machine or the disc portion of a disc-cylinder. There were only a few plants in which the doghair reel was placed in the line so that all the seed passed through it. One plant had its doghair reel situated so that any fraction of the seed could be run through it, depending on the extent of the contamination.

Debearders (including seed hullers, seed polishers, and hammermills used for the same purpose) were used most often on chewing fescue and bentgrass. Use was restricted to the tailings in most cases, with the exception of merion bluegrass. One-half the plants cleaning this seed had a debearder through which was run their entire volume of bluegrass. This accounts for the use of debearders on "other crops" in Table 7. When hammermills were used to perform the same function as a debearder, it was usually run at 50 percent to 60 percent of the normal grinding speed.

In only one plant was the first machine in the line other than a cleaner. This plant used a disc-cylinder as the first machine in cleaning common vetch and oats. Another variation in the use of a disc-cylinder was found in a farm plant cleaning chewings fescue. The disc-cylinder had been modified so that the seed coming from the first cleaner went through the cylinder first, then the clean fraction was elevated back up to go through the disc section. This meant that the tailings of the disc section could be run back through the cylinder if desired, while the clean fraction went on to a final cleaner.

Appendix Table 1 shows several combinations with two cleaners plus other machines. Usually, when two cleaners were used together, the seedlots were split so that half the lot went over one cleaner while the other half went over the other cleaner, and then were rejoined to go through another machine. Sometimes, however, the machines were used one after the other. While capacity is probably a little higher with the first method, the second one allows more complete separation or cleaning overall, according to users of this method. In this same connection, it should be mentioned that several of the larger commercial plants had two or three different lines, though they were usually of the same combination of machines. This offered them the opportunity to split lots of seed and clean them faster, or to clean more than one lot at once. Where a plant had more than one line, but just one combination, it is listed only under that combination. However, some plants had only one complete cleaning line, but used it in different combinations on different seeds. These are listed under each combination they used for each seed.

The preceding discussion points out the fact that it is possible to have some flexibility in the cleaning operation even with a limited number of machines. The main requirement for flexibility is to have enough elevators and a sufficient valving arrangement to direct the flow of seed as desired. Lack of sufficient elevators hindered seed cleaning operations in several plants. This was particularly true in some of the smaller plants, but was also the case in some of the larger plants.

The question of hourly capacity must be considered in the selection of the optimum combination of equipment needed to clean any particular

seed or group of seeds. This study has only presented the equipment combinations in use; it is not intended to serve as a guide to the selection of equipment. Limitations of the data prevent a relating of capacity to equipment, but a following section will deal with capacity to the extent of the findings.

Cleaning Capacities

Hourly cleaning capacities vary widely among the survey plants (Table 8). Most of the differences are attributable to such factors as size and type of equipment, amount and nature of contaminants in the seed, and the type of seed itself. The skill of the operator or cleaner man is undoubtedly a factor, too.

The data contained in Table 8 were derived from operators' estimates of the pounds of clean seed their cleaning plants could turn out per hour under normal conditions. Since they are averages of estimates, it should be emphasized that they represent only average conditions. The data illustrate the differences in capacity that are associated with differences in kinds of seeds.

Information on volume of field-run seed input per hour would possibly have reduced some of the errors associated with estimates of clean seed output. Due to the manner in which most of the field-run seed is handled--that is, no weights are taken between storage and the cleaning line--very few plant operators indicated any knowledge of input weights. Future studies can possibly resolve this question.

It should be noted here that there was an apparent relationship between capacity and cleanout.1/ The average cleanout within a kind of

1/ Cleanout, in this report, represents the weight loss from removal of impurities in the cleaning process.

Table 8. Average Cleaning Capacities for Specified Grass and Legume Seeds, Willamette Valley, Oregon, 1957 /1

	Number of Plants Reporting/2	Pounds of Clean Seed Processed per Hour/3		
		Low	High	Average
Grasses:				
Perennial Ryegrass	20	700	2000	1238
Common Ryegrass	28	500	2400	1230
Alta Fescue	19	300	2000	953
Creeping Red Fescue	10	200	1000	425
Chewings Fescue	21	100	1050	398
Bentgrass	14	150	950	427
Merion Bluegrass	6	50	400	172
Meadow Foxtail	4	60	250	146
Legumes:				
Common Vetch	12	800	3000	1966
Hairy Vetch	17	500	4000	1715
Crimson Clover	14	200	1500	954
Red Clover	7	300	1000	586

/1 Capacities are stated in pounds per hour. The table includes only those seeds for which four or more estimates were available.

/2 This column does not indicate the number of plants which processed each kind of seed, but indicates the number of plants which gave an estimate of their hourly output for some of the different seeds.

/3 Does not include values from those plants whose output of a particular kind of seed was based on salvage of that seed from another crop or from screenings (salvage values usually were about 40% to 50% of the corresponding values for regular cleaning).

seed was inversely related to capacity--as cleanout goes up, capacity goes down. The relationship also holds true for different kinds of seed. The seeds (except for the vetches) with lower average cleanouts usually had higher capacities. This is not to be construed as meaning that cleanout was the only factor affecting capacity, but with a given set of machinery, cleanout (and its composition) is the main variable affecting capacity on any particular kind of seed.

Contaminants and Special Problems

Docks and sorrels were reported by the cleaning plants to be the most usual contaminants of the seed crops (Table 9). They are found in practically all crops, and are particularly troublesome in the rye-grasses and red clover. Rat-tail fescue was of nearly equal importance over-all, though it wasn't mentioned as a contaminant of the legume seeds.

A complete list of all the contaminants found in seed produced in the Willamette Valley would include practically all the weeds and crops in this area. Some of them are common enough to come to the attention of cleaners because of their quantity or because of the difficulties they cause in seed cleaning. (See Appendix Table 2). Rat-tail fescue or dog-hair, as it is often called, was mentioned most often as the usual contaminant of alta and chewings fescues, and was of equal importance to the docks and sorrel in creeping red fescue. Silverhair grass was an important contaminant of bentgrass, while in merion bluegrass, annual and Canadian bluegrass were most common.

Buckhorn plantain was of equal importance to docks and sorrel in red clover, whereas wild mustard and cutleaf cranesbill appeared most

Table 9. These Weed and Crop Seeds Were Listed Most Often as the Usual Contaminants of Turf, Forage, and Cover Crop Seeds Cleaned in the Willamette Valley, Oregon, 1957 Crop Year

(Figures in body of table show what percentage of the total number of plants cleaning a particular crop mentioned a weed or crop seed as being a usual contaminant.)

Crop / Contaminant	Perennial Ryegrass	Common Ryegrass	Alta Fescue	Creeping Red Fescue	Chewings Fescue	Bentgrass	Merion Bluegrass	Crimson Clover	Red Clover	Vetches	Relative Importance
	%	%	%	%	%	%	%	%	%	%	%
Docks and sorrel	24	30	16	18	22	9	11	4	35	-	20
Rat-tail fescue	24	27	25	18	30	13	11	-	-	-	19
Chesses	11	6	16	6	10	4	-	-	-	12	8
Mesquite grass	7	8	6	6	8	9	22	-	-	6	6
Ryegrass	-	-	16	18	10	-	11	11	12	6	6
Buckhorn	2	1	6	6	5	9	-	8	35	-	6
Mustard	2	1	-	-	-	-	-	31	-	25	5
Silver hair grass	-	1	-	-	2	39	11	-	-	-	4
Wild garlic	4	-	6	-	-	4	-	-	-	25	3
Annual and Canadian Bluegrass	-	-	-	-	3	9	34	-	-	-	2
Cut-leaf crane's bill	-	-	-	-	-	-	-	23	-	-	2
Other/1	26	26	9	28	10	4	-	23	18	26	19
Total	100	100	100	100	100	100	100	100	100	100	100

/1 Includes: French pink, Canada thistle, quackgrass, bristly dogtail, rape and dodder.

often in crimson clover. As for the vetches, mustard and wild garlic were mentioned more often than any other contaminants.

In addition to the question on usual contaminants, each respondent was asked to name the contaminants which presented special problems in cleaning each of the various crops (Table 10).

Rat-tail fescue and the docks and sorrel were the most frequently mentioned special problems. Silverhair grass was the third most important problem, mainly because it was mentioned so frequently for bentgrass. It will be noticed in the table that ryegrass was a problem in the cleaning of the fine fescues.

A comparison of Tables 9 and 10 reveals quite a bit of similarity between the most important "usual" contaminants of a particular crop and the contaminants which were listed as special problems for that crop. This indicates a correlation between what a cleaner considers a special problem and what he considers a usual contaminant. Nonetheless, the data are considered indicative of some of the problems of cleaning plants, and suggest that better means of weed control and better methods of processing are needed.

Cleaning Charges

Commercial and semi-commercial processors used three methods of charging for seed cleaning. These were (1) based on the inweight of the seed and impurities as received, (2) based on an hourly charge for labor and use of the equipment, and (3) based on the cleaned weight.

Charges on the inweight were the most commonly used method. Of the 44 million pounds (clean weight) custom cleaned by the survey plants,

Table 10. These Contaminants Were Listed Most Often As Being Especially Troublesome to the Cleaning of Turf, Forage, and Cover Crop Seeds in the Willamette Valley, Oregon, 1957 Crop Year

(Figures in body of table show what percentage of the total number of plants cleaning a particular crop mentioned a contaminant as being a special problem.)

Crop / Contaminant	Perennial Ryegrass	Common Ryegrass	Alta Fescue	Creeping Red Fescue	Chewing Fescue	Bentgrass	Merion Bluegrass	Crimson Clover	Red Clover	Vetches	Relative Importance
	%	%	%	%	%	%	%	%	%	%	%
Rat-tail fescue	32	36	33	22	45	15	-	-	-	-	27
Sorrels and docks	36	30	-	11	5	8	33	10	57	-	22
Silver hair grass	-	-	-	-	10	77	-	-	-	-	9
Ryegrass	-	-	17	34	15	-	-	-	-	-	5
Buckhorn	-	-	17	-	-	-	-	30	29	-	5
French pink	5	6	-	-	-	-	-	-	-	33	3
Annual and Canadian Bluegrass	-	-	-	-	-	-	50	-	-	-	2
Mustard	-	-	-	-	-	-	-	30	-	-	2
Cut-leaf crane's bill	-	-	-	-	-	-	-	30	-	-	2
Wild radish	-	-	-	-	-	-	-	-	14	67	2
Other/1	27	28	33	33	25	-	17	-	-	-	21
Total	100	100	100	100	100	100	100	100	100	100	100

/1 Includes: chesses, quackgrass, Canada thistle, bristly dogtail, sweet vernal grass.

80 percent was charged for on this basis. An hourly charge was applied on about 12 percent, while the remaining 8 percent received a charge based on the cleaned weight.

The actual cleaning charges for a particular seed varied from plant to plant. Table 11 shows the average charge and the lowest and highest charges for several of the seeds encountered in the survey. It should be noted that these charges are for cleaning only and do not include testing fees, sacks, or any other services for which a charge is made by the processor. The one exception to this is noted in part C of the table. It should also be mentioned that there was no apparent difference between commercial and semi-commercial plants as to the charges each group levied for any given seed. There was, however, an apparent difference between certain areas as to the charges for some seeds, but the survey data did not indicate the reasons for these differences.

Though there were only three methods of levying cleaning charges, there was some variation between plants in the application of these charges for different seeds. Semi-commercial plants tended to charge more often on an hourly basis than the commercial cleaners did. However, several processors who charged on an inweight basis said they reserved the right to charge by the hour on certain seeds or on difficult lots. This was particularly true for those plants that used special pieces of separating equipment to do finishing work on lots cleaned by other plants. Only one semi-commercial and one commercial cleaner charged by the cleaned weight on their total volume, yet here again several others used this method on special lots.

Whereas the data obtained in the survey are insufficient to determine which is the most equitable method, it is possible to point out some of

Table 11. Cleaning Charges of the Commercial and Semi-Commercial Processors for Specified Seeds, Willamette Valley, Oregon, 1957

A. Based on Inweight

Kind of Seed	Number of Plants Reporting	Charge per ton weighed in		
		Low	High	Average
Perennial Ryegrass	15	$ 11.00	$ 14.00	$ 13.27
Common Ryegrass	17	9.00	12.00	10.71
Alta Fescue	13	10.00	40.00	25.00
Creeping Red Fescue	4	40.00	80.00	57.50
Chewings Fescue	7	50.00	80.00	61.43
Bentgrass	5	50.00	80.00	60.00
Merion Bluegrass	2	80.00	100.00	90.00
Meadow Foxtail	3	60.00	100.00	86.67
Vetch and Oats	21	5.00	11.00	7.76
Vetch and Wheat	4	9.00	12.00	10.25
Crimson Clover	12	20.00	60.00	35.83
Red Clover	9	30.00	60.00	45.28

B. Based on Hourly Charge

Kind of Seed	Number of Plants Reporting	Charge per Hour of Cleaning Time		
		Low	High	Average
Perennial Ryegrass	4	$ 3.75	$ 8.00	$ 6.19
Common Ryegrass	5	3.75	8.00	6.55
Alta Fescue	3	4.00	5.50	5.00
Chewings Fescue	5	5.50	8.00	6.50
Bentgrass	3	4.00	6.50	5.00
Meadow Foxtail	1	--	--	8.00
Blanket Rate for all seeds cleaned	5	3.50	8.00	6.10

C. Based on Clean Seed Yield

Kind of Seed	Number of Plants Reporting	Charge per Ton of Clean Seed		
		Low	High	Average
Perennial Ryegrass	1	$ --	$ --	$ 15.00[1]/
Common Ryegrass	2	8.00	15.00	11.50
Alta Fescue	1	--	--	12.00
Chewings Fescue	1	--	--	80.00
Meadow Foxtail	2	--	--	80.00

1/ This is the only figure which includes sacks in the cleaning charge reported.

the advantages and disadvantages of each. For instance, on an inweight basis, the grower's cost per ton of clean seed varies as the cleanout; or to put it another way, the smaller the amount of impurities to be removed, the lower the cost per ton of clean seed. (Figure 2). For example, assume the charge is $14 per ton of field run seed. With a 10 percent cleanout, the equivalent cost per ton of clean seed is $15.56 whereas for a cleanout of 20 percent the cost is $17.50 per clean ton.

The cleaning plant also benefits from receiving cleaner seed. The fewer the impurities to be removed, the faster the seed can be cleaned, within limits. If the cleaning plant charges $12 per ton for cleaning common ryegrass, the plant would receive $60 for cleaning a 5-ton lot. Assume the plant capacity is 1,500 pounds clean seed per hour when the cleanout is 10 percent. This might reduce to 1,200 pounds of clean seed per hour if the cleanout were 25 percent.

With a 10 percent cleanout, at 1,500 pounds per hour, it would take six hours to clean a 5-ton lot. With a 25 percent cleanout, at 1,200 pounds per hour, it would take 6½ hours. The plant would receive the same amount of money in either case, but the return per hour of operating time would be greater for the lot with the lower cleanout.

The above is a theoretical example only, but it does serve to illustrate one way in which variations in the amount of impurities in the seed can affect cleaning costs. A further aspect of the inweight charge is that accurate weighing of the seed as it is received, and of the separations made, shows the grower exactly what he is bringing to the plant. He should, therefore, be able to adjust his production or harvesting methods to improve the quality of his seed.

Figure 2. Relationship between Cost per Ton of Clean Seed and Cleanout Percentage for Various Typical Inweight Charges

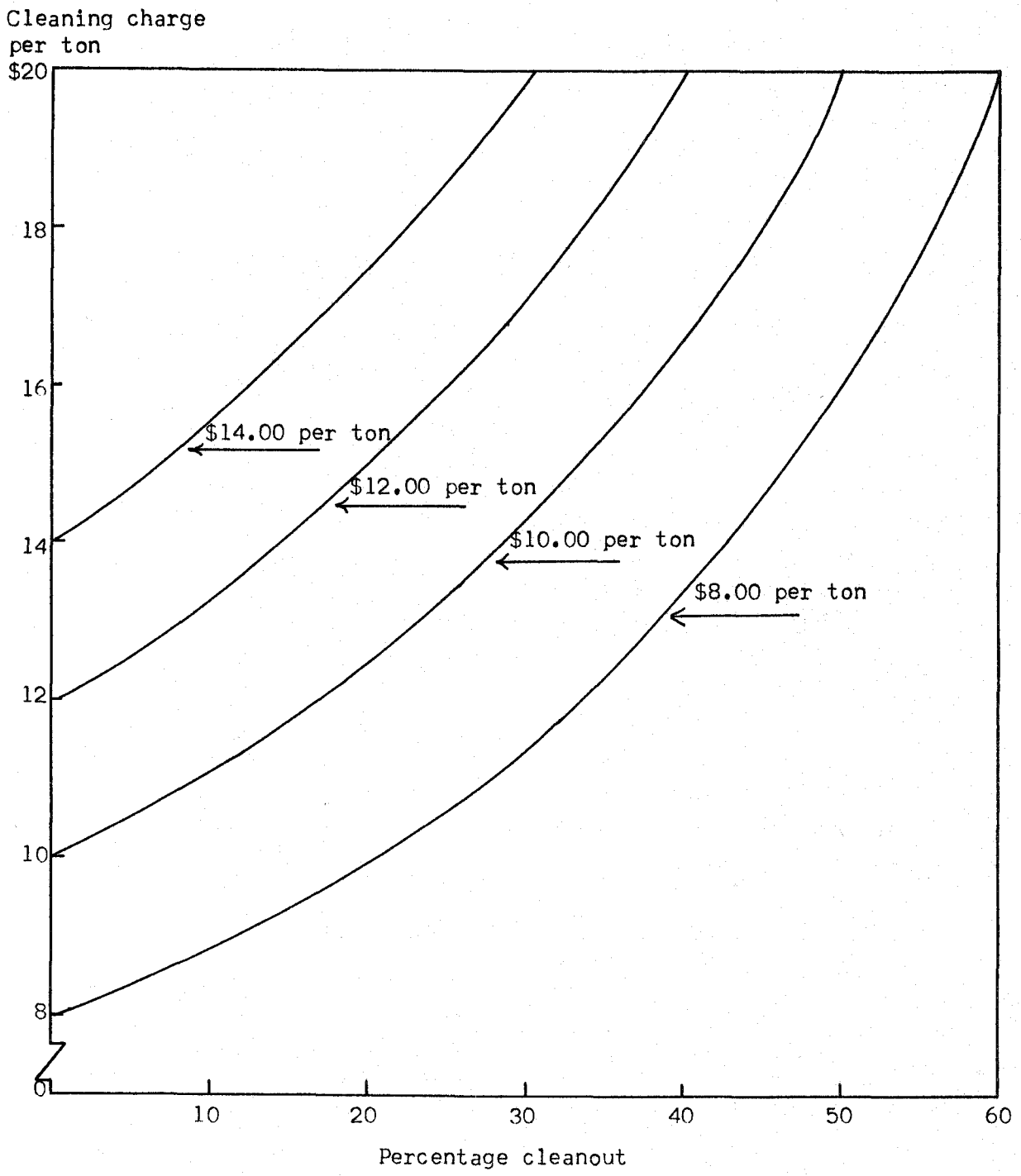


Figure 3. Relationship between Cleaning Charge per Ton of Clean Seed and Hourly Capacity for Several Typical Hourly Cleaning Charges

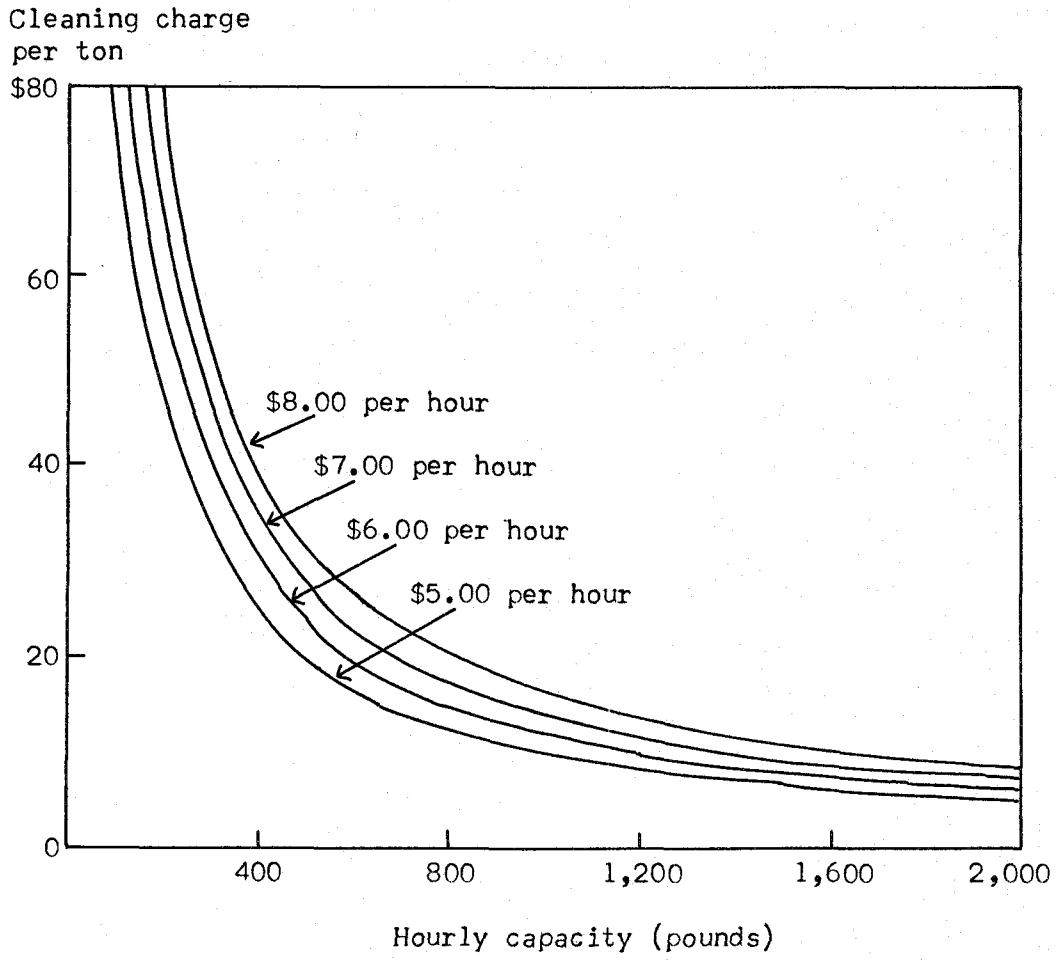


Figure 3 relates the behavior of cost per ton of clean seed for various typical hourly charges to hourly outputs which can be or are achieved by processors of several different seeds. To the extent the hourly capacity of a given plant for a particular seed is determined by cleanout, the grower benefits from having as low an amount of impurities as possible. It can be seen from the figure that cost per clean ton goes up for the grower as hourly output goes down. Because of this relationship, some growers, and cleaners as well, feel an hourly charge gives the processor an unfair advantage through his ability to control output. If the cleaning plant manager has made an accurate appraisal of his costs per hour of operation, charging by the hour would appear to be the fairest method of recovering costs. Available data are insufficient to compare realistically one method with another, however.

A cleaning charge based on the cleaned seed weight assures all growers of paying the same cleaning charge per ton of clean seed. Under this method, though, the cleaner receives the benefit of any decrease in cleanout. The producer of the cleanest seed from the field is, in this case, subsidizing producers whose seed is higher in cleanout than his own.

Selling Methods

Sales to local dealers are the most important method of selling used by farm and semi-commercial cleaners in 1957. For the commercial plants, sales to local dealers were of equal importance to sales through the plant's parent company or subsidiary outlets.

The majority of the farm plants indicated they often contracted for sale at some time prior to cleaning, usually after harvest. About one-fourth said they contracted most of the time. Sales were to local dealers, and commercial seed processing plants, except for one plant whose seed went to a local cooperative.

Direct sales to seed dealers in other areas were utilized by only 8 percent of the semi-commercial plants and 20 percent of the commercial plants. Since direct sales were most often used by the larger plants, these figures probably understate the total volume of seed sold in this manner. Only 16 percent of the commercial plants indicated they made some sales through brokers.

Table 10. Selling Methods Used by the Survey Plants in 1957.

Selling Method	Type of Plant/1		
	Farm	Semi-Commercial	Commercial
	Percent	Percent	Percent
To Local Dealer	91	84	28
To Cooperative	3	8	-
Direct to Other Areas	-	8	20
To Broker	-	-	16
Retail	-	-	12
Company Outlets	-	-	28
Unknown	6	-	8

/1 Figures in these columns are expressed as percentages of the number of each type of plant in the survey.

Appendix Table 1. Equipment Combinations Used to Clean Specified Turf, Forage, and Cover Crop Seeds in the Willamette Valley, Oregon, 1957

Numbers of plants using each combination on a particular seed, expressed as a percentage of the total number of plants cleaning each specified seeds.

	Perennial ryegrass	Common ryegrass	Alta fescue	Creeping red fescue	Chewings fescue	Bentgrass	Merion bluegrass	Meadow foxtail	Orchard grass	Hairy vetch	Common vetch	Crimson clover	Red clover	Alsike clover	Dry field peas	Plants using each/1
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
One cleaner	--	2	--	8	--	20	--	17	--	12	10	27	20	--	--	10
Two cleaners	--	--	--	--	4	20	--	--	--	4	5	13	20	--	17	7
Cleaner plus disc	5	10	4	--	--	--	17	--	--	36	15	7	10	--	17	10
Cleaner plus disc-cylinder	24	27	25	23	21	7	--	17	34	8	25	7	--	--	50	20
Two cleaners plus disc	9	7	13	15	17	--	--	--	--	--	5	--	--	--	--	5
Two cleaners plus disc-cylinder	5	5	13	15	8	13	--	--	--	8	5	--	--	--	--	5
Cleaner plus disc plus cleaner	9	2	4	--	--	--	--	--	--	16	5	7	--	--	16	4
Cleaner plus disc-cylinder plus cleaner	24	20	25	23	25	20	50	17	33	8	10	13	20	34	--	15
Cleaner plus cylinder	5	7	8	--	13	13	--	--	--	8	5	--	--	--	--	6
Cleaner plus cylinder plus cleaner	5	2	4	--	--	--	--	33	--	--	10	7	--	33	--	4
Cleaner plus two discs	5	7	--	--	--	--	--	16	33	--	--	7	10	--	--	4
Two cleaners plus cylinder	--	--	--	--	4	7	--	--	--	--	--	6	10	--	--	1
Two cleaners plus two discs	5	2	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Cleaner plus cylinder plus disc plus cleaner	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	1
Cleaner plus cylinder plus two discs	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	1
Disc-cylinder plus two cleaners	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	1
Cleaner plus three discs	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	1

Appendix Table 1--Continued

	Perennial ryegrass	Common ryegrass	Alta fescue	Creeping red fescue	Chewings fescue	Bentgrass	Merion bluegrass	Meadow foxtail	Orchard grass	Hairy vetch	Common vetch	Crimson clover	Red clover	Alsike clover	Dry field peas	Plants using each/1
	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Two cleaners plus disc plus disc cylinder	4	3	4	--	--	--	16	--	--	--	--	--	--	--	--	1
Two cleaners plus two cylinders plus disc	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Cleaner plus two cylinders plus two cleaners plus two cylinders	--	--	--	8	--	--	--	--	--	--	--	6	10	33	--	1
Cleaner plus cylinder plus cleaner plus disc-cylinder	--	--	--	8	4	--	--	--	--	--	--	--	--	--	--	1
Totals	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Associated equipment/2																
Doghair reel	48	44	4	--	--	--	--	--	--	--	--	--	--	--	--	17
Gravity separator	5	5	4	8	--	--	67	17	--	12	10	33	30	67	--	9
Spiral separator	--	--	--	--	--	--	--	--	--	72	60	--	--	--	--	22
Draper	--	--	--	--	--	--	--	--	--	12	20	7	30	--	50	6
Buckhorn sawdust mill	--	--	--	--	--	--	--	--	--	--	--	20	--	--	--	3
Debearder/3	5	--	--	--	33	47	50	--	--	--	--	--	--	--	--	14
Electromagnetic separator	--	--	--	--	--	--	--	--	--	--	--	--	20	--	--	2
Electrostatic separator	--	--	--	8	--	--	--	--	--	--	--	7	10	--	--	1

/1 Relative importance of each combination, taken as a percentage of the column total. This is not equal to the total number of plants in the survey (70) because several plants used their equipment in more than one combination.

/2 These items were used in addition to or as part of the regular cleaning line. Usage is expressed as a percentage of number of plants cleaning each crop.

/3 Includes hullers, seed polishers and hammermills used in the cleaning process.

Appendix Table 2. Contaminants in the Seeds Cleaned by Farm, Semi-Commercial, and Commercial Cleaning Plants in the Willamette Valley, Oregon, 1957.

Common Name	Botanical Name
Canadian Thistle	Cirsium arvense
Buckhorn Plantain	Plantago lanceolata
Radish (Wild)	Raphanus raphanistrum
Sheep Sorrel	Rumex acetosella
Curly Dock	Rumex crispus
Sour Dock	Probably means Rumex obtusifolius, broad leaved or Bitter dock, "Sour" dock not found in Oregon
Rat-tail fescue	Festuca myuros
French pink	Centaurea cyanus
Wild Garlic	Allium vineale
Wild Onion	Allium sp.
Quackgrass	Agropyron repens
Dodder	Cuscuta sp.
Mesquite or Velvet grass	Holcus lanatus
Downy Chess	Bromus tectorum
Soft Chess	Bromus mollis
Cheat	Bromus secalinus
Hairy Chess	Bromus commutatus
Silverhair grass	Aira caryophyllea
Dog Fennel	Anthemis cotula
Mountain Brome	Bromus marginatus
Wild Vetch	Vicia sp.
Mustard	Brassica sp.
Cut Leaf Cranesbill	Geranium dissectum
Bristly Dogtail	Cynosurus echinatus

Common Name	Botanical Name
Lamb's Quarter	Chenopodium album
Morning Glory (Wild)	Convolvulus arvensis
Bird Rape	Brassica campestris
Wild Carrot	Daucus carota
Annual Bluegrass	Poa annua
Wild Canada Bluegrass	Poa compressa
Little Quaking Grass	Briza minor
Wild Oats	Avena fatua
Field Madder	Sherardia arvensis
Rattle grass	Possibly Briza minor
Rabbit grass	Possibly Polypogon monspeliensis, Rabbitfoot grass
Scorpion grass	Plagiobothrys figuratus
Wild Buttercup	Ranunculus sp.
Rough Hawkbit	Leontodon nudicaulis
Burnet	Sanguisorba annua
Common Groundsel	Senecio vulgaris
Pigweed	Amaranthus sp.
Ripgut	Bromus rigidus
Sweet Vernal	Anthoxanthum odoratum
Spotted Cat's Ear	Hypochaeris radicata
Mouse Ear	Cerastium sp.
Meadow Barley	Hordeum brachyantherum
St. John's Wort	Hypericum perforatum
Spike Bent	Agrositis exarata
---	Lathyrus sphaericus

Appendix Table 3 .. These Weed and Crop Seeds Were Listed Most Often as the Usual Contaminants of Turf, Forage, and Cover Crop Seeds Cleaned in the Willamette Valley, Oregon, 1957 Crop Year.

(Figures in body of table show what percentage of the total number of plants cleaning a particular crop mentioned a weed or crop seed as being a usual contaminant.)

Contaminant \ Crop	Perennial ryegrass	Common ryegrass	Alta fescue	Creeping red fescue	Chewings fescue	Bentgrass	Merion bluegrass	Crimson clover	Red clover	Vetches	Relative Importance
	%	%	%	%	%	%	%	%	%	%	%
Docks and sorrel	24	30	16	18	22	9	11	3	35	--	20
Rat-tail fescue	24	27	25	18	30	13	11	--	--	--	19
Chess	11	6	16	6	10	4	--	--	--	12	8
Mesquite grass	7	8	6	6	8	9	22	--	--	6	6
Ryegrass	--	--	16	18	10	--	11	11	12	6	6
Buckhorn	2	1	6	6	5	9	--	8	35	--	6
French pink	10	5	3	11	2	--	--	4	--	13	5
Mustard	2	1	--	--	--	--	--	31	--	25	5
Canada thistle	2	8	--	11	3	--	--	4	--	13	4
Quackgrass	7	6	--	6	5	4	--	--	--	--	4
Silver hair grass	--	1	--	--	2	39	11	--	--	--	4
Bristly dogtail	7	7	6	--	--	--	--	--	--	--	4
Wild garlic	4	--	6	--	--	4	--	--	--	25	3
Annual and Canadian Bluegrass	--	--	--	--	3	9	34	--	--	--	2
Cut-leaf crane's bill	--	--	--	--	--	--	--	23	--	--	2
Rape	--	--	--	--	--	--	--	15	--	--	1
Dodder	--	--	--	--	--	--	--	--	18	--	1
Total	100	100	100	100	100	100	100	100	100	100	100

Appendix Table 4 ..These Contaminants Were Listed Most Often as Being Especially Troublesome in the Cleaning of Turf, Forage, and Cover Crop Seeds in the Willamette Valley, Oregon, 1957 Crop Year.

(Figures in body of table show what percentage of the total number of plants cleaning a particular crop mentioned a contaminant as being a special problem.)

Contaminant \ Crop	Perennial ryegrass	Common ryegrass	Alta fescue	Creeping red fescue	Chewings fescue	Bentgrass	Merion bluegrass	Crimson clover	Red clover	Vetches	Relative Importance
	%	%	%	%	%	%	%	%	%	%	%
Docks and sorrel	36	30	--	11	5	8	33	10	57	--	22
Rat-tail fescue	32	36	33	22	45	15	--	--	--	--	27
Silver hair grass	--	--	--	--	10	77	--	--	--	--	9
Chesses	14	8	--	11	5	--	--	--	--	--	6
Quackgrass	5	6	17	11	5	--	17	--	--	--	6
Ryegrass	--	--	17	34	15	--	--	--	--	--	5
Buckhorn	--	--	17	--	--	--	--	30	29	--	5
French pink	5	6	--	--	--	--	--	--	--	33	3
Canada thistle	--	6	--	11	5	--	--	--	--	--	3
Bristly dogtail	4	6	--	--	5	--	--	--	--	--	3
Sweet vernal grass	4	2	16	--	5	--	--	--	--	--	3
Annual & Canadian Bluegrass	--	--	--	--	--	--	50	--	--	--	2
Mustard	--	--	--	--	--	--	--	30	--	--	2
Cut-leaf crane's bill	--	--	--	--	--	--	--	30	--	--	2
Wild radish	--	--	--	--	--	--	--	--	14	67	2
Total	100	100	100	100	100	100	100	100	100	100	100