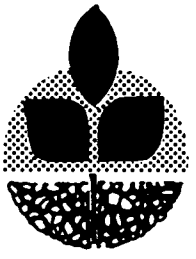
Economic Characteristics of Farms Producing Grass Seed in Oregon's Willamette Valley



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HISTORICAL BACKGROUND

Recent public concern over environmental quality problems in Oregon has focused attention on Willamette Valley grass seed production. Grass seed producers in the valley adopted, in the mid-1940's, the practice of open field burning as the least-cost cultural practice for post-harvest field sanitation and residue disposal. The practice creates an air quality problem during the late summer months. In 1971, the State Legislature passed a measure to ban open field burning in Oregon January 1, 1975. Alternatives to open field burning are being developed and evaluated by the grass seed industry and Oregon State University. It is hoped that both technically feasible and economically satisfactory solutions can be reached by 1975. Fundamental to that hope is an understanding of the technical and economic relationships within the industry itself. This study is directed toward that end.

Field Burning History

The grass seed industry in Oregon began around 1935 with introduction of ryegrass for pasture and covercrop seed production, and commercial acceptance of Highland bent as a turf grass. Bentgrass, native to Western Oregon, previously was considered a serious weed grass. The fescues were introduced some two years later [15]. All of these grasses experienced dramatic acreage increases during the 1940's and 1950's.

Application of commercial fertilizers increased seed yields and the volume of straw residue or aftermath. Unless removed, the residue retarded

plant growth and provided a medium for disease transmission from one year to the next. In the early 1940's, it was discovered quite accidentally that field burning removed the undesirable crop residue both quickly and cheaply. The practice expanded slowly at first because of suspected damage to perennial grasses. However, research in 1948 by Dr. John Hardison, U.S.D.A. Plant Pathologist, Oregon State University, verified the significant role of burning for control of blind seed disease in ryegrass, nematode in fine fescue, and several disease pathogens in all grasses [5].

Further research demonstrated that field burning provided secondary benefits of (1) stand thinning and physiological plant stimulation, (2) increased fertilizer efficiency, (3) increased effectiveness of soil active herbicides, (4) extended stand life, and (5) reduced pesticide needs [1]. By 1950, burning in grass seed and small grain fields had become a widely adopted cultural practice, and has continued its prominence to the present.

The Burning Practice

Open field burning is conducted in July, August, and September of each year following grass seed harvest. Dry summers, favoring seed maturation, also produce dry, highly combustible straw aftermath and stubble, a necessary condition for effective burns. Fire control usually requires four to six men and three to five water tanks pulled by tractors. Crew size varies according to field size and presence of nearby fire hazards such as buildings, trees, and unburned fields. A plowed strip four to eight feet wide around the field is maintained as a fire break. The strip is cultivated periodically to control vegetative growth.

Wind direction and velocity dictate the burning operation. The fire is ignited on the leeward edge of the field, and allowed to burn against the wind as a backfire. When the backfire has burned a safe distance from hazards, the main fire is ignited around the perimeter of the field with torches or pitchforks. Once the field is encircled with fire, the rising heat creates a draft which draws the fire together from all sides,

completing the operation in a matter of minutes. Whirlwinds and unpredictable wind shifts constitute the primary danger, necessitating constant patrol of the fire perimeter. The hazard is particularly acute after a backfire has been started, since a wind shift could easily transform the backfire into a main burn, often sweeping across a field with disastrous results. Although smoke dispersion is optimal when wind levels are high, this condition paradoxically is the most difficult to control.

A Perspective of the Willamette Valley Grass Seed Industry

Grass seed production in Western Oregon is confined almost entirely to the Willamette River Basin [7]. The valley enjoys an advantage over most areas of the world with climatic conditions ideal for grass seed development. Grass growth is prompted by consistently moist and mild weather conditions during fall, winter, and spring months. Summers, which are usually dry, permit seed development, maturation, and harvest with minimal danger of reducing seed viability.

The Willamette River Basin extends from the Eugene-Springfield metropolitan area northward along the Willamette River to Portland. The valley's width increases from less than 10 miles at its southern extremity near Eugene to 40 miles at its northern end, near the city of Portland. The valley is bounded on the east by the Cascade Mountains and on the west by the Coast Range. Portions of nine counties - Benton, Clackamas, Lane, Linn, Marion, Multnomah, Polk, Washington, and Yamhill - are contained within the geographical boundaries of the basin. Relative location of the Willamette Valley seed producing area is shown on the insert map of Oregon in Figure 1.

Estimated grass seed acreage in the Willamette Valley, in recent years, has ranged from 231,000 acres in 1969 to 270,000 acres in 1972. All but some 6,000 acres of the total consisted of seven major seed types: Highland bentgrass, Kentucky bluegrass, fine fescue, tall fescue, orchardgrass, annual ryegrass, and perennial ryegrass. The valley produces essentially all of the U.S. grown ryegrass, 90 to 95 percent of the bentgrass and fine fescue,

40 to 50 percent of the orchardgrass, and 10 to 25 percent of the Kentucky bluegrass and tall fescue seeds. The remaining 6,000 acres contain varying quantities of Merion bluegrass, wheatgrass, bromegrass, and Sudan grass seed production.

Annual and perennial ryegrass accounted for nearly 60 percent of total acreage, with fine fescues and bentgrasses in distant second and third positions respectively from 1968 through 1970 (See Appendix Table 1). Linn County contained nearly 55 percent of total valley acreage of grass seed production. Benton, Lane, and Marion Counties also were important grass seed producing areas (See Appendix Table 2).

Annual and perennial ryegrass collectively accounted for 56 percent of total grass seed sales in the valley in 1968 and 1969 (See Appendix Table 3). Bentgrass, bluegrass, fine fescue, orchardgrass, and tall fescue shared the remainder. Nearly 50 percent of grass seed sales originated from Linn County (See Appendix Table 4). Marion County followed a distant second with 12 percent.

Relative to total agricultural land use, grass seed acreage accounted for 28 percent of harvested cropland acreage in the Willamette Valley in 1969 (See Appendix Table 5). In Linn County, grass seed production accounted for 67 percent of total harvested cropland acreage, but was a minor crop in Multnomah, Washington, and Yamhill Counties.

Topography and soil characteristics contribute to the wide range of crop and livestock enterprises in the Willamette Valley. Vegetables and fruits, including green beans, sweet corn, strawberries, cane berries, and cherries predominate on the fertile, well-drained river-bottom soils. Much of the dryland hill areas are devoted to production of Highland bentgrass and fine fescue grasses. Between the well-drained river-bottom and the dryland hill areas are thousands of acres of bench land which contain soils comparable in quality to the river-bottom soils, except for inclusion of an impermeable hardpan some 16 to 24 inches below the surface, which severely restricts drainage. These soils are primarily of the Dayton soil series,

and are commonly referred to as "Whiteland" soils. The high water table during winter months makes these soils unsuitable for cultivation of most crops unless drainage is improved. Ryegrass is one of the few crops which tolerates this adverse winter condition. Tall fescue, orchardgrass, and bluegrass are not as tolerant to "Whiteland" soil conditions as the ryegrasses, so are generally grown on the better drained bench soils of the Woodburn series.

Open Field Burning: An Environmental Problem

An estimated 230,000 acres of grass straw residue and stubble were burned annually in the Willamette Valley as a post-harvest cultural practice during the 1960's. Straw residues ranged from 1.5 tons per acre on bent, fine fescue, and bluegrasses, to as much as 7 tons per acre on annual ryegrass. With an estimated average residue of 3.8 tons per acre, the volume burned approached one million tons annually. Extended rainy springs, such as occurred in 1971, will promote excessive vegetative growth with higher than average straw residue levels.

Residents of the Willamette Valley are exposed to smoke emissions from field burning during July, August, and September which generate visibility loss, soiling, other property damage, and possible health hazards [1]. Air pollution is aggravated by meteorological and geographic characteristics of the Willamette Valley. The Cascade Mountains and the Coast Range form east and west boundaries respectively of the valley which provide effective barriers for retention of air currents. The southern boundary, a series of foothills which form a semi-circle around the east, south, and west sides of the Eugene-Springfield area, also provides an effective barrier.

Meteorological conditions in summer often produce temperature inversions which stratify air masses into upper and lower levels with little air mixing between levels. Smoke rises but a few hundred feet, is retained at that elevation by the inversion, pushed by the prevailing winds to the southern end of the valley, contained by foothills and the Cascade Range, and ultimately deposited upon a substantial portion of the 100,000

inhabitants of the Eugene-Springfield metropolitan area. These people were principal recipients of smoke from Willamette Valley field burning until inception of a controlled burning program.

It has been estimated that field burning contributes only 17 percent of total annual air pollutant emissions in Oregon. Its concentration in July, August, and September in the Willamette Valley makes its presence obvious even to the most casual observer. Visibility recorded at Mahlon-Sweet Airport outside Eugene dipped below 6 miles, for at least one hour, on 18 days between July 16 and September 21 in 1969, and to 200 feet at times [9]. Smoke intensity, during some of these days, reached a level in Eugene sufficient to cause stinging of the eyes, a condition similar to that experienced from smog in Los Angeles. Such conditions are not taken lightly by Oregonians who boast of "liveability", "clean environment", and "views of distant mountains". Over 5,000 complaints were registered against field burning during the summer of 1969. Visibility loss was the most frequently mentioned complaint [8]. Problems of driver visibility occurred when fields adjacent to highways were burned, particularly along heavily-traffiked Interstate Freeway I-5, which runs north-south through the heart of the valley. At least two deaths on Oregon highways in 1969 were attributed to the smoke hazard. A cursory study by several doctors in the Eugene area during the late summer of 1969, when most field burning was being conducted, indicated an increase in office calls from patients with respiratory problems when visibility was at low levels [12].

Recent Field Burning Regulations

Increased concentration and magnitude of smoke emissions made field burning a primary target for public efforts toward its regulation. Prior to 1969, a farmer wishing to burn could obtain a permit simply by phoning local fire district officials and agreeing to meet specified manpower and water supply standards.

In 1969, the state legislature granted the State Department of Environmental Quality (DEQ) jurisdiction over field burning, but provided no funds

for control and enforcement of regulations [3]. On August 12, 1969, dubbed "Black Tuesday" by Eugene residents, a heavy burn, a low inversion layer, and strong northwesterly air currents aloft combined to produce an oppressive smoke condition in Eugene. Burning was banned by Governor McCall for seven days. After the seven-day moratorium, burning was restricted by DEQ to days when meteorological conditions were favorable for smoke dispersion. Daily acreage limitations were established for each fire district in accordance with forecasted and actual meteorological conditions.

Fire district quotas were continued in 1970 with more detailed acreage quotas established from the total acreage base to be burned within each district. Smoke dispersal predictions were more reliable in 1970 than in 1969 as meteorological research and experience became more precise. Farmers in the southern portion of the valley were allowed to burn only when southerly winds prevailed, so that the City of Eugene was kept relatively smoke-free. Burning in the northern portion was permitted only when northerly winds prevailed, to protect Portland. Priority areas were established around cities of 3,000 inhabitants or more, and areas within one-fourth mile of a major highway. Fields in these priority areas were burned only when prevailing winds would carry smoke away from the city or road concerned.

Since 1970, as a result of the new regulations, residents of the eastern mid-valley have been burdened with smoke to a greater degree than in previous years, and residents of Eugene-Springfield to a lesser degree, reflecting the generally eastward flow of winds in the valley. Smoke management, which involves shifting the flow of smoke from one portion of the valley to another, has limitations since the valley has a finite air capacity, and relatively heavy urban population densities exist throughout the valley.

The biennial nature of Oregon's legislature provided the 1971 legislature with its first opportunity, following the smoke crisis of 1969, to develop more permanent legal control. Increased public awareness of environmental problems, plus unique elements of visibility and health, led the 1971 state legislature to pass a measure calling for an immediate phased reduction of uncontrolled open field burning and a complete ban by January 1, 1975.

STUDY OBJECTIVES

General observations of the Willamette Valley grass seed industry indicate that considerable variability exists between grass seed producers in the types of grass grown, cultural practices employed, resource levels used, and other crop and livestock enterprises grown on farms with grass seed. This suggests that costs and returns also vary between grass producers. If so, these differences might influence substantially the range of choice of alternatives to open field burning, the structure of the grass seed industry, and the number of growers who might survive a ban on open field burning. A further implication involves the capability of the Willamette Valley grass seed industry to maintain its competitive position in foreign and domestic seed markets faced with alternatives to open field burning which suggest possible quality deterioration, increased production costs, and yield reduction prospects. Knowledge of economic characteristics of individual producers in the industry is important for understanding and ultimate resolution of these issues.

Recent research efforts have focused upon the seed processing phase of the grass seed industry [2]. Unfortunately, little is known of the economic characteristics of grass seed production at the farm level. The last comprehensive economic study of grass seed farms was conducted in 1948 [6]. Current economic indicators and production research suggest that marked change in farm size, machine and labor use, and cultural practices have occurred since then.

Two objectives are served by this study:

(1) Identify and describe physical and economic characteristics of farms which produce grass seed in the Willamette Valley with special emphasis upon those factors which appear to exert the greatest influence upon profitability and resource use among grass seed growers.

(2) Establish benchmarks of profitability for grass seed operations to serve as inputs in subsequent research efforts.

This study is one of a series of economic research efforts focusing upon the Willamette Valley grass seed industry. Special Report 336 provided an economic appraisal of on-farm alternatives to open field burning as perceived in 1971 [4]. Circular of Information 638, published March 1973, evaluates technical and economic considerations in shipping grass straw residue to Japan [10]. Other studies will follow which evaluate alternative on-farm adjustments to selected public policy controls on open field burning, domestic and foreign supply and demand relationships facing the grass seed industry, and use of grass straw residue as a substitute for wood chips in the pulp and paper industry.

STUDY PROCEDURES

If variation between farms producing grass seed in the Willamette Valley is exhibited in resource use and income levels, then it is reasonable to assume that some farms would be better able to survive probable cost increases associated with a field burning ban than others. Applied farm management research suggests not only that variation in resource use and income levels exist between farms, but they often are attributable to:

(1) type of seed produced,
(2) size of farm,
(3) ownership cost vs. operating cost structure,
(4) resource combination and use,
(5) production uncertainties which affect risk preferences and other managerial practices.

To determine principal factors affecting profitability of grass seed production, as well as differences and similarities between farms, collection and analysis of on-farm technical and economic data from a sample of Willamette Valley grass seed farms were undertaken. Data from the study are tabulated and presented as averages by production region and seed type, thereby assuring confidentiality of data taken from the sample farms in the study.

Data Collection

A field survey was conducted to obtain physical and economic data for the 1969 production year from a sample of Willamette Valley farms producing

grass seed. Historical evidence indicates that 1969 was a relatively typical year in terms of production conditions, and a somewhat better than average year in terms of farm price. Above average farm price was received by growers for bentgrass, tall fescue, annual ryegrass, and perennial ryegrass seed when compared with Oregon's ten year average from 1960 through 1969. Prices received in 1969 for Kentucky bluegrass, fine fescue, and orchardgrass were about average.

An attempt was made to interview approximately 10 percent of the valley's grass seed growers. Available grower lists indicated that approximately 1800 farm operators were producing grass seed in the Willamette Valley in 1969. Publicly-distributed seed grower lists were obtained from Seed Certification Specialists, Department of Agronomic Crop Science, Oregon State University. Revisions were made under supervision of Oregon's grass seed commodity commissions. The population was stratified by seed type and farm size, with an estimated 10 percent sample drawn from each substrata to insure that variation in costs and returns attributable to seed type and farm size influences would be recorded. Seed type substrata included annual and perennial ryegrasses, fine fescue, Highland bentgrass, Kentucky bluegrass, tall fescue, and orchardgrass. Four farm-size strata were used: 0 to 150, 151 to 300, 301 to 900, and over 900 acres of total land operated, which included rented and owned cropland and non-cropland acres. Farm size data were obtained from County Directories, Tscheu Publishing Company, for Willamette Valley counties, 1960-1969 [14].

Usable records were obtained from 147 farm operators. The initial sample contained names of 204 farm operators. Of this total, 35 growers no longer raised seed, or had rented their operation to other farmers whose names were included in the sample. Another 22 growers could not be contacted or declined to cooperate.

Farm data from each of the farm operators interviewed were recorded on field schedules. Information which was recorded included type of farm organization, recent organizational changes, capital investment, resource use, farming practices, costs and returns, and enterprise combinations.

Sample Coverage

A comparison was made of grass seed acreage reported by the 147 sample farms with total grass seed acreage in the Willamette Valley reported by the Oregon Crop and Livestock Reporting Service. This was done to determine if sample coverage appeared to be large enough so that inferences from the sample could be extended to the total grass seed industry in the valley. The sample of 147 farms accounted for 26 percent of the estimated total grass seed acreage in the Willamette Valley in 1969, as shown in the far-right column of Table 1. Stratification by seed type provided uniform and far greater than expected overall acreage coverage, with the sample accounting for at least 18 percent of total valley acreage within each seed type, and nearly 50 percent on orchardgrass.

Two or more types of grass seed were grown on nearly three-fourths of the farms sampled. Many farms were larger than the size class shown in the initial sample stratification. This suggested that stratification of the farm survey data for analytical purposes should use criteria different from that used in the sampling process. Published seed production data by counties indicated that soil patterns and urban concentrations appeared to influence type of farm organization. Consideration of urban and soil factors prompted separation of the 147 sample farms into five regional classes for analytical purposes. The five production regions are shown in Figure 1. Regional characteristics are discussed in the next section. Stratification by region was reasonably uniform with exception of Region 1, where the sample accounted for only 2 percent of 1969 reported grass seed acreage. Since Region 1 contains less than 4 percent of total grass seed acreage in the valley, its small representation in the sample is not serious. In all other regions the sample accounted for over 25 percent of total grass seed acreage reported in each region.

Scope of sample coverage suggests that the actual number of grass seed producers in 1969 was significantly smaller than that implied by the listings from which the sample was drawn. Two reasons, both potentially valid, are advanced to explain this discrepancy: (1) the grower lists from which the

Table 1. Grass Seed Acreage Reported from 147 Willamette Valley Farms Producing Grass Seed, by Seed Type and Producing Region, 1969

Seed type	Region 1 Multnomah, Clackamas	Region 2 Linn, Benton Lane	Region 3 Marion	Region 4 Polk	Region 5 Yamhill, Washington	Total		Sample as percent of total acres by seed type
						Sample acreage by seed type	Willamette Valley acreage by seed type a/	
Bentgrass.....	---	3,203	4,023	---	1,057	8,283	24,450	29.1
Bluegrass.....	---	4,093	421	18	105	4,637	13,280	35.8
Fine fescue.....	214	942	4,960	573	251	6,940	29,300	24.1
Tall feacue.....	7	3,622	110	---	---	3,739	15,920	23.4
Orchardgrass.....	---	4,847	283	234	30	5,394	11,300	48.4
Annual ryegrass.....	---	22,314	514	3,240	396	26,464	104,200	25.6
Perennial ryegrass..		7,150	310	598	9	8,067	44,800	18.0
Total sample acreage by region.....	221	46,171	10,621	4,663	1,848	63,524	---	25.7
Eatimated total grass seed acreage a/.....	9,850	175,090	42,700	12,750	6,860	---	247,250	---
Sample as percent of total grass seed acres, by region.....	2.2	26.4	24.9	36.6	26.9			

a/ Estimates by Cooperative Extension Service, Oregon State University, Corvallis, and Oregon Crop and Livestock Reporting Service, USDA, Portland.

sample was drawn overstated the actual number of growers, and (2) the sample, to the extent that it did not accurately represent all farm size classes, understated the actual number of growers. Analysis of these elements was undertaken to establish realistic upper and lower limit estimates for the actual number of grass seed producers in 1969. Results of the analysis are treated in detail in the appendix. The analysis indicates that the actual number of Willamette Valley grass seed growers in 1969 was between 765 and 1,500 growers. The lower bound represents commercial grass seed growers whose principal share of income is generated from farming, while the upper bound includes both commercial and part-time farming operations.

Regional Characteristics

Grass seed production appears to be influenced by several geographically related forces, especially urban and soil effects. This prompted separation of the 147 sample farms into five grass seed producing regions and initial analysis of the data on a region-by-region basis. Region 1 includes portions of Multnomah and Clackamas Counties; Region 2 encompasses Linn, Benton, and Lane Counties; Region 3 contains Marion County; Region 4 is Polk County; and Region 5 includes Washington and Yamhill Counties. Locations of the five regions are shown in Figure 1 with urban and soil influences identified.

Region 1 - Clackamas and Multnomah Counties

Region 1 includes the hill area of Clackamas County and a small section of south-central Multnomah County. The grass seed producing area, devoted almost exclusively to fine fescue production, is characterized by small acreages of farmland intermixed with forest land and urban developments. The area is located 5 to 20 miles from the Portland metropolitan area. Urbanization, with its demand for homesites, is an external force which precipitates increased values on farm land. This economic force exerts pressure to shift land from grass seed production into more intensive agricultural uses including small fruits, vegetables, and nursery crops, and eventually into home and industrial development sites.

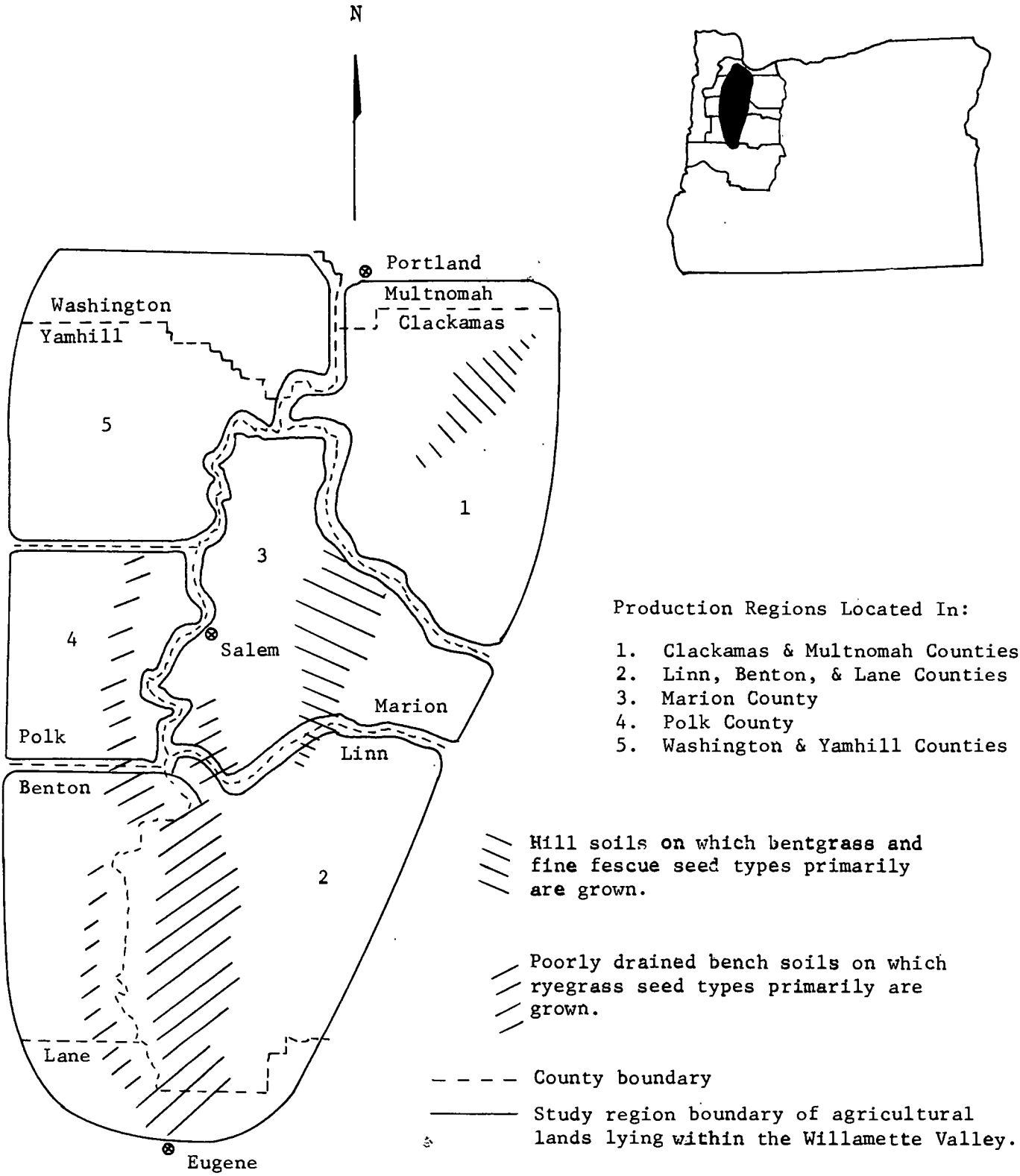


FIGURE 1. Identification of production regions for Willamette Valley grass seed study.

SOURCE: Oregon State Water Resources Board. "General Soil Map. Willamette Drainage Basin." In: Oregon's Long-Range Requirement for Water. Oregon Agricultural Experiment Station in cooperation with the USDA and the Oregon Water Resources Board, Corvallis, 1969.

Five sample farms were in Region 1. All were located in hill areas 5 to 20 miles east of the Willamette River. Each of the five sample farms produced fine fescue as the primary grass seed crop.

Region 2 - Linn, Benton, and Lane Counties

Region 2 contains the upper Willamette Valley seed producing area. It accounts for three-fourths of all Willamette Valley grass seed acreage. Much of it consists of poorly drained "whiteland" soils on which ryegrasses are produced. Linn County produced 75 percent and Lane County produced 10 percent of the U.S. ryegrass seed crop in recent years. Region 2 produces tall fescue, orchardgrass, and bluegrass on the higher, better-drained bench soils, and Highland bentgrass in hill areas.

Sixty-seven sample farms were in Region 2. Fifty-three farms produced annual ryegrass and 40 farms produced perennial ryegrass with most of it grown on "whiteland" soils.

Region 3 - Marion County

Region 3 contains the mid-valley area east of the Willamette River in Marion County. Marion is the leading Oregon county in value of agricultural crop production. Most of the intensive high-valued fruit and vegetable crops are located on well-drained river bottom soils.

The primary grass seed area extends along the eastern foothills of the valley. Highland bentgrass and fine fescue are grown almost exclusively on the well-drained hill soils occupying some 30,800 acres of cropland in Marion County which accounted for 70 percent of the county's value of agricultural production from grass seed in 1969. Some 4,200 acres of ryegrass are grown on poorly drained "whiteland" bench soils. Small acreages of tall fescue, bluegrass, and grass types not included in the study were found on a variety of soil types in the county.

Forty-eight sample farms were in Region 3. Highland bentgrass and/or fine fescue were the only seed crops grown on 32 hill farms. Neither grass was grown on 5 farms which were located in poorly drained areas near the Willamette and Clackamas Rivers. These farms produced annual ryegrass.

Region 4 - Polk County

Region 4 is located on the west bank of the Willamette River in Polk County. The topography is rolling, characterized by lowlands and low hills interspersed over much of the area. Drainage is better than on Region 2 lands, as indicated by dominance of small grain production which does not grow well on "whiteland" soils. Small grains, primarily wheat and barley, comprise over 45 percent of the total harvested cropland [18]. Only 11 percent of the cropland contained grass seed. Ryegrass accounted for 75 percent of the region's value of grass seed production and acreage [7].

Fourteen sample farms were in Region 4. Only one did not report production of small grains. Twelve of the sample farms reported annual ryegrass production.

Region 5 - Washington and Yamhill Counties

Region 5 is located on the western side of the lower Willamette Valley. The region's proximity to the Portland metropolitan area is noted by increasing urban and industrial use of the land.

A wide range of topography and soils explains the diversity of cropping patterns. About 43 percent of the total harvested cropland was devoted to small grains, while 53 percent produced a wide variety of intensive crops including fruits, nuts, and vegetables. Grass seed was produced only on 7,000 acres, or less than 4 percent of the total cropland in Region 5.

Thirteen sample farms were in Region 5. Seven reported annual ryegrass and six reported bentgrass seed production. Twelve of the 13 farms reported legumes grown for seed.

SAMPLE FARM CHARACTERISTICS

Presentation of the general characteristics of the 147 sample farms is treated in this section. It includes description of family characteristics, resource base, income and expenses, and resource returns on a total farm

basis. Description of separate grass seed enterprises is reserved for a later section.

Farm Family Characteristics

Agricultural production is both a user of family labor and a source of income for family living. Its dual role appears to be of particular significance in Oregon grass seed production, since all 147 sample farms were operated as family farms with very limited family income generated from off-farm sources. Eighty-one percent (119 farms) were organized as single proprietorships, 14 percent (20 farms) were family partnerships, and 5 percent (8 farms) were family corporations.

Farm Labor Utilization

Nearly all the sample farms were operated as commercial farm units as evidenced by 93 percent of the farms providing full-time employment for the farm operator. Only in Region 1 was the farm considered as something less than a full-time operation, and this occurred with two of the five sample farms. Only 15 of the 147 sample farms reported that the operator worked off-farm to supplement family income. Only nine farm wives worked off-farm. Farm families employed their children to a limited extent. There were 114 children who worked on 76 farms, with an average age of 16 years. Their labor was utilized primarily during seed harvest months of July and August. Fifteen operators employed their children full time.

Operator Age

The average age of farm operators in the sample was 46 years with a range of 24 to 82 years. Fifty-one percent of the operators were 49 years of age or older. While both small and large farms prevailed for all operator ages, farm size in general was positively related with operator age up to 50 years and then was inversely related, as shown in Figure 2. This relationship is consistent with the U.S. agricultural situation reflecting, at least in part, the important role of farm earnings as a capital source in expansion of the farm business. For operators above 50 years in age, it appears that

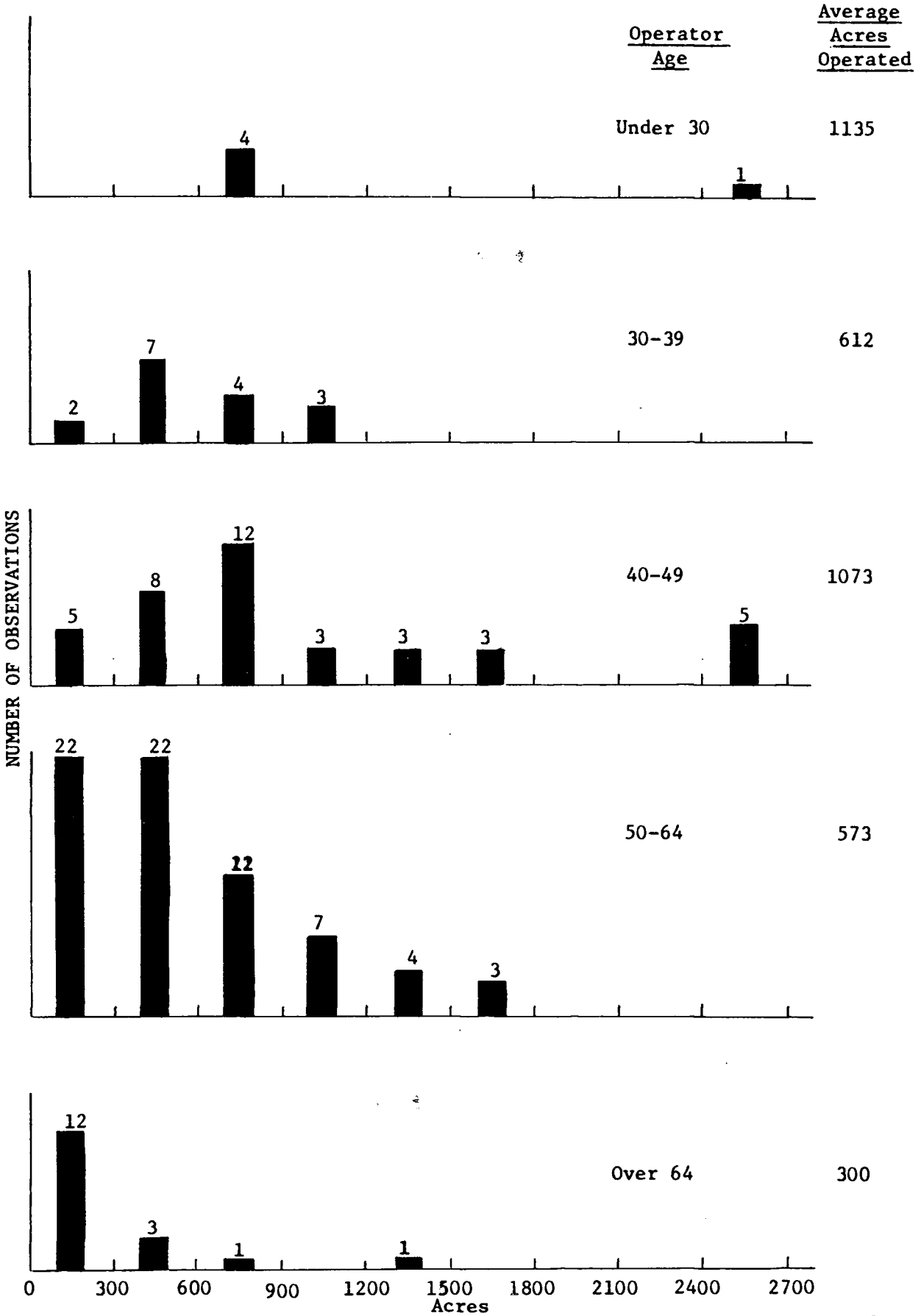


Figure 2. Comparison of Operator Age and Total Acres Operated per Farm for 147 Willamette Valley Farms Producing Grass Seed, 1969.

greater attention was directed toward transfer of resources to subsequent generations rather than increasing the operator's own resource base.

Family Income

Farm family income is obtained both from farm earnings and from non-farm earnings. Table 2 summarizes averaged family earnings from both sources for the sample farms in each production region. Farm earnings are specified as net farm income which represents the earnings from 1969 farm production which could be withdrawn from the farm business without depleting the farm resource base. It represents a residual return both to the operator's equity capital and his labor-management skills for the 1969 production year. Off-farm earnings include off-farm wages earned by the operator and his wife and other off-farm income expressed as interest on capital, stock dividends, social security payments, and miscellaneous income.

Farm family income averaged $14,860 for the 147 sample farms with 13 percent or $1,971 derived from off-farm sources. Net farm income ranged from 84 to 88 percent of farm family income for sample farms in Regions 2, 3, 4, and 5 with average off-farm earnings not exceeding $1,800 per farm. For farms in Region 1, off-farm income generated 82 percent of farm family income.

Farm Resources

Land

The 147 sample farms occupied 101,486 acres of land, of which 88,668 acres were devoted to crop production, as shown in Table 3. The remaining 12,818 acres contained timber, unimproved pasture, and other non-crop land. Seventy-two percent (63,524 acres) of the cropland acreage was devoted to grass seed production, of which approximately 59,600 acres were harvested. Grass seed production dominated land use on sample farms in Region 2, where 86 percent of total reported cropland was devoted to grass seed enterprises. Sample farms in Regions 1, 3, 4, and 5 reported 67, 60, 50, and 26 percent, respectively, of total cropland acres devoted to grass seed production.

Table 2. Average Farm Family Earnings, by Source and Region, on 147 Willamette Valley Farms Producing Grass Seed, 1969

Income source	Region 1		Region 2		Region 3		Region 4		Region 5		Total sample	
	Earnings	% of total earnings	Earnings	% of total earnings	Earnings	% of total earnings	Earnings	% of total earnings	Earnings	% of total earnings	Earnings	% of total earnings
Net farm income[a/] ..	669	18	19,800	88	4,522	84	8,510	85	17,578	88	12,889	87
Off-farm earnings:												
Operator job....	—	—	918	4	351	7	143	1	2,208	11	742	5
Wife job.....	100	3	—	—	243	4	1,379	14	111	1	224	1
Other off-farm earnings [b/].....	2,903	79	1,780	8	285	5	5	—	15	—	1,005	7
Total family earnings.....	3,672	100	22,498	100	5,401	100	10,037	100	20,012	100	14,860	100

[a/] For a detailed analysis of farm income and expenses, see Table 7.

[b/] Includes earnings from capital invested off the farm, Social Security payments, stock dividends, and miscellaneous.

Table 3. Classification of Cropland, as Reported by 147 Willamette Valley Farms Producing Grass Seed, 1969

	Cropland owned			Cropland rented			Total cropland acreage	Total grassland acreage	Total farm acreage reported	Grass seed acreage as percent of cropland	Cropland as percent of total farm acreage
	Total acres	Percent of total cropland	Grass seed acres	Total acres	Percent of total cropland	Grass seed acres					
Region 1.....	292	89	213	37	11	8	329	221	675	67	49
Region 2.....	25,408	47	19,010	28,350	53	27,161	53,758	46,171	58,692	86	92
Region 3.....	11,205	62	6,158	6,872	38	4,463	18,077	10,621	23,904	60	76
Region 4.....	4,994	54	2,153	4,263	46	2,510	9,257	4,663	10,220	50	90
Region 5.....	2,958	41	673	4,289	59	1,175	7,247	1,848	7,995	26	91
TOTAL SAMPLE.....	44,857	51	28,207	43,811	49	35,317	88,668	63,524	101,486	72	87

Almost one-half of total cropland and 55 percent of grass seed acreage on the 147 sample farms were rented. Rental of grass seed acreage was especially common in Regions 2 and 4. Grass seed type was strongly related to land tenure determination. Table 4 shows that over 60 percent of annual and perennial ryegrass acreages were on rented land while only 37 to 41 percent of fine fescue and bluegrass acreages were rented. High establishment costs for the fine fescues and bluegrasses, as shown in Table 12, apparently contribute to the reluctance in growing those grasses on rented land.

Operator age is also related to land tenure, since land rental is an alternative to land purchase for farm size expansion. Some 70 percent of the operators over 65 years of age owned all land they farmed, 33 percent of the operators aged 50 to 65 years owned all of their acreage, and only 20 percent of the operators under 40 years owned all of their acreage.

Land rental was more dominant with the larger farms. Of the 94 sample farms over 350 acres in size, 49 (52 percent) of them reported that more than 50 percent of their total land was rented. By contrast, 32 of 53 (60 percent) of the farms under 350 acres in size, rented no land at all.

Labor

Farm labor was divided into operator, family, and hired categories. Thirty-eight sample farms reported at least 36 man-months (three full-time man-equivalents) of labor per year. Several of these farms reported row crop enterprises with heavy summer labor requirements. Thirty-two farms utilized 24 to 36 man-months of labor. Generally, these were partnerships or individuals employing full-time hired men. Seventy-seven farms utilized less than 24 man-months of labor per year, with most of it constituted by operator labor and part-time family help during harvest time. Labor composition and its level of use varied during the year, reflecting variations in farm size and enterprise combination. Operator labor was used more evenly throughout the year than other labor sources, while the wife, children, and hired labor fluctuated to meet seasonal requirements. The seed harvest period during July and August demanded the highest level of labor use for grass seed production.

Table 4. Total Grass Seed Acreage by Land Tenure and Seed Type, 147 Willamette Valley Farms Producing Grass Seed, 1969[a/]

	Land owned		Land rented		Total	Percent of
	Acres	Percent of total owned acres	Acres	Percent of total rented acres	Owned and rented acres	total grass seed acres
Bentgrass	3,628	43.8	4,655	56.2	8,283	13.0
Bluegrass	2,719	58.6	1,918	41.4	4,637	7.3
Fine fescue	4,395	63.3	2,545	36.7	6,940	10.9
Tall fescue	1,708	45.7	2,031	54.3	3,739	5.9
Orchardgrass	2,627	48.7	2,767	51.3	5,394	8.5
Annual ryegrass	9,952	37.6	16,512	62.4	26,464	41.7
Perennial ryegrass	3,121	38.7	4,946	61.3	8,067	12.7
TOTAL	28,150	44.3	35,396	55.7	63,524	100.0

[a/] A total of 277 acres of grass seed types other than the seven identified in the study were produced on the sample farms, of which 232 acres were owned and 45 acres were rented. These grass types included meadow foxtail, Penncross bentgrass, and Merion bluegrass.

In Region 1, an average of 11 man-months of labor was provided by the operator annually with 3 man-months of labor hired for early spring, summer, and late fall field work. About 7 man-months per farm, or 64 percent of total labor use, were devoted to grass seed production.

In Region 2, labor use averaged 31.7 man-months per year, or nearly 3 full-time man-equivalents per farm. The operator(s) accounted for 12.3 man-months, while other family labor accounted for an additional 7.2 man-months per year. Family labor provided over 60 percent of total farm labor requirements. Children worked mostly during summer months, while labor of the operator's wife was evenly distributed throughout the year, and accounted for the majority of family labor exclusive of operator labor. Approximately one man-equivalent was hired for year-round employment. During the harvest months of June, July, and August, an average of two men per month were hired. About 25 man-months, or 80 percent of total labor, were used for grass seed production on the sample farms.

Sample farms in Regions 3, 4, and 5 reported similar labor use characteristics. Average labor use per farm was slightly over 2 full-time man-equivalents per year. The operator(s) provided 12.5 to 13.2 man-months, while other family members contributed an additional 5 man-months per year. Family labor constituted about 72 percent of total farm labor use. In Regions 3 and 4, some 50 percent of total labor was used on grass seed enterprises, while only 20 percent of total labor reported from Region 5 farms was used for grass seed production.

Capital Investment

Capital investment in farming includes the total value of land, buildings, machinery, and livestock. The averaged total capital investment per farm by region is shown in Table 5. Investment figures represent total assets owned by the farm operator, rather than net worth. Value of rented land and buildings and operating capital are excluded. A charge for rented resources is included as a cash farm expense in the farm income and expense section. The total capital investment per farm ranged from a low of $120,000 in Region 1 to a high of $232,000 in Region 4, with an average of slightly over $200,000 per farm for the 147 farms.

Table 5. Total Capital Investment Per Farm, by Region, Averaged for 147 Willamette Valley Farms Producing Grass Seed, 1969 [a/]

Item	Region 1	Region 2	Region 3	Region 4	Region 5	Average [b/]
Acres owned	128	425	326	416	269	346
Value per acre	$ 786	$ 386	$ 416	$ 443	$ 475	$ 438
Total capital investment:						
Land	$106,150	$163,918	$135,856	$183,970	$128,000	$151,548
Buildings	7,153	18,860	17,636	21,132	16,690	18,768
Machinery	4,584	36,125	21,425	24,663	21,082	27,898
Livestock	2,326	2,460	3,276	2,495	15,321	3,862
TOTAL	$120,213	$221,363	$178,193	$232,260	$181,093	$202,076
Grass seed investment: [c/]						
Land	$ 33,800	$126,700	$ 58,700	$ 89,700	$ 33,600	$ 97,700
Buildings	2,577	13,985	9,025	4,613	10,425	10,494
Machinery	2,712	30,685	14,755	13,162	4,251	19,716
TOTAL	$ 39,084	$171,320	$ 82,500	$107,475	$ 48,276	$127,910
Percent of total investment for grass seed use	33	77	46	46	27	63

[a/] Includes operator equity and operator debt, but does not include value of resources rented by the operator, such as land and machinery. Charges for use of rented resources are included in farm expenses, shown in Table 7.

[b/] Averages were calculated over all 147 farms. Ten operators owned no land, 16 no buildings, 7 no machinery, and 58 no livestock.

[c/] Sample operators reported the acreage and value of land devoted to each farm enterprise, and specified the total value and proportion devoted to grass seed enterprises for buildings and machinery.

Land constituted 71 to 88 percent of total asset value in each region. Average value of land investment per farm ranged from $106,000 in Region 1 to $184,000 in Region 4. While farm size was low in Region 1, total farm value was bolstered by urban influences, as evidenced by average land values per acre of $786 which were nearly double that found in the other four regions.

Buildings represented 6 percent of total capital investment and 9 to 10 percent in all other regions. Region 1 operators reported building values averaging $7,000 per farm, while a range of $16,000 to $21,000 per farm was reported for the other four regions.

Machinery values ranged from $4,600 per farm, or 4 percent of total assets in Region 1, to $36,000, or 16 percent of total assets in Region 2. In Regions 3, 4, and 5, machinery investment averaged $21,000 to $25,000 per farm, or 12 percent of total capital investment.

The averaged total value of resources devoted to grass seed production, exclusive of rented resources, was estimated at $128,000 per farm for all regions. Region 1 had the lowest with $39,000 per farm. Region 2 had the highest with $171,000. Timber, pasture, and other crops constituted over half the total land use in Region 1. Livestock and crops other than grass seed dominated agricultural production in Region 5.

Since calculation of averages over all 147 farms sampled does mask extremes, it is of note that 10 operators owned no land, 16 no buildings, 7 no machinery, and 58 no livestock at all.

Resource Use

Although grass seed enterprises dominated land use on most farms sampled, other crop and livestock enterprises were reported. The acreage of grass seed by seed type for each region is listed in Table 6. Other land use also is specified.

Table 6. Average Acreage Per Farm, Grass Seed in Production, by Region and Seed Type, from 147 Willamette Valley Farms Producing Grass Seeds, 1969

Region:	1	2	3	4	5	Total sample
Number of farms:	5	67	48	14	13	147
	Acres					
Bentgrass.....	---	48	84	---	81	56
Bluegrass.....	---	61	9	1	8	32
Fine fescue.....	43	14	103	41	19	47
Tall fescue.....	1	54	2	---	---	25
Orchardgrass.....	---	72	6	17	2	37
Annual ryegrass....	---	333	11	231	30	180
Perennial ryegrass.	---	107	6	43	1	55
Other grass.....	---	2	4	---	---	2
TOTAL GRASS SEED.	44	691	225	333	142	434
Other crops.....	22	112	152	328	415	169
Total cropland.....	66	803	377	661	557	603
Pasture, timber, and other a/.....	69	73	121	69	58	87
TOTAL FARM ACREAGE.	135	876	498	730	615	690
Grass seed acreage as percent of total farm acreage.....	33	79	45	46	23	63
Grass seed acreage as percent of total cropland acreage.....	67	86	60	50	26	72

a/ Other land includes farmstead, roads, and rights-of-way.

Sample farms in Region 1 averaged 135 acres in size, with less than half the land devoted to crop production. Pasture and timber dominated non-crop land use. Grass seed enterprises occupied 67 percent of the cropland. Fine fescue was essentially the only seed type grown.

Sample farms in Region 2 averaged 876 acres in size. Grass seed production occupied 79 percent of the total land base and 86 percent of the cropland. Ryegrasses constituted 64 percent of the grass seed acreage, with production centered on "whiteland" soils. Bentgrass, bluegrass, tall fescue, and orchardgrass were produced on the hill land and better drained bench soils.

Region 3, Marion County, is noted for diversity of crop production. The high frequency of grain, hay, row crop, pasture, timber, and summerfallow enterprises reported in Table 6 from 48 sample farms in Region 3 substantiates this. Grass seed occupied 60 percent of cropland acreage on the sample farms. Highland bentgrass and fine fescue accounted for 83 percent of the grass seed acreage with essentially all of it grown on well-drained hill soils. Only minor acreages of the other five grass seed types were reported. The high incidence of summerfallow, 26 of 48 farms, reflects the difficulty of controlling weed grasses in preparation of hill soils for grass seed stand establishment.

Sample farms in Region 4 averaged 730 acres in size, with small grains and grass seeds sharing the dominant land use role. Annual ryegrass was the principal grass seed type, accounting for 82 percent of total grass seed acreage. Some production of fine fescue and orchardgrass occurred on rolling hills and better quality bottomlands.

Crop production in Region 5 centered on small grains, fruits, nut crops, vegetables, and nursery crops. Grass seed production played a minor role, accounting for 26 percent of cropland acreage reported by the 13 sample farms. Bentgrass and fine fescue were the major grass seed types grown on well-drained hill soils, while annual ryegrass was grown on poorly-drained bottomland soils.

Farm Income and Expenses

Gross farm incomes, expenses, and net farm incomes per farm were calculated and averaged for the sample farms. Gross farm income is defined to include value of all grass seed produced including landlord shares, value of other crop production, value of livestock production, and value of other farm income, including custom work and government payments. Results are presented in Table 7. Gross farm income averaged $65,000 per farm for the 147 sample farms. Gross farm income by region ranged from a low of $8,000 in Region 1 to a high of $93,000 in Region 2. Grass seed enterprises provided 78 percent of total sales in Region 2, 61 percent in Region 3, 56 percent in Region 1, 49 percent in Region 4, and 28 percent in Region 5. Other crops constituted 34 percent of gross income in Region 4 and 42 percent in Region 5. Livestock contributed 28 percent of gross income in Region 5, but was of minor importance in the other four regions.

Farm expenses were divided into seven categories: cash operating expenses, land rent, livestock expense, overhead, miscellaneous operating expenses, and depreciation on machinery and buildings. Cash operating expenses include hired labor, seeds, chemicals, fuel, supplies, storage, and machine hire. Land rent includes cash rent and an estimated value of crop share distributed to landlords. In instances where complete crop-share data was were not obtained, net landlord share was assumed equal to average cash rent reported in that region. Livestock expense includes feed, breeding fees, and veterinary services. Overhead expenses include interest on operating and mortgage capital borrowed, taxes, insurance, utilities, dues, licenses, and farm travel expenses. A miscellaneous expense category accommodates those items which sample operators did not include in the other six categories. Livestock inventory changes were not calculated. For individual farm observations this can lead to erroneous net farm income computations. However, for this study, the averaging of incomes over the sample farms was assumed to compensate for individual farm errors. Also, the generally limited importance of livestock on the sampled farms suggested that increased accuracy was not warranted.

Table 7. Farm Income and Expenses, Averaged Per Farm, by Source and Region for 147 Farms Producing Grass Seed, Willamette Valley, 1969

	Region					Total sample
	1	2	3	4	5	
Gross farm income:						
Grass seed crops	$4,504	$72,528	$22,772	$27,479	$15,070	$44,596
Other crops	1,724	15,776	9,877	19,006	22,788	14,300
Livestock	1,298	1,588	2,644	5,315	15,448	3,504
Other	577	3,102	2,226	4,715	1,308	2,725
TOTAL	$8,103	$92,994	$37,519	$56,515	$54,614	$65,125
Farm expenses:						
Cash operating	$4,946	$41,650	$19,064	$22,087	$18,778	$29,141
Cash land rent	44	7,600	2,164	5,298	4,415	5,067
Crop-share rent[a/]	0	4,184	1,442	1,758	1,370	2,667
Livestock	352	447	1,211	2,350	2,883	1,090
Overhead	1,454	9,106	5,326	8,873	5,953	7,310
Miscellaneous	73	4,130	893	3,633	176	2,538
Depreciation	565	6,077	2,897	4,006	3,461	4,423
TOTAL	$7,434	$73,194	$32,997	$48,005	$37,036	$52,236
Net farm income[b/]	$ 669	$19,800	$ 4,522	$ 8,510	$17,578	$12,889

a/ Net crop-share rent per acre received by landlords was assumed equal to average cash rent per acre reported in the region.

b/ Net farm income is the return to labor, management, and capital resources owned by the farm operator. This income can be removed from the farm operation without depleting its current capital level.

Resource Returns

Net farm incomes reported in Table 7 represent earnings to operator equity capital, operator labor, and management. Calculation of residual return to these resources is necessary in determining whether net farm income is adequate relative to the level of farm resources expended to achieve it. Division of residual returns between capital and labor resources, while arbitrary, does provide a measure for determining efficiency of resource use between farms and regions. This study assumed local market value for labor and capital as appropriate opportunity cost or alternative use levels. Operator labor was assigned a value of $2.50 per hour or $7,500 per year for a full-time operator-equivalent. Operator capital was assigned 6 percent for long-term, 7 percent for intermediate, and 7.5 percent for operating capital. Results are presented in Table 8.

For the sample of 147 farms, net farm income averaged nearly $13,000 per farm for the 1969 production year. Net farm incomes per farm ranged from a low of $669 in Region 1 to a high of $19,800 in Region 2. Net farm incomes in Regions 1, 3, and 4 were not adequate to provide both an equivalent off-farm wage to the operator for his labor used on the farm and a positive return to his equity capital. In Regions 2 and 5, net farm incomes were adequate to provide an equivalent off-farm wage for operator labor and a return to operator equity capital in excess of 5 percent. Return to capital averaged 6.1 percent in Region 2 and 5.5 percent in Region 5. Return to capital averaged 2.7 percent for all regions, a level insufficient to provide labor and capital earnings comparable to that which might be expected if these resources were used off the farm. These results were consistent, but somewhat lower than returns to operator equity in U.S. agriculture generally, which in 1969 averaged 4.3 percent [16]. A decline in price of grass seeds to "normalcy" might well have erased the high return in Region 2 since 1969 ryegrass prices were 40 percent above the 1960-69 average price. Livestock, especially dairy, may have contributed to the high rate of return in Region 5.

Table 8. Estimated Average Residual Returns to Operator Capital, and Labor and Management Resources Per Farm by Region, from 147 Farms Producing Grass Seed, Willamette Valley, 1969

Item	Region 1	2	3	4	5	Average
NET FARM INCOME	$ 669	$ 19,800	$ 4,522	$ 8,510	$ 17,578	$ 12,889
Operator equity capital[a/]						
Land and buildings	113,303	163,559	146,660	181,004	136,533	156,316
Machinery and livestock	6,910	30,185	21,713	16,629	32,840	25,635
TOTAL	$120,213	$193,744	$168,373	$197,633	$169,373	$181,951
Interest on operator equity[b/]	$ 7,282	$ 11,926	$ 10,320	$ 12,024	$ 10,491	$ 11,173
Return to labor and management[c/]	$ -6,613	$ 7,874	$ -5,798	$ -3,514	$ 7,087	$ 1,716
Full-time operator equivalent[d/]	.68	1.05	1.05	1.17	1.10	1.05
Charge for operator labor and mgt.[e/]	$ 5,130	$ 7,890	$ 7,860	$ 8,750	$ 8,270	$ 7,900
Return to equity capital[f/]	$ -4,461	$ 11,910	$ -3,338	$ -240	$ 9,308	$ 4,989
Percent return to equity capital	0	6.1	0	0	5.5	2.7

a/ Estimated from interest payment data reported by the sampled farm operators. Some overstating of operator equity is suspected because of incomplete reporting, thereby underestimating returns to capital.

b/ An estimated charge of what the capital could earn if invested off the farm, with 6 percent used for long-term, 7 percent for intermediate, and 7.5 percent for operating capital.

c/ Residual claimant to labor and management, after subtracting interest on operator equity from net farm income.

d/ Assumes an operator works 25 10-hour days per month for 12 months.

e/ Operator labor charged at $2.50 per hour, resulting in a $7,500 per year charge for a full-time operator equivalent, representing an estimated earning potential off the farm in gainful employment.

f/ Residual claimant to capital, after subtracting the charge for operator labor and management from net farm income.

ANALYSIS OF FACTORS AFFECTING SAMPLE FARM PROFITABILITIES

The previous section on sample farm characteristics identified that large differences in resource use and returns existed between grass seed producing regions in Oregon's Willamette Valley. Cursory examination of the cost and return information suggests that several factors contribute to these differences. The purpose of this section is to transcend regional comparisons and (1) analyze the 147 sample farms in terms of the contribution that grass seed production provides generally, and (2) to evaluate the relative profitabilities of each of the seven major grass seed types in terms of income and costs.

Total Farm Characteristics

The 147 sample farms producing grass for seed did so at varying levels of intensity. Some produced grass seed almost exclusively. Others produced grass seed as an integral, but not necessarily dominant, portion of the farm operation. A few produced grass seed as a minor crop in terms of percent of total income.

Intensity of Grass Seed Production

To analyze resource use and incomes from grass seed production and compare them with the total farm operation, the sample farms were divided into three categories: Type 1 (grass seed) farms represent those with at least 80 percent of gross farm sales derived from grass seed; Type 2 (mixed) farms generated at least 40 percent, but less than 80 percent, of gross farm sales from grass seed; and Type 3 (other) farms had less than 40 percent of farm sales generated by grass seed production.

Regrouping of the 147 farms by sales from grass seed resulted in 72 Type 1, 42 Type 2, and 33 Type 3 farms. Average net farm incomes for each type were $9,909, $9,738, and $11,301 per farm, respectively. The data are summarized in Table 9. Residual returns to capital and management for each farm type were considerably lower than returns expected from comparable resource levels invested off-farm. Average return to operator equity capital

Table 9. Net Farm Income and Resource Return Levels, by Farm Type, from 147 Willamette Valley Farms Producing Grass Seed, 1969

Item	Farm type 1 (Grass seed)[a]	2 (Mixed)[b]	3 (Other)[c]
Number of sample farms.....	72	42	33
Net farm income.....	$ 9,909	$ 9,738	$ 11,301
Operator equity capital:			
Land and buildings.....	189,000	165,700	168,700
Machinery and livestock.....	27,100	33,300	39,900
TOTAL.....	$216,100	$199,000	$208,600
Interest on operator equity.....	$ 13,237	$ 12,273	$ 12,915
Return to labor and management.....	-3,328	-2,535	-1,614
Full-time operator equivalent.....	1.05	1.05	1.05
Charge for operator labor and mgt.....	7,900	7,900	7,900
Return to equity capital.....	2,009	1,838	3,401
Percent return to equity capital.....	1.0	1.0	1.6

[a] Type 1 (grass seed) farms - Those sample farms with 80 percent or more gross income from grass seed production.

[b] Type 2 (mixed) farms - Those sample farms with 40 to 80 percent of gross income from grass seed production.

[c] Type 3 (other) farms - Those sample farms with less than 40 percent of gross income from grass seed production.

was less than 2 percent for all three farm types. These results suggest that, at least for 1969, farms specializing in grass seed production, with one exception, generated about the same resource returns as those farms in which grass seed played a relatively minor role in a diversified farm operation. The specialized dairy farms in the Type 3 class generated higher than average returns.

Seasonality of Grass Seed Production

Resource requirements for grass seed production are highly seasonal. Response from the 147 sample farms indicates that most intensive resource use occurs during the summer months of July, August, and September when swathing, combining, seed handling, and field burning functions occur. Secondary peaks occur during spring and fall. Fall requirements include planting of annual ryegrass and grains, and application of fertilizer and herbicides. Spring requirements include fertilizer and chemical application and stand establishment of perennial grasses. Little or no resource use is required during winter months from November through February.

Most grass seed growers in the sample produced two or more grass seed types on the same farm, as shown in Table 6. Some operators may produce several grass seed types as a hedge against price and yield variability since production and price trends between grass seed types are not necessarily related positively, an issue treated more fully in a later section. Some growers appear to combine several grass seed types to achieve greater utilization of family labor, machinery, and seed cleaning resources. This is possible because non-competitive resource use exists between some grass seed types in timing of operations.

In Region 3 (Marion County), both Highland bentgrass and fine fescue are grown on the same farm. Although pre-harvest field operations are essentially identical for both crops, fine fescue develops and matures about six weeks earlier than bentgrass, permitting most harvest operations for it to be completed well in advance of the harvest requirements for bentgrass. Seed harvest is the field operation requiring the highest share

of annual machine and labor use. Seed harvest is from July 5 to July 20 for fine fescue, and from August 20 to September 10 for bentgrass. An operator utilizes labor and machinery over a longer harvest period when he produces both crops than when he produces only one, with less risk of yield loss from late harvest seed shatter.

In Region 2, many farms produce orchardgrass, Kentucky bluegrass, tall fescue, and ryegrass on the same farm to achieve similar resource use advantages. Harvest for these four crops generally ranges from June 22 to August 15, with harvest of each successive seed type commencing in five day intervals, starting with orchardgrass. In Region 4 (Polk County), non-competitive resource use often occurs between grains and annual ryegrass on the same farm. Although the two crops compete for land and capital, they do not compete directly in use of labor and machine resources during planting and harvest periods, since field operations for annual ryegrass generally occur two to three weeks in advance of those for grain. The economic advantage of non-competitive resource use between certain grass seed types involves potential for lower machine and labor requirements for a given farm. The result is lower ownership costs on a per acre production basis and/or potential to farm more acreage with existing fixed labor and equipment resources in the event those resources are currently underutilized.

Seed cleaning operations were present on 44 (30 percent) of the 147 sample farms. The seed cleaning enterprise, while generally used to improve seed quality and, hence, farm price, also utilizes operator labor during fall and winter months when field work is not required. Most operators who owned cleaning facilities provided custom cleaning services for neighboring farmers. Some cleaning plant operators also provided seed marketing services to farmers whose seed they cleaned.

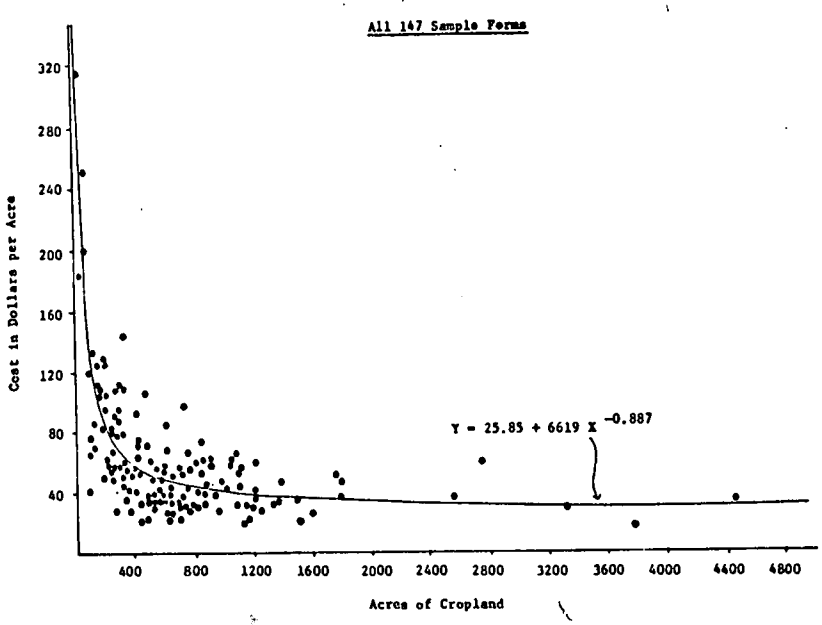
Total Farm Costs

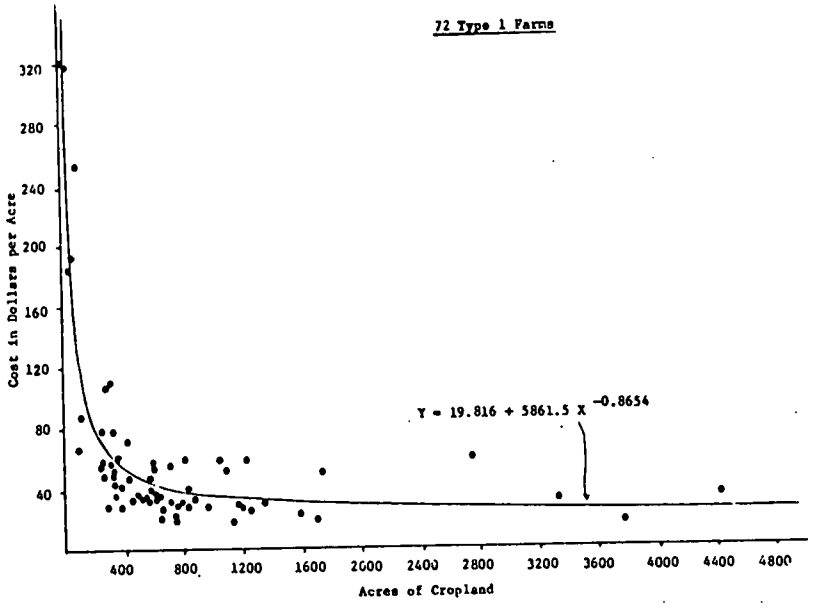
This section analyzes each farm type by taking total farm cost associated with each farm type and separating it into several cost components and analyzing each component. Costs are divided into ownership, operating, and total cost categories.

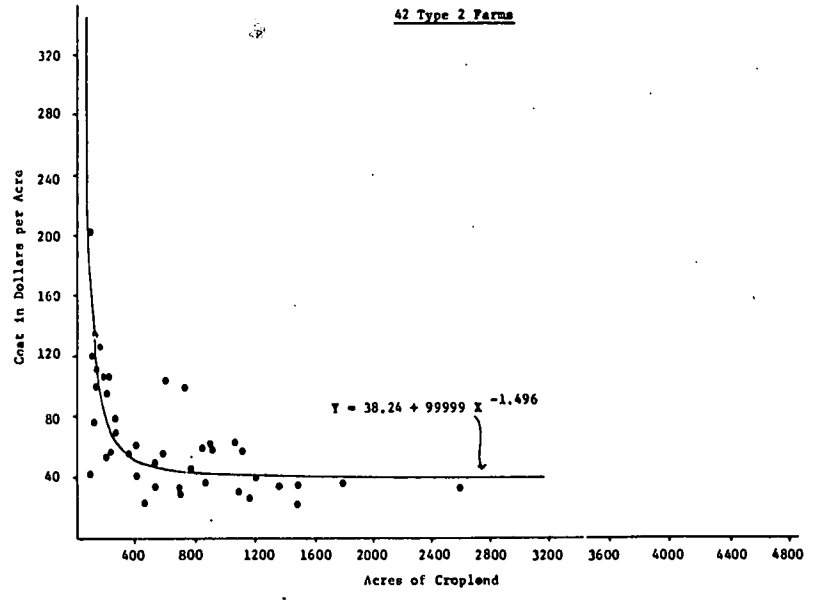
Average Ownership Cost Per Acre. Ownership or fixed costs are those costs which a farm incurs regardless of the level of farm production. This cost category includes depreciation on buildings and machinery, interest, taxes, insurance, overhead items such as utilities and licenses, and an opportunity cost charge for operator labor and real estate capital. An operator labor charge of $7,500 per man-equivalent and 6 percent interest on operator equity in real estate were used in this study. No charge was imputed for operator management. Total ownership costs for each sample farm are converted to average ownership costs by dividing each farm's total ownership cost by the cropland acres reported for that farm.

Average ownership costs per acre were calculated for each of the 147 sample farms. Results were separated by farm type and plotted in Figure 3. A series of mathematical functions were fitted to the data plots. The mathematical model $Y = b_1 + b_2 \times {}^{b}3$, a decreasing curvilinear polynomial function, provided the best statistical fit for each farm type. Hence, that function was to represent all four situations shown in Figure 3 to most closely approximate the nature of average ownership costs per acre from the sample farms.

Average ownership costs per acre for the total sample and for each farm type showed definite decreasing cost tendencies as farm size increased. In general, costs per acre declined rapidly until farm size of 600 to 800 acres was achieved. Only limited size economies were obtained for farms larger than 800 acres in size. Type 1 farms, on the average, had ownership costs averaging $12 per acre lower than either Type 2 or Type 3 farms. It is suspected that this reflects lower land values and lower machinery investment requirements per acre of grass seed production than that required for the more intensive crops grown in Type 2 and 3 farms. Complementarity in machine and labor resource use between grass seed enterprises may also have contributed to low unit costs for Type 1 farms. Some downward bias of the ownership cost curves existed, especially for the Type 1 farms, since land rental charges are reported as operating costs rather than ownership costs. For land owned, taxes and interest on investment are ownership costs. The downward bias exists to the extent that land rental is more







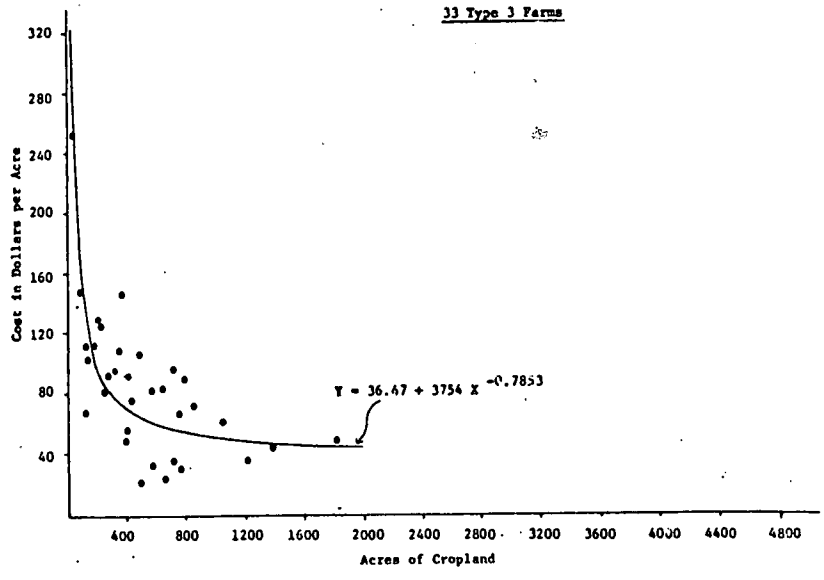


Figure 3. Average ownership cost per acre by farm type.

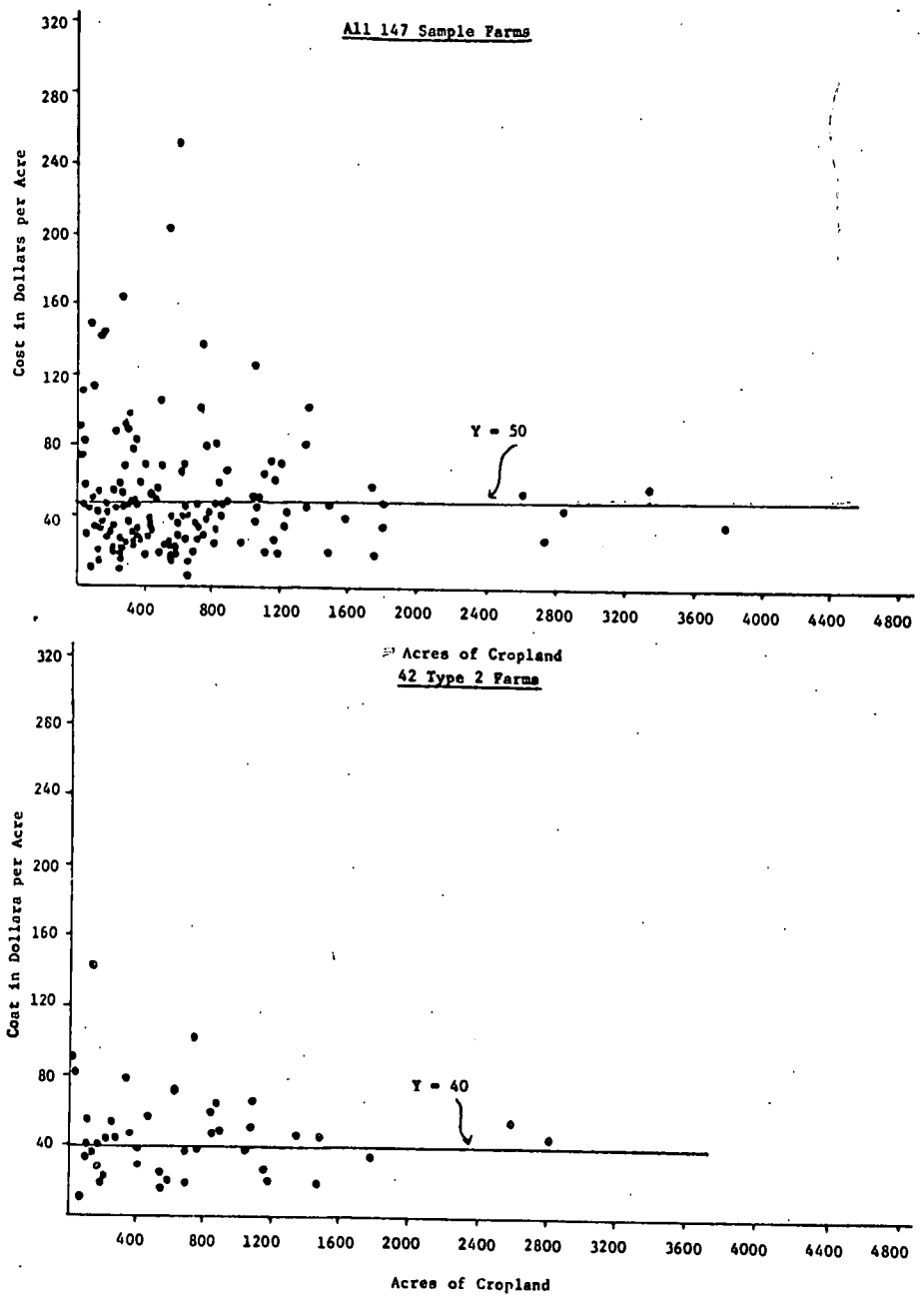
common with grass seed production than with other crops. This issue is of no consequence when ownership and operating costs are combined and reported as average total cost relationships in a later section since all costs are listed either in the ownership or operating cost categories.

Average Operating Cost Per Acre. Operating costs are those costs directly related to farm production. They include fertilizer, chemicals, hired labor, machine operation, and crop-share rents. Average operating costs per acre for each of the 147 sample farms were obtained by dividing total operating costs on each farm by the cropland acres reported for that farm.

Average operating costs per acre were plotted graphically for the 147 sample farms and each of the three farm types and presented in Figure 4. A linear model of the form $Y = k$, where k is a constant term, provided the best statistical fit to the data. This is consistent with economic theory, since average operating costs per acre are a function of the type of crop grown, technology, and management intensity and not farm size.

Average operating cost for the 147 farms was $50 per acre. On Type 1 and 2 farms average operating costs were $40 per acre, reflecting the more extensive (low gross income and low cost) nature of grass seed production when compared with other crops grown in the Willamette Valley. The average operating cost for Type 3 farms was $85 per acre reflecting the intensive (high gross income and high cost) row crop production found on Type 3 farms. However, not all Type 3 farms produced row crops, as evidenced by the range of $12 to $310 for average operating cost per acre for that farm type. Average operating costs of less than $15 per acre were reported from four Type 1, two Type 2, and two Type 3 farms.

Average Total Cost Per Acre. Average total cost per acre for each sample farm was derived by summing the average ownership and operating cost components with each of the 147 farms. Results are reported by farm type and presented graphically in Figure 5. The decreasing cost relationship for the 147 farms is due entirely to the average ownership



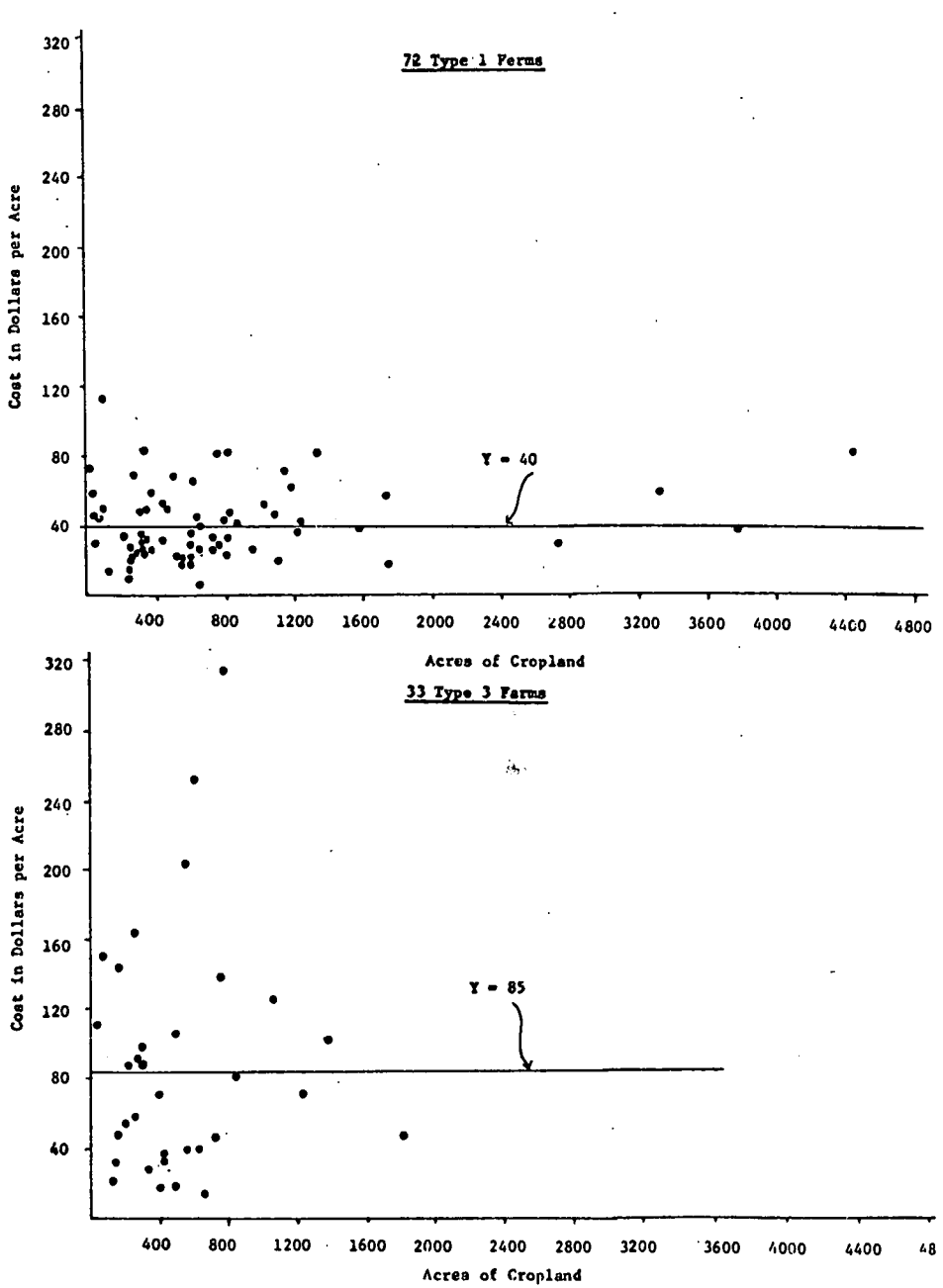
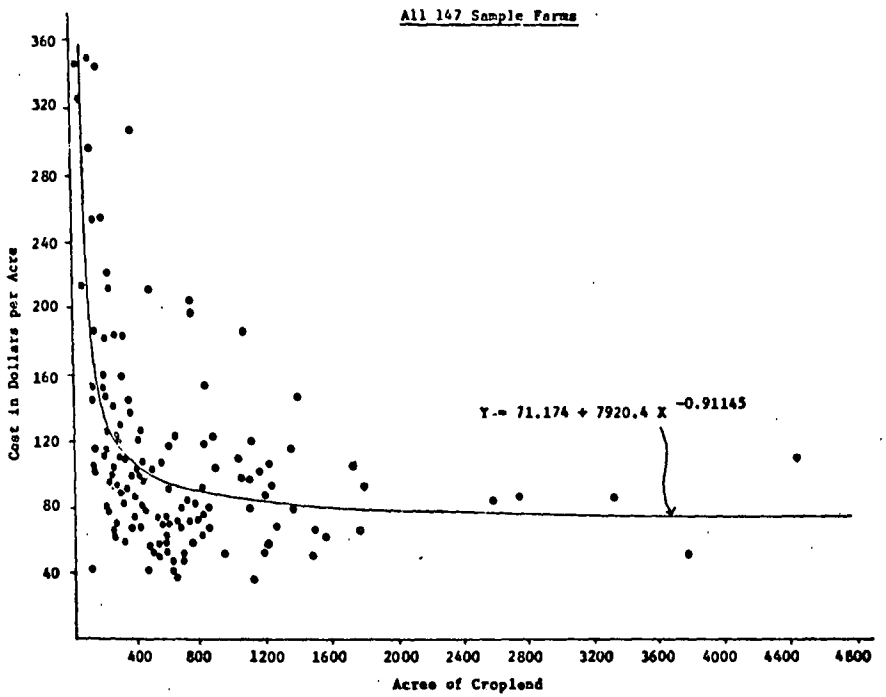
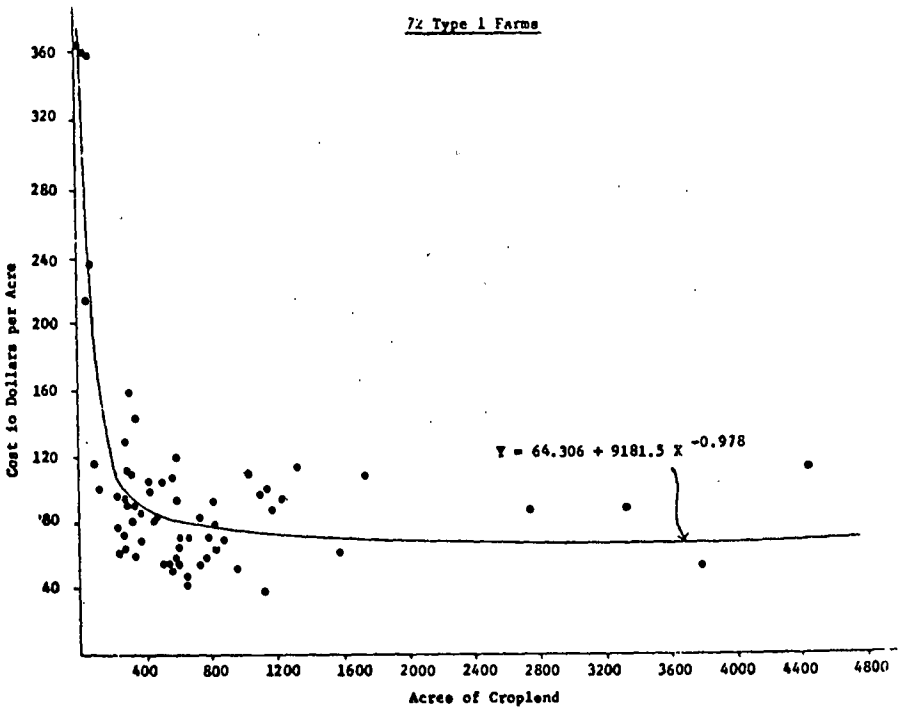
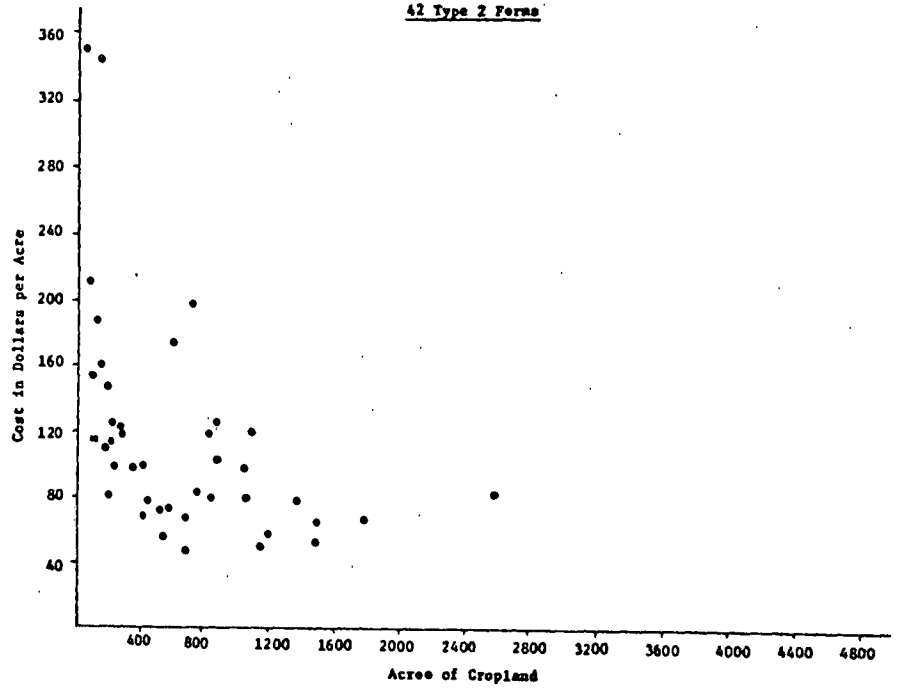


Figure 4. Average operating cost per acre by farm type.







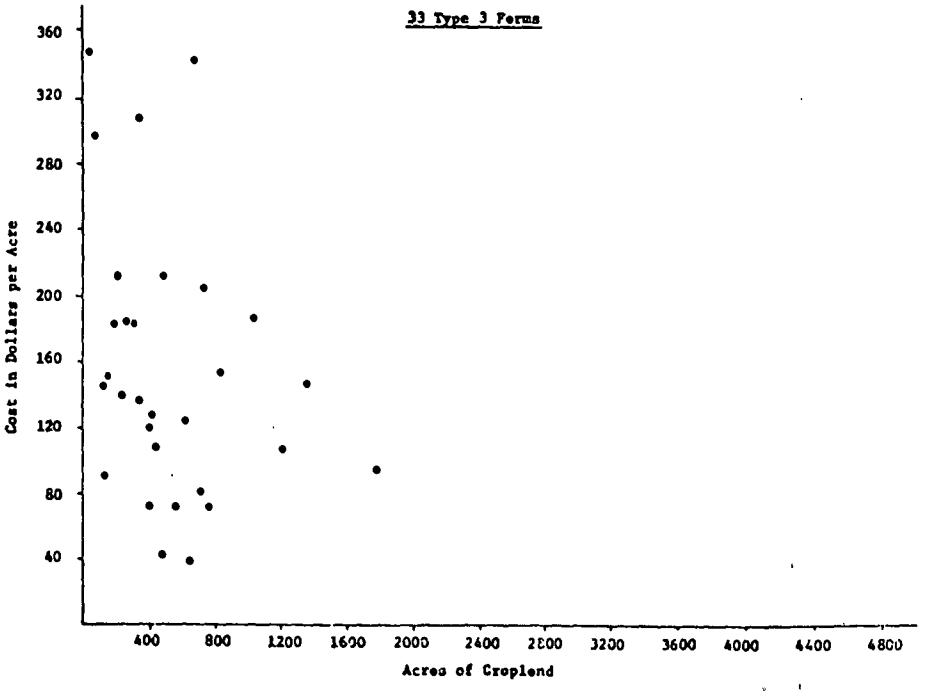


Figure 5. Average total cost per acre by farm type.

component since average operating costs, shown graphically in Figure 4, demonstrated no functional relationship to farm size. This evidence suggests two important relationships: (1) that similar production practices are employed by a large group of grass seed producers regardless of their farm size, and (2) that significant size economies exist for the grass seed industry because of the important role which the ownership cost component plays relative to total costs.

Operating costs per acre were remarkably consistent, particularly with Type 1 and 2 farms. The average was $40 per acre with very few farms exceeding a range of $20 to $80. This reflects both the extensive nature of grass seed production and an apparent high degree of similarity or homogeneity of production practices between grass seed producers. Average ownership costs per acre were, in general, substantially lower on large farms, resulting in significantly lower average total costs when compared with small farms. Major cost economies were achieved for farms up to 600 cropland acres, and generally were negligible above 1,000 acres. This relationship is evidenced by the steep sloped average total cost curve up to 600 acres and an essentially flat or linear relationship above 1,000 acres. This implies, generally, that grass seed farms substantially smaller than 600 acres in size would be expected to have costs significantly higher than farms with more than 600 acres in size. However, large farms (1,000 acres or more), on the average, had average total costs per acre comparable to farms of 600 to 800 acres in size. This implies that 600 to 800 acre sized farms can produce grass seed of comparable costs per acre with farms which are much larger in size. Visual examination of the data generated inconclusive evidence either for or against the largest farms in the sample having increasing average total costs.

While all farm types enjoyed economies of size, as demonstrated in Figure 3, the influence of operating costs in Figure 5 obscures this relationship. Curves were not fitted to the Type 2 and 3 farms because of their great average total cost dispersion. Review of individual farm data suggests that low cost variability for Type 1 farms is due partly to their specialization in grass seed production which requires but a single line of machinery

and relatively limited scope of production inputs relative to farms which produce more intensive crops and require a distinct line of machinery for each. Type 2 and 3 farms, having enterprises other than grass seed, required additional machinery components which added to ownership costs, and more intensive production input requirements which increased operating costs per acre. However, review of Figures 3 and 4 suggests that, in addition to cost dispersion attributable to differences between farm types, cost differences created by composition of ownership and operating costs deserve further analysis.

Cost Composition and Its Variability. Ownership (fixed) costs as a percentage of total costs were calculated for each farm, then separated into farm type and size categories. These results are presented graphically in Figure 6. In general, as farm size increases, the share of total cost contributed by ownership cost decreases as the influence of operating costs becomes more pronounced and fixed ownership costs are distributed over large numbers of acres. While this relationship was more pronounced with Type 1 farms, wide variation existed between individual farms in cost composition even within specific farm type and size classes. This is evidenced not only in Figure 6, but also in dispersion of the data plots in Figures 3, 4, and 5. For example, even though sample farms 300 acres or smaller in size averaged 71 percent of total costs as fixed costs, the range was from 30 to 95 percent. For the 300 to 800 acre size farms, while the average of fixed costs to total costs was down to 55 percent, the range of 20 to 90 percent was equally as great as the smaller size group. Hence, while considerable size economy potential exists in Oregon's grass seed industry, it is not assured automatically that individual farmers desirous of decreasing average total cost per acre in grass seed production will achieve it simply by expanding farm size. While size is a necessary condition for cost economies in a highly mechanized agriculture, such as grass seed production, it is certainly not a sufficient condition. Some of the large sample farms had considerably higher average total costs per acre than some of the smaller units. High equity levels, excess machine capacity, and high operating costs which were not necessarily offset by higher yields, may have been factors

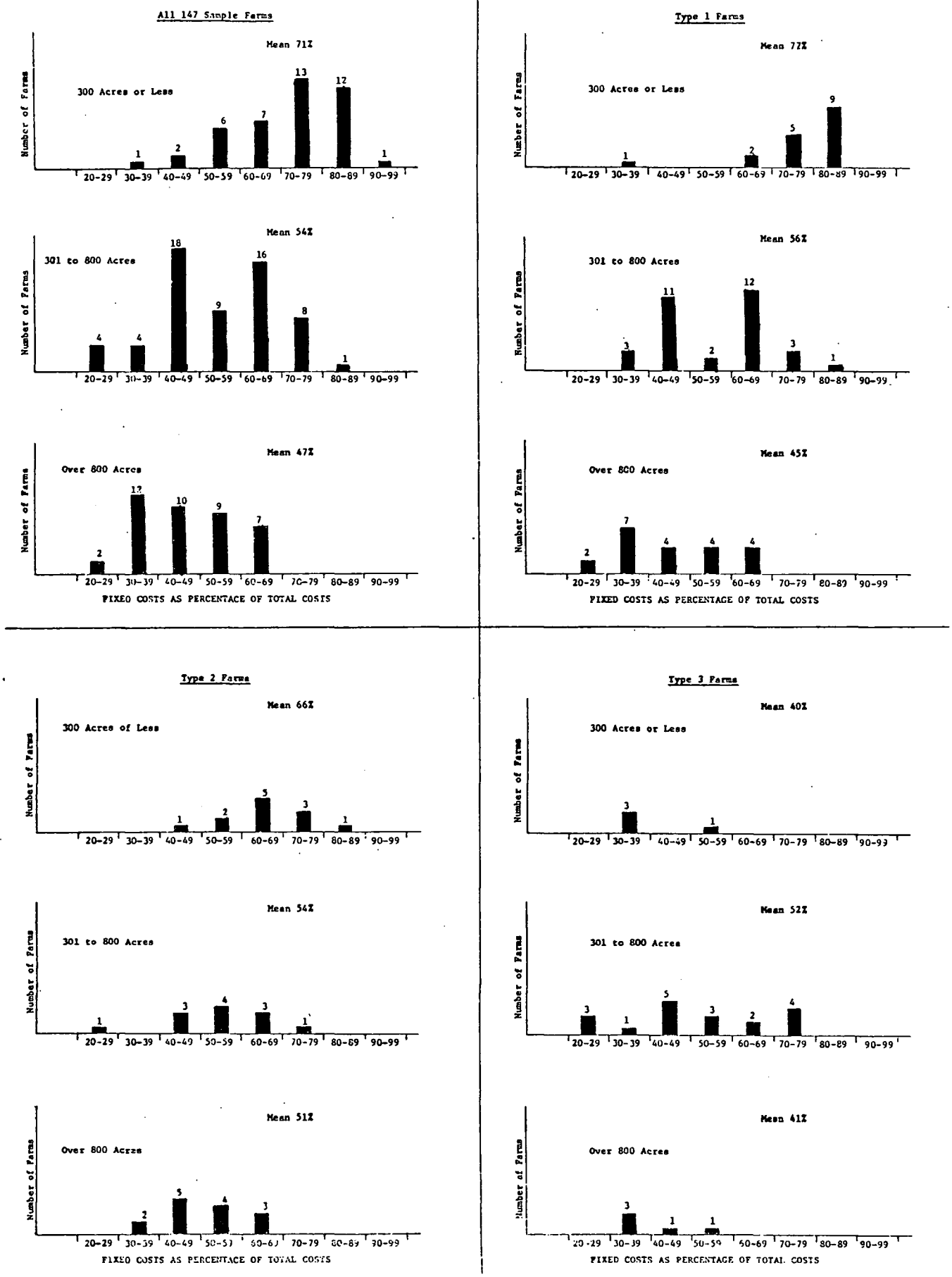


Figure 6. Fixed costs as a percentage of total costs by farm size and farm type categories.

which contributed to this condition. Evaluation of costs by seed type in the following section is intended to shed light on the issue of high operating costs. The issue of excess machine capacity was not capable of being evaluated by this study.

Grass Seed Type Characteristics

This section is directed toward identifying similarities and differences between grass seed types in terms of production costs and relative profitabilities. Comparisons are made within and between seed types in gross returns, production costs, yields, prices, and income variability.

Gross Returns

Gross return represents the value of annual crop production (farm yield x farm price). Year-to-year variation in crop yield and farm gate price for each grass seed type was analyzed. Willamette Valley average grass seed yields and prices for the 11-year period from 1960 through 1971 were used. These data were obtained from unpublished sources compiled by Willamette Valley county extension agents. Data from the sample farms, being cross-sectional in nature, were not used since they could provide only within-year yield variation between farms for 1969 rather than between-year variation attributable to both production and price changes over time.

Standard deviation and coefficient of variation computations were used as dispersion indexes for yield, price, and gross incomes for each of the seven seed types. Standard deviation represents the range of dispersion or variation above and below the mean value within which the element may be expected to fall two-thirds of the time. The coefficient of variation provides a basis for relative comparisons between grass seed types by expressing standard deviation as a percentage of the average or mean. Mean yield, price, and gross income statistics and their standard deviation and coefficient of variation calculations by seed type, are presented in Table 10. Mean gross income and its dispersion indexes represent the aggregate or collective effects of yield and price on income.

Table 10. Yield, Price, and Gross Returns Per Acre by Seed Type and their Dispersion, Willamette Valley, Oregon, 1960-69

	Unit	Highland bentgrass	Kentucky bluegrass	Fine fescue	Tall fescue	Orchard-grass	Annual ryegrass	Perennial ryegrass
Mean yield[a/]	lbs/ac	250	565	390	720	730	1,290	910
Standard deviation[b/]	lbs/ac	32.2	98.5	71.6	66.7	122.8	137.7	127.9
Coefficient of variation [c/]	lbs/ac	.129	.174	.183	.093	.168	.107	.141
Mean farm price per lb.[a/]	$	.299	.279	.250	.128	.237	.051	.079
Standard deviation	$	.068	.045	.092	.035	.036	.014	.022
Coefficient of variation	$	.228	.161	.368	.274	.152	.275	.278
Mean gross return per acre [d/]	$	74.82	157.82	97.65	92.37	172.94	66.35	71.66
Standard deviation	$	14.38	41.42	37.86	23.74	28.71	22.22	14.55
Coefficient of variation	$	.192	.262	.388	.257	.166	.335	.203

SOURCE: Unpublished statistics compiled by county extension agents in Willamette Valley.

[a/] Average for the 11-year period 1960-1971, Willamette Valley, Oregon.

[b/] Standard deviation (S_x) measures how far from the mean each item within a frequency distribution is located. A $\pm S_x$ measures the expected range of dispersion within which an element will be two-thirds of the time.

[c/] Coefficient of variation = $\frac{S_x}{\overline{X}}$ = standard deviation expressed as a percent of the mean.

[d/] Mean gross return per acre = mean yield per acre, in pounds, multiplied by the mean price per pound.

Mean gross returns ranged from a low of $66.35 per acre for annual ryegrass to a high of $172.94 per acre for orchardgrass. Kentucky bluegrass also generated a high gross return of $157.82. The remaining grass seed types generated mean gross returns ranging from $71.66 to $97.65 per acre. Annual ryegrass, perennial ryegrass, and highland bentgrass generated much lower gross incomes than did the other four grass seed types.

Year-to-year yield variability, attributable primarily to weather changes, was generally a small contributor to gross income variability. Kentucky bluegrass, fine fescue, and orchardgrass had substantially greater yield variation than did the other four seed types. Year-to-year price variability was highest for fine fescue, followed by perennial and annual ryegrasses and tall fescue. Highland bentgrass, Kentucky bluegrass, and orchardgrass showed the lowest relative price variability. The combined effects of price and yield variability are shown by the coefficients of variation for mean gross return. Fine fescue and annual ryegrass were the most risky choices of the seven seed types. Orchardgrass and Highland bentgrass were the least risky choices. In addition to being a low risk seed type, orchardgrass had the highest mean gross income per acre.

Production Costs

Production costs, as defined in this study, include all costs associated with production of a particular seed type. Operating or direct costs and overhead costs are included. The overhead costs embody imputed charges for operator labor, overhead machine costs, general overhead, and a land charge which can be viewed either as a cost for renting land or a combined property tax and interest charge for owned land. Detailed production cost data were obtained for each seed type grown on each of the 147 sample farms. A limited number of growers producing more than one seed type reported cost data only for their major seed type. Production costs by seed type were separated into operating, stand establishment, general overhead, and land rental charge categories, and by individual field operation. Both average costs and ranges in costs are reported.

Operating Costs. Operating costs included all expenses which could be directly associated with yearly crop production. Operating costs were divided into cash machine cost, hired labor, materials, overhead machine cost, and operator labor components. A standard hourly rate for machine overhead was imputed, representing 150 percent of cash machine cost to account for depreciation, interest, repairs, taxes, and insurance on the machinery [11,13]. The combined cash and overhead machine costs approximate machine custom rates. This procedure was used to avoid allocation of machine ownership costs to individual grass seed type for the sample farms where several enterprises existed on each farm. In using this procedure on machine costs, it must be kept in mind that some machine cost variability which might exist between farms and is attributable to variation in machine use intensity, has been influenced. Operator labor was imputed at a rate of $2.50 per hour.

Average operating costs per acre by field operation, seed type, and cost levels are reported in Table 11. Kentucky bluegrass had the highest operating costs of the seven grass seed types. This was due principally to higher fertilizer and chemical applications and higher harvest costs per acre than that found with the other seed types. Operating costs for perennial ryegrass were lowest of the seven seed types with lower costs associated with nearly all field operations. The mean or average operating costs, in general, were surprisingly similar for all seed types with only $23 separating the low of $39 on perennial ryegrass with the high of $62 per acre on Kentucky bluegrass. Fertilizer, herbicides, harvesting, and seed cleaning generally represented the major field operation cost categories.

In addition to mean operating costs, Table 11 also summarizes a range of operating costs by seed type. Low and high cost extremes were obtained by averaging cost data from those four sample farms within each seed type which had the lowest and highest operating costs respectively for each seed type.

Major cost variations occurred in chemical weed control and fertilizer application categories. For Highland bentgrass, Kentucky bluegrass, and

Teble 11. Averege and Range in Operating Costs Per Acre by Field Operation for Each Seed Type for Sample Ferms Producing Each Seed Type; with Ranges Repreaented by Averege of Four High and Four Low Cost Ferms for Each Sead Type, 1969

FIELD OPERATION	Operating costs per acra																				
	Highland bentgrass			Kentucky bluegrass			Fine fescue			Tall fescue			Orchardgrass			Annual ryegraaa			Perennial ryegraaa		
	low	ave.	high	low	ave.	high	low	ave.	high	low	ave.	high	low	ave.	high	low	ave.	high	low	ave.	high
Plow.....	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.97	3.27	---	---	---
Chisel plow.....	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	.07	---	---	---	---
Disk.....	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	.58	1.39	1.12	---	---	---
Cultivate.	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	.44	---	---	---	---
Harrow....	---	.02	.13	---	.09	---	---	---	---	---	---	.13	---	.02	.13	---	1.91	4.81	---	---	---
Roll.....	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	.31	.64	2.63	---	---	---
Seed.....	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.35	4.81	10.86	---	---	---
Overseed..	---	.32	2.75	---	.53	1.25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Maintain firebreak	.14	.54	3.13	.07	.22	.34	.23	.30	---	.02	.26	.14	.46	.82	.27	.07	.49	.14	---	.56	2.99
Fall fertilizer..	1.71	3.92	11.33	2.06	6.61	9.42	---	7.56	14.15	3.03	5.30	5.41	1.18	6.84	14.76	1.18	2.87	1.02	1.18	4.08	10.32
Fall herbicide...	1.97	4.25	7.15	4.08	7.50	11.72	2.89	4.54	5.16	4.12	5.75	9.60	3.40	5.86	12.57	---	.58	---	3.27	3.30	7.75
Spring fertilizer.....	8.46	11.71	15.04	10.07	14.90	16.99	9.17	9.73	12.24	9.58	16.42	22.68	9.58	12.33	16.95	7.38	10.75	17.74	6.07	11.32	17.97
Spring herbicide	1.10	2.09	4.61	3.56	5.72	7.38	1.42	1.75	.65	.23	1.54	2.34	2.01	2.22	3.19	.45	1.09	1.22	---	1.05	1.43
Spot spray	---	.69	.63	1.27	.83	1.31	---	1.90	3.99	---	.89	2.87	---	.63	1.00	---	.05	.20	---	.23	.20
Haul chemicals....	.05	.01	---	---	.02	---	---	.05	.19	.07	.02	---	---	---	---	---	.16	---	---	.01	---
Hand weeding.....	---	---	---	---	---	---	---	.78	.63	---	.15	.69	---	.34	.63	---	---	---	---	---	---
Windrow...	1.28	2.70	2.26	1.94	2.38	3.12	2.37	2.13	1.28	.80	2.08	2.64	1.25	2.54	3.97	1.81	2.26	1.98	2.41	2.01	1.19
Combine...	11.33	11.50	15.91	5.93	13.83	10.56	8.45	10.43	13.58	2.94	7.91	9.52	3.78	9.10	10.94	4.92	7.85	10.88	4.22	7.47	9.53
Haul seed.	2.13	1.28	1.47	1.72	1.17	1.58	1.11	1.16	.53	1.33	.94	1.30	.95	1.16	1.53	1.08	1.25	1.01	1.18	1.16	.82
Seed cleaning.	6.90	5.77	9.07	5.00	6.66	8.93	11.26	10.88	21.13	2.15	6.91	14.57	7.00	9.38	18.13	8.00	10.05	18.96	2.10	6.76	16.22
Insurance.	---	.02	---	---	.16	.75	---	.01	.01	---	---	---	---	.01	---	---	.01	.14	---	---	---
Field burning..	.34	.69	.98	.85	.94	.79	.91	1.08	1.17	.90	.72	1.10	.60	.89	1.35	.75	.60	1.25	.43	.60	.10
Management	.01	.39	.31	.06	.81	---	---	.29	.83	.20	.43	.63	---	.84	1.15	.16	.52	.94	---	---	---
TOTAL OPERATING COSTS.....	35.42	45.90	74.77	41.24	62.37	84.51	37.81	52.59	75.54	25.37	49.32	73.60	30.21	52.98	86.57	28.04	49.76	78.17	19.64	38.55	69.74
Ave. seed yield/acre (lbs) [a]/..	345	337	394	611	621	738	563	560	644	700	846	1,000	912	816	912	1,128	1,427	1,650	850	851	850
Ave. stand life (yrs)	15	13	12	9	9.8	10	12	9.2	6	18	15.8	12	10	10.3	11	---	---	---	7	9.7	10
No. of sample farms.....	4	35	4	4	22	4	4	42	4	4	20	4	4	24	4	4	44	4	4	30	4

[a]/ Average seed yields for 1967-68-69, as raported by aampled farms.

fine fescue, the high-cost farms in each seed type category reported costs roughly double those of low-cost farms. The high-cost farms raising tall fescue, orchardgrass, annual ryegrass, and perennial ryegrass reported operating costs per acre roughly triple those of the corresponding low-cost farms. The highest disparity occurred on perennial ryegrass with operating costs ranging from a low of $20 to a high of $70 per acre. The average for low cost farms for certain cost components, particularly combining and seed hauling, exceeded those of the high cost farms. This is not unusual since farms with low operating costs relative to an average of farms cannot be expected to have lower than average costs in each and every cost category. In some instances, the higher harvest costs may have been due to higher yields.

Stand Establishment Costs. Establishment costs, amortized over the average stand life for each seed type, are included as a component of production costs. Cash and overhead costs associated with tillage, seed bed preparation, seeding and fertilizer, and herbicide applications prior to the first crop year are included. Also included as costs during the establishment period are land rent (or property taxes and interest on investment in land at 3 percent) and interest on operating capital at 7.5 percent. To place total establishment costs on an annual basis, it is amortized over the average stand life for each seed type at a rate of 7.5 percent.

Average establishment costs by seed type from the sample farms are reported in Table 12. Fine fescue growers reported the highest establishment costs. For fine fescue, land was required to be fallowed at least two summers prior to seeding to permit extensive cultivation for perennial weed grass control. Several herbicide applications, either preceding planting or during the first growing season, also were required. Perennial ryegrass and tall fescue establishment costs were low primarily because of a short establishment period and few herbicide applications. With annual ryegrass, reseeding is accomplished each fall by "grasslanding" methods which permit direct seeding following field burning. Plowing and additional tillage practices are employed at three- to five-year

Table 12. Establishment Costs Per Acre, by Seed Type, Average of Sample Farms Producing Each Seed Type

Seed type	Stand life	Average establishment costs per acre	Amortized establishment costs a/
Bentgrass.....	14	$82.90	$ 9.77
Bluegrass.....	11	88.90	12.15
Fine fescue.....	10	99.10	14.44
Tall fescue.....	17	68.60	7.27
Orchardgrass.....	11	66.20	9.05
Annual ryegrass b/	1	2.98	—
Perennial ryegrass.....	10	51.30	7.47

a/ Total establishment cost amortized at 7.5 percent interest rate over life of stand.

b/ Represents an average annual establishment cost which reflects grasslanding for 3 years; complete seedbed preparation, including plowing, prior to seeding only once every 4 years.

intervals to provide necessary control of weed populations which build up over time from "grasslanding" practices.

General Overhead Costs. A general overhead charge equal to 5 percent of production costs was imputed and included as a production cost. This charge accounts for general farm overhead costs which can be directly attributable to grass seed production. Such items as office expenses, dues, travel, etc., are included in this category. Selection of the 5 percent rate, while arbitrary, was included to explicitly recognize the existence of these costs.

Land Charge. The land charge represents the average cash rent per acre paid for each seed type. The land charge is approximately equivalent to a land ownership charge which covers property taxes and pays 3 percent interest on average investment in land.

Summary of Production Costs and Their Variability

The four production cost categories discussed in the previous section are combined and summarized collectively in this section. Cost variability also is shown by including costs for the four low- and high-cost farms in each type as was done in the previous section. Detailed results are presented in Table 13.

Production costs per acre by seed type, as shown in Table 13, are summarized in increasing cost order as follows:

Seed type	Production costs per acre		
	Low	Average	High
Perennial ryegrass	$46.40	$67.20	$102.50
Annual ryegrass	49.50	72.50	102.20
Highland bentgrass	60.00	75.80	116.10
Tall fescue	51.30	77.80	105.40
Orchardgrass	59.50	84.90	123.90
Fine fescue	63.40	85.30	128.00
Kentucky bluegrass	72.00	97.50	125.00

Table 13: Summary of Production Costs, by Seed Types and Ranges, Calculated for Groups of Four High-Cost and Four Low-Cost Farms, and Sample Averages, 1969

	Highland bentgrass			Kentucky bluegrass			Fine feacue			Tall fescue			Orchardgraas			Annual ryegrasa			Perennial ryegrass		
	low	ave.	high	low	ave.	high	low	ave.	high	low	ave.	high	low	ava.	high	low	ave.	high	low	ave.	high
Operating costa:																					
Machine costs....	7.44	8.41	11.38	7.00	10.44	13.48	8.66	9.89	15.08	2.93	7.06	11.96	3.68	8.55	13.37	6.76	10.24	15.70	3.44	6.66	11.39
Hired labor....	1.03	1.35	2.26	1.53	2.06	4.76	.48	.78	.85	1.49	2.01	2.86	1.52	2.17	4.29	.70	1.66	2.40	.93	1.45	1.62
Materiala	11.72	18.12	35.01	17.64	28.05	38.89	11.36	20.05	29.29	14.14	27.08	36.15	14.16	24.39	42.32	7.68	15.82	26.99	8.40	17.75	36.61
Machine overhead costs a/.	11.13	12.62	17.09	10.48	15.66	20.21	12.99	14.82	22.61	4.38	9.83	17.97	8.58	12.81	20.09	10.14	15.37	23.47	5.15	9.49	15.90
Operator labor b/.	4.10	5.40	9.03	4.59	6.16	7.17	4.32	7.05	7.71	2.43	3.34	4.68	2.27	5.06	6.45	2.76	6.67	9.61	1.72	3.20	4.22
TOTAL OPERATING COSTS..	35.42	45.90	74.77	41.24	62.37	84.51	37.81	52.59	75.74	25.37	49.32	73.62	30.21	52.98	86.57	28.04	49.76	78.17	19.64	38.55	69.74
Amortized estab. costa.....	5.13	9.77	19.28	8.95	12.15	16.21	8.37	14.44	32.09	6.04	7.27	9.37	7.62	9.05	12.62	2.98	2.98 c/	2.98	6.54	7.47	9.88
General overhead d/	1.92	2.65	4.52	2.33	3.56	4.84	2.18	3.20	5.11	1.45	2.71	4.00	1.74	2.94	4.78	1.40	2.64	3.91	1.15	2.15	3.80
Land charge e/..	17.52	17.52	17.52	19.44	19.44	19.44	15.04	15.04	15.04	18.45	18.45	18.45	19.95	19.95	19.95	17.11	17.11	17.11	19.04	19.04	19.04
TOTAL PROD. COSTS..	59.99	75.84	116.09	71.96	97.52	125.00	63.40	85.27	127.98	51.31	77.75	105.44	59.52	84.92	123.92	49.53	72.94	102.17	46.37	67.21	102.46
Price (10-yr. ave.) f/..	.299	.299	.299	.279	.279	.279	.250	.250	.250	.128	.128	.128	.237	.237	.237	.051	.051	.051	.079	.079	.079
GROSS RETURNS...	103.00	100.70	117.80	205.90	173.20	170.30	140.70	140.00	161.00	89.80	108.20	128.00	216.00	193.20	216.00	57.50	72.70	84.20	67.10	67.20	67.10
RETURNS OVER PROD. COSTS.....	43.01	24.86	1.71	133.94	75.68	45.30	77.30	54.73	33.02	38.49	30.45	22.56	156.48	108.28	92.08	7.97	.21	-17.97	20.73	-.01	-35.36
AVE. COST PER LB....	.174	.225	.295	.118	.157	.169	.113	.152	.199	.073	.092	.105	.065	.104	.136	.044	.051	.062	.055	.079	.121

a/ Fixed component of machine costs imputed at 150 percent of machine operating costs.

b/ Operator labor imputed at $2.50 per hour.

c/ Represents an average annual establishment cost which reflects grassland ing for 3 years and complete seedbed preparation, including plowing, prior to seeding only once every 4 years.

d/ General overhead was imputed at 5 percent of operating plus establishment costs.

e/ Average rather than ranges in land charge was used because of limited data. The charge represents average cash rent per acre, and approximates a land ownership charge which covers property tax and 3 percent interest on average investment.

f/ 10-year average prices used, since 1967-69 prices reflected low carryover supplies due to poor 1968 crop.

Perennial ryegrass showed the lowest average production costs with $67 per acre. Kentucky bluegrass had the highest average production costs with $97 per acre, $30 per acre higher than for perennial ryegrass. Three grass seed types — annual ryegrass, highland bentgrass, and tall fescue — had very similar average production costs, falling in the $72.50 to $77.80 per acre cost range. Both orchardgrass and fine fescue had average production costs approximating $85 per acre. The range in production costs between low and high cost sample farms was similar for each seed type. The range was from $53 to $64 per acre. It should be recognized, however, that the cost range quoted here is probably somewhat less than actually exists since the machine-overhead cost procedure, described in a previous section, affected between farm variability attributable to differences in machine use intensity.

To identify those components of cost which appeared to influence production cost levels and cost variability the most, appraisal of individual components is necessary. That comparison is made in Table 14. In Table 14, costs from the sample averages are expressed as a percentage of total production costs. Machine costs, land charges, and material costs accounted for at least 70 percent of total production costs for all seven grass seed types.

The materials category, which includes almost entirely the purchase of fertilizer and chemical herbicides for weed control, accounted for the dominant share of cash operating costs, ranging from an average of $16 to $28 per acre across seed types. Annual ryegrass consistently had the lowest, while Kentucky bluegrass had the highest materials requirements.

Total labor costs representing hired, paid family, unpaid family, and operator labor consistently accounted for only 7 percent to 11 percent of production costs for all seed types, while machinery costs represented 22 to 35 percent of production costs. The more significant role of machine costs indicates that, relatively speaking, grass seed production is more machine intensive than labor intensive.

Table 14. Distribution of Costs Expressed as Percentage of Total Production Costs, by Seed Type, Calculated from Sample Averages

Item	Perennial ryegrass	Annual ryegrass	Highland bentgrass	Tall fescue	Orchard grass	Fine fescue	Kentucky bluegrass
	percent						
Total machine cost.....	25	35	29	22	26	30	28
Total labor cost.....	7	11	9	7	9	10	9
Materials.....	28	22	25	36	30	24	30
Land charge.....	30	24	24	24	24	18	20
Establishment cost.....	7	4	10	7	7	14	9
General overhead.....	3	4	3	4	4	4	4
TOTAL.....	100	100	100	100	100	100	100

Stand establishment costs and general overhead costs, on the average, accounted for only 8 to 18 percent of total production costs across seed types.

Distribution of production costs per acre by components was evaluated for low and high cost operations to determine if cost proportions for them appeared to be different from the average. Results are presented in Table 15. Consistent differences between low and high cost farms, in proportion of production cost components, were evidenced only with materials costs. Materials costs were consistently higher for high cost farms across all seven seed types.

What conclusions or inferences can be drawn in evaluating production costs per acre for each of the seven grass seed types from a large sample of farms producing these seed types? Results of this study indicate the following:

(1) While production costs per pound of seed produced varied widely between seed types, as shown in Table 13, because of seed yield differences, production costs per acre across seed types were quite similar. On the average, with exception of Kentucky bluegrass, production costs per acre for all seed types ranged from $67 to $85 per acre. Kentucky bluegrass averaged $98 per acre.

(2) Large cost differences per acre existed between farms producing a given seed type.

(3) Factors which contribute to large cost differences per acre between farms producing a given seed type are diverse.

(4) Machine costs, materials costs, and land charges account for at least 70 percent of total costs per acre for all seed types.

Table 15. Distribution of Production Costs, in Percent, by Seed Type, for Low and High Cost Farms

Item	Perennial ryegrass		Annual ryegrass		Highland bentgrass		Tall fescue		Orchard grass		Fine fescue		Kentucky bluegrass	
	low	high	low	high	low	high	low	high	low	high	low	high	low	high
	percent													
Total machine cost.....	20	28	34	38	32	25	15	29	22	28	35	31	26	28
Total labor cost.....	6	6	7	12	9	10	8	8	7	9	8	7	9	10
Materials.....	20	37	16	26	20	31	29	35	25	35	19	24	26	32
Land charge.....	44	19	34	17	31	16	38	18	36	17	25	12	28	16
Establishment cost.....	7	6	6	3	5	14	7	6	7	7	10	22	8	10
General overhead.....	3	4	3	4	3	4	3	4	3	4	3	4	3	4
TOTAL.....	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Production costs per acre were similar between seed types with cost averages ranging from $67 to $85 per acre for all seed types, except Kentucky bluegrass, which averaged $98 per acre. Further evidence of similarity exists in comparing cultural practices and costs by seed type, as shown in Tables 11 and 13. These results are consistent with the non-competitive resource use concept discussed in the seasonality of grass seed production section explaining why individual grass seed producers generally produce at least two grass seed types on the same farm.

In spite of similar production costs per acre between seed types, large cost differences per acre existed between farms producing a given seed type. These differences, in some cases, exceeded $60 per acre. This result is somewhat indicative of the wide range of resource levels and intensity of use (farm size, number and type of farm enterprise, soil type, and farm location) employed in grass seed production, as identified earlier in this study. Some implications exist in terms of high cost producers of a particular seed type being unable to compete with low cost producers unless attempts are made over time to reduce costs. However, the extent to which this is a serious problem is not fully understood. No attempt was made to see whether high cost producers of a particular seed type also were high cost producers of other seed types grown on the same farm. Furthermore, it is not clear whether certain cost components could be reduced by high cost growers or whether certain physical conditions (soil, topography, etc.) inherently prevent lower cost practices from being feasible. Because of this, it cannot be presumed that high cost producers operate more inefficiently in an economic sense than low cost producers.

A myriad of factors contribute to the unique cost characteristics of each farm producing grass seed. This is reflected not only by the large cost differences which exist between farms producing the same seed types, but also, and more importantly, by the inability to distinguish or identify a unique set of factors which might contribute to cost differences. Only in the case of materials costs was there a consistent difference in level of materials use (fertilizer and chemicals) between low and high cost farms. To attribute this to management or economic efficiency, however, is

untenable. For some seed types, higher material use levels (higher costs) were directly correlated with higher yield. For others, the relationship was inverse. Even if correlation were consistently positive or negative for all seed types, one could not imply generally that fertilizer and chemical applications should be increased or decreased to improve farm income without knowing resource use and production response on each farm over time.

Some sources believe that stand life plays a vital role in grass seed yields and income and that the level of input intensity during stand establishment is an important factor. Comparison of the average and range in stand establishment costs, stand life, and yields in Tables 11 and 13 shows no consistent positive effect of increased stand establishment costs either on increased stand life or on yields. As with fertilizer and chemical costs, while increased stand establishment costs might increase stand life and yields for selected grass seed producers, it is not necessarily assured for grass seed producers generally. This suggests that preoccupation upon specific cost factors and their generalization for the industry, is not only misleading but likely a dangerous policy. Some have suggested that regional differences are useful in explaining between farm differences. To check out this possibility, operating costs for each grass seed type were separated by producing region to determine if some cost variability might be due to soil and topography differences which affect either costs or yield, or both.[1/] No regional trends of significance were evident. It does, however, suggest that grass seed producers readily discern soil type differences and grow those grass seed types which are most physiologically adapted to a particular soil type, or adjust their farm organization and field operations accordingly. So again, it must be stressed that a myriad of factors combine to determine why cost differences exist between farms. Analysis of individual farms would be useful in identifying specific

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[1/] Detailed presentation of the analysis is provided in Fisher, Douglas E., "An Economic Analysis of Farms Producing Grass Seed in the Willamette Valley, With Special Attention to the Cultural Practice of Field Burning." Unpublished Ph.D. dissertation. Oregon State University, Corvallis, June 1972.

factors which may be corrected to reduce unit costs, but to generalize and say that is what all high cost farmers should do, is presumptuous and potentially dangerous.

One broad generalization concerning cost components can be offered. If grower concern exists in identifying measures for reducing production costs per acre, it is suggested that materials and machine cost categories be investigated first. This is simply because, on the average, the two categories collectively represent at least 50 percent of total production costs (Table 14). Consequently, a specific percentage reduction of costs in either or both of these categories would involve much larger dollar amounts than an equal percentage reduction in cost of the other cost categories. Whether certain individual farms have high materials and machine costs can be determined only by analysis and presupposing this condition is dangerous. Furthermore, even if costs are deemed to be excessive whether or not a farm is able to change this condition is not altogether obvious.

One final point should be made. Table 14 shows land charge as an important cost component. Unfortunately, its absolute cost level is relatively constant ($15 to $20 per acre), and not subject to producer control since market conditions dictate the land charge level. Hence, the opportunity to reduce this cost component is essentially nil.

Relative Profitability of Grass Seed Types

Cost differences between seed types become a mute point if they are more than compensated by income generated from seed production. To evaluate this issue, mean prices from Table 10, yields from Table 11, and production costs from Table 13 were combined to obtain net returns per acre by seed type. Results of the comparison are presented in Table 16. The data represent average returns over production costs for each seed type. Price data for the 11 year period, from 1960 through 1971, for Oregon, and average seed yield for 1967, 1968, and 1969, from the sample operators, were used. Three year yield data were used since they are believed to more closely represent average performance over the life cycle of a stand than single year data. Single year data runs the risk of being adversely affected by weather conditions,

Table 16. A Summary of Average Annual Net Return Over Production Costs, Per Acre, by Seed Type, for Willamette Valley Sample Farms, Using Historical Prices and Yields

	Unit	Highland bentgrass	Kentucky bluegrass	Fine fescue	Tall fescue	Orchard grass	Annual ryegrass	Perennial ryegrass
Ave. gross returns per acre[a/]	$	100.70	173.20	140.00	108.20	193.20	72.70	67.20
Ave. total production costs per acre.....	$	75.80	97.50	85.30	77.80	84.90	72.70	67.20
Ave. operating costs per acre[b/]	$	45.90	62.40	52.60	49.30	53.00	49.90	38.60
Ave. return per acre over operating costs.....	$	54.80	110.80	87.40	58.90	140.20	22.90	28.60
Ave. returns per acre over production costs.....	$	24.90	75.70	54.70	30.40	108.30	-.20	0

[a/] Price data represents the average price for the 11-year period from 1960 through 1971, as shown in Table 10. Yields represent average seed yields for the 1967-69 period as reported by the sample farms and shown in Table 11.

[b/] Obtained from Tables 11 and 13.

either good or bad. Average 1968 through 1970 Oregon prices were not used since poor yields in 1968 and small carryover of seed supply from previous years resulted in abnormally high farm gate prices in those years.

Average return data in Table 16 show that individual grass seed types differ substantially in relative profitabilities. Kentucky bluegrass and orchardgrass had markedly greater net returns per acre than did the other five grass seed types. Annual and perennial ryegrasses showed zero net returns. These results suggest that some economic gain might be realized on grass seed farms which have the physical and economic resources amenable for increasing production levels of Kentucky bluegrass and orchardgrass. This does not suggest, however, that all Willamette Valley grass seed producers should shift production toward greater emphasis upon Kentucky bluegrass and orchardgrass. Soil type differences, resource levels and combinations, production contracts at the farm level, and changes in relative price of grass seeds, as affected by market conditions, including consumer tastes and preferences, all play roles over time in determining appropriate grass seed type combinations for each grass seed producer. It should also be recognized that high-cost producers in one grass seed type probably may well remain, often from circumstances beyond their control, as high-cost producers when shifting to other seed types, hence, end up no better off and possibly worse off economically than before. Finally, results in this section represent relative rather than absolute profit differentials between grass seed types and future changes in the market may alter those relationships. Inclusion of ownership cost components at the whole farm level, as treated in an earlier section, would be necessary for each grower to determine absolute farm profit levels for his farm.

Other Components

Variation in costs and returns occurs not only among grass seed types, but also within groups of farms raising one type of seed. In addition to the factors of farm type, farm size, enterprise combination, resource combination, resource use levels, and regional location differences treated

by this research, it is known that other factors have contributed to cost and returns variations. These may well include differences in operator utility and risk preferences, labor and capital restrictions, debt position, opportunity cost or alternative use values for resources, and unique physical characteristics on certain farms which may be too costly to modify. For example, risk aversion and limited capital may cause an operator to invest lower levels of inputs per acre than what may be generally recommended. Limited labor or machinery resources, on the other hand, might cause an operator to intensify usage of fertilizer and chemicals, rather than renting additional land. Demands of a farm family for more leisure time or more consumptive income may affect the rate at which farm income is converted to capital resources used by the farm operation. Farm debt position affects the level of family living. Under a debt-free situation, all net farm income, after income taxes are deducted, could be used, if desired, for family living. This is not the case when debt load is high and debt retirement (principal payments) must come out of net farm income, thereby reducing the level of earnings available for family living and/or capital investment. This suggests that those operators with high debt may rent rather than buy additional land, thereby avoiding principal payments. These are economic variables known to exist which influence the level of resources used, production, and profits. Unfortunately, these factors also are difficult to quantify by known emperical research tools. So, while they have not been discussed explicitly in this study, these factors should be recognized as determinants which contribute to profit and its variation between farms and within farms over time.

SUMMARY

A study of 147 grass seed producers for the 1969 crop year was conducted for the purpose of identifying physical and economic factors which characterize grass seed producers and production in Oregon's Willamette Valley. A secondary objective was to establish benchmarks of profitability for grass seed operations to serve as inputs in future research which will seek to

evaluate the grass seed industry as it adjusts to an environmental pollution ban on the cultural practice of open field burning.

Sampling procedures used in the study indicate that approximately 765 to 1,500 farmers produced grass seed in the Willamette Valley in 1969. Some 765 to 1,000 are commercial operators whose principal share of income is from farming, while the others are part-time farming operations. All but five of the 147 sample farms were operated as commercial units with less than 20 percent of family earnings derived from off-farm sources.

Eighty-one percent (119 farms) of the sample farms were organized as single proprietorships, 14 percent (20 farms) as family partnerships, and 5 percent (8 farms) as family corporations. Average age of the farm operator was 46 years with a range of 24 to 82 years. With exception of a few operators approaching retirement, all operators worked full time on the farm. Family labor, generally, played a minor role. Hired labor was common, particularly for the larger operations, with peak labor demands occurring in the summer months.

While the role of grass seed varied widely from one sample farm to another, on the average, 72 percent of cropland acreage was devoted to grass seed production. Some 55 percent of grass seed acreage was rented with the largest share occurring in Linn, Benton, and Lane Counties where annual and perennial ryegrasses production dominates.

Total capital investment averaged slightly over $200,000 per farm with 63 percent of it devoted to grass seed use. Although grass seed enterprises dominated land use, various crop and livestock enterprises were reported. Thirty percent of the sample farms had seed cleaning operations utilizing labor during winter months. Nearly all sample farms produced at least two grass seed types to (1) hedge against price uncertainties from one seed type to another, (2) to reflect soil type differences within a farm, and (3) to provide complementarity in use of fixed resources.

Grass seed production by seed type is somewhat regionalized -- fine fescue is dominant in Clackamas and Multnomah Counties; nearly all annual

and perennial ryegrass production occurs in Linn, Benton, and Lane Counties; Highland bentgrass and fine fescues are grown on the hill soils of Marion County, with small acreages of tall fescue and bluegrass grown on the bench soils; Polk County combines grain production on the hills with ryegrass production on the lowlands; diversity of topography and soils in Washington and Yamhill Counties resulted in small acreages of ryegrass and bentgrass grown on the poor soils.

Resource returns from the 147 sample grass seed farms averaged 2.7 percent to equity capital, using a $7,500 charge for operator labor and management. This was achieved in 1969, a year in which grass seed prices generally were higher than average. Variability in resource returns between sample farms ranged from negative to well in excess of 10 percent on equity capital. Production cost variability between farms producing the same seed type, and between seed types, contributed to the situation.

Factors which contributed to large cost differences between farms producing the same seed type, in general, were diverse. That is, factors which made one grower a high cost operator, in general, could not be extrapolated or generalized as the set of factors which caused high costs for other operators. A highly complex set of unique qualities or characteristics existed on each sample farm, and the way in which they were combined influenced the income obtained. It is suggested that, since materials (fertilizer and chemicals) and machine cost categories were the most important contributors to total production costs (generally over 50 percent), any serious attempts to reduce production costs ought to start with an evaluation of those costs. It must be recognized that, for many farms, other cost components may well be more important, however.

Production costs per acre between seed types showed less variability than within seed types. The results reflect similar cultural and managerial practices used across all grass seed types.

Net returns over production costs per acre differed markedly from one seed type to another. The greatest variability per acre came from yield and

price differences since production costs per acre were similar across seed types. Price variation was the largest contributor. Kentucky bluegrass and orchardgrass were considerably more profitable than the other grass seed types with average returns over production costs in the $75 to $110/acre range. Returns over production costs, on the average, were lower for tall fescue, fine fescue, and Highland bentgrass, ranging from $25 to $55/acre. It was zero or negative for annual ryegrass and perennial ryegrass. In terms of price and yield variability, perennial ryegrass, Highland bentgrass, and orchardgrass provided less risky choices relative to the other four grass seed types.

Return over operating costs was positive for all 147 sample farms. It was positive also for each grass seed type grown. Annual and perennial ryegrasses generated the lowest return over operating costs per acre. This indicates that, while each farm and each seed type were able to generate sufficient income to more than cover out-of-pocket operating costs, many farms were not able also to cover overhead costs and provide a positive return to operator equity capital and labor and management resources, as well.

Potential farm size economies were evident for all farm types, but were particularly so for the smaller farms of less than 600 acres in size. Capabilities for spreading ownership costs (depreciation, interest, taxes, and insurance) from existing machinery and equipment by controlling more acreage were greatest in that size class. Under-utilization of machinery resources was particularly costly from a cost per acre standpoint for smaller farms.

Farm size economies rapidly dissipated once farm size exceeded 1,000 acres. The implication is that farms of 600 acres in size can be just as efficient from a cost per acre standpoint as farms producing well over 1,000 acres of grass seed. Furthermore, large farm size alone did not assure low unit costs per acre. That is, large farms were not immune from being high unit cost operations.

IMPLICATIONS FOR ADJUSTMENT

Results of this study provide economic information describing complexities of grass seed production in the Willamette Valley of Oregon. What implications or judgments might be drawn from this study relative to adjustments which individual grass seed growers will make as they anticipate termination of open field burning by legislative edict effective January 1, 1975? Alternatives are expected to be more costly than open field burning. Thermal sanitation by commercial field sanitizers combined with some residue removal and its commercial utilization has been the most discussed choice.

About 20 percent of the 147 grass seed farms sampled did not generate sufficient farm revenues both to cover production costs and depreciation on machinery, equipment, and buildings. This group of 26 to 30 sample farms were hanging on in 1969, but, of necessity, using depreciation reserves to provide family living. In many instances, this cannot go on indefinitely. For those operators, the adjustment choices appear to be (1) transfer of farmland to urban or other non-farm use, (2) transfer of farmland to other grass seed producers by rental or sale, (3) reorganization of the present operation to obtain cost reductions per acre comparable with low cost producers, and (4) evaluate alternative cropping choices and their profitabilities relative to seed production.

Capital appreciation of land has been viewed by some operators as a form of delayed operator return. This option will be most prevelant in areas affected, or to be affected, by urban development. Nationwide, farm land values have increased at an average rate of nearly 6 percent per annum in recent years [17]. It must be recognized, however, that real estate appreciation varies widely among geographic areas and is influenced not only by returns in agriculture but also by demand for land in non-agricultural uses, hence farm location and its relation to urban development are crucial. Future trends are problematical and beyond the scope of this study.

Shifting to more profitable non-grass seed enterprises generally is limited severely by the level of the resource base, soil characteristics,

access to markets, and managerial abilities [4]. Large shifts to other crops are not expected. Large-scale shifts to livestock also appear unlikely at the present, being restricted by weather and soil limitations, and availability of high quality-low cost feed in the Willamette Valley which will permit livestock produced here to compete with other producing regions. Grass straw is viewed as a high cost-low valued feed because (1) of its high cellulose and lignin content, and (2) high cost for densifying, transporting, and storing relative to other feed sources. In summary, threat of the January 1, 1975 burning ban probably will hasten exodus by some 20 percent or more of the grass seed growers in the Valley who are not able to do much more than cover operating costs and do not perceive an increase in the size of their operation as an attractive alternative.

The remaining 80 percent of Willamette Valley grass seed producers, while achieving varying rates of returns, appear to be competitive enough to stay in business, at least for some time. Exodus from the industry is not necessarily imminent for this group, in general, and certainly not for the low cost operators. Of course, a part of the issue involves what alternatives to open field burning will be feasible by January 1, 1975, to what extent they increase production costs, and by how much. Answers to these questions, unfortunately, are not yet obvious. For high cost producers desirous of staying in business, several adjustment alternatives appear to exist: (1) increase farm size, particularly if it provides more complete utilization of existing machinery and operator labor resources, (2) inclusion of a seed cleaning operation to utilize operator labor in the winter and to obtain price advantages for seed requiring specified quality standards which are facilitated by cleaning, and (3) selective and judicious combining of several seed types to obtain a net price advantage. Wide spread grower adjustment using choices (2) and (3) could generate adverse price effects negating their positive influence.

Average returns over production costs show Kentucky bluegrass and orchardgrass to be significantly more profitable than the other grass seed types. Annual ryegrass and perennial ryegrass showed the lowest returns. These data suggest merit in seed type substitution where soil condition, market opportunities, and managerial limitations permit, particularly for

the more efficient low cost operators. It is doubtful that this choice offers a cost panacea for many high cost operators, particularly those whose cost structure would not be reduced by shifting to different grass seed enterprises. For operators with strong risk aversion, continued production of perennial ryegrass combined with Highland bentgrass or orchardgrass may be justified because of their low price and/or yield variability. Large-scale acreage shifts between grass seed types in the Valley, if they occurred, would serve to dampen markedly the relative prices differentials in grass seed types, as reported in this study. These forces, hopefully, would serve to limit large scale production shifts between grass seed types in the Valley.

Farmer adjustments probably will not be uniform throughout the Willamette Valley. Grass seed farms in Clackamas and Multnomah Counties characterized by small size, advanced operator age, low returns, and urban pressure on land use will likely adjust first. Those farms likely will convert to more intensive agricultural and/or non-agricultural uses when their operators retire. Their effect upon the industry will be negligible, however. Grass seed farms in Linn, Benton, and Lane Counties generally are large, specialize in grass seed production, and obtain higher returns to grass seed production than other grass regions in the Valley. It is likely that organizational adjustments in this region will involve further grass seed specialization and reduction in farm numbers as the more efficient operators replace those earning low or negative returns. The heterogeneous nature of Marion County precludes making meaningful generalizations. Some increased specialization in grass seeds, as well as shifting to other enterprises, is expected, depending upon individual farm situations. In Polk County, complementarity between grain and ryegrass production suggests continued production of both on many farms. In Washington and Yamhill Counties, grass seed enterprises often provide less than 30 percent of farm sales, so serve a complementary or supplementary role relative to other farm enterprises. In those instances, major economic gains are not expected from improvement in internal grass seed efficiency and economies of size. Those operators may increase production of proprietary seed varieties and breeders seed stock

requiring higher unit costs and more intensive managerial effort, with the expectation of obtaining a significant price advantage.

What influence will individual grower adjustments be expected to have upon the aggregate of grass seed production in Oregon's Willamette Valley? There is no simple or easily identifiable answer. Many complex technical and economic issues remain, as yet unanswered, which could profoundly influence the industry. These include such elements as the degree of progress towards a commercially feasible field sanitizer, economic viability of alternative cultural practices, scope and nature of commercial markets for grass residue, and relative prices for alternative crops. All of these are affected by such dynamic forces as new technology, changing markets, public attitudes, policies, etc. In spite of these difficulties, some generalizations concerning the health of the industry can be made. The Willamette Valley grass seed industry, with its natural advantage in production, is generally healthy, dynamic, and sensitive to change. As a consequence, its importance as an industry in the Valley is not likely to change significantly as a consequence of a burning ban. Certainly there will be fewer growers but because of cost efficiency potential which gives the industry great flexibility to adjust, the fundamental issue of survival is not in doubt, having, of course, events of a catastrophic nature.

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APPENDIX

DETERMINATION OF NUMBER OF FARMS PRODUCING GRASS SEED IN OREGON'S WILLAMETTE VALLEY, 1969

The total population for sampling purposes was constructed by compiling seed grower lists from several sources, which totaled 2,400 names. Elimination of duplicate names of individual farmers producing several seed types reduced the population level to 1,800 growers. In sampling from this population of 1,800 names, it was found that 35 of the initial sample of 204 seed growers no longer raised grass seed. This phenomenon is reasonable to expect in a dynamic agricultural environment, such as exists in the U.S., where the trend to larger, but fewer, farms has been rapid in recent decades. While periodic revision of grower lists has accounted for inclusion of new growers, only limited success appears to exist in removal of names of operators who no longer raise grass seed.

Direct extrapolation from the sample suggests possible overstating of the true population by as much as 17 percent, or 300 growers. Downward adjustment by 300 growers results in a population estimate of 1,500. These results were compared with the 1969 Census of Agriculture, a population enumeration which was published in 1972 [17]. The census reports a total of some 1,600 grass seed growers. While census data combine annual and perennial ryegrass, thereby eliminating duplication of those growers who produce both of these seed crops on a single farm, they do not eliminate duplication of growers who produce more than one major seed type per farm, such as ryegrass and bentgrass, or those growers who produce both red and Chewings fescue on the same farm, since the census separates these two fescues in its reporting. The 147 sample farms reported 355 grass seed enterprises for an average of 2.4 per farm. A conservative downward adjustment of the census population by 10 percent, or 160 growers, to account for duplications, appears valid. This produces a result comparable to the population estimate of 1,500 from the study sample. The figure of 1,500 grass seed farms will be taken as the probable upper limit of the actual population in 1969.

Several factors appear to bear upon why the sample may understate the actual population number. Four have been identified and discussed below.

(1) Aggregate acreage estimates, as reported by the USDA Crop Reporting Board, are expressed in terms of harvested acres.[1/] A portion of total acreage reported by the growers sampled was seeded to a perennial grass in 1968 and not harvested in 1969. Examination of data from the sampled growers reveals that 5 to 15 percent of the sampled perennial crop acreage was newly seeded and not harvested. Using an average of 10 percent of total acreage as seedling acreage for all perennial grasses in the sample, the total harvested acres in the sample are reduced from the 63,524 acres, as shown in Table 1 of the text, to approximately 59,600 acres. This represents 24.1 percent of the estimated harvested grass seed acreage, as reported by the USDA Crop Reporting Service, rather than the 26 percent quoted in Table 1 of the text. This adjustment increases the probable lower limit of the real population from 565 to 610 growers.

(2) There may exist more acres of harvested grass seed in the Willamette Valley than estimates indicate. It is known that some farmers are reluctant to report seed production statistics to the USDA Statistical Reporting Service which compiles and publishes the sample estimates. The 1969 Census of Agriculture, a population enumeration, lists 255,000 acres of grass seed harvested in 1969, a 3.5 percent increase over the 247,250 acres reported in Table 6 from the USDA Statistical Reporting Service. Using the 59,600 harvested acres in the sample from (1) above, the 147 farms account for 23.3 percent of estimated harvested grass seed acreage, increasing the probable lower limit of the real population from 610 growers in (1) above to 630 growers.

[1/] All seed production reports issued by USDA Crop Reporting Board list "harvested acres". See Seed Crops: Annual Summary (1969) by States, USDA Statistical Reporting Service, Crop Reporting Board, Statistical Bul. No. 206, April, 1970.

(3) The random selection of sample farms may have resulted in a disproportionate number of the large farms entering the sample. Comparison of average grass seed acreage per farm, by seed type, reported by sample farms and by the 1969 Census of Agriculture, is shown in Appendix Table 6. Wide discrepancies in acreages per farm are evident, particularly with ryegrass, for which sample farms reported an average of 356 acres per farm, while census data report an average of 252 acres per farm. If census averages per farm for each seed type were used, a 147-farm sample would report some 49,000 harvested acres of grass seed instead of the 59,600 acres stated in (1) above, or about 19.2 percent of estimated harvested grass seed acreage. Use of the census data increases the probable lower limit of the real population from 630 growers in (2) above to 765 growers.

(4) The seed grower lists may have underestimated the true seed grower population, since only the names of growers selling seed were used. Some small farmers, possibly 10 percent of the population, simply deliver seed to neighboring processors who clean and sell the seed in their own names. Several Willamette Valley Agricultural Extension personnel suggested this factor. These growers are not included in the grower lists from which the sample was drawn, adding validity of the possibility of a disproportionate number of larger farmers entering the sample noted in (3) above. If correct, this factor could involve some 150 growers, thereby increasing the 765 grower base in (3) above to approximately 900 grass seed producers as a likely lower limit on the true population.

Table A-1. Willamette Valley Grass Seed Acreage, by Major Seed Type, 1968-70

Seed type	Acreage			Percentage of total by seed type		
	1968	1969	1970[a]	1968	1969	1970
Bentgrass[b]	23,360	28,450	29,500	10.0	11.5	11.3
Bluegrass[c]	13,500	13,280	12,050	5.8	5.4	4.6
Fine fescue[d]	28,480	29,300	28,570	12.3	11.8	11.0
Orchardgrass	8,600	11,300	13,550	3.7	4.6	5.2
Tall fescue	15,425	15,920	16,500	6.7	6.4	6.4
Ryegrass[e]	134,000	149,000	160,000	58.0	60.3	61.5
All other grasses grown for seed	8,105	n.a.	n.a.	3.5	n.a.	n.a.
TOTAL	231,470	247,250[f]	260,170[f]	100.0	100.0[f]	100.0[f]

SOURCE: Estimates by Cooperative Extension Service, Oregon State University, Corvallis, and the Oregon Crop and Livestock Reporting Service, USDA, Portland, cooperating.

[a] Preliminary estimates.

[b] Includes all bentgrasses, with Highland being the principal type.

[c] Includes all bluegrasses, with Merion Kentucky and other Kentucky bluegrasses being the principal types.

[d] Includes all fine fescues, with creeping red and Chewings being the principal types.

[e] Includes both annual and perennial ryegrass.

[f] Includes only major grass seed types, since statistical data for 1969 and 1970 was not available for the minor grasses grown for seed.

Table A-2. Grass Seed Acreage by Major Seed Type and County Location, Willamette Valley, 1969[a/]

Seed type	Benton	Clackamas	Lane	Linn	Marion	Polk	Yamhill	Washington	Total
Bentgrass.....	2,400	—	540	3,900	19,400	200	1,900	110	28,450
Bluegrass.....	650	700	300	10,000	1,000	150	330	150	13,280
Fine fescue.....	900	8,000	500	2,300	15,400	1,200	900	100	29,300
Orchardgrass....	3,750	200	1,250	4,100	1,000	800	200	—	11,300
Tall fescue.....	2,200	850	2,200	8,000	1,700	800	—	170	15,920
Ryegrasses.....	12,700	100	12,500	106,900	4,200	9,600	2,750	250	149,000
TOTAL.....	22,600	9,850	17,290	135,200	42,700	12,750	6,080	780	247,250
PERCENT OF TOTAL	9.1	4.0	7.0	54.7	17.3	5.2	2.4	5.2	100.0

SOURCE: Estimates by Cooperative Extension Service, Oregon State University, Corvallis, and Oregon Crop and Livestock Reporting Service, USDA, Portland.

[a/] Very small acreage levels precluded reporting of data for Multnomah County.

Table A-3. Farm Price and Value of Farm Sales by Major Seed Types for Willamette Valley, 1968 and 1969

Seed type	Average farm price per cwt.			Value of farm sales: Dollars (1,000)		Value of farm sales: Percent by seed type	
	1968	1969	1970[a]	1968	1969[a]	1968	1969
Bentgrass[b]	34.20[b]	50.00[b]	47.00[b]	1,912	2,457	8.5	9.3
Kentucky bluegrass	28.50	27.00	30.00	2,374	1,796	10.3	6.8
Fine fescue	21.50	24.50	34.00	2,424	3,101	11.0	11.8
Orchardgrass	26.75	25.80	25.20	1,925	2,421	8.3	9.2
Tall fescue	13.50	18.50	13.00	1,230	2,006	5.3	7.6
Annual ryegrass	6.93	7.30	5.70	8,643	10,262	37.7	39.2
Perennial ryegrass	10.59	11.50	10.40	4,382	4,225	19.0	16.1
TOTAL	---	---	---	22,890	26,268	100.0	100.0

SOURCE: Estimates by Cooperative Extension Service, Oregon State University, Corvallis, and Oregon Crop and Livestock Reporting Service, USDA, Portland.

[a] Preliminary estimates.

[b] Price includes Astoria and Seaside bentgrasses grown in coastal areas. Farm prices of these varieties are substantially higher than that of Highland bentgrass grown in the Willamette Valley.

Table A-4. Value of Sales by County for Grass Seed Grown in the Willamette Valley, 1968

	Acreage	Production 1,000 lbs.	Value $1,000	Value Percent
Oregon	250,207	215,994	26,136	100.0
Willamette Valley counties[a/]				
Linn	130,760	141,056	13,024	49.8
Marion	41,300	15,051	3,190	12.2
Benton	15,275	14,852	2,272	8.7
Lane	16,850	15,801	1,567	6.0
Clackamas	9,465	4,253	909	3.5
Polk	11,070	10,101	876	3.4
Yamhill	6,295	3,788	527	2.0
Washington	455	208	43	--
VALLEY TOTAL	231,470	204,110	22,408	85.7

SOURCE: Middlemiss, Willis E. and Robert O. Coppedge, "Oregon's Grass and Legume Seed Industry in Economic Perspective." Special Report 284, Cooperative Extension Service, Oregon State University, Corvallis, April 1970.

[a/] Data for Multnomah County were not separated from state totals.

Table A-5. Willamette Valley Farms and Farmland, by County, 1964 and 1969

County	Farmland acreage[b] 1964	Farmland acreage[b] 1969	Total harvested cropland[b] 1964	Total harvested cropland[b] 1969	Grass seed acreage[c] 1969	Percent of harvested cropland devoted to grass seed 1969
Benton.....	207,633	129,034	51,232	50,814	22,600	44
Clackamas.....	261,812	210,055	83,245	67,634	9,850	15
Lane[a].....	416,195	270,587	86,506	79,403	17,290	22
Linn.....	467,276	374,826	207,413	203,321	135,200	67
Marion.....	333,624	302,065	172,684	159,575	42,700	27
Multnomah.....	66,728	70,792	19,433	16,989	n.a.	--
Polk.....	215,054	213,108	102,505	99,763	12,750	13
Washington.....	200,343	172,055	99,313	92,525	780	1
Yamhill.....	254,970	227,555	108,822	94,128	6,080	6
TOTAL.....	2,423,655	1,970,077	983,303	864,152	247,250	28

[a] A majority of Lane County farms are outside the area defined as the Willamette Valley.

[b] Obtained from Bureau of Census, 1964 Census of Agriculture, Vol. 1, Part 47, and 1969 Census of Agriculture, preliminary reports. Department of Commerce, Washington, D.C., 1967 and 1971.

[c] Estimates by Cooperative Extension Service, Oregon State University, Corvallis, and Oregon Crop and Livestock Reporting Service, USDA, Portland.

Table A-6. Comparison of Average Grass Seed Acreage Per Farm, by Seed Type; Sample Data and 1969 Census of Agriculture

	Highland bentgrass	Kentucky bluegrass	Fine fescue	Tall fescue	Orchard grass	All ryegrass
Sample of 147 farms						
Number of farms.....	51	40	63	33	42	97
Total acreage[a/].....	8,283	4,637	6,940	3,739	5,394	34,531
Average acreage per farm.	162	116	110	113	128	356
1969 Census of Agriculture						
Number of farms.....	212	125	250[b/]	131	163	647
Total acreage.....	21,200	19,500	26,000	12,000	14,000	162,600
Average acreage per farm.	100	156	104	92	86	252
Number of sample farms x census average acreage per farm.....	5,100	6,240	6,550	3,040	3,610	24,420

a/ Includes seedling acreage not harvested, estimated to total 3,700 acres or 10 percent of perennial grass seed acreage.

b/ Estimated number of fine fescue growers as reported in 1969 Census of Agriculture, after eliminating duplication of growers raising both Chewings and red fescue varieties.