The Economics of GRASS SEED PRODUCTION *in the Willamette Valley, Oregon*

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FOREWORD

The development and introduction of a new crop is always accompanied by new problems. Practices followed on similar well-established crops may not work satisfactorily on the new crop. Time and experimentation by technicians and farmers are required to develop truly satisfactory plans of operation.

This bulletin presents and evaluates in monetary terms the problems, practices, and economic success of farmers in the Willamette Valley in growing five important grass seeds. With the exception of the rye grasses, these grass seeds have been produced in Oregon for only a decade. Great improvements in techniques have been made. This bulletin should help point out the pathway to future success through its appraisal of the past.

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Dean and Director

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SUMMARY

Oregon ranks number one in the production of several grass seeds. Nearly all the widely used rye grasses, common and perennial, are produced in Oregon. A very high proportion of the relatively new and increasingly important grass seeds, Chewings fescue, Alta fescue, and Highland bentgrass are harvested here. The above grasses are grown primarily in the Willamette Valley in western Oregon, although the drier areas of eastern Oregon are becoming more important in the production of the fescues.

The Willamette Valley has a natural advantage in the production of grass seeds. Consistently mild, its wet falls, winters, and springs promote the growth of the grasses. Consistently dry summers allow the grass seed to be harvested without danger of destroying the germination of the seeds.

Grass-seed production is adapted to many types of farms: to intensive-crop farming where often there is a little land that is available for a field crop and especially for a soil building one; to livestock farms that want supplementary pasture as well as a cash crop; to part-time farming where year-around labor is not available; and to specialized grain and forage-seed farming with its heavy mechanization.

Common and perennial rye grasses are grown mostly on poorly drained valley soils. More acreage is devoted to common rye grass than to all other grasses combined. Chewings fescue is grown on well-drained valley and hill soils. Highland bentgrass is found in restricted areas on hill soils and Alta fescue seed is produced on all soil classes but mostly on well-drained soils.

RATING METHODS OF ESTABLISHING SOLID STANDS OF GRASSES BY SOIL CLASSES

(Willamette Valley, Oregon)

Method of stand establishment	Common rye grass	Perennial rye grass	Chewings fescue	Alta fescue
Seeded with a nurse crop	.....	Good	Poor	Fair
Plowed for previous crop, seeded in fall	Fair	Fair	.....	.....
Plowed in fall, seeded same fall	Good	.....	.....	Good
Plowed in fall or spring, seeded in spring	.....	Fair	Good	Good
Summer fallowed one season before seeding	Poor	Good if grassy	Good if grassy	Good if grassy

Establishment of stands

The total cost of establishing perennial rye grass was $15 per acre. Total costs for Chewings fescue and Alta fescue in solid stands were nearly twice as high. It cost $54 per acre to establish Alta fescue in rows. In rows, extra costs were involved in cultivating and hoeing out undesirable grasses. Although the row system was more costly, it was fully justified by the higher returns obtained.

Many distinctly different methods are used to establish grass stands for seed production for all grasses except Highland bentgrass. The preceding table rates the methods used for each grass seed.

Production of grass seed crops in 1948

The reason rye grasses are not grown widely on well-drained soil can be seen in Table 13 on page 37. The net returns per acre on well-drained soils are much lower for rye grasses than for the other kinds of grass seeds. Rye grasses will grow nearly as well on the poorly drained soils as on the well-drained soils. Chewings fescue does not grow well on poorly drained soils. Highland bentgrass is not entrenched on poorly drained soils as yet although it has secured a foothold.

Chewings fescue and Alta fescue (solid stands) have important places on both well-drained valley and hill soils, both in terms of acreage grown and profitability of the crops. The production of Alta fescue on poorly drained soils is less profitable than on other soil classes; nevertheless a higher average net return was obtained from Alta fescue than from the rye grasses on the poorly drained soils. Farmers who grow Alta fescue on poorly drained soil may have difficulty with rye grasses whose seeds are hard to separate from Alta fescue.

The advantage of growing Alta fescue in rows can be seen by the higher average yield and net returns per acre under this practice in comparison with growing it in solid stands. Another advantage, not apparent in the averages, is the greater uniformity in yield from year to year under the row cultivation method. Alta fescue becomes sod-bound easily as the stand becomes older and the yield decreases rapidly with sod-binding. Stands cultivated in rows do not become sod-bound so quickly and a high, more nearly uniform yield is maintained which at prevailing 1948 prices more than pays for the added expense.

Because of sod-binding of Alta fescue in solid stands it appears that this grass seed should be plowed or renovated after the second or third crop.

Perennial rye grass did not appear to be profitable after the second crop in most cases. The situation for Chewings fescue is

different. This grass does not become sod-bound or run out very easily and it can be maintained profitably for some time. It must be pointed out, however, that fertilizer applications are generally higher on old stands. They are high enough that it might pay to plow or renovate and reseed the stands from time to time, but this must not be taken as a hard-and-fast rule. Where fields are producing well and economically, whatever the reason, they should not be plowed.

Fertilizers are applied to the fescues at a higher rate than to the rye grasses even though the rye grasses frequently respond more readily to fertilization. The reason more fertilizer is applied to the fescues than to the rye grasses lies in the relative prices received for the seeds. Under the cost-price relationships found in 1948, the following amounts of grass seed would be required to pay for an additional 100 pounds of ammonium sulphate (20 per cent nitrogen) and the accompanying incidental costs that go with the additional application: 65 pounds of common rye grass, 52 of perennial rye grass, 17 of Alta fescue (solid stand), 14 of Chewings fescue and 9 pounds of Highland bentgrass seed.

Most all rye-grass fields were swathed and combined from the swath. About an equal proportion of the fields of the other kinds of grass were swathed or were combined standing. Neither method proved definitely superior to the other for those grass seeds where both methods were used. Since so few farmers cut the grass with binders and threshed with stationary separators, it is impossible to evaluate this method. This procedure is followed in other areas on high priced seed. It is claimed that the seed saved will more than pay for the added cost.

Many Alta fescue fields were pastured heavily. There seemed to be no decrease in the yield of grass seed or hay because of it. Agronomists do not advise grazing in the spring, however, when the seed shoots are starting to grow.

The Economics of GRASS SEED PRODUCTION *in the Willamette Valley, Oregon*

By

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Introduction

This bulletin reports a study of common (Italian) rye grass, *Lolium multiflorum;* perennial (English) rye grass, *Lolium perenne;* Chewings fescue, *Festuca rubra var. commutata;* Alta (tall) *fescue, Festuca elatior var. arundinacae;* and Highland bentgrass, *Agrostis tenuis.*

Importance of the grass seed industry in Oregon

The nation looks to Oregon for a large portion of its supply of certain grass and cover-crop seeds. Nearly our whole production of common (Italian) rye and perennial (English) rye grass seeds is grown in Oregon, mostly in the Willamette Valley. Oregon produces most of the Alta fescue seed but another selection of tall fescue, Kentucky 31, is raised in the state whose name it bears. Approximately 95 per cent of the Alta fescue seed produced in Oregon in 1946 was grown in the Willamette Valley. Union County, in northeastern Oregon, also produces this crop but under different conditions and practices. The production of Alta fescue has increased rapidly in that county since 1946.

Oregon likewise produces a large proportion of the Chewings fescue seed, and the Willamette Valley accounted for 72 per cent of that seed in 1946. Union County is another area of concentrated production. Oregon grows a large percentage of the bentgrass seeds, Highland bentgrass, the most important variety, being produced primarily in the Willamette Valley.

Growth of grass seed industry in Oregon

Common rye grass seed was an important crop in the Willamette Valley prior to 1936. Bentgrass seed was being produced in commercial quantities although most of the bentgrass seed was of the coastal varieties, Astoria and Seaside. In 1936 there were only 775 acres of perennial rye grass seed grown in Oregon, only 50 acres of Chewings fescue, and not until 1938 were as many as 70 acres of Alta fescue seed reported harvested (Table 1).

From this it can be seen that the grass seed industry in the valley is relatively new. Since 1936 the industry, which involves not only the growers but many seed cleaning and marketing establishments as well, has increased rapidly. The economic activities of many communities of the state have been stimulated by this industry.

Table 1 shows the increase in the seedings of the five crops included in this study from 1936 to 1948. While part of the upsurge in the seedings took place during World War II, it would be unreasonable to claim that the war was the primary cause for the increase. Prior to and during that period there was a national interest in soil conservation. Grasses were expected to play a major role in putting such a program into effect. Farmers saw the place of improved grasses in their crop-rotation programs. There was increasing interest in pasture improvement programs as farmers sought more efficiency in the production of livestock and livestock products. Finally, the building cycle was in its upward phase during this period —despite the war. This increased the demand for grass for landscaping purposes.

Although the acreage devoted to these specific grass seeds has greatly increased over the past 13 years, the rate of increase has slowed considerably during the last few years. The question may be asked: Are these decreases caused by lack of suitable land for growing these grass seeds in Oregon? Is their production becoming

Table 1. ESTIMATED ACREAGES OF FIVE GRASS SEEDS GROWN IN OREGON, 1936-1948[1]

Year	Common rye grass	Perennial rye grass	Chewings fescue	Alta fescue	Highland bentgrass
	Acres	*Acres*	*Acres*	*Acres*	*Acres*
1936	23,500	775	50	.....	.....
1937	21,000	2,200	190	.....	.....
1938	42,000	3,700	500	70	105
1939	55,000	7,000	925	150	155
1940	65,000	9,500	2,200	750	415
1941	70,000	12,500	3,750	1,250	850
1942	84,000	13,200	4,100	1,850	1,995
1943	60,000	14,500	4,200	2,100	1,750
1944	72,000	16,500	4,300	3,800	1,790
1945	80,000	15,000	5,100	5,000	2,100
1946	98,000	16,500	6,700	7,200	2,810
1947	96,000	17,300	7,300	8,400	5,925
1948 p	76,000	19,000	7,500	8,500	5,780

p Preliminary.

[1]Estimates prepared by the Oregon State College Extension Service, Agricultural Economics Section, and the Bureau of Agricultural Economics, U. S. Department of Agriculture.

less profitable? Is there fear that further increase in production will reduce prices?

The answer to the first question is that there is much more land in the Willamette Valley and other parts of Oregon that may be used to grow grass seed. This bulletin supplies data on the question of relative profit to be obtained from the grass seeds. It can be said that the actions, conversations, and reports of farmers indicate they have fear of oversupplying the grass seed market with a further increase in production. Whether the fear is fully warranted can not be told by this study. A more detailed study of market demand for the grass seed is needed to help answer the question.

Preliminary reports for 1949 indicate an increase in seedings of Alta fescue and possibly other grasses, under the stimulus of government price supports.

Relative importance of the crops

In 1946, the last year of detailed information on all seed crops, there were an estimated 131,210 acres in Oregon of the five grass seeds studied (Table 1). The total, cash, farm value of these crops was estimated at $7,264,000. There were nearly seven times as many acres of the two rye grass seeds than of the other three grass seeds combined. The value of the rye grass crops, however, was only 2.3 times the value of the other three crops studied. The difference between the two ratios lies in the prices received. In the 1948 study the average seed prices per pound received by farmers were as follows: common rye grass 7.5 cents, perennial rye grass 9.3 cents, Chewings fescue 35.3 cents, Alta fescue 28.5 cents, and Highland bentgrass 52.2 cents.

Purpose of the Study

The purposes of this study are: (1) To provide information on the costs of establishment and production of certain grass seeds on different soil classes. (2) To find out why the different soil classes were used to produce the grass seeds grown on them in 1948 and to determine the most desirable grass seeds for each soil class. (3) To study the influence of important factors on yield, costs, and net returns.

Procedure

Oregon State College seed-testing and certification lists and a fescue growers' organization membership list were used to develop samples. These lists were checked and enlarged by the county extension agents. The agents also noted for each farm the probable

major soil class upon which the grass seed was produced. Random samples were drawn from these lists so that a minimum of 20 records were taken from each grass-soil class group. Where less than 20 records were available in a group, all names listed were taken. A few more than 20 records were taken for the groups with long lists.

Trained enumerators visited the farms and gathered information on a field-by-field basis. Data collected concerned cost of establishment adjusted to the 1948 price level; cost of production, 1948: agronomic practices followed during the life of the crop; yields, wherever possible, during the life of the crop; and acres of crops and numbers of livestock on the farm, 1948.

The net cost of establishment was spread over the productive life of the seeding. The 1948 crop was charged with its proportionate share of the establishing cost as well as 4 per cent interest on the unapportioned establishing cost in 1948.

Description of Farms Growing Grass Seeds

Type of farms

The Willamette Valley is a geographic area noted for its wide diversity in farming systems. Grass seeds are extensive crops since a small amount of labor is required per unit of land. However, their production is not excluded from farms that are intensive in nature. Of the 197 farms studied, 22 intensive-crop farms, 41 dairy farms, and 11 poultry farms harvested grass seeds (Table 2). All farms with less than 100 productive man-work units were classified as residence farms. Farms with more than 100 work units but where the operator spent more than 25 per cent of his time working off the farm were considered part-time farms. Full-time farms were typed by the enterprise in which at least 40 per cent of the work units were found.

Only 29 farms were classified as forage-crop seed farms even though every farm studied, of course, grew seed. Vetch and clover seeds, where no hay was cut, were crops included with grass seeds to make up the forage-crop seed classification. The intensive-crop type of farms really included several rather distinct types. There were 8 orchard, 5 strawberry, 4 cane fruit, 2 hops, 1 vegetable, 1 peppermint, and 1 medicinal-plant farms making up this classification.

Size of farm

In terms of work involved the intensive crop, poultry, and the two hay farms were the largest (Table 2). The permanent labor force on the poultry farm is greater than on the other two types

Table 2. SIZE OF FARM AND IMPORTANCE OF GRASS SEED ENTERPRISE BY TYPE OF FARMING: FARMS GROWING GRASS SEED IN THE WILLAMETTE VALLEY, OREGON, 1948

Type of farm	Number of farms	Work units per farm	Crops per farm	Grass seed per farm
			Acres	*Acres*
Small grain	10	324	378	72
Hay	2	855	720	251
Forage crop seed	29	326	400	181
Intensive crops	22	984	166	39
General crop	14	477	437	174
Dairy	41	397	165	63
Beef	3	436	412	363
Sheep	6	508	260	165
Poultry	11	849	127	47
General livestock	3	436	134	43
General crops and livestock	32	404	260	108
Part-time	10	292	96	53
Residence	14	66	63	46
Total all farms	197	461	244	100

[1]A productive man-work unit is the amount of directly productive work accomplished by a man in 10 hours under average conditions. This does not include work required to repair equipment and buildings, keep records, and do other general overhead work. Total work units may be thought of as the number of 10-hour days the average farmer would need at his command to accomplish the work to be done on the farm within the year.

which have extreme peaks in labor requirements. Livestock farms generally were larger than crop farms.

In terms of acres of crops per farm, the two hay farms were in a class by themselves but small grain, forage-crop seeds, general crops, and beef farms all averaged nearly 400 acres of crops per farm. Sheep farms, and general crop and livestock farms averaged 260 acres per farm. The average amount of land in crops was somewhat smaller for the other types of farms.

Importance of grass seed to each type of farm

INTENSIVE-CROP FARMS. Intensive-crop farms find grass seed to be valuable in their rotation. After establishment, the labor requirement of the crop is low and it is possible to get most of the harvesting of these small fields done by custom work. The portion of the land not devoted to the intensive crops can be easily handled this way. The soil-building action of the grass is greatly desired for the intensive crops.

FARMS WHERE LIVESTOCK ARE IMPORTANT. Where livestock are kept, the grass-seed fields work well as supplementary pastures.

Most livestock farms in the study, especially the extensive types, had considerable acreages in grass-seed plantings (Table 2). Depending on the grass and soil, livestock can be grazed on the grass early in the spring, sometimes until permanent pastures are available. After the grass seed is harvested in early July, the fields then can be used to supplement permanent, non-irrigated pastures which dry up in the summer. When the rains start in the fall these fields are valuable for pasture, since they start to green up again. There are cases where fields have been pastured the entire winter, although heavy grazing of this sort may be a questionable practice.

GRAIN AND VETCH SEED FARMS. Once the grass-seed crop is established the major job from year to year is that of harvesting. Fertilizing and hauling the seed to the cleaners are minor jobs. Most of the harvesting is done by combines.

If equipped with tractors and combines to harvest grass seed a farmer also is equipped to handle small grains—and vice versa. Although some small grains, grass seeds, and other cover-crop seeds are harvested at nearly the same time there is enough difference in harvest periods that this equipment can be used on almost all crops. This economy in the use of specialized equipment has encouraged specialization in these extensive crops.

Other general considerations in growing grass seeds

STRAW AND HAY AS BYPRODUCTS. A large proportion of the farmers producing Alta fescue seed also bale the straw and use or sell it for hay. This has proved to be a profitable practice. Straw is seldom utilized from the other grass seeds although sometimes it is removed and burned.

IMPROVEMENT IN GENERAL SOIL FERTILITY. The root systems of some of these grasses add considerably to the organic content of the soil for future crops. Some of the fertilizer applied to the grass stand is "locked" up in this root system and released again to other crops when the stand is plowed. The indirect value of this improvement in fertility, being difficult to measure, is not considered in the data to follow.

Income by Type of Farms

It has been shown that the production of grass seed is well adapted to several types of farming but that there are some farms that specialize in its production on an extensive scale. In 1948 data were collected on improved pastures in the Willamette Valley as well as for the grass-seed study reported here. Several of the farms in

Table 3. AVERAGE LABOR INCOME AND PER CENT RETURN ON CAPITAL ON SEED AND GRAIN, GENERAL, AND DAIRY FARMS[1]
(Willamette Valley, Oregon, 1948)

Type of farm	Number of farms	Labor income[2]		Return on investment[3]	Average capital investment
		Average	Average deviation		
				Per cent	
Seed and grain	30	$7,797	$4,751	9.3	$85,561
General	24	2,914	3,866	3.9	76,980
Dairy	21	2,275	1,934	2.7	60,851

[1]Oregon Agricultural Experiment Station Bulletin 471.
[2]See footnote at bottom of page.
[3]In calculating the per cent return on investment a charge is made for the value of the operator's labor and management but no charge is made for interest on investment.

these two studies were revisited and information was taken on the entire farm business for 1948. The sample was drawn so that most of the farms fell into three types: seed and grain farms, dairy farms, and general farms. Classification was made on the basis of work involved in, and income derived from, the various enterprises.

The average labor income[1] for the seed and grain farms was $7,797. It was only $2,914 for general farms and $2,275 for dairy farms (Table 3). The difference in average income between the seed and grain farms and the two other types of farms was highly significant. The variation in labor incomes among farms was highest for seed and grain farms and lowest for dairy farms. Even with the wider variation, the seed and grain farms as a whole were in a better position since most of the less profitable farms made acceptable incomes; however, this was not true for dairy farms. The average deviation in labor income was very large for general farms in relation to the average labor income. Some high incomes were recorded but 8 of the 24 general farms had negative labor incomes. In other words, there was less than no income at all returned to these operators for their labor and management functions.

It must be borne in mind that these income data are for the year 1948—a good agriculture year throughout the nation.

During the course of the study, it was found that farmers were somewhat fearful that even a small increase in grass seed production would bring about a serious decline in price. They could not see a strong and unlimited demand for grass seeds. An illustration of

[1]Labor income is the return to the operator for his own labor and management—after paying all farm expenses (including unpaid family labor), after allowing for any changes in inventory, and after deducting 4 per cent interest on the total farm investment.

likely actions of farmers, as customers, in regard to purchase of grass seeds might be given in justification for their fears.

A prospective farmer-customer will most likely choose a plan of operation which involves the planting of grass. Then he chooses the grass seed he thinks best for his purpose. Seldom will he stop if grass seed costs 50 cents per pound when he had planned on paying 40 cents. In a pasture development, for example, the total cost of the grass seed is all too small in relation to the total cost, or in relation to the value of the feed to be obtained, so that such an increase in price will hardly stop his plan of operation. Nor would he buy much more seed if the price were 30 cents per pound if he does not need it. The new home owner and manager of the golf course will act the same way. Of course there is a limit to this reasoning. If a farmer planned on paying 40 cents per pound and found the price to be 95 cents he might seriously consider some alternative.

Although in 1948 seed and grain farming was not in economic equilibrium with the other types of farming shown in Table 3, the adjustments will be slow so long as most farmers think there will be a grass-seed price collapse if the supply of grass seed is increased much more. Partial proof of the uneasiness with which farmers view the grass-seed market is evidenced in their actions in 1949. Preliminary indications are that there has been a considerable increase in the seeding of Alta fescue and that much of the stimulus has been from government price support even though the support price in 1949 was about the same as the price would have been without the support. The stimulation came not necessarily from the magnitude of the support price but rather because the farmers had an indication of the price they could depend on in years to come. In other words, they were encouraged by a stabilizing feature in the price system. It appeared to them that much of the risk had been removed. It might be well to point out, however, that the governmen price program can be subjected to swift and violent change; consequently, the farmer must view this "stabilizing feature" with caution.

Soils Upon Which Grass Seeds Are Grown

Common and perennial rye grasses

The "domain" of the rye grass seeds is the poorly drained valley soils. Linn County leads in the production of these grasses. Occasionally these crops are grown on well-drained valley soils. Very seldom are the seeds grown on river-bottom or hill soils.

Chewings fescue

This grass seed has found a place on hill soils. Important counties in its production are Marion and Yamhill. It also is grown on well-drained valley soils. A few fields are found on river-bottom soils, but few farmers have successfully grown it on poorly drained valley soils.

Alta fescue

Alta fescue is adapted to many soil types throughout the valley. It is a popular grass seed on hill and well-drained valley soils. A few fields are found on river-bottom soils. A fairly good sample of fields was obtained on poorly drained valley soils in 1948.

Highland bentgrass

Most of this grass seed is grown on hill soil. The heaviest concentration is in one area of Marion County.

Establishment of Stands

Since common rye grass is an annual crop, labor and costs of establishment will be discussed in the section on production. Methods of establishing perennial rye grass, Chewings fescue, and Alta fescue will be discussed in this section. Commercial stands of Highland bentgrass were not seeded, but were established by plowing volunteer stands and were renovated from time to time by this simple procedure. Establishment of Highland bentgrass, therefore, is not discussed in detail.

It is hardly possible to present through tables in the text the entire picture of establishment costs on so many grasses grown in so many soil classes. More complete classifications of establishment costs are found in the Appendix (Tables 18, 19, and 20).

There is a fairly close relationship between labor expended and total costs. This is not because labor is a major cost but because practically all the work done in establishment was done with equipment; and the combined costs, labor, and equipment were important variable costs in establishment. In addition to labor and equipment, expenses were incurred for seed and fertilizer in establishment.

Land charges

Land charges were made for taxes and for interest at 4 per cent of the 1948 land values. Land charges varied not only with the value of the land, but with the time required to establish the stand. Where the land was tied up for two years in establishing a stand, the stand was charged with the use of the land for two years. If the seeding was done in the fall and a crop obtained the first year, no land charge was made, and so forth.

Net credits explained

Crops or pasture are obtained from some fields in the process of establishing grass stands. They may be planned as in the case of seeding with a nurse crop. They may be incidental where volunteer grain or vetch is harvested. Sometimes the new seeding is pastured or cut for hay. Once in a while a "baby" seed crop is harvested. The procedure in this study was to charge the seed establishment with any cost (such as plowing) that was necessary for both the grass seed stand and the credit crop. Any cost on the credit crop alone, such as combining the nurse crop, was charged to the credit crop. Thus total costs under all methods of establishment are more comparable. The net value of the credits was subtracted from the total cost of establishment. These credits are not something to be ignored as a nuisance in analysis but play an important part in determing what grass seeds are grown and how they are grown.

Costs of Establishment

Perennial rye grass

Farmers used as much labor establishing perennial rye grass stands on poorly drained valley soils as they did on well-drained valley and river-bottom soils (Table 4). Farmers on poorly drained valley soils had the advantage of larger fields and, in some cases, larger equipment; but they went over the land more times in preparing seedbeds. With the equipment now in use, farmers establish perennial rye grass stands with a small amount of labor—about 2.8 hours per acre.

The average total cost of establishment was nearly the same for both the well-drained and the poorly drained soils—about $15 per acre. Similarity of labor expense has been mentioned. Heavier equipment was used on poorly drained soils. Net credits were higher on the better-drained soils.

Chewings fescue

There was a great deal of difference in the time required to establish a stand on well-drained valley soils compared with the time required on hill soils. More fields were summer fallowed on hill soils, but even under comparable establishment practices the farmers on hill soils went over the land more times. As a result, it required an average of 5.6 hours of labor per acre on hill soils compared with 2.4 hours on well-drained valley soils (Table 5).

The average total cost of establishment was $11 more per acre on hill soils than on well-drained valley soils—$34 compared with $23. Most of the individual costs were higher on the hill soils.

Table 4. PERENNIAL RYE GRASS: SUMMARY OF COST OF ESTABLISHMENT PER ACRE ON 1948 PRICE LEVEL
(Willamette Valley, Oregon)

Soil class	Number of fields	Labor	Total cost	Less: net credits	Net cost
		Hours			
Well-drained valley and river-bottom	15	2.6	$15	$6	$ 9
Poorly drained valley	28	2.8	15	3	12

Table 5. CHEWINGS FESCUE: SUMMARY OF COST OF ESTABLISHMENT PER ACRE ON THE 1948 PRICE LEVEL
(Willamette Valley, Oregon)

Soil class	Number of fields	Labor	Total cost	Less: net credits	Net cost
		Hours			
Well-drained valley	16	2.4	$23	$26	$—3
Hill	37	5.6	34	26	8

Many stands were established with a nurse crop. This meant that there were large net credits on both soil classes—about $26 per acre. The average net cost of establishment was very small; in fact, a slight average net income, $3 per acre, was made in the process of establishment on well-drained valley soils.

Alta fescue

Considering all methods of establishment, farmers spent as much time establishing a stand on well-drained valley and river-bottom soils as they did on hill soils—an average of about 5 hours per acre (Table 6). Little more than one-half this time was required on poorly drained soils (equipment, size of field, and terrain again were factors) and the land was gone over fewer times in preparing the seedbed.

Cultivating Alta fescue in rows was not a common practice in the Willamette Valley, although it is the standard procedure in the drier climate of eastern Oregon. Only nine fields were studied where the grass was grown in rows. Much more labor is required to establish a stand in rows than in solid seedings. An average of 4.2 hours per acre was required for soil seedings on all soil classes,

Figure 1. Cultivating Alta fescue in rows is becoming a popular method of handling the crop in the Willamette Valley. In this way the yield per acre can be doubled over the average yields for solid stands. Row cultivation also prolongs the life and improves quality.

compared with 21.1 hours per acre for row seedings. In the row seedings almost every operation was done more slowly and the land was gone over more times in preparing the seedbed. In addition, the grass was cultivated an average of 4 times and then nearly 60

per cent of the fields were hoed by hand. Those who hoed did so an average of 3 times during the establishment period. Hand hoeing was the major cost. It was done to get better quality seed and consequently a higher price.

Table 6. ALTA FESCUE: SUMMARY OF COST OF ESTABLISHMENT PER ACRE ON THE 1948 PRICE LEVEL
(Willamette Valley, Oregon)

Soil class	Number of fields	Labor	Total cost	Less: net credits	Net cost
		Hours			
Solid stands					
Well-drained valley and river-bottom	27	4.8	$32	$17	$15
Poorly drained valley	18	2.6	19	13	6
Hill	30	5.1	33	20	13
All solid stands	75	4.2	$28	$17	$11
All row seedings	9	21.1	$54	$ 3	$51

Again the close relationship is noted between hours of labor and total cost and for the same reason as explained previously (Table 6). The average number of years required to establish a stand was quite comparable among the soil classes for this grass, and as a result, land charges followed closely the pattern of land values—poorly drained valley soils being valued only half as high as the other soils. The average total cost on hill and well-drained valley soils was a little more than $30 per acre. It was $19 per acre for poorly drained soils but $54 for the row seedings. The average total cost for rows was nearly twice the average cost of all solid stands.

Many Alta fescue fields in solid stand were established with nurse crops although the practice was not quite as common as it was for Chewings fescue. However, more hay and pasture were obtained from new seedings of Alta fescue. The net credits on this grass seed were high on all soil classes, but highest for hill soils at $20 per acre and lowest for poorly drained valley soils at $13 per acre. Row seedings are not established with nurse crops and usually very little hay and pasture are obtained.

The influence of net credits is evident again in the net cost of establishing the stand. The average net cost was quite low for solid

seedings on all soil classes, being lowest on poorly drained soils at $6 per acre. The care with which the row seedings were established and the almost complete absence of net credits in the process meant that the net costs of establishment were high in relation to the net costs for solid seedings—$51 per acre compared with an average of $11 for all solid seedings.

Methods of Stand Establishment

There is no standard method of establishing a stand of grass. Furthermore, there is little uniformity for any one grass seed even within the same soil class. A possible exception is Highland bentgrass, which invades the land in certain areas and "takes over." Farmers use various methods depending on the situations that confront them and on their personal opinions of the relative merits of the establishing methods.

Seed with a nurse crop

Where seed is sowed with a nurse crop income is obtained from a crop during the establishment period. The nurse crop may pay all or most of the cost of establishment. It will be seen later, however, that the yields obtained from Alta and Chewings fescue generally do not justify the cheapness of this method of establishment. Common ryegrass seed is not established this way, of course, since it is an annual crop.

Plowing done for previous crop, disk and seed in the fall

Some farmers felt it unnecessary to plow for the grass seeding when the seeding was done in the fall following a plowed spring crop. They merely disked and prepared the seedbeds without plowing. The expensive plowing operation was eliminated in this manner. In such cases in this study one-half the plowing charge for the previous spring crop was charged to the grass seed.

Fall plowing and seeding

In this instance the farmer feels that plowing is necessary even though the land may have been plowed in the spring. It may be used where the land is too poorly drained for spring plowing. By seeding in the fall, the grass gets an early start over spring plantings and the establishing period may be shortened in some cases. Seeding in the fall is not advocated on the friable hill soil since the grass may be damaged by heaving in the winter time.

Fall or spring plowing, disking, and seeding in spring

This method is used where there is fear that the young stand will suffer during the winter and where it is desired to destroy the spring weeds and grasses. Some farmers may feel that the grass will become established just as quickly by spring seeding.

Summer-fallowing one season before seeding

The process of summer-fallowing the land one complete season prior to seeding is done to get cleaner seed. Generally speaking, a higher yield is obtained the first year by summer-fallowing but it will be seen that in many cases this is not the most economical method where the land is relatively clean. The reason it may not prove economical is that more work is involved and an income is lost from the land for one year. These costs may offset the additional income obtained. In most cases where this plan is followed the grass is seeded in the fall.

Method of Stand Establishment for Various Seeds

Common rye grass

The most common method used to establish the annual crop, common rye grass, was to let the plowing for the previous spring crop suffice and just disk and seed in the fall (Table 7). The average yield obtained under this method was 443 pounds of seed per acre compared with 574 pounds under the next most common method of plowing and seeding in the fall. The average total cost was $3

Table 7. COMMON RYE GRASS: METHOD OF STAND ESTABLISHMENT COMPARED WITH YIELDS, COSTS, AND RETURNS ON POORLY DRAINED AND WELL DRAINED VALLEY SOILS
(Willamette Valley, Oregon, 1948)

Method of stand establishment	Number of fields	Clean seed per acre	Costs per acre		Net returns per acre
			Total	Net	
		Pounds			
Plowed and seeded in fall	9	574	$28	$26	$19
Plowing done for previous crop, seed in fall	12	443	25	22	11
Summer-fallowed one season prior to seeding	3	678	47	45	6

per acre more where plowing was done, not only as a result of the extra one-half plowing charge but also as a result of harvesting and handling costs for the additional seed. The extra seed obtained, however, was worth the added costs involved. The net return per acre was $8 greater where land was fall-plowed instead of just disked.

Only three fields in the study were summer-fallowed one season before seeding. The average yield was greater by about 100 pounds of seed than it was for the best of the other two methods. All three summer-fallowed fields yielded about the same amount. This system was costly, however, not only because of the extra cultivations involved and the extra seed, but because the land was idle one year. The net return under this system was only $6 per acre. In addition, returns for one year's use of the land were lost.

Figure 2. Swathing common rye grass on poorly-drained valley soil. All fields of this grass seed in the study were swathed before being combined. Note the characteristic level terrain and the large fields.

Perennial rye grass

All producers of this grass seed do not follow the same procedure in establishing a stand. The four distinct methods used are shown in Table 8. The average yield the first year after establishment was about the same for all methods except where the plowing was done for the previous crop and the crop was seeded after a fall disking. The average yield was somewhat lower in this case.

The summer-fallow method was the most expensive followed by the system of fall or spring plowing and seeding in the spring. The average total cost was lowest where the crop was seeded in the fall

Table 8. PERENNIAL RYE GRASS: METHOD OF STAND ESTABLISHMENT COMPARED WITH YIELDS, COSTS, AND RETURNS, ON POORLY DRAINED AND WELL-DRAINED VALLEY SOILS
(Willamette Valley, Oregon)

Method of stand establishment	Number of fields	Time required to establish	Clean seed per acre at first crop	Cost of establishment per acre[1]	
				Total	Net
		Years	*Pounds*		
Seed grass with nurse crop in spring	7	1.0	495	$17	$—17
Plowing done for previous crop, seed alone in fall	9	.1	367	8	8
Plow in fall or spring, seed alone in spring	10	1.0	475	15	13
Summer-fallow one season prior to seeding alone in fall	14	1.1	504	22	21

[1]1948 price level.

following the disking. This was true not only because half the plowing charge was foregone but because there was no land charge since a crop was produced the first year on most fields. At least a year was required to establish a crop by the three other methods. Most fields that were summer-fallowed were seeded in the fall.

Over a period of three years the nurse crop method appears to be superior to the other methods. Perennial rye grass grows rapidly and consequently becomes established quite well in competition with the nurse crop. Since it is vigorous the yield is not greatly reduced by the nurse crop. In addition an income is obtained from the land during the year of establishment.

Chewings fescue

The most common method used in seeding Chewings fescue on hill soils was with a nurse crop (Table 9). This was true on well-drained valley soils as well. Most farmers seeding with a nurse crop summer-fallowed prior to seeding in the fall. It required two years in most cases to establish a crop under this method, but the farmers using it obtained income from the nurse crop in one year of the establishing period. An average net return of $7 per acre was

realized in establishing the stand under this system rather than a net cost being incurred.

Two years were required to establish a stand under the summer-fallow method. The average net cost was $39 per acre. However, the average yield under this method was 122 pounds of clean seed per acre higher for the first crop than under the nurse-crop method. This additional yield for the first crop nearly paid for the extra cost involved and the absence of income from the nurse crop. The average was higher for the second crop as well, although the difference was not so great. Information beyond the second crop is not complete although there is an indication that the yields tend to come in line with each other.

In experiments by the Farm Crops Department, Oregon State College, the yields were lower under the nurse-crop system during the entire life of the stand. These experiments were conducted on well-drained valley soil. Soils may have made a difference or farmers may have partly counteracted the effect of the nurse crop by varying other practices which would not be done in a controlled experiment. In any event, the practice of seeding Chewings fescue with a nurse crop is to be questioned because of the possibility of low yields of grass seed throughout the life of the stand.

The third practice was to seed the grass seed alone in the spring

Table 9. CHEWINGS FESCUE: METHOD OF STAND ESTABLISHMENT COMPARED WITH YIELDS, COSTS, AND RETURNS ON HILL SOILS

(Willamette Valley, Oregon)

Method of stand establishment	Number of fields	Time required to establish	Clean seed per acre at first crop	Cost of establishment per acre[1]	
				Total	Net
		Years	*Pounds*		
Seed grass with nurse crop (mostly in fall)	18	1.9	205	$34	$—7
Plow in fall or spring, seed alone in spring	8	1.2	238	32	30
Summer-fallow one season prior to seeding alone in fall	9	2.0	327	45	39

[1]1948 price level.

after the land had been fall or spring plowed. This appeared to be a good method where the land was free of weeds and foreign grasses. The average yield for the first crop was not as high as under the summer-fallow method, but in subsequent years the yields came into line with each other. The great advantage over the summer-fallow method was that the stand was established in most cases in one season instead of two. There was a little more income to be gained by shortening the growing period one year by the above practice than from the additional yield obtained through summer-fallowing one extra season. If the land is very grassy, however, it will be necessary to summer-fallow before planting to Chewings fescue.

Practically no Chewings fescue was seeded in the fall by itself. This method, if used on land free of grass, may be considered as desirable as the method of seeding the grass alone in the spring.

Alta fescue

More diverse methods were used to establish Alta fescue than any other grass seed studied. At least five distinct methods are shown in Table 10. Two methods involve the use of nurse crops either seeded or from volunteer seed. In one method the land is

Table 10. ALTA FESCUE: METHOD OF ESTABLISHING SOLID STANDS ON ALL SOIL CLASSES COMPARED WITH YIELDS, COSTS, AND RERURNS

(Willamette Valley, Oregon)

Method of stand establishment	Number of fields	Time required to establish	Clean seed per acre at first crop	Cost of establishment per acre[1]	
				Total	Net
		Years	*Pounds*		
Seed grass with nurse crop in fall:					
Not summer-fallowed	12	1.2	238	$21	$—15
Summer-fallowed	10	1.9	309	40	7
Plow and seed in fall	8	.9	334	25	19
Plowing in fall or spring and seeding in spring	22	1.1	337	29	27
Summer-fallow one season prior to seeding	15	1.8	485	45	41

[1]1948 price level.

plowed and the nurse crop and grass seed are seeded in the fall. Most fields were established in one year under this method and a valuable crop obtained in the process. An average net return of $15 per acre was realized over and above the cost of establishment and handling the nurse crop. The big disadvantage of the method was that the yields were low not only the first year but in subsequent years.

In the other method involving a nurse crop the land was summer-fallowed before the seeding took place in the fall. Two years were required on all but one farm to establish a stand under this system—one year for summer-fallowing and one year for the nurse crop and grass. The nurse crop defrayed most of the cost of establishment so the average net cost was only $7 per acre. The average yield was somewhat higher under this system than under the nurse-crop, no summer-fallowing method.

It took nearly two years to establish the crop where the land was summer-fallowed one season before seeding the grass alone. The net cost of establishment was high under this system—$41 per acre—since there was no nurse crop to help bear the heavy cost. The yields obtained throughout the life of the crop, however, were much higher than under the summer-fallow, nurse crop method. It was high enough to more than pay for the loss of the nurse crop.

The other two systems, seeding grass alone in the fall and seeding grass alone in the spring, were quite similar in desirability. Satisfactory yields were obtained for the first crops, and the yields of the second crops were about the same as for the summer-fallow method. The advantage of this method was that most stands were established in one year.

Study of returns and costs over a period of four to five years indicate that the last two methods, seeding the grass alone in the fall or in the spring, were most profitable. Where the land is moderately infested with grass and weeds, the spring seeding is probably preferred since it will allow the late fall and early spring weeds to be destroyed. More farmers used this method than any other. Where the land is relatively clean, the grass may get a more vigorous start if seeded in the fall. If the land is very foul of grass the summer-fallow method must be used. Seeding Alta fescue with a nurse crop, with or without summer-fallowing, does not appear to be as profitable over a period of four to five years as the other methods discussed.

Highland bentgrass

Farmers did not seed Highland bentgrass to establish it for seed production in the area studied. In fact in the hill soil section of Marion County farmers fought it as a weed for a few years before

they started cultivating it. The heaviest establishment was on some of the more run-down soils. Farmers in the area can tell interesting stories of how they capitalized on a seemingly impossible situation. It took a few years to find out how to handle the grass most advantageously.

When a field becomes badly infested with the grass a farmer may decide to cultivate it instead of fight it. The general procedure is to rough plow the land and work it down lightly. Sometimes a season is lost in establishment but usually not. Many farmers say that the stand should be renovated every three or four years by another plowing, although this practice has not been adopted by all farmers in the few years that the crop has been cultivated.

1948 Cost and Returns

Once the perennial grasses are established, the major portion of the work is in harvesting the seed. Nearly all the grass seeds were harvested with combines. Very few fields were harvested by binding and shocking the grass and threshing the seed with a stationary machine. Most combines were operated by two men—even when self-propelled combines were used. In a few cases one man operated the combine with a tank storage. Some men were thinking of this procedure in further reducing labor costs, but most likely would not attempt it until their combines were worn out. Others were skeptical of the idea since few, if any, seed cleaners were set up to handle bulk seed. The seed had to be sacked anyway.

For the most part, equipment costs were from the use of tractors and combines. Of less importance were truck and fertilizer-spreader costs. Fertilizer, field and seed sacks made up most supply costs. Other costs were seed cleaning and testing, taxes and interest on land, and stand depreciation.

This last item varied with the method of establishment as is apparent from the previous discussion. Often, where a nurse crop was planted with the grass seed, the nurse crop more than paid the cost of establishment. In these cases the crop produced was credited with its proportionate share of the establishment profit. For example, if a nurse crop was used and the net return from establishment was $16 per acre, then if the field was expected to stay in production four years, the stand depreciation would be a minus $4 per acre for 1948. This procedure made a more nearly fair comparison between fields with high establishing costs and high yields and fields with low establishing costs and low yields.

Itemized costs of production can be found in Appendix Tables 21 to 25.

Explanation of costs not included

Total costs include all direct expenses incurred in raising and delivering the seed to the cleaner. They do not include a charge for the time the labor force was not fully occupied such as during the winter months. No charge was made to the grass seed for land and buildings not fully used but which were taxed and had to be maintained; moreover, minor items of expense such as telephone charges and office expenses were ignored. Analysis of a sample of these farms in greater detail showed that taking the study as a whole, these overhead costs would most likely amount to $2 to $3 per acre on the average.

Common rye grass

Common rye grass seed is an annual crop and therefore must be established each production year. For that reason more labor is required to produce a crop than for perennial rye grass seed. An average of nearly 5 hours of labor per acre was required to produce the 1948 crop (Table 11).

Although labor costs were nearly the same on well-drained valley soils and poorly drained valley soils, most other costs were higher on the well-drained valley soils. Land charges were greater on the higher-valued, well-drained soils. Credits for vetch and grain screening, hay, straw and pasture were small as an average on both soil classes. Both higher costs and higher yields were found on the well-drained soils.[1] The higher yields, however, were not high enough to completely offset the greater cost, since common rye grass is not a high-priced seed. The net return per acre was $11 on well-drained valley soils compared with $14 per acre on poorly drained valley soils.

The fact that the net returns were higher on poorly drained valley soils does not of itself explain why common rye grass seed is produced mainly on these soils. The difference between soil groups in net returns was not significant. Of prime importance is the fact that the well-drained soils are better adapted to other, more profiable crops. A farmer on poorly drained soils has no such wide selection of crops he can grow profitably.

Perennial rye grass

As in the situation for common rye grass seed, the costs were higher in producing perennial rye grass on the better-drained soils than on the poorly drained valley soils (Table 11). Farmers on the

[1]The yields reported in this study are higher than those shown in crop statistics. There is likely some bias in farmers insisting on talking about the better fields. More important is the fact that no volunteer seeded fields were studied. Yields on fields of volunteer common rye grass are lower than on seeded fields.

Table 11. SUMMARY OF COSTS, YIELDS, AND RETURNS OF FIVE GRASSES GROWN FOR SEED IN THE WILLAMETTE VALLEY, OREGON, 1948[1]

Grass and soil type	Number of fields	Labor per acre	Costs per acre			Returns			
			Total	Less total net credits	Net cost of production	Clean seed per acre	Price per pound	Seed value per acre	Net returns per acre
		Hours				*Pounds*	*Cents*		
Common rye grass									
Well-drained valley soils	5	4.9	$38	$ 2	$36	615	7.6	$ 47	$ 11
Poorly drained valley soils	25	4.8	26	2	24	509	7.5	38	14
Perennial rye grass									
Well-drained valley and river-bottom soils	15	3.5	31	6	25	467	11.2	52	27[2]
Poorly drained valley soils	28	2.5	21	1	20	340	9.0	31	11
Chewings fescue									
Well-drained valley soils	17	4.3	42	7	35	290	35.2	102	67
Hill soils	37	4.8	40	7	33	252	35.4	89	56
Alta fescue									
Well-drained valley and river-bottom soils (solid seedings)	28	4.9	40	19	21	310	27.3	85	64
Poorly drained valley soils (solid seedings)	18	3.9	28	9	19	176	29.5	52	33
Hill soils (solid seedings)	30	4.5	37	15	22	322	28.8	93	71
Average for all solid seedings	....	4.4	35	14	21	274	28.5	78	57
Cultivated in rows in all soil types	9	11.8	71	11	60	626	31.3	196	136
Highland bentgrass									
Hill soils	21	3.2	28	3	25	164	52.2	85	60

[1]See Appendix Tables 21 to 25 for a more detailed classification.

[2]If price were adjusted to that received on poorly drained valley soils, the net return would be $17 per acre. Time of marketing rather than quality of seed accounts for the difference.

better-drained soils generally were more diversified and therefore could make better use of pasture and straw. During wet weather livestock do not mire so easily on well-drained soils.

As in the case of common rye grass seed, the average yield per acre was much higher on the better-drained soil. The difference, in fact, was greater than in the case of common rye grass. The average price received was much higher too—11.2 cents per pound compared with only 9.0 cents on poorly drained soil. Only a portion of the difference in price can be attributed to higher quality seed on the better-drained soils. Blind-seed disease caused the price of perennial rye grass to rise markedly during the year. It happened that more farmers on well-drained soils sold late. When an adjustment is made for this difference in price, the net returns per acre are more nearly in line with each other.

The explanation in the last paragraph on common rye grass seed above is also applicable in explaining why perennial rye grass is grown most commonly on poorly drained soil—a high alternative opportunity cost of well-drained soils.

Chewings fescue

There was marked similarity in costs of production in 1948 on well-drained valley and hill soils. The crop was harvested more

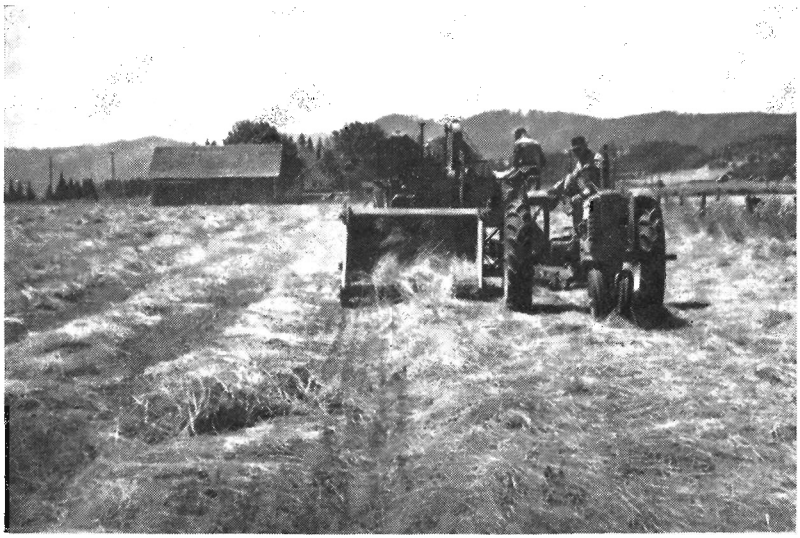

Figure 3. Combining perennial rye grass seed from the swath on well-drained valley soil. Most of this seed was harvested this way.

slowly than were the rye grasses and more fertilizer was applied. About four and one-half hours of labor per acre was required to handle the crop. Cleaning and testing seed accounted for nearly 30 per cent of the total cost. Total cost of production averaged little more than $40 per acre and the average net cost was nearly $35 per acre (Table 11). This grass was pastured a little more heavily than were the rye grasses.

The average yield per acre was a little higher on the well-drained valley soils than on the hill soils. The importance of getting a high yield of Chewings fescue is evidenced by the price received in 1948 —an average of 35¢ per pound. The net return above all costs, except those ignored overhead costs explained earlier in this section, was $67 per acre on well-drained valley soil and $56 per acre on hill soils.

Alta fescue

SOLID STANDS: Most of the Alta fescue seed produced in the Willamette Valley is grown in solid stands. It is grown in important quantities on all soil classes. The average yield in 1948 on hill soils was 322 pounds of clean seed per acre. The average yield was slightly less on river-bottom and well-drained valley soils, but the average yield on poorly drained valley soils was only 176 pounds per acre (Table 11).

Coincident with lower yields on the less valuable, poorly drained valley soils, were lower costs for most items of expense. The average total cost of production per acre on poorly drained valley soils was about three-fourths the cost on either of the other two soils, but the yield was only a little more than one-half as great.

Of the five kinds of grass seeds studied, none had as much value for uses other than grass seed as Alta fescue. Considerable pasture and hay were obtained from the solid seedings on well-drained soils —an average of $15 to $19 per acre. The net credits were less from poorly drained soils—$9 per acre. They were so much less that the net cost of production per acre was about the same for all soil classes, approximately $20 per acre.

With almost identical average net cost per acre on all soil classes, the much lower yield on poorly drained soils meant that the net return per acre was considerably lower there—$32 per acre compared with $64 for well-drained valley and river-bottom soils, and $71 for hill soils. It should not be concluded on the strength of these data that Alta fescue has no place on poorly drained valley soils. Comparison must be made of net returns on these soils for all kinds of grass seed.

PLANTINGS IN ROWS COMPARED WITH THOSE IN SOLID STANDS: Not only was the cost of establishment higher for row seedings but it cost more to produce the crop. Additional expense was involved in cultivating between the rows. Harvesting was a slower, more costly job. An average of 4.4 hours per acre of labor was required for all solid seeding compared with 11.8 hours per acre for the grass in rows (Table 11). More fertilizer was used on the row seedings and other costs were higher. The result was that the average total cost of production for the row plantings was double the average for solid stands.

Credits were important on row seedings. Most of it came from hay made after the seed was harvested. But the credits were not as large as they were for the solid stands. As a result, the net cost of production per acre was nearly three times that for solid stands.

On a per acre basis row seedings were the most expensive, but greater yields were obtained from the effort. Row seedings averaged 626 pounds of clean seed per acre compared with 274 pounds on solid stands.

The net cost per pound for row seedings was a little higher than it was for solid stands. Still there were two advantages of the row seedings. One was the fact there were more pounds of seed per acre. The other was that better quality seed was produced. Blue tag or first quality seed was produced on all but one of the fields. Row-seeded fields returned an average of three cents per pound more than solid stands. As a result the net return per acre was $136 for the fields cultivated in rows compared with $57 per acre for all solid stands.

Will drastic price declines force solid stands out of production before row seedings? At first observation of the data in Table 11 one would say that row seedings can weather price declines much better than those in solid stands since the average net return per acre was much higher for row seedings. If one reduces the prices shown in Table 11 by almost any constant amount down to the point where the average net return is zero, he finds that the relationship between net returns under the two systems is about the same.

This is explained by he fact that the average net return per pound was nearly the same under the two systems—20.9 cents per pound for solid stands and 21.7 cents per pound for row seedings. The row seedings were more profitable mainly because there were more pounds of seed per acre. Therefore, if the price fell 20.9 cents per pound, all the average net return under the solid stand system would be wiped out and only 0.8 cents per pound would remain under the row system, which would mean that for all practical purposes there was no net return there either.

One qualification should be made. It has been mentioned that the average quality of the seed produced in rows was better than that produced under solid stand. If such a large quantity of seed were produced to cause a large decline in price it is quite likely that there would be little market for any except first quality seed. Producers who cultivated the seed in rows would have a distinct advantage.

A moderate price decline could cause a heavy reduction of solid stand seedings but very little reduction in row seedings. Suppose there were a uniform decrease in the price of all grades of Alta fescue seed of 15 cents per pound. Assuming no change in cost, the average net return from all solid stands would be $16 per acre compared with $42 per acre for row seedings. Other competitive crops may return more than $16 per acre but less than $42 per acre. Then farmers with solid stands would be encouraged to plow up their fields but the grass in rows would be left.

Highland bentgrass

An average of 3.2 hours of labor per acre was required to handle the 1948 crop of Highland bentgrass (Table 11). Fertilizer was applied at a lower rate on this seed than on the fescues. About 30 per cent of the total cost was for seed cleaning. The total cost of production was $28 per acre. Credits for hay and pasture were small.

In 1948, there were short crops of Astoria bentgrass and most other grass seeds that compete in the market with Highland bentgrass. The average price received was 52.2 cents per pound and was much higher than had been anticipated earlier in the year. An average net return above all costs, except the minor overhead costs mentioned previously, was $60 per acre.

Variations in Yields and Net Returns

Up to this point data presented have been in terms of averages. There has been little or no discussion of the deviations from the averages. These deviations should be considered. The average is merely the best single figure representing the data. No farmer has exactly average costs and returns.

Yields

The yield of a particular crop varies a great deal from farm to farm. Where the average yield is high, as in the case of common rye grass seed, the yield variation is much greater in terms of pounds of seed than where the average yield is low, as in the case of Highland bentgrass.

The yield variation was of about the same magnitude for Chewings fescue, Highland bentgrass, and Common rye grass seeds when each yield variation was compared with its respective average. But the variation for Alta fescue in solid stands was very much wider. However, the variation was lower for Alta fescue cultivated in rows than for any of the grass seeds studied.[1]

In the production of Alta fescue (solid stand), it appears that there is a greater chance of excelling over one's neighbors than in other grass seeds. Conversely, there is a greater chance of not being able to do as well as one's neighbors. One important reason for this is the rapid decrease in yield with age for Alta fescue and the fact that the rate of decrease varies considerably from field to field according to physical factors and agronomic practices. It is important to know that this wide variation in yields for Alta fescue can be reduced very materially by row cultivation. The yield of Alta fescue in rows does not decrease over time as much as the yield of Alta fescue in solid stands.

Net returns

Like yields, net returns per acre vary considerably from field to field. They are influenced by many more factors than just yield alone and by factors that may influence both yield and net returns.

Low net returns per acre were realized from rye grasses and the absolute variations in net returns were small in comparison with the variations of other grass seeds (Table 12). The average deviations for Chewings fescue and Highland bentgrass were about the same.

The variations were much wider for Alta fescue (solid stands). It was especially wide on hill soils, the average deviation being $64 from an average of $79 per acre. On the other hand, the average deviation for row seedings, even considering all soil classes, was only $26 from an average of $133 per acre. This bears out the observation made in studying variation in yields. There is wide variation in net returns from Alta fescue (solid stands) but where the crop is handled in rows the variation is very materially reduced.

Influence of Price Changes

Assuming that cost relationships between the grasses studied here remain much the same, then price will have an important bearing upon the relative profitability of the grass seeds. For example, a rise in the price of one grass seed could be brought about by a

[1]See Appendix Table 26 for presentation of average deviations and coefficients of variation.

Table 12. VARIATIONS IN NET RETURNS FOR GRASS SEEDS BY SOIL CLASSES
(Willamette Valley, Oregon, 1948)

Grass seeds by soil classes	Net returns per acre[1]	Net returns average deviation
Common rye grass		
Poorly drained valley soils	$14	$ 9
Perennial rye grass		
Well-drained valley and river-bottom soils	26	16
Poorly drained valley soils	10	12
Chewings fescue		
Well-drained valley soils	64	29
Hill soils	55	24
Alta fescue (solid stand)		
Well-drained valley and river-bottom soils	59	42
Poorly drained valley soils	40	24
Hill soils	79	64
Alta fescue (rows)		
All soil classes	133	26
Highland bentgrass		
Hill soils	57	24

[1]Net returns are not weighted by number of acres in each field and therefore do not agree exactly with the average net returns shown in previous tables which are weighted averages.

shortage of a competitive seed produced in another region, even though there was a normal crop of the grass seed in question. In 1948 there were short crops of blue grass and red top, grown in the Mid-West, and Astoria and Seaside bentgrasses, grown in the Oregon coast counties. The price of Highland bentgrass was somewhat higher than expected in spite of a rather large crop. The other grass seeds studied were influenced only slightly by these short crops mentioned. On the other hand, a decrease in price could occur as a result of a surplus of a competitive seed.

Inauguration of an acreage control program by the government, wherein the "surplus" land would be planted to conserving crops could raise the price of the forage crop grasses (perennial and common rye grasses and Alta fescue) without directly affecting the price of lawn grasses (Chewings fescue and Highland bentgrass). It seems quite safe to say that barring a price-support program, there will likely be wide fluctuations from time to time in the relative price and profitableness of the various grass seeds.

Seed Selection for Specific Soil Classes

A farmer cannot change the soil on his farm to fit his whims or desires. He must organize his farm business in keeping with the kinds of soil that he has. There is always the problem of deciding which crops to grow. Grass seed farmers are interested in seeding their lands to the most profitable grasses. Absolute profitability is not the only thing to consider. Other things are: variations in profitableness, that is, can a farmer depend on getting a good crop if he seeds it? A second factor is the manner in which the crop fits into the farming program. Does the grass supply valuable supplemental feed? When must the seed be harvested? A third consideration is the effect of the crop on soil fertility. Will the soil be made more, or less, fertile by including the crop in the rotation? Each soil class will be discussed primarily from the point of view of profitableness of the grass seeds grown on it, although the other factors will be considered.

Well-drained valley and river-bottom soils

Table 13 summarizes the net returns per acre from each important grass seed grown on the different soil classes. All of the five grass seeds studied except Highland bentgrass are grown on well-drained valley or river-bottom soils. The average net return for both the rye grasses was much less than it was for the two fescues in 1948. Barring some drastic changes, it appears that farmers with the better-drained soils should not grow rye grass seeds as a general rule since they have better opportunities with the fescues.

An exception would be when a farmer has other important crops and does not want his land tied up long in perennial grasses. Common rye grass could be grown on a year to year basis in these cases but only as a special practice. Alta fescue works well on farms that keep livestock since it provides considerable feed and pasture in addition to grass seed.

Poorly drained valley soils

In 1948, the average net return per acre on poorly drained valley soils for Alta fescue seed (solid stand) was more than double the net returns on the rye grasses. This was true even though the poorly drained soils are considered the domain of the rye grasses. Other things must be considered than the average net returns. The variation in yield and net returns is greater on these soils for Alta fescue. The rye grasses are easier to handle and farmers have better chances of getting good crops. The market for the rye grasses is large and well-developed. Alta fescue is increasing in popularity, but if much

Table 13. NET RETURNS PER ACRE FOR GRASS SEEDS GROWN ON SPECIFIC SOIL CLASSES
(Willamette Valley, Oregon, 1948)

Kind of seed	Well-drained valley and river-bottom soils	Poorly drained valley soils	Hill soils
Common rye grass	$10[1]	$15	....
Perennial rye grass	27[2]	11	....
Chewings fescue	67[1]	....	$56
Alta fescue (solid stand)	64	32	71
Highland bentgrass	....	....	60

[1]All fields on well-drained valley soil.
[2]If price were adjusted to that received on poorly drained valley soils the net return would be $17 per acre.

of the land now devoted to rye grasses were planted to Alta fescue, the price of Alta fescue undoubtedly would decrease materially.

Farmers who grow Alta fescue on poorly drained soils usually devote a much larger acreage of land to the rye grasses. This diversification appears to be wise. In this manner a farmer still can devote some of his acreage to the more profitable crop without taking a heavy risk. He must, however, be careful that the Alta fescue does not become infested with the rye grasses. These grass seeds are not easily separated and a small percentage of rye grass seed greatly reduces the quality and price of Alta fescue.

Hill soils

Chewings fescue, Alta fescue (solid stand) and Highland bentgrass seeds were grown on hill soils. Very few rye grass fields were found on this soil. In 1948 the net return was high for all three kinds of seed. The average net return was highest for Alta fescue but the variations in yield and net return was widest for this grass seed.

Over a period of years it is doubtful if one could expect Highland bentgrass to be as profitable as the two fescues. The price was high in 1948 due to small crops of competitive grasses. Some farmers said they had expected about 35 cents per pound early in the 1948 season. If this had been the price, the net return would have been about $32 per acre rather than $60 per acre.

Many farmers on hill soils grow both Alta and Chewings fescue. This seems to be a good practice. If the relationship between the two grasses found in 1948 is considered typical, then the little higher average net return of the Alta fescue is offset, in part, by the smaller variability in yield and income of the Chewings fescue.

Factors Affecting Yield and Returns

It was found that high yields were associated with a high net return for all grass seeds. This is not to suggest that a farmer should aim at high yields of grass seeds regardless of cost. Under certain circumstances additional yield will be obtained at excessively high cost.

Method of stand establishment

In the section on stand establishment, the method of stand establishment was shown to be very important in influencing yields and net returns.

Age of stand

The age of the grass seed stand has an important influence on yield and net returns. The average yield for the second crop fields of perennial rye grass seed in 1948 was somewhat lower than for the first crop fields (Table 14). The average fertilizer application was higher the second year and the average net return per acre was much smaller.

In the case of Alta fescue (solid stand) a more striking difference in yield was observed between the first and second year's crop. Furthermore, the average yields for subsequent crops were consistently lower, even though average fertilizer applications were

Figure 4. Alta fescue on hill soils ready to combine. About one-half of the fields were harvested standing. Chewings fescue in background.

Table 14. AGE OF CROP COMPARED WITH YIELD, FERTILIZER APPLICATION, AND NET RETURNS BY GRASS SEEDS[1]
(Willamette Valley, Oregon, 1948)

Item	Age of crop			
	First crop	Second crop	Third crop	Fourth crop or more
Pounds of clean seed per acre				
Perennial rye grass	384	295	.....	.....
Chewings fescue	270	310	256	257
Alta fescue (solid stand)	488	303	251	164
Pounds of nitrogen and P_2O_5 per acre				
Perennial rye grass	20	28	.....	.....
Chewings fescue	58	47	56	80
Alta fescue (solid stand)	43	49	56	45
Net returns per acre				
Perennial rye grass	$ 17	$ 5	.....	.....
Chewings fescue	56	64	$62	$47
Alta fescue (solid stand)	114	66	38	30

[1]Soil classes are as follows: Perennial rye grass, poorly drained valley; Chewings fescue, well-drained valley and hill soils; Alta fescue, all classes except poorly drained valley.

a little higher for the second and third crops. The average rate of application did not increase beyond the third year but old fields receiving heavy applications of fertilizer showed only moderate yields. The net return per acre fell off very rapidly with increase in the age of the stand.[1]

Of the nine fields of Alta fescue seeded in rows, seven were considered by farmers to have "indefinite" life. In other words, they observed little decrease in yield as the stands became older. Studies by the Farm Crops Department, Oregon State College, show some reduction in yield as the stands become older, although not at the same rate of reduction experienced on solid stand plantings. This shows an important advantage of the row cultivation system. Furthermore the average yield in rows was about double the average yield in solid stands.

Some farmers have combined the advantages of both systems, i.e., the low cost of the solid seeding system and the consistently higher yields of the row system. They do this by establishing the

[1]The Alta fescue average yield for the first crop fields in 1948 was higher than normal due to a bias, method of establishment. A higher proportion of these fields than normal was established by the better methods which resulted in a high yield. However, when an adjustment is made for this bias, the general relationships shown in Table 15 still persisted.

stand on the solid seeding basis, harvest the first crop, which has a high yield, and then cultivate the stand into rows for subsequent crops. A rotary-type tiller generally is used for this operation.

The situation for Chewings fescue was much different. The average yield for the second crop fields was a little higher than for the first crop fields. The yields for the third and subsequent crops fell off quite slowly. Fertilizer application and net returns varied very little for the first three years. Beyond the third crop the average rate of application was increased and the net returns per acre fell.

From the above it appears that a stand of perennial rye grass seed cannot be left long because of decreasing yield and low price which will bring a low margin of net returns. There may be a fairly good net return for Alta fescue (solid stand) in spite of the decreasing yield over time, but a farmer is foregoing considerable net return by leaving the stand long. Under the relationship found in 1948 it would be to his advantage to plow or renovate the crop after the second crop, most certainly after the third crop, unless some unusual situation exists. A tendency for early sod binding is a major reason Alta fescue yields decrease as the stands become older. Alta fescue seeded in rows has a much longer, profitable life because there is not such a tendency for sod binding.

Sod binding is a much smaller problem for Chewings fescue. It is hard to tell how long a stand may be maintained profitably. The data presented above indicate that older stands require higher applications of fertilizer. Over a long period of time occasional renovation may be more profitable than heavy fertilizer applications every year when the stand is old.

Fertilizer application

Unfortunately, the effect of varying fertilizer applications on different grass seeds could not be measured completely by the survey procedure in spite of rather extensive data. The experimental techniques of the soils man and the agronomist likely would be more fruitful. An insufficient number of observations were available to isolate satisfactorily the effect of these variables. However, a few general observations were made.

As shown in Table 14, fertilizer was applied at a higher rate on the fescues and even Highland bentgrass than on the rye grasses. This does not mean that the rye grasses do not respond to fertilizer as readily as the other grass seed. In fact, just the opposite seems to be the case. But the value of the products received is a very important thing to consider. For example, suppose 100 pounds of

ammonium sulphate (20 per cent nitrogen) costing $3.25 were applied to both common rye grass seed and Chewings fescue. Assume the additional yield due to the fertilizer was 100 pounds of seed for common rye and 50 pounds for Chewings fescue. At 7.5 cents per pound the additional production of common rye grass seed would be worth $7.50 while at 35 cents per pound the Chewings fescue seed would be worth $17.50. This does not consider costs in addition to the fertilizer itself.

Only two-thirds of the common rye grass fields received any fertilizer and 100 pounds of ammonium sulphate was the common rate of application. It appeared that farmers felt that at the present price relationship another 100 pounds or more would not be applied profitably. On the other hand, nearly all farmers applied fertilizer on the Alta and Chewings fescues. Both extremes in rate of application were found. Some farmers could undoubtedly apply more than they did and profit by it. Others appeared to have used it excessively, especially when they made heavy applications to sod-bound Alta fescue fields.

The importance of price received for the crop in determining how much fertilizer a farmer can afford to apply can be illustrated another way. Suppose a farmer wants to know whether it would pay to apply another 100 pounds per acre of ammonium sulphate costing $68 per ton to his grass seed field. Under the cost-price relationships prevailing in 1948, Table 15 shows the pounds of each kind of seed he must expect in order to pay for the application.

Other things than the actual cost of the fertilizer must be considered. The seed must be sacked, hauled, and cleaned. A seed sack must be provided. The combine can not move quite so fast in heavy foliage and thus heavier labor and equipment expenses are required. If the operator regularly makes some applications of fertilizer each year, then he may apply the extra 100 pounds by simply spreading it at a heavier rate. This is less costly than where an extra spreading is required. The 1948 study showed that it cost an average of $1 per acre to spread one application of fertilizer, not considering the cost of the fertilizer itself or the additional harvest costs.

Under the conditions specified it would require 53 pounds of common rye grass seed to pay for the application of 100 pounds of ammonium sulphate, 20 per cent nitrogen, when an extra operation was not required to spread it. It would require 41 pounds of perennial rye grass seed, 11 pounds of Chewings fescue seed, 14 pounds of Alta fescue (solid stand) seed and 7 pounds of Highland bentgrass seed. Where the fertilizer was applied in a separate operation, 65

Table 15. ESTIMATED ADDITIONAL POUNDS OF SEED PER ACRE REQUIRED TO PAY FOR THE APPLICATION OF 100 POUNDS OF FERTILIZER[1]

(Willamette Valley, Oregon, 1948)

Grass seed	Price of seed per pound	Additional seed per acre required to pay for 100 pounds of fertilizer[1]	
		By increasing the amount applied at usual time of fertilization	Making an extra operation with fertilizer spreader
	Cents	*Pounds*	*Pounds*
Common rye grass	7.5	53	65
Perennial rye grass	9.3	41	52
Chewings fescue	35.3	11	14
Alta fescue (solid stand)	28.5	14	17
Highland bentgrass	52.2	7	9

[1]Fertilizer: Ammonium sulphate, 20 per cent nitrogen at $68 per ton. Seed prices: Average of 1948 study.

pounds of common rye grass seed, 52 pounds of perennial rye grass seed, and so forth, were required to pay for the fertilizer.

As explained before, the rye grasses seem to respond to fertilization more readily than do most other grass seeds. But the response of other, higher priced, grass seeds need not be anywhere nearly so great under the conditions found in 1948. This explains further why farmers fertilized the high price grass seeds much heavier than the rye grasses.

Fertilizer should be applied with full consideration of the condition of the stand in addition to the price of the seed. In fact, it might be wise to make heavier rates of application on young, well-established stands that will respond to fertilizer readily rather than to try to combat decreasing yields on old stands by increasing the rate of fertilization.

Method of harvesting crop

All common rye grass fields were swathed and combined from the windrow (Table 16). All but three perennial rye grass fields were handled the same way. These three fields were combined standing. About an equal proportion of the Chewings fescue fields were (1) combined from the swath and (2) combined standing. The same was true from Alta fescue (solid stand) on well-drained soils except that seven fields were harvested with binders and stationary

Figure 5. **Combining standing Chewings fescue seed on hill soils. About one-half of the fields in the study were combined standing.**

threshers. Most Alta fescue fields on poorly drained valley soils were combined from the swath. Two-thirds of the Highland bentgrass fields were harvested that way. Five of the nine Alta fescue fields in rows were combined standing. This is contrary to the procedure in eastern Oregon where most row plantings are bound and threshed by a stationary machine.

It appears that there was very little difference in labor expended per acre under the two prevalent methods of harvest. Swathing was usually done quite rapidly with 7½-foot-cut mowers, whereas few combines cut swaths that wide. Then too, some seed combined standing had to be stirred to prevent heating although there were some areas in the valley where this was not necessary in 1948. One of these areas was in Marion County.

The average yield was highest on the Alta fescue (solid stand) fields that were harvested standing. Other influences, such as age of crop, make it difficult to conclude from these data that higher yield was due to harvesting the crop standing. It is contended that there is less loss from shattering by binding the grain and threshing at a sta-

Table 16. METHOD OF HARVESTING GRASS SEEDS, BY NUMBERS OF FIELDS
(Willamette Valley, Oregon, 1948)

Grass seed	Fields swathed and combined	Fields combined standing	Fields shocked and threshed
Common rye grass			
Poorly drained valley soils	25	0	0
Perennial rye grass			
Poorly drained valley soils	25	3	0
Chewings fescue			
Well-drained valley and hill soils	27	25	2
Alta fescue (solid stand)			
River-bottom, well-drained valley and hill soils	25	26	7
Poorly drained valley soils	12	4	2
Alta fescue (rows)			
All soils	3	5	1
Highland bentgrass			
Hill soils	13	7	1

tionary thresher. Some also think that a little less shattering is caused by combining the fescues standing. This study cannot test these statements, but it is very important to lose little of the fescues and bentgrass seeds since they are high value crops.

Rate of pasturing

ALTA FESCUE ON WELL-DRAINED SOILS: Strong talking points for growing Alta fescue are that much pasture and hay are supplied in addition to the grass seed. Every grower of Alta fescue does not pasture it. The fields may not be readily accessible to livestock on some farms. Possibly a more important reason is the fact that some farmers fear the yield of seed will be reduced and the land fouled with weeds by grazing.

There was no grazing of twenty-five fields on well-drained soils between the 1947 and 1948 seed crops (Table 17). Twenty-two fields were grazed moderately—from 1 to 89 animal-unit (one cow or five sheep equivalent) days per acre. Ten fields were grazed heavily at an average of 176 animal-unit days per acre. Most fields that were not grazed between the 1947 and 1948 crops also were

Table 17. RATE OF PASTURING ALTA FESCUE (SOLID STAND) COMPARED WITH OTHER FACTORS

Fall and Spring Grazing Between 1947 and 1948 Crops on River-Bottom, Well-Drained Valley, and Hill Soils

(Willamette Valley, Oregon)

Item	Animal unit days grazing per acre in 1948		
	None	1 to 89	90 and over
Average animal unit days grazing	.....	49	176
Number fields	25	22	10
Average number seed crops harvested	3.0	2.5	2.7
Average number seed crops pastured	.4	2.0	2.5
Pounds nitrogen and P_2O_5 per acre	32	65	52
Estimated value pasture per acre	.....	$6	$22
Value hay and screenings per acre	$11	$10	$23
Pounds clean seed per acre	281	351	379
Net returns per acre	$50	$75	$101

not grazed in previous years. Conversely, most fields grazed in 1947-48 were grazed previously.

The feed obtained by the livestock was rated by farmers as being light, medium, or heavy. Values of 9, 11, and 15 cents respectively per animal-unit day were assigned to these ratings. At these rates the pasture was valued at $6 per acre on moderately grazed fields and $22 per acre on heavily grazed fields.

Pasture was not all that was obtained. The average value of hay and screenings (mostly hay) was about $10 per acre both where no grazing and moderate grazing was done. It averaged $23 per acre where the fields were heavily grazed. One cannot conclude from these data that the higher value of hay on the heavier grazed fields was due to the heavier grazing. It can be pointed out that the heavy grazing probably did not prevent one from getting a large hay crop.

It will be observed that the average yield of seed increased from low to high rates of grazing. It is doubtful if much of the difference

is due to grazing itself. Age of crop and fertilizer application affect the yield, although Table 17 shows very little difference in age of crop. The average price received for the seed was a little less where grazing was heavy, but the difference was not significant.

The main point brought out is not that grazing increases the hay and seed obtained from the Alta fescue stands but that, if properly done, it does not materially reduce it. Farmers are also encouraged to graze and cut hay from fields with heavy foliage. Agronomists strongly warn against grazing any grass for seed after the seed shoots start growing in the spring.

ALTA FESCUE ON POORLY DRAINED SOILS: Alta fescue on poorly drained valley soils is not grazed heavily. There is less feed on these fields and the livestock trample the land in wet weather.

OTHER GRASSES: About two-thirds of the Chewings fescue fields on well-drained soils were grazed. The rate of grazing was considerably lower than for Alta fescue on the same soil. Like Alta fescue there seemed to be anything but ill effect to seed yield from grazing. The same thing can be said for the other grasses. It is likely that the rate of grazing was less on these grasses, not so much because of fear of damage to the seed crop as that they provided less forage.

Removal of straw

Farmers are not in agreement on the method of disposing the grass straw. All know that straw has fertilizer value. Nevertheless, some feel that the yield is reduced by leaving it on the field.

Some farmers go to the expense of removing the straw from the field. On some farms the straw is burned after removal. Other farmers haul it off for livestock bedding. Where the straw has feed value, as in the case of properly handled Alta fescue straw, it may be baled and fed to livestock on the farm or sold to other farmers. Where straw is used for hay it should be baled as soon as possible after the seed is harvested. The hay quality rapidly deteriorates if the straw is left in the swath.

Some farmers prefer to remove the straw rather than to burn it on the field. It is argued that burning kills the grass. Weeds and other grasses may take the place of the killed grass and reduce the yield and quality of the seed. Not all farmers are of this opinion. Nearly all agree that if burning is to be done, it must be done with a "hot, fast fire." The straw should not be in heavy piles which will burn long and destroy the grass. At the present time it is advised to burn over perennial rye grass fields that are in Blind Seed disease areas. Burning is advocated sometimes on fields infested by nematode and sod web-worm or other insects.

Burning fields was not a common practice on all kinds of grasses at the time of this study, so the practice cannot be fully analyzed. It was most prevalent on Chewings fescue. In fact, the straw was left on only four of 44 two-year or older stands. Ten fields were burned and the straw was removed from 30 fields. The average yield was a little higher where the straw was removed than where it was burned, but the cost of removal just about compensated for the difference.

For other grass seeds, the average yield was somewhat higher where burning took place. Again, it must be pointed out that observations were too few to approve definitely of burning. Some agronomists advocate removing the straw from the field for sanitary purposes, that is, to discourage rodents, insects, and diseases. If the straw can be taken off and used for fertilizer on other farm crops after it decomposes, the fertility has not been lost. Those grasses which have heavy rooting systems do not need the straw for organic matter and fertility can be supplied by commercial fertilizers.

Until better information is available through agronomic experiments, it appears that burning should be done with caution or limited to disease and insect control measures. Where the land is clean and the straw is not removed, a higher fertilizer application should be made in order to decompose the straw and provide fertility to the grass crop at the same time.

APPENDIX

In the following Appendix tables, all costs are based on the 1948 price levels.

Total costs include all direct expenses incurred in raising and delivering the seed to the cleaner. They do not include a charge for the time the labor force was not fully occupied, such as during the winter months. No charge was made to the grass seed for land and buildings not fully used but which were taxed and had to be maintained. Also, minor items of expense such as telephone charges and office expenses were not included. These overhead costs would likely amount to an average of $2 to $3 per acre.

The data listed under *Average for all soil classes* are adjusted for the fact that some soils were sampled more heavily than others. They are influenced by a few records taken on other kinds of soils than those shown here. Adjustment also is made for the average size of the fields.

Table 18. COST OF ESTABLISHING STANDS OF PERENNIAL RYE GRASS PER ACRE BY ITEMS OF EXPENSE

(Willamette Valley, Oregon, 1948 price level)

Item	Well-drained valley and river-bottom soils	Poorly drained valley soils	Average for all soil classes
Number of fields	15	28	....
Acres studied per field	32	59	56
Hours of labor per acre	2.6	2.8	2.8
Expenses per acre			
Labor	$ 3.00	$ 3.20	$ 3.20
Tractor	$ 1.60	$ 1.90	$ 1.90
Other equipment	1.10	1.70	1.60
Total equipment costs	$ 2.70	$ 3.60	$ 3.50
Fertilizer	$ 1.70	$ 1.60	$ 1.70
Seed	2.10	2.30	2.30
Total supply costs	$ 3.80	$ 3.90	$ 4.00
Taxes on land	$ 1.00	$ 1.10	$ 1.10
Interest on land at 4 per cent per year	4.40	3.70	3.60
Total land charge	$ 5.40	$ 4.80	$ 4.70
Total costs	$14.90	$15.50	$15.40
Less total net credits	5.60	3.20	3.40
NET COST OF ESTABLISHMENT	$ 9.30	$12.30	$12.00

Table 19. COST OF ESTABLISHING STANDS OF CHEWINGS FESCUE PER ACRE BY ITEMS OF EXPENSE

(Willamette Valley, Oregon, 1948 price level)

Item	Well-drained valley soils	Hill soils	Average for all soil classes
Number of fields	16	37	....
Acres studied per field	29	24	26
Hours of labor per acre	2.4	5.6	4.2
Expenses per acre			
Labor	$ 2.80	$ 7.10	$ 5.20
Tractor	$ 1.60	$ 3.30	$ 2.50
Other equipment	1.30	2.00	1.70
Total equipment costs	$ 2.90	$ 5.30	$ 4.20
Fertilizer	$ 2.20	$ 4.00	$ 3.20
Seed	4.80	5.10	4.90
Spray	.30	.10	.20
Total supply costs	$ 7.30	$ 9.20	$ 8.30
Taxes on land	$ 2.20	$ 2.70	$ 2.50
Interest on land at 4 per cent per year	8.00	9.30	8.80
Total land charge	$10.20	$12.00	$11.30
Total costs	$23.20	$33.60	$29.00
Less total net credits	25.70	25.80	25.50
NET COST OF ESTABLISHMENT	$—2.50	$ 7.80	$ 3.50

Table 20. COST OF ESTABLISHING STANDS OF ALTA FESCUE PER ACRE BY ITEMS OF EXPENSE

(Willamette Valley, Oregon, 1948 price level)

Item	Solid seedings				Cultivated in rows (all soil types)
	Well-drained valley and river-bottom soils	Poorly drained valley soils	Hill soils	Average	
Number of fields	27	18	30	.....	9
Acres studied per field	14	24	19	19	12
Hours of labor per acre	4.8	2.6	5.1	4.2	21.1
Expenses—per acre					
Labor	$ 6.40	$ 3.60	$ 6.30	$ 5.50	$21.10
Tractor	$ 2.80	$ 1.80	$ 2.90	$ 2.50	$ 4.70
Other equipment	1.80	1.50	1.90	1.80	2.80
Horse work	.....	.....	.....	.....	.20
Total equipment and horse costs	$ 4.60	$ 3.30	$ 4.80	$ 4.30	$ 7.70
Fertilizer	$ 2.50	$ 1.00	$ 4.80	$ 3.00	$ 7.20
Seed	5.60	5.60	6.50	6.00	2.40
Other supplies	.10	.30	.....	.10	.40
Total supply costs	$ 8.20	$ 6.90	$11.30	$ 9.10	$10.00
Taxes on land	$ 2.30	$ 1.00	$ 2.50	$ 2.00	$ 2.60
Interest on land at 4 per cent per year	10.10	3.70	8.50	7.40	12.50
Total land charge	$12.40	$ 4.70	$11.00	$ 9.40	$15.10
Total costs	$31.60	$18.50	$33.40	$28.30	$53.90
Less total net credits	16.60	12.90	20.50	17.10	3.20
NET COST OF ESTABLISHMENT	$15.00	$ 5.60	$12.90	$11.20	$50.70

Table 21. COST OF PRODUCING COMMON RYE GRASS PER ACRE BY ITEMS OF EXPENSE

(Willamette Valley, Oregon, 1948)

Item	Well-drained valley soils	Poorly drained valley soils	Average for all soil classes
Number of fields	5	25	....
Acres studied per field	50	57	56
Pounds clean seed per acre	615	509	535
Hours labor per acre	4.9	4.8	5.0
Expenses per acre			
Labor	$ 6.20	$ 5.50	$ 5.80
Tractor	$ 2.30	$ 2.00	$ 2.10
Truck	.10	.10	.10
Other equipment	3.50	2.80	3.00
Total equipment costs	$ 5.90	$ 4.90	$ 5.20
Fertilizer	$ 5.00	$ 2.60	$ 2.90
Seed	1.20	1.70	1.60
Sacks	2.70	2.20	2.40
Spray	.40	.10	.10
Total supply costs	$ 9.30	$ 6.60	$ 7.00
Seed cleaning and testing	$ 3.10	$ 2.40	$ 2.70
Taxes on land	2.90	1.30	1.50
Interest on land at 4 per cent	10.10	5.50	6.00
Total costs	$37.50	$26.20	$28.20
Less total net credits	1.20	2.60	2.40
NET COST OF PRODUCTION	$36.30	$23.60	$25.80
Total cost per pound	6.1¢	5.1¢	5.2¢
Net cost per pound	5.9¢	4.6¢	4.8¢
Price received per pound	7.6¢	7.5¢	7.5¢
NET RETURN PER ACRE	$10	$15	$15

Table 22. COST OF PRODUCING PERENNIAL RYE GRASS PER ACRE BY ITEMS OF EXPENSE

(Willamette Valley, Oregon, 1948)

Item	Well-drained valley and river bottom soils	Poorly drained valley soils	Average for all soil classes
Number of fields	15	28	....
Acres studied per field	32	59	56
Pounds clean seed per acre	467	340	358
Hours of labor per acre	3.5	2.5	2.6
Expenses per acre			
Labor	$ 4.00	$ 2.80	$ 2.90
Tractor	$ 1.00	$ .70	$ .70
Truck	.10	.10	.10
Other equipment	2.40	2.10	2.10
Total equipment costs	$ 3.50	$ 2.90	$ 2.90
Fertilizer	$ 7.00	$ 3.70	$ 4.00
Sacks	2.50	1.50	1.60
Total supply costs	$ 9.50	$ 5.20	$ 5.60
Seed cleaning and testing	$ 2.40	$ 1.50	$ 1.60
Taxes on land	1.80	1.10	1.20
Interest on land at 4 per cent	7.50	3.90	4.20
Stand depreciation	2.50	3.50	3.40
Total costs	$31.20	$20.90	$21.80
Less total net credits	5.80	1.20	1.70
NET COST OF PRODUCTION	$25.40	$19.70	$20.10
Total cost per pound	6.6¢	6.2¢	6.2¢
Net cost per pound	5.4¢	5.8¢	5.7¢
Price received per pound	11.2¢	9.0¢	9.3¢
NET RETURNS PER ACRE	$27	$11	$13

Table 23. COST OF PRODUCING CHEWINGS FESCUE GRASS PER ACRE BY ITEMS OF EXPENSE

(Willamette Valley, Oregon, 1948)

Item	Well-drained valley soils	Hill soils	Average for all soil classes
Number of fields	17	37	.....
Acres studied per field	29	24	26
Pounds of clean seed per acre	290	252	270
Hours of labor per acre	4.3	4.8	4.6
Expenses per acre			
Labor	$ 5.30	$ 6.00	$ 5.70
Tractor	$ 1.20	$ 1.50	$ 1.40
Truck	.30	.30	.30
Other equipment	3.50	3.40	3.40
Total equipment costs	$ 5.00	$ 5.20	$ 5.10
Fertilizer	$ 8.80	$ 6.50	$ 7.50
Sacks	1.60	1.50	1.50
Spray	.10	.10	.10
Total supply costs	$10.50	$ 8.10	$ 9.10
Seed cleaning and testing	$12.20	$12.60	$12.40
Taxes on land	2.00	1.50	1.70
Interest on land at 4 per cent	7.60	5.30	6.40
Stand depreciation	—.50	1.00	.40
Total costs	$42.10	$39.70	$40.80
Less total net credits	7.10	6.50	6.80
NET COST OF PRODUCTION	$35.00	$33.20	$34.00
Total cost per pound	14.5¢	15.8¢	15.2¢
Net cost per pound	12.1¢	13.2¢	12.7¢
Price received per pound	35.2¢	35.4¢	35.3¢
NET RETURNS PER ACRE	$67	$56	$61

Table 24. COST OF PRODUCING ALTA FESCUE GRASS PER ACRE BY ITEMS OF EXPENSE

(Willamette Valley, Oregon, 1948)

Item	Solid seedings				Cultivated in rows (all soil types)
	Well-drained valley and river-bottom soils	Poorly drained valley soils	Hill soils	Average	
Number of fields	28	18	30	76	9
Acres studied per field	14	24	19	19	12
Pounds of clean seed per acre	310	176	322	274	626
Hours of labor per acre	4.9	3.9	4.5	4.4	11.8
Expenses per acre					
Labor	$ 6.10	$ 4.40	$ 5.20	$ 5.20	$12.10
Tractor	$ 1.30	$ 1.20	$ 1.30	$ 1.30	$ 2.80
Truck	.20	.10	.30	.20	.30
Other equipment	3.30	4.00	2.90	3.40	10.50
Total equipment costs	$ 4.80	$ 5.30	$ 4.50	$ 4.90	$13.60
Fertilizer	$ 6.40	$ 5.20	$ 5.70	$ 5.70	$ 8.00
Sacks	1.60	1.00	1.60	1.40	3.30
Other supplies	.10	.....	.....	.10	1.00
Total supply costs	$ 8.10	$ 6.20	$ 7.30	$ 7.20	$12.30
Seed cleaning and testing	$ 8.90	$ 5.30	$ 9.50	$ 8.00	$12.20
Taxes on land	1.60	1.30	1.60	1.50	2.50
Interest on land at 4 per cent	7.40	4.70	5.60	5.80	11.50
Stand depreciation	2.80	.90	3.00	2.30	6.70
Total costs	$39.70	$28.10	$36.70	$34.90	$70.90
Less total net credits	18.70	8.70	15.20	14.20	11.00
NET COST OF PRODUCTION	$21.00	$19.40	$21.50	$20.70	$59.90
Total cost per pound	12.8¢	15.9¢	11.4¢	12.7¢	11.3¢
Net cost per pound	6.8¢	11.0¢	6.7¢	7.6¢	9.6¢
Price received per pound	27.3¢	29.5¢	28.8¢	28.5¢	31.3¢
NET RETURNS PER ACRE	$64	$32	$71	$57	$136

Table 25. COST OF PRODUCING HIGHLAND BENTGRASS PER ACRE BY ITEMS OF EXPENSE

(Willamette Valley, Oregon, 1948)

Item	Hill soils
Number of fields	21
Acres studied per field	28
Pounds of clean seed per acre	164
Hours of labor per acre	3.2
Expenses per acre	
Labor	$ 4.10
Tractor	$ 1.10
Truck	.20
Other equipment	3.10
Total equipment cost	$ 4.40
Fertilizer	$ 3.50
Sacks	1.20
Total supply cost	$ 4.70
Seed cleaning and testing	$ 8.30
Taxes	1.40
Interest on land at 4 per cent	4.20
Stand depreciation	.70
Total cost	$27.80
Less total net credits	2.50
NET COST OF PRODUCTION	$25.30
Total cost per pound	17.0¢
Net cost per pound	15.5¢
Price received per pound	52.2¢
NET RETURNS PER ACRE	$60

Table 26. VARIATIONS IN YIELDS OF GRASS SEEDS BY SOIL CLASSES
(Willamette Valley, Oregon, 1948)

Grass seed by soil classes	Clean seed per acre[1]	Yield average deviation	Coefficient of variation
	Pounds		
Common rye grass			
Poorly drained valley soils	490	133	.27
Perennial rye grass			
Well-drained valley and river-bottom soils	497	162	.33
Poorly drained valley soils	325	117	.36
Chewings fescue			
Well-drained valley soils	296	96	.32
Hill soils	266	92	.35
Alta fescue (solid stand)			
Well-drained valley and river-bottom soils	292	126	.43
Poorly drained valley soils	214	94	.44
Hill soils	360	222	.62
Alta fescue (rows)			
All soil classes	612	114	.19
Highland bentgrass			
Hill soils	163	56	.34

[1]Yields are not weighted by number of acres in each field and therefore do not agree exactly with the average yields shown in previous tables which are weighted averages.