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Soil Survey of The Dalles Orchard Area, Oregon

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FOREWORD

This publication reports the identification, description of properties, and classification of the soils of Wasco County, Oregon, that are devoted to orchard production in the vicinity of The Dalles. A few soils used for orchards near Mosier are also included.

Included in the report is a general statement relative to the workability of the various soils, their productive capacity, and the erosion hazard. This survey furnishes fundamental background information needed for planning a research program that may lead to better management practices, soil improvement, and increased production of fruit in the area.

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by

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THE DALLES Orchard Area includes only a small part of Wasco County, Oregon. The greater part of the area is near the city of The Dalles, which is situated on the south bank of the Columbia River about 90 miles east of Portland. Only those lands devoted to orchard production are covered in this survey. The boundaries of the orchards comprise the limits of the area. There are two large blocks of orchard lands with only very minor intervening areas and the rest of the area is somewhat scattered. The various orchards mapped are not continuous. A small area near Mosier, 17 miles west of The Dalles, also is included in the survey.

The main part of the orchards is on old stream terraces adjacent to the present stream channels. One orchard is on a recent terrace bordering the Columbia River. This tract has the lowest elevation of the orchards surveyed, or about 130 feet above sea level. The orchards referred to locally as the Skyline district are at elevations up to 1,250 feet. The majority of the orchards are at elevations ranging from 350 to 750 feet.† Orchards at elevations above 750 feet are apparently inferior to the ones at lower levels. There are many exceptions to this but the higher orchards are sometimes on inferior soils, subject to exposure and winter damage, and also are subjected to more intense winds.

The Columbia River is the master stream and receives all of the drainage. Chenoweth, Mill, Fivemile, and Threemile creeks traverse the area from southwest to northeast. Fifteenmile Creek, where it crosses the area, flows westward and Mosier Creek flows northward. All empty directly into the Columbia River except Fivemile Creek, which discharges through Fifteenmile Creek. Chenoweth, Threemile, and Fivemile creeks are intermittent and only the spring runoff reaches the points of discharge.

The geology of The Dalles region has been adequately described by Piper.‡ The oldest rock is the Yakima basalt, which is of Mio-

* In cooperation with R. E. Stephenson, Soil Scientist, Oregon Agricultural Experiment Station.

† Elevations from: United States Geological Survey. Topographic map. The Dalles sheet.

‡ Piper, A. M. 1932. Geology and ground water resources of The Dalles region, Oregon. United States Geological Survey. Water-supply paper 659: 163 pages, illustrated. Prepared in cooperation with the Oregon Agricultural Experiment Station.

cene age. It is overlain by the Dalles formation of Miocene or lower Pliocene age. This formation is made up of "semiconsolidated stream-laid sandstone, sandy shale, and conglomerate, together with fine-grained volcanic tuff, tuffaceous sandstone, and coarse andesitic pyroclastic rocks."* Most of the orchards are on Quaternary stream terraces that are rather inextensive. They are of three ages but only the most recent one along the river gives rise to a different soil series. Outcroppings of the underlying Dalles formation are frequent in many orchards.

CLIMATE

The Dalles region is semiarid and is characterized by warm, dry summers and rather cold, wet winters. The weather data from 1850 to 1930 are summarized as follows: average annual precipitation, 15.92 inches; highest precipitation, 43.65 inches in 1858; lowest precipitation, 7.51 inches in 1889; the highest since 1900 is 21.70 inches in 1921. There is an average of 73 days with 0.01 inches or more of precipitation. The average temperature is 52.9° F.; average maximum, 64° F.; average minimum, 41.8° F.; highest temperature, 115° F.; lowest temperature, –30° F. The prevailing wind is from the west for all months except December when it is from the east. The average date of the last killing frost in the spring is April 11 and the earliest in the fall, October 24, or an average frost-free season of 196 days. Frost has occurred as late as May 12 and as early as September 24. The shortest growing season on record was 145 days and the longest was 245 days.

Since 1930 the climate has been somewhat drier than the average and the period 1931 to 1942 inclusive had an average precipitation of only 12.7 inches. The year 1939 had but 6.37 inches of rainfall and the highest for this period was 19.26 inches in 1937. All of these data are from The Dalles station and are fairly representative of the area. The orchards at Mosier receive slightly more rainfall.

Many orchards are on exposed sites and show evidence of winter damage that in many instances has resulted in the death of trees. This condition is more prevalent at the higher altitudes. The prevailing wind damages the trees in exposed areas but the result is seldom more than misshapen trees. There is little evidence of uprooting or splitting of trees from the wind. Tornadoes, hail storms, and other catastrophic disturbances are unknown.

* See footnote (‡) page 1.

AGRICULTURE

The soil survey of this area is confined wholly to the orchard areas. The 1940 agricultural census lists 5,338 acres of orchards in the county. Not all of these are covered in this survey as a few outlying tracts were omitted. The acreage of each of the various kinds of fruit is given in Table 1.

Table 1. FRUIT TREES, NUT TREES, AND GRAPEVINES WITH YIELDS
Wasco County, 1940 and 1930

	1940			1930		
	Non-bearing age	Bearing age	Harvested	Non-bearing age	Bearing age	Harvested
	Number	*Number*		*Number*	*Number*	
Apples	1,360	9,834	11,474 bu.	3,727	35,242	27,251 bu.
Cherries, sour	1,580	4,598	246,853 lb.	52,039	50,586	52,193 bu.
Cherries, sweet	32,863	123,186	8,694,330 lb.	.....	.....	.....
Peaches	13,883	22,281	30,750 bu.	5,935	20,962	27,250 bu.
Pears	315	3,619	7,384 bu.	2,147	4,747	3,784 bu.
Plums and prunes	1,642	11,896	386,493 lb.	3,626	25,541	26,489 bu.
Grapes	207	16,961	106,314 lb.	2,487	67,723	286,000 lb.
Apricots	6,167	21,695	2,293,670 lb.	6,061	19,024	18,064 bu.
Walnuts	21	114	575 lb.	.....	.....	.....
Filberts	45	21	190 lb.	.....	.....	.....

The census lists 493 acres as irrigated. The water is pumped from wells or streams and forced to the higher parts of the orchards through pipes or flumes and application is usually by the furrow system. The furrows usually run straight down the slopes and erosion is a severe hazard. A very small head of water is used and no attempt is made to irrigate the steeper slopes. A few of the younger orchards have overhead sprinkler systems but these are largely in connection with interplanted truck crops. There appears to be very little chance of expanding the irrigated acreage by development of gravity systems. Piper* discussed the ground-water resources and concludes that development of these sources is limited and expensive.

In recent years the acreage of cherries, apricots, and peaches has increased at the expense of other fruits. The production of apples became unprofitable during the late twenties and the acreage was vastly reduced. The few remaining apple orchards are mostly in the Mosier area. Much of the former apple orchard area has been replanted to cherries. Many of the orchards are old, as fruit growing was introduced many years ago.

METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

* See footnote (‡) page 1.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures such as those in road or railroad cuts are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, and gravel are noted. The reaction of the soil and its content of lime and salts are determined by simple tests. Drainage, both internal and external, and other external features such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features that influence the adaptation of the land for the growing of crop plants, grasses, or trees. On the basis of these characteristics soils are classified into mapping units. Three principal units of classification are: (1) series, (2) type, and (3) phase. Areas not readily classified into series, types, and phases are called (4) miscellaneous land types.

The most important group is the series that includes soils having the same genetic horizons, similar in important characteristics and arrangement in the soil profile, and usually developed from similar parent material. Thus the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil type is based on these textural variations. The soil series are given names of places or geographic features near which they were first recognized or mapped. Thus, Chenoweth is the name of an important series in this area.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus the class name of a soil texture, such as sand, loamy sand, or loam, is added to the series designation to give the complete name of the soil type. For example, in this area, the Chenoweth loam is a type within the Chenoweth series. Except for the texture of the surface soil, all types of the Chenoweth series have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its special character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, which differs from the type in some minor characteristics that may have prac-

tical significance. Phases based on relief or slope of the land are recognized in this area. Each soil type has a typical or "normal" relief and slope, and therefore any departure from these are phases.

SOILS

The soils of The Dalles Orchard Area are all somewhat similar yet have distinct differences. Only four series are recognized and two of these are of minor extent. The Chenoweth and Cherryhill soils are the normal soils of the uplands. They have light yellowish-brown, noncalcareous, friable surface soils with weakly developed, fine blocky structure. Both typically have friable permeable upper subsoils but in places have comparatively tight clayey layers. The Chenoweth soils are deep and bedrock never occurs at depths of less than 6 feet. The Cherryhill soils overlie bedrock at shallow depths. The Columbia soils occur on low terraces adjacent to the Columbia River. They are formed from stream-laid materials that have been reworked by the wind. The Yakima soils occupy the narrow stream valleys and are developed on low stream terraces. All of the soils in the area are low in organic matter, but have a fairly high water-holding capacity. All of the soils are easily eroded and those on the steeper slopes are highly erodible. Considerable erosion has already occurred but visible rills and gulleys are mostly obliterated by tillage.

Table 2. GROUPING OF SOILS OF THE DALLES ORCHARD AREA ON BASIS OF POSITION AND DEPTH

Uplands (high terraces)		Low terraces	
Deep	Shallow (over bedrock)	Deep	Shallow (over gravel)
Chenoweth	Cherryhill	Columbia	Yakima

Each of the fifteen soil types and phases in The Dalles Orchard Area is described in the following pages. The soils are listed and their acreage and proportionate extent are given in Table 3.

Chenoweth loam

Chenoweth loam is the most extensive soil in the area and nearly all of it is devoted to orchards. It is deep, friable, and well suited for the production of tree fruits. The moisture-holding capacity is relatively high, but trees are apt to suffer from drought during periods of less than average precipitation.

SETTING. Chenoweth loam occurs on steeply rolling relief with short smooth slopes. The dominant slopes range from 10 to 20 per

Table 3. SOIL TYPES AND PHASES; ACREAGE; AND PROPORTIONATE EXTENT OF EACH IN THE DALLES ORCHARD AREA, OREGON

Soil	Acreage	Per cent of total area
Chenoweth loam	1,567	32.8
Chenoweth loam, steep phase	690	14.5
Chenoweth very fine sandy loam	277	5.8
Chenoweth very fine sandy loam, steep phase	190	3.9
Chenoweth fine sandy loam	600	12.7
Chenoweth fine sandy loam, steep phase	70	1.4
Chenoweth sand	90	1.9
Chenoweth silt loam	42	.9
Cherryhill loam	608	12.7
Cherryhill loam, steep phase	391	8.1
Cherryhill very fine sandy loam	110	2.3
Cherryhill very fine sandy loam, steep phase	6	.1
Columbia loamy fine sand	66	1.4
Yakima loam	60	1.3
Yakima gravelly sandy loam	11	.2
	4,778	100.0

cent with few areas of lower gradient. The soil is formed from water-laid materials deposited over the Dalles formation. The depositional material is very thick as the underlying Dalles formation is always more than 6 feet from the surface and may be as much as 150 feet. Internal drainage is good; surface runoff is rapid and may lead to severe erosion. All of this soil within the limits of this area is used for orchards, but adjacent virgin areas have a cover of grass, shrubs, and an occasional pine tree. The Chenoweth loam occurs generally on the slopes and terraces adjacent to Mill Creek and Threemile Creek.

PROFILE DESCRIPTION. The following is a representative profile of Chenoweth loam: (1) Pale brown or light yellowish-brown, friable loam with weakly developed fine blocky structure, readily broken down into a fine granular condition. It contains a moderate quantity of organic matter, is noncalcareous, free of gravel and stone, and readily penetrated by water and roots. About 6 inches thick. (2) Moderate yellowish-brown, friable heavy loam, relatively low in organic matter, and very slightly more compact than the surface layer. It is readily penetrated by water and roots, and continues to a depth of about 30 inches. (3) Moderate yellowish-brown, soft-granular loam. Differs from the layer above in having a higher content of silt and somewhat greater compaction. This layer in places appears to be high in clay and becomes hard when dry and sticky when wet, but offers only slight resistance to penetration of water and roots. Underlain at about 48 inches by (4) Light yellowish-brown to moderate yellowish-brown loam. Somewhat stratified, with varying degrees of slight compaction and an occasional layer of fine sandy material. Extends to great depth and rests directly on bed-

rock. The entire profile is noncalcareous but slightly basic in reaction. It is free of gravel and stone, is readily permeable, and has a fair water-holding capacity.

Chenoweth loam, steep phase

The steep phase of the Chenoweth loam differs from the type only in that it occurs on slopes of more than 20 per cent. Only rarely does the slope exceed 30 per cent. The steep phase is cropped mostly to cherries with small acreages in peaches and apricots.

Chenoweth very fine sandy loam

Chenoweth very fine sandy loam occurs mostly along lower Threemile Creek, but scattered small bodies occur throughout the area. The total extent is only 277 acres. It is cropped to both cherries and apricots with satisfactory yields, although the trees suffer from drought during years of less than normal rainfall.

SETTING. The soil occurs on steeply rolling relief with rather short slopes. Drainageways are deeply intrenched but gullies are infrequent. It occurs on stream terraces either high above the present streams or on slopes adjacent to the present streams. The parent material is somewhat sandier than that found under the loam type, but is like it in other respects. The soil is very well drained with very rapid internal and external drainage. The latter often results in rather severe erosion. The very fine sandy loam has developed under a grass cover and probably under a trifle less rainfall than the loam.

PROFILE DESCRIPTION: (1) Weak-brown very fine sandy loam, relatively well supplied with organic matter. Soft, weak granular structure. About 4 inches thick. (2) Similar material but with slightly less organic matter and very weakly developed coarse blocky structure. Soft and mellow. Continues to about 30 inches. (3) Very slightly compact material similar to that above. Underlain at about 46 inches by (4) Weak-brown sandy loam that is mellow and friable. This material extends to great depth and rests directly on the Dalles formation.

The entire profile is noncalcareous, free of gravel and stone, and has a fair water-holding capacity. It is readily permeable to both water and roots.

Chenoweth very fine sandy loam, steep phase

The steep phase of the Chenoweth very fine sandy loam has the same character of profile as the normal type and differs from it only in that it occurs on steeper slopes. All areas of this soil with a slope

of more than 20 per cent are considered as the steep phase. Very few of the slopes exceed 30 per cent.

Chenoweth fine sandy loam

The Chenoweth fine sandy loam has a more pronounced brown color than other members of the Chenoweth series. It occurs in areas of slightly higher rainfall than the other types, but this reflects only very slight increases in yields. It is used for the production of cherries, peaches, apricots, and apples. Apples are raised mostly adjacent to Mosier.

SETTING. The Chenoweth fine sandy loam occurs only along Chenoweth Creek and in the vicinity of Mosier. It occupies rolling relief with rather short steep slopes of less than 20 per cent. The predominant slopes range from 10 to 20 per cent. The soil is formed on stream-laid material on terraces high above the present streams. These materials are deep and overlie the Yakima basalt. The soils are well drained, with both interior and exterior drainage well developed. Surface runoff is rapid and often results in moderate erosion. This soil type has developed under a mixed brushy type of vegetation, with oak brush predominating.

PROFILE DESCRIPTION: (1) Moderate brown to moderate yellowish-brown fine sandy loam. Weakly developed fine-granular structure. Soft and mellow but with a tendency to bake and crust. About 6 inches thick. (2) Similar material but with weakly developed blocky structure with slight compaction. Readily crumbled to a fine-granular mass. Underlain at about 24 inches by (3) Similar material but slightly more compact and of somewhat heavier texture. Underlain at about 40 inches by (4) Soft, mellow, fine sandy loam with considerable stratification. This material continues to great depths and rests directly on the Yakima basalt.

The entire profile is noncalcareous, neutral in reaction, free of gravel and stones, readily permeable to both water and roots, and has a fairly good water-holding capacity.

Chenoweth fine sandy loam, steep phase

The steep phase of the Chenoweth fine sandy loam differs from the typical Chenoweth fine sandy loam only in that it occurs on slopes of more than 20 per cent. The profiles are similar but the problems of management are somewhat different. Most of the phase is on slopes that only slightly exceed 20 per cent, but a few are above 30 per cent.

Chenoweth sand

Chenoweth sand is relatively unimportant as there are only 90 acres in the area. This type is used mainly for apricot production as these trees are better adapted to withstand the droughty nature of this soil.

SETTING. Chenoweth sand occurs on stream terraces high above the present stream channels. The only bodies in this area are adjacent to Mill Creek just outside the city limits of The Dalles. It has steeply rolling relief with short steep slopes of less than 20 per cent. Very few slopes are less than 10 per cent. The soils are formed on wind-modified stream-laid material that overlies the Dalles geological formation at great depths. All bodies within the area surveyed are cropped, but adjacent virgin areas have an open cover of scattered dwarfed yellow pine and considerable grass. The soils are excessively drained. Percolation is very rapid so there is comparatively little surface runoff.

PROFILE DESCRIPTION: (1) Moderate yellowish-brown sand, loose, mellow, single-grained and fairly low in organic matter. About 6 inches thick. (2) Similar material but very slightly darker colored and somewhat coherent or firm; very low in organic matter; continues to about 30 inches. (3) Moderate yellowish-brown very fine sand; firm but soft and easily crumbled to single grains.

The entire profile is noncalcareous, free of gravel and stones, readily permeable, and has a low water-holding capacity.

Chenoweth silt loam

Chenoweth silt loam has a different profile than other members of the series and would have been established as a new series had it been greater in extent—it occupies only 42 acres. The soil has a hard, compact, silty clay loam subsoil layer that resists penetration of water and roots. This soil is used for the production of cherries, apricots, and peaches. Yields are somewhat lower than on the other Chenoweth soils.

SETTING. The Chenoweth silt loam occurs on rolling or dissected stream terraces well above the channels of the present streams. The slopes range from 5 to 20 per cent, with the steeper slopes predominating. The surface drainage is good or excessive and rapid runoff often results in erosion losses. This soil has developed under a grass cover and slightly less rainfall than in some other parts of the area. It occurs only in a limited area between Dry Hollow and Threemile Creek, and is intimately associated with the Chenoweth loam.

PROFILE DESCRIPTION: (1) Dark yellowish-brown silt loam with weakly developed fine-granular structure, relatively well supplied with organic matter. It is soft and friable, although the surface has a tendency to bake and crust over. About 6 inches thick. (2) Moderate yellowish-brown silt loam, somewhat hard and compact, with fine blocky structure. Aggregates are roughly subangular and are rather hard and not easily crushed. Underlain at about 24 inches by (3) Strong yellowish-brown silty clay loam, hard, tough, massive, breaking with difficulty into very small, hard, angular aggregates. Permeability is low. Underlain at about 40 inches by (4) Strong yellowish-brown fine sandy loam high in silt. Firm and slightly compact but easily crumbled. This material extends to great depths and rests directly on the Dalles formation. The entire profile is noncalcareous and free of gravel and stones.

Cherryhill loam

Cherryhill loam is a shallow soil over bedrock, either the Dalles formation or Yakima basalt, and steep slopes and rock outcrop are typical. This soil is devoted largely to cherry orchards. Yields are commonly lower than on the Chenoweth soils and vary with the depth of the soil.

SETTING. The Cherryhill loam occurs generally at higher elevations than the closely associated Chenoweth soils. A few areas occur at low elevations along Mill and Threemile creeks, but they are of limited extent. The soil occurs on uneven, rolling, dissected areas with frequent rock outcrops. The slopes generally are short and steep and range up to 20 per cent. The soil is formed from a mixture of materials. Much of it is local alluvium and disintegrating particles of the bedrock, but some is stream-terrace material like that of the Chenoweth soils. The latter material is restricted to lower elevations. The soil is well drained, but local pockets or depressional areas in the underlying rock may have impeded internal drainage. The natural vegetation consisted of grasses, brush, and a few pine trees.

PROFILE DESCRIPTION: (1) Weak-brown to moderate yellowish-brown loam with weakly developed fine-granular structure; soft and mellow, although the surface is apt to crust and bake; fairly well supplied with organic matter. May appear pale brown in cultivated fields. About 4 inches thick. (2) Similar material, very slightly compact but easily crumbled. Underlain at about 28 inches by (3) Pale-brown silty clay loam or silt loam, rather compact and hard, breaking into fine irregular blocky aggregates; somewhat sticky when

wet; slowly permeable. Underlain at about 36 inches by (4) Bedrock of the Dalles formation, which is usually comparatively soft and stratified and of a wide range of materials, or the Yakima basalt, which is fragmental in the upper part.

This depth to bedrock is extremely variable within short distances, although the soil seldom exceeds 6 feet in thickness.

Cherryhill loam, steep phase

The steep phase of the Cherryhill loam differs from the normal type only in that it occurs on steeper slopes or those above 20 per cent. Few slopes exceed 25 per cent but some as great as 35 per cent exist. The soil profile is the same as that of the normal soil, that is, gray gritty loam, appearing light yellowish brown when moist, with dark brown sandy clay subsoil over a substratum of the Dalles geological formation.

Cherryhill very fine sandy loam

Cherryhill very fine sandy loam occurs only along Threemile Creek and Fifteenmile Creek. The surface soil closely resembles the Chenoweth soils but the underlying Dalles formation occurs at depths of less than 6 feet. This soil is used largely for the production of apricots.

SETTING. Cherryhill very fine sandy loam occurs on low terraces above and bordering the present streams. It occurs on moderately rolling, dissected relief with short, uneven slopes of less than 20 per cent. It has been formed under a grass cover in the drier part of the area. The soil is well drained but in local spots internal drainage may have been impeded by depressions in the underlying bedrock.

PROFILE DESCRIPTION: (1) Light yellowish-brown soft, mellow, granular very fine sandy loam, low in organic matter. About 4 inches thick. (2) Similar material but with less organic matter and very weakly developed blocky structure. Underlain at about 20 inches by (3) Light brown to moderate yellowish-brown silt loam, very slightly compact but readily crumbles to small, irregular soft granules. Underlain at about 40 inches by (4) Bedrock of the Dalles geologic formation. This formation is extremely variable but usually consists of disintegrating sandstone. The depth to the bedrock may vary greatly within short distances but is always less than 6 feet.

Cherryhill very fine sandy loam, steep phase

The steep phase of the Cherryhill very fine sandy loam is characterized by slopes greater than 20 per cent. The soil profile is

similar to that of the normal Cherryhill very fine sandy loam. It is a light yellowish-brown very fine sandy loam over bedrock at shallow depths.

Columbia loamy fine sand

Columbia loamy fine sand is a loose deep sandy soil on low terraces adjacent to the Columbia River. The profile is uniform throughout. This soil is used for the production of tree fruits, berries, and truck crops. All these crops are irrigated and yields are high.

SETTING. Columbia loamy fine sand occupies smooth terraces only 15 to 20 feet above the river. The soil material is probably of stream-laid origin but has been reworked by wind. At least a part of the area resembled Dune sand before it was leveled. All of the soil is farmed. In the virgin condition the vegetation probably consisted of annual grasses and shrubs, with a small proportion of perennial grasses adapted to such a droughty sandy soil. The soil is of minor extent and occurs only in one area adjacent to the Columbia River at the mouth of Fifteenmile Creek.

PROFILE DESCRIPTION: (1) Dark yellowish-brown loamy fine sand, loose, single-grained and low in organic matter. About 6 inches thick. (2) Moderate yellowish-brown loamy fine sand without appreciable compaction, low in organic matter, single-grained. This material extends to depths of more than 6 feet.

The entire profile is noncalcareous, micaceous, loose and porous, with little stratification or change with depth.

Yakima loam

Yakima loam includes the stream bottoms and low-lying stream terraces of the area. Although it is of limited extent, there is considerable variation in the profile characteristics. This soil is used for a variety of truck and orchard crops, largely under irrigation.

SETTING. Yakima loam occurs in narrow bodies 10 to 15 feet above the present flow of small streams or as narrow strips on first bottoms along smaller tributary streams. In the latter instance, the soil materials are largely local alluvium from the adjacent hills. The larger valleys bordering Mill Creek and Threemile Creek have well-defined terraces composed of material deposited by the streams. Where terraces occur at different elevations the loam type is only on the higher ones. The soils are well drained and originally supported a grass and brush type of vegetation.

PROFILE DESCRIPTION: (1) Light yellowish-brown to moderate yellowish-brown loam with very weakly developed fine granular structure, moderately well supplied with organic matter. About 6 inches thick. (2) Similar-textured material with very slightly compact, weakly developed fine blocky structure. Underlain at about 30 inches by (3) Light yellowish-brown sandy loam with considerable fine gravel. This is usually underlain by stratified gravel at depths of 5 or 6 feet.

The entire profile is noncalcareous and low in organic matter. The upper layers have fairly high water-holding capacity, but the lower one is comparatively poor in this respect. Scattered gravel is common in the two upper layers, whereas the third layer contains considerable quantities.

Yakima gravelly sandy loam

Yakima gravelly sandy loam is of very small extent and of little agricultural importance. Much of it is nonagricultural because of its content of gravel and stones and its low position, which subjects it to overflow.

Table 4. CLASSIFICATION OF SOILS IN THE DALLES ORCHARD AREA AS TO SUITABILITY FOR ORCHARD PRODUCTION

Soil type	Productivity*	Workability†	Erosion hazard‡	Grade§
Chenoweth loam	High	Fairly easy	Moderate	1
Chenoweth loam, steep phase	High	Difficult	Great	3
Chenoweth very fine sandy loam	High	Fairly easy	Moderate	1
Chenoweth very fine sandy loam, steep phase	High	Difficult	Great	3
Chenoweth fine sandy loam	High	Fairly easy	Moderate	2
Chenoweth fine sandy loam, steep phase	High	Difficult	Great	3
Chenoweth sand	Medium	Easy	Moderate	3
Chenoweth silt loam	Medium	Fairly easy	Moderate	3
Cherryhill loam	Medium	Fairly easy	Moderate	2 and 3‖
Cherryhill loam, steep phase	Medium	Difficult	Great	4
Cherryhill very fine sandy loam	Medium	Fairly easy	Moderate	3
Cherryhill very fine sandy loam, steep phase	Medium	Difficult	Great	4
Columbia loamy fine sand¶	High	Easy	Slight	1
Yakima loam	High	Easy	Slight	1
Yakima gravelly sandy loam	Low	Difficult	Moderate	4

* Productivity refers to the relative capacity of the soils to produce the common tree fruits under the usual system of management and is based on estimated yields.

† Workability refers to the relative ease of cultural practices, including cultivation, irrigation where practiced, and harvest operations.

‡ Erosion hazard refers to the susceptibility to damage from erosion by water and wind and by movement of soil down the slopes as a result of cultural operations.

§ Grade is a comparative figure to express the suitability of the soils for production of tree fruits. It reflects the three factors, productivity, workability, and erosion hazard. The best soils are in Grade 1 and the poorest in Grade 4.

‖ This soil varies considerably in depth. In places where it is deep it is given a grade rating of 2, and where shallower, a rating of 3.

¶ The Columbia loamy fine sand is all irrigated, hence the data are for irrigated agriculture. All data for other soils are for production without irrigation.

SETTING. Yakima gravelly sandy loam occurs only on stream terraces less than 10 feet above the present streams. Few areas are more than 5 feet above the streams. The soil is formed only from recent stream-deposited material containing much coarse gravel and stone. It is subject to overflow during flood periods and is excessively drained in periods of low water. The native vegetation is brush and trees such as is normally found in this climate bordering small streams. The type occurs only along Mill Creek.

PROFILE DESCRIPTION: (1) Dark yellowish-brown sandy loam with considerable fine gravel; well supplied with organic matter; soft granular structure; about 4 inches thick. (2) Stratified layers of gravel, coarse sand, and stones. The entire profile is noncalcareous. Stones often occur on the surface as well as throughout the profile. The quantity of gravel and stone is variable but always enough to interfere seriously with cultural practices.

MANAGEMENT

Present soil management practices are largely concerned with control of weeds and conservation of moisture. Cultivation is frequent throughout the growing season, probably more frequent and deeper than necessary. Deep cultivation may cause root injury and unnecessary loss of moisture by evaporation from the cultivated depth.

Because of moisture shortage, cover cropping is only inextensively practiced. Orchards that are irrigated not only have the advantage of more moisture for the trees, but can be improved by the growing of cover crops to renew the humus. Little fertilizer is used on either the cover crops or the trees.

Erosion is slight on slopes of less than 10 per cent but increases with the steepness of slope. Cultivation across slopes, particularly the last cultivation in the fall, would help control erosion. Seeding of cover crops, where practical, also would help in this respect.

Cultivation of the steeper slopes has caused serious mechanical movement of the soil down the slopes. In some cases terraces have been formed as a result of cultivation. The break between the terraces occurs at the tree rows and this causes an accumulation of soil along the upper side and a cutting along the lower side of the tree. Severe damage has resulted to the trees as many roots have been cut by tillage machinery.

Only a minor amount of irrigation is practiced because of a limited supply of water for the purpose. The chief method of irrigation is by the sprinkler system. Due to steepness of slopes and consequent

serious erosion hazard any other system of irrigation would be impracticable in most of the orchards. A few truck crops are furrow irrigated on the gentler slopes using a small head of water, but even here some erosion has resulted.

Some of the young orchards are intercropped with berries or truck crops, but this practice is limited to those areas having irrigation.

Success with orchards in this area depends on the depth, permeability, fertility, and moisture-holding capacity of the soils. Most of the soils are deep, permeable, reasonably fertile, and have fairly good moisture-holding capacity. Some of them, however, are not so favorable. Among these are shallow soils such as the Cherryhill, especially near the rock outcrops, and soils underlain by tight subsoil of relatively high clay content (Chenoweth silt loam). These are of comparatively low value as orchard sites, as the fruit trees growing upon them are of medium to low productivity under prevailing management, and only special costly management practices would increase productivity. The Chenoweth sand, a deep porous sandy soil, also has medium to low productivity. Frequent light applications of water by the sprinkler system would help to compensate for the lack of moisture-holding capacity and increase the productivity of such shallow and excessively sandy soils.

Steep phases of the various soils are harder to till, more subject to damage by tillage and erosion, and need careful management. Wind erosion is a hazard on some areas of the looser sandy soils such as the Chenoweth sand and the Cherryhill very fine sandy loam. Control measures are needed.

SUMMARY

The soil survey of The Dalles Orchard Area was made at the request of the Oregon Agricultural Experiment Station to furnish basic information for studies relative to the production of tree fruits. The information is presented as in standard soil surveys. Only the orchards were surveyed, the mapping of the intervening areas being left until some future date. Most of the orchards occupy uplands or high terraces adjacent to the Columbia River and are on soils formed from old stream-laid material that has been modified by winds. Only a few orchards are irrigated, although the average annual rainfall is low—only 12.7 inches during the period 1931 to 1942 inclusive. Most of the orchards are on fairly steep slopes and the existing problem of erosion would be intensified with irrigation.

Only four soil series are mapped, two of which are relatively inextensive. The more extensive soils are those of the Chenoweth and Cherryhill series, which occur on uplands or high terraces and have similar surface soils. Both are underlain by the Dalles geological formation, which in the Cherryhill soils occurs at shallow depths and in the Chenoweth is more than 6 feet below the surface. The Columbia soils occupy low terraces adjacent to the Columbia River, and are from alluvial materials reworked by the wind. The Yakima soils are on low terraces and in first bottoms along the smaller streams.

All orchards are clean cultivated, with frequent deep cultivation. The use of shallow cultivation to control weeds and maintain a surface mulch is suggested. Some changes in tillage practices are suggested to decrease the erosion hazards, particularly the movement of soil down the slopes as a result of tillage.

The related problems of soil fertility and management are being studied by the Oregon Agricultural Experiment Station and are discussed in a separate report.