WETLANDS Update

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DISTRIBUTION OF SEASONAL PONDS IN THE WILLAMETTE VALLEY

Editors note: This article is condensed from a report submitted to the Division of State Lands (DSL) by J. Herbert Huddleston, Ph D. and Will Austin. DSL and EPA helped fund the study due to its importance to the understanding and mapping of agricultural wetlands. Contact the authors at the Soil Science Department, Oregon State University, Corvallis, Oregon 97331 for a copy of the complete report.

Seasonal ponding implies that soils will have water standing on the surface for some period of time in response to late fall, winter, and early spring precipitation. For this study, the extent of ponding was characterized by observing the frequency of ponding and the general size of ponds along three transects across the Willamette Valley.

Soils and Geomorphic Surfaces

Because there is a good relationship between soils and the landforms on which they occur, observations were stratified according to geomorphic surfaces. Major geomorphic surfaces of the Willamette Valley include the Ingram, Winkle, Calapooyia, and Senecal surfaces.

The *Ingram surface* represents the floodplain of the Willamette River and its tributaries. Well drained Newberg and Chehalis soils dominate this surface, but there is some natural swell and swale topography, and poorly drained Waldo, Wapato, and Bashaw soils occur in some of the swales and on the floodplains of smaller tributaries. If ponding occurs, we would expect to find it in the swales and associated with the poorly drained soils.

The *Winkle surface* represents a stream terrace of the Willamette River system. Major soils include the well drained Malabon and Salem soils, the moderately well drained Coburg soils, the somewhat poorly drained Clackamas soils, and the poorly drained Awbrig, Conser and Cove soils. Swell and swale topography is less pronounced than on the Ingram surface, and we would expect ponding to be associated primarily with the poorly drained soils.

The *Calapooyia surface* represents the broad, flat surface that constitutes much of the main valley floor. This surface was created by deposition associated with the Pleistocene-era Missoula floods; it has very little relief and a very poorly developed drainage system. The soils are characterized by a very slowly permeable clay layer at shallow depth that perches water throughout the winter rainy season. Consequently, the majority of the soils are the poorly drained Dayton and Concord soils and the somewhat poorly drained Amity and Holcomb soils. Ponding is known to occur on this surface, and we would expect to observe ponding in many places.

The *Senecal surface* is also on the main valley floor, but it is more dissected and the soils do not have a

continued on page 2

Seasonal Ponds, continued from page 1

restrictive clay layer. It is characterized by the well drained Willamette soil and the moderately well drained Woodburn soil. We would expect ponding to occur very infrequently on these soils.

Methods

Three east-west transects were laid out adjacent to roadways that run perpendicular to the geomorphic surfaces of the Valley. The Benton-Linn transect (south of Corvallis) lies mostly on the Calapooyia surface. The Polk-Marion transect (from Airlie to Suver to Stayton) is on the Ingram and Winkle surfaces. The Yamhill-Marion transect (from Bellevue through Amity to Wheatland) is largely on the Calapooyia and Senecal surfaces.

Observational data were collected at a total of 233 locations along all three transects. A location is defined as a 0.1 mile segment on a transect. At each location, observations were made of the estimated number of ponds visible and the relative size of the ponds, and photographs were taken.

Surface photos were first taken in late October, after most harvest operations along the transects appeared to be completed. This allowed for maximum visibility of soil color patterns, micro relief and land contours, which are important indicators of predicted sites of future ponding. Surface photos were taken again in January and in early March to document ponding and show how vegetation patterns develop during the rainy season.

Summary of Major Findings

- The threshold for the first occurrence of extensive ponding requires about five inches of cumulative rainfall at the onset of the rainy season.

- Extensive ponding first develops on the slowly permeable, somewhat poorly drained and poorly drained soils on the Calapooyia, Winkle, and Ingram surfaces. Ponding on the better drained soils occurs later in the rainy season.

- Fully 50 percent of the locations at which ponding was observed are on the Calapooyia geomorphic surface. One-third are on the Ingram surface, 15 percent are on the Winkle surface, and only two percent are on the Senecal surface.

- The density of ponding, defined as the number of ponds per observation location, is much higher on the Calapooyia surface than on other surfaces.

- There is some evidence that ponds on the Calapooyia surface retain water for longer periods of time than ponds on other geomorphic surfaces. Conversely, many ponds on the Calapooyia surface contain water for only short periods of time.

- Pond size is relatively evenly distributed among small, medium and large ponds on all geomorphic surfaces.

- As late spring rainfall decreases, ponds begin to dry up at about the same time and at the same rate on all geomorphic surfaces. The rate of drying is slower for ponded sites in the southern Willamette Valley than for those in the northern Willamette Valley. This probably reflects the difference in relief, the south end being broader and flatter than the north end.

- Tillage practices in farm fields affects ponding either by reshaping naturally occurring ponded areas (often into a linear pattern) or by creating depressions that subsequently retain water in the rainy season.

- Naturally occurring wetland plants are good indicators of sites that later become ponded, but they are not infallible. Some sites characterized by wetland vegetation did not pond water at the times of observation.

- Yellowing of cultivated crops provided a good indicator of ponded sites.

See related article, page 8.

WET SOILS PROJECT REFINES KNOWLEDGE OF WILLAMETTE VALLEY SOILS

- by Will Austin and Herbert Huddleston, Ph D.
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Wet soils during the rainy season are a familiar feature of the Willamette Valley. Cultivated fields are ideal for making casual observations of saturated soil conditions. However, direct measurements of the depth and duration of soil saturation require specialized field equipment.

The Oregon State University "Wet Soil Monitoring Project" is entering its fourth year. The project is funded by the Soil Conservation Service. Data from the project will be used to illustrate regional characteristics that will be incorporated into the national wet soil database.

Geomorphology and Transect Location

Geologically, the Willamette Valley is a structural depression filled with sediments. Some of these sediments are Plio-Pleistocene age Missoula flood deposits. These deposits are composed of layers of silts and clays. It is the underlying, slowly permeable clay materials (identified as Malpass clay member of the Willamette Formation) that often restrict water movement through some valley soils. The restricted water movement is expressed in some poorly drained soils as saturated conditions and/or surface ponding.

In order to better understand the character of Willamette Valley wet soils, two study transects were selected. One transect is in Benton County near Finley National Wildlife Refuge and the other is in Polk County near Suver. The two transects were set up to sample a toposequence of soils representing the Calapooyia geomorphic surface.

Soils included within both toposequences are the moderately well drained Woodburn, somewhat poorly drained Amity, and poorly drained Dayton and Waldo. The Dayton soil is the only project soil underlain by the Malpass clay. Also included in the Benton transect is a well drained Willamette soil.

Water Dynamics

Depth and duration of saturation are controlled by the input and outflow of water. Most input to all study sites was from precipitation. Outflow is generally uniform in the soils that did not have the Malpass clay. In the Dayton soil, water movement is less uniform and also moves laterally over the clay layer.

Monitoring for the Wet Soil Project began on October 1, 1991. Precipitation for the period through June 30, 1992 was 69 percent of normal. This period was one of the warmest and driest on record. The second year, Oct. 1, 1992 through June 30, 1993, was almost the opposite. The spring months were cooler and wetter than normal followed by summer conditions that were the coolest and wettest on record.

Instrumentation

Piezometers were selected to record water table depths because of the known stratigraphic differences in these soils. Tensiometers were used to measure soil moisture status in unsaturated soil. Mercury junction platinum electrodes were used to measure redox potentials. Chromel-Alumel thermocouples were used to record soil temperatures.

Piezometers, tensiometers, and platinum electrodes were all installed in triplicate at each of three depths: 25 cm, 50 cm, and 100 cm. In some soils, these depths were modified slightly to correspond with observed soil horizons. In soils with a restrictive clay layer, we made sure that one set of readings was in soil above the clay layer, one set was within the clay layer, and one set was below the clay.

Single thermocouples were placed at the same depths as the piezometers and electrodes. A single piezometer was installed at a depth of 200 cm to track the water

continued on page 9

Wet soils, continued from page 8

table as it rose from below.

Relationships Between Saturation and Reduction
Piezometer data for the Dayton soil showed that the water table depth, as indicated by both the 30 and 60 cm piezometers, is the same and also is nearer the soil surface than the water table measured in the 100 cm piezometers. This is evidence of a "perched water table" (episaturation) above the slowly permeable clay layer.

The figure below illustrates the relationships between duration of saturation and soil redox potentials as measured with platinum electrodes in the Dayton soil in Benton County. In this figure, the heavy black line at 200 millivolts indicates the redox potential at which iron is reduced from the ferric to the ferrous state.

Selected data from the 30 cm depth of the Dayton soil shows the relationships between duration of saturation, soil temperature, and redox potential. A comparison of the duration of saturation for the two years shows that in the second year, saturation continued into late spring. During spring of either year, when the soil was saturated and the soil temperature was above 8° C, the redox potential markedly dropped into the iron reduction range.

Summary
Water table data changes from year to year depending on the amount of precipitation. Therefore, multi-year observations are needed to accurately determine the periodicity of depths and durations of saturation. Soils that are saturated in the spring when temperatures are rising may develop iron reducing conditions.