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Department of Chemistry

SOME IDAHO SOILS

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NORTH IDAHO STAR PRESS

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BULLETINS.

The regular bulletins of the Station are sent free to all who request them. Some bulletins issued lately are:

21. The Codlin Moth.
22. Onion Growing
23. Meteorological Records and Prediction of Frosts.
24. Cattle Feeding and Crop Tests.
25. The Composition of Arsenical Insecticides.
26. (1) Crude Petroleum, (2) The Elm Louse, (3) The Pear Leaf Blister Mite
27. Mushrooms or Toadstools; a Natural Food Product.

SOME IDAHO SOILS.

During the year a number of samples of soils from some of the representative portions of Idaho have been collected and analyzed. The result of this work is here given in the hope that it may increase our present knowledge of the soil conditions within our State and form the basis of a larger and more comprehensive work in the future.

For our present purpose, the soils of the State may be roughly grouped into the following classes:

1. Coarse sandy soils of the foothills and timber lands.
2. Fine sandy silt soils.
3. River sand soils.
4. Sandy soils of the arid regions.
5. Alkali soils.

The first class comprises those soils formed mainly from the talus of the foothills. They are characterized, physically, by their light brown color, very course sandy or gravelly texture and abundant quantities of feldspar fragments and mica. The principal chemical characteristics seem to be a low lime and nitrogen content with high percentages of phosphoric acid and potash and especially of magnesia.

The second class includes the fine grained soils of basaltic origin, such as are found in the Palouse and Potlatch regions. These soils are characterized by their dark color and fine texture. Mechanical analysis shows them to contain practically no coarse material, about 41 per cent. of fine sand, 47 per cent. of silt and usually not over 2 per cent. of clay. The distinguishing chemical features of these soils are high percentages of all the mineral plant foods except lime and unusually large amounts of organic matter and humus. Many of our best wheat soils belong in this class.

The third class, found mostly along the larger rivers, comprises those soils formed almost entirely from river sand and "wash." They contain about 90 per cent. moderately fine sand (mostly quartz and mica) the silt and clay having been for the most part washed out. Like most sandy soils, this type is highly insoluble in acids, contains very little organic matter, humus and nitrogen and has very limited capacity for retaining moisture. These soils are somewhat analogous physically to the early truck soils of the East, but unlike them chemically in that our river sand seems to contain large amounts of potash and phosphoric acid.

The fourth group consists of those sandy soils of the irrigated region that do not contain an excess of soluble salts. These soils are usually of a light brown color and are made up of about 60 per cent. sand and 20 per cent. silt with some gravel and clay. They are of volcanic origin and are usually rich in the mineral plant foods but contain small percentages of nitrogen and some are rather deficient in lime.

The fifth group comprises the soils of the arid region that contain an excess of salts soluble in water. The term "alkali soil" is no longer used in a derogatory sense but means simply, a soil in which there is an excessive accumulation of these salts. This excess of alkali salts may or may not be large enough to be harmful to vegetation. In any case, the alkali soils are almost without execption exceedingly rich in mineral plant food and when the alkali condition is corrected, often form our most productive soils.

In interpreting the results of a soil analysis it must be constantly borne in mind that it is generally impossible to say dogmatically, "This soil is good and this one is poor." There are so many local conditions affecting the productivity of a soil that one that would be considered highly fertile in this or that section of the country may show a grave deficiency in Idaho for instance. For this reason, only conclusions of the most general character can be drawn with certainty from the rather limited data at hand at the present time.

In general, it may be said of our Idaho soils, that they are unusually rich in all the mineral plant foods except lime. The volcanic origin of the greater part of our soils makes them especially rich in potash and phosphoric acid. Some of the soils of the humid regions contain unusually high percentages of humus and nitrogen.

The extent of "alkali" in the State has not yet been investigated, but thus far in our soil work no soils analyzed have contained harmful amounts of either white or black alkali. The soils received from Cassia county contain both kinds of alkali but not as yet in sufficient quantity to be dangerous to crops.

It is quite probable that none of the soils thus far examined will need potash or phosphoric acid fertilizers. Some, however, will probably at no very distant time require lime dressings, not because of an actual deficiency of lime as plant food, but to render some of the more inert forms of potash and phosphoric acid available. Many of the soils doubtless would be improved by increased amounts of humus and nitrogen and some show a marked deficiency in these substances.

Laboratory Number 4.

Marked "Cassia County No. 1."

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	.68
Coarse sand	2. to .5	1.53
Sand	.5 to .05	62.14
Silt	.05 to .005	31.08
Clay	.005 and less.	.25
Loss on ignition		4.41

CHEMICAL ANALYSIS

Insoluble matter 72.732 / Soluble silica 8.121	80.853
Potash (K_2O)	.775
Soda (Na_2O)	.403
Lime (CaO)	1.971
Magnesia (MgO)	1.387
Manganese oxide (MnO)	.024
Ferric oxide (Fe_2O_3)	3.104
Alumina (Al_2O_3)	6.362
Phosphorus pentoxide (P_2O_5)	.183
Sulphur trioxide (SO_3)	trace
Carbon dioxide (CO_2)	.942
Water and organic matter	4.411
Total	100.415
Humus	.623
Nitrogen	.093
Hygroscopic moisture	2.066
Total alkali salts soluble in water	.020

No. 4. An "alkali soil" from Roseworth, Cassia county, collected by D. B Hartwell.

In brief the description sent with the soil is as follows:

Samples are of virgin soil. Number 1 and 2 are surface soils taken from seven different points representing the average soil of this locality. Number 6 is a subsoil taken from six places and at depths of from one to three feet. A hard soil (hard pan) occurs at from 16 to 36 inches from the surface and varies in thickness from two inches to about two feet. Loose rock appears at depths of from 2½ to 5 feet, with occasional layers of sand below and mixed with the loose rock. The soil rests on lava.

The mechanical analysis shows these soils to be not greatly different in texture from those of the Boise Valley.

The most marked chemical characteristic is the high lime and carbon dioxide content. All the mineral plant foods occur in large amounts.

These soils are slightly alkaline A determination of the soluble salt content of this sample showed .020 per cent soluble in water. The soluble salts consist largely of sodium carbonate (black alkali) with sulphates and a little chloride. This amount is far below the limit of tolerance for crops and hence with good drainage and proper cultivation no trouble may be expected.

The humus and nitrogen precentages are low.

Laboratory Number 5.

Marked "Cassia County No. 2."

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	.79
Coarse sand	2. to .5	2.26
Sand	.5 to .05	62.74
Silt	.05 to .005	29.04
Clay	.005 and less.	.89
Loss on ignition		4.42

CHEMICAL ANALYSIS.

Insoluble matter	76.310	81.766
Soluble silica	5.456	
Potash (K_2O)		.695
Soda (Na_2O)		.407
Lime (CaO)		1.870
Magnesia (MgO)		1.322
Manganese oxide (MnO)		.025
Ferric oxide (Fe_2O_3)		3.051
Alumina (Al_2O_3)		5.858
Phosphorus pentoxide (P_2O_5)		.137
Sulphur trioxide (SO_3)		trac

Carbon dioxide (CO_2)	.911
Water and organic matter	4.424
Total	100.466
Humus	.734
Nitrogen	.093
Hygroscopic moisture	1.893

No. 5. This soil shows no material difference from No. 4 and what was said of that applies equally to this.

Laboratory Number 6.

Marked "Cassia County No. 3."

CHEMICAL ANALYSIS.

Insoluble matter 49.886, Soluble silica 14.256	64.142
Potash (K_2O)	.558
Soda (Na_2O)	.601
Lime (CaO)	11.513
Magnesia (MgO)	2.743
Manganese oxide (MnO)	.019
Ferric oxide (Fe_2O_3)	2.535
Alumina (Al_2O_3)	5.477
Phosphorus pentoxide (P_2O_5)	.137
Sulphur trioxide (SO_3)	trace
Carbon dioxide (CO_2)	8.763
Water and organic matter	4.622
Total	101.110
Humus	.552
Nitrogen	.045
Hygroscopic moisture	2.203
Total alkali salts soluble in water	.160
Sodium carbonate (black alkali)	.072

No. 6. This is the subsoil to Nos. 4 and 5 and is described in connection with No. 4.

Its most prominent characteristic is the very high percentage of lime and carbon dioxide. This is due to the so-called hard pan formation which it contains and which consists mainly of calcium carbonate. These calcareous hard pans are quite common in arid regions and are formed from clay and other fine soil particles firmly cemented into a rock like mass by calcium carbonate.

The total alkali salts soluble in water amount to .160 per cent and the sodium carbonate (black alkali) to .072 per cent. This places the soil at about the maximum limit compatible with a full yield of such crops as barley as determined by Hilgard. In other words there need be no trouble experienced unless these salts become concentrated at the surface.

The excessively high percentage of lime carbonate will limit the usefulness of the soil as some crops are sensitive to its presence in large quantities. In other respects the soil shows proper amounts of the mineral plant foods.

Laboratory Number 7.

Marked "Surface soil No. 1."

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT
Gravel	Larger than 2.	4.06
Coarse sand	2. to .5	45.95
Sand	.5 to .05	30.28
Silt	.05 to .005	13.58
Clay	.005 and less.	.62
Loss on ignition		5.75

CHEMICAL ANALYSIS.

Insoluble matter 75.173, Soluble silica 6.520		81.693
Potash (K_2O)		.440
Soda (Na_2O)		.239
Lime (CaO)		.533
Magnesia (MgO)		1.290
Manganese oxide (MnO)		.038
Ferric oxide (Fe_2O_3)		3.563
Alumina Al_2O_3)		6.471
Phosphorus pentoxide (P_2O_5)		.188
Sulphur trioxide		.....
Carbon dioxide		.070
Water and organic matter		5.750
Total		100.275
Humus		1.747
Nitrogen		.090
Hygroscopic moisture		1.540

No. 7. This sample was sent to the Station by Jas. Reid, of Coeur d' Alene, and is a representative of the timber soils. It is a composite sample taken to a depth of from 7 to 8 inches and represents the average surface soil of this locality. It is of fairly uniform texture to a considerable depth though in some places a "little loom can be found to 4 or 5 feet."

During the dry summer months no apparent moisture was found in uncultivated land within two feet of the surface and only very little at greater depths.

Mr. Reid says: "There has been so little farming done on our timber lands, which constitute at least 7/8 of our land that there is little or nothing in past experience to give light on their value."

The mechanical analysis shows this to be an extremely light sandy or gravelly soil containing a little silt and a very small amount of clay. Fully one half of the soil is composed of particles too large to play any part in plant nutrition. Such a light open soil permits free percolation of water into the subsoil during the rainy season and prevents its return to the surface by capillarity during drought. Soils of this type have very slight capacity for retaining moisture. For comparison, the average physical composition of Maryland truck soils, which are considered rather coarse, is here given.

CONVENTIONAL NAME	DIAMETERS IN MILLIMETERS.	PER CENT.
Gravel	Larger than 2.	.....
Coarse sand	2. to .5	6 28
Sand	.5 to .05	73.40
Silt	.05 to .005	14.63
Clay	.005 and less.	4.05

The chemical analysis shows this soil to be for the most part, well stocked with mineral plant food. Considered in connection with its very coarse texture, the percentages are usually high for the humid regions except in the case of lime. It is quite probable that there is a deficiency of lime. While the soil contains many times more ultimately available potash and phosphoric acid than the average fertile soil, its lime content is below the normal figure To keep sufficient quantities of these materials in an immediately available condition in the presence of so much alumina (which is rather high for such a light soil) would require more lime.

The humus content is fair but there is a rather low percentage of nitrogen.

If the soil is to be productive its texture must be altered by the introduction of organic matter, nitrogen must be supplied and a lime dressing would probably prove beneficial.

Laboratory Number 8.

Marked "Subsoil No. 1."

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	4.71
Coarse sand	2. to .5	49.29
Sand	.5 to .05	31.48
Silt	.05 to .005	11.09
Clay	.005 and less.	.45
Loss on ignition		2.98

CHEMICAL ANALYSIS.

Insoluble matter 75.771, Soluble silica 8.850	}	84.621
Potash (K_2O)		.476
Soda (Na_2O)		.301
Lime (CaO)		.415
Magnesia (MgO)		1.543
Manganese oxide (MnO)		.016
Ferric oxide (Fe_2O_3)		3.645
Alumina (Al_2O_3)		5.914
Phosphorus pentoxide (P_2O_5)		.120
Sulphur trioxide (SO_3)		......
Carbon dioxide (CO_2)		.019
Water and organic matter		2.977
Total		100.047
Humus		.455
Nitrogen		.032
Hygroscopic moisture		1.183

No. 8. This sample is the subsoil to No. 7. It was taken at a depth of from 8 to 24 inches below the surface.

The mechanical analysis shows a slight increase in coarseness with increasing depth.

It contains a little more potash than the surface soil but the remaining forms of plant food are present in less amount.

Laboratory Number 9.

Marked "Surface soil No. 2."

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	13.99
Coarse sand	2. to .5	45.60
Sand	.5 to .05	22.80
Silt	.05 to .005	11.56
Clay	.005 and less.	.24
Loss on ignition		5.81

CHEMICAL ANALYSIS.

Insoluble matter	72.859	80.471
Soluble silica	7.612	
Potash (K_2O)		.467
Soda (Na_2O)		.180
Lime (CaO)		.432
Magnesia (MgO)		1.527
Manganese oxide (MnO)		.030
Ferric oxide (Fe_2O_3)		3.949
Alumina (Al_2O_3)		6.403
Phosphorus pentoxide (P_2O_5)		.205
Sulphur trioxide (SO_3)		trace
Carbon dioxide (CO_2)		.059
Water and organic matter		5.811
Total		99.534
Humus		1.973
Nitrogen		.103
Hygroscopic moisture		1.680

No. 9. This sample is from the same source as No. 7. Mr. Reid describes it as being a surface soil and very much like No. 8, but coarser and with different vegetation.

Its mechanical analysis shows it to be of the same type as No. 7, but composed of larger particles and with even less clay. It contains more potash and phosphoric acid than No. 7, but less lime, so there is probably little difference in the amounts of these substances available to plants. The phosphoric acid content is among the highest found in Idaho soils. The humus and nitrogen, while present in fair amount, are probably not well distributed but occur in the extreme surface layer.

Laboratory Number 10.

Marked "Subsoil No. 2."

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	16.61
Coarse sand	2. to .5	40.65
Sand	.5 to .05	28.82
Silt	.05 to .005	9.35
Clay	.005 and less.	.24
Loss on ignition		3.54

CHEMICAL ANALYSIS.

Insoluble matter	78.407	83.271
Soluble silica	4.864	
Potash (K_2O)		.499
Soda (Na_2O)		.272
Lime (CaO)		.278
Magnesia (MgO)		1.692
Manganese oxide (MnO)		.016
Ferric oxide (Fe_2O_3)		4.073
Alumina (Al_2O_3)		6.264
Phosphorus pentoxide (P_2O_5)		.152
Sulphur trioxide (SO_3)		.....
Carbon dioxide (CO_2)		.024
Water and organic matter		3.539
Total		100.080

Humus	.587
Nitrogen	.042
Hygroscopic moisture	1.283

No. 10. This sample is the subsoil to No. 9.

Mechanical analysis shows increasing coarseness in the subsoil as in Nos. 7 and 8.

Both potash and phosphoric acid are present in large amount but the lime content is very low. In other respects the soil does not differ materially from the others of this section.

Analysis, both mechanical and chemical, shows these soils to be very much alike and not very promising for general farming. All are gravelly and contain abundant supplies of the very essential potash and phosphoric acid but are low in humus, nitrogen and lime.

It has been generally found true that soils containing relatively small percentage of lime and large amounts of magnesia are not very productive. Sometimes these are found to be benefited by liming.

The extremely coarse texture of the soils and subsoils will however prove their worst feature. In this locality where most of the rainfall occurs during the winter months and where irrigation is not as yet practiced, the soils, to sucessfully withstand the summer droughts, must be of such a nature that they can store up the moisture of the rainy season and return it to the surface in the summer. These coarse soils, however, simply allow the water to percolate through them and are without capacity for its retention. The soil would be much improved, however, by introducing nitrogenous organic matter, by green manuring or other method, with perhaps a lime dressing. A large amount of organic matter will do much to modify its excessive coarseness beside supplying the much needed humus and nitrogen.

Laboratory Number 11.

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	none
Coarse sand	2. to .5	.40
Sand	.5 to .05	42.74
Silt	.05 to .005	46.82
Clay	.005 and less.	2.28
Loss on ignition		7.79

CHEMICAL ANALYSIS.

Insoluble matter 73.610 } Soluble silica 5.369 }	78.979
Potash (K_2O)	.459
Soda (Na_2O)	.188
Lime (CaO)	.507
Magnesia (MgO)	.905
Manganese oxide (MnO)	.025
Ferric oxide (Fe_2O_3)	4.122
Alumina (Al_2O_3)	6.965
Phoshorus pentoxide (P_2O_5)	.188
Sulphur trioxide (SO_3)	.....
Carbon dioxide (CO_2)	.033
Water and organic matter	7.794
Total	100.095
Humus	3.382
Nitrogen	.190
Hygroscopic moisture	2.410

No. 11. This is the surface soil from Mr. H. A. Russell's ranch one mile south of Southwick, Nez Perces county. It is a basaltic silt soil and its mechanical analysis shows the characteristic features of this class of soils. Almost the entire soil is included in the two divisions of fine sand and silt, the division between the two being very nearly equal. There is very little clay

but sufficient to prevent locseness and insure a good water capacity. The occurrence of gravel and coarse sand in these soils is probably accidental as the majority show none.

Chemically, this is a very strong soil. It is well stocked with potash and phosphoric acid, while its humus and nitrogen content is all that could be desired. In regard to lime, however, it is little better than the Coeur d'Alene soils though its magnesia content is lower. While it cannot be said that there is a deficiency of lime, its use will probably be necessary to prevent the gradual "wearing out" of the soil. With proper methods of cultivation and due regard for the maintenance of the humus and nitrogen, probably no other fertilizers than a lime dressing will be required within any reasonable length of time.

Laboratory Number 12.

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	none
Coarse sand	2. to .5	none
Sand	.5 to .05	46.96
Silt	.05 to .005	46.25
Clay	.005 and less.	.55
Loss on ignition		6.24

CHEMICAL ANALYSIS.

Insoluble matter	72.397	79.132
Soluble silica	6.735	
Potash (K_2O)		.684
Soda (Na_2O)		.313
Lime (CaO)		.557
Magnesia (MgO)		.997
Manganese oxide (MnO)		.022

Ferric oxide (Fe_2O_3)	4.211
Alumina (Al_2O_3)	7.498
Phosphorus pentoxide (P_2O_5)	.157
Sulphur trioxide (SO_3)	......
Carbon dioxide (CO_2)	.037
Water and organic matter	6.240
Total	99.848
Humus	2.087
Nitrogen	.138
Hygroscopic moisture	2.243

No. 12. From H. A. Russell's ranch, American Ridge. This soil, composed of almost equal parts fine sand and silt, with no coarse material and very little clay, with its high percentages of potash, phosphoric acid, humus and nitrogen and low lime content, is a typical example of the Palouse and Potlatch soils.

It is very fertile though does not yield quite as well as No. 11. The main point of difference as shown by analysis is in the humus and nitrogen content which is much larger in No. 11 than in No. 12.

Laboratory Number 13.

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT
Gravel	Larger than 2.	none
Coarse sand	2. to .5	none
Sand	.5 to .05	45.22
Silt	.05 to .005	47.43
Clay	.005 and less.	.84

Loss on ignition 6.51

CHEMICAL ANALYSIS.

Insoluble matter 66.701 / Soluble silica 12.133	78.834
Potash (K_2O)	.673
Soda (Na_2O)	.198
Lime (CaO)	.722
Magnesia (MgO)	1.019
Manganese oxide (MnO)	.038
Ferric oxide (Fe_2O_3)	4.311
Alumina (Al_2O_3)	7.271
Phosphorus pentoxide (P_2O_5)	.131
Sulphur trioxide (SO_3)	......
Carbon dioxide (CO_2)	.031
Water and organic matter	6.509
Total	99.737
Humus	2.273
Nitrogen	.135
Hygroscopic moisture	2.356

No. 13. Surface soil from Mr. Hutchinson's ranch near Kendrick, Latah county.

In general this soil is quite similar to No. 12 except that it contains more lime. It is worthy of note that this soil and No. 14 contain about twice as much soluble silica as the average Palouse soil. While this item does not furnish any very reliable or valuable information, it gives a rough measure of the extent to which the silicates of the soil are decomposed and thus in absence of much alumina and clay, indicates the presence of the so called zeolites which are supposed to play a very inportant part in the process of humification and fixation.

Laboratory Number 14.

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	2.21
Coarse sand	2. to .5	1.66
Sand	.5 to .05	47.01
Silt	.05 to .005	40.06
Clay	.005 and less.	1.31
Loss on ignition		7.74

CHEMICAL ANALYSIS.

Insoluble matter	65.910	77.690
Soluble silica	11.780	
Potash (K_2O)		.557
Soda (Na_2O)		.292
Lime (CaO)		.767
Magnesia (MgO)		.802
Manganese oxide (MnO)		.022
Ferric oxide (Fe_2O_3)		4.258
Alumina (Al_2O_3)		7.698
Phosphorus pentoxide (P_2O_5)		.206
Sulphur trioxide (SO_3)		......
Carbon dioxide (CO_2)		.026
Water and organic matter		7.739
Total		100.057
Humus		2.189
Nitrogen		.162
Hygroscopic moisture		2.240

No. 14. Surface soil from the Harris place near Kendrick, Latah county. The general composition of this soil is quite similar to No. 13. It has a much higher phosphoric acid content, ranking second in this respect, of the soils thus far analyzed. Physically it is of slightly coarser texture than the majority of the soils of this class.

In general the same remarks apply to it that were made in connection with Nos. 11 and 13.

Laboratory Number 15.

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	none
Coarse sand	2. to .5	3.88
Sand	.5 to .05	85.69
Silt	.05 to .005	7.52
Clay	.005 and less.	none
Loss on ignition		2.91

CHEMICAL ANALYSIS.

Insoluble matter	80.504	
Soluble silica	5.782	86.286
Potash (K_2O)		.526
Soda (Na_2O)		.181
Lime (CaO)		.872
Magnesia (MgO)		1.150
Manganese oxide (MnO)		.012
Ferric oxide (Fe_2O_3)		3.442
Alumina Al_2O_3)		4.536
Phosphorus pentoxide (P_2O_5)		.148
Sulphur trioxide		......
Carbon dioxide		.075
Water and organic matter		2.914
Total		100.142
Humus		.746
Nitrogen		.062
Hygroscopic moisture		.813

No. 15. From S. G. Isaman's prune orchard on an island in the Clearwater river, Lewiston.

This soil is practically river sand and mica. Its mechanical analysis shows very little silt and no clay. In texture it corresponds closely with some of the early truck soils of the west and the sand dunes of the Pecos Valley, New Mexico. The latter soil is found to be particularly suited to melons, potatoes and small fruits. Experience has shown this Lewiston soil to be an exceptionally good prune soil.

From a chemical point of view it is a very strong soil considering its light character. This is especially true of its phosphoric acid as this substance is usually quite low in very light sandy soils. It contains very little organic matter and humus and is probably deficient in nitrogen.

Owing to its sandy nature and the absence of organic matter, the soil has slight water capacity, but in this case (as the soil is subirrigated from the Clearwater river) this is not an essential.

Laboratory Number 16.

CHEMICAL ANALYSIS.

Insoluble matter	74.775	80.465
Soluble silica	5.690	
Potash (K_2O)		.563
Soda (Na_2O)		.247
Lime (CaO)		.939
Magnesia (MgO)		.886
Manganese oxide (MnO)		.009
Ferric oxide (Fe_2O_3)		4.009
Alumina (Al_2O_3)		6.157
Phosphorus pentoxide (P_2O_5)		.192
Sulphur trioxide (SO_3)		.....
Carbon dioxide (CO_2)		.041

Water and organic matter	6.250
Total	99.886
Humus	3.103
Nitrogen	.159
Hygroscopic moisture	2.010

No. 16. This sample is surface soil from the unfertilized plats on the University campus. It is a representative sample of the Palouse type of soils. There is an abundant supply of all the plant foods. The lime content is good though not large. The humus content is excellent and the nitrogen sufficient.

Laboratory Number 17.

CHEMICAL ANALYSIS.

Insoluble matter	73.971	80.538
Soluble silica	6.567	
Potash (K_2O)		.552
Soda (Na_2O)		.277
Lime (CaO)		.793
Magnesia (MgO)		.918
Manganese oxide (MnO)		trace
Ferric oxide (Fe_2O_3)		3.111
Alumina (Al_2O_3)		7.773
Phosphorus pentoxide (P_2O_5)		.141
Sulphur trioxide (SO_3)		....
Carbon dioxide (CO_2)		.028
Water and organic matter		5.467
Total		99.598
Humus		3.068
Nitrogen		.116
Hygroscopic moisture		2.273

No. 17. Subsoil to No. 16.

It is characteristic of these basaltic silt soils that there is no line of demarcation between the soil and subsoil. In the absence of this dividing line, surface soils were taken to a depth of 12 inches and subsoils to 24 inches.

The analyses reveal very little difference between the surface and subsoil. It is noteworthy that some of these subsoils contain over twice as much humus as many of the most fertile surface soils of other types.

Laboratory Number 18.

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	.27
Coarse sand	2. to .5	.55
Sand	.5 to .05	33.51
Silt	.05 to .005	54.37
Clay	.005 and less.	2.94
Loss on ignition		8.36

CHEMICAL ANALYSIS.

Insoluble matter	73.584	78.849
Soluble silica	5.265	
Potash (K_2O)		.677
Soda (Na_2O)		.418
Lime (CaO)		.999
Magnesia (MgO)		.766
Manganese oxide (MnO)		trace
(e_2O_3)		3.719
Alumina (Al_2O_3)		6.237
Phosphorus pentoxide (P_2O_5)		.176

Sulphur trioxide (SO_3)	....
Carbon dioxide (CO_2)	.037
Water and organic matter	8.365
Total	100.243
Humus	3.975
Nitrogen	.212
Hygroscopic moisture	1.893

No. 18. This sample is surface soil from one of the Station plats adjacent to that from which No. 16 was taken. The plat was heavily manured three years ago with stable manure.

The effect of the fertilizer is especially noticeable in the increased percentages of potash, humus and nitrogen.

While the percentage of phosphoric acid in No. 18 is less than in No. 16 it is probable that the fertilized soil contains more of this substance in an available form.

Last year these Station plats were used for sugar beet experiments and it was found that the yield from soil No. 18 was over twice that from soil No. 16.

This sample contains the highest percentages of humus and nitrogen of the Idaho soils thus far analyzed.

Laboratory Number 19.

MECHANICAL ANALYSIS.

CONVENTIONAL NAME	DIAMETERS IN MILLIMETERS.	PER CENT.
Gravel	Larger than 2.	none
Coarse sand	2. to .5	.37
Sand	.5 to .05	45.95
Silt	.05 to .005	46.03
Clay	.005 and less.	.50
Loss on ignition		7.15

CHEMICAL ANALYSIS.

Insoluble matter 73.919 Soluble silica 6.118		80.037
Potash (K_2O)		.559
Soda (Na_2O)		.211
Lime (CaO)		.901
Magnesia (MgO)		.752
Manganese oxide (MnO)		.015
Ferric oxide (Fe_2O_3)		3.760
Alumina (Al_2O_3)		6.415
Phosphorus pentoxide (P_2O_5)		.189
Sulphur trioxide (SO_3)		....
Carbon dioxide (CO_2)		.047
Water and organic matter		7.147
Total		100.033
Humus		3.328
Nitrogen		.156
Hygroscopic moisture		1.730

No. 19. This sample is the subsoil to No. 18. It shows no additional features to those noted in connection with No 17. It would make an excellent surface soil just as it occurs.

Laboratory Number 20.

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	.35
Coarse sand	2. to .5	2.50
Sand	.5 to .05	41.07
Silt	.05 to .005	48.14
Clay	.005 and less.	3.34
Loss on ignition		4.60

CHEMICAL ANALYSIS.

Insoluble matter 73.475 / Soluble silica 6.685	80.160
Potash (K_2O)	.789
Soda (Na_2O)	.671
Lime (CaO)	1.567
Magnesia (MgO)	1.090
Manganese oxide (MnO)	.010
Ferric oxide (Fe_2O_3)	5.289
Alumina (Al_2O_3)	5.582
Phosphorus pentoxide (P_2O_5)	.237
Sulphur trioxide (SO_3)	.020
Carbon dioxide (CO_2)	.556
Water and organic matter	4.602
Total	100.573
Humus	1.380
Nitrogen	.071
Hygroscopic moisture	2.876

No. 20. This sample represents the surface soil from the prune orchard of Dr. H. P. Ustick, of Boise.

It is an irrigated soil of a light brown color and in texture is rather more like the silt soils of the Palouse than the Boise Valley soils thus far examined. It, however, contains more coarse material and more clay than they.

So far as the mineral plant food is concerned, this is one of the richest soils thus far analyzed. The potash, lime and phosphoric acid are present in amounts sufficient to insure high fertility for a long period of time. The nitrogen seems low, but all the Boise Valley soils thus far analyzed show a similarly low nitrogen content and in view of insufficient data it cannot be said definitely whether they are deficient or not. It seems highly probable, however, that an increased nitrogen percentage would prove beneficial. The humus content is very good for the arid region. The rather high percentage of soda suggests the possibility of slight alkalinity, though this was not tested.

This soil ranks first in its percentage of phosphoric acid.

Laboratory Number 21.

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	15.53
Coarse sand	2. to .5	31.28
Sand	.5 to .05	29.35
Silt	.05 to .005	19.00
Clay	.005 and less.	.68
Loss on ignition		4.17

CHEMICAL ANALYSIS.

Insoluble matter 78.715, Soluble silica 3.310	82.025
Potash (K_2O)	.896
Soda (Na_2O)	.214
Lime (CaO)	.893
Magnesia (MgO)	1.006
Manganese oxide (MnO)	.025
Ferric oxide (Fe_2O_3)	4.689
Alumina Al_2O_3)	5.628
Phosphorus pentoxide (P_2O_5)	.184
Sulphur trioxide (SO_3)	trace
Carbon dioxide (CO_2)	.032
Water and organic matter	4.169
Total	99.761
Humus	1.499
Nitrogen	.090
Hygroscopic moisture	2.600

No. 21. This is a typical surface soil of the Boise Valley from the prune orchard of J. D. Riggs, of Boise.

Physically these soils are characterized by their uniformly light brown color, their high percentage of sand, mostly of rather coarse quality, their moderate silt content and low percentage of clay.

Chemically, the soils are very rich in mineral plant food especially potash and phosphoric acid and usually lime. The low content of soluble selica is in accordance with their sandy nature and is characteristic of the arid soils not containing large amounts of lime.

The relatively low content of soda indicates better drainage than is the case with No. 20, probably partially accounted for by the much coarser texture of this soil.

Laboratory Number 22.

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	.56
Coarse sand	2. to .5	9.00
Sand	.5 to .05	69.84
Silt	.05 to .005	16.79
Clay	.005 and less.	1.04
Loss on ignition		2.76

CHEMICAL ANALYSIS.

Insoluble matter	87.151	88.813
Soluble silica	1.662	
Potash (K_2O)		.459
Soda (Na_2O)		.134
Lime (CaO)		.465

Magnesia (MgO)	.535
Manganese oxide (MnO)	trace
Ferric oxide ($Fe_2 \; _3$)	2.780
Alumina (Al_2O_3)	4.172
Phosphorus pentoxide (P_2O_5)	.141
Sulphur trioxide (SO_3)	trace
Carbon dioxide (CO_2)	.102
Water and organic matter	2.764
Total	100.365
Humus	.930
Nitrogen	.083
Hygroscopic moisture	1.130

No. 22. Surface soil from the prune orchard of A. McPherson, Boise.

This soil is not markedly different from the preceding except in its content of potash and lime, both of which are comparatively low for this region. There is, however, by no means a deficiency of potash, though more lime might be beneficial.

In other respects the remarks made in regard to No. 21 apply to this soil.

Laboratory Number 23.

MECHANICAL ANALYSIS.

CONVENTIONAL NAMES	DIAMETER IN MILLIMETERS	PER CENT.
Gravel	Larger than 2.	.26
Coarse sand	2. to .5	2.19
Sand	.5 to .05	65.17
Silt	.05 to .005	27.00
Clay	.005 and less.	1.98
Loss on ignition		4.06

CHEMICAL ANALYSIS.

Insoluble matter 82.433 } Soluble silica 1.750 }	84.183
Potash (K_2O)	.572
Soda (Na_2O)	.164
Lime (CaO)	.780
Magnesia (MgO)	.831
Manganese oxide (MnO)	.021
Ferric oxide (Fe_2O_3)	3.982
Alumina (Al_2O_3)	5.010
Phosphorus pentoxide (P_2O_5)	.143
Sulphur trioxide (SO_3)	trace
Carbon dioxide (CO_2)	.031
Water and organic matter	4.063
Total	99.780
Humus	1.015
Nitrogen	.062
Hygroscopic moisture	2.460

No. 23. Surface soil from the prune orchard of Rugg and Eichelberger, Boise.

This soil resembles No. 22 but probably contains a sufficient supply of lime.