HYDROGEN-ION REACTION OF NATIVE INDIANA FERN SOILS

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This paper is only the minor beginnings of what is intended in this research. One could collect and test for years and still be undecided about the exact acid and alkaline tolerance span of each of our Indiana ferns.

Three samples of ferns and of root soils of each species are collected from three different places in the same locality. Each frond is pressed and labeled as to county in which it was collected, date, type of association and soil. Each soil sample is placed in a sack and labeled as above also. The fronds are collected for herbarium sheets while the soils are obtained for tests which are made in the laboratory.

The Youden Hydrogen-ion Consentration apparatus is used in determining the acidity of these soil samples. The e.m.f. in volts are then converted into pH results. These results from the three separate samples of each species from each locality are tabulted and averaged on a card. Of course the more collecting done the more cards one will have for each species and the more accurate the tolerance range can be determined.

So far in this research definite conclusions are hard to draw. No species have been found in superacid soils. Certain species though, like *Aspidium cristatum* (Crested wood fern) and *Osmunda cinnamomea* (Cinnamon fern) are found to grow in highly mediacid soils. With more collecting they may be found in low superacid soils. *Dicksonia punctilobula,* (Hay scented) *Pteris aquilina* (Common Brake) *Polypodium vulgare,* (Polypody) and *Osmunda regalis* (Royal) are found limited to mediacid region but it is felt that there is a much broader variation here than what is shown. Other species such as *Ophiglossum vulgatum* (Adder's tongue) *Aspidium spinulosum, Woodsia obtusa* (Rusty) *Aspidium marginale,* (Marginal shield) and *Osmunda Claytoniana* (Interrupted) are found in subacid soils—the two later are low in subacid or nearly high minimacid. Aspidia as a rule show a broad range. There is no one species found limited to a highly alkaline soil but there are various species as *Aspidium Thelypteris* (Swamp) and *Polystichium acrostiochoides,* var. *Schweinitzii* which have a very broad tolerance from minimalkaline up to mediacid in the former and subacid in the latter. The wide variation of the swamp fern is not to be considered surprising since it is often found in a rather high acid soil with peaty substrata or growing more often in a foot or so of water. *Polystichium acrostiochoides* var. *Schweinitzii* shows a broad circumneutral range, yet *Aspidium Goldianum* (Goldie's Wood fern) grows in a low minimalkaline soil and has a narrow range in so far as the reactions to date denote.

Two species of the same genus, *Cystopteris fragiles* (Fragile) and *Cystopteris bulbifera* (Bladder), plus *Asplemium platyneuron* (Ebony spleenwort) and possibly *Polystichium acrostiochoides* all show a range of weak alkaline to a weak acid soil reaction. The latter found in various localities of Indiana indicates that it is on the average a subacid plant but which also has a low alkaline limit. *Onoclea sensibilis* (Sensitive) and *Botrychium virginianum* (Rattlesnake fern) reveal a

broad soil tolerance from subacid to a strong alkaline strata. In between the extremes there are a few ferns that show a broad range but on the average they are minimacid soil plants. These include *Asplenium filix-femina* (Lady fern), *Camptosorus rhizophyllus* (Walking fern), *Asplenium acrostichoides* (Silver spleenwort), *Phegopteris hexagonoptera* (Beech), *Adantum pedatum* (Maiden-hair), and *Asplenium angustifolium* (the Narrow-leaved spleenwort).

From localities found it seems that the walking fern and the narrow-leaved spleenwort should be more nearly alkaline but so far results do not show it.

It will be interesting to note how the next collection of ferns will change or verify the present results.

The following is a table showing present results.

SPECIES (Nomenclature after Gray's Manual, 7th Ed.)	Number of Samples	pH Range	Characteristic Reaction	Natural Type of Association and Soil of the species
1. Adiantum pedatum (Maiden-hair fern)	9	5.8-7.3	High minimacid	Various mesophytic woodlands drained soils.
2. Aspidium cristatum (Crested wood fern)	3	4.3-4.5	High mediacid	Interior of bog thicket with Rhus vernix, Populus tremuloides. Peat substratum.
3. Aspidium Goldianum (Goldie's Wood fern)	3	7.0-7.3	Low minimalkaline	Rocky and wooded river valley. Damp shaded; alkaline drained soil.
4. Aspidium marginale (Marginal shield-fern)	6	5.4-6.5	Low subacid	Low mesophtic woodland and cliffs. Washed, drained, clay loam soils.
5. Aspidium noveboracense (New York fern)	6	4.9-6.6	Subacid	Various beech and maple woodlands. Well drained silt.
6. Aspidium spinulosum	6	4.3-6.2	High subacid	Interior of bog thicket and sandy cliff base. Damp or peaty substrata.
7. Aspidium Thelypteris (Swamp fern)	9	4.4-7.2	Low subacid	In wet meadows around bog margins and in boggy spring area. Peat and muck soils.
8. Asplenium acrostichoides (Silver Spleenwort)	7	4.5-7.6	High minimacid	Dense growth of beech, maple, poplar, etc. Well drained, rich clay loam.
9. Asplenium angustifolium (Narrow-leaved spleenwort)	6	6.6-6.8	Minimacid	Low wooded creek bottoms or slopes. Soil damp, sandy loam.
10. Asplenium Filix-femina (Lady fern)	9	5.4-6.7	Minimacid	Wooded upland and hillsides with Beech fern, etc. Sandy clay loam.
11. Asplenium platyneuron (Ebony Spleenwort)	9	6.0-7.6	Low minimacid	Wooded underbrush of hillsides and cliff base. Sandy shale, dry.
12. Botrychium virginianum (Rattlesnake fern)	10	5.4-7.1	High minimacid	Woodland. Shale and clay loam.
13. Camptosorus rhizophyllus (Walking Leaf fern)	3	6.4-6.6	Minimacid	On rocks or cliffs in damp and shady gorge. Leafmold and sandy loam.
14. Cystopteris bulbifera (Bladder fern)	4	6.7-7.6	Low minimalkaline	Deep and damp wooded gorge. Leafmold and sandy shaled cliffs.

SPECIES (Nomenclature after Gray's Manual, 7th Ed.)	Number of Samples	pH Range	Characteristic Reaction	Natural Type of Association and Soil of the species
15. Cystopteris fragilis (Fragile fern)	13	6.1-7.7	Low minimacid	Scattered from wooded upland to lowland weedy patches. From damp to well drained clay loam.
16. Dicksonia punctilobula (Hay scented fern)	3	4.9-5.0	Low mediacid	Growing rank on wooded well-drained hillsides in sun or shade. Red sandy soils.
17. Onoclea sensibilis (Sensitive fern)	16	5.4-7.8	Minimacid	Open, high and sloping hillsides and at marsh edge with Salix nigra. Rich loam or peat substrata.
18. Ophiglossum vulgatum (Adder's Tongue fern)	3	5.2-6.0	Subacid	Sassafras-aspen thicket on hillside. Poor clay loam not well drained.
19. Osmunda cinnamomea (Cinnamon fern)	3	4.3-4.5	Mediacid	Interior of bog thicket. Sandy clay and peat substrata.
20. Osmunda Claytoniana (Interrupted fern)	6	5.5-6.1	Low subacid	Shaded wooded hillsides. Damp shale and sandy clay.
21. Osmunda regalis (Royal fern)	3	4.5-4.7	Mediacid	In wet meadows and interior of bog thicket. Muck and peat substrata.
22. Phegopteris hexagonoptera (Beech fern)	12	4.8-7.9	High minimacid	Open or dense sloping woodland. Maple, beech and oak. Drained silt and clay loam.
23. Polypodium vulgare (Polypody or Hardy Cliff fern)	4	4.4-4.9	Mediacid	Overhanging rocky cliff. Sandy loam soil.
24. Polystichium acrostichoides (Christmas fern)	12	5.3-7.4	Minimacid	Everywhere on hillsides and wooded glens. Clay or silt well drained.
25. Polystichium acrostichoides var Schweinitzii	8	6.0-8.0	Circumneutual	Low floodplain or shaded hillside. Silt or clay well drained.
26. Pteris aquilina (Common Brake fern)	3	4.4-4.6	Mediacid	Wooded rock cliff. Damp shale.
27. Woodsia obtusa (Rusty fern)	3	6.3-6.9	Minimacid	Beech, maple woods. Well drained silt.

In conclusion it can be said that the type of ecological investigation here undertaken finds immediate practical application in fern culture. With knowledge of the native soil types, with special reference to acidity, and of the vegetation types with which the various species are most frequently associated, greater assurance of success can be had in the cultivation of many highly desirable native species of ferns.

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