

PHYTOPATHOLOGICAL NOTES

Quantitative Interferometry of Epidermal Nuclei of *Podophyllum peltatum* in Response to *Puccinia podophylli*

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ABSTRACT

Infection of *Podophyllum peltatum* by *Puccinia podophylli* produced a 7% increase in nuclear area (x.s.), an 18% decrease in nuclear dry matter concn, and a 14% decrease in total nuclear dry matter of host epidermal cells below infected mesophyll when compared to cells from adjacent "normal" epidermis. *Phytopathology* 61:237-238.

Swelling followed by shrinkage (pynosis) of host nuclei has been described as generally occurring during fungus infections (1, 3). Swelling is associated with increased host metabolic activity, and varies in duration according to the nature of the disease, whereas pynosis is associated with terminal aspects of a disease. Kulfinski & Pappelis described epidermal nuclear area (NA) decrease in onion bulb scales in response to neckrot fungi (6) and NA and nuclear dry mass (NDM) decreases in cells of the same host tissue due to *Botrytis allii* (4, 5). They also described slight increases in host NA at some distance from the infection. Since the fungal pathogens studied in onion produced disease symptoms and death in host tissue very quickly, it was decided to perform the present study to determine the effects of an obligate fungal parasite acting over a long period of time, for purpose of comparison.

MATERIALS AND METHODS.—*Podophyllum peltatum* L. leaves naturally infected with *Puccinia podophylli* Schw. (aecial stage) were found in Thompson Woods on the campus of Southern Illinois University, Carbondale, and studied in late May 1968. Nuclei in cells of the lower epidermis which covered rust pustules (yellow regions) were compared with those of adjacent epidermis (green regions) over nonpustulate areas. Cells were randomly selected for study from epidermal strips approximately 1 × 0.5 cm in size. Seven replicates were employed, each one from a different leaf, and five nuclei were measured in each sample of epidermis removed. Nuclei were photographed using a Leitz Orthomat camera, photographic negatives were projected, nuclear images were traced, and NA was determined from each tracing by means of a planimeter. Retardation values were obtained using a Leitz Interference microscope, and these were converted to concn

TABLE 1. Mean nuclear area (NA), nuclear dry matter concn (DM/A), and dry mass per nucleus (NDM) of epidermal cells of *Podophyllum peltatum* over pustules produced by *Puccinia podophylli* (P) and from epidermal cells adjacent to pustules (C)

Location of nuclei	Nuclear characteristics ^a		
	NA cm ² × 10 ⁻⁷	DM/A g/cm ² × 10 ⁻⁵	NDM g × 10 ⁻¹¹
P	11.5 ^a	16.1 ^a	18.0 ^a
C	10.7	19.6	20.8
P/C%	107%	82%	86%

^a Each mean represents 35 subsamples obtained from seven replications. Means for characteristics of nuclei over pustules are also expressed as a per cent of those for nuclei in adjacent tissues (P/C%).

of dry matter per unit area (DM/A) according to the computations described by Beneke (2) using $\alpha = 0.0018$ and light of $\lambda = 546$ nm. NA was multiplied by DM/A to yield NDM.

RESULTS AND DISCUSSION.—Mean values of nuclear measurements in absolute quantities and percentages are presented in Table 1. Nuclei in host epidermal tissue over pustules were 7% greater in NA than those in adjacent tissue, although they were 18% lower in DM/A and 14% lower in NDM.

Correlation coefficients (r) were determined for pairs of nuclear characteristics. The r value for NA and DM/A was negative and changed from -0.37 in non-pustular epidermis to -0.51 in pustular epidermis. The r value for NA and NDM decreased from 0.37 to 0.24, while the r value for DM/A and NDM decreased from 0.72 to 0.68, with proximity to the pustule. The trends for r value-change with proximity to the pustule are the opposite of the trends exhibited in onion with proximity to infection by several different fungi (4, 5, 6).

The decrease in NDM was less than those reported for nonobligate fungal pathogens in onion (4). In previous studies, Kulfinski & Pappelis (5, 6) indicated decline in host NA due to fungi, whereas the data herein indicate an increase in host NA due to *P. podophylli*. Clearly, these are different types of host responses. The onion diseases previously reported (4, 5, 6) involved killing of host epidermal cells in a short time span, whereas that reported herein was nonlethal to epidermal cells in a longer time span. Another factor to consider is that while the control tissues in the onion studies were not infected, those in this study were adjacent to pustules, and fungal products may have influenced the characteristics of these "control" nuclei. It was previously shown (4, 5, 6) that fungal products influence even those host nuclei at a distance from the mycelium. Noninfected host plants were not found in Thompson Woods for comparison.

Many pathologists have suggested that long-term parasitism by fungi is marked in its early stages by increased host nuclear activities and later by nuclear disintegration (1, 3). We suggest that the stage of *P. podophylli* infection studied may have been between the early stimulatory and late degenerative phases, still exhibiting increased NA but already decreasing in

NDM. We conclude that this host response by *Podophyllum* to *P. podophylli* differs greatly from the non-obligate systems previously studied (4, 5, 6), primarily on the basis of swelling of host nuclei in the present study.

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