

STUDIES ON THE PHYSIOLOGY OF HIGHER FUNGI. XIII.
EFFECT OF TEMPERATURE AND HYDROGEN-ION-
CONCENTRATION ON GROWTH OF *HEXAGONIA*
POLYGRAMMA MONT. IN CULTURE

BY

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The present investigation has been undertaken for collecting information on the role of temperature and hydrogen-ion-concentration on growth of *Hexagonia polygramma* Mont. The different temperatures used in the experiment are 15°, 20°, 25°, 30°, 35° & 40°C. It has been found that 35°C is the optimum one. The effect of hydrogen-ion-concentration (pH) on growth has also been noted. It has been observed that *H. polygramma* is a acid loving one, the optimum pH for growth being 5.5.

INTRODUCTION

Temperature and pH play important roles directly or indirectly on all metabolic activities of fungi. Previous investigators have shown that fungous growth is partly controlled by a minimum and maximum temperature. The role of temperature in relation to growth of wood-rotting fungi have, however, been thoroughly reviewed by Humphrey and Siggers (1933), Cartwright and Findlay (1934), Wolf and Wolf (1947), Cochrane (1958) and others. Fungi can tolerate a wide range within a grade of hydrogen-ion-concentration both in the acidic and alkaline side. Several workers have stated that most of the wood-rotting basidiomycetous fungi grow better in acidic side ranging between pH 3.0 – 7.0 (Meachum, 1918 ; Melin, 1924 ; Weis and Neilson, 1927 ; Montgomery, 1936 ; Lindeberg, 1944 and others). Robbins (1950), Fries (1956) and several others have shown that some fleshy basidiomycetes grow better in alkaline medium.

In the present investigation an attempt has been made to evaluate the role of temperature and pH on the growth of *Hexagonia polygramma* Mont. In order to find out any possible impact of these two factors on the pathogenic association with the host tree *Diospyros embryopteris* Pers.

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MATERIAL AND METHODS

The fresh basidiocarps were collected from infected branches of *Diospyros embryopteris* Pers. in the field and brought into the laboratory. From a basidiocarp typical dikaryophasic and monokaryophasic mycelia were obtained. These two cultures were maintained on *potato dextrose-agar* medium for experimental purposes. *Glucose-casein-hydrolysate* medium (Lilly and Barnett, 1951) was used as basal synthetic medium. The different temperature used in this experiment were 15°, 20°, 25°, 30°, 35° & 40°C. The different grades of pH were 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5 & 8.0. 25 ml. of the medium was taken in each required number of 250 ml. Erlenmeyer flasks, properly plugged and sterilized at 15 pounds pressure for 15 minutes. The pH of the medium was adjusted with N/15 citrate-phosphate buffer. The inoculation was done according to the method already described by Samajpati and Banerjee (1969). Sufficient numbers of flask was inoculated both with the monokaryophasic and the dikaryophasic mycelia of the test-fungus in order to provide three replicates for each treatment for each type of mycelium and incubated (stationary) for 15 days. Every fifth day, three replicates of each treatment of both types of mycelia were harvested. In harvesting, the content of each flask was filtered through a tared filter paper (Whatman No. 1.), placed on a Buchner funnel. The residual mycelia of the flask were washed separately with distilled water to remove any trace of the medium, and dried at 60°C. in an oven for 24 hrs. After drying they were kept in a closed vacuum desiccator over magnesium perchlorate, cooled and later weighed in an electrically operated chemical balance. The other necessary experimental procedure were, however, remained the same as described in Samajpati and Banerjee (1969).

RESULTS

The observations so far made during this experiment were given in Tables 1—6.

Table 1. Data (mean) showing the effect of different temperature on the vegetative growth (mg.) of the monokaryophasic and dikaryophasic mycelia of *Hexagonia polygramma*.

Temperature (°C)	Mycelium		Temperature mean
	Monokaryophasic	Dikaryophasic	
15	38.33	58.66	48.50
20	132.66	123.46	128.06
25	142.55	145.55	144.05
30	173.22	165.66	169.44
35	215.77	197.88	206.82
40	91.33	92.55	91.94
Mycelium mean	71.45	70.54	
S. E. for Mycelium = ± 0.00002			
S. E. for Temperature = ± 0.0000346			
S. E. for Mycelium X = ± 0.0000479			
Temperature			
C. D. for Mycelium at 0.05 of P = 0.000554			
C. D. for Temperature at 0.05 of			
P = 0.00095842			
C. D. for Mycelium X Temperature at			
0.05 of P = 0.00132683			

Table 2. Data (mean) showing the effect of different incubation periods on the vegetative growth (mg.) of the monokaryophasic and dikaryophasic mycelia of *H. polygramma*.

Incubation period (Days)	Mycelium		Incubation period mean
	Monokaryophasic	Dikaryophasic	
5	70.00	71.72	70.86
10	154.90	150.34	152.89
15	171.50	169.83	170.66
Mycelium mean	132.31	130.63	

S. E. for Incubation period = ± 0.000244

C. D. for Incubation period at
0.05 of $P = 0.00006$

S. E. for Incubation period X Mycelium = ± 0.000346

C. D. for Incubation period
X Mycelium at 0.05 of
 $P = 0.00095842$

Table 3. Data (mean) showing the effect of interaction of different temperature and the different incubation periods on the vegetative growth (mg.) of the monokaryophasic and dikaryophasic mycelia of *H. polygramma*.

Temperature (°C)	Incubation period (in Days)			Temperature mean
	5	10	15	
15	22.66	63.50	69.33	48.50
20	53.33	157.70	173.10	128.06
25	73.33	170.33	188.50	144.05
30	88.83	198.50	221.00	169.44
35	138.50	230.83	251.16	206.83
40	48.50	106.50	120.83	91.44
Incubation period mean	62.52	152.89	170.66	

S. E. for Incubation period

X Temperature = ± 0.000591

C. D. for Incubation period X Temperature at

0.05 of $P = 0.00163707$

The data so far recorded clearly indicate that the optimum temperature for vegetative growth of both the monokaryophasic and the dikaryophasic mycelia is 35°C. The range of temperature for growth lies between 15°C and 40°C. It is also noted from the experiment that with the increase of temperature the growth of the fungus also increase to an optimum, but at higher temperature the reaction is maximum and the growth in both the monokaryophasic and dikaryophasic declines abruptly.

Table 4. Data (mean) showing the effect of different hydrogen-ion concentrations on the vegetative growth (mg.) of the monokaryophasic and the dikaryophasic mycelia of *H. polygramma*.

pH	Mycelium		pH mean
	Monokaryophasic	Dikaryophasic	
4.5	52.66	58.11	55.38
5.0	102.00	104.22	103.11
5.5	133.68	141.44	137.66
6.0	92.11	108.77	100.44
6.5	49.33	55.77	52.55
7.0	30.22	33.33	31.77
7.5	19.44	21.00	20.22
8.0	0.00	0.00	0.00
Mycelium mean	68.52	74.66	
S. E. for Mycelium = ± 0.0000331		C. D. for Mycelium at 0.05 of P = 0.00000831	
S. E. for pH = ± 0.00000616		C. D. for pH at 0.05 of P = 0.0000167552	
S. E. for Mycelium X pH = ± 0.00591		C. D. Mycelium X pH at 0.05 of P = 0.0163707	

Table 5. Data (mean) showing the effect of different incubation periods on the vegetative growth (mg.) of the monokaryophasic and the dikaryophasic mycelia of *H. polygramma*.

Incubation period (Days)	Mycelium		Incubation period mean
	Monokaryophasic	Dikaryophasic	
5	47.66	55.23	51.45
10	69.33	74.90	72.11
15	88.57	93.85	91.21
Mycelium mean	68.52	74.66	
S. E. for Incubation period = ± 0.00001088		C. D. for Incubation period at 0.05 of P = 0.0000301486	
S. E. for Incubation period X Mycelium = ± 0.00387		C. D. for Incubation Period X Mycelium at 0.05 of P = 0.0107199	

Table 6. Data (mean) showing the effect of interaction of different hydrogen-ion concentrations and different incubation periods on the vegetative growth (mg.) of the monokaryophasic and dikaryophasic mycelia of *H. polygramma*.

pH	Incubation period (Days)			pH mean
	5	10	15	
4.5	39.83	57.50	68.83	55.38
5.0	75.50	101.16	132.66	103.11
5.5	107.50	137.16	168.33	137.66
6.0	82.50	103.16	115.66	100.44
6.5	33.50	52.66	71.50	52.55
7.0	13.66	31.83	49.83	31.77
7.5	7.66	21.33	31.66	20.22
8.0	0.00	0.00	0.00	0.00
Incubation period mean	57.45	72.11	91.21	
S. E. for Incubation period X pH = ± 0.00591		C. D. for Incubation period X pH at 0.05 of P = 0.0163707		

From the foregoing tables, it is evident that the optimum pH for growth of both the monokaryophasic and the dikaryophasic mycelia of *H. polygramma* is 5.5. The medium with pH values 4.5 and 6.5 have slight inhibitory effect, whereas pH 7.0–7.5 of the media have considerable inhibitory effect, on the growth of both the monokaryophasic and the dikaryophasic mycelia of *H. polygramma*. No growth has, however, been noted in the medium with pH 8.0.

DISCUSSION

A study on the responses exhibited by the primary and the secondary mycelia of *H. polygramma* under different and uniformly controlled environmental conditions, makes it possible to discuss in a general way some of the salient features regarding the relation that exists between them and the environments.

After evaluating the role of temperature on vegetative growth of the test-fungus, it has been found that 35°C is the optimum. The temperature growth curve obtained for the fungus is found to be almost symmetrical rather than of the skewed type. The test-fungus is in the low-temperature-group of Humphrey and Siggers (1933). The influence of temperature, however, become more evident as a result of its effect on the many complex chemical and physical process included in vegetative growth. This effect of temperature may be direct on some metabolic step or it may be indirect.

The tolerance of hydrogen-ion concentration by the test-fungus reveals that it is acid loving. The evidences so far obtained show convincingly that pH is an environmental factor of enormous consequences in modifying their metabolic activity. These effects are always intricately correlated. It is known that pH may act in several ways such as influencing enzyme action, altering solubilities, modifying surface reactions or preventing or facilitating the entry of vitamins or organic acids or minerals into the hyphae (Lilly and Barnett, 1951).

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(Accepted for publication 21st January, 1972)