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STUDIES ON THE PHYSIOLOGY OF HIGHER FUNGI : *IX.* EFFECT OF DIFFERENT HORMONES ON THE VEGETATIVE GROWTH OF SOME SPECIES OF *FOMES* AND *GANODERMA*

By

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The role of different hormones on the vegetative growth of all the test-fungi has been studied. The experimental procedure for the study has also been described. Of all the hormones tested (IAA, IBA, NAA, GA, and MH), IAA is the best source for growth, while IBA, NAA and GA are also good sources for growth of all the test-fungi. The low MH concentration has been noted to have stimulatory effect on all the fungi although it is known as an antiauxin.

Introduction

Soon after the discovery of the presence of growth hormones or auxins in higher plants, other sources were searched for the same and it was Nielson (1928) who reported that the *Rhizopus suenus* and *Absidia ramosa* contained substances which could promote the growth of *Avena* coleoptiles. In the following years, production of auxins by numerous fungi was gradually demonstrated and it was recorded that 89 percent of the fungi investigated could produced growth hormones or auxins. Boysen-Jensen (1937), Janke (1939), and Gruen (1959) made critical reviews on auxin relation of fungi. Melin (1953), Slankis (1958) and Ulrich (1960) discussed auxins in relation to mycorrhizal association. Allen (1954) summarized some works on auxin production by phytopathogenic fungi, particularly with regard to causation of pathological symptoms.

With regard to basidiomycetes, investigations in this direction are rather meager. Nothing has so far been done on the species of *Fomes* and *Ganoderma* under consideration. Defago (1940) found that spore-germination of *Tilletia tritici* was strongly inhibited by the presence of IAA, which, however, increased the mycelial growth six times as per dry weight. The vegetative growth of *Schizophyllum commune* could be strongly inhibited by a wide range of concentration of

IAA, NAA, 2-4-D and 2-4, 5T (Richards, 1949). It was also demonstrated that IAA had no positive effect on growth of *Boletus variegatus*, *Clavaria dendroides* and *Cortinellus berkelyanus* (Melin, 1946) while Konishi (1957) reported promotion of mycelial growth and in the dry weight of the mycelium of *Cortinellus berkelyanus* by IAA and also by GA. Fahræus and Tullander (1956) found that 10^{-5} M and 10^{-3} M of IAA, had inhibitory effect on growth of *Polyporus versicolor* and *Marasmius scordonius* respectively. Fahræus *et al.* (1958) showed that IAA (10^{-3} to 10^{-4} M) had slight inhibitory effect on growth of *Marasmius graminum* and *Stereum hirsutum*. Fries (1950) reported that 0.4 mg/1. of IAA and IBA had no effect on the dry weight of the mycelium *Lentinus omphalodes*, 4 mg/1 of IAA strongly inhibited its growth while 4 mg/1 of IBA with or without tryptophane increased the growth of the fungus. It has been reported that 10μg/1 of IAA had slight stimulatory effect on growth of *Agaricus campestris*. Aschan-Aberg (1958) stated that no stimulatory effect on growth was found with IAA, though fruit body production was stimulated in *Collybia velutipes*. Recently, Banerjee and Mukherjee (1957) and Banerjee and Nandi (1966) observed that .01 PPM IAA and .1 PPM IBA increased the mycelial growth of *Merulius similis* and *Lentinus prærigidus* respectively.

Materials And Methods

The standard basal medium was first prepared but without any hormones source. After preparation a source of hormone was added to the medium in several flasks. The concentrations and hormones used were 0.01, 0.1, 1, 10 and 100 PPM of IAA, IBA, NAA, MH and GA. Several flasks with the medium but without hormones were also kept as controls. The media were then sterilized by filtration, inoculated separately by the test-fungi and incubated in the usual way. The other necessary experimental procedures, however, remained the same as in Samajpati and Banerjee (1970).

Results

The results obtained during the experimental period are given in Tables 1—3.

From the fore-going Tables (Tables 1—3) it is evident that 0.1 PPM of IAA is by far the best of all the five sources of hormones under investigation for vegetative growth of all the test-fungi. Next comes IBA (0.1 PPM), NAA (0.01 PPM) and GA (0.01 PPM) in order of preference while all the concentration of MH have but little stimulatory effect on all the test fungi.

It has been observed during the experiment that in all the above treatments higher concentrations have inhibitory effect on growth of all the fungi rather than a stimulatory one.

Table 1. *Data (mean) showing the effect of different hormones on vegetative growth (mg.) of three species of* Fomes *and* Ganoderma *at different incubation periods.*

Fungi (F) X Hormones (T)

Hormones	Fungus / Conc. (%)	Ganoderma applanatum	Ganoderma lucidum	Ganoderma collossus	Fomes senex	Fomes fastuosus	Fomes durissimus	T-means
IAA	0.01	292.6	290.6	318.1	130.2	129.8	134.8	216.1
	0.10	312.4	309.5	310.3	124.6	140.2	143.6	223.4
	1	286.1	289.4	301.4	121.8	125.2	139.2	210.5
	10	268.1	272.1	290.1	108.6	113.6	111.6	194.1
	100	260.2	269.4	279.1	96.7	100.6	101.1	184.5
IBA	0.01	290.4	291.9	306.0	126.1	144.2	150.6	218.2
	0.10	311.5	311.4	316.2	128.9	140.0	148.0	226.0
	1	280.7	289.8	291.4	117.6	114.0	122.4	203.1
	10	265.6	272.3	274.4	108.2	104.5	114.5	189.0
	100	259.8	271.6	258.1	85.2	62.0	88.5	170.8
NAA	0.01	280.6	319.8	314.8	123.2	136.2	135.1	219.6
	0.10	277 4	306.8	302.0	111.2	124.2	125.2	207.8
	1	276.1	303.4	280.6	109.0	113.2	113.4	199.2
	10	274.2	261.4	249.0	100.2	94.6	94.2	178.9
	100	270.1	220.1	245.1	92.6	82.4	84.6	165.8
MH	0.01	281.8	284.1	308.2	135.1	128.2	130.8	211.3
	0.10	277.5	279.4	292.1	122.4	120.1	125.2	202.7
	1	276.4	270.1	285.4	110.2	102.7	108.6	192.1
	10	254.1	253.4	279.1	90.1	88.6	84.8	175.2
	100	224.1	246.5	258.2	79.4	76.8	58.2	157.2
GA	0.01	299.6	307.8	303.8	149.2	132.1	129.4	220.3
	0.10	293.1	298.4	290.2	136.2	128.2	120.4	211.0
	1	276.5	283.5	275.3	116.4	108.4	104.8	194.1
	10	268.4	275.4	265.2	96.6	88.8	86.5	180.1
	100	262.2	260.1	238.4	78.4	68.4	67.6	162.5
Control		276.3	279.5	281.3	98.2	103.4	109.3	191.3
F-means		276.7	281.4	285.1	111.2	110.4	112.7	

S. Em. for F = ±0.0009
S. Em. for T = ±0.0096
S. Em. for F × T = ±0.0036

C. D. for F at 5% of P = 0.001976
C. D. for T at 5% of P = 0.002456
C. D. for F × T at 5% of P = 0.003896

Table 2. *Data (mean) showing the interactions of different hormones and incubation periods on the vegetative growth (mg.) of three species of* Fomes *and* Ganoderma.

Incubation periods (I) X Hormones (T)

Hormones	Incubation periods Conc. (%)	4 days	8 days	12 days	16 days	20 days	T-means
IAA	0.01	124.8	178.4	220.2	261.5	295.6	216.1
	0.1	128.8	182.8	234.7	268.8	301.9	223.4
	1	124.2	176.5	215.6	252.8	283.4	210.5
	10	130.5	189.1	198.1	212.6	240.2	194.1
	100	144.5	165.0	187.0	200.5	225.5	184.5
IBA	0.01	126.9	180.5	222.3	263.6	297.7	218.2
	0.1	133.9	188.5	230.3	274.6	305.7	226.0
	1	116.8	169.1	208.2	245.4	276.0	203.1
	10	149.0	169.5	191.5	205.0	230.0	189.0
	100	130.8	151.3	173.3	186.8	211.8	170.8
NAA	0.01	128.3	181.9	223.7	265.0	299.1	219.6
	0.1	121.5	173.8	212.9	250.1	280.7	207.8
	1	135.6	194.2	203.2	217.7	245.3	199.2
	10	138.9	159.4	181.4	194.9	219.9	178.9
	100	125.8	146.3	168.3	181.8	206.8	165.8
MH	0.01	125.0	177.3	216.4	253.6	284.2	211.3
	0.1	116.4	168.7	207.8	245.0	275.6	202.7
	1	128.5	187.1	196.1	210.6	238.2	192 1
	10	135.2	155.7	177.7	191.2	216.2	175.2
	100	117.2	137.7	159.7	173.2	198.2	157.2
GA	0 01	130.6	175.7	202.8	235.8	302.6	220.3
	0.1	125.3	166.4	193.5	226.3	293.3	211.0
	1	118.4	159.5	186.6	219.6	286.4	194.1
	10	104.4	145.5	172.6	205.6	272.4	180.1
	100	86.8	127.9	155.0	188.0	254.8	162.5
Control		100.4	150.3	191.4	239.6	274.8	191.3
I-means		125.0	167.6	197.3	225.6	262.1	

S. Em. for I = ±0.00512 C. D. for I at 5% of P = 0.002112
S. Em. for I × T = ±0.0016 C. D. for I × T at 5% of P = 0.003326

Table 3. *Data (mean) showing the effect of different incubation periods on the vegetative growth (mg.) of three species of* Fomes *and* Ganoderma *under different sources of vitamins.*

Fungi (F) X Incubation periods (I)

Fungus / Incubation periods (Days)	Ganoderma applanatnm	Ganoderma lucidum	Ganoderma collossus	Fomes senex	Fomes fastuosus	Fomes durissimus	I-means
4	199.6	204.6	208.3	46.7	44.8	46 4	125.0
8	248.5	253.5	257.2	83.0	81.4	82.3	167.6
12	281.1	283.1	286.8	112.6	111.0	112.6	197.3
16	306.5	311.5	317.1	141.0	137.7	139.9	225.6
20	342.7	347.9	351.6	177.0	175.8	177.4	262.1
F-means	276.7	281.4	285.1	111.2	110.4	112.7	

S. Em. for F × I = ±0.0096 C. D. for F × I at 5% of P = 0.003816

Discussion

A study on the responses exhibited by six species of basidiomycetes, viz., *Fomes senex, F. fastuosus, F. durissimus, Ganoderma applanatum, G. lucidum* and *G. colossus,* under different and uniformaly controlled environmental and nutritional conditions makes it possible to discuss in a general way some of the salient features regarding the relation that exists between these fungi and the environments, both physical and chemical. The present investigation confirms the findings of other workers in that the test-fungi under consideration differ widely among themselves in these respects.

In detecting the role of hormones on nutrition of the test-fungi it has been found that IAA (0.1 PPM) has maximum stimulatory effect on all the test fungi (Tables 1—3). Next to IAA, come IBA (0.1 PPM), NAA (0.01 PPM) and GA (0.01 PPM) in order of degree of stimulation on growth. All the concentrations of MH have but negligible stimulatory effect on all the test-fungi.

The maximum stimulatory effect of IAA reveals its vital role in the fungal metabolism. NAA, IBA and GA also have somewhat similar role possibly. The only peculiarity noted in case of MH is that it has but very little stimulatory effect though it is known as an antiauxin (Leopold, 1964).

The above statement on the effects of different auxins on growth of fungi is still controversial and rather speculative.

To establish the real mechanism of the metabolism, work has been taken up on different lines in this laboratory but uptil now no appreciable or convincing result is at hand which can be stated here.

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