Spore Production of Hericium erinaceus

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Accepted for publication 15 June 1970.

ABSTRACT

Phenological data on *Hericium erinaceus* sporulation in 1968-70 indicates that spore production is highest at about midday and is related to daily increases in temperature and decreases in relative humidity (RH). Sporulation in the laboratory at 85-95% RH increased as the temperature was increased from 0 to 24-27 C and ceased at 31-33 C. At 20 C sporulation was higher at 30% RH than at 90% RH. Phytopathology 60:1639-1641.

Hericium erinaceus (Bull.) Pers. frequently causes butt rot in southern bottom-land hardwoods (8). Sporophores are produced and sporulate in fall and winter on living trees as well as on slash and stumps of cut trees. Information concerning the influence of environmental factors on spore production of wood-decay fungi is sparse, and pertains to genera other than *Hericium* (3, 5, 6, 7). Such information is a necessary precursor to any practical study of the disease. Ingold (1) concluded that different factors or combinations of factors control sporulation in different fungi. This paper describes spore production of *H. erinaceus* under natural conditions in west-central Mississippi and under controlled conditions in a laboratory.

MATERIALS AND METHODS.—Field production of basidiospores was measured in 1967 and 1968 on a total of five sporophores which were growing on slash and on living willow oak (*Quercus phellos* L.) and bitter pecan (*Carya aquatica* [Michx. f.] Nutt.) trees in the Delta Experimental Forest. Production rates were measured with a Kramer-Collins (K-C) impinging sampler (2). A 1-cm × 1-1.5-m plastic tube was attached to the intake orifice of the K-C sampler. The tube opening was placed approximately 5 cm below the spines on the sporophore. The K-C sampler was operated at an airflow rate of 22 liters/min. The length of collections was varied inversely with expected spore production to prevent clogging of the slit orifice. A thermal-delay relay timer (4) was used to set collection time at from 5 to 60 sec. Samples were taken at 1-hr intervals. Silicone-coated slides were changed daily about 9 AM. The battery was replaced when the voltage began to decrease, usually after 7 days. During the collection period, temp and relative humidity (RH) were monitored with a hygrothermograph placed in the forest near the sporophores.

The numbers of spores per sample were estimated by counting under a microscope the number in 0.027-mm^2 areas delineated by an eyepiece reticule. For each sample, the number of spores in 30 such areas was averaged. Stacking and overlap prevented counting more than 27 spores on each area.

For the laboratory experiments, young mature sporophores were detached from slash or from living trees. Some were attached to 2-ft lengths of wood, and all were oriented to their natural position in a controlled environment chamber containing a small cold-water humidifier and dehumidifier. Temperature gradients were programmed on a cam-type controller to give a straight-line temp increase from 0 to 35 C over a 20-hr period. A recording thermometer probe was inserted between the spines adjacent to the sporophore context. Sporophore and ambient temp differed by less than 1 C. Humidity was maintained between 85 and 95%. Sporulation of two sporophores was also recorded at a constant temp of 18 C and a RH of 90% in the absence of light.

The effect of RH on spore production was determined by subjecting four sporophores to alternating high and low humidity treatments, each 12 hr long, for 46 days. Temperature was held at 20 ± 1 C. Relative humidity was determined with an aspirated psychrometer. The high RH was about 90%, and the low about 30%. The sporophores in this test were left attached to the wood on which they were found, because detaching them appears to hasten mortality. Basidiospore production was evaluated as in the field experiments.

All sporophores were producing when sampling was started. None of the sampled individuals sporulated for more than 33 days.

RESULTS.—During the sporulation season (October-December), temp in the forest ranged from −8 to 28 C, and RH ranged from 30 to 100%. Sporulation ceased when sporophores became frozen, but resumed upon thawing. A definite daily sporulation pattern was observed. Highest production occurred in all sporophores in the daytime, usually in the afternoon, and appeared to be related to high temp and low RH. Increases in spore production associated with increased daily temp and decreased RH were recorded on 60 afternoons of 75 days sampled. Production patterns on the remaining 15 days were difficult to interpret. On 8 of the days there were no well-defined peaks in temp or production. On 4 days, production peaks were not observed, even though afternoon temp peaks were recorded. On three successive dates, highs in production were recorded at midnight. The reason for these peaks is not known.

The highest production recorded was 18,400 spores/liter of air. Production for a typical sporophore and changes in temp and RH are shown in Fig. 1. Mean temp and RH during periods of peak output were 15 Ç

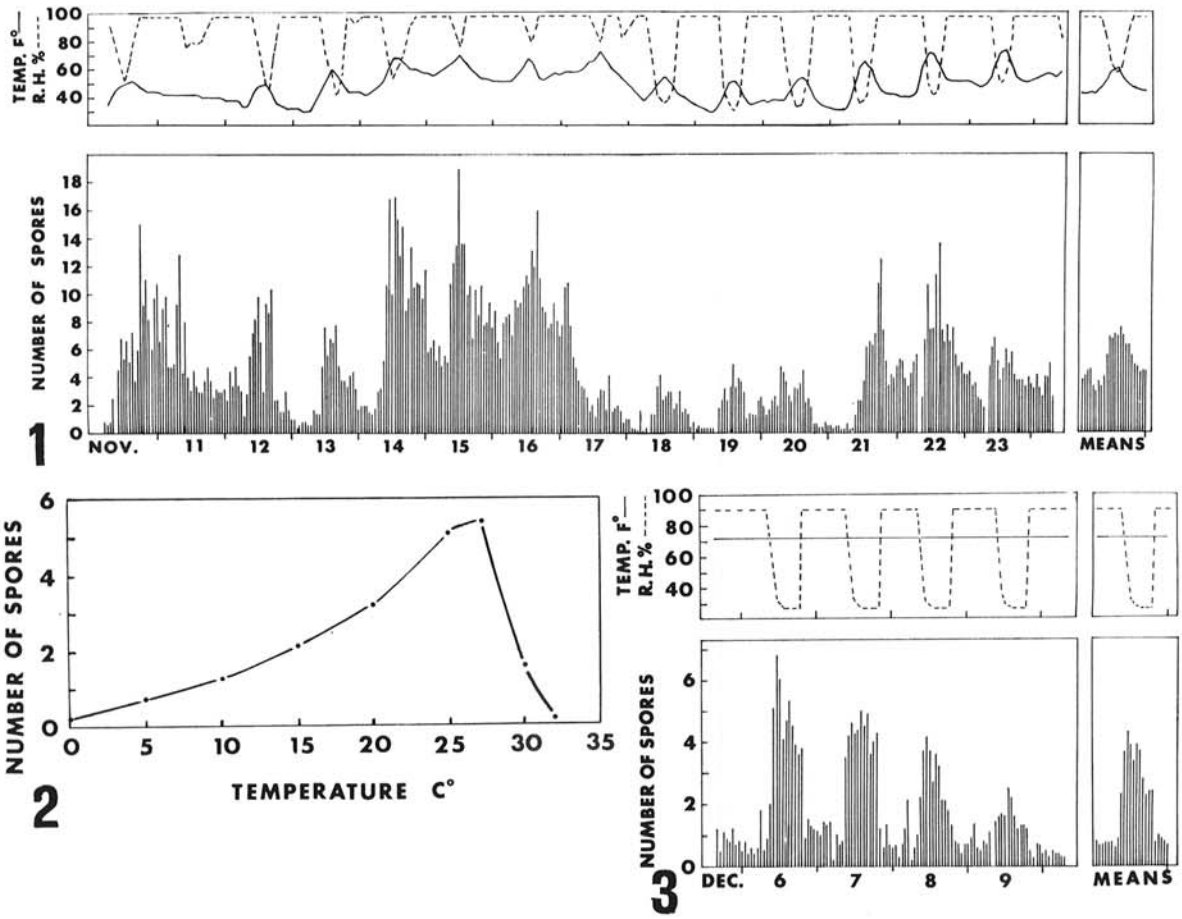

Fig. 1-3. **1)** Spore discharge during 10-24 November 1968 from a sporophore of *Hericium erinaceus* attached to a willow oak log. Spore samples were taken for 60 sec at 1-hr intervals. Number of spores times 800 equals approx number of spores per liter. **2)** Temperature effect on spore discharge of *Hericium erinaceus* detached from willow oak and placed in a controlled environment chamber. Production curve is a mean from six individuals. Number of spores times 2,000 equals approx number of spores per liter. **3)** The effect of changing relative humidity on sporulation of a *Hericium erinaceus* sporophore attached to an oak log placed in a controlled environment chamber. Number of spores times 800 equals approx number of spores per liter.

and 69% RH. Corresponding figures for periods of lowest production were 6 C and 100% RH. Frequently, daily peaks in spore production occurred up to 4 hr after max daily temp.

Sporulation of excised sporophores in the controlled environment started at 0 C, increased to a max at 24-27 C, and ceased at 31-33 C (Fig. 2). An exponential regression equation, $Y = (0.1126)(0.0207)^X - 1$, where $Y =$ number of spores and $X =$ temp in C, accounted for 83% of the variation about the mean for production at temp up to 25 C. Some sporophores produced spores when returned to a temp less than 25 C; others did not. The spines of sporophores subjected to high temp in the laboratory frequently became brownish and curved at the tips.

Spore production of an attached sporophore in a controlled environment chamber at 20-21 C with alternating 12-hr treatments at 25-35 and 90% RH is shown in Fig. 3. All sporophores tested gave similar results. Sporulation varied inversely with RH. Production increases were detectable approximately 1 hr after the RH started to decrease. Air temp in the chamber increased 0.6 C during dehumidification. Sporophore spine surface temp was the same as that of air when the RH was high, but dropped 3-4 C at 30% RH.

Sporulation at constant temp and RH varied little, but there was a tendency at the start of sporulation in the growth chamber to produce one or two peaks. These peaks were usually centered at about noon, the same time of day at which peaks occurred under natural conditions.

Discussion.—The relationship between temp and *H. erinaceus* sporulation agrees with results reported on other fungi (3, 5, 6). High RH has been reported to favor sporulation in some hymenomycetes (5, 6), but Sinclair (7) found that increased production was not correlated with moisture content of the air. The results of my field and laboratory observations on the effects

of daily changes in RH clearly indicate that production is favored during the daily period of low RH; however, it should not be assumed that long or continuous periods of low RH would favor high total production. Tissue temp indicate considerable sporophore water loss at low (30%) RH. The sporophore tissue temp was 4 C less than the ambient temp at 30% RH, but equal to that at 90% RH.

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