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ΦΥΤΟΠΑΘΟΛΟΓΙΑ.– Perpetuation of the brown rust of barley in Attica, *by* ***P. Critopoulos****. Ἀνεκοινώθη ὑπὸ τοῦ κ. Ἰωάνν. Πολίτου.

Puccinia anomala Rostr. (Syn. *Puccinia hordei* Otth, *Puccinia simplex* Eriks. and Henn.) causing brown rust on barley is known to have as an alternate host any one of the following 4 species, *Ornithogalum umbellatum* L., *O. pyramidale* L. (Syn. *O. narbonense* (L.) A. & G.), *O. tenuifolium* Guss. and *O. pyrenaicum* L.

The life cycle of the fungus was demonstrated for the first time by Tranzschel (1914), who used aeciospores from *O. umbellatum.* The work of Tranzschel has been confirmed in the United States by Mains and Jackson (1924), who reported the production of the aecial stage as a result of cultures. The connection between *P. anomala* and an alternate host has been confirmed in Austria by Beck (1924), in France by Ducomet (1926), in Switzerland by Mayor (1929) and in Britain by Dennis and Sandwith (1948). The last 2 workers inoculated barley plants with aeciospores pro-

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duced in nature on *O. pyrenaicum* and obtained uredia of *P. anomala* on the inoculated leaves.

In Attica, Greece, the first uredia *P. anomala* on cultivated barley can be found annually in the beginning of April. On February 20, 1950, however, an area about 1 meter in diameter in which the plants were heavily infected with brown rust, was found in a barley planting near Nea Philadelphia, Athens. In other parts of the same planting and in other barley plantings no trace of the disease could be detected at that time. This early and heavy infection of barley coinsided with the period of the year (November-April), in which *Ornithogalum* spp. are in leaf in Attica.

Since 1950 several collections of aeciospores from young *Ornithogalum*-like plants, not identifiable because of their early stage of development, were used to inoculate barley plants. One collection made in January 1954, gave positive results. These were growing in Menidi in a fallow field that carried barley during the season of 1952-53.

MATERIALS AND METHODS

Barley plants of the variety Athinais growing in 20 cm. pots filled with ordinary soil, were inoculated at stages of growth varying from the seedling stage up to the stage the plants were about 30 cm. high. The plants were sprayed with a 0.1% agar solution and inoculated by transferring with a needle aeciospores from aecia directly to the barley leaves. Inoculations were made in January and February. The inoculated plants were protected with glass cases and infection was allowed to develop out-of-doors. Control plants were included in all tests.

After performing the inoculations with the various aeciospores that were tested, the aecia-bearing plants were planted in 20 cm. pots filled with ordinary soil and were retained until the outcome of the inoculation. The ones that gave the positive result were retained until flowering. At the end of March 1955, 6 of these plants started to flower but the scape of 4 of them dried when it reached a height of 3-4 cm. The other 2 plants produced a scape 5-8 cm. high, which bore 4-5 normal flowers. Two or 3 flower buds at the tip of these scapes dried rather early. One of the flowering plants was left to mature seeds. The ovaries at first developed and then dried out. No seeds were produced.

The alternate host produced numerous bulbils, which were quite uniform in size with a length of 6 mm. and a width of 5 mm. A 1-year old

bulbil occasionally formed a single cylindrical leaf. A 2-year old bulb produced 2 leaves, one of which was more or less cylindrical and the other was channeled, and many bulbils. A 3-year old bulb produced 4-5 channeled leaves, whose maximum width was 4 mm., a scape, and about one hundred bulbils. The alternate host was identified to be *Ornithogalum umbellatum* L. This species occures in cultivated areas and stony ground in lower altitudes up to the subalpine region in most parts of the country, including the islands.

The testing of teliospores for germination was made by the usual hanging drop method.

RESULTS

On all inoculated leaves, including the first leaf of seedlings, uredia of *P. anomala* developed in about 10 days. These could be found scattered on both surfaces of the leaves. They were minute, oblong, up to 0.8 mm in length; on the sheaths they were somewhat more elongated. The uredia were erumpent and light orange-brown. On the barley variety used, they were surrounded by chlorotic areas, which often fused to form larger chlorotic spots. In February telia were not produced on heavily infected and almost withered leaves. The urediospores were broadly ellipsoid, 19-24 by 21-34 μ, with straw-colored, 1.5-2 μ thick, finely echinulate wall, and were provided with numerous, scattered pores.

On the infection spots telia were formed in the middle of April. These were amphigenous, blackish-brown, oblong, often confluent and remained covered by the epidermis for a long time. The sori were divided into compartments by clusters of brown paraphyses, which were flattened at the top. On leaf blades the telia reached a length of 3 mm. whereas on sheaths they reached a length of 6.5 mm. The teliospores were angularly oblong or clavate, 17-22 by 34-56 μ, truncate or obtuse above, narrowed below, slightly constricted at the septum; the spore wall was chestnut-brown and smooth, about 1.5 μ thick at the sides, darker and usually broader near the apex; pedicel was short and brownish. Mesospores were abundant, 15-28 by 26-41 μ, variable and slightly thickened at the apex (4-6 μ).

THE NATURAL INFECTION OF THE ALTERNATE HOST

On infection spots of the alternate host, groups of pycnia were surrounded by more or less regular circles of aecia. Further out from one

of these aecial circles, more pycnia and aecia were produced in varying patterns. Both pycnia and aecia were amphigenous. The pycnia were cyclical to ellipsoid, 85-144 by 99-158 μ and were formed below stomata; pycniospores pear shaped to elongated, 2 by 3-5 μ.

The aecia were yellow and were provided with a colorless peridium. They were elongated-cylindrical, straight or curved, attaining approximately a length of 0.3 mm. In cross section they were circular or slightly oblong, about 200 μ in diameter. Young aecia were pointed; upon rupturing, the peridium split irregularly at the tip into recurving segments. The aeciospores were globoid or ellipsoid, 18-23 by 21-33 μ, wall colorless, 1.5-2 μ thick, minutely and thickly verrucose.

As the infected leaf tips of the alternate host died because of the infection, new pycnia and aecia were produced continuously toward the lower portion of these leaves. At the end of April, when telia had already been produced on the cereal host, the production of new pucnia and aecia was continued.

COMPLETION OF THE LIFE CYCLE

After the production of uredia and telia on barley through the use of aeciospores, a search was made for viable teliospores. In the fall of 1954, teliospores were taken from barley leaves lying on a bare field, which carried barley during the season of 1953-54. This field was located adjacent to the field, where the infected plants of *O. umbellatum* were collected. The teliospores germinated profusely producing basidiospores on November 3, 1954, after the long summer, which in this climate is the most adverse period of the year.

In the summers of 1955 and 1956, temperature measurements of the field, where the leaves with telia were collected, were taken by placing the thermometer on the surface of the bare ground. The temperature at 2 p.m. on July 22, 1955, was 45° C, on August 5, 1955, was 40° C. and on July 24, 1956, it was 58.3° C. These temperatures could be taken as indicative of the temperatures under which the germinating teliospores had survived. Low temperatures up to the date the spores were tested for germination rarely if ever go below 10° C, according to data from the Meteorological Institute, Athens.

The life cycle of the fungus is completed by the transportation of the basidiospores to the nearby growing plants of *O. umbellatum*. Ample pro-

duction of aeciospores then follows affording inoculum for the barley, which sprouts here at about the middle of October. The uredo stage of the fungus on other gramineous hosts during late summer or fall so far has not been reported for Attica and may not occur.

On plants of *O. umbellatum* growing in the same field, where the pycnial and aecial stages of *P. anomala* were collected, the pycnia and telia of *Puccinia Lojkaiana* Thuem. were also commonly found.

ΠΕΡΙΛΗΨΙΣ

Αἰκιδιοσπόρια παραχθέντα ὑπὸ φυσικὰς συνθήκας ἐπὶ τοῦ εἴδους *Ornithogalum umbellatum* L. ἐχρησιμοποιήθησαν πρὸς μόλυνσιν φυτῶν κριθῆς, ἀναπτυχθέντων ἐντὸς γαστρῶν. Μετὰ πάροδον περίπου δέκα ἡμερῶν ἀπὸ τῆς μολύνσεως παρήχθησαν σωροὶ οὐρεδιοσπορίων τῆς *Puccinia anomala* Rostr., περὶ τὰ μέσα δὲ Ἀπριλίου πλησίον αὐτῶν ἀνεπτύχθησαν σωροὶ τελειδιοσπορίων. Περιγράφονται τὰ πυκνίδια καὶ αἰκίδια μετὰ τῶν ἀντιστοίχως ἐντὸς αὐτῶν παραγομένων σπορίων. Ἐπίσης περιγράφονται τὰ παραχθέντα κατόπιν τῶν διεξαχθεισῶν μολύνσεων οὐρεδιοσπόρια καὶ τελειδιοσπόρια. Τελειδιοσπόρια τοῦ ἐν λόγῳ παθογόνου μύκητος, παραγόμενα κατὰ τὴν διάρκειαν μιᾶς βλαστικῆς περιόδου καὶ διατηρούμενα ἐπὶ τμημάτων τοῦ ξενιστοῦ ἐπὶ τοῦ ἐδάφους ὑπὸ φυσικὰς συνθήκας, διεπιστώθη ὅτι παράγουν βασιδιοσπόρια τὸν ἑπόμενον Νοέμβριον. Τὰ σπόρια ταῦτα μεταφέρονται εἰς τὰ εἰς μικρὰν ἀπόστασιν ἀναπτυσσόμενα φυτὰ τοῦ ἐναλασσομένου ξενιστοῦ ἐπὶ τοῦ ὁποίου παράγονται πυκνιδιοσπόρια καὶ αἰκιδιοσπόρια. Δεδομένου ὅτι τὰ φυτὰ τῆς κριθῆς κατὰ τὴν ἐποχὴν αὐτὴν εἰς τοὺς ἀγροὺς εἶναι ἤδη προχωρημένης ἡλικίας, ταῦτα ὑφίστανται προσβολὴν διὰ τῶν αἰκιδιοσπορίων, συμπληρουμένου οὕτω τοῦ βιολογικοῦ κύκλου τοῦ μύκητος.

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