AD NUMBER

AD843463

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; JAN 1968. Other requests shall be referred to Department of the Army, Fort Detrick, Attn: Technical Release Branch/TID, Frederick, MD 21701.

AUTHORITY

Fort Detrick/SMUFD ltr dtd 15 Feb 1972

TRANSLATION NO. 3114

DATE: 30 January 1968

DEPARTMENT OF THE ARMY
Fort Detrick
Frederick, Maryland

CHOKE-WEEDS: I - EXPERIMENTAL CULTURES*

By Robert Cézard
Botanical Laboratories of the Faculty of Natural Sciences
(Laboratoire de Botanique - Faculté des Sciences), Nancy

Académie & Société Lorraine des Sciences (Lorraine Academy and Society of Natural Sciences), Vol 5, No 4, 1965, pp 279-285

Summary: Description of simple, effective method permitting germination and growth of choke-weeds on the roots of their hosts. Positive results in nine of twelve strains studied.

The first stages of the parasite can easily be observed in-vitro.

1. INFORMATION ABOUT THESE PARASITES

Choke-weeds, parasitic plants of higher vegetable plants, are for the most part unknown to the general public. Their color and appearance keep them from being used in flower bouquets, but it sometimes happens that their abundance intrigues the layman.

Here and there, however, they are formidable enemies of crops: around the Mediterranean, Orobranche crenata Forsk. exhaust bean cultivation which in under-nourished regions is a protein food in great demand; in the USSR, O. cumana Wall. decreases the sunflower harvest; Striga sp., which is more generally classed among the Scrophulariaces, attacks sorghum, corn and sugar cane in warm climates; Phelipaea ramosa Mey. causes hemp and tobacco to wither in Rumania and in the Loire valley in France; O. minor Sutton inflicts damage to clover fields in the same region. Nearer us, O. medicagnis Duby

*This paper was read at the meeting of 22 April 1965, submitted by Mr. Werner.

reduces the yield of lucern fields around Pont-à-Mousson and Pont-Saint-Vincent.

The biology of these plants has been of interest to many researchers, both botanists and agronomists: in 1827 Vaucher wrote a "Monograph on Choke-Weeds" and tried to observe their germination; Koch carried on this work (1878, 1887); Bartsinsky used rootlet excretions of the host in making O. cumana germinate; Chabrolin (1934-1938) studied the germination of O. crenata; Brown and his colleagues (1944-1952) tried by chromatography to separate and determine those products responsible for the germination of Striga hermonthica, S. lutea and O. minor; Izard and his colleagues studied Phelipaea ramosa and tried to find agents capable of making it germinate without a host in order to destroy it in crops; Racovitza works on the same species in Rumania and sought plants that make it germinate without serving as host; Kadry and Tewfic study the germination and development of O. crenata; Privat (1960) collected many studies of O. hederae on its host Hedera helix and on their relations.

2. EXPERIMENTAL REQUIREMENTS

Studying the role of rootlet excretions of plants in nature, it seemed very interesting to us to know the action of different phanerogams that can be parasited on 12 strains of choke-weed.

To successfully carry out our work it was necessary both to be able to follow the germination and the first stages of attachment of the parasites and also to make a collection of them in order to observe their biological cycle.

For the seeds of the parasite to germinate, they must locate themselves in the rhizosphere of the host or receive the products excreted by the roots; very rare germinations were, however, observed in the absence of a host, in moist sand -- Chabrolin (1936) -- or on distilled water -- Izard (1957), Krenner (1958) -- in O. crenata, P. ramosa, O. cumana; several mineral or organic products have allowed the germination of P. ramosa -- Izard and Hitier (1953, 1958) -- and of O. hederae -- Privat (1959). For growth to take place, the procaulom (germinating tube starting from the seed and carrying the embryo) must come in contact with a root: the parasite penetrates this and a mixed organ is formed, the tubercle. A true graft occurs at this same level with a reorganization of vascularization to the advantage of the parasite.

The small size of the seeds (40 to 100 µ by 150 to 600 µ) and sometimes the small volume of available amounts means that in the earth contact between the roots of the host and the seeds of the parasite is experimentally chancy.

On the other hand, natural stations benefit by the viability of the seeds (ten years and more) and of their accumulation over the years.

3. METHODS USED

Whether one is studying the first stages of the parasite or obtaining adult plants, the fixation on the host roots is done in vitro. The eventual replanting in the earth of the nourishing plants and their choke-weeds can thus be carried out later with full knowledge of the facts.

The following technique yields good results:

The host seeds are set to germinate on moistened perlite with the help of a nutritive mineral solution of Hoagland and Arnon. When the roots reach 5 to 7 centimeters length, the sprouts are replanted individually in test tubes 25 centimeters long, 25 mm in diameter, a third filled with the above nutritive solution. A rubber stopper with an 8 mm opening holds each sprout at the level of the neck. The roots sit on the surface of a thin glass plate covered by a strip of filter paper immersed in the solution. The nutrition of the sprout and the aeration of the root system are thereby ensured. The test tubes are then placed in opaque supports.

After a good redevelopment of the host, the seeds of the parasite are distributed at the periphery of the roots, touching them. A preliminary washing of the seeds allows elimination of brown, tegumentary substances harmful to the young roots. This last procedure is carried out in a Swinny filter unit, the seeds being placed between two Durieux No. 268 filters and rinsed by a stream of distilled water.

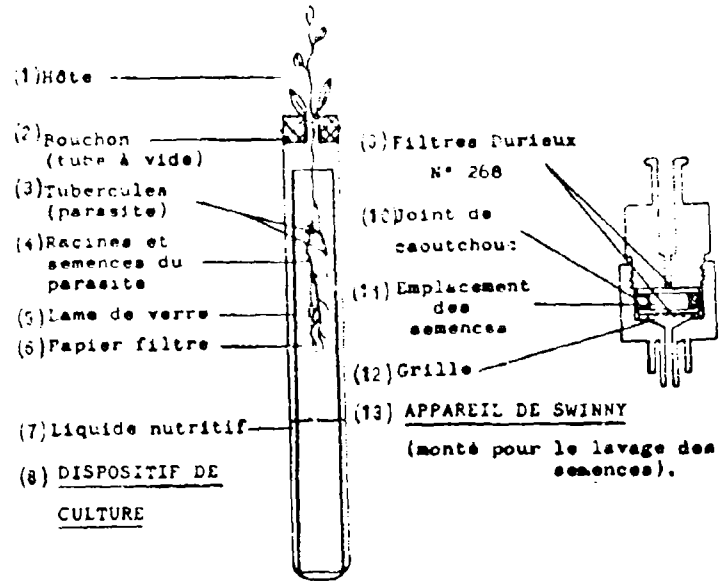
Ten to twenty days later the seeds germinate and a month after being set in place young tubercles due to the parasite are visible.

When the tubercles reach 8 to 10 mm size, the procedures differ depending on the goals in view:

a) if one wishes to obtain young tubercles whose pseudo-root spread does not exceed 20 to 25 mm, the thin glass plate and strip of paper are removed, the nutritive solution is replaced by a fresh medium, the level of which is brought to slightly under the insertion point of the first tubercle.

b) if a more advanced stage or adult individuals are sought, the parasited plants are replanted in pots containing fine-grain soil.

c) if the final goal is making a collection, the transferral to pots is followed by a final planting two to three months later.



1 -- Host; 2 -- Stopper (empty tube); 3 -- Parasite tuber; 4 -- Parasite roots and seeds; 5 -- Thin glass plate; 6 -- Filter paper; 7 -- Nutritional liquid; 8 -- Culture arrangement; 9 -- Durieux filters No. 268; 10 -- Rubber gasket; 11 -- Placement of seeds; 12 -- Screen; 13 -- Swinny apparatus (assembled for washing of the seeds).

4. RESULTS

Positive results can be obtained with:

Orobanche epithymum D.C.	on *Thymus serpyllum* L.
O. eryngii Duby	on *Eryngium campestre* L.
O. galii Duby	on *Galium mollugo* L.
O. hederae Duby	on *Hedera helix* L.
O. major L.	on *Centaurea scabiosa* L.
O. minor Sutton	on *Trifolium repens* L.
O. picridis Schultz	on *Picris hieracioides* L.
Phelipaea caerulea Mey.	on *Achillea millefolium* L.
P. ramosa Mey.	on *Trigonella foenum-graecum* L.

On the other hand, the parasite did not germinate in the presence of its usual host in the cases of:

O. medicaginis Duby	and *Medicago sativa* L. et *M. falcata* L.
O. ramosa Thuill.	and *Sarothamnus scoparius* K.
O. teucrii Schultz	and *Teucrium chamaedrys* L.

In each of these three cases the seeds of the parasite may not germinate until an advanced stage of vegetation of the host plant, for example flowering for O. crenata Forsk, which parasites beans as Kadry and Tewfic pointed out.

5. CONCLUSIONS

This method can facilitate the biological study of root-parasitic phanerogams: by supplying a pure, intact body the early stages of which are difficult to harvest on the land; by allowing regular observation of the growth of the parasite; by facilitating the study of certain mechanisms of parasitism (germination of the seeds, resistance of the host to invasion, modification or suppression of certain functions by degradation and adaptation to parasitic life). The fight against a parasite is more effective as its biology becomes better known.

One must note that the special characteristics of these plants makes them sought after for reasons of curiosity by many botanical gardens.

The many calls for seed reaching the Botanical Garden of Nancy since their listing in the catalogue of exchanges reflects the interest in them.

Using this method to gather a collection of such parasites avoids many failures, for 200 to 300 seeds are sufficient, whereas to have any chance of success one must mix four to five ml. of seed -- in other words several million -- to fine-grain soil in each pot which will receive the host seeds.

BIBLIOGRAPHY

Bartsinsky, R. M. (1932). "Contribution to the Study of the Physiology of Germination of Orobanche cumana" (in Russian). Bull. Krasnodar, No 2, 1932, p 3 (according to Izard and Hitier, 1953).

Brown, R. and Edwards, M. "The Germination of the Seed of Striga lutea. I Host Influence and the Progress of Germination." Ann. Bot., No 8, 1944, pp 131-148.

Brown, R. and Edwards, M. "Effects of Thiourea and Allylthiourea on the Germination of the Seeds of Striga lutea." Nature, London, Vol 155, 1945, pp 455-456.

Brown, R., Greenwood, A., Johnson, A. and Long, A. "The Stimulant Involved in the Germination of Orobanche minor Sutt." Biochem. J., No 48, 1951, pp 559-568.

Brown, R., Johnson, A., Robinson, E. and Todd, A. "The Stimulant Involved in the Germination of Striga hermonthica." Proc. Roy. Soc. London, B, No 136, 1949, pp 1-12.

Chabrolin, C. "The Germination of Orobanche Seeds." C. R. Acad. Sci. (Reports of the Academy of Sciences), Vol 198, 1934, pp 2275-2277.

Chabrolin, C. "The Germination of Orobanche and Bean Seeds." C. R. Acad. Sci., No 200, 1935, pp 1974-1976.

Chabrolin, C. "The Germination of Orobanche speciosa Seeds." C. R. Acad. Sci., No 203, 1936, pp 203-204.

Chabrolin, C. "The Germination of Orobanche speciosa Seeds." C. R. Acad. Sci., No 205, 1937, pp 245-246.

Chabrolin, C. "The Germination of Orobanche speciosa Seeds." C. R. Acad. Sci., No 206, 1938, pp 1990-1992.

Izard, C. "On the Germination of the Orobanche Parasite of the Tobacco Plant." Bull. Soc. Fr. Physio Veget. (Bulletin of the French Society for Plant Physiology), Vol 3, No 3, 1957, pp 92-93.

Izard, C. and Hitier, H. "In-Vitro Germination of Orobanche Seeds of the Tobacco Plant." Ann. Institut du Tabac (Annals of the Tobacco Institute), Bergerac, No 1, 1953, pp 47-56.

Izard, C. and Hitier, H. "New Researches on the Germination of Orobanche Tobacco Parasite Seeds." Ann. Institut du Tabac, Bergerac, Vol 2, No 1, 1954, pp 9-13.

Izard, C. and Hitier, H. "Action of 1-3-dichloropropane, 1-2-dichloropropane, Rinditol and Giberellin on the Germination of Seeds of Orobanche Parasite of the Tobacco Plant." C. R. Acad. Sci. No 246, 1958, pp 2659-2661.

Kadry, A. R. and Tewfic, H. "Seed Germination in Orobanche crenata Forsk." Svensk Bot. Tidskrift, Vol 50, No 2, 1956, pp 270-286.

Kadry A. R. and Tewfic, H. "A Contribution to the Morphology and Anatomy of Seed Germination in Orobanche crenata." Botaniska Notiser, Vol 109, No 4, 1956, pp 385-399.

Koch, L. "On the Developmental History of the Orobanche Seeds." Jahrb. Wiss. Bot. (Yearbook of Scientific Botany), No 11 1878, pp 218-261.

Krenner, J. "The Natural History of the Sunflower Broomrape, Orobanche cumana Wall. I, The Morphological Anatomy of the Sunflower Broomrape Seed. Its Germination and the Infection Mechanism of Its Germs." Acta Bot. Acad. Sci. Hungar., Vol 4, No 1-2, 1958, pp 113-144.

Privat, G. "On the Germination in-vitro of Orobanche du Lierre (O. Hederae Duby)." C. R. Acad. Sci., No 249, 1959, pp 156-158.

Privat, G. "Researches on the Parasite Phanerogams (Study of Orobanche Hederae Duby)." Ann. Sci. Nat. Bot. Bio. Veg. (Annals of Natural Sciences. Botany and Biology of Plants), Vol 1, No 4, 1960, pp 721-871 (Thesis).

Racovitza, A. "Carum ajowan Benth and Hook, a New and Interesting Host for Orobanche ramosa L." J. Agr. Trop. et Bot. Appl. (Journal of Tropical Agriculture and Applied Botany), Vol 5, No 6-7, 1958, pp 490-496.

Racovitza, A. "New Observations on the Germination of Orobanche ramosa L. Seeds." J. Agri. Trop. et Bot. Appl., Vol 6, No 1-2-3, 1959, pp 111-114.

Racovitza, A. "Contributii la cunoasterea plantelor gazda si stimulente ale lupoaiei ramificate (Orobanche ramosa L.)." Lucrarile Inst. Cercetari Alimentare, No 4, 1959, pp 215-221.

Racovitza, A. "Contributii noi la cunoasterea plantelor gazda si stimulente ale lupoaiei ramificate (Orobanche ramosa L.)" Studii Cercetari Agron., No 11, 1960, pp 139-143.

Racovitza, A. "Contributii la cunoasterea mecanismuliu rezistenteii plantelor foarte rezistente la atacul lupoaiei ramificate (Orobanche ramosa L.)." Commun. Acad. Rep. Pop. Romine, Vol 11, No 11, 1961, pp 1392-1398.

Racovitza, A. "O noua contributii la cunoasterea plantelor gazda si stimulente ale lupoaiei ramificate (Orobanche ramosa L.)." Commun. Acad. Rep. Pop. Romine, Vol 12, No 7, 1962, pp 831-835.