INTRODUCTION TO THE SUBJECT

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The initial phase of research in biological weed control consists of a search for candidate control organisms. Since later research phases depend entirely upon the acquisition of test organisms, the search and problems connected with it merit considerable thought. The separate research efforts involving phytophagous insects on the one hand, and infectious agents such as phytopathogenic fungi on the other, are so similar in methodology, principle, and purpose that they can be considered as a single approach to biological weed control. Hence, the same general problems would apply regardless of whether an insect or a fungus were being sought.

Problems of the search can be placed conveniently into two distinct groups. The first group consists of logistical problems, examples of which are listed below.

1. Inaccessibility of the search area
   a. National and international political ramifications
   b. Transportation difficulties
   c. Weather restrictions

2. Customs clearances for temporary importation of equipment into the search area.

3. Provision of laboratory facilities within the search area

4. Maintenance of cultures or collections during an extended search

5. Quarantine restrictions regarding the importation of collections for testing purposes

Such logistical problems may vary considerably from project to project, depending upon particular research needs, the search areas selected, and the type of candidate sought, but any search will involve a number of these problems. Fortunately, they are rarely serious,
and can usually be handled satisfactorily by advance planning and communication, with arrangements for assistance from persons resident in the search area. Thus, logistical problems are considered the least troublesome of the two.

The second problem group is more significant. These are the biological problems that arise simply because we are dealing with organisms and their environments. The more serious of these problems are listed and discussed briefly below.

1. Which organisms should be collected for testing? This question arises because, prior to the outcome of tests, there is no assured way of telling which candidates will work as control agents. Consequently, the searcher is forced into making educated guesses, and it is subsequently important that he knows as much as possible about the kind, number, and distribution of candidate organisms on the target weed and its near relatives. To obtain this information both the field and the literature are open to him. To which should he go first? It matters little, as long as both are explored extensively, for each has its deficiencies, and one must be used to supplement the other. A literature survey presents us with a list of candidates, but which of them might work? Might not there also be unlisted candidates or unknown strains or races, which could only be uncovered by field exploration? The latter activity also presents an array of possibilities, but should all organisms observed be collected for testing on the chance that one will work, or should choice be exercised? There is no satisfactory solution. Searchers can only put previous training and experience to the best possible use, knowing that most candidates collected will eventually prove unsatisfactory, and also that there is good possibility of bypassing a useful candidate.

2. Where should the search be conducted? The knowledge of host populations and candidate organisms is often lacking in a given region which might otherwise offer good search possibilities. Moreover, in highly referenced regions the flora and/or fauna may have changed since the time when descriptions were made. Hence, the searcher is often frustrated, either by lack of information prior to the search, or by the failure to find the host or the parasite in areas where they supposedly occur.

3. When should the search be conducted? Since weather and environmental conditions may vary considerably, candidates may appear at different times in different areas, or travel may be restricted in regions which have radical seasonal changes in weather. Hence, a good deal
of time and money can be wasted if sufficient information
is not obtained beforehand on the behaviour of hosts and
candidates in specific areas. The assistance of resident
collaborators would be most useful in obtaining such
information.

4. How should a search be organized? Should a
searcher make a single trip through an extensive search
area at a chosen time of the year, or should he attempt
to examine host populations in a more restricted area
over an entire season? Both methods are limiting, the
first in the number of host stages that can be observed
at a given time of year, and the second in the area
covered in the search. Both would affect the number and
kind of candidates that could be collected. Yet, because
of the limitation of time and funds, a searcher must often
choose one or the other approach, neither of which is
completely satisfactory in itself. The use of resident
collaborators would again be of great benefit in solving
this problem.

The above problems are the major ones involved in
searching for and collecting candidates. They are mainly
encountered when a project is new, and searching is in its
initial stages. As a project matures, and as investiga-
tors become more acquainted with specific candidates and
their behaviour, these problems lessen in complexity,
largely because the search itself becomes simplified and
more specialized. It is apparent, however, that the use
of resident collaborators could greatly increase the
efficiency of the search, regardless of whether the project
is new or well established. The use of resident collabo-
rate to facilitate the search should be thoroughly
explored.

Discussion

Dr. Wapshere brought up the questions: Which of the
recorded insects should be taken into consideration and
would it be worthwhile attempting to obtain and work with
extremely rare insects? In the Chondrilla work, he had,
by trial and error, come to the conclusion that the best
method is to search for a particular environment first
and then for Chondrilla organisms. The number and timing
of the samples to assess the Chondrilla situation is
dependent on the biology of the host-plant and the pheno-
logy of the control organism. Therefore, the investigator
is restricted in the places which he can visit.

A large part of the discussion dealt with the possi-
bility of using resident collaborators. Resident collec-
tors may often provide important information and by making collections they may supplement the work of the principal investigator. With certain long-term projects the European Station, CIBC, had much better results from highly qualified technicians belonging to the staff than by hiring resident collaborators. Before a resident co-operator starts his work, the principal investigator must go to the area. If possible the principal investigator and the resident collaborator should start the work together. There was a general consensus that M.Sc. students or Ph.D. students who are paid a grant for work on special aspects of a biocontrol project may form very valuable co-operators. In some countries such students are difficult to find, since professors are reluctant to "farm out" their students. In other countries, authorities are interested that capable students co-operate in biocontrol projects.

Other possible sources of control agents from foreign countries are: exchange of material between organizations working on biocontrol of weeds; buying certain insect species from professional collectors of biological supply houses; advertising in entomological journals such as the "Insektentørse".

All participants of the session were convinced that a high degree of responsibility is involved in working with foreign phytophagous insects, phytopathogens or weed species. Special arrangements have been made between the USDA Rome Station and the Italian authorities, the Chondrilla Control Unit (Montpellier) and the French authorities, and the European Station, CIBC, and the Swiss authorities concerning the introduction of foreign material. All three organizations have quarantine facilities for handling certain insects or pathogens. The precautionary measures involved depend largely on the type and origin of the experimental material.