Root in Illinois. He attempted to correlate the number of days with snow on the ground between December and March inclusive, or the number of days in March with freezing weather while the ground was bare, or even the number of days throughout the whole winter when the temperature was below 20° F. with the ground bare, with the yield of wheat in central Illinois, and in every case, he obtained a correlation coefficient so small as to cast great doubt upon the importance of the snow cover in determining the yield of wheat. More specifically, he found that there is reason to believe that wheat has a better prospect when the ground is not covered in January. The best years have been those with less than normal snowfall and with the temperature above normal for the winter. The years of poorest yield were those in which the winters had heavy snow and the temperatures were below normal. The companionship of warm winters and subnormal snowfall, and of cold winters and above-normal snowfall, is doubtless attributable to the fact that in a warm winter much of the precipitation falls as rain and that a snow cover tends to lower surface temperatures.

Studies of this type are important. It is true, however, that they are, through the complexity of weather factors and the pitfalls of the correlation coefficient, not always final in their result. Nevertheless, each serves a useful purpose in drawing the attention of agriculturists and others to the possibilities of relations or aspects of a subject which are either new or are opposed, as in this case, by a less scientific belief.

C. LeRoy Meisinger

SPECIAL ARTICLES

TRANSFERENCE OF NEMATODES (MONONCHS) FROM PLACE TO PLACE FOR ECONOMIC PURPOSES

Speaking generally, it is now beyond question that many soil-inhabiting mononchs feed more particularly on other nemas. However, they never follow these latter into plant roots, except in the case of open root cavities fairly readily accessible. They do not enter living plant tissues in pursuit of their prey. It follows that the good they do is in devouring the larvæ and young of injurious nemas at such times as the latter are accessible either in the soil or in open cavaties in the roots of plants.

In transferring mononchs from place to place with a view to making use of them in combating injurious nemas, the first requisite is a supply of mononchs. Such a supply may be obtained from soils in which the mononchs are numerous, and although we have comparatively little experience to guide us, yet it is now demonstrated that supplies of mononchs existing under these conditions are available. Thus far these supplies have been discovered more or less by accident; the cases, however, are numerous enough to establish the belief that special search will lead to the discovery of a sufficient number of these original sources of mononchs to furnish an adequate supply for trial.

The methods of collecting the mononchs, and transferring them, once they have been found, have been sufficiently elaborated for practical purposes, and published.

In transferring the mononchs to new situations, it is of course best to pay careful attention to the relative physical and biological conditions of the two habitats—the soil from which they are transferred and that to which they are transferred. The physical and biological conditions of the two habitats should be such as to insure the persistence of the mononchs after they have been transferred from the old to the new habitat. If the climatic and soil conditions of the new habitat closely resemble those of the old habitat, there is every reason to suppose that the mononchs will survive and flourish if there is a supply of suitable food.

The practical details may be illustrated by a hypothetical example. Suppose a region in Holland having a sandy soil has distributed in it as a plant pest the devastating nema, *Tylenchus dipsaci*, which, though more or less prevalent, is not doing very serious damage because held in check by mononchs. Suppose the existence of another region, like that in

the vicinity of Bellingham, State of Washington, U. S. A., having a soil and climate similar to that of the district in Holland just mentioned, and suffering more or less severely from the ravages of *Tylenchus dipsaci* because this nema is not sufficiently held in check by any natural force. We may suppose that in this latter case *dipsaci* has been introduced at Bellingham without the enemies and parasites that hold it in check in the first-mentioned place. The mononchs found in the soil of the Holland district feeding upon *Tylenchus dipsaci* are collected and transported to Bellingham and introduced into the soil. There is good reason to suppose that under the new conditions, finding their food abundant, including the larvæ and young of *Tylenchus dipsaci,* the mononchs will flourish *Tylenchus dipsaci* in check.

If it be asked why injurious nemas are transferred from place to place without their enemies being transferred at the same time, the answer is that nemas injurious to plants are often transferred in the interior parts of plants imported in a living condition, and, as already indicated, the mononchs and other predatory nemas are less common in these situations than they are in the adjacent soil, which latter in the course of commerce often is removed from the roots and not shipped. One need only instance the case of bulbs and similar importations to see how much better chance the injurious parasitic nemas have of being imported than have those nemas which feed upon them. There is also reason to believe that sometimes the parasitic nemas infesting crops are more resistant to untoward conditions, *e. g.,* dryness, than are the predaceous nemas.

We have at the present time arrived at a stage where logically the next step is to try out the introduction of promising species of mononchs. Efforts of this kind will necessarily be somewhat expensive, probably more expensive than the corresponding early efforts to introduce beneficial insects. There can be no doubt, however, that the enormous losses due to plant-infesting nemas fully justify the expenditure of even large sums of money in an effort to apply this remedy, more particularly because the remedy, when successful, bids fair to be permanent and self-sustaining.

After long-continued and intensive studies I am thoroughly convinced that many of the practises evolved in the transfer of beneficial insects can, with appropriate modification, be applied to the nemas. At the present time the greatest drawback in the case of the nemas is the small number of people who are technically competent to make the necessary biological examinations. It is in this respect principally that their introduction will differ from that of the introduction of useful insects, for the nema problem is essentially a microscopic one. Though the collection of the nemas from the soil differs entirely from the collection of beneficial insects, the methods have already been brought to such a state that there are no insuperable obstacles.

The percentage of mononchs in miscellaneous collections of soil-inhabiting nemas taken from various situations is roughly indicated by the following figures based on the writer's examinations—in each case of from one thousand to several thousand specimens:

1. Miscellaneous collection from very small quantity of soil taken from the roots of 14 species of plants imported from Brazil, 6.5 per cent. mononchs.
2. Sandy soil about the roots of astilbe and peony, Holland, 11.6 per cent. mononchs.
3. Soil from cornfield in New Jersey in autumn, the prevailing genus was *Mononchus.*
4. Sand from Washington filter beds, 96 per cent. mononchs.

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THE INTERACTION OF ETHYLENE AND SULPHURYL CHLORIDE

SOME time ago,[1] while treating suphuryl chloride (SO_2Cl_2) with ethylene gas (C_2H_4) at room temperature, the writer discovered a reaction quite different from any other which has come under his observation. It was noted that when a fairly strong, steady stream

[1] First observed on February 28, 1918.