

Insects in Relation to Production of Red Clover Seed

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In preparing the following manuscript the author has in mind that the only consideration to be dealt with is the production of seed of red clover. The factors considered, their effect on the plant, and recommendations offered are based entirely on that premise. The suggestions do not in all cases agree with those that would be made where red clover is used as a hay and fertility-maintenance crop.

Red clover is attacked by insects at various stages of growth and almost continually during its entire life. The production of seed by the plant is affected either directly or indirectly in several ways and several factors influencing the development of a good crop of seed are affected.

EFFECT OF INSECTS ON STAND

One of the primary requisites for a satisfactory seed crop is, of course, the development of a good stand of plants in the field. This may be affected by insects at two times.

Leafhoppers.—First, during the seedling stage and the remainder of its first season of growth red clover is attacked by the Potato Leafhopper, *Empoasca fabae* Harris. The amount of damage done by this insect can and does determine whether or not the crop will survive to produce any growth at all, or whether the growth that does survive will be strong and healthy. The plant is also affected during the second year of growth, soon after the first cutting, at which time the leaves are affected by so-called 'tip-burn' or 'yellows'. The damage may develop to the extent of practical destruction of the plant.

Prior to 1927 this was considered a physiological condition. At that time it was found that this condition was directly caused by the Potato Leafhopper mentioned above. Research demonstrated that foreign clovers were unable to survive the attacks of these insects, but that native strains of red clovers could survive under most field conditions. This work has been previously reported.¹

The use of native strains of red clover seed will largely prevent serious losses from this cause.

Clover Leaf Weevil.—During the fall and winter of its first season and the spring of the second season red clover is attacked by the larvae of the Clover Leaf Weevil, *Hypera punctata* Fab. The adults of this insect deposit their eggs in the mature, hollow stems of the clover plant during September. A portion of the eggs hatch during the fall, while the remainder stay in the stems until the following spring before hatching. Those larvae which have hatched spend the winter in the trash under the plants.

¹Hollowell, E. A., Monteith, John Jr., and Flint, W. P., Leafhopper injury to clover. *Phytopath.* 17, 6, 339-404, June, 1927.

The losses are caused by the feeding of the larvae on the leaves. The larvae are small, green, footless worms with a white or yellowish stripe down the back. They feed during the nights or on dark, cloudy days. During the day they are usually found curled up in the base of the plant or in the trash under the plant.

During long, cool springs the damage by the insects is frequently so severe as to cause total destruction and death of the plants. In 1927 hundreds of acres of red clover were plowed under because of this condition.

Farmers have found that much of this damage may be prevented by burning over the stubble during the winter. If this is done while the plants are fully dormant they survive this treatment, but if they have started to grow they will be killed by it. Spraying of the plants with an arsenical poison would produce control, but is not economical under present conditions. The insects are frequently controlled by a fungus disease which will develop on them during warm, wet weather. This is the most common check to an outbreak.

Clovers other than red clover do not suffer as badly as this crop, especially in mixtures.

EFFECT OF INSECTS ON THE NUMBER OF BLOOMS

Another essential to the production of seed is the development of a large number of heads in which the seed may be produced. This depends, of course, on the general condition of the plants and is indirectly affected by the Clover Leaf Weevil as described above. It is also directly affected by the Lesser Clover Leaf Weevil, *Phytonomus nigrirostris* Fab.

Lesser Clover Leaf Weevil.—The adults of this insect are small (about $\frac{1}{8}$ inch long) snout beetles covered with green hairs so that it appears green to casual observation. The adult spends the winter in trash in hedgerows, fence rows and, to a certain extent, in the trash under clover plants in the field.

The eggs of the insect are deposited in the inter-epidermal layer of the stems during mid-April to mid-May and hatch in 2-3 weeks into footless, maggot-like worms, whitish in color, with a black head and a black or brown line across just behind the head. When taken from the plant they lie in a crescent shape in the hand.

Much of the feeding of these insects is done in the axils of the leaves and stems. They burrow into the stem just below where the bloom is forming and either cut off the stem or entirely devour the newly-formed bloom before it develops beyond the leaf-axil.

The importance of the insect may be shown by the results of a single survey trip June 3-4, 1929 in western Illinois where it was found that 17.3 per cent of the stems and 58.2 per cent of the blooms were infested, and 33.6 per cent of the blooms were completely destroyed. Other and similar observations could be quoted from other years, the infestation varying, of course, from season to season.

Much of the damage can be avoided by delaying the development period of the clover by pasturing lightly until about May 1st. Some benefit should be obtained by destroying the adults in the winter by cleaning up the hedges and fence rows and burning the stubble.

EFFECT OF INSECTS ON CONDITION OF BLOOM

After the clover blooms have developed it is essential that they remain intact if they are going to produce a satisfactory crop of seed. The Clover Head Caterpillar, *Grapholitha interstinctana* Clem., attacks the plant in this stage.

Clover Head Caterpillar.—This insect attacks the red clover plants both fall and spring. In the fall they feed in the crowns of the plants, reducing the vitality of the plants so that they are not able to withstand winter as well as they might, and this is important. But the greatest damage as a red clover seed pest is the feeding on the blooms in the spring and summer.

There are three generations of the insect. The fall larvae hibernate and produce moths in the spring which lay eggs at the base of the developing florets. The larvae from these feed in the flowers at the base of the florets and cut them off, thus destroying their ability to produce seed. The adults of these develop in time to attack the normal second crop of red clover heads and damage them, and the third brood of adults appear in time to produce the over-wintering larvae in late blooms in the fall or on tender shoots at the base of the plants.

The importance of this insect is indicated by survey figures. For instance, in 1923 in western Illinois 33 per cent of the first crop blooms were attacked. In 1924 as high as 86 per cent of the heads were infested. In 1926 54-70 per cent showed damage, and 23 per cent were infested in 1928. Certain counts showed that about 7 per cent of the infested heads are completely destroyed.

Certain important records were made in 1927. In that year first crop clover showed 1.5-2.7 per cent of infested heads, but second crop clover developed 17.2-23.6 per cent infested heads on several counts. The damage that year was light but the increase between the first and second crop infestations is rather spectacular.

It is not supposed that all losses caused by this insect can be averted, but they may be reduced by: (1) Destroying the over-wintering generation by fall clipping and removing volunteer crops by plowing clover fields in the fall; (2) delaying the development of blooms in the spring by clipping or pasturing; (3) the use of first crop clover for the seed crop and avoiding the heavy second brood damage.

DIRECT EFFECT OF INSECTS ON SEED

Finally, the seed produced must be plump, healthy, mature seed. Two insects may be responsible for the destruction of the seed of red clover after or just as it is being formed, namely, the Clover Seed Chalcid, *Bruchophagus fuscicornis* How., and the Clover Seed Midge, *Dasyneura leguminicola* Lint.

Clover Seed Chalcid.—The adult of the Clover Seed Chalcid is a small, black, four-winged fly to be seen about the maturing heads of red clover. There are at least three broods of the insect occurring on the first crop, second crop, and volunteer heads of the fall crop. The generations are not distinct.

The damage is done by a tiny, white, footless maggot which lives inside the seed, causing a total loss of each seed so infested. The seed is very light or broken and only the hull is left. These are blown out by the fan in threshing and constitute a large part of the seeds which go into the straw pile and cause the farmer to think that he is getting 'a poor job of threshing'.

Losses from this insect vary greatly from year to year, but may be very serious. Records show infestation, and consequent loss of 18.8 per cent of the seed in 1925, 12-15 per cent in 1927, and 16.6 per cent in 1928. These are estimated to cause a reduction in yield of approximately a peck an acre, and are for first crop clover. Second crop records are not available, but it is observed to be more severe than the first crop.

These losses cannot be entirely eliminated, but certain practices will be of benefit: (1) The use of the first crop for seed will avoid the heavy second brood damage; (2) clipping or pasturing in the fall to remove the overwintering population will reduce the number present the following spring; (3) destroying the straw stacks into which much of the infested seed is blown will remove that many.

Clover Seed Midge.—The Clover Seed Midge is much like the Chalcid except that it attacks the ovules before the seed is entirely formed. Their presence in the field is indicated by flowers that are partly in bloom and partly green where development has been stopped. Infestation at Urbana has been reported by Mr. Flint as high as 25 per cent.

Infestations are more severe in the second crop clover than the first crop. The appearance of the adults coincides with the development of blooms in the clover so that the broods come along with each crop of clover.

The application of remedies for the Clover Seed Chalcid will help reduce damage by the Midge.

SUMMARY

The grower whose aim is to produce a maximum of red clover seed cannot afford to neglect the importance of insects affecting the crop.

Clover is attacked in all stages by insects that affect the seed production indirectly or directly by influencing (1) the condition of the stand; (2) the production of an abundance of blooms; (3) the development of well-rounded, full blooms; and (4) the production of an abundance of plump, mature seed.

The maximum results in controlling these insects may be expected by following the following practices:

- (1) The use of native strains of seed.
- (2) Fall clipping or pasturing.
- (3) Winter burning when the plant is fully dormant.
- (4) Pasturing lightly in the spring until about May 1st.
- (5) Cleaning up fence rows and volunteer growths in the fall.
- (6) Disposing of old straw stacks.
- (7) The use of the first crop for seed.