Biology and Control of The Sweet Clover Weevil[1]

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THIS investigation centered around (a) delayed seeding as a factor in controlling the sweet clover weevil, (b) difference in susceptibility of sweet clover varieties to weevil attack, (c) insecticidal dusts and baits, (d) notes on the biology of the sweet clover weevil, (e) burning of ground cover as a possible means of destroying the weevils, and (g) effect of shading.

(a) **The Effect of Delayed Seeding:** The results obtained on this phase of the project strongly suggest that delayed seeding may have a most important application in protection of the young plants from weevil damage. This is due to the diminishing weevil population and shortening of the oviposition period as the spring season advances. The indications are that sweet clover seeded after June 15 receives but slight injury from the weevil. Results of observations made to date have been prepared as an article entitled "Will Delayed Seeding Reduce Damage Caused by the Sweet Clover Weevil?"

(b) **Sweet Clover Varieties and Weevil Damage:** This was a continuation of the investigation on this phase of the problem begun in 1943 on 15 varieties of sweet clover. In that these varieties were sown in 1943 and two of them were of the annual type, it left but 13 for our study this year.

The arrangement of the varieties in the rows of the NDAC Experimental plots beginning from the north side is as follows: 1. Evergreen; 2. Wisconsin Late White; 3. Iowa Late White No. 2; 4. Iowa Late White No. 1; 5. Sangamon; 6. Alpha; 7. Brandon Dwarf; 8. Grundy County; 9. Pioneer; 10. Early yellow; 11. Aura; 12. Erector, and 13. Albotrea. Several rows of one of the common varieties at the sides of the plots served as buffer zones.

Susceptibility of Sweet Clover Varieties to Weevil Damage

VARIETY	Replicates	Ave. No. of Notches per 105 leaves-1944	Ave. No. of Notches per 105 leaves-1943
Brandon Dwarf	3	109	48.5
Wisconsin Late White	3	112	89.0
Evergreen	3	120	34.0
Erector	3	136	32.7
Alpha	3	149	69.8
Albotrea	3	149	52.5
Early Yellow	3	161	68.5
Aura	3	170	56.2
Grundy County	3	190	26.5
Pioneer	3	197	67.5
Sangamon	3	249	94.9
Iowa Late White No. 1	3	256	82.5
Iowa Late White No. 2	3	262	79.0

[1]Progress report upon North Dakota Agricultural Experiment Station Bankhead-Jones Project No. 28 on the "Biology and Control of the Sweet Clover Weevil, **Sitona cylindricollis** (Fabr)"

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The varying amount of damage done by the weevils to the different varieties was determined by picking at random 35 trifoliate leaves (105 individual leaves) from each of 3 replicated plots of the 13 varieties of sweet clover. The leaf notches, representing the feeding damage caused by the weevils, were counted and tabulated during the period June 9 to 12, 1944 and August 7, 1943 as shown in the above table.

In comparing the 1944 results with those of 1943, it is found that several of the varieties, including Iowa Late White No. 1, Iowa Late White No. 2, and Sangamon, were the most susceptible to leaf injury for both years. The greatest discrepancy appears to be for Wisconsin Late White. This variety in the first year growth (1943) showed the second highest degree of injury of all varieties, but in 1944 stood second to Brandon Dwarf for the least amount of injury. To what extent the stage of maturity of the plant may have accounted for this great difference in rate of feeding injury on the Wisconsin Late White variety and to lesser extent on a few other varieties is not understood. A census on the stand of plants was not made in 1944 because of the denseness of the entire stand. We cannot attribute the difference to non-uniformity of the stand as suggested by the 1943 study.

(c) **Insecticidal Dusts and Poisoned Baits:** Results obtained from dusting barium fluosilicate (dutox) on three replicated plots on a weevil infested sweet clover field northwest of Chaffee on May 24 produced apparently confusing results according to two different methods of evaluation conducted on June 6. The degree of control was about 40 percent as indicated by the number of weevils captured with a net. But a tabulation of the leaf notches showed no significant reduction in feeding injury for the dusted plots. This discrepancy is apparently due to the main damage of feeding having been caused prior to the application of the poison dusts with the result that the late dusting showed no significant reduction of damage. Earlier dusting of the plots would probably have resulted in a more marked reduction of the damage to the foliage.

Possibly because of this same delay in application, a poisoned bran bait scattered over sweet clover plots at Fargo on June 15, produced no significant results in control of the weevils. The bait was made of wheat bran ,95 percent, poisoned with sodium fluosilicate, 5 percent, mixed while dry and then moistened with water. The mixture was divided into two lots; one lot was slightly flavored with coumarin. (0.01 percent.) The baits were applied in late afternoon at the rate of about 20 lbs. per acre. Table of results are as follows:

TREATMENT	Weevils captured Per 50 sweeps of insect net
Poisoned bran bait	34
check (no treatment)	36
Poisoned bran bait with coumarin	31
check (no treatment)	27

(d) **Notes on the Biology of the Sweet Clover Weevil:** Inspection of the plants showed that the overwintered weevils began feeding on the plants as soon as green growth appeared in the spring. It was at this stage that the weevils were able to inflict the highest percentage of damage to the foliage. In late April, at which time the overwintered weevils were most abundant and the leaf growth was slight, the weevils were often observed to destroy the foliage almost as fast is it developed. It was at this period that the greatest amount of flight dispersal occurred. Weevils were then most frequently collected by students and members of the Agricultural Entomology Staff. These weevils were in flight apparently in search of sweet clover plants to provide suitable feeding and oviposition places. As the season advanced and the amount of foliage became greater the weevils were less commonly observed in flight. This satisfying of the "hunger urge" was probably the main factor in tapering off the flight dispersal activity. It was observed that a weevil did not search further as long as it was located amongst an adequate supply of sweet clover foliage. While the peak of the population is early in the spring when the weevils emerge from hibernation, and development is at the lowest ebb, subsequent

changes are not entirely clear. Examination of plantings at weekly to ten-day intervals to determine the number of weevils at the base of plants or on the plants proved disappointing largely because the weevils were difficult to find; this was particularly so because of their color being so like that of the soil, their smallness of size and their habit of "playing possum" or feigning death when disturbed. Sweeping with a net at intervals of time to determine the changing population proved unsatisfactory because the time of day, prevailing temperature, and intensity of the light influenced the number of weevils on the foliage, and correspondingly the number which might be captured in a net or found otherwise. Ordinarily the weevils were most abundant on the foliage in late afternoon.

The combination of sweeping, with the insect net over the plants, and searching around the base of the plants for weevils, however, gave a rough approximation of the changing population. The indications were that the population changes but little until the beginning of June. From then the trend is downwards, becoming most pronounced after mid-June. By mid-July it is extremely difficult to find any weevils of this generation remaining.

Weevils taken from plants during the week of May 10 and placed in petri dishes supplied with sweet clover leaves failed to oviposit which indicated that oviposition had not normally begun. This operation was not repeated until June 6, when one weevil, placed under observation in a petri dish, laid a total of 19 eggs in 24 hours. During the ensuing week numerous weevils placed in petri dishes laid eggs. The eggs were oval and white, but changed to black the first day.

The incubation period was determined for the 19 eggs laid June 6 to be approximately 14 days. One of the eggs hatched late on the 13th day and the remaining 18 had emerged by the morning of the 14th day. A newly hatched larva measured .7473mm in length, which is approximately double the length of the egg.

Newly hatched larvae were maintained for a period of 24 hours in glass vials with rootlets and fresh leaves, from a sweet clover plant, to serve as food. At the end of the period it was observed that the larvae had fed slightly. Those with foliage only, showed a greenish color of the "leaf" meal in their intestinal tract; except for slight feeding noted on the rootlets supplied the other larvae, there was no other apparent indication for their having fed.

While it is probable that weevil oviposition may occur over an extended period, it is believed from the evidence obtained, that the intensive egg laying may extend over a comparatively short period, possibly two or three weeks at the most. This is borne out by examination for the grubs or larvae in the soil around the roots of the plants. Their stage of development did not appear to vary more than the above time would permit. Furthermore, the comparatively short period of weevil emergence which has locally been observed to begin during the last week of July and extend to the middle of August should correspond in duration closely with the oviposition period.

The emerging weevils, of this new generation, are by no means as destructive to the plants as they are following their hibernation period. This is probably not due to any marked difference in their extent of feeding upon the plants (fall or spring) but rather to the greatly decreased amount of foliage in spring (as compared with later in the summer) which results in higher percentage defoliation of the plants by the overwintered weevils.

During late September and well into November these weevils have been found in large number underneath bee hives, shocks of sweet clover and to a lesser extent among the plants, in preparation for the hibernation period. Normally they remain in these places, with such

MEASUREMENTS OF 3 EGGS	No. 1	No.2	No. 3	AVERAGE
Length	.3718 mm.	.3718 mm.	.3861 mm.	.3765 mm.
Width	.3289 mm.	.3146 mm.	.3217 mm.	.3217 mm.

further protection which the snowfall affords, until spring weather revives them as well as the overwintered plants.

(e) **Burning of Ground Cover as a Possible means of Destroying the Weevils:** Two nearby fields of sweet clover south of Chaffee, one of which had been burned over during the fall of 1943, and the other allowed to remain unburned, were examined in May and again in June of 1944 to determine what possible effect the burning might have had on the weevil population. There was no significant difference in the weevil damage of either of these fields, being unusually light in both fields. While it is highly probable that the burning of the sweet clover in late fall may have destroyed the weevils in the one field, there was no way of measuring the possible effectiveness of it; because flight dispersal probably brought about a redistribution of the weevils from the untreated area into the burned area and might have masked whatever degree of control was accomplished.

(f) **Effect of Shading:** Mr. John C. Thysell, Associate Agronomist, U. S. Great Plains Field Station Bureau Plant Industry, at Mandan, called attention to the more extensive sweet clover growth along the east, south and west margins of the plots. A careful check indicated that there was little difference in uniformity in the stand of plants. The difference noted was due largely to the great amount of sunlight along the margin stimulating the development of these plants as compared with the weaker plants located a distance in from the margin and more densely shaded by the cereal nurse crop. That dense shade contributes at times to sweet clover damage was evidenced by this occurrence.

SWEET CLOVER Diseases

All agricultural crops are subject to injury by plant diseases and insect pests. From the time of its general introduction into the State about 25 years ago, the sweet clover crop has been relatively free from diseases. In Bulletin 166, published in May, 1923, Wanda Weniger, then Plant Pathologist, described a root rot of sweet clover apparently caused by a **Fusarium** species. She also called attention to a stem canker disease caused by **Ascochyta caulicola.**

In 1932, W. E. Brentzel, Plant Pathologist, in Bulletin 255 of this Station (a revision of Bulletin 166) called attention to the "mosaic" disease of sweet clover and noted that it was fairly abundant on plants found growing wild, and he indicated that the disease might be identical with the mosaic diseases on beans and red clover.

During 1944 Mr. Brentzel has re-examined the whole situation with respect to sweet clover diseases with the assistance of the cooperation of the Emergency Plant Disease Prevention Program of the United States Department of Agriculture and of Dr. F. Gray Butcher, Extension Pathologist of this institution. No seedling blight was observed in 1944. A black stem disease whose symptoms resemble those caused by **Ascochyta** species, as described by Johnson and Valleau, was noted. Seed collected from such infected plants were grown to normal healthy maturity under greenhouse conditions with no appearance of the disease throughout the life of the plant.