SCREENING FOR THE PROTECTION OF CABBAGE
SEED BEDS.

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* Riverhead, N. Y.
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SCREENING FOR THE PROTECTION OF CABBAGE SEED-BEDS.

W. J. SCHOEEN.

SUMMARY.

1. This bulletin deals with experiments to test the value of cheesecloth screening for the protection of cabbage seed-beds against injuries by root-maggots.

2. Two species attack the underground parts of seedlings, which are the cabbage-maggot (Pegomya brassicae Bouché) and the seed-corn maggot (Pegomya fusciceps Zett.). These insects are very destructive to young plants, and are pests which have been very difficult to combat successfully in seed-beds.

3. In the experiments, four large beds were made, the seed being sown respectively on April 29, May 13, May 17 and May 28. Screening was applied to 21 rows of 150 feet in length of the planting of May 13. The remainder of the bed, consisting of 68 rows of equal length, was considered as a check.

4. Plants raised under cloth grew faster and reached the desired size for transplanting one week before the seedlings in the check area. The screened sets were seasoned by the removal of the covering thirteen days before the time of replanting, and showed no more wilting when transplanted than did the check seedlings.

5. The screened bed was entirely free of maggots, and produced 50,000 sets, which were replanted. The check bed, of more than three times the size, yielded only 30,000 desirable plants. The cabbage-maggots were generally very destructive to unprotected seedlings.

6. The planting of April 29 was practically destroyed by flea-beetles and maggots. The beds sown on May 17 and 28, owing to the lateness of the season and injuries by maggots, did not produce any plants of the desired size.

7. The experiments show that screening entirely protects seedlings from injuries by maggots, and indicate that it is possible to season the plants, by removal of the covering a few days before transplanting, so as to avoid the excessive wilting and losses, which sometimes attend the planting in the field of sets grown in covered frames.
INTRODUCTION.

In many parts of the State where late cabbages are extensively grown, farmers frequently experience much difficulty in raising enough seedlings, of required size, to plant the desired acreage. The principal handicaps in the growing of seedling plants are flea-beetles and root-maggots, which in years of abnormal numbers stunt and destroy a large percentage of the young cabbages in the seed-beds. It not infrequently happens that cabbage growers, after having sown several beds and planted several times the amount of seed ordinarily required, are finally compelled to buy plants to supply the deficiencies. On this account, in various cabbage-growing sections large quantities of sets have been imported from New Jersey and Maryland for the past several years. Farmers generally are opposed to this practice and prefer home-grown plants, if they can be had, for reasons of economy and safety. It is claimed that seedlings can be grown for about ten to fifteen cents a thousand, while the usual cost of imported plants will average from seventy-five cents to one dollar and a quarter per thousand. It is also generally believed that home-grown plants are more hardy and usually recuperate quicker upon transplanting in the field; and that they do not require to be reset in such large numbers as the imported seedlings. In addition, the importing of plants or the transplanting of them from one farm to another is attended with certain risks, especially in the introduction of club-root into clean fields.

Various cabbage seed-bed problems, largely concerned with destructive insects, have been under consideration by the Station for several years. One of these is to determine means of protecting seed-beds from cabbage-maggots. Of the various measures that have been employed in the experiments with this pest, screening of the plants has afforded the most efficient protection to seed-beds. Because of its efficiency for this purpose, the attention of growers is called to the value of screening of beds as one means of protecting plants from injuries by root-maggots.
GENERAL DISCUSSION.

IMPORTANT SEED-BED INSECTS AND NATURE OF INJURIES.

Two species of flea-beetles are destructive to cabbage seedlings, which are the turnip flea-beetle (*Phylloptera vittata* Fab.) and the smartweed flea-beetle (*Systena hudsonias* Forst.) These injure the young plants largely by feeding on the cotyledons, which in severe attacks are often destroyed or are so severely punctured that the plants die or fail to make the required growth in time for replanting. The principal injuries by these insects occur while the plants are appearing above ground and until they are two inches in height. As the cabbages increase in size, the work of the flea-beetles in the seed-bed gradually diminishes in importance. The turnip flea-beetle is the more injurious of the two species.

Attacking the underground parts of seedlings are two species of maggots, which are the cabbage-maggot (*Pegomya brassicae* Bouché) and the seed-corn maggot (*Pegoma fusciceps* Zett.). The adults make their appearance in the seed-beds about the same time as the flea-beetles, but injuries by the maggots are usually later and the effects of the attacks are not fully apparent until after the principal work of the flea-beetles has ended. Of the two kinds of pests attacking seed-beds, the root-maggots are commonly regarded as the more destructive and the more difficult to combat.

FARM PRACTICES TO PROTECT SEED-BEDS FROM MAGGOTS.

Farmers generally are not successful in protecting their seed-beds from injuries by maggots. One of the methods most commonly recommended is to wet the ground about injured plants with diluted kerosene-emulsion or crude carbolic acid emulsion. This treatment, while destructive to young maggots, is, as commonly employed, not satisfactory. The chief reason for the failures is that the applications are made too late or are not frequent enough. Because of the doubtful results attending the use of emulsions, many growers have abandoned the employment of insecticides and now endeavor to raise the desired number of
plants by making larger seed-beds, and by sowing beds at various intervals of time. These have, in the main, proven somewhat uncertain and costly practices.

A method of protecting seedling beds, which is much more efficient, is that of growing plants under cheesecloth screening. The use of screening has been tried by a few farmers, but for obvious reasons with somewhat varied success. As a rule the screened plats were not as free of maggots as they apparently should be and the plants, grown under cloth, did not usually recuperate as quickly or in as large numbers after replanting in the field as the seedlings grown in the open. Observations on various screened beds indicated that these failures could largely be obviated by making the frames entirely fly-proof, so that the insects could not get through or under the screens, and by hardening the plants by the removal of the screening several days before transplanting. The growing of cabbage seedlings in frames for protection against maggots has not been carefully considered from all standpoints, so that there are many details regarding the raising of plants in this manner, on which more knowledge is needed.

EXPERIMENTAL.

EXPERIMENTS WITH SCREENING TO PROTECT SEED-BEDS.

To determine the value of screening as a means of protection against maggots, and to ascertain methods by which plants could be grown under frames, without appreciably reducing their vitality for transplanting purposes, some cooperative experiments were undertaken in 1907 with Mr. Levi Page of Seneca Castle. Cabbage is one of the principal crops in this part of Ontario county, and much trouble has been experienced in recent years in growing seedlings because of the severe attacks of the cabbage-maggots. As screening of beds was to be tried by a number of growers on a more or less extensive scale, a favorable opportunity was also presented, by cooperation with a number of farmers, to determine the practicability of this means of protecting seed-beds.
PLATE I.—CABBAGE SEED-BED SHOWING FRAME AND SCREENING IN POSITION AND CONDITION OF PLANTS AT REMOVAL OF SCREENING.
GENERAL CONDITIONS OF EXPERIMENTS.

The field selected for the planting of the beds consists of a rich black loam with a clay subsoil and was quite free of weeds. Previous to seeding, the portion of the field selected for the beds was heavily enriched with chemical fertilizers and was then harrowed at various intervals, as the condition of the soil permitted. Four beds were made, the seed being sown respectively on April 29, May 13, May 17 and May 28. For the purposes of this bulletin the second sowing, for which bed cheesecloth screening was used, need only be considered.

DETAILS OF EXPERIMENT WITH CHEESECLOTH SCREENING.

In this bed the seed was sown on May 13. The larger part of the seeding was made in rows twelve inches apart, using a garden drill, while for the portion intended to be screened, the seed was planted in rows only six inches apart. The number of rows included in the closer planting was 21, and the rows were 150 feet long. On May 20, this portion of the bed was enclosed. For the frame 12-inch boards were used, which were held in place by lapping the ends and by upright stakes driven in the ground. Cheesecloth was used for the covering. Four 3-foot widths were required, which were sewn to make one sheet. The cloth was fastened firmly to the frame by short nails driven through laths. To prevent sagging of the cloth, a heavy wire, supported by upright stakes, and running lengthwise of the bed, was used. All openings into the enclosed area, due to the uneven ground, were filled by banking the boards with earth.

For the purposes of comparison as to the growth of the plants and injuries by various insects, the uncovered portion of this bed, consisting of 68 rows, of 150 feet in length, may be considered as a fair check. Under this heading there may also be included some earlier and later plantings, which were also unprotected, and which may be properly referred to, for the purpose of bringing out more clearly than do the real check sets, some important features of the attacks of injurious insects in the seed-beds.
RESULTS ON PLANTS IN SCREENED PLAT.

The plants in the screened area began to appear above ground on May 20, which was seven days from the time of seeding. In the interval following the sowing of the seed and the appearance of the plants, the turnip flea-beetles were present in large numbers and destroyed a large percentage of the seedlings in the earlier plantings in other parts of the field. At this date they were, however, not so ravenous and were gradually becoming less destructive in the seed-beds. Only a few of the beetles entered the screened frame, and these caused unappreciable injuries. The seeds were a little too thickly sown in the row, but as the conditions of soil as regards moisture and warmth were very favorable, the plants made a good growth. On June 20, one month after covering the frame, the screen was removed to harden the plants in preparation for transplanting. At this time the sets were quite uniform in size and averaged from about six to seven inches in height above ground, and in growth were fully one week ahead of the checks.

Upon removing the screening, the bed was carefully examined from day to day for the eggs of the cabbage flies, the intention being to start the transplanting immediately upon the appearance of maggots, which would have allowed sufficient time to finish the work without important losses by these insects. But as no eggs were detected, the plants were allowed to become more seasoned, and the resetting was done by machine, as is common in the field operations in this community. The number of plants, by actual count, taken from the screened bed was 50,000, which were set by July 3. As compared with seedlings grown in the open, the sets upon transplanting showed no more wilting than is usual and made a normal growth.

RESULTS ON CHECKS.

Early seeding.—This bed consisted of 63 rows of 90 feet in length and the seeding was made on April 29. Owing to the cold weather, the plants did not commence to appear above ground until May 12, when they were immediately attacked by flea-
beetles, which during the following week destroyed over 50 per ct. of the planting or approximately 70,000 plants. The cabbage flies (Pegomya brassicae and P. jusciceps) were also present in large numbers and eggs were being deposited about the roots of the seedlings as early as May 29. The injuries caused by the flea-beetles, and especially by the cabbage-maggots, stunted and destroyed a large proportion of the remainder of the plants so that only a few dozens of sets were available for replanting.

Medium time of seeding: Checks proper.—This bed consisted of 68 rows of 150 feet in length and was sown on May 13. The conditions were the same as with the screened area, except that the rows were 1 foot apart and were not protected by covering. The date of the appearance of the plants above the ground was May 20, which was the same for both lots. The warm weather and frequent showers were very favorable to the plants which at the start made a good growth. A few flea-beetles were present in this bed but they did not cause important injuries. The cabbage flies were very numerous and on still warm days were very active in depositing eggs about the plants. On June 20 the first appearance of injuries by maggots was detected, and although there was no general wilting of the plants, partly due to the moist condition of the soil, an examination showed that the bed was well infested with root-maggots. During a succession of hot days in the following week these insects destroyed many seedlings and affected very appreciably the growth of the remainder of the plants, which made no material increase in size. It was estimated that at least 40 per ct. of the plants were killed by the maggots. On July 3 the plants that were still alive were much smaller than those grown under screening and, as they were generally undersized, only 30,000 seedlings were used for transplanting. The amount of seed that was sown in this bed was considered sufficient to produce the required number of sets for planting forty acres but only a little more than four acres were actually planted.

Late seeding.—Additional beds were sown on May 17 and May 28, but owing to the attacks of root-maggots and the lateness of the season, all of the plants that survived were undersized and none were transplanted.
COST OF MATERIALS FOR FRAME AND SCREENING.

The length of the seed-bed was 150 feet and the width was 12 feet. The items of expense for materials for the frame and covering are as follows:—

**ITEMS OF EXPENSE.**

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 yards cheesecloth at 2½ cts. and cost of sewing</td>
<td>$6.00</td>
</tr>
<tr>
<td>324 feet lumber (12 inch) at 4 cts.</td>
<td>12.96</td>
</tr>
<tr>
<td>Laths, wire and tacks</td>
<td>1.25</td>
</tr>
</tbody>
</table>

**$20.21**

The number of seedlings transplanted from this bed was 50,000, which makes the first cost of the frame and screening approximately about 40c. per 1,000 plants. Estimating that the screening could be used for three seasons, as is generally agreed, and that the boards could be used for this purpose for at least ten years, the cost of the materials for screening a bed, on the basis of these experiments, would be approximately 8 cents per thousand plants each year. The initial cost of the lumber could have been much reduced by having the frame more nearly square, rather than oblong.

**OPINIONS OF FARMERS ON SCREENING CABBAGE SEED-BEDS.**

The screening of cabbage seed-beds for protection against maggots has not generally proven successful. However, a number of growers during the past season covered a portion of their beds in the manner described in the Station’s experiment and all have been well satisfied with the quantity and the growth of the seedlings in the screened frames.

The opinions of a number of farmers, who have reported their results, are summed up as follows: The cost of boards is not entirely considered as an item of expense; for if it were necessary to purchase a new supply, the value of the lumber for other farm purposes is not materially lessened. All report that in the growing of plants under screening considerably less seed is needed than by the old methods to produce the required number of seedlings.
and some assert that this saving is sufficient to pay for the cheesecloth. The belief is generally expressed that the screening of seed-beds in communities where the cabbage-maggot is an annual pest, is practical and that seedlings can be efficiently protected from injuries by these insects.

**SUMMARY AND CONCLUSIONS.**

The experiments that have been made show that by the use of tight frames, covered with cheesecloth, cabbage sets can be grown free from injuries by root-maggots. The plants raised under cloth grow faster and in average years will probably reach the desired size for transplanting earlier than the seedlings in the open beds. The screened sets are also quite liable to be more tender, and if not well hardened, are generally more subject to wilting on replanting. Present experience indicates that the seedlings may be made more resistant to the usual injuries upon transplanting by the removal of the screening for at least one week before the time of planting, and that this seasoning may be done without much risk of injuries by maggots.

Screening of cabbage seed-beds is practiced by comparatively few growers, and usually only small percentages of the number of plants required for their purposes are at present raised under cloth. The methods that are employed in growing seedlings under screened frames often vary in minor particulars with individual farmers, and there is a diversity of opinions on such details as the grade of cloth and size of mesh to use, and the amount of seed to sow in beds to be screened, to produce the maximum number of plants, &c. More exact methods in growing sets in this manner can only be determined after more time for proof and verification. There is no question but that with screened frames, cabbage seedlings can be raised absolutely free from losses by maggots, but the practicability of the attempt, by the average grower in this State, to raise all or a large proportion of his plants under cloth, remains to be demonstrated. For this reason we would not advise, at least for the present, the extensive use of screening; but it is hoped that cabbage growers who are subject to annual losses in their seed-beds by maggots will make at least a small test to determine the
value of screened frames under their own conditions. Precise instructions can not be given in some of the details in raising seedlings by this method, as would be desirable, but observations of the practices of a number of cooperating farmers are the basis of the following suggestions to the grower who desires to test the practicability of screening seed-beds as a means of protection against root maggots.

SUGGESTIONS ON SCREENING CABBAGE SEED-BEDS.

Locate the seed-bed on a fertile and well drained piece of land, where there can be no accumulation of water or washing by rains under the frame. The ground should be free of weeds and should not have grown, the year before, cabbages or other cruciferous plants. For seed-beds it is customary to apply to the land a liberal quantity of a high grade chemical fertilizer. The seed should be drilled in rather thickly in rows six inches apart. The planting of the seed may be done at the usual season, but to avoid injuries by the flea-beetles it would be well to delay the seeding till the appearance of the beetles, which will largely have satisfied their ravenous appetites by the time the young plants appear. As the seedlings begin to show above ground, screen the bed immediately. For the frame, 12-inch boards are generally employed, which are held in place by upright stakes. To prevent the covering from sagging in the middle a heavy wire, running the length of the bed and a little above the height of the boards, and supported by stakes, is used. The screening, consisting of three or more widths of cheesecloth, sewn together to make one sheet, should be fastened to the frame by laths, through which small nails are driven. All openings into the bed, due to the unevenness of the ground, should be filled up by banking the boards with earth. To season the plants before transplanting, the screening should be removed one week or ten days before the time of setting. In this interval of time examinations should be made occasionally about the stems of the young plants near the surface of the ground for eggs, deposited by flies coming to the bed from the outside. When any are discovered transplanting in the field should commence.