OBSERVATIONS ON INSECTS---SEASON OF 1894.

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THE CHINCH BUG.

The chinch bug has been destructive over a considerable area of the state. In its distribution it has occupied the southeastern quarter of the state. With the exception of a few isolated cases and the somewhat more extended patch in Howard and Winneshiek counties, all the damage could be included within a line drawn southwest from Dubuque to Des Moines, and from Des Moines south to the border of the state. Throughout this region there was an extended and severe drouth during the preceding spring and fall, and but little rain, so that the bugs had an opportunity to hibernate under excellent conditions. In many cases wheat and barley were badly injured, and in some cases rye, but in most cases where winter wheat and rye were attacked the grain ripened early enough to avoid serious injury, although the bugs developed in such numbers as to cause great injury to adjacent fields of oats and corn. Throughout this area Osage hedges are a very common feature of the farms. In a great proportion of the reports received it is evident that these, or conditions similar to the presence of hedges, have permitted the hibernation of the bugs, and that in most cases the movement has been directly from such places into the fields of wheat or rye most convenient. It would seldom appear that the bugs traveled any great distance from their place of secretion. A point that is rather interesting is that the bugs have been most injurious in regions where winter wheat and rye have been a common crop for some years past, while in the districts where spring wheat or barley are the principal crops there has been less injury. The inference would seem to be that while winter wheat and rye were not so seriously injured by the bugs they furnished the most favorable conditions for their development in early spring, possibly furnished them winter quarters, and,

as a result, other crops in their vicinity are more seriously attacked.

In some of the localities where bugs were plentiful the farmers undertook measures to destroy them to prevent their migration into other fields, and in some cases with apparently good success. Plowing under to a considerable depth and the maintenance of obstructions to migration, either in the form of dusty furrows, strips of tar, or, in some cases, the cutting of a row or two of corn and piling the stalks where the bugs could gather under them and be destroyed by drenching with kerosene emulsion, appear to have been very satisfactory.

EXPERIMENTS WITH THE CHINCH BUG DISEASE.

As soon as the first reports of chinch bug abundance were received, indicating that this pest would be troublesome during the season, we made arrangements to secure a supply of the chinch bug disease, and are indebted to Prof. Snow, of Kansas, for supplies of infected material. It was, however, some time before we could secure any quantity of bugs from outside localities, as the bugs were so few in number at Ames that nothing could be done with the material collected here. So it was sometime before we had a supply of material ready for distribution. In many of the localities where bugs were reported as plentiful, the parties reporting, when attempting to secure a supply to send in, found difficulty in securing any quantity and only very small numbers were obtained. By the latter part of June, however, we received a supply and began distributing. For a time the infection material did not operate satisfactorily, and the first lot of bugs sent out did not seem to be thoroughly infected, and for a number of places where these were sent, duplicate lots were sent later. In some cases we found that the first lot sent out, while developing rather slowly at first, later produced an abundance of the fungus growth. The period from the time infection material was first sent until after the damage for the year had been done was extremely dry, and consequently very unfavorable for the rapid spread of the disease. It is probably due in large part to this that the results of this state cannot be con-

sidered as very encouraging, especially in a season such as we have just had.

The station sent out infected bugs to 164 different persons, in many cases sending two and three lots to each individual, which, in a number of cases, were distributed among a number of farmers in the neighborhood, thus giving the method quite an extended trial. In a great many cases it can be stated with confidence that the trials were made thoroughly, the directions being carefully followed, and the infected bugs very uniformly scattered in fields showing bugs in abundant numbers, so that there can be no doubt that the material distributed from the station was for the most part active and ready to spread rapidly with suitable conditions. Out of the 164 points, reports have been received from but 58. Of these 58 reporting, 32 reported that they considered the infection successful, giving various statements as to the rapidity and extent to which bugs became diseased, and the points from which they base their opinion of the successful result; 24 reported distinct failures; one reported the result was too doubtful to give an opinion either way; while in one case the material was not used at all. Of the 32 reporting success, however, only five reported observation of the white fungus growth on the bugs, or gave proof that the bugs actually died as the result of their infection; while a number reported bugs dying in other fields where the infection was not used. Others simply based the report on the fact that bugs were less numerous or had disappeared. Several, who sent in what they supposed to be bugs that had died of the disease, sent for the most part only the moulted skins of bugs, which had been taken for dead bugs. With these facts in view, it would be unsafe to claim that more than ten per cent of the attempts were really successful. Considering the extremely dry weather that prevailed for the period of the trial, great success could not be expected.

The following statement sent out in a press report regarding measures for immediate adoption, may bear repeating here:

It may be considered as established that the greatest injuries occurred in localities where wheat, rye or barley have

been grown continuously, and that the fields infested are those adjacent to hedges, thickets, or places where old corn stalks, weeds, slough grass, straw piles or rubbish have furnished suitable shelter for the bugs during winter; that the injury to corn and other crops, aside from wheat, barley or rye, is practically in all cases due to such crops being adjacent to fields of these grains from which the bugs migrated into the other fields; that obstructions to prevent migration even for a few days will serve to destroy a large proportion of the undeveloped bugs, and force the others to scatter to such an extent that subsequent injuries are much less severe. The use of the white fungus disease, while in many cases considered effective, and with suitable conditions greatly depleting the numbers of bugs, cannot be depended upon in all cases as an efficient check; and it is believed to be the part of wisdom to use other measures, and not to place reliance upon this for the prevention of possible injuries the coming season.

It is especially important, therefore, that the following suggestions be carefully considered, and wherever the presence of bugs indicates possible damage the coming year, that energetic treatment be adopted. During October and November, or in early December if the conditions permit, see that every possible place of hibernation of the bugs is thoroughly burned over. This process will, of course, be most effective after the bugs have entered such places and become somewhat dormant. Either burn out the rubbish in hedge rows, or rake out carefully all dead branches, leaves, weeds, etc., and get these into convenient piles, where the bugs may enter them, and where they can later be burned without damage to the hedge or to fences. In case burning is impracticable during autumn on account of wet weather, improve the first dry weather of spring for this purpose, making an effort in every case to thoroughly renovate all places of hibernation by means of fire.

In planning the crops for the coming season, arrange so far as possible to put wheat, barley or rye so they will not be adjacent to corn or oats; or, if this be necessary, plant a strip a rod or so wide, to potatoes, beans, or some crop not attractive to the bugs, and which can be kept cultivated throughout and used as an obstruction through the migratory period.

Plant some pieces of grain early as possible, and where it will be as attractive to the bugs as possible, using these as baits to attract as many bugs as possible, and then as soon as bugs appear in these places take measures to destroy them, either by drenching thoroughly with kerosene emulsion, or, if so numerous as to threaten destruction to the piece, by plowing entirely under to the depth of six inches or more, and follow this by thoroughly harrowing and rolling, so as to effectually bury the bugs.

THE WESTERN ONION THRIPS.[1]

(*Thrips alii Gillette.*)

This form seems to be distinct from the species discussed by Packard; and, inasmuch as it was first described as destructive in Colorado, and appears to be the form particularly destructive in Iowa, we may term it the Western Onion Thrips. The species has been recognized in Colorado, Iowa and Indiana; and probably the same insect has been forwarded from Long Island, but it was there taken from cabbages, instead of from onions. It occurs also on Stonecrop, Heal-all, Blanket Flower, Cinquefoil, Nasturtium, Candytuft, Squash, Four o'clock, Turnip, Catnip, Sweet Clover, Rudbeckia, Mignonette and Cucumber.

The greatest damage has been reported from Colorado, and from the vicinity of Davenport, where during the present season it has caused very extensive injury to the onion crop. This species is slender, light colored; most of the insects being light yellowish, but varying from this to dusky, and they are distinguished particularly by the eighth joint of the antennæ being fused with the seventh, and by the arrangement of the spines on the veins, those on the subcostal vein being usually ten in number, and arranged in groups of three or four—four near the base, three a little farther out and four rather widely separated ones on the apical half. Those on the median vein are about twelve or thirteen in number, and regularly placed from about one-third of the distance from the base to the tip, the basal portion of the vein being

[1] NOTE—A large part of the matter regarding this insect is based on observations and studies by Miss Alice M. Beach, a graduate student in Entomology during 1893 and 1894.

unarmed. The injury of this species appears to be the same as reported for the other species, and consists of gouged or corroded surfaces upon the onion stems, resulting in the whitish appearance and the wilting of the plant, the infested stem in many cases dropping over. The insects collect particularly in the axils of the leaves, and in the bent portions of leaves which have drooped over, or have been broken by the wind. The eggs are deposited slightly beneath the surface of the leaf and imbedded in the cell structure; the larvæ hatch from the eggs, work their way through the surface of the leaf, issue and very soon begin to feed upon the plant tissue. They evidently grow quite rapidly, and there is in all probability a number of generations each year, but just how many is not yet known. In all probability the winter is passed in the larval or adult form, very likely both; both stages being represented during the winter months, and the adults beginning the deposition of eggs as early in the season as vegetation is ready for them. Mr. Jesse Ammel informs me that on his place the most injury occurs next a heap of horse manure, insects crossing from this to the onion patch.

With regard to treatment for this species I have recommended particularly the use of kerosene emulsion, and I am still of the opinion that if thoroughly applied and sufficiently diluted it will be found of great service, killing a large portion of the insects without injury to the plant. It was found to check the work of the insects promptly in our experiments. It does not, however, destroy all the insects, as those which are secreted at the base of the stems, or under bent stems where the liquid does not reach them, would escape and survive to continue the injury, so that the plants after a short time may be pretty thoroughly infested. The eggs being deposited within the leaf would not be very apt to be destroyed; so that spraying will be of advantage after the young ones hatch out, which is probably soon after deposition. On this account the treatment with the emulsion should be repeated within four or five days after the first application, and if a few days after this the insects still appear numerous a third application would be necessary. Such treatment, I am confident, would so far reduce the numbers as to make

the growth of the crop possible, even in seasons when the insects are most abundant.

This remedy is, on the whole, so far as I know, the most beneficial for the amount of expense and labor involved; but it is desirable to find, if possible, some method which will be still more effective, especially one which will destroy all the insects occurring on the plants and which will check further increase. In this direction, experiments with some gaseous material, which will penetrate to all parts of the plant surfaces, are desirable. Bisulphide of carbon has been used successfully in the case of plant lice on melons, and it seems quite probable that its use can be adapted to the attack of this insect also. The trouble of covering the plants and the time involved in the method are, however, serious drawbacks.

It is possible to gain some advantage by clearing up and burning all onion tops as soon as the crop is harvested, thereby destroying the larvæ, eggs and adults, that may occur in them, and lessening the number that can hibernate. Occurrence on so many different plants, however, is against its success. It is not probable that the change of location would be of any special service, unless it were to a locality some miles distant from the field in which the onions had been grown before, as these insects can fly quite readily, and would, no doubt, seek out any new patch planted within the range of the same farm.

So far as observations go, or reports have been received, there is no difference in the varieties of onions attacked, and it is not likely that anything can be done in planting varieties that would escape injury. In some cases the injury appears to radiate from some center, a certain small patch of the field being badly infested while the remainder of the field is practically free. In such a case it might be very serviceable to entirely destroy the plants in this infested area; at least, to cut the tops close to the ground, burn them, and then use the emulsion pretty freely upon the plants surrounding this area, destroying any that may commence to spread from the infested center.

Dr. Packard's recommendation to pull and burn the infested plants is intended to accomplish this result. Deter-

mination of winter retreats may open way for wholesale destruction.

The onion crop is sufficiently valuable so that treatment is profitable even if it involves some amount of labor and expense. I would consider it very unwise to abandon the growth of onions because of the injuries which have occured from this insect. I believe it can be attacked with success. While it may require a little time and patience to determine the best and cheapest methods to accomplish this end, there are no difficulties which cannot be met by study and persistent treatment. So far as can be seen at present, there is nothing in the history of the insect, or in its method of work, which will render it so baffling as many other of the insect pests with which we have to contend. The fact that it is a new pest with us, and has not claimed our attention heretofore, is the only reason why it is a little difficult to adopt measures at once for its complete subjection. The great variety of food plants affected by this pest suggests the idea that its attacks on onions may be due to some conditions of the plants in certain seasons, and that in ordinary years it may be less troublesome. It is evident that these insects seek succulent plants, or parts of plants, and it may be that dry weather impels them to seek plants particularly succulent in tissue for food; onions and nasturtiums this season, for example. The fact, however, that they deposit eggs and breed so readily in onions shows it to be a suitable food plant.

OTHER SPECIES.

Aside from this common onion Thrips, just described, there has appeared at Ames a species which is somewhat like it in appearance, and apparently in habit, and which is very likely to increase in numbers, causing the same kind of injury, but in all probability requiring the same kind of treatment.

THE SQUASH BORER.

Until the present season I have not known of any destructive outbreak of this insect in Iowa, but its attacks this year in widely separated localities and in large numbers would indicate that it has gained foothold heretofore, and has re-

mained unnoticed because of occurring only in small numbers. With the outbreak of this year it is evidently bound to attract a good deal of attention and require decided treatment, or else it will prove a very serious pest. Its history throughout the country extends over a considerable period of time, it having been recognized a good many years ago, but its most extensive injuries are recorded for New Jersey, by Prof. Smith. His studies of the insect furnish us a considerable basis for conclusions with regard to treatment. It attacks various species of cucurbits, but is particularly partial to squashes, and, according to Prof. Smith, this is the only species to which it is injurious. Of these, it seems to favor the Hubbard, and is less injurious to the earlier varieties. Proportionately less damage occurs where the crop is raised on a large scale than in small gardens, as in the latter case large numbers of larva may occur on a single plant and cause its complete destruction.

The adult insect is a slender-bodied moth with transparent hind wings, the front wings being opaque and covered with minute scales, and the hind legs appear very large, from bearing tufts of hairs. These moths appear during June and deposit their eggs, which hatch in 12 to 15 days, and the larva begin their work and obtain their growth in about four weeks. When fully grown the larva enter the ground and bury themselves to a depth of one to two inches, spin a tough coccoon in which they remain through the winter unchanged, and become pupæ in the spring a short time before they issue as moths. The larva is, of course, the injurious stage, and its injuries are caused by its forming extensive burrows in the stems of the vines, these burrows being most abundant at and just above the ground. The infested vines indicate the injury by a wilting of the leaves, and in the field it is generally an easy matter to select the affected plants by simply a casual glance over the field. An examination of the vines near the root will reveal a burrow, generally coming to the surface, and out of which there is usually a smaller passage of borings, indicating the places where the larva has been at work. By cutting into the vines the larva itself will be found, or perhaps a number of them close together. I have found as high as a dozen in a single squash vine, which was, of course,

completely killed by their work. Being protected within the vines the larvæ are shielded from any direct method of treatment except cutting into the vines and killing them. This, however, will be of little avail where a number of larvæ are in a stalk and the plant is already wilted.

For method of treatment, I may quote directly from Bulletin 94, by Prof. Smith, which presents the most available statement, and most of which will apply as well here as in New Jersey:

"*First*—Manure or fertilize heavily, not in the hills only.

Second—Plant the land to summer squshes; preferably, crooknecks, as early in the season as feasible. If the fruit can be marketed to advantage, a full set can be planted; if not, a few rows only will answer as traps.

Third—Plant the Hubbards, marrowfats or other main crop, as late as advisable without risking the crop, making the hills between those of the early varieties.

Fourth—Keep a lookout for the moths, and when they are noticed go over the field every evening during the twilight and kill all that are found sitting on the leaves. A little practice will enable one to cover three rows at one time without missing a specimen, and in less than an hour a large field can be cleared of moths.

Fifth—When the late varieties need the ground, the crooknecks will have made at least a partial crop, even if badly infested by borers, and the vines can be taken out and removed, leaving the ground to the later varieties. This should be done carefully, so that all the borers remain in the vines, and the latter should be thoroughly destroyed in some way that will kill all the contained larva.

Sixth—As soon as the late vines begin to run well they should be covered to the fourth joint, or even beyond it, and the ground should be kept in such condition that they can readily send down suckers from all the joints. This will enable the vine to resist injury and to ripen fruit, even if it becomes infested by a few belated borers; but there must be plant food enough where these joint roots are sent down, for that in the hill may be cut off.

Seventh—When the crop is made, the vines should be at once removed and destroyed, as were those of the summer

squashes, so as to prevent the maturing of any borers then in them."

THE MELON LOUSE.

(*Aphis cucumeris*, Forbes.)

The insect has appeared several times in the State before, but we have had no such serious outbreak as the one of the present year, and to most of the parties who have reported it it seems to be an entirely new pest. It has destroyed many acres of melons and cucumbers. The most serious damage has occurred during the month of August, and apparently it has not been noticed to any extent earlier than the latter part of July. Its work upon these plants, however, began sometime in June, at which time a winged form appears upon the melon vines and starts the colonies of wingless individuals, their multiplication proceeding sexually, the generations of individuals producing living young and each generation following in rapid succession, so that their numbers increase enormously, and if unchecked soon destroy all plants on which they occur. This multiplication goes on until September or later; and sometime in autumn they must migrate from these plants to some plant which is occupied during late fall, winter and spring by the egg-laying brood of autumn. The eggs, during winter, and the generations in spring, are preceded by the winged migratory generation. Until we find the winter host-plant of this species, treatment will have to be based entirely upon the occurrence on the melons, cucumbers, etc.; and the most available plan yet known is the spraying with kerosene emulsion, which for these insects may be diluted to twelve or fifteen parts water to one part emulsion. As the bugs cluster particularly on the under surface of the leaves, the spray should be applied so as to reach them there. This can be done by use of a nozzle arranged to throw a spray upward; but in practice at the Experiment Station it has been found easier to lift the vines carefully and expose the under surface to a direct spray. This can be done best by two men working together; one working the machine, the other lifting the vines and turning them into position.

EXPERIMENTS WITH BI-SULPHIDE OF CARBON FOR PLANT LICE.

Bi-sulphide of carbon is a well-known insecticide, having been used extensively for destroying underground insects and insects infesting stored grain. It has been recommended by Prof. Garman for the Aphids, and some experiments reported by Prof. Smith, of New Jersey, show decidedly favorable results. Our experiments began early in September, and before the later reports of Professor Smith had been published, so that the methods adopted were in much part such as suggested themselves at the time, and prove to be the same in a few cases as had been adopted by other workers. The object of this record, therefore, is to give the results of these tests, rather than to propose any original method of treatment. In the experiments we used as covers for the infested plants wash tubs, hay caps, which were made of water-proof wood fibre, and also a covering of simple muslin. The bi-sulphide of carbon was evaporated under these from small watch glasses or shallow tins, placed in some cases on the ground, in others above the ground, and in some cases on top of the plant. The annexed table gives in condensed form the conditions under which each experiment was made, and the effect upon lice and plants, and also upon the parasites:

EXPERIMENTS WITH CS_2 FOR CABBAGE PLANT LICE.*

Number.	Date.	Time.	Hour, P. M.	Temp.[3]	Relative Humidity.	Cover.	CS^2 used.	CS^2 left.	CS^2 evap.	Lice inactive or dead	Lice active.	Lice revived.	Effect on plant.	Effect on parasites.
5	9-10-'94	1 hr. 5 min.	4.15-5.20	70° F.	27	Tub.....	10 cc	2-4 cc	6-8 cc	"	....	Many.....	Uninjured....	
10	9-13-'94	1¾ hr.....	2.40-4.25	74° "	62	"	10 cc	.....	10 cc	"	....	A few....	"	All issued.
8	9-10-'94	1 hr..... ..	4.45-5.45	70° "	27	Hay cap....	15 cc	5 cc	10 cc	"	....	Many	Uninjured....	
9	9-10-'94	35 min.	4.54-5.30	70° "	27	Tub.....	15 cc	5 cc	10 cc	"	....	"	"	
11	9-13-'94	1 5-6 hrs....	2.55-4.45	75° "	62	Hay cap....	15 cc	.....	15 cc	"	....	A few....	"	All issued.
16	9-28-'94	1½ hrs. .	3.50-5.20	85° "	41	Tub.....	15 cc	5 cc	10 cc	"	....	Many.....	"	" "
12	9-13-'94	35 min.	3.10-3.45	74° "	62	Hay cap....	20 cc	3 cc	17 cc	"	....	Many.....	Uninjured....	All issued.
7	9-10-'94	1 hr.....	4.35-5.35	70° "	27	" "	20 cc	5 cc	15 cc	"	....	" .. .	"	
4	9- 5-'94	1½ hrs.	12.00-1.30	80° "	60	Muslin net..	20 cc	.....	20 cc	....	All.....	.....	"	
2	9- 5-'94	1½ hrs.	12.00-1.30	80° "	60	Tub.....	20 cc	.....	20 cc	"	....	None	Slight injury.	
†1	9- 4-'94	1 hr.....	5.00-6.00	87° "	50	"	20 cc	.....	20 cc	"	....	Many.....	Uninjured....	
13	9-13-'94	1½ hrs.	3.25-4.55	75° "	62	"	20 cc	2 cc	18 cc	"	....	Very few.	"	All issued.
6	9-10-'94	50 min.	4.25-5.15	70° "	27	Hay cap....	25 cc	10-12 cc	12-13 cc	"	....	Many.....	Uninjured....	
14	9-18-'94	1 hr.....	3.45-4.45	73° "	40.8	Tub.....	25 cc	15 cc	10 cc	"	....	"	"	
3	9- 5-'94	2¼ hrs.	3.45-6.00	85° "	60	"	25 cc	.....	25 cc	"	....	....	Killed.....	
15	9-18-'94	1 hr.	4.00-5.00	74° "	40.8	Tub.....	30 cc	20 cc	10 cc	"	....	Many.....	Uninjured....	

*The dirt had been plowed up to the rows, leaving a strong ridge, making it necessary to cover the edges of the tub with dirt and tramp it down firmly.

†The CS^2 was poured into watch glass and placed on ground under the plant, near the stem. In all the others the lid of a baking powder can was used and placed on top of plant.

[3] Mr. Geo. M. Chappel, Ass't Director of I. W. & C. S., Des Moines, kindly furnished me the hourly temperature for September and October, 1894. An exact record of the temperature was not taken only during the latter experiments. The temperature recorded here differed only one or two degrees either way from the official record. So for uniformity all the temperatures were taken from Mr. Chappel's record. He also furnished the relative humidity record for experiments 1, 5, 6, 7, 8 and 9, the humidity given being that recorded at 7 P. M.

It will be observed that the results are rather variable and by no means as satisfactory as the experiments upon the melon lice reported by Prof. Smith. While subjection of the plants to the fumes for a period of nearly an hour in nearly all cases resulted in the apparent killing of the lice, in many cases they revived afterward, and in only a few cases was the destruction so complete that it can be considered as sufficient to prevent any futher increase of the insects. It may be noted that the only case in which the lice all escaped was with the muslin covering, which evidently did not retain the fumes so as to secure the saturated atmosphere necessary.

The difference in the amount of liquid that would evaporate under covers of equal size, would seem to show some variability in rate of evaporation, and possibly in some cases where the dishes used were not specially flat and shallow, evaporation was too slow to produce a saturated atmosphere within an hour.

Some later experiments in which the bisulphide of carbon was simply poured upon the ground at base of plant and covers placed at once and left for an hour, as before, resulted in a destruction of all the lice, none showing any signs of revival.

EXPERIMENTS WITH HYDROCYANIC GAS.

Following the results with bisulphide of carbon, we made a few tests with Hydrocyanic gas, for the sake of determining its efficiency upon such plants as cabbages, more particularly with reference to its use upon plants of such height that the bisulphide of carbon was somewhat ineffective. In the first test made the sulphuric acid used to generate the gas had been standing so long that it proved to be useless, and the result was negative. In using this material a small quantity of sulphuric acid, ten to fifteen cubic centimenters, was placed in a shallow dish upon the ground under the plant and a cover arranged so as to drop quickly into place; then a small lump of cyanide of potassium, from two to three grammes, was dropped into the sulphuric acid, the cover immediately pressed to the ground and the edges covered with dirt, which was then tramped down firmly.

In the first test, with fresh sulphuric acid (No. 4 of the series), 1½ gramms cyanide, in ten cubic centimeters sulphuric acid, were used, and the plant covered twenty-five minntes. Some of the lice were killed but some revived, the plant remaining entirely uninjured. In No. 5, ten cubi centimeters of sulphuric acid, one gramm of cyanide, covered twenty minutes, plaut lice were stupefied but many revived, plants entirely uninjured. No 6, 1½ gramm cyanide in ten cubic centimeters sulphuric acid, covered one hour, plant lice killed, plant uninjured. No. 7, 3$\frac{9}{10}$ gramms cyanide in fifteen cubic centimeters of sulphuric acid, covered twenty-five minutes, plant lice all dead, the plant considerably injured. Experiments 6 and 7 were made between 10:30 and 11:30 A. M., and the others between 4:00 and 5:45 P. M. The expense of this treatment, the greater part of which is the cost of sulphuric acid, would amount to about one cent per head for cabbages, with covers the size used in these experiments.