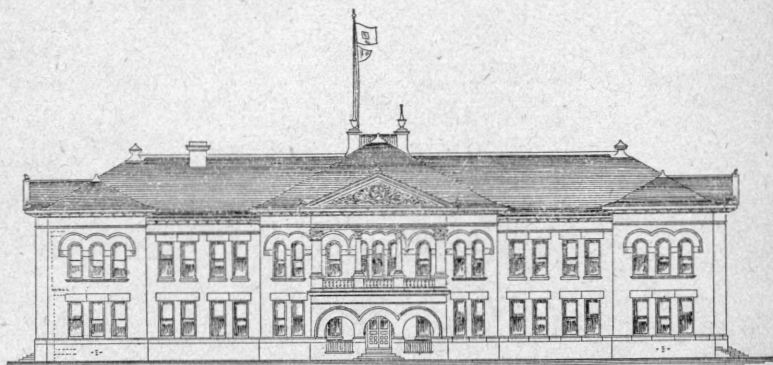


TEXAS AGRICULTURAL EXPERIMENT STATIONS.

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INSECT PESTS ATTACKING TRUCK CROPS.



-FRONT - ELEVATION -

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METHODS OF PROTECTING TRUCK CROPS FROM THE RAVAGES OF INJURIOUS INSECTS.

BY

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In this short bulletin the author can present only a few important factors in the management and protection of truck crops from insect ravages, which have been of great value to him as a truck grower in Texas.

It must be urged in the beginning that no truck grower should undertake to raise a crop without first having equipped himself with insecticides, fungicides and apparatus with which to apply them. Should the emergency then arise where quick action might be imperative the crop may be protected from insect depredations before serious damage can have been done. In these days of severe competition and quick results where both quality and earliness count for so much, it is utter folly to undertake truck growing without suitable provision for all emergencies of insect attacks or plant diseases.

Good farm management is also essential. By this is meant keeping the truck lands and their surroundings free from rubbish or growing weeds which affords food and shelter for all kinds of depredating insects. The torch cannot be applied to such too freely when occasion demands. Then, too, it means the destruction of the refuse parts or stumpage of any given crop immediately after harvesting it. This is to be especially urged, since leaving any portion of the refuse of the crop means the propagation of the insect pests of that crop, and hence a menace to its future successful and profitable production. For the reason that each crop breeds its own enemies it is well, and in fact almost imperative, to rotate the following year with some other crop in order that the insect enemies of the previous crop will have to go elsewhere and will mostly perish before reaching their food plant. If the same truck crop is grown for a number of years on the same land there can be no other result, ultimately, than that all the pests of that crop will have furnished them all the conditions for successful breeding, and will sooner or later make it impossible to grow that crop profitably.

LIFE HISTORY OF INSECTS.

There are four stages in the life development of insects. 1. The egg. 2. The larva. 3. The pupa or chrysalis. 4. The adult or imago. When the egg hatches it produces a larva. It is during this second stage that insects grow. The newly hatched larva is very small. As it feeds voraciously and grows, its old skin becomes too small. What is called *molting* then takes place, and the old skin is changed for a new and

larger one. This process goes on until the larva becomes full grown. During the last molt the larva changes into the pupa and becomes quiescent. During this period internal changes take place until the pupa hatches into the adult or full grown insect. Adults never grow any more, but often feed as vigorously as the larvæ before them, though not always on the same host plant. The cycle of life just given is one in which each stage of development differs radically from the other, and applies only to a portion of the insect world. For example, egg, larva, pupa, butterfly. There are other orders of insects in which, when the egg hatches, the larva may be at once recognized as resembling the adult. This larva molts the same as any other larva, but each time it becomes larger and more nearly resembles the complete full grown insect. The stage just before the last molt is called the nymph, and corresponds to the pupa of the butterfly. The molting of the nymph then produces the full grown insect. For example, egg, larva, nymph, grasshopper. These insects have a direct development and the growing period occupies the larval as well as the nymph stages. Those of the first group grow only during the larval state.

The methods of obtaining and eating their food and hence of doing injury are very varied and distinct and are very important because the methods of warfare against any given insect depends directly upon a knowledge of how it feeds. There are insects which do their injury by biting off and actually chewing and swallowing their food as solid substance. For these arsenical poisons may be administered on or with their food. Others have beaks for puncturing through the outer skin of plants and pumping the sap from underneath. Hence no outside solid matter is ever taken into the stomach and for that reason poisons cannot be administered. For these, contact insecticides, such as whale oil soap or kerosene emulsion, must be used and actually sprayed upon their bodies to be effective. Hence in any proposed insect warfare it is important to first determine the character of the mouth parts, which, therefore, also largely determine the manner of their feeding and attack.

PREVENTION BY RIGHT PREPARATION OF HOT BEDS, COLD FRAMES AND FIELD AREAS.

HOT BED MANAGEMENT.

The hot bed is the first battle ground. This, prepared with the utmost care, becomes, especially during the winter season, the most attractive spot in the vicinity for certain insect pests. Here the choicest plants of favorite varieties are grown by the thousands in the smallest possible space. Hence also the wholesale destruction of the plants in a remarkably short time is a very easy matter once an insect depredator gains entrance. If at such time the truck grower must first order apparatus and insecticides the plants are more frequently lost than saved, owing to the delay in application of the remedial measures which otherwise might have saved them. Two of the greatest inducements to certain insect pests during the winter time are sufficient moisture and warmth, or both. These conditions if carried to excess also invite fungus attacks. It has been my observation that more hot bed plants are lost from too much moisture or heat, or both, than from insect depredations. To obviate this difficulty the author has for a number of years practiced sub-irrigation

of hot beds and seed beds and never watering from the surface except at transplanting time. Either three or four inch tiling is used and laid on a dead level in forty to fifty foot beds. For four foot seed beds only one series of tiling is laid along the center. For six foot beds, two are used parallel with each other, and somewhat nearer the outer edge than the center of the beds. A T joint is used at one end of the string of tile and pieces of boards block the underground openings. Both ends of the tile are under the sash or cloth covering, if in a hot bed. When the plants show that they need moisture, water is poured in at the T end of the tile and allowed to diffuse from the joints along the line. In a hot bed this tiling lies above the level of the furnace flues distributing the heat, and this warms the water, or even vaporizes it, driving it upwards in a warmed condition. This avoids all danger of chilling the plants from the application of water colder than the temperature of the hot bed soil. Then, too, the plants are constantly sending their roots downward after moisture, rather than upwards, and the result is that they are more uniformly finely rooted than can possibly be produced by any other method. At the same time the surface is constantly and uniformly dry, which at once affords the greatest possible protection against fungus diseases or insect visits.

Hot beds in winter, or seed beds for midsummer or autumn, should be well prepared fully a month ahead of seed sowing. The soil should be well dug up, watered thoroughly, then pulverized and leveled off. This done, treat with carbon bisulphide (also called high life) as follows: Take any ordinary garden dibble and punch holes six inches deep two feet apart all over the surface of the bed. Then pour an ounce of carbon bisulphide into each hole, immediately fill it up with earth, giving it a slight pressure. Do this as quickly as possible and then cover with hot bed sash or cloth. In case of autumn seed beds cover the surface with wet gunny sacks. Allow the beds to remain in this condition for a couple of weeks and then uncover and air well. This fumigation process destroys any insect eggs or lower animal life in the soil and at the same time most all of the fungus spores. In addition it stimulates a healthy vigorous plant growth afterwards.

As the season progresses save and gather up plenty of wood ashes. Pile them so as to leach well and rot thoroughly by the time fumigation is completed. At sowing time spade the seed bed over thoroughly, pulverize well, and level off as before. Sow the seed, cover well (about an inch deep), and tamp the surface lightly. If it be an autumn seed bed give a liberal top dressing of tobacco dust at the rate of 500 pounds per acre and rake in lightly. Then apply a dressing of the well leached wood ashes to a depth of about one-sixteenth inch. This is done by taking a coarse sieve and sifting the ashes evenly over the entire surface. If for a hot bed sift the wood ashes on first and then apply a dusting of a mixture of one ounce of sulphur to three ounces of air-slaked lime. Use a finer meshed sieve than for the ashes, and sift on enough to make the surface look like a frosty morning. Then take the coarser sieve again and give an evenly distributed application of tobacco dust at the rate of about 300 pounds per acre, or until the whitishness of the lime application is hidden. The lime and sulphur prevent damping off, and the tobacco dust destroys or drives out all insect or animal life. The ordinary heat of the hot bed generates vapor enough from the moisture to set free the fumes of tobacco to such an extent that the odor is very noticeable when

the sash is opened for airing the beds. For this reason, if for no other, hot bed sash are preferred to the cloth covers. With sub-irrigation keeping the surface dry, and with the dressings of fungicide and insecticide materials above indicated, the author has yet to experience his first losses of plants in seed beds, or hot beds, due to insect ravages or fungus diseases. Root maggots in autumn seed beds are especially easily prevented by the fumigation and anti-pest dressing manipulation just outlined. This kind of management is also especially advisable in those localities where onions and cabbage are grown extensively, in order that the various root troubles may be avoided. The above outlined treatment and preventive measures apply equally well to all locations or for any season of the year, and should therefore have a much wider application among gardeners than has heretofore been given the system.

COLD FRAME MANAGEMENT.

It has been my practice to give these almost the same management as to preparation that is given the hot bed. There is of course no bottom heat, water is used more freely and, except in permanently located cold frames, the watering is done from the surface. Where cold frames have a permanent location it is well to provide for sub-irrigation. Cold frames should be given the carbon bisulphide treatment some two weeks in advance of transplanting time. After the plants have been transferred to the cold frames then a liberal top dressing of about one pound of tobacco dust per 100 square feet is sifted evenly over the surface. The next day after transplanting they are thoroughly sprayed with a solution of arsenate of lead in the proportion of one pound to twenty-five gallons of water. This should be done as a general precautionary measure to guard against the sudden appearance of some voracious leaf-feeding insect which would cause sad havoc before proper treatment might otherwise be given. Just before the plants are taken from the cold frames to the field for transplanting they should be well sprayed with the arsenate of lead solution already indicated.

FIELD MANAGEMENT.

For such crops as are taken from the cold frame to the fields with a small block of the cold frame earth, it is to be urged that a small handful of tobacco dust be applied as a fertilizer at the time of transplanting, followed with a liberal application as a top dressing around the plants.

In the case of onions which are transferred direct from the original seed bed to the field, the rows should be first marked off lightly with a bull tongue, and tobacco dust applied at the rate of about 500 pounds per acre. Mix with earth well by running a bull tongue through it. Bed lightly so as to fill up the furrow, and smooth down the rows to a level. A good fertilizer drill will answer the purpose as well and is more expeditious. After the onions are transplanted give another liberal top dressing of tobacco dust along side of the rows and in between the plants. This treatment applies equally well to all crops or seeds to be planted or sown directly in the fields. Such operations should always be accompanied with the intelligent and liberal use of tobacco dust.

PREPARATION, NATURE AND USE OF INSECTICIDES.

BISULPHIDE OF CARBON ("HIGH LIFE").

When of good quality this is a colorless liquid and is made by passing sulphur fumes over charcoal brought to a white heat. While perfectly safe for handling and applying, yet great care should be exercised to keep it from heat or exposure to flames. It is extensively used in fumigating operations against soil infesting pests. Its fumes are heavier than air and readily permeate throughout all portions of the soil to which it may be applied. It readily destroys animals, insects or eggs found in the soil. It is especially valuable for the fumigation of buildings or granaries infested with objectionable insect or other pests. It is often used to fumigate plants in the open by placing hoods over them with the high life in a suitable vessel underneath. See page 12 for treatment of melon louse. It is invaluable as a remedy against plant lice, inasmuch as the fumes diffuse to every nook and crevice and reach these little pests where and when it would be impossible to do so with any other insecticide or manner of application. Though a liquid, it is sold by weight and may be had at any drug store.

TOBACCO DUST.

The value of this waste product as an aid to successful truck growing is too little appreciated. If there is one insecticide which should be on hand and used by the truck grower first, last, and all the time, it is tobacco dust. Aside from its insecticidal value it is worth practically all it costs as a fertilizer to any soil or crop to which it may be applied. Hence it is gross folly not to use it more generally and liberally in truck growing operations.

Any good fertilizer drill will answer for drilling it into the soil into which seeds are to be sown later on. The combination seed and fertilizer drill is the one which has given best results in my practice. Use at the rate of 400 pounds per acre with the seed when drilled in. Fertilizer drills may also be used to give the top dressing on the surface alongside of the plants as they come up. The cultivator shoe needs only to be taken off ahead, and the singletree and beam so set as to keep the end of the fertilizer guide out of the ground.

KEROSENE EMULSION.

This is perhaps the most generally used of all the contact insecticides of its class. It is best prepared as follows: Take one pound of whale oil soap and boil in a gallon of water until dissolved. While hot add two gallons of kerosene oil. Churn this mixture through a force pump with nozzle attached, directing the spray against the wall of the vessel again. This process should be kept up until the liquid mass thickens like butter. Then allow to cool. After cooling it should not separate. If so, it must be boiled, more soap added, and churned again. Rain water should be used, or water which has been made soft by using lye with it. This forms what is called the stock solution. Any good lye soap will make the emulsion, but whale oil soap is to be preferred. The stock solution may be diluted to any strength required for any given plant.

The proportions will depend upon the resistance of the plant or the tenacity of the insect.

It must be remembered that this insecticide kills by closing the breathing spiracles of insects and in a manner suffocates them. Hence each individual insect must be struck in the application of this kind of an insecticide and it will be evident at once that unless the very best nozzles are used, the best designed force pumps employed, and the work done thoroughly, only partial results will follow. It is always good practice to spray at frequent intervals for such pests as plant lice in order that they may be kept in control. One application seldom ever suffices to eradicate these pests. Contact insecticides are necessary for all those insects which have puncturing mouth parts and which, therefore, do not take in solid food and cannot be poisoned. It will, therefore, be apparent, as was urged in preceding pages, that the eating habits must be determined first and then the nature of the insecticide to be used.

WHALE OIL SOAP.

If a good quality of this soap can be obtained, it is a valuable insecticide, which may be used against the same kinds of insects as is kerosene emulsion. There is more danger to the foliage of the plants if used too frequently than follows the use of kerosene emulsion. There is little danger from its use, though, if the operator is very exact in all his preparations, and applications are made during a cool, cloudy or rainy season. For more resistant plants, the soapsuds may be formed by dissolving one pound of the soap in four gallons of water. More tender foliage requires dilutions up to one pound to eight gallons. Specific tests will, in most cases, have to determine the exact strength which the plants will withstand without injury, and at the same time prove effective against the insect.

PARIS GREEN.

This is one of the poisonous insecticides used against insects which actually eat solid food, and which may, therefore, be poisoned. Paris green is recommended only in those cases where arsenate of lead cannot be utilized with equally good practice and results. This is notably the case where the insecticides must be applied in the powder form. When this is the case, there is no better poisonous insecticide than this one. For tender foliage plants, use one pound of Paris green to fifteen pounds flour; mix well. Sift on to the plants through a cloth bag of some kind having fine meshes through which the mixture will escape in clouds of dust when shaken over the plants. For more resistant foliage, use one pound in ten of flour. Apply after a rain while foliage is yet damp, or while dew is yet on in the morning.

Many growers have used Paris green upon Irish potato crops in their fight against the potato beetle without meeting with success. The same result follows for all those insects requiring an excessive amount of poison to kill. The failure is due to the fact that if enough Paris green is applied to be effective against the insect, it will also seriously injure the plants. This is at once the greatest objection to the general use of Paris green, or rather it is an obstacle, which is more serious than an objection. This is especially noteworthy when application is to be made

upon plants or crops in the fruiting stages early in the season. Fortunately, all these obstacles are overcome in

ARSENATE OF LEAD.

This is a compound made of acetate of lead and arsenate of soda. Both chemicals are put into solution, then mixed in the proper proportions, and arsenate of lead is precipitated. This is filtered out and prepared as a manufactured product called arsenate of lead. The important advantages of this poison over Paris green are as follows:

1. It comes manufactured as a paste, is easily dissolved or suspended in water, safely handled, and applied without danger to man or beast in the process of application.

2. It is of about the same specific gravity as water, and, therefore, remains in suspension well during its application.

3. It can be used in great strengths on the most delicate foliage or fruits without danger of injury to them. This one property makes it pre-eminently the insecticide for the truck-grower, who has so many delicate foliaged crops to protect. Especially is this the case in hot beds or seed beds. It can be applied to these with perfect safety. Hence, no matter how much poison any given insect may require, the arsenate of lead mixture can be made strong enough to meet that requirement and yet do not the slightest injury to the crop.

4. It has the property of adhesiveness. It is of such consistency that once it has had time to dry on the plant after being applied, ordinary rains or dews do not wash it off, and it remains effective for a longer period. A few hours of bright sunshine after application will suffice to dry it well. Instances are on record where drenching rains have followed shortly after applications were made, and yet the insects ravaging the crops afterwards were destroyed. Had this been an application of Paris green, the time, labor and cost of materials would largely have been a loss.

The four distinct advantages of arsenate of lead just recited may be given as distinct disadvantages of Paris green. (1) It is a powder and a menace to man and beast during the process of its application. (2) It is heavier than water, and does not remain in suspension well. (3) It readily scorches fruit and foliage if used too strongly. (4) It is easily washed off by rains or heavy dews.

BLAST TORCH.

There are the ordinary blast torches used so generally by plumbers, tanners and painters. They burn gasoline, holding about a quart or half gallon. An air pump is attached with which air pressure is given. This forces the gas out under great pressure, and when lighted produces a long, roaring flame. This flame is flashed about, underneath, and overhead the infested plant. Many insects are instantly killed by the process or their spiracles are so scorched that they die shortly after. Plant lice are especially susceptible to destruction by this process, and also the much dreaded calico or Harlequin bug of cabbage. By practicing a little, one soon learns to envelope the plant with the flame so as not to injure it and yet produce great havoc among the insect pests attacking it. Mr. S. A. McHenry, Superintendent of the Beeville Branch of the Texas

Experimental Station, deserves the credit for being the first, so far as our records go, of utilizing this blast torch with which to destroy the Harlequin bug on cabbage. He states that the young are easily killed, but that the older ones require a great deal more scorching. This again enforces the argument of the importance of early warfare on all insect pests. More may be accomplished with prompt and persistent action in the beginning than by spending hundreds later on. The blast torch is simple, and may be brought into action with the scratch of a match, if kept on hand and ready for use. Hence, every truck-grower should have one of these little torches. They come into use in a hundred different ways, once they are on the premises. They may be gotten of any wholesale hardware establishment at a nominal cost compared to their usefulness.

BRAN MASH AND OTHER POISONED BAITES.

Young grass, wheat or oats, freshly cut or mown, is dipped into a solution of half a gallon of molasses to one gallon of water in which has been dissolved two pounds of arsenate of lead. This poisoned food is laid in small baits about the young plants in the garden and a shingle or small piece of board is laid over it loosely. This is a good trap and bait for cutworms.

Bran mash is also quite popular, and is very successfully used against grasshoppers when these become numerous. Take four pounds of arsenate of lead and dissolve in two gallons of water. Mix thoroughly with one gallon of molasses. Then sift in wheat bran to make a stiff but moist mash. In fact, have it rather too moist than too dry. For grasshoppers, this is simply scattered broadcast in the fields where they are very numerous. If for flower beds or garden patches, small portions of this mash may be placed as above indicated for poisoned bait. White arsenic is as good for this mash as anything else, but care must be taken to get it evenly distributed throughout the materials. It is much heavier than either water or bran. Oftentimes gardeners have failures for the reason that the arsenic settles before all of the mash has a portion distributed to it. If arsenic is used, greater care should be exercised in placing the bait, as it should not be placed too near the plants. If the arsenate of lead is not fresh, it will be advisable to use greater quantities than have been here indicated.

Poisoned baits are most successful during rainy seasons, when the ground is full of moisture. This is owing to the fact that if the soil is very dry it absorbs the moisture from the mash, which then becomes uninviting to cutworms. For this reason, also, it is well to place the shingles or pieces of board as indicated. In climates where there are prevailing dry and hot winds, the mash must be applied in a very moist condition. If only small areas are involved, the mash should be well sprinkled each evening, or fresh bait placed.

BORDEAUX MIXTURE.

Stock solution: Take six pounds sulphate of copper, four pounds quick lime, twenty-two gallons water. Dissolve the copper sulphate in eleven gallons of rain water by placing in a flour or other cloth sack and allow it to hang in the water over night. By morning it will all be dissolved.

Slack the lime in the same amount of water the night previous, and allow to stand and settle. Then draw off the lime water. Pour the lime water and the copper solution simultaneously into a larger vessel, allowing the two streams to mix well as they are poured in. Stir and mix up well. This gives twenty-two gallons of stock solution. This must be taken the same as kerosene emulsion, in smaller quantities, and diluted to suit the plants to be sprayed. Diluting this to forty-five gallons is safe for all except the most tender plants. This formula is here given, because it is the best fungicide to be used in treating plants for fungus diseases, and because arsenate of lead may be used with it, and the plants sprayed with a combination solution as to protect them from both insect pests and fungus diseases.

PROTECTING TRUCK CROPS FROM INSECT PESTS.

CABBAGE, CAULIFLOWER, ETC.

Cabbage Louse.—This pest often becomes numerous during a favorable season. Use the blast torch, or kerosene emulsion, one gallon to ten of water. When the weather is not too cold, much good can be done by simply bringing water to the boiling point, keeping it as hot as possible, and then thoroughly spraying the plants with it. This will kill the lice while very young quite satisfactorily, but in cold weather the temperature cools too quickly in the fine spray as it escapes from the nozzle, and results are not so good.

The first lice to appear are always few in number, and are found only here and there on single plants. If these are given prompt attention with the blast torch or emulsion as indicated, their spread to the entire crop will, at least, be greatly delayed, if not entirely prevented. If neither of these is available, a small hood placed over the plant with a tablespoonful of carbon bisulphide poured into the bag, as explained later, will destroy them. Make the hood air-tight by raking up earth around the edges and closing all openings.

Root Maggots.—This pest is likely to develop as a result of continuously cropping the same land with cabbage for a number of years. Hence, the first important move is to change the land and put the cabbage crop on fresh land. As a general precaution, also apply tobacco dust liberally at transplanting time, both in with the soil and as a top dressing. If land is well known to be infested, and cabbage must be planted thereon, it will be imperative to fumigate the whole plant with carbon bisulphide the same as though it were a cold frame or hot bed. Make the holes somewhat deeper and tamp the surface a little more solidly than if it were under cover. This will do for the smaller truck gardens, but for larger acreages it will be best to proceed as follows: Take out the minor attachments of any ordinary fertilizer drill and place a vessel or can of carbon bisulphide in position. This vessel should have a funnel attached projecting downward from the can to the earth beneath. The opening at the lower end should be about an eighth of an inch. The drill should then be pulled along the same as though fertilizer were being distributed. The high-life will flow out slowly at the lower end and be covered by the shovels or discs behind. The drill should be made to run as deeply as possible. This will thoroughly fumi-

gate the soil along the rows, and will go far towards preventing the development of the pest. If it is found later that the pest is developing, then take dibbles and make a hole from two sides of the plants, beginning about two inches away from them and slanting towards each other until they meet down underneath the plant at a depth of four or five inches. Pour a tablespoonful of high-life into each hole and plug with earth rather tightly. If the soil is dry, irrigate a short time before the application of the carbon bisulphide, as it will act better and for a longer period when the soil is quite damp. If the plants have been growing for some time, the holes should be made further away and run deeper down. Judgment should be exercised in this, as when the fumes of high-life come in direct contact with the roots of the plants it will check their growth, if it does not kill them. There is no occasion for this kind of a loss if the gardener uses proper judgment in any given case.

Harlequin, or Calico Bugs.—These are best destroyed by the blast torch method already explained under that head. Another and very helpful method is to sow trap rows of mustard early, and some time ahead, of the cabbage or other crops which they are likely to attack. This is especially advisable in spring, when only a few hibernating individuals first appear. They prefer mustard as a food plant, and if successive sowings of this crop are maintained from time to time, they will hardly leave it for cabbage. Here, then, the very first in spring may be scorched by the blast torch, and especially the first brood of young. This can be done more successfully on mustard, as they are colonized there, as it were, and the same time and effort will kill greater numbers. Then, too, the mustard may be sprayed with a full strength of kerosene oil. This will kill the plants, but also all the Harlequin bugs it strikes. The price of immunity from this pest is relentless warfare from the earliest appearance in spring on through the season. The eggs are easily gathered from the first generation in spring, especially on trap mustard, and it cannot be too strongly urged that it is important to destroy the first brood early in the season.

Green Cabbage Worms.—The crop should be well sprayed with arsenate of lead, two pounds in fifty gallons water, as soon as set out into the field and well started. Spraying should be kept up until the plants begin heading. There is positively no danger from this method previous to the heading of the cabbage. After that time it will be well to use kerosene emulsion or hot water, as already indicated in previous pages.

Cut Worms.—These can be largely prevented by the liberal use of a top dressing of tobacco dust and stems, especially if at the same time the cabbage is kept well sprayed with arsenate of lead while young. To make doubly sure, use the poisoned baits already described (see p. 10), and place them along the plants, keeping them covered and moist. Fresh baits should be furnished as soon as the old ones become too dry or uninviting.

CUCUMBERS, CANTALoupES AND WATERMELONS.

Melon Louse.—The most serious menace to melon crops is what has come to be popularly called "honey dew." This is produced by a species of louse found on the plants. It is the same species as attacks cotton so seriously some seasons, but is different from the louse on cabbage and similar crops. If the melon grower will observe his vines carefully, he

will find scattering lice, green bodied, here and there on the under side of some of the leaves on some of the plants. These begin the deposition and development of living young at an astonishing rate, and soon there will be leaves here and there which will curl downwards, at last closing and leaving only a small opening. Within will be found a mass of living lice. They eject the peculiar liquid substance called "honey dew" from honey tubes at the posterior and dorsal end of the abdomen. Melon fields should be carefully inspected each week, in order that the first colonies which begin breeding may be destroyed and their further spread at least delayed. If these first colonies here and there be systematically destroyed, the crop will be made and gathered in many sections of the melon district before the pest becomes numerous enough to ruin the plants. It is important, also, not to plant cotton near melon fields, and it is even more important not to plant melons on lands which were in cotton the season before. Neither is it advisable to plant melons twice in succession, especially if the lice appeared plentifully on this crop the previous year. To make the most successful fight against the melon louse, it will be necessary to educate the growers to the importance of beginning the campaign very early. As to remedial measures, the first important step is to have used tobacco dust freely in the hills at planting time, and to have plenty of it as a top dressing around the plants, and under the vines.

In the Beeville district, the melon lice have been found as early as the middle of April, and that is the time the first fight should be made. Once the infestation has reached the "honey dew" stage, little need be done except to repent of the folly of putting things off too long. Melon growers should provide themselves with a hundred or more small fumigating hoods. These can be used from year to year, and also to destroy the first colonies of lice developing on cabbage or other crops. In fact, they will be found to be the most useful thing on the premises before the first season is over. They are easily made, as follows: Take $\frac{3}{16}$ inch spring steel or brass wire and form a hoop about two feet in diameter. Then make another and cut in two halves. Fasten the ends of these to the hoop so that they may cross at right angles over the center and form the hood over which the canvas is to be stretched. This should be heavy oiled or tarred domestic, which will make it close and air-tight. A little to one side of the center from the top, cut and sew in a large button hole, as it were, and to the inner edge sew in a bag of mosquito bar containing a considerable wad of loose cotton, or old rags. Provide a suitable plug to close the button hole tightly. When prepared, and the few scattering lice have made their appearance, place these hoods over the plants and pour in a tablespoonful of carbon bisulphide through the button hole and close tightly. Of course, earth should be raked around the lower edge of the hood, so as to make the edge tight. Allow these hoods to remain over the plants about an hour. Every louse within the enclosure will be killed, and if done systematically for the entire field early in the season, there need be no fear of loss of the crop. If the pest should spread later from cotton and endanger the crop, another treatment should be given. In fact, a second treatment should be given whenever it is found that colonies are again being formed. The objection so often raised against this method—that the vines are too large—is not valid, for the reason that it is then also too late, and the treat-

ment should be given before they are too large. The advantage of a great number of hoods is that one workman can be kept busy resetting, and thereby cover a considerable acreage each day. He should have as many hoods as he can set in an hour.

Adjoining or near-by cotton fields should be closely watched, and with the first appearance of the lice on this crop, it should be well sprayed with kerosene emulsion at the rate of one gallon to ten of water. This should be repeated each week, or during the period when the winged generation is produced, and the general spread takes place, the treatment should be made twice a week. This method will kill millions of the lice which might otherwise escape and migrate to the melon vines. The importance of prompt, early and determined action can not be too strongly urged.

ONIONS.

Thrips.—In addition to the discussion already given for onions under the head of general seed bed and field management this pest has been a menace to the crop at several points along the coast where the crop is extensively grown. It is a small, delicate, straw colored insect, and is found by the thousands on the plants. The crop should be thoroughly sprayed with kerosine emulsion, one gallon to ten of water, and the operation repeated within a few days if any live specimens are found to have escaped the first treatment. A general precaution is not to plant the crop twice on the same land in succession.

IRISH POTATOES.

Colorado Potato Beetles and Spanish Fly.—It has been already explained under the head of Paris green that these beetles need a great deal of poison, and in fact so much that it is not possible to apply this old remedy with perfect success in sufficient strength, without seriously injuring the crop. Hence arsenate of lead is par excellence the remedy for the above named pests. Use five pounds arsenate of lead to fifty gallons of water. Spray as soon as any beetles appear and at intervals of two weeks for about three applications. At least one application should be made about the time the plants are full grown so that there may be no unsprayed new growth. Spraying need not be repeated after each rain as is necessary if Paris green be used.

TOMATOES.

In addition to what has already been outlined in general under other headings, it is necessary to protect this crop from the attack of the cotton boll worm, or more properly speaking the roasting ear worm. They eat small holes into the tomato, either half or full grown, and destroy it for market. They prefer corn in roasting ear condition, however, and if this crop is given them in the way of trap rows planted for that purpose the tomato will escape attack. The spring crop seldom suffers much injury owing to the fact that the crop is made before roasting ears are all gone. It is the fall crop which suffers most, and to protect this trap rows of Mexican June corn should be planted along the edges of the acreage to be put into the fall crop, so as to be in roasting ear condition during the fruiting period of that crop. Several successive plantings of

the corn should be made so as to cover the entire fruiting time of the tomato.

It must be urged again to apply a liberal top dressing of tobacco dust around the plants at transplanting time. Also spray with arsenate of lead up to within a month of the time for gathering the first picking. Use two pounds to fifty gallons of water.

SQUASH BUGS.

These bugs puncture the young fruit of cucumbers, cantaloupes, melons, squash and the fall crop of tomatoes. It is difficult to kill them with the ordinary contact insecticides, unless they be sprayed before they become adults. In that case kerosene emulsion, one gallon to ten of water, will be of service.

These bugs are especially partial to early squash, and either the crook-neck or the scalloped variety should be planted as a trap crop. A few hills should be planted scatteringly in several rows across the fields in which it is proposed to plant any of the other crops named. The first planting should be as early in spring as possible and will catch the first brood of eggs. These trap plants, being comparatively few in number, should be carefully handpicked of all eggs which are laid upon their leaves. At the same time a couple of shingles should be placed loosely around the trap plants and the adults will hide or take refuge under them. Here they may be destroyed by the thousands. The plants of the other crops around will escape attack, and if a succession of young squash are kept growing the other crops will continue to escape serious injury until the crop has been made and gathered. In connection with this the other crops should be well sprayed with Bordeaux mixture to render their leaves distasteful to the bugs. This enforces the colonization to the trap plants still more, and will enable the grower to concentrate his attack on the trap plants. These latter of course should not be sprayed with the Bordeaux mixture at any time during the period they are to serve as traps. These trap squash will also attract the feeding of the striped cucumber beetles and also the egg deposition of the pickle worm. In the latter case, however, the blooms should be gathered every few days, beginning about June first, and be burned in order that no fresh moths may develop for another period of egg laying. It is important to inspect the blooms carefully in order that no moths may escape. As soon as the crops which the trap squash are protecting have been harvested all vines and fruits should be gathered and burned.

WHITE GRUBS.

For these give three injections of carbon bisulphide at equal distances on each square yard, using a half ounce for each hole. This is for light sandy soils. For heavier clay formations make four injections per square yard and make them deeper. In any case this treatment should be made in the fall or early spring while the grubs are deeper down in the soil. In midsummer they may be too near the surface to get the full effect of the fumes of the carbon bisulphide, especially if it be a dry season.

SELECTION OF SPRAYING APPARATUS.

It is in the selection of spraying outfits that the average man makes the greatest blunders. This is owing to the fact that he does not distinguish between a sprinkle and a spray. He often takes the precaution of getting good insecticide materials and looks well to all other details. Yet when the apparatus for applying those materials are to be purchased, any glib-tongued salesman at a country store can sell him anything from a sprinkling pot to a squirt gun, with the fullest assurance that "they will do just as well." Let it be understood once for all that this Department urges and recommends spraying and not sprinkling, and that we will assume no responsibility for the slipshod methods of applying insecticides. Those who sprinkle need not expect to get the best, nor even satisfactory, results. Spraying has been reduced to almost mathematical accuracy. Nozzles are now made which have no guess work in their design. Of course, there are good and bad nozzles on the market, and let it be understood that none of the good ones are cheap. With this special appeal for higher priced, reliable apparatus, instead of the cheap and disreputable makeshifts, will proceed to indicate some of the best apparatus in which the gardener can invest.

For the gardener of small acreages there is no kind of spraying apparatus better, or of more general utility, than the best made knapsack sprayer. Buy the best design made by any of the following firms, or their agents in Texas, and results will always be satisfactory. The Deming Co., Salem, Ohio; The Goulds Mfg. Co., Seneca Falls, N. Y.; Wm. Stahl, Quincy, Ill.; F. E. Myers, Ashland, Ohio; and the Field Force Pump Co., Lockport, N. Y.

For those truck growers of larger acreages there is a complete line of sprayers available which is thoroughly satisfactory. There are a number of devices which may be attached to wagons, etc., but they are all awkward of management in the field, even though they will give good results if well operated. The cart or two wheeled automatic sprayers with horse and driver are the most modern in design, and are easily operated in any field, small or large, clear or stumpy, with about equal facility and efficiency. The Aspinwall Mfg. Co., Jackson, Mich., have two models which are entirely satisfactory. One they call the Daisy and the other the Junior sprayer. Both sprayers have been thoroughly tested by this department and the latter was extensively used in Texas the past season and gave splendid service in every instance. The Daisy sprayer is one of the best all purpose automatic sprayers, capable of being utilized under a greater variety of conditions than any other outfit on the market now known to the author. It tracks only twenty-eight inches, has vertical and horizontal sprayer attachments so that it may be used between nursery rows, in the vineyard, in the truck patch, or on the farm. It is light (350 pounds), and so easily handled that the operator can dodge around stumps almost as readily as a plowman with a cotton sweep. It is pre-eminently the stumpy land sprayer. It takes two rows at a time, and hence is capable of treating about fifteen acres per day of any truck or farm crop. Its list price is \$45.00, and for an all purpose automatic sprayer there is nothing better on the market.

The Aspinwall Junior is equally satisfactory in results and operation, but is heavier (about 500 pounds) and takes four rows at a time. Hence

it has a capacity of about twenty-five to thirty acres per day. Its list price is \$50.00. The important consideration in both of these sprayers is that their nozzle arms are so designed that one nozzle is directed on the plants from each side of the row. These nozzle arms may be raised or lowered and the nozzles directed upwards, or they may be spread or closed laterally to suit the width of rows. In this manner the plants in any row are sprayed from the sides and underneath, as well as from the top. No other sprayers, except the Deming to be mentioned later, are thus designed and equipped. To get perfect results it is of the greatest importance to spray the plants thoroughly, sufficiently, and from every quarter. It has long since been proven that with the ordinary speed of a horse one nozzle to a row of any kind of truck or farm crops has not sufficient capacity. Hence the distinct advantage of a double set of nozzles to each row. It should be remembered, however, that this advantage compels greater cost, owing to the number of nozzles, and that, therefore, the cheapness of machines offered in competition really becomes the greatest objection to them.

The Deming Co., Salem, Ohio, has just recently perfected a sprayer of cart design which is certain to become popular, inasmuch as it meets all the conditions above mentioned for the successful spraying of larger acreages of truck and farm crops. It is adjustable to from two to five rows, has a pair of nozzles to each row, and may be used either as an automatic sprayer when in operation in the field for farm crops, or pumped by hand for orchard work when stationary. It is one of the best all-purpose designs on the market, and merits careful consideration. It is listed at \$75.00.

NOZZLES.

There is only one really all-purpose nozzle which this department recommends for use first, last and all the time; that is the Vermorel. It is the best designed and most accurately made nozzle on the market for general utility, and hence, is also the most expensive. No one should be misled into buying any other design because it is "equally as good," and "cheaper." At this writing, there is positively no other nozzle as good, and none are cheaper when service and results are considered. When buying or ordering spraying apparatus of any kind, always specify that they be equipped with Vermorel nozzles.

PROTECTING THE FARMER AGAINST ADULTERATED INSECTICIDES.

The State wisely provides for the analysis and inspection of poisonous insecticides sold in Texas. Heretofore, many failures in spraying have resulted, owing to the fact that the insecticides bought were adulterated.

Following is Section 7 of the law regulating the sale of poisonous insecticides, which explains itself:

Any agriculturalist or farmer, a purchaser of any commercial fertilizer or commercial poison in this State, may take a sample of the same under rules and regulations to be prescribed by the Professor of Chemistry of the Agricultural and Mechanical College, and forward the same to him for analysis, which analysis shall be made free of charge.

Section 4 of the same law reads as follows:

Every box, barrel, keg or other package or quantity of commercial fertilizer or commercial poison (within the limitations of Section 1 of this law), in any shape or form, sold or offered for sale in this State shall have attached to it in a conspicuous place the label as provided for in Section 3 of this law, with the signature of the Professor of Chemistry attached.

Purchasers should, therefore, see to it that the dealer from whom they buy complies with this law, in order that he may be held liable if subsequent investigations should justify legal prosecution, as provided for by other sections of this law.

HOW TO MAIL INSECTS TO THE ENTOMOLOGIST.

Oftentimes inquiries about insects are made and recommendations as to remedial measures asked for, without the insects in question being forwarded for examination. It is a rule of this department to make no specific recommendations unless specimen insects accompany the inquiry or request. In attempting to comply with this requirement, the insects are often thrown into the envelope with the letter. Of course they arrive in a broken and crushed condition, entirely beyond recognition. For this reason it is urged that the insects be placed in a tight box of sufficient strength to carry them through the mails safely. If larvæ are sent, place some of their food plant with them. In all cases, use tight boxes, as the insects will not suffer for air in transit. Butterflies or moths should first be killed with chloroform and then packed securely between papers, so that they will not jostle about in the box and rub off their wing scales, thereby obscuring their characteristic markings.

Insects should never be enclosed in an envelope with the letter. Mail them separately, and be especially careful to write your name and address plainly on the package, in order that it may be correctly identified with your letter after arrival at this office.