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PEA WEEVIL CONTROL

UNIV. OF IDAHO MOSCOW

BY T.A. BRINDLEY & W.E. SHULL

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Pea Weevil Control

By

T. A. BRINDLEY and W. E. SHULL*

Introduction

THE pea weevil (*Bruchus pisorum* L.) is one of the most important enemies of peas, a menace to both the seed pea and the green pea industries. In the dry peas it decreases the weight, reduces the percentage of germination, and lowers the value of the peas as feed for livestock. Weevil-infested peas, under the provisions of the Federal Food and Drug Act, are regarded as adulterated food. The pea weevil has become an important pest in all parts of Idaho where the acreages of canning, freezing and seed peas have increased during recent years, except in the upper Snake River Valley in the eastern part of the State. In this region it is believed that the insect rarely survives the winter on account of the prevailing low temperatures.

Description of the Pea Weevil

The pea weevil adult is a small, grayish or brownish-gray weevil about 1/5 inch long. It is marked with black and white spots as shown in Figure 1d. The female weevil lays its eggs singly upon the outside of the pea pod, attaching these eggs to the pod by means of a transparent glue-like substance. The egg (*Fig. 1a*) is orange in color, oval in shape, slightly less than 1/16 inch long and about one-half as wide as it is long. About two days prior to hatching, a black spot appears at the end of each egg. This black spot is the head of the weevil grub or larva which is developing within the egg and which can be seen through the transparent egg shell. When the larva is ready to hatch, it bores through the thin shell of the egg at the point where the egg is in contact with the pea pod and also through the wall of the pod and into one of the young peas within the pod cavity. The newly hatched larva is white in color and about 1/16 inch long. It continues to feed within the growing pea and increases in size slowly, gradually consuming a large part of the interior of the pea. At the end of five or six weeks the weevil larva or grub reaches full growth. At this time its body usually fills a large part of the interior of the pea, and the pea has developed to the ripened stage. The fully grown larva is about 1/5 inch long and about half as wide (*Fig. 1b*). It is crescent shaped, robust, slightly curled in appearance, and white or cream in color. Soon after reaching full growth the weevil larva transforms to the pupa or resting stage within the cavity which it has formed by its feeding

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inside the pea. The pupa is about the same size as the adult weevil and cream colored (*Fig. 1c*). The pupa, roughly oval in shape, shows on the delicate surface of its body the outlines of the legs, antennae, eyes, and mouthparts of the future adult. After the expiration of a period ranging from eight days to two or three weeks, depending upon temperature conditions, the pupa transforms to the adult, thus completing the life cycle.

Life History and Habits

The pea weevil adults pass the winter in any situation affording some protection from the cold weather. They are found commonly under the rough bark of the ponderosa pine, in the duff beneath pine trees, in debris under brush, in cracks in posts, in straw left on harvested fields, and in many other similar situations. Temperatures below 0° F. may kill many overwintering weevils and reduce the infestation the following year, but weevils which are protected by a covering of snow may survive temperatures of –30° F., or lower.

The pea weevils begin to come out of winter quarters or hibernation in the spring, at about the time the earliest peas begin to bloom, and fly to the nearest blooming pea fields, sometimes flying as far as three miles. Emergence from hibernation and flights to the pea fields continue during the entire period when peas are blooming but most of these activities occur during May and June whenever weather conditions are favorable, particularly on pleasant days when the temperatures range from about 70° to 80° F.

The weevils usually alight first near the edges of blooming pea fields close to their hibernation quarters. They gradually scatter farther out into the field, feeding and depositing eggs. Consequently, the edge of the fields nearest favorable hibernation quarters, that is, the edge nearest extensive timbered or brushy areas, ravines or gullys, trees or shrubs, usually have a higher degree of infestation than the remainder of the field and the most heavily infested fields are those located close to such quarters. In some instances, however, when the plants in certain parts of a field bloom earlier than the surrounding peas, the weevils concentrate on such early-blooming plants, regardless of their location at the edge of or within the field. In any event, they are apt to concentrate for the purpose of feeding and depositing their eggs wherever the earliest pea blooms occur.

It is necessary for the female pea weevil to feed upon pollen, usually the pollen of the pea blossom, in order to develop her eggs. For this reason four or more days usually elapse between the time she reaches the blossoming peas until she begins to lay eggs on the small, newly formed pea pods. A female may lay several hundred eggs during the season, and as many as 50 eggs in any one day.

The time required for the egg period depends upon the temperature; the egg may hatch in five days from the time it is deposited in very warm weather, or it may take several times as long in cool weather, the average time being about eight or nine days.

As explained previously in this bulletin the newly hatched larva bores into the pod and enters one of the young peas. A small, dark

spot or "sting" on the seed coat of the pea indicates the point where the larva enters the pea (*Fig. 2a*). Figure 2b shows the larva of the pea weevil feeding beneath the seed coat of a green pea.

Several pea weevil larvae may enter a single pea, but in such instances only one larva is able to survive. The larva feeds and develops within the pea as the pea increases in size, and becomes full-grown in five or six weeks. The fully grown larva eats away the interior of the seed as far as the outer skin, leaving a thin circular cap or "window", which serves as a means of exit for the future adult. The larva then transforms to the pupal or resting stage within the pea. This stage lasts from eight days to two or three weeks, depending upon the temperature, at the end of which time the pupa transforms to the adult pea weevil.

When the adult pea weevil is ready to emerge from the pea it pushes out the circular "window" formed by the larva, and crawls out. It may leave the pea soon after it has transformed to the adult stage or under storage conditions it may remain within the pea all the winter and emerge during the following spring. Sometimes in storage, it remains within the seed for two winters and emerges the second spring.

The entire life history period from egg to adult requires about two months, on an average. It is late July or early August before adults are developed within early seeded peas.

Principal Sources of Pea Weevil Infestation

Field shatter.—Field shatter is the most important source of pea weevil infestation in seed pea producing areas. From 7 to 50 per cent of the peas on seed pea fields are lost on the ground. The pea weevils emerge from these peas, overwinter until the following spring, then attack the next year's crop.

Volunteer peas.—Peas left on harvested fields often sprout during the winter and bloom in the winter wheat the following year. These volunteers frequently become heavily infested with pea weevils and shatter out before the wheat is harvested. Weevils emerge from the shattered peas and return the next spring to infest pea fields.

Pea hay.—Peas grown for hay may liberate many pea weevils unless the hay is fed before such weevils can complete their development and

escape. Even hay cut while the pods are still nearly flat may contain seeds large enough to permit the pea weevil to complete its development.

Weevil-infested seed.—Seed containing living pea weevils is obviously a source of infestation. Many of such weevils can escape from peas planted 3 or 4 inches deep.

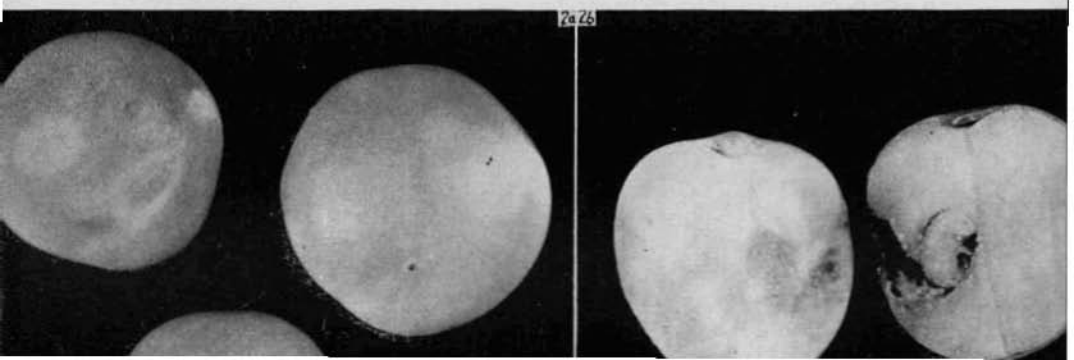
Control

There are several measures which can be used to prevent the pea weevil from infesting green peas and to reduce infestations in peas grown for seed. Dusting with rotenone-bearing dusts prepared from either cube or derris, cultural control, and clean-up measures are all of value in reducing losses from the pea weevil. Field control by dusting is directed against the adult weevil and its degree of effectiveness depends upon the timeliness of the applications of the dust.

Dusting with a rotenone-containing dust.—Dusting with materials containing rotenone has proved an efficient control measure for the pea weevil. Rotenone is found in the roots of certain tropical plants. The ground roots at present used in weevil control are known as derris, cube, and timbo. The powdered root usually contains 4 per cent or more of rotenone, together with other active ingredients, and is diluted with an inert carrier to reduce the rotenone content to 1 per cent. The dust should be applied at the rate of 20 pounds per acre.

The carriers most often used are talc or diatomaceous earth. Lime, or other alkaline substances, should not be used as a carrier because such materials may reduce the insecticidal value of rotenone. Rotenone dust should be stored in tightly closed bags or other containers that will not admit light in order to keep the dust at full strength until the time of application.

A rotenone-containing dust kills the pea weevil principally by coming in contact with the weevil's body, although particles of the dust are often swallowed by weevils in dusted fields when they clean the dust from their feet and antennae. Dusts containing rotenone are not poisonous to human beings nor to any warm-blooded animal when used at the rate suggested for weevil control. These dusts do irritate the mucous membranes of the nose and



throat, and anyone continually exposed to the dust should wear a respirator.

Time of application of dust to peas to be processed while green. —Peas to be harvested while green should be dusted during the interval between the appearance of the first blossoms and the appearance of the first pods. This period varies from two or three days in hot weather to more than a week in cool, cloudy weather. The peas should be dusted wherever weevils are found in the field.

Obviously the longer the dust application is delayed, the more weevils are apt to fly into the field, and the more will be killed by the dust. However, heavy infestations may result if dusting is delayed until eggs are being laid. A delay of even one day after small pods have appeared may mean that the peas will have become infested to such an extent as to render them unfit for canning or freezing. In general, it is much better to dust a little early than to dust a little late.

Rain and wind sometimes interfere with the correct application of the dust, since the dusting equipment may not be able to operate in muddy fields, and very windy weather may make dusting impractical. Both of these conditions are frequently accompanied by cool weather in which the weevils are inactive. No eggs are deposited at temperatures below 65° F. and only a few until after temperatures have reached 70° F.

Since power dusting equipment cannot operate effectively on muddy fields, peas grown in irrigated areas should not be watered until after dusting operations against the pea weevil have been completed. Under normal conditions and proper culture no damage to the peas results from the delayed watering.

After the dust has been applied, the action of sunlight rapidly reduces its killing power. Much of its toxicity is lost within 24 hours. It may be necessary to dust a second or even a third time to protect the peas entirely from pea weevil infestation if more weevils fly into the field. The period between successive applications will vary from two days to more than a week, depending upon the time when these flights of the weevils occur.

The first eggs laid by the pea weevil adults will be the first to hatch, and the larvae produced from these eggs will be those most likely to be well within the green peas when they are cut for the cannery. Eggs laid by weevils coming into the field after the first dusting are not as apt to be hatched by the time the peas are vined.

Time of application of dust to seed peas.—While the producers of green peas attempt to eliminate the pea weevil from their fields the seed pea growers, on the other hand, apply the rotenone dust mixture to reduce the infestation as much and as economically as possible. Weevil-infested seeds can be eliminated from dry peas, but cannot be separated as effectively from the green peas. When one application of rotenone dust is all that can be economically applied, the timing of this application becomes very important. It is best to wait until within a day of the appearance of the first tiny pods, and if unfavorable weather conditions occur at that time, the rotenone dust mixture should not be applied until the weather clears. The temperature should be above 66° F. before the dust is applied, but it should be remembered that if dusting is delayed until pods have formed, the grower must be prepared to treat his peas immediately with the rotenone dust mixture as soon as weather conditions become favorable. If these directions are not followed carefully a sufficient number of eggs may be laid within a short time to produce a serious pea weevil infestation.

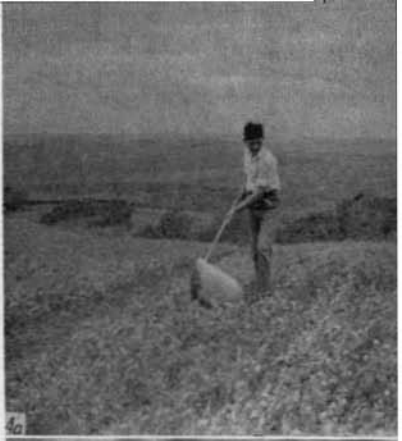
Sweeping with an insect net to determine when and where to dust for weevil.—The individual grower can determine where to dust for weevil control and check on his results by sweeping his peas with an insect-collecting net. Figure 3a shows the unassembled net and 3b shows the assembled unit commonly used for this purpose. The handle of this net is 3 feet, 4 inches long; the diameter of the net opening is 15 inches; and the bag is 20 inches deep.

The method of checking may be outlined as follows: sweep the field first just before dusting; that is, soon after the first blossoms have appeared. Go into the field in several places on each of the four sides, or if it is irregular in shape, sweep at intervals around the field. Each stroke across the upper part of the vines is considered a sweep. Hold the net at an angle so that weevils knocked off the vines will fall into it. Take a step or two between each sweep. Figure 4a shows the proper way to sweep. Make two or more 25-sweep collections at each place swept; examine the catch and count the weevils in each collection. Go out toward the center of the field until no more weevils are found. If it is a seed pea field, examine toward the center of the field until the weevil population drops below the number for which it is considered profitable to dust. Mark the locations of collections on a rough map of the field. To keep track of these locations, it is helpful to step off the distance from the edge and sweep at 100-foot intervals. For instance, if a number of weevils are found at 200 feet, walk out another 100 feet and sweep again. Then it is easy to mark the distances on the map.

Particular attention should be paid to the locations most apt to be severely infested. Some of these are: the edge nearest extensive timbered or brushy areas, ravines and gullys running into the field, the vicinity of sheds or trees, areas where the first peas blossomed. Check on the effect of the dusting operations in a similar manner 18 to 24 hours after dusting. If many weevils are found, it may be necessary to dust again within three or four days and to check on this dusting in a similar manner. It is easier to check a seed pea

field than a green pea field. The green pea field must be kept practically weevil-free, but a light infestation is not so important in seed peas. For this reason a more thorough check is needed on the green pea field, both before and after dusting.

Pea weevil populations and infestations in the peas.—The question is frequently asked, "How many pea weevils does it require to make an infestation of 1, 2, or 5 per cent in peas at harvest?" The infestation due to the same number of weevils swept up in the collecting net varies greatly in different fields. Weather conditions have an important effect by influencing the yield of the peas and the activity of the weevils. The same number of weevils picked up in the collecting net result in a much greater number of infested seeds in the later fields than in the early fields. In a three-year study the following results were obtained: very roughly, a population of five weevils in 25 sweeps usually caused an average infestation at the canning stage of about 2 to 3 per cent in the early Alaska, Surprise, and Wisconsin Sweet peas, while the same population in the later varieties (Perfection and others) blooming after June 15 resulted in an infestation at the canning stage of from 10 to 35 per cent. The infestation in the dry seeds where five weevils were found in 25 sweeps averaged from 5 to 7 per cent in the early peas and from 20 to 70 per cent in the late peas. Part of the difference in the percentage of infestation between the early and late peas, resulting from an apparently identical pea weevil population, was due to higher temperatures (which are more favorable for egg deposition) later in the season, and a part of the apparent difference was caused by the ranker, leafier type of growth of the later varieties which make them more difficult to sweep and


4a

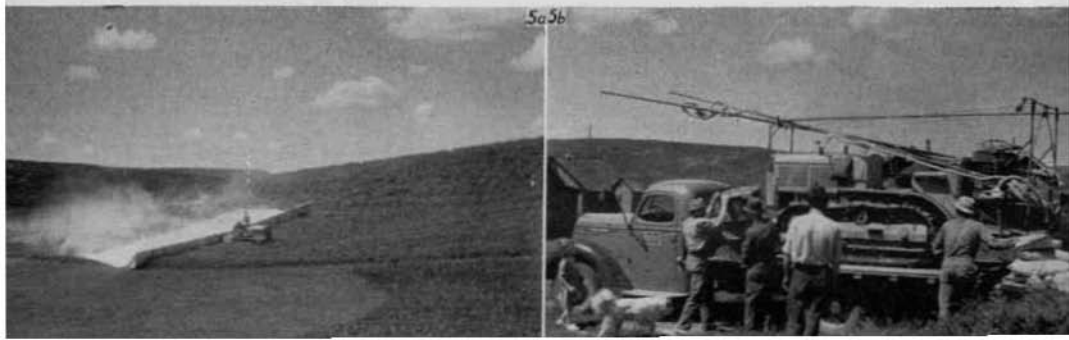

4b


4c

which resulted in a smaller fraction of the weevils present being picked up by the collecting net.

Dusting equipment.—Several efficient types of dusters have been developed for use in weevil control. The use of a light canvas hood on a frame built out over the dust outlets makes possible satisfactory application under windy conditions. The dust swirls in a heavy "fog" within this hood before settling on the vines with the result that a very even distribution is secured. Most hoods are 3 or 4 feet high, and project from 12 to 25 feet on either side of a tractor, truck, or trailer. The top is supported by a stout frame; the bottom is weighted with some heavy material such as hose, heavy rope, or chains in order to prevent whipping by the wind; the top is jointed to the sides of the truck or trailer so that it can be folded when moving to or from the field. The efficiency of the hood is further improved by the addition of a short canvas trailer about 20 feet long, which affords additional protection from the wind during the application of the dust and which is not heavy enough to damage the peas. Probably the simplest arrangement of this type is made by making the top, back, and ends all in one piece and joined to a curtain which hangs down vertically on either side of the front of the duster. No two machines have been built entirely alike and the hoods have been folded in various ways. A hood constructed so that it can be easily and quickly folded speeds operations and enables better timing of applications. Some hoods have been built so that they fold and swing either to the front or the rear of the machine; others may be telescoped to reduce the length when traveling to or from the field. On others the frame is jointed on either side of the machine so that it can be folded over before being raised to a vertical position. If the duster is efficiently constructed, it should not take more than four or five minutes to fold the hood and make all prepartions to move to the next field. Such a machine is pictured in action in Figure 5a and folded ready to be moved to a new location in Figure 5b.

Most of the dusters are between 30 and 50 feet wide. They have been mounted on trucks, trailers, or tractors and pulled by trucks or drawn by tractors or horses. Most of them are operated by two men; one drives the machine and one regulates the distance of the hood from the ground by means of a simple windlass arrangement. One windlass for each side of the hood enables the operator to secure the best adjustment on sloping land. The windlass should



be large enough in diameter to enable the hood to be raised without a great deal of turning of the windlass wheel.

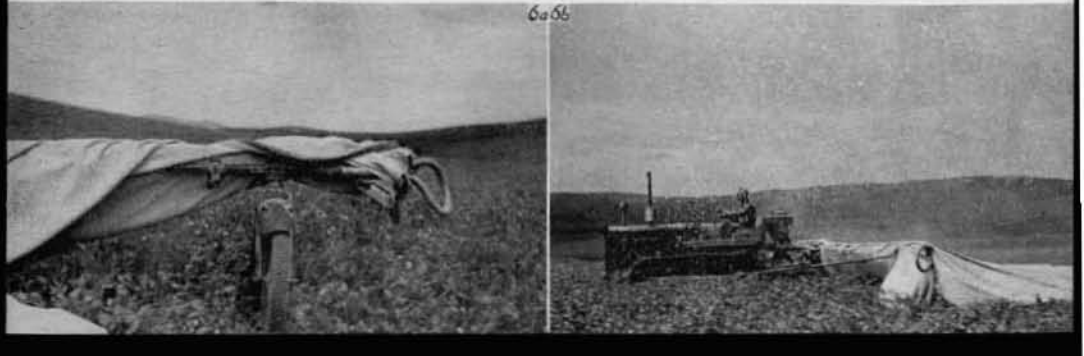
The windlass wheel has been entirely eliminated on some machines. In its place castor wheels made from the front wheels of motorcycles were placed near the end of the supporting boom (*Fig. 6a*). These wheels keep the trailer hood at a uniform height from the peas no matter what type of terrain is being dusted. The use of castor wheels also eliminates the construction of costly and heavy supporting framework for the duster boom. Little damage is done to the vines by these wheels because they support little weight. Figure 6b shows a machine equipped with castor wheels in action. Note that one man is operating the entire machine.

Accurate mileage records can be kept by a bicycle or automobile wheel and tire connected to a speedometer that rides on the duster wheel or, if the duster is mounted directly on a tractor, rides on the treads of the tractor. Such a record makes it possible to determine just how many pounds of dust are being applied per acre so that the grower may know whether he is wasting dust or whether he is not putting on enough.

Horse-drawn equipment, similar in design to the machines mounted on or pulled by tractors, has been utilized effectively to combat the pea weevil. Figure 7a shows a horse-drawn duster folded and ready to be moved to a new location and 7b shows a horse-drawn unit in action.

The number and arrangement of the discharge nozzles apparently make little difference in the effectiveness of the machines. They should be so arranged, however, that an even covering of dust is obtained. Good results were also obtained by the use of a tapered boom. The tapered booms on a 40-foot machine were prepared by welding an 8-foot section of 3½-inch pipe to a 6-foot section of 2¾-inch pipe and welding this to a 6-foot section of 2¼-inch pipe. This 40-foot machine, of course, was made by using two 20-foot booms, one on each side of the machine. These booms were drilled along the lower edge with holes ⅜ inch in diameter and spaced 4 inches apart. The length of each section varies with the swath to be dusted.

Injury caused by the dusting equipment.—The damage to the peas caused by running the dusting equipment over the vines varies with the slope of the ground, the weight of the duster, the width of the duster, the width of the duster tracks, and other factors.

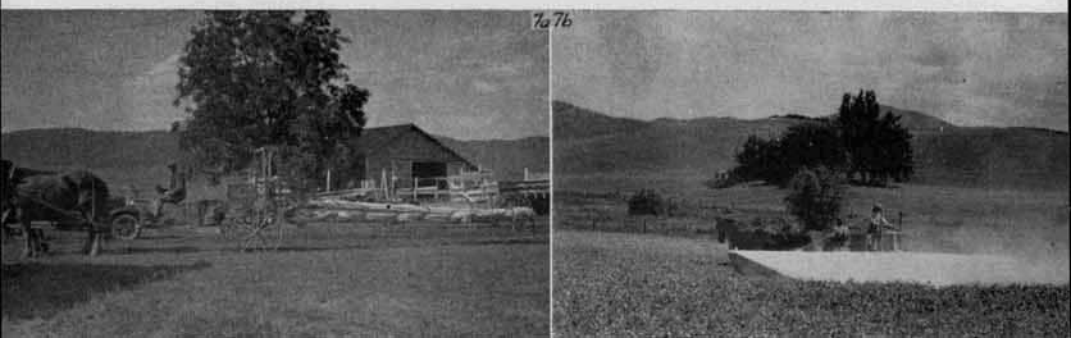


For instance, a 30-foot duster mounted on a truck or a duster pulled by a caterpillar tractor with 8-inch cleats may reduce the yield between 3 and 4 per cent over the area dusted. Duster damage can be materially reduced by increasing the width of the swath to be dusted and by decreasing the width of the tractor cleats.

Cost of dust application.—The cost of dusting for weevil control varies from year to year with the cost of labor and materials. The dust used in 1939 in the Palouse Area cost 7½ cents per pound and was applied at the rate of 20 pounds per acre. Dusting materials, therefore, cost $1.50 per acre dusted. Cost application studies were made by the Department of Agricultural Engineering of the University of Idaho and published in Experiment Station Bulletin No. 234. The average cost per acre treated was found to be $1.88. However, since it is often unnecessary to dust the entire acreage, the cost per acre protected is often somewhat less. Occasionally, on the other hand, a second or third application to parts of certain fields may be necessary, which will increase the cost per acre dusted and consequently the cost chargeable to the acres protected.

Border trap strips.—In some areas a strip of early-blooming peas is sown around the margin of large fields as a trap crop. This strip is usually one drill width wide, and is planted so that it blossoms a week to 10 days ahead of the main field. The advantage gained by the use of a border trap strip is that it concentrates large numbers of pea weevils where they may be destroyed by dusting.

The use of border trap strips is, on the other hand, accompanied by several disadvantages. First, if the weevils in border strips are not killed before the peas in the main field become attractive to the pest, the weevils will move from the strip and in such event it will be necessary to dust approximately as many acres as would be the case if the borders had not been planted. Second, in cases where certified seed is being grown for dealers in seed peas, great care must be taken to guard against seed mixtures. In such cases it is advisable to use the same strain and variety of peas in the border strip planting as is to be used in the main field. Even in such cases, border strips should not be planted without the knowledge and supervision of the field man of the contracting firm. Third, once the border strip has served its purpose it should be destroyed by plowing followed by packing. This is necessary to destroy the weevils that have started their development on the plantings and to eliminate the peas which might cause seed mixtures.



Other control measures.—In order to reduce weevil populations from year to year, certain cultural and sanitation practices should be followed:

Plant weevil-free seed.—Large numbers of weevils are able to escape from weevily seed and infest the growing crop.

Use good seed stock.—Any practice that will eliminate early blooming pea plants will aid in keeping down the weevil infestation and the cost of control. Good seed planted in a good seed bed is a very important factor in this respect. A few early blossoms in a pea field may attract weevils out into the field several days before the whole field begins to bloom. To destroy these weevils before they lay eggs, it may be necessary to dust when few blooms are present. Because this dust application is very early, a second dusting may be required after the field comes well into bloom and more weevils have flown in, whereas only one dusting would have been needed had the peas all bloomed at the same time.

Destroy infested peas left on the field.—Deep plowing, using jointers, immediately following harvest destroys most of the weevils in peas left on the field. Weevil-infested canning peas left for seed are the source of more weevils for succeeding crops. These peas are sometimes cut and put in the viner stack. Peas grown as a green manure crop should be plowed under shortly after blossoming and before any pods have started to fill.

Livestock pastured in harvested fields destroy some of the weevily peas. Because the harvest loss is usually much less on fields cut green, and because stock may pasture for a month or more before the weevils develop to adults, cattle, hogs and sheep may do a good job of cleaning up weevil-infested peas on fields cut for green processing. Livestock pastured on seed fields, however, usually destroys only a fraction of the shattered peas and often the adult weevils have already begun to emerge before the livestock is put on the field.

Burning over the harvested fields, a practice which reduces soil fertility, is not recommended as a control measure.

Harvest seed peas as soon as they ripen.—It is important, both from the standpoint of yield and from the standpoint of weevil damage, that seed peas be harvested as soon as possible after they ripen in order to minimize field shatter. Sometimes peas are cut while still green and left in windrows to dry before harvesting. This practice enables the farmer to thresh the peas earlier but does not materially reduce field shatter.

Destroy the weevils in harvested seeds.—Harvested peas should be kept in tight bags or bins from which the weevils cannot escape, and should be fumigated or otherwise treated to kill the weevils before the peas are cleaned or milled. If the peas are cleaned before fumigating, many weevils may escape from the screenings.

Austrian winter field peas should be fumigated immediately after harvest, otherwise the feeding of the weevil larvae within the

peas will steadily decrease both the weight and germination of the seeds.

Fumigation is the most satisfactory method of killing the weevils in the harvested crop. Effective fumigants include hydrocyanic acid gas, chloropicrin, carbon disulphide and others.

Clean up overwintering places.—Whenever fields are located some distances from an abundance of favorable overwintering places, such as timbered or brushy areas, it may be advantageous to clean up abandoned orchards, old fences and farm buildings or any other places in which the weevils pass the winter near the peas.

Take care of field refuse.—Most viner refuse from the field harvested for the cannery is either stacked for ensilage or spread out on the field and dried for hay. No weevils can develop in peas within the ensilage stack which decomposes rapidly, but it is possible for some to develop in the refuse dried for hay. In practice few weevils are liberated in such hay because it is usually made from peas in which the infestation is very light.

Weevil Control in Home Gardens

The home gardener can obtain nearly weevil-free peas by dusting at intervals of four or five days from the time the peas blossom until they begin to go out of bloom. Use dust containing 1 per cent of rotenone and apply with a hand duster. A quarter of a pound of dust to each 100 linear feet of row should be sufficient. A hand examination of the vines and blossoms (*Fig. 4b*) will show the presence or absence of weevils, and whether or not it is necessary to dust. If any weevils are found in five minutes of examination, the peas should be dusted. Figure 4c shows the proper way to apply dust with a hand duster.

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