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Department of Entomology



Grasshopper and Cricket Outbreaks.
By J. M. Aldrich.

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Grasshopper and Cricket Outbreaks.

Prof. J. M. Aldrich.

The frequent complaints coming to the Station of loss by grasshoppers and crickets have led to the preparation of the present bulletin, in which the principal grasshopper outbreaks occurring in Idaho within the last twenty years are discussed. A study of these cases, with the means used to save crops, will enable the farmer to understand the nature of his problem, the prospects of relief by natural causes, and the remedies best adapted to his circumstances.

The cricket is discussed separately, in the latter part of the bulletin.

Grasshoppers

Although the early investigations of the United States Entomological Commission showed that the Rocky Mountain or Migratory Locust (*Melanoplus spretus*) occurs in Idaho, and sometimes rather plentifully, the insect has not been a factor in any of the outbreaks noted below. These have been, except as mentioned, all of one species of grasshopper, which has been referred to in published reports of entomologists as the Pellucid-winged Locust (*Camnula pellucida*). The term locust, in this connection, means the same as grasshopper.

The trouble with this species has been mainly in two localities, namely, the Big Camas Prairie and Market Lake.

BIG CAMAS PRAIRIE.

This is a large prairie of oval shape, lying along the Malad River, west of Hailey and north of the main Snake River plain, in the central part of South Idaho. It is about fifty miles long east and west, and perhaps fifteen miles in width,

surrounded by mountains, those on the south being comparatively low. The river runs through the prairie near the south side.

About as early as 1886, there was a little loss by swarms of grasshoppers in spots in the west end of the region. After gradually increasing for two years, the insects began to spread eastward, and in 1889, 90, and 91, were numerous and very destructive. In a general way they progressed slowly eastward, and after 1891 were so reduced in numbers as to cause no particular trouble for several years. In 1901 they once more became troublesome in the west end of the prairie; in 1902 they spread over the whole area, causing severe loss again. When I visited the region in July, 1903, there was still considerable trouble, but it seemed worse in the east end of the prairie, and the indications were that the insects were again becoming reduced to their normal and comparatively small numbers.

The first outbreak was investigated and reported upon for the Department of Agriculture by Professor Bruner, of the University of Nebraska. From his report and conversation with Mr. W. Y. Perkins, of Soldier, I gather the outline of the course of the outbreak and its subsidence; from Mr. Perkins and other citizens of the prairie, and from personal inspection, I ascertained the events of the second outbreak.

The insect is always a common species of the foothills and the prairie itself. It is generally believed that the excessive numbers of the two periods mentioned had their origin in the foothills close to cultivated land. In 1899, according to Professor Bruner, they largely left the prairie and deposited their eggs in the dry foothills, giving rise to the hope that they would not return; but the next spring they came back again.

No serious efforts were made to destroy the insects in either cutbreak, so we have apparently a normal cycle of increase and decrease. The increase is probably to be accounted for by their finding a good supply of tender vegetation on the ranches, which is favorable to their development and has, I think, an influence on the number of eggs laid by the female. Thus a small swarm becomes a plague in a few years. Absence of parasites or other favoring conditions in a very small area accounts for the nucleus.

From observation at Market Lake, it appears that the gradual increase of parasites will in a few years bring the numbers back to the normal, or even below it. Many kinds of insects have been observed to be subject to this periodic fluctuation in numbers.

MARKET LAKE.

This place is a station on the Oregon Short Line railway in the southern part of Fremont Co. The surrounding country has been but recently settled, and the population is quite sparse except close to the town.

The trouble with grasshoppers began in 1897. Early in 1898 the eggs began hatching in large numbers, and I was detailed to go and investigate the outbreak. I arrived June 4; in that high altitude the eggs were still hatching at that time. The region was not all infested, but there was an area south of town and another northwest where considerable damage was being done. Passing over the efforts made to destroy the grasshoppers and save the crops, it may be mentioned that the plague continued for five successive years, finally passing away in 1902, when no particular damage was done.

During this time a number of remedies were tried, as noted below, but the final disappearance of the trouble was without doubt due to the increase of parasitic insects.

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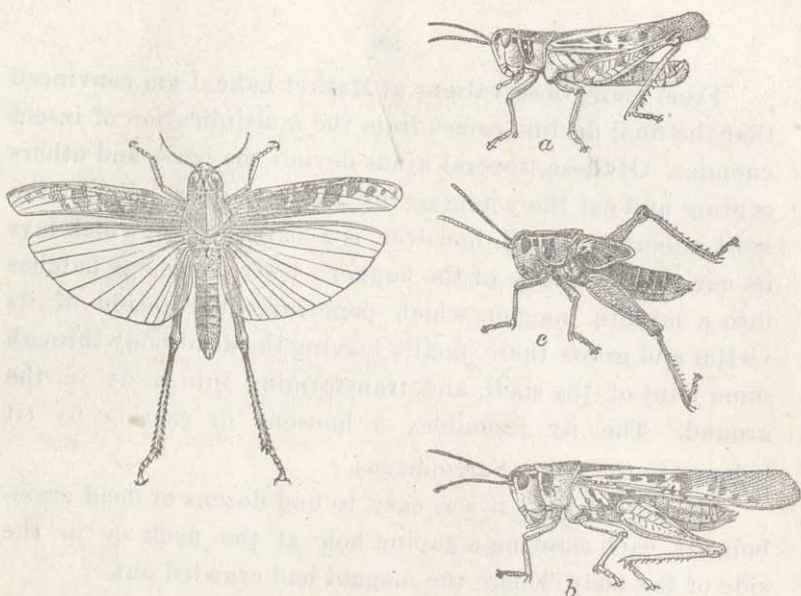
In late summer of 1895, there was considerable complaint of injury by grasshoppers to fruit along the Clearwater River, just above Lewiston, and to general crops in the upper part of Tammany Hollow, a valley some fifteen miles south of Lewiston. In company with Professor Bruner, I visited both of these sections. In both the conditions were much the same; the rough range land lying above the farms and orchards had been closely grazed off, and in the midst of the dry season afforded little food even for grasshoppers. These being compelled to travel, had naturally gravitated to the cultivated lands below. Apple and pear trees were seen without a leaf upon them, the fruit however remaining untouched, presenting a very odd appearance.

Along the Clearwater on both sides there has been from time to time a repetition of this condition, but on a small scale, generally only a part of one side of an orchard or vineyard being affected. Several common species of grasshoppers were numerous in these places, no one kind being predominant.

HABITS.

The appearance of our principal injurious grasshopper is shown by the accompanying figures. The wings when spread do not show any brown or red or yellow color, but are almost transparent.

The eggs hatch rather late in spring, the latter part of May and first of June at Market Lake, and somewhat earlier at Soldier. They do not all hatch at once, those in wet or cold locations being much delayed. While very young, the insects show a marked tendency to herd together, especially at night. The habit disappears when they grow older. They attain their wings along in July, varying a great deal in the



CAMUNLA PELLUCIDA: Adult with wings spread: a, male; b, female; c, larva.
[Dept. of Agriculture, Div. of Entomology, Bull. 25 and Circular 53]

date, according to the time of their hatching. Egg-laying begins soon after wings are attained. Each female lays several packets or masses of eggs, depositing them in a hole bored about an inch into the ground. The eggs are laid at intervals, which may extend over a month in all. In late summer or fall the insects all die, only the eggs living over winter.

This species rarely if ever migrates in swarms. It flies usually only a short distance at a time, and progresses slowly, often in no definite direction.

NATURAL ENEMIES.

It is easily seen that every grasshopper outbreak sooner or later comes to an end. Our species however is more tenacious than most, and stays sometimes five years in abnormal numbers.

From many observations at Market Lake, I am convinced that the final decline comes from the multiplication of insect enemies. Of these, several kinds devour the eggs, and others capture and eat the young or full-grown hopper. By far the most important of all, however, is a parasitic fly, which lays its egg on the outside of the hopper's body. This egg hatches into a minute maggot, which penetrates the inside of its victim and grows there, finally leaving the dead body through some joint of the shell, and transforming into a fly in the ground. The fly resembles a housefly or carrion fly (it belongs to the genus *Sarcophaga*).

At Market Lake it was easy to find dozens of dead grasshoppers, each showing a gaping hole at the neck or in the side of the body, where the maggot had crawled out.

Unfortunately, it seems impossible to increase this parasite by any artificial means. Hence as a general rule the usual remedial measures must be carried on without regard to it.

REMEDIES.

Fungous Disease.—This is the remedy which appeals most readily to the imagination of the suffering farmer, as he hopes that it will enable him to dispose of the grasshoppers with almost no labor. This is a perfectly laudable thing to desire, and it is only to be regretted that all efforts to the present time have failed to discover a fungous disease [that will attack grasshoppers in dry weather to any important extent.

The late Mr. Mart Patrie, of Market Lake, succeeded in obtaining from South Africa a supply of fungus in cultures, which it was reported had been successfully used on grasshoppers there. At his request, I was sent to Market Lake to superintend the process of inoculating the grasshoppers. The

same fungus was obtained from South Africa by the U. S. Department of Agriculture and used for experiment in several places the same spring. This was in 1901.

At Market Lake the first operation was to soak up the gelatin culture in water and sugar. In two or three days filaments of fungus made their appearance. A quantity of grasshoppers were then secured and placed in a small enclosure. These were fed upon fresh clover which had been sprinkled with a dilution of the fungus culture; the same dilution was also sprinkled directly upon the grasshoppers. The atmosphere of the large box in which they were confined was kept moist by sprinkling.

A large part of the confined grasshoppers died in a few days, and some became mouldy, showing filaments like those in the culture, although no microscopic examination was made to determine the identity.

From time to time after the first two or three days, portions of the material, both dead and living grasshoppers, were taken out and distributed in favorable localities where the undisturbed grasshoppers were numerous, and where the soil was moist.

About this time I was absent from Market Lake for a week. On my return, I heard before reaching the town, even as far away as Pocatello, that the fungus was working, and the grasshoppers were dying off in large numbers. At Market Lake the business men and farmers were elated with what they believed to be the success of the fungus. On thorough examination, however, I found that the reports had been started from the finding of a considerable number of grasshoppers killed by the parasitic fly mentioned above and a few by a native fungus of slight importance. This is mentioned to show how easily wonderful reports of success with

fungus become started. I could not find evidence that a single grasshopper, not in captivity, had been killed by the fungus; even those in confinement were more likely killed by that than by the fungus.

The experiments made by others the same year with the same fungus, which they obtained from the Department of Agriculture, gave substantially the same results.

Crude Petroleum.—In 1902, by the aid of the county commissioners of Fremont County, and the liberal co-operation of the Oregon Short Line railway, the citizens of Market Lake procured a carload of crude petroleum from Colorado. This they applied by spraying it upon vegetation where the hoppers were most numerous, especially upon sagebrush, and also directly upon the insects where practicable; then where possible they set fire to the oil. I was not present when this method was used; citizens afterward assured me that they destroyed great numbers of hoppers, but the oil was too expensive for a small, new community to purchase at ordinary rates. Hence after the carload was used no more was procured.

Burning with Straw—In 1893 a favorite method with the very young insects at Market Lake was to cover the clusters where they were most numerous with a light layer of straw and set it on fire. This was very effective, especially while they were sluggish in the cool mornings of that elevated region. With older insects it would not be very valuable, as these do not collect in masses, and are also much more active in escaping when approached with the straw.

Collecting with the Hopper-dozer.—The hopper-dozer is a long pan or tray of sheet iron, made to draw along on the ground sidewise, and containing water and kerosene, which kills all the hoppers that jump in. On my first trip to

Market Lake I had one made, and the plate shows it in use in a wheat field. As the grasshoppers were very small, but few could jump high enough to get into the pan as it was drawn along; but it was found that we could draw it up to a mass of the little insects and "shoo" them up and into it quite successfully. The picture shows this operation.

The pan or dozer shown in the illustration was made from a single sheet of commercial galvanized iron, 30 inches by eight feet in size. It is $7\frac{1}{2}$ feet long, 15 inches wide, 2 inches high in front, 3 at ends, with about 13 inches turned up to form the back. For use with larger hoppers a width of 20 inches would be better than 15; in that case a large screen of cloth two feet wide should stand up behind the pan, to keep the hoppers from jumping over. The pan is drawn by ropes from the corners, by two men. For large hoppers it may be raised on low runners to go over the vegetation. The partitions shown in the figure are to keep the liquid from running to one end when on sloping ground.

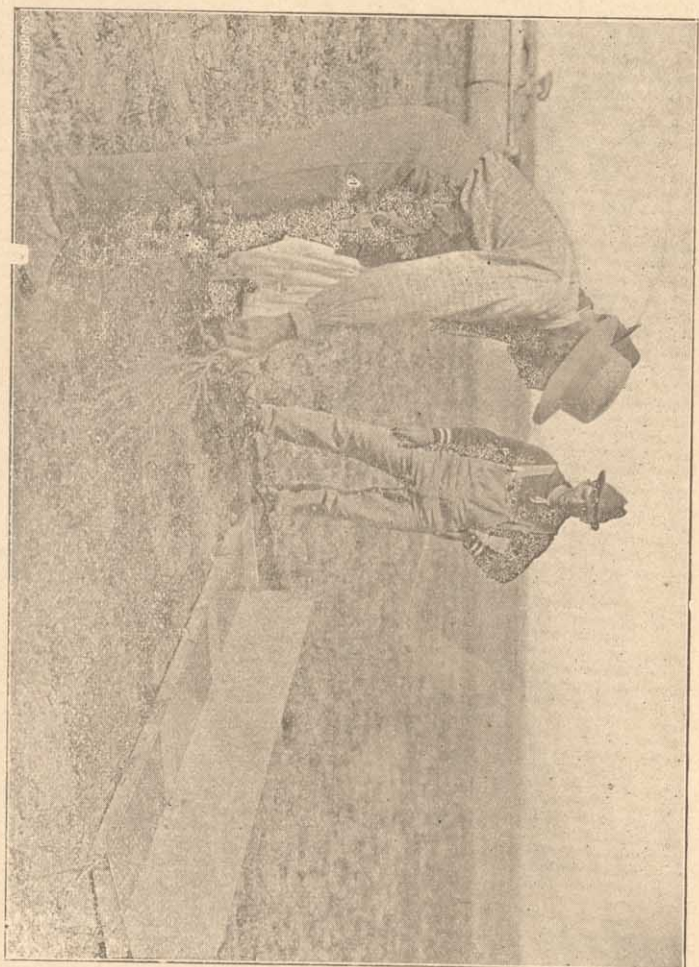
In working with large hoppers, it is very necessary to take advantage of temperature, and collect them when they are inactive from cold, in the mornings and evenings. In the hot part of the day most of them will dodge the instrument.

More has been accomplished against grasshoppers by the use of the dozer than by any other method, with the possible exception of plowing up the eggs. In Minnesota in 1888 a bounty of a dollar a bushel was given for grasshoppers in a county where a bad outbreak occurred; in the single season more than *fifteen thousand bushels* were collected and paid for. Again in 1891 in the Red River valley of Minnesota and North Dakota, more than 200 dozers were reported to be in use, and the quantity of grasshoppers destroyed was estimated at from 8,000 to 10,000 bushels.

At Market Lake a serious difficulty with the use of the dozer was the sagebrush, which prevented drawing it except on the cultivated land and a few small areas outside. In spite of the small size of the hoppers, we estimated that two men could destroy a bushel an hour with one machine. This would be an enormous number.

Plowing up the Eggs.—The eggs of grasshoppers are laid along in the latter part of summer, in clusters about an inch below the surface of the ground. Each cluster or mass is surrounded with a frothy material, which seems to act as a protection from excessive moisture. Plowing the ground where eggs are laid breaks up these masses and destroys the protection; in some cases it turns the masses down so deep in the soil that the young hoppers, even though they hatch, cannot force their way upward to the surface. Almost no grasshoppers will hatch in ground that has been plowed. Hence it is desirable to watch closely the egg-laying habits, and see if the eggs are not laid in places where plowing can be done. With the Rocky Mountain locust, this has several times served to destroy a whole swarm. With our principal species there are certain preferred kinds of soil for egg-deposition. At Market Lake they selected generally the edges of slight depressions in the plains. These depressions or hollows were low enough so that they produced a kind of salt-grass, and not sage-brush. The absence of sage made them more conspicuous than the difference of level. About the edges of these places the newly-hatched young were very numerous. Plowing could have been applied here with good results.

The land in Big Camas Prairie lies differently, and does not offer many of these spots. Here the hoppers showed a marked preference for sandy or gravelly places along the



Using Hopper Dozer at Market Lake.

edges of creeks. I did not have an opportunity to judge whether plowing could be done in these places.

Ground under cultivation is rarely or never used for egg-laying by grasshoppers. All the species seem to prefer a harder texture of earth and some will even choose the wheel-tracks of roads.

Keeping off with Water.—This applies especially to the very young insects. At Market Lake in early summer a good deal was accomplished by the use of water. As the hoppers never hatch in the cultivated field, they must always invade it. A ditch with standing or running water will keep them away for a long time. Furthermore, when they are in the field, while still small, they will constantly move from the moist to the dryer parts. I noted that by giving the field a thorough irrigation, the hoppers were driven collect in a few dry places, where they were covered with straw and burned.

Poisoning.—The use of arsenical poisons against grasshoppers has never been a general practice; it has not been attempted in Idaho as far as I know. There is however one method that has produced good results in Manitoba, and deserves trial here. From the inventor, the material is named the Criddle mixture, and is as follows:

Paris green	-	2 lbs.
Fresh horse manure	100	"
Salt (dissolved in water)	2	"

Mix very thoroughly. Scatter along the edge of the field.

This is in the nature of a poisoned bait. It does not require the use of a spray pump, and is very inexpensive. •It is quite slow in its action. I am indebted to Professor Jas. Fletcher, Dominion entomologist, for the revised formula.

Crickets

There is only one species which causes appreciable loss to crops:—the large kind sometimes called the Idaho cricket (*Anabrus simplex*).

This insect figures largely in the early history of agriculture in Idaho, as it over-ran many of the scattered ranches of the early days. This was true not only of the arid sections, but also in less degree of the northern part of the state.

In recent years it has not occurred in the non-arid regions, but it still gives cause for complaint annually in some part of southern Idaho. Almost every year it occurs and does some damage in the region lying north of the town of Shoshone, generally close to the edge of the mountains on the Hailey branch of the Short Line railway. Last year I encountered a drove of this species a little south of Bellevue; a few years ago I encountered them at Minidoka; in 1901 I drove out from Blackfoot to see where they had been working on the north side of Snake River.

The appearance of the insect in both sexes is shown by the accompanying figures. The one on the title page shows the male, natural size. They have only rudimentary wings, and never fly. The male can make a shrill, penetrating sound by a movement of his wings, which seems to be their only function.



ANABRUS SIMPLEX: Female, natural size. [Original pen drawing by Miss Metta E. Woodworth.]

The insects seem to hatch mainly in the arid foothills; as they have been seen to deposit eggs in the plains, it is probable that they also hatch there, but not so numerously. Next to their ravenous appetites and superb digestive powers, the most singular thing about the crickets is their migrations. One would not expect much travel from a wingless insect, but this species has a remarkable faculty for congregating in droves and moving across country in a uniform course by steady jumping. They sometimes cover many miles without any material change of direction. The observations I have made, together with what information I have gathered from settlers and reports of entomologists, tend to indicate that the general course of their migrations is southwest, south and southeast from the foothills forming the north border of the Snake River plain, more especially from those lying about in the central part of Southern Idaho.

The region infested by the crickets in recent years is mostly unsettled; hence the actual damage done has been slight. The cricket feeds normally on sagebrush. It has a gizzard or grinding apparatus inside of such strength and complexity that it can utilize very woody, tough materials for food.

The insect has been kept off from cultivated fields to some extent by the use of water in ditches, although when the migrating instinct is strong it will jump in and swim across, or even fill the ditch by its numbers.

Another method that has given some relief is "herding," which as the word implies is to drive them away like cattle, changing the direction of their movement.

Near Horseshoe Bend a farmer told me that he had succeeded in protecting a garden by placing boards end to end with the edge up around it. The boards were about eight

inches wide, and at the top it was necessary to have a strip of tin horizontally, projecting two inches to the outer side. He said the insects would crawl up the board, reach out and get a claw over the edge of the tin, then hang and kick vigorously while trying to get over but they did not succeed. A few old kerosene cans furnished tin enough to go around the garden.

Others have used a dry ditch around the field, making a smooth vertical surface on the inner side. In this ditch at intervals deep holes are dug, into which many fall and cannot get out. Others instead of the deeper holes use a post of heavy timber, drawn along in the ditch by a horse, which crushes many crickets. Those not killed outright if at all injured, are immediately seized upon and eaten by their uninjured companions.

These are a few of the most practical and successful methods of handling crickets. From the stories told me, I am inclined to think that a great deal of ingenuity has been expended in this line of entomological work, as many other methods have been described to me. I have not yet met the crickets except in the sagebrush.

While they often move quite continuously in one direction, this is by no means always the case, and a drove will often work back and forth for some time near the same place, changing its direction of movement, or seeming to have no particular direction.

The Criddle mixture would be a promising remedy, were it not somewhat slow in action. If not used until the crickets were in the field, they would have abundant time to eat everything in sight before the poison would begin to take effect.