OREGON AGRICULTURAL COLLEGE
EXPERIMENT STATION
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REPORT OF WORK IN CONNECTION WITH DEVELOPMENT OF METHODS OF APPLYING DUST FOR INSECT CONTROL BY THE USE OF THE AIRPLANE

by

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1. Experiments at Monroe.

With the co-operation of Mr. Johnson, manager of the OACO Orchards at Monroe a tract was set aside for dusting with a plane. The U. S. Air Service furnished the airplane and pilot.

With the meager information that could be obtained from the two previous experiments in airplane dusting a hopper was designed as shown in figure 1.

There were a number of disadvantages encountered from the start. First only a single type of airplane was available for use. The Curtiss JN-4 a training plane with a 180 H.P. Hispano motor - with a speed of 70-80 m.p.h. Not capable of lifting a very heavy load. Second, it was also found to be impossible to install a hopper inside the ship as this would necessitate a complete disassembling of the machine. Third, the planes were at Vancouver, Washington, and the hopper was made at Corvallis.

The hopper as designed was 28" from front to rear, 10" wide and 31" from the top to the point of contraction, and 14" from that point to the outlet. The outlet was an opening 8" in diameter with a shut-off. To the bottom of this vertical pipe was attached a ventura tube 12" in diameter at the large end and 8" in diameter at the small end. The entire hopper was built of Number 18 galvanized iron. The top was fitted with a sliding cover.

The entire apparatus was shipped to Vancouver for trial.

Four hundred pounds of hydrated lime was purchased, the hopper mounted and on the first trial the cut-off was opened wide and it was found that the suction was not enough to draw the dust out at any where near the rate required for orchard dusting, as it required a mile of flight to empty the 50 lbs. The ventura tube was turned so that the large opening was to the rear, another flight showed that this increased the flow of dust about 30%, but still far from the speed required. The hopper was removed and a 3" down spout run from a funnel down to the opening so that a blast of air entered at the top (fig. 1-a) and was discharged just above the opening Fig. 1-b. Subsequent flight gave an increase in the delivery of dust but still insufficient. The hopper was again removed and a hood constructed as shown at c fig. 1. by opening or closing the sliding door on top of the hopper a greater or less amount of air pressure was exerted on the contents of the hopper. It was now found that with the plane flying at 75 miles an hour or 110 feet per sec.

and covering 4 rows of trees or a strip 130 feet wide approximately 1/3 of an acre would be covered each second and at the rate of 3/4 of a pound of dust to a tree, (50 trees per acre) approximately 12 pounds of dust would be required each second or 36 pounds each 3 seconds. Our trials convinced us that with the hopper designed we could liberate approximately 14 to 15 pounds of dust per acre or every 3 seconds and in order to get the required amount on it would be necessary to fly each strip two or more times.

The first trials were impossible to check as the plane flew too high and the wind carried the dust too far. After the pilot brought the plane down to approximately ten to fifteen feet above the trees it was found that we were covering six rows well with some drift to the 10th row on the windward side. Three trips were made over this strip to compensate for the drift. The dust was liberated at the rate of 14 pounds each 330 feet on each trip or 42 pounds on the three trips. A strip of 6 rows, or 180 feet wide, was covered with approximately 31 pounds per acre.

A large number of samples were collected from this area and similar samples gathered from an area dusted by a land machine the same morning.

In the case of the land machine 48 pounds of dust per acre was applied. In the case of the airplane 31 pounds per acre was applied. Chemical analysis of these samples of foliage gave the following:

Machine dusted .0079 grams lead arsenate on 100 sq. inches.
Aeroplane " .0076 " " " " " " "

From data secured it is safe to say that with an aeroplane of high lifting capacity carrying an improved hopper, 20 to 25 acres of orchard can be dusted each minute.

Orchards on very uneven ground, i.e., with deep swales and steep rises offer difficulties in the shape of wind currents which will be difficult to overcome. Wind is a factor and in order to obtain results dusting should be done early in the morning or at such times as there is little or no wind.

The dust used in this experiment was 15 lbs. of lead arsenate and 85 pounds of sulfur to each 100 pounds so that only an average of .093 lbs. or approximately 1.5 ounces of lead arsenate is allotted to each tree.

The application was made May 1st as a calyx spray for the codling moth and for apple scab.

EXPERIMENTS IN DUSTING ALFALFA WEEVIL BY THE USE OF THE AIRPLANE.

With the knowledge obtained in the work on apple dusting at Monroe, an entirely new type of hopper and dust release apparatus was designed.

Mr. H. C. French, of Portland, obtained a contract to dust 500 acres of alfalfa for the Eastern Oregon Land Company near Ontario, Oregon. The services of a commercial aviator was obtained. The plane used was what is known as an all-upper wing Standard, equipped with a 260 H.P. Mercedes motor, and capable of lifting from 650 to 800 pounds.

The hopper was designed to fit in the front cock pit, thus eliminating the wind pressure so pronounced where the hopper was fastened to the side of the ship. The hopper was made of number 20 galvanized iron, 24 inches square, and 24 inches deep to the point where it was contracted to an eight-inch opening at the bottom and having a capacity of approximately 16,000 cubic inches.

Previous experience, both at Monroe, and from the meager data obtainable on other experiments, showed that the one main drawback to the work up to date was the absence of a method whereby the output of dust could be controlled and measured. It seemed that in order to be successful it would be necessary to invent a method whereby a given quantity of dust could be mechanically expelled from the hopper into the propeller stream in a given time. In order to accomplish this, the apparatus shown in figure 2 was built. This apparatus consisted of a six-inch galvanized iron pipe 20 inches long (2A) closed at the front end, and having a down spout at the rear end. Within this pipe was a worm (2B) mounted on ball bearings at each end, and having a sprocket at the rear end (2C); another sprocket wheel with crank (2D) was mounted near the top of the hopper; these two sprockets were connected with a bicycle chain. Each revolution of the crank gave four complete turns of the worm and each turn of the worm discharged a certain quantity (which had to be weighed for each form of mixture prior to the flights) of the dust mixture into the down spout, from whence the propeller blast carried it into the crop to be treated.

Previous experiments with a land dusting machine were carried out by Mr. G. I. Reeves of the Federal Alfalfa Weevil Experiment Station. Mr. Reeves applied "Mab sand", "Diato" and sulfur in various quantities combines with calcium arsenate.

The following mixtures seemed to give the best results:

Diato one part to calcium arsenate 2 parts.
Diato one part - calcium arsenate 1 part.
Sulfur one part. Calcium arsenate 1 or 2 parts

Exact results could not be obtained at the time I saw Mr. Reeves last, but a kill of at least 85% seemed assured.

Pure calcium arsenate was also applied and gave promise of fair control.

These applications were made on the Pipe-Line Ranch approximately 10 days prior to the airplane dusting.

Upon the advice of Messrs. Reeves, Wakeland and Breithaupt, the Manager of the Pipe-Line Ranch decided on the mixture to be used as one part "Diato" and two parts calcium arsenate applied as nearly as possible at the rate of three pounds per acre, i.e., two pounds of poison and one pound of carrier.

Trial flights were made at 11 a.m. on May 25 to establish the height at which the plane should fly in order to get the least drift from the strong breeze, and to establish the width of strip which would be covered. It was found that by flying about 15 feet above the alfalfa, a strip 120 to 130 feet wide was well covered and when flying directly into or directly with the wind, there was little or no drift. The material settled quickly, and from all appearance, gave an excellent distribution and good cover. In the afternoon 120 pounds of material was put in the hopper, and it was figured that in order to put 2 pounds of poison per acre, it would be necessary for the ship to cross the field eight times. It actually crossed seven times and completed approximately three-quarters of the eighth crossing when the hopper was emptied. In later flights, no difficulty was experienced in controlling the amount of dust discharged.

On Tuesday 200 acres were dusted in exactly one hour elapsed time, including two landings for material.

The average progress with a land machine is about 6-8 acres per hour.

A flag system was used to indicate the path of flight to the pilot.

Much interest was aroused by the trials and some 1200 to 1500 people were present. Many of the growers were impressed, as signified by their desire to employ Capt. French to dust their holdings.

The cost of application has been reduced to approximately one-third and there is no damage to the standing hay, as is the case where land machines pass through the fields.

According to information received after my return, the worms on airplane-dusted fields were showing considerable mortality the second day. This is unusual, as in the case of land machine dusted material, little or no mortality occurs until the third, fourth and sometimes the fifth day.

At this date, September 15, word has been received directly or indirectly from all parties for whom dusting was done. Without exception they are well pleased. In their opinion the application from airplane has proved equal to or better than other common methods of applying insecticides.

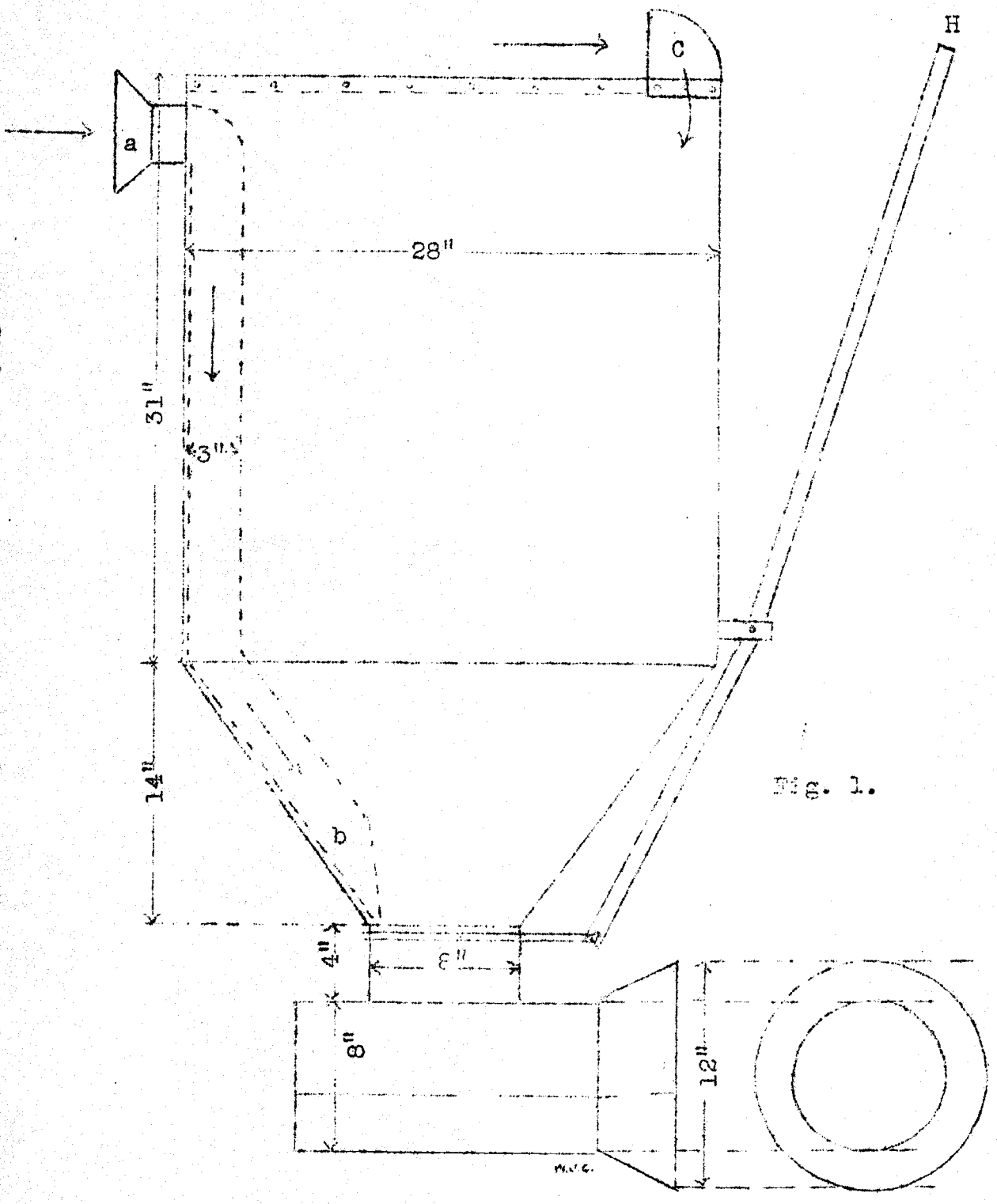

Fig. 1.

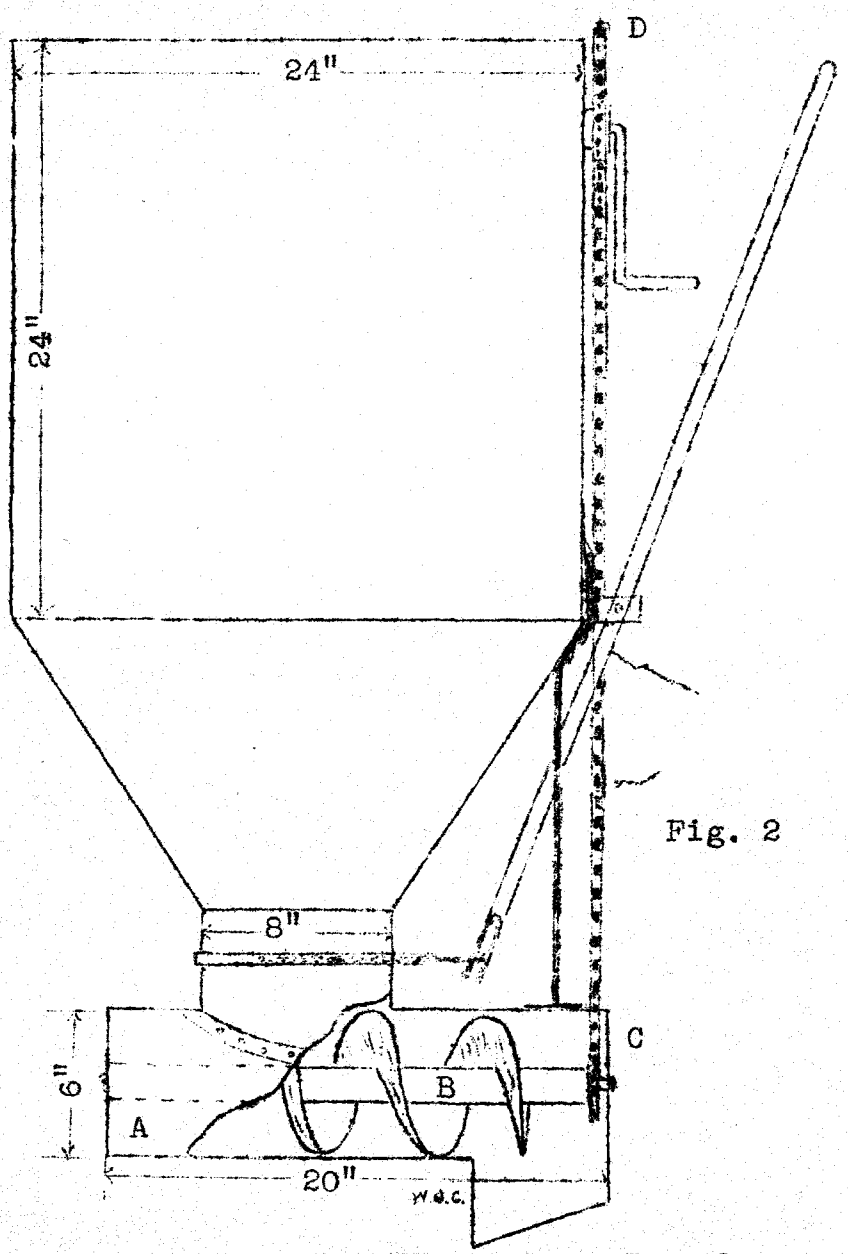

Fig. 2

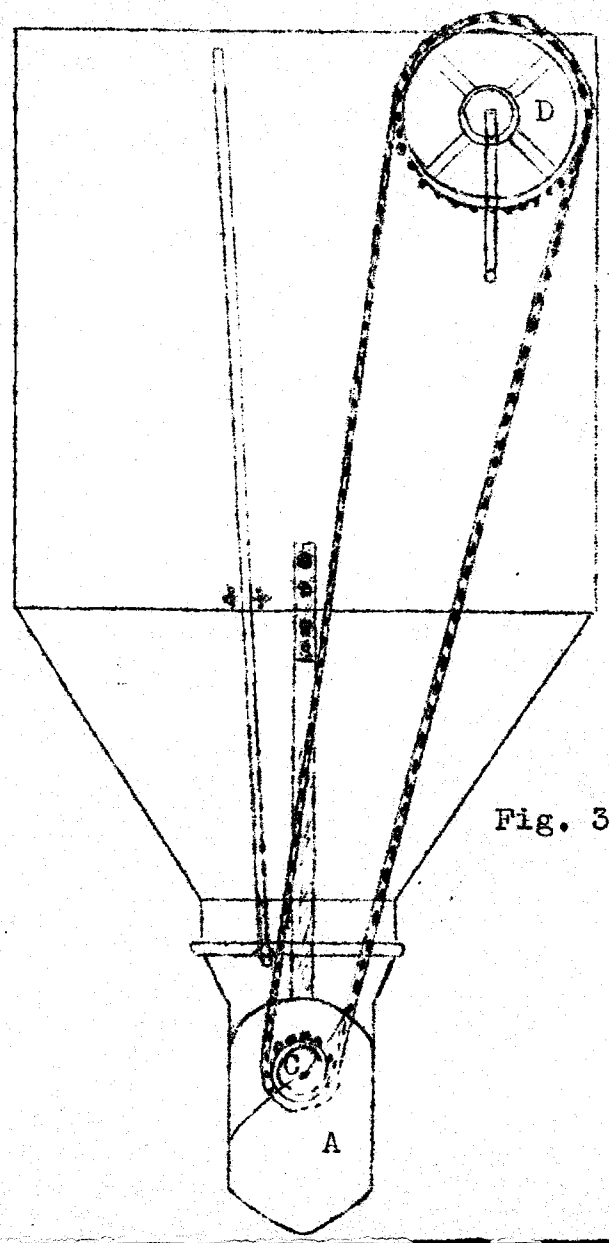

Fig. 3