ence between returns of the two types was not enough to conclusively consider one greatly superior to the other.

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TWO DEVICES FOR APPLYING HERBICIDES TO SMALL PONDS

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ABSTRACT

Two boat-mounted machines for applying herbicides or other similar materials to small ponds are described.

A dry materials spreader was assembled from three lawn-type fertilizer spreaders. Powered by a small air-cooled gasoline engine the spreader operated effectively to uniformly distribute granular herbicides, lime or similar materials. Distribution of granular material at rates ranging from 100-1,000 lbs. per acre was possible.

A boat-mounted spray rig employing a 15-foot boom eliminated the need for a two-man crew for treating small ponds with liquid materials. The spraying operation could be controlled by the boat operator once the spray tank has been filled and the sprayer was started.

Both of the machines can be assembled from commercially available parts by a good mechanic in a relatively short period of time.

INTRODUCTION

Devices employed in applying herbicides to small ponds have been relatively few and simple. Where water or oil carriers were employed the chemical was distributed by dipper, or power sprayer (Surber, 1948). For treatment of hatchery ponds, sprayers used are usually of the agricultural type although in some cases spray rigs have been especially developed for a specific set of conditions.

The increased use of granular or other dry formulations of herbicides has resulted in a need for equipment to apply such material more or less uniformly to the vegetation to be treated. A Gandy fertilizer spreader was employed by Grigsby, Hamilton and Smith (1956) to apply granular 2,4-D. Satisfactory performance of such equipment appears to be limited to ice covered areas or to relatively dry pond bottoms. At Marion, granular herbicides have been applied with a portable, man-powered grass seeder. Distribution of seed or materials is accomplished by means of a spreading device powered by a hand crank. This method of distributing dry herbicides was more applicable to our existing pond conditions but exposed the operator unduly to dust or toxic fumes from the chemicals being spread. Also, uniform coverage of an area was difficult to achieve on windy days.

Two pieces of equipment have been developed at the Marion National Fish Hatchery in recent years to fill the need for equipment to apply liquid and dry herbicides to small ponds. Both are boat mounted, capable of being operated by one man and can be assembled from component parts that are commercially available. A person with some mechanical aptitude, or the average small-town

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machine shop should be able to assemble the devices with a comparatively small number of man hours.

MATERIALS SPREADER

For a boat mounted materials spreader, three 30-inch lawn type fertilizer spreaders less wheels and handles were bolted together on a metal frame. The metal frame was built to fit the stern of a 14-foot aluminum boat and was held in place by means of a ½-inch steel pin that fitted into a pin-holder permanently mounted to the transom of the boat.

The shafts actuating the agitators of the spreaders were joined into a single unit by means of a shaft coupling between two units and a 6-inch pulley between the second and third, making possible operation of the agitators with power from a 1½ H. P. gasoline engine. A slip clutch made possible stopping the agitators by throttling down the motor speed. This served to stop the flow of material. The hoppers were two inches apart making the machine cover a swath 94 inches in width. A continuous piece of one-inch angle iron was bolted to the front edge of the hoppers to hold them firmly together. Additional reinforcement was achieved by bolting 6-inch strips of the one-inch angle iron to the hoppers in the rear at both top and bottom of the hopper.

A control rod at the top and front of the hopper was connected to the bottom shut-off plate for each hopper section. Made of 5/16 steel rod, this control enabled the operator to regulate the flow of materials from zero to wide open settings. Two turnbuckles on the control rod permit the outside hoppers to be calibrated with the center one for uniform disribution. The throttle of the engine was also mounted on the control handle.

The supporting frame which fitted over the stern of the boat was made of one-inch angle iron joined by welding and braced with ½-inch strap iron.

The frame was stabilized with two tie rods which extended from the top of the hoppers to the boat seat brackets where they fastened by means of a hook and eye arrangement. Turnbuckles could be tightened so that the rods prevented forward or backward movement of the device. The motor speed was reduced by the inclusion of a 10 to 1 gear reduction box which was V-belt driven and mounted on the frame and offset 12" from a line extending from the drive shaft of the motor to the center of the middle hopper unit.

When dismounted, the machine was supported by the pin which attached it to the boat and by legs made of one-inch conduit bent in a "U" shape and bolted to each end of the hopper. Additional stability is given when the spreader is mounted on the boat by an empty 10-quart oil can which was lashed to each of the hopper legs. When the boat was tipped from side to side the buoyancy of the air-filled cans helped to prevent the hopper from being immersed in water. This attachment was added to the original design when clogging of the hopper openings resulted from wetting of the material being distributed if the boat was tipped during operation. Another addition to the original design of the machine was added height to the hopper to increase load capacity. The extra six inches of galvinized sheet metal added to the sides of the hopper increased the capacity of the hopper by about 100 percent.

Materials required for assembling the spreader are shown in Table 1. It is estimated that a good mechanic could construct the machine in about 16-20 man hours. Cost of parts and materials should be about $125.00. Figure 1 illustrates the unmounted machine without extra hopper sides or float stabilizers. Figure 2 shows the machine mounted on a boat.

The materials spreader has been used over a two-year period to treat more than 50 acres of ponds with such materials as granular 2,4-D, ground limestone and hydrated lime. It has proven to be quite satisfactory in evenly spreading these materials at rates ranging from 100 to 2,000 pounds per acre.

In operation, the hopper is filled with the material to be applied. The motor is then started and the boat rowed to the starting point with the shut-off plate closed or the motor running slowly enough so that the slip clutch is disengaged. At the starting point, the control lever is operated to open the hopper gate to give the desired volume of application. The boat is rowed over the area to be treated making swaths 94 inches wide until the required area is covered or the material is applied.

Using lime as the material applied. a two-man crew can cover about 3/4 acre per hour when spreading at a rate of 1,000-1,200 pounds per acre. Uniformity of coverage depends upon the skill of the operator and is very good if he is proficient.

A desirable modification of the device would be to redesign the mounting so that a stern-mounted outboard motor could be used to propel the boat. While the oars are adequate, more effort and skill are required to row than to operate an outboard.

TABLE 1. PARTS AND MATERIALS LIST FOR THE SPREADER

Quantity required	*Item*
4 sq. ft.	Galvanized metal
2	Used 10 qt. oil containers
3	30-inch lawn-type fertilizer spreaders
1	1½ H. P. Gasoline Engine
1	Automatic clutch
2	V-belts
1	10-1 reduction box
15 ft.	One-inch angle iron
12 ft.	1/2-inch strap iron 1/8" thick
24 ft.	5/16-inch steel rod
4	5/16-inch turnbuckles
6 ft.	One-inch conduit
1½	3/4-inch conduit
4 dozen	1/4 x 1-inch machine bolts
1 ft.	1/2-inch steel rod

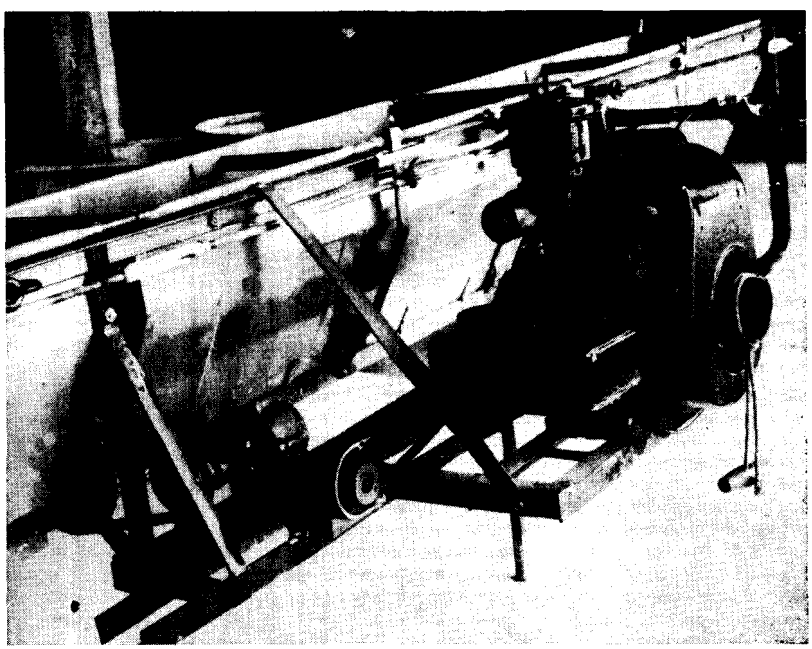

Figure 1. Unmounted Machine Without Extra Hopper Sides or Float Stabilizers.

BOAT MOUNTED SPRAY RIG

To meet the need for a one-man spray rig suitable for plot or pond treatment of hatchery or similar size ponds the following machine was developed.

A sprayer pump of the type used with tractor mounted power take-off driven spray rigs was mounted on a steel base plate. The base was equipped with

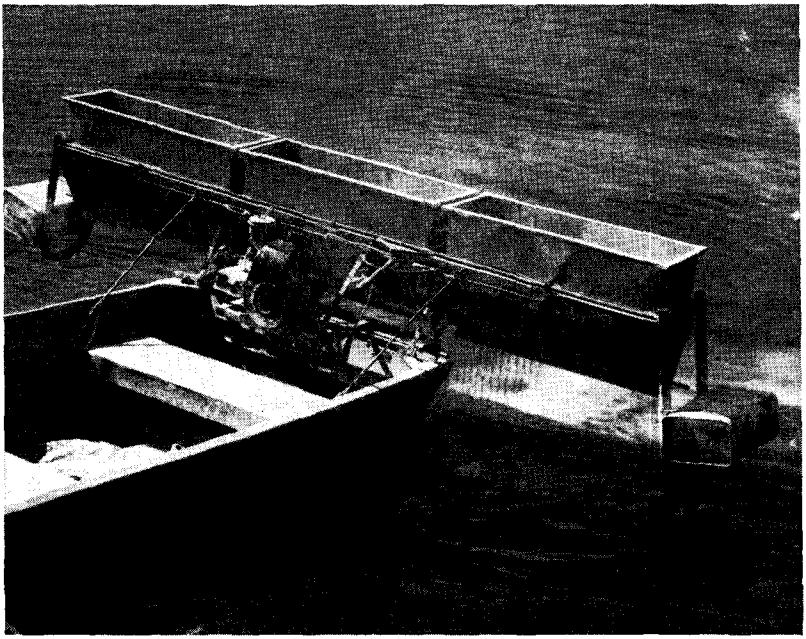

Figure 2. Machine Mounted on a Boat

lifting handles made of ½-inch galvanized pipe. The sprayer was powered with a 2½ H. P. air-cooled gasoline engine connected to the pump with a V-belt running from a 3-inch to a 7-inch V-pulley. The motor was fitted with a slip clutch as a control over pump operation. The tank of the sprayer was a 30-gallon drum treated on the inside with epoxy resin to reduce corrosion and equipped with pipe fittings to receive the suction line to the pump, a bypass line from the pump and an opening for filling the tank. The tank was supported on a low wooden cradle for a low center of gravity and greater load stability.

The most significant feature of the rig was a 15-foot spray boom made by clamping three commercially available, 4-foot, four nozzle smaller booms on a support made of ½-inch conduit reinforced with ¼-inch steel rod. The support boom was spot welded together and then welded to a frame made of angle iron which fitted over the bow of a 14-foot square-end aluminum boat. The frame was clamped to the boat by means of four-inch "C" clamps. The supply hoses of three smaller booms were connected to a ½-inch cross which also received the discharge line from the pump. Each section of the boom could be controlled by means of a cutoff valve on the line leading to each of the three sections. This permitted treatment of areas from 4 to 15 feet wide. Application of spray materials could also be controlled by means of a control valve mounted in the discharge hose which extended from the pump back to the operator's seat and forward to the boom mounted on the bow of the boat.

This rig delivered spray solution at about 2½ gallons per minute enabling one man operating an outboard powered boat to treat an acre pond with as much as 100 gallons of spray solution in one hour or less. At a lower volume, an acre has been treated in as little time as 35 minutes. The spray boom gave a uniform application of liquid herbicides with little drift. Drift could be further reduced by redesigning the mount so that the boom height would be adjustable from water level to a height of 15-18 inches. A spray gun could be connected in place of the boom to enable the operator to reah inaccessible areas.

The boom and sprayer arrangement enabled one man to do jobs that formerly required two men. The entire rig is relatively inexpensive and can be built in about 20 man-hours. Estimated cost of parts and materials at present

prices is $115.00. Parts and materials required are shown in Table 2. Considerable deviation from the fittings listed is possible depending upon how the lines are assembled. Figure 3 shows a view of the apparatus mounted on a boat.

TABLE 2. LIST OF MATERIALS FOR A BOAT SPRAY RIG

Number required	*Item*
1	2½ H. P. air cooled gasoline engine
1	3″ pulley
1	7″ pulley
1	¾″ nylon roller—6 roller gear pump
1	⅜″ globe valve
7	¾″—½″ reducer
3	½″—⅜″ reducer
6	2″ x ⅜″ nipples
1	¾″ street ell
1	½″ street ell
1	¾″ coupling
1	½″ cross
1	½″ tee
24 feet	½″ sprayer hose
14	hose clamp small size
40 inches	⅜″ gal. pipe
50 inches	1¼ x 3/16 angle iron
54 inches	¾″ x ⅛″ angle iron
300 inches	¼″ steel rod
32 feet	½″ thin wall conduit
1	pump base
1	cradle
1	30 gallon steel drum

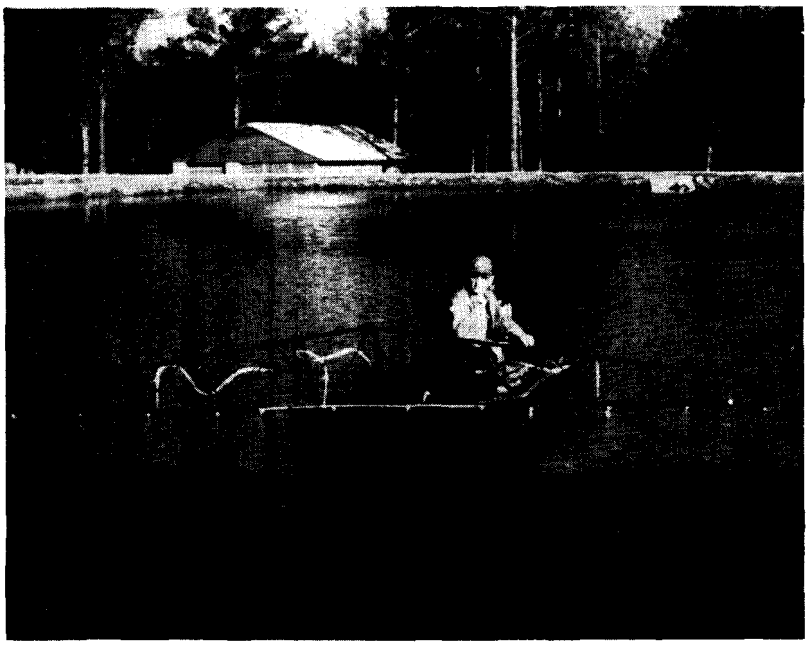

Figure 3. Spray rig in operation

The spray rig works best for soluble materials. Some difficulty was experienced in applying high concentrations of water suspended herbicides as the

bypass agitation was not sufficient to keep the particles from settling out in the bottom of the tank and eventually clogging the spray nozzles. Except for this difficulty, the apparatus has given excellent service during a season of testing. To minimize foreign materials clogging the nozzles, all solutions are strained through a fuel funnel as they are poured into the tank.

SUMMARY AND CONCLUSIONS

It was found that devices to apply both dry and liquid herbicides could be assembled from commercially available components to give machines that would do a satisfactory job of applying the materials to small ponds at a uniform rate. Both machines could be operated by one man although the dry materials spreader needed a two-man crew where the rate of application was several hundred pounds per acre. Field testing indicated that both machines were reasonably durable and could be expected to give several years of service when given ordinary care and maintenance. It is believed that both machines may have an application in the management of both public and private fish hatcheries and by custom operators or biologists assisting with the management of farm fish ponds.

ACKNOWLEDGMENTS

The assistance of James C. Thompson, Maintenanceman, Marion, Alabama National Fish Hatchery in designing and assembling the boom and L. L. Henkle, Hatchery Manager of the Marion Station, for assistance, suggestions and criticism is gratefully acknowledged.

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STUDY OF THE VALUE OF NAVIGATION LOCKS FOR THE PASSAGE OF ANADROMOUS FISH [1]

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Successful passage of American shad (*Alosa sapidissima*) by fishways on dams in the Columbia River in the Pacific Northwest and the Neuse River in North Carolina, and by a trap and bucket lift on the Connecticut River in Massachusetts stimulated efforts for workable fish passage devices to restore anadromous fish runs above other existing and proposed barriers.

In the spring of 1962 studies were made by the Bureau of Commercial Fisheries Biological Laboratory, Beaufort, N. C., in cooperation with the Corps of Engineers and the North Carolina Wildlife Resources Commission, at Lock and Dam No. 1 on the Cape Fear River in North Carolina to determine the practicability of locking anadromous fishes upstream during their spawning migration.

The lock and dam are located at river mile 65. They prevent fish from entering the river above, except during boat lockages and periods of extended high flow. The dam is 12 feet high and the inside dimensions of the lock chamber are: width, 40 feet; length, 240 feet; depth, 32 feet; with the downstream entrance 160 feet from the base of the dam. The lock gates and gate valves

[1] Presented at the Southeastern Meeting of the Southern Division of the American Fisheries Society, Charleston, South Carolina, October 14-17, 1962.