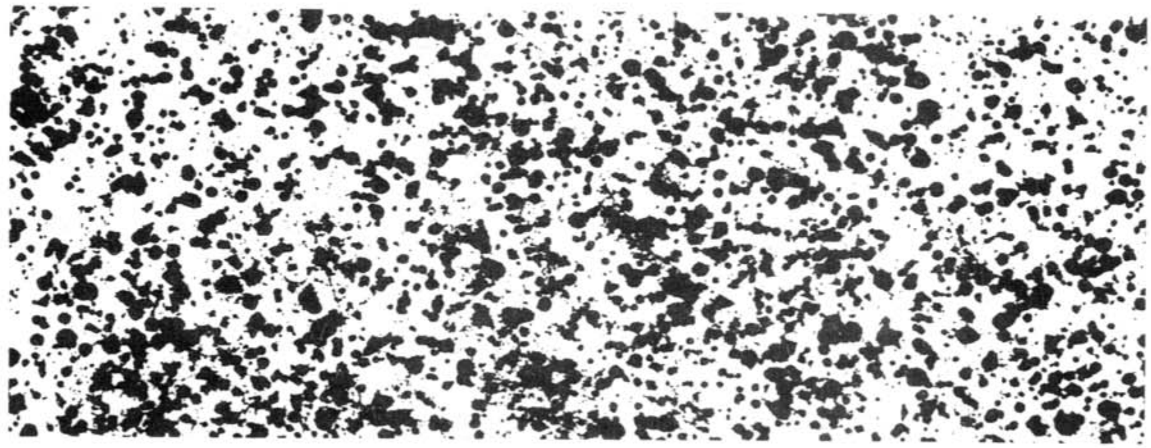
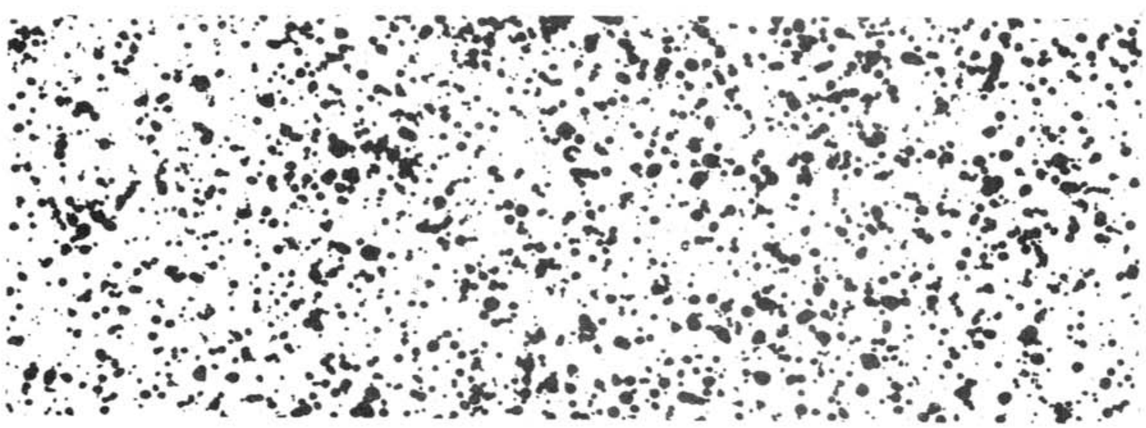


(7 pounds 2, 4-D in 4 gallons carrier per acre)

METHOD OF DETERMINING SPRAY DROPLET PATTERNS

The determination and recording of spray droplets per unit area and the uniformity of droplet distribution are interesting points to check when herbicides are applied in low volumes by aircraft. These determinations especially are essential when applications of herbicide are performed under contract in order to verify the adequacy of spray coverage in conformity with terms of the agreement for the spraying work. Information on spray droplet patterns also is essential in studies to determine the volume of herbicide and diluent which is the most effective but the least expensive.

When oil-base materials are used as the spray diluent, or when the commerical herbicide preparation has an oil base and is not further diluted with water, the number and distribution of spray droplets can be determined and recorded by the following method without using dyes or other chemical compounds.



(7 pounds 2, 4-D in 2 gallons carrier per acre)

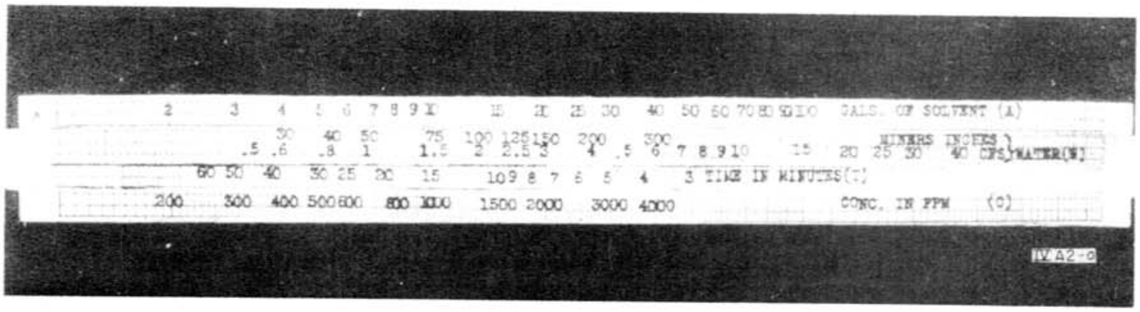
Sheets of bond paper or ribbons of good grade adding machine tape are placed on the ground throughout the area to be treated, or in case of a ditchbank the tapes are placed at right angles to the flight swath extending the full width of the rights-of-way. After the application has been made, the papers are marked as to location and treatment. When it is desired to study the droplet patterns, the papers are drawn through a pan of water which makes the oil spots translucent and easily seen. The oil spots do not show when the paper is dry. The spots will not disappear even after long periods of storage and the paper can be rewetted as often as desired to expose the patterns.

If a permanent record is desired, sections of the wet paper are placed on a black background and photostated or photographed as has been done to the illustrations which are shown on the foregoing page. This procedure was developed by personnel of the Bureau of Reclamation, Region 4, Salt Lake City, Utah.

SLIDE RULES FOR COMPUTING WEED PROBLEMS

Handy and inexpensive slide rules for rapidly calculating problems involving the use of 2, 4-D and aromatic solvent have been devised. The photographs on this and the following page show arrangements of scales made on 3-cycle semilog paper attached to inexpensive engineer's slide rules from which the regular scales have been removed.

<u>Slide Rule for calculating aromatic solvent application problems</u>



The gallons of solvent and the concentration in parts per million vary in direct proportion and these constants are put on the outside scales which are labeled A and C. The log paper should be pasted so that units 2, 3, etc. on the A scale are opposite to numbers 200, 300, etc., on the C scale. The time and water variables are placed on the inner movable scale. Both miner's inches and cubic feet per second are shown. In the illustration 50 miner's inches equal 1 cubic foot per second.

Any one of the following variables of chemical, cubic feet per second of water, time, or concentration, can be determined quickly if the other three are known or assumed. These variables can be determined from the following formulae:

$$\text{Gallons of chemical} = \frac{\overset{(1)}{450} \times \overset{(2)}{\text{cfs}} \times \overset{(3)}{\text{time}} \times \overset{(4)}{\text{ppm}}}{1,000,000}$$

$$\text{Cubic feet per second} = \frac{1,000,000 \times \text{gal. of chemical}}{450 \times \text{time} \times \text{ppm}}$$

$$\text{Time in minutes} = \frac{1,000,000 \times \text{gal. of chemical}}{450 \times \text{cfs} \times \text{ppm}}$$

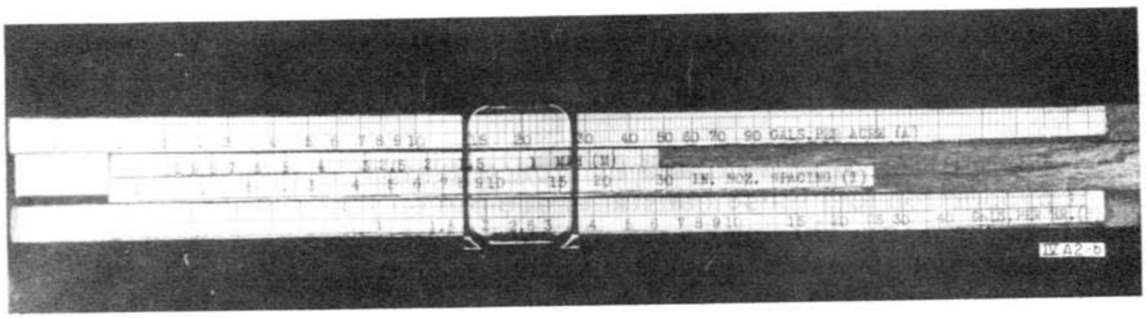
$$\text{Concentration (ppm)} = \frac{1,000,000 \times \text{gal. of chemical}}{450 \times \text{cfs} \times \text{time}}$$

(1) 450 is the number of gallons of water per minute in 1 cubic foot per second
(2) Cfs in cubic feet per second
(3) Time is in minutes
(4) Ppm is parts per million on a volume basis

For example to find gallons of aromatic solvent required for 400-parts-per-million concentration for 30 minutes in a 2 cubic feet per second ditch, set 30 on T scale over 400 on C scale. Move hairline to 2 on W scale and read A scale under hairline. The answer is approximately 10.8 gallons of chemical required.

This slide rule was developed by Agronomist Jesse M. Hodgson, Bureau of Plant Industry, Soils and Agricultural Engineering, Department of Agriculture, Bozeman, Montana, and construction details were outlined in detail in the April 1950, Reclamation Era. At least one commercial firm has followed these instructions to manufacture slide rules for computing aromatic solvent problems. The rules are distributed for advertising purposes and possibly may be obtained in your area.

Slide Rule for calculating 2, 4-D application problems



By using one of the following formulea and by making corresponding manipulations with the computer, problems involving gallons per acre, miles per hour, nozzle spacing, and gallons per hour can be determined provided three of the variables are known or assumed.

(1) $GPH = GPA \times .01 \times MPH \times inches$

(2) $GPA = \frac{GPH}{.01 \times MPH \times GPA}$

(3) $Inches = \frac{GPH}{.01 \times MPH \times GPA}$

(4) $MPH = \frac{GPH}{.01 \times GPA \times inches}$

When
GPH = gallons per hour per nozzle
GPA = gallons per acre
MPH = miles per hour
Inches = inches between nozzles

For example to determine the gallons applied per acre when one nozzle discharges 4 gallons per hour, with nozzles spacing of 12 inches, and the forward speed of the sprayer is 5 miles per hour, use formula (2).

Set 12 on I scale opposite 4 on H scale
Move hairline to 5 on M scale
Read A scale under hairline
Answer 6.7 gallons per acre.

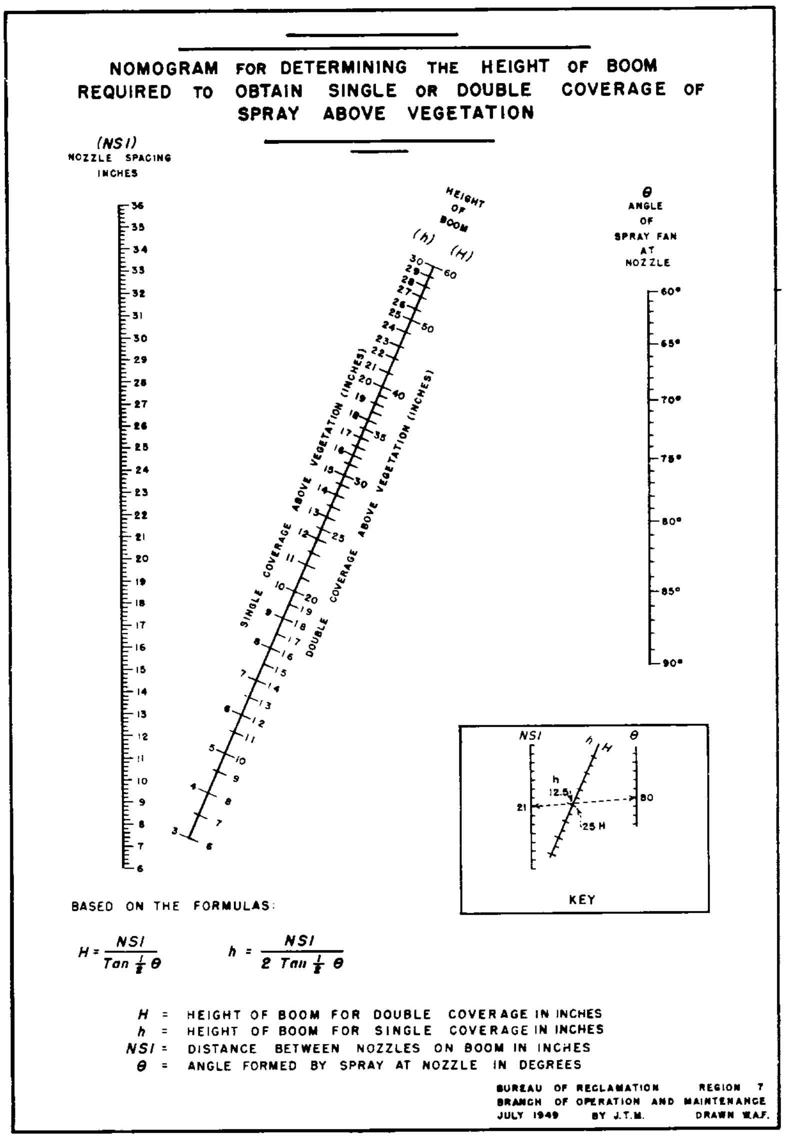
Similar computers can be made for calculating many other problems. For example, it is possible to construct the scales to show quantity of liquid or solid commercial formulations required for small experimental plots or lawns which will give a rate of application equivalent of a known number of pounds of chemical expressed on an acre basis.

This slide rule was developed by Agronomist L.S. Evans, Bureau of Plant Industry, Soils and Agricultural Engineering, Department of Agriculture, Beltsville, Maryland. Additional information regarding the rule can be obtained on request or by referring to the December 1948 issue of Reclamation Era.

SHORT CUTS TO WEED-KILLING CALCULATIONS

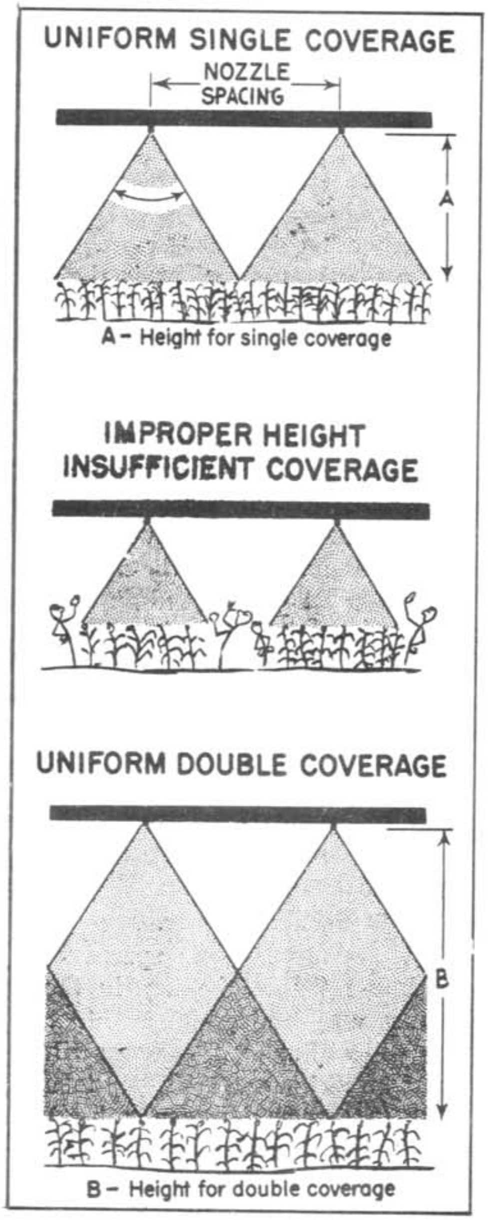
When spraying weeds good results can be obtained without wasting time and money if the spray equipment is calibrated and chemicals are properly mixed. The Handbook of Weed Control Calculations prepared by Mr. John Maletic, Region 7, Bureau of Reclamation, and the Reclamation Era series "Short Cuts to Weed Killing Calculations" published in the April 1951 through February 1952 issues will help with the calculations involved. Several of the nomograms which are included in the above-mentioned publications are being reproduced herein to illustrate how easily problems on application rates of herbicides and aromatic solvent, or problems pertaining to spray rig calibration, etc., can be solved.

Height of Boom for Proper Spray Coverage



How high the boom is raised above the tops of the weeds determines how effective the spraying operation will be. The nomogram on the left can be used to figure the height of the boom to attain the most effective spray coverage. To use the nomogram, the nozzle spacing on the boom and the angle that the nozzles deliver the spray must be known. For example, if the nozzles are spaced 21 inches apart and at the pressure being used, the spray is discharged at an 80^{o} angle, take a straight edge and connect the figure 21 on the left-hand scale (NSI) with the figure 80 on the right-hand scale as illustrated in the key at the corner of the nomogram. The answer will be found at the point where the rule crosses the center diagonal scale (small "h" for single coverage, capital "H" for double coverage.) In this example, you would set the boom 12-1/2 inches above the weeds to get single coverage, or 25 inches to obtain double coverage. The height of the boom for double coverage always is twice as much as for single coverage.

To figure the proper distance of the boom from the ground, simply measure the height of weed growth and add that to the answer obtained from the chart. For double coverage the nozzles should be staggered on alternate side of the boom or tilted so that the spray from one nozzle does not strike and deflect the spray from an adjacent nozzle.



Illustrative of proper spray height are the drawings to the left. The weeds in the upper illustration are being well covered, but those in the center are not and a poor kill of the weeds will result.

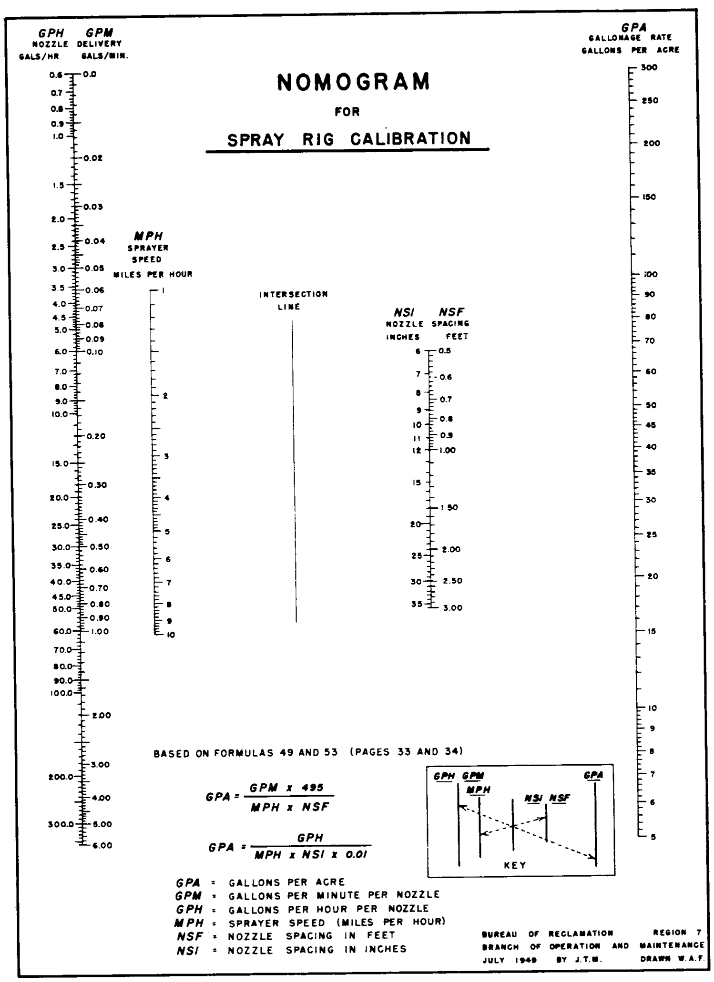
Plants in the lower illustration are receiving double spray coverage, yet the same volume of fluid per acre is being applied as for the other illustrations.

Spray-rig Calibration

To obtain good results with a spray rig it must be calibrated. The nomogram on this page can be used to help with this calculation.

A speed of 4 miles per hour is usually satisfactory for ditchbank spraying. This is shown as MPH on the nomogram. The quantity of spray solution that should be applied per acre appears on the GPA scale, and distance between nozzles on the rig in inches and in feet appears on the NSI scale or NSF scale. With this information the nomogram can be used by connecting a straight-edge with the known values as shown by the key to determine the gallons per minute that each nozzle should put out.

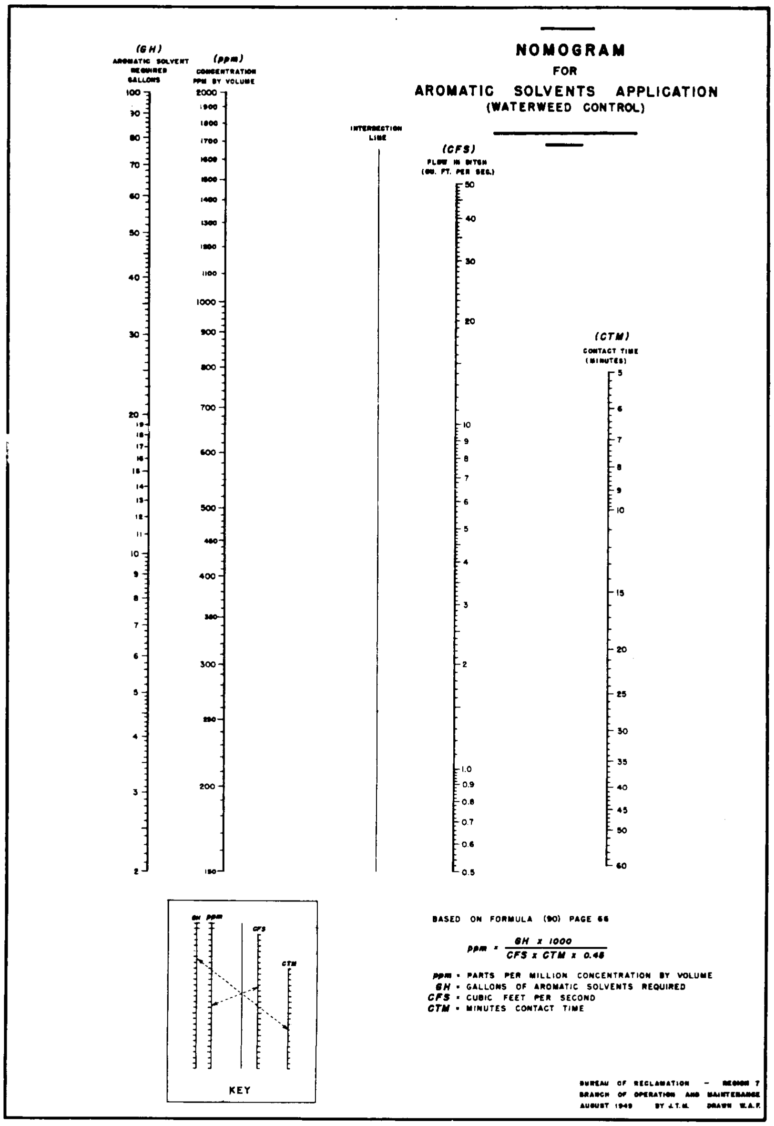
Now to determine if the nozzles are discharging the calculated amount, fill the tank with a few gallons of the spray solution that is being used. Adjust the operating pressure at the approximate value to deliver the necessary volume. While the rig is operating catch and measure the discharge from one nozzle during a timed period. If the measured discharge rate from the nozzle corresponds to what was previously calculated from the nomogram then the rig is calibrated. If the volume is less or more it then will be necessary to increase or decrease the pressure setting and repeat the nozzle discharge measurements until the desired rate is obtained. Calibrations of several nozzles at different locations along the boom is suggested.



Aromatic Solvent Application

The nomogram on this page can be used to quickly compute the amount of aromatic solvent required during the specified contact time to control waterweeds. The next step, as outlined on page IVA3-5 will be to calibrate the spray rig so that the discharge from each nozzle delivers the chemical into the water at the correct rate.

The key in the lower left-hand corner of the nomogram shows how to use this chart to determine the quantity of solvent necessary for waterweed control. For example, suppose you are making an aromatic solvent application into a lateral flowing 6 cubic feet per second. The recommended concentration to control this species of weed is to apply 400 parts per million of aromatic solvent for a 30-minute contact period. By connecting the 400 ppm with the 6 cfs and making the reference line, and then by connecting the point of the reference line with 30 minutes contact time, the answer of 32 gallons is shown on the left side.

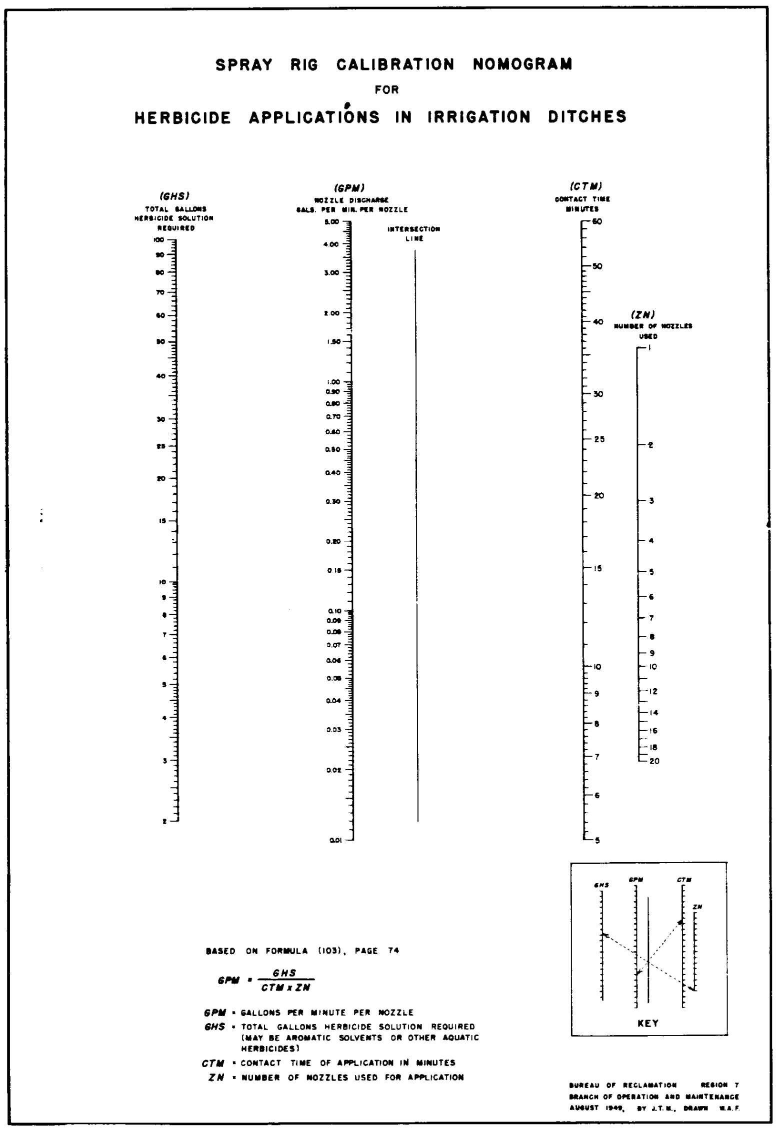


The CFS scale can be modified to read in miner's inches. It states where 50 miner's inches equal 1 cubic foot per second, insert 50 opposite 1 on the CFS scale and 100 opposite the 2 on the CFS scale, etc. Computation then is made in the described manner as as shown in the key.

Calibration of the Spray Rig in Applying Aromatic Solvent

Effective, economical use of aromatic solvents depends upon the accuracy of calibration. The nomogram on this page will assist you in rapidly and easily determining the nozzle discharge needed to apply aromatic solvents over the desired contact time. From the chart the discharge rate in gallons per minute required to build up the desired chemical concentration for one nozzle is shown. After obtaining this computed GPM, the pressure is adjusted on the rig or larger nozzled tips are substituted until the measured amount obtained in a timed interval from a single nozzle is approximately equal to the computed GPM.

For example to control pondweed a concentration of 400 ppm of aromatic solvent applied over a contact time of 30 minutes (CTM) is recommended. If a boom with seven nozzles is used (ZN) and the total amount of aromatic solvent needed is 32 gallons (GHS) it is shown from the nomogram that 0.15 gallons per minute for each nozzle is required.



When applying aromatic solvents, a booster shot of chemical frequently is needed about 2 miles downstream from the original application point. If the booster shot also is to be applied with a 7 nozzle (ZN) boom at a concentration of 300 ppm for a contact time of 30 minutes (CTM) it will require 24 gallons (GHS) of chemical. To determine the required nozzle discharge rate (GPM) connect the 24 GHS with 7 (ZN). Mark this point on the reference line. Then connect this point with 30 CTM. It is shown that 0.11 gallons per minute per nozzle will be required.

OUTPUT OF SPRAY RIGS
FOR
2, 4-D DITCHBANK SPRAYING

One of the major problems in ditchbank spraying is the development of a spray rig of a proper size to do the job economically. Output is the most important item affecting the cost per acre. Factors affecting the output may be listed as: (1) length of boom; (2) speed of rig; (3) rate per acre; (4) size of tank; (5) rate of refill; (6) time worked; and (7) efficiency. By knowing the value of the several factors, the output can be calculated for any spray rig.

There is given below a formula for computing the output and also a typical problem illustrating use of the formula.

The Problem: How many acres of ditchbank will a 300-gallon spray rig cover in an 8-hour day, traveling 4 miles per hour, if the width of spray pattern is 25 feet, the refiller pump has a capacity of 50 gpm and the application rate is 25 gallons per acre?

$$\text{Output} = \frac{TAE}{\frac{(A \times t)}{F} + R} = \frac{480 \times 12 \times 50\%}{\frac{(12 \times 60)}{12.12} + 16} = \frac{2880}{75.4} = 38.2 \text{ acres}$$

where, T = 8 hours (480 mins.) = Time worked in minutes

A = 300/25 = 12 acres = Number of acres covered by 1 tank load (Number acres = $\frac{\text{Tank Size in gals.}}{\text{Rate per acre}}$)

E = 50% maximum output = Use 50% maximum output unless the efficiency factor is known. (For crop land spraying and under excellent conditions for ditchbank spraying use 75% maximum output.)

F = 25/8.25 x 4 = 12.2 = Spray pattern factor expressed in acres per hour. It is the product of the width of the spray pattern expressed in acres per mile (1/8.25) multiplied by the speed of the rig in mph.

t = 60 = Minutes in one hour

R = 300/50 + 10 = 16 = Refill time in minutes plus 10 minutes. Refill time is calculated by dividing size of tank by capacity of refiller. The extra 10 minutes for refill is to account for extra work during the refilling operation.

The maximum width of spray pattern and/or rate of application per acre is directly affected by the capacity of the pump. A simple formula for calculating the pump capacity is:

$$\text{Pump Capacity in gpm} = \frac{\text{Spray pattern factor x rate per acre}}{\text{Minutes in one hour}}$$

A Problem: The pump capacity for the sample problem above would be:

$$\text{Spray discharge} = \frac{12.12 \times 25}{60} = 5.05 \text{ gpm}$$

where, Spray pattern factor = 12.12 acres per hour
Rate per acre = 25 gpa
Minutes in one hour = 60

Some discussion

Spray pattern factor values are shown in Table 1 attached. All figures shown are based on formula for calculating output for spray rigs.

Figures 1 through 6 show output curves of various size spray rigs. The charts clearly show that the output is greater at the lower rates per acre and that the gains are greater at the higher spray pattern factors.

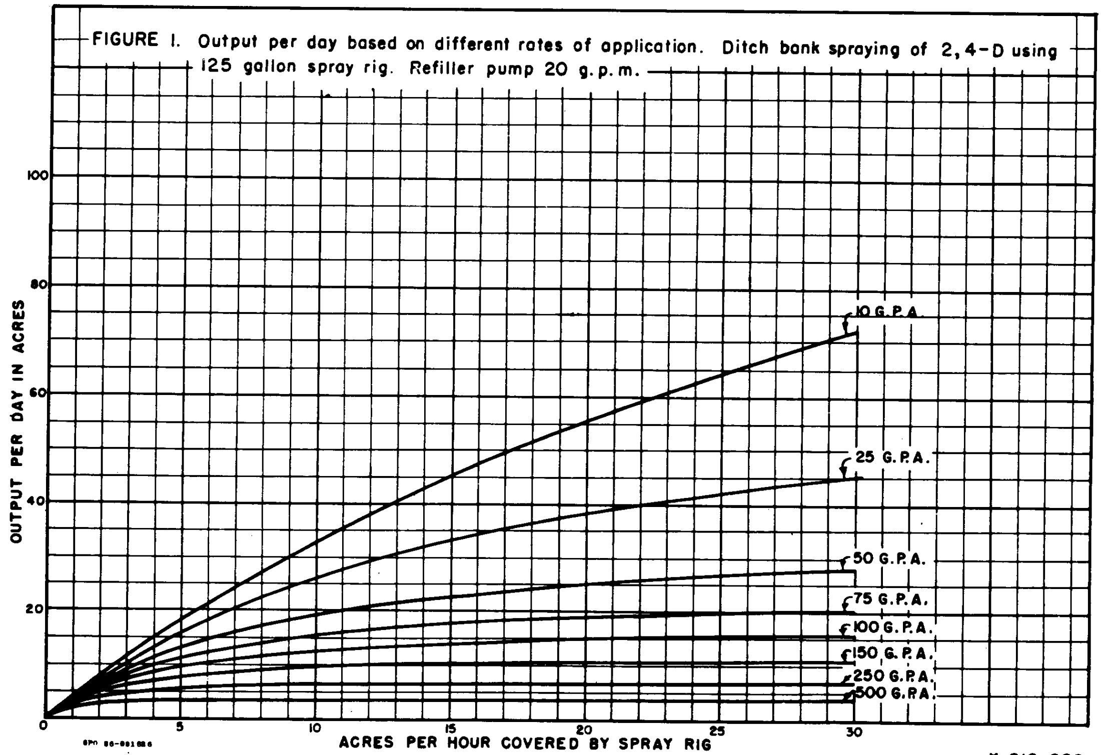
Figure 7 shows that at the lower spray pattern factors there is not much advantage in the larger spray rigs. As the factor increases, the larger rigs become more advantageous, but since the average value is about 10 or smaller the tank size can be limited from 300 to 500 gallons.

The greatest improvement that can be made in spray rigs to increase the output is by using a larger refiller pump. The output of a 100-gallon rig having a 50 gpm refilling pump is equivalent to a 500-gallon rig using a 10-gallon refilling pump. The smaller rig, however, will do the job at less cost because of the lower original and operating cost. Figure 8, shows that the output is increased by using the larger refiller pumps, and this increase is greater at the higher spray pattern factor values.

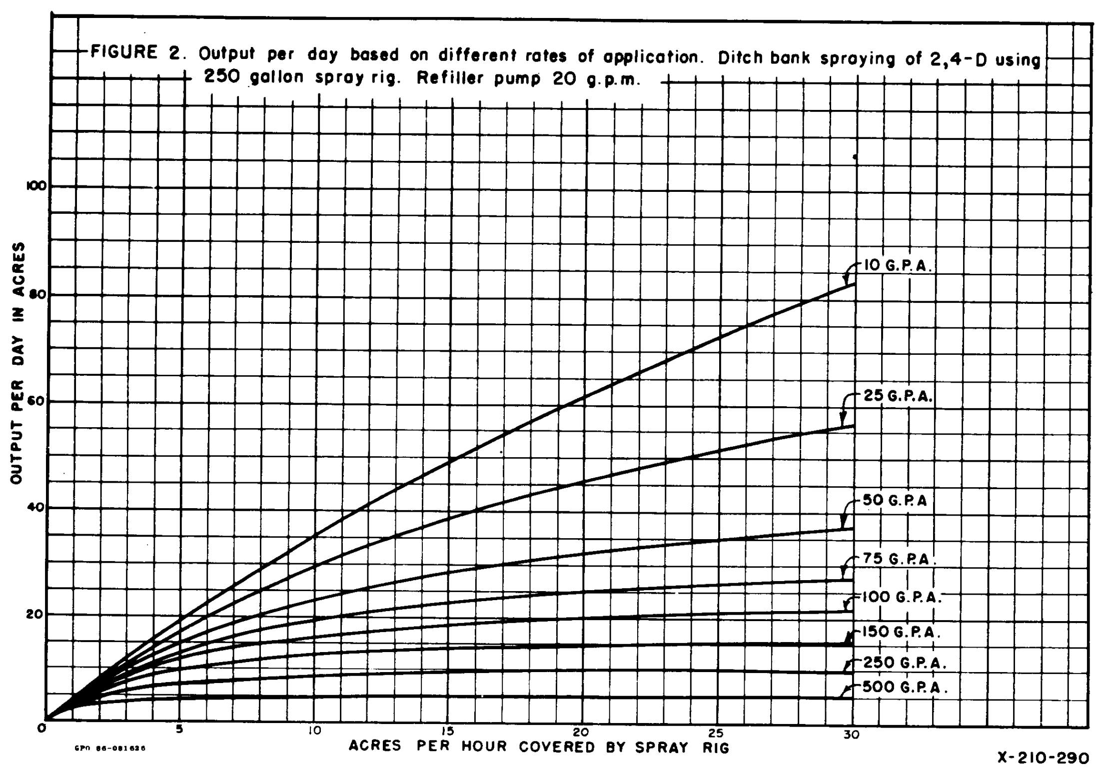
TABLE 1

Spray Pattern Factor Values Based on Different Widths and Speeds

Width of Spray Pattern		Spray Pattern Factor Acres per hour				Width of Spray Pattern		Spray Pattern Factor Acres per hour			
		Speed in Miles per Hr.						Speed in Miles per Hr.			
Feet	Acres Per Mi.	2	3	4	5	Feet	Acres Per Mi.	2	3	4	5
1	.12	.24	.4	.5	.6	26	3.16	6.3	9.5	12.6	15.8
2	.24	.5	.7	1.0	1.2	27	3.27	6.5	9.8	13.1	16.4
3	.36	.7	1.1	1.4	1.8	28	3.40	6.8	10.2	13.6	17.0
4	.46	1.0	1.5	2.0	2.5	29	3.52	7.0	10.5	14.1	17.6
5	.61	1.2	1.8	2.4	3.1	30	3.64	7.3	10.9	14.6	18.2
6	.73	1.5	2.2	2.9	3.7	31	3.76	7.5	11.3	15.0	18.7
7	.85	1.7	2.6	3.4	4.3	32	3.88	7.8	11.6	15.5	19.4
8	.97	1.9	2.9	3.9	4.9	33	4.00	8.0	12.0	16.0	20.0
9	1.09	2.2	3.3	4.4	5.5	34	4.13	8.3	12.4	16.5	20.7
10	1.21	2.4	3.6	4.8	6.1	35	4.25	8.5	12.8	17.0	21.3
11	1.34	2.7	4.0	5.4	6.7	36	4.37	8.7	13.1	17.5	21.9
12	1.46	2.9	4.4	5.8	7.3	37	4.49	9.0	13.5	18.0	22.5
13	1.58	3.2	4.7	6.3	7.9	38	4.61	9.2	13.8	18.4	23.1
14	1.70	3.4	5.1	6.8	8.5	39	4.73	9.5	14.2	18.9	23.7
15	1.82	3.6	5.5	7.3	9.1	40	4.85	9.7	14.6	19.4	24.3
16	1.94	3.9	5.8	7.8	9.7	41	4.97	9.9	14.9	19.9	24.9
17	2.06	4.1	6.2	8.2	10.3	42	5.09	10.2	15.3	20.4	25.5
18	2.18	4.4	6.5	8.7	10.9	43	5.22	10.4	15.7	20.9	26.1
19	2.31	4.6	6.9	9.2	11.6	44	5.34	10.7	16.0	21.4	26.7
20	2.43	4.9	7.3	9.7	12.2	45	5.46	10.9	16.4	21.8	27.3
21	2.55	5.1	7.6	10.2	12.8	46	5.58	11.2	16.7	22.3	27.9
22	2.67	5.3	8.0	10.7	13.4	47	5.70	11.4	17.1	22.8	28.5
23	2.79	5.6	8.4	11.2	14.0	48	5.82	11.6	17.5	23.3	29.1
24	2.91	5.8	8.7	11.6	14.6	49	5.95	11.9	17.9	23.8	29.8
25	3.03	6.1	9.1	12.1	15.2	50	6.07	12.1	18.2	24.3	30.4



X-210-289



X-210-290

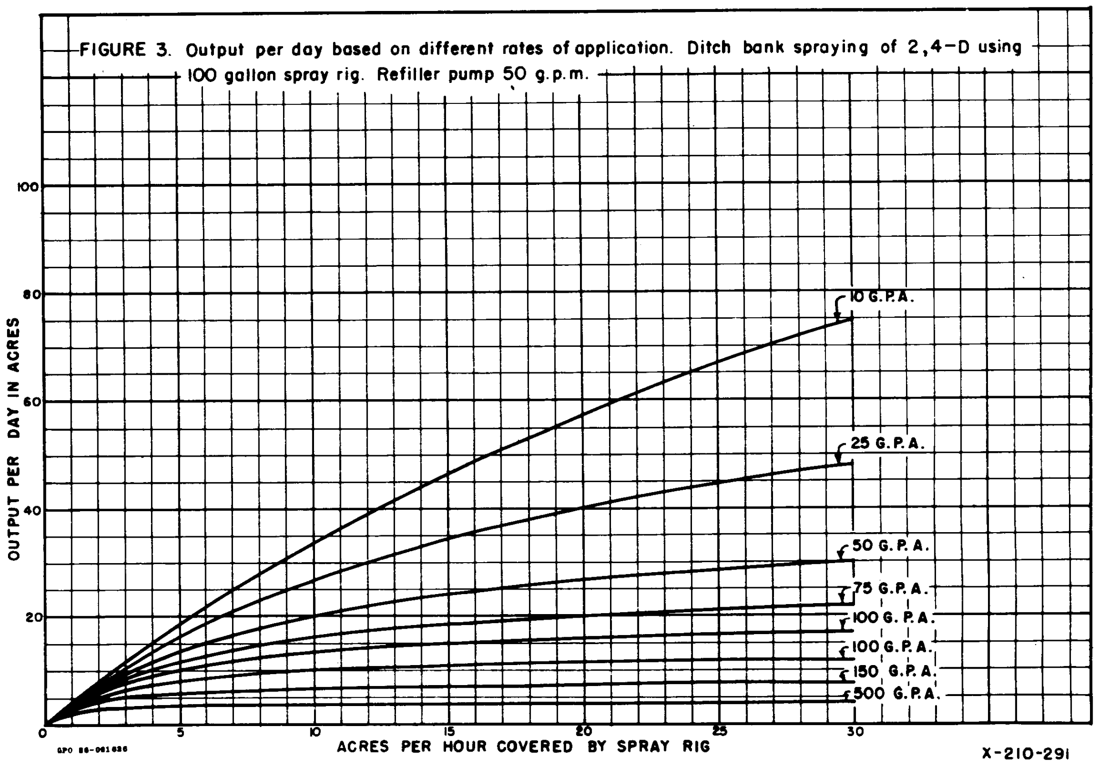


FIGURE 3. Output per day based on different rates of application. Ditch bank spraying of 2,4-D using 100 gallon spray rig. Refiller pump 50 g.p.m.
OUTPUT PER DAY IN ACRES
ACRES PER HOUR COVERED BY SPRAY RIG
10 G.P.A.
25 G.P.A.
50 G.P.A.
75 G.P.A.
100 G.P.A.
100 G.P.A.
150 G.P.A.
500 G.P.A.
X-210-291

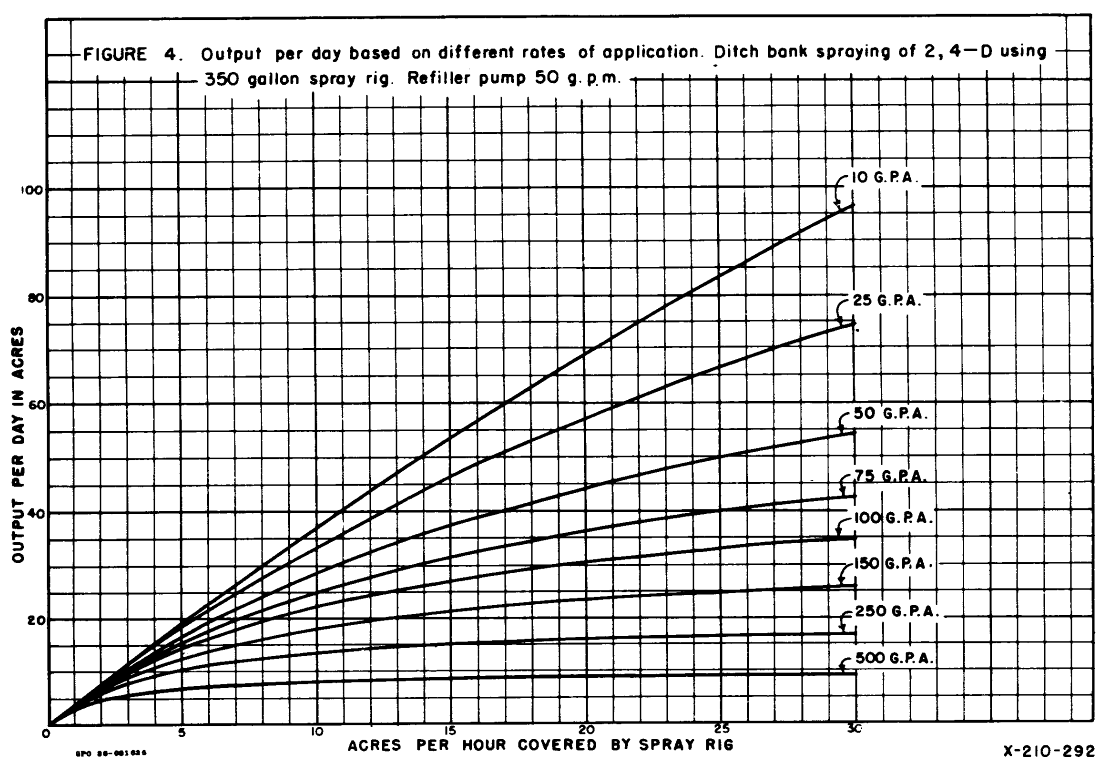
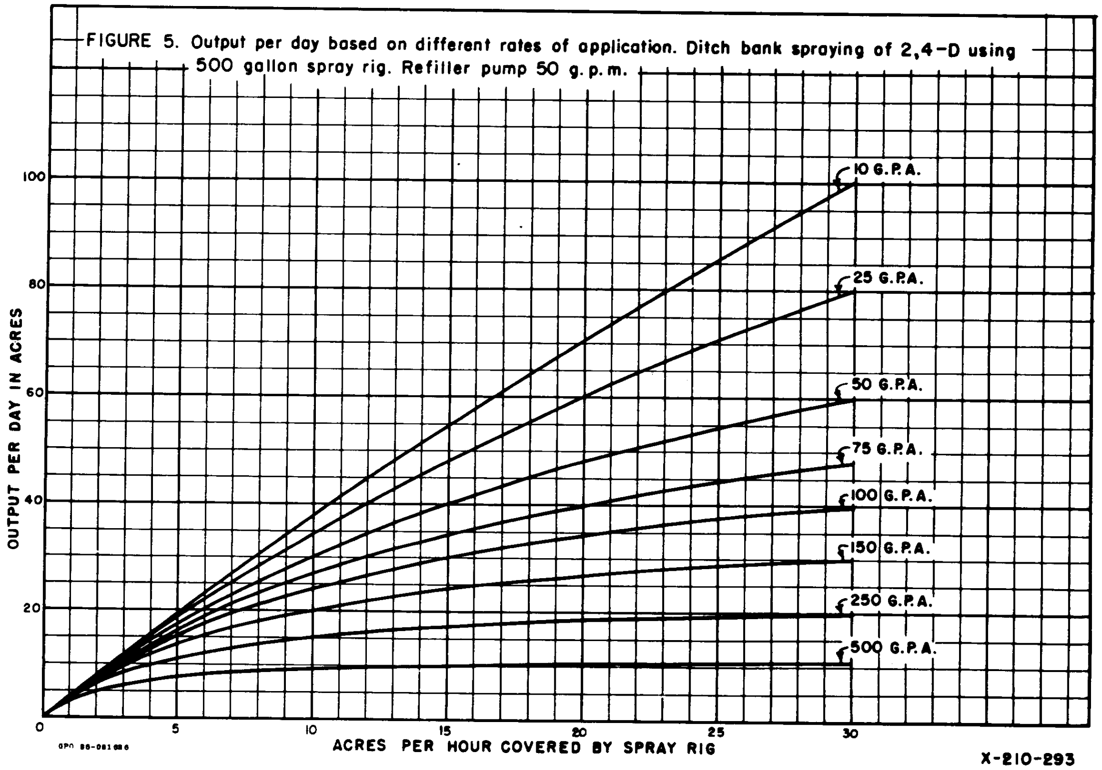


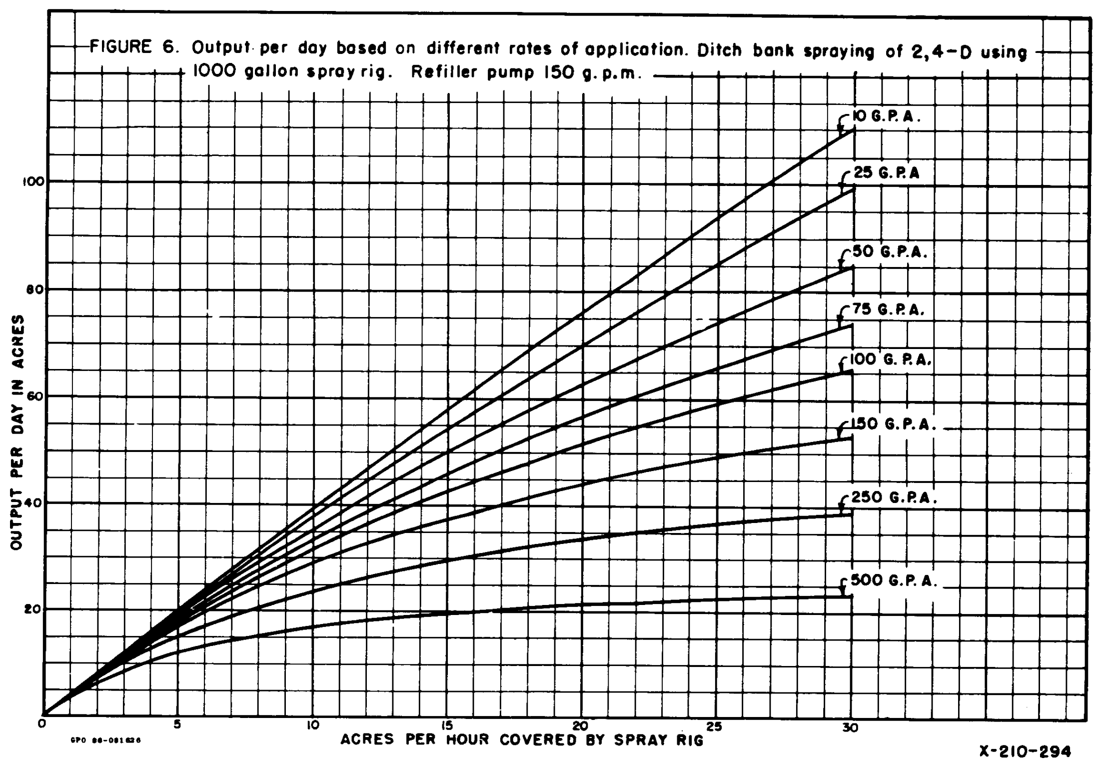
FIGURE 4. Output per day based on different rates of application. Ditch bank spraying of 2,4-D using 350 gallon spray rig. Refiller pump 50 g.p.m.
OUTPUT PER DAY IN ACRES
ACRES PER HOUR COVERED BY SPRAY RIG
10 G.P.A.
25 G.P.A.
50 G.P.A.
75 G.P.A.
100 G.P.A.
150 G.P.A.
250 G.P.A.
500 G.P.A.
X-210-292

FIGURE 5. Output per day based on different rates of application. Ditch bank spraying of 2,4-D using 500 gallon spray rig. Refiller pump 50 g.p.m.



X-210-293

FIGURE 6. Output per day based on different rates of application. Ditch bank spraying of 2,4-D using 1000 gallon spray rig. Refiller pump 150 g.p.m.



X-210-294

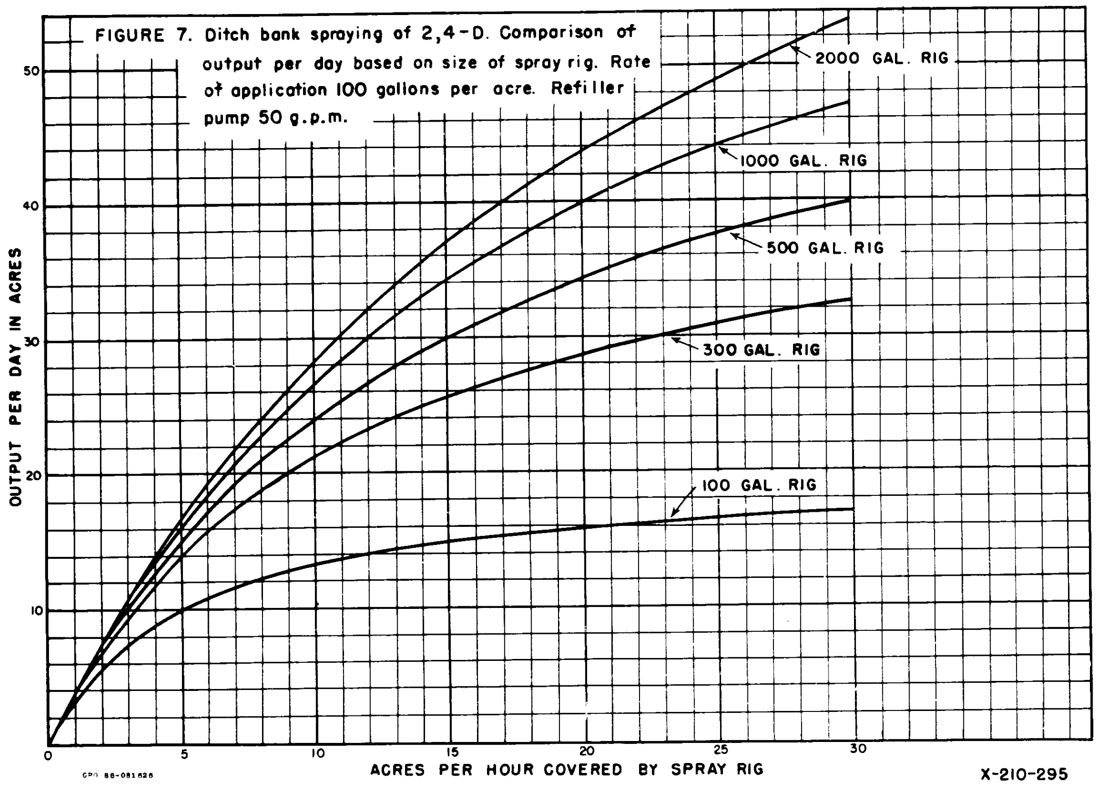


FIGURE 7. Ditch bank spraying of 2,4-D. Comparison of output per day based on size of spray rig. Rate of application 100 gallons per acre. Refiller pump 50 g.p.m.
2000 GAL. RIG
1000 GAL. RIG
500 GAL. RIG
300 GAL. RIG
100 GAL. RIG
OUTPUT PER DAY IN ACRES
ACRES PER HOUR COVERED BY SPRAY RIG
0
5
10
15
20
25
30
40
50
X-210-295

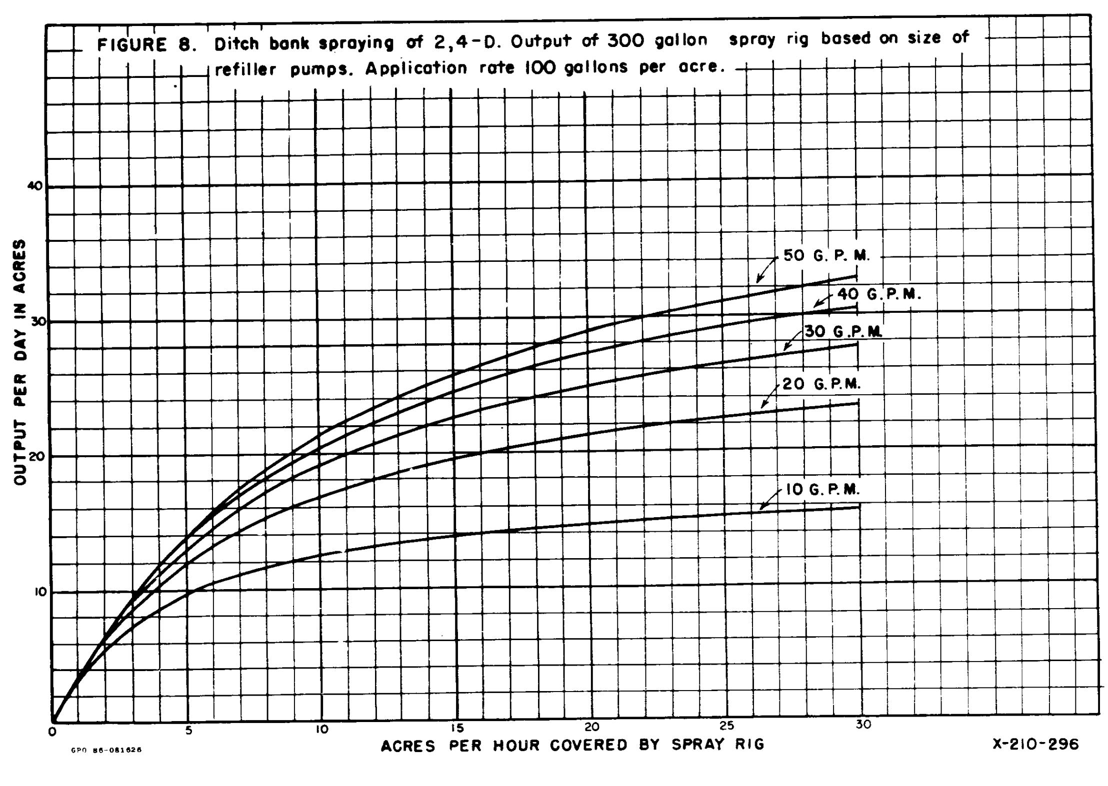


FIGURE 8. Ditch bank spraying of 2,4-D. Output of 300 gallon spray rig based on size of refiller pumps. Application rate 100 gallons per acre.
50 G. P. M.
40 G. P. M.
30 G. P. M.
20 G. P. M.
10 G. P. M.
OUTPUT PER DAY IN ACRES
ACRES PER HOUR COVERED BY SPRAY RIG
0
5
10
15
20
25
30
40
X-210-296

A METHOD FOR THE TESTING AND COMPARISON OF BRODJET SPRAYERS

by

Cady S. Corl, Agricultural Engineer
Hanson Chemical Equipment Co.,
Beloit, Wisconsin

A review of methods applicable to the testing of agricultural sprayers indicates that while individual nozzles of the flat spray and cone type have been tested by very satisfactory laboratory methods, (Ref: R. E. Larson, University of Minnesota, and G. L. Shanks, University of Manitoba) no satisfactory performance tests of multiple nozzle booms and/or Brodjet nozzles, either in the laboratory or field, have been reported or described heretofore.

In order to evaluate and compare Brodjet spray nozzles and assembled multiple nozzle boom sprayers, a test table of 1-1/4 inch corrugated aluminum sheets, 27 feet long and 16 feet wide was constructed. This was considered to be of sufficient length to obtain accurate data on one half of the spray swath width of the two-way Brodjet and the full width of most standard multiple nozzle sprayers.

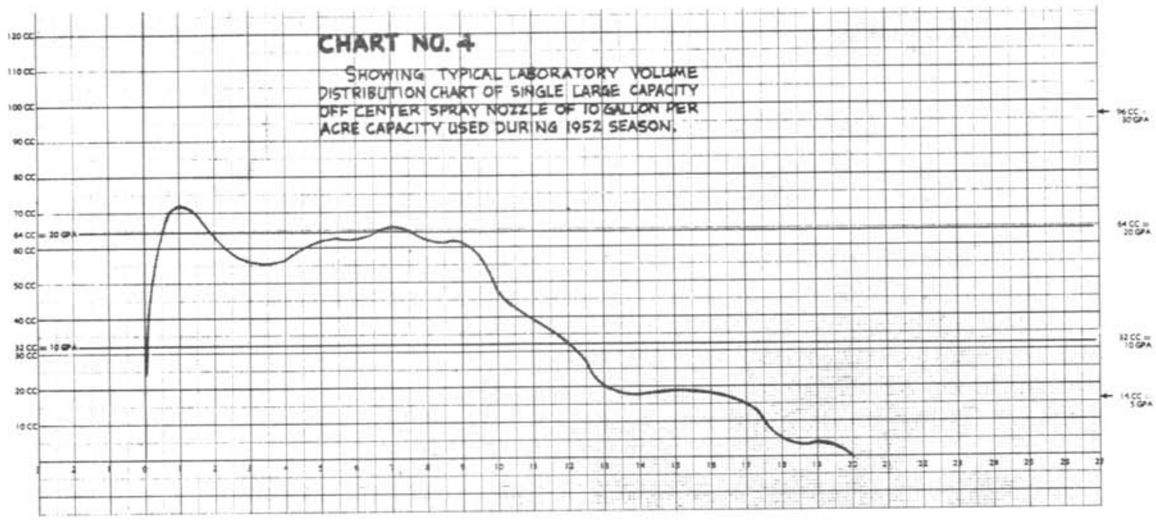
A pumping control stand connected to an electric motor and pump, consisting of a high pressure and low pressure standard gauge, pressure regulator and a meter, supply the necessary instruments. A stop watch and 100 cc graduated cylinders make up the balance of the equipment requirements.

The nozzle or nozzles under test are set at the specified height above the board. The pressure regulated (in all of our tests at 40 lbs.) the initial meter reading and the number of gallons per minute determined.

The run-off (for a period of one minute) from each 1-1/4-inch trough is measured in graduated cylinders. These volumes are the points on all of the charts involved in this study.

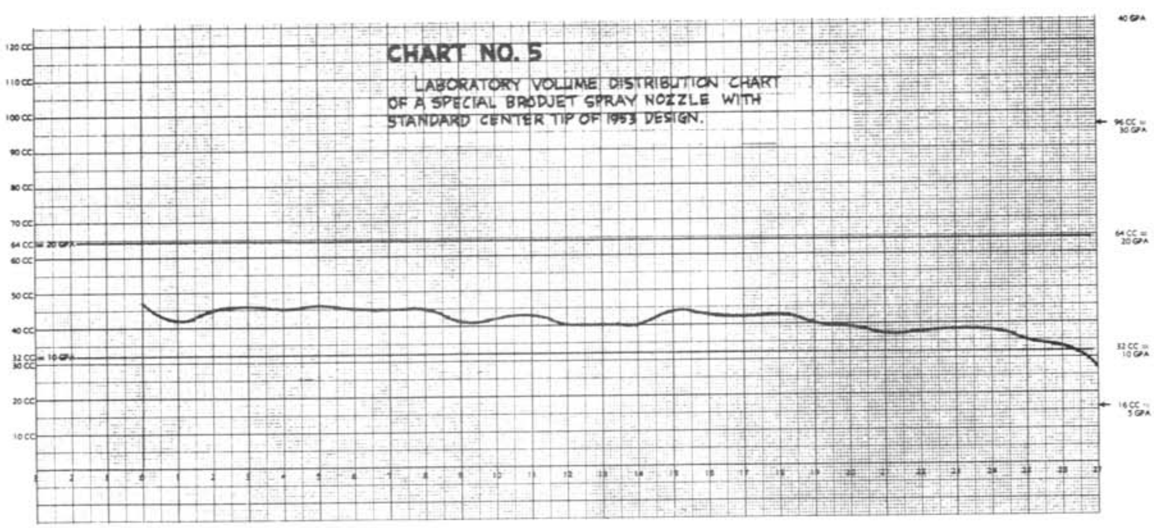
Calculations will show that 32 cc per 1-1/4-inch strip for one minute represent a spray volume of ten gallons per acre at four miles per hour.

The charts in this study are based on a standard condition of set-up, namely three feet above the crop, forty pounds pressure and a vertical position. Later, the height above the crop was established at 12 inches or less for horizontal spraying. The following slides are indicative of the results obtained using the equipment just described. Most all slides show 1/2 of entire swath.



A chart showing the laboratory performance of a single typical off center spray nozzle of 10 gallon per acre capacity, used during the 1952 season.

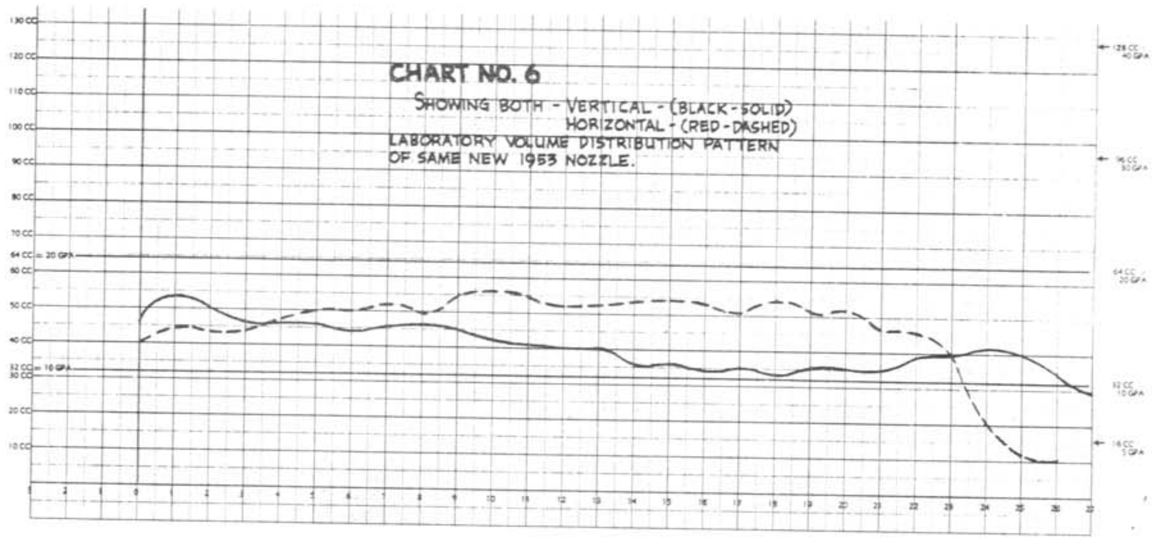
Any short coming (short swath and uneven distribution) of the 1952 off center sprayers were undoubtedly most noted in very sensitive crops and in the eradication of very resistant weeds. They performed with remarkable success generally for the more hardy crops and in the control of the less resistant weeds.



A laboratory performance chart of an improved special Brodjet spray nozzle, available since August, 1952.

In certain areas there has been an insistent demand for a sprayer that would minimize the effect of gusty, almost ever present, wind conditions.

It was found in our work that the new Brodjet nozzle could be used in a horizontal position from 2 inches to 12 inches above the crop with satisfactory distribution pattern over the entire swath, and with only a small reduction in the swath width, obtained in the normal vertical position of the sprayer. No other nozzle has been found to produce a satisfactory pattern in both the vertical and horizontal position.



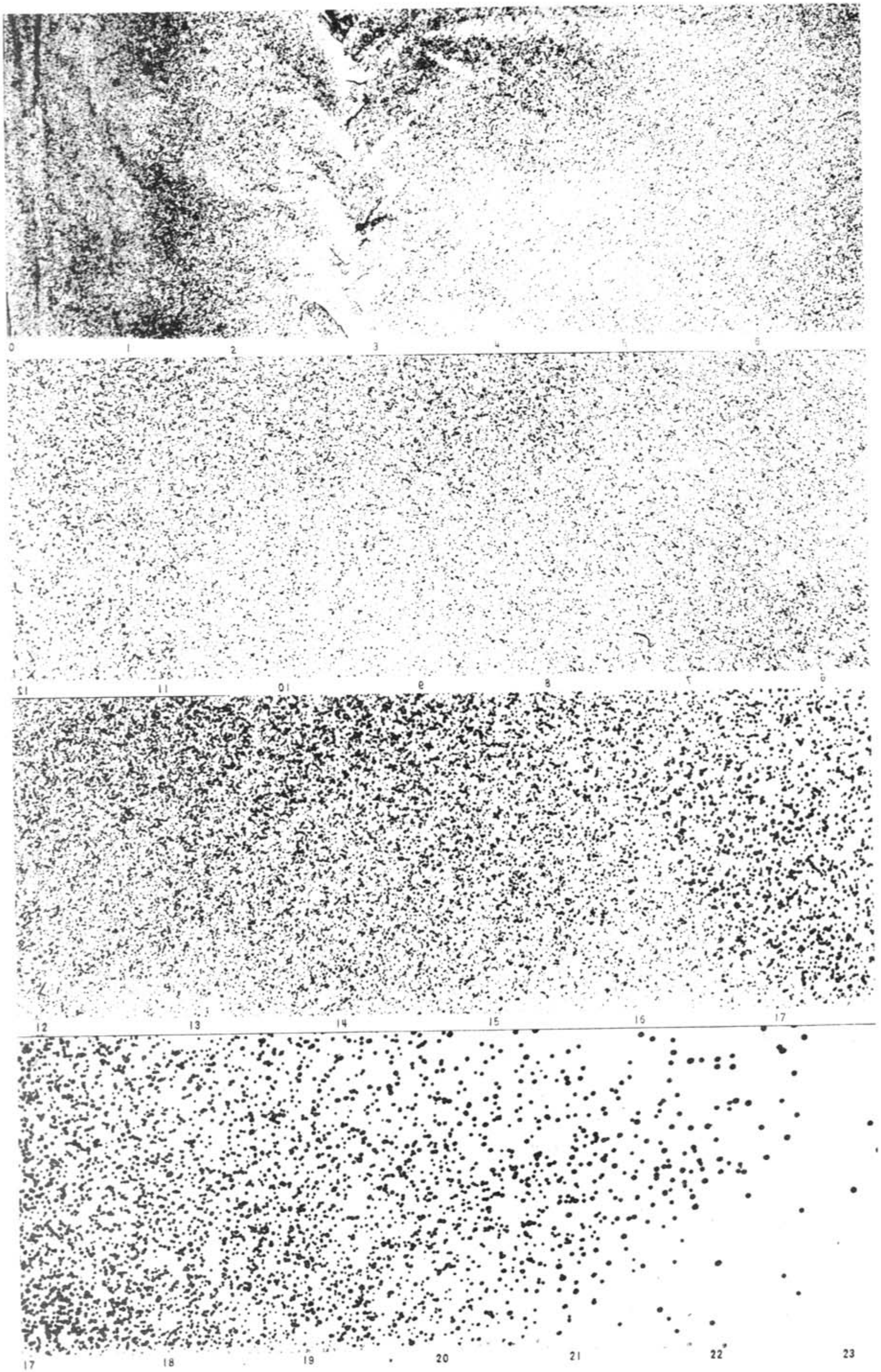
This chart shows the distribution pattern of the new Brodjet spray nozzle in both the vertical position at 36 inches above the crop and horizontal position at just above the crop. Both curves are at 40 lbs. pressure and 4 M.P.H. The dotted line indicates the distribution of the horizontal pattern.

Correlation of Laboratory and Field Performance

In order to correlate laboratory performance data with field performance, this same set of nozzles were mounted on a tractor in a standard manner and tests were made as follows:

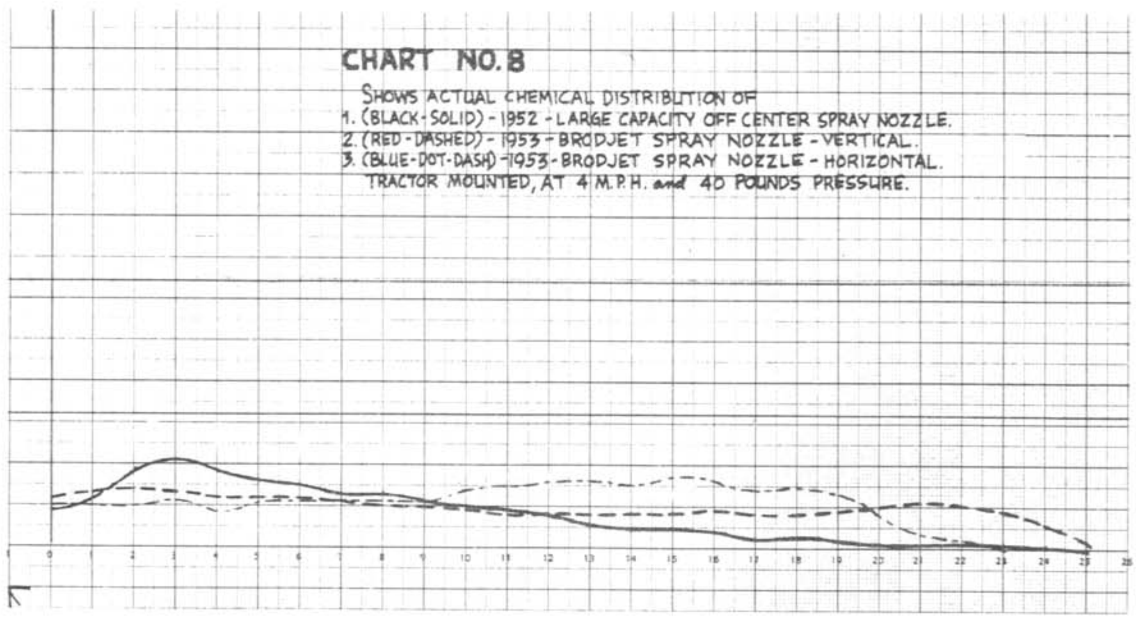
Conditions of Test:

1. Operation inside, without wind interference.
2. 36 inches above the crop for the vertical.
3. 12 inches above the crop for the horizontal.
4. 4 M.P.H. and 40 lbs. pressure.
5. Solution A;--a dye solution only, to show visually the spray swath and pattern.
6. Solution B;--a solution of Sodium Carbonate (Approx. 2# / gal.) to show actual chemical distribution.


0 1 2 3 4 5 6
12 11 10 9 8 7 6
12 13 14 15 16 17
17 18 19 20 21 22 23

Sheets of 36-inch white paper, about 30 feet long, were laid down perpendicular to the direction of the tractor, and with the sprayer properly adjusted as to height, pressure and throttle, and gear setting on the tractor adjusted to 4 M.P.H., the paper was sprayed with the dye solution "A." The general pattern noted and the maximum swath noted for both the vertical and the horizontal position are indicated in the slides, page IVA6-4.

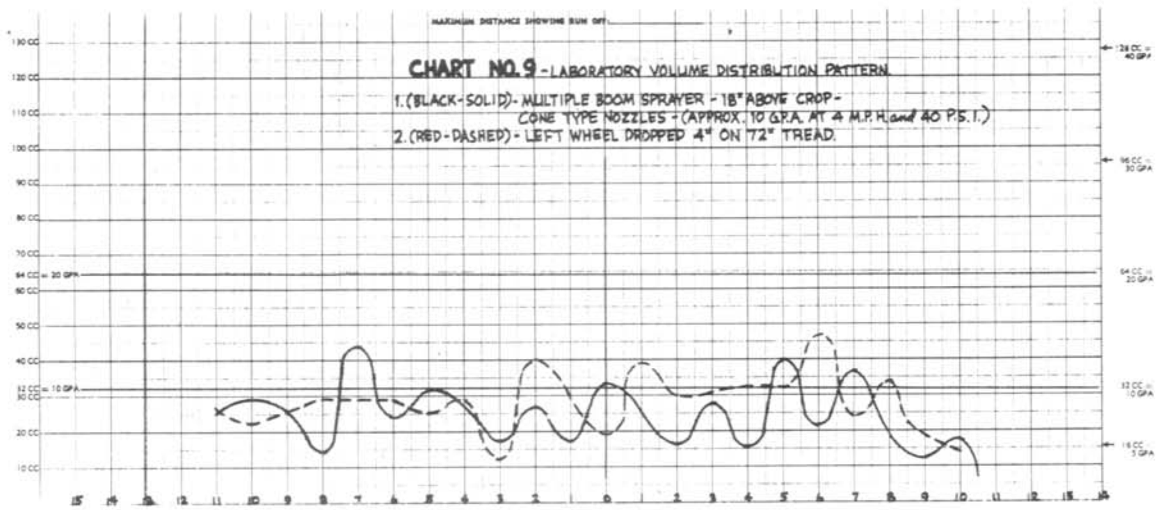
In general the larger drops fall to the far end of the spray pattern providing greater resistance to pattern distortion then the smaller drops which fall to the inside of the spray swath. It appears that the swath width has been reduced about 20 per cent at 4 M.P.H. over the maximum swath obtained in a standing position. This tractor operation was repeated, using the Sodium Carbonate solution "B" under the same conditions and the sheet of paper dried and carefully folded twice with the treated side inside. Two inch strips of this sprayed paper were carefully cut with a paper cutter at each one foot interval and digested in distilled water and titrated with N/10 Hydrochloric acid.



The three tests and resulting graph show the actual chemical distribution over the width of the swath and is indicated in slide No. 8, showing both the vertical and the horizontal application for the improved Brodjet and the vertical position graph for the old type off center nozzle (vertical). The horizontal pattern being indicated by the dotted line, and the vertical by a dot and dash.

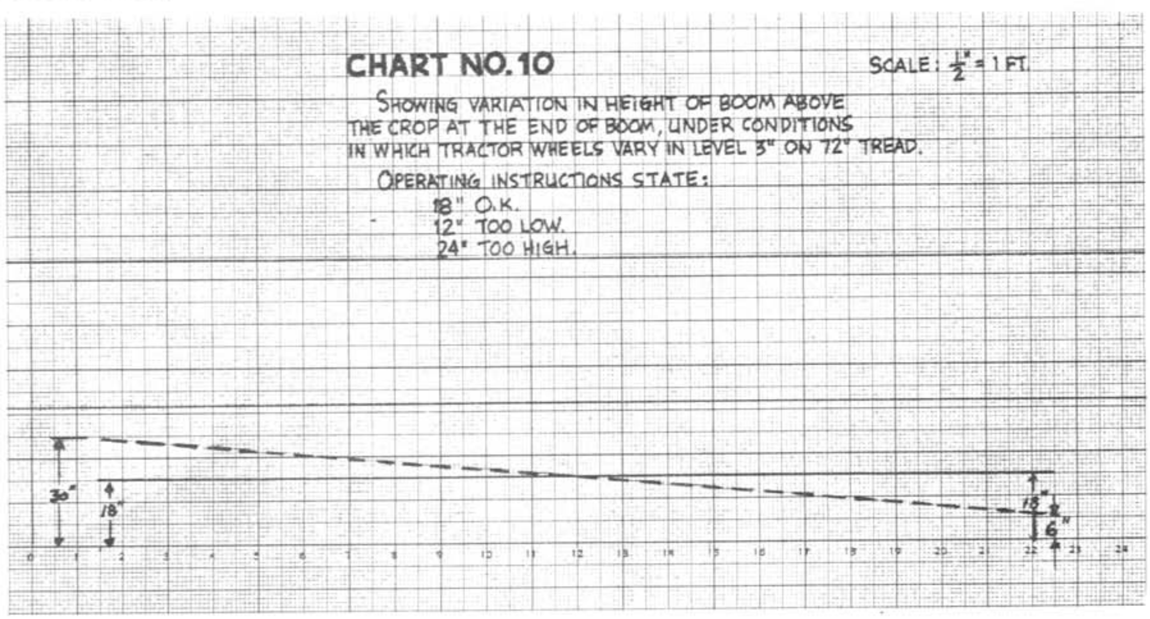
By comparison with tests made in the laboratory, or what could be called with no forward movement of the tractor, the swath at 4 M.P.H. has been reduced by about 20 per cent, resulting in an operating swath of about 45 feet in the vertical position and about 40 feet in the horizontal position. It is to be particularly noted in the graphs showing tests of actual chemical distribution that the pattern has been uniformly condensed by this amount and that the uniformity of the original swath has been maintained.

Proper evaluation and testing of any spraying method can only be accomplished by comparisons with other methods used for the same purpose. A search for laboratory tests and field operating data of multiple nozzle spraying methods was made and other than single nozzle tests, none were found. It was felt that inasmuch as the facilities were available, a comparative test of an entire multiple nozzle unit with currently used nozzles should be made. The following slides showing results obtained in testing a regular multiple nozzle boom sprayer using the test methods; show first, the unevenness of pattern under ideal conditions as specified in the operating direction.

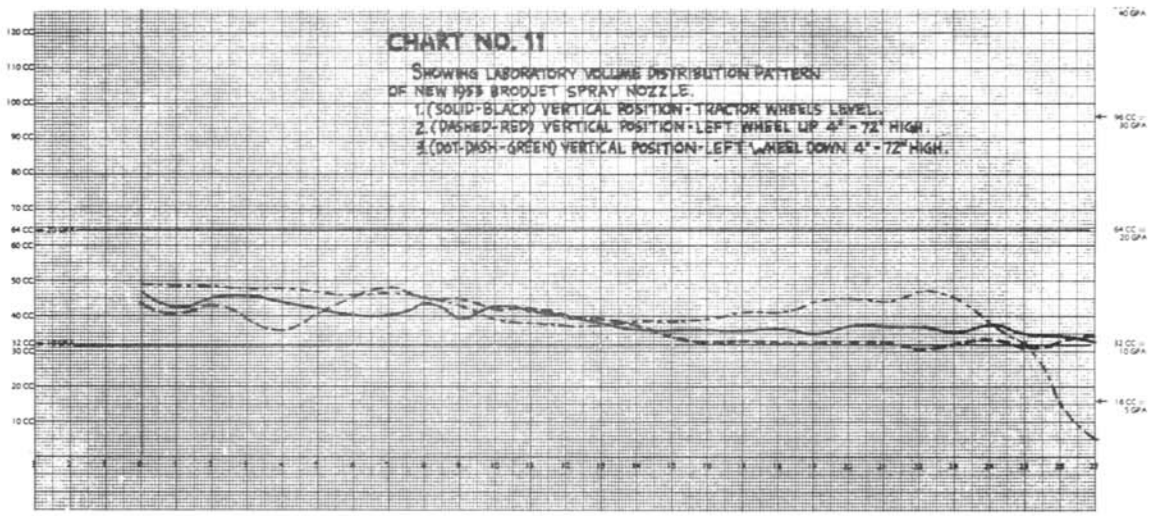


The solid black line shows the laboratory volume distribution pattern of a multiple nozzle boom, with cone nozzles approximately 10 G. P. A. set according to direction, 18 inches apart, at 18 inches above the crop and 40 lbs. pressure.

Then the resulting spray pattern which results when one tractor wheel is dropped 4 inches lower than the other on a 72-inch tread, is shown by the red dotted line.

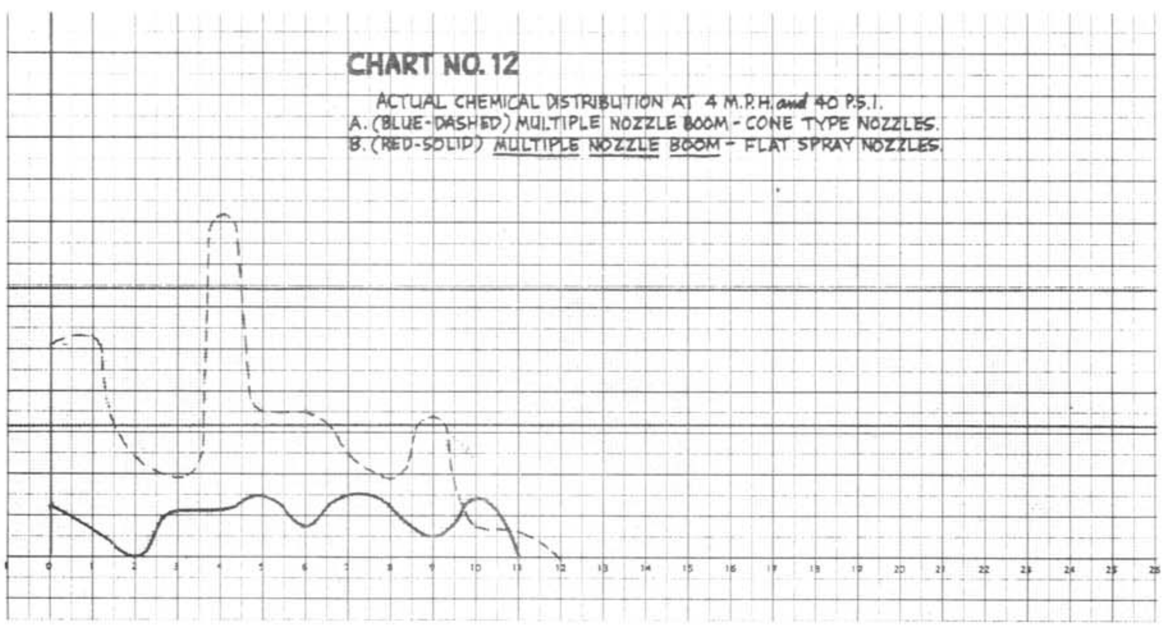


The actual position of the boom which results from dropping one wheel 4 inches from the horizontal, chart No. 10 results in an obvious condition, described in the instructions as too high on one end and too low on the other. The solid black line for the level condition, the dotted red line, the dropped wheel position.



A similar test with the Brodjet nozzle in which one tractor wheel is dropped 4 inches on a 72-inch tread shows only a slight difference in distribution from that obtained when the tractor wheels were level.

Solid black line--vertical position--wheels level.
Dotted red line--vertical position--left wheel up 4 inches--72-inch tread.
Dot and Dash green line--vertical position--left wheel down 4 inches--72-inch tread.



This slide, chart No. 12, shows the actual chemical distribution determined by chemical analysis as previously described for a multiple nozzle boom.

The dotted blue line--equipped with cone nozzles.
The solid red line--flat spray nozzles.

To Summarize

A method and the necessary equipment for laboratory and field testing of the Brodjet nozzle and the comparison with multiple nozzle boom sprayers has been described. A distribution pattern of certain off center nozzles available during the 1952 season has been reported. A substantially improved Brodjet nozzle has been tested in both the laboratory and under field operating conditions in both the vertical plane and horizontal plane operations.

It has been shown that this new Brodjet nozzle produces uniform distribution of chemicals in both the vertical and horizontal positions and that their use in the horizontal position will undoubtedly broaden to a great extent the ability to spray during continuous, gusty wind conditions heretofore considered impractical with all types of sprayers.

By comparison it has been shown, Chart No. 6, page IVA5-3 that the Brodjet nozzle produces a more uniform pattern than the conventional multiple nozzle boom, which apparently is subject to irregular and erratic distribution curves not previously appreciated. The new improved Brodjet nozzle is so designed that it can be used either in the vertical or horizontal position so as to produce considerably more uniform distribution of agricultural chemicals than has been heretofore possible. Continued research during the coming year will involve the thermal effect on spray patterns, droplet size and other factors.

TURBIDIMETER FOR ESTIMATING CONCENTRATION OF BENOCLOR 3-C

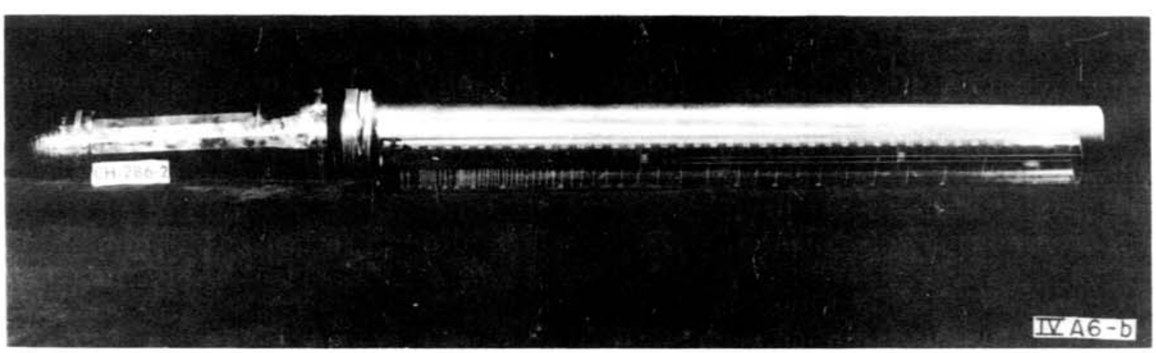
Benoclor 3-C is a mixture of chlorinated benezenes with added emulsifying agents used to suppress aquatic weed in irrigation systems. The general practice of determining the necessary quantity of Benoclor has been by observing intensity of the milky cloud in the ditch resulting from contact of the emulsifier and the water. Benoclor is absorbed by the plants and will settle to the bottom of the ditch thereby making it impossible to determine the exact concentration of chemical at any given location downstream of initial introduction point.

The turbidimetric method for estimating concentration of Benoclor 3-C was developed by Chemist John M. Shaw, Chemical Engineering Section, Bureau of Reclamation, Denver Federal Center, Denver, Colorado. The technique is explained in detail in Chemical Laboratory Report No. CH-89, Tests for the Estimation of Benoclor 3-C in Irrigation Water.

Construction Details:

A modified Jackson turbidimeter shown below may be fabricated in a shop according to the sketch on the following page. A standard two-cell flashlight is fitted with a brass cylinder 1-1/4 inches inside diameter and 18 inches in length into which is placed a flat-bottom glass tube graduated in centimeters.

The glass tube is placed in the brass casing and the flashlight turned on. The solution, containing a known amount of Benoclor 3-C mixed with water taken from the ditch to be treated, is poured slowly into the glass tube until the filament of the flashlight bulb barely is obscured from sight. The reading in centimeter is plotted on cross section paper against the known parts per million of Benoclor 3-C.



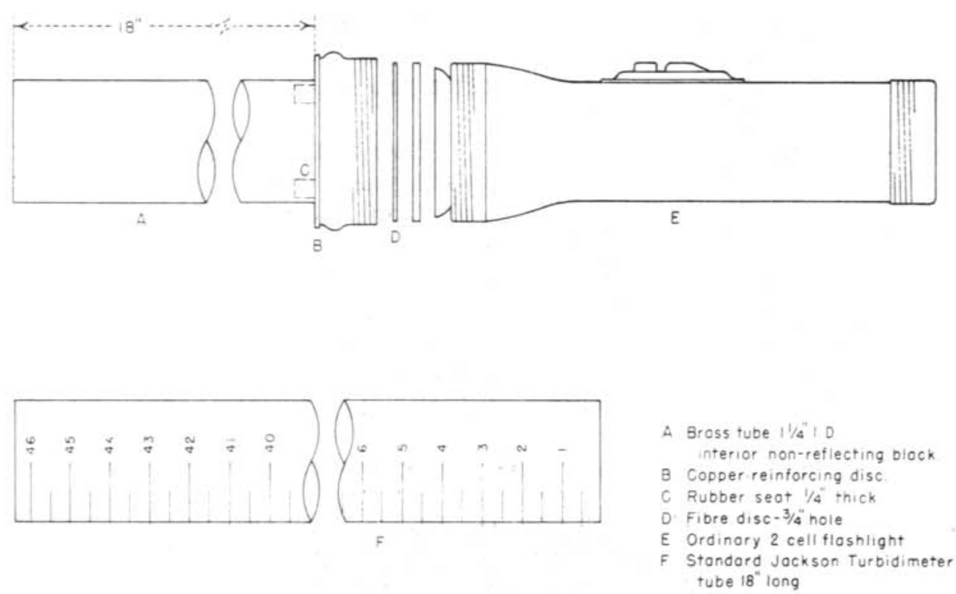
The procedure is repeated using concentrations from 90 to 300 parts per million and a curve similar to the one on page IVA6-3, is established.

Test Procedure

Samples are taken from the canal at various locations during the period of treatment with Benoclor 3-C, and the above procedure is followed to obtain the depth of solution required to obscure the light filament. By checking these readings again the curve previously plotted with known parts per million, the concentration of Benoclor 3-C being used in the canal to control the submerged weeds can be estimated.

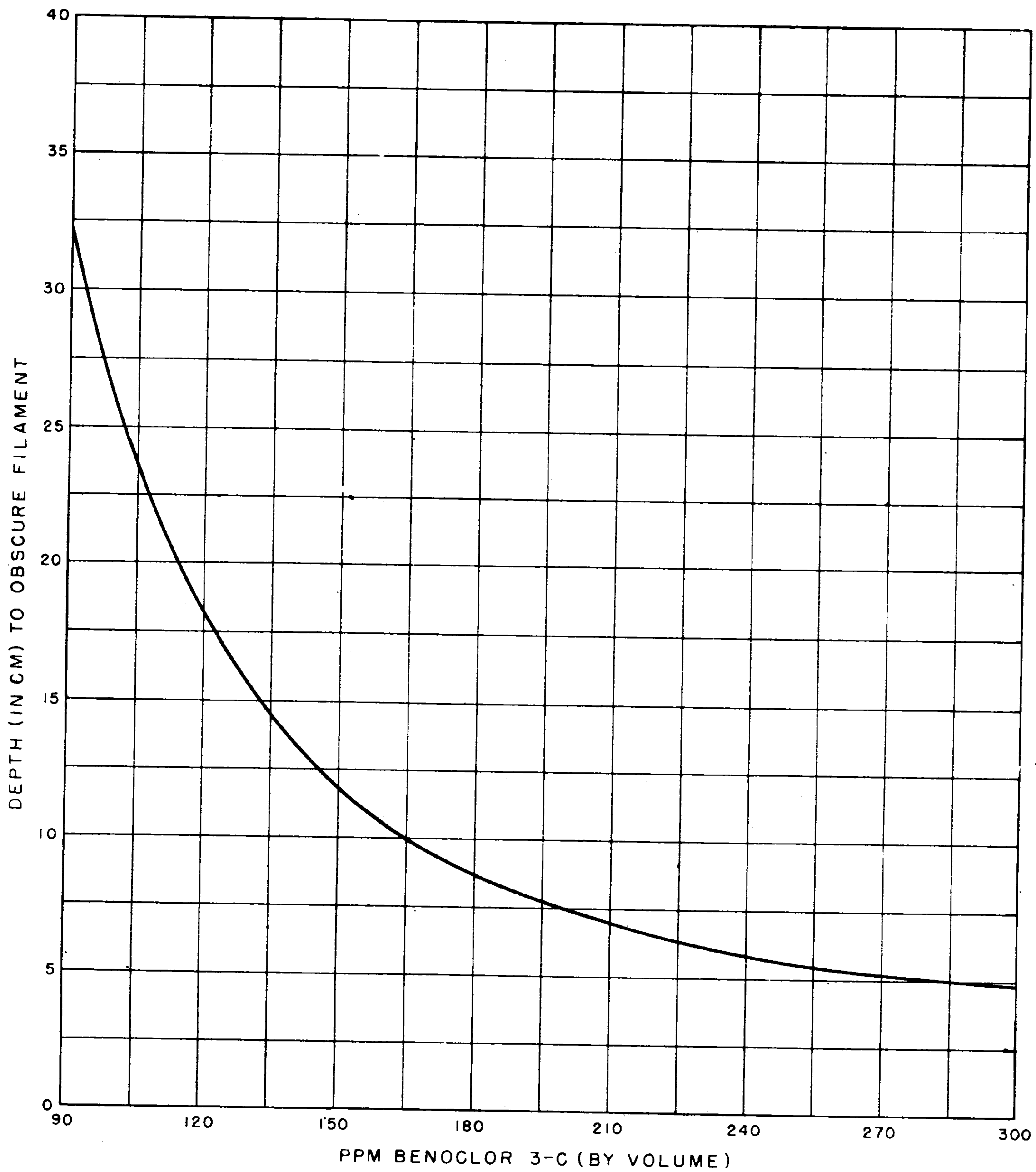
This estimation represents results in terms of parts per million of Benoclor 3-C by volume. To convert to parts per million by weight, multiply the results obtained by 1.45 which is the specific gravity of Benoclor 3-C.

This method of determination can be applied to aromatic solvents as well as to Benoclor in instances where the type of emulsifiers used produces a milky or white cloudy mixture when the material is thoroughly mixed with water.



MODIFIED JACKSON TURBIDIMETER

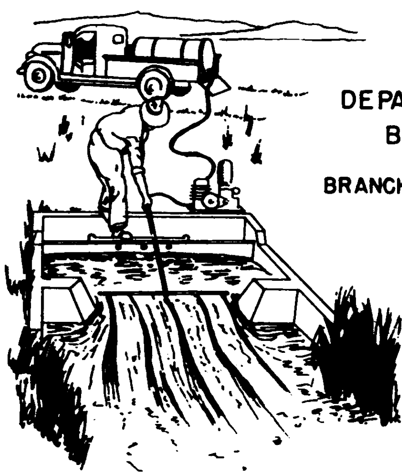
IVA6-c



STANDARDIZATION OF JACKSON TURBIDIMETER WITH BENOCLOR 3-C

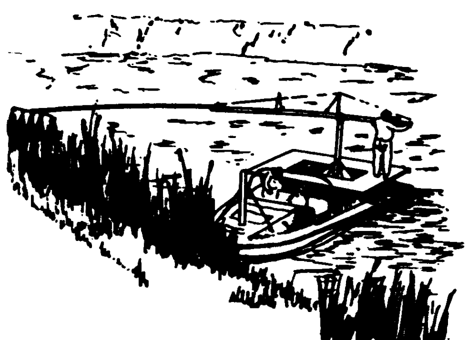
IVA6-d

ON LOAN.....
FREE OF CHARGE..
Borrower required to pay shipping charges both ways...



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

BRANCH OF OPERATION & MAINTENANCE



Announces

WEED CONTROL ON IRRIGATION SYSTEMS

A 16 mm. sound, color film of thirty-two minutes running time which is suitable for educational use or for showing to any group interested in irrigation project maintenance.-------

OBTAINABLE FROM THE FOLLOWING BUREAU OF RECLAMATION OFFICES:~

Commissioner, Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C.

Chief Engineer, Bureau of Reclamation, United States Department of the Interior, Denver Federal Center, Denver, Colorado

Regional Director, Region 1, Bureau of Reclamation, P. O. Box 937, Boise, Idaho

Regional Director, Region 2, Bureau of Reclamation, P. O. Box 2511, Sacramento, California

Regional Director, Region 3, Bureau of Reclamation, Administration Building, Boulder City, Nevada

Regional Director, Region 4, Bureau of Reclamation, P. O. Box 360, Salt Lake City, Utah

Regional Director, Region 5, Bureau of Reclamation, P. O. Box 1609, Amarillo, Texas

Regional Director, Region 6, Bureau of Reclamation, P. O. Box 2130, Billings, Montana

Regional Director, Region 7, Bureau of Reclamation, 318 New Customhouse, Denver 2, Colorado