California Vocational Agriculture Curriculum Guidelines Instructional Unit

CALIBRATION

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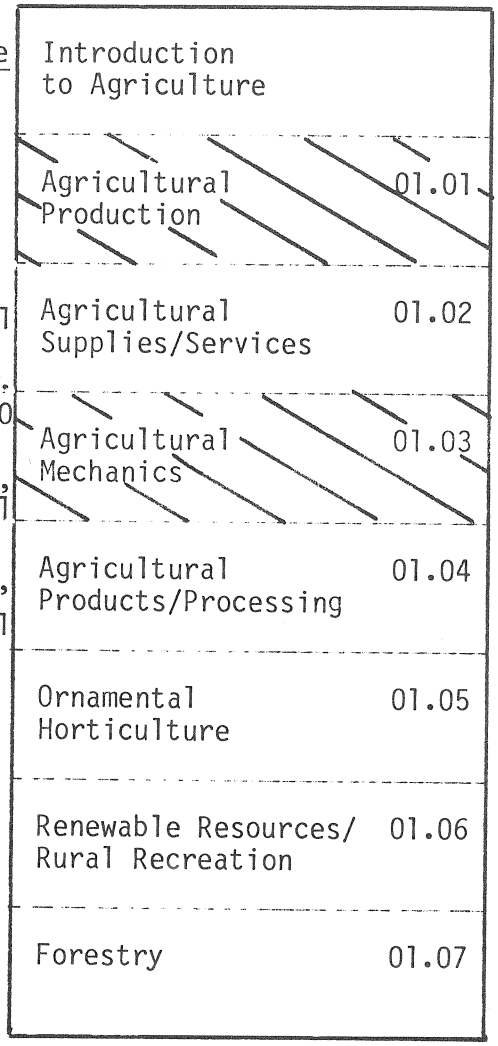


CALIBRATION

Unit Goal

The goal of this unit is to increase the students knowledge and skill in the mechanics of calibration of farm equipment.

Unit Objectives

Upon completion of this unit the student will be able to:

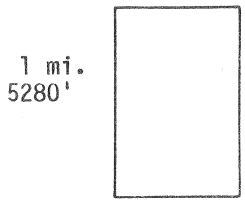
1. Field check the calibration of a fertilizer spreader or grain drill.
2. Calibrate a grain drill in the shop.
3. Calibrate a spray rig.
4. Field check the calibration of an aqua ammonia or NH_3 fertilizer rig.

Teaching Outline

I. Constants

A. In calibrating most equipment two factors you work with all of the time are speeds in mile per hour, and area of ground covered. These are a few aids that can make this more simple for the student.

1. If you have an implement 1 foot wide and travel a distance of 1 (one) mile then the implement covers 0.121 acres. This can be easily remembered and is used all of the time.



$$\frac{\text{width X length}}{\text{43560 sq. ft./A}} = \text{Acres}$$

$$\frac{1' \text{ X } 5280'}{43560} = 0.121 \text{ Acres}$$

2. In calibration you are working with distances covered in a given time -- most often miles per hour.

$$\frac{5280 \text{ ft.}}{60} = 88 \text{ ft./min.}$$

or

$$\frac{88 \text{ ft./min.}}{60} = 1.46 \text{ ft./sec.}$$

or

5280 ft./hr. or 60 minutes = 1 mph

1 mph same as 88 ft./min. same as 1.46 ft./sec.

B. Example: If you have a disc space 10 feet wide and the tractor pulling it is travelling 4 mph then how many acres/hour can be disced (figuring 100% field efficiency. To determine MPH speed of travel, mark off the distance covered by the tractor in one minute. The tractor travels 352 feet in one minute.

$$\frac{352 \text{ ft. distance/min.}}{88 \text{ ft./min.}} = 4 \text{ mph speed travel}$$
$$= 1 \text{ mph}$$

To determine area in acres covered:

.121 X 10' wide disc X 4 mph = 4.84 A/hr.

With any calibration the greater the area covered in the calibration the more accurate the calibration.

SUGGESTED LEARNING ACTIVITIES

SUGGESTED RESOURCE MATERIALS

II. Calibrating fertilizer spreader like Ex-flow or field calibration of a grain drill.

A. Set the units regulating lever as recommended by the chart in the seed hopper or manual. Always move the lever past the setting number and then back to the recommended number.

B. Fill the hopper with fertilizer to recognized level, (so you can fill it to the same level after your run).

C. Measure off a distance with the pickup being as accurate as possible, say 0.4 miles, or measure the distance with your calibrated pace or measuring wheel. Cover the measured distance with the implement, then determine how much fertilizer or seed you must add to the hopper to get it filled back up to the same degree of fullness you had at the start.

Example: 12 feet wide fertilizer spreader covers 0.4 miles. How much material should be added at the end of the run if the rate of application was 120 lbs./A?

12 ft. wide X 0.121 X 0.4 = 0.58 A X 120 lbs./A = 69.6 lbs. added to hopper.

D. The most accurate way to calibrate a drill is in the shop.

Precautions:

1. When you turn one wheel only 1/2 the openers are depositing seed (6 feet for a 12' drill).
2. Jack one wheel up but do not put the jack on the canvas you are using to collect seed.
3. Do not drop the openers on the canvas unless you need a canvas with 12 holes in it.
4. Determine the number of revolutions of the wheel required to lift the opener up. (It is depositing seed).
5. Calibrate for at least 1/4 acre. (About 120 revolutions).
6. There is no need to calibrate each opener unless you want to keep your students busy. It will also turn them off for calibrating.

Example:

You are using a 12' feet drill with a 12' circumference wheel, 90 lbs. of grain/A. The chart on the inside of the hopper recommends the levers be set at

SUGGESTED LEARNING ACTIVITIES	SUGGESTED RESOURCE MATERIALS
II. 1. Have students calibrate a grain drill in the shop.	1. Local farmer or equipment dealer.

II. D. #16.

6' width X 14' wheel X 120 revolutions = 10,080 sq. ft. ÷ 43,560 sq. ft./A = 0.23A. 0.23 Acres X 90 lbs/A = 20.7 lbs. (amount seed that should be dropped). Assume you only drop 19 lbs. then to figure your correction find the percentage correction. In this case only 19 lbs. of seed was dropped so you must increase the setting by:

$$\frac{20.7}{19} = 1.09 \text{ percentage increase}$$

1.09 percent X #16 original setting = #17 1/2

Which is the corrected setting. Recheck your calibration at this setting.

Note: Other factors that effect the calibration are being sure the adjustable lip on the back of the seed cup is in the correct position, use a stiff hitch on the tractor.

III. Calibrating Spray Rig

A. The following factors effect correct rate of application:

1. correct speed
2. nozzle orifice size
3. system pressure
4. correct amount of material added to the tank
5. height and spacing of the nozzles on the boom
6. density of the material (calibrating with the material that is being sprayed is necessary).

B. A typical nozzle for field spraying (the nozzle numbers describe its characteristics)

1. tee jet flat spray #6501
2. 65 is spray angle
3. 01 is orifice size

C. The spray angle influences the boom height. 65 degree angle 21" - 23" high with a 20" space between nozzles. The 01 refers to the orifice size.

D. When calibrating a field sprayer you need only calibrate for the output of one nozzle but use the average of several nozzles at different locations on the boom.

1. Example: Tank size width " X height " X length "

SUGGESTED LEARNING ACTIVITIES	SUGGESTED RESOURCE MATERIALS
III. 1. Hook up a spray boom to water supply and check output of nozzles at varying pressures.	1.

III. D. = cu in ÷ 231 cu in/gal.

= gals. capacity of the tank

2. Tank 48" high, 36" wide, and 60" long = 103,680 cu in ÷ 231 = 448 gal. capacity

3. Problem: You have the above sprayer 448 gallon tank, 30 gallons of water/A with 2 lbs. of spray material/A, 4 mph, nozzles 20" apart.

448 ÷ 30 = 14.9 Acres/Tank X 2 lbs. = 29.8 lbs. spray material/tank.

20" = 1.66'

1.66 width between nozzles X 0.121 A/mi. 1 ft. wide X 4 mph = 0.80 A/hr.

0.80 A/hr X 30 gal/A = 26.4 gal/hr.

26.4 ÷ 60 = 0.44 gpm/nozzle

E. With the above information the proper nozzle can be found in the nozzle book. For examples in the above situation we need 0.44 gpm/nozzles the book suggests nozzle #6504 and if we set the pressure at 40 psi at 4 mph you should get 30 gal/A.

F. Now you must check the output/nozzle for several nozzles and use the average. If the flow rate is 1 gal/min (or 60 sec.) then this is the same as 1 pt. should take 7.5 seconds to fill. 60 ÷ 8 = 7.5 sec./pt.

G. If it took 15 seconds to fill a pint then the flow rate is 1/2 gpm or if it took 3.75 seconds to fill a pint then the rate of flow is 2 gpm. (We use a pint, 2 cups, for collecting the material from the nozzle). If the material foams drain it like you would a beer. From the above we can now see:

$\frac{7.5}{\text{seconds to fill one pint}}$ = gpm

or from the above problem:

$\frac{7.5}{\text{sec/pt.}} = 0.44$ or $\frac{7.5}{0.44}$ = 17 seconds to fill a pint.

H. Now with the spray rig set correctly; collect the material and regulate the time (17 sec.) to fill a pint. If the time is too long/pint then increase the pressure but it is not directly proportional. (Double the pressure doesn't double the output).

IV. Aqua-Ammonia Applicator

A. The liquid or aqua ammonia applicator is calibrated the same way. Instead of

SUGGESTED LEARNING ACTIVITIES

SUGGESTED RESOURCE MATERIALS

IV. A. nozzles you have shanks to calibrate for the width between shanks. Speed in mph is not important in this case as the pump is ground driven by the applicator wheel. The pump is a variable output pump and by moving a cam you change the stroke length.

Aqua 7.56 lbs./gal. 20% N N/gal. = 1.51 lbs. N

B. Example: Shanks are 12" apart and the wheel has a paint mark on it to facilitate counting revolutions. Take a hose off of the shank and collect for 20 wheel revolutions. The wheel is 12' circumference.

Want 60 lbs. N/A

60 ÷ 1.5 = 40 gal. Aqua/A

1'
12"

20 rev.
×
12' cir.

1' X 20 rev. X 12' circum. = 240 sq. ft. ÷ 43560 =
.005 A X 40 gal./A = 0.22 gal. X 8 = 1.76 pts. collected.

V. NH_3 Applicator

A. NH_3 is a gas and we cannot collect it to calibrate so one figures the percentage used out of the tank in a given time.

NH_3 82% 5.15 lbs./gal. = 4.22 lbs. N/gal.

B. Problem: A 20' wide applicator with a 500 gallon tank travels 282' in a minute. You set up a gauge similar to oxygen gauge for the above rate of application but we calibrate to check this, (want 130 lbs. N per acre).

Speed 282' ÷ 88 = 3.2 mph

0.121 X 20' wide X 3.2 mph = 7.74 A/hr.

$$\frac{7.74 \text{ Acres X } 130 \text{ lbs. N}}{4.22 \text{ lbs. N/gal.}} = 238 \text{ gal./hr.}$$

10 minutes = 1/6 hr. X 238 = 39.6 gal. in 10 min.

500 gallon tank each 5 gallons represents 1 percent

39.6 gallon 10 min. ÷ 5 = 7.92% used in 10 minutes from the tank at the end of a ten minute run the operator checks the percentage full gauge to see how much material he has used out of the tank.

The tank can only be 85% full when it has maximum load so if he started with 85% then at the end of 10 minutes the gauge should read 85-8 or 77% full.

SUGGESTED LEARNING ACTIVITIES	SUGGESTED RESOURCE MATERIALS
IV. 1. Field trip to see application in use (and field check if possible).	1. Local farmer.

Student Evaluation

Practice Problem:

Spraying to control weeds in a grain field. A sprayer has the following: 250 gallon tank -- 30' wide boom -- nozzles spaced 20" apart -- speed of travel 370 ft./min. -- mechanical agitation -- pump 85% efficient -- minimum amount of liquid by-passed is 0.56 pm. You want to apply 3/4 lbs. of material/acre with 30 gallons of water/acre.

1. How much spray material is added/tank load?

2. What is the speed of travel in mph?

3. What is the outputin gpm/nozzle?

4. How many seconds to fill a pint jar at the above flow?

5. When in the field you travel a distance of 40' with the sprayer, how much would be used out of the tank?

General References

Spraying Systems, Nozzle Catalog.

Tee Jet, Nozzle Catalog.

Harang Engineering Co. Bulletins

For Plate Planter Calibration, see Production Crops.

Manuals for Planters.