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1980

## G80-500 Ecofarming: Selection of Tractor Mounted or Pull-Type Sprayers

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Klocke, Norman L.; Wicks, G. A.; and Fenster, R., "G80-500 Ecofarming: Selection of Tractor Mounted or Pull-Type Sprayers" (1980). *Historical Materials from University of Nebraska-Lincoln Extension*. 1233.  
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# Ecofarming

## Selection of Tractor Mounted or Pull-Type Sprayers

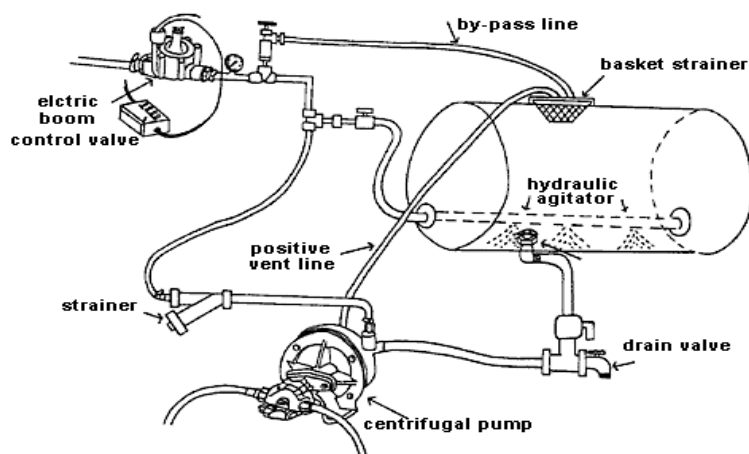
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Uniform application of dependable herbicides in the ecofarming program is a key to its success. A good sprayer is needed to accomplish this, and not every new sprayer available will do the job. The following sprayer components should be checked carefully: pump, tank, tank agitation, flow-control assembly, strainers and screens, distribution system (including boom), and nozzles. Each of the components is important if the sprayer is to do an accurate and uniform job of application (*Figure 1*).



**Figure 1.** Circuit diagram of a sprayer using a centrifugal pump.

## Pumps

Centrifugal, turbine, roller, piston, gear and diaphragm pumps are available for applying spray solutions.

Centrifugal or turbine pumps are best suited for applying herbicides needed in ecofarming or reduced tillage systems because of their durability, simplicity, and ability to handle abrasive materials, such as atrazine. They have sufficient capacity to supply the nozzles plus agitation. Centrifugal pumps should run between 3,000 to 4,500 rpm, so a speed step-up gear is needed if the pump is to be operated by the tractor power take-off. Turbine pumps generally operate at 1,100 rpm and can be mounted directly to the power take-off shaft. Centrifugal and turbine pumps can also be run by a hydraulic motor. An external bypass kit may be needed to reduce heat buildup in tractors with open center hydraulic systems and oil flow of 18 to 24 gpm. Check the operator's manual for the tractor and the manufacturer's instructions for installation and operation.

Pumps should supply the volume required by the nozzles, plus the volume required by the tank agitators, plus an additional capacity of 10 to 20 percent.

## Tanks

Sprayer tanks should be easy to fill and clean, be corrosive resistant, have a shape suitable for mounting and effective agitation, and have adequate openings for pump and agitation connections. Side tractor mounted tanks generally have a capacity of 100 to 200 gallons, and 3-point hitch tanks that of 100 to 300 gallons. Pull type sprayers can have a larger capacity. Baffles are needed in the large tanks for safety purposes. However, they do present problems for cleaning and agitation. Tandem axles will help eliminate some boom bouncing. Determine the size of tank required by the number of acres you can efficiently spray (*Table I*), and the size of the tractor available. The tractor may be tied up for days or weeks depending upon acreage and weather conditions, so select equipment that can be easily removed and cleaned. The tractor should be large enough that speed can be increased to decrease herbicide rate where needed in the field.

**Table I. Acres/hour sprayed, assuming no down time.<sup>1</sup>**

Boom width	Miles/hour				
feet	4	5	6	7	8
15	7.3	9.1	10.9	12.7	14.5
20	9.7	12.1	14.5	17.0	19.4
30	14.5	18.2	21.8	25.5	29.1
40	19.4	24.2	29.1	33.9	38.8
50	24.2	30.3	36.4	42.4	48.5
60	29.1	36.4	43.6	50.9	58.2

<sup>1</sup>Average down time is about 20 to 30 percent. Consider distance from water source, mixing time, roughness of field, and wind to determine how many acres you can spray. Gauge wheels are needed for booms wider than 30 ft so boom is kept at a uniform height.

Polyethylene tanks are relatively inexpensive and are available in many sizes and shapes. They are noncorrosive and can be used with liquid fertilizers except ammonium phosphate solutions or complete-analysis liquid fertilizers. Stainless steel tanks are needed for these materials. Polyethylene tanks are tough and durable. Purchase your supply tank from a reputable dealer who will stand by his product. Polyethylene breaks down under ultraviolet light, so these tanks should be kept out of the sun when not in use.

Consider using water supply tanks in the field for more efficient operation. A pump is needed to move the water from the supply tank to the sprayer. It takes considerable time to prepare the spray solution so plan to

do this as quickly as possible.

## **Agitation**

Agitation of most spray solutions is necessary. Any separation will vary the spray concentration, so thorough agitation is a must. Agitation can be done either by mechanical paddle wheels or by a hydraulic jet stream. Jet agitation is simple and effective, provided the device is installed correctly. Jet agitation can be achieved through holes drilled in a pipe running the entire length of the tank or through special agitator nozzles. Agitators should receive fluid from the discharge side of the pump, not just from the bypass line. The amount of flow needed for agitation depends on the chemical used and on the shape of the tank.

For a simple orifice jet agitator, a flow of 6 gpm for every 100 gallons of tank capacity is usually adequate. If suction venturi attachments are used, the agitator flow from the pump can be reduced to 2 to 3 gpm for every 100 gallons of tank capacity.

The jet agitator should be fastened securely inside the tank. Keep the jet submerged at all times to prevent foaming. Some wettable powder suspensions can wear a hole through the tank, so the high-speed stream coming from the agitator should pass through at least 12 inches of liquid before hitting the tank. For large sprayer tanks it is desirable to have a separate pump for agitation.

Although hydraulic agitation will keep a suspension from settling, it is not intended to mix the chemical and form the initial suspension. It is usually best to make a slurry in a separate container first, and then add it to the tank. Detailed mixing instructions are usually printed on the herbicide label. Once you have filled the tank, try to use the entire tank before stopping. Do not stop agitation when moving from field to field. If the tank can not be entirely emptied in one day, the lines should be flushed so that the chemical does not settle out or cause flaking problems when the sprayer is restarted.

## **Flow-Control Assembly**

Controlling nozzle pressure and flow when a centrifugal pump is used does not require a pressure relief valve. The pump output can be regulated with a simple gate or globe valve. For accurate pressure control, special throttling valves requiring several turns to open completely are available. Electrically controlled throttling valves are available for remote pressure control. These valves are especially useful for tractors with enclosed cabs. A second valve may be added to the agitation line and used to regulate the amount of agitation required. When the volume in the tank is reduced, lower agitation is needed. A valve-controlled bypass line is sometimes added to the tank from the pressure side of the pump to control pressure. In this case, the amount of solution returned to the tank is excessive and may cause a foaming problem with some herbicides.

A minimum of two pressure gauges should be used, one in the view of the operator and one on the boom to check the pressure at the nozzle. Select a gauge for the pressure range you will be using. A range of 0 to 60 psi is adequate for herbicides. When a 200 psi gauge is used for operating at 30 psi, accurate pressure adjustment is difficult if not impossible. Ground speed or nozzle tips should be changed to increase or decrease herbicide rate, not pressure.

The boom shut-off valve allows one or more sections of the sprayer boom to be shut off while the pump and the agitation system continue to operate. A quick-acting control valve, such as an electric solenoid valve, is desirable.

## **Strainers and Screens**

A 10 to 20 mesh/inch basket strainer should be used in the tank manhole. A 50-mesh/inch strainer should be placed on the outlet side of the centrifugal or turbine pump, and should be cleaned frequently.

Each nozzle must have a screen sized to stop any particle that may plug the nozzle orifice. If tip size is LF8, 8008 or 11008, no screen is necessary. A check-valve type or strainer that eliminates dripping while turning or stopping is desirable. For wettable powders, 50-mesh/ inch screens should be used.

A simple device called a loop can be placed on the boom. It is made of 0.25 inch aluminum pipe or plastic tubing bent in a U shape. The boom is turned 180° so that the liquid is removed from the top. This reduces plugged tips and is easier to flush the boom. A leveling device on the boom would be needed to prevent dripping if check-valves are not used.

## Distribution Systems

*Lines.* Spray lines must be properly sized for the system. The suction hose should be air-tight, noncollapsible, as short as possible, and as large as the pump intake. A collapsed suction hose can restrict flow and "starve" a pump, causing decreased flow. When pressure cannot be maintained, the suction line is always a prime suspect.

Other lines, especially those between the pressure gauge and the nozzles, should be as straight as possible, with a minimum of restrictions and fittings. The proper size of these lines will vary with the size and capacity of the sprayer. A high, but not excessive, fluid velocity should be maintained throughout the system. If lines are too large, the velocity will be so low that the herbicide will settle out and clog the system. If lines are too small, an excessive drop in pressure will occur. A flow velocity of 5 to 6 feet per second is recommended. The following are suggested hose sizes for various flow rates:

Pump Output	Hose Size	
	Suction	Pressure
gpm	in	in
1-12	3/4	5/8
12-25	1	3/4
25-50	1 1/4	1

*Booms.* Boom stability is important for achieving uniform spray distribution. The boom should be relatively rigid in all directions; swinging back and forth or up and down is undesirable. The break-away hinge arrangement of the boom should be dampened so that the boom is rigid in the fore and aft direction. The boom should be constructed to permit folding for transport. Check for interference of the folded boom with tractor bars and roll bars.

Boom height should be adjustable from about 20 inches up to 4 feet above the ground. Hydraulically operated booms are becoming more popular. The length of the boom depends upon stability and roughness of land. Booms longer than 30 feet need gauge wheels. Do not use any iron fittings in the system because of rust. Booms should be mounted behind the sprayer to prevent tractor wheel tracks from disturbing the herbicide.

Some commonly used chemicals, such as Lasso, react with some plastic materials. It is important to check with the sprayer manufacturer and the chemical manufacturer for compatibility.

*Nozzles.* Nozzles determine the uniformity of application, the droplet distribution and influence drift potential. Select nozzles that give adequate coverage at the desired application rate, speed and pressure for a given herbicide. Contact herbicides, such as paraquat, need smaller droplet size for good distribution as compared to translocating herbicides. Although nozzles have been developed for practically every kind of spray application, only a few are commonly used for applying herbicides to wheat stubble. For this purpose, we suggest the use of flat fan tips because they have better distribution patterns than flood tips. Nozzles should be

turned slightly from straight alignment so that the overlapping patterns will not interfere with one another. Select stainless steel tips as they will last longer than brass, and generally produce more uniform spray patterns than nylon tips.

Flat-fan nozzles are available in 65°, 73°, 80°, 110° angles. The large angle tips (80° to 110°) can be operated closer to the target. The 80° spray angle tips are normally spaced on 20-inch centers with a boom height from the target of 16 to 20 inches. Thirty inch spacings can be used if the wide angle (110°) nozzle tips are used.

The pressure at the nozzle should be between 30 to 40 psi for postemergence applications. Contact herbicides, such as paraquat, depend on thorough coverage for performance. The outer edges of the individual nozzle pattern receives less herbicide concentration, which means that overlapping is required for uniform coverage. Overlapping for flat fan tips should be at least 30 to 50 percent of the nozzle spacing. Overlap of 100 percent would help for more uniform coverage. Raising or lowering the boom will also increase or decrease the amount of overlap. Select the tip size from *Tables II* and *III*. Two or more sizes should be selected to make the sprayer versatile, one in the 20 gpa range and the other in the 30 gpa. A 20 gpa could be used for spraying 2,4-D in growing wheat and the 30 gpa size for spraying herbicides in wheat stubble. A 10 gpa tip would reduce water needed for spraying small grains or if the herbicide label called for lower volume. Refer to the manufacturer's manuals for other nozzle or tip selections.

**Table II. Nozzle selection and application volumes for wettable powder herbicides for 20 inch spacings.**

Nozzle tip	Pressure at nozzle	Cap/Nozzle	Miles/hr			
	psi	gpm	3	4	5	7.5
			_____gal/acre_____			
LF3 80° or 110°	30	0.26	26	19	15	10
or 8003 or 11003	40	0.30	30	22	18	12
LF4 80° or 110°	30	0.35	34	26	21	14
or 8004 or 11004	40	0.40	40	30	24	16
LF5 80° or 110°	30	0.43	43	32	26	17
or 8005 or 11005	40	0.50	49	37	30	20
LF6 80° or 110°	30	0.52	52	39	31	21
or 8006 or 11006	40	0.60	59	45	36	24
LF8 80° or 110°	30	0.69	69	52	41	27
or 8008 or 11008	40	0.80	79	59	48	32

**Table III. Nozzle selection and application volumes for wettable powder herbicides for 30 inch spacings.**

Nozzle tip	Pressure at nozzle	Cap/Nozzle	Miles/hr			
	psi	gpm	3	4	5	7.5
			_____gal/acre_____			
LFS 110°	30	0.26	17	12	10	7
or 11003	40	0.30	20	14	12	8

LF4 110°	30	0.35	22	17	14	9
or 11004	40	0.40	26	20	16	10
LF5 110°	30	0.43	28	21	17	11
or 11005	40	0.50	32	24	20	13
LF6 110°	30	0.52	34	26	21	14
or 11006	40	0.60	39	30	24	16
LF8 110°	30	0.69	46	34	27	18
or 11008	40	0.80	52	39	32	21

### Operation and Care

A properly maintained sprayer is essential for good operation. After each day's use, the sprayer must be thoroughly cleaned and serviced. In freezing weather, the sprayer must be winterized. Pumps should be drained and filled with antifreeze or oil.

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***File G500 under: PESTICIDES, GENERAL***

***F-2, Equipment***

*Issued August 1980; 15,000 printed.*

*Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Leo E. Lucas, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.*

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