

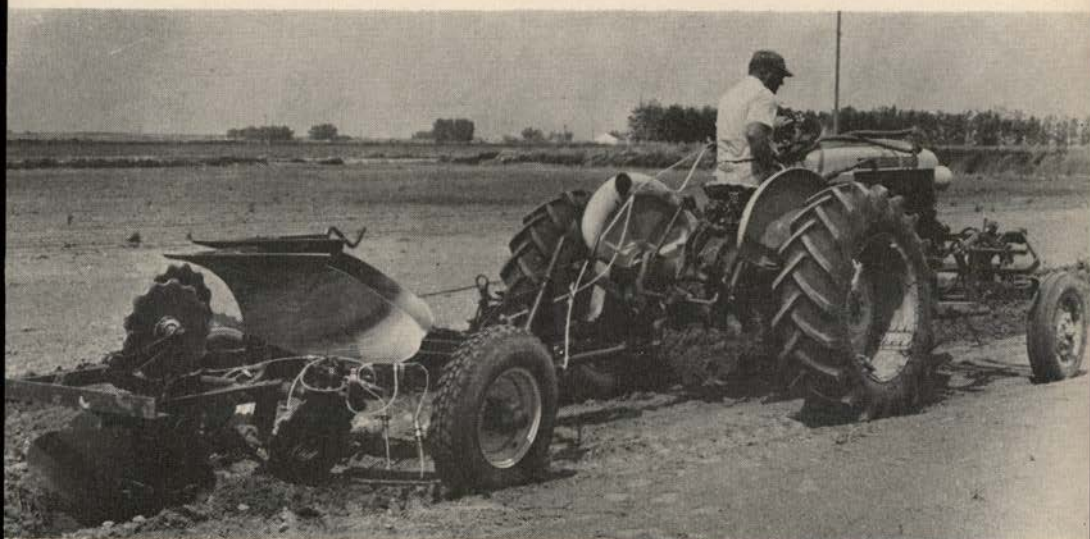
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UNIVERSITY OF IDAHO
College of Agriculture

Soil Fumigation With A Two-Bottom Two-Way Plow

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NEMATODES or eelworms can be controlled by soil fumigation. To be effective, very specific conditions must be met. The application must be of adequate quantity and properly made. It costs no more to do a good job of fumigation than a poor, inadequate job.

Requirements for soil fumigation:

1. Do not add manure or other organic matter when preparing land for fumigation.
2. The soil temperature must be at least 50° F. at a depth of 6 to 8 inches below the surface.
3. The soil moisture level should be ideal for tillage.
4. Apply the chemical 8 to 10 inches below the surface. **In plow sole fumigation place the chemical in the plow furrow ahead of the over-turning soil. Use two outlets for plows cutting a swath of more than 12 inches.**
5. Seal the soil surface as a separate operation by disking, harrowing, and rolling to remove large air pockets, break up clods, and compact the surface.
6. Allow a period of 2 to 3 weeks from date of fumigation to date of planting.

Do not attempt to fumigate while plowing under alfalfa, clover, or grasses.

For personal safety **never** work alone when fumigating soil.

Fall is a better time to fumigate than spring

Handle soil fumigants with care

READ THE LABEL — FOLLOW INSTRUCTIONS

Calibrate applicator accurately

Flush system with good quality fuel oil or a mixture of equal parts motor oil and kerosene when through fumigating.

Plug or cap all openings so that oil remains in all parts of the fumigator to prevent damage to threads and entrance of dust and dirt.

Front Cover: A two-bottom two-way plow equipped for soil fumigation.

Soil Fumigation With a Two-Bottom Two-Way Plow

C. E. DALLIMORE¹

AMONG the organisms causing plant diseases are small round-worms known as nematodes. It is possible to control these pests by placing volatile chemicals below the surface of the soil. This is known as soil fumigation. The chemical recommended will depend upon the crop to be grown, the species of nematode, and soil type.

These chemicals may be applied to the soil while plowing or as a separate operation. **To be effective, however, certain very specific conditions must be met. The application must be of adequate quantity and properly made.**

The conditions for effective soil fumigation are given in this bulletin. Satisfactory control of these nematode pests can be achieved only by following them carefully. The parts necessary to convert a two-bottom two-way trail type plow into an efficient soil fumigator are described and suggestions are made for assembly.

Requirements for Soil Fumigation

Volatilization of the chemicals and dispersion of the resulting gases through the upper foot of soil is dependent upon a number of soil conditions. Each condition must be as near the optimum level for volatilization and dispersion of gas as possible. Since many of these factors are beyond the control of man it is necessary to apply soil fumigants at those periods of the year when conditions are naturally favorable. The following factors must be taken into consideration for effective fumigation:

1. SOIL TYPE—Light soils are more easily fumigated than heavy soils. In general, the heavier the soil the greater the quantity of fumigant required. The fumigating gases are not readily dispersed through tightly compacted soils. Compact layers such as plow soles and hardpans prevent downward movement of the gases. **Large air pockets and cloddy conditions must be avoided.** The gases escape too readily from large air pockets and do not penetrate clods.

2. ORGANIC MATTER AND DEBRIS—Organic matter absorbs the fumigant before the gases have the opportunity to be dispersed through the soil. **The addition of manure or other organic matter should be avoided in preparing land for fumigation.** Removal of all debris prior to fumigation is highly recommended.

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3. SOIL TEMPERATURE—The temperature at which soil fumigants volatilize varies with the chemical. In general, the soil temperature at a depth of 6 to 8 inches should be between a minimum of 50° F. and a maximum of 80° F.

4. SOIL MOISTURE—The soil should be neither too wet nor too dry. When the soil moisture is adequate for good plowing without formation of clods, or for good seed bed preparation and seed germination, it is right for soil fumigation.

5. DEPTH AND DISTANCE—Since dispersion of the gases from soil fumigants is in all directions the chemical is usually applied in concentrated lines at depths of 8 to 10 inches and 10 to 12 inches apart. When applying fumigants at the time of plowing, the chemical must be placed in the plow furrow ahead of the over turning soil. Do not place the fumigant on the surface of the soil and then plow it under. When plow bottoms wider than 12 inches are used two concentrated lines of chemical must be placed in each plow furrow.

6. SEALING—It is essential that the fumigating gases be distributed well throughout the soil and be retained in the soil until lethal concentrations are attained. This can be accomplished by breaking up the clods and removing large air pockets by thoroughly disking and harrowing. This operation should closely follow the application of fumigant and will thus require a second tractor and operator. The seal is completed by rolling twice with a cultipacker. The second rolling should be at right angles to the first. No plant material should be left protruding through the surface of the soil when the seal is completed. The gases will escape from around protruding objects more rapidly than from a clean soil surface.

Even though this leaves the surface rather compact the gas still escapes from the upper 2 or 3 inches before lethal concentrations are reached. The drying of the soil itself is lethal to many of the nematodes in this surface area. If a more complete kill is desired it is necessary to make a second application while placing this surface layer of soil at greater depths where lethal concentrations can be obtained. Such a practice increases the expense of fumigation and is recommended only for special situations where it is necessary to approach eradication. Eradication of plant parasitic nematodes does not appear possible at the present time.

7. AERATION—Between fumigation and planting allow sufficient time for adequate aeration as soil fumigants are toxic to plants. This period will vary with the chemical used, soil temperature, and soil moisture. It is generally recommended that the interval between fumigation and planting be 3 weeks. This time may be reduced to 2 weeks if the soil is worked to a depth of 6 to 8 inches prior to planting so that the gas can escape more rapidly than through the compacted surface. This should not be done sooner than 10 days after fumigation.

Preceding Crop

To have the land suitable for soil fumigation may require some change in the crop rotation. Crops which leave the land relatively free from plant material are the most desirable to be grown preceding fumigation. Where the straw has been cut as close to the ground as possible, raked, and removed, an effective job of soil fumigation can be done while plowing under grain stubble. This addition of organic matter will necessitate an increase in the amount of fumigant used. All of the straw must be completely turned under so that an effective seal can be obtained.

Time must be allowed for thorough decomposition of nematode infested roots if host crops are included in the rotation. It is impossible to do an adequate job of soil fumigation while plowing under many crops, notably alfalfa, clovers, and grass.

Time of Fumigation

Most fumigants must be applied prior to planting. Whether the application is made in the spring before planting or the preceding fall is immaterial as long as the factors influencing fumigation are optimal.

1. SPRING FUMIGATION—Disadvantages: (1) Soil temperatures are usually too low as early in the spring as it would be necessary to fumigate and allow adequate time for aeration before planting. (2) Spring is the most common time for applying manure. Fumigants should not be applied until the manure has been thoroughly decomposed. (3) Soil fumigation increases the farm operations and must be done very carefully. Fumigate only when there is adequate time to do a good job.

Advantages: There is no special advantage to spring fumigation as compared with fall fumigation.

FALL FUMIGATION—Disadvantages: It is necessary to work the soil again in the spring before planting.

Advantages: (1) At the end of the growing season more nematodes are in a stage of their life cycle where they are more susceptible to the action of fumigation gases than in the spring. (2) More nematodes are within the portion of the soil that is easy to fumigate. (3) The soil temperature is high enough for good fumigation. (4) Irrigation water is available so that the soil moisture can be controlled. (5) There is adequate time between fumigation and planting for proper aeration. (6) There is less pressure from other farm work, making it possible to devote the necessary time to effective fumigation.

Precautions in Using Soil Fumigants

Care must be exercised in handling soil fumigants. They can be dangerous to humans as well as to nematodes. They can be handled safely if all precautions listed on the label are carefully followed. The greatest danger is from careless handling. Exposing bare hands to some fumigants does not seem to be injurious except in the case of allergies. Burns that may become severe are produced when the gases from these chemicals are confined to the body by ring bands, watch bands, gloves, shoes and clothing. While handling fumigants do not wear gloves unless the label indicates that rubber or plastic gloves should be worn. **Clothing wetted by soil fumigants should be removed IMMEDIATELY.** Shoes which have fumigants spilled on them should be allowed to air and dry for several days until the odor of the fumigant is no longer noticeable before being worn again. Other clothing should be aired, dried, and washed before being worn again.

After handling fumigants wash the hands thoroughly before proceeding with other operations. Mechanics waterless soap is excellent for this purpose. **ALWAYS** have soap and an adequate supply of water available in the field when fumigating. Paper towels are convenient for drying. For personal safety never work with soil fumigants when alone.

A heavy rubber or plastic apron will protect the wearer from splashing chemicals when transferring them from one container to another as might be necessary when combining left-over fumigant from several containers. Plastic freezer bags large enough to fit over the shoes and tied above the ankles will protect the feet.

Plow Sole Application

The liquid chemical must be placed below the surface of the soil for adequate soil fumigation. **In plow sole applications it is essential that the chemical be placed in the plow furrow ahead of the overturning soil.** This is more readily accomplished with some plows than others. By proper attachment of the outlets the chemical can be placed in both furrows of some two-bottom two-way trail plows rolling over in the direction of travel. No simple method has been devised to place the chemical in the inside plow furrow of spinner type two-bottom two-way mounted plows always turning toward the same side and at right angles to the direction of travel. **Do not place the chemical on the surface of the soil and then turn it under** as would be necessary with the above mentioned spinner type plow. **For plow bottoms over 12 inches in size there should be two outlets per share.** When more than one outlet per plow share is required, or extensive lengths of tubing are necessary to deliver the chemical to the proper place, a pressure-flow fumigation system should be used.

Pressure Flow Soil Fumigator

A pressure flow soil fumigator is similar to a spray system used for insecticides and fungicides. Although in many instances the parts are the same or similar it is inadvisable to use the parts interchangeably. Soil fumigator parts used with water solutions would soon corrode and rust, resulting in an applicator that would not work efficiently and would need frequent replacement of parts.

All hoses and gaskets in soil fumigators must be made of neoprene or polyethylene. For a satisfactory long lasting applicator **all metal parts in contact with fumigants should be brass or copper.** The use of ferrous metals should be avoided. Black pipe may be suitable for one season, although it corrodes and rusts readily. Small flakes of rust from this pipe, when used a second season, will plug the screens and orifices, resulting in a number of difficulties and an unsatisfactory job of soil fumigation. Several soil fumigants react with the zinc of galvanized pipe causing it to slough off. Screens and orifices become plugged with this material and the inside of the pipe rusts making it inadvisable to use it the second season.

A pressure flow soil fumigation system for a two-bottom two-way plow is shown diagrammatically in Figures 1 and 2. A list of parts is provided in Table 1. These parts are listed in order of attachment from supply drum through pump and control unit, return to supply drum, and then from control unit to delivery at plow share.

Construction of Fumigator

Attach pieces of strap iron to the plow frame as in Figure 3. Before assembling the rest of the fumigator, plow several rounds to make sure these pieces of strap iron clear the moldboard as the plow turns over when tripped. At the same time determine the speed and throttle setting at which the tractor pulls the plow at the depth it is intended to plow.

SUPPLY DRUM—Determine the best place to locate the supply drum. Frequently a plank attached to the cultivator supports serves very well for this purpose. The supply drum may be held in position by long hook bolts. Remove the bungs only after securely attaching the drum. Rub soap from softened bar of hand soap on pipe threads and assemble pipe in suction and return lines. Place the suction line in the 2-inch bung and the return line in the $\frac{3}{4}$ " bung. Ream the 2" x $\frac{3}{4}$ " bushing so that the stand pipe will slip through it. This should be a tight fit so that the chemical will not splash out. Parts for these pieces are shown in order of assembly in Figure 4 minus hoses and clamps. Comparative cost of pipe and 1-inch heavy-wall, neoprene lined suction hose and location of supply drum will determine their length. If pipe is the least costly, use a longer piece than shown in the picture, thus reducing the amount of hose necessary. The union between the pipe and the pump must be made flexible with hose.

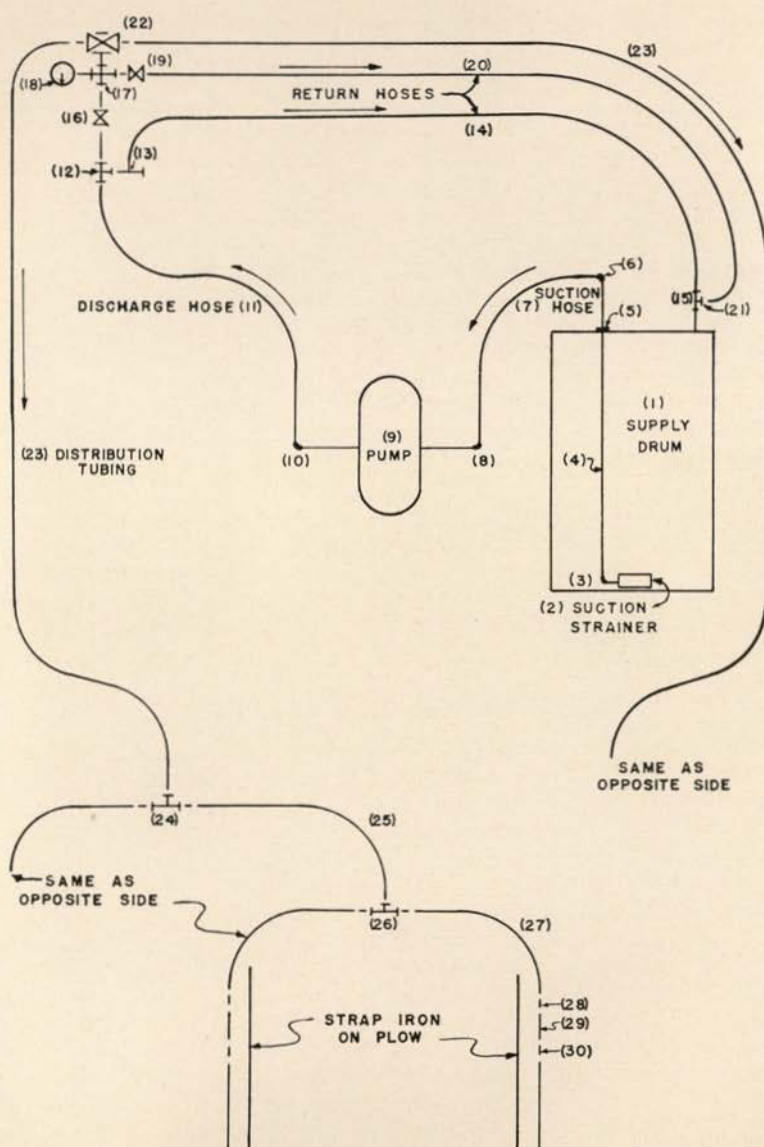


Figure 1.—Diagram of pressure flow soil fumigator for two-bottom two-way plow. Numbers refer to parts list, Table 1.

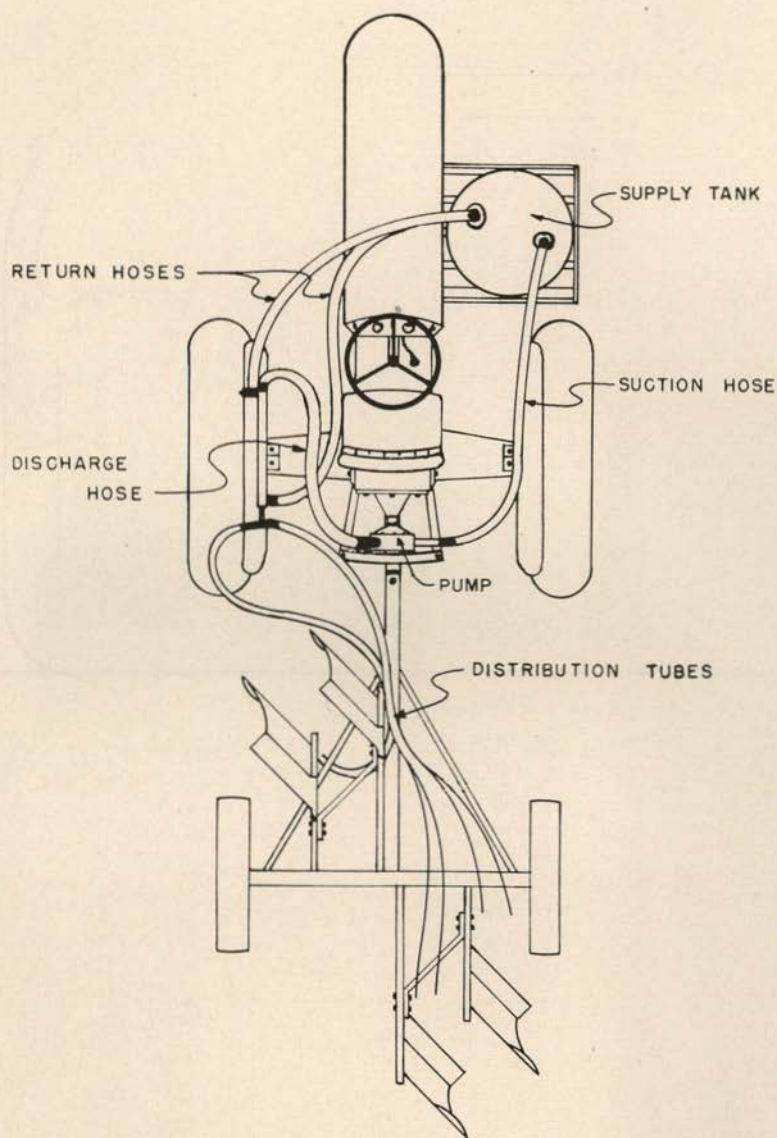


Figure 2.—Diagram of general arrangement of pressure flow soil fumigator on tractor and two-bottom two-way trail plow.

Table 1.—Parts listed in order of attachment for pressure flow soil fumigator for two-bottom two-way trail plow¹.

Name of system	Illustrated in Figure No.	Part No. Figure 1	Description of part	Amount
Supply		1	drum	1
			hook bolt	3 or 4
Suction	4	2	$\frac{3}{4}$ " suction strainer, monel screen ²	1 - plus extra
		3	$\frac{3}{4}$ " 90° street ell	1
		4	$\frac{3}{4}$ " pipe	1 - longer than supply drum
		5	2" x $\frac{3}{4}$ " bushing	1
		6	$\frac{3}{4}$ " 90° ell	1
		7	$\frac{3}{4}$ " pipe	1 - 4 or 5 ¹
		7	$\frac{3}{4}$ " union	1
		7	1" heavy wall, neoprene lined suction hose with $\frac{3}{4}$ " nipple cemented and clamped in each end	1 - 4 ¹
Pump		8	$\frac{3}{4}$ " ell ³	1
		8	$\frac{3}{4}$ " nipple	1 - 6" ¹
		9	pump, power take-off, direct drive, nylon roller, neoprene gaskets, leather seals	1
			passing link chain	1 - 3 ¹
		10	$\frac{3}{4}$ " nipple	1 - 6" ¹
		10	$\frac{3}{4}$ " ell ³	1
		10	$\frac{3}{4}$ " pipe to hose adapter	1 - female hose
Discharge		11	$\frac{3}{4}$ " neoprene lined pressure hose with male connector on one end and female on oppo- site end	1 - 6" ¹

¹Lengths given are for mounting of supply drum ahead of the rear wheels of tractor and on opposite side of control unit mounted on fender of tractor. Lengths will vary according to location of these and other parts and will have to be determined for each tractor individually.²Size of screen, 50 or 100 mesh, depends upon fumigant and quantity to be applied; it is advisable to have extras on hand.³Angle depends upon location of tractor power take-off and obstructions such as shield.

Control Unit
Double by-pass

5

12	3/4" pipe to hose adapter	1 - male hose
12	3/4" tee	1
13	3/4" by-pass valve, m.p.t.	1 - with male hose adapter
12	3/4" x 1/2" bushing	1
	1/2" x 2" nipple	1
16	1/2" shut-off valve, quarter turn, with stops	1
	1/2" close nipple	1
17	1/2" cross	1
17	1/2" x 3/8" bushing	1
18	3/8" surge dampner	1
18	3/8" m.p.t. pressure gauge, 100#	1
19	1/2" m.p.t. by-pass valve	1 - with 3/4" male hose adapter
	1/2" x 3/8" bushing	1
22	3/8" x 3/8" x 3/8" m.p.t. three-way shut-off valve	1
16	3/4" pipe to hose adapter	1 - male hose
16	3/4" shut-off valve, quarter turn, with stops	1
17	3/4" cross	1
18	3/4" x 3/8" bushing	1
18	3/8" surge dampner	1
18	3/8" m.p.t. pressure gauge, 100#	1
19	3/4" m.p.t. by-pass valve	1 - with 3/4" male hose adapter
19	3/4" x 3/8" bushing	1
22	3/8" x 3/8" x 3/8" m.p.t. three-way shut-off valve	1

Control Unit
Single by-pass

(Continued Next Page)

SOIL FUMIGATION WITH TWO-WAY FLOW

Return Line Double by-pass	4	14	3/4" neoprene lined hose with female connectors both ends	1 - 7' ¹
		15	3/4" pipe to hose adapter	1 - male hose
		15	3/4" ell 90°	1
		15	3/4" x 4" nipple	1
		15	3/4" tee	1
		21	3/4" pipe to hose adapter	1 - male hose
		20	3/4" neoprene lined hose with female connectors both ends	1
			3/4" x 8" nipple	1
Return Line Single by-pass		14	3/4" neoprene lined hose with female connectors both ends	1 - 7' ¹
		15	3/4" pipe to hose adapter	1 - male hose
		15	3/4" ell 90°	1
		15	3/4" x 8" nipple	1
Distribution Line	6	22	266-P ⁴ connectors 1/2" plastic x 3/8" f.p.t.	2
		23	88-P 1/2" o.d. clear poly-flo tubing (polyethylene)	1 - 20' ⁵ 1 - 24'
	6	24	266-P connector 1/2" plastic x 3/8" f.p.t.	2
		24	3/8" x 1/4" bushing	2
		24	272-P tee 3/8" plastic x 3/8" plastic x 1/4" m.p.t.	2
		25	66-P 3/8" o.d. clear poly-flo tubing (polyethylene)	4 - 2'
		26	266-P connector 3/8" plastic x 1/4" f.p.t.	4
		26	272-P tee 1/4" plastic x 1/4" plastic x 1/4" m.p.t.	4
		27	44-P 1/4" o.d. clear poly-flo tubing (polyethylene)	2 - 8" 4 - 12" 2 - 15"

⁴Catalogue numbers of Imperial Poly-flo tubing and brass fittings.⁵Length will depend upon location of control unit and make of plow.

Orifice Assembly ^d	7	28	268-P half union 1/4" plastic x 1/4" m.p.t.	8
		29	Spray body, female, brass, 1/4" f.p.t.	8
		29	Cap, spray body, brass	8
		29	Strainer, monel screen	8 ^e
		29	Orifice plate, No. 4916 ^f	8
		30	Adapter No. 4928	8
Mountings	3	30	268-P half union 1/4" plastic x 1/8" m.p.t.	8
			44-P 1/4 o.d. clear poly-flo tubing (polyethylene)	8 - total length 5'
			Strap iron 1/8" x 1"	
			4" with 2 holes 3" apart	8
			14" -16" with 2 holes 3" apart at one end	8
			Bolts, machine, 5/16" x 2 1/2"	16
Miscellaneous supplies	6		Plumbers tape	1 roll
			Bolts, stove 1/4" x 1"	1 box
			Rubber tubing or hose	
			Water supply	15 gallons
			Soap	1 box
			Paper towels	1 roll
			Mechanics waterless soap	1 can
			Plastic bags to fit over shoes	2
			Plastic apron or rubber apron	1
			Measuring device	1
			Graduated in milliliters (ml.)	

^dSpraying Systems Tee Jet parts and numbers.

^eThis is orifice plate number, there are various size orifices under this number. Size will depend upon fumigant and quantity to be delivered. It is advisable to have several sizes available.

PUMP—A good nylon roller type pump directly driven by tractor power take-off is recommended. This pump should have neoprene gaskets (rubber gaskets will soon leak) and leather seals (some fumigants react with the metals used in some seals). Rub soap on the threads of pipe fittings and assemble with pump before mounting on tractor. Place chain around pipe at discharge end of pump and attach to a stationary part of the tractor to prevent the pump from turning over. Connect suction hose to proper side of pump and join to suction pipe through a union fitting.

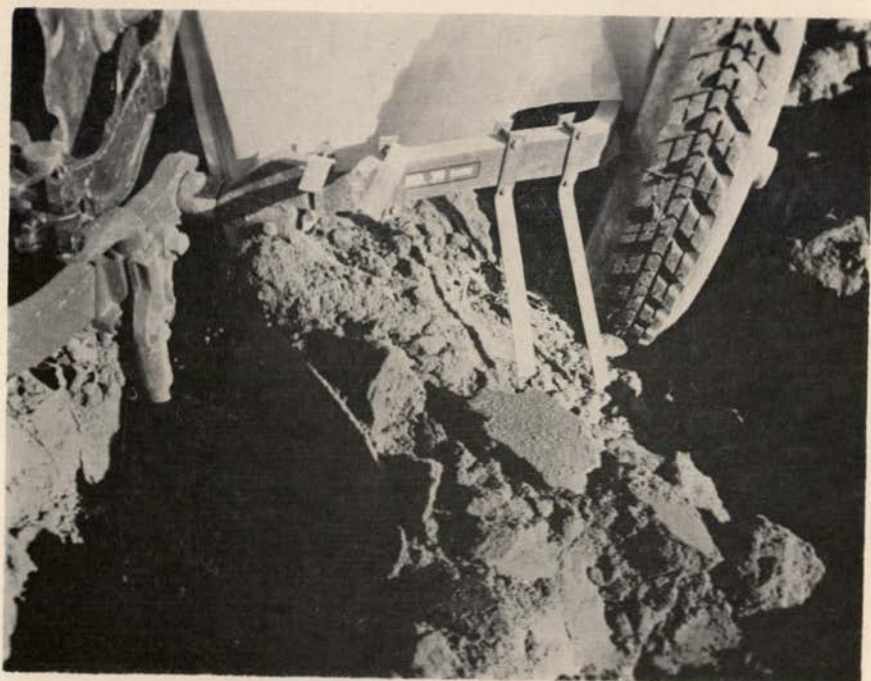


Figure 3.—Pieces of strap iron attached to plow frame as supports for fumigator orifice assemblies.

CONTROL UNIT—When applying fumigants that require less than 10 gallons per acre it is necessary to use a double by-pass control unit with a pump of the capacity recommended. The parts for a double by-pass control unit are shown in order of assembly in Figure 5. All joints should be soaped. When applying large quantities of fumigant a single by-pass control unit will be adequate. Such a unit can be constructed in the same manner by eliminating the first by-pass valve on the pressure side. By-pass valves should have metal seats or replaceable neoprene gaskets.

The control unit should be mounted in a position where the operator can reach the valves easily and can see the pressure gauge. Connect the return lines between control unit and supply drum. The

pressure line connects the control unit and power take-off pump. **Neoprene or polyethylene gaskets** should be used in all female hose connectors.

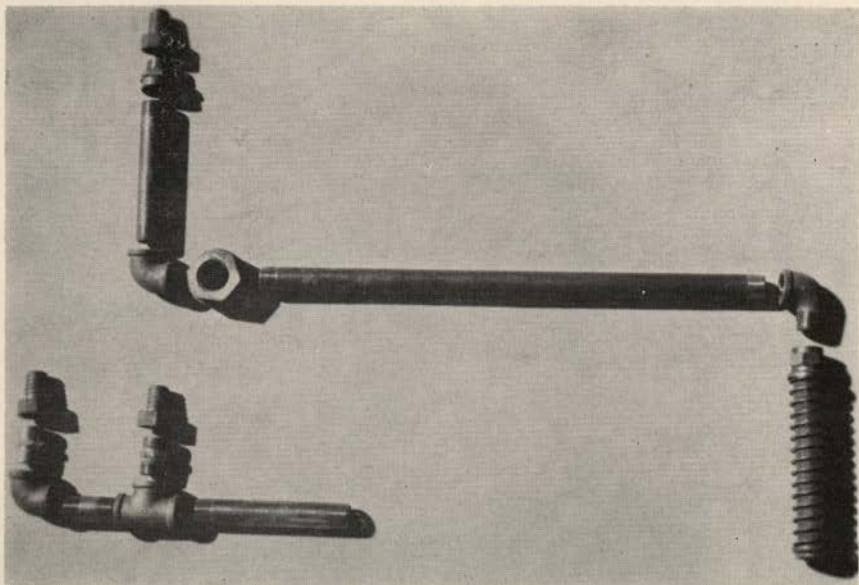


Figure 4.—Parts for suction and return lines (double by-pass) minus hoses and clamps in proper order of assembly. Suction strainer to be of 50 or 100 mesh monel screen depending upon fumigant and amount to be applied.

DELIVERY LINES—After connecting the $\frac{1}{2}$ " polyethylene delivery lines to the control unit, attach one line to each side of the plow frame with plumbers tape in such a manner that the tubing will not be pinched or damaged during operation of the plow. A piece of rubber hose slipped over the tubing at points of attachment (Figure 6) prevents damaging the tubing. By means of a bushing and tee, each line is subdivided and reduced in size to $\frac{3}{8}$ " tubing for delivery at each plow. For plow shares wider than 12" the delivery tubes should be further subdivided and reduced to $\frac{1}{4}$ " by means of a tee. This allows for two outlets per plow share.

ORIFICE ASSEMBLY—Fit together the parts of the orifice assembly as illustrated in Figure 7. Size of screen and orifice will depend upon the chemical, rate of application, tractor speed and pump pressure. These may be tentatively determined by the data in Tables 2 and 3. It is advisable to have on hand several sizes of orifices as well as extra orifices of the size used. Attach orifice assembly, two for each plow over 12" in size, to $\frac{1}{4}$ " delivery tubes and fasten to strap iron supports, Figure 6. Adjust the $\frac{1}{4}$ " outlet tubes to deliver at approximately equal distances in the two plow

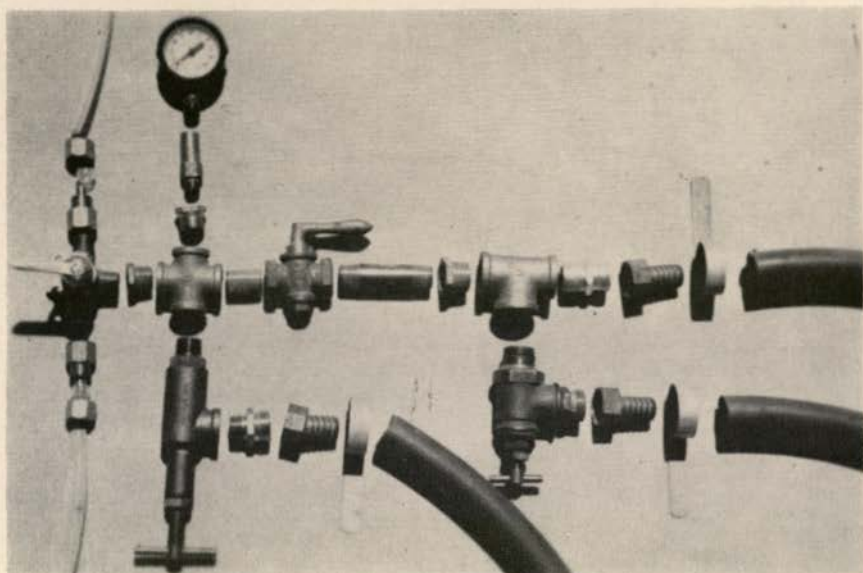


Figure 5.—Parts for control unit (double by-pass) in order of assembly.

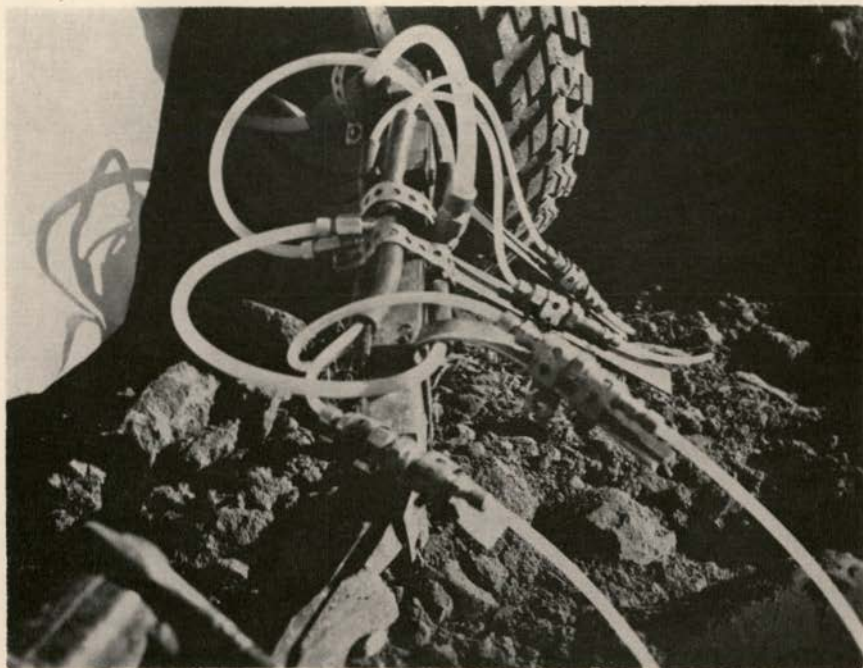


Figure 6.—Mounting of polyethylene tubing and orifices assemblies to plow frame and strap iron with plumbers tape.

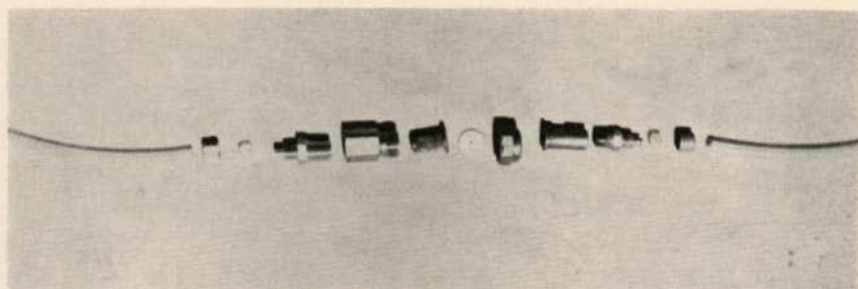


Figure 7.—Parts of orifice assembly with outlet side at left.

Table 2.—Number of milliliters (ml.) per outlet (two outlets per plow) for plow sole applicator of soil fumigants at indicated dosages and speeds (M.P.H. = miles per hour) for 14" and 16" plow shares.

Gallons per acre	MILLILITERS PER MINUTE									
	3 M.P.H.		3½ M.P.H.		4 M.P.H.		4½ M.P.H.		5 M.P.H.	
	14"	16"	14"	16"	14"	16"	14"	16"	14"	16"
4½	60	69	70	81	81	92	91	103	101	114
5	67	76	78	89	89	102	101	114	112	127
6	80	92	94	107	107	122	121	137	134	152
10	134	152	157	178	179	203	201	229	224	254
15	201	229	235	267	268	305	302	343	336	382
20	268	305	313	356	358	407	403	457	447	509
25	336	382	391	445	447	509	503	572	560	635
30	403	457	470	535	538	610	605	686	671	763

Table 3.—Suggested pressure settings and orifice sizes to obtain indicated milliliters (ml.) of fumigant per minute.*

Orifice Size	Gauge Pressures			
	10 p.s.i.	15 p.s.i.	20 p.s.i.	25 p.s.i.
.014	40	50	58	68
.016	62	72	84	92
.018	68	80	92	100
.021	92	108	120	140
.024	120	140	160	172
.028	172	212	248	276
.029	180	220	252	280
.035	228	280	316	360
.040	300	400	440	504

* The information in this table is given through the courtesy of the Dow Chemical Company.

furrows. The outlet tubes for the inside plow furrow should be pointed over the moldboard of the outside plow, Figure 8, so that the fumigant will drop into the inside plow furrow ahead of the overturning soil. Although the plow strikes and bends these tubes during the tripping operation, they return to their original position when the plow passes by. It may be necessary to replace these tubes periodically, though they will last for many acres of plowing.

Calibration of Applicator

Accurate calibration of soil fumigation applicators to deliver the proper amount of fumigant at all times is essential for good nematode control. The number of milliliters that should be delivered from each outlet when there are two outlets per plow is given for some dosages and tractor speeds in Table 2.

Carefully follow the steps below and calculate the proper rate of delivery.

1. Determine the tractor speed and throttle setting while pulling applicator as in actual use. Tractor speed in miles per hour (M.P.H.) may be estimated rather accurately by counting the number of 3-foot paces the tractor moves in 20 seconds and dividing by 10².

$$\text{M.P.H.} = \frac{\text{yards in 20 seconds}}{10}$$

2. Calculate the number of feet traveled per minute (F.P.M.)

$$\text{F.P.M.} = \frac{5280 \times \text{M.P.H.}}{60}$$

3. Determine how many minutes per acre (M.P.A.) with one plow.

$$\text{M.P.A.} = \frac{43,560}{\text{F.P.M.} \times \frac{\text{plow cut}}{12}}$$

4. Calculate the rate per minute (R.P.M.) for number of gallons per acre (G.P.A.) to be applied.

$$\text{R.P.M.} = \text{milliliters per gal. (3785)} \div \frac{\text{M.P.A.}}{\text{G.P.A.}}$$

5. Divide by number of outlets per plow share to obtain milliliters per outlet (M.P.O.).

$$\text{M.P.O.} = \frac{\text{R.P.M.}}{2}$$

An example: A tractor traveling 30 yards in 20 seconds is traveling 3 miles per hour $\frac{5280 \times 3}{60} = 264$ feet per minute. With 16" plow:

$$\frac{43,560}{264 \times 1.33^3} = 124$$

minutes to plow 1 acre. Applying 6 gallons per acre: $3785 \div \frac{124}{6} = 183$ ml. per plow or 92 ml. per outlet.

²Suggested by Rex Blodgett, Idaho Potato Growers, Idaho Falls, Idaho.

³Multiply by 1.17 instead of 1.33 when using a 14" plow.

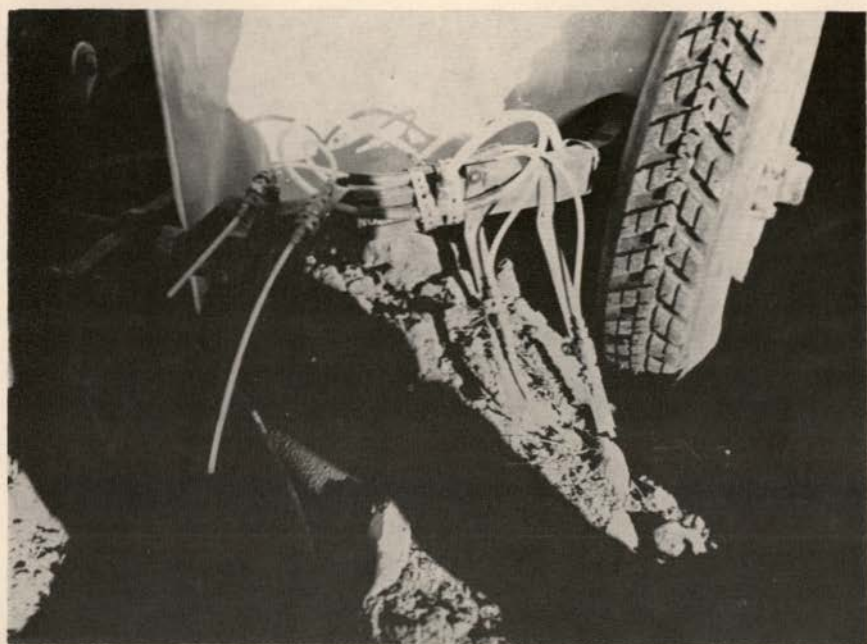


Figure 8.—Outlet tubes which deliver fumigant into plow furrow ahead of over-turning soil.

After determining the rate of flow per outlet consult Table 3 to determine approximate gauge pressure in pounds per square inch (p.s.i.) and orifice size. With tractor stationary but throttle at determined setting for plowing speed, adjust by-pass valve to obtain pressure setting as given in Table 3. Collect fumigant for one minute from one outlet and measure. Adjust pressure or orifice to obtain desired flow. For accurate measurement, measure in milliliters. Containers calibrated in milliliters usually can be obtained from drug stores. Plastic baby bottles marked in milliliters are particularly suitable for small quantities. It is advisable to catch the fumigant from all outlets to prevent waste. If large quantities of fumigants are allowed to run in one place the soil may be temporarily sterilized.

Storage of Applicator

When through fumigating, flush applicator with a good quality fuel oil or a mixture of equal parts motor oil and kerosene. Circulate this mixture through the applicator for 15 minutes. When dismantling the applicator, carefully plug or cap all openings so that the oil mixture remains in the pump, control unit, lines, etc. This will keep the parts lubricated as well as prevent damage to threads and entrance of dust and dirt. An applicator properly cared for will last for many seasons and give trouble-free operation. Do not allow fumigants to remain in the applicator for extended periods. **DO NOT** use water solutions of any kind in your applicator.

Storage of Chemicals

Follow the suggestions on container labels. Place containers out of reach of children and animals. Small amounts of chemical are better stored in glass than metal containers. Iron containers will corrode and rust. Some fumigants react with metals.

**It costs no more to do a good job of fumigation
than to do a poor job**

HANDLE FUMIGANTS WITH CARE

Follow recommendations carefully

READ THE LABELS

Do not work with soil fumigants while alone