FERTILIZING THROUGH SPRINKLERS

M. A. Hagood

Fertilizer has been applied through sprinklers for many years. I first saw this practice in the Willamette Valley of Oregon in the early 1940's.

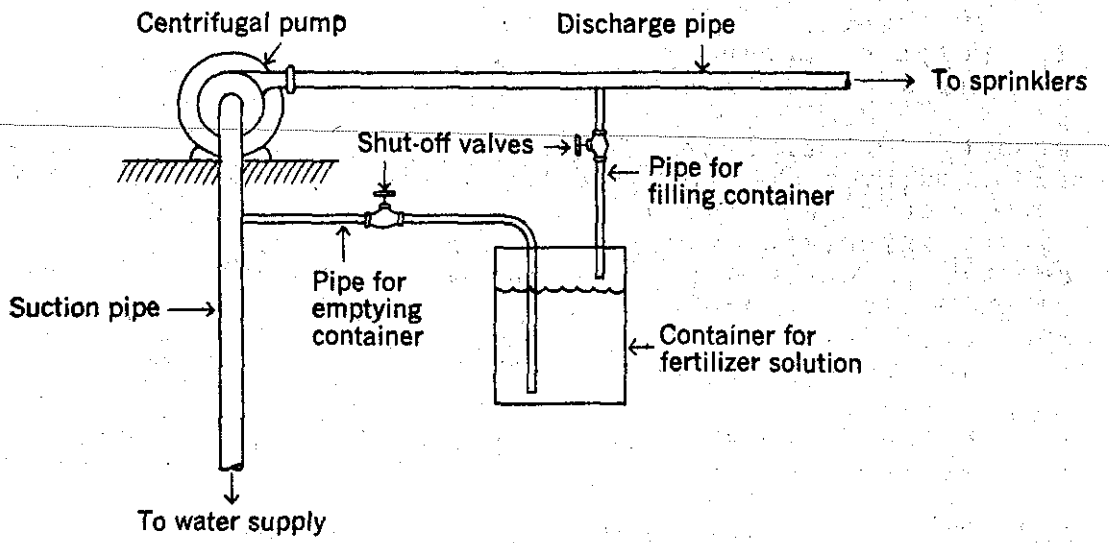
Any material which goes into solution can be applied. This includes nitrogen principally and some of the phosphates in the form of 16-20 or 11-48 and also potassium chloride and potassium sulfate.

Aqua and anhydrous ammonia should not be applied since volatilization may cause as high as 50-60% loss.

The timing of application during the irrigation will depend upon the type of material being applied ie. whether it moves readily through the soil with water or whether it is relatively immobile.

Firuges 1 and 2 are schematic drawings of the principles of application methods. Figure 3 shows relationship of material applied to the system layout.

Figure 1



Arrangement of the equipment used for introducing fertilizer into a centrifugal pump. (Fo bility, garden hose can be used in place of pipe).

Figure 2

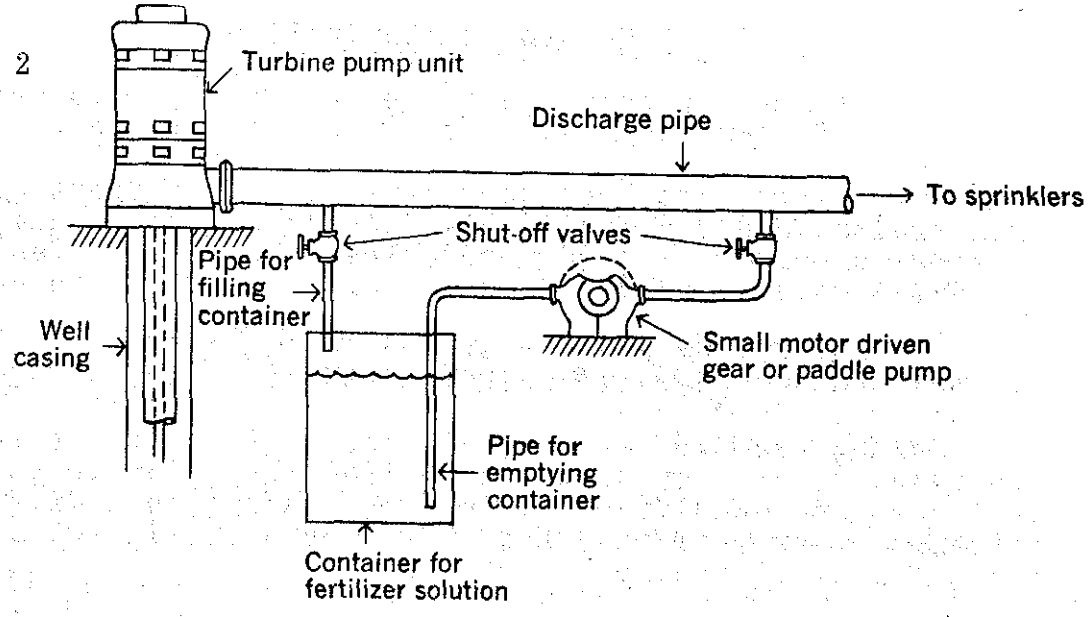


Figure 3

Pounds of fertilizer to use for each setting of a sprinkler line

Length of line in feet	Distance line moved per setting	*Rate of nutrient application in pounds per acre*				
		20	*40*	*60*	*80*	*100*
		Pounds of fertilizer per setting				
330 (20 rods).....	40 ft.	6 lb.	12 lb.	18 lb.	24 lb.	30 lb.
	60	9	18	27	36	45
	80	12	24	36	48	60
660 (40 rods).....	40	12	24	36	48	60
	60	18	36	54	72	90
	80	24	48	72	96	120
990 (60 rods).....	40	18	36	54	72	90
	60	27	54	81	108	135
	80	36	72	108	144	180
1320 (80 rods)....	40	24	48	72	96	120
	60	36	72	108	144	180
	80	48	96	144	192	240

Frost Control by Sprinkling

Information supplied to Mel Hagood by Otto Geisert, Balcom and Moe, Inc., Pasco, Washington.

Sprinklers have been used many years for frost control on tree fruits, and especially low growing crops; such as, strawberries, cranberries, and vegetables. They have also been used for frost control around Klamath Falls and Tulelake on Potatoes.

In 1967 Balcom and Moe started using this method of control on their potato operations just north of Pasco, Washington.

During the 1967 season, 450 acres of solid-set irrigation was used on the operation and in 1968 they plan to have 475 acres. Their setting consists of a 40 x 60 spacing on a diamond shaped pattern. Last year they had 350 acres of solid-set system in place for frost control.

The varieties grown included Russet Burbank and Norgold. There was no yield information obtained to show the difference in the areas receiving frost control over those receiving no control, but the Norgolds were harvested ten days and Russets fourteen days earlier on frost control fields versus those not controlled. Price fluctuations are great on early potatoes and nearly always there is a tremendous price differential within a few days period early in the season. The potatoes were planted from February 27 to March 20. The number of times the system was used for frost control varied from field to field, but on one field the system was protected five times during the season.

The worst frost occurred on the night of April 27, when Temperatures dropped to about 24 to 26°F. Pipe had been placed in the field after the first cultivation. Water was available through the project facilities and had been ordered in anticipation of a cold period. This was stored in a reservoir constructed by the company to provide the large quantity required, as about 3,200 gallons per minute or about 7 cfs were used during theis period.

The pumps were started at 11 o'clock the night of the 27th and were kept running until about 9:30 the following day at which time all ice had melted from the plants. Water was applied to about 1/3 of the acreage at a time or a 20-minute operation out of each hour. Two extra tractor P.T.O. pumps were used to provide from 38 to 40 psi at the heads. Heads are 11/64".

Sequencing from one lateral to another was done by hand. This next year they plan to irrigate blocks of fields utilizing several laterals in an area, then sequencing to a completely different area to sequence from the pump or central points with less labor.

Frost Protection Principle

Heat is applied in one way or another to turn ice into water

Similarly to turn water into ice, heat is produced.

When water is applied to plants at 32°F. or lower, ice forms and in so doing gives off heat, some of which enters the plants and some warms the air. Since it is the process of forming ice which provides the heat, it is important to either keep water running continuously or if water or equipment is limiting the sequencing should be often. Possibly when 20 minutes on and 40 minutes off sequencing was followed by Balcom and Moe, a certain amount of protection was provided by drift and overlap from sprinklers nearby. When sequencing from one field to another, frequency of application should be more often.

MULTIPLE USES OF SPRINKLER IRRIGATION - A PANEL

Mel A. Hagood, Extension Irrigation and Water Use Specialist
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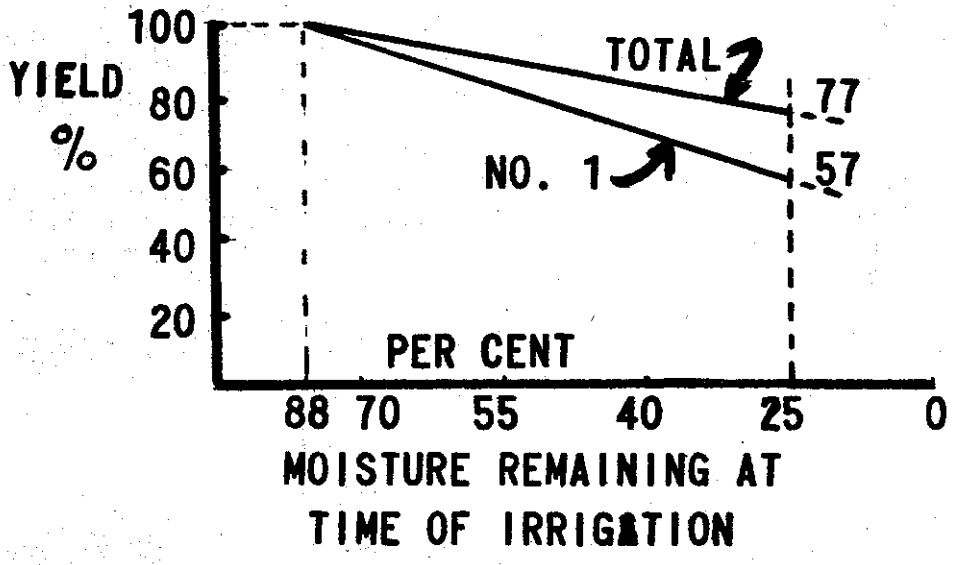
In 1965 at this conference a discussion on the principles of soil moisture plant relations and a paper on research work at Othello pointed to the advantages of light, frequent irrigations. [Fig.s 1 and 2] In 1966 at your conference a panel presented several types of so-called solid set sprinkler systems which provided these light, frequent irrigations with a minimum of labor. In 1967 your last year's conference included



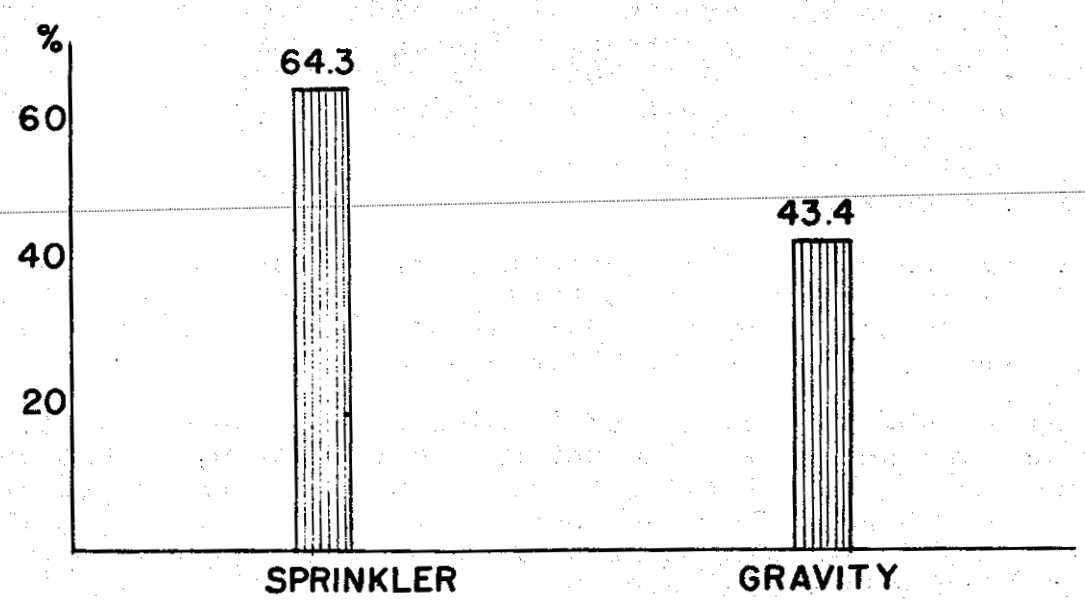
CONVENTIONAL VS. MIST IRRIGATION
HANCOCK EXP. FARM, WISC.

VARIETY	CONV. TOTAL CWT	MIST	CONV. U.S. NO.1 CWT	MIST
EARLY GEM	488	416	245	254
RED PONTIAC	718	813	374	531
NORGOLD RUSSET	414	383	269	259
RUSSET BURBANK	628	703	366	477
RUSSET SEBAGO	583	820	447	601

a discussion on the need to over-irrigate slightly when salt conditions were hazardous. It was pointed out at this time that leaching for salt control could also leach fertility.

With properly designed sprinkler systems it is possible to have good water control to apply very closely the correct amount of water for optimum yield and quality. It is also possible to leach salts if necessary and when this must be done it is possible to apply fertilizers through the sprinkler system to off-set fertility loss. In addition to applying fertilizers through the sprinkler systems there is an increasing interest in the application of herbicides, fungicides, and pesticides through systems as well as using sprinklers for climate control. There is some evidence that the light, frequent irrigations which produce better potatoes may be due somewhat to the colling effect of evaporating water applied by sprinklers. There is also increased interest in using sprinkler systems to combat frost damage early in the season.

There is a trend for increasing the use of sprinkler irrigation on potatoes in the Northwest states. The two main reasons probably, in addition to water control, are labor saving and the trend toward irrigating lighter textured, less water-holding capacity soils. [Fig. 3]



IRRIGATION EFFICIENCIES
1959-1960

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MDG-66-68s
Feb. 8, 1968

APPLICATION OF HERBICIDES BY MEANS OF SPRINKLER IRRIGATION SYSTEMS

The original idea of a solid-set sprinkler system was that of primarily saving labor, thus allowing the irrigator to be more certain he could apply water when needed. However, since the inception of the idea, many new innovations have been introduced for the expanded use of a solid-set system when irrigating fruit and vegetable crops.

First, application rates have been reduced by the use of smaller sized nozzles and sprinklers. With this has come the closer spacing of sprinklers for better coverage. This has helped to perfect the technique of temperature control--both to warm, protect from freezing, and also cool the crop when temperatures are too high.

The next logical step was to use the solid-set sprinkler system as a vehicle for applying materials the crop needed. The first of these was nitrogen fertilization. Next, the fruit growers realized the potential for applications of materials to control diseases and insects. At the 1964 Sprinkler Irrigation Technical Conference at Aurora, Illinois, Robert E. Palmer of the Sodus Fruit Exchange of Sodus, Michigan, reported that Michigan strawberry growers had successfully applied Guthion and Seven for insect control by means of solid-set sprinklers. Cyprex, Captan, and Thylate had also been successfully applied for disease control.

In the October, 1967, Sprinkler Irrigation Newsletter, the same Mr. Palmer reported that they had achieved 95% weed control in strawberries by the application of the herbicide Dacthal through their solid-set sprinkler systems.

As for the application of herbicides for weed control in potatoes by means of a solid-set sprinkler system, it has been done only on a limited field trial basis. No detailed replicated research work has been reported on this subject to date. Field trials of applying herbicides with sprinklers have been attempted in California, Oregon, Washington, and Idaho. The reported results of these trials have ranged from glowing success stories to that of complete failure.

To the knowledge of this author, materials tried to date have been Eptan, Dinitro [Dow Premerge], and Dacthal. In order for one to safely experiment with this type of herbicide application, it is important to understand the basic concepts of the method, as well as the major problems. First, it is basically more difficult to apply a herbicide than a fungicide or insecticide. A slight over-application of an insecticide or

fungicide usually will not kill the potato plants. However, herbicides must be applied on a given rate of material per area basis. Tolerances are often times very narrow between a safe application and one that might damage the crop.

A boom-type sprayer travels in a straight line and distributes the spray material quite uniformly over a rectangular-shaped piece of ground. With irrigation sprinklers, however, one attempts to cover a rectangle by means of a circular application pattern compensated for by overlapping. One must expect somewhat heavier applications on some areas than on others, even under the best design situations. With some herbicides it is entirely possible and probable that one could experience poor weed control and injured potato plants within the same field. Any windy conditions while sprinkling will worsen this situation.

The next consideration is the physical nature of the materials. Wettable powders may settle out of suspension in the main line. Concentrated materials will be extremely diluted in the irrigation water, with the subsequent questionable distribution of the active ingredients on the soil surface.

The usual method for sprinkler application of herbicides is to premix the weed chemical with water to be certain it is in suspension or solution. Usually 50-100 gal. of water will suffice for this. Then the mixture is injected into the main line, or it can be introduced on the suction side of the pump, if a centrifugal pump is being used. It usually takes about ten minutes for the material to reach to the end of a $\frac{1}{4}$-mile lateral, if the material is injected directly into the head end of the lateral. Each system should first be checked for this by using dyes or color markers in the water. Usually 1/2 to 3/4 inch of irrigation water is applied to the field after the herbicide is introduced into the sprinkler system.

Consider the herbicides that have been tried from the standpoint of recommendations and potential problems.

1. Eptam. This material is usually used at 3 to 4 lbs. per acre of technical material applied as a preplant and incorporated treatment. It is an emulsifiable concentrate. Therefore, getting it into solution in the water should be no problem. The material is quite volatile and gives a fairly long residual weed control. As to Eptam sprinkler application, the big question is how much does it take to injure the potato plant in case some areas receive an overdose? The answer to this question would be desirable before any large-scale sprinkler applications of Eptam are attempted.

2. Dinitro. This is usually used as Dow premerge, or Sinox P.E. The usual practice is to apply this material to the soil surface with a sprayer using 20-40 gallons of water per acre, just prior to potato plant emergence, at a rate of 3 pounds per acre of technical material. Dinitro is essentially a contact weed killer and has a short re-

sidual. Its activity depends upon temperature and humidity. It is extremely volatile. As this material is a liquid that goes into a water solution very easily, there should be no problem to dissolve it in the irrigation water. Over-application shouldn't be too serious, as this material is not systemic. However, it is possible to burn the growing point off from the potato sprouts under adverse conditions.

3. Dacthal. The recommended method of application of this herbicide is to apply 8-10 pounds of the 75% wettable powder on sandy and slit loam soils in 80 gallons per acre of water as a spray. This should be followed by an irrigation of at least $\frac{1}{2}$ inch of water. It can also be applied by incorporation of the same amount of material with a rolling cultivator just prior to emergence. A post emergence. A post emergence or lay-by application can also be made. It appears that the main problem with Dacthal is that it is a wettable powder and could possible settle out of suspension in the main line. There is a possibility that an overdose could cause phyto-toxicity, but this is not likely, judging by the double application, i.e., pre-emergence and lay-by, recommended on the label.

4. Lorox. The DuPont Company representatives have stated they will not have a label for use of Lorox in the Columbia Basin in 1968. It may be possible to purchase it, if the grower is willing to sign a waiver or a disclaimer.

5. Treflan. The recommended application of Treflan is to apply one pint per acre on light soils as a spray in 10 to 40 gallons per acre of water incorporated into the top 2-4 inches of soil, postplant. This material dissolves in water easily, so it could quite easily be applied through a sprinkler system. There may be a danger of potato plant injury if any areas in the field receive an overdose of Treflan.

In summation: [1] It is important to recall that the application of herbicides through sprinkler irrigation systems is still in the experimental stage. If any grower wants to try this, he should remember this and approach it on that basis.

[2] In addition, he should be sure that he understands the material that he is working with and applies it accordingly.

[3] It would be wise to treat a part of the same potato field with the same herbicide applied as the manufacturer recommends for purposes of comparison with the irrigation sprinkler-applied treatment.