

RESEARCH PROJECT OUTLINES

## HYDRAULIC RAM INVESTIGATIONS

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By

DEPARTMENT OF AGRICULTURAL ENGINEERING

VIRGINIA POLYTECHNIC INSTITUTE

1924-1925

The principle of the action of the hydraulic ram was recognized in 1772, and the first self-acting ram was built in 1796. Since that time, quite a little experimental work has been done, but more or less of a commercial nature.

While the hydraulic ram is an old pumping device, its application is not as widely understood as it should be. People throughout the State show an utter lack of information on this subject. During the past few years, the Department of Agricultural Engineering has had an opportunity to make a study of the farm water supply in the State at close range. The department has, by request, made surveys for sixty four ram installations during the past year. In most cases, the entire water supply comes from these springs, which means an enormous expenditure of time and energy in carrying the amount of water used an average distance of several hundred feet, and an average elevation of possibly 35 feet. Recognizing the lack of dependable information on the subject of ram installation, and the very positive need for it, this department will endeavor to obtain it in such a way as to be of practical benefit to the average user.

**OBJECT\*** An investigation of the operation of hydraulic rams working under practical conditions.

**PROBLEMS:** The problem will be conducted, having the following points in mind:

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- (1) To test the efficiency of all makes of rams used in this State. Each ram to be installed and worked under similar conditions.
- (2) To determine the advantages of a stand pipe. To note the effect effect the stand pipe has on the operation of the ram at different distances from it. To check the formula now used for different pipe lengths.
- (3) To find the minimum flow necessary to operate all the smaller rams, working under practical conditions.
- (4) To get the most efficient relation between fall and length of drive pipe. To get a definite relation between fall and elevation.
- (5) To get some data on friction as applied to the delivery pipe.
- (6) To experiment with different sizes of drive pipe on the size ram.

(7) To get the most efficient number of strokes per minute for the different heights of fall and lengths of drive pipe.

PROCEDURE: The investigation will include the installation and running of all rams that are available. No difficulty is anticipated in getting one or more of all the well known rams. The smaller sized will be used, as they are more applicable to Virginia conditions. The work will be done in the rear of the Farm Machinery Laboratory. Water from the college tank is accessible there; it is convenient to the tool room, and the contour of the grounds lends itself admirably to hydraulic ram conditions. The various manufacturers are expressing their desire to cooperate by consigning the needed equipment. With the possible exception of a small outlay for pipe fittings, the equipment will represent no money.

GRADUATE REQUIREMENTS: This investigation will represent the major subject for a degree in Master of Science in Agricultural Engineering to Mr. C. H. Robeson. He will meet the following requirements:

(1) Regular attendance of graduate seminar in Agricultural Engineering during the school year 1924-1925

(2) An accepted thesis, typewritten and bound, upon the investigation to be divided into these general heads:

- |                  |                            |
|------------------|----------------------------|
| (a) Introduction | (f) Conduct                |
| (b) Object.      | (g) Calculations           |
| (c) Theory       | (h) Curves.                |
| (d) Subject      | (i) Results                |
| (e) Arrangement  | (j) Summary and Conclusion |

(3) A year of resident work;

1. June 1924, to Sept. 1924, academic work,--obtaining ~~the~~ studying all available literature on hydraulic rams.

2. Sept. 1924, to June 1925, Academic work,-- investigation work as outlined.

(4) The following academic subjects will be required; Business Law, Industrial History.

(5) An examination in the major subject will be required after the completion of all other work for the degree.

AN ECONOMIC STUDY OF FARM WATER POWER PLANTS.

The subject of power development from small streams for farm use receiving widespread attention throughout the State. Authentic information is lacking as to the cost of such development. There are hundreds of installations of water wheels and water turbines in this State, and a study should be made of their installation for the purpose of finding out the cost of such installations.

**OBJECT:** To obtain reliable information on the methods, costs and uses of water power plants.

**PROBLEM:** An investigation of farm water power plants, with special reference to the economy of such installations.

1. To what extent are water power plants being used in Virginia, and for what purpose.
2. What types of water power plants are being used in Virginia, and what are the best conditions for their use?
3. What is the average life of such plants, and the cost of operation?
4. What is the average cost of installing water power plants?

**PROCEDURE:** A list of water power installations of all types in Virginia will be secured from manufacturers of such plants, County Agents and other sources. A questionnaire will be sent to all the owners of such plants in order to get the information necessary for making this study and arriving at conclusions.

**GRADUATE REQUIREMENTS:** This investigation will represent the major subject for a degree of Master of Science in Agricultural Engineering for H. M. Wallace. He will meet the following requirements:

1. Regular attendance of graduate seminar in Agricultural Engineering during the school year 1924-1925.

2. An accepted thesis, typewritten and bound, upon the investigation, to be divided into the following general heads:

- |                  |                            |
|------------------|----------------------------|
| (a) Introduction | (g) Calculations           |
| (b) Object       | (h) Curves                 |
| (c) Theory       | (i) Results                |
| (d) Subject      | (j) Summary and Conclusion |
| (e) Arrangement  | (k) Bibliography           |
| (f) Conduct      |                            |

3. A year of resident work:

(1) September 1924 to June 1925, academic work,-- investigations as outlines.

(2) An examination in the major subject will be required after the completion of all other work for the degree.

## THE APPLICATION OF ELECTRICITY TO AGRICULTURE

This is a problem of state wide interest and importance. The constantly increasing shortage of farm labor has made it necessary that the farmer adopt labor saving devices and practice if he is to make a success of his farming operations. Many farmers and others familiar with the subject believe that electricity offers a means of solving many of the farmer's labor and power problems, and everyone admits that electricity in the home will be a boon to the farm housewife and will be an important factor in improving living conditions on the farm.

The economic features of the application of electricity to agriculture are of first importance from the farmer's standpoint. He is vitally interested in knowing the comparative costs of the various methods of getting electricity on the farm, such as purchasing electric power from central service electric power companies, using isolated gas engine electric plants, using farm water power plants.

**OBJECT:** To obtain reliable information on the methods, costs and use of electricity on the farms of Virginia.

**PROBLEM:** An investigation of the present available sources of electricity power, covering its application to agriculture.

1. To what extent is electricity now being used, and for what purpose, on the farms of the State?
2. What are the methods of supplying electric service to rural customers.
3. What are the costs of supplying electric service to rural customers?

**PROCEDURE:** The method of procedure will be to send a questionnaire to all electric power companies in the State. In this questionnaire, the companies will be asked for the number of farm customers they are serving; amount of electricity used by each farm customer; number of farmers to the mile of transmission line; type of contract; rates charged farm consumers; method of financing the rural distribution lines; names of farmers who are on rural lines. A questionnaire will also be sent to the farmers having individual electric light plants, in order to get the information required in regard to these plants. Tests will be run on the individual electric light plants in the department laboratory to get the K. W. hour cost of electricity from this source. Comparative tests will also be run on feed grinding with electricity from this source, as compared with gas engine, power.

**GRADUATE REQUIREMENTS:** This investigation will represent the major subject for a degree of Master of Science in Agricultural Engineering for Mr. F. M. Sommerville. He will meet the following requirements:

1. Regular attendance of graduate seminar in Agricultural Engineering during the school year, 1924-1925.

2. An accepted thesis, typewritten and bound, upon the investigation, to be divided into the following general heads:

- |                  |                  |
|------------------|------------------|
| (a) Introduction | (e) Arrangement  |
| (b) Object       | (f) Conduct      |
| (c) Theory       | (g) Calculations |
| (d) Subject      | (h) Curves.      |
- (i) Results  
(j) Summary & Conclusion  
(k) Bibliography

3. A year of resident work;

(1) September, 1924 to June 1925, academic work investigations as outlined.

(2) The following academic subject will be required: Industrial History, Business Law-two terms- Elements of Electrical Engineering.

(3) An examination in the major subject will be required after the completion of all other work for the degree.

## SPRAY EQUIPMENT INVESTIGATION.

**FOREWORD:** The control of insect and disease parasites of fruit crops is one of the major problems of the fruit grower. Methods of control have been determined in a large measure, yet a considerable percentage of loss occurs each year. This loss must be the result of the orchard being underequipped with spray outfits; to the use of faulty equipment, or to the poor application due to the personnel of the labor force, weather conditions, etc.

At this time, we are particularly interested in the type of outfit offered to the grower. High powered outfits of large capacity, working under very heavy pressure are generally advocated as a means of rapid and efficient application. The larger outfits are a labor saving development and came into use both on account of labor shortage and for the reason that finely divided spray is said to be more effective in parasite control. Very high power engine and large pump capacity are necessary to secure a large volume of spray and at the same time to deliver it in a finely atomized form. The use of such equipment is very expensive; the initial cost is high and constant, repairs are necessary, due to the fact that the outfits are worked at full, or over, capacity. Any further increase in pressure can only be met by the companies redesigning the outfits, according to the work received from the manufacturers of spray outfits. Redesigning is very expensive and the cost would be passed on to the growers at a time when economy in production is especially essential.

The spray outfits have now reached the size that limits their rapid transportation through the orchard and limits the use of the larger outfits on the rougher orchard lands. A size limit has to be reached at some point; this limit should be at the point where efficiency of application and economy of use coincide. No data are available to fully determine the efficiency and economy of the various per minute rates of application now available by the use of various types of modern equipment. Neither is the effect of degree of atomization or the covering power of the spray material, burning, amount of material used, nor the required type of outfit, etc. known. It seems as though there is a real need for a study of some of the physical problems connected with orchard spraying and the following tentative outline is suggested for such an investigation.

**PROBLEM:** An investigation of spray equipment, with a special reference to effects of size of nozzle orifices and pressure on atomization of spray material and the resultant effects on:

1. Covering power of the spray material.
2. Penetration power of the spray material.
3. Carrying power of the spray material.
4. Economy of spray material.
5. Impaction of force of spray material.
6. Injury to fruit and foliage.

In addition, the corrosive action of the spray material in increasing the size of the nozzle orifice, under different pressure constants will be measured. Its accessories will be recorded as they come to light.

**EQUIPMENT AND MATERIALS:** A five-horse-power Deming spray outfit is available to furnish power for the tests. If higher power than the Deming outfit will furnish is thought advisable, it is probable that such a pump can be secured from the Engineering College. If found advisable, other makes of spray outfits will also be used.

The Friedn type nozzle will be used in the test. The Friedd Manufacturing Company will probably furnish these accessories free of charge. Instruments for accurately measuring the size of the orifice and for correctly determining amount of pressure can be obtained from the Engineering College.

A mechanical driven sprayograph can possibly be secured from the Iowa State College. Dyes to color spray material, gasoline, photographic supplies, etc. will have to be purchased; screens for penetration tests can be purchased or obtained from hardware of spray companies. Some method of measuring impaction force will have to be devised if this information is to be secured.

**PROCEDURE:** The laboratory procedure involves the testing of several definitely measured nozzle orifices under numerous pressure constants. The distance from the sprayograph at which tests will be determined will be varied for each pressure constant, so that they approximate field conditions under which spraying is done. (See graphic outline)

The effect of each test will be recorded for atomization of spray material, covering power, penetration, carrying power (horizontally and at incline) amount of discharge per minute, rate of erosion of the orifice, impaction force, etc. The power required in each case will be determined.

**GRADUATE REQUIREMENTS:** The investigation will represent the major subject for a degree of Master of Agricultural Engineering to Mr. W.F. Simpson. He will meet the following requirements.

1. Regular attendance of graduate seminar in Agricultural Engineering during the school year, 1924 - 1925.

2. An accepted thesis, typewritten and bound, upon the investigation, to be divided into these general heads:

- |                   |                             |
|-------------------|-----------------------------|
| (a) Introduction, | (f) Conduct,                |
| (b) Object,       | (g) Calculations,           |
| (c) Theory,       | (h) Curves,                 |
| (d) Subject,      | (i) Results,                |
| (e) Arrangement.  | (j) Summary and conclusion. |

3. A year of resident work.

1. June, 1924, to September, 1924, academic work, - obtaining and studying all available literature on spray equipment.

2. September 1924 to June, 1925, academic work, - investigation work as outlined.

3. The following academic subjects will be required, Industrial History, Business Law.

4. An examination in the major subject will be required after the completion of all other work for the degree.