The Irrigation of Truck Crops in the Okanagan Valley

by

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OKANAGAN VALLEY

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A Thesis Submitted for the Degree of

Master of Science in Agriculture

in the Department

of

Horticulture.

The University of British Columbia.

April 1923.

Accepted April 1923

F. F. Barss

PLATE I

General View of Plots. August 15, 1922.

Field Equipment used in making Soil Moisture and Soil Temperature Determinations.

PLATE II

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Plot B. August 15th, 1922. This plot received 12 inches of irrigation water during the season.

PLATE III.

Plot C. August 15, 1922. This plot received 18 inches of irrigation water during the season.

Plot D. August 15, 1922. This plot received 24 inches of irrigation water during the season.

PLATE IV.

Plot A. August 15, 1922. This plot received 6 inches of irrigation water during the season.

Plot B. August 15, 1922. This plot received 12 inches of irrigation water during the season.

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INTRODUCTION

The Relation of Irrigation to Human Progress

Our present day civilisation is closely associated with the development of the Science and Art of Irrigation. Not only is the huge population of India and the Orient supported largely through the artificial application of water to the land, but the Western peoples, also, owe much of their material prosperity to the practice of irrigation farming. About twenty-five per cent of the earth's surface receives ten inches or less of rainfall annually, and can, with our present knowlege, be made productive only through irrigation. On another thirty per cent of the earth's surface the rainfall is such that dry farming methods are necessary to produce even the extensive crops, while for intensive production irrigation is required. Even in those areas where the annual precipitation is relatively heavy, droughts often occur, during which it is found profitable to supplement the natural rainfall by irrigation. So great is the area of land

\# A preliminary report of an irrigation experiment which is being conducted at the Dominion Experimental Station, Summerland, B.C.

which would be benefitted by irrigation that even could all the water resources of the world be utilized to the full, it is probable that over four-fifths of the earth's surface would be left thirsting. In many lands the prosperity and progress of the people will be determined, in large measure, by the extent to which care is taken to make the most economical use of every available drop of water.

The Evolution of Irrigation Practices.

The practice of irrigation is probably almost as old as Agriculture itself. It dates back to the time when primitive man discovered that he could strengthen his hold on life by giving protection and encouragement to those plants which provided him with food. History records that irrigation had been brought to a high stage of development in Egypt, long before the Christian Era. Indeed, the marvelous civilizations of Egypt and Babylonia could never have existed without irrigation, the influence of which prevades the economics, politics, social life, agriculture, legislation, and even the religion of these ancient peoples. We read that in the time of the Pharaohs the "basin"system of irrigation was used. In this system the flood waters were held over the land for some forty-five days per annum to a depth of several feet. The times of flood of the Nile, and the climate of Egypt are particularly adapted to this method of applying water; so much so that even today half of Upper Egypt is irrigated in this way. While such a method has certain advantages, in that it minimises the labour of applying the water and of cultivating the land, it also has a very serious defect, since it permits of the application of water only at flood time. About the year 1820 Mohamed Ali Pasha changed the irrigation system of L ower Egypt by excavating a number of deep canals capable of discharging the low level summer supply of the Nile. The summer flow, is, however, very limited, and as more land was brought under summer irrigation it became necessary to store water, and it is for this reason that the great Assuan dam was built, impounding approximately 2,000,000 acre-feet of water. By the use of this stored supply as a supplement to the waters of the flood period it has been possible to so extend the irrigation season that at the present time crops are kept growing every month of the year. This economy in the use of water is largely responsible for the fact that Egypt now supports one and a half persons per acre.

The evolution of irrigation has involved the development not only of storage reservoirs, but also of less wasteful methods of distribution. From the "basin" system, with its uneven flooding of the land - the depth of water varying from one to ten feet with the topography - various advances have been made with the idea of ensuring a uniform distribution of water with the minimum loss through percolation, evaporation and run-off. Thus, there are in use today such methods of distributing water as Free Flooding by Contour Ditches, the Border Ditch System, the Border Dyke System, the Furrow or Corrugation,Method, Sub-irrigation and various Overhead Systems each Method or System adapted to some particular set of conditions, but all devised with the common purpose of effecting an economical and efficient distribution of water.

Throughout the history of irrigation one fact stands out very clearly. There has, as has been said, been a gradual advance in the direction of more economical use of water. The custom of using water only at flood time, which involved a deluge followed by a drought, has given way to the storage of water in natural or artificial reservoirs, from which it may be drawn off with the minimum of waste and applied to the soil when the crops are most in need of it. The ancient method of applying water in one large application has been superseded by the modern plan of delivering water more frequently and in smaller amounts so that the maximum quantity will be held in the upper soil strata where it is available to growing plants.

The Necessity for Irrigation Experiments.

The method through which improvement in irrigation practice has been brought about is largely that of experimentation. The observant irrigator obtains the answer to the question "how can I make the best use of my available water supply?" by noting and comparing the results obtained by applying various amounts of water to various crops at various times. Although this process of securing information through experimentation has doubtless been going on since prehistoric man first applied water to the roots of a plant there still remains much to be learned. As is well known, the actual volume of water required to irrigate successfully an acre of any specific crop is dependent on a large number of variable factors, chief among which are the soil and climatic conditions. Therefore, until mankind has acquired a more complete knowledge of the fundamental principles which underlie the correct application of irrigation water, it will still be necessary to conduct local experiments whenever any new set of conditions is encountered. The reaearches of such men as Widtsoe (38), Fortier (9), Hammatt (17) and Harding (18) have contributed to our understanding of the many "whys" of irrigation practices. Sufficient insight has not yet been gained, however, to permit of the recommendation of detailed practices in a new district, without first subjecting these practices to the test of loçal experiment.

The Diversity of the Results of Irrigation Experiments.

The truth of the statement that irrigation practices, to be economical and efficient, must be adapted to the local conditions existing in any particular district is clearly indicated by the diverse results obtained from irrigation experiments conducted at the various Experimental Stations in the United States. To use the work with potatoes as an example. Widtsoe(36), working on a gravel bench soil at the Utah Station found that land which received 40 inches# of water in seven irrigations, produced larger yields, both total and marketable, than did smaller amounts with fewer applications. Results obtained at the same station by Richman(32), showed that the largest yield of marketable potatoes was produced on plots receiving a total of only 14 inches of water. In a summary of five years investigations of the water requirements of the potatoe, Harris(19), also of Utah, makes the statement that "One inch weekly, or a total of 12.8 inches during the season, gave a higher yield than any other treatment". Snelson(33), in a report on a series of eight experiments dealing with the irrigation of the potato at Brooks, Alberta, recommends applying a total of 20 inches, and suggests 3 inches as the most economical depth to apply at one time. Experiments conducted in Arizona by McClatchie(27) indicated that a total of 18 to 24 inches of water during the irrigation season, used in applications of about 5 inches, was ample for

#Unless otherwise stated, wherever "inch" of water is used in this report it refers to the depth to which the water would cover the ground.

most potato soils. From extensive experiments and observations covering five years, carried out by Bark(1) at Gooding, Ohio, it appeared that the yield of potatoes tended to increase as irrigation water was applied up to 26 inches. Welch(35) working in the same state found that about 21 inches of water produced the largest yield of marketable potatoes, and that 8 inches gave the largest yield per inch of water.

The tremendous variation in the results of these numerous experiments, carried on with the same crop and in each case by trained investigators, demands an explanation. The apparent inconsistency in these results merely serves to prove conclusively that the efficiency of various irrigation practices in any particular instance is dependent on the inter-relation of a large number of variable factors, some of the more important of which are:

1. Climate.
2. Soil.
3. Topography.
4. Crop.
5. Cultural Methods.
6. Composition of Irrigation Water.
7. Method of Applying Water.
8. Previous Irrigation.
9. Skill of the Irrigator.
10. Experimental Technique.

The variability of these several factors not only constitutes an explanation of the diverse results obtained from irrigation experiments in the past, but also suggests the necessity for additional investigations, especially in areas recently brought under irrigation. An understanding of the effects which change in soil, climate, etc., have, on the economy of various irrigation practices is necessary before the justification for local irrigation experiments can be fully appreciated. Furthermore, a realization of the fact that cultural methods and the chemical content of irrigation water etc., have an influence on the results of irrigation experiments is essential before an intelligent interpretation of these results can be attempted.

It is therefore, considered advisable to discuss briefly, at this point, the bearing of each of these factors upon irrigation practices.

Climate.

The irrigation requirements of crops are affected by rainfall, temperature, hours of sunshine, humidity of the air, and the prevalence of drying winds. Soil moisture is affected not only by the total rainfall, but also by the time of year at which precipitation occurs. Widtsoe(38) has shown that light showers during the summer often do more harm than good in that they tend to destroy the soil mulch, thus restoring capillary connection with the damp soil below the surface and facilitating the loss of moisture by evaporation. Widtsoe(37) has also demonstrated that it is advisable to employ different methods of moisture conservation when the precipitation takes place in the winter than is the case when most of the annual rainfall occurs during the growing season. Investigations carried out by Fortier(12) indicate that temperature is the most important factor in determining the amount and rate of evaporation. Fortier(12) is also authority for the statement that evaporation is increased by low humidity and by air movement. Widtsoe(38) reports that at Utah the shading of soil from the direct rays of the sun reduced the evaporation by 25 per cent.

It is quite evident, therefore, that in comparing irrigation results careful consideration must be given to meteorological records.

Soil.

The most advantageous number of applications and the most beneficial amount of irrigation water to apply, depend largely on the character of the soil and subsoil. The presence of humus or decayed organic matter in a soil increases its power to absorb and retain moisture. A sandy soil absorbs water more rapidly than does a clay soil. There is also greater danger of loss through percolation beyond reach of plant roots where the subsoil is of a gravelly nature, than where the underlying stratum is relatively impervious.

It must not be inferred, however, that a layer of impervious hard pan near the surface of a soil provides a condition where heavy applications are desirable. Exactly the reverse is the case, for such soils are easily over saturated resulting in a condition of soil moisture unfavorable to plant growth. Similiarly, in soils where the water table is near the surface, optimum growing conditions are provided only by relatively small and frequent applications of irrigation water.

Widtsoe(42) is authority for the statements that evaporation is more rapid from soils of fine texture than from those made up of coarse particles; that water evaporates more quickly from dark-coloured than from light-coloured soils; that other conditions being similiar, a deep soil loses more moisture through evaporation in a given time than does a shallow soil; and that a concentration of soluble salts in the soil retards the vaporization process. The observation that it requires less water to grow a crop on a fertile soil, than on one which is deficient in plant nutrients has so much experimental proof that it is regarded as a law. Widtsoe(39) in experiments carried out in Utah found that when very small quantities of commercial fertilisers were applied to infertile soils, the number of pounds of water required to produce a pound of dry matter was reduced from 1,012 to 459 in the case of a sandy soil, and from 1,331 to 445 in the case of a clay soil.

A series of carefully conducted tests made by Bouyucos (2) indicate that the quantity of water required to produce a pound of dry matter is decreased by an increase in the concentration of the soil solution, provided the dissolved substances are plant nutrients.

It is evident, therefore, that in studying the results of irrigation experiments, it is of vital importance to make due allowance for the physical and chemical nature of the soil, as well as for its depth and moisture holding capacity.

Topography.

The efficiency with which water can be applied to the soil is considerably affected by the contour, slope and grading of the land. It is difficult to irrigate abrupt hillsides without waste, while a gentle slope facilitates the economical application of water. Where land is poorly graded, hollows and hillocks are formed, which result in an uneven distribution of moisture in the soil. A tract of land sloping to the south, since it is exposed to the direct rays of the sun, loses moisture through evaporation more rapidly than does one with a northern aspect, or one which is comparatively level. The topography of the land, therefore, has a direct bearing on irrigation practice, and its influence on the results of irrigation experiments must be given due consideration.

Crop.

The irrigation requirements of individual crops vary with their ability to absorb and utilize soil moisture, the extent of their root system and their season and rate of growth. The recent investigations of Briggs(5) indicate that in any particular soil there must be a certain percentage of moisture to prevent plants from undergoing permanent wilting, and that in a saturated atmosphere, this percentage of moisture is substantially the same for all plants. It is common knowledge however, that up to the point where wilting occurs crops differ markedly in their ability to absorb moisture from the soil. According to Widtsoe (41) crops which mature early appear to use water more rapidly than those which have a longer growing season. Thus, the short season crops such as wheat and oats are considered to take up water more rapidly than do crops such as corn and potatoes which make a slower growth over a longer season. The total water used by the long season crops, however, is often greater than that required to bring the more rapidly growing crops to maturity.

While Lloyd's (25) researches on the physiology of the stomata indicate that plants cannot regulate the rate of flow of the transpiration stream before wilting actually occurs; yet, it is well known that transpiration is far more rapid from some types of plants than from others. Although the stomata are not considered to be adaptive or regulatory in nature, yet, the rate of transpiration from any particular type of plant is greatly influenced by the number, size and location of the stomata. Thus in desert plants the number of stomata is greatly reduced. In some cases transpiration is further limited by the fact that the stomata are located at the base of pits or are protected by hairs.

Furthermore a large number of experiments conducted by such investigators as Leather, King, Lawes, Wollny, Hellriegel and Briggs and summarised by Lyon.(26) prove conclusively that the quantity of water required to produce a pound of dry matter is not only different for each type of crop, but that even closely related species of the same type of crop do not have the same ability to utilize water. Aside from the fact that plants vary in their power to absorb and utilize soil moisture it is obvious that the economy of various irrigation practices will be affected by differences in the extent of root systems of various crops. Thus, with a normally deep-rooted crop such as alfalfa, water can be applied in larger amounts than would be desirable when the more shallow feeding crops, such as the cereals, are under consideration. The importance of this statement is emphasized by the fact that recent investigations on the capillary rise of soil moisture conducted by Rotmistrov, Briggs and other research workers and summarised by Gardner (14) indicate that very little of that moisture which percolates below reach of plant roots is available for plant use.

In view of these facts it is obvious that in estimating the most economical irrigation practices for any particular locality adjustments must be made to suit the individual water requirement of the crops which are to be grown.

Cultural Methods.

The importance of cultural operations in the conservation of moisture is universally recognized. Time and depth of plowing, frequency of cultivation, destruction of weeds, crop rotation, manuring, cover-cropping, fallowing, and drainage all have a direct bearing on the amount of moisture which is retained in the soil for the use of growing crops. Less irrigation water is required where crops are grown in rows, and intertillage is practiced after each irrigation, than where the furrows are left uncultivated.

While recent experiments by Grantham (15) and Thompson (34) suggest that tillage conserves moisture mainly by the eradication of weeds, and that the importance of the soil mulch in this connection has been somewhat overestimated, the work of Briggs (3), Fortier (10) and Widtsoe (38) all tends to support the statement that the condition of the top soil as influenced by such cultural operations as plowing, cultivation, rolling and packing, does have a very significant incluence on the amount of water lost through evaporation from the soil surface.

It is evident, then, that irrigation practices are very closely linked up with cultural methods, and that this fact must be given due weight when the results of irrigation experiments are under discussion.

Composition of Irrigation Water

The results of experiments may be seriously affected by the mounts and nature of dissolved and suspended substances carried own in the irrigation water. Analyses of river waters by larke (7) indicate that there is a wide range in the propor-ion of dissolved substances which they contain. Widtsoe (43) as shown that in some cases irrigation water contains in sol-tion, salts of phosphorous, nitrogen, and potassium, in suf-icient quantities to supply all of these chemicals required to roduce a full crop. In other cases the amount of plant nut-ients available from this source is practically negligible. earney (22) has shown that the concentration of saline solu-ions which plants can withstand is influenced not only by the mount of such injurious salts as magnesium sulphate and sodium arbonate which are present, but also by the proportion between hese salts and others such as calcium sulphate and magnesium arbonate, which act as antidotes.

Not only is the soluble matter in water important from the standpoint of irrigation, but suspended matter, also, may play a significant role. Forbes (8) reports that in Arizona the sediment from one season's irrigation frequently covers the land to a depth of from 4 to 6 inches. The tremendous fertil-iser value of the overflow of the Nile, heavily laden with sus-pended matter, is well known.

In attempting to understand the response of a crop to var-ious applications of water, attention must therefore be paid to the chemical analysis of the water used.

[M]ethods of Applying Water

The ideal system of irrigation is that which, with the [m]inimum loss of water through percolation, evaporation, trans[p]iration and run-off, ensures the most uniform distribution of [m]oisture throughout the soil where plant roots are feeding. [I]n actual practice the system of distribution adopted depends [o]n many factors such as the nature of the soil, the topography, [a]nd the intensity of cultivation. Thus various systems of [f]looding, of overhead irrigation, of furrow distribution, and [o]f sub-irrigation have been devised to meet the particular con[d]itions which exist in each irrigation district. Water losses [t]hrough excessive transpiration, evaporation, percolation and [r]un-off are not the same for these various systems of distrib[u]tion. For instance, Fortier (13), in a summary of investigati[o]ns conducted at Reno, Nevada, states, that not only was the [l]oss through evaporation less where the furrow method of ir[r]igation was used than was the case when flooding was practic[e]d, but that an increase in the depth of the furrow gave a [m]arked reduction in the exaporation loss. The length of the [f]urrow is also an important factor, since where the furrows [a]re unduly long a large excess of water sinks into the soil at [t]he upper end of the field and percolates down below the reach [o]f plant roots.

It may be readily comprehended, therefore, that the method [o]f applying water can very materially affect the results of [i]rrigation experiments.

Previous Irrigation

In a consideration of the irrigation requirements of crops account must be taken of the number of seasons irrigation has been practiced. That continued irrigation has a cumulative effect on the soil moisture is an established fact. In extreme cases of over irrigation the water table may be brought undesirably near the soil surface, while it is common experience that when a new tract of land is brought under irrigation more water must be applied the first few years than is the case after the subsoil has become thoroughly moistened. Furthermore the researches of Cameron (6) have shown that the physical nature of a soil is profoundly influenced by the application of irrigation water.

It is important, therefore, to take into account the previous irrigation history of land where irrigation experiments are carried out, as well as to make allowances for the amount of moisture present in the soil and subsoil at the beginning and close of an experiment.

Skill of the Irrigator

The efficient utilization of irrigation water depends largely on uniformity of distribution. Probably the most important factor in the reduction of wastage through uneven distribution of moisture, is the skill of the irrigator. The capable and experienced irrigator so handles the water as to reduce to a minimum the losses through evaporation, percolation and run-off. Inexperience and inefficiency on the part of the irrigator result in extravagant and wasteful use of water.

The efficiency of the irrigator, therefore, has a great deal to do with the success or failure of any particular irrigation practice.

Experimental Technique.

It is only within the last decade that investigators have ome to a full realization of the very significant role which echnique plays in determining the reliability of experimental esults. Such research workers as Kiesselbach (23), Hall (16), ood (44) and Pickering (29) have shown that serious errors may reep into the results of experiments not only through failure o employ sufficient care in planning and carrying out a proj-ct, but also through the adoption of faulty methods of inter-retation. It is now recognized that the results obtained rom an experiment may be completely invalidated owing to the ffects of soil heterogeneity, competition between adjacent ows, failure to eliminate border rows, incomplete stand, etc. arious suggestions for the reduction of experimental error to minimum are advocated by the several investigators, but all re agreed upon the necessity for conducting experiments over series of years and for the frequent replication of plots.

It is altogether probable that differences in the techni-ue of planning experiments and of interpretating data are esponsible for a great deal of the apparent contradiction in he results of irrigation experiments.

From a consideration of the possible influence of the bove factors on the results of previous irrigation experiments t is clearly apparent that the results secured in other irri-ated areas should not be accepted as applying directly to ritish Columbia conditions.

IRRIGATION OF TRUCK CROPS IN THE OKANAGAN VALLEY.

In attempting to ascertain the irrigation practices most dapted to the production of truck crops in the Okanagan Valley t was deemed advisable to conduct local experiments. In order o avoid unnecessary duplication of effort, advantage was taken f the work of other investigators who had carried out experients along similar lines. A careful study was made of the esults of numerous experiments conducted in the irrigated secions of the United States. From a survey of these results, and knowledge of the local conditions of soil, climate, etc., it as possible to predict with a fair degree of accuracy, these rrigation practices which would be most likely to meet with access in the Okanagan Valley.

igest of Approved Methods of Irrigating Truck Crops.

The following is a digest of the general observations of idtsoe (40) and Fortier (11) concerning the irrigation of ruck crops.

. Most truck crops can be grown successfully under the clim-tic conditions which prevail in irrigated regions.

. Where irrigation is practiced it is possible to obtain rofitable yields of truck crops on a wide range of soils. est results are secured, however, on loose friable soils with ood under-drainage.

. For success in the production of truck crops under irrig-tion it is of primary importance to maintain the soil in a igh state of fertility. Some system of rotation involving the se of a legume is advisable, in order that both the nitrogen nd the humus content of the soil may be replenished. Contin-ous cultivation without the use of cover crops or manures soon xhausts the soil and causes yields to decline.

. Before planting truck crops the land should be carefully raded and leveled to facilitate the uniform distribution of rrigation water.

. It is important to have the soil in such good physical con-ition that it absorbs and retains moisture readily. This can nly be accomplished by practicing approved methods of soil anagement, such as deep fall plowing followed by thorough reparation of the soil before planting.

. Cultivation should be practiced after each irrigation and everal times between irrigations. A dust mulch should be aintained until the plants shade the soil, or until the grow-h of the crop prohibits further use of the cultivator. The oil should be worked deeply at first, but as the season ad-ances the cultivations should be made shallower to avoid njuring the root system of the plants.

. All in all, the furrow method of irrigation gives the most atisfactory results with truck crops. Sub-irrigation is feas-ble only in a few localities where the lands are naturally ub-irrigated. Flooding is conducive to sun scald, tends to njure the physical condition of the soil, and results in great oss through evaporation. Overhead Irrigation is expensive to nstall, and requires clean water under considerable pressure o ensure efficient operation. Like flooding it involves great oss of water through evaporation. Where the furrow method s employed it is universally conceded that less water is re-quired where comparatively narrow, deep furrows are used, ince less wet soil is exposed to evaporation than is the case here wide shallow furrows are made. The loss of water through ercolation is much greater with long furrows, than is the case here the water is run for only a short distance. Runs of reater length than 300 feet are inadvisable, while in porous oils best results are secured with much shorter furrows.

. There should be moisture enough in the soil in the spring o germinate the seeds without further irrigation. Where the atural winter precipitation is not sufficient to moisten the oil to the full depth of root action, winter or fall irrigat-on is of advantage. The question of whether, in the event of

iere being insufficient moisture in the soil to ensure rapid
id complete germination, it is preferable to apply water just
efore or just after seeding is still undecided; both practices
re to be avoided whenever possible.

. The first irrigation should be postponed as long as possibl
fter planting, because early irrigations bring the root system
the surface, which in turn means a large, wasteful use of
ater later in the season.

). Water applied late in the season causes late growth, thus
elaying the period of maturity.

1. Truck crops as a whole are most in need of irrigation dur-
ng the months of July and August.

2. The amount of water which it is advantageous to apply at
ne time varies with the crop and the local conditions, but it
s seldom advisable to apply more than 6 inches at a time while
or 4 inches is an average application.

3. The total amount of water which can be applied to advantag
uring the growing season depends on the nature of the crop and
n local conditions, but applications of more than 30 inches
re seldom economical; while frequently the most profitable
ields are secured where smaller amounts of water are applied.
he increased yield due to the increase in irrigation is not
roportional to the added quantity of water. Many crops are
eriously injured by over irrigation, while the produce of
ighest quality is invariably obtained where water is applied
n medium rather than in large quantities.

4. Where the soils are deep and well cultivated and where the

nual rainfall is from 10 to 15 inches good crops of the llowing vegetables can be produced with the amounts of water dicated.

ans.........	10 to 15 inches.	Cabbage..........	24 to 30 inches
rrots.......	18 to 24 "	Corn.............	10 to 15 "
ntaloupes...	10 to 12 "	Potatoes.........	15 to 24 "
matoes......	12 to 18 "		

. Water may be economized, and a greater quantity handled by e irrigator where distributing devices, such as flumes with equent adjustable gates, are employed.

. The maintenance of uniform conditions of soil moisture is e key to success in the irrigation of all truck crops.

The acceptance of the above general information concerning rigation practice as applied to the production of truck crops rrows the necessary scope of local experiments, but does not iminate the necessity for conducting local irrigation invest-ations, especially in a region such as the Okanagan Valley ere conditions are decidedly unique.

'ustification of this Particular Experiment.

In the Okanagan Valley there are thousands of acres of :ertile land over which the precipitation is such that satis-:actory yields of fruit, truck, and farm crops can be secured)nly by the artificial application of water to the soil. /ith irrigation, however, the conditions become highly favour-able to crop growth. Truck crops such as tomatoes and canta-loupes thrive particularly well in the southern end of the valley, while onions and potatoes are grown extensively in the north. The total acreage of the Okanagan Valley to which water can be applied with profit depends on many factors, such as the fertility of the land and the cost of installing distrib-ution systems, but is limited in the final analysis by the quantity of water available for irrigation purposes. There is not sufficient water available, at reasonable cost, to irrig-ate all the thirsting agricultural land in the Okanagan. It is therefore imperative that the available water be used with care and economy so that it may be made to cover as much land as possible.

In order that the most economical use may be made of the irrigation resources of the Okanagan Valley it is a vital necessity that accurate information be secured as to the quantity of water necessary to ensure optimum development of the crops grown. Such information provides a sound basis for calcultaing the amount of land which can be served to best advantage by the available water supply. Furthermore, a knowledge of the irrigation requirements of individual crops

s of inestimable value to the grower, since it enables him to
:ilize the water at his disposal, when and where it will give
:eatest returns. Realizing that trustworthy information as
) the conditions of soil moisture most favourable to the pro-
ıction of specific crops is essential if losses due to faulty
:rigation practices are to be avoided it was decided to con-
ıct local irrigation investigations in the Okanagan Valley.

Previous to 1914 no accurate records had been kept of the
)lume of water used in the production of crops under Okanagan
)nditions. In that year the Federal Department of Agriculture
stablished an Experimental Station at Summerland. Measuring
evices were installed at this Station, and detailed records
re being kept of the quantity of water supplied to the various
rops produced.

This report deals chiefly with an irrigation experiment
nstituted at the Summerland Station in 1920. The project was
ndertaken to obtain information as to the irrigation require-
ents of those truck crops grown extensively throughout the
kanagan Valley. To ensure reliability in the results secured
his experiment must of necessity be carried on over a number
f years. However, it is considered that sufficient informat-
on has already been secured to justify the compilation of
his preliminary report.

STATEMENT OF THE EXPERIMENT.

ırpose of the Experiment.

A comprehensive investigation of the irrigation require- ınts of truck crops was started in 1920 at the Summerland ɪperimental Station. The primary object of this experiment is ı obtain reliable data concerning the water requirements of ɪrious truck crops when these are grown under the soil and .imatic conditions which prevail in the Okanagan Valley. In- ɪrmation is being sought with regard to the most advantageous:

1. Amount of irrigation water to apply per season.
2. Time to apply irrigation water.
3. Frequency with which to apply irrigation water.
4. Amount of water to apply at each irrigation.

The project has also a secondary purpose: to demonstrate ꞅ a concrete illustration, the efficiency and the feasibility ꞉ practicing approved methods of irrigation farming in the ꞏoduction of truck crops in the Okanagan Valley.

ocation of the Experiment.

This experiment is being conducted at the Summerland perimental Station. The environment of this station is pical of conditions as they exist over much of the bench nd of the Okanagan Valley. With respect to climate, authentic teorological records indicate that the precipitation and mperatures experienced at Summerland are midway between those countered at the Northern and Southern extremities of the lley.

The soil, like that of much of the Okanagan bench land, is nature lacking in humus and nitrogen, but gives no indicat- n of being deficient with regard to mineral plant nutrients.

It is evident, therefore, that the location of the project such that the results secured may be considered to apply to large area of the Okanagan Valley.

ite of the Experiment.

The project is being carried out on a block of land which as an Eastern aspect. Very little grading was necessary to ender the slope ideal for furrow irrigation. The soil consiss of about two and a half feet of fertile sandy loam, underaid with a subsoil of fine sand. Such conditions, though by o means general in the valley, are nevertheless representative f much of the land devoted to truck crops. Previous to 1920, hen this experiment was started, the cultural treatment of he block of land selected as a site had been such as to proote uniform fertility. No barnyard manure or commercial ertiliser had ever been applied. The block had been operated s a unit and had received the following treatment:-

1914 - Plowed.

1915 - Planted to Oats - no irrigation - crop harvested.

1916 - Planted to Oats - irrigated - crop harvested.

1917 - Planted to Potatoes - irrigated - crop harvested.

1918 - Planted to Vetch - irrigated - crop plowed under.

1919 - Planted to Vetch - irrigated - crop plowed under.

eneral Plan of Procedure.

t was planned:-

1. To carry on the experiment for at least five years.
2. To measure out from a block of land of uniform fertility, eight equal plots, each a fraction of an acre in area.
3. To plant four of these plots to truck crops and four to vetch each year; the vetch to be plowed under as a cover crop.
4. To maintain the productivity of the soil by rotating the truck crops with the vetch; thus each plot would be planted to vegetables one year and to vetch the next.
5. To practice approved methods of soil and crop management.
6. To apply water at the rate of 6, 12, 18 and 24 inches respectively, to each vegetable plot, and to each corresponding vetch plot; the water to be applied by the furrow method of irrigation.
7. To make careful observations of the comparative growth and condition of the crops in each plot at regular intervals throughout the growing season.
8. To record indications of drought and unfavourable moisture conditions as they were observed.
9. To harvest and weigh each crop as it reached marketable condition.
10. To prepare a summary of the results obtained.

ocedure in 1920.

The entire block of land, selected as a site for the ex- riment, was plowed and harrowed on May 12th. Eight plots, ch 1/20 acre (21' x 103.7') in area were then measured out d designated A, B, C, D, and A', B', C', D'.

Plots A', B', C', and D' were then sown to vetch. During e season these plots received, respectively, the same amount water as was applied to the corresponding vegetable plots. e vetch was plowed under early in July, and these plots were llowed for the remainder of the season.

Owing to the fact that the land was plowed late in the ring there was insufficient of the natural precipitation ored in the soil to ensure good germination of truck crops. nsequently the sowing of the vegetables was deferred until ter the first irrigation had been applied. This was not fected until June 12th, Although it was realized that the wing of seeds immediately subsequent to irrigation is a prac- ce to be avoided whenever possible, yet, in view of the fact at the season was already well advanced it was considered visable to proceed with the planting as soon after the first rigation as the soil could be worked into a good seed-bed. cordingly plots A, B, C, and D were cultivated on June 14th, d planted to vegetables on June 15th.

In the selection of vegetables to be grown in this experi- ent it was considered advisable to include widely divergent pes, since such a procedure would permit a ready comparison f the water requirements of root crops, foliage crops, and

rops grown for their fruits or seeds. Care was taken, how-
ver, to choose only types and varieties of recognized commer-
ial importance in the Okanagan Valley.
even rows of vegetables were planted in each plot - the rows eing 3' apart and 103.7' long. The method of planting was dentical for each plot and each crop series. Eight species f vegetable were used. The following table shows, for each rop and for each plot; the row number, variety and method of lanting.

Table I. Plan and Method of Planting each Crop and Each Plot.

ow o.	Crop	Variety	Method of Planting.
.	Potato	Jersey Royal	Cut to 2 eyes - planted 18" apart.
.	Cucumber	Davis Perfect	5 seeds in a hill - hills 3' apart
.	Carrot	Chantenay	1 oz. to 100 ft. drill.
.	Cantaloupe	Hoodoo	5 seeds in a hill - hills 3' apart.
.A	Cabbage	Danish Ball Head	1 month old plants set 18" apart (½ row).
.B	Bean	Stringless Green Pod	1 pt. to 50 ft. drill (½ row
.	Tomato	Earliana	6 week old plants set 3' apart.
.	Corn	Golden Bantam	5 seeds in a hill - hills 3' apart.

Where germination of the first sowing of seed was insufficient to ensure a uniform stand of plants a second sowing was de in an attempt to fill up the blanks. The method of thinng, training, etc., was the same for each crop series; thus matoes in all plots were pruned to a single stem and trained

;o stakes, corn, cucumbers, and cantaloupes were, in all cases ;hinned to one plant to a hill, carrots were thinned to two .nches, and beans were thinned to six inches.

Water was applied by the furrow method. The furrows were 'un out with a small single horse plow, one furrow being plac- ·d between each two rows of vegetables. For recording the 'ater applied, a Miner's Inch Box was used. The unit of ıeasurement adopted was the Acre Inch, the exact equivalent ıf an inch of rainfall. The first irrigation was applied to ıll plots on June 12th, subsequent applications being made at 'ortnightly intervals until each plot had received its quota.

The following table gives the plan on which water was ıpplied.

Table II. Plan for Application of Water.

'lot	Dates when Water was Applied.	Amount of Water Applied at each Irrigation.	No. of irrigat-ions per season.	Total Water applied per season.
ı	June 12 & 28. July 12	2"	3	6"
3	June 12 & 28. July 12 & 28.	3"	4	12"
;	June 12 & 28. July 12 & 28. August 12.	3.6"	5	18"
)	June 12 & 28. July 12 & 28. Aug. 12 & 28.	4"	6	24"

Cultivation was practiced as soon after each irrigation as the soil was in condition to be worked. When showers occured between irrigations a dust mulch was reestablished y additional cultivations. Similarly, even after any plot ad received its quota of water, cultivation was still contin- ed until the soil was adequately shaded by the crop. Deep ıltivation was practiced early in the season to encourage the lants to root deeply and to keep the soil in good condition or absorbing moisture. As the season advanced cultivation was ade shallower in order to avoid undue disturbance of the root ystem of the crops.

A careful survey of the growth and condition of crops was ade at monthly intervals from the date of planting. A record as kept of all drought injury and of conditions of crop rowth indicating an unfavourable moisture supply. The crops ere harvested and weighed when they reached marketable con- ition. Thus, beans were picked as soon as the pods were large nough to be sold as green beans; cabbages were cut when the eads were well formed; cantaloupes were gathered when ripe nough to ship; carrots when large enough to store for winter se; corn when ready to serve on the cob; cucumbers when they eached marketable size; potatoes when ready to dig for inter use; and tomatoes as the fruit ripened. When the crops ere weighed a record was kept of both marketable and unsale- ble produce.

At the close of the season a summary of the field obser- ations was compiled, and the yields were tabulated, Market- ble produce only was included in the tables of yield.

rocedure in 1921.

The procedure followed in 1921 was substantially the ame as that outlined for 1920, with the following modificat- ons. The entire block of land was plowed in the Fall of 1920, nd was disced, floated, and harrowed early in the Spring of 921. By this means sufficient of the natural precipitation as preserved to germinate all seeds without irrigation. Consequently it was possible to have all crops well started efore any irrigation water was applied. The plots on which egetables had been grown in 1920, were sown to vetch early n May and the vetch was plowed under in July. The plots which ad been sown to vetch the previous year were planted to egetables. The planting plan adopted was the same as that sed in 1920. Water was applied as in the previous year ith the exception that the first irrigation was given on June st instead of June 12th. Subsequent applications being made t fortnightly intervals from June 1st. As in 1920 the plots n which vegetables were planted were designated A, B, C, and , while the corresponding vetch plots were given the letters ', B', C', and D'.

rocedure in 1922.

The same procedure was followed in 1922 as in 1921 with he modifications and additions noted below. The vegetables ere planted in the plots where vetch had been turned under n 1921. In each plot the vegetables were moved one row over rom the location occupied in 1920, it being considered advis-ble not only to rotate the vegetables with the vetch, but lso to practice a rotation of the vegetables with each other. he first irrigation was given on June 8th, and subsequent pplications were made at fortnightly intervals from that date, he final irrigation being applied to Plot D on August 17th. n addition to the yields and field observations recorded in revious years, data were secured with regard to the soil oisture and soil temperature at various times during the grow-ng season. Each plot was designated by the same letter assig-ed to it in 1920.

STATEMENT OF RESULTS.

The results secured from this experiment in 1920, 1921 and 22, are set forth in the following pages. The yields obtain- where the various amounts of water were applied are present- in tabular form. The tables showing the effect of applying rious quantities of water to each variety of vegetable are llowed by a brief discussion of the data presented, and are pplemented by field notes with regard to per cent of germin- ion and per cent of unmarketable produce. In the case of ans, cantaloupes, corn, cucumbers and tomatoes, tables have en compiled to indicate the dates when these crops reached rketable condition. Since the potatoes, cabbages and carrots re each harvested in one operation it is not possible to ow, by means of tabulated data, the effect which the applic- ion of various quantities of water had on the length of time quired to bring these crops to maturity.

Soil temperature and soil moisture observations made in 20 and 1921 are treated under separate headings, while the re detailed records of these observations collected in 1922 e embodied in tables. These tables are accompanied by a scussion of the information which they contain, and an attem- is made to correlate this imformation with crop behaviour.

eld Records.

The following tables show, for each variety of vegetable d for each plot:-

Amount of water applied at each irrigation.

Number of applications each season.

Total water applied each season.

Yield per plot in 1920, 1921 and 1922.

Average yield from each plot.

Average yield from each acre.

Relative yield from each acre.

Average yield from each acre inch of water.

Relative yield from each acre inch of water.

. Date when crops reached marketable condition.

It is recognized that, when acreage yields are computed om the results of experiments conducted on a small fraction an acre, any experimental error is greatly multiplied. wever, it is considered probable that the relation between e yields secured in the various plots is substantially the me as would be obtained under field conditions. It is for is reason that the figures showing the relative yield are cluded in the tables. In computing these figures the yield om Plot B has been taken as the standard and given the value 100. The yields from the other plots have then been expressed as a percentage of the yield in Plot B. This method of pressing yields on a percentage basis presents, in a form ich can be readily comprehended, the comparative yield secured the several plots.

Table III. Yield Secured from Beans (Stringless Green Pod)

When Various Amounts of Water Were Applied.

Applications of Water				Yield per Plot 1/280 Acre				Average Yield per Acre		Average Yield per Acre Inch of Water.	
Plot	Amount Applied at each Irrigation	Number of Applications	Amount Applied each Season	1920	1921	1922	Average	Actual	Relative	Actual	Relative
	ins.		ins.	lbs.	lbs.	lbs.	lbs.	lbs.	%	lbs.	%
A	2	3	6	44.00	35.25	39.00	39.42	11,038	85.8	1,840	171.6
B	3	4	12	56.25	41.25	40.25	45.92	12,858	100.0	1,072	100.0
C	3.6	5	18	64.25	30.75	47.25	47.42	13,278	103.3	738	68.9
D	4	6	24	59.00	31.75	45.75	45.50	12,740	99.1	531	49.5

Table IV. Dates when Beans (Stringless Green Pod) Reached Marketable Condition.

	1920				1921				1922			
Date	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D
July	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs	lbs.	lbs.	lbs.	lbs.
13					2	4	1.50	.75	2	3.	3.25	3.25
18					7	12	8	6	12	9	11	14
21					5	6	5	4	8.50	8.	8.50	6.50
25					5	10	2	8	8.50	8.25	6.50	5.25
29					6.50	2.50	3.50	2.50	3.75	7	11	9.75
Aug.3	3	.75	1.25	.75	4.75	2.75	1.75	3.50	2.50	3	4	4
5									1.75	2	3	3
10	16.50	11.25	9.25	9.25								
17	12	7	15	8.50	5	4	3	7				
23	5	26	23	28								
30	7	7	6.25	3								
Sept.8	.50	4.25	9.25	9.50								
Total	44	56.25	64.25	59	35.25	41.25	30.75	31.75	39	40.25	47.25	45.75

A study of Table III reveals the fact that applications
more than 18 inches (3.6" x 5)# of water per season actually
used a reduction in yield per acre. Furthermore, there was
increase in yield per acre in 1921 when more than 12 inches
" x 4) was applied, while in 1920 and 1922 the increase brou-
t about by the application of more water was only very
ight. In all three years a satisfactory yield was secured
ere only 6 inches (2"x 3) was used. By far the greatest
eld per acre inch of water was obtained where only 6 inches
"x 3) was applied.

Table IV shows that the crop reached marketable condition
o weeks earlier in 1921 and 1922 than was the case in 1920.
is difference in date of maturity can no doubt be attributed
rgely to the fact that the seed was sown almost a month ear-
er in 1921 and 1922 than was possible in 1920. The larger
plications delayed the date of ripening in 1920 and 1921 but
peared to have little effect on the date when the crop reach-
marketable condition in 1922. The crop was observed to be
ffering from drought in Plot A during the month of August
each year, but the yield does not seem to have been greatly
duced from lack of moisture even in this plot, which receiv-
only 6 inches (2"x 3) of water during the entire season.

In 1920 when irrigation was practiced immediately pre-
ous to seeding the per cent of germination was considerably
duced where the larger applications of water were made.

(3.6"x 5) indicates 5 applications of 3.6 inches each.

From these results it would seem that, under Okanagan onditions and where good cultural methods are followed, there little to be gained form the application of more than 12 ches (3"x 4) of irrigation water to beans.

Table V. Yield Secured from Cabbage (Danish Ball Head) When Various Amounts of Water were Applied.

	Applications of Water			Yield per Plot 1/280 Acre				Average Yield per Acre.		Average Yield per acre inch of water	
Plot	Amount Applied at each Irrigation	Number of Applications	Amount Applied each Season	1920	1921	1922	Average	Actual	Relative	Actual	Relative
	ins.		ins.	lbs.	lbs.	lbs.	lbs.	lbs.	%	lbs.	%
A	2	3	6	39.0	12	47	32.7	9,156	62.6	1,526	125.3
B	3	4	12	49.5	16	91	52.2	14,616	100.0	1,218	100
C	3.6	5	18	60.5	23	108	63.8	17,872	122.3	993	81.5
D	4	6	24	48.7	33	127	69.6	19,482	133.3	812	66.6

As indicated by the data presented in Table V, Cabbage gave the highest production per acre where 24 inches (4"x 6) of water was applied; The yield per acre increased progressively with each increase in the amount of water, but the figures for yield per acre inch of water show that the increase in yield brought about by applying more than 6 inches (2"x 3) of water was not proportional to the increase in the amount of water applied.

In an attempt to calculate the most profitable amount of ter to apply to cabbages account must be taken of the relat- n between cost of water, rental value of land, and cost of oducing the crop. The fact that the application of 24 acre ches (4"x 6) of water per acre resulted in the highest yield r acre does not necessarily indicate that it is, in all ses, advisable to apply this much water. A greater net re- rn may often be secured by spreading the same quantity of ter over a larger area of land. The heads produced, where ss than 18 inches (3.6"x 5) of water was used, were, however, such inferior size and quality that it seems to be doubtful ether cabbages can be produced commercially on the soil most evelent in the Southern Okanagan with less than this quant- y of water. Under the conditions of this experiment fairly tisfactory yields were secured with 18 (3.6"x 5) and 24 "x 6) inches of water, but the soil is rather light for this op, so that even where these relatively large quantities of ter were used the yields were somewhat below the requirements r successful commercial production.

Table VI. Yield Secured from Cantaloupes (Hoodoo) When Various Amounts of Water were Applied.

Plot	Application of Water: Amount Applied at each Irrigation	Number of Applications	Amount Applied each Season	Yield per plot $\frac{1}{140}$ acre: 1920	1921	1922	Average	Average Yield per acre: Actual	Relative	Average Yield per Acre Inch of Water: Actual	Relative
	ins.		ins.	lbs.	lbs.	lbs.	lbs.	lbs.	%	lbs.	lbs.
A	2	3	6	135.0	61.5	151.5	116.0	16,240	70.1	2,707	140.2
B	3	4	12	227.5	56.0	213.0	165.5	23.170	100.0	1,931	100.0
C	3.6	5	18	156.25	58.0	198.0	137.4	19,239	83.0	1,069	55.4
D	4	6	24	133.0	54.0	209.0	132.0	18,480	79.7	707	36.6

Table VII. Dates when Cantaloupes (Hoodoo) Reached Marketable Condition.

	1920				1921				1922			
Date	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Aug.23 to Sept2									81.50	27	3	12
4									30	31	20	22
6									9	16	22	16
8									10	22	15	6
9									9	27	24	19
11									3	31	38	35
13									6	32	30	39
16									3	20	28	34
18									-	-	8	10
20									-	7	10	16
23	13.75											
24	6					.75						

Table VII. (Continued)

	1920				1921				1922			
Date	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Sept29	4.75	3.50	--	--	--							
Oct.1	6.50	-	--	--	3.50	1.25						
6	1.25	7.50	3.25	7.75	--	--						
9	3.75	3.50	1.25	4.50	8	28						
13	-	-	15	3.25	--	--						
16	-	-	45	-	--	--						
20	73	68	5.75	4.50	14	11	5	1				
23	-	62	47	-	36	15	53	53				
26	26	41	39	62								
27	0	42	--	51								
Total	135	227.50	156.25	133	61.50	56	58	54	151.50	213	198	209

The data incorporated in Table VI indicate that in 1920 and 1922 the greatest yield per acre of marketable cantaloupes was secured where only 12 inches (3"x 4) of water was applied, while in 1921 6 inches (2"x 3) gave the greatest tonnage of marketable produce.

all cases the yield per acre inch of water was greatest where
ly 6 inches (2"x 3) of water was used and the efficiency of
e water decreased rapidly as larger applications were made.
e information set forth in Table VII shows that the crop was
ry late in coming to maturity in 1921. This was due largely
the fact that the first sowing of seed failed to germinate,
l a second sowing had to be made well on in June. In each
the three seasons there was a very remarkable postponement
the date of maturity where the larger amounts of water were
plied. The produce ripened first in the plot where only 6
ches (2"x 3) of water was used, but a considerable percentage
the cantaloupes produced in this plot were too small to be
leable. The undersized fruits are not included in the tables
owing yields of marketable produce.

In 1920, when water was applied immediately previous to
eding, germination was markedly weaker where the larger
plications were made. It is evident that the application of
re than 12 inches (3"x 4) of water during the season was
tually injurious to cantaloupes, in that it reduced the yield
r acre and delayed the date of maturity. Under the condit-
ns of this experiment the application of 12 inches (3"x 4)
water during the season appears to have provided moisture
nditions which approached the ideal for the production of
ntaloupes.

Table VIII. Yield Secured from Carrots (Chantenay) when Different

Amounts of Water Were Applied.

	Application of Water.			Yield per plot 1/140 acre				Average yield per acre.		Average yield per acre inch of water	
Plot	Amount Applied at each Irrigation	Number of ap-lic-ations	Amount Applied each Season	1920	1921	1922	Average	Actual	Relative	Actual	Relativ
	ins.		ins.	lbs.	lbs.	lbs.	lbs.	lbs.	%	lbs.	lbs.
A	2	3	6	87	101	104	97.3	13,622	90.3	2,272	180.8
B	3	4	12	90	71	162	107.7	15,078	100.0	1,257	100.0
C	3.6	5	18	124.3	113	150	129.1	18,071	119.9	1,040	82.7
D	4	6	24	154	157	170	160.3	22,442	148.8	935	74.4

Table VIII shows that with carrots the yield per acre increased progressively with each increase up to 24 inches (4"x 6) in the amount of water applied. The yield per acre inch of water, however, decreased with each successive increase in the amount of water applied. The most profitable amount of water to apply depends, therefore, on the relations between cost of water, value of land and cost of production. Where water is the most expensive item it will pay to apply only a small quantity of water over a large area of land. Where water is plentiful and land is limited the most profitable procedure will be one which involves ıe application of a relatively large quantity of water to a ıall area of land. Where cost of production, other than the ›plication of water, is great it will be of advantage to work relatively small area of land and apply comparatively large ıantities of water. Where cost of applying the water is the ırge item in the expense account it will be advantageous to ;e a large area of land and do as little irrigating as pos- ible consistent with commercial yields.

The germinating power of carrot seed was adversely affect- l by planting immediately subsequent to heavy irrigations. ıe size and quality of the produce was inferior when only 6 ıches (2"x 3) of water was applied.

Under the conditions of this experiment 12 inches (3"x 4) f water produced a satisfactory yield of good quality carrots.

Table IX. Yields Secured from Corn [illegible] When [illegible]
Amounts of Water Were Applied.

Plot	Applications of Water: Amount Applied at each irrigation (ins.)	Number of Applications	Amount Applied each Season (ins.)	Yield per plot 1/140 acre: 1920 (lbs.)	1921 (lbs.)	1922 (lbs.)	Average (lbs.)	Average yield per acre: Actual (lbs.)	Relative (%)	Average yield per acre inch of water: Actual (lbs.)	Relative (%)
A	2	3	6	29	68	77	58.0	8,120	74.4	1,353	148.7
B	3	4	12	80	41	113	78.0	10,920	100.0	910	100.0
C	3.6	5	18	55	55	113	74.3	10,402	95.3	578	63.5
D	4	6	24	54	60	101	71.7	10,038	91.9	418	45.9

[illegible]

Condition.

	1920				1921				1922			
Date	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Aug. 6					25	24	24	21				
13					35	15	12	20	54	48	20	14
18					8	2	19	19	10	39	64	51
Sep. 1	5								13	26	29	36
9	2.75	19										
15		2.50	6.50	3.75								
18	8.25	20.50	5	14.75								
21			4.50	2.25								
Oct. 16	13	34	39	33.25								
Total	29	80	55	54	68	41	55	60	77	113	113	101

As indicated by the figures presented in Table IX the application of more than 12 inches (3"x 4) of water during the season brought no increase in yield per acre in 1920 and 1922,

.le in 1921 the highest acre yield was obtained by applying
.y 6 inches (2"x 3) of water. In each year the greatest
ld per acre inch of water was obtained with an application
only 6 iches (2"x 3) during the season. The yield was not
atly reduced when more than 12 inches (3"x 4) was applied,
the data included in Table X indicate that there was a
iceable postponement of the date of ripening where the larg-
applications were made. Where corn is grown as a truck crop
s lengthening of the time required to bring the ears to
ketable condition may be of considerable importance. The
tponement of the date of maturity consequent upon unneces-
ily heavy applications of water may mean the difference
ween profit and loss in the price obtained for the product.

In 1920 when the seed was planted immediately subsequent
irrigation, the germination in Plots C and D was consider-
y weaker than in Plots A and B.

These results suggest that there is no justification for
lying large amounts of water to sweet corn. Under the
ditions of this experiment 12 inches (3"x 4) of water pro-
ed ample moisture to promote optimum development of ears
table purposes.

Table XI. Yields Secured From Cucumbers (Davis Perfect) When Various Amounts of Water Were Applied.

Plot	Application of Water: Amount Applied at each Irrigation	Number of applications	Amount Applied each Season	Yield per plot 1/140 acre: 1920	1921	1922	Average	Average yield per acre: Actual	Relative	Average yield per acre inch of water: Actual	Relative
	ins.		ins.	lbs.	lbs.	lbs.	lbs.	lbs.	%	lbs.	%
A	2	3	6	117.25	159.50	220.50	165.7	23,205	60.9	3,868	121.8
B	3	4	12	256.75	263.50	296.00	272.1	38,091	100.0	3,174	100.0
C	3.6	5	18	334.00	215.00	332.75	293.9	41,149	108.0	2,286	72.0
D	4	6	24	406.75	284.50	299.50	363.4	50,879	133.6	2,120	66.8

Table XII. Dates When Cucumbers (Davis Perfect) Reached M arketable Condition.

	1920				1921				1922			
Date	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D
	lbs	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
July 20					1	1.50		1.50	-	-	-	-
22					3	3	1	2	-	-	-	-
25					10	11	6	9	2.50	2	2.75	4.50
29					11.50	12	5	8.50	7	18.50	13	11
Aug.1					-	-	-	-	8	12.50	25	27
5					15	35	22	27	25	29	49	44
13					15	34	18	23	25	32	25	40
17	-	-	5	1.75	20	28	26	33	14	40	20	44
22	-	4.50	1.25	12.75	-	-	-	-	31	52	44	77
25	10	8	10	26	16	44	23	35	-	-	-	-
31	18.50	38.50	18	42	15	34	27	51	88	110	154	152
Sep.10	8.50	46	37	82	28	29	38	42	-	-		-
16	2.75	39	27.25	47	-	-	-	-		-		-

	1920				1921				1922			
Date	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Sept. 21	5.50	8.50	34	32.25	25	32	49	52				
24	1.25	10.25	4.25	11.25								
28		-	-	8								
Oct. 2	62	36	32.75	31								
5	4.50	11	5.50	5.25								
14	4.75	57	59	106								
Total	117.25	256.75	334	406.75	159.50	263.50	215	284	220.50	296	332.75	399.50

From Table XI it is apparent that the greatest yield per acre of cucumbers was secured where 24 inches (4"x 6) of water was applied during the season. The acreage yield decreased progressively as smaller amounts of water were used. The yield per acre inch of water, on the other hand, was greatest where least water was applied, and decreased consistently as more water was used. A fair yield was secured where only 6 inches (2"x 3) of water was applied during the season, but the percentage of unmarketable produce was larger than where re water was used. The vines in Plot A were observed to wilt eely during the month of August and the yield was no doubt riously reduced by drought. From the data presented in Table I it appears that the application of comparatively large ounts of water had little effect on the length of time requir to bring cucumbers to marketable condition.

The sowing of cucumbers immediately subsequent to irrig-ion had no apparent effect on the germinating power of the ed.

It is evident that the cucumber responded satisfactorily larger amounts of water than proved desirable in the case the cantaloupes and corn. Under the conditions of this periment the cucumber seems to have justified the application 24 inches (4"x 6) of water. It must not be forgotten, how-er, that yield per acre inch of water is an important factor determining the economical application of irrigation water. us Table XI shows that, over the three year period, Plot D oduced an average of 50,879 lbs of cucumbers per acre, while ot B produced an average of only 38,091 lbs. This would pear to indicate that the application of 24 inches (4"x 6) water to Plot D was justified. However, when it is consid-ed that the same 24 inches (4"x 6) of water if applied to able the acreage at the same rate as water was applied to ot B (3"x 4) would have produced 76,182 (38,901 X 2) lbs of cumbers, the advantage of the larger application is seen to questionable. The problem becomes one of the relations be-een the cost of water, the rental value of land and the cost producing the crop. Since there is not sufficient water ailable at reasonable cost to irrigate all the agricultural nd in the Okanagan it is probable that more economical proction will be achieved, if this water is applied over a mparatively large area, rather than by concentrating it on small fraction of the land which needs irrigation. Conseqntly it seems plausible to state that, although the yield cucumbers was increased when more than 12 inches (3"x 4) water was applied, yet it is questionable whether the inease in yield was sufficiently great to justify the larger plications.

Table XIII. Yields Secured From Potatoes (Jersey Royal) When Various Amounts of Water Were Applied.

Plot	Applications of Water: Amount Applied at each Irrigation ins.	Number of Applications	Amount Applied each Season ins.	Yield per plot 1/140 acre: 1920 lbs.	1921 lbs.	1922 lbs.	Average lbs.	Average yield per acre: Actual lbs.	Relative %	Average yield per acre inch of water: Actual lbs.	Relativ lbs.
A	2	3	6	70.0	108.0	302.0	160.0	22,400	61.8	3,733	123.5
B	3	4	12	109.0	171.0	497.0	259.0	36,260	100.0	3,022	100.0
C	3.6	5	18	109.5	141.0	445.0	232.2	32,508	89.7	1,806	59.8
D	4	6	24	163.0	144.0	453.0	253.3	35,462	97.8	1,478	38.9

From the figures presented in Table XIII it is apparent that in two years out of the three the greatest yield per acre of potatoes was secured when only 12 inches (3"x 4) of water was applied. Application of water in excess of this amount actually resulted in a decrease in yield, except in 1920. In all cases the yield per acre inch of water decreased when more than 6 inches (2"x 3) of water was used. There was apparently no consistent relation between the per cent of unmarketable tubers and the rate of applying water. The quality the produce, however, was inferior where more than 12 ches (3"x 4) of water was applied. In Plots C and D the ps remained green and the tubers failed to ripen up as tisfactorily as did those in Plots A and B.

Under the conditions of this experiment 12 inches (3"x 4) water appeared to provide ample moisture to promote optimum velopment of tubers. It seems logical to conclude that der Okanagan conditions there is nothing to be gained by plying large quantities of water to potatoes.

Various Amounts of Water Were Applied.

	Applications of Water			Yield per plot 1/140 acre				Average yield per acre		Average yield per acre inch of Water.	
Plot	Amount Applied at each Irrigation	Number of Aplic-ations	Amount Applied each Season	1920	1921	1922	Average	Actual	Relative	Actual	Relative
	ins.		ins.	lbs.	lbs.	lbs.	lbs.	lbs.	%	lbs.	%
A	2	3	6	159.75	158.00	136.75	151.5	21,210	90.3	3,535	181.1
B	3	4	12	232.25	138.00	133.00	167.7	23,485	100.0	1,957	100.0
C	3.6	5	18	243.50	229.50	159.75	210.9	29,529	125.8	1,641	83.8
D	4	6	24	251.75	226.00	130.50	202.7	28,385	120.9	1,183	60.4

Table XV. Dates when Tomatoes (Earliana) Reached Marketable [illegible]

	1920				1921				1922			
Date	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D
July	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
25									-	.50	.75	1
29									1.25	4	7.50	8
Aug.1									1	7	6.50	6
5					4	8	-	-	17	21	26	15
10	.50	.25	1.25	.25	-	-	-	-	46	33	33	27
13	2	3.25	2.50	.75	27	20	20	12	-	-	-	-
16	-	-	-	-	-	-	-	-	17	17	22	20
19	3	1.25	3.50	.50	21	15	21	15	-	-	-	-
21	1.25	2.50	5	2.50	-	-	-	-	6.50	4.50	4	4.50
23	6	9	9	11.50	-	-	-	-	-	-	-	-
25	14	14	12	11	23	21	32	25	-	-	-	-
31	22	17	15	16	12	8	30	12	11	16	10	14
Sep10	13	13	12	13.25	8	18	32	38	8	8	10	5
13	16	10.50	13.25	13	-	-	-		-	-	-	-

	1920				1921				1922			
Date	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D	Plot A	Plot B	Plot C	Plot D
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Sep. 16	7.50	10	7	7.50	-	-	-	-	-	-	-	-
20	9.50	24	22	14	9	7	28.50	39	2	2	4	3
24	13	15	18	17	54	41	76	85	27	20	36	27
Oct. 2	4.50	30.75	19.75	30.75								
9	6	11.25	19.75	22.75								
25	-	-	4.50	13								
26	7.50	22.50	80	24.50								
27	34	48	-	33.50								
Total	159.75	232.25	243.50	251.75	138	138	229.50	226	136.75	133	159.75	130.50

From a survey of Table XIV it is apparent that the yield per acre did not justify the application of more than 18 inches (3.6"x 5) of water to tomatoes. Quite satisfactory yields were secured where a total of only 12 inches (3"x 4) of water was applied. By far the greatest yield per acre inch of water was obtained where a total of only 6 inches (2"x 3) of water

given. Table XV is evidence that the application of more
n 12 inches (3"x 4) of water had no appreciable effect on
length of time required to bring the fruit to marketable
dition. The plants in Plot A suffered visibly from drought
ing the month of August.

Some interesting observations were made with regard to the
valence of physiological diseases of the tomato. In order
facilitate irrigation and cultivation of the adjoining crops
h tomato plant was pruned to a single stem and trained to an
ividual stake. Although this method of culture has met with
at success in the coast regions of the Province it is appar-
ly not adapted to Okanagan conditions. The extremes of
perature to which the fruit is subjected, owing to the fact
t it is exposed to the full heat of the sun during the day,
is held up off the ground so that it cools down rapidly at
ht, seem to set up physiological disturbances in the cellu-
tissue. Each of the fruit was rendered unsalable either by
ssom-end rot or by cracking. It was observed that whereas
blossom-end rot decreased, the cracking increased where the
ger applications of water were made. This appears to indic-
that the prevalence of physiological diseases is intimately
ociated with moisture conditions in the soil, and suggests
t these diseases may be largely controlled by maintaining
per conditions of soil moisture.

As with cucumbers, the exact amount of water which it is
t profitable to apply to tomatoes can be calculated only by

onsideration of the cost of water, rental value of land,
t of production, and cost of applying water. Since these
ts vary with the districts and with each individual grower
is impossible to make a general statement which will apply
all cases. The final interpretation of the results rests
n the grower, who must apply them to his own local conditions

il Temperature Records.

No actual records of soil temperature were kept in 1920. vever, the fact that the application of relatively large antities of water immediately previous to seeding of beans, rn, carrots and cantaloupes, seriously reduced the percenta- of germination in these crops, suggested that the water had chilling effect on the soil. This contention is substantiat- by the work of several American investigators. In 1910 vers (31) of the Oregon Agricultural Station, made a study the effect of irrigation on soil temperature. He found that rigation lowered the temperature of the surface soil in ltivated plots as much as 4 deg. F. The investigations con- cted by Lewis (24) in the Rogue River Valley, showed that the il temperature might be reduced as much as 3 deg. F, immed- tely following an irrigation. Harris (20) in his work with e irrigation of sugar beets at Logan, Utah, found that irrig- ing the land after the seed was sown and before it came up, duced the yield below that secured where no irrigation water s applied.

In view of the results of these soil temperature investi- tions conducted elsewhere, it was considered probable that e temperature of the soil in this experiment had been preciably lowered by the application of irrigation water. rthermore, it was conceived that such a lowering of the soil nperature might account, at least in part, for the postpone- nt in the date of maturity of such heat-loving crops as corn d cantaloupes, which was observed to take place in the plots which the larger applications of water were made.

Accordingly it was planned to keep accurate records of the il temperature of each of the plots throughout the following owing season. Such a procedure was not found to be possible 1921, but in the summer of 1922 considerable data relating soil temperature were secured.

Unfortunately the special soil thermometers ordered for is work did not arrive until after the crops were well start-. However, readings were taken of the soil temperature in ch of the plots, almost every day, during the latter half of e growing season.

The thermometers used have a brass point which was forced to the soil to a depth of six inches (6"), so that the re-rds secured indicate the temperature of the soil six inches low the surface. It is considered, therefore, that the fig-es represent a fair average of the temperature conditions in e upper foot or two of soil.

Four thermometers were used, one in each plot, and when a ading was taken these thermometers were placed in the same lative position in each plot. In order to ensure that the cords taken gave an accurate representation of the temperat-e conditions which existed in each plot the thermometers re moved to a new location each time a reading was made. To termine the changes of temperature which took place in the il during the day, readings were made at 7 A.M., 12 Noon, d 6 P.M.

The daily range in temperature of the soil in Plot A ring the month of August is shown in Table XVI.

Table XVI. Daily Range of Soil Temperature In Plot A During August 1922.

ate	7 A.M.	12 Noon	6 P.M.
	°F	°F	°F
g.1	72	82	81
2	72	77	80
3	73	81	84
4	73	75	--
5	72	78	--
6	--	77	--
7	66	76	78
8	68	73	80
9	68	72	78
10	68	71	71
11	--	--	--
12	--	--	--
13	66	--	--
14	75	--	--
15	63	67	--
16	60	80	80
17	--	74	78
18	64	72	71
19	65	--	--
20	62	--	--
21	60	65	68
22	59	69	68

Table XVI (Continued)

Date	7 A.M.	12 Noon	6 P.M.
.23	60	68	67
24	60	69	--
25	62	75	--
26	64	70	--
27	--	--	--
28	65	71	76
29	--	--	75
30	67	67	72
31	63	64	64
erage	65.9	72.7	74.8

From the data incorporated in the Table XVI it is apparent ıt, on an average, the soil in Plot A was about 9°F warmer 6 P.M. than was the case at 7 A.M., and that the temperature noon was about 2°F below that registered at 6 P.M. - With ight variations these relations between the records taken rning, noon and night were observed to hold true for Plots B, ınd D, and for the months June, July and August.

The average daily temperature of the soil in each plot was obably somewhere about midway between that registered at .M. and that observed at 6 P.M. - However, since the relation ıip between the soil temperatures in the several plots was ınd to be essentially the same at 7 A.M., 12 Noon and 6 P.M. is apparent that the data recorded at any one of these times fords an accurate indication of the relative temperature of the soil in each plot. Accordingly, to avoid unnecessary plication, only those records made at 7 A.M. are included subsequent tables.

The temperature of the soil is determined largely by the mperature of the air above it. Rain also materially affects soil temperature. Consequently in any investigation of influence of irrigation on the temperature of the soil, count must be taken of temperature changes due to rainfall l to fluctuations in the atmospheric temperature. The folving tables show: the soil temperature in each plot at 7 A.M. maximum and minimum atmospheric temperature; and the rainl1, for each day that records were taken during June, July l August. A note is also appended giving the dates when rigation was practiced and the temperature of the water plied.

Table XVII. Temperature of the Soil in Each Plot - June 1923.

	Soil Temperatures 7 A.M.				Atmospheric Temperatures		Rainfall
te	Plot A	Plot B	Plot C	Plot D	Max.	Min.	
	°F	°F	°F	°F	°F	°F	Inches.
22	66	66	66	66	70	50	.15
23	--	--	--	--	73	47	
24	67	67	67	67	79	59	
25	--	--	--	--	80	55	
26	68	68	67	67	90	57	
27	72	72	72	71	80	63	
28	72	72	70	70	91	60	
29	--	--	--	--	88	57	
30	72	70	70	69	86	61	
erage	70.2	69.8	69.2	68.8			

B. Irrigation water at a temperature of 74° F was applied to all plots on June 22nd.

It will be noted that the soil temperature records presented in Table XVII indicate that during the ten days subseq-nt to the irrigation of all plots the average temperature of e soil, six inches below the surface was about 1° F lower in ot D than in Plot A. It will be remembered that water was plied to Plot A in two inch (2") applications, and that to ot D 4 inches of water was applied at a time.

It appear from the data set forth in Table XVII that the
plication of various amounts of water at a temperature of
°F to a soil the temperature of which was [illegible]°F, had, for
veral days, no appreciable effect on the soil temperature.
the end of a week from the time the water was applied,
wever, the temperature of the soil which had received 2
ches of water, had risen to as much as 5°F above that of the
il where 4 inches of water had been given. A logical
planation of this phenomenon would appear to be forthcoming
om a consideration of the fact that the evaporation losses
uld likely be greater from the plot receiving the larger
antities of water. If such were the case it is probable
at some of the heat required for vaporization would be ab-
rbed from the soil. It is also possible that where the
rger amounts of water were applied the moisture content of
e soil was increased to such an extent as to check the power
the soil to absorb and transfer heat. Elaborate investi-
tions by Patten (28) have shown that the ease with which
at is transmitted through soil is closely associated with
e moisture content.

Table XVIII. Temperature of the Soil in Each Plot - July 1922.

	Soil Temperatures 7A.M.				Atmospheric Temperatures		Rainfall
;e	Plot A	Plot B	Plot C	Plot D	Max.	Min.	
:y 1					84	60	
2					92	58	
3					98	65	
4					87	69	
5					87	65	
6					88	62	
7					71	64	.12
8					79	52	
9					79	59	
10	67	--	64	65	72	54	
11	--	--	--	--	82	49	.01
12	--	--	--	--	86	55	
13	68	68	66	66	93	59	
14	67	70	68	68	83	58	
15	67	68	66	66	76	59	
16	--	--	--	--	83	58	
17	68	70	68	68	90	57	
18	72	71	71	71	91	62	
19	72	72	72	72	88	60	
20	70	70	66	60	82	58	
21	68	67	64	64	81	55	

Table XVIII (Continued)

	Soil Temperatures 7 A.M.				Atmospheric Temperatures.		Rainfall
te	Plot A	Plot B	Plot C	Plot D	Max.	Min.	
	°F.	°F.	°F.	°F.	°F.	°F.	Inches.
ʼ22	68	65	62	63	70	58	
23	--	--	--	--	77	48	
24	68	65	65	64	83	53	
25	71	67	67	67	81	60	
26	68	65	66	65	81	56	
27	68	65	65	65	76	56	.02
28	66	63	63	62	83	56	
29	70	67	66	66	84	60	
30	--	--	--	--	89	62	
31	72	69	68	71	91	60	
rage	69.4	67.5	66.2	65.9			

. Irrigation water at a temperature of 62°F was applied to all plots on July 8th., and on July 19th water at a temperature of 67°F was applied to Plots B, C and D.

The data embodied in Table XVIII indicate that during the th of July the temperature of the soil in Plot D was, on the rage, 3.5°F lower than that registered at the same hour in t A. This difference in temperature may be explained on the is of indirect loss of heat, as was suggested in the discus- n of the soil temperature records for June.

Another possible explanation is brought to mind by an
amination of the soil temperature data secured before and
ter the application of irrigation water on July 19th. On
at date, water at a temperature of 67°F was applied to Plots
C and D. Previous to the application of water the tempera-
re of the soil in all plots at 7 A.M. was 72°F. At the same
ur on the following day the temperature of the soil in Plot
had dropped to 70°F, while the thermometer in Plot D register-
only 60°F. Since no water was applied to Plot A it is fair
assume that the drop in temperature from 72°F to 70°F,
corded in this plot was due to causes other than the applic-
ion of irrigation water. Allowing that the same modifying
fluences had caused a drop of 2°F in the temperature of the
il in Plot D, there is still a difference of 10°F to be
counted for. It seemed logical to infer that the application
a relatively large quantity of water at a temperature 5°F
wer than that of the soil had exerted a direct chilling
fect on the soil. This contention was not supported, how-
er, by the data secured during the month of August.

Table XIX. Temperature of the Soil in Each Plot - August 1922.

	Soil Temperatures 7 A.M.				Atmospheric Temperatures		Rainfall
te	Plot A	Plot B	Plot C	Plot D	Max.	Min.	
	°F	°F	°F	°F	°F	°F	
g.1	72	67	68	67	91	65	
2	72	70	71	71	87	64	
3	73	71	71	71	87	64	
4	73	68	70	70	82	66	
5	72	69	70	68	85	60	
6	--	--	--	--	79	59	
7	66	64	59	59	79	55	
8	68	66	63	62	84	57	
9	68	67	66	65	91	57	
10	68	67	65	65	72	58	
11	--	--	--	--	72	56	.03
12	--	--	--	--	67	54	.35
13	66	66	62	63	67	52	.10
14	75	75	69	72	78	53	
15	63	62	61	62	68	55	.09
16	60	60	59	59	77	55	.05
17	--	--	--	--	82	54	
18	64	63	63	63	77	57	
19	65	63	62	64	68	61	.82
20	62	62	62	62	70	52	.07

Table XIX. (Continued)

	Soil Temperatures 7 A.M.				Atmospheric Temperatures		Rainfall
te	Plot A	Plot B	Plot C	Plot D	Max.	Min.	
	°F	°F	°F	°F	°F	°F	Inches
g.21	60	59	58	58	72	52	.05
22	59	58	57	58	78	50	
23	60	62	60	61	79	57	
24	60	60	60	59	82	54	
25	62	60	60	58	85	54	
26	64	64	60	60	81	56	
27	--	--	--	--	87	60	
28	65	63	62	62	81	63	
29	--	--	--	--	81	58	
30	67	66	63	60	80	59	
31	63	62	61	61	62	57	
rage	65.9	64.6	63.3	63.2			

. Irrigation Water at a temperature of 65°F was applied to ts C and D on Aug. 2nd and 3rd., and Plot D received an lication of water at a temperature of 60°F on Aug.16th and h.

The data incorporated in Table XIX show that during the th of August the temperature of the soil six inches below the face, was an average of about 3°F higher in Plot A than in t D. It is evident, therefore, that the application of comratively large amounts of water had brought about a lowering the soil temperature. A critical examination of the records fore and after irrigation, however, does not reveal any rect relation between the temperature of the water applied d the temperature of the soil. There was no significant ange in soil temperature subsequent to the irrigation of ots C and D on Aug. 2nd. and 3rd. Following the application water to Plot D on Aug. 16th and 17th there was a uniform se in temperature of about 4°F in the soil of all plots. is rise in soil temperature was probably closely associated th the rise in the maximum atmospheric temperature from 68°F Aug.15th to 82°F on Aug. 17th.

It is interesting to note the effect on the soil temper-ure of the .82" of rain which fell on Aug.19th. - At 7 A.M. Aug.19th the soil temperature in each plot was: Plot A 65°F, ot B 63°F, Plot C 62°F, Plot D 64°F. At the same hour on g.20th the temperature of the soil in all plots was 62°F.

From the foregoing Tables it is readily apparent that rigation did have an appreciable effect on the soil tempera-re. Throughout June, July and August the average temperature the soil in the plot which received 24 inches of water was wer than was the case in the plots which received less water. isolated cases the difference in temperature between the il in Plot D and that in Plot A was as great as 10°F; the erage difference throughout the season was just under 3°F. e soil in Plots B and C was intermediate in temperature tween that in Plots A and D.

This difference in temperature of the soil in heavily and ghtly irrigated plots might, conceivably be due to two main ses. It seems logical to expect that the application of er at a temperature lower than that of the soil would exert irect cooling effect, and that this cooling effect would be ensified by an increase in the amount of water applied. in, the losses of water through evaporation and percolation ld undoubtedly be greater from the plots which received the ger quantities of water. Water lost through percolation ht carry away heat which it had absorbed from the soil, while seems altogether probable that some of the heat required to orize the evaporation losses was drawn from the soil. The a collected appear to substantiate, in the main, the conten- n that the cooling effect of the larger applications was ef- ted through indirect means. The lower temperature registered the plots receiving the larger amounts of water appears to e been associated with the increased soil moisture content of se plots, rather than with the temperature of the water lied.

Through whatever means the lowering of the soil was brought ut it is clear that the application of irrigation water was primary cause. It is manifest, also that the application of cessively larger quantities of water was accompanied by a gressive lowering of the average soil temperature. Here, n, may be at least a partial explanation of the fact that the lication of unnecessarily large quantities of water materially tponed the date of maturity of such heat-loving crops as ɔrn and cantaloupes, and seriously affected the germinating ɔwer of beans, carrots, corn and cantaloupes.

il Moisture Records

Although no actual soil moisture determinations were made 1920, several important observations were recorded. It was served that as the season advanced it became increasingly fficult to get the soil in Plots C and D to take up the preribed quantity of water, even when irrigation was prolonged er two or three days. Plot A on the other hand, absorbed s quota in a few hours.

In order to determine the distribution of moisture between rrows after various amounts of water had been applied, trenchs were dug to a depth of three feet, across each of the ots, twenty-four hours after the third irrigation. A uniform stribution of moisture was found to exist in all plots except Plot A. In this plot the application of 2 inches of water intervals of two weeks had apparently failed to thoroughly isten the soil between furrows.

Plot B represented the happy medium. The soil absorbed s application of 3 inches of water quite readily in an eleven ur day. Furthermore the 3 inch application appeared to be rge enough to ensure a uniform distribution of moisture beeen the irrigation furrows. At no time between irrigations re the plants in Plot B observed to be suffering from lack moisture.

From these observations it seemed logical to infer that th the soil and climatic conditions under which the experiit was conducted, and where approved methods of irrigation rming were followed, the application of 3 inches of water fortnightly intervals during the growing season, was ficient to maintain conditions of soil moisture favourable the growth of many of our common truck crops. This observation is substantially in agreement with the results obtained Powers (31) at West Stayton, Oregon, in 1911. The soil at Stayton is a gravelly loam. It was found that on this s of soil a 3 inch application at intervals of fifteen was about the best amount and frequency of irrigation for ivated crops.

il Moisture Observations 1921.

No actual soil moisture determinations were made in 1921, t the field observations substantiated in the main, the notes de in 1920. It was found, however, that in 1921 a uniform stribution of water was secured between furrows three feet art even when only 2 inches of water was applied at an appli- tion. This is probably explained by a consideration of the ct that the improved cultural methods adopted in the second ar of the experiment effectually stored a good deal of the tural winter precipitation in the soil and subsoil. Owing the presence of this reserve supply of moisture it is likely at the soil at no time dried out as completely as was the se in the Spring of 1920. Consequently a uniform distrib- ion of soil moisture might well have been maintained by a aller application of water in 1921, than was the case in the evious year. The difficulty of getting Plots C and D to sorb their allotted quota of water was again experienced in 21. Owing to the impossibility of measuring water accurately night, irrigation was carried on in the daytime only. A cord was kept of the actual time which was required to apply ch irrigation. Table XX shows for each plot the dates when ter was applied; the amount of water applied; and the time quired to apply the water.

	Plot A		Plot B		Plot C		Plot D	
Dates when Water was Applied	Amount of Water Applied	Time required to apply water	Amount of Water Applied	Time required to apply Water	Amount of Water Applied	Time required to apply water	Amount of Water Applied	Time required to apply water.
	Inches	Hours	Inches	Hours	Inches	Hours	Inches	Hours
June 1 & 2	2	4	3	6	3.6	9½+6=15½	4	9½+8=17½
" 15 & 16	2	7¼	3	10¾	3.6	9½+7=16½	4	9½ +10=19½
" 29 & 30	2	7¾	3	10½	3.6	9+ 8=	4	9½+10=19½
July 14,15 & 16	-	-	3	10½	3.6	9+9+8=26	4	9+10+10=29
" 30, 31 & 1	-	-	-	-	3.6	9+9+8=26	4	10+10+13=33
Aug. 15, 16 & 17	-	-	-	-	-	-	4	10+10+13=33
Total	6	19	12	37¾	18	101	24	151½

Table XX shows clearly that the time required to apply er increased as larger amounts were used. Furthermore, an rease in the quantity of water applied resulted in a greater n proportional increase in the time required to apply it. s when 12 inches (3"X 4) were applied the time required was hours, but when 24 inches (4"x 6) was given, 151½ hours e required to apply it. In other words a doubling of the ntity of water applied resulted in the quadrupling of the e required for application.

It is readily apparent that the longer the time required apply an irrigation the greater is the opportunity for loss moisture through evaporation. Consequently it is obvious t it is advisable to apply water only in such quantities as soil can take up fairly quickly. In order that enough wat- to supply the needs of plants over the period between irrig- ons may be absorbed in a relatively short time, it is of the ost importance that the soil be maintained in good physical dition.

Again the time required to apply water increased as the son advanced. Thus, when the first application of four nes was made to Plot D on June 1st and 2nd., only 17½ hours e required to apply the water, while when the final applic- on of four inches was made on August 15th, 16th and 17th it necessary to run the water for 33 hours in order to get the l to take up the allotted quantity of water.

It was thought that this increase in the time required to ly water as the season advanced might be explained as a

lt either of a diminution in the power of the soil to absorb
r due to impairment of physical condition, or on the grounds
the previous irrigations had had a cumulative effect on the
nt of soil moisture. It seemed quite conceivable that a
iderable quantity of the water applied at one irrigation
t still be present in the soil at the time the next irrig-
n was made. It also seemed possible that the reduction of
depth of cultivation after the crops had reached a certain
e of development might have resulted in a diminution of the
r of the soil to absorb moisture rapidly. In order to
in further light on this question it was decided to make
ratory determinations of the moisture content of the soil
arious times during the growing season.of 1922.

l Moisture Observations 1922.

It was planned to make extensive moisture determinations ing the irrigation season of 1922. Unfortunately the ipment necessary to make these determinations did not arrive time for use before the crops were planted. Soil samples e collected, however, during the growing season, and a com- te determination was made of the moisture content of the l in each plot at the close of the growing season. The ults of these moisture determinations are presented in ular form.

Considerable care was exercised with a view to ensuring accuracy of the data embodied in the tables which follow. l samples were obtained with the aid of a small post-hole ur. In order to ensure that the determinations were resentative of average conditions a large number of borings made in each plot. Separate samples were taken of each inches of soil down to a depth of three feet.

The hygroscopic coefficient is a measure of the percentage moisture by weight which a thoroughly dried soil will absorb n exposed to a saturated atmosphere at a standard temperature order to ascertain the value of this coefficient for the l on which this experiment was carried out, the soil samples tioned above were dried to constant weight by heating in electric oven, which was so regulated as to maintain the perature between 95°C and 100°C. Ten grammes of each sample e then weighed out and placed in a saturated atmosphere ntained at a temperature of 60°F. After allowing the soil stand in this atmosphere until no more moisture was taken the weight was again recorded; the increase in weight rep- sented the hygroscopic moisture acquired by the soil. This termination was thoroughly checked by repeating the above ocedure five times for each plot, and averaging the results, ich were then expressed in percentage of the dry weight of e soil.

The wilting coefficient was calcultaed from the hygros- pic coefficient with the aid of the formula worked out by iggs (4):

$$\text{Wilting coefficient} = \frac{\text{hygroscopic coefficient.}}{.68}$$

The wilting coefficient is an index of the percentage of isture contained by the soil when plants undergo permanent lting.

The field capacity represents the maximum percentage of isture which the soil can retain against gravity under free ainage conditions. It was estimated by making determinations the moisture content of the soil forty-eight hours after avy applications of irrigation water had been made.

The total capacity indicates the percentage of water the il can hold when completely saturated, that is to say, when e entire pore space is occupied by water.

For the purpose of estimating the total water capacity, pore space of the soil, a small metal container about 12 cm. diameter, and having a perforated bottom was used. A circle thin filter paper, cut to fit the container, was wetted and d inside, any superfluous water being wiped away. A hundred mmes of soil was then carefully placed on the filter paper, depth of the soil when spread out over the base of the tainer being about 1 cm. A note was made of the combined ght of the container and the soil. The container was then pended over a dish of distilled water, so that the water od about 1 m.m. above the lower surface of the soil inside box. The dish was covered over to prevent evaporation. about half an hour's time the soil had absorbed all the wat- possible, when the container was lifted above the water and owed to drain for a few minutes, after which the excess er clinging to the under surface was wiped away and the le reweighed. The increase in weight represented the total er capacity or pore space and was expressed in percentage the dry weight of the soil. The data shown in Table XXI resent the averages of a large number of determinations.

ter Holding Capacity of Soil in Per Cent of Dry Weight.

Experiments conducted by Hilgard (21) suggest that the il moisture condition most favourable to crop growth exists en between 40% and 60% of the pore space is occupied by water. ting on this assumption the optimum moisture content was rked out from the total capacity as Table XXl shows, in per- ntage of the dry weight of the soil: the hygroscopic coef- cient, the wilting coefficient, the field capacity, the total pacity and the optimum moisture content of each foot of the per three feet of the soil on which this experiment was con- ted.

Table XXI. Water Holding Capacity of Soil
In Percentage of Dry Weight.

pth	Hygroscopic Coefficient	Wilting Coefficient	Field Capacity	Total Capacity	Optimum Content
eet	%	%	%	%	%
1	1.82	2.68	17.19	35.0	14.0 - 21.0
2	1.80	2.65	16.88	32.5	13.0 - 19.5
3	1.37	2.01	14.60	29.0	11.5 - 17.5
erage	1.66	2.45	16.22	32.2	12.8 - 19.3

It is considered that the data presented in Table XXI are thy of a somewhat detailed examination. It will be observed t in the first three feet of soil the amount of moisture ch is not available for plant use, i.e. the percentage below wilting point, is slightly less than 2.5%. The average mum field capacity of the upper three feet of soil is over 16% from which it is apparent that the amount of sture available for plant use which can be stored in the r three feet of this soil is only about 13.5%.

The total water capacity is just about double the field acity, which means that the higher limit of the optimum mois- content estimated by Hilgard (21) at 60% of the pore space never be reached with this soil, so long as there is free nage. Consequently under field conditions, there is little, ny, danger of this soil becoming too wet for satisfactory t growth. There is, however, a very real danger of losing r through percolation down below reach of plant roots.

ter Holding Capacity of Soil in Inches

The significance of these moisture determinations will obably be more readily appreciated by the practical irrigat- if the percentage of moisture is expressed as depth of water er the soil surface. In Table XXII tha above data have been nverted to inches of water, so that they may be compared rectly with rainfall and applications of irrigation water.

Table XXII. Water Holding Capacity of Soil in Inches.

oth	Hygroscopic Capacity	Wilting Point	Field Capacity	Total Capacity	Optimum Content
eet	inches	inches	inches	inches	inches
1	.33	.48	3.09	6.30	2.5 - 3.8
2	.32	.47	3.03	5.85	2.4 - 3.5
3	.25	.36	2.62	5.22	2.1 - 3.2
al	.90	1.31	8.74	17.37	7.0 - 10.5

A survey of Table XXII brings to light the fact that in the r three feet of the soil on which this experiment was car- out there is always about 1.3 inches of water which is not ilable for plant use. The amount of moisture which the same th of soil can retain against the pull of gravity where there free drainage is about 8.7 inches. The quantity of water ilable for plant use which can be stored in the upper three t of soil is the difference between these two figures, or roximately 7.4 inches. In the irrigation of crops, the root ystem of which does not penetrate below three feet, it is obvious that even should the moisture in the upper three feet f soil be reduced to the wilting point, it would be folly to pply more than 7.4 inches of water at one application. Theoretically the optimum moisture content of the upper three feet f this soil ranges between 7 and 10.5 inches, but actually the ange is much carrower. For, as has already been pointed out, he maximum field capacity is only about 8.7 inches. Under uch conditions it would seem that the aim of the grower should e to maintain the moisture content of the upper three feet of oil somewhere between 7.0 and 8.7 inches. It is obvious that his can only be accomplished by applying water at the rate of ot more than 2 inches per application as often as the plants educe the amount of water in the soil to the 7 inch limit. ith this knowledge of the moisture holding capacity of the oil it is now possible to proceed to a critical examination f the moisture conditions which actually existed in the several plots at various times during the growing season.

isture Content of Upper Foot of Soil During Growing Season.

Table XXIII shows the moisture content of the upper foot soil in each plot 48 hours after the 2nd, 3rd, 4th, 5th, and nal irrigations. It will be remembered that Plot A was irri-ted three times, Plot B four times, Plot C five times and ot D six times during the season. It will also be recalled at at each irrigation Plot A received 2 inches, Plot B 3 hes and Plot C 3.6 inches and Plot D 4 inches of water.

Table XXIII. Moisture Content of First Foot of Soil at Various Dates During Growing Season.

Date	Plot A	Plot B	Plot C	Plot D
ne 24th - 48 hrs. after 2nd rigation of all plots.	1.93	2.12	2.60	2.61
ly 9th - 48 hrs. after 3rd rigation of all plots.	2.38	2.68	2.94	3.05
ly 22nd - 48 hrs. after 4th rigation of Plots B,C & D	1.45	2.72	2.98	3.08
g.2nd - 48 hrs. after 5th rigation of plots C & D	.88	1.90	2.88	3.02
g.21st - 48 hrs after final rigation of plot D.	1.24	2.32	3.03	3.09

The data contained in Table XXIII were arrived at in much same way as the figures for field moisture capacity includ- in Table XXII. Samples of the first foot of soil in each t were collected with the aid of a soil augur. In order to ure that the soil samples were representative of the average l moisture content of each plot an equal number of borings re made between each two rows of vegetables. Furthermore nese borings were made midway between the irrigation furrow d the row of vegetables. The soil from these borings was nen thoroughly mixed and a determination made of the total isture, both hygroscopic and capillary, which was contained the composite sample. This moisture content was then expessed in inches to facilitate ready comparison with rainfall d applications of irrigation water.

A careful scrutiny of Table XXIII brings to light several cts worthy of note. Although only 2 inches of water was plied to Plot A on July 6th the amount of water in the first ot of soil on July 9th was almost half an inch more than was e case on June 24th. This is direct evidence that in spite the losses of water due to evaporation, transpiration and ssibly percolation, the 2 inch application of water received Plot B early in the season had, at least for the time being, cumulative influence on the soil moisture content. This mulative effect of successive irrigations is more strikingly parent in the plots receiving the larger applications of ter - thus the moisture content of the upper three feet of il in Plot D increased from 2.61 inches on June 24th to 3.05 ches on July 9th. As soon as the point of maximum field pacity was reached, however, there was no further accumulatn of moisture in the upper foot of soil even where large plications of water were made. Thus it will be noted that e figures showing the moisture content of the first foot of il in Plot D, 24 hours after the 4th and 5th and 6th irrig-ions indicate that there was no appreciable accumulation of isture after July 9th.

A comparison of the actual moisture content of the plots th the optimum content shown in Table XXII indicates that on ly 9th the Moisture condition of the first foot of soil in all ots was favourable to plant growth. For on that date the isture content of the first foot of soil in each plot was ove the lower optimum limit of 2.5 inches. In Plot A, which ceived its final irrigation on July 6th the moisture content the first foot of soil had fallen to 1.45 inches on July nd and to .88 inches on Aug.2nd. It is noteworthy that even Aug.2nd the moisture in the upper foot of soil in Plot A s still considerably above the theoretical wilting point. the field, however, serious wilting of crops was observed in is plot during August. This observation can no doubt be exained as the result of low atmospheric humidity. In Plot B, ich received its final irrigation on July 22nd, the moisture ntent of the upper foot of soil had fallen below the optimum mit by Aug. 2nd, but was still considerably above the theorical wilting point. No appreciable amount of wilting of ops was observed in this plot at any time during the season. ot C received its last irrigation on Aug.2nd. It is imposble to say whether, in the ordinary course of events, this ot would have shown a reduction of moisture content below the timum for the upper foot of soil at any time during the reinder of the season, for between Aug. 2nd and Aug.21st. there s an unusually heavy natural precipitation, over 1.5 inches

f rain being recorded. This rainfall also accounts for the
.se in moisture content of all plots indicated by the deter-
.nations made on Aug.21st.

The most striking fact brought out by the data included
ı Table XXIII is that successive irrigations, given at
rtnightly intervals, did have a marked cumulative effect on
ıe moisture content of the upper foot of soil, even in the
.ot to which water was applied at the rate of only 2 inches
r application. This accumulation of moisture took place in
ite of the losses of water through evaporation, transpirat-
n and percolation. Where more than 3 inches of water was
plied every two weeks, however, the limit beyond which
rther accumulation became impossible was soon reached. This
mit was determined by the field moisture capacity of the soil
ich was in turn dependent upon the power of the soil to re-
in moisture against the pull of gravity. It seems probable,
erefore, that the increased difficulty experienced in get-
ng the soil in Plots C and D to take up the alloted quantity
water as the season advanced was the result largely of an
cumulation of moisture in the soil, but may also have been
e, to some extent, to a diminution of the power of the soil
absorb and retain water.

sture Content of Soil Before and After Irrigation.

The comparative moisture content of the upper three feet soil in Plots C and D before and after the 5th irrigation of se plots is shown in Table XXIV. This irrigation was given August 3rd. and 4th. The soil samples from which the moist- determinations were made were taken on August 2nd and 6th.

- Table XXIV. Moisture Content of Soil Before and After Fifth Irrigation of Plots C and D -

	Plot C		Plot D	
ate	Before	After	Before	After
eet	inches	inches	inches	inches
1	2.06	2.88	2.24	3.02
2	2.27	2.80	2.38	3.00
3	2.43	2.56	2.56	2.62
tal	6.76	8.24	7.18	8.64

The figures in Table XXIV include both hygroscopic and illary moisture. Care was taken to make sure that the soil ples from which the data were secured represented the aver- soil moisture content of each plot. An equal number of rings were made between each irrigation furrow and the row of getables on either side of it. The earth from the first foot each of these borings was thoroughly mixed and a determinat- made of the moisture in the composite sample. Similarly earth from the second foot of each of the borings was mixed gether and a composite sample secured. The third foot of soil s treated in identically the same manner before being taken the laboratory, where the moisture content was ascertained.

From an examination of the data embodied in Table XXIV it apparent that just previous to the fifth irrigation of Plots nd D, the soil in these plots already contained quite a ge amount of moisture, in fact, by comparing the figures in above table with those set forth in Table XXII it is evid- that these plots were not at that time actually in any at need of irrigation. Although the moisture content of the er three feet of soil in Plot C was just below the lower imum limit of 7 inches it is doubtful whether the practical igator would consider it advisable to apply more water until amount of moisture in the soil had been still further re- ed.

Theoretically it might seem of advantage to maintain the sture content always above the lower optimum limit, but in ual practice it is often found more satisfactory to wait un- the moisture supply has been depleted almost to the point re plants begin to wilt before making additional applicat- s. The economy of such procedure in the present instance be readily comprehended by a study of the results which llowed the application of water when the soil was already irly well supplied. On August 2nd the upper three feet of il in Plot D contained 7.18 inches of water. On August 3rd 4th 4 inches of water were applied to this plot. On August h the amount of water retained in the upper three feet of il was found to be 8.64 inches. From which it is apparent at of the 4 inches of water applied less than 1.5 inches was ained where it could be utilized by plants having a root tem which did not penetrate deeper than three feet. The er 2.5 inches had been lost either through evaporation, nspiration or percolation. When it is recalled that the max m field moisture capacity of the upper three feet of this l was found to be only about 8.7 inches it is obvious that, er the circumstances, such a loss was inevitable. Much the e results followed the application of water to Plot C on . 3rd and 4th. Previous to the 5th irrigation this plot tained, in the first three feet of soil, 6.76 inches of wat-

Forty-eight hours after the application of 3.6 inches of er, the upper three feet of soil were found to have a moist- content of 8.24 inches. Almost 2 inches of the water ap- ed was unaccounted for. It is very evident that under the l conditions of this experiment the application of more than nches of water before the soil moisture supply had been re- ed below the optimum limit for plant growth, was a most teful practice. Of course it must be remembered that in the igation of plants the roots of which penetrate to a greater th than three feet, slightly larger applications might be tified. The essential point appears to be that, with a soil which the maximum field capacity is but little above the low- limit of the optimum moisture content, it is wasteful to ly large quantities of water until the soil moisture has n reduced considerably below the optimum range. The results sented in Table XXIV suggest that under conditions similar those encountered in the carrying out of this experiment it

ld be well to wait until the moisture content of the upper
ee feet of soil had been reduced to about 5 inches and
n to apply an irrigation of about 3 inches.

isture Content of Soil at Close of Growing Season.

Table XXV shows, for the upper three feet of each plot, e moisture content at the close of the growing season:

Table XXV. Moisture Content of Soil

At Close of Growing Season - September 31st.

Depth	Plot A	Plot B	Plot C	Plot D
feet	inches	inches	inches	inches
1	.96	1.61	2.15	2.14
2	1.05	2.01	2.31	2.47
3	1.18	2.07	2.53	2.62
Total	3.19	5.69	6.99	7.23

The data set forth in the above Table were secured by termining the amount of moisture in soil samples collected on pt.31st. These samples were obtained in much the same manner those used to ascertain the moisture content of the soil in ots C and D, before and after irrigation. In order to ensure at the samples were representative of the average soil moiste content of each plot, an equal number of borings were made tween each two rows of vegetables. The soil from these borgs was then thoroughly mixed and a determination made of the isture in the composite sample. Separate determinations were de for each foot of soil down to a depth of three feet.

From a survey of the data presented in Table XXV it is ident that at the close of the growing season there was still considerable amount of moisture in the upper three feet of il. In fact, in plots C and D, the moisture content was still hin the optimum range for the promotion of plant growth. importance of this fact, from the standpoint of moisture servation, will be readily recognized when it is recalled t the field moisture capacity of the upper three feet of s soil was found to be only about 8.7 inches. After the ps had completed their season's growth the upper three feet soil in Plot D still contained 7.25 inches of water. It is once apparent that not more than 1.5 inches of winter precip- tion could be stored in the upper three feet of this plot. rain or snowfall in excess of this amount must inevitably lost, through percolation, evaporation or run off.

It is probable that the greatest loss would take place ough percolation, with accompanying harmful effects due to sing of the general level of the ground water, leaching out plant nutrients and waterlogging of lands in the lower lying tions of the district. In Plot A, on the other hand, there was m in the upper three feet of soil for the storage of 5.5 hes of winter precipitation, while in Plot B the available rage capacity was about 3 inches. Since one of the basic nciples of successful irrigation farming is the conservation economic utilization of the natural precipitation it is ious that any irrigation practice which precludes such action inefficient and undesirable. Consequently it is evident that er the conditions of this experiment the application of more n 12 inches of water during the season was ill advised in t it brought about a condition of soil moisture which prevent- the conservation of the natural winter precipitation.

From the foregoing discussion of Soil Moisture Observat -
s it appears logical to conclude that with soil and cultural
ditions similar to those under which this experiment was
ducted it is wasteful and inefficient to apply more than
nches of water at a time. Furthermore, under such condit-
s it is disadvantageous and uneconomical, from the stand-
nt of moisture conservation, to apply more than 12 inches
x 4) of water during the season.

SUMMARY

Although this experiment has been conducted on a compararely small scale, and although the records extend over a iod of three years only, it is nevertheless considered justable and advisable that a brief summary of the results be mpiled. The statements which follow are based on the foreing Tables of experimental results: they also embody field servations made during the growing season.

The highest yield per acre was obtained by applying 12 inches (3"x 4) of water to corn, potatoes and cantaloupes; 18 inches (3.6"x 5) to beans and tomatoes; and 24 inches (4"x 6) to cabbages, carrots and cucumbers.

The highest yield per acre inch of water was obtained, with each of the crops under test, where a total of only 6 inches (2"x 3) of water was applied during the season.

Applications of 3.6 inches and 4 inches of water immediately previous to seeding noticeably reduced the percentage of germination below that secured where smaller amounts of water were applied. The injurious effect of large quantities of water applied just before seeding was especially marked with corn, beans and cantaloupes.

Serious wilting of crops was observed during the month of August in the plot which received only 6 inches (2"x 3) of water during the season. In accordance with the prearranged plan of irrigation this quantity of water had all been applied by July lst.

The application of 3 inches of water at fortnightly intervals was sufficient to promote satisfactory growth in all crops under test.

The application of 24 inches (4"x 6) of water during the season caused crops such as corn and cantaloupes to mature as much as fourteen days later than was the case where a seasonal application of only 6 inches (2"x 3) was made.

An increase in the amount of water applied was accompanied by a decrease in the percentage of blossom-end rot of the tomato.

The application of large quantities of water appeared to induce cracking of the tomato.

Where a total of 24 inches (4"x 6) of water was applied during the season the average temperature of the soil, six inches below the surface, was about 3 F lower than was found to be the case where only 6 inches (2"x 3) of water was the seasonal quota applied to the soil.

. Application of 3 inches of water at a time gave a uniform distribution of moisture between furrows three feet apart. This was not always found to be the case where 2 inches of water was applied.

. The soil, although in excellent physical condition, did not absorb more than 3 inches of water in an eleven hour day.

. The application of 3.6 inches and 4 inches of water at fortnightly intervals resulted in an unnecessary loss of irrigation water.

When 18 inches (3.6"x 5) and 24 inches (4"x 6) of water was applied during the season the moisture content of the upper three feet of soil, at the close of the growing season, was such as to prevent the storage, in that depth of soil, of any but a small fraction of the natural winter precipitation.

ACTORS WHICH MAY HAVE INFLUENCED THE RESULTS OF THIS EXPERIMENT

It is considered advisable that brief mention be made in his report of some of the more important factors, other than application of irrigation water, which may have exerted a erial influence on the results secured from this experiment. is believed that these factors may be most advantageously cussed under the four general headings: Climate, Soil, Cultur- Methods and Experimental Technique.

luence of Climate on Results of this Experiment.

As has been previously explained, the climatic conditions erienced at Summerland are midway between those encountered the Northern and Southern extremities of the Valley. For s reason it is readily apparent that results secured at the merland Station can be considered to apply, with but slight ification, to the bulk of the irrigated land in the Valley.

In order to facilitate such necessary modifications, and order that the results of this experiment may be the more dily compared with the results secured from experiments con- ted elsewhere it is deemed expedient to present a statement the climatic conditions which prevailed while the experiment in progress. Furthermore, it is recognized that any attempt an interpretation of the results of this experiment should :e into account the possible influence of seasonal differences temperature, rainfall, sunshine etc. For this reason it is sidered imperative that a section of this report be devoted

a study of weather conditions. Accordingly a summary of the
eorological records secured at the Summerland Station during
), 1921 and 1922, has been compiled. These records are set
th in tabular form and are compared as far as possible with
rious meteorological data collected at the Station.

The following Tables show for each month during 1920, 1921
1922, the maximum, minimum and mean temperatures; the rain-
l, snowfall and total precipitation; and the hours of sun-
ne. The average mean temperature, average precipitation,
average sunshine, for each month, over the five years pre-
as to 1921, are also shown in the tables. Records of wind
ocity, relative humidity and evaporation are available for
years 1921 and 1922 only.

	1920			1921			1922			
	Max. °F.	Min. °F.	Mean °F.	Max. °F.	Min. °F.	Mean °F.	Max. °F.	Min. °F.	Mean °F.	Average Mean for 5 years previous to 1921
Jan.	57.0	5.0	24.68	54.0	12.0	29.05	37.0	2.0	20.88	23.94
Feb.	46.0	18.0	30.90	50.0	10.0	21.14	43.0	-1.	20.625	27.14
Mar.	57.0	18.0	38.11	62.0	19.0	38.97	50.0	12.0	34.145	39.15
Apr.	72.0	19.0	43.70	69.0	26.0	44.85	68.0	26.0	45.08	46.77
May	77.0	33.0	53.51	82.0	34.0	56.15	85.0	29.0	54.37	54.70
June	90.0	40.0	59.70	86.0	43.0	63.60	94.0	47.0	67.47	61.80
July	96.0	52.0	72.14	90.0	47.0	68.45	98.0	48.0	70.75	69.32
Aug.	98.0	44.0	71.03	92.0	47.0	67.92	91.0	50.0	67.83	68.65
Sept	82.0	40.0	57.60	72.0	37.0	55.21	82.0	42.0	60.03	59.52
Oct.	61.0	25.0	44.90	70.0	26.0	48.95	62.0	31.0	48.89	47.24
Nov.	52.0	19.0	38.30	55.0	2.0	34.865	46.0	25.0	34.46	36.54
Dec.	45.0	20.0	33.60	49.0	-3	24.21	49.0	-5.	22.09	28.35

A careful study of the mean monthly temperatures, as shown Table XXVI indicates that, in the main, the temperature con- ions experienced in 1920, 1921, and 1922 did not depart gre- y from the average as expressed by the mean monthly tempera- e for the five years previous to 1921. Probably the most nificant temperature factor, in relation to the growth of ck crops, is the mean temperature during the months of May, e, July and August. The average mean temperature for these r months, as shown by the above table, was just below 64°F the five years previous to 1921; just above 64°F for 1920 1921; and just above 65°F for the same period in 1922. The n temperature during April, which would undoubtedly have a at influence on the temperature of the soil at the time the ps were getting started, was slightly below the average in h of the years 1920, 1921 and 1922. This was especially no- eable in 1920 when the mean temperature for April was three grees lower than the average for the five years previous to 21. The highest monthly mean was experienced in July 1920, temperature for this month being almost 3°F above the aver- e. The highest daily temperature was registered in August of e same year. It is apparent, therefore, that the mean temper- ures experienced during the growing seasons of 1920, 1921 and 22 approximated closely the conditions encountered in previous ars. Nevertheless, there was sufficient fluctuation in the mperatures during each of these years, to provide a variety conditions representative of what may be expected to occur om year to year in the district.

Table XXVII. Monthly Precipitation.

	1920			1921			1922			
	Rainfall in.	Snowfall in.	Total in.	Rainfall in.	Snowfall in.	Total in.	Rainfall in.	Snowfall in.	Total in.	Average precipitation for 5 years previous to 1921
Jan.	.29	13.5	1.64	.05	9.6	1.01	--	[illegible]	.4[illegible]	.[illegible]
Feb.	--	.3	.03	.03	.8	.11	.04	5.2	.[illegible]	.47
Mar.	.34	1.2	.46	.21	5.4	.75	.13	12.9	1.[illegible]2	.[illegible]5
Apr.	1.58	.5	1.63	1.13	--	1.13	.07	.[illegible]	.75	.[illegible]
May	.06	--	.06	1.30	--	1.30	.[illegible]	--	.[illegible]	.[illegible]4
June	.98	--	.98	1.90	--	1.90	.2[illegible]	--	.[illegible]	.[illegible]
July	.84	--	.84	.34	--	.34	.15	--	.1[illegible]	.[illegible]
Aug.	.18	--	.18	.98	--	.9[illegible]	1.[illegible]	--	[illegible]	.[illegible]
Sept.	1.51	--	1.51	.39	--	.39	1.[illegible]	--	[illegible]	.[illegible]
Oct.	1.66	--	1.66	.23	--	.23	1.[illegible]	--	1.[illegible]	.72
Nov.	.70	--	.70	.56	10.5	1.61	.[illegible]	.[illegible]	.[illegible]	[illegible]
Dec.	.20	3.4	.54	1.37	1.4	1.51	.[illegible]	7.[illegible]	.[illegible]	[illegible]
Total	8.34	18.9	10.23	8.51	27.7	11.[illegible]	[illegible].12	[illegible]	[illegible]	.[illegible]

From Table XXVII it is evident that the total annual pre-
itation during each of the years 1920, 1921 and 1922 was
ghtly in excess of the average for the five years preceding
1. This increase in the natural precipitation was particu-
ly noticable in 1922, when the combined rain and snowfall was
e than 3 inches in excess of the average for the five years
ceding 1921. It is to be noticed, however, that in 1920 and
2 the rainfall during the four main growing months, May, June
ly and August was actually about an inch lower than the aver-
e for this period. In 1921 the rainfall during the four mon-
s of most rapid growth was almost 2 inches in excess of the
erage. The autumn of 1919 was an unusually dry one, which
ld tend to lessen the amount of natural moisture stored in
e soil for the use of the 1920 crop. On the other hand be-
een the time the 1920 crop was harvested and the time the 1921
op was planted there was a total precipitation of over 7 inch-
, much of which was undoubtedly stored in the soil for the use
the 1921 crop. In June 1921 the rainfall was almost twice
e average for the month, while in June 1922 there was only
e-fifth the average precipitation. It is apparent therefore,
at while the total annual precipitation during each of the
ars 1920, 1921, 1922 was slightly above the average, yet the
fferences in distribution of this rain and snowfall for the
erage years were such as to provide quite a wide range of con-
tions. It is considered, therefore, that the precipitation
ring 1920, 1921 and 1922, while on the whole greater than may
commonly experienced in the Okanagan Valley was, neverthe-

, fairly representative of the fluctuations in rain and
fall usually encountered in this district.

	1920 hours	1921 hours	1922 hours	Average for 5 yrs previous to 1921 hrs.
Jan.	45.4	68.2	70.8	59.0
Feb.	163.2	79.6	105.8	90.7
Mar.	117.8	157.4	128.6	135.8
Apr.	142.8	175.9	195.1	177.8
May	239.3	294.0	269.2	228.4
June	239.5	225.1	327.0	242.8
July	343.6	342.1	321.1	328.8
Aug.	294.0	284.0	245.7	284.7
Sept.	186.3	170.2	206.7	207.1
Oct.	125.5	153.1	158.2	139.0
Nov.	86.5	63.5	51.1	61.3
Dec.	31.1	56.1	43.5	43.3
total for yr.	2015.0	2069.2	2122.8	1998.7

Inspection of Table XXVIII discloses the fact that the tal annual sunshine for each of the years 1920, 1921 and 22 was several hours in excess of that which might be expec- d from a review of the records of sunshine registered during e five years 1916 to 1920 inclusive. Furthermore, a consid- ation of the records for the months, May, June, July and gust reveals the fact that the total number of hours of nshine for this period was 1163.0 in 1922, 1145.2 in 1921, d 1116.4 in 1920, while the average for the five years pre- ous to 1921 was only 1084.7 hours. The explanation lies in e fact that the years 1917 and 1918 were characterized by unusually large number of days when the sky was overcast. 1917 the total annual sunshine was considerably below the erage, only 1912.9 hours being registered. Similarly in 18 there was apparently less sunshine than usual, for, ring May, June, July and August there were only 966.9 hours en the sun was not obscured. It is evident, therefore, that lthough there was considerably more sunshine experienced aring 1920, 1921 and 1922 than had been the rule during the eriod between 1916 and 1920, yet it is altogether likely that he conditions which prevailed during the time that this xperiment was in progress were quite typical of what may ormally be experienced in the Okanagan Valley.

Table XXIX. Monthly Wind Velocity.

	Greatest Velocity in 24 hrs.		Greatest Velocity in 1 hr.		Average Velocity for Month.		Prevailing Direction.	
	1921	1922	1921	1922	1921	1922	1921	1922
Jan.	548	511	45	39	9.8	9.2	South	South
Feb.	574	761	53	45	10.6	9.8	South	West
Mar.	401	597	42	46	8.9	9.2	South	South
Apr.	451	363	35	35	9.0	2.6	South East	South East
May	428	434	53	51	8.9	8.1	North West	North
June	343	329	41	28	8.0	9.3	South East	North West
July	430	330	38	27	10.0	8.7	North	North West
Aug.	308	387	32	30.	8.5	8.0	West	South West
Sept.	559	354	50	29	9.9	8.4	South West	South West
Oct.	941	452	57	36	11.6	7.6	South East	South
Nov.	558	500	44	42	8.9	9.8	South	South East
Dec.	507		38		9.2		South	

glance at Table XXIX suffices to suggest that the movement ' air over the site of this experiment, may have been an nportant factor in determing the rate of evaporation from the)il, and the amount of transpiration through the crops. In)21 the average movement of air was over nine miles an hour)r every hour in the year. During the month of May 50 mile n hour gales were experienced both in 1921 and in 1922, while nere were times during the months of June, July and August n each of these years when the wind velocity exceeded 25 miles n hour. Exposure to wind is often quite a local condition. nere is reason to believe, however, that the Summerland tation, while it undoubtedly occupies an exposed position, is evertheless so situated as to be subjected to air movements imilar in intensity and direction to those which occur over a arge area of the truck-growing section of the Okanagan. hose winds which have been observed to cause the most noticable ncrease in evaporation and transpiration sweep up the Valley rom the South. The drying influence of these winds is felt)re or less throughout the entire Valley. It seems plausible) infer, therefore, that the air movements experienced at the ummerland Station are indicative of conditions which the ajority of truck crop growers in the Okanagan Valley must be repared to meet.

Table XXX. Daily Relative Humidity.

	1921				1922				
Date	June %	July %	Aug. %	Sept. %	May %	June %	July %	Aug. %	Sept. %
1		60	50	66	54	47	--	39	79
2		44	42	76	45	48	--	38	69
3			44	72	78	--	--	42	66
4		43	49	--	93	--	44	41	54
5		51	64	--	57	40	--	48	64
6		44	66	63	65	47	38	41	62
7		57	--	65	--	45	64	61	58
8		50	46	73	--	66	46	51	71
9	66	49	47	54	71	55	--	56	
10	61		48	63	73	48	64	75	
11	82	52	54	--	56	--	56	70	
12		50	57	56	60	34	51	84	
13	65	47	51	56	61	45	42	83	
14	61	40	48	81	--	35	32	74	
15	61	37	40	68	52	40	40	79	
16	77	53	51	66	45	38	44	67	
17	54		84	83	64	48	43	61	
18	65	49	66	83	63	--	46	48	
19		44	84	82	53	50	43	85	
20	53	38	60	69	79	58	35	64	
21	67	49	60	50	--	44	49	74	
22	64	45	62	67	62	53	68	62	
23	57	46	83	58	57	50	69	56	
24	52		73	63	--	53	62	62	
25	45	48	69	57	86	--	51	62	
26		64	72	66	45	51	56	58	
27	49	49	63	58	57	44	63	61	
28	56	44	--	58	--	34	56	59	

Table XXX.- Continued

	1921				1922				
Date	June %	July %	Aug. %	Sept. %	May %	June %	July %	Aug. %	Sept. %
29	49	40	60	71	53	38	57	67	
30	89	54	55	74	50	46	69	66	
31		40	60		51		56	79	

An examination of Table XXX leaves no doubt as to the truth of the contention that the relative humidity of the atmosphere at the Summerland Station during the summer months is frequently quite low. There is no grounds for supposing that this condition is peculiar to the atmosphere in the neighborhood of the Experimental Station. While local atmospheric disturbances are of frequent occurence in the Okanagan Valley, it is nevertheless altogether probable that, in the large, the atmospheric moisture conditions experienced where this experiment was conducted are representative of those conditions encountered wherever truck crops are grown in the Valley. It is universally recognized that, other conditions being identical, a low relative humidity increases the rate of evaporation, and tends to cause plants to transpire more water. The effect of a low percentage of moisture in the atmosphere is, therefore, to increase the water requirement of crops, and to intensify the necessity for taking every precaution to check the evaporation of water from the soil. While the low

ative humidity of the atmosphere over the site of this
eriment may have appreciably increased the losses of water
ough evaporation and transpiration, nevertheless, as has
n shown, such losses were in all probability no greater
n those likely to be experienced by growers of truck crops
oughout the Valley.

Table XXXI. Daily Evaporation from

	1921				1922				
Date	June in.	July in.	Aug. in.	Sept. in.	May in.	June in.	July in.	Aug. in.	Sept. in.
1		.22	.17	.12	.06	.30	.27	.27	.12
2		.16	.26	.16	.20	.18	.25	.09	.14
3		.27	.30	.08	.12	.28	.22	.12	.08
4		.15	.22	.12	.16	.22	.12	.19	.06
5		.22	.22	.09	.08	.18	.24	.20	.09
6		.21	.15	.12	.17	.09	.07	.17	.05
7		.15	.21	.10	.05	.19	.21	.14	.09
8		.15	.11	.06	.11	.15	.24	.10	.11
9	.13	.20	.25	.22	.07	.26	.25	.09	.17
10	.19	.25	.30	.16	.12	.20	.35	.14	.17
11	.08	.15	.20	.27	.10	.27	.31	.06	.08
12	.20	.24	.16	.06	.16	.23	.16	.17	.14
13	.09	.20	.16	.09	.14	.34	.24	.18	.13
14	.24	.20	.11	.11	.07	.23	.24	.13	.12
15	.11	.30	.18	.13	.15	.26	.26	.18	.12

Date	June	July	Aug.	Sept.	May	June	July	Aug.	Sept.
16	.18	.26	.23	.09	.15	.27	.20	.11	.18
17	.16	.30	.30	.14	.15	.20	.22	.11	.13
18	.18	.17	.09	.12	.18	.13	.18	.15	.10
19	.22	.23	.16	.05	.12	.15	.16	.17	.14
20	.16	.40	.12	.20	.11	.17	.23	.20	.06
21	.14	.20	.20	.18	.15	.18	.17	.19	.17
22	.09	.22	.14	.09	.18	.23	.14	.11	.14
23	.18	.21	.13	.06	.15	.15	.14	.21	.10
24	.21	.18	.08	.12	.11	.25	.17	.13	.11
25	.12	.21	.11	.11	.12	.25	.27	.15	.04
26	.20	.26	.20	.16	.14	.30	.15	.09	.11
27	.20	.16	.12	.03	.21	.30	.26	.04	.11
28	.16	.21	.19	.27	.14	.22	.26	.14	.11
29	.22	.34	.11	.12	.18	.22	.24	.08	.07
30	.18	.23	.12	.10	.26	.30	.24	.21	.08
31	--	.23	.20	--	.22	--	.18	.17	.03
Total	3.64	6.88	5.50	3.73	4.33	6.70	6.64	4.49	3.35

In order to secure the above records of evaporation a gal-
nized iron tank six feet square and three feet deep was sunk
the ground till the rim protuded only about an inch above
le surface of the soil. The tank was then filled with water
within four inches of the top, and the daily evaporation
easured in hundredths of an inch.

It is interesting to note that the total evaporation dur-
ng May, June, July, August and September 1922, was over twenty
our inches. That is to say, a greater depth of water was
vaporated from the surface of the water in the tank than was
pplied, during the entire season, to any of the plots in this
xperiment.

Extensive investigations carried out by Fortier (11) have
hown that the main governing factor in the rate of evaporation
rom a soil is not the temperature of the soil or air, the
ovement of the wind, or the humidity of the atmosphere, but
he percentage of moisture in the top layer of the soil. Thus
vaporation from a saturated sandy loam was over twice as great
s that from a water surface under the same climatic conditions.
When the same soil contained only 17.5% of water the loss from
evaporation was found to be less than that from a water surface.

There is every reason to believe that the above figures
of evaporation indicate the general conditions which exist in
the Okanagan. While the rate of evaporation was not as exces-
sive as that observed in many other irrigated regions, never-
theless, it was sufficiently great to indicate the necessity
for adopting in the Okanagan every feasible method for the

duction of evaporation losses.

From this brief review of the climatic conditions which evailed while this experiment was in progress it is evident at the location of the experiment is such as to make the sults secured applicable to a large area of the Okanagan lley. Furthermore, it is apparent that although the experint has been conducted over a period of only three years, the ather experienced has been such as to test the efficacy of rious irrigation practices under as wide a range of climatic nditions as is likely to occur, with any frequency, in the uck crop sections of the Valley.

he Influence of Soil on the Results of this Experiment.

As has already been stated, the soil on which this experi-ent was carried out is a fertile sandy loam about two and a alf feet in depth, underlain with fine sand. It is quite pos-ible that altogether different results might be secured under ifferent soil conditions. However, as has already been point-d out in the introduction to this report, the soil formation n the site of this experiment is typical of that which prev -ils in many of the truck crop sections of the Okanagan.

In determining the reliability of the data secured from n experiment of this nature, consideration must be given to he possible influence of soil heterogeneity. In this connec-ion it is important to bear in mind that the natural formation nd the previous treatment of the site of this experiment were uch as to promote uniformity of soil conditions. Furthermore, hen oats and potatoes were grown on the land previous to the nauguration of this experiment there was no noticeable dispar-ity in the yields obtained from the several sections later occupied by the various plots. The fact that no appreciable amount of grading was necessary to fit the land for irrigation was also conducive to uniformity of soil conditions. It is true that the slope of the land is slightly more abrupt in the area occupied by Plots C and D in 1921, than in the area occup-ied by the remaining plots and that this increase in gradient is accompanied by a small decrease in the depths of the surface soil. Nevertheless, it seems justifiable to conclude that, all in all, the reliability of the results has not been greatly paired by variations in the fertility or depth of the soil, by inequalities in the slope of the land.

e Influence of Cultural Methods on the Results of this Experiment.

From the statements made in the introduction to this
port it is manifest that the nature of the cultural methods
lopted may have an appreciable effect on the results secured
om irrigation experiments. Consequently the results of this
periment must be considered to apply directly, only where the
ystems of soil and crop management are similar to those under
hich this experiment was carried out. It is altogether proba-
ble that, where less effective means of maintaining soil
ertility or less efficient methods of conserving moisture were
n vogue the quantity of irrigation water required for the
roduction of crops would be materially increased. Nevertheless
t is considered that the culture received by the crops in
his experiment was such as might be practiced to advantage by
ommercial growers of truck crops. In view of this situation
t seems logical to contend that any influence which cultural
ethods may have had on the results of this experiment could
e duplicated with profit by the grower of truck crops in the
Okanagan Valley.

The Influence of Experimental Technique on the Results of this Experiment.

Throughout this experiment an earnest attempt was made to provide growing conditions which approximated as closely as possible those which would normally be encountered in the field. However, the fact that the plots were only a fraction of an acre in area, and that it was impossible to repeat the experiment undoubtedly introduced a large possibility of experimental error. As explained in the outline of procedure, every effort was made to ensure a uniform stand of each crop in each plot.

Great care was taken in making all measurements and weighings. The Miners' Inch Boxes used in recording the water applied were checked by measuring in gallons the volume of water delivered in a given time. A Fairbanks Morse Scale was used for weighing the crops in the field, while a Christian Becker Balance was employed in making the soil moisture determinations in the laboratory.

From the point of view of correct experimental technique the planting plan adopted is open to several serious objections. The different types of vegetables were grown side by side in single rows in each plot. The yields secured under such conditions are in no sense strictly comparable to those which might be obtained were each vegetable to be grown by itself on an acreage basis. Undoubtedly the root systems of the various crops crossed and intermingled making it imposs -

ble to determine accurately the water requirements of each ndividual crop. Furthermore, the portion of each crop above ground was subjected to different atmospheric conditions than vould be experienced were each crop to be grown in a block by tself. Again, those vegetables which were planted in the outside rows of each plot enjoyed an unfair advantage over their neighbors within the plot. Not only with regard to availability of soil fertility, sunshine etc.; but also with reference to the soil moisture at their command. The fact that the outside rows of experimental plots produce greater yields than inside rows is a matter of common observation. Similiarly the competitive effect of adjacent rows has much experimental proof. According to Pickering (30) this behavior is at least partially due to the excretion of toxic substances by the plants. The production of such substances is still a debatable question, but whatever the cause it is universally conceded that competition between adjacent rows and excessive yields of the outside rows, are factors which have a considerable bearing on the reliability of experimental results.

Notwithstanding these obvious short comings in the experimental technique employed in the conduct of this experiment, it seems reasonable to assume that the results secured indicate at least the relative behaviour of the several crops under various conditions of irrigation practice.

CONCLUSIONS

There can be no finality to conclusions arrived at from a survey of results obtained in a single experiment, conducted over a period of only three years, and exposed to the many modifying influences referred to above. It is considered, however, that the information already secured is sufficiently reliable to justify the following general statments, which may be of interest and of value to growers of truck crops in the Okanagan Valley.

1. Where care is exercised in applying irrigation water, and where approved methods of soil management are followed, satisfactory yields of many truck crops can be obtained with comparatively small applications of irrigation water.

2. When the soil is maintained in good physical condition and when proper attention is given to the preservation of soil fertility, the quantity of water required to give the highest yield per acre of such crops as tomatoes, potatoes, beans cantaloupes and corn, is considerably smaller than generally conceived.

3. Application of water in excess of the actual requirements of truck crops is not only a wasteful practice, but actually reduces the total yield and postpones the date of maturity, particularly of such crops as corn and cantaloupes.

4. Although such crops as carrots, cabbage and cucumbers give an increased yield from the application of relatively large amounts of water, it is questionable whether such

increase is economical. The increase in yield is not always sufficiently great to cover the cost of procuring and applying the additional water.

5. In those sections of the Okanagan Valley where the annual precipitation is not more than 10 inches and where not more than six inches of irrigation water is available during the growing season, or where no water is available after July 1st it would seem inadvisable to undertake commercial production of truck crops. With proper care, however, vegetables for home use may be produced with even this small quantity of water.

6. It is inadvisable to apply large quantities of water to the soil immediately previous to sowing seeds of truck crops. Large applications at this time appear to chill the soil to such an extent as to seriously reduce the percentage of germination, particularly of the heat-loving crops, such as corn, beans and cantaloupes. If sufficient of the natural precipitation to ensure good germination has not been stored in the soil, the land may, with advantage, be irrigated ten days or so before seeding time, cultivated thoroughly, and then allowed to warm up before sowing the seeds.

7. Applications of 3 inches of water at 15 day intervals can be expected to give satisfactory results only where water is applied according to approved methods, and where cultivation is practiced as soon after irrigation as the ground can be worked.

8. Three inches of water per application appears to be nec-

essary to ensure uniform distribution of moisture in the type of soil most prevalent in the truck crop sections of the Okanagan Valley.

9. The type os woil most prevalent in the Okanagan will not take up moisture at the rate of 3 inches per eleven hour day unless adequate measures are taken to ensure the incorporation of plenty of organic matter with the soil.

10. Most of the distributing systems in the Okanagan Valley are operated so as to deliver water to individual growers on only two days of each week, or four days a fortnight. Conseq- uently it is of the utmost importance that the soil be thor- oughly prepared previous to irrigation, and that it be main- tained in such a condition that it readily absorbs and retains moisture.

11. Irrigation should never be regarded as a substitute for cultivation.

12. Every effort should be made to conserve the natural precipitation.

13. Physiological diseases or disorders of the tomato, such as blossom-end rot and cracking, can be at least partially controlled by maintaining proper conditions of soil moisture.

14. To make the most efficient use of his available water supply the irrigator must study the moisture holding capacity of his soil as well as the water requirements of his crops, and then apply his water accordingly.

15. In any attmept to determine what is the most economical practice for his particular conditions the grower must not

only consider yield per acre, but must also take into account yield per acre inch of water. He must balance the cost of water against the rental value of land. Where water is relatively more expensive than land it will pay the grower to apply a comparatively shallow depth of water over a large area of land. Even where water is plentiful and land is limited, the irrigator is justified in increasing the amount of water which he applies only so lont as this practice results in an increase in yield sufficient to more than offset the cost of procuring and applying the additional water.

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