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Health and Biology

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FIRST ANNUAL REPORT OF THE BOTANY FIELD STATION

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ABSTRACT

This is the first annual report of the Botany Field Station No. 1. The location, layout and method of irrigating the station are described. The crops grown and their yields are given. Results of analyses for radioactivity are reported in tabular form. No evidence of radioactivity above accepted tolerance levels in foods was obtained for any of the crops tested.

A plane table plot of the Field Station and photographs are included.

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FIRST ANNUAL REPORT OF THE BOTANY FIELD STATION

INTRODUCTION

The water used to cool the piles at the Hanford Works contains radioactive elements, formed in its passage through the pile. Some of the elements are short-lived. However, a small but important group retain their activity over a long time. It is possible to hold the effluent water in the retention basins before discharge into the river until the short-lived elements have been materially reduced by decay. Dilution of the effluent water with the Columbia River water is such that these active elements are not considered important as long as they remain in solution. Factors which influence the dilution of the radioactive elements are: the ability of algae and other micro-organisms, both plant and animal, to concentrate the active materials in and on their bodies; and where the river water is used for irrigation, the possible concentration of the radioactive elements in the soil (1) (2) (3). Because of the latter possibility it was considered desirable to establish a field station where this problem could be studied over an extended period.

Throughout 1947 and 1948 all the possible areas on both banks of the Columbia River within the boundary of the Hanford Works Project were examined as possible sites for the field station. The west bank of the Columbia River was considered by the Botany Group as the most

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desirable because of the higher concentration of radioactive elements in the water on that side and the difficulty conducting an operation across the river (5).

However, the Foster Ranch, government tract CC-133, two miles up stream from the Hanford Ferry, on the east bank of the Columbia River was finally selected because: (1) it was of a size (22.8 acres) sufficient to yield valid data, (2) it possessed an irrigation system in good operating condition, (3) it included a good producing peach orchard, (4) the house and supplementary buildings were adequate for use, (5) the tract was located where it was easy to prevent trespass by unauthorized persons, (6) it was down stream from the operating units, (7) it was located on the same side of the river and up stream from the 5552 acre Pasco Pumping Project, (9) the soil was a heavy sandy loam, and (10) the physical features of the tract are such that it could be divided into two approximately equal experimental plots.

METHODS

Operation of the field station was deemed necessary to furnish data on what could be expected in the Pasco-Kennewick area from the use of the Columbia River water for irrigation purposes. It was considered essential to know the rate of increase of activity in the soil, the amount of activity taken up by the plants, and the yields of the crops grown.

The arrangement of the station is such that the pump line from the river divides it into two plots essentially equal in area, soil,

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state of cultivation and orchard. The orchard, principally peach trees occupies about six acres. The rest of the land consists of 14 acres of alfalfa and two acres for buildings, yards, and waste land. The fruit trees consist of one large bing cherry, 20 apricot, nine apple, five plum, and 510 peach trees. The apricot trees are distributed along the margin of the tract and in the edge of the peach orchard. The apple trees are mostly along the road and runs to the house from the highway. There are 311 peach trees on the west end and 199 on the east end of the tract. The west orchard is much younger than the east orchard and contains most of the Hale and Elberta peaches, the only marketable peaches. The remainder of the peach trees are of odd varieties and seedlings which produce inferior fruit or fruit ripening at the wrong season.

The land between the orchards and buildings is alfalfa meadow which was in poor condition because of its age and heavy infestation with dodder and bind weed. All of the fruit trees on the place had been neglected and required heavy pruning.

When the tract was taken by the Botany group the irrigation system was supplied by a Fairbanks-Morse electrically-driven, centrifugal pump capable of delivering 450 gallons per minute to the diversion box if the pump was not more than 10 feet above the source of water supply. The lateral irrigation mains of 12-inch wooden piping run east and west along the highest point above the diversion box. These mains are drilled with 3/4-inch holes at about ten foot intervals, allowing the water to flow into the ditches for the rill type of irrigation. The contour of

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the land is such that flooding is not possible, and it was not considered desirable to install a sprinkler irrigation system.

It was planned to use the up stream or west area as a control area and the down stream or east area as a treatment plot. A well capable of delivering 150 gallons per minute was drilled fifty feet north of the central diversion box to secure water free from radioactive contamination.

A wall was placed in the diversion box so that the river water could go only to the east side of the tract, and well water could go only to the west side of the tract.

A domestic well supplying five gallons per minute furnished the water for the use of the workers on the tract.

A Farmall Model C tractor with plows, cultivating and mowing equipment was rented from Transportation Division as an economy measure to reduce the hand work in cultivating and handling the crops.

The crops grown and studied the first season were beans, oats, carrots, sweet corn, potatoes, alfalfa, peaches, cherries, apricots, plums and apples. Space for the annual crops was obtained by establishing a two and one-half acre plot in the treatment area and one of similar size in the control area. The radioactivity present in samples taken from the soil, roots, stems, leaves and fruit of each species or variety of plant grown was determined. All samples were collected in series of thirty from both the control and treatment plots.

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The soil samples were mounted as one gram samples on stainless steel plates and counted directly for beta activity. The counts of these thirty samples were combined into an average figure.

The vegetation samples were mounted in one gram samples and counted directly, or digested and the ash mounted on stainless steel plates and counted for beta activity. The average beta activity for each part of the plant was recorded. Alpha activity was not considered in this years work. It was not possible to secure a chemical analysis of either soil or vegetation.

Orchards were pruned, sprayed, cultivated, and irrigated by the Botany group members. Peaches were harvested and marketed by a contractor obtained through the Atomic Energy Commission. All crops were planted in season. The work was begun using the river water and well irrigation as planned. On the twenty-eighth of May the well began to pump sand which cut the pump bearings out. It was decided that there was no possibility of using the well until some method of controlling the sand was developed. The failure of the well left us without a control plot and necessitated the use of river water to keep the control orchard alive. Since it was considered desirable to prevent the addition of the radioactive isotopes to the soil of the control plot on which the field and vegetable crops were grown, it was plowed up and summer fallowed. To secure control data, samples of as many crops as possible were obtained from a farm on the Roza Project nine miles northeast of Prosser, Washington.

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A total of 90 acre-feet of water was pumped from the river, just short of the quantity required by the soil and crops for the season, had it been properly distributed. Trouble with the river irrigation pump resulted in poor distribution of the water. The difference of 17 feet between the low water and flood stage of the river made it necessary to change the position of the pump twice. Repeated changes in the length of the inlet pipe to the pump were necessary to maintain the flow of water. Proper timing of irrigation is essential for high yield and good quality of the crops grown. For example the yield of the potatoes on the plot was good but the quality of the potatoes grown was poor. This was directly attributable to faulty irrigation, for there was no scab, bacterial rot or wire worm injury.

RESULTS

The results of the years work have been condensed to the tables and figures which follow.

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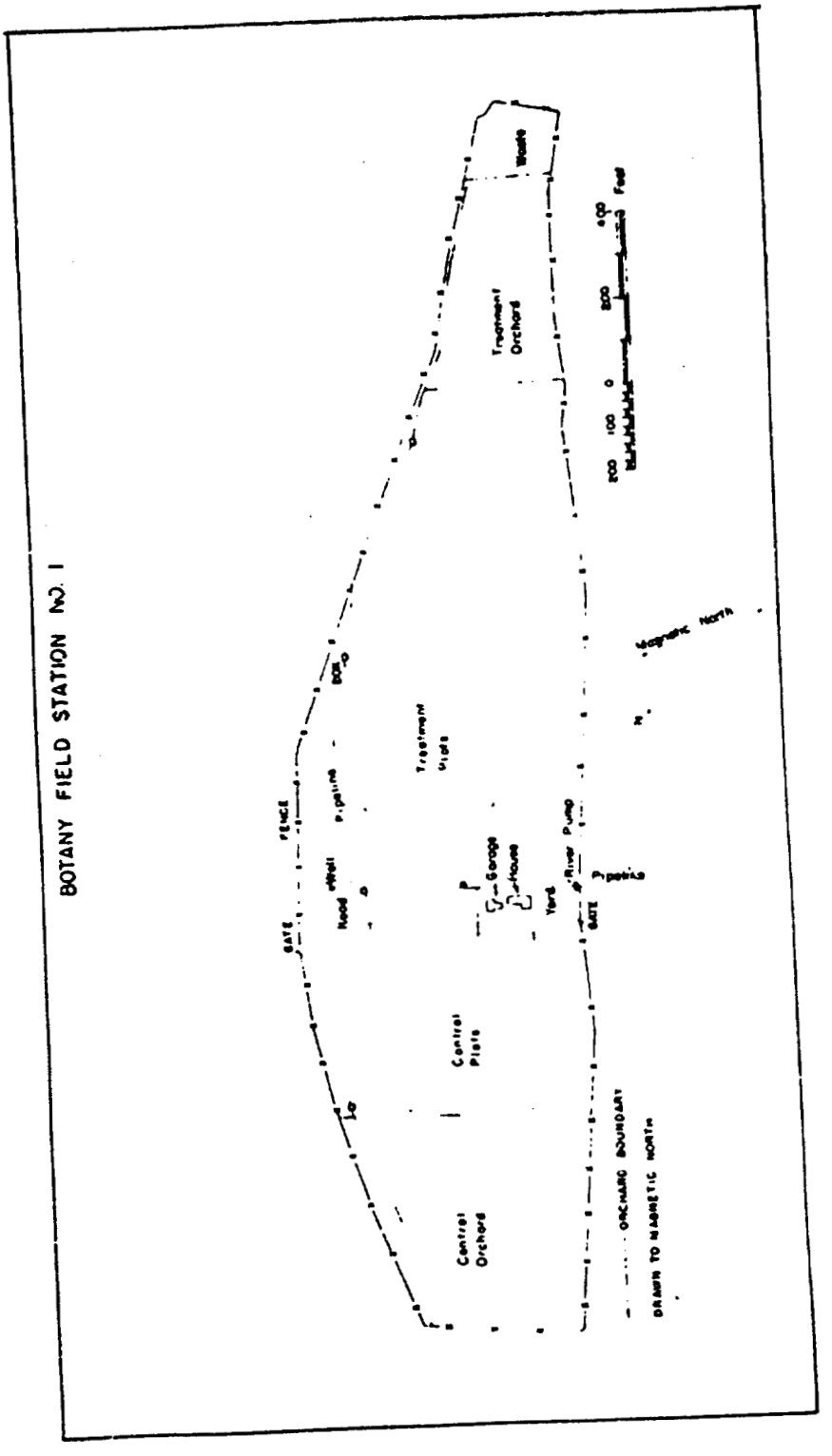

Figure 1. Plane table plot of the Botany Field Station.

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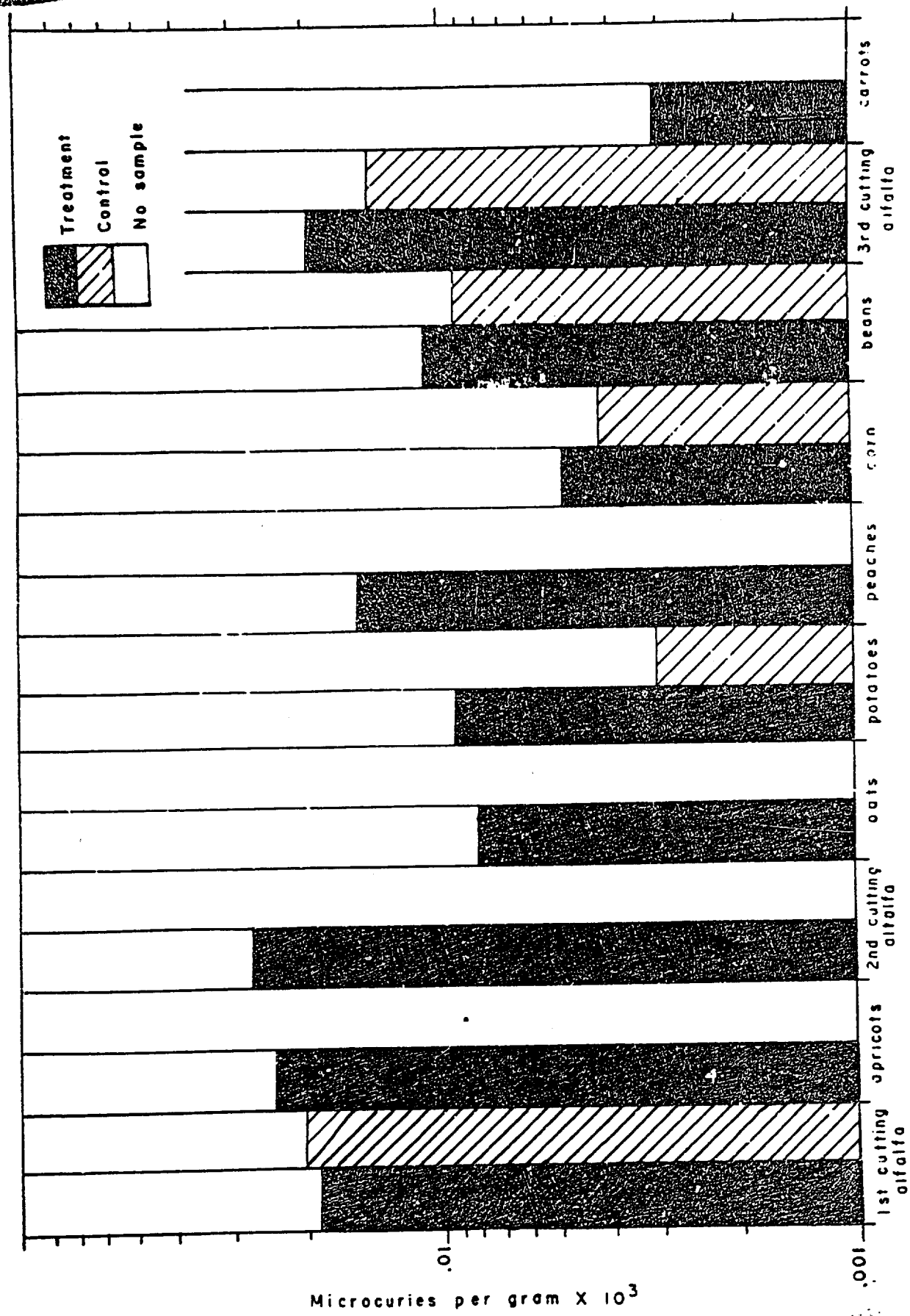

Figure 2. Comparison of beta-activity of crops in treatment and control plots

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TABLE 1

AVERAGE BETA ACTIVITY PER MONTH FROM TREATMENT PLOTS
(figures in microcuries per kilogram)

Sample	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average
Soil	0.021	0.013	0.022	0.022	0.019	0.02	0.02	0.02	0.019	0.02
Alfalfa		0.022	0.019*		0.028*		0.014*			0.02
Oats				0.01	0.008*					0.009
Beans							0.011*			0.011
Carrots							0.003*			0.003
Corn						0.005*				0.005
Potatoes					0.009*					0.009
Peaches					0.016*					0.016
Apricots			0.016*							0.016
Cherries			0.013*							0.013
Plums			0.038*							0.038
Apples				0.009*						0.009

* Sample readings at harvest time.

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TABLE 2

YEARLY AVERAGE OF BETA ACTIVITY EXPRESSED IN MICROCURIE PER KILOGRAM

Name of Crop	Control	Treatment
Soil	0.015	0.02
Alfalfa	<0.015	0.024
Beans	<0.009*	0.011*
Sweet Corn	<0.004*	<0.005*
Late Potatoes	<0.003*	<0.002*
Oats	**	<0.008
Carrots	**	<0.003*
Early Potatoes	**	<0.009
Peaches	**	0.016
Apricots	**	0.052
Cherries	**	<0.013
Plums	**	0.023
Apples	**	0.009

* All samples of these crops were digested in concentrated HNO_3 and other crops were mounted and counted directly.

** It was impossible to obtain values on these crops because of the failure of the well and loss of the control areas.

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TABLE 3

CROP YIELDS

CROP	FIELD STATION	AVERAGE FOR CENTRAL WASHINGTON (7)
Alfalfa	3.7 tons per acre	3.6 tons per acre
Oats	60 bushels per acre	57.6 bushels per acre
Beans	36.5 bushels per acre	27 bushels per acre
Carrots	5.7 tons per acre	10 tons per acre
Potatoes	256.6 bushels per acre	313.9 bushels per acre
Peaches	14 000 pounds per acre	10,000 pounds per acre

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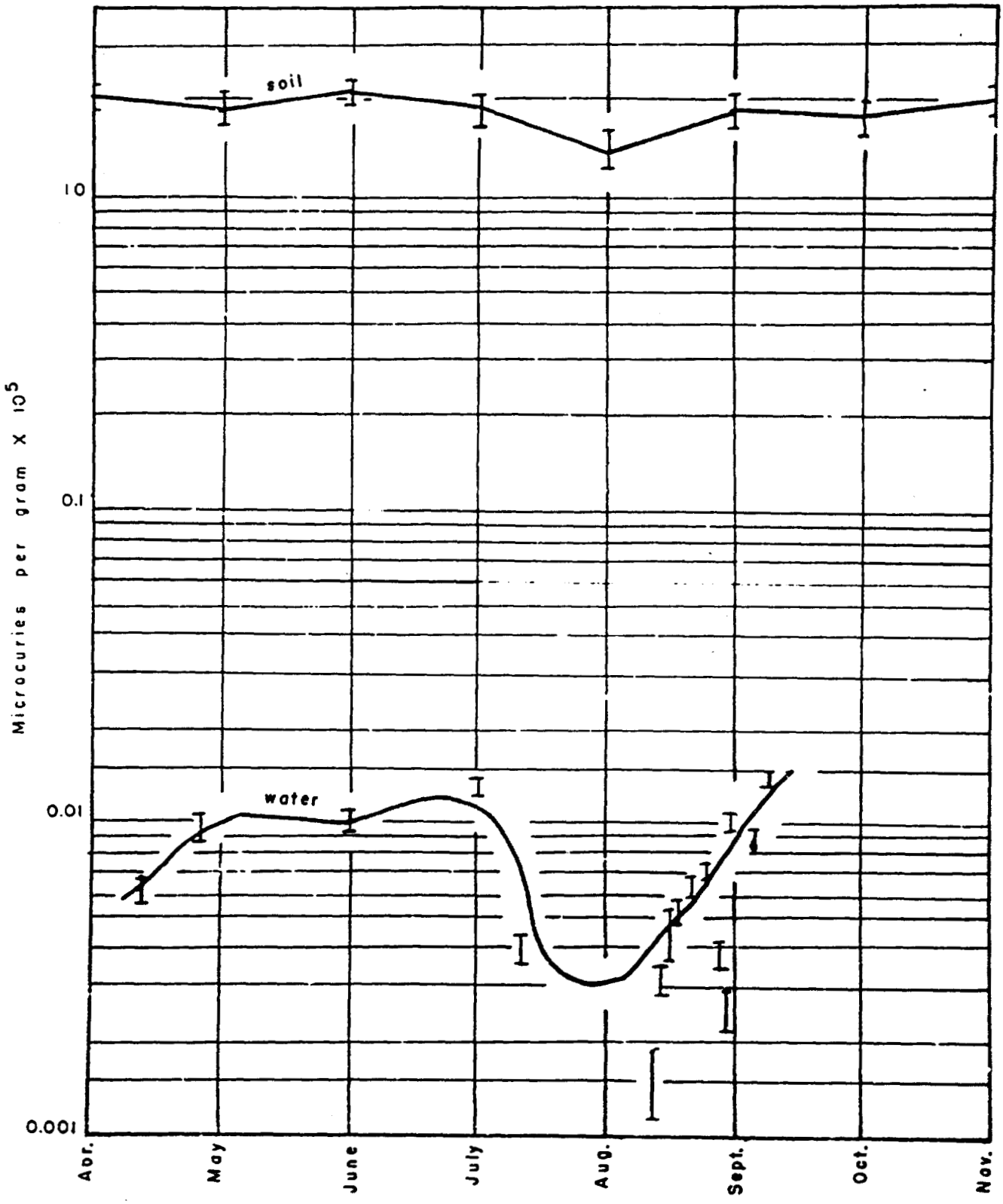

Figure 3. Beta Activity of Treatment Soil and Irrigation Water

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TABLE 4

BETA-ACTIVITY OF RIVER WATER AT THE INLET OF THE IRRIGATION LINE*

Month	Number of samples	Average beta-activity (Readings in microcuries per c.c. X 108)	Maximum beta-activity
Jan.	1	35.3	35.3
Feb.	3	19.9	34.8
Mar.	4	30.5	34.9
Apr.	4	28.5	35.4
May	3	12.3	17.3
June	5	6.7	8.3
July	4	15.2	21.6
Aug.	4	14.3	15.7
Sept.	3	22.7	30.1
Oct.	4	48.7	52.6
Nov.	3	49.0	51.7

* There was no detectable alpha reading on the water samples from this location. The data on the water activity was obtained from Site Survey (4).

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Figure 4. View of the Botany Field Station

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TABLE 5

OPERATING STATISTICS

	Man hours used
Pruning and clean up of the station	607
Spraying of the orchards	68
Cultivation and plowing	268
Seed preparation and crop sampling	448
Hay harvest	
1 st cutting	164
2 nd cutting	93
3 rd cutting	50
Total	371
Pump repairing and pipe line shifting (Battery personnel)	161
Total man hours used	1904

WATER PUMPING HOURS

Number of hours of river pump operation	1613
Number of hours of well pump operation	158
Total pumping hours	1771

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DISCUSSION

The average monthly beta activity of the soil and crops of the plots receiving Columbia River water for irrigation is shown in Table 1. All readings on plants or portions of plants were considerably lower than the tolerance levels accepted for vegetation. Marketable peaches and alfalfa were sold for use as food.

Readings on the soil are higher by a factor of ten than the average given for non-irrigated land on the east bank of the Columbia River in the vicinity of the Field Station (6).

A comparison of beta activity of crops in treatment and control plots shown in Figure 2 gives a higher reading on the control alfalfa than on the treatment plants. The difference between the two groups is so small that it could be ascribed to variations in counting and technique of handling. The increase of 5×10^{-6} $\mu c/gm$ beta activity in the soil of the treatment plots is not enough to show the need of any great concern about the use of Columbia River water for irrigation.

The crop yields were better than had been expected for the first season. Fifty percent of the crops grown exceeded the average yield for Central Washington (7). The alfalfa showed evidence of a lack of phosphorus in the soil. The entire plot would profit by a moderate addition of nitrogen-phosphorus-bearing fertilizer.

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In considering the operation of the station attention should be called to the item of man hours required to take care of the alfalfa hay. There is no return in scientific data from the hay that is commensurate with the 272 man hours required to take care of the hay. The 161 hours required to move the irrigation pump and pipe are excessive and some corrective measure should be taken.

SUMMARY

The operation of the Botany Field Station (a 25 acre tract), irrigated with the water from the Columbia River which contains diluted effluent from the 100 Areas, has failed to show any significant absorption or translocation of beta emitting radioactive isotopes in the crops grown. The crops produced yields that compare well with the yields that have been established as average for the Central Washington area. There was no significant increase in the beta activity of the soil as a result of the use of irrigation water from the Columbia River.

The data obtained tend to prove the contention that the operation of Hanford Works does not contribute a hazard to the farming operations near the river.

ACKNOWLEDGEMENTS

We wish to express our thanks to A. A. Selders, Josephine Sommers, and the many other members of the Biology Division who have helped materially with the planting, cultivating, harvesting and preparation of specimens of the Botany Field Station through this past season.

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