EFFECTS OF WATER TEMPERATURE ON THE EARLY GROWTH AND DEVELOPMENT OF TARO

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ABSTRACT

Taro *(Colocasia esculenta* (L) Schott) plants exposed to 28°C water temperature exhibited better plant growth and leaf area development, more and longer roots and higher dry matter content than those grown at other water temperature, i.e., 18-22°C (normal) and 37°C. Inferior vegetative growth and least and shortest roots were noted in plants grown at 37°C. In a follow-up experiment conducted using 2 taro varieties, production of higher number and significantly longest roots was found to be greatly favored by a temperature range of 27-29°C. Reduction in both number and length of roots occurred when temperature became higher but drastic effect of temperature was very apparent at 36-38°C. Temperature beyond 29°C seemed to be detrimental to root growth in newly planted taro. At 36-38°C, roots of the 2 varieties used did not grow beyond 2 cm.

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KEY WORDS: Taro *Colocasia esculenta.* Bun Long. Lehua Maoli. Water temperature. Vegetative development. Root development. Initial growth.

INTRODUCTION

Taro *(Colocasia esculenta* (L) Schott) is an important root crop extensively cultivated in most tropical countries. It is also grown in the subtropics and to a lesser extent as a summer crop in temperate countries (Plucknett, 1970). The ability of this crop to thrive under a wide range of environmental conditions which are adverse for other crops may have facilitated its worldwide distribution (Leon, 1976).

In Hawaii where taro is commercially grown, many farmers particularly in Kauai island assert that taro planted during summer does not grow well and consequently produces lower yield than those planted after the summer season. Although there is no strong evidence to support their contention, Pardales et al. (1982) believed that a similar thing happens when taro is planted in lowland areas during the summer months in ViSCA, Leyte. Like any other crop, the growth of taro can be influenced by several environmental factors. However, data to explain the effects of temperature on the growth and development of taro are still insufficient, hence this study was undertaken.

MATERIALS AND METHODS

Two separate experiments were conducted and a randomized complete block design with 3 replications per treatment was used.

Pot Experiment. — The 3 water temperature levels used were: 1) 37°C, 2) 28°C and 3) the normal temperature (control) of water coming from a domestic supply line which fluctuated within 18-22°C. Temperatures of 28°C and 37°C were attained by regulating the proportional flow of hot water from a gas water heater (Rheem Mfg. Co., U.S.A.) and cold water (i.e., normal temperature) from the water supply line. Thermistor thermometer (Omega Engineering, U.S.A.) was used to control fluctuations especially in the higher temperature levels.

Planting materials of taro variety Bun Long used consisted of about 10 mm of the upper part of the corm and 20 cm of the lower portion of the petioles. One planting material was planted in each plastic pot (15 cm dia) containing inert horticultural perlite. Later the pots were placed in plastic tubs filled with water to simulate flooding. Continuous water flow was maintained throughout the duration of the experiment. The 3 tubs prepared had different water temperature levels. Those with high temperature, i.e., 28 and 37°C, were allowed to stabilize before setting in the plants.

Greenhouse Experiment. — This was done to check the validity of results in the pot experiment and to establish the exact temperature range that would be very favorable for the early growth of taro. The different temperature regimes used were 1) 27-29, 2) 30-32, 3) 33-35 and 4) 36-38°C. These were attained by allowing water from an electric water heater with a temperature of 38° to pass through two 600-cm long plastic pipes (15 cm dia) planted with taro. The pipes were then laid down horizontally with one end slightly elevated to allow hot water to flow gradually and continuously inside. After the incoming water temperature had stabilized at 38°C, the 2 pipes were slightly repositioned to let the temperature drop to 27°C at the lower ends of both pipes. Each pipe was filled with horticultural perlite to serve as growing medium for taro. Twenty holes for planting taro were made 30 cm apart on one side of each pipe. Taro was then planted in each of the holes made with the recorded temperature drop of 3°C after every 5 planted holes. The plants were grouped according to their temperature exposure for observation purposes at 15 days after planting.

Two varieties of taro were used for this experiment. Bun Long was planted first then Lehua Maoli. The length of planting materials used was the same as that in the pot experiment.

RESULTS AND DISCUSSION

Pot Experiment

Vegetative Growth and Development.

Although temperature treatments did not bring about significant

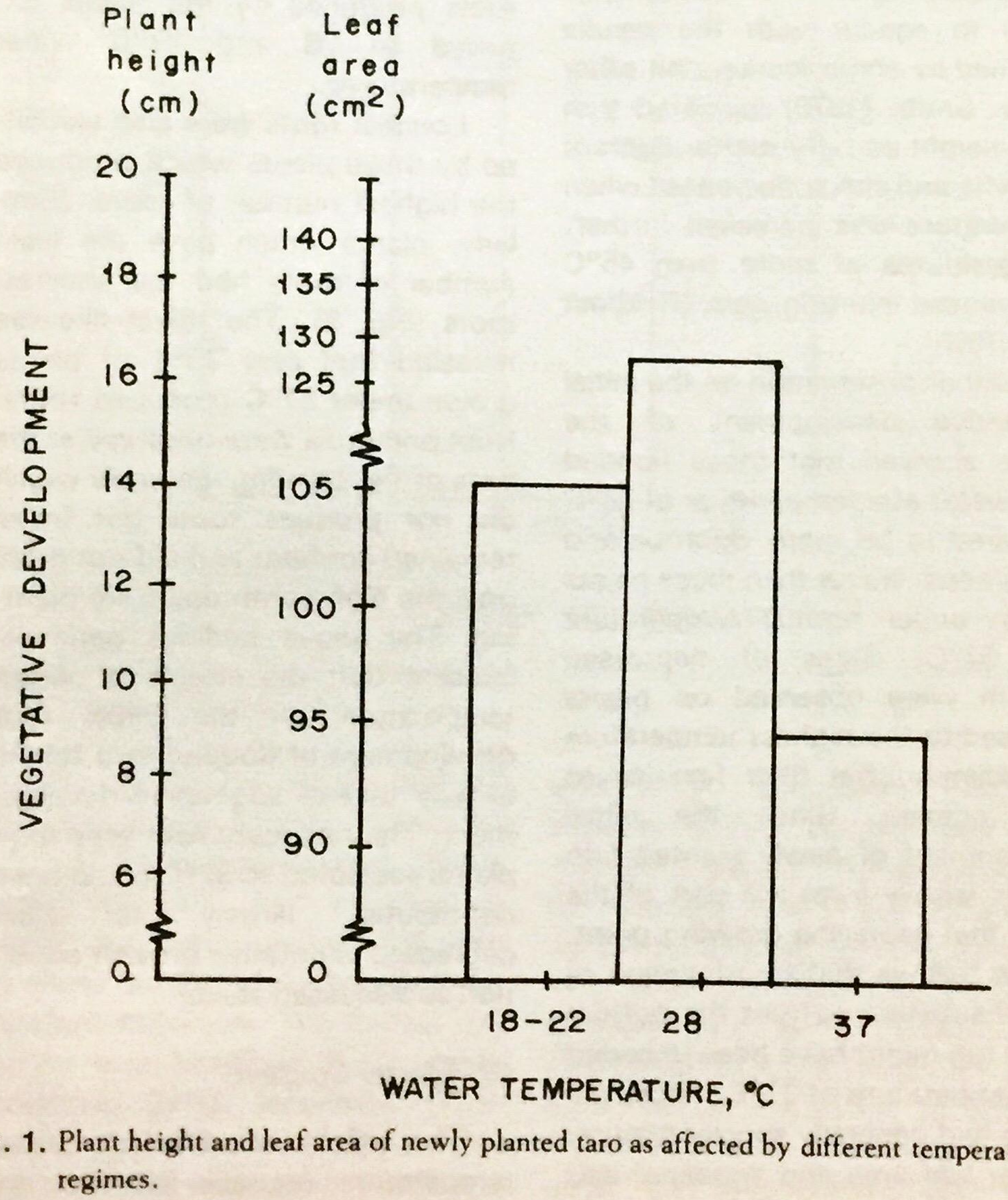

Fig. 1. Plant height and leaf area of newly planted taro as affected by different temperature regimes.

differences in plant height and leaf area development, it is apparent that plants grown at 28°C were the tallest and had the biggest leaf area followed by those grown under normal water temperature (18-22°C). Plants subjected to a water temperature of 37°C had the shortest height and smallest leaf area (Fig. 1). These results may indicate that there is a detrimental effect of high water temperature on the early growth and development of flooded taro. This observation tends to concur with the results obtained by some workers on other crops. Smith (1970) indicated that plant height and dry matter content of alfalfa and clover decreased when temperature was increased further. Temperatures of more than 45°C also caused injury in corn (Rykbost et al.,1975).

Further observation on the initial vegetative development of the plants showed that those flooded with water at a temperature of 28°C appeared to be more vigorous and had greener leaves than those plants grown under normal temperature and 37°C. Signs of depressed growth were observed on plants exposed to the highest temperature immediately after their first leaves fully opened. Since the initial nourishment of newly planted taro comes largely from the part of the corm that bears the growing point, it then follows that translocation of stored substances from the bottom to the top might have been impeded at a temperature of 37°C. Thus, the plants had generally shorter stature, smaller leaf area and appeared less vigorous with pale green leaves.

Root Development.

Plants grown under water temperature of 28°C produced significantly highest number of roots followed by plants grown at normal temperature (Fig. 2). The least number of roots was observed in plants exposed to the highest water temperature. However, this significance was perhaps due to the very wide disparity in the number of roots produced by the plants exposed to 28 and 37°C water temperatures.

Longest roots were also exhibited by those plants which produced the highest number of roots. Similarly, plants which gave the least number of roots had the shortest roots (Fig. 2). The result likewise revealed that only 33% of plants grown under 37°C produced roots. Root primordia were observed at the base of the planting materials which did not produce roots but these remained dormant and did not grow until the eighteenth day from planting. The above findings generally indicate that the effects of water temperature on the initial root development of flooded taro follow exactly that of vegetative development. The restricted root growth in plants subjected to 37°C could have contributed largely to their depressed vegetative growth condition as discussed earlier.

Dry Matter Content.

The effect of different water temperature regimes on the dry

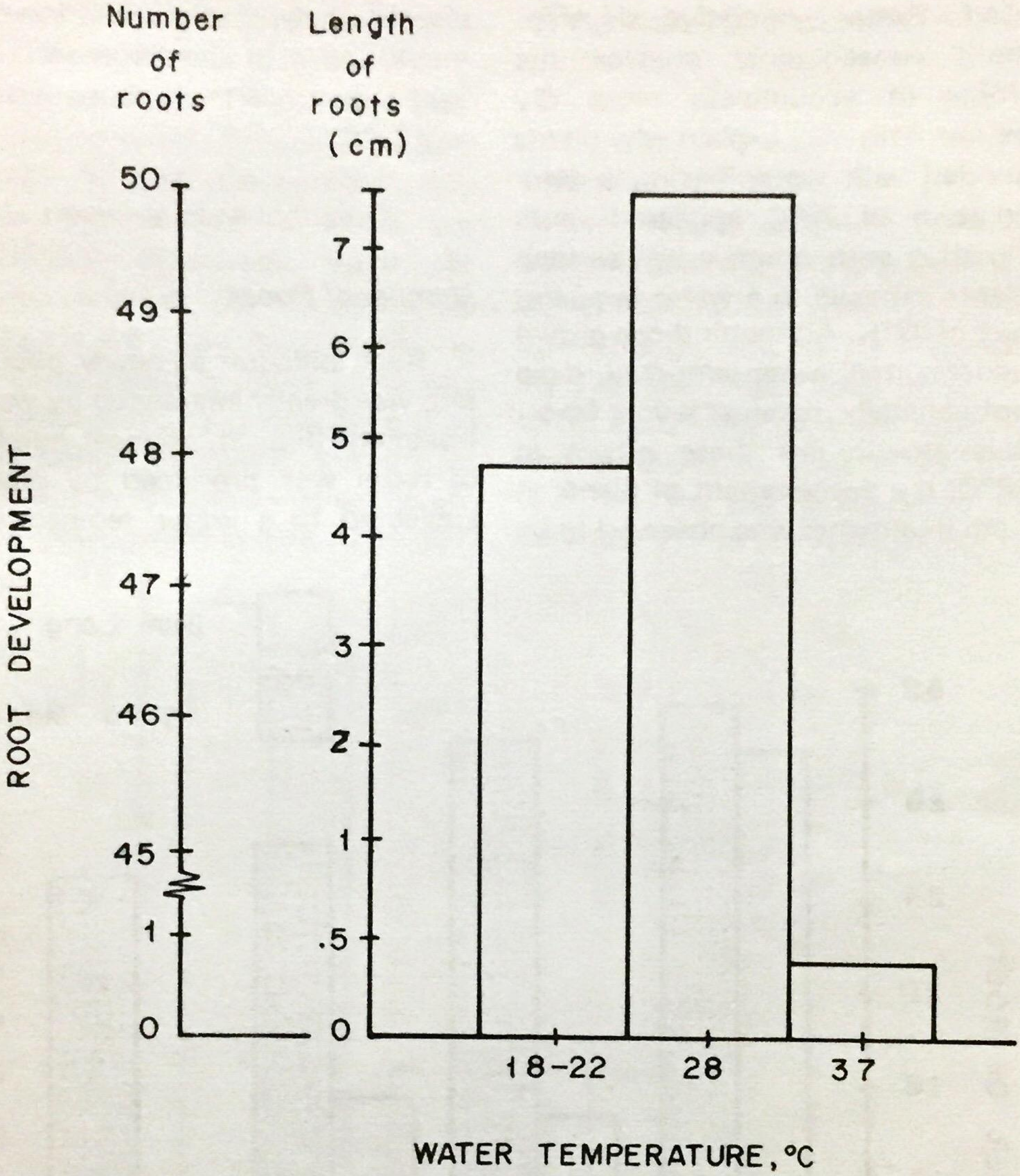

Fig. 2. Number and length of roots of newly planted taro as affected by different water temperature regimes.

matter content of newly planted taro was similar to that on vegetative and root development. Plants grown at 28°C had significantly higher dry matter content followed by those subjected to normal temperature condition. The lowest dry matter was obtained from plants grown at 37°C. However, these results were expected because like any other root crop, taro maintains a satisfactory agronomic balance between its root development and vegetative growth. Translocation of the reserved food in the portion of the corm that goes with the planting material is therefore favored by a temperature of 28°C. Furthermore, the favorable root development may have caused the plants to absorb other important nutrients from the water that was continuously supplied. Better vegetative development consequently enables the plants to accumulate more dry matter. This may explain why plants flooded with water having a temperature of 28°C appeared more vigorous with greener leaves than plants exposed to a water temperature of 37°C. Although those grown under normal water temperature did not generally manifest a very favorable growth like those grown at 28°C, the development of plants in both treatments was observed to be closely similar. Differences in vegetative and root development were very pronounced only between 28° and 37°C.

Greenhouse Experiment

Number of Roots.

Root initiation in newly planted taro was greatly influenced by water treatment (Fig. 3). Highest number of roots was produced by plants subjected to a water temperature

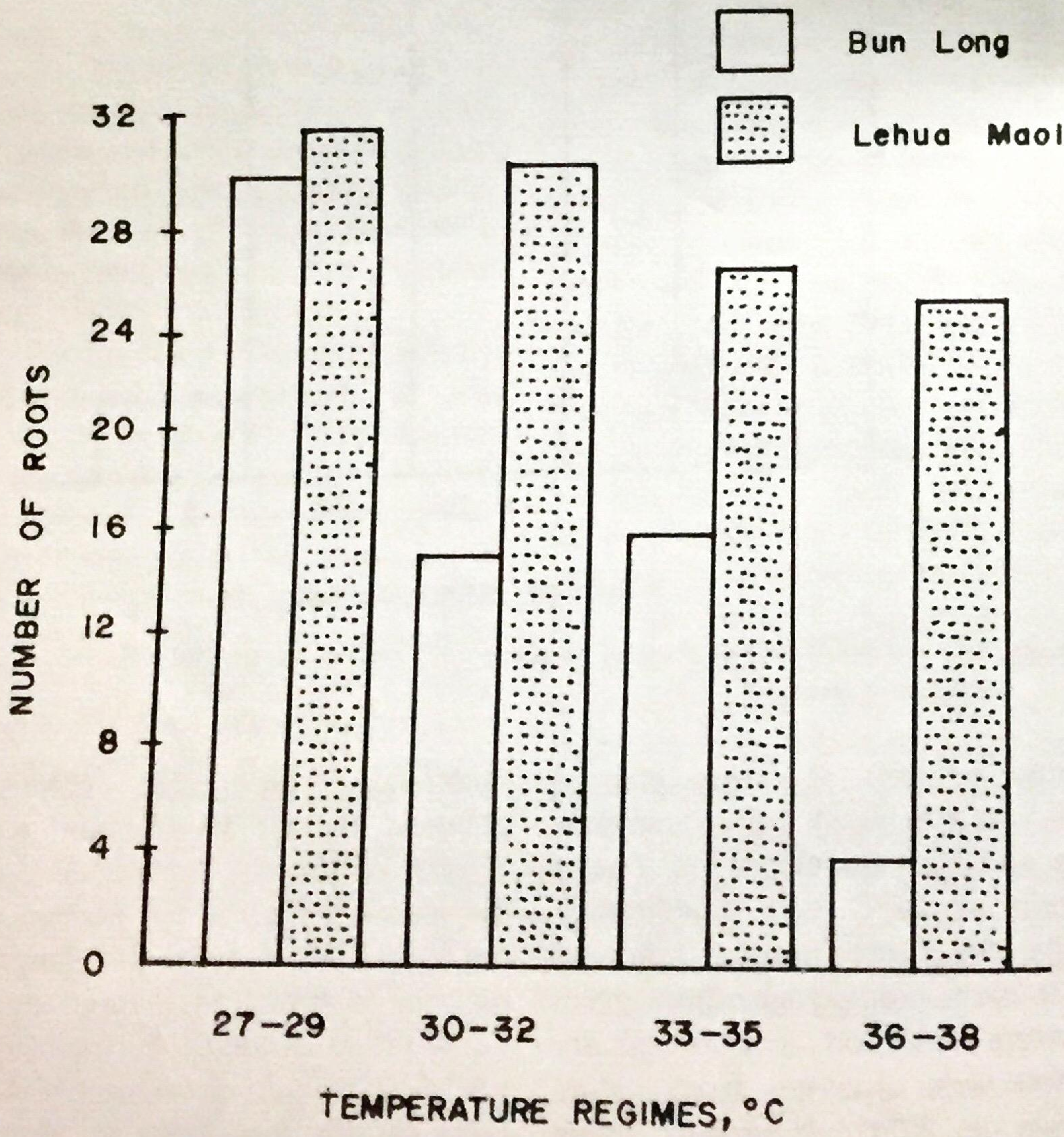

Fig. 3. Number of roots of 2 newly planted taro varieties as affected by different temperature regimes.

within 27-29°C for both Bun Long and Lehua Maoli varieties. Plants grown at 36-38°C had the least number of roots. Greater reduction in root number was noted in Bun Long than in Lehua Maoli but significant differences were observed only in the former. This suggests that root initiation during the early growth of Lehua Maoli was less influenced by temperature than Bun Long. Generally, the results very closely followed that of the pot experiment which showed that 28°C favors the initial formation of more root in newly planted taro.

Length of Roots.

The results obtained tend to confirm those in the first experiment which implied that water temperature strongly affects root elongation. Longest roots were produced when the 2 varieties were exposed to a temperature range of 27-29°C (Fig. 4). As the temperature increased a corresponding

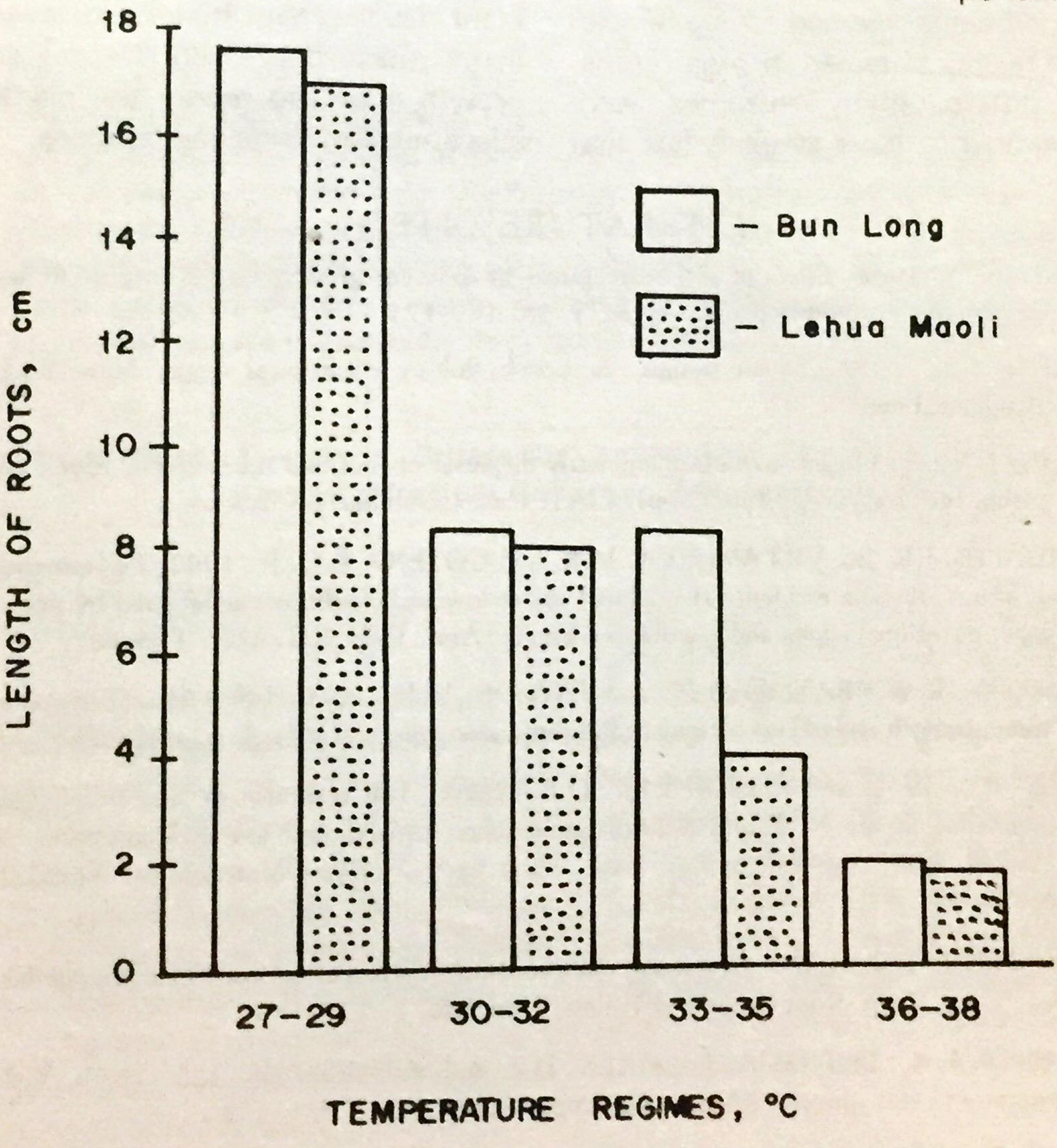

Fig. 4. Length of roots of 2 newly planted taro varieties as affected by different temperature regimes.

decrease in root length was observed for both Bun Long and Lehua Maoli. However, the biggest reduction in root length was noted between the temperature ranges of 27-29°C and 30-32°C. At the highest temperature level studied (36-38°C) the roots of Bun Long did not elongate beyond 2 cm. Root elongation in Lehua Maoli was reduced at temperatures beyond 29°C. At 36-38°C, its root growth was limited to 1.98 cm.

The overall result of the 2 experiments seemed to agree with the results obtained in other crops. In potato, many rhizomes were observed to have swollen tips that failed to develop at high temperature (Epstein, 1966). Hahn (1977) found that at 35°C roots of sweet potato did not swell to form tubers. Likewise, root elongation failed sharply as soil temperature was increased to 36°C in cotton seedlings (Pearson et al., 1970). In taro, impaired root development brought about by temperature beyond 29°C during the early establishment of the crop may subsequently contribute to a drastic reduction in its future yield potential because the general plant development may be delayed if not totally depressed. Depressed growth may also render the plants susceptible to pests and diseases.

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