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EFFECTS OF ALKALINE WATER ON ROOT GROWTH IN *ALLIUM CEPA* L.: AN EXPERIMENTAL ANALYSIS

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Abstract: *The quality of water used in agriculture is a critical factor in maintaining plant health and soil fertility, especially in the context of using marginal waters characterized by high salinity and alkalinity. This article analyzes the influence of water pH on plant development parameters, with a focus on the effects generated by irrigation with alkaline water. A review of the relevant literature highlights that a high water pH affects nutrient availability, soil microbial activity, and plant physiological processes, leading to osmotic stress and nutritional imbalances. In parallel, the experimental study examined the impact of irrigation with water having a maximum pH of 9.4 on root development in Allium cepa L., under hydroponic conditions. The results indicated an increase in dry biomass in the batch treated with alkaline water, compared to the controls irrigated with distilled or tap water. These findings support the need for rigorous monitoring of irrigation water quality to prevent soil degradation and reduced crop productivity. Future research should explore remediation solutions for the negative effects of alkaline water on soil and plants, as well as the adaptation of irrigation strategies based on crop type and pedoclimatic conditions.*

• Introduction

Impact of saline/alkaline water irrigation practices

Morphological effects

- reduced plant height
- root deformation
- leaf chlorosis and necrosis
- reduced leaf area
- decreased root/stem ratio

Physiological effects

- inhibition of photosynthesis
- ionic imbalance
- decreased nutrient absorption
- reduced antioxidant enzyme activity
- accumulation of reactive oxygen species (ROS)

• Material and method

- Sixty *Allium cepa* bulbs of uniform size were selected based on the absence of visible defects or disease symptoms and were randomly allocated into three experimental groups, corresponding to the three water treatments - distilled water as the neutral pH control; tap water, exhibiting a slightly alkaline pH; and commercially available alkaline water with the highest marketed pH value (9.4), used to simulate a strongly basic environment.

- The experiment was carried out over a period of 10 days, during which the following parameters were assessed: wet biomass, dry biomass, and ash content, measured separately for roots and bulbs.

FIG. 1-2. Experimental hydroponic installation

• Results and discussions

Mean values of tested parameters obtained from weighing measurements

Analyzed parameter		Group treated with alkaline water	Group treated with tap water	Group treated with distilled water
Initial wet biomass		*2,5794*	2,5643	*2,1681*
Intermediate wet biomass		*2,8378*	2,7399	*2,3892*
Final wet biomass	bulbs	*3,1120*	3,0582	*2,7270*
	roots	*0,2234*	*0,1771*	0,1972
Dry biomass	bulbs	0,4541	*0,4587*	*0,3852*
	roots	*0,0141*	*0,0120*	0,0130
Ash content	bulbs	*0,0418*	0,0385	*0,0318*
	roots	*0,0013*	0,0009	*0,0008*

Note: highlighted in red are the highest mean values obtained, while the ones highlighted in blue are the lowest.

Summary of Kruskal–Wallis and Mann–Whitney U Test Results

Kruskal–Wallis Test

Evaluated parameter		H	p-value
Wet biomass	bulbs	3.660	0.1604
	roots	0.5708	0.7516
Dry biomass	bulbs	4.093	0.1292
	roots	0.214	0.8985
Ash	bulbs	4.250	0.1194
	roots	2.491	0.2867
Bulb/root ratio	wet biomass	3.359	0.06861
	dry biomass	6.590	*0.03703*
	ash	2.037	0.1192

Note: statistically significant values ($p < 0,005$) are highlighted in red

Mann–Whitney U Test (for Bulb/Root Dry Biomass Ratio)

Comparison between groups	U	p-value
Alkaline water vs. tap water	130	0,060099
Alkaline water vs. distilled water	180	0,59769
Tap water vs. distilled water	110	*0,015474*

• Conclusions

- Preliminary results from the hydroponic test revealed notable, yet statistically insignificant, differences between the batches treated with alkaline water (pH 9.4) and those irrigated with distilled water (neutral pH) or tap water (weakly basic pH).

- Bulbs exposed to high-pH water exhibited higher mean values for wet biomass, dry biomass and ash than the samples from batches treated with tap water and distilled water respectively, a phenomenon contradictory to the osmotic stress and nutritional imbalances induced by the increased basic pH.

- The study was unable to confirm the negative effects associated with elevated pH of the tested water, presenting minimal impact on plant development under the present experimental conditions.

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