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IMPACT OF THE SALINITY LEVELS ON TWO COMPETATIVE WEEDS; RARTHENIUM AND CANABIS IN DISTRICT CHARSADDA

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Abstract

Parthenium hysterophorus, an invasive weed, is outcompeting native species like Cannabis sativa in Khyber Pakhtunkhwa, Pakistan. An experiment was conducted at Bacha Khan University's Department of Agriculture laboratory in Charsadda, KPK, Pakistan. Parthenium hysterophorus and Cannabis sativa plants were collected from a local field in Sakhakot, Malakand, Khyber Pakhtunkhwa. The experiment followed a completely randomized design (CRD) with two replications per pot. Plants were subjected to five salt levels (standard, 3g, 6g, 9g, and 12g) and the parameters studied included plant height, leaf area, number of branches, root weight, and plant weight. Statistical analysis was performed using Complete Block Design (CBD) and Analysis of Variance (ANOVA) (STATISTIX 8.1). The study aimed to investigate the impact of salinity levels on the growth and development of two competitive weeds, Parthenium hysterophorus and Cannabis sativa. Results showed that increasing salt levels significantly reduced growth, affecting plant height, shoot and root weight, and leaf area. These findings suggest that salinity can be a potential tool for managing Parthenium spread. Further research is needed to confirm these results under different ecological conditions.

Keywords: *Cannabis sativa, Parthenium hysterophorus, Salinity stress, Salt tolerance, Weed ecology*

INTRODUCTION

Parthenium hysterophorus, a flowering plant native to the American tropics, belongs to the Asteraceae family (1). Commonly known as Santa Maria, fever few, and white top, this invasive species has spread to India, Australia, and parts of Africa, thriving in disturbed lands, farms, pastures, and waysides (2). P. hysterophorus is a ruderal herb that inhabits a wide range of habitats, including grazing land, summer crops, and urban areas (3).

This weed poses a significant threat to natural ecosystems and agroecosystems in over 30 countries, with over 6,000 reported occurrences worldwide, contributing to species extinctions (4). *P. hysterophorus* has been linked to various health issues, including skin rashes, respiratory problems, and allergic reactions (4). Despite its negative impacts, *P. hysterophorus* has been used in traditional medicine to treat fever, diarrhea, and neurological disorders.

Salinity is a significant abiotic stress that severely impacts plant growth and yield (5). The escalating salinity levels in arable land, exacerbated by poor agricultural practices and climate change, pose devastating global consequences. It is projected that approximately 50% of cultivable land will be lost by the mid 21st century. Currently, around 1,125 million hectares of agricultural land are severely affected by salinity, rendering it a substantial threat to agriculture.

In China alone, salinity has significantly impacted 36.7 million hectares of land, with 12.3 million hectares being agricultural land (6). Salinity tolerance is a complex trait, influenced by multiple physiological interactions, making it challenging to determine. While morphological changes can indicate salinity's effects, understanding other physiological and biochemical factors, such as toxic ions, osmotic potential, and nutrient deficiencies, is crucial.

Cannabis sativa, a plant originating from Central Asia and the Indian subcontinent, is a versatile crop used for producing hemp fiber, as a drug, and for medicinal purposes (7).

The general objective of this study is to investigate the impact of *Parthenium hysterophorus* on natural ecosystems and agroecosystems, as well as to explore its potential uses in traditional medicine. Furthermore, this study aims to examine the effects of salinity on plant growth and yield.

Specifically, this research seeks to assess the tolerance of *Parthenium hysterophorus* to salinity stress, investigate the physiological and biochemical changes in the plant under salinity stress, and compare its salinity tolerance with other plant species, such as Cannabis sativa. Additionally, this study aims to identify potential strategies for mitigating the negative impacts of *Parthenium hysterophorus* on ecosystems and agricultural productivity.

MATERIALS AND METHODS

An experiment was conducted at the Department of Agriculture, Bacha Khan University, Charsadda, KPK, Pakistan. *Parthenium hysterophorus* and *Cannabis sativa* plants were collected from a local field in Sakhakot, Malakand, Khyber Pakhtunkhwa. To ensure healthy growth, plants were initially grown in soil for two days without additives. All plants were grown under identical conditions, with soil collected from the same location. Planting took place in the morning at 10 am. Plants were 3 inches tall, and pots were 9 inches in size. The experiment followed a completely randomized design (CRD) with two replications per pot, each containing two plants. Plant height, shoot and root weight, and leaf area were analyzed using a foot scale, digital scale, and graph paper, respectively.

The experiment consisted of two factors: Factor A, which included two types of weeds (*Parthenium hysterophorus* and *Cannabis sativa*), and Factor B, which comprised five salt levels (standard, 3g, 6g, 9g, and 12g). The parameters studied included plant height, leaf area, number of branches, root weight, and plant weight. Statistical analysis was performed using Complete Block Design (CBD) and Analysis of Variance (ANOVA) on replicate data using STATISTIX 8.1. When significant effects were detected, means were separated by least significant differences (LSD) at $P < 0.05$.

RESULTS AND DISCUSSIONS

NUMBER OF BRANCHES (PLANT^{-1})

The present study's results, as presented in Table I, reveal significant effects of salinity and plant species on the number of branches per plant. Specifically, *Parthenium hysterophorus* exhibited the maximum number of branches (17.46), while *Cannabis sativa* showed the minimum (16.46) (Table I). The treatment means indicated that control pots had the highest number of branches (19.24), whereas the minimum (12.25) was observed in pots with 3 mg of salt. Notably, the interaction between salinity and plant species revealed that the combination of control pots and *Cannabis sativa* resulted in the maximum number of branches, while the combination of 3 mg salt and *Parthenium hysterophorus* yielded the minimum (8.33) (Table I).

These findings are consistent with recent literature highlighting the detrimental effects of salinity on plant growth and development (8-9). The significant reduction in the number of branches per plant under saline conditions observed in this study supports the notion that salinity imposes osmotic stress, ionic toxicity, and nutrient deficiencies, ultimately affecting plant morphology and productivity 10). Furthermore, the interaction between salinity and plant species suggests that the response of these species to salt stress is complex and influenced by multiple factors, including genetic predisposition and environmental conditions (11). These results have important implications for the management of *Parthenium hysterophorus* and *Cannabis sativa* in saline environments and highlight the need for further research into the mechanisms underlying their responses to salt stress.

Table I. Effects of salt concentration on Branching Patterns (BP), Plant Height (PH), leaf area (LA), Root Weight (RW) and Stem Weight (SW) of *Parthenium hysterophorus* (PH) and *Cannabis sativa* (CS)

Salt (mg)	BP		PH		LA		RW		SW	
	PH	CS	PH	CS	PH	CS	PH	CS	PH	CS
3	8.3 b	16.2 a	3.16	6:00	55.8 b	24.83 a	0.47	0.47	2.0 b	1.9 a
6	14.7 ab	15.6 a	6.16	5.83	137.3 ab	12.0 a	0.67	0.37	2.7 b	2.3 a
9	18.8 ab	17.3 a	4.83	9.33	163.2 a	27.83 a	0.67	0.6	3.7 ab	2.4 a
12	22.8 a	15.6 a	7.16	7.16	171.0 a	35.50 a	1.07	0.4	5.2 ab	2.5 a
Control	22.7 a	17.5 a	8.66	10.5	173.5 a	39.00 a	1.3	0.87	7.3 a	3.9 a
Means	17.46 ab	16.46 a	6	7.76	140.17	27.33	0.83	0.54	4.19	2.6

HEIGHT (PLANT^{-1})

The results of the present study, as presented in Table I, reveal significant effects of salt amount and plant species on plant height. Notably, Cannabis sativa exhibited the maximum height (7.76 cm), while *Parthenium hysterophorus* showed the minimum height (6 cm) (Table I). The treatment means indicated that control pots had the highest height (10.5 cm), whereas the minimum height (3.16 cm) was observed in pots with 3 mg of salt. Interestingly, the interaction between salt amount and plant species revealed that the combination of 9 mg salt and *Cannabis sativa* resulted in the maximum height (9.33 cm), while the combination of 3 mg salt and *Parthenium hysterophorus* yielded the minimum height (3.16 cm) (Table I).

These findings are consistent with recent literature that reveals the detrimental effects of salinity on plant growth and development (11). The significant reduction in plant height under saline conditions observed in this study supports the notion that salinity imposes osmotic stress, ionic toxicity, and nutrient deficiencies, ultimately affecting plant morphology and productivity (12). Furthermore, the interaction between salt amount and plant species suggests that the response of these species to salt stress is complex and influenced by multiple factors, including genetic predisposition and environmental conditions (12). These results have important implications for the management of *Parthenium hysterophorus* and *Cannabis sativa* in saline environments and highlight the need for further research into the mechanisms underlying their responses to salt stress.

LEAF AREA (PLANT^{-1})

The results of the present study, as presented in Table 1, reveal significant effects of salt amount and plant species on leaf area per plant (Table I). Notably, *Parthenium hysterophorus* exhibited the maximum leaf area (140.16 cm^2), while *Cannabis sativa* showed the minimum leaf area (Table I). The treatment means indicated that control pots had the highest leaf area (106.25 cm^2), whereas the minimum leaf area (40.33 cm^2) was observed in pots with 3 mg of salt. Interestingly, the interaction between salt amount and plant species revealed that the combination of control pots and Cannabis sativa resulted in the maximum leaf area, while the combination of 6 mg salt and *Cannabis sativa* yielded the minimum leaf area (12 cm^2) (Table I).

The results of this study are in agreement with recent research emphasizing the detrimental effects of salinity on plant growth and development, particularly with regards to leaf area (13-14). The observed reduction in leaf area under saline conditions supports the notion that salinity induces osmotic stress, ionic toxicity, and nutrient deficiencies, ultimately impacting plant morphology and productivity (15). Moreover, the interaction between salt amount and plant species suggests a complex response to salt stress, influenced by genetic and environmental factors (16). These findings have significant implications for managing *Parthenium hysterophorus* and *Cannabis sativa* in saline environments, highlighting the need for further research into the underlying mechanisms of salt stress response.

ROOT WEIGHT (PLANT^{-1})

The results of the present study, as presented in Table I, reveal significant effects of salt amount and plant species on root weight per plant (Table I). Notably, *Parthenium hysterophorus* exhibited the maximum root weight (0.83 g), while *Cannabis sativa* showed the minimum root weight (Table I). The treatment means indicated that control pots had the highest root weight (1.3 g), whereas the minimum root weight (0.46 g) was observed in pots with 3 mg of salt. Interestingly, the interaction between salt amount and plant species revealed that the combination of control pots and *Cannabis sativa* resulted in the maximum root weight, while the combination of 3 mg salt and both plant species yielded the minimum root weight (0.46 g) (Table I).

The results of this study align with emerging evidence on the deleterious effects of salinity on plant growth and development, particularly root growth and weight (17-18). The observed reduction in root weight under saline conditions underscores the role of salinity in inducing osmotic stress, ionic toxicity, and nutrient deficiencies, ultimately impacting plant morphology and productivity (18). Moreover, the interaction between salt amount and plant species suggests a complex response to salt stress, influenced by genetic and environmental factors. These findings have significant implications for managing *Parthenium hysterophorus* and *Cannabis sativa* in saline environments, highlighting the need for further research into the underlying mechanisms of salt stress response.

STEM WEIGHT (PLANT^{-1})

The results of the present study, as presented in Table I, reveal significant effects of salt amount and plant species on shoot weight per plant (Table I). Notably, *Parthenium hysterophorus* exhibited the maximum shoot weight (4.18 g), while *Cannabis sativa* showed the minimum shoot weight. The treatment means indicated that control pots had the highest shoot weight (7.33 g), whereas the minimum shoot weight (1.9 g) was observed in pots with 3 mg of salt. Interestingly, the interaction between salt amount and plant species revealed that the combination of control pots and *Parthenium hysterophorus* resulted in the maximum shoot weight, while the combination of 3 mg salt and *Cannabis sativa* yielded the minimum shoot weight (1.9 g) (Table I).

These findings are consistent with recent literature showing the detrimental effects of salinity on plant growth and development, particularly on shoot growth and weight (19-20). The significant reduction in shoot weight under saline conditions observed in this study supports the notion that salinity imposes osmotic stress, ionic toxicity, and nutrient deficiencies, ultimately affecting plant morphology and productivity (21). Furthermore, the interaction between salt amount and plant species suggests that the response of these species to salt stress is complex and influenced by multiple factors, including genetic predisposition and environmental conditions (22). These results have important implications for the management of *Parthenium hysterophorus* and *Cannabis sativa* in saline environments and highlight the need for further research into the mechanisms underlying their responses to salt stress.

CONCLUSION

In conclusion, this study demonstrates that increasing salinity levels significantly impede the growth and development of *Parthenium hysterophorus* and *Cannabis sativa*, suggesting that salinity can be a potential tool for managing the spread of invasive Parthenium weed. These findings have important implications for weed management strategies in saline environments, and further research is needed to explore the potential applications of salinity in controlling Parthenium infestations.

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Conflict of interest:

There is no conflict of interest among authors regarding this article.

Authors` contribution:

Concept: ZH, RA. Plan: ZH, RA. Data analysis: RK, RA. Writing, review and editing: RK, RA, AK and FA. All authors have reviewed and consented to the final version of the manuscript for publication.

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