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Changes of Plant Growth and Soil Physicochemical Properties by Cultivating Different Economic Plant Species in Saline-Alkali Soil of Hetao Oasis, Inner Mongolia

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Abstract

Due to prolonged irrigation from the Yellow River, a large area of farmland in the Hetao Oasis has undergone different degrees of salinization and alkalization, leading to reduced crop yields and incapable soil for plant growth. To enhance the productivity of the farmland with saline-alkali soils, it is important to select salt-tolerant economic plant species that are capable of growing under the local climate and soil conditions in the Hetao Oasis. We conducted the experiment by planting *Ziziphus jujuba* var. *spinose*, *Elaeagnus angustifolia*, *Hippophae rhamnoides* and *Lycium chinense* in the Bayan Taohai Farm of the Hetao Oasis. Changes of plant growth (the survival rate, plant height, canopy, basal diameter and new branch length) and soil physicochemical properties (soil organic carbon, total carbon, total nitrogen, pH, electrical conductivity and particle size distribution) were continuously monitored during two growing seasons. Results indicated that, by the end of the first growing season, the survival rate of the *Z. jujuba* was less than 10%, making it unsuitable for plantation in the saline-alkali soils of the Hetao Oasis. In terms of plant growth, the *E. angustifolia* exhibited the highest survival rate (94.71%) and the fastest growth rate, indicating that *E. angustifolia* is adapted in the saline-alkali soils of the Hetao Oasis. The survival rates for *L. chinense* and *H. rhamnoides* were 86.46% and 65.64%, respectively, indicating that these species could grow in the saline-alkali soils, but at a slower rate. From the perspective of soil improvement, *E. angustifolia*, *H. rhamnoides* and *L. chinense* could reduce the soil pH, and *E. angustifolia* could significantly increase soil nutrients. In conclusion, it is not recommended to plant *Z. jujuba*, while the *E. angustifolia* is recommended as a proper economic species to be widely planted in the saline-alkali soils of the Hetao Oasis. *H. rhamnoides* could be selectively planted in areas with better soil conditions, and the *L. chinense* could be planted following soil improvement measurements. The research enhanced the effective utilization of the saline-alkali farmland and provided proper economic plant species for sustainable agriculture management in the Hetao Oasis of Inner Mongolia.

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Academic Editor: Mercè Llugany

Received: 29 April 2025
Revised: 25 June 2025
Accepted: 26 June 2025
Published: 30 June 2025

Citation: Ma, R.; Du, F.; Qin, Y.; Lv, J.; Xing, G.; Xu, Y.; Fu, N.; Qiao, J.; Hong, G.; Wang, S. Changes of Plant Growth and Soil Physicochemical Properties by Cultivating Different Economic Plant Species in Saline-Alkali Soil of Hetao Oasis, Inner Mongolia. *Agriculture* **2025**, *15*, 1421. https://doi.org/10.3390/agriculture15131421

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Keywords: Hetao Oasis; saline-alkali soil; economic tree species; soil improvement

1. Introduction

Soil salinization and alkalization were major environmental challenges, affecting approximately 20% of the world's irrigated lands, which decreased agriculture's productivity worldwide, particularly in arid and semi-arid regions [1–3]. These processes lead to the accumulation of soluble salts and exchangeable sodium ions in the soil, resulting in degraded soil structure, reduced fertility, inhibited plant growth and agricultural productivity losses [4–7]. Hetao Oasis in Inner Mongolia has experienced significant soil salinization due to prolonged irrigation with Yellow River water, which contains high levels of dissolved minerals, and the severity of salinization varies across the oasis, with some areas exhibiting significant declines in agricultural productivity and crop quality [8,9]. The saline-alkali conditions have led to reduced crop yields and prevented sustainable agricultural development in the region [10]. In fact more than 60% of the irrigated land in the Hetao Oisis is saline-alkali, critically restraining agricultural development [11].

Traditional methods improve saline-alkali soils by adding chemical amendments. These amendments react with soil colloids and reduce sodium (Na^+) adsorption through ion exchange or porous adsorption [12,13]. This process lowers soil pH and salinity. People often use industrial wastes like desulfurization gypsum, coal gangue, fly ash and rare-earth tailings for soil reclamation [14–16]. However, the long-term use of chemical agents damages soil structure, weakens water-holding capacity and reduces fertility. These changes harm soil health and crop productivity. Biological approaches have been increasingly recommended to restore saline-alkali soils [17,18]. Economic tree species are valued for their ability to produce fruits, nuts or medicine materials. Meanwhile, these plants can enhance soil structure, increase soil nutrients and facilitate salt leaching through root activity, consequently generating income while increasing biodiversity and soil health [19,20]. Cultivating certain economic plants is one of the most effective ways to reclaim saline-alkali agricultural land.

The cultivation of salt-tolerant plants not only ameliorates soil conditions and enhances the ecological environment, but also significantly increases positive returns for investors while delivering substantial economic and social benefits to users [6]. This approach constitutes an essential strategy for achieving the sustainable utilization of saline-alkali lands [21]. *Elaeagnus angustifolia* is a pioneer species for saline-alkali soil amelioration. This species demonstrates high tolerance to salinity and sodicity, and significantly enhances nutrient content, particularly nitrogen levels in moderately to severely saline-alkali soils [22–25]. Furthermore, all botanical parts of *Elaeagnus angustifolia* possess exploitable value. Under comparable conditions, its cultivation yields superior economic returns relative to *Populus euphratica* and *Ulmus* species [26]. *Hippophae rhamnoides* is extensively employed in ecological restoration projects due to its vigorous growth rate, high propagation capacity, and extensive root system, enabling rapid coverage of large exposed land areas. The species exhibits remarkable survival capabilities under adverse conditions such as drought, salinity and wind erosion [27,28]. *H. rhamnoides* demonstrates notable tolerance to salinity and alkalinity stress through the accumulation of organic acids [25]. Furthermore, it possesses significant economic value: its fruits are rich in essential nutrients including vitamin C, polyunsaturated fatty acids, minerals and trace elements which confer demonstrable health benefits [29]. *Ziziphus jujuba* var. *spinosa* could survive in highly saline-alkali soils with poor health condition [11]. Furthermore, *Z. jujuba* var. *spinosa* possesses significant nutritional value, renowned for its exceptional vitamin content. The dried mature seeds of jujube

hold substantial medicinal value [30]. *Lycium chinense* possesses inherent biological traits conferring tolerance to drought, salinity and cold stress. As an exemplary plant species for ameliorating desertified soils, windbreak and sand fixation, and soil-water conservation, it holds significant ecological value [31,32]. Furthermore, *L. chinense* exhibits diverse nutritional and bioactive properties, including promoting longevity, enhancing musculoskeletal integrity, nourishing blood for ocular health and moistening lungs to alleviate cough. Its fruits constitute a noble medicinal material in traditional pharmacopeia [33].

However, a concurrent comparative assessment of these four species under field conditions representative of the Hetao Oasis is absent from the current literature. This study aims to assess the ecological restoration potential of four economically relevant plant species (*E. angustifolia*, *H. rhamnoides*, *L. chinense* and *Z. jujuba* var. *spinosa*) in saline and alkaline soils of the Hetao Oasis by quantifying their survival rates, growth performance, and capacity for soil amelioration, while concurrently generating foundational data to inform future evaluations of their agricultural economic viability in this region. The results could provide a sustainable agricultural management and ensure long-term soil remediation in the Hetao Oasis of Inner Mongolia.

2. Materials and Methods

2.1. Study Area

The study was conducted in the Bayan Taohai Farm, Dengkou County, Bayannur City (40.58° N, 106.79° E). The area has a temperate continental monsoon climate with cold, long winters, short spring and autumn, and hot summers. This area presents low precipitation, sufficient sunshine and large temperature differences from day to night. The annual sunshine exceeds 3300 h and the frost-free period is 136–205 days. The average annual temperature is 7.6 °C. The plant growth period is from May to September, with an effective radiation of 40.19 kcal/cm^2. The variations in temperature and precipitation patterns during the research period's growing seasons are illustrated (Figure 1). The average annual precipitation is 144.5 mm, and the evaporation is 2397.6 mm. The soil is characterized as aeolian sandy soil and brown calcic soil [34]. The native plant species include *Ammopiptanthus mongolicus*, *Prunus mongolica*, *Haloxylon ammodendron*, *Nitraria tangutorum*, *Oxytropis aciphylla*, *Corethrodendron scoparium*, *Calligonum mongolicum*, *Artemisia desertorum* and *Agriophyllum squarrosum* in this region [35,36].

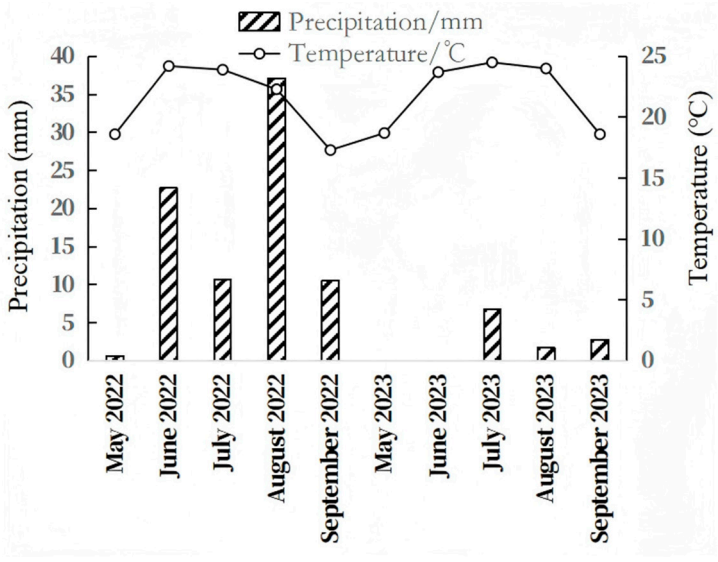


Figure 1. Variations in monthly mean air temperature and precipitation during growing seasons of the study period.

2.2. Experimental Design

The study employed a randomized complete block design with five treatments: four economic plant species (*Ziziphus jujuba* var. *spinose*, *Elaeagnus angustifolia*, *Hippophae rhamnoides* and *Lycium chinense*) and one bare land control (CK). Three replicates per treatment were established, resulting in 15 experimental plots distributed across three blocks aligned with topographic gradients. Two-year-old healthy seedlings with a 0.8–1 cm basal diameter and 60–80 cm height of each species were planted in three dedicated 20 m × 20 m plots per species during mid-April 2022. Each plot contained only one species, with planting spacing of 2 m × 2 m. Standard management practices were uniformly applied across all plots. During the growing season, standard forestry management by irrigation, weeding and ploughing were applied to ensure the survival of the plants.

2.3. Measurement and Data Analysis

Plant growth monitoring was conducted monthly from May to September during both 2022 and 2023. Twenty permanently labeled individuals per plot were tracked for all measurements. The survival rate was assessed by counting living plants, with survival defined as the presence of green tissue. Canopy diameter was measured along north–south and east–west axes using a tape measure, and the mean value of these two directions was recorded per plant. Basal diameter at 10 cm height was monitored beginning in 2022 to capture early establishment dynamics; two perpendicular measurements per plant were taken using a vernier caliper and averaged. Plant height from soil surface to apical bud and new branch length representing current-year growth on five standardized branches were measured with a tape in both years. However, due to minimal initial growth variation observed in 2022, only the 2023 height data were included in the formal analysis.

Soil particle size distribution was measured using the wet sieving method according to the international and USDA classification systems [37]. Soil samples from 0 to 20 cm depth were collected annually in late September. Five subsamples per plot were homogenized into one composite sample using a 3-cm diameter soil auger. Soil pH and EC were determined in a 1:1 and 1:5 soil-water extract using a Multiline P4 pH and EC probe, respectively. Soil organic carbon (SOC) was determined using the potassium dichromate oxidation method. Soil total carbon (C) and nitrogen (N) were analyzed using an elemental analyzer (Costech ECS 4010, Valencia, CA, USA) [38].

The descriptive statistical parameters and significance tests were performed and graphed by Origin software (Version 2021). Significant differences among the plant species and time series were assessed by ANOVA and LSD tests at $p < 0.05$.

3. Results

3.1. Plant Growth

3.1.1. Survival Rate

The survival rates of four economic plant species were monitored over the first growing season. The survival rates were getting stabilized by the second month (Figure 2) after plantation. *E. angustifolia* exhibited the highest survival rate at 94.71%, followed by *L. chinense* at 86.46% and *H. rhamnoides* at 65.64%. The survival rate of *Z. jujuba* was extremely low, with a final survival rate at 8.29%. Therefore, *E. angustifolia*, *L. chinense* and *H. rhamnoides* could be selected candidates for improving saline-alkaline soils in the Hetao Oasis. However, *Z. jujuba* is not suitable in such soil conditions. Due to its low survival and poor growth conditions, *Z. jujuba* was terminated in the further monitoring.

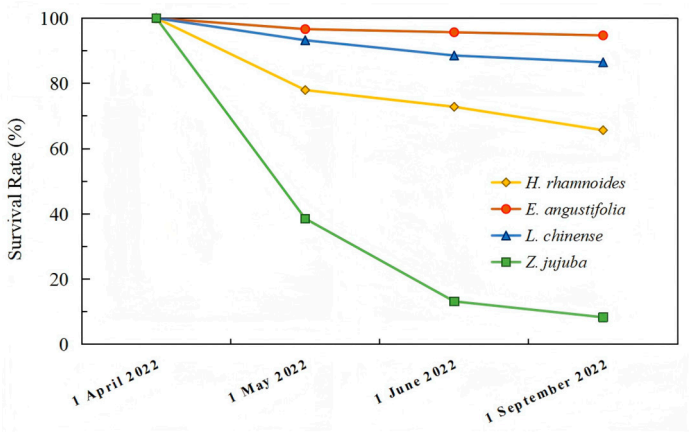


Figure 2. Survival rates of the four plant species. Note: species (*Elaeagnus angustifolia*, *Hippophae rhamnoides*, *Ziziphus jujuba* var. *spinosa*, *Lycium chinense*); location (Bayan Taohai Farm, Dengkou County, Bayannur City 40.58° N, 106.79° E); study period (April to September 2022).

3.1.2. Plant Height Growth

During the second year after establishment, plant height was continuously monitored for *Hippophae rhamnoides*, *Elaeagnus angustifolia* and *Lycium chinense* in saline-alkaline soils of the Hetao Oasis. All species exhibited significant height increments ($p < 0.05$) during the second growing season (Figure 3). Reflecting inherent growth habits, *E. angustifolia* showed the highest absolute growth in contrast, the shrub species *H. rhamnoides* and *L. chinense* displayed lower absolute growth. Notably, when compared to their own growth rates in non-saline nursery soils during the establishment year, *E. angustifolia* exhibited the fastest growth with a height increase of 90.20 cm, representing 4.08 cm growth per week. *H. rhamnoides* and *L. chinense* showed lower height growth, with height increases of 32.83 cm and 28.91 cm, representing 1.64 cm and 1.45 cm growth per week, respectively. These results indicated that *E. angustifolia* could grow well in saline-alkaline soils of the Hetao Oasis, while *H. rhamnoides* and *L. chinense* grow relatively slowly.

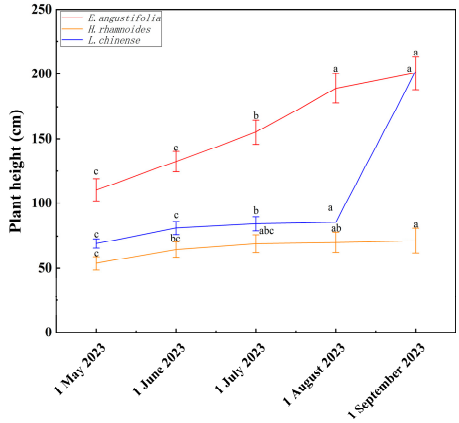


Figure 3. Changes in plant height of the three plant species. Note: species (*Elaeagnus angustifolia*, *Hippophae rhamnoides*, *Ziziphus jujuba* var. *spinosa*, *Lycium chinense*); location (Bayan Taohai Farm, Dengkou County, Bayannur City 40.58° N, 106.79° E); study period (May to September 2023); error bars represent ± SEM; different lowercase letters denote significant differences ($p < 0.05$) among sampling dates within the same species.

3.1.3. Canopy

The canopy of three plant species increased significantly during the second growing season (Figure 4). The canopy of *H. rhamnoides* and *L. chinense* increased by 2.79 and

1.94 times from May to September, respectively. The canopy of *E. angustifolia* increased remarkably from 0.63 m^2 in May to 4.42 m^2 in September.

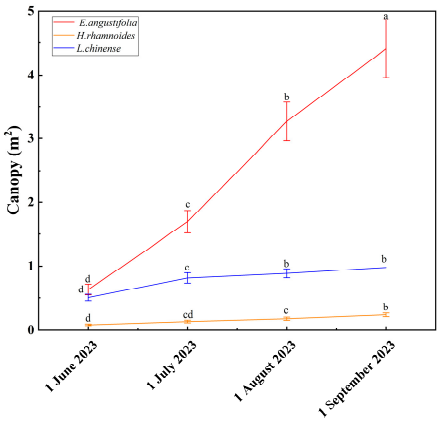


Figure 4. Changes in canopy growth of the three plant species. Note: species (*Elaeagnus angustifolia*, *Hippophae rhamnoides*, *Ziziphus jujuba* var. *spinosa*, *Lycium chinense*); location (Bayan Taohai Farm, Dengkou County, Bayannur City 40.58° N, 106.79° E); study period (June to September 2023); error bars represent ± SEM; different lowercase letters denote significant differences ($p < 0.05$) among sampling dates within the same species.

3.1.4. Basal Diameter

Basal diameters were continuously measured during the two growing seasons, showing that the changes of basal diameters varied among the three plant species (Figure 5). The basal diameter of *H. rhamnoides*, *E. angustifolia* and *L. chinense* increased 12.8%, 15.2% and 19.2% at the end of the first growing season, respectively. The plants grew faster in the second growing season compared to the previous year. By the end of the second growing season, the basal diameters of *H. rhamnoides*, *E. angustifolia* and *L. chinense* increased significantly ($p < 0.05$), reaching 2.06, 2.44 and 2.27 times their initial diameters, respectively. Specifically, the basal diameter of the *E. angustifolia* increased 15.10 mm in the last two months, presenting 20% more than the previous 14 months.

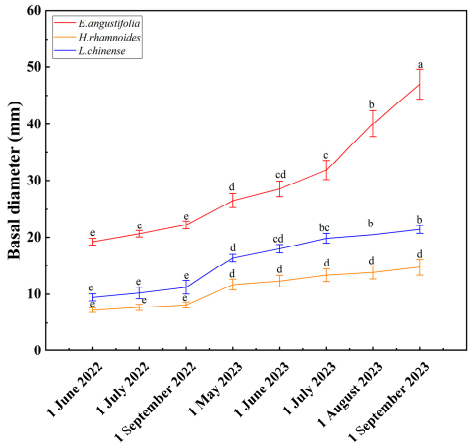


Figure 5. Changes in basal diameter of the three plant species. Note: species (*Elaeagnus angustifolia*, *Hippophae rhamnoides*, *Ziziphus jujuba* var. *spinosa*, *Lycium chinense*); location (Bayan Taohai Farm, Dengkou County, Bayannur City 40.58° N, 106.79° E); study period (June 2022 to September 2023); error bars represent ± SEM; different lowercase letters denote significant differences ($p < 0.05$) among sampling dates within the same species.

3.1.5. New Branch Length

New branches were labeled in the plant specimen, and their lengths were measured monthly during the two growing seasons (Figure 6). In the first growing season, the new branch increased 24.74 cm, 44.52 cm and 29.12 cm for *H. rhamnoides*, *E. angustifolia* and *L. chinense*, respectively, indicating that *E. angustifolia* grew the fastest. In the second growing season, the growth rate of *L. chinense* slowed down, and the increased length was 28.65 cm. The new branch of *E. angustifolia* grew dramatically fast by 79.35 cm, while *H. rhamnoides* exhibited the slowest growth (19.24 cm) during the second growing season.

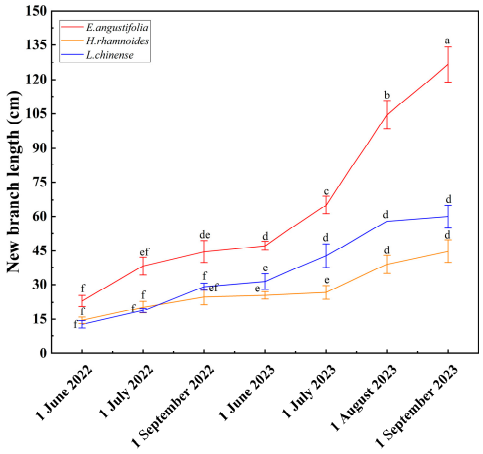


Figure 6. Changes in new branch length of the three plant species. Note: species (*Elaeagnus angustifolia*, *Hippophae rhamnoides*, *Ziziphus jujuba* var. *spinosa*, *Lycium chinense*); location (Bayan Taohai Farm, Dengkou County, Bayannur City 40.58° N, 106.79° E); study period (June 2022 to September 2023); error bars represent ± SEM; different lowercase letters denote significant differences ($p < 0.05$) among sampling dates within the same species.

3.2. Soil Physicochemical Properties

3.2.1. Soil pH and EC

The pH value of the native control soil at the experimental site was 9.15, indicating the alkalinity of the initial soil. After cultivating the three plant species, the soil pH showed a slight decrease compared to the control (CK) at the end of the first growing season. By the end of the second growing season, the soil pH decreased significantly, reaching 8.5 ($p < 0.001$) (Figure 7a). The soil EC did not change at the end of the first growing season ($p > 0.05$). However, it increased significantly in the second growing season. The soil EC under *H. rhamnoides*, *E. angustifolia* and *L. chinense* were 2.38, 4.77 and 8.55 times higher than control soil (CK), respectively, at the end of the second growing season (Figure 7b).

3.2.2. Soil Organic Matter

Soil organic matter contents showed various changes after cultivating the three plant species. *H. rhamnoides* and *L. chinense* did not significantly alter soil organic matter content compared to the control ($p > 0.05$). *E. angustifolia* significantly increased the soil organic matter content, which were 2.51 and 1.56 times more than that of the control soil (CK) at the end of the first and second growing season, respectively (Figure 8). The interannual variation in SOM enhancement under *E. angustifolia* reflects differential precipitation regimes, with the wetter conditions in the first year promoting faster litter decomposition compared to the drier second year.

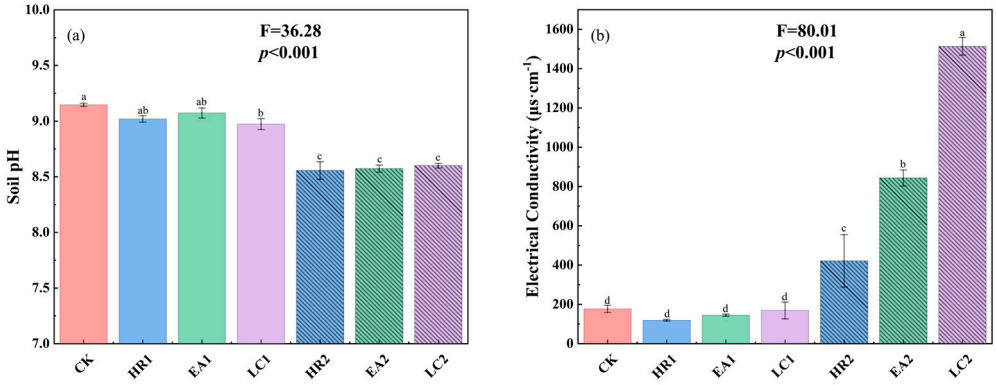


Figure 7. Effect of different plant species on soil pH (**a**) and electrical conductivity (EC) (**b**). Note: Shading indicates the second growing season. CK—native soil as control; HR1—*H. rhamnoides* at the end of the first growing season; EA1—*E. angustifolia* at the end of the first growing season; LC1—*L. chinense* at the end of the first growing season; HR2—*H. rhamnoides* at the end of the second growing season; EA2—*E. angustifolia* at the end of the second growing season; LC2—*L. chinense* at the end of the second growing season. Same notes for the following figures. Error bars represent ± SEM. Different lowercase letters indicate statistically significant differences among treatments ($p < 0.001$).

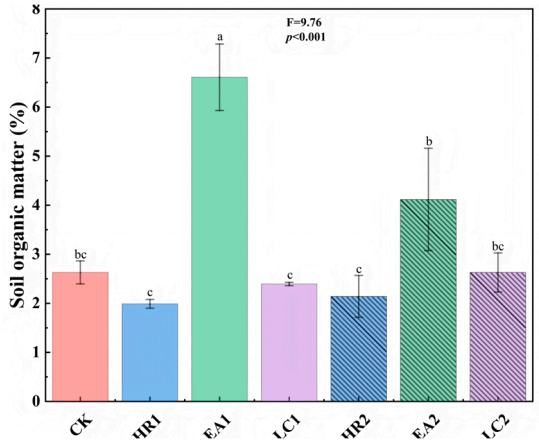


Figure 8. Effect of different plant species on soil organic matter. Note: Shading indicates the second growing season. CK—native soil as control; HR1—*H. rhamnoides* at the end of the first growing season; EA1—*E. angustifolia* at the end of the first growing season; LC1—*L. chinense* at the end of the first growing season; HR2—*H. rhamnoides* at the end of the second growing season; EA2—*E. angustifolia* at the end of the second growing season; LC2—*L. chinense* at the end of the second growing season. Same notes for the following figures. Error bars represent ± SEM. Different lowercase letters indicate statistically significant differences among treatments ($p < 0.001$).

3.2.3. Soil Total Carbon and Nitrogen

Total soil carbon content in the experimental site ranged from 0.25% to 0.17%, while total nitrogen content ranged from 0.01% to 0.06%. Both total carbon and nitrogen were relatively low, indicating poor soil fertility in the study area. After cultivating the three economic plant species, the changes of total carbon and nitrogen contents were consistent with the changes of soil organic matter. For *H. rhamnoides* and *L. chinense*, total soil carbon content showed non-significant reductions of 23.64% and 9.05% relative to the control (CK) at the end of the first growing season ($p > 0.05$), but significantly decreased by 62.65% and 52.16% at the end of the second growing season ($p < 0.001$). On the other hand, cultivation of *E. angustifolia* significantly increased the total carbon contents, which were 2.22 and 1.42 times compared with control soil at the end of the first and second growing seasons (Figure 9a). Cultivation of *E. angustifolia* significantly increased the total nitrogen

content, which was 3.26 to 3.99 times compared to the control soil (Figure 9b). This robust nitrogen input, combined with high-nitrogen leaf litter, drives simultaneous soil C and N enrichment through rapid decomposition and microbial turnover. The increase in nitrogen is attributable not only to nitrogen fixing bacteria, but also to litter decomposition. The non-concomitant increase in carbon and nitrogen may be attributed to litter input for the *E. angustifolia*.

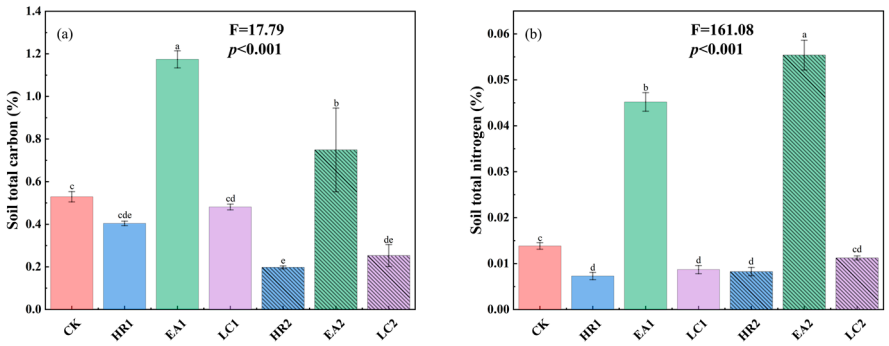


Figure 9. Effect of different plant species on soil total carbon (**a**) and total nitrogen (**b**). Note: Shading indicates the second growing season. CK—native soil as control; HR1—*H. rhamnoides* at the end of the first growing season; EA1—*E. angustifolia* at the end of the first growing season; LC1—*L. chinense* at the end of the first growing season; HR2—*H. rhamnoides* at the end of the second growing season; EA2—*E. angustifolia* at the end of the second growing season; LC2—*L. chinense* at the end of the second growing season. Same notes for the following figures. Error bars represent ± SEM. Different lowercase letters indicate statistically significant differences among treatments ($p < 0.001$).

3.2.4. Soil Particle Size Distribution

The soil in the experimental site was mostly composed with coarse sand (0.1–2 mm), accounting for 84–92% of the total soil. The content of fine sand (0.05–0.1 mm) ranged from 6 to 15%, while the content of silt and clay (<0.05 mm) only occupied 0.5–3.2% (Figure 10). Overall, the soil particle size distribution did not change significantly in the two growing seasons.

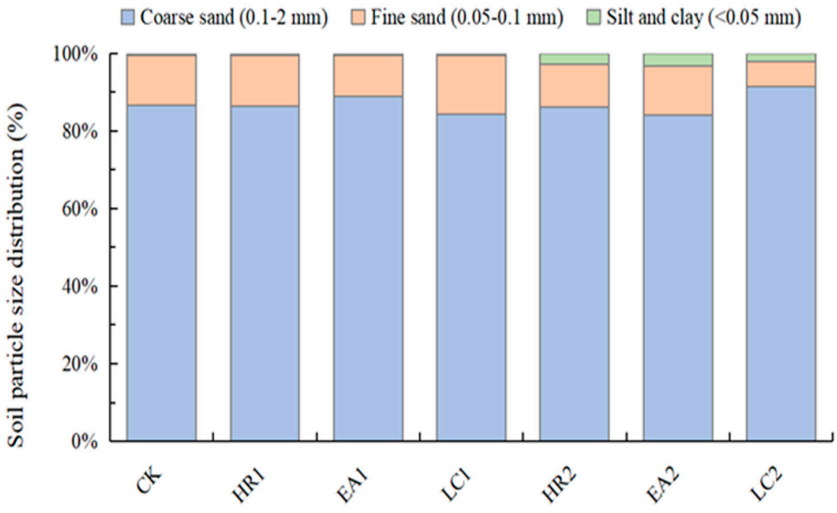


Figure 10. Effect of different plant species on soil particle size distribution. Note: CK—native soil as control; HR1—*H. rhamnoides* at the end of the first growing season; EA1—*E. angustifolia* at the end of the first growing season; LC1—*L. chinense* at the end of the first growing season; HR2—*H. rhamnoides* at the end of the second growing season; EA2—*E. angustifolia* at the end of the second growing season; LC2—*L. chinense* at the end of the second growing season.

3.3. Relationships Between Plant Growth and Soil Physicochemical Properties

Pearson's correlation analysis showed that plant growth indices were significantly correlated with soil properties (Figure 11). The plant survival rate was positively correlated with total soil carbon and soil organic matter contents. Plant height growth, canopy, basal diameter and new branch length were positively correlated with total soil carbon, organic matter and electrical conductivity. The results suggested that soil carbon, organic matter and electrical conductivity play important roles in determining plant growth in the salinized soil of the Hetao Oasis.

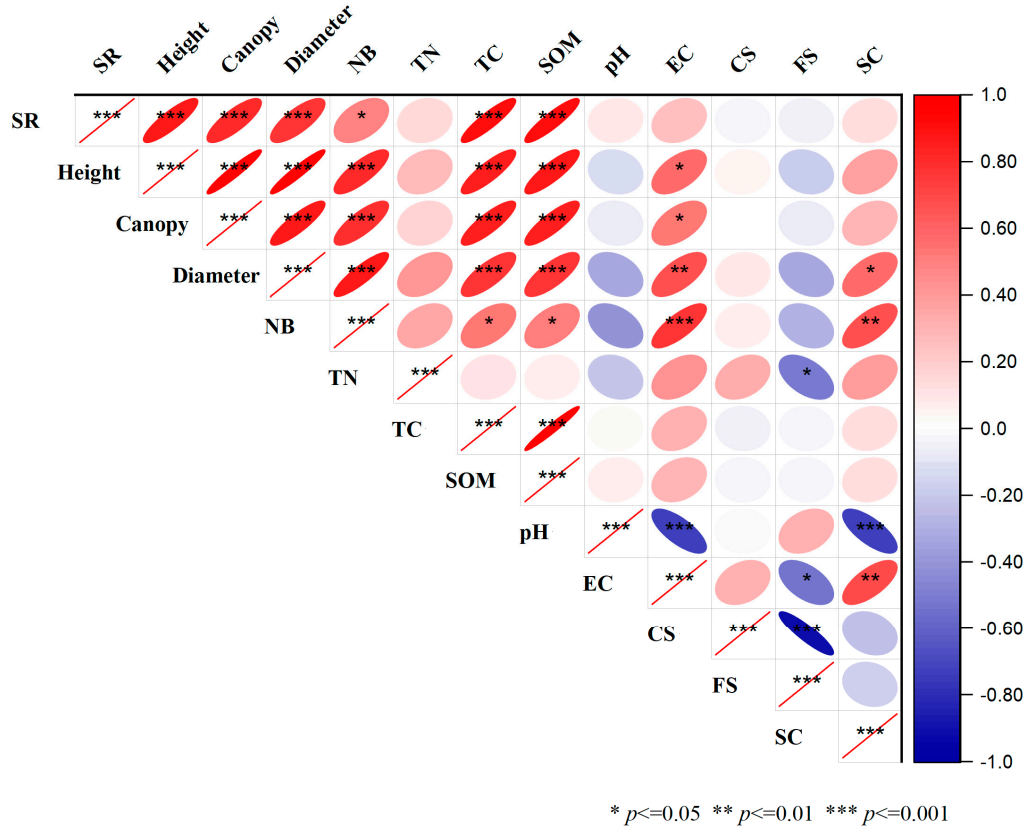


Figure 11. Pearson's relationship between plant growth and soil physicochemical properties. Note: SR-plant survival rate; height-plant height growth; canopy-plant canopy; diameter-plant basal diameter; NB-plant new branch length; TN-soil total nitrogen content; TC-soil total carbon content; SOM-soil organic matter; pH-soil pH value; EC-soil electrical conductivity; CS-soil coarse sand content; FS-soil fine sand content; SC-soil silt and clay content.

4. Discussion

This study evaluated the survival rates, growth performance and effects on the soil physicochemical properties of four economic plant species cultivated in the saline-alkali soils of the Hetao Oasis over two growing seasons. The findings highlighted significant differences among the species in terms of adaptability and impact on soil improvement. *H. rhamnoides*, *E. angustifolia*, *L. chinense* and *Z. jujuba* var. *spinosa* are regarded as outstanding plant species with both ecological and economic advantages, particularly well adapted to the arid regions of northern China. Their extensive cultivation across various regions has not only obtained ecological restoration achievements, but also substantially enhanced the economic productivity, accompanied by impressive outcomes in terms of both environmental sustainability and economic development.

The results showed that *E. angustifolia* exhibited the highest survival rate (94.71%) and the most vigorous growth in plant height, canopy size, basal diameter and new

branch length. The results are consistent with those of previous studies demonstrating the high salt tolerance of *E. angustifolia*. Its symbiotic relationship with nitrogen-fixing bacteria contributes to increased soil nitrogen levels and enhanced soil fertility [25,39]. Our study confirmed significant increases in soil organic matter, total carbon and total nitrogen under *E. angustifolia*, supporting its potential role in soil remediation. *L. chinense* and *H. rhamnoides* also demonstrated the ability to survive in saline-alkali soils in Hetao Oasis, with survival rates of 86.46% and 65.64%, respectively. However, their growth rates were slower compared to *E. angustifolia*. The decreases in soil pH observed under these species suggested a gradual improvement in soil conditions, possibly due to root exudates and organic matter from plant residues [32,40]. However, the reduction in total soil carbon under *H. rhamnoides* and *L. chinense* indicates that these species may not contribute significantly to soil nutrient enrichment over the short term. *Z. jujuba* var. *spinosa* exhibited an extremely low survival rate (<10%), indicating this species is unsuitable for cultivation in the saline-alkali soils of the Hetao Oasis. The results aligned with reports that *Z. jujuba* var. *spinosa* has limited salt tolerance and requires better soil conditions for optimal growth [41].

As a result, many regions in northern China have been promoting the large-scale cultivation of *Z. jujuba* var *spinosa* to obtain higher income. However, our study indicated that this species is not suitable for cultivation in soils with high salinity and alkalinity in Hetao Oasis.

An interesting observation was the significant increase in soil electrical conductivity (EC) under the three surviving species at the end of the second growing season, particularly under *L. chinense*, where EC increased by 8.55 times compared to the control. The elevated soil EC, indicating higher soluble salt content, results from the accumulation of ions released through root exudation and litter decomposition [42]. Increasing EC had a negative effect on plant growth. The growing performance of *E. angustifolia* suggested this species could tolerate higher soil salinity levels. However, the implications of increased EC under *L. chinense* and *H. rhamnoides* need further investigation. The significant decrease in soil pH under all surviving plant species after two growing seasons showed a positive indicator of soil improvement. Lower soil pH can enhance nutrient availability and microbial activity, promoting better soil health [43].

5. Conclusions

In conclusion, the cultivation of *E. angustifolia* in saline-alkali soils shows significant increases in growth parameters and positive trends in soil properties, positioning it as a high-potential species for ecological restoration in the region. Conversely, *Z. jujuba* var. *spinosa* has proven unsuitable for plantation in this area, due to its low survival rate. Our results suggest that *E. angustifolia* is recommended for pilot cultivation on 5–10-ha plots with continuous yield monitoring in the saline-alkali soils of the Hetao Oasis. *H. rhamnoides* require targeted soil amendments to offset growth limitations in areas with less severe soil salinity or in combination with soil improvement measures to enhance its growth. *L. chinense* could also be considered following soil amendments to reduce salinity levels. Further long-term studies should be conducted to monitor the sustainable impacts of these economic plant species on soil health and productivity.

Author Contributions: Conceptualization, R.M., F.D. and S.W.; formal analysis, R.M. and S.W.; investigation, R.M., F.D., Y.Q., J.L., G.X., Y.X., N.F., J.Q. and G.H.; writing—original draft, R.M.; writing—review and editing, S.W. All authors have read and agreed to the published version of the manuscript.

Funding: This paper was supported by the Inner Mongolia Autonomous Region's Major Scientific and Technological Project (No.2024JBGS001302) and Science and Technology Innovation Project of Bayannur City (K202130, K202322).

Data Availability Statement: Data can be obtained from the corresponding author upon reasonable request.

Acknowledgments: We appreciate the assistance of Bayan Taohai Farm, and the staff of Urat Desert-grassland Research Station of CAS for their help in the field and laboratory work.

Conflicts of Interest: The authors declare no conflicts of interest.

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