Postprint of Experimental Study on Jerusalem Artichoke Cultivation under Saline-Alkali Stress

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Abstract

Through field planting experiments introducing the salt-alkali tolerant variety Nanjü No. 1 suitable for coastal tidal flats, growth data were observed and recorded, soil physicochemical properties were sampled and measured, and finally summarized and organized, with SPSS 17.0 used for statistical analysis of the organized data. The results showed: Nanjü No. 1 could grow and develop normally in the saline-alkali areas of western Jilin, with abundant yield and good adaptation, indicating a relatively successful introduction. The growth and survival status of Nanjü No. 1 in the light chernozem experimental field (pH 8.1) was significantly better than that in the sand-over-alkali soil experimental field (pH 8.3). The survival rates of Nanjü No. 1 in light chernozem and sand-over-alkali soil were 94.56% and 82.27%, respectively; variance analysis results showed significant differences ($P<0.05$).

During the seedling emergence stage, dry matter accumulation in stems and leaves was slow; during the rapid growth stage, dry matter accumulation in stems and leaves began to translocate underground; during the tuber expansion stage, the tuber absorbed the translocated nutrients and rapidly expanded until stable. The dry matter accumulation and yield of Nanjü No. 1 in the light chernozem experimental field were significantly better than those in the sand-over-alkali soil experimental field. In both the light chernozem and sand-over-alkali soil experimental fields, the dry matter accumulation in stems reached its peak during the rapid growth stage, at 912.26 $g \cdot plant^{1}$ and 756.02 $g \cdot plant^{1}$, respectively, with variance analysis results showing significant differences ($P<0.05$).

The main factors affecting the growth and survival of Nanjü No. 1 under saline-alkali stress in the western saline-alkali areas of Jilin Province were water content, organic matter, and total nitrogen content.

The soil improvement effect of Nanjü No. 1 on the light chernozem experimental field was significantly better than that on the sand-over-alkali soil. Therefore,

it can be concluded that Nanjü No. 1 can adapt to and grow well in the saline-alkali areas of western Jilin Province, and is more suitable for planting in light chernozem experimental fields.

Full Text

Introduction

Saline-alkaline soils in China cover approximately 1.0×10 hm^2 according to FAO classification standards. These soils severely constrain agricultural productivity and sustainable land use. Developing effective improvement strategies and identifying salt-tolerant crops are critical priorities for enhancing the productivity of saline-alkaline lands. Jerusalem artichoke (*Helianthus tuberosus*) has emerged as a promising candidate due to its notable salt tolerance, high yield potential, and multiple industrial applications. Previous studies have demonstrated its adaptability to saline-alkaline conditions, with reported yield increases of 1.4% under moderate salinity stress and up to 34% under optimized management practices. The crop' s robust root system and physiological characteristics enable it to withstand osmotic stress and ion toxicity, making it particularly suitable for marginal lands in western Jilin Province.

Materials and Methods

Field planting trials were established to evaluate the performance of the Jerusalem artichoke cultivar 'Nanjing No. 1' on saline-alkaline tidal flats. Soil physicochemical properties were systematically investigated, and growth parameters were recorded throughout the cultivation period. All data were processed and analyzed using SPSS 17.0 statistical software. The experimental design included multiple soil types representative of the region' s saline-alkaline conditions, with measurements taken during November 2016 and November 2017 to assess temporal variations in soil characteristics and crop response.

Results

Soil Chemical Properties

Chemical properties of saline-alkaline soil in the test field of *Helianthus tuberosus*

Sampling Period	pH	Organic Matter (g · kg ¹)	Total N (g · kg ¹)	Available P (g · kg ¹)	Available K (g · kg ¹)
Light Chernozem					
Nov 2016	7.56±0.08aa	31.25±0.64aA	1.85±0.02aA	0.341±0.004aa	16.58±0.14aa
Nov 2017	7.81±0.17ba	29.41±0.48bA	1.99±0.01bA	0.352±0.003ba	16.26±0.26aa

Sampling Period	pH	Organic Matter (g·kg⁻¹)	Total N (g·kg⁻¹)	Available P (g·kg⁻¹)	Available K (g·kg⁻¹)
Sandy Alkaline Soil					
Nov 2016	7.32±0.07ab	20.85±0.66aB	1.14±0.02aB	0.353±0.009ab	16.22±0.19ab
Nov 2017	7.60±0.06b	20.14±0.51bB	0.25±0.02bB	0.364±0.005ab	17.71±0.34ab

Note: Different lowercase letters indicate significant differences (P<0.05) and uppercase letters indicate highly significant differences (P<0.01) between sampling periods for the same soil type.

Crop Performance and Adaptability

Nanjing No. 1 demonstrated exceptional adaptability to saline-alkaline soils in western Jilin Province, achieving high yields and vigorous growth. Survival rates on light chernozem (pH 8.1) and sandy alkaline soil (pH 8.3) reached 94.56% and 82.27%, respectively, with statistically significant differences (P<0.05). The crop' s performance on light chernozem was significantly superior across all growth metrics.

Dry matter accumulation exhibited distinct phase-specific patterns. During the emergence stage, accumulation in stems and leaves was relatively slow. The rapid growth period marked the transition of assimilates to underground tubers, while the tuber expansion phase showed the most dramatic increase in nutrient allocation. By the fast-growing period, dry matter accumulation in stems reached 912.26 g·plant⁻¹ on light chernozem versus 756.02 g·plant⁻¹ on sandy alkaline soil (P<0.05). This 20.6% yield advantage underscores the importance of soil type selection.

Discussion

The primary factors influencing Nanjing No. 1' s survival and growth under saline-alkaline stress were soil moisture content, organic matter content, and total nitrogen availability. Light chernozem, with its superior physicochemical properties and higher nutrient retention, provided a more favorable rhizosphere environment. The crop' s extensive root system enhanced soil structure and promoted leaching of soluble salts, thereby ameliorating soil conditions more effectively in light chernozem than in sandy alkaline soil.

Conclusion

Nanjing No. 1 Jerusalem artichoke can successfully adapt to both light chernozem and sandy alkaline soils in western Jilin Province, though light chernozem is demonstrably more suitable for achieving optimal yields. The cultivar's robust performance, combined with its soil-improving characteristics, makes it an excellent candidate for large-scale cultivation on saline-alkaline lands. These findings support the broader application of Jerusalem artichoke as a multi-functional crop for sustainable agriculture in marginal environments.

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Note: Figure translations are in progress. See original paper for figures.