

## EFFECT OF SALINITY AND ALKALINITY AND FERTILIZATION ON SUNFLOWER GROWTH

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### Abstract

In order to utilize the saline-alkali land in the western part of Jilin Province , a study was carried out for testing the saline-alkali tolerance of sunflower and improving the soil conditions around the sunflower rhizosphere by applying the acid fertilizers in the lab and plots . The results showed that the sunflower seedlings emerged normally with a emergence rate of more than 86% and the seedlings developed normally in the soil conditions of total salt content 0.1-0.3% and the alkalinity 10-30%. The sunflower seed yields increased by 25.4-45.5% by applying acid fertilizers.

Key-words: Rhizosphere soil, pH, Total salt, Alkalinity

### Introduction

In the western area of Jilin Province, there are 238680 ha of cultivated saline-alkali lands, making up 15.965 of the total cultivated land areas in the area. Of which , light and middle alkali land areas are about 225000 ha , making up 94.3% of the total saline-alkali land areas. The salinized or alkalized lands make very poor crop productivity by influencing the crop development during the seedling stage. The objective of the study was 1) to test the tolerant ability of the sunflower plants to salt and alkali and 2) to improve the rhizosphere conditions of the plants by applying the acid fertilizers for increasing the seedling emergence rate and the seedling survival rate.

### Materials and methods

**Trials on sunflower tolerance to salt.** The lightly salinized soil with total salt of 0.2377% and pH of 9.45 was used as a basis. NaCl , CaSO<sub>4</sub> , K<sub>2</sub>CO<sub>3</sub> , CaCO<sub>3</sub> and Na<sub>2</sub>CO<sub>3</sub> were used for preparing the saline soils with the total salt content of 0.1%, 0.3%, 0.5%, 0.7%, 1.0% and 1.5%, serving as 6 treatments. Five sunflower seeds were sown in the prepared soil in a Pitri dish for a treatment with 3 replicates in a completely randomized block design in lab to test the sunflower tolerance ability to salt .

**Trials on sunflower tolerance to alkali.** The alkalized soils with different alkalinities were collected from the fields for the trials. The pH values of the soils were 8.35, 8.62, 9.00, 9.45, 9.50 and 10.10 with the alkalinities of 10%, 19%, 30%, 37%, 46% and 60%, respectively, serving as 6 treatments. The trials were conducted in the same way with the last one.

**Trials on emergence of sunflower seedlings.** Small pots were used in the trials and each contained 1.5 kg soil. Applying none fertilizer(CK), double ammonium phosphate(DAP) (pH=8.31) 8.25g/pot, calcium superphosphate(CS)(pH=2.80) 24.75g/pot, sunflower special compound fertilizer(SSCF)(pH=5.1) 11.55g/pot served as 4 treatments with 3 replicates in a completely randomized block design. 20 sunflower seeds were sown in each pot .

**Field fertilizer application trials.** The trials were carried out in the alkalized soil with pH of 8.42, total nitrogen of 0.99g/kg , total P<sub>2</sub>O<sub>5</sub> of 0.47g/kg , total K<sub>2</sub>O of 33.12g/kg and total salt of 0.83g/kg. Four treatments included applications of manure(CK)(base dressing), manure + CS(base dressing), manure + DAP(base dressing) and manure + CS (base dressing) + urea(top dressing) with applying amount as 495kg CS/ha, 165kg DAP/ha and 64.5 kg urea/ ha. The field was divided into 35 m<sup>2</sup> plots with 3 replicates in a completely randomized block design. The plant density was 20000 plants/ha.

## Results and discussion

The results showed that the sunflower plants grew normally in the soils with total salt of 0.1-0.5% and alkalinity of 10-37% and abnormally in the soils with total salt of 0.7-1.5% and alkalinity of 46-60%(Table 1 and Table 2). That meant that the sunflower plants had the relatively higher ability tolerant to salt and alkali.

Table 1. Effect of salt on the sunflower plant growth

Total salt (%)	No. of emergence of seedlings	Rate of emergence of seedlings(%)	Plant hight(cm)	Growing situation
0.1	4.7	94	7.17	Normal
0.3	4.7	94	11.20	Normal
0.5	3.3	66	8.24	Normal
0.7	1.3	26	0	Short
1.0	0.3	6	0	Short , rugose leaf
1.5	0	0	0	Abnormal

The results of emergence of seedling trials showed that CS application increased the rate of emergence of the sunflower seedlings and was much better than DAS and SSCF application because CS is a acid fertilizer which reduces the pH values of the soil around the plant rhizosphere(Table 3).

Table 2. Effect of alkali on the sunflower plant growth

alkalinity (%)	No of emergence of seedlings	Rate of emergence of seedlings(%)	Plant hight(cm)	Growing situation
10	5.0	100	13.50	Normal
19	5.0	100	11.29	Normal
30	4.3	86	14.27	Normal
37	4.0	80	10.93	Normal
46	4.0	80	7.38	Brown spots on cotyledons
60	0.3	6	0	Almost no seedlings

Table 3. Effect of different fertilizers on the rate of emergence of sunflower seedlings

Fertilizers	No of emergence of seedlings	Plant hight(cm)	Rate of emergence of seedlings(%)
Manure(CK)	16	31.52	80
DAP	8	23.32	40
CS	17	34.41	85
SSCF	13	29.79	65

Table 4. Effect of different fertilizers on the sunflower seed yields

Fertilizers	Seed yields (kg/ha)	Increased rate of seed yields(%)	Fertilizer Invest(Yuan/ha)	Net benefit (Yuan/ha)
Manure(CK)	2130.0	-	-	-
Manure+CS	2670.0	25.4	99.00	969.00
Manure+DAP	2700.0	26.8	247.50	832.50
Manure+CS+urea	3100.5	45.5	165.67	1074.60

Application of CS as base dressing and urea as top dressing significantly increased the seed yields. Compared with application of DAP, the yields were increased by 14.8% and the net income / ha was increased by 242.10 Yuan.

In line with the character of sunflower tolerant to salt and alkali, application of CS can increase the emergence rate of the seedlings, the survival rate of the seedlings and the seed yields for the sunflower production in saline-alkali lands.