EMERGENCE OF NINE VARIETIES OF SUNFLOWER (*HELIANTHUS ANNUUS* L.) IN SALINIZED SOIL CULTURES

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Accumulation of salt in irrigated soils of arid and semiarid regions of the world results in reduction of seed germination and plant growth (Abel & MacKenzie, 1964). It is difficult, if not impossible, to evaluate adequately the level of salinity conditioning the germination or emergence of seeds under field conditions. The amount of soil moisture and the salt concentrations adjacent to the seed are continually changing through the influence of evaporation, capillary transmission, rainfall, or irrigation. It is first necessary to ascertain the effect of varying levels of salinity on germination when all other factors are held constant or as uniform as possible (Ayers & Hayward, 1948).

Kapp (1947) observed that soil salinity at the time of planting resulted in a greater decrease in grain yield than a comparable level of salinity induced when the plants were six weeks old. This reduction in yield by salinity present at the time of planting was attributed to a decrease in the percentage of germination.

In sunflower culture areas, soil salinity is a factor limiting plant growth. In the Middle East, for example, the sunflower has been observed growing on lands visibly affected by salinity. Such fields often contained spotty areas where differences in height, vigor and stand showed the detrimental effects of salinity. In making the best use of lands which may be somewhat saline or subject of the hazards of salinity, the relative salt tolerance of the sunflower varieties, climatically adapted to the area, should be known.

Because of saline irrigation water, high water table, or low permeability of the soil, it may not be economically feasible to maintain low salinity. In such instances, the judicious selection of varieties that can produce satisfactory yield under saline conditions and the use of special management practices to minimize salinity may make the difference between success or failure (Hayward & Wadleigh, 1949).

In selecting sunflower varieties for saline soils, particular attention should be given to the salt tolerance of the varieties during emergence, because poor crops frequently result from failure to obtain a satisfactory stand. The purpose of this investigation was to study the salt tolerance of sunflower varieties in salinized soil in order to make better recommendations for planting on saline lands and for future breeding programs.

MATERIALS AND METHODS

Nine high oil varieties of sunflower (*Helianthus annuus* L.) selected for this study were : Louch, VNIIMK-8931, Chernianka-66, Record, Armavirsky, Peredovik, Orizont, Majak and Zarea. Sodium chloride was added to the nonsaline soil of culture falts at 0, 500, 1000, 1500 and 2000 mg/kg on a dry soil basis corresponding to electric conductivities of the saturation extracts of 0, 4.40, 7.60, 10.03 and 12.80 mmhos/cm, respectively. Zero salt concentration was taken as control. Basically the culture techniques were the same as those described in detail by *Ayers & Hayward* (1948) and *Ayers* (1953). It involved moistening the soil with a volume of water containing the desired amount of salt and the flats covered with glass and maintained, at a constant temperature of 27 ± 1 C for 2 weeks before seeding. The soil was a silty clay loam having a field capacity of approximately 30%, wilting point of 12% and saturation of 40%.

The experiment was performed in split-plot design replicated three times. The sodium chloride concentrations were applied to main-plots and varieties to sub-plots. Twenty five seeds of each variety were planted in each culture flat and the NaCl concentration treatments applied to complete culture flats. Duplicate determination for all varieties were made at 15-day intervals.

The moisture content of the soil in each covered culture flat was determined at the begining and at the end of the test and kept constant during the test period. Electric conductivities of the saturation extracts were determined on soil samples from each salinity level in duplicate. Emergence was recorded daily until three was no change in the count. The experiment terminated after 12 days.

The percentage data were transformed to angles before analysis. However, the values reported are in percentages. Variety means at different salt concentration were adjusted to the control by means of a covariance analysis and the Duncan's Multiple Range Test was used to test for significant differences among treatment means (Steel & Torrie, 1960).

RESULTS AND DISCUSSION

The relative tolerance of nine high oil varieties of sunflower to salinity concentrations during emergence are shown in figs. 1, 2 and 3. Addition of salt affected the emergence of nearly all varieties under investigation, but some of them were affected more than the others. There were significant differences in seed emergence due to NaCl concentration. The nine varieties subjected to the zero salt concentration

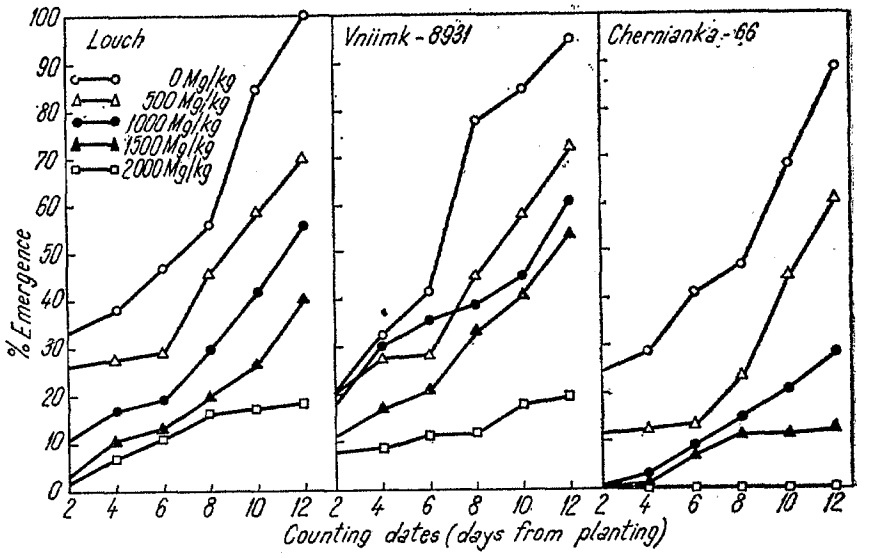

Fig. 1 — Effect of NaCl concentrations on the rate of emergence (%) of Louch, VNIIMK-8931 and Chernianka-66 varieties of sunflower.

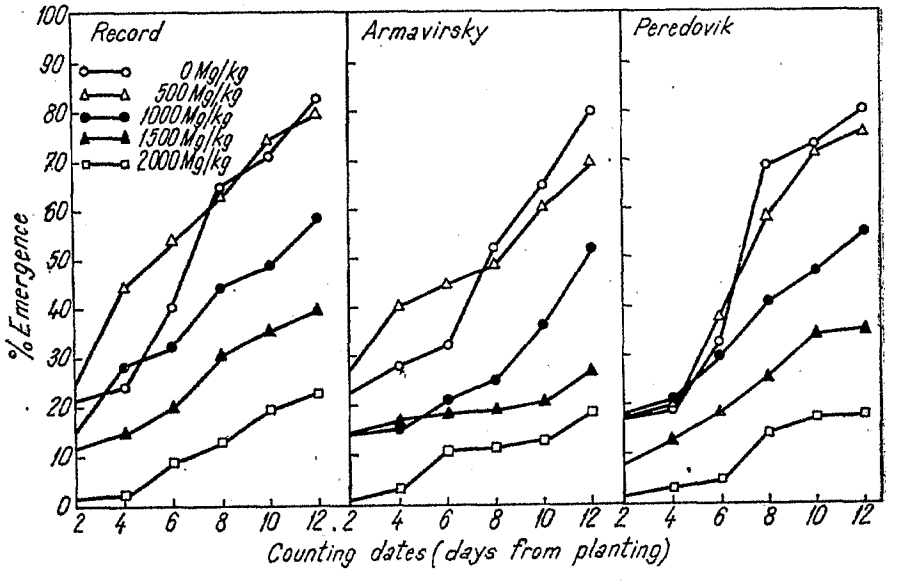

Fig. 2 — Effec t of NaCl concentrations on the rate of emergence (%) of Record, Armavirsky and Peredovik varieties of sunflower.

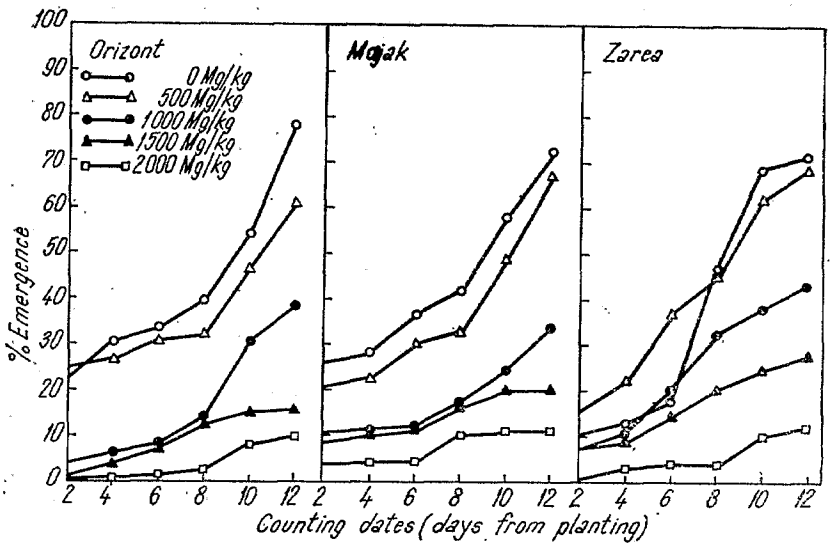

Fig. 3 — Effect of NaCl concentrations on the rate of emergence (%) of Orizont, Majak and Zarea varieties of sunflower.

differed in ultimate emergence (table 1). The differences in emergence at control may be a varietal characteristic and to overcome this effect the data for different salt concentration were adjusted to the control by means of a covariance analysis. The four varieties of Record, Peredovik, Majak and Zarea achieved almost the same percentage of emergence as control at 4.40 mmhos/cm (500 mg/kg NaCl), but soil salinities above 7.60 mmhos/cm (1000 mg/kg NaCl) delayed emergence in all varieties

Table 1

Effect of NaCl concentrations on final emergence (%) of nine varieties of sunflower

Variety	NaCl concentration (mg/kg)				
	0	500	1000	1500	2000
Louch	100,00 a*	70.48 ab	54.43 a	39.94 b	17.51 ab
VNIIMK-8931	94.33 b	72.11 ab	60.42 a	54.37 a	19.47 a
Chernianka — 66	88.00 c	60.49 c	28.63 d	18 29 fg	0.00 d
Record	82.33 d	79.56 a	58.31 a	39.24 b	22.35 a
Armavirski	80.00 d	73.52 ab	51.08 ab	31.24 d	19.04 a
Peredovik	78.00 d	75.06 ab	55.84 a	34.55 c	17.07 ab
Orizont	78.00 d	60.75 c	38.55 c	16.39 g	10.01 c
Majak	72.00 e	66.99 bc	34.12 cd	20.16 f	11,82 c
Zarea	71.00 e	68.32 c	43.96 c	43.96 bc	25.48 e
Mean	82.55	69.64	47.26	31.07	14.44

* Means in the same column followed by the same letter do not differ significantly at 5% leve (Duncan's Multiple Range Test).

(figs. 2 and 3). Similar results are reported for soybean varieties by Rudolfes (1920). Abel and MacKenzie (1964) also showed that soybean varieties subjected to the salinity of 0.05 percent of added salt generally achieved ultimate germination, but salinities above 0.10 percent of added salt decreased the final germination. This may have due to combined effects of osmotic pressure and toxicity of the salt (Bernstein, 1958, and Uhvits, 1946).

There were significant differences for percentage of emergence among varieties (table 1.) The VNIIMK-8931 (a tall variety) with 60.42 percent and Chernianka-66 (a dwarf variety) with 28.63 percent of emergence at 7.60 mmhos/cm (1000 mg/kg NaCl) showed the highest and the lowest tolerance to soil salinity, respectively. The results of this experiment and the data reported by Abel and MacKenzie (1964) indicate that the variation in seed germination and emergence of the crop varieties may be due to inherent differences in ability to absorb water against the osmotic pressure of the substrates.

Data in table 1 indicate that there are also marked differnces in the response of sunflower varieties at higher salinity levels. When the electric conductivity of the saturation extract was around 10.03 mmhos/cm (1500 mg/kg NaCl) more than 54 per cent of the VNIIMK-8931 seeds had emerged after 12 days. While, at the same salinity level and time interval, there were only 18 percent and 16 percent emergence in Chernianka-66 and Orizont varieties, respectively. Under similar conditions, a concentration of 12.80 mmhos/cm (2000 mg/kg NaCl) completely inhibited emergence of Chernianka-66 but caused an average emergence of more than 20 per cent in Record and VNIIMK-8931 varieties. Ayers (1953) has shown marked differences in the germination of barley varieties due to soil salinities.

These differential responses of crop varieties to salinity levels may have agronomic importance. If sunflower is to be planted in a saline soil, which is the case in most arid and semi-arid regions of the world, the selection of a climatically adapted salt tolerant variety rather than one of a lower salt tolerant may mean the difference between a good to fair stand, or a poor to no stand at all.

According to the results obtained in this test, the nine varieties of sunflower may be classified at three categories with respect to relative salt tolerance. VNIIMK-8931, Record, Louch, Peredovik and Armavirski as high salt tolerant, Zarea, Majak and Orizont as medium salt tolerant and Chernianka-66 as low salt tolerant varieties.

An indication of good tolerance of sunflower varieties in salinized soil culture may be a good evidence for salt tolerance of varieties throughout their life cycle. Working with barley varieties Ayers, Brown & Wadlegh (1952) found a good correlation between seed emergence in salinized soil culture and later growth period. The same results reported for safflower François & Bernstein (1964) and for soybean Abel & MacKenzie (1964) during emergence and later

growth. Considering these evidences for other crop varieties, selection of sunflower varieties for saline soils can be made directly by measuring salt tolerance during emergence.

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