Salinity Effects on the Performance of Alfalfa Populations in a Semiarid Environment of Argentina

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Salinity is a major environmental stress that limits agricultural production. The main goal of this study was to evaluate the performance of alfalfa populations (AP) under natural saline conditions. The study was located in the Experimental field of INTA Santiago del Estero, Argentina (28º 01'00" S, 64º 13' 00" W). The climate is mesothermal and semiarid type; the minimal and maximal average annual temperature and precipitation during the experimental period (May 2019-Oct. 2021) were 11.7°C, 28.3°C and <550 mm, respectively. The soil is classified as haplustol torriorthentic texture silty loam. Twelve AP (including varieties and bred population) were evaluated: Ameristand801S (AME), Salado (SDO), Sardi (SAR), Chenini (CHE), MS0036 (M36), MS0037 (M37), MSI0038 (M38), Monarca (MON), ProINTA SuperMonarca (SMO), Salina (SNA), Salinera INTA (SRA), Kumen PV INTA (KUM). All were sown in May 2019, directly on the saline soil in a Latinized Row-Column design (4x3) with three replications. A minimum amount of water was applied to moisten the soil surface during establishment and low irrigation was applied during winter and early spring 2020. Fifty-five plants were kept on each plot (1 m^2) after the first cut (discarded). In three moments: March 2019, December 2020, and October 2021, salinity conditions in the field were evaluated to know the specific salinity in each plot. For that: 1) apparent soil electrical conductivity (ECa) measurements were made in the field with EM-38 DD instrument (Geonics); 2) extracted soil electrical conductivity (ECex) measurements were determined in the laboratory (0-30, 30-60, 60-90 cm) in selected soil samples taken in the field after interpretation of the ECa; 3) the EC was estimated (ECes) for each plot using an adequate linear regression (P<0.05) at each moment between ECex (average from three depth) and ECa. The biomass production was evaluated from 16 cuts by measuring: the dry matter biomass (DM) per plot (DMplot, $g.m^{-2}$), the biomass per plant (DMplant, g), and the relative survival (S, %) over time. The data were subjected to ANOVA using GLM model including AP as a fixed factor while column, row, and replications as random factors, and the ECes as a covariable. AP means were compared using the LSD Fisher test (P<0.05).

At the beginning of the experiment, the average ECes in the plots was 9.5 dS/m (6.0 to 13.5). However, due to the salt dynamic, the ECes changed over time. The average values were 27.4 (22.0 to 33) in December 2020 and 25.8 (23.4 to 29.2) at the end, which represented an increment near 3 fold compared to the initial salinity. Analysis by cut showed significant differences among AP for DMplot and DMplant from cut 9 to 16. For the first 8 cuts (P>0.05), the range of the cumulated DMplot was from 941.4 to 649.5 $g.m^{-2}$ (SAR and CHE, ranked first and last), and DMplant from 17.6 to 12.2 g (M37 and CHE, idem). For the second 8 cuts (9 to 16) there were differences among AP by DMplot (P<0.05) and DMplant (P<0.01). The ranges were from 812.5 to 315.5 $g.m^{-2}$, and from 27.3 to 10.2 g; M37 and CHE ranked first and last in both ranks. The S decreased over time but only showed differences among AP in cut 13 (P=0.06), the final S was from 14 to 0 % (SRA and SNA, respectively). Our results reveal when the salinity increased the AP displayed a different aptitude to cope with this stress. Since alfalfa, is perennial, salinity imposed an extra challenge due to the typical variations in salt dynamics within and between years. Our study provides more knowledge about the decrease and variability of alfalfa productive performance under saline conditions and information about the behavior of different populations evaluated in Argentina.