

## Improving salinity tolerance of alfalfa (*Medicago sativa* L.) through conventional breeding

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A new cultivar with increased salinity tolerance was obtained from the INTA alfalfa genetic breeding program. The *Medicago sativa* germplasm (Synthetic Santiago=SISA 14) is a salt-tolerant synthetic population derived from three cycles of phenotypic recurrent selection under a semiarid saline natural condition at the Isla Verde, Santiago del Estero, Argentina (28°38'41.9"S, 64°05'03.8"W; soil taxonomy: typic Natracualf). The parental material is derived mainly from cv. Salado (fall dormancy=FD 9), with minor contributions from AZ-97MEC-ST and AZ-97MEC populations (FD 9). The best genotypes at each cycle were selected based on the ability to emerge, grow, and produce forage and seeds under a natural condition of medium to moderate high saline soil. The saline site where the seeds germinated and emerged was the same in the three selection cycles, having an electrical conductivity of saturated paste extract ( $EC_{ex\ 0-5cm}$ ) between 10.6 to 32.8 dS m<sup>-1</sup> and average pH of 7.74 (a minimum amount of water was applied to moisten the soil surface). Selection in cycle I (March 2007): 250 seedlings were selected after emergence. Each seedling was transplanted temporarily to an individual small bag. Later, each plant was transplanted directly to the soil in a nearby paddock ( $EC_{ex\ 0-30cm}$  oscillated from 4.1 to 20.8 dS m<sup>-1</sup> between April to November, respectively; with increasing salinity in depth) within the same field with the proper isolation to preserve its genetic purity. Plants were grown and intercross until December. The seeds were harvested from selected plants for good vigor, large size, lack of foliar disease and bulked to form the first selection cycle. In March 2008, these seeds were sown in the germination site described before, and a new selection was done after seedling emergence. Thereafter, it followed the same procedure previously described. The site in where second intercross cycle was made had  $EC_{ex\ 0-30cm}$  oscillated between a maximum of 32.2 in September 2008 to a minimum of 19 dS m<sup>-1</sup> in March 2009. Only 70 genotypes were selected to produce the intercrossing seeds. Seed harvests were done in December 2008 and March 2009 and bulked to form the second selection cycle. These seeds were sown in March of 2010 and 84 seedlings were selected and following the same procedure as before. The site in where third intercross cycle was made had  $EC_{ex\ 0-30\ cm}$  14 dS m<sup>-1</sup> in average. Seed harvests were done in December 2010 and March 2011, and bulked to form the third selection cycle. These seeds becoming the *breeder* seeds or Syn-1. Intercross where made by native effective pollinators bees *Xylocopa* spp. As it was mentioned, the soil salinity is rarely spatially uniform in field conditions and each of the three cycles has been done under a different level of saline stress. Thus, a long-term study was carried out under controlled conditions of temperature, light and different concentrations and type of salts in the facilities of the USDA Salinity Laboratory, Riverside USA (2011-2012). The irrigation system and closed drainage utilized allow maintaining the levels of stress constant, which allowed lead a comparative evaluation of several alfalfa populations. SISA 14 (Syn-1) combined high tolerance (in relative terms) and higher biomass production (gr pl<sup>-1</sup>), explained in part by a lower concentration of Na<sup>+</sup> in its aerial biomass as one of the attributes associated with one of the mechanisms contributing to the tolerance in alfalfa (Cornacchione and Suarez, 2017). The Syn-1 seeds were sent to the EEA INTA San Juan, Argentina in the fall of 2011 and Syn-2 seed was obtained in April 2012. Subsequently, the Syn-2 was sent in April 2015 and the Syn-3 was obtained in 2016. Syn-2 were used to conformed (in Argentina) evaluation trials of agronomic behavior sowed on fall of 2015 and conducted for 3 seasons (2015/2016, 2016/2017 and 2017/2018) at two locations (EEA Manfredi, EEA Santiago del Estero) and one season at the EEA Rafaela (2015/2016). From Syn-3, the population was conducted as a synthetic cultivar.

**REFERENCE:** Cornacchione, M.V., and D.L. Suarez. 2017. Evaluation of alfalfa (*Medicago sativa* L.) populations response to salinity stress. *Crop Sci.* 57(1):137–150. doi:10.2135/cropsci2016.05.0371