

The productivity of alfalfa accessions in contrasting environments in Kazakhstan

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Introduction: Global climate change is increasing the surface temperature of the planet, elevating the importance of drought tolerance as a trait in forage breeding. Crop wild relatives (CWR) of alfalfa are adapted to arid environments and offer the potential to contribute novel alleles for drought tolerance selection. Kazakhstan is rich in flora ecotypes of wild species of alfalfa: tetraploid *Medicago sativa* subsp. *falcata* (syn *M. tianschanica*, *M. falcata*), *M. s. varia* and diploid species *M. s. caerulea*, (syn. *M. s. trautvetteri*), and *M. s. falcata* (syn *M. s. difalcata*). In this paper we illustrate the targeted evaluation of varieties, landraces and CWR in low (Almaty) and high drought x cold stress (Kokshetau) environments in Kazakhstan.

MATERIAL AND METHODS: Almaty (south Kazakhstan) is characterized by a climate with hot summers and milder winters. Most alfalfa genotypes are sufficiently adapted to the average annual +7.50°C temperature and 417 mm rainfall. More than 70% precipitation occurs in the spring months April – June and there is a winter snow cover 25 – 35 cm. The fertile loam soil has a neutral pH. Kokshetau is characterized by severe climate in the winter months with minimum temperature reaching -35 – 45°C. Here, winter hardiness is one of the important criteria in the evaluation of varieties. The average annual temperature is +2.1°C and annual rainfall of 320 mm is dominated in summer. Winter snow can reach 50 – 70 cm. The soil is a leached chernozem with neutral pH. Forty-eight diverse lines were evaluated from the Crop Trust CWR alfalfa project. Information on these lines can be found at <https://ics.hutton.ac.uk/cwr/alfalfa/#home>. Forage yield was cut by hand shears and oven dried. Means of fixed effects for forage yield were calculated using spatial linear mixed models using variety x site as the treatment structure, performed by GenStat 18.

RESULTS: In Almaty, the entries APG 38688, Kokbalausa, SARDI Grazer, K 271, Titan 7, Darkhan 90, Alta Sierra 2, Q 75, Kokorai, Stamina 5, SARDI 7 Series 2, APG 19018 produced an average yield of over 13500 kg/ha (Figure 1). In Kokshetau, APG 45644, APG 38688, Force 5, Chiza, APG 58577, APG58575, KWP809317 with dry matter yield greater than 2500 kg/ha. Entries APG35169, APG45677, Alta Series 2, K267 and K266 were not winter-hardy and, consequently, their productivity (influenced by survival and recovery) was the lowest. The CWR accession APG 38688 (*M.s.falcata* collected from Alakol in southeastern Kazakhstan) showed the best combination of yield across the two sites of Almaty and Kokshetau, showing high ductility to different environments.

CONCLUSIONS: The evaluation of 48 diverse alfalfa varieties, landraces and accessions to Almaty and Kokshetau will be an important step in the development of more drought tolerant accessions for future climate scenarios in Kazakhstan.

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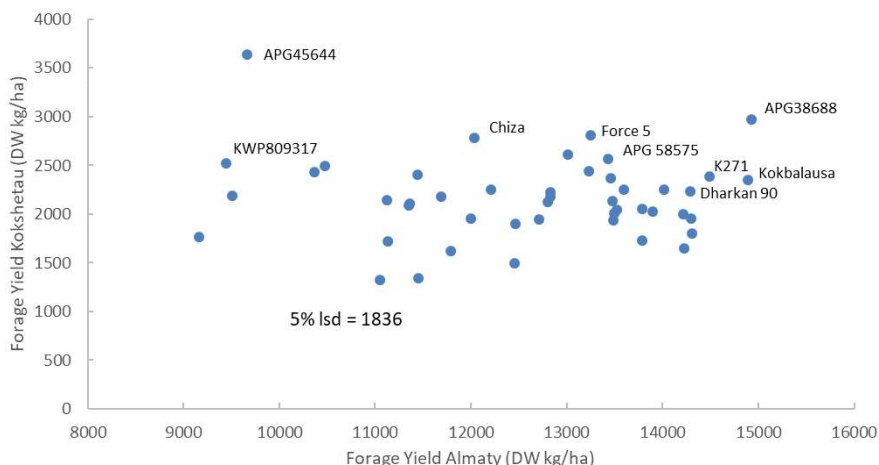


Figure 1. Average annual forage yield production at Almaty (low stress environment) and Kokshetau (high stress environment) for 48 diverse *Medicago sativa* populations.