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Assessment of important environmental factors affecting *Agropyron trichophrum* establishment by using an ordination method

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Introduction Iran is the homeland of diverse plant and animal species. Our knowledge of the environmental factors affecting these species and their distribution will help to develop more efficient range improvement plans. Plants growing in different sites represent the climatic and topographic characteristics of their natural habitats (Elinberg, 1992). Knowledge of these characteristics will help to develop range improvement plans based on ecological demands of different plant communities (Escudero et al., 2000). For example, Allen et al., (1995) found a significant correlation between soil and topographic properties. These results indicated that there is a possibility to estimate site potentials from both topographic features and existing plant communities. Similarly, EL-Ghareeb and Shabana (1990) investigated correlations between soil and vegetation cover characteristics. The effective factors on establishment and growth of plant species were classified in two categories. Our studies built upon this earlier work.

Materials and methods

Study area

The study area was located in Karchambu watershed, Faridan, 200km west of Isfahan. The total karchambu watershed area is about 11000 hectares which geographically is located between 49°50' and 50°36' eastern longitudes and 32°2' and 33°11' northern latitudes. The minimum and maximum elevations from the sea level are 2360 and 3710m, respectively.

Sampling methods

To identify the most important edaphic factors contributing in *Agropyron trichophrum* establishment and distribution in the range, 15 different sites with uniform cover of mentioned species were identified and selected. Quadrat samples of one square meter (1m²) were used to measure percent vegetation cover, species density and soil physical and chemical characteristics on transects representing the highest diversity of *Agropyron trichophrum* ecotypes (Mueller et al., 1974). The least essential samples number for vegetations cover measurements in each site was calculated by the following equation (1):

$$N = \frac{t^2 \times s^2}{(x \times k)^2} \quad (1)$$

N: number of essential samples, T: t student value with n-1 and $\alpha = 5\%$, S: standard variation, X: mean vegetation cover

N: primary sample number, K: Precision coefficient (10%). All the soil samples were transferred to the laboratory in separate plastic bags, where the pH value, EC as well as Na, K, Ca and Mg content were measured. Sodium absorption ratio was calculated by the following equation (2) (Miller and Keenly, 1986).

$$SAR = Na / \left[\frac{Ca^2 + Mg^2}{2} \right]^{1/2} \quad (2)$$

Soil texture was measured by hydrometric method (Black, 1965). The relationship among all measured edaphic attributes with *Agropyron trichophrum* establishment and distribution in all 15 range sites was explained by normal ordination grouping of CA categories using CANOCO and PC-ORD software (Ter Braak, 1987 and 1988).

Results The relationship of plant parameters with soil characteristics were identified by RDA (define) method. This method was applied to demonstrate these relationships graphically. The results of these analyses in 15 sites showed that there is strong correlation between two plant characteristic-plant density and percent vegetation cover. The increment of these two parameters is exactly in direction of high density plant sites with over 14, 10, 5, 2, 6 and 12 which indicated the high presence of *Agropyron trichophrum* on these sites. The correlation between these plant parameters (density and percent vegetation cover) are well indicated by the coefficient of correlation values. Soil characteristics like Ca content at soil A layer, sand, Cl, Mg, and Na at B and silt, clay Sp, EC, pH, and OC at A and B layers have no effects on *Agropyron trichophrum* vegetation cover. Parameters like gavel percentage, Mg content and Na at A layer, and Cl at B as well as C/N and Ca content at both A and B layers of the soil have a moderate effects on vegetation cover of *Agropyron trichophrum*. Soil parameters like sand parentage and soil pH at soil a layer have a moderate effect on the vegetation cover while the same factors at B layer were the most effective ones on percent vegetation cover. The most important factors on *Agropyron trichophrum* density were C/N ratio and soil pH at B layer. Among the selected soil parameters, C/N ratio, SAR, sand, gravel and calcium percentage at A layer and SAR, C/N ratio and Cl at B layer had the highest positive correlation while Sp, pH, and EC parameters at A layer had the lowest correlation with plant parameters.