

Evaluation of snow clover (*Trifolium pratense* L. subsp. *nivale* Asch. et Gr.) germplasm native to the Retic Alps, Italy, of potential interest for the restoration of degraded landscapes at high altitude

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In the last 50 years, the Alps have experienced an extensive development of ski runs and other infrastructures for winter tourism. The need of an ecological restoration of the disturbed areas has arisen, to limit or prevent environmental problems due to soil erosion, increased water runoff, depletion of the native flora, etc. The revegetation of degraded landscapes at high altitude requires plant material able to meet the technical purposes of the restoration, adapted to the peculiar pedo-climatic conditions and compatible with the existing ecosystems (particularly in wilderness areas). Some key species, including snow clover, have been identified that may act as 'starters' in the process of renaturation, favoring the natural reentry of a wider range of species. Information is needed on these key species to define the existing level of variation in the native germplasm, the presence of superior variants for a possible selection, and the optimal environment for seed multiplication in view of their commercial distribution. A collection of snow clover was carried out in the Retic section of Alps, in the framework of the Project SEMENSCI funded by the Region Lombardy, which aims at implementing the production of seed of local germplasm suitable for the restoration of degraded areas at high altitude. Three valleys were explored above 1800 m a.s.l., and 12 populations were collected altogether, five each from Upper Valtellina and Valchiavenna and two from Valmalenco. Two evaluation fields were established for this material, in a mountain (1300 m a.s.l.) and in a lowland location (81 m a.s.l.), respectively, to assess any interaction effect between the alpine germplasm and the site of growth, with a special emphasis on seed multiplication in areas different from those of origin. So far, data from the lowland location only are available. Variation among and within valleys was examined for traits of interest in landscape restoration, such as plant morphology, phenology and seed yield. Significant differences among valleys were found for flowering time, number of seeds per plant and susceptibility to mildew. Upper Valtellina and Valmalenco had contrasting behavior, with the latter showing earlier blossom, lower disease susceptibility and higher seed yield. Overall populations within valleys differed among them in the above-mentioned traits, as well as in plant height, vigor, and number of stems per plant. The estimate of the variance component 'among populations within valleys' was greater than the component 'among valleys' for all traits. This finding bears a certain relevance for further germplasm collection, as exploring several sites within valleys may be more effective than exploring several valleys to gather variable material for breeding exploitation. The greatest within-valley variation was observed in Valchiavenna. The frequency of plant flower color and growth habit also displayed great variation among valleys, with Upper Valtellina showing 95% of plants with white flowers, versus 74% in Valmalenco and 45% in Valchiavenna (where pink flowers were as frequent), and Valmalenco showing 51% of plants with prostrate or semi-prostrate habit, versus 37% in Valchiavenna and 21% in Upper Valtellina (where erect or semi-erect plants exceeded 58%). Information on the species' mating system was also obtained in this study, confirming its almost absolute self-incompatibility and its dependence from pollinators to set seed. These results are just preliminary and need to be confirmed in the high-altitude evaluation site. Nonetheless, there appears to be an interesting variation in the genetic resources of snow clover from the Retic Alps, which is a pre-requisite for the selection of the most interesting germplasm. Promising populations were noted that were able to combine positive traits, such as early flowering, high vigor, great seed yield and good tolerance to mildew.