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Soil texture and climatc conditions for biocrust growth limitation: a meta analysis

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Along with afforestation, attempts have been made to combat desertification by managing soil crusts, and is has been reported that recovery rates of biocrusts are dependent on many factors, including the type, severity, and extent of disturbance; structure of the vascular plant community; conditions of adjoining substrates; availability of inoculation material; and climate during and after disturbance (Belnap & Eldridge 2001). Because biological soil crusts are known to be more stable on and to prefer fine substrates (Belnap 2001), the question arises as to how successful crust management practices can be applied to coarser soil. In previous studies we observed similar crust biomasses on finer soils under arid and on coarser soils under temperate conditions. We hypothesized that the higher water holding capacity of finer substrates would favor crust development, and that the amount of silt and clay in the substrate that is required for enhanced crust development would vary with changes in climatic conditions. In a global meta study, climatic and soil texture threshold values promoting BSC growth were derived. While examining literature sources, it became evident that the amount of studies to be incorporated into this meta analysis was reversely related to the amount of common environmental parameters they share. We selected annual mean precipitaion, mean temperature and the amount of silt and clay as driving variables for crust growth. Response variable was the "relative crust biomass", which was computed per literature source as the ratio between each individual crust biomass value of the given study to the study maximum value reported. We distinguished lichen, green algal, cyanobacterial and moss crusts. To quantify threshold conditions at which crust biomass responded to differences in texture and climate, we (I) determined correlations between bioclimatic variables, (II) calculated linear models to determine the effect of typical climatic variables with soil clay content and with study site as a random effect. (III) Threshold values of texture and climatc effects were identified using a regression tree. Three mean annual temperature classes for texture dependent BSC growth limitation were identified: (1) <9 °C with a threshold value of 25% silt and clay (limited growth on coarser soils), (2) 9-19 °C, where texture did have no influence on relative crust biomass, and (3) >19 °C at soils with <4 or >17% silt and clay. Because biocrust development is limited under certain climatic and soil texture conditions, it is suggested to consider soil texture for biocrust rehabilitation purposes and in biogeochemical modeling of cryptogamic ground covers.

References

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