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Cyanogenesis polymorphism in Lotus alpinus s. l. and Ranunculus montanus s. l. from the Swiss Alps

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Lotus alpinus s. l. and Ranunculus montanus s. l. occurring within the alpine vegetation belt in the Swiss Alps share several interesting features. Both groups comprise diploid and tetraploid populations; both grow upon various Alpine substrata viz. acidic silicate, carbonate and serpentine; both are polymorphic for cyanogenesis. For references see e. g. Dickenmann 1978, 1979, 1982, Urbanska 1979, 1982, Urbanska and Schwank 1980, Urbanska and Wildi 1975.

Polymorphism of cyanogenesis was studied recently in both groups within the same restricted yet geologically heterogenous area near Davos(Grisons, E Switzerland). Population samples from acidic silicate and those from carbonate were examined in either group independently: the senior author dealt with Lotus alpinus, whilst the junior author studied Ranunculus montanus. The HCN-tests used were different in each investigation. For evaluations, two gross phenotypes i. e. acyanogenic and cyanogenic were taken into consideration.

Compared to Lotus alpinus, Ranunculus montanus group was found to be in general less cyanophoric. According to preliminary semi-quantitative assessments, the HCN content per Kg fresh weight varied in Ranunculus montanus from approximately 2-5mg to over 50mg, whereas the corresponding values in Lotus alpinus were 30 mg to at least 250 mg. In spite of this difference, phenotypic frequencies found in the two groups form an amazingly similar pattern. The principal aspects can be summarized as follows:

1. Polymorphism of cyanogenesis in Lotus alpinus s. l. and Ranunculus montanus s. l. within the study area is apparently influenced by edaphic factors, the substratum type possibly playing an important rôle.

2. The cyanogenic phenotype seems to be directly selected; plants carrying both the cyanogenic glycoside(s) and the corresponding β-glucosidase apparently are more favoured upon carbonate than in acidic silicate soils(Fig. 1). The respective phenotypic frequencies in Lotus alpinus increased by factor 3, differences in Ranunculus montanus being still more pronounced(factor 3.5).

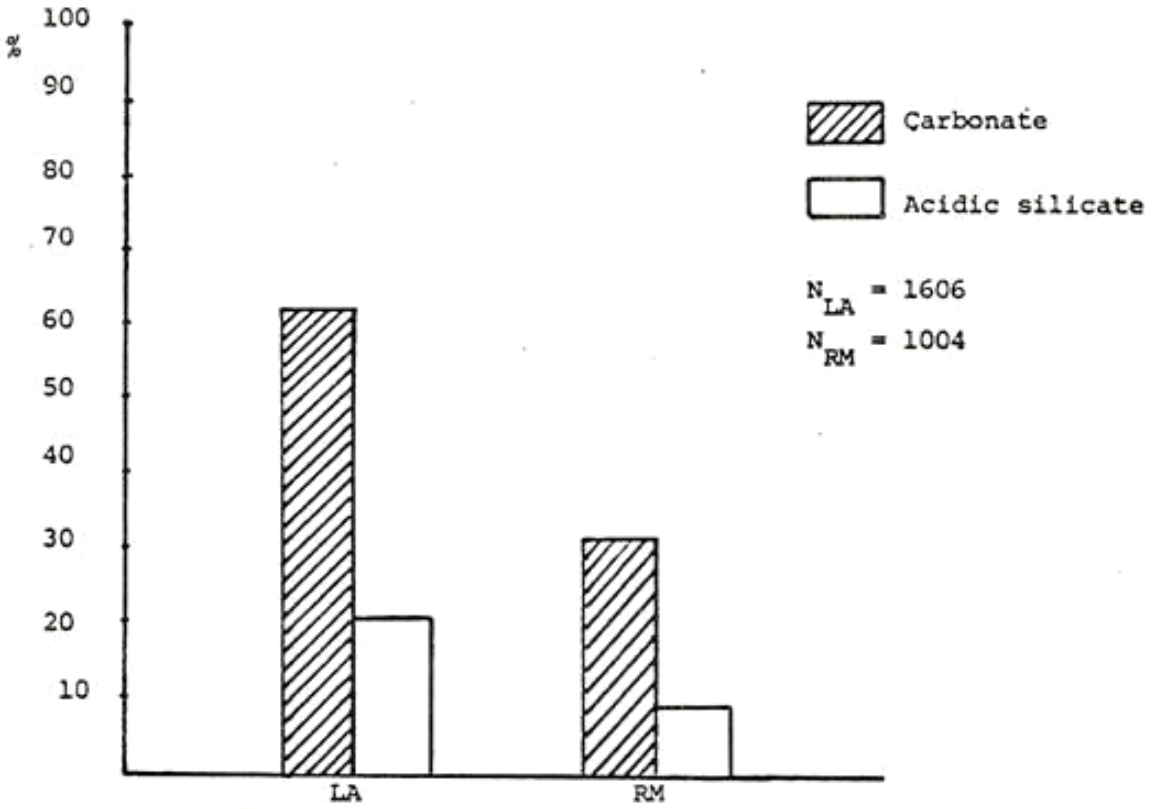

Fig. 1. Global frequencies of cyanogenic phenotypes in the material from carbonate and acidic silicate. LA = Lotus alpinus s. l.; RM = Ranunculus montanus s. l.

3. HCN-positive individuals from carbonate were often strongly cyanogenic, whereas plants from acidic silicate most frequently gave only weak positive readings in the HCN-tests(Fig. 2). It seems therefore that modifying genes controlling the amount of cyanogenic glycoside(s) produced might be selected under influence of substratum, modificators resulting in a strong allele expressivity being favoured

upon carbonate.

Studies dealing with a small-scale distribution of phenotypic frequencies revealed a rather pronounced variation within both groups; on the whole, however, the samples examined conformed to the general trend. In some cases, differences between acidic silicate and carbonate were exceedingly clear.

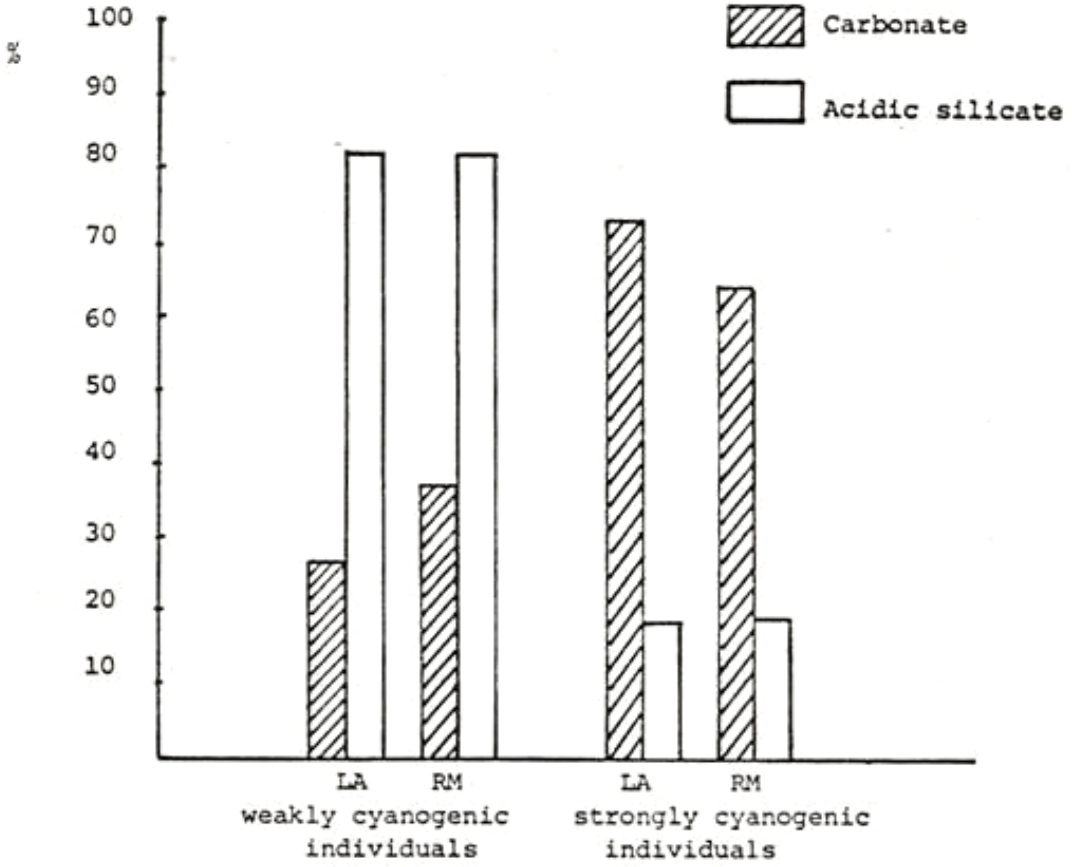

Fig. 2. Frequencies of particular cyanogenic phenotypes in the material from carbonate and acidic silicate. LA = Lotus alpinus s. l.; RM = Ranunculus montanus s. l.

The problem of the cyanogenesis polymorphism is very complex; thus, long-term studies comprising various approaches are indispensable for a better comprehension of this phenomenon. Phenotypic frequencies may remain under influence of abiotic and/or biotic habitat components; furthermore, a possible regional variation should not be neglected. As to relationships between the substratum type and cyanogenesis, the present results demonstrate for the first time a largely comparable pattern of behaviour in two plant groups that stay phylo-

genetically very far apart but were studied from the same restricted area. It should be noted parenthetically that Boyd et al.(1938) found in Sorghum vulgare var. sudanense a distinct increase in the cyanide production when plants were grown in soils rich in nitrogen(particularly nitrate), low in available phosphorus and subject to drought. Whatever the factors influencing the cyanogenesis polymorphism in Lotus alpinus s. l. and Ranunculus montanus s. l., the relatively high frequencies of strongly cyanogenic plants do coincide with the alpine carboniferous soils, known to be rich in NO_3-N, liable to phosphorus deficiency and frequently suffering from an unfavourable water regime. At the time being, the authors do not know to what extent are the results obtained to be considered as aleatory; it seems to us that the patterns observed tend to reach beyond a mere chance-variation scope, but further studies are obviously required. Our investigations are in progress.

References

Boyd F.T., Aamodt O.S., Bohstedt G. and Truog E. 1938. Sudan grass management for control of cyanide poisoning. J. Amer. Soc. Agron. 30, 569-582.

Dickenmann R. 1978. Ecological borders between two closely related taxa. Ber. Geobot. Inst. ETH Stftg Rübel 46, 25-26.

Dickenmann R. 1979. Microdifferentiation patterns in Ranunculus montanus Willd. s. l. Ber. Geobot. Inst. ETH Stftg Rübel 47, 46-49.

Dickenmann R. 1982. Cyanogenesis in Ranunculus montanus s. l. from the Swiss Alps. Ber. Geobot. Inst. ETH Stftg Rübel 49.

Urbanska K. 1979. Some variation patterns in Lotus alpinus(DC) Schleicher from Switzerland. Lotus Newsletter 10, 3-7.

Urbanska K. 1982. Polymorphism of cyanogenesis in Lotus alpinus. I. Small-scale distribution pattern of phenotypic frequencies in acidic silicate and carbonate. Ber. Geobot. Inst. ETH Stftg Rübel 49.

Urbanska K. and Schwank O. 1980. Variation within Lotus corniculatus L. s. l. from Switzerland. III. Microdifferentiation in L. alpinus(DC) Schleicher above the timberline. Ber. Geobot. Inst.ETH Stftg Rübel 47, 29-45.

Urbanska K. and Wildi O. 1975. Variation within Lotus corniculatus L. s. l. from Switzerland. I. Preliminary report on chromosome numbers and cyanogenesis. Ber. Geobot. Inst. ETH Stftg Rübel 43, 54-82.