Gibt es saisonale Unterarten von *Rhinanthus alectorolophus*?

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Rhinanthus alectorolophus

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ORIGINAL ARTICLE

Ecotypes and genetic structure of *Rhinanthus alectorolophus* (Orobanchaceae) in southwestern Germany

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Abstract European annual species of the genus *Rhinanthus* often exhibit seasonal ecotypic variation, a phenomenon also known from related genera of hemiparasitic Orobanchaceae. Populations with different flowering times exist, correlated with differences in a number of morphological characters. The present study evaluates the correlation of morphological characters and genetic differentiation of populations of *Rhinanthus alectorolophus*. Thirty-nine populations of three different subspecies from southwestern Germany were sampled. A total of 798 individuals were used for morphological analyses and 187 of these for AFLP analyses. Principal component analysis showed that morphological variation is mostly continuous. In a discriminant analysis based on morphological characters, only 89.7 % of all individuals were correctly assigned to their previously determined subspecies, indicating that subspecies identification is ambiguous for some populations. Using AFLP data and Bayesian assignment analysis, the sampled individuals could be grouped in three genetic clusters which do not correspond to the three subspecies. Instead, the clustering shows a clear geographic pattern and a Mantel test likewise revealed a significant correlation between genetic and geographic distances. Correlations of genetic distances with differences in morphological characters were weak and mostly insignificant. The results indicate that the subspecies of *R. alectorolophus* do not form discrete entities and that the character combinations distinguishing them are homoplastic.

Keywords AFLP · Isolation by distance · Morphology · Orobanchaceae · *Rhinanthus alectorolophus* · Ecotypes · Subspecies

Introduction

Many European annual species of hemiparasitic Orobanchaceae, especially in the genera *Rhinanthus*, *Euphrasia*, and *Melampyrum*, exhibit high ecotypic variability (Karlsson 1974). Populations with different flowering times and differences in associated morphological characters can be

Rhinanthus alectorolophus

- Halbparasit
- Orobanchaceae (früher Scrophulariaceae)
- Temperates Europa (Atlantik bis Russland)
- Diverse Saisonale Unterarten beschrieben

Alle Wähnert

Rhinanthus alectorolophus

- unterschiedliche Mähzeiten
=> Anpassung durch unterschiedliche Ökotypen?

Mai

Sept.

Rhinanthus alectorolophus

Zopfi 1993 a & b hat Schweizer Populationen v. *Rhinanthus alectorolophus* untersucht:

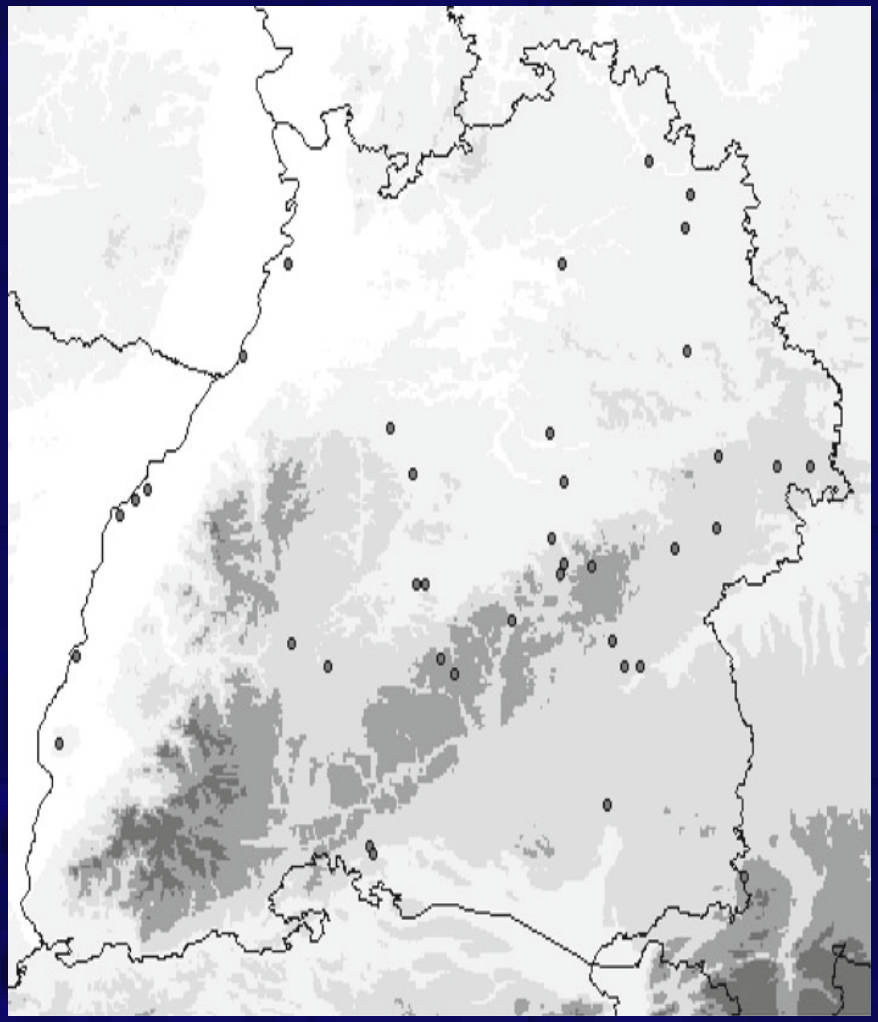
-Morphologie korreliert mit Landnutzung.

-Ökotypen wohl genetische Basis.

-Verpflanzungsexperimente bestätigten dies.

Rhinanthus alectorolophus

Proben von *Rhinanthus alectorolophus* in BW für morphologische und genetische Analysen



Rhinanthus alectorolophus

Wichtige morphologische Merkmale:

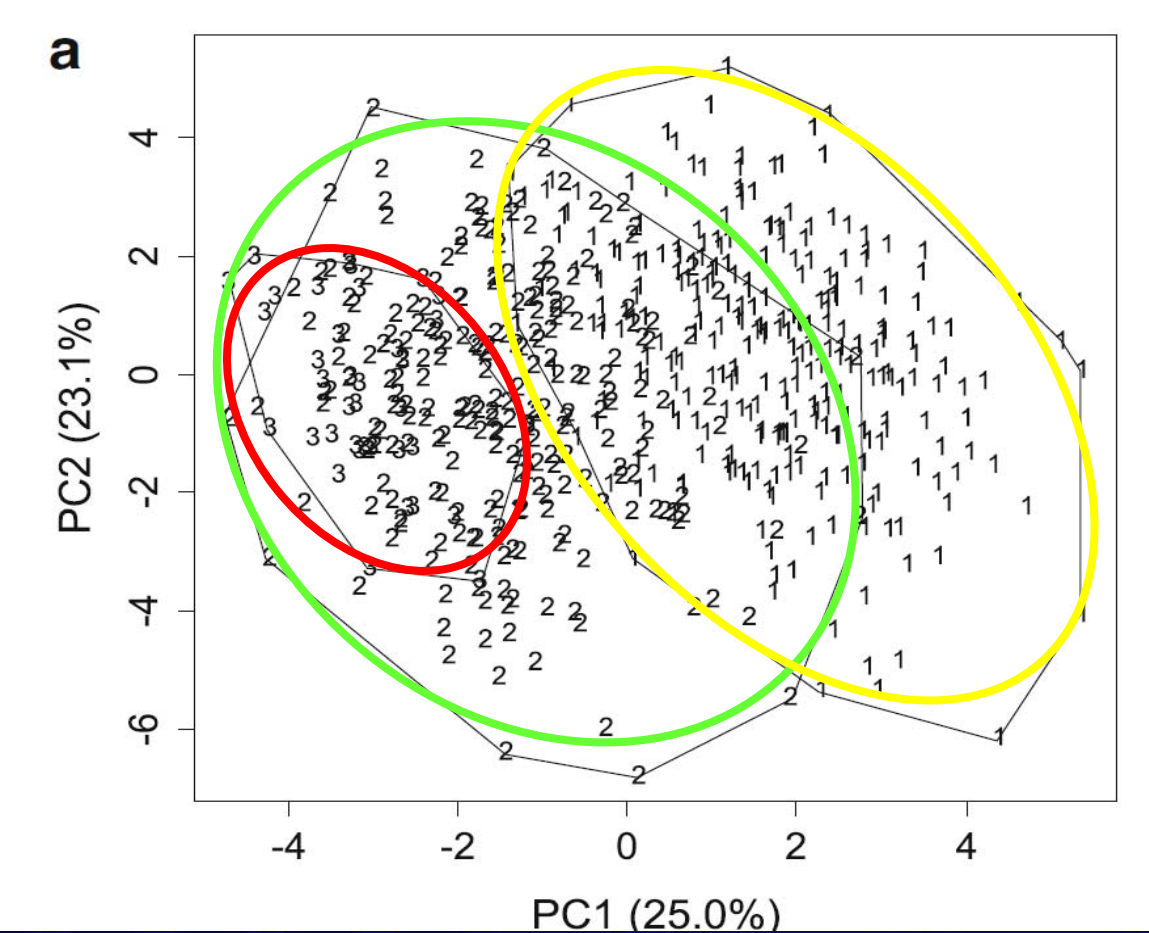
- Pflanzenhöhe
- Anzahl der Internodien
- Länge der Internodien
- Stamm Blattlänge
- Brakteen Länge & Breite

Weitere wurden erhoben.

Rhinanthus alectorolophus

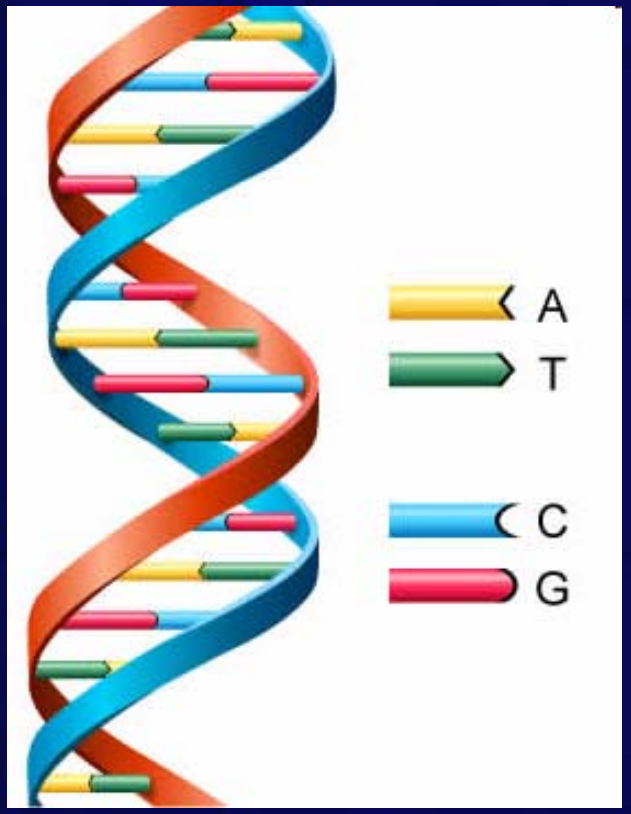
Morphologische Analyse

nach morphologischer
a priori Bestimmung:
1 subsp. alectorolophus
2 subsp. semleri
3 subsp. patulus



Rhinanthus alectorolophus

DNA-Aufbau:
4 Basen



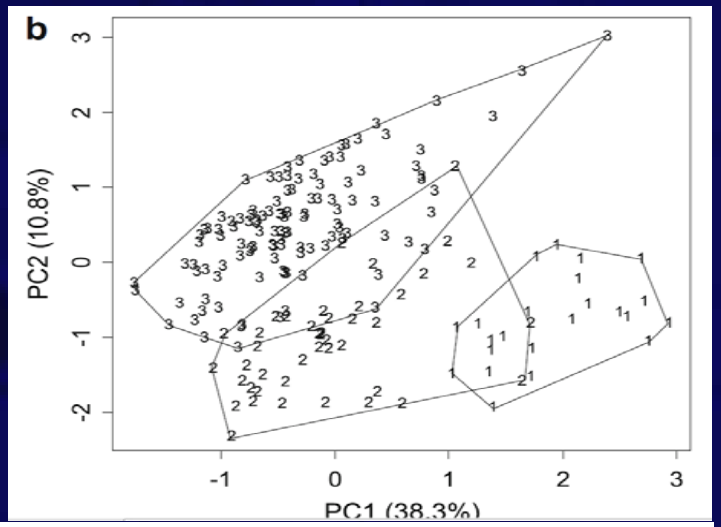
Adenosin (A) - Thymidin (T)

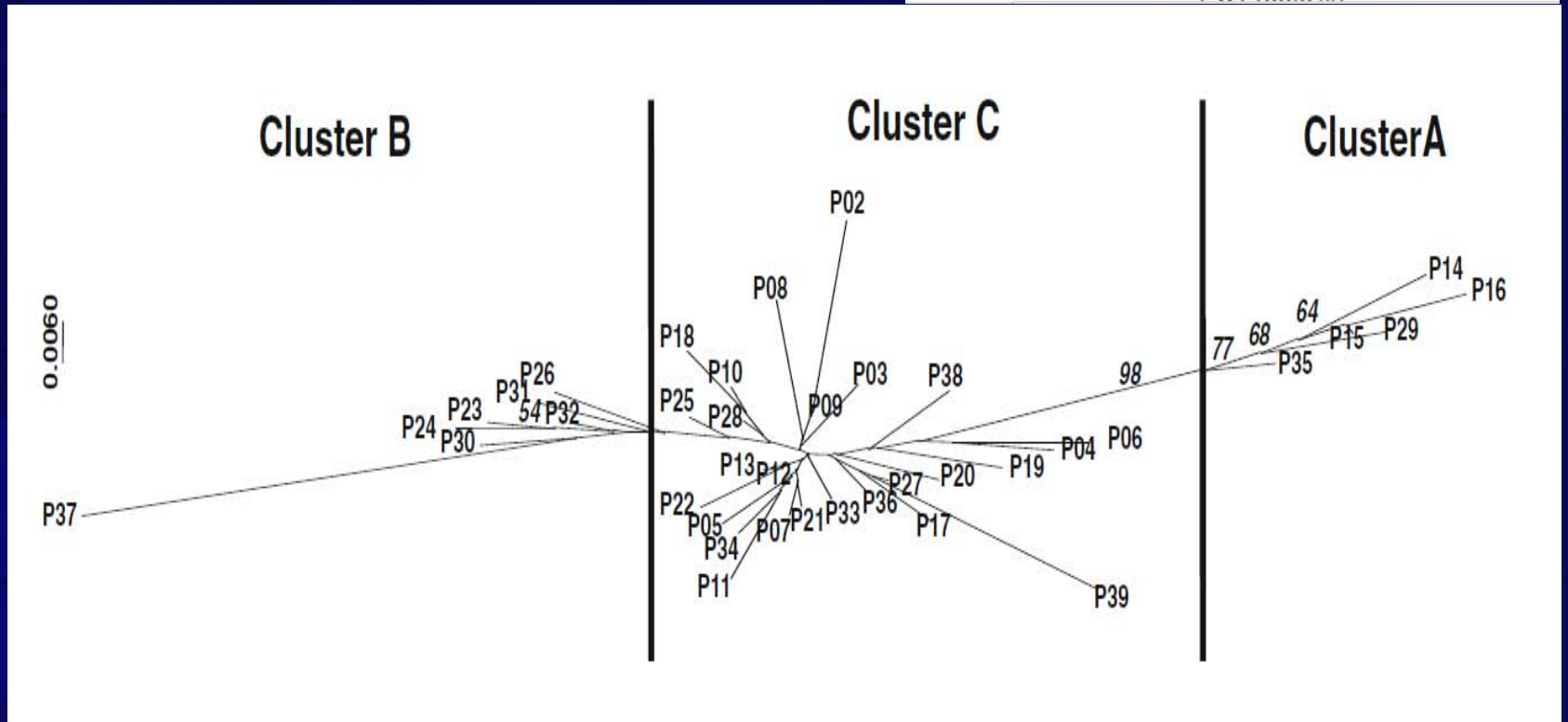
Guanidin (G) - Cytosin (C)

Sogn. *AFLP*-Technik:
Variable Bereiche im Genom geschnitten und analysiert => Bandenmuster (Fingerabdruck)

Rhinanthus alectorolophus

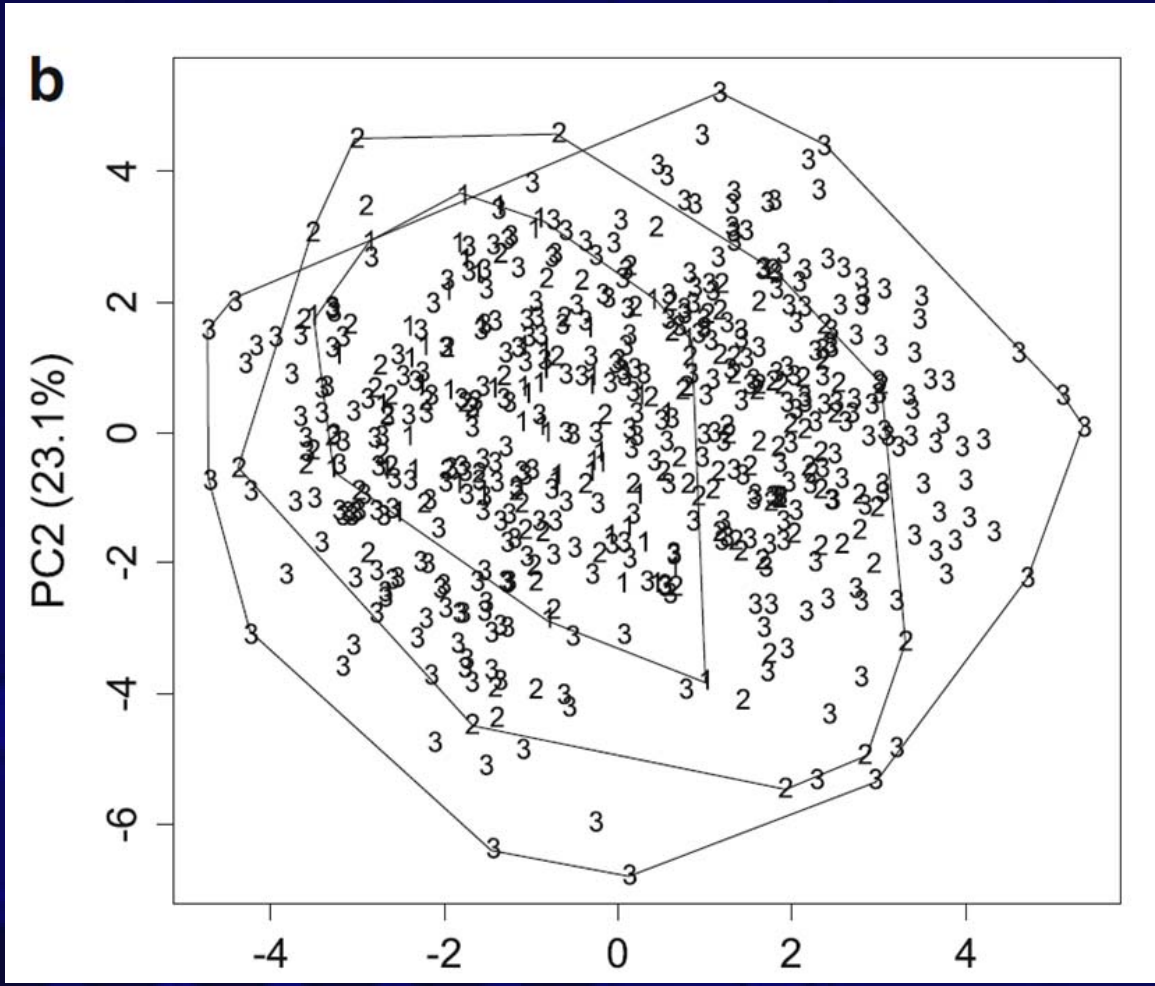
Genetische Daten:
3 Haupt-Cluster wurden gefunden





Rhinanthus alectorolophus

Morphologie der 3 genetischen Cluster



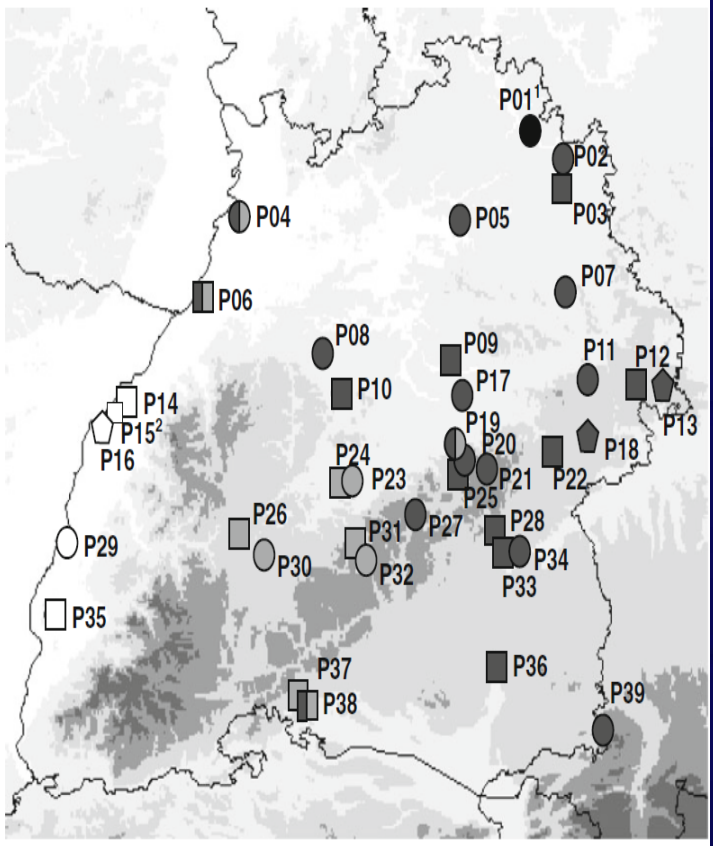
=> Keine klare Abtrennung

Rhinanthus alectorolophus

Geographische Struktur in genetischen Daten:

- Rheinebene
- Schwäb. Alb
- östl. Cluster

Fig. 1 Map of Baden-Württemberg with location of the 39 populations used in this study. *Circles*: *Rhinanthus alectorolophus* subsp. *alectorolophus*; *squares*: subsp. *semleri*; pentagons: subsp. *patulus*. *Colors* are according to genetic clusters obtained by Bayesian assignment analysis based on AFLP data. *White*: genetic cluster A; *gray*: genetic cluster B, *dark gray*: genetic cluster C. *1*: population without genetic data; *2*: population without morphological data



Rhinanthus alectorolophus

Schlußfolgerung

- *Die* Unterarten/Ökotypen v. *Rhinanthus alectorolophus* sind morphologisch und genetisch schlecht abgrenzbar.
- Saisonale Ökotypen konnten nicht erkannt werden.
- Die Art ist geographisch strukturiert.

=> Bei Kartierung keine Unterarten berücksichtigen!