The U.S. hairy vetch germplasm contains two subpopulations

Summary

- Background on hairy vetch and smooth vetch
- Genetic relationships
- Smooth vetch performance

Cover Crop Breeding Network Hairy Vetch Program

- Winter hardy legume
- High biomass and N credits
- High seed dormancy/pod dehiscence
- 80% out-crossing

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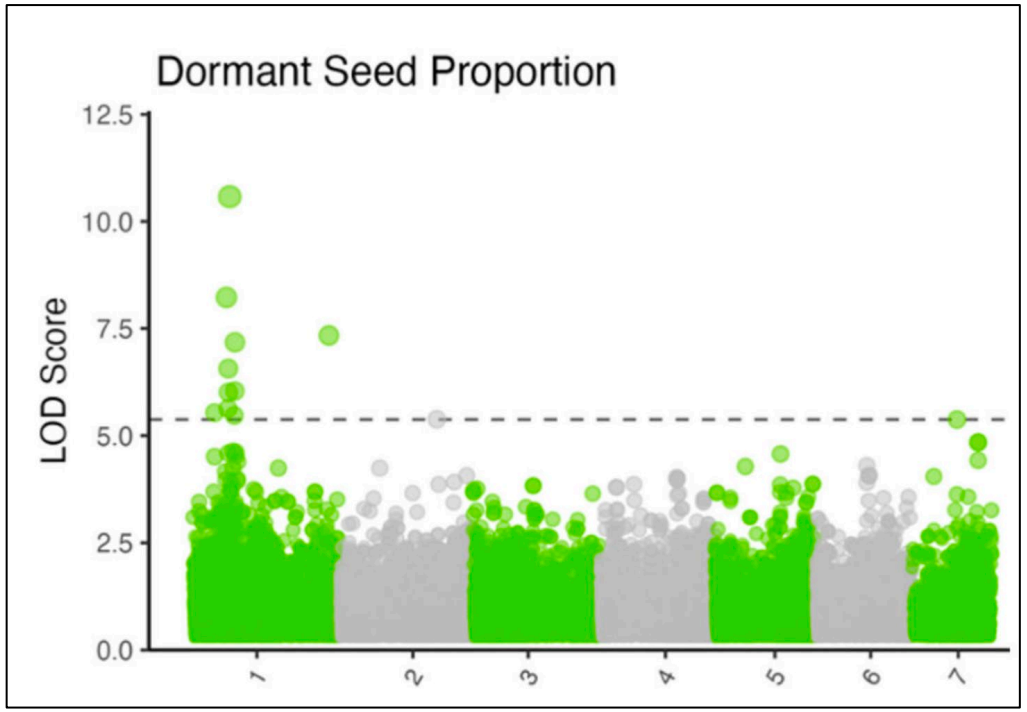
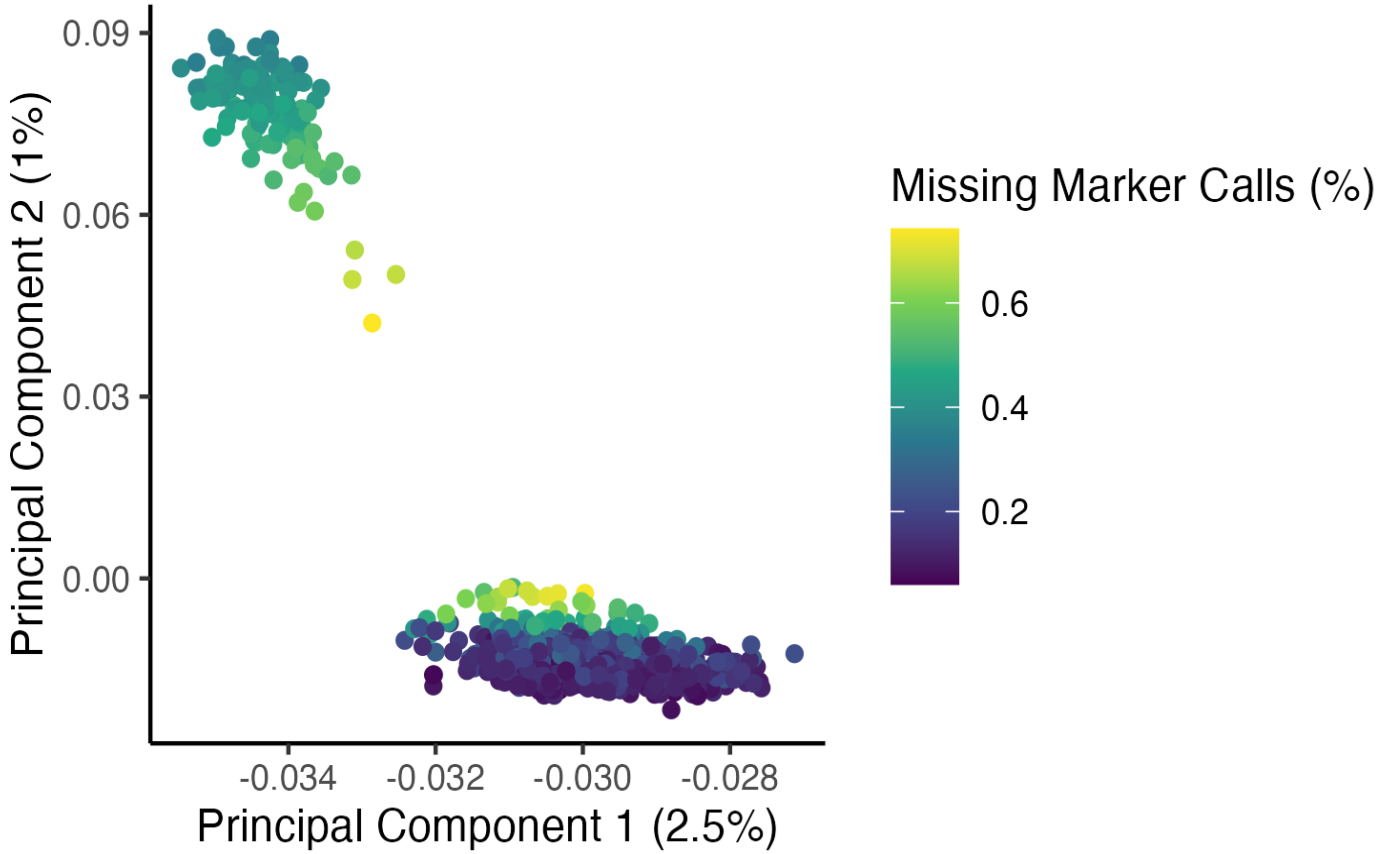
Smooth vetch rediscovery





The two four principal components of 1,019 *Vicia* genotypes based on 100,000 randomly selected SNPs subsampled from a panel of 908,994 SNPs.

Literature review

Prior reports of ‘smooth’ vetch ecotype (pre-1960)

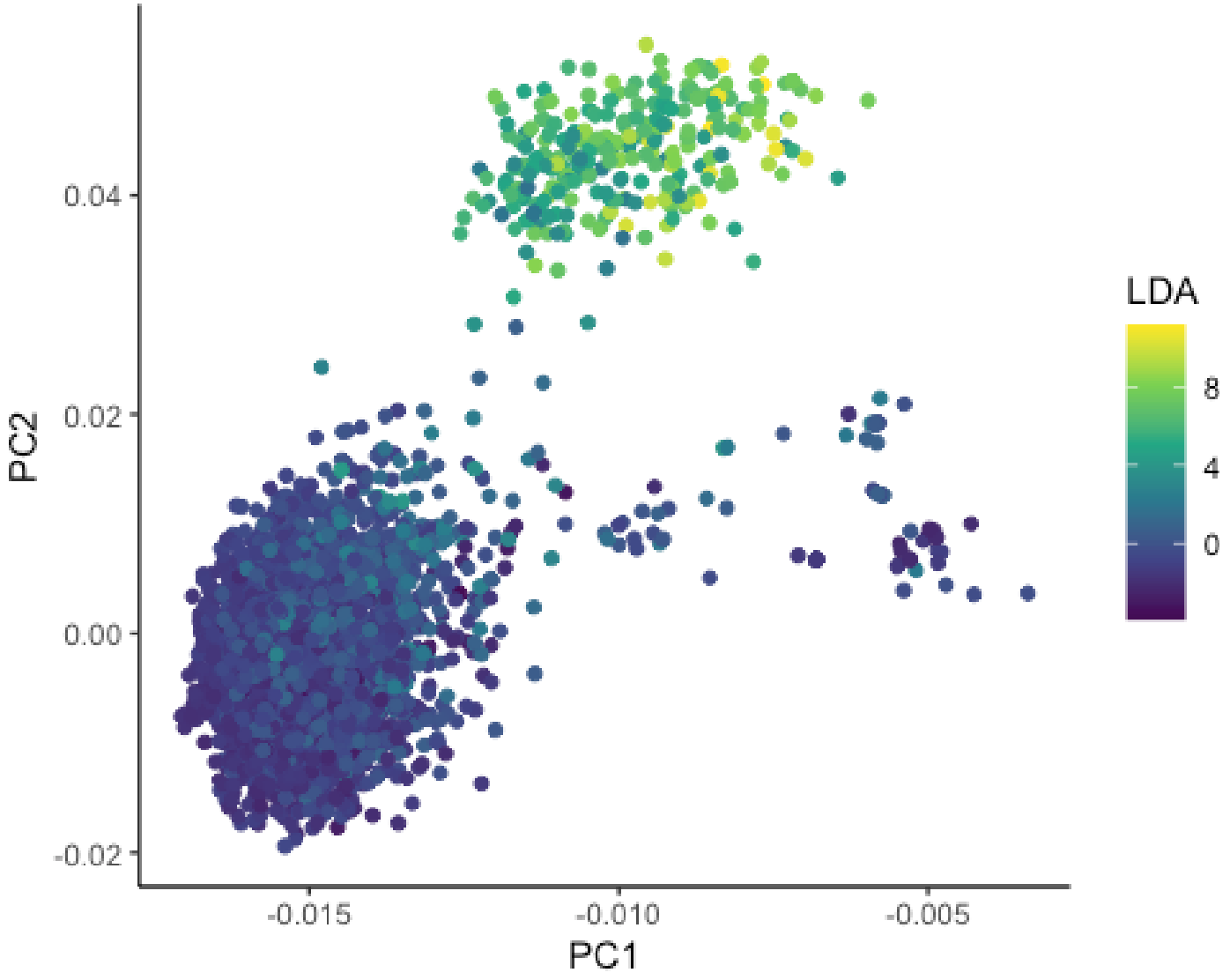
- Currently classified as *Vicia villosa* subsp. varia
- Poor winter survival
- Superior performance in southern U. S. and Oregon
- Assumed to be ecotype-level variation

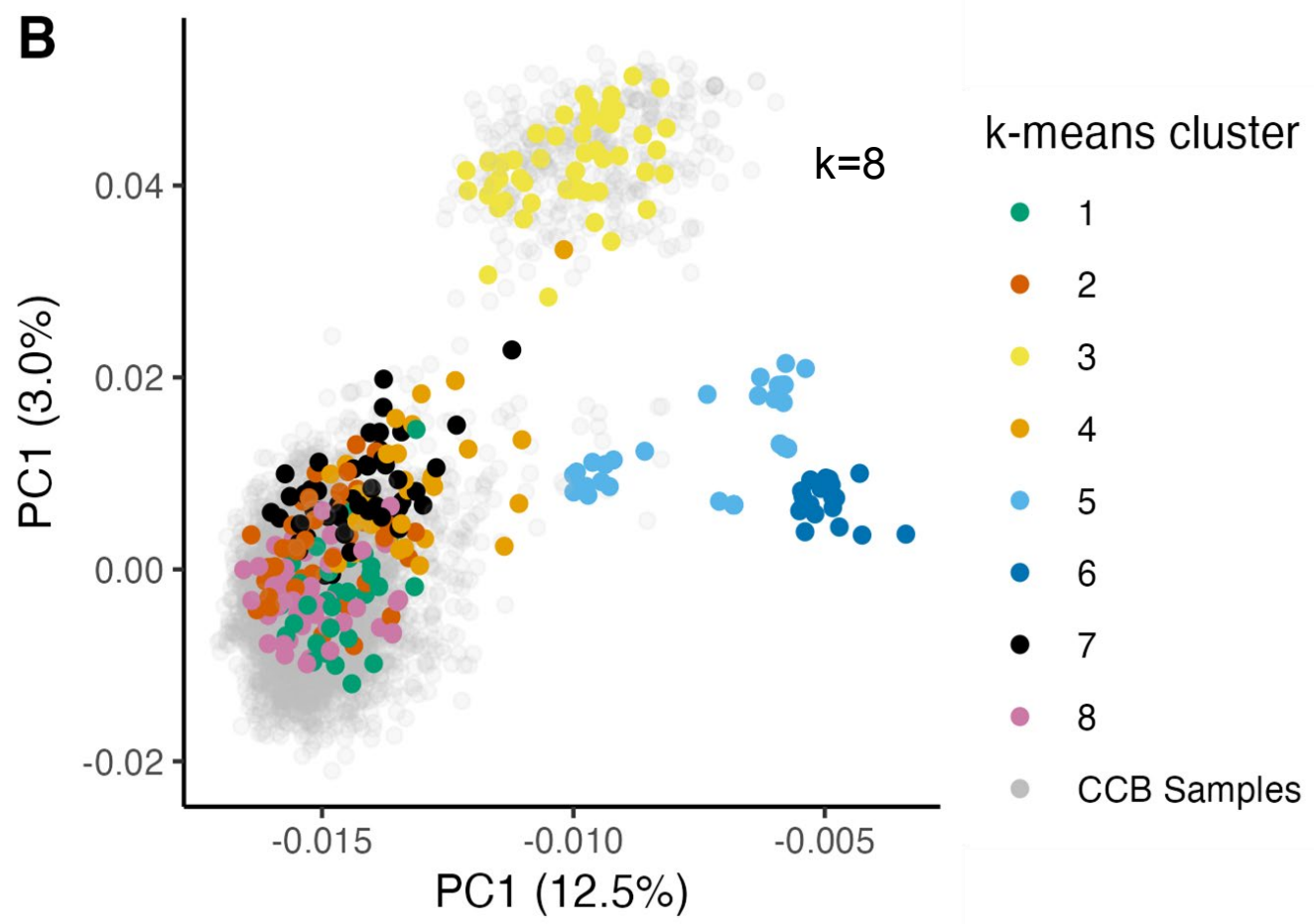
Wollypod vetch (*Vicia dasycarpa/V. villosa* subsp*. varia*) is closely related to both

- Occasionally considered distinct species
- Arid adapted

SSR marker linear discriminant classification

98% model prediction accuracy based on masked subsets





Expanded SSR panel, including:

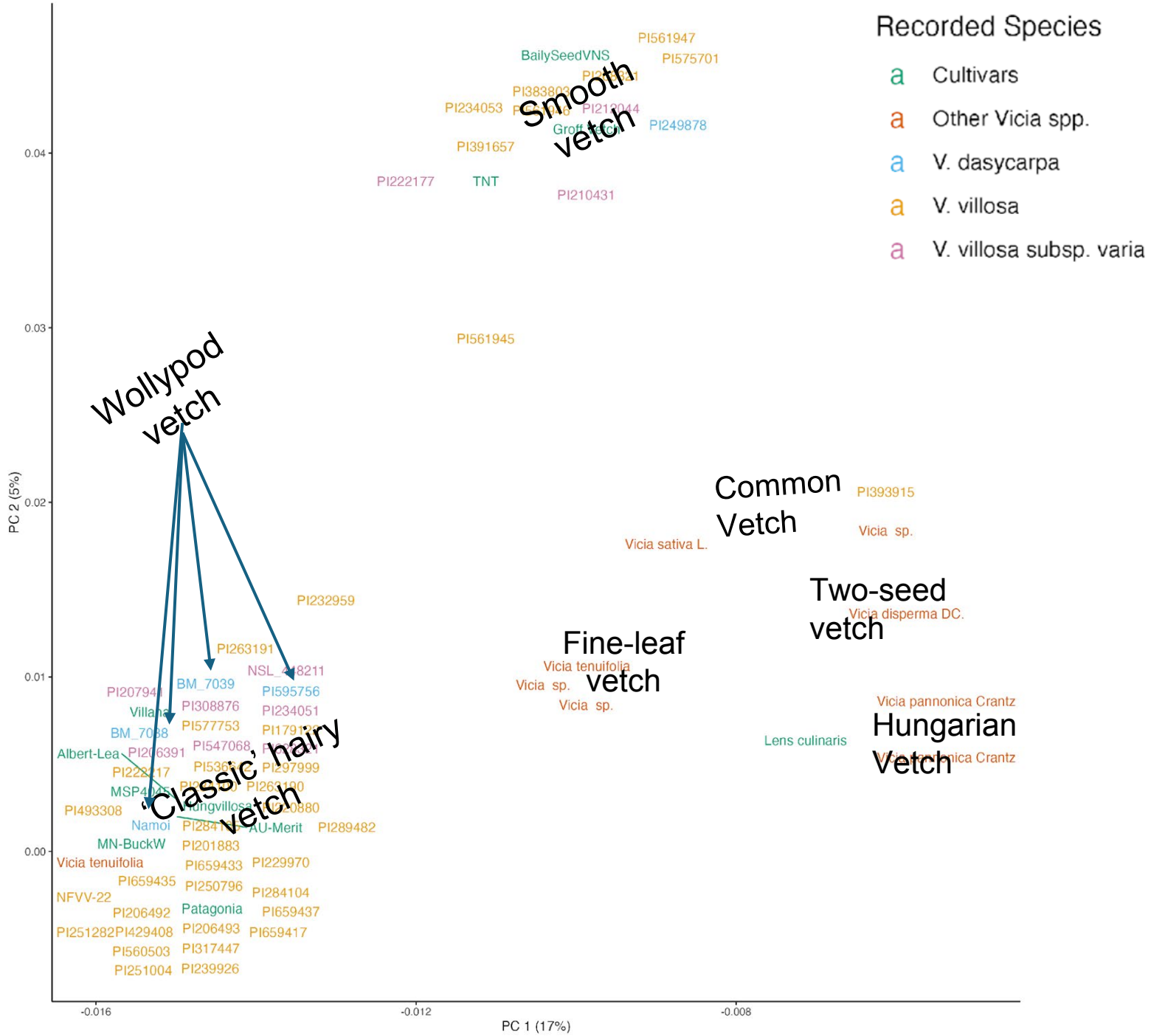
-58 PIs from GRIN

-8 commercial cultivars

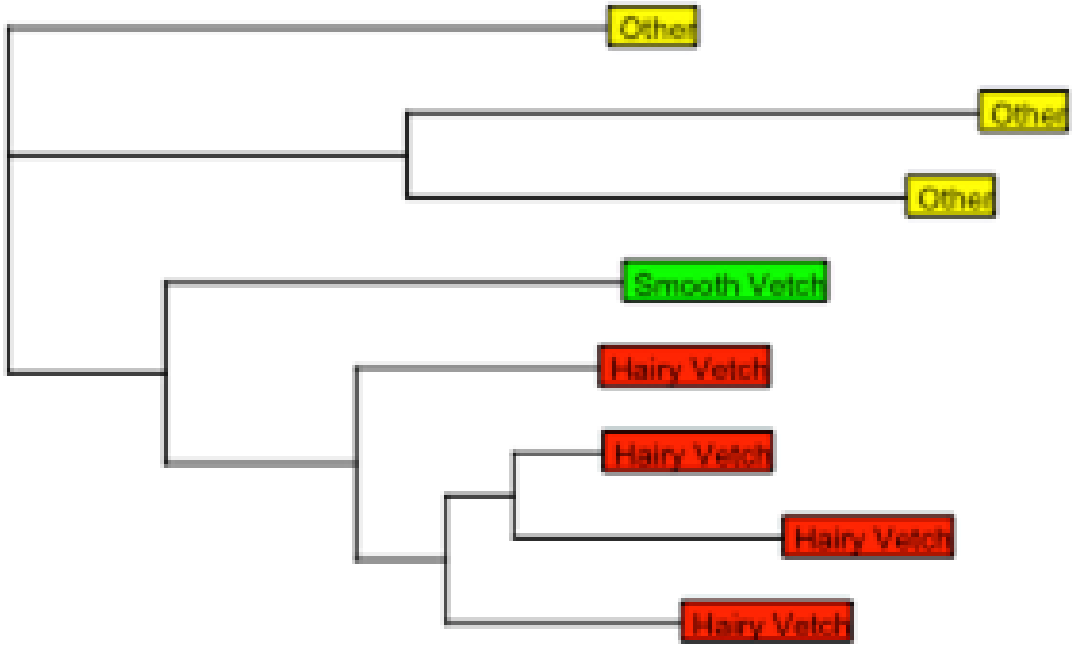
-'Wollypod vetch', Vicia disperma, Vicia pannonica, Vicia sativa, Vicia tenuifolia

Germplasm Source	Smooth Vetch	Hairy Vetch
Purple Prosperity	35	2
Purple Bounty	33	1
Nebraska VNS	21	0
Winterking/Groff	14	2
Baily Seed VNS	11	1
Namoi	0	8
TNT	4	5
Villana	2	18
Patagonia	0	15
Savanne	0	9
Albert Lea VNS	0	81

- Half of named U.S. cultivars are smooth vetch
- Similar results for VNS samples
- Contamination is common



Species or subpopulation?



Ongoing analysis to get an accurate ‘molecular clock’ measurement of divergence between hairy vetch and smooth vetch using RNAseq

Tentative latin name *Vicia varia*, since *Vicia dasycarpa* is associated with wollypod vetch (should be called *V. villosa* subsp. *dasycarpa)*.

Is smooth vetch useful?

No evidence of cross-pollination within the breeding program

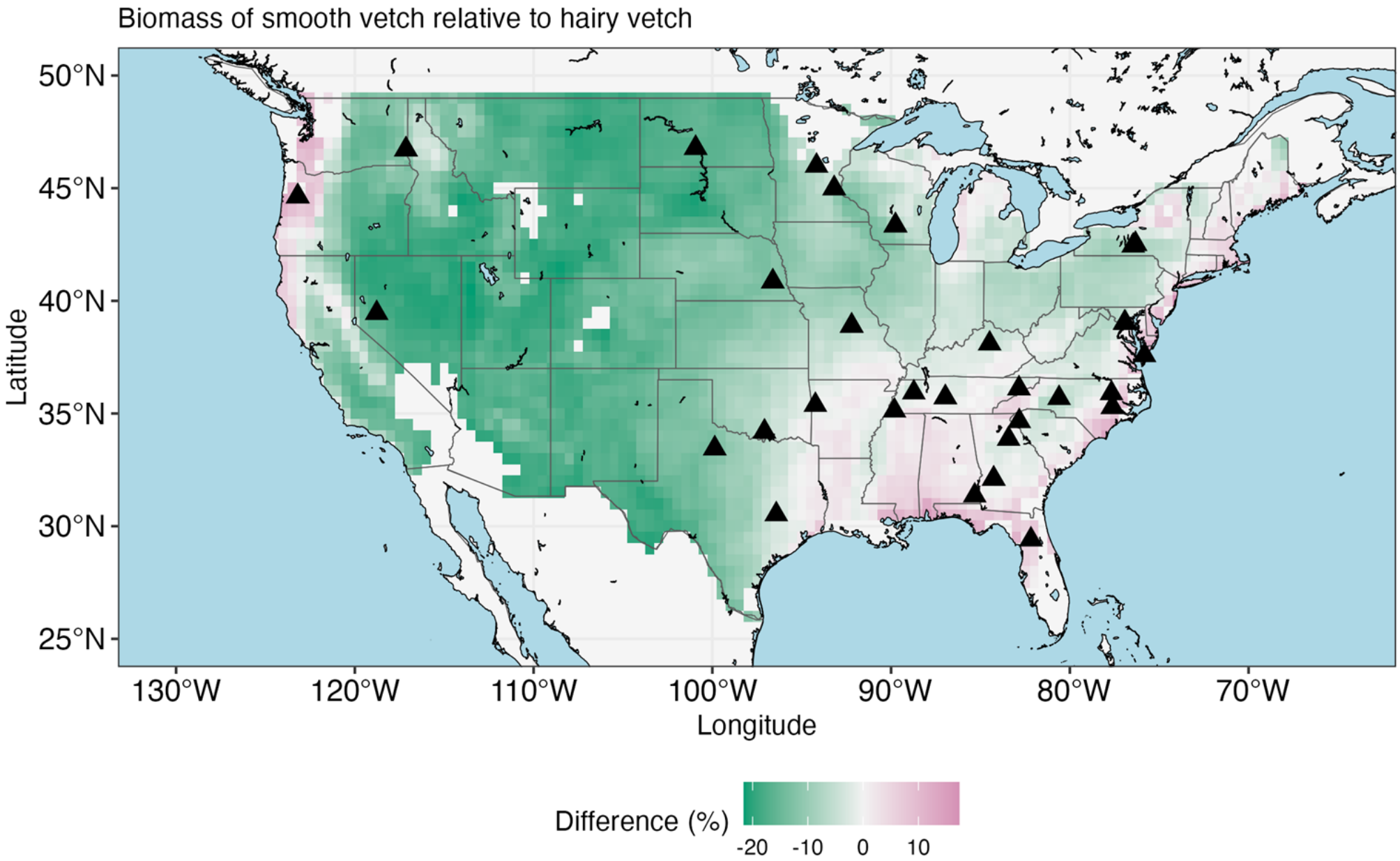
Smooth vetch becoming rare

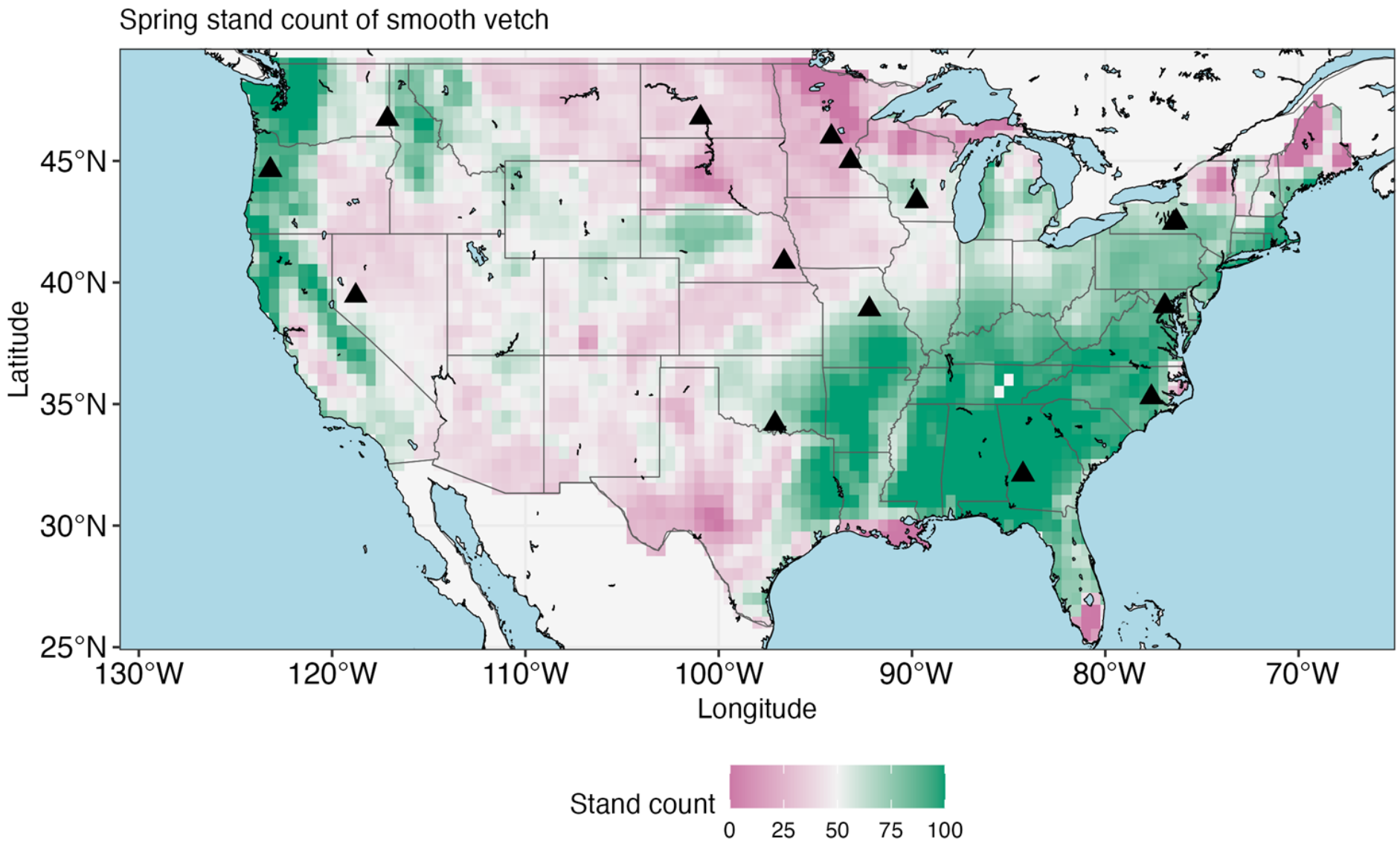
Advanced line trial reanalysis of smooth vetch performance

27 entries measured at 35 site-year combinations
Two populations with >75% smooth vetch
Three populations between 25% and 75% smooth vetch

Merged with southern cover crop council trials across three years and 12 locations. Biomass of 2 hairy vetch cultivars compared to 1-2 smooth vetch cultivars.

Built elastic net model combining 24 environmental variables and:
-The relative biomass performance of smooth vetch relative to hairy vetch
-Spring stand count of smooth vetch (in percent).

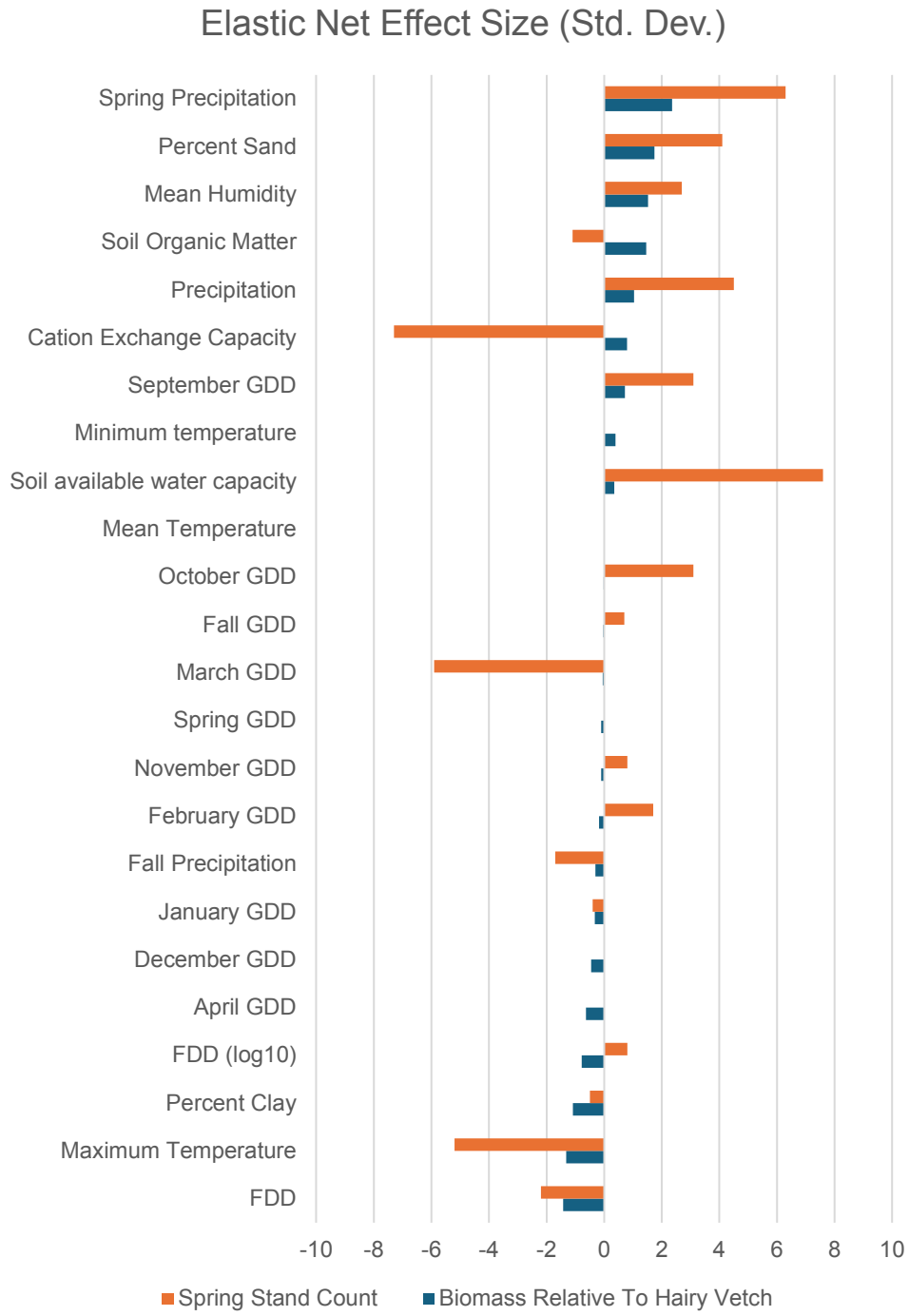

Biomass of smooth vetch relative to hairy vetch
50°N
45°N
40°N
35°N
30°N
25°N
Latitude
130°W
120°W
110°W
100°W
90°W
80°W
70°W
Longitude
Difference (%)
-20
-10
0
10


Spring stand count of smooth vetch
45°N
40°N
35°N
30°N
25°N
Latitude
130°W
120°W
110°W
100°W
90°W
80°W
70°W
Longitude
Stand count
0
25
50
75
100

Coefficients

Smooth vetch has greater biomass and survival with:

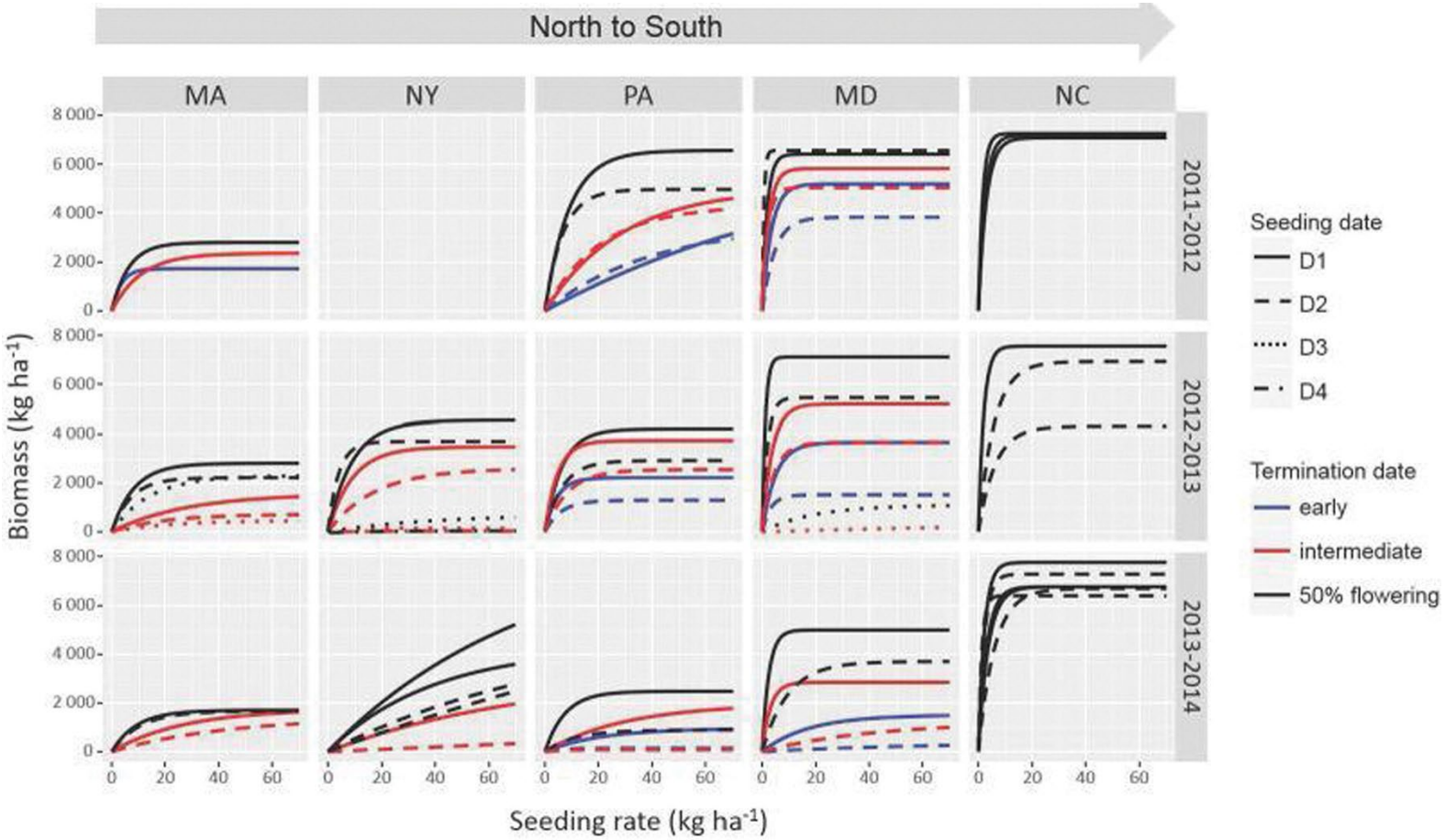
-Sandy soil
-High precipitation
-Mild temperatures



Many recent published studies used VNS or Purple Prosperity.

Best available seeding rate study used smooth vetch cultivar

Reported reduced biomass in north



Mirsky et al. 2017. Hairy Vetch Biomass across the Eastern United States: Effects of Latitude, Seeding Rate and Date, and Termination Timing.

Summary

- Smooth vetch is a distinct subpopulation or species of vetch
- It does not cross pollinate with hairy vetch
- It grows well in the south-central and coastal US
- Earlier flowering
- Different performance

Questions?

Hairy Vetch

Smooth Vetch

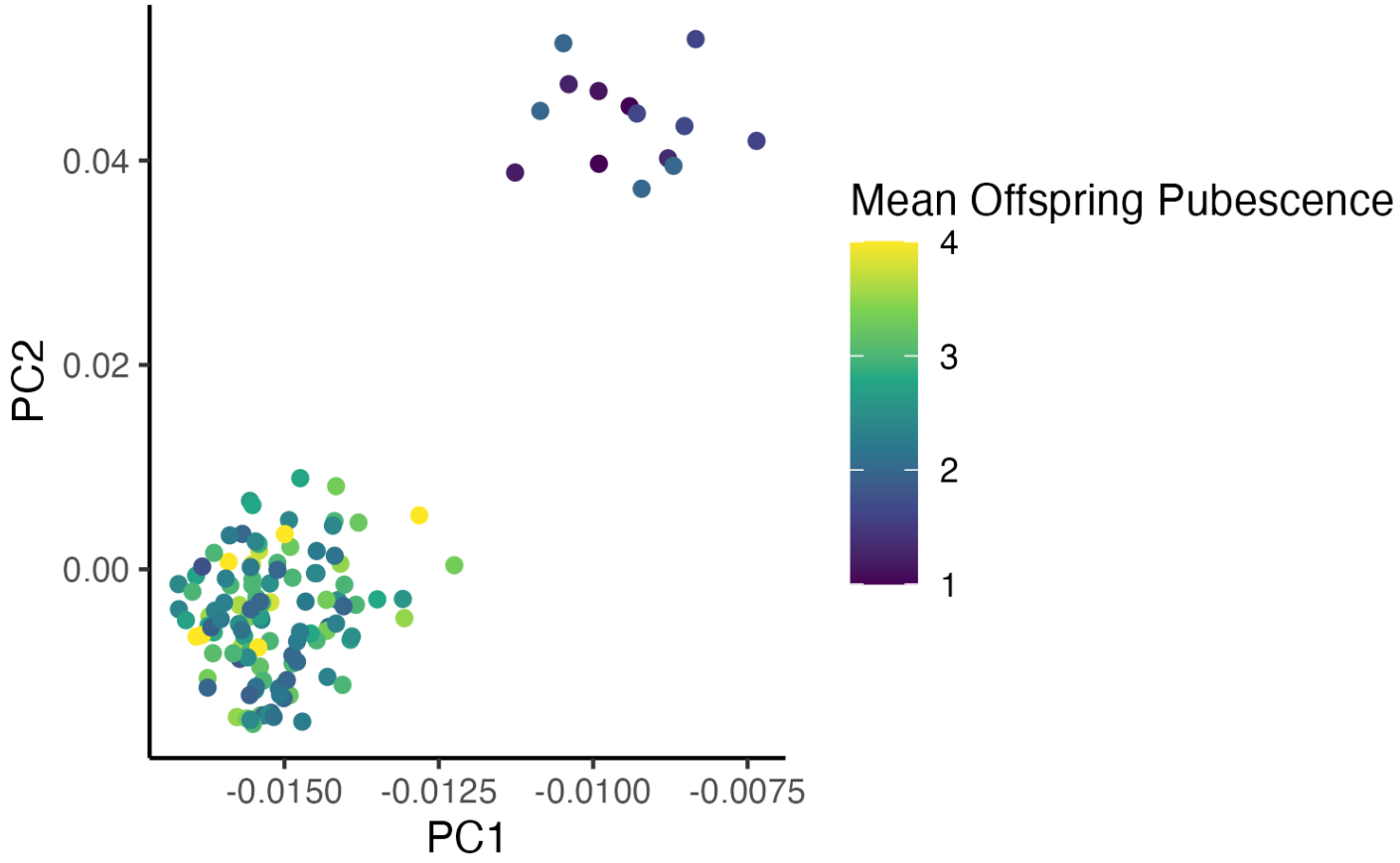
Morphological markers

Pubescence (visual 1-5) accurate at a family level, but subjective

-V. varia: always 1

-V. villosa: 2-5

Maturity informative but also variable and subjective



Morphological markers

Pug-nosed

V. villlosa

V. varia

<u>Bottom Calyx Lobe</u>

p=6.01 x 10^{-8} across 6 populations

Independent from pubescence