

Hairy Vetch in sustainable agriculture systems

(+) Winter annual legume, high biomass and nitrogen fixation, cold tolerant, evidence of disease suppression in veggie systems, improved soil aggregation, weed suppression.

(-) Some hard seededness, out-crosser(?), susceptible to extreme heat or cold, (OK in zones 7-4), may harbor nematodes over winter, few improved cultivars

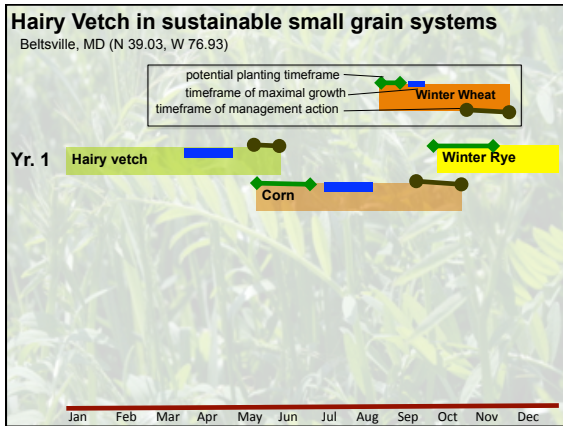
AU-early cover, Merrit (Mosijids, Auburn, AL)
Groff (Cover crop solutions, S. Groff, PA)
Purple Bounty & Prosperity (Tom Devine, USDA-ARS MD)
Madison (Nebraska), Albert Lea, other VNS

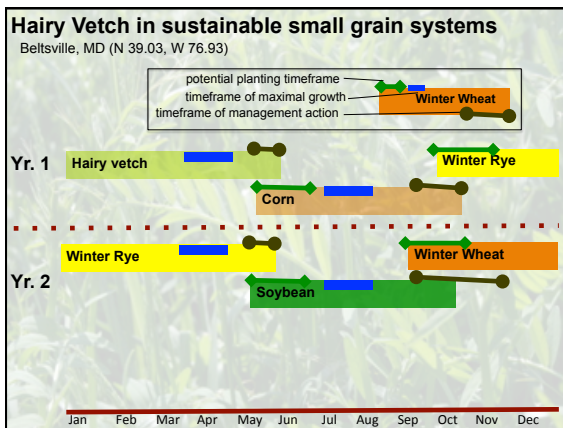
Hairy Vetch in sustainable agriculture systems

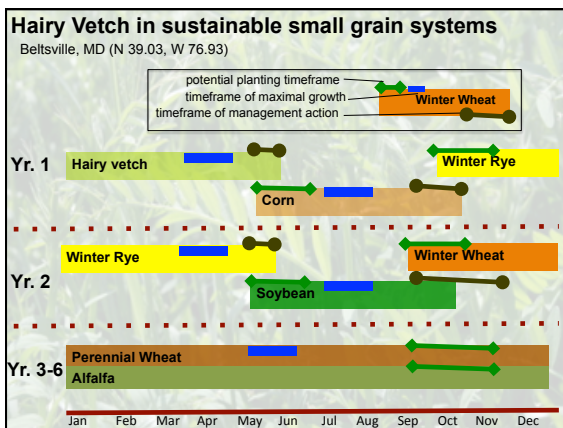
(+) Winter annual legume, high biomass and nitrogen fixation, cold tolerant, evidence of disease suppression in veggie systems, improved soil aggregation, weed suppression.

(-) Some hard seededness, out-crosser(?), susceptible to extreme heat or cold, (OK in zones 7-4), may harbor nematodes over winter, **few improved cultivars**

AU-early cover, Merrit (Mosijids, Auburn, AL)
Groff (Cover crop solutions, S. Groff, PA)
Purple Bounty & Prosperity (Tom Devine, USDA-ARS MD)
Madison (Nebraska), Albert Lea, other VNS







Hairy Vetch in sustainable agriculture systems



Hairy Vetch improvement via classic methods

•Tom Devine made selections from AU-early cover and close relatives

Purple Bounty
Purple Prosperity



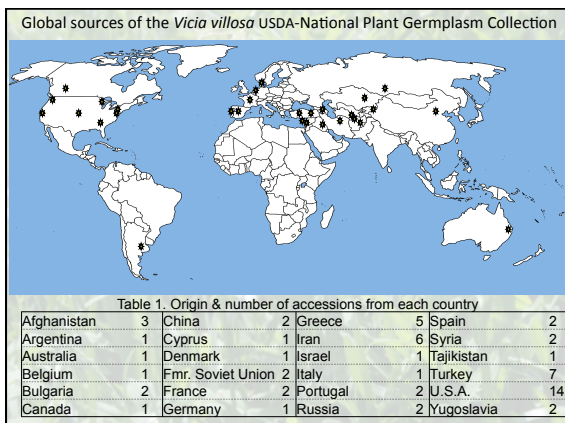
Hairy Vetch improvement via classic methods

•Tom Devine made selections from AU-early cover and close relatives

Purple Bounty
Purple Prosperity

He recently retired and I inherited an experiment





Hairy Vetch improvement via molecular assisted methods

J. J. Steiner et al. Crop Science 41:1968-1980 (2001)

A Description and Interpretation of the NPGS Birdsfoot Trefoil Core Subset Collection

Hairy Vetch improvement via molecular assisted methods

•We conducted Amplified Fragment Length Polymorphism (AFLP) analysis with the objective of characterizing the genetic relatedness among all vetch accessions in the USDA germplasm collection

Hairy Vetch improvement via molecular assisted methods

•We conducted Amplified Fragment Length Polymorphism (AFLP) analysis with the objective of characterizing the genetic relatedness among all vetch accessions in the USDA germplasm collection

1) Collect biomass fragments 2) Extract gDNA & amplify 3) Cut gDNA 4) Determine sizes of gDNA

The diagram illustrates the AFLP process. It starts with a photograph of hairy vetch plants. An arrow points to a tangled mass of black lines representing gDNA. A second arrow, accompanied by a pair of scissors icon, points to a gel electrophoresis image. The gel has six lanes labeled A through F. Lane A shows a single band. Lane B shows two bands. Lane C shows three bands. Lane D shows four bands. Lane E shows five bands. Lane F shows six bands.

Hairy Vetch improvement via molecular assisted methods

•We conducted Amplified Fragment Length Polymorphism (AFLP) analysis with the objective of characterizing the genetic relatedness among all vetch accessions in the USDA germplasm collection

1) Collect biomass fragments 2) Extract gDNA & amplify 3) Cut gDNA 4) Determine sizes of gDNA

This diagram is identical to the first one, but with lanes C and D highlighted in yellow in the gel electrophoresis image.

Hairy Vetch improvement via molecular assisted methods

•We conducted Amplified Fragment Length Polymorphism (AFLP) analysis with the objective of characterizing the genetic relatedness among all vetch accessions in the USDA germplasm collection


1) Collect biomass fragments 2) Extract gDNA & amplify 3) Cut gDNA 4) Determine sizes of gDNA

This diagram is identical to the previous ones, but with lanes C, D, E, and F highlighted in red in the gel electrophoresis image.

Rhizobium leguminosarum ecology in organic farming systems


- Grossman Lab at North Carolina State Univ.
- Fullbright Scholar Nape Mothapo

Explore *Rhizobium* ecology in relation to the host's genotype

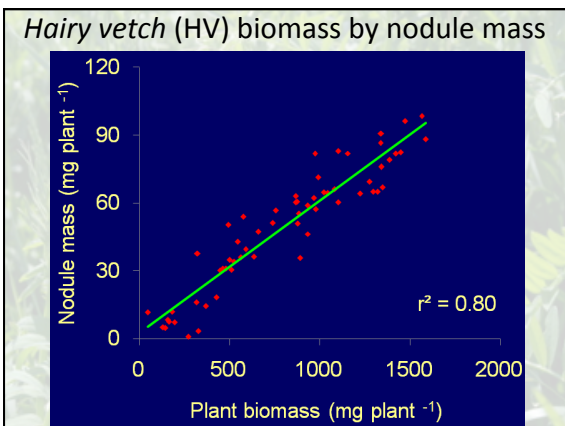


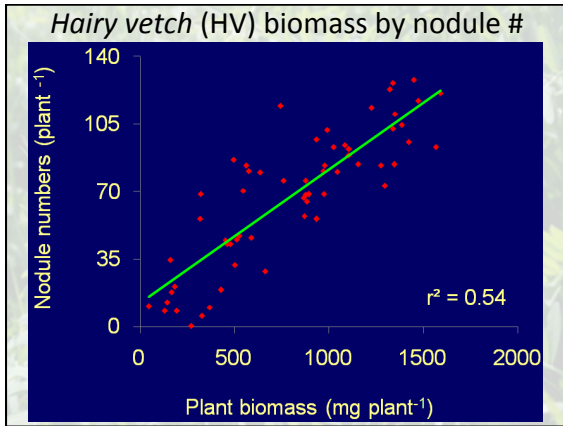
Rhizobium leguminosarum ecology in organic farming systems

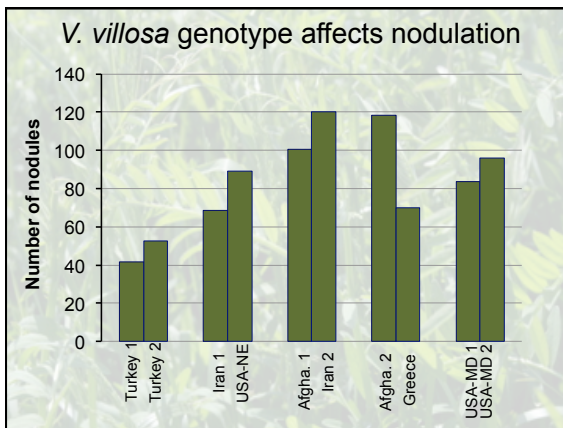
Hairy vetch (HV) genotypes

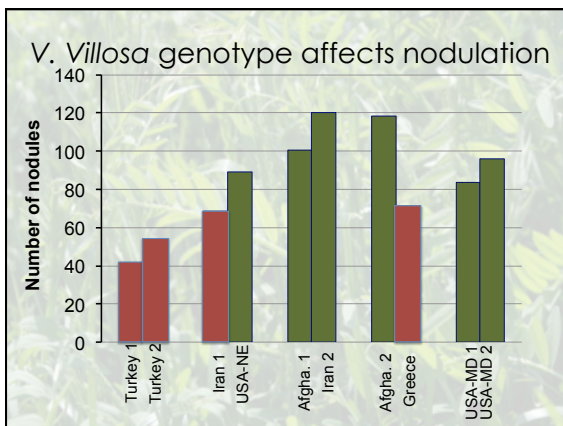


Five groups of genetically-similar accessions of *Vicia villosa* were grown in three soils collected from farms in the piedmont and coastal plains North Carolina.





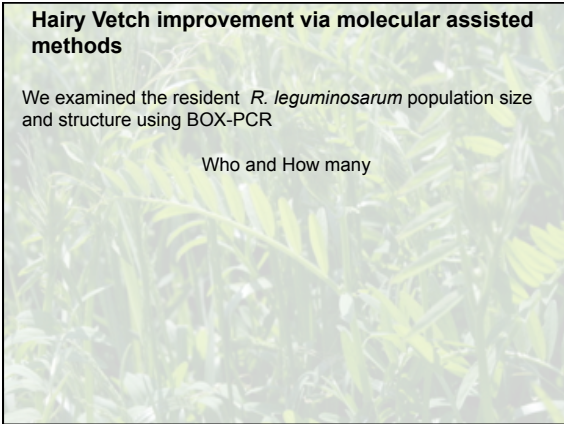




Hairy Vetch improvement via molecular assisted methods

We examined the resident *R. leguminosarum* population size and structure using BOX-PCR

Who and How many

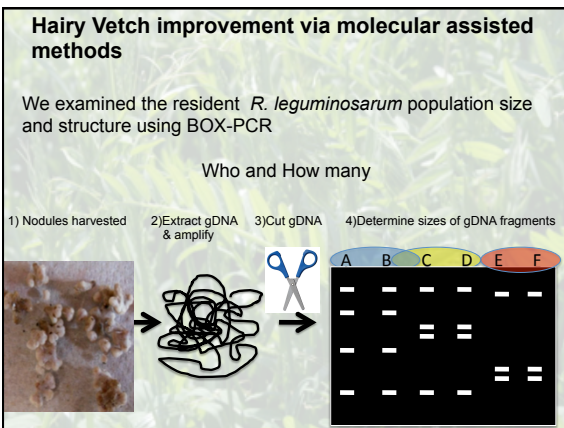


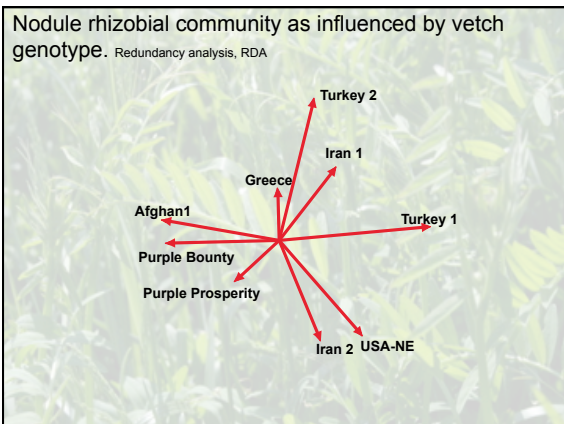
Hairy Vetch improvement via molecular assisted methods

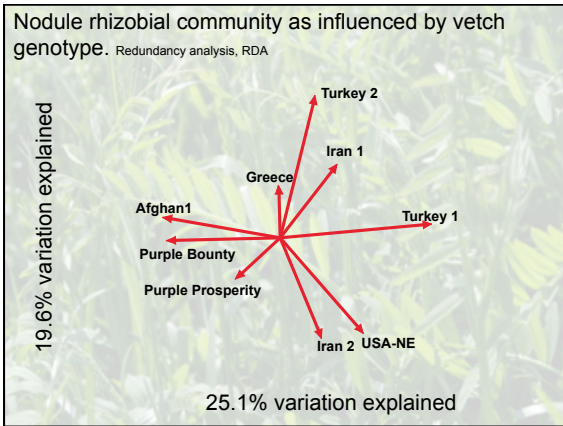
We examined the resident *R. leguminosarum* population size and structure using BOX-PCR

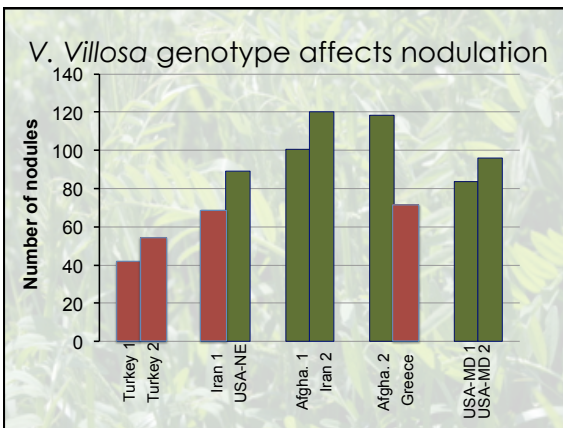
Who and How many

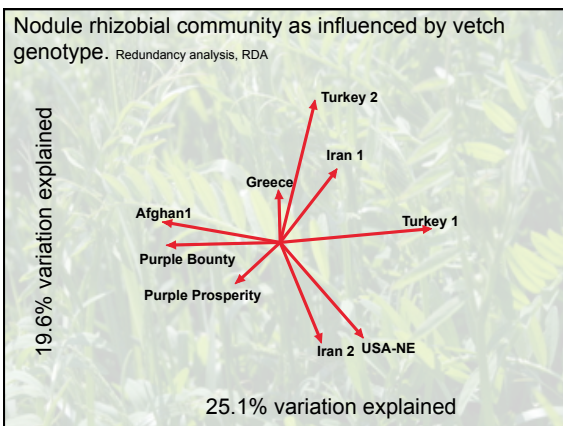
1) Nodules harvested 2) Extract gDNA & amplify 3) Cut gDNA 4) Determine sizes of gDNA fragments

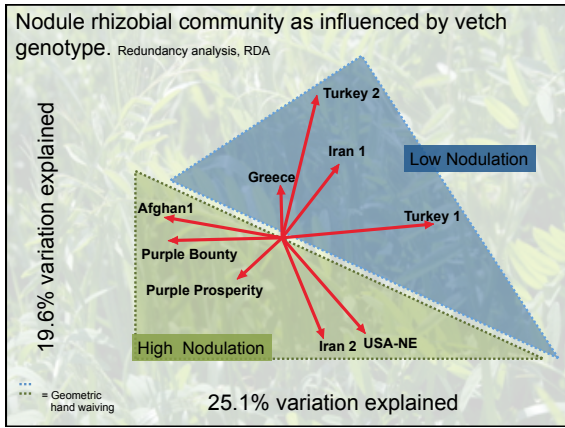


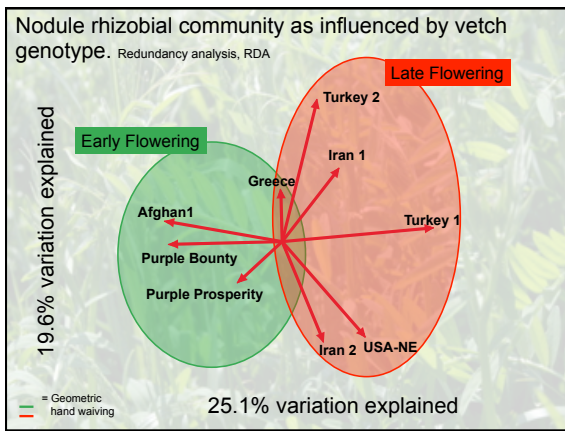


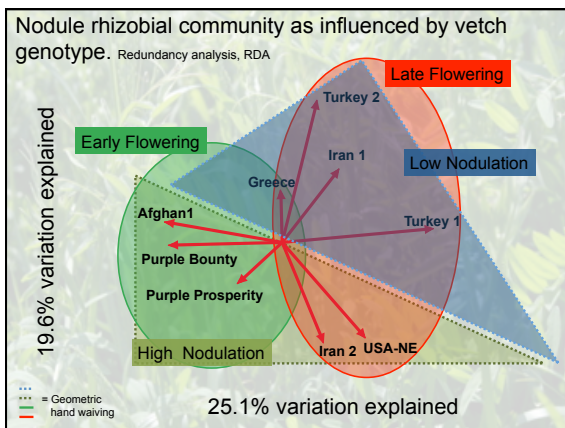


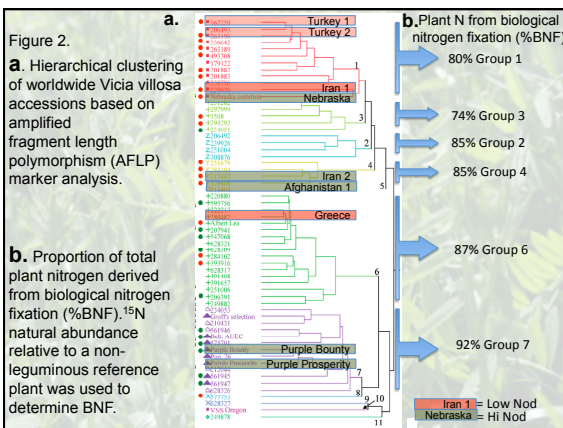
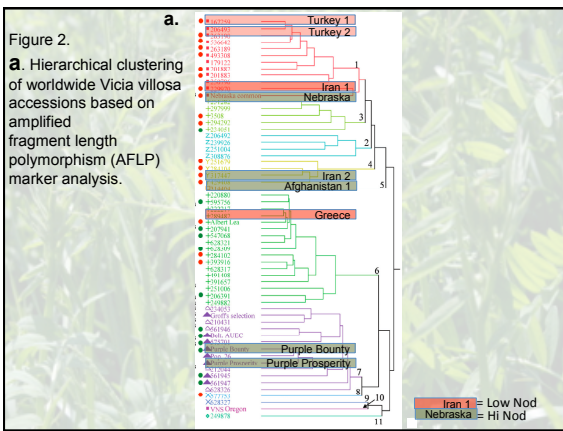
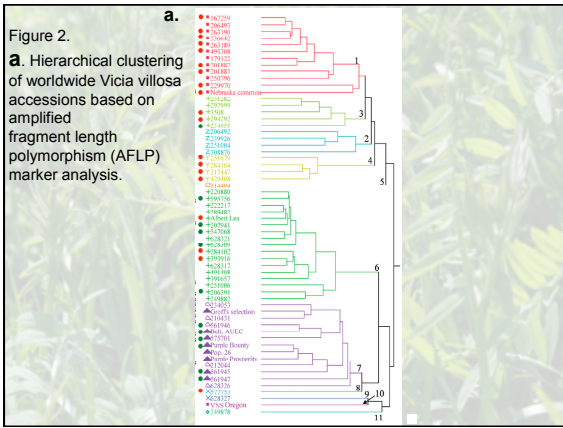












Conclusions

- Vetch genomic markers were able to predict relationships among known related provenance

Conclusions

- Vetch genomic markers were able to predict relationships among known related provenance

- There are predictable patterns among between genotype and flowering

Conclusions

- Vetch genomic markers were able to predict relationships among known related provenance

- There are predictable patterns among between genotype and flowering

- Nodulation and nodule mass is correlated to plant biomass and nitrogen accumulation.

Conclusions

- Vetch genomic markers were able to predict relationships among known related provenance
- There are predictable patterns among between genotype and flowering
- Nodulation and nodule mass is correlated to plant biomass and nitrogen accumulation.
- Vetch genotype is responsible for about 44% of the nodule rhizobial community structure.

Questions and Directions

- Hard Seededness

Questions and Directions

- Hard Seededness
- Vetch in mixtures (BNF, weed suppression, decomp.)

Questions and Directions

- Hard Seededness
- Vetch in mixtures (BNF, weed suppression, decomp.)
- Cold Hardiness / adaptation to change

Questions and Directions

- Hard Seededness
- Vetch in mixtures (BNF, weed suppression, decomp.)
- Cold Hardiness / adaptation to change
- Flowering Mechanism
- Outcrossing

**Linking Hairy Vetch (*Vicia villosa* Roth)
Germplasm diversity to Traits Facilitating
Improved Nitrogen Fixation**



Thanks
Maul Lab members, Grossman Lab, Steven Mirsky, Tom Devine, John Teasdale

Maul et al. (2011) Evaluating a Germplasm Collection of the Cover Crop Hairy Vetch for Use in Sustainable Farming Systems Crop Sci. 51:2615–2625 (2011).
