MAXIMIZING ALFALFA'S YIELD POTENTIAL

or

Is Yield Improvement Possible in Alfalfa?

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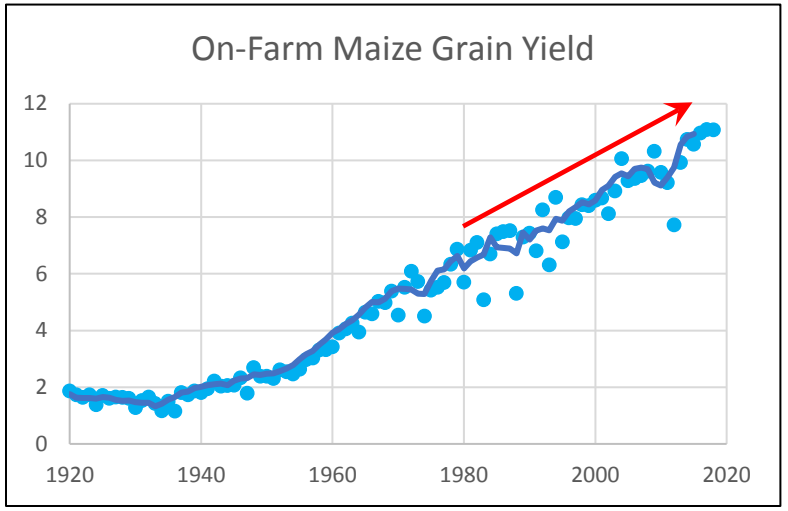
Rustici Rangeland and Cattle Research Endowment

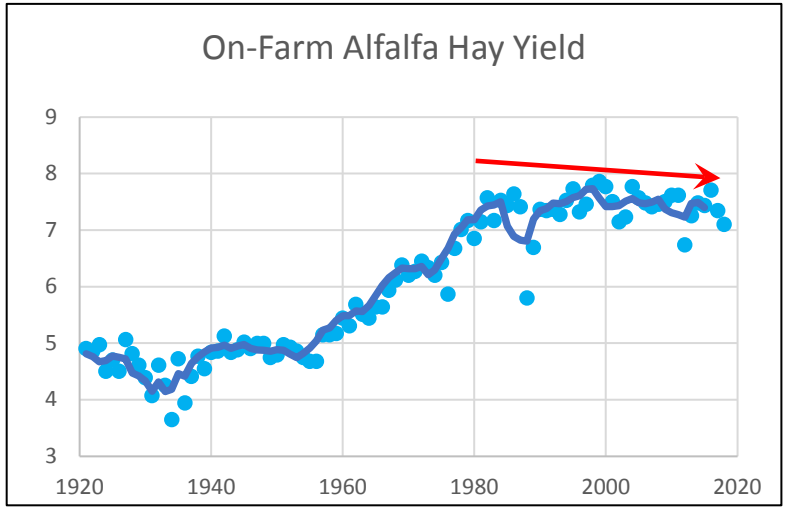
Tulelake, CA, 30 May 2024

Breeding Programs
see yield improvement

Commercial Production
of improved cultivars

On-Farm Yield Trend
realized yield gain

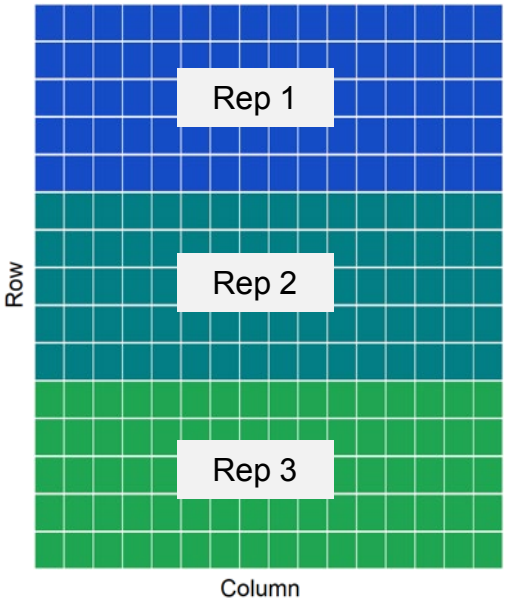




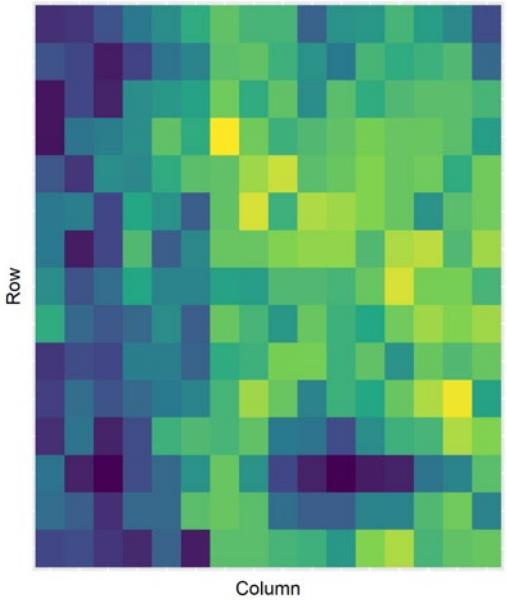
1. Better data analysis

a. Account for spatial trends

Plot Layout

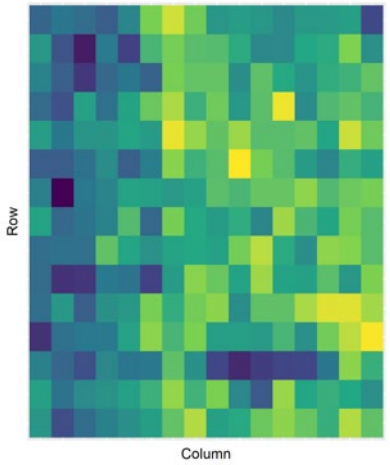


Raw Data

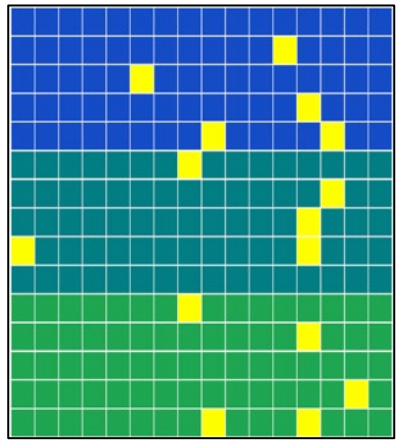


Actual alfalfa trial data from DLF Seeds

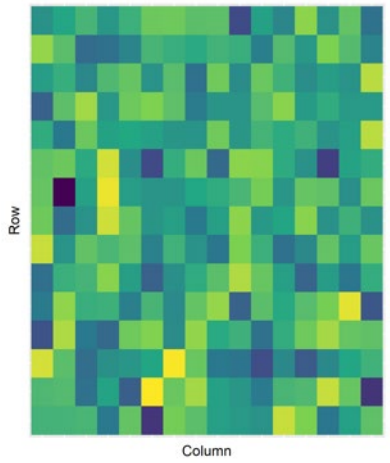
Residuals

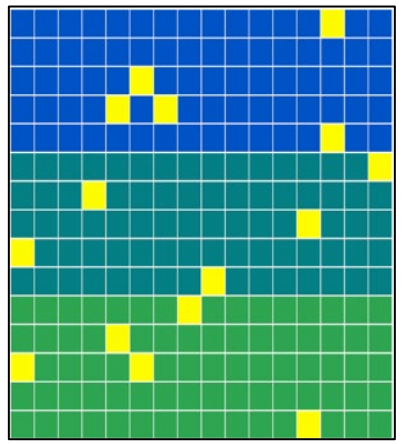


Location of Selections



Least Square Means – $H^2 = 0.24$





BLUPs with SpATS – $H^2 = 0.62$

Spatial Analysis of Field Trials with Splines

Ranks of selections

Entry	SpATS	LSMeans
D	1	6
B	2	4
A	3	36
Z	4	11
Q	5	2
F	6	44
L	7	13
H	8	8
M	9	14
C	10	1

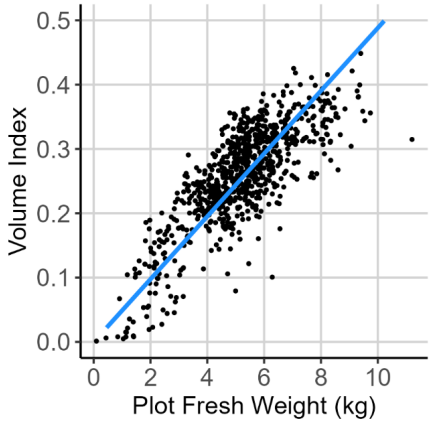
b. Account for genomic relationships

2. Sensor Based Phenotyping

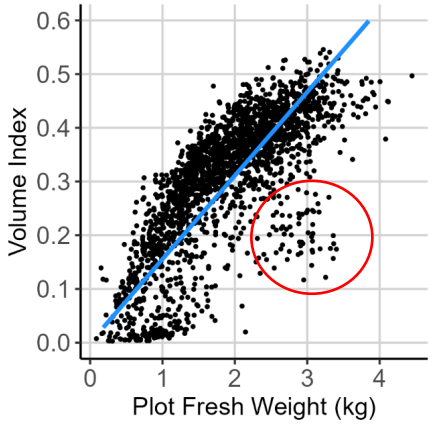
More data in less time – increase population sizes

Francis et al., in prep.

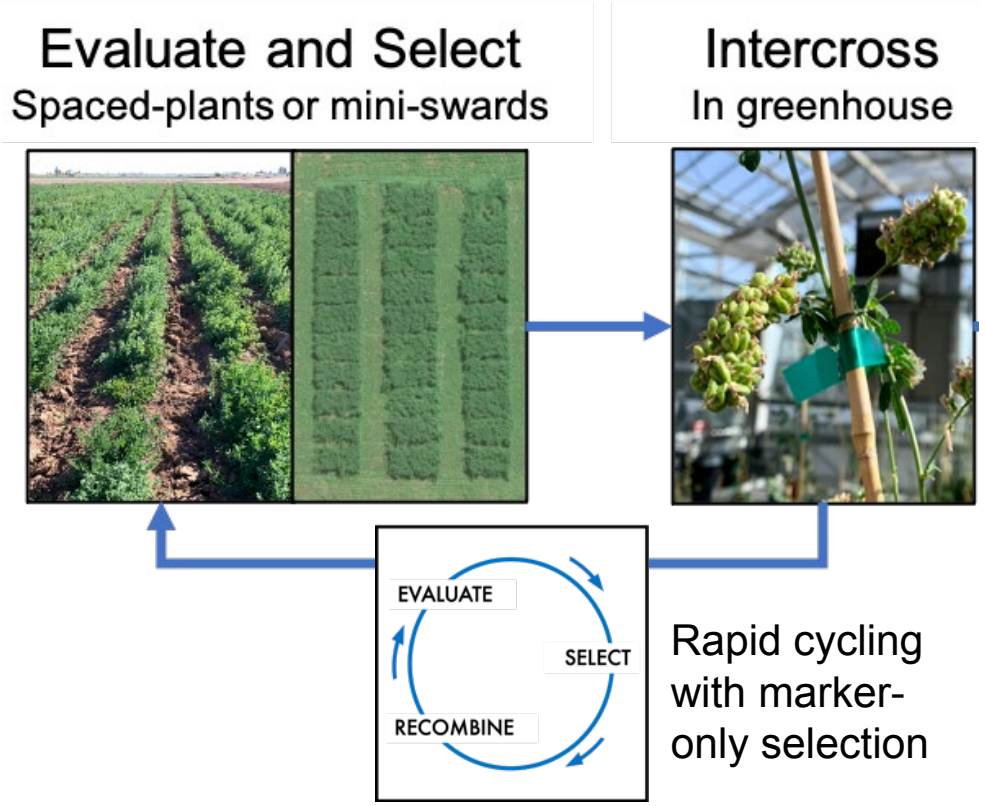
Yield – Variety trials



Yield – Breeding plots



3. Genomic Prediction



Rapid cycling with marker-only selection

Our data – gain from genomic selection is 80% that of phenotypic selection per cycle
but much faster cycles (6 months vs. 3-5 years)

But, of course, phenotypic selection hasn't resulted in observable on-farm yield gains so are we just going nowhere faster?

The only way to improve alfalfa yield is to reduce dormancy.

Bill Knipe, FGI Alfalfa Breeder

This is a paraphrase; Bill might have asked, rhetorically,
“Is the only way to improve yield to reduce dormancy?”

Enhancing Alfalfa Yields and Stand Life by Improving Management of Seed Rot and Seedling Damping-Off

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[3] Winfield United

Issue: "Killer" soils in which current seed treatments do not provide adequate protection for stand establishment

Question: Are there newer products to substitute or extend the activity of Apron/ApronXL?

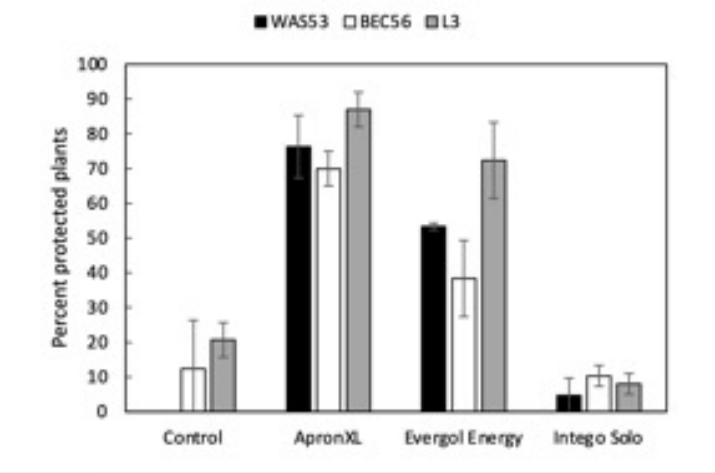
In vitro tests of commercial fungicides

Fungicide	Pythium (6)	Aphanomyces (4)	Phytophthora (3)	Fusarium (3)
★ ApronXL	E-VG	P	E	P
Rancona Dimension	E-VG	P	E	E-VG
Rancona Summit	E-G	P	E	VG
Rancona V RTU FS	E-VG	P	E	VG
Trilex	P	P	P	P
Dynasty	G-F	G	G-F	P
★ Evergol Energy	E-VG	G	E	G-F
Vibrance	P	P	P	P
★ Intego Solo	VG	E	E-V	P
Rizolex	ND	ND	ND	F-P

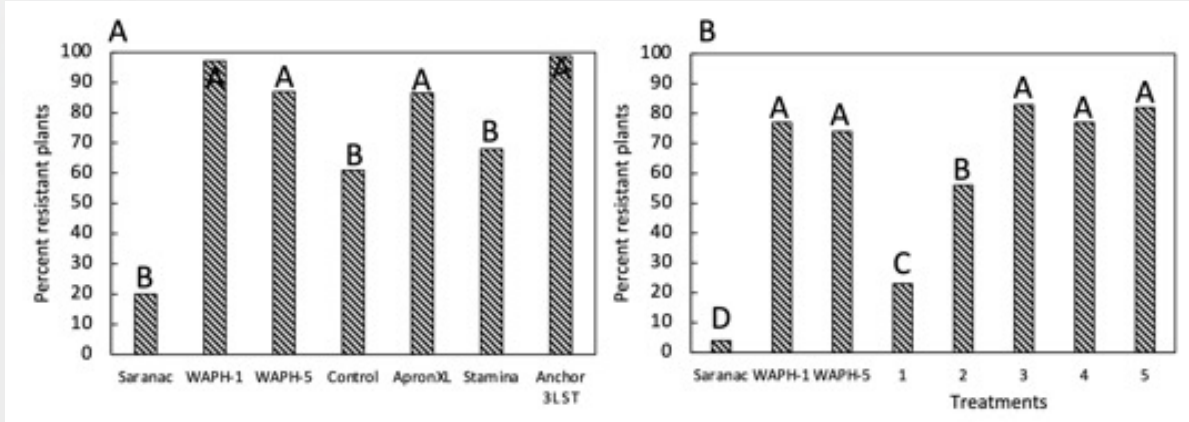
EC 50 values
Excellent (E)= <0.05-0.1 µg/ml, Very Good (VG) = 0.11-0.99 µg/ml, Good (G) = 1.0-9.9 µg/ml, Fair (F) = 10-99.9 µg/ml, Poor (P) = >100 µg/ml. ND= not determined.

Single pathogen bioassays with treated seeds

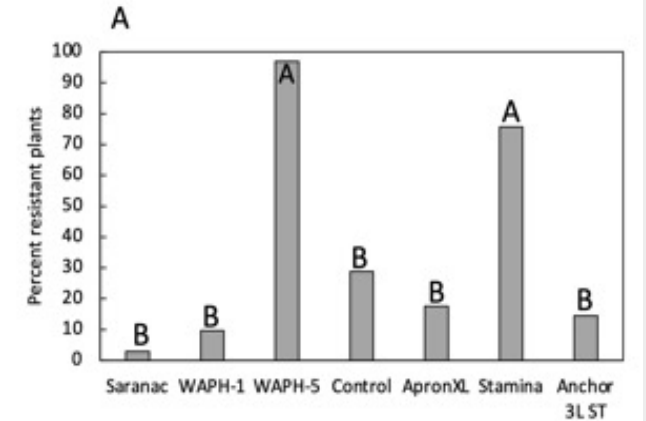
Pythium assay: ApronXL and Evergol Energy similar

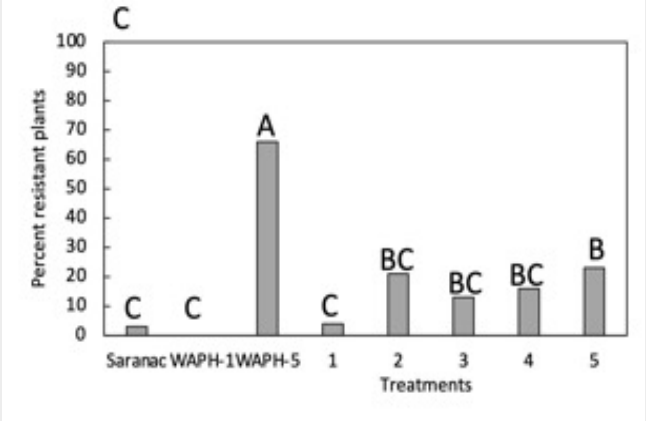


Phytophthora root rot (PRR): Evergol Energy effective but less than ApronXL



Aphanomyces root rot (ARR race 2): Stamina effective



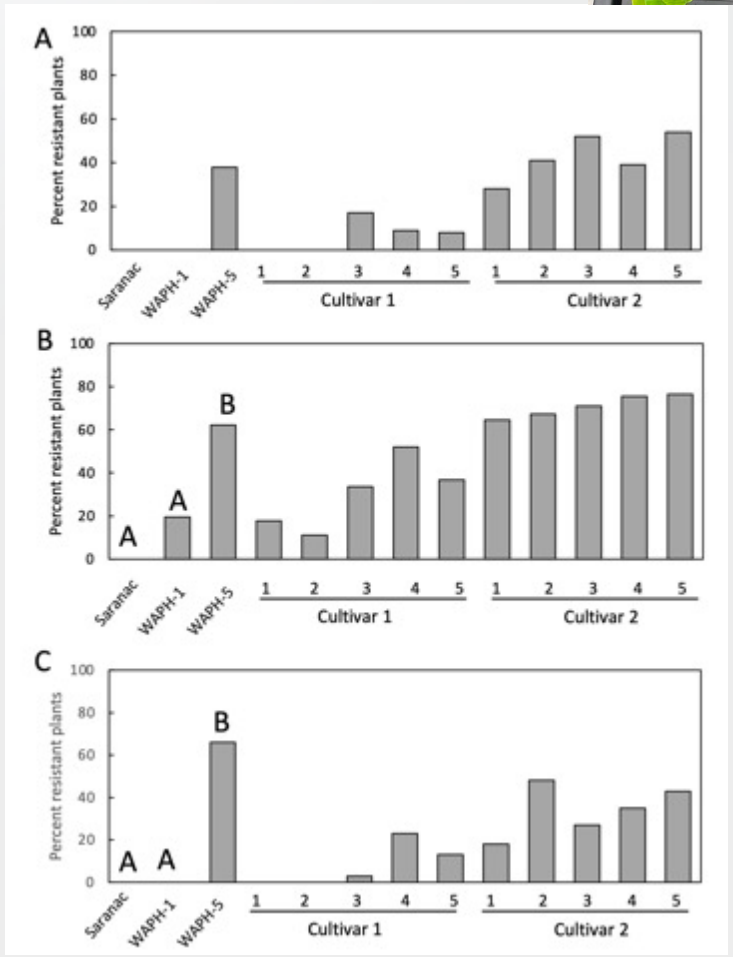


1= control
2 = Evergol Energy
3 = Apron + Stamina
4 = Apron + Stamina + Intego Solo
5 = Apron + Stamina + Intego Solo + Maxim

How effective are treatment mixtures on a small seed?

Soil bioassays

- Three locations with varying disease pressure
  - A: ARR and *Ph. sansomeana*
  - B: ARR race 2
  - C: ARR and *Pythium*
- Soil removed from the field
- Tested with treated seeds
  - Soil saturated 3 days after plant emergence
  - Rated 21 days after planting
- No treatment was highly effective
  - No significant differences from control untreated seeds



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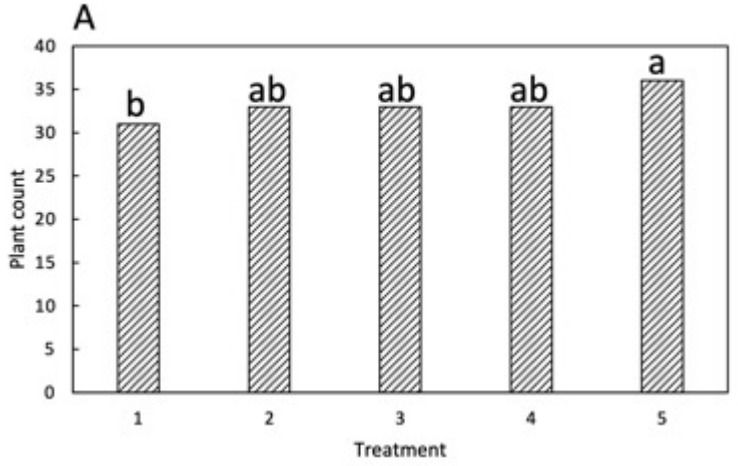
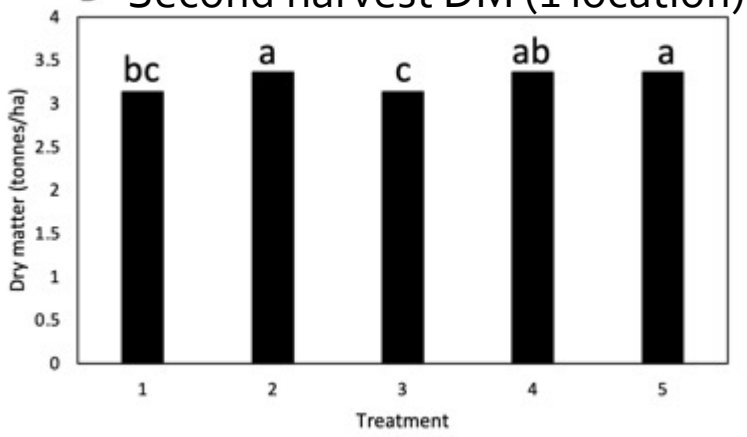
Field experiments in 3 locations with treated seeds

Second plant count (4-6 trifoliates)



B Second harvest DM (1 location)



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Conclusions:

- Treatments had only modest effects in field soil and field environments
- Evergol Energy (prothioconazole, penflufen, metalaxyl) could be used to replace Apron/Apron XL for early season protection against *Pythium* spp. and PRR, with some ARR activity
  - Some protection for cultivars susceptible to PRR
- Genetic resistance to *Pythium* spp. and enhanced resistance to ARR race 2 would provide season-long protection
- Improve seed coating technology with use of multiple products to obtain effective concentrations of active ingredients