Field Pea Input Optimization

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Agri-ARM Research Update
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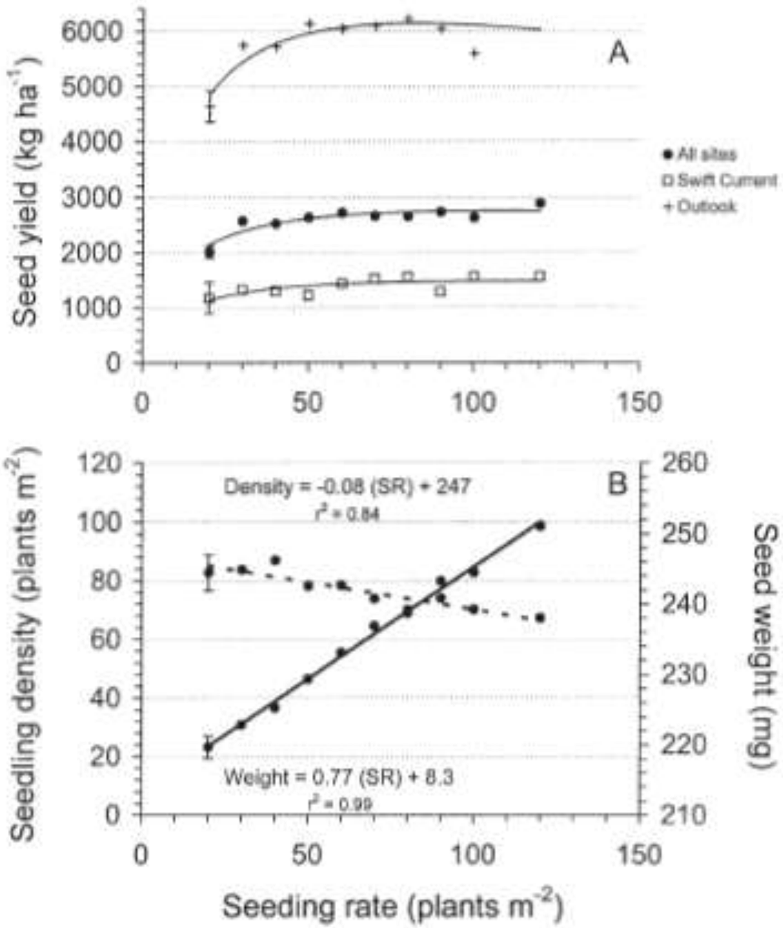
Background

- Many agronomic studies have been conducted on one aspect of field pea production
- The effect on yield when many agronomic factors are combined is unknown
- It is unknown what factors may affect yield more than others

Previous Field Pea Research

1) Seeding rate
2) Seed treatment
3) Inoculant
4) Starter fertilizer
5) Foliar fungicide

Seeding Rate



- Seed weight declined as pea density increased
- Estimated optimum seeding rate for yield was 108 seeds/m^2 (80 plants/m^2)
- Yield increases were small at seeding rates >50 plants/m^2
- Yield was reduced with seeding rates <50 plants/m^2

Johnston et al. 2002. Can. J. Plant Sci. **82**: 639-644

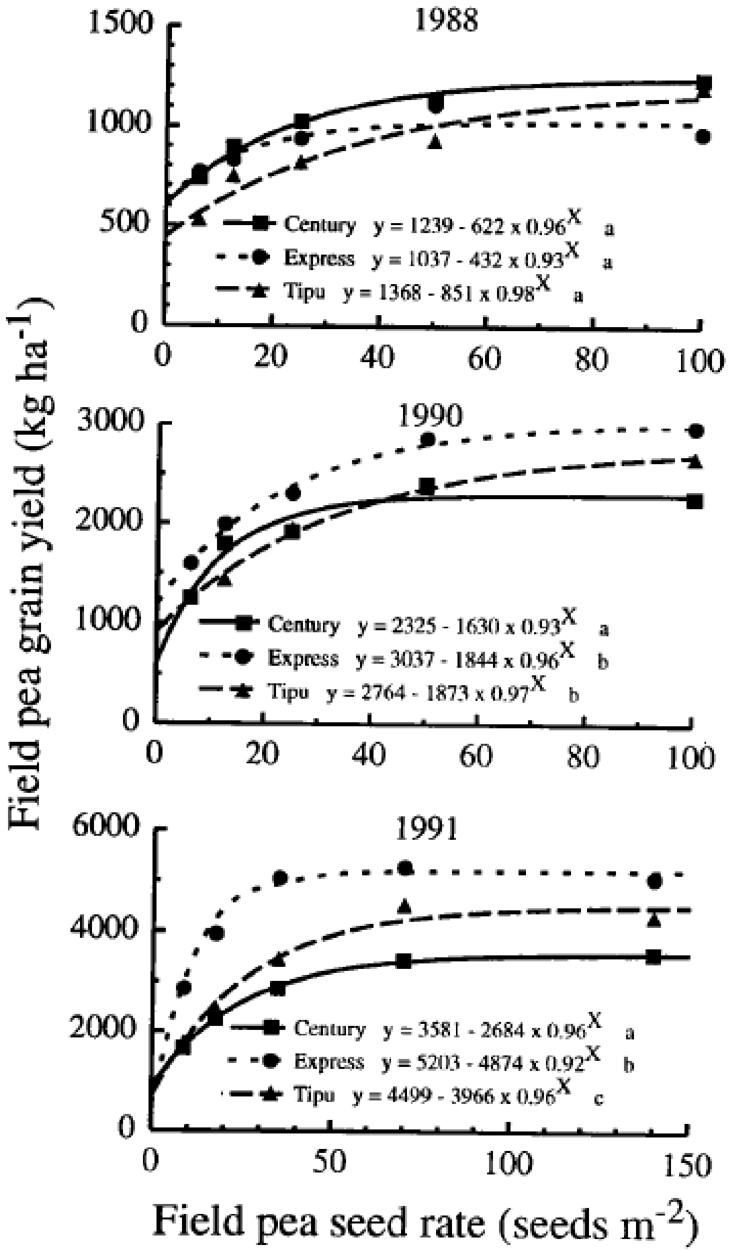


Fig. 8. Field pea grain yield in response to seed rate and cultivar in 1988, 1990 and 1991. Equations, within a graph, followed by the same letter are not significantly different from each other at $P \leq 0.05$.

Seeding Rate and Weed Control

- Increasing stand density reduced weed populations
- Growth habit didn't affect number of weeds
- Field pea yield increased with increasing seeding rate to a rate between 50-100 seeds/m^2

Townley-Smith and Wright. 1994. Can. J. Plant Sci. **74**: 387-393.

Inoculants

- Rhizobium inoculation can increase field pea seed yield and improve yield stability
- Previous research has found granular inoculant to be more effective than seed applied inoculants

Granular > Peat > Liquid

Table 2. Effect of inoculant formulation averaged over all N rates and locations on agronomic characteristics of field pea in the Peace River region

Inoculant formulation	Biomass[z] (kg ha^{-1})	Seed yield (kg ha^{-1})	Harvest index	Seed protein (g kg^{-1})
Granular	4190	4850	0.37	194
Peat powder	3810	4150	0.35	176
Liquid	3800	3230	0.33	170
Uninoculated	3740	3110	0.32	168
SE	67	68	0.02	2
Orthogonal contrasts				
Inoc vs. No inoc	NS	**	*	**
Soil vs. Seed	**	**	*	**
Peat vs. Liquid	NS	**	NS	NS

[z]Biomass dry matter at flatpod stage of pea growth.
*, ** Significant at the 0.05 and 0.01 levels of probability, respectively; NS, not significant.

Granular inoculant resulted in 17, 50 and 56% higher pea seed yield than peat, liquid or the uninoculated check, respectively

Clayton et al. 2004. Can. J. Plant Sci. **84**: 89-96

Inoculant Product and Formulation Effect on Field Peas

Treatment	Inoculant	Formulation
1	No inoculant	-
2	Nodulator XL	Granular
3	Nodulator XL	Liquid
4	Nodulator XL	Peat
5	Cell-Tech	Granular
6	Cell-Tech	Liquid
7	Cell-Tech	Peat
8	TagTeam	Granular
9	TagTeam	Liquid
10	TagTeam	Peat
11	Optimize	Granular
12	PulseSignal II	Liquid
13	No inoculant + 60 lb/ac N	-

Methods

- 3 sites: Melfort, Swift Current, Scott
- Variables measured:

  Biomass

  Nodulation

  Yield

Results – Swift Current

Orthogonal Contrasts	Yield (kg/ha)	Biomass (kg/ha)	Nodulation
Check	177	4103	9.8
Liquid	1886	4393	11.6
Significance	NS	NS	**
Check	1777	4103	9.8
Granular	1890	4399	11.4
Significance	NS	NS	**

** Significance at P <0.01; NS, not significant at P <0.05.

Nodulation Rating:
11-13 = effective nodulation
7-10 = nodulation less effective
1-6 = generally unsatisfactory nodulation

Starter Nitrogen Fertilizer

- Fertilizer N is known to have a negative effect on nodulation and N_2 fixation of legumes
- Small starter doses of fertilizer N can be beneficial to plant development, nodulation and N_2 fixation
- Research trials have found varying responses to starter N fertilizer

Table 2. Nitrogen fertilizer recommendations for pea in the various soil zones of Alberta.

Soil Test N (0-12 inch depth; 0-30 cm)	Soil Test N (0-12 inch depth; 0-30 cm)	Brown and Dark Brown	Thin Black	Black & Gray Wooded	Irrigated
(lb/ac)	(ppm)	Recommended N (lb/ac)			
0-8	0-2	20	25	10*	30
8-16	2-4	15	20	0	20
16-24	4-6	10	15	0	10
24-32	>6	0	10	0	0

* At very low soil test N levels, 10 lb of N/ac could be applied to ensure N deficiency does not occur before N fixation begins.

- Starter N improved pea yield in 24% of 58 trials conducted in Alberta
  (avg. yield increase = 9%)
- Greater benefit to starter N when spring soil test N was less than 18 lb/ac
  (average yield increase = 11%)

McKenzie et al. 2001. Can. J. Plant Sci. **81**: 637-643

General Recommendations

Seeding rate: target 75 plants/m^2

Seed treatment: recommended when spring conditions favour disease development or when inoculum levels are high

Inoculant: granular more effective than liquid or peat

Starter fertilizer: may provide a benefit with very low soil N levels

Foliar fungicide: recommended when conditions favour disease development

Field Pea Input Study

Objectives:

1) To determine which agronomic practices contribute most to field pea seed yield
2) To determine which combinations of agronomic practices produce the highest pea yield in different areas of Saskatchewan and provide the best economic return for producers

Materials and Methods

- Compare ‘full’ input package with ‘empty’ input package
- 4 sites: Melfort, Swift Current, Indian Head, Scott
- 3 year study (2012, 2013, 2014)

Treatments

	Empty	Full
Variety	CDC Meadow	CDC Meadow
Seeding rate	60 seeds/m2	120 seed/m2
Seed treatment	None	Apron Maxx RTA
Inoculant	Liquid	Granular
Starter fertilizer	None	30 lb/ac 46-0-0
Fungicide	None	2 applications (Headline EC + Priaxor DS)

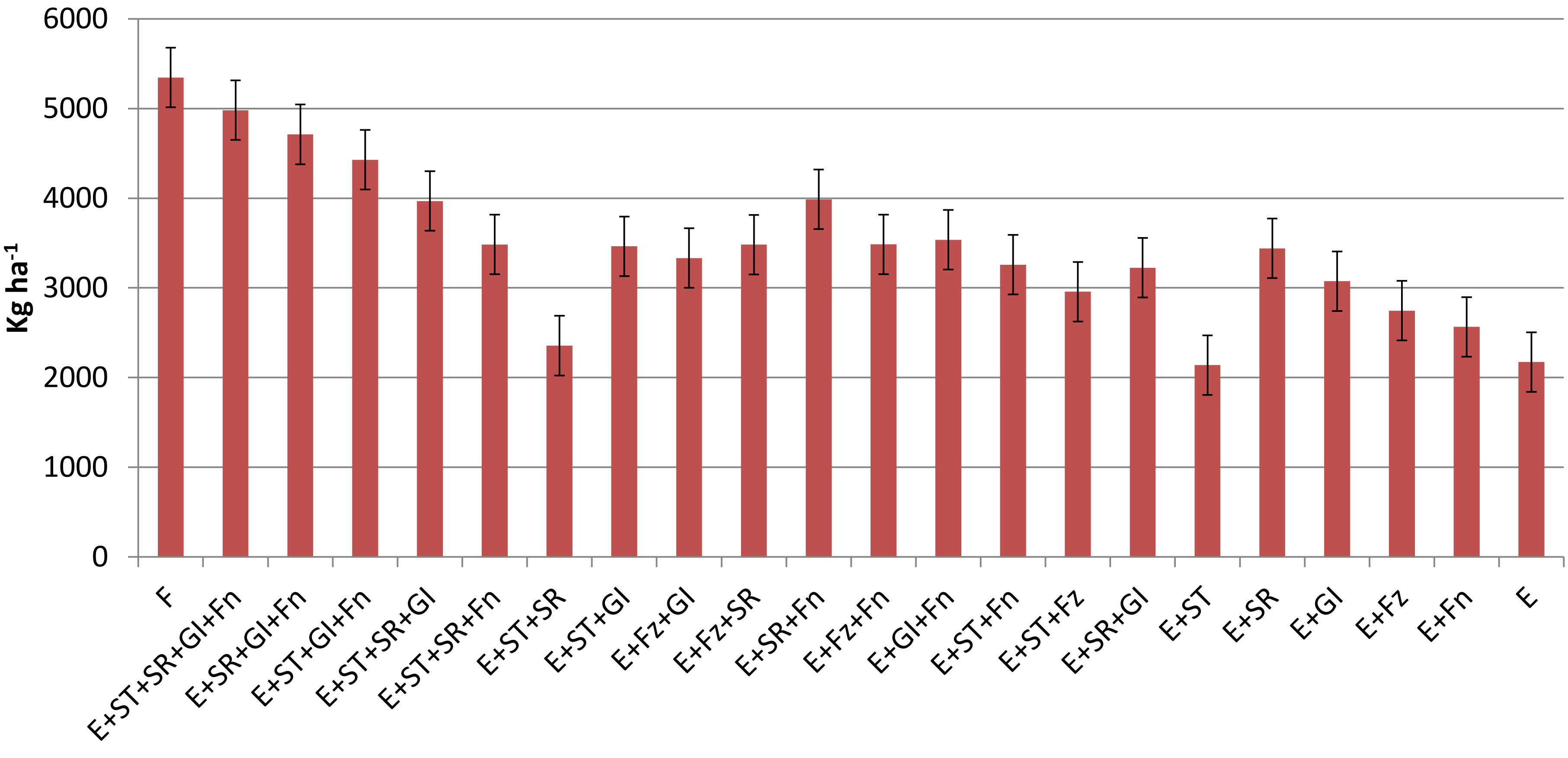
Treatment List

1) Empty package
2) Full package
3) E + ST
4) E + SR
5) E + GI
6) E + Fz
7) E + Fn
8) E + ST + SR
9) E + ST + GI
10) E + Fz + GI
11) E + Fz + SR
12) E + SR + Fn
13) E + Fz + Fn
14) E + GI + Fn
15) E + ST + Fn
16) E + ST + Fz
17) E + SR + GI
18) E + ST + SR + GI + Fn
19) E + SR + GI + Fn
20) E + ST + GI + Fn
21) E + ST + SR + GI
22) E + ST + SR + Fn

ST – seed treatment
SR – seeding rate
GI – granular inoculant
Fz – starter fertilizer
Fn – foliar fungicide

Preliminary Results – 1st year of study

Yield - Scott



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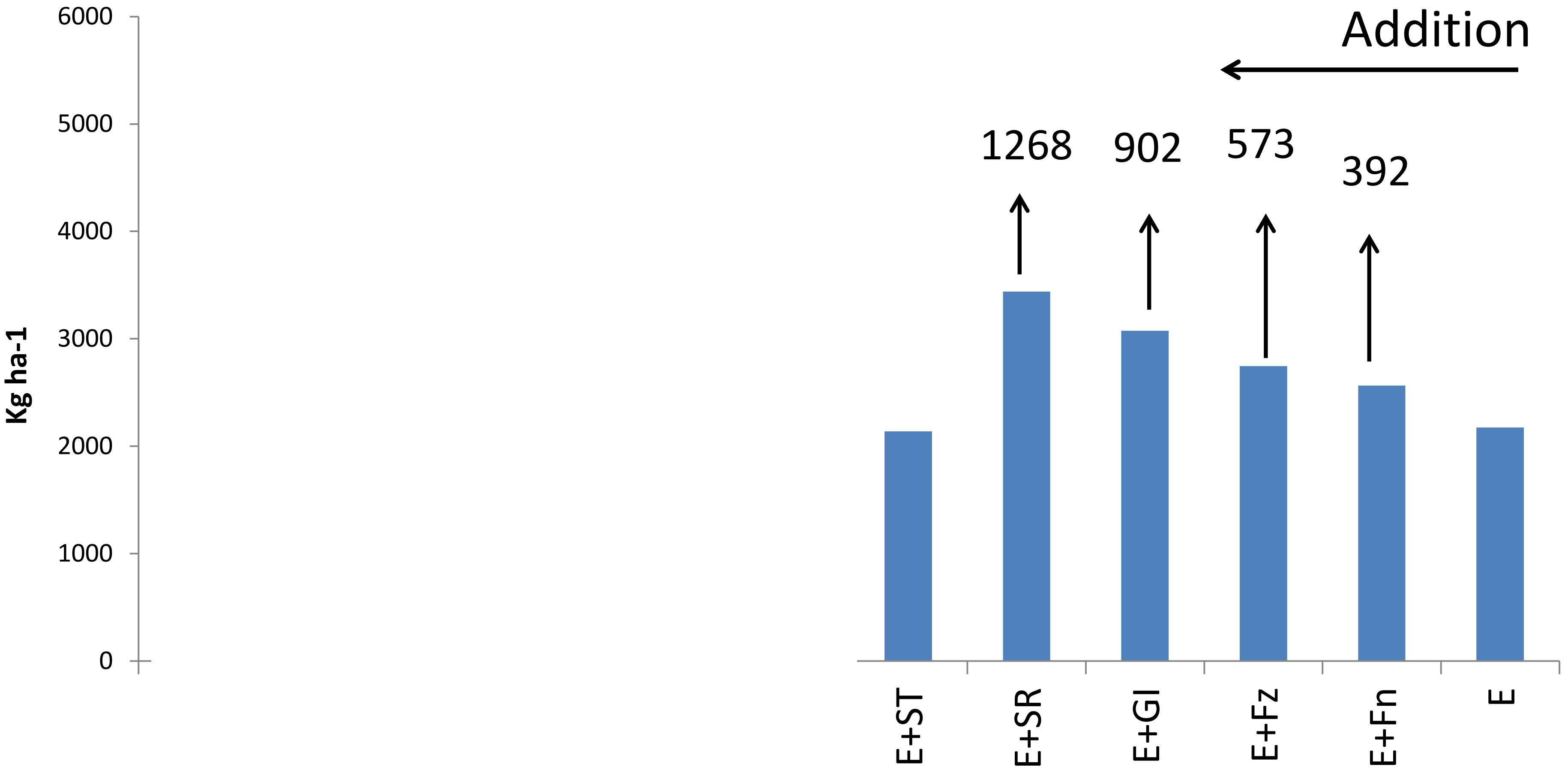
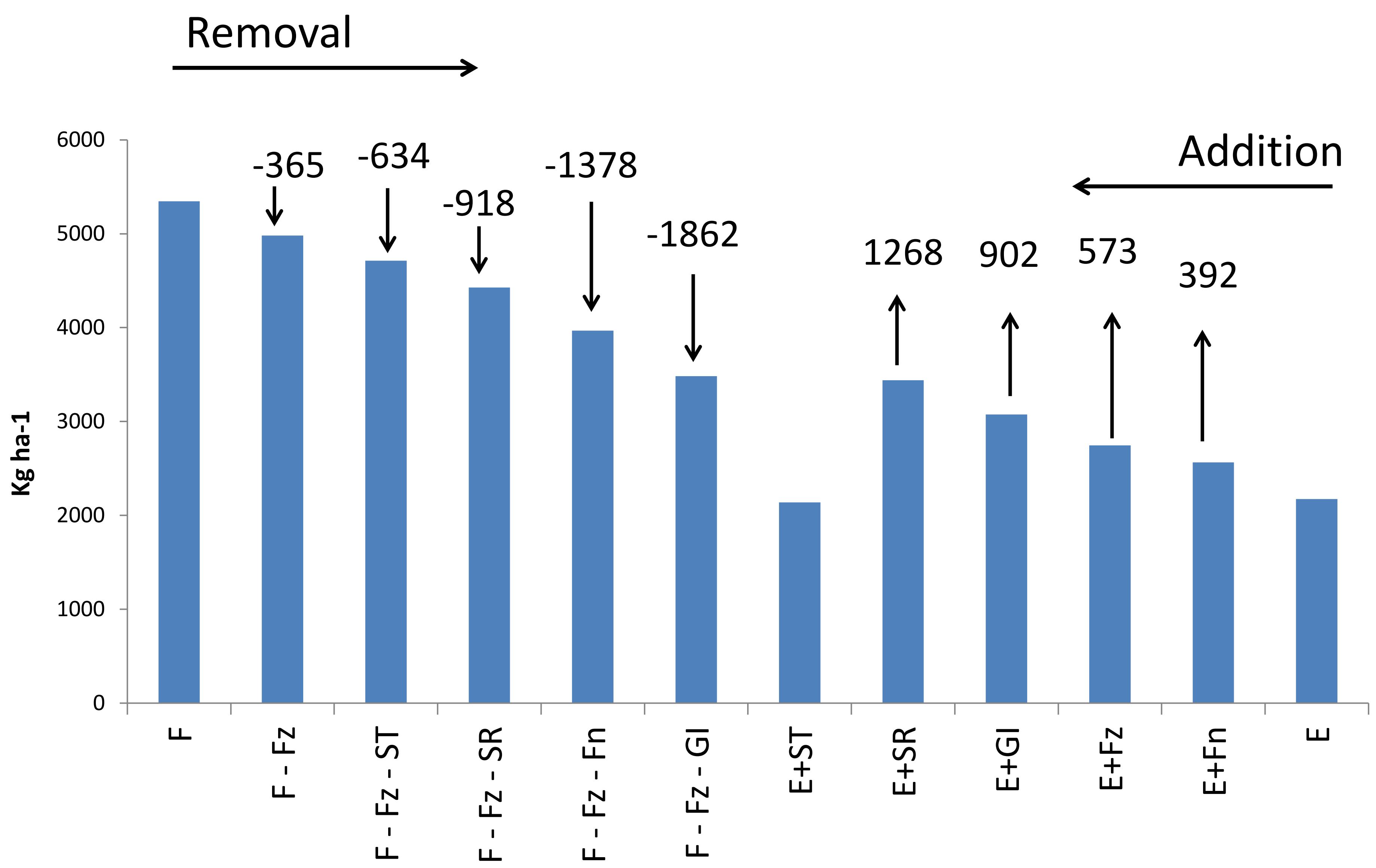
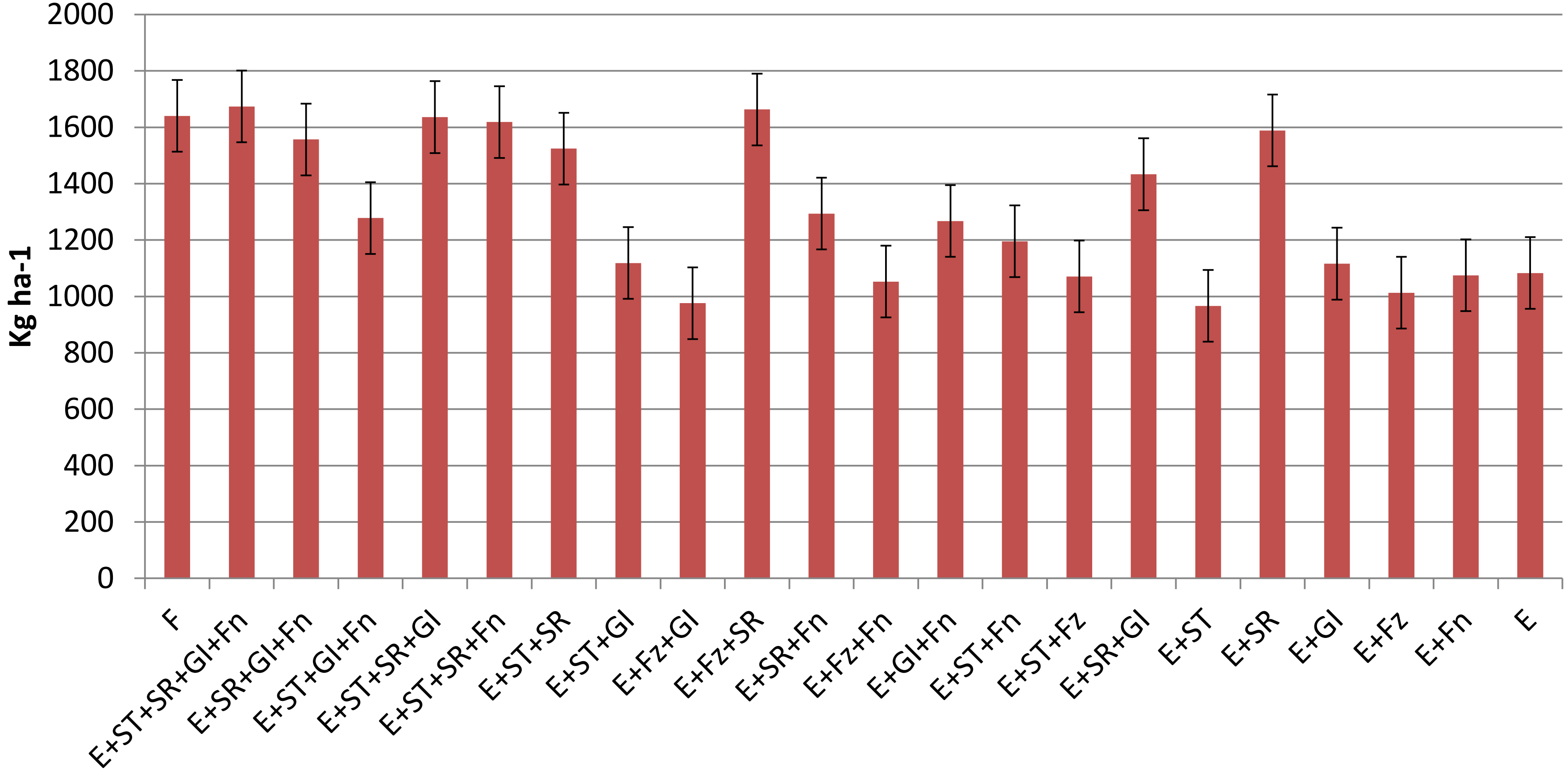
Scott – Actual yield increase or decrease



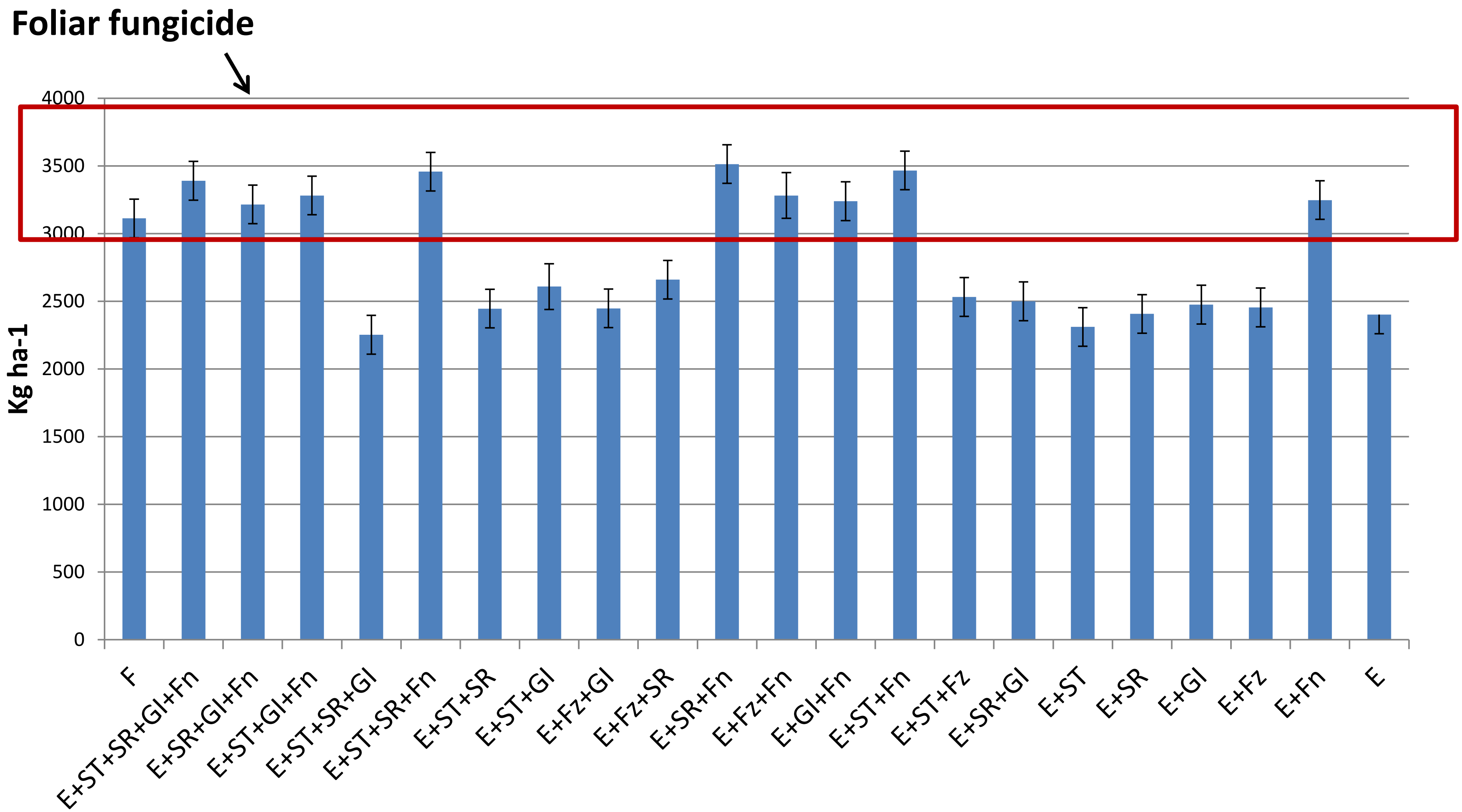
Scott – Actual yield increase or decrease



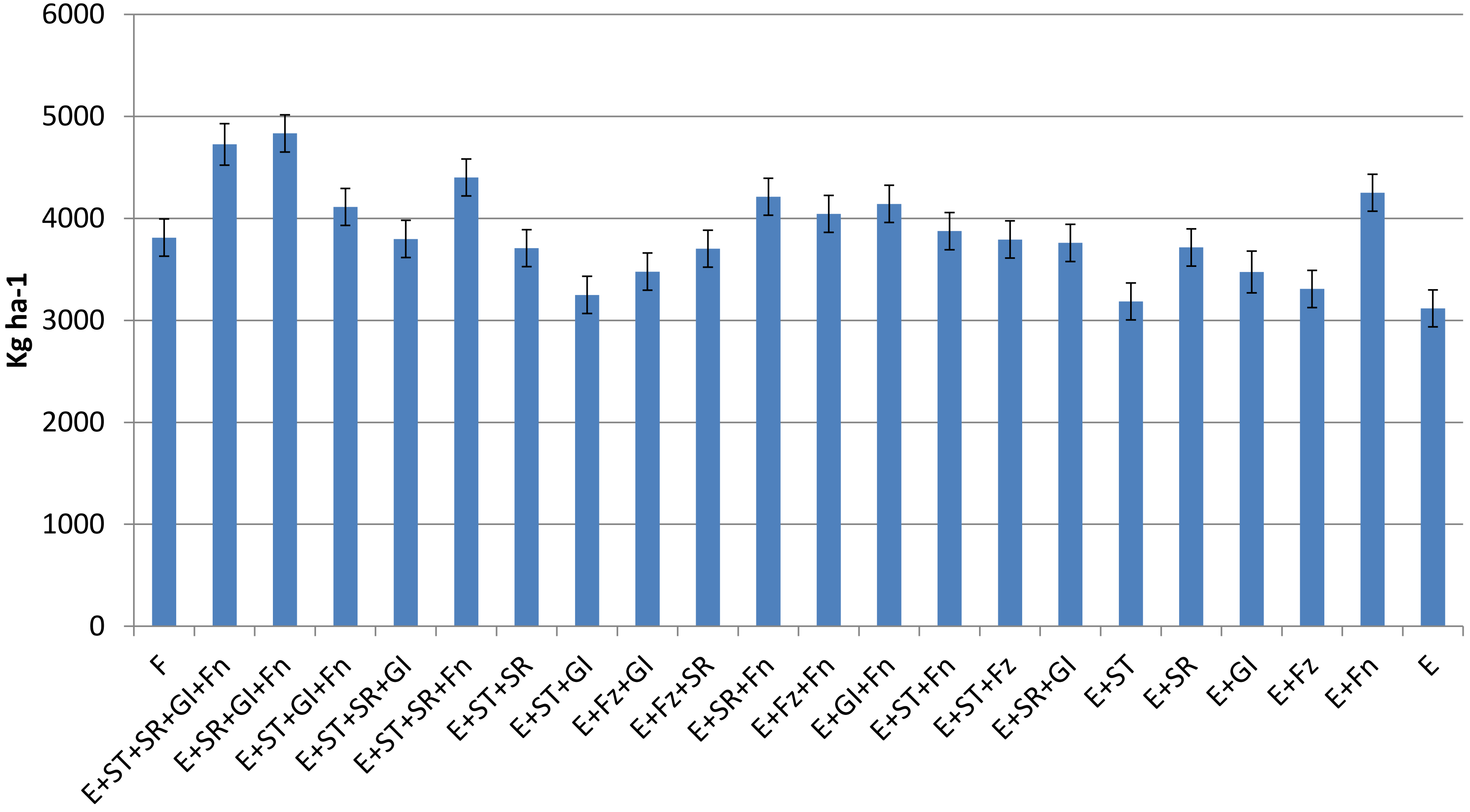
Yield – Swift Current



Yield – Indian Head



Yield – Melfort



Seeding rate, granular inoculant and fungicide had the greatest impact on yield

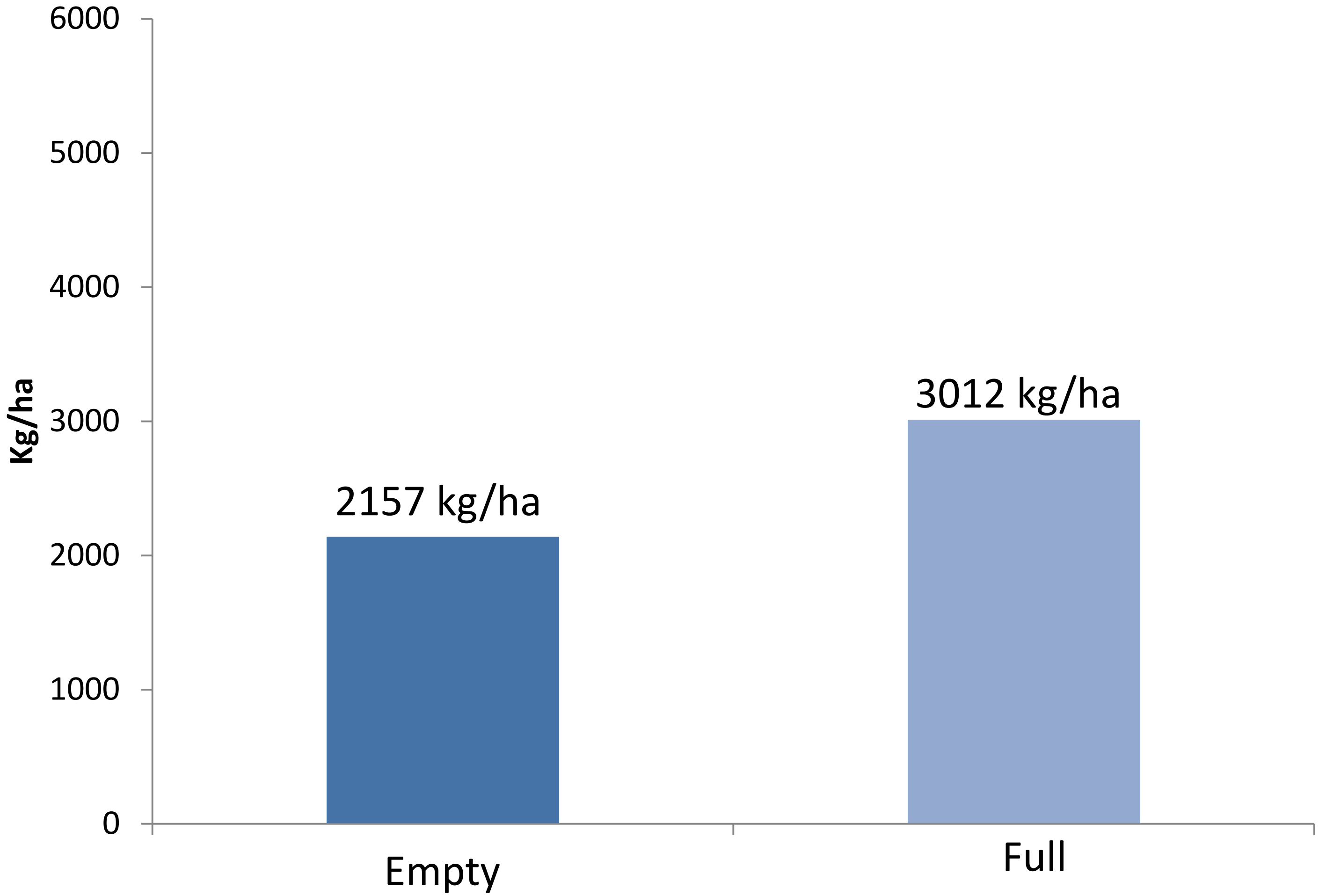
	Yield Increase (decrease) in kg/ha				
	Scott	Indian Head	Melfort	Swift Current	All Sites
Seed treatment	(-34)	(-92)	68	(-117)	42
Seeding rate	1268	4	598	506	604
Granular inoculant	902	73	357	33	364
Starter fertilizer	573	52	191	-70	195
Fungicide	392	845	1134	-8	1004

Crop Input Interactions

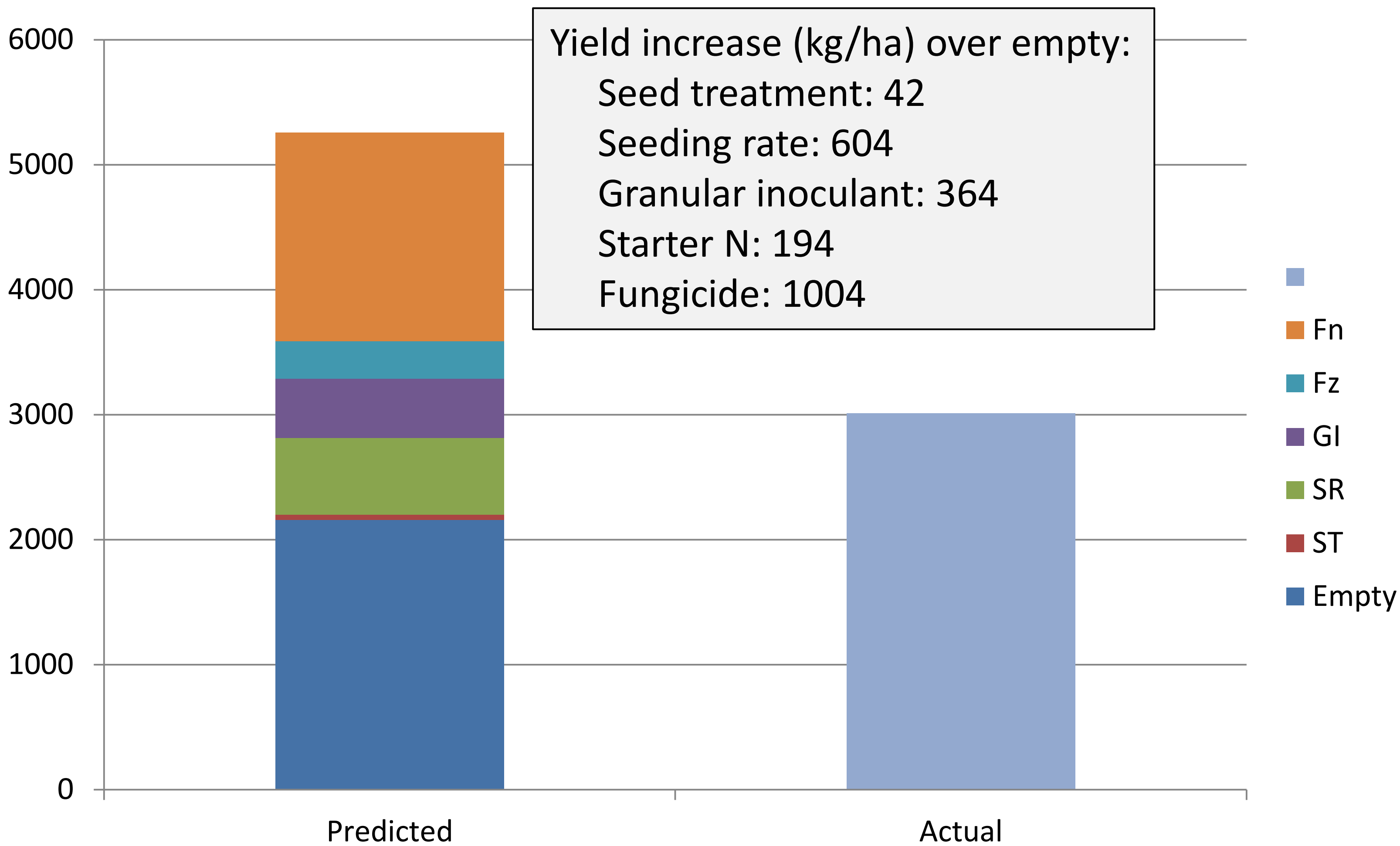
Crop inputs generally interact in a sequentially additive manner, provided there are no limiting factors

> "The largest net response comes when there are no limiting factors and the magnitude of the response will increase as more limiting factors are corrected. The attained yield is greater than of the individual parts (inputs) because the various parts interact to multiply the values of the others."
>
> – Wallace and Wallace (1993) "Law of the Maximum"

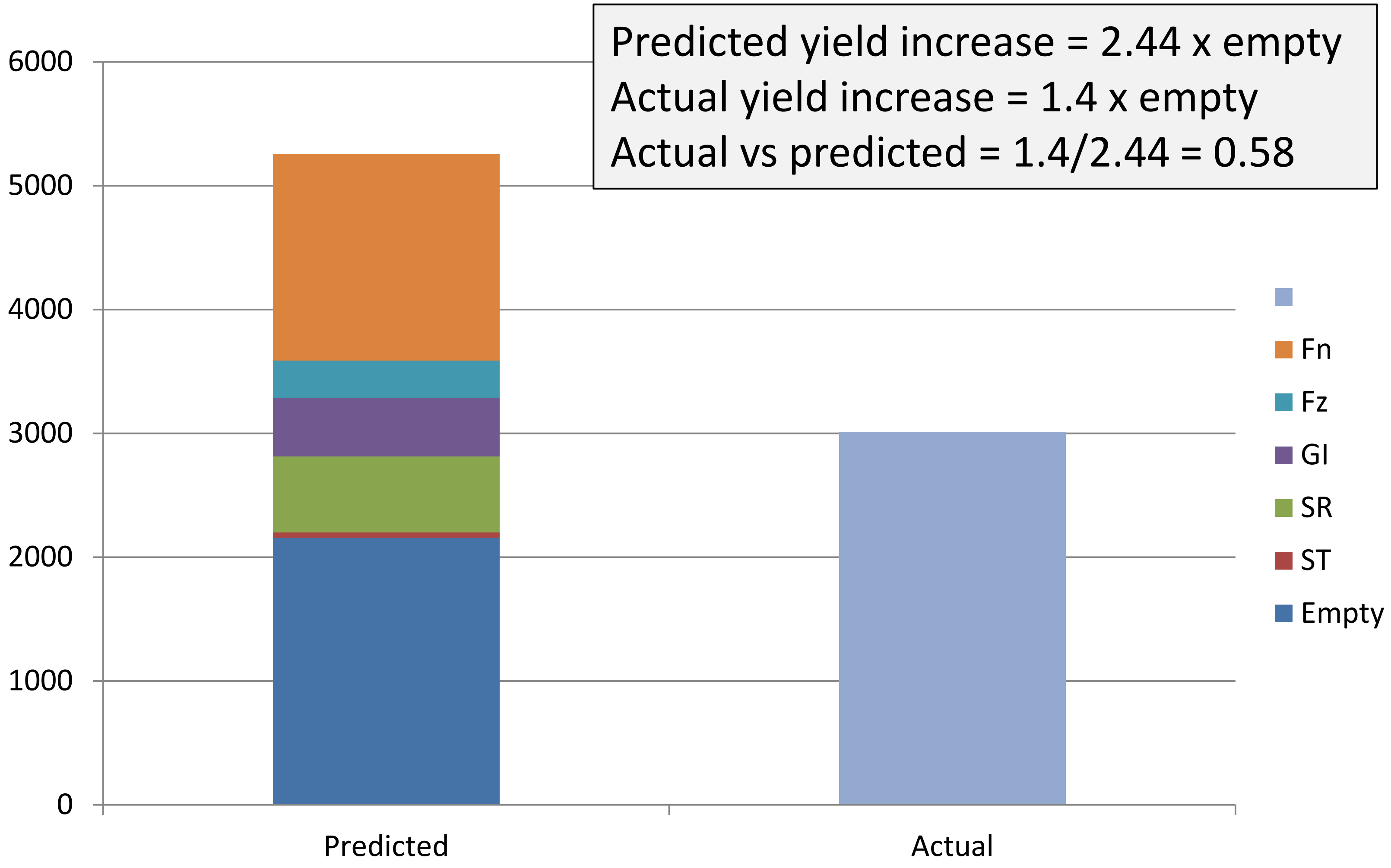
Input Effects on Pea Yield



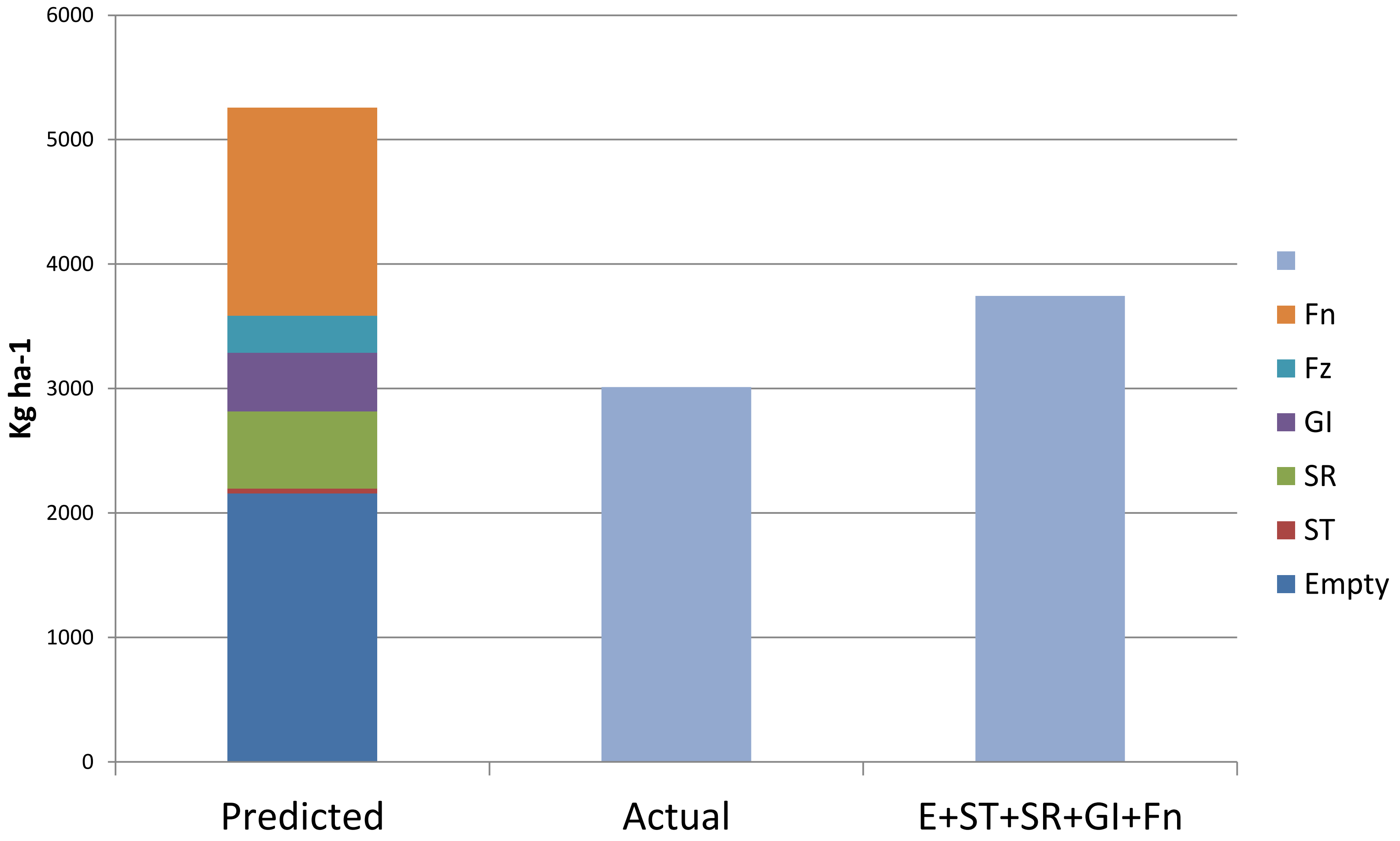
Input Effects on Pea Yield



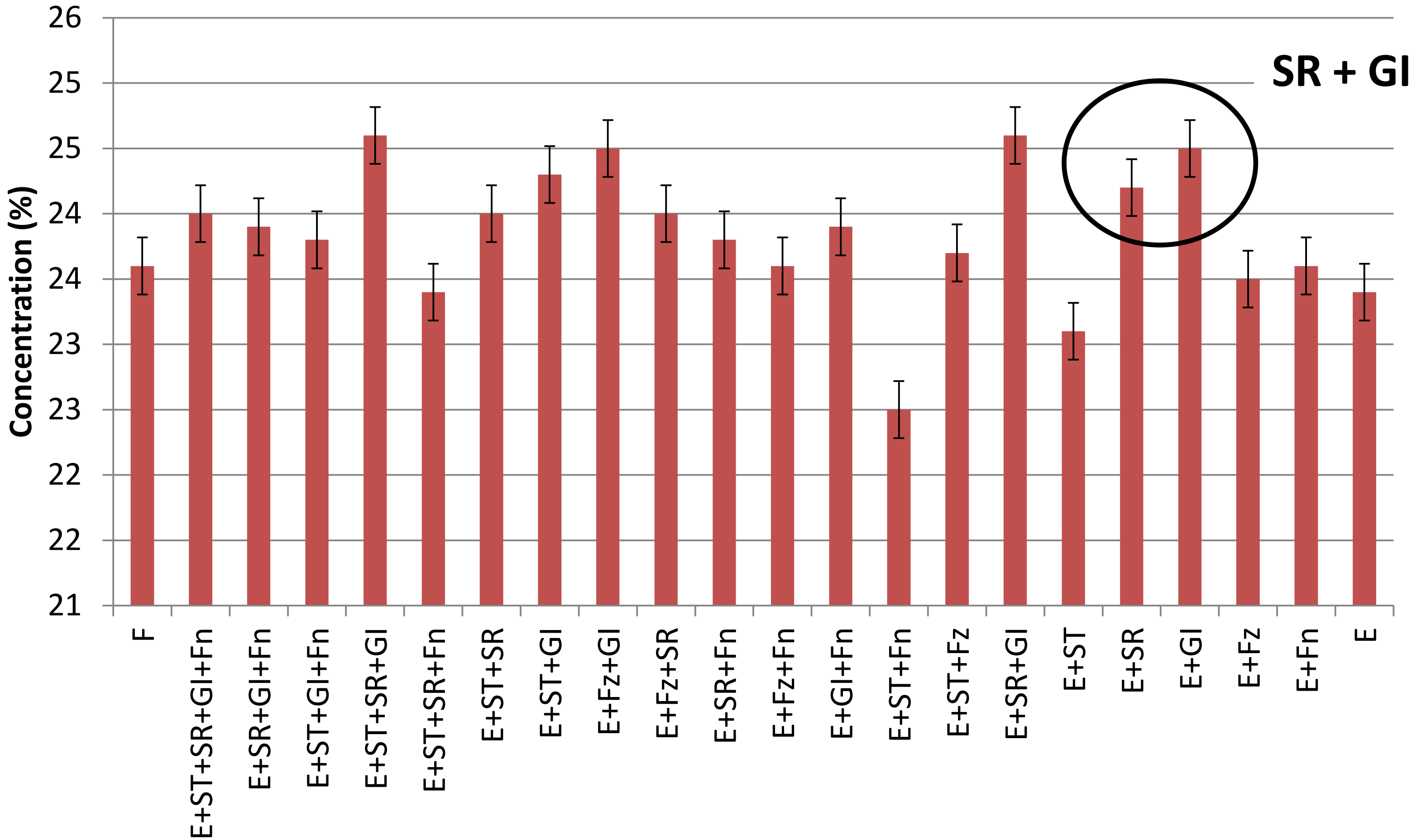
Input Effects on Pea Yield



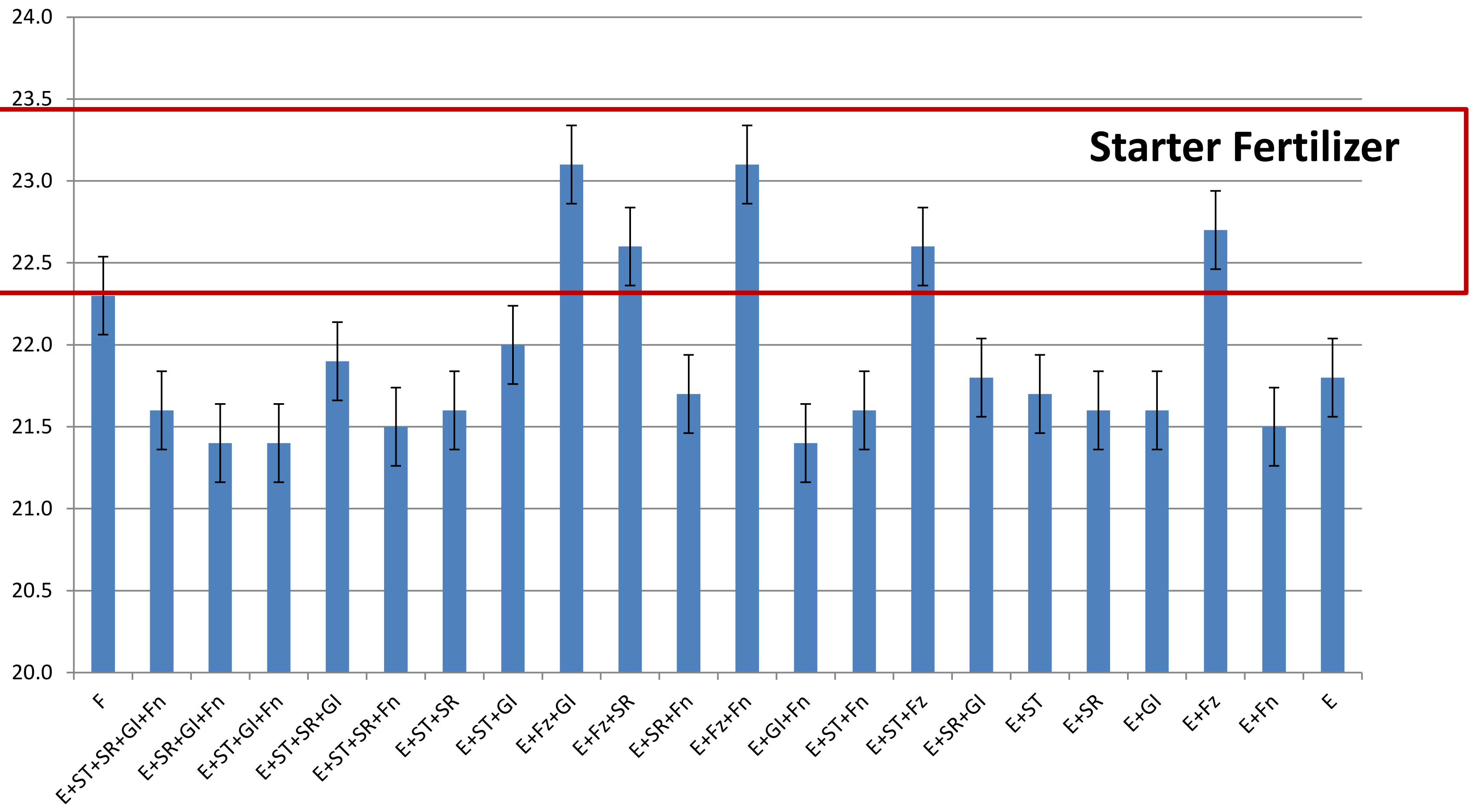
Antagonism between inputs?



Protein - Scott



Protein – Swift Current



Summary

- More research needs to be conducted on effects of combining field pea inputs
- 2012 results show increased seeding rate and fungicide application are the individual inputs contributing the most to field pea production
- Yield of the full input package not as high as predicted – more site years needed

What's Next?

- In-depth look into the interactions between inputs
- More site years of data will allow us to further investigate how inputs interact
- Economic analysis

Acknowledgements

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Growing Forward

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Rethink Tomorrow

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