Impact of Cover Crops and Compost in a Long-Term Trial on Organic Vegetable Production

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Acknowledgements

Research Collaborators: Nathan Boyd (Nova Scotia Agricultural College), Richard Smith, Michael Cahn, Laura Tourte (UCCE, Monterey and Santa Cruz), Steve Fennimore, Howard Ferris (UC Davis)

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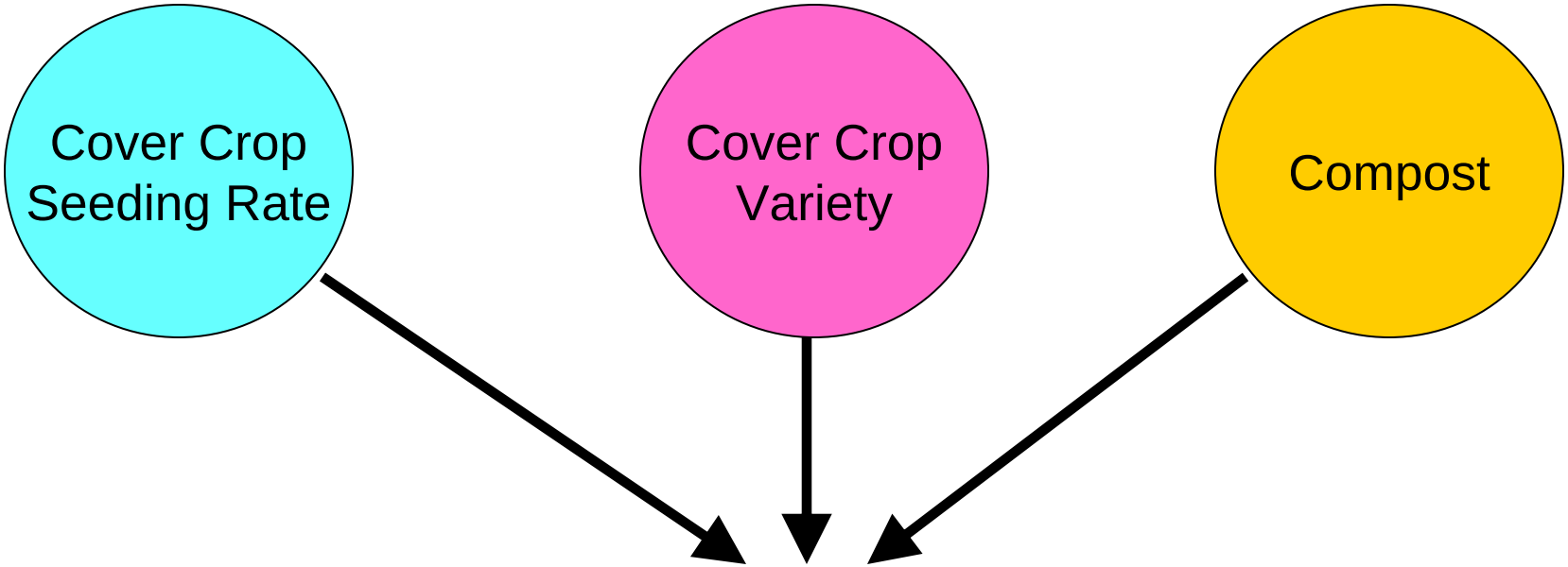
Focus for Today



Cover crop biomass production

Soil quality

Vegetable yield & profitability

Annual Rotation

Cover Crops
Oct.-Feb./Mar.

Romaine Lettuce
(May-June)

Broccoli or
spinach
(July-Sept./Oct.)

Started: Oct. 2003

Description of Systems

Practice	Cover Crop		
1	No Cover Crop		
2	No Cover Crop		
3	Legume/Rye*		
4	Legume/Rye		
5	Mustard**		
6	Mustard		
7	Rye		
8	Rye		

*Legume/Rye = 10% ‘Merced’ Rye, 35% bell beans, 25% peas, 15% purple vetch, 15% common vetch, by weight.

**Mustard = 69% ‘Ida Gold’ (*S. alba*), 31% ‘Pacific Gold’ (*B. juncea*) by weight.

Description of Cover Crop and Compost Practices

Practice	Cover Crop	Seeding Rate	
1	No Cover Crop	-	
2	No Cover Crop	-	
3	Legume/Rye	1x (100lb/acre)	
4	Legume/Rye	3x (300lb/acre)	
5	Mustard	1x (10lb/acre)	
6	Mustard	3x (30lb/acre)	
7	Rye	1x (80lb/acre)	
8	Rye	3x (240lb/acre)	

Description of Cover Crop and Compost Practices

Practice	Cover Crop	Seeding Rate	Compost * (10 tons/acre/yr)
1	No Cover Crop	-	No
2	No Cover Crop	-	Yes
3	Legume/Rye	1x (100lb/acre)	Yes
4	Legume/Rye	3x (300lb/acre)	Yes
5	Mustard	1x (10lb/acre)	Yes
6	Mustard	3x (30lb/acre)	Yes
7	Rye	1x (80lb/acre)	Yes
8	Rye	3x (240lb/acre)	Yes

* Green waste compost, split application of 5 tons/acre before each vegetable.


Planting Cover Crops


Fail Mowing Cover Crop (Feb. – Mar.)


Spading Cover Crop
FALC


Post-Incorporation Period:
2004: 59 days
2005: 55 days
2006: 105 days

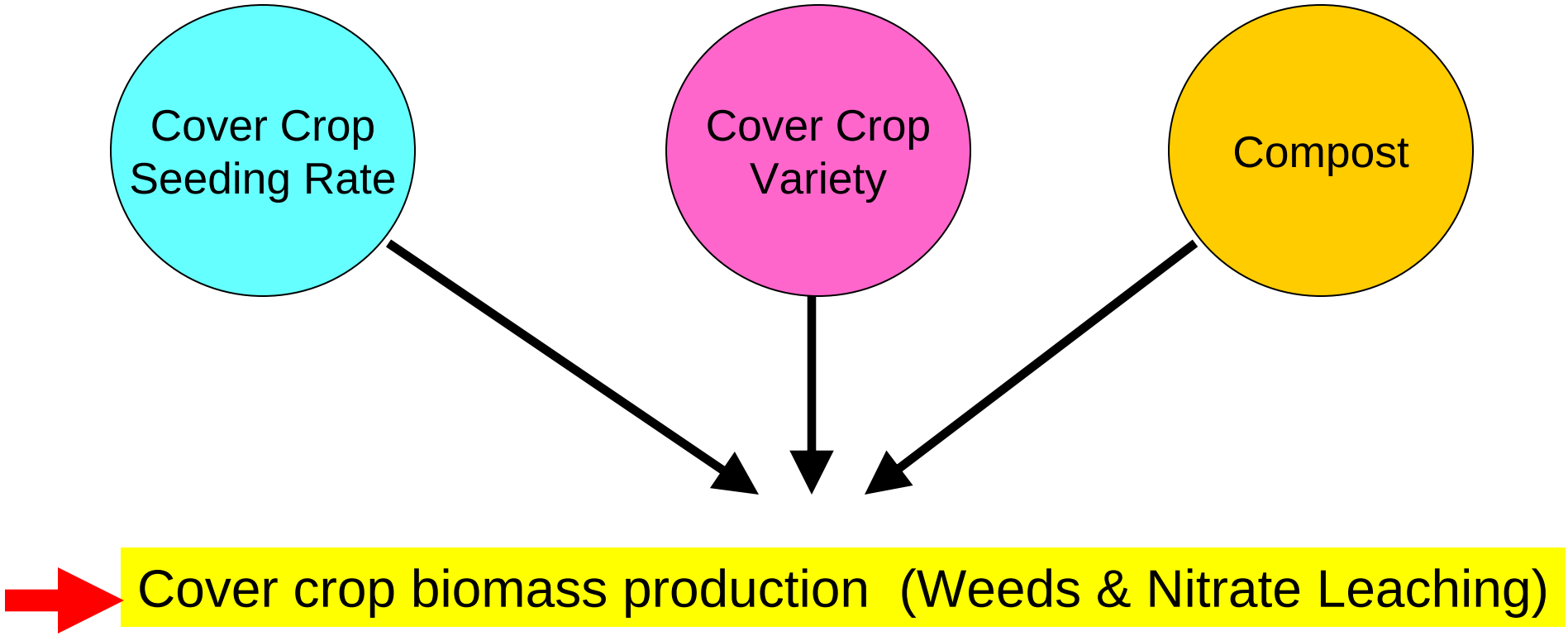

50 lb N/acre 4-4-2 Pre-plant fertilizer for Romaine


Compost application: 5 tons/acre/vegetable crop

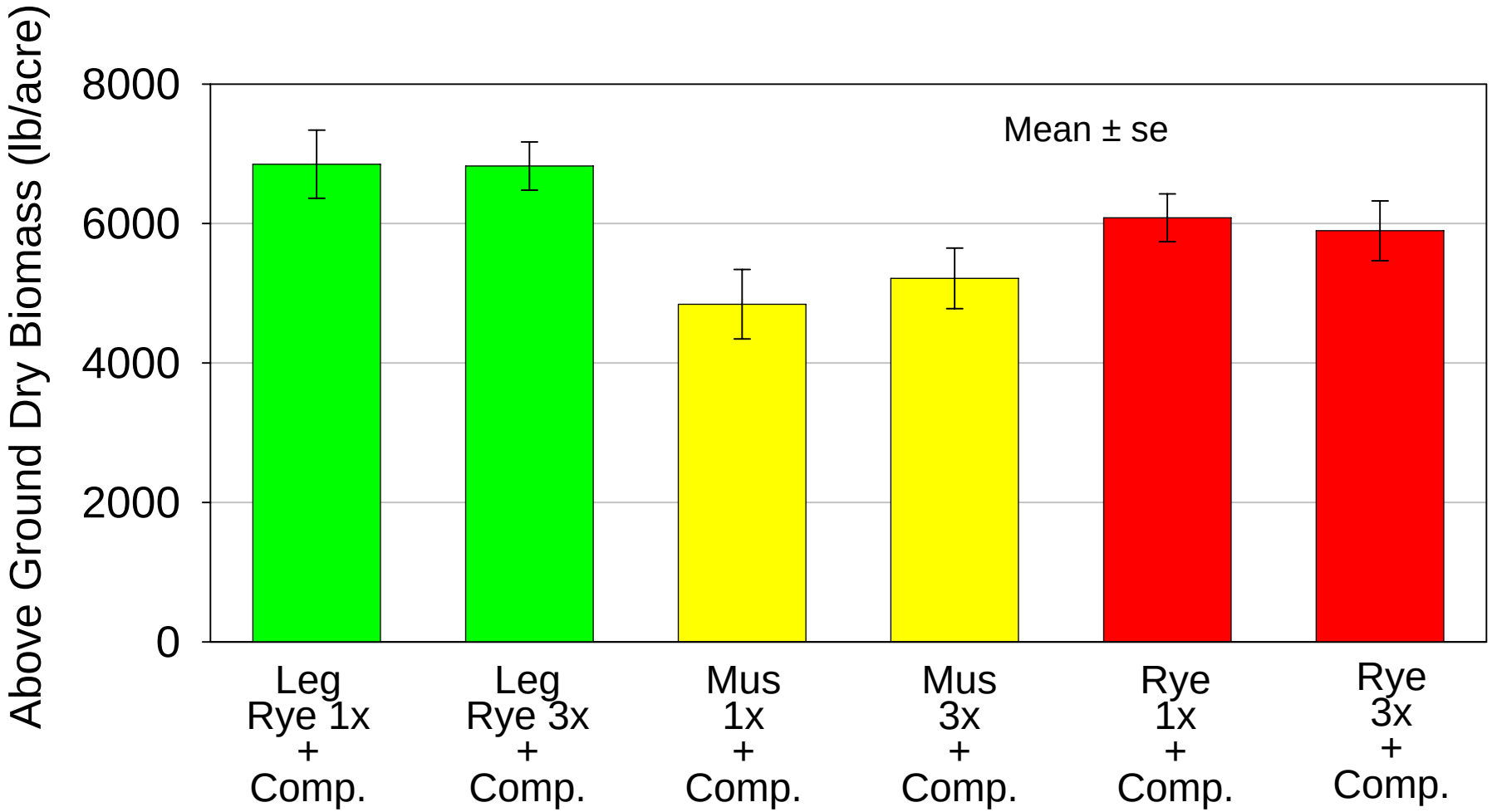

Transplanting ‘Triton’ Romaine
JOHN DEERE
5520


24 Count Romaine Harvest

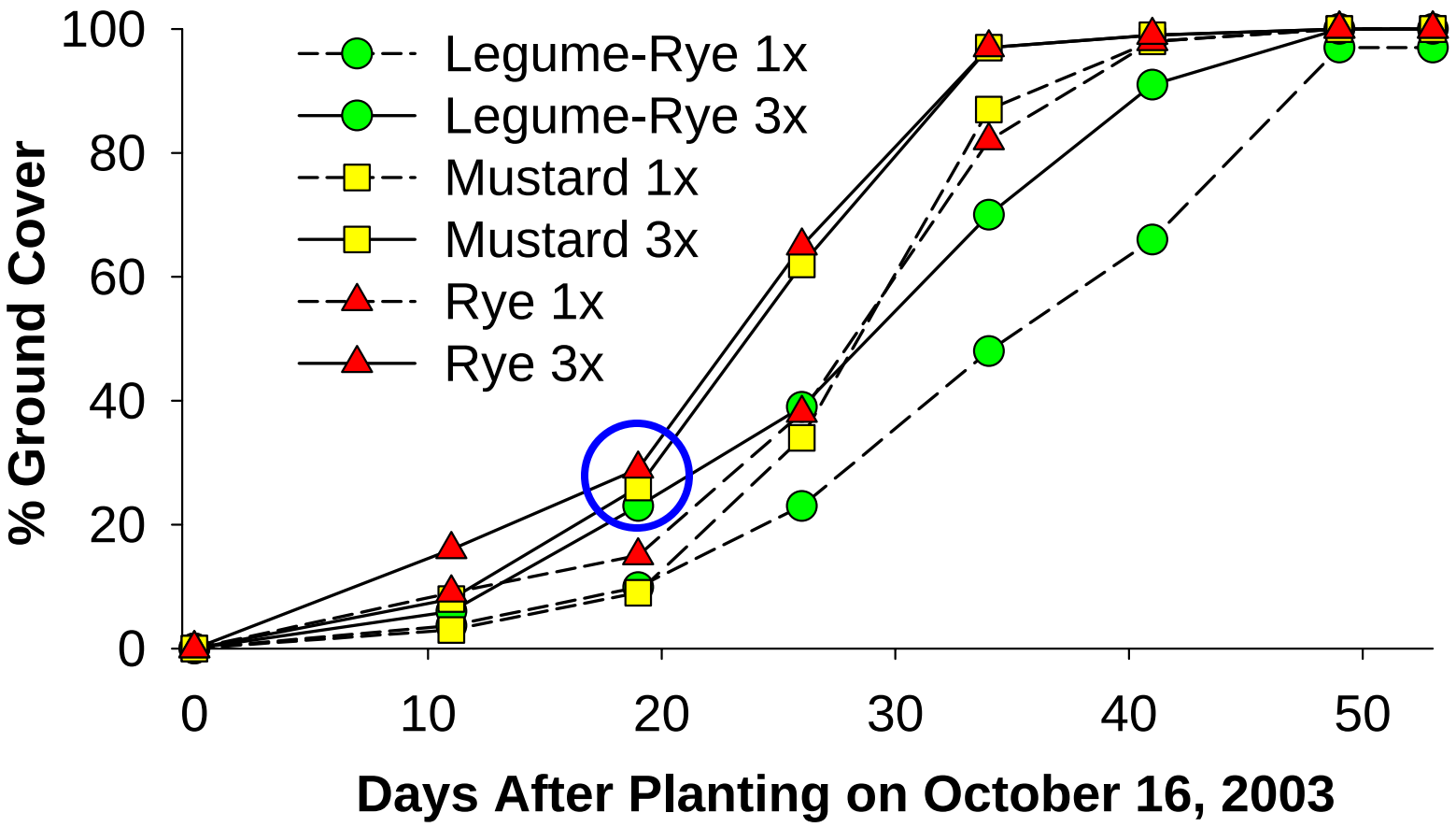

Romaine Hearts Harvest


Cover Crop Seeding Rate
Cover Crop Variety
Compost
Cover crop biomass production (Weeds & Nitrate Leaching)

Average cover crop biomass production over 3 years.

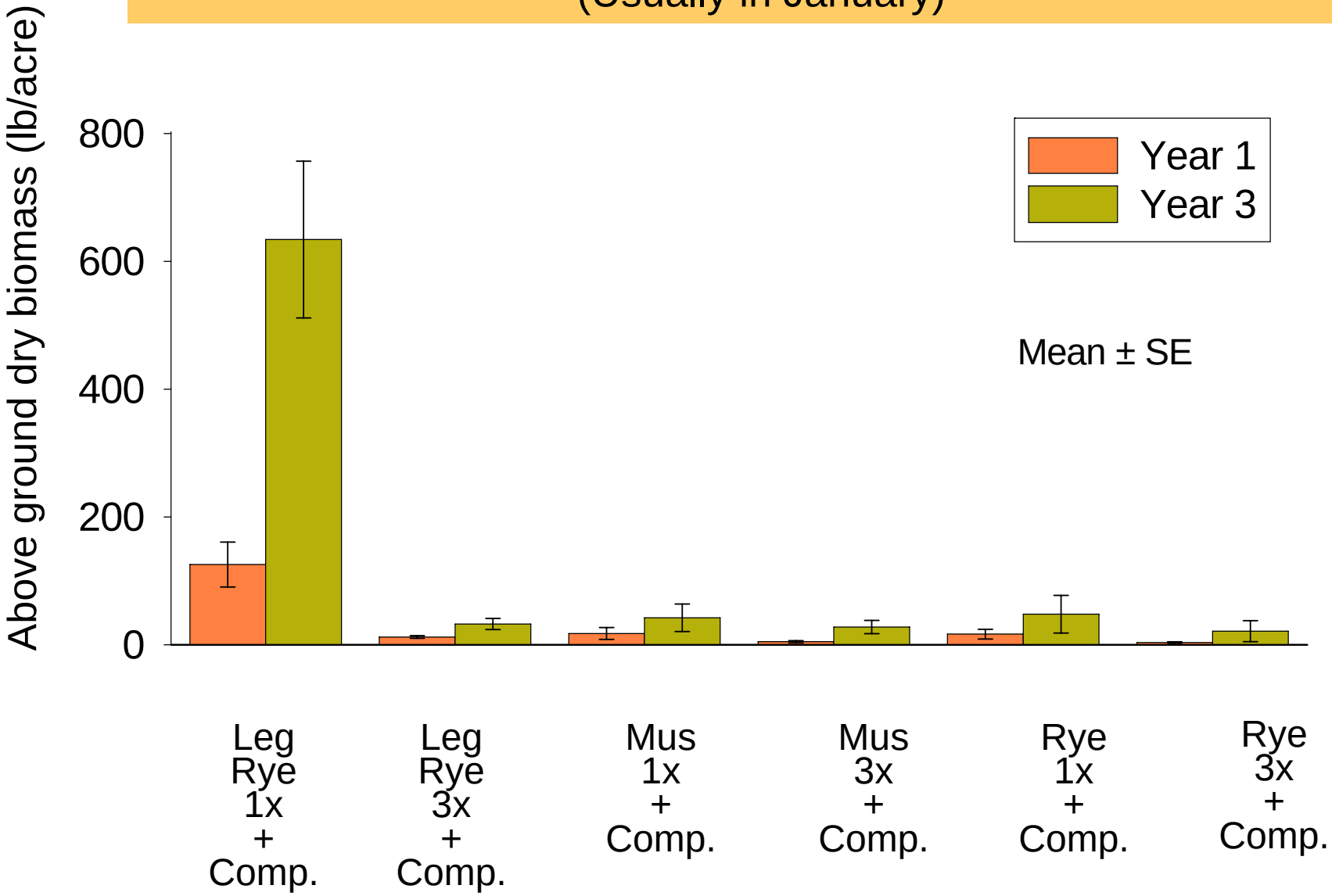


Early Season Canopy Development of Cover Crops

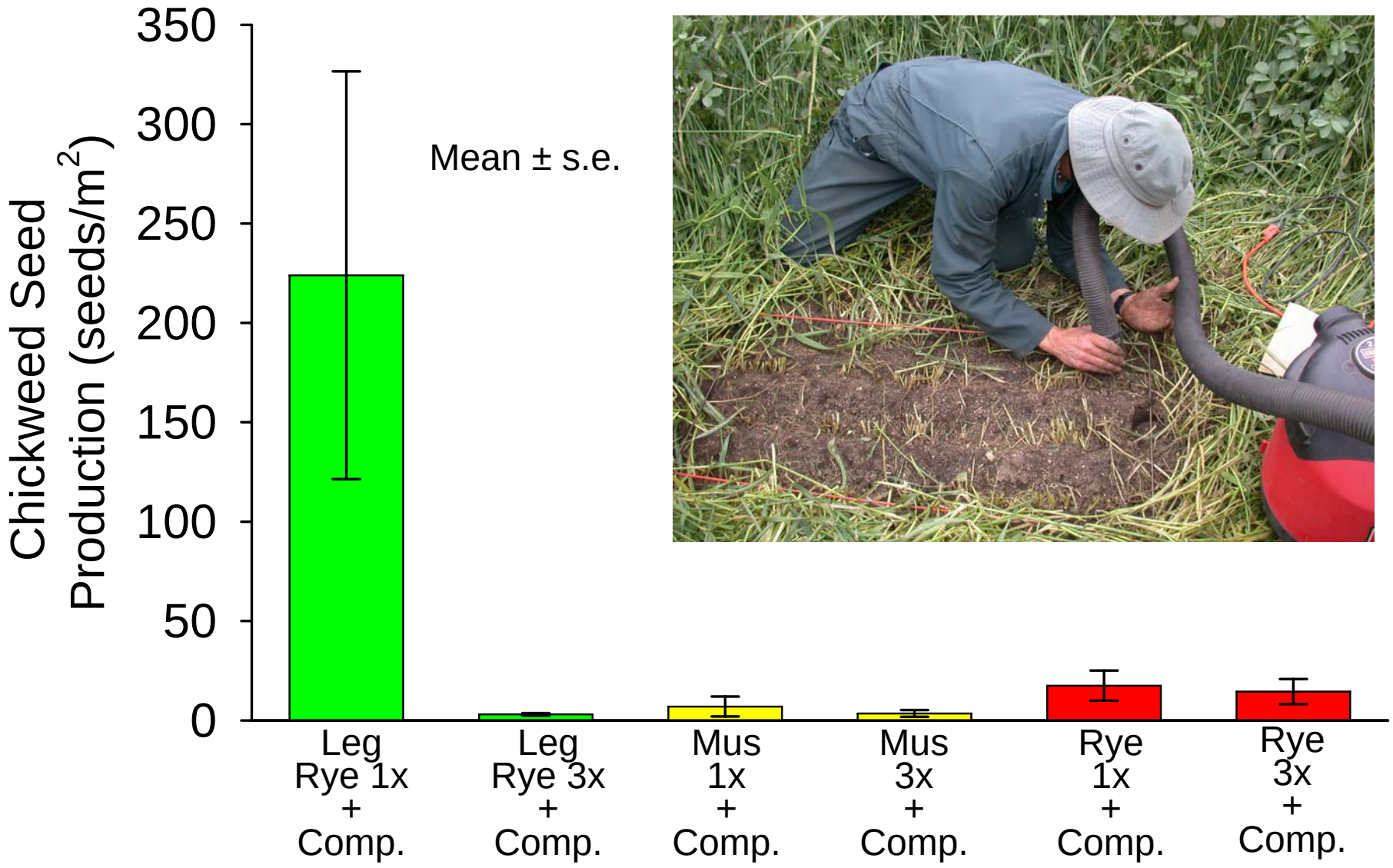


Cover Crop Canopies 11/21/03
37 Days After Planting

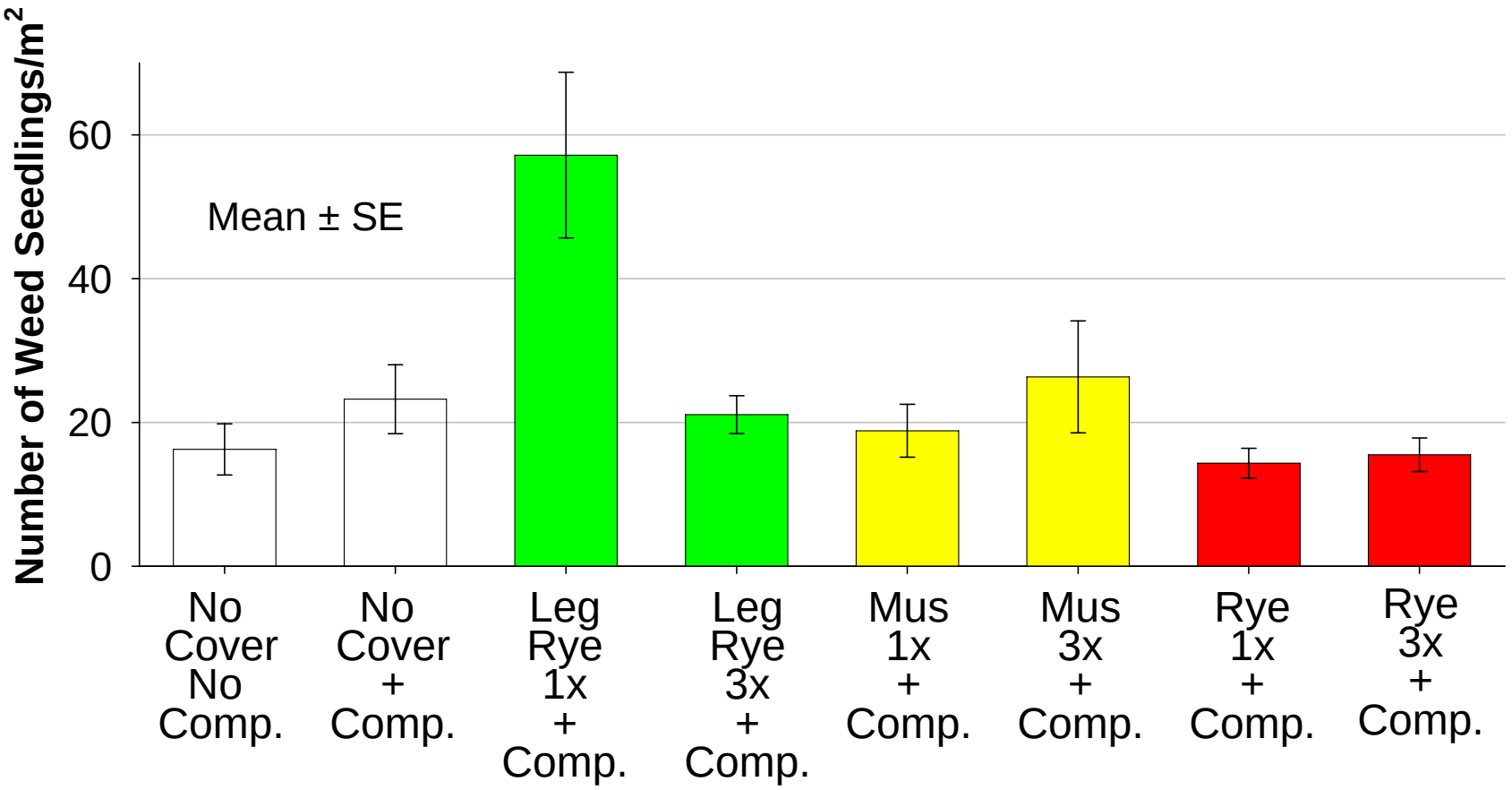
Maximum Weed Biomass in Cover Crops
(Usually in January)



Chickweed Seed Production at the End of Cover Crop (Year 1)

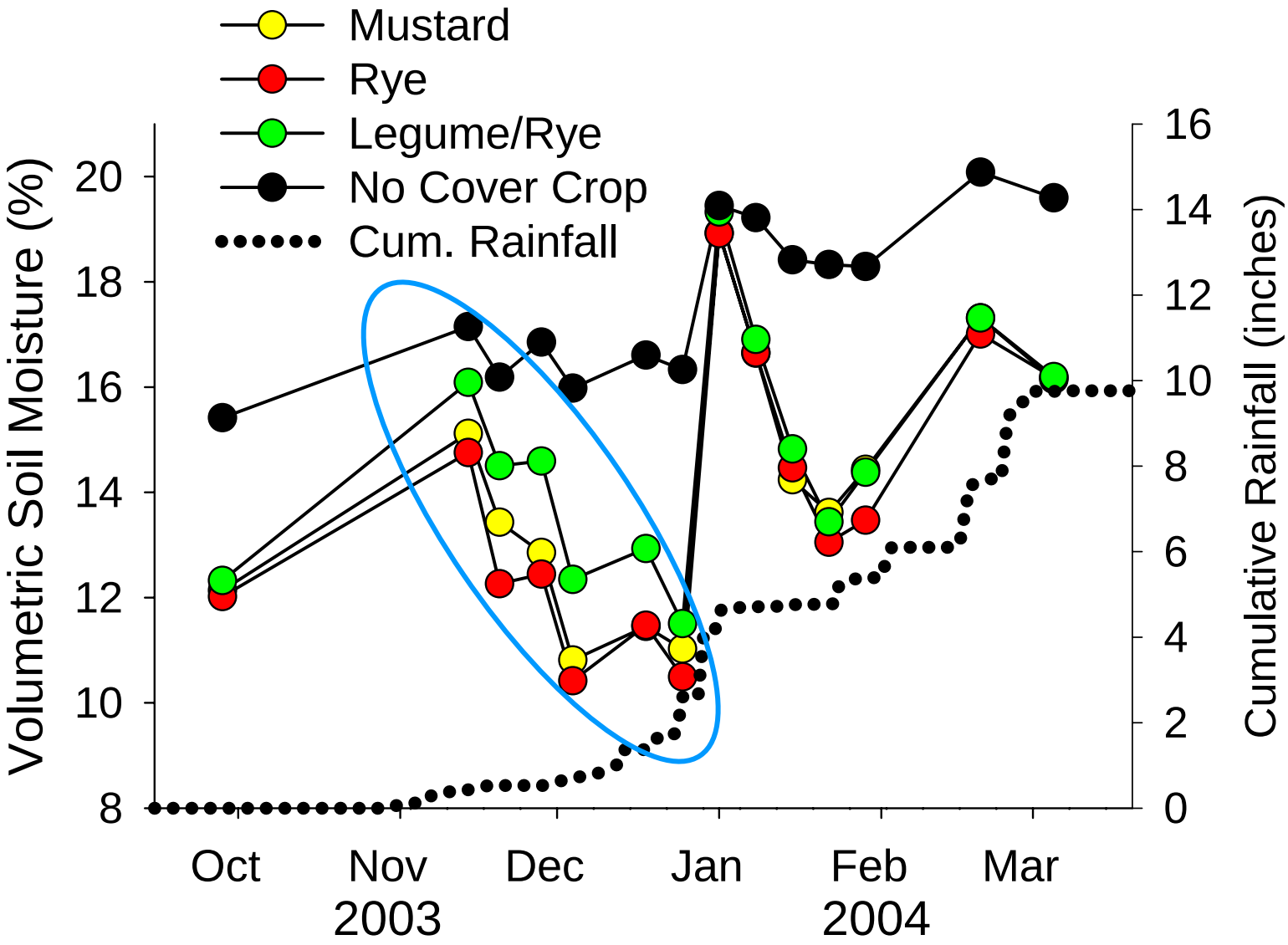


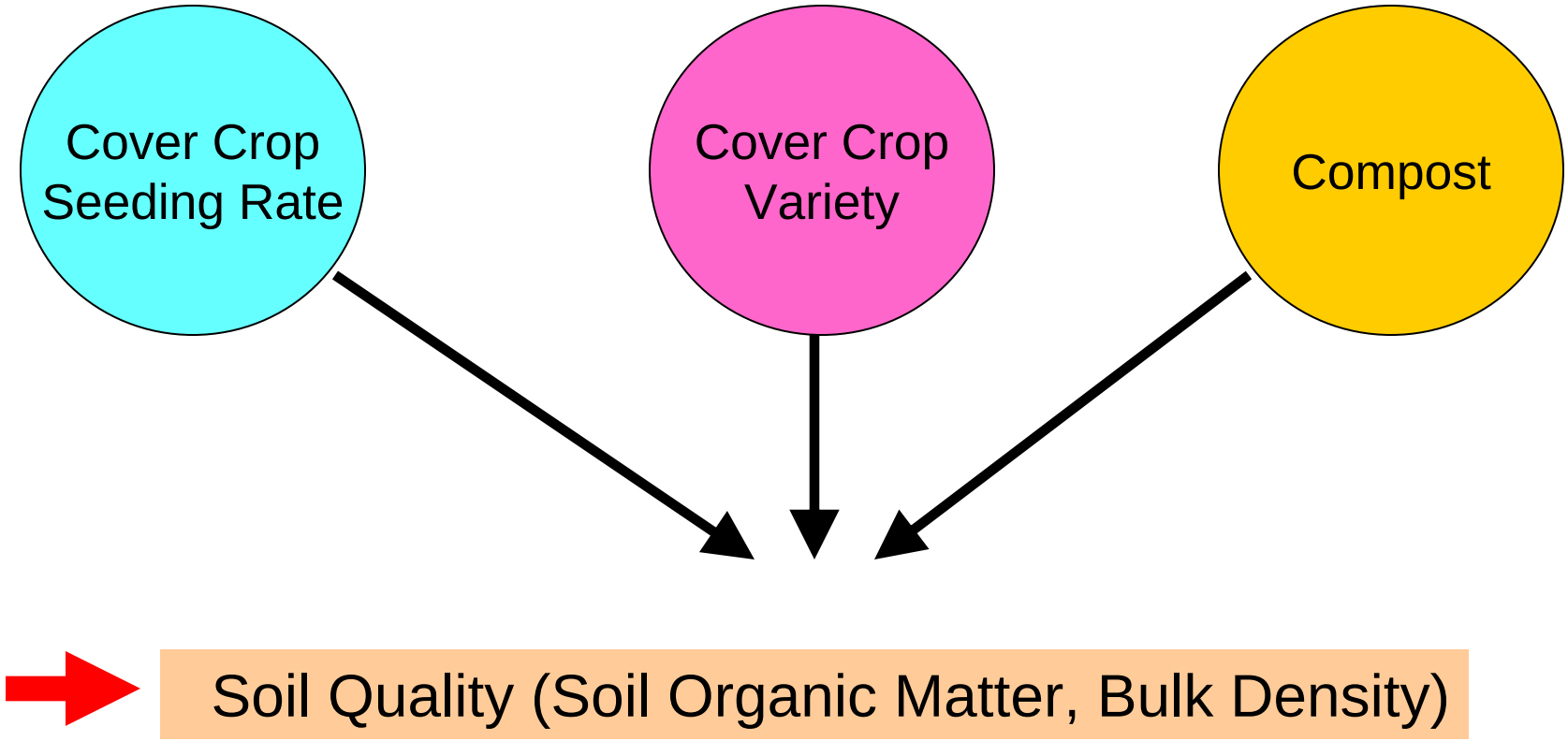
Weed Emergence on Bed Top in Broccoli, 2006 (Year 3)



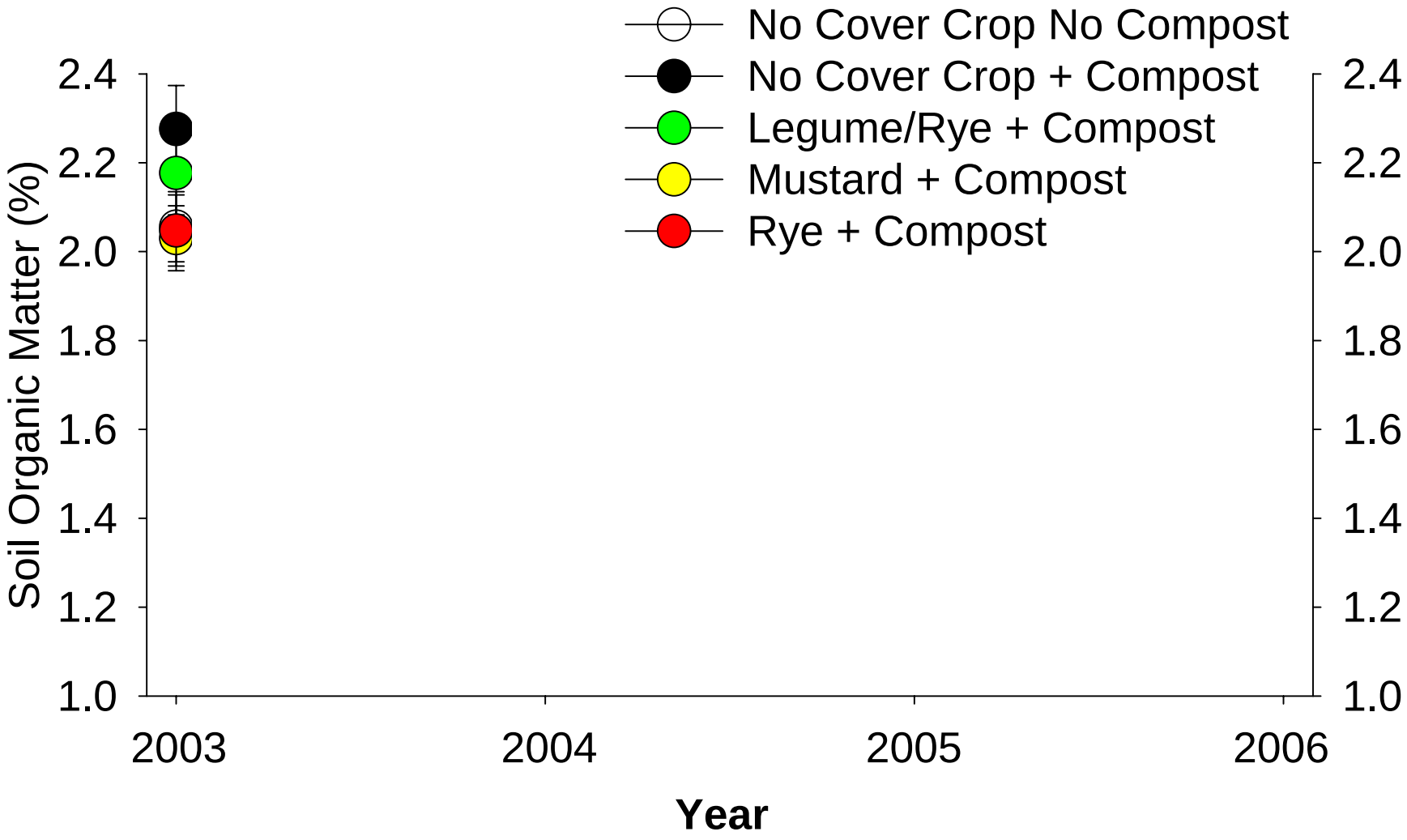
Cover Crop Canopies on Nov. 21, 2003, 37 Days After Planting

Cover Crop Effects on Soil Moisture and Potential Leaching of Nitrate



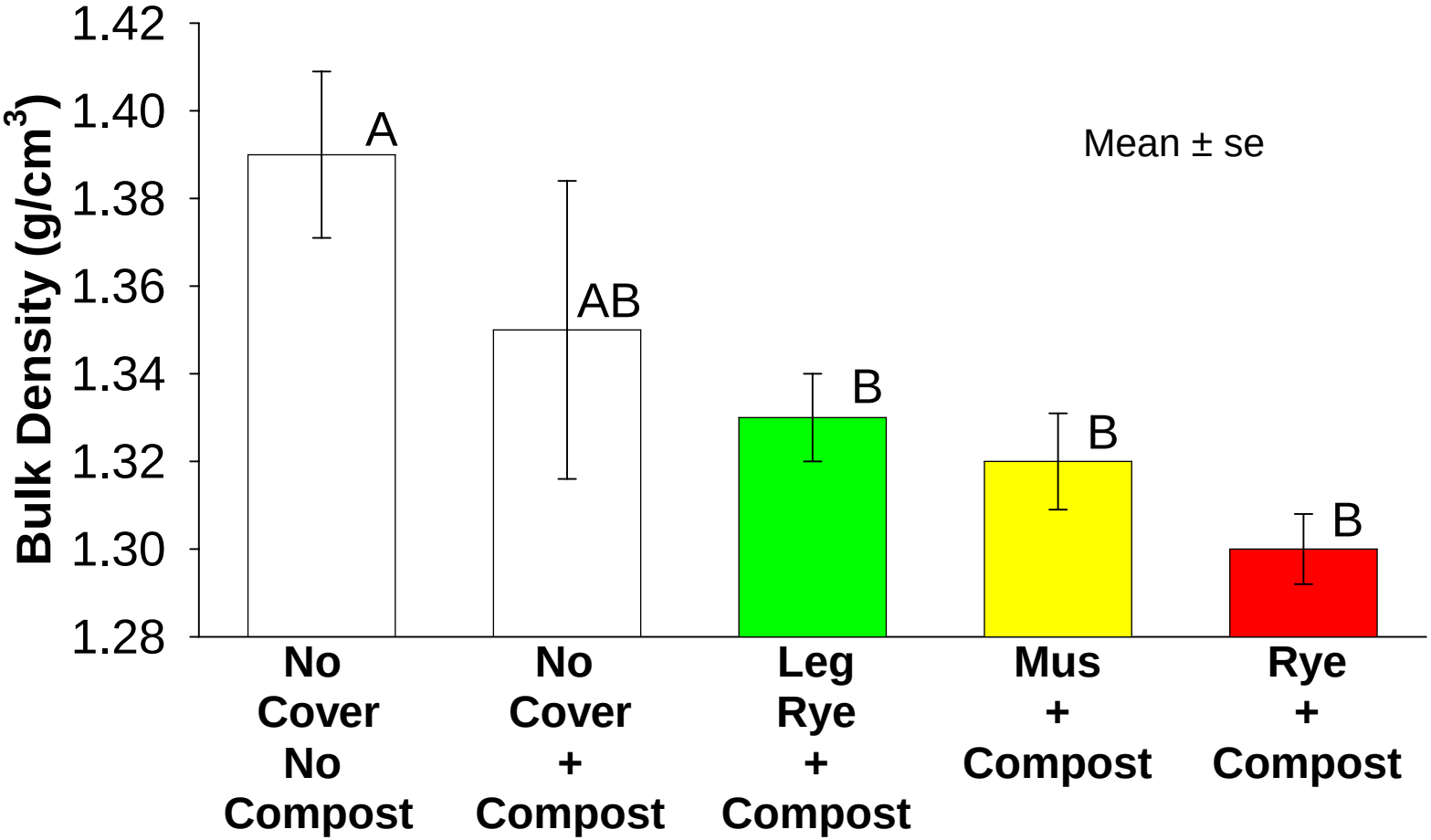

Cover Crop Seeding Rate
Cover Crop Variety
Compost
Soil Quality (Soil Organic Matter, Bulk Density)

Soil Organic Matter in 0 to 12” Depth*

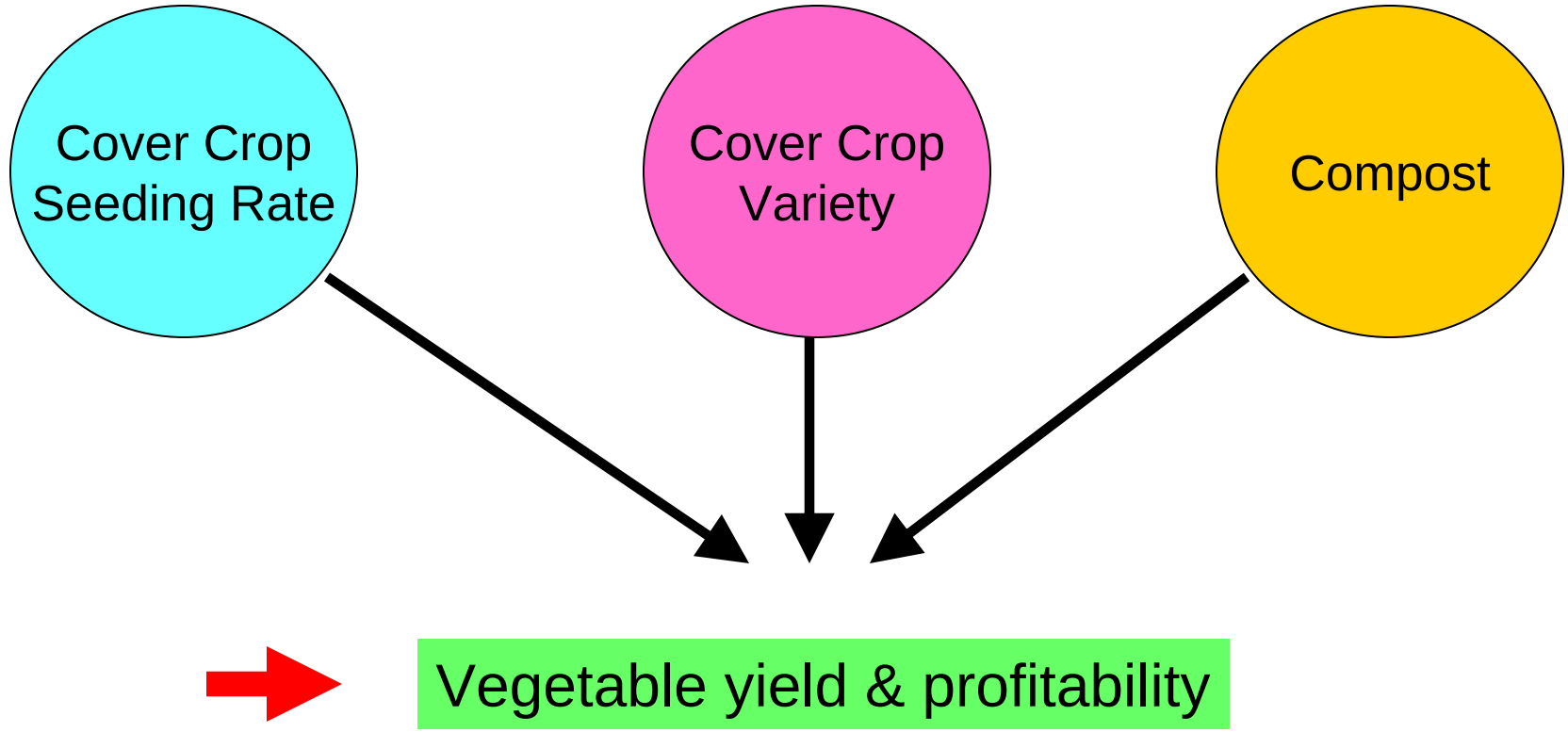


* Sampled each fall before planting cover crops

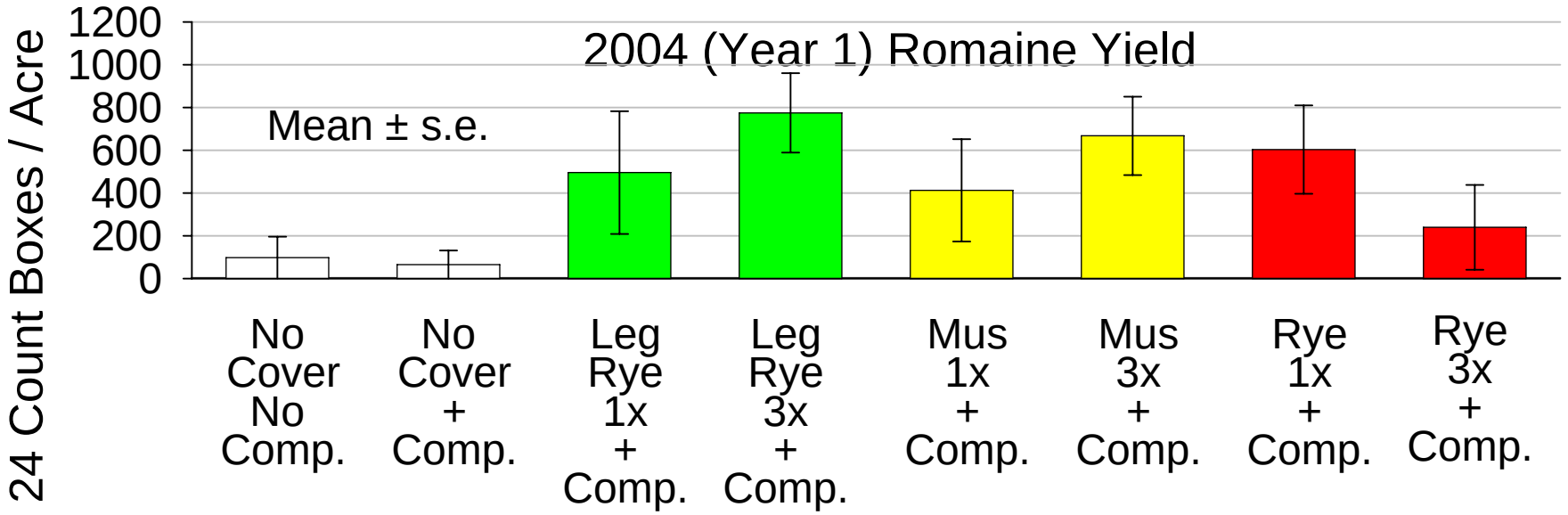
Soil Bulk Density in 0 to 5” Depth in November, 2006



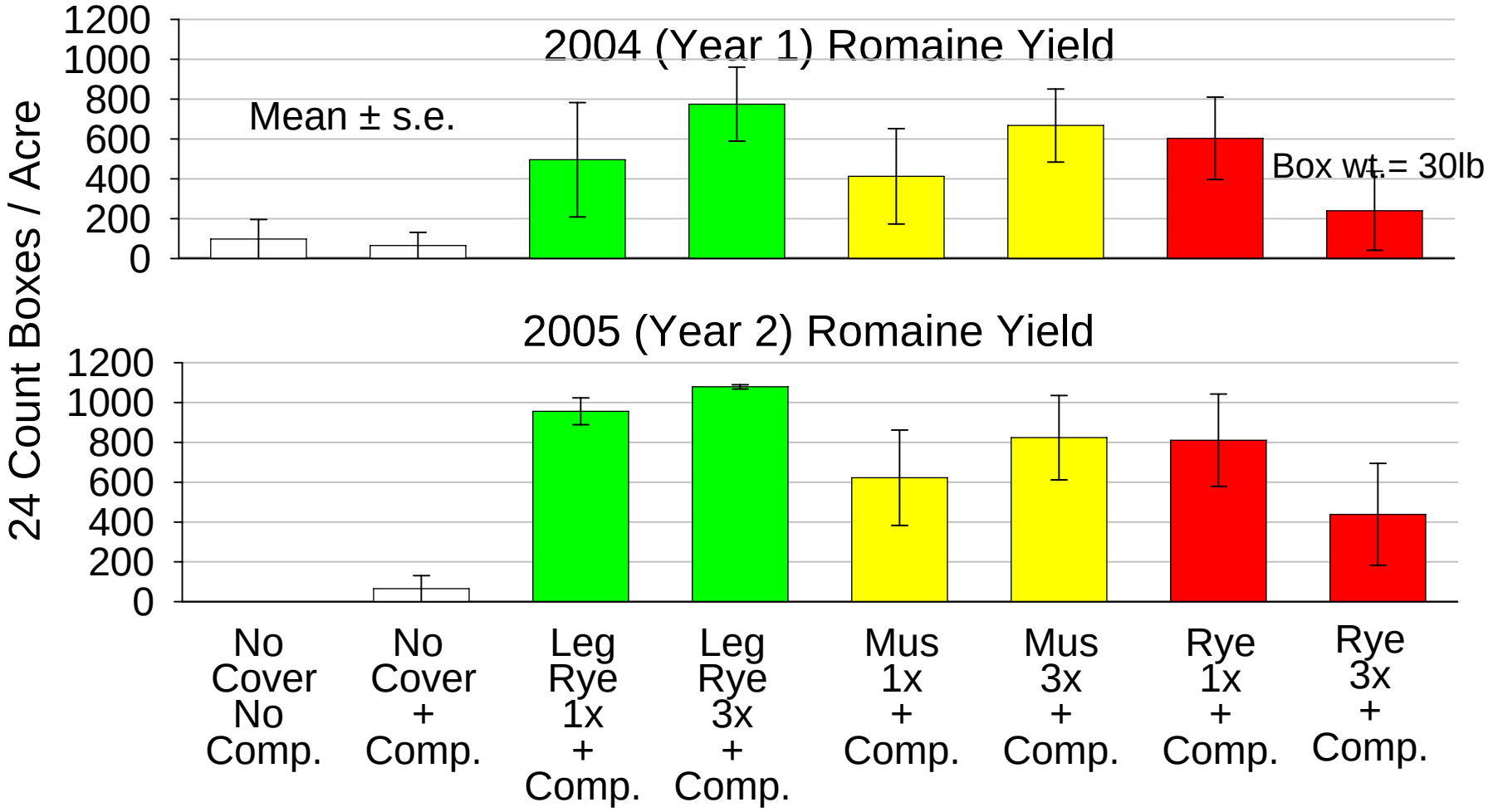
* Bars topped with different letters are significant at p<0.05

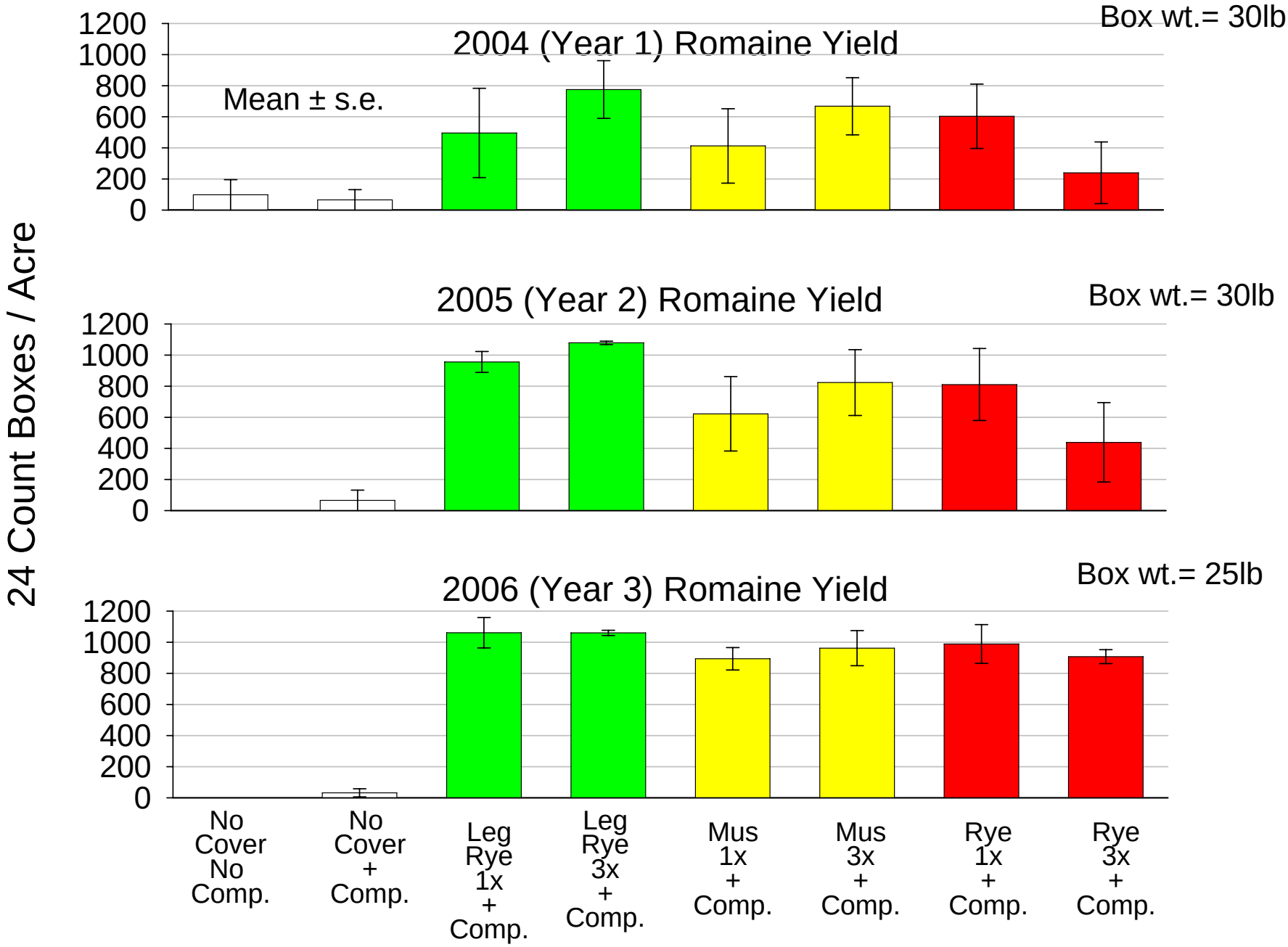

Cover Crop Seeding Rate
Cover Crop Variety
Compost
Vegetable yield & profitability

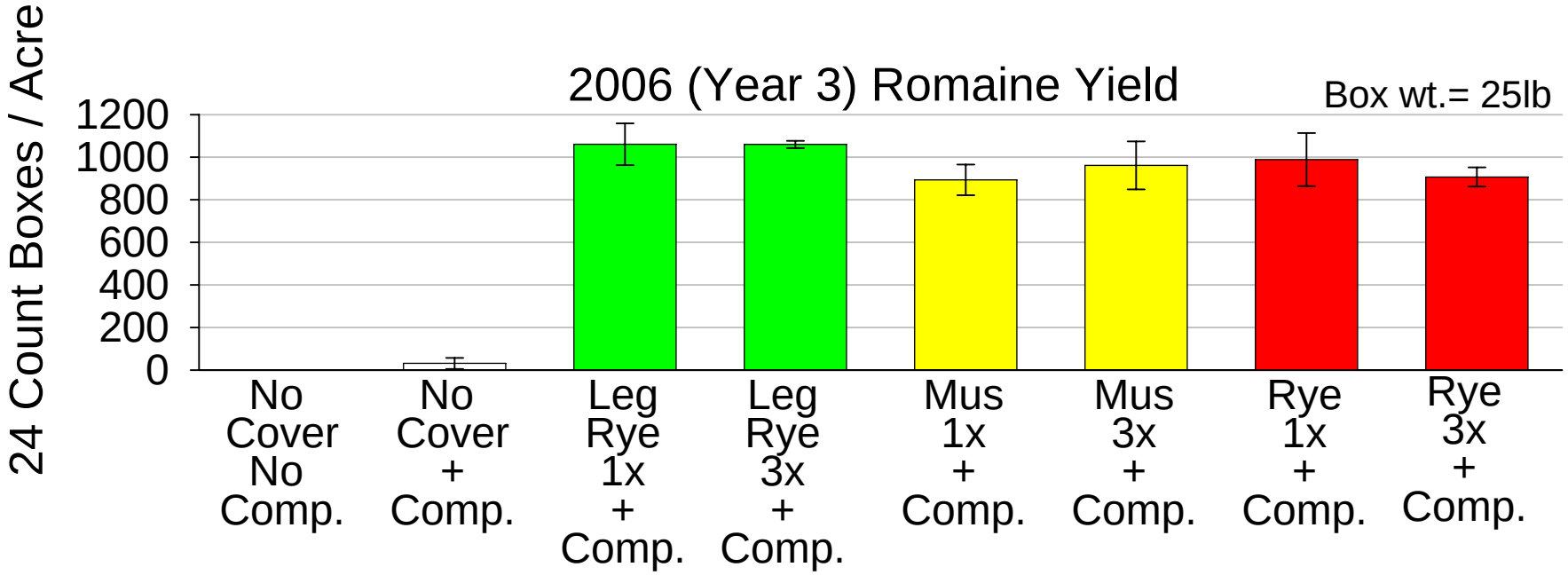
Box wt.= 30lb


2004 (Year 1) Romaine Yield
Mean ± s.e.
24 Count Boxes / Acre
1200
1000
800
600
400
200
0
No Cover No Comp.
No Cover + Comp.
Leg Rye 1x + Comp.
Leg Rye 3x + Comp.
Mus 1x + Comp.
Mus 3x + Comp.
Rye 1x + Comp.
Rye 3x + Comp.

Box wt.= 30lb


2004 (Year 1) Romaine Yield
Mean ± s.e.
Box wt.= 30lb
2005 (Year 2) Romaine Yield
24 Count Boxes / Acre
1200
1000
800
600
400
200
0
No Cover No Comp.
No Cover + Comp.
Leg Rye 1x + Comp.
Leg Rye 3x + Comp.
Mus 1x + Comp.
Mus 3x + Comp.
Rye 1x + Comp.
Rye 3x + Comp.


2004 (Year 1) Romaine Yield
Box wt.= 30lb
Mean ± s.e.
2005 (Year 2) Romaine Yield
Box wt.= 30lb
2006 (Year 3) Romaine Yield
Box wt.= 25lb
24 Count Boxes / Acre
1200
1000
800
600
400
200
0
No Cover No Comp.
No Cover + Comp.
Leg Rye 1x + Comp.
Leg Rye 3x + Comp.
Mus 1x + Comp.
Mus 3x + Comp.
Rye 1x + Comp.
Rye 3x + Comp.



1. Why was romaine yield much higher where cover crops were used?

2. Why was romaine yield relative similar across all cover crops?

Economics and Profitability

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Partial Budget for Systems - Romaine 2005

Cover Crop Variety & Seeding Rate	Compost 5t/acre/yr			Cover Crop and Compost Cost	
No Cover	No			21	
No Cover	Yes			268	
Leg/Rye 1x (100lb/acre)	Yes			*456*	
Leg/Rye 3x (300lb/acre)	Yes		$70 (13%)	*526*	
Mustard 1x (10lb/acre)	Yes			*450*	
Mustard 3x(30lb/acre)	Yes		$58 (13%)	*508*	
Rye 1x (80lb/acre)	Yes			*449*	
Rye 3x (240lb/acre)	Yes		$55 (12%)	*503*	

Cover Crop and Compost Cost = cover crop seed, planting, irrigation, mowing, incorporation with spader. Compost, and application. Three cultivations with rolling cultivator in No Cover Crop systems.

Partial Budget for Systems - Romaine 2005

Cover Crop Variety & Seeding Rate	Compost 5t/acre/yr	Yield†	Gross Cash Income‡	Cover Crop and Compost Cost	
			<----------$/acre---------->		
No Cover	No	0	0	21	
No Cover	Yes	65	802	268	
Leg/Rye 1x (100lb/acre)	Yes	956	11,806	*456*	
Leg/Rye 3x (300lb/acre)	Yes	1,079	13,325	*526*	
Mustard 1x (10lb/acre)	Yes	622	7,681	*450*	
Mustard 3x(30lb/acre)	Yes	824	10,176	*508*	
Rye 1x (80lb/acre)	Yes	810	10,003	*449*	
Rye 3x (240lb/acre)	Yes	438	5,409	*503*	

† Yield = 24 count boxes/acre (30 pounds/box).

‡ Gross cash income = yield x $12.35 (price/box).

Partial Budget for Systems - Romaine 2005

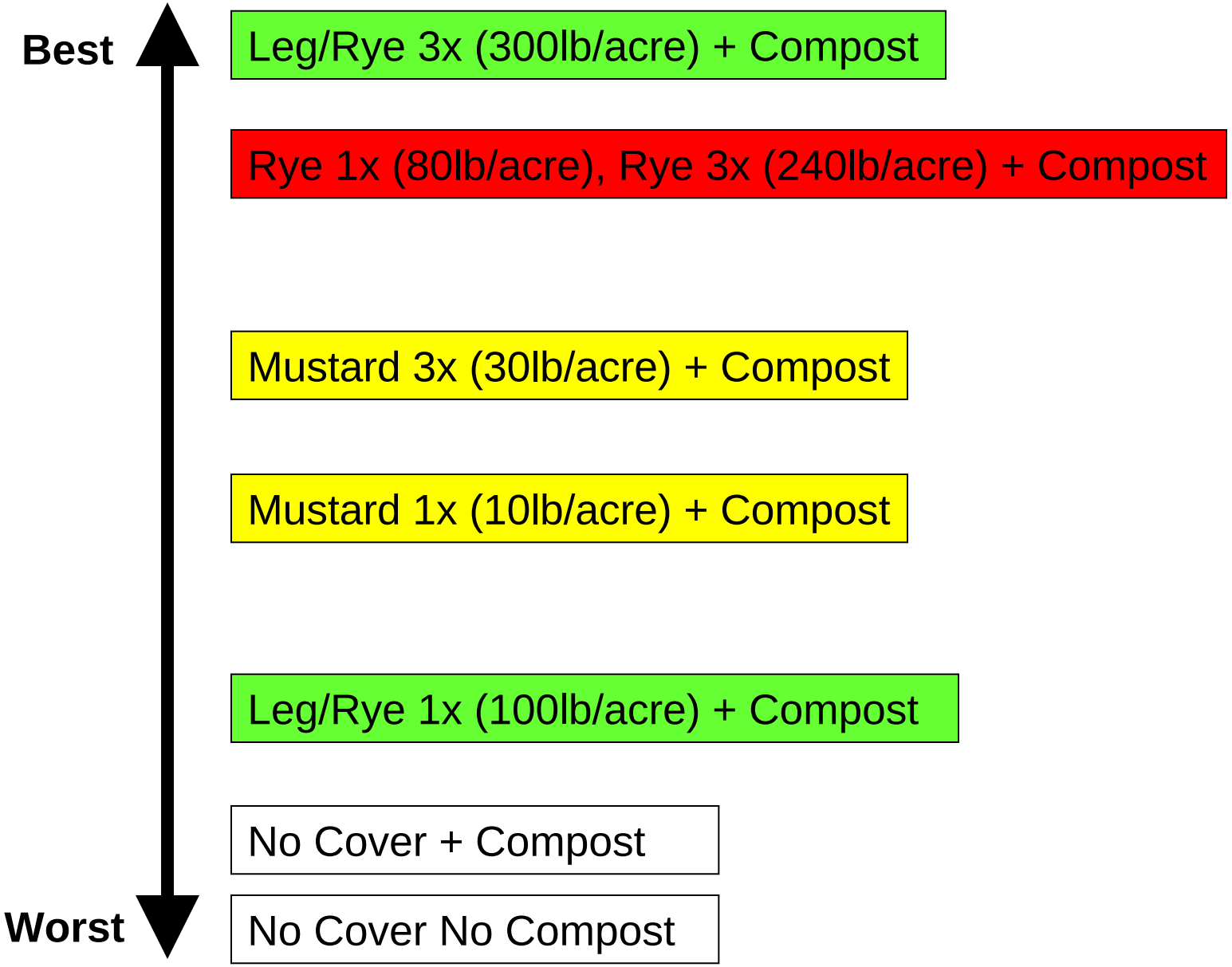
Cover Crop Variety & Seeding Rate	Compost 5t/acre/yr	Yield†	Gross Cash Income‡	Cover Crop and Compost Cost	Net Cash Income §
			<----------$/acre---------->		
No Cover	No	0	0	21	-21
No Cover	Yes	65	802	268	534
Leg/Rye 1x (100lb/acre)	Yes	956	11,806	*456*	*11,350*
Leg/Rye 3x (300lb/acre)	Yes	1,079	13,325	*526*	*12,799*
Mustard 1x (10lb/acre)	Yes	622	7,681	*450*	*7,231*
Mustard 3x(30lb/acre)	Yes	824	10,176	*508*	*9,668*
Rye 1x (80lb/acre)	Yes	810	10,003	*449*	*9,554*
Rye 3x (240lb/acre)	Yes	438	5,409	*503*	*4,906*

† Yield = 24 count boxes/acre (30 pounds/box).

‡ Gross cash income = yield x $12.35 (price/box).

§ Net cash income = income above cover crop and compost costs only.

Preliminary Ranking based on Overall Performance



All New !

Stay Tuned !

Description of Cover Crop and Compost Practices

Practice	Cover Crop	Seeding Rate	Compost * (10 tons/acre/yr)
1	No Cover Crop 3 yrs, Legume/Rye 3x in 4th yr	-	No
2	No Cover Crop 3 yrs, Legume/Rye 3x in 4th yr	-	Yes
3	Legume/Rye Mix	1x (100lb/acre)	Yes
4	Legume/Rye Mix	3x (300lb/acre)	Yes
5	Mustard	1x (10lb/acre)	Yes
6	Mustard	3x (30lb/acre)	Yes
7	Rye	1x (80lb/acre)	Yes
8	Rye	3x (240lb/acre)	Yes

Summary

Cover Crop Seeding Rate

-Higher Rates → Early Season Growth → Weeds & N Leaching Potential

-No effect on romaine yield or soil quality.

-Minimal effect on cover cropping cost

Cover Crop Variety

-Early Season growth slowest with Legume/Rye

-Mustard was least reliable cover crop

-No effect on soil quality

-Leg/Rye produced highest and least variable romaine yields in Yr 1 and 2

-Romaine yield good in all cover crops in Yr 3.

Compost

-Extremely low yields without cover crop.

-Helped to maintain soil organic matter and reduce compaction


Cover crops are an inconvenient
but essential part of the solution!
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