Intercropping Peas & Canola:

Row/Crop Configuration & N Fertility

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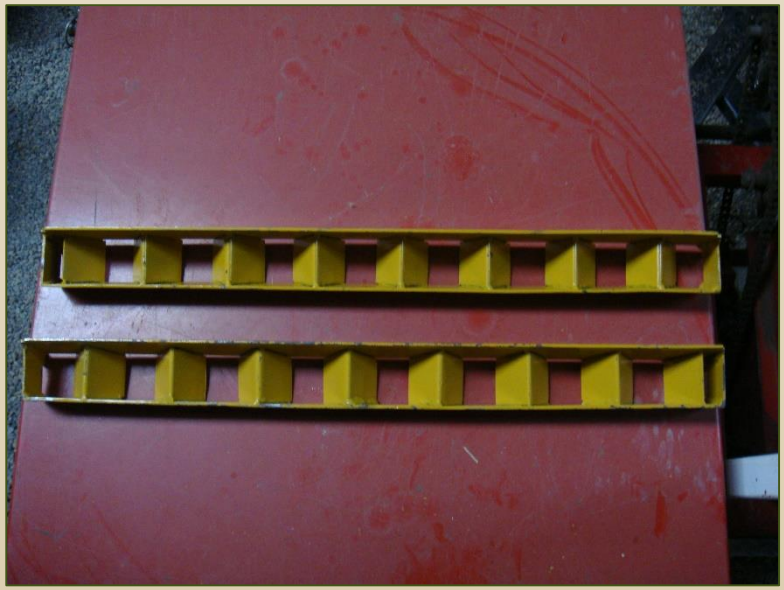
IHARF Intercropping Trials: Background & Objectives

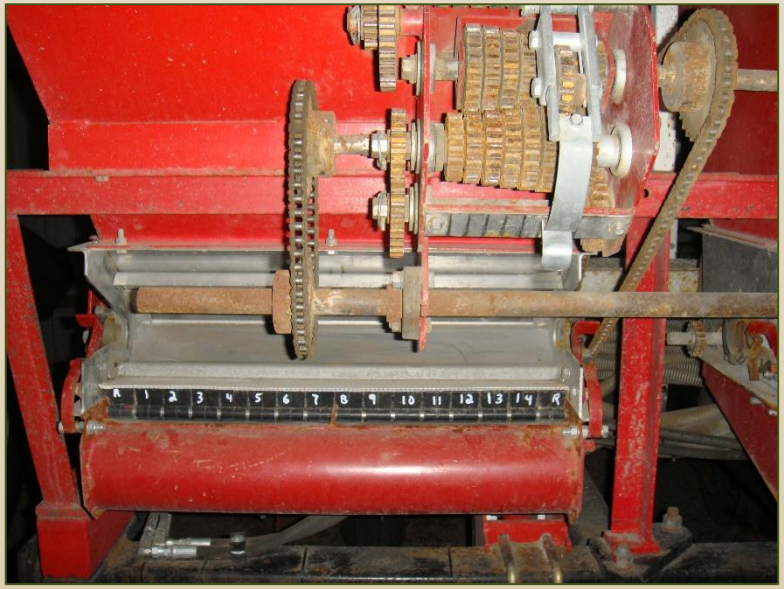
- In response to interest from both IHARF Directors & an appreciable number of producers, several field trials with intercropped field pea & canola were conducted from 2010 through 2012

Objectives:

1. To gain experience with intercropping canola & (yellow) pea while demonstrating the potential agronomic and economic merits of this practice under local field conditions
2. To compare the performance of alternating versus mixed rows
3. To optimize N fertilizer management in pea-canola intercrops and assess whether optimal levels are affected by row-crop configuration

Equipment Adaptation – Alternate Rows





- Indian Head plots seeded with Conserva-Pak plot drill with 14 openers (12” spacing)
- Products delivered through 4 independent Valmar boxes and metering system
- Only modification required was fabrication of special inserts which were placed between the rollers and venturis to direct all product to either odd or even rows for alternating row configuration (no modifications required for mixed row intercrops)
- Both field peas and canola were seeded at the same depth of approximately 1” for the purposes of these trials

Pea-Canola Intercrop Treatments

Trial #1: Indian Head 2010-12

	Indian Head Clay 2010	Indian Head Clay 2011	Oxbow Loam 2011	Indian Head Clay 2012
1) Canola (monocrop)	X	X	X	X
2) Field pea (monocrop)	X	X	X	X
3) Mixed-Rows (intercrop)			X	X
4) Alternate-Rows (intercrop)	X	X	X	X

- From 2010-12, basic trials at Indian Head compared intercropped (yellow) peas and (Clearfield) canola to monocultures of the same two crops
- Intercrop seed rates were 67% of the rates used in the respective monocrops
- P, K and S rates constant across treatments, total N fertilizer rate in the intercrop was 50% of that used in the canola monocrop (97-107 lb N/ac)
- All treatments replicated a minimum of 4 times with some variation in the specific treatments from trial to trial

Equipment Adaptation – Alternate Rows

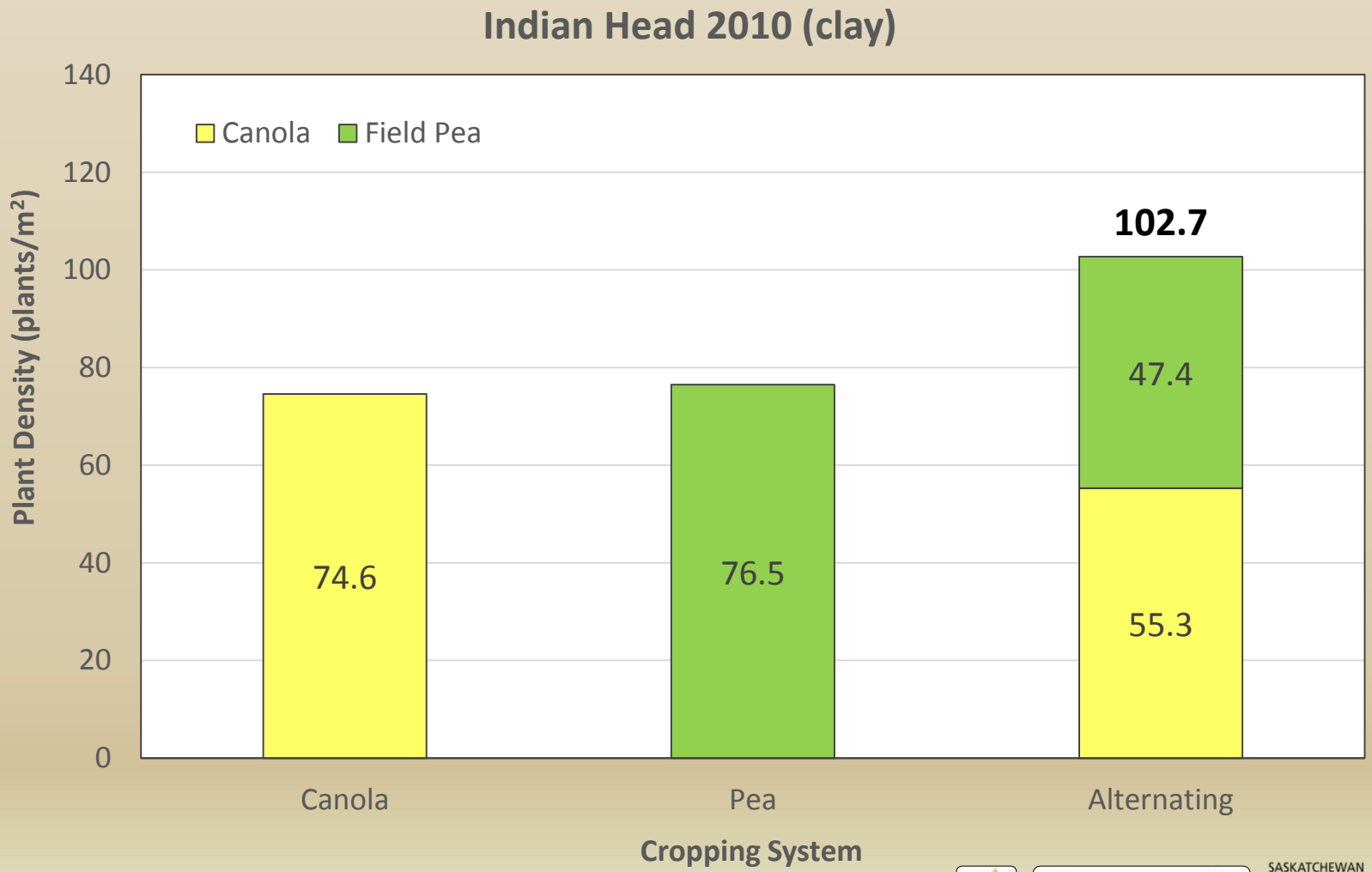
Marginal Profit Assumptions

- Market prices & seed costs taken from SK 2018 Crop Planning Guide & only take into consideration variable expenses that differed between treatments (seed & N costs)
- N fertilizer price of $0.50/lb N assumed
- Values do not represent absolute returns (i.e. not all expenses accounted for) nor do they include cost of separating crops

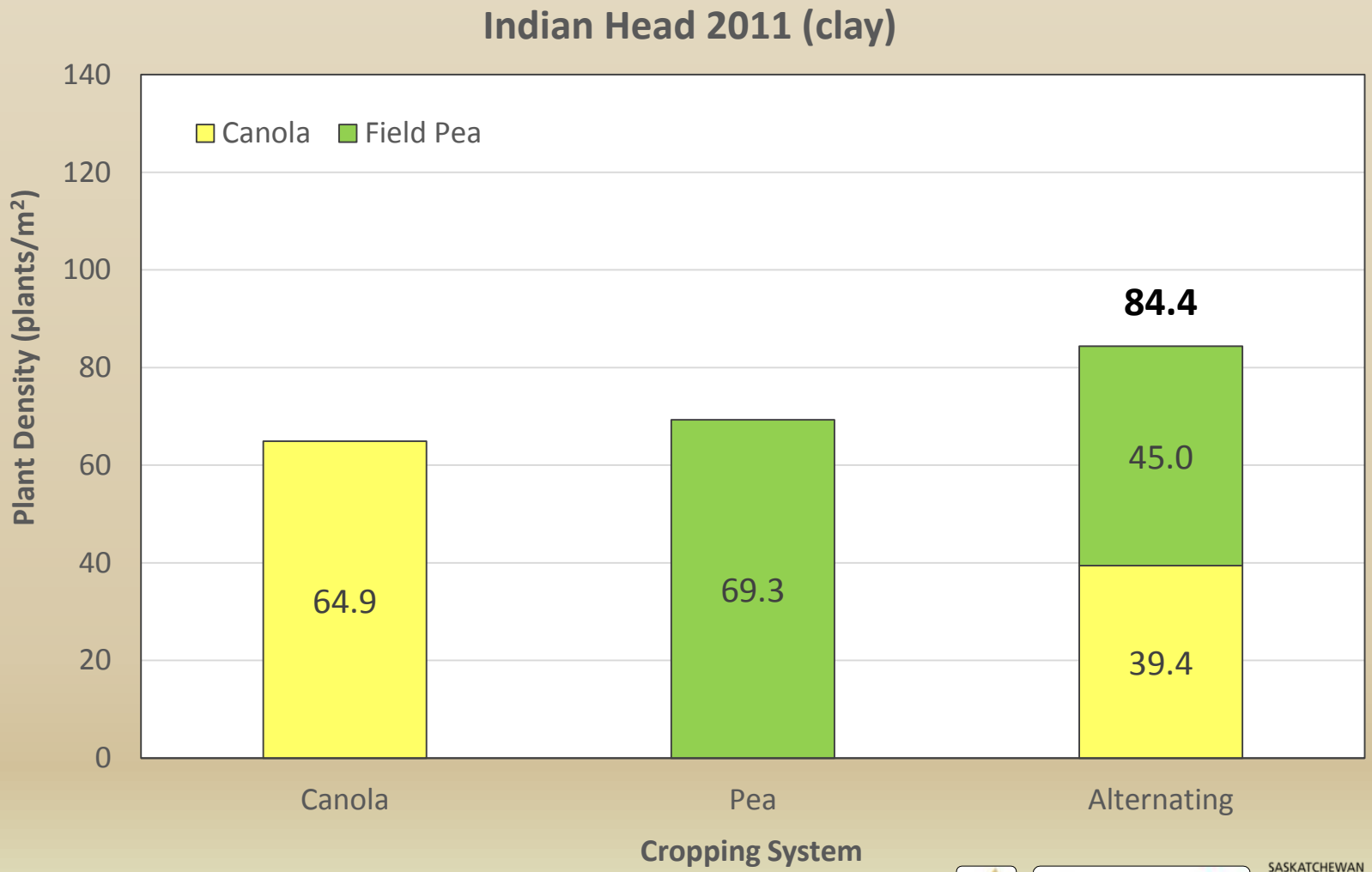
Treatment	Revenue	Seed*	Nitrogen*
	$/bu	$/ac	$/ac
Can-Mono	11.36	62.60	52.50
Can-Inter	11.36	41.94	26.25
Pea-Mono	7.00	35.55	0
Pea-Inter	7.00	23.82	0

*67% seed rates & 50% of monocrop canola N rate in intercropped treatments

Indian Head Clay 2010 (Exp#1)
Plant Establishment



Indian Head Clay 2011 (Exp#1)
Plant Establishment



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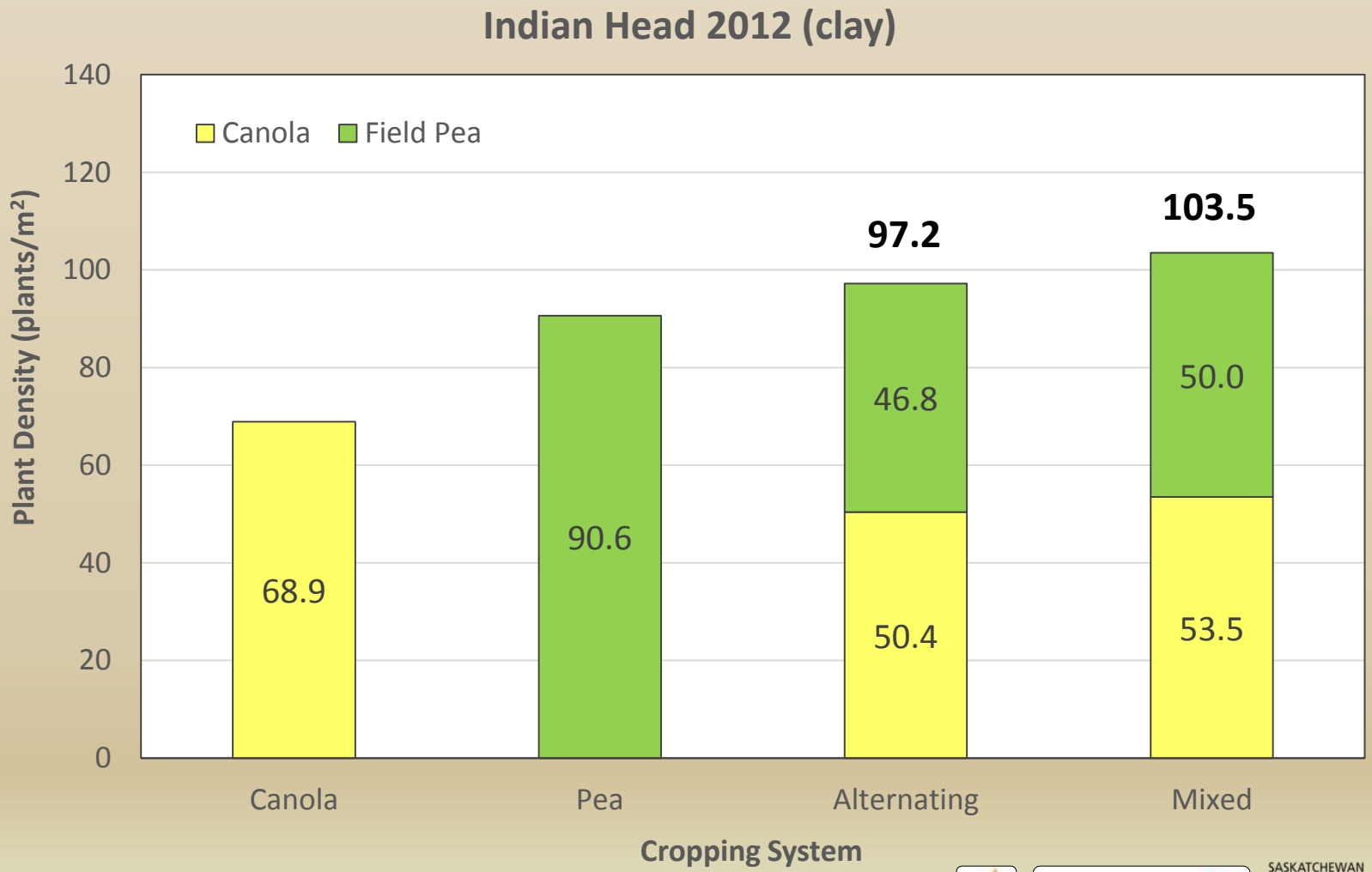
Indian Head Clay 2012 (Exp#1)
Plant Establishment



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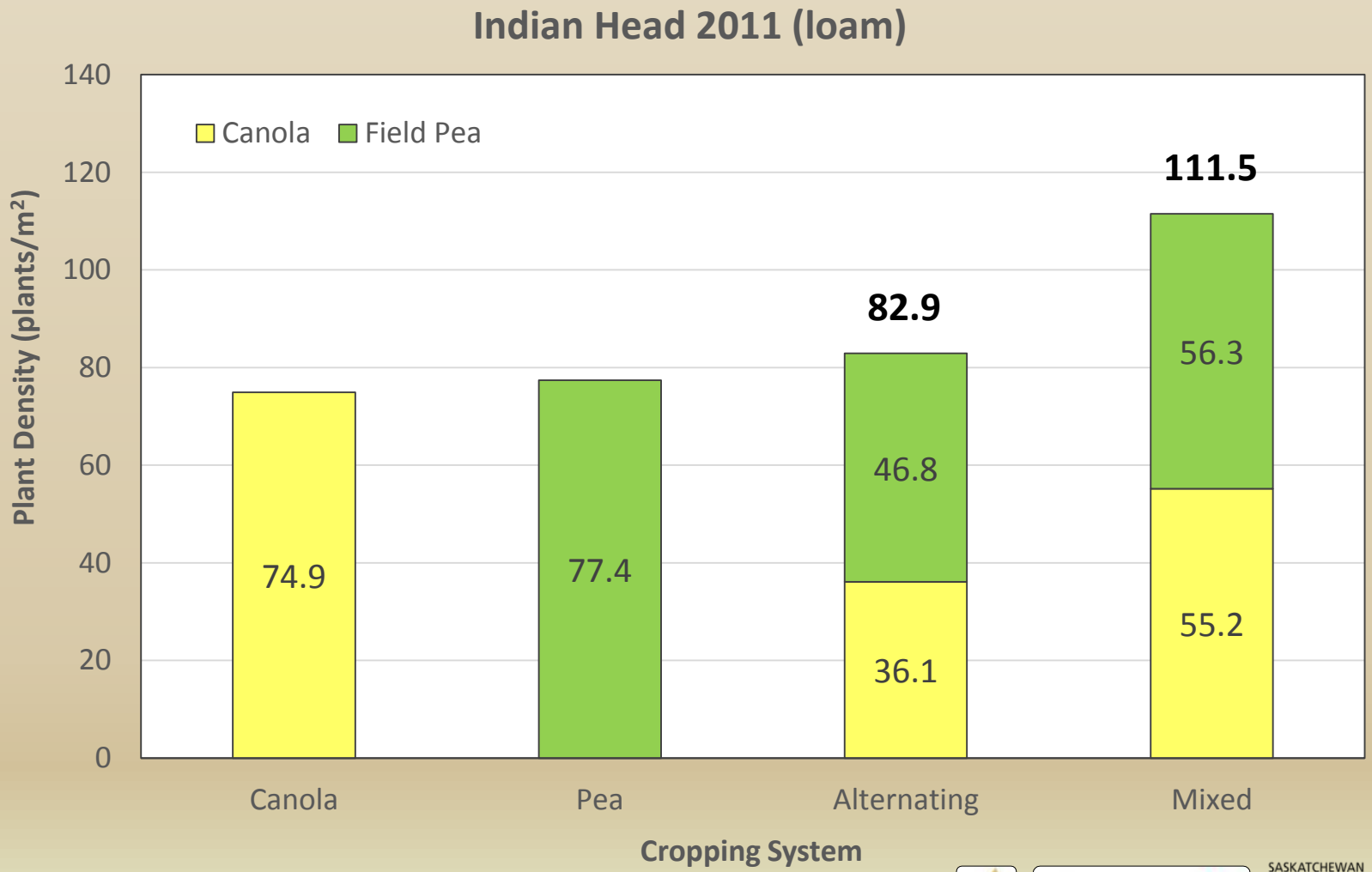
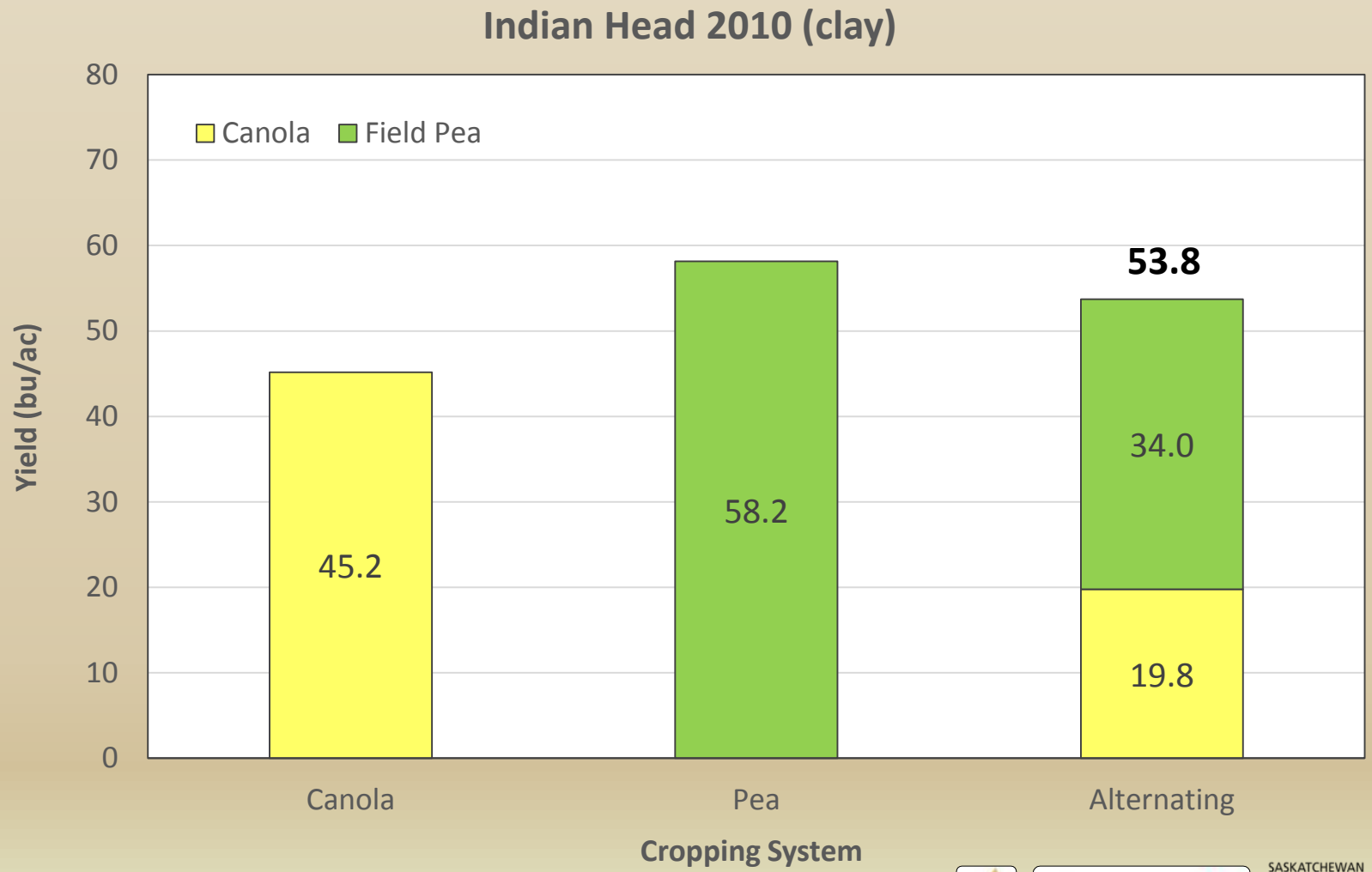
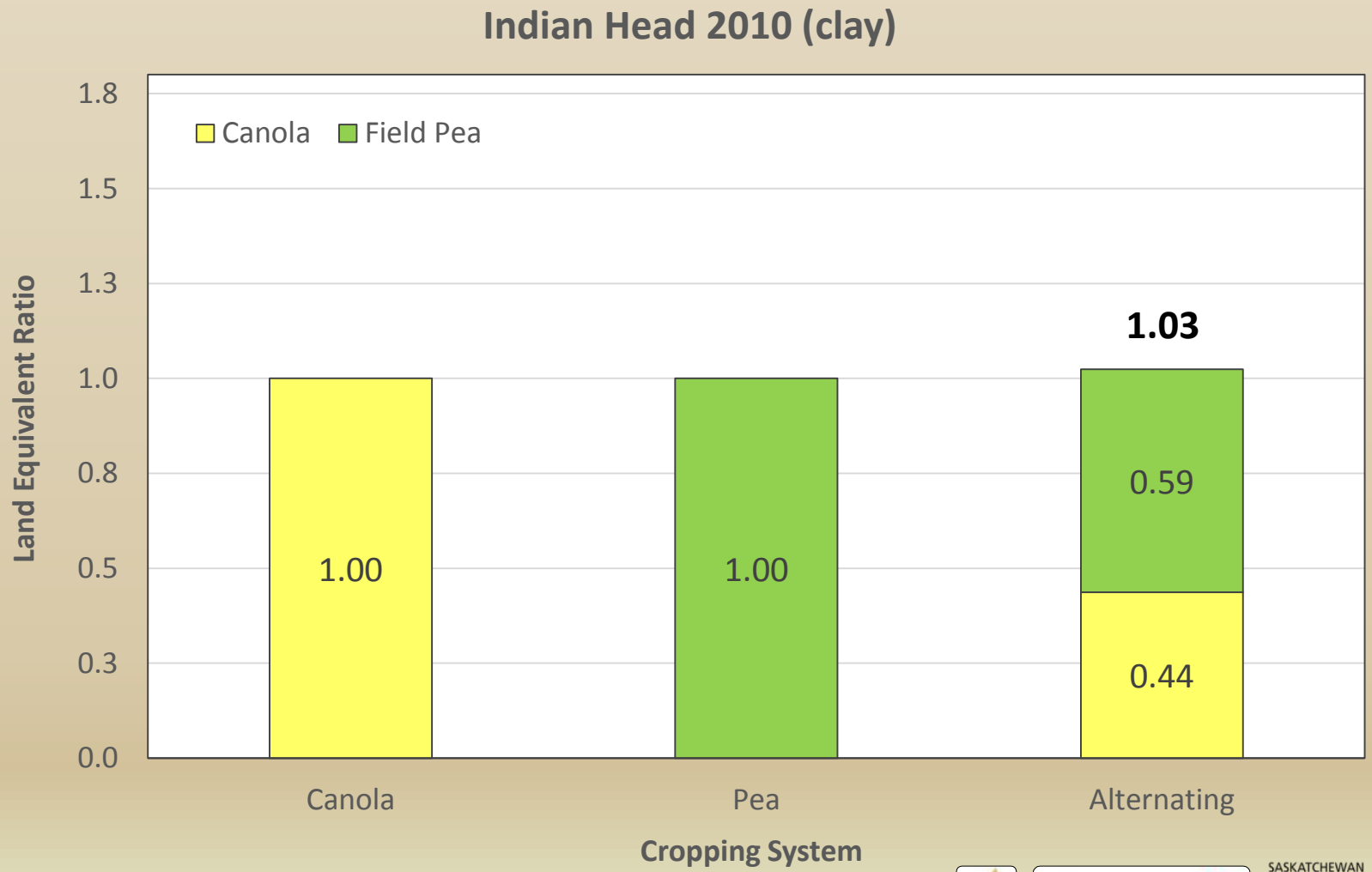
Indian Head Loam 2011 (Exp#1)
Plant Establishment



Indian Head Clay 2010 (Exp#1)
Grain Yield



Indian Head Clay 2010 (Exp#1)
Land Equivalent Ratio



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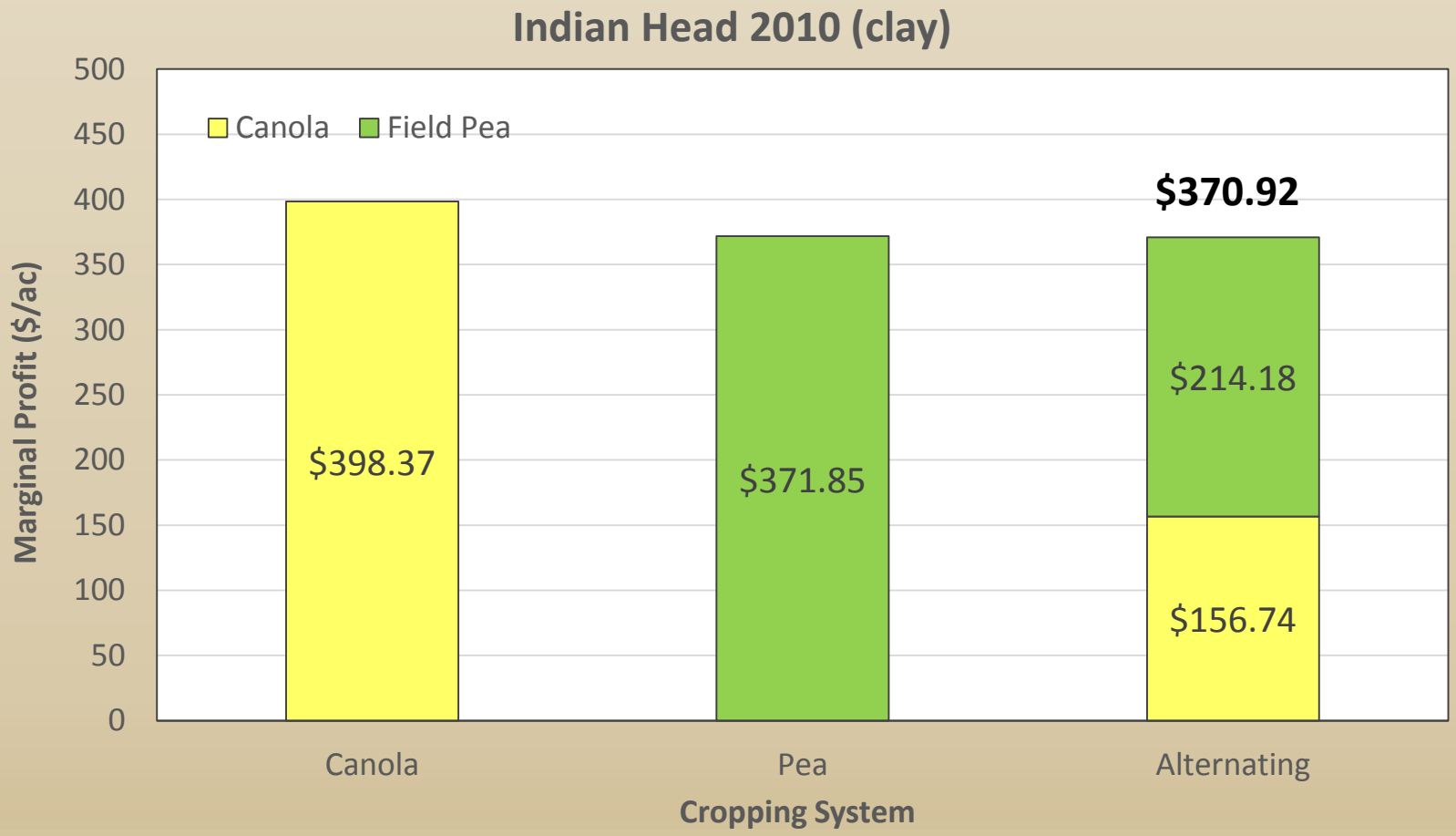
Indian Head Clay 2010 (Exp#1) Marginal Profits*



* Does not include all variable or any fixed expenses

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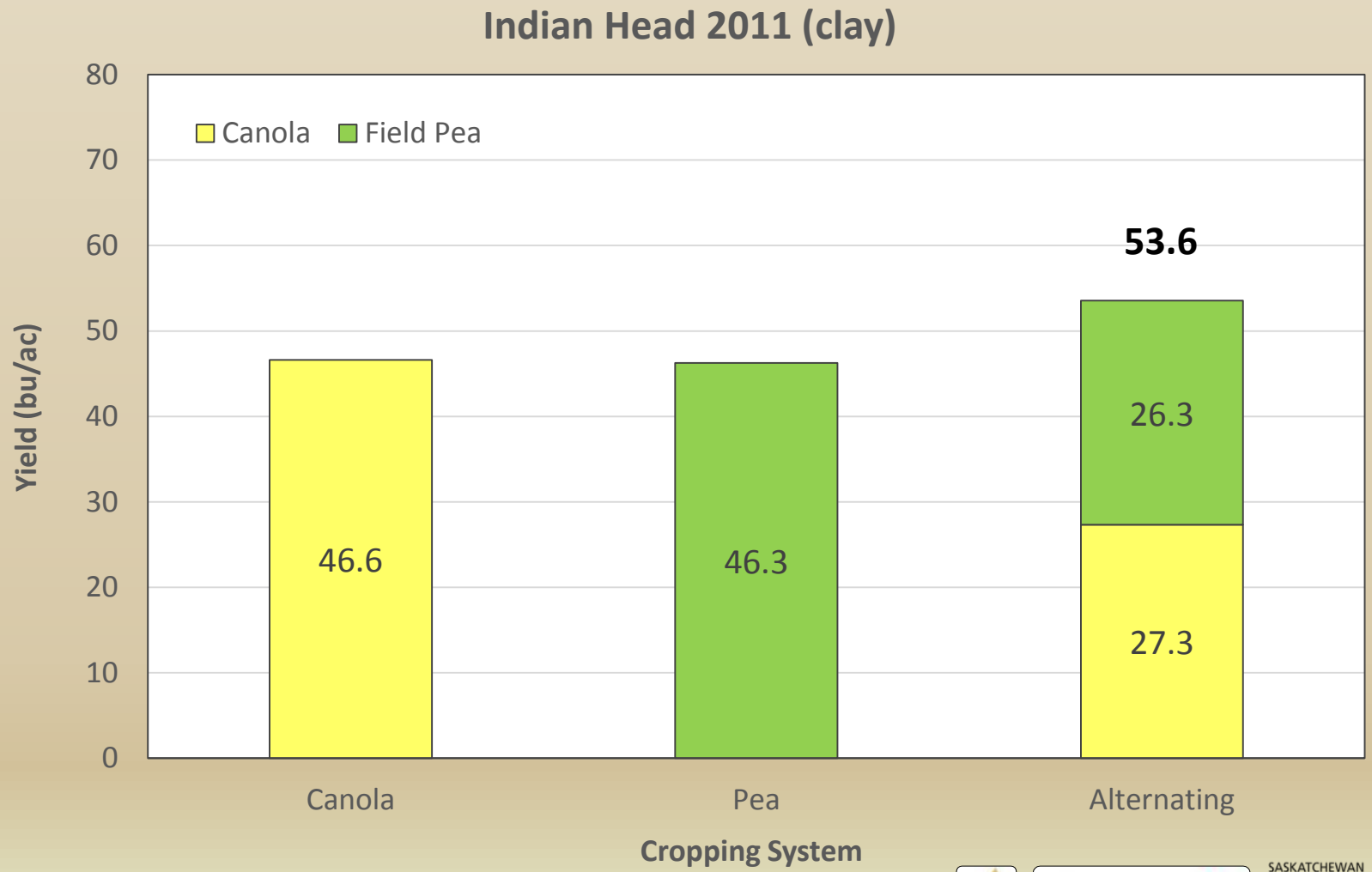
Indian Head Clay 2011 (Exp#1)
Grain Yield



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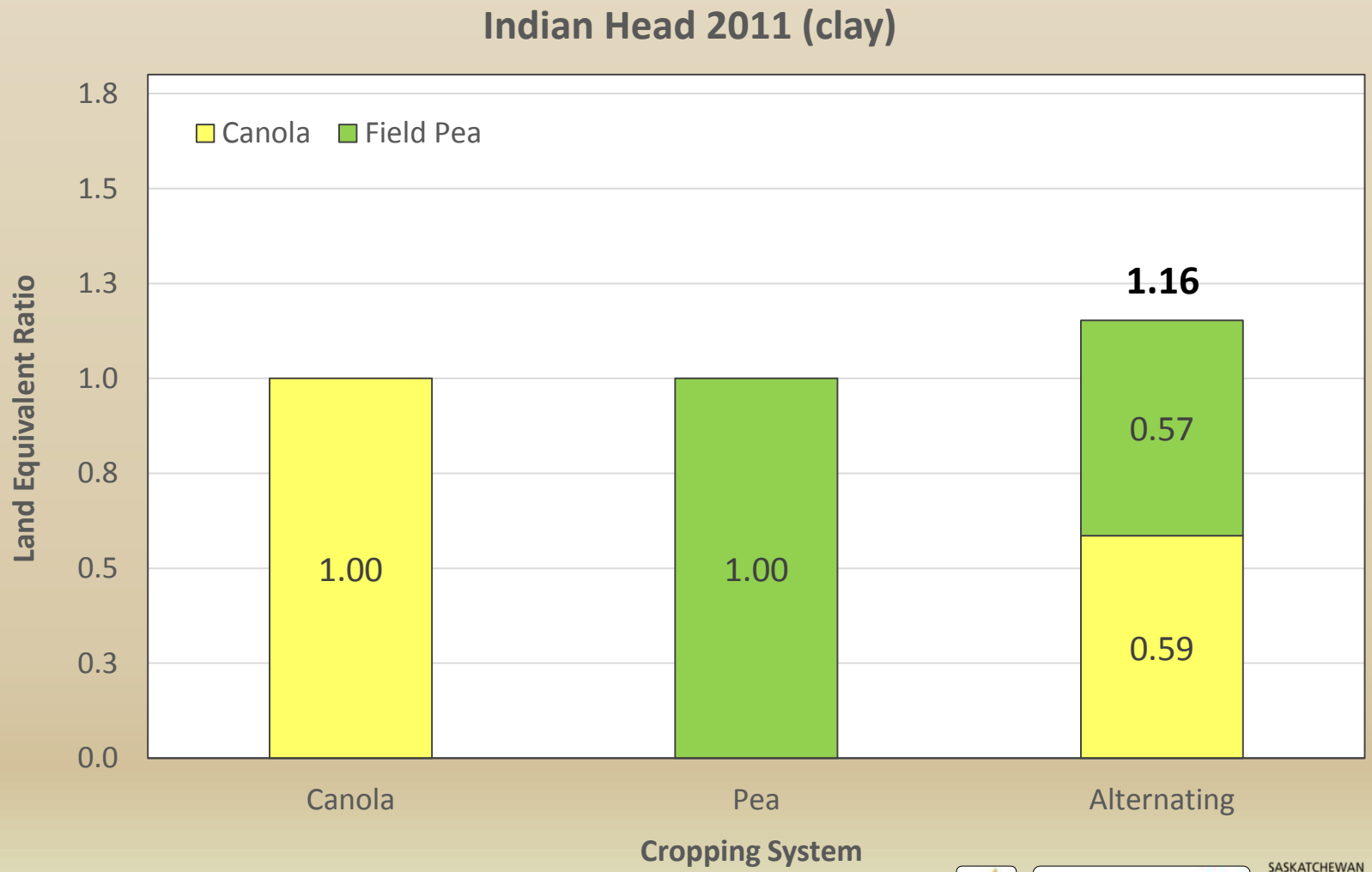
Land Equivalent Ratio



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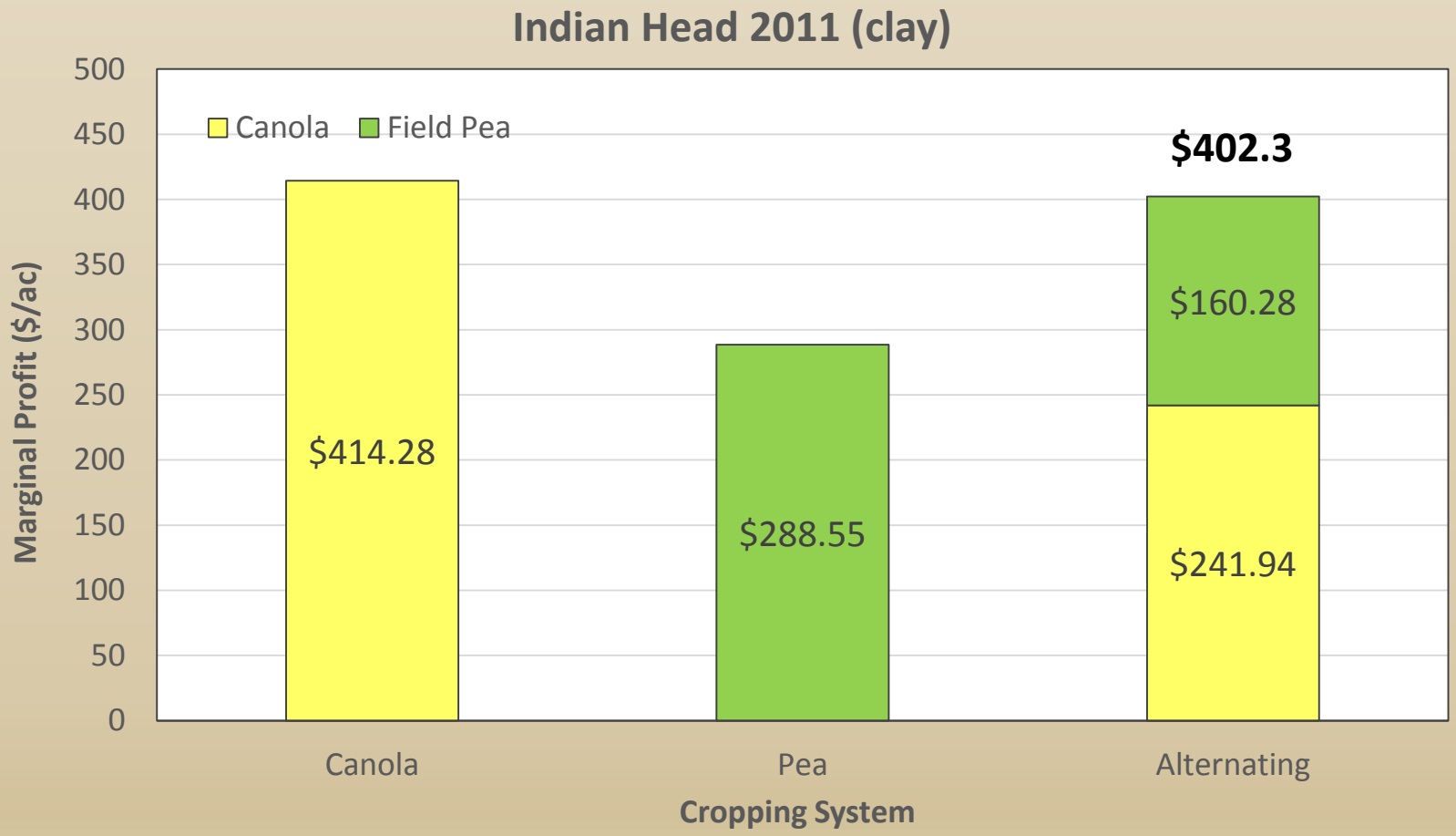

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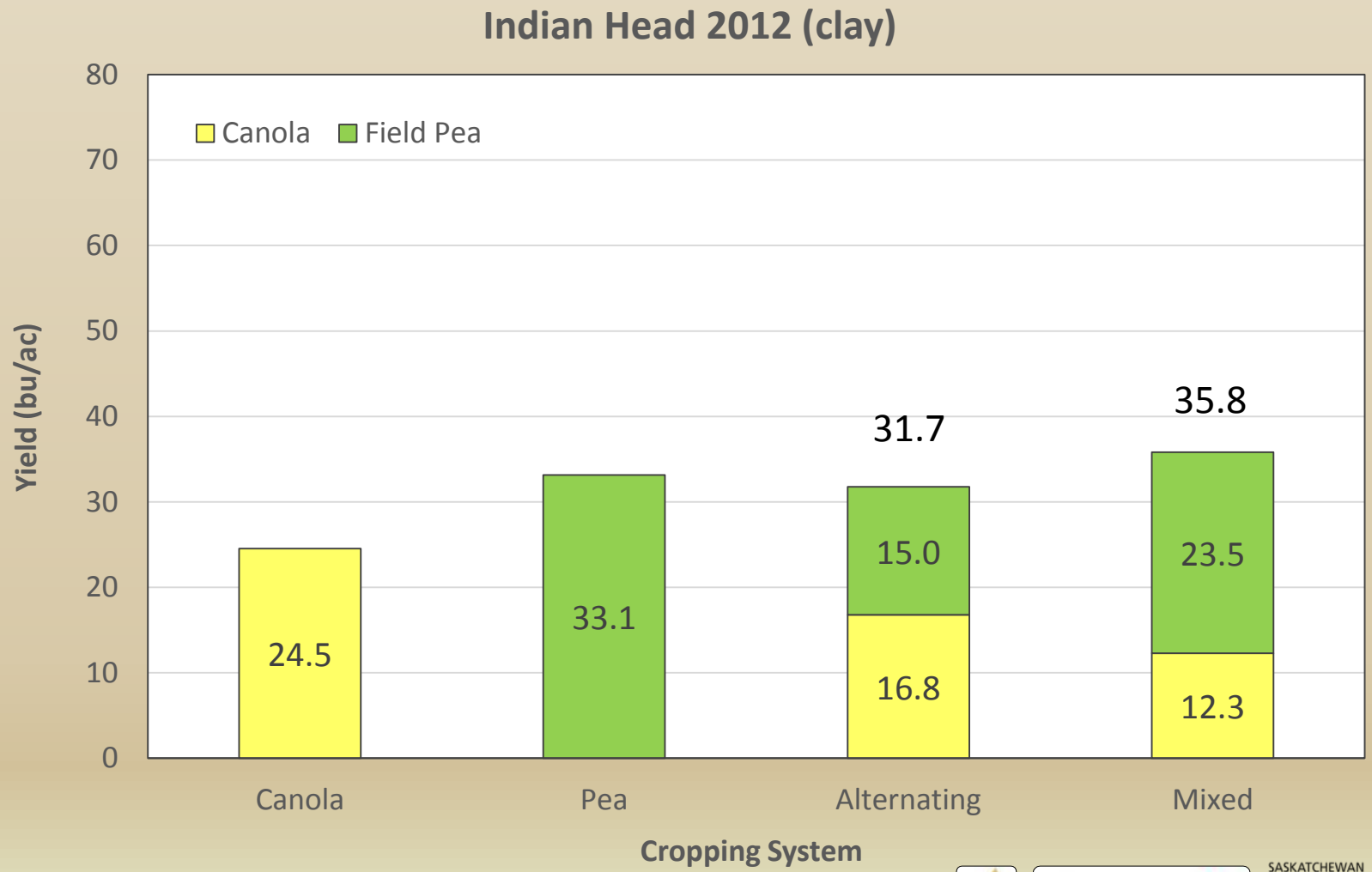

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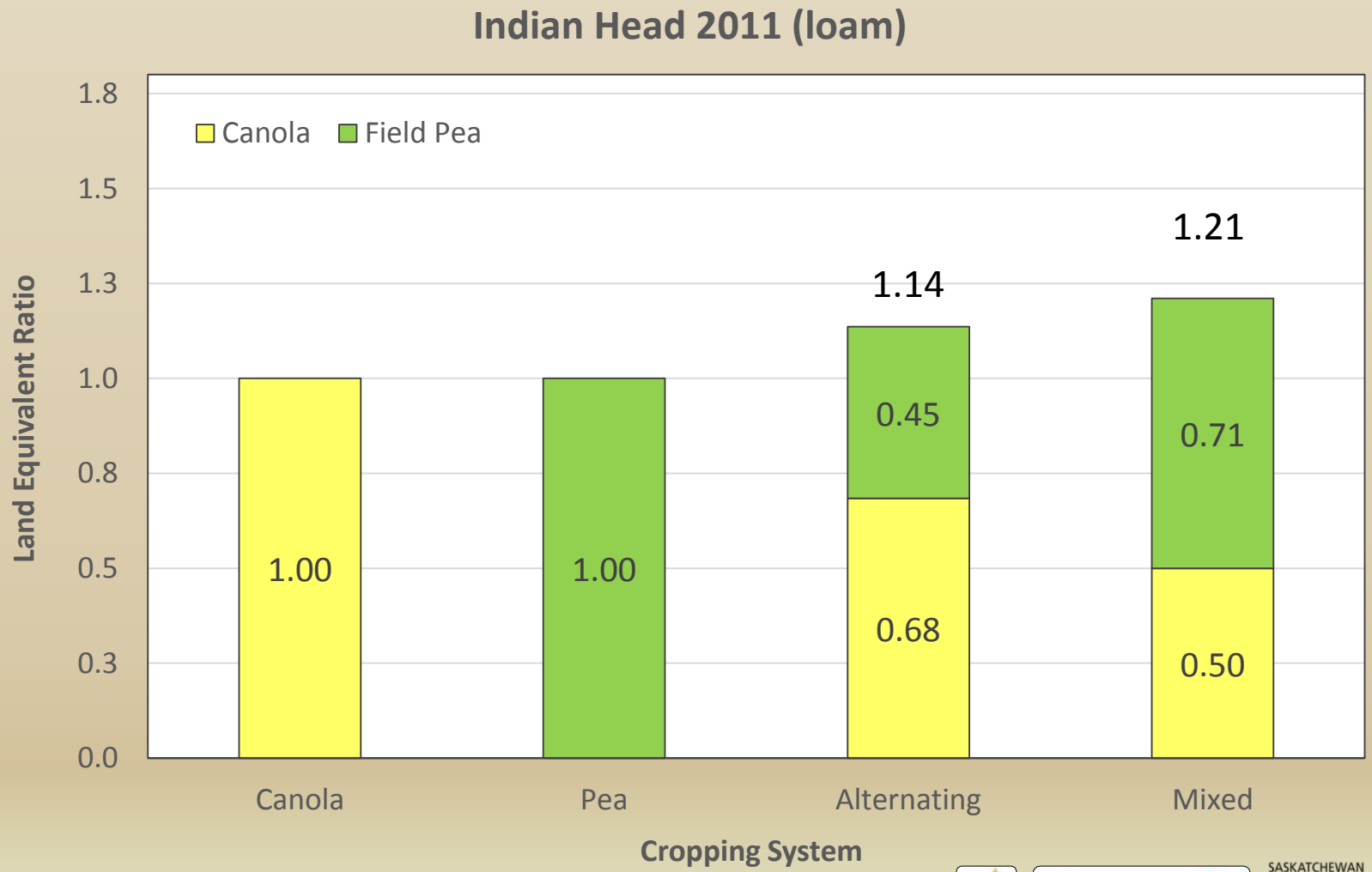
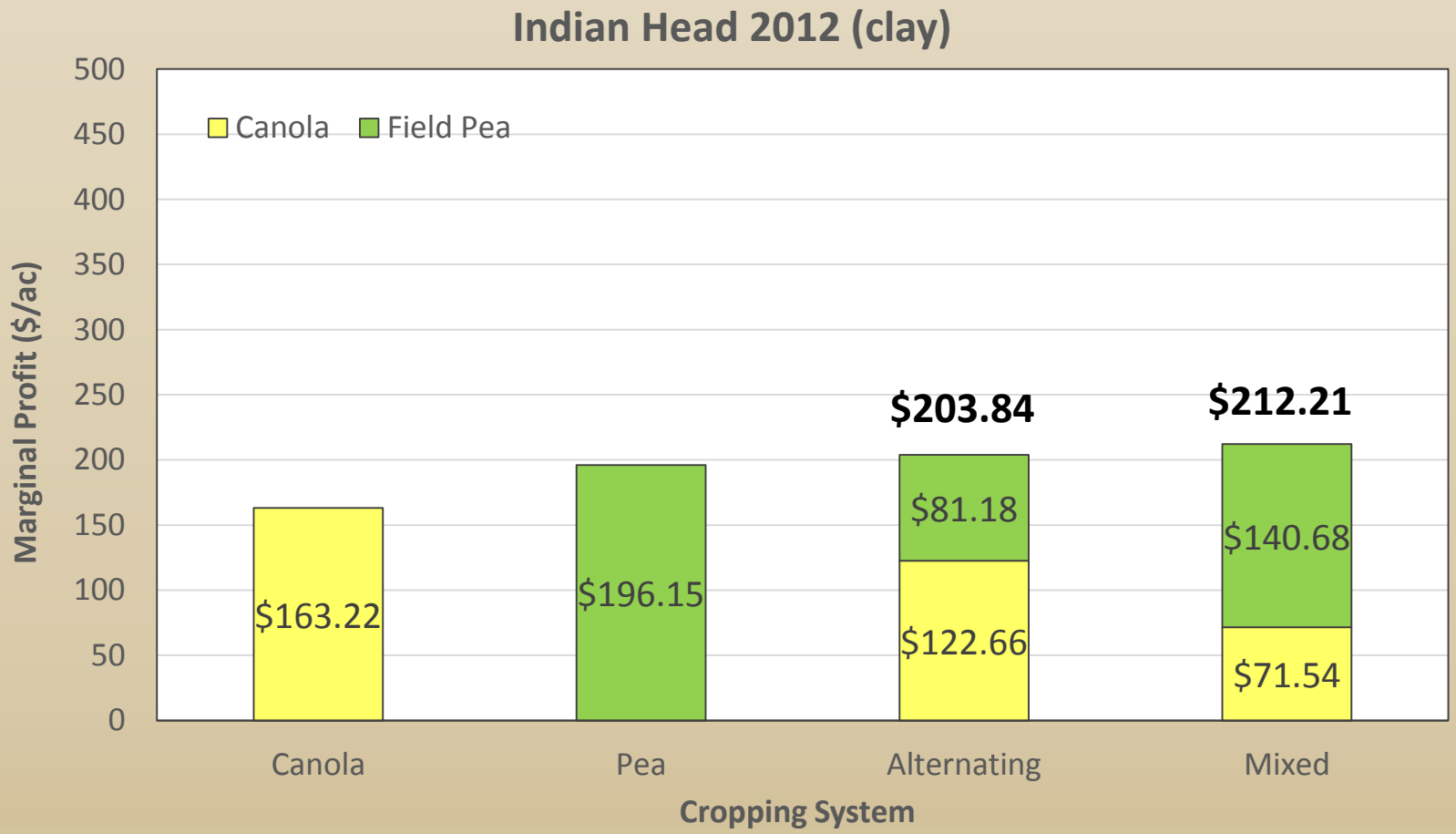


Indian Head Clay 2012 (Exp#1) Marginal Profits*



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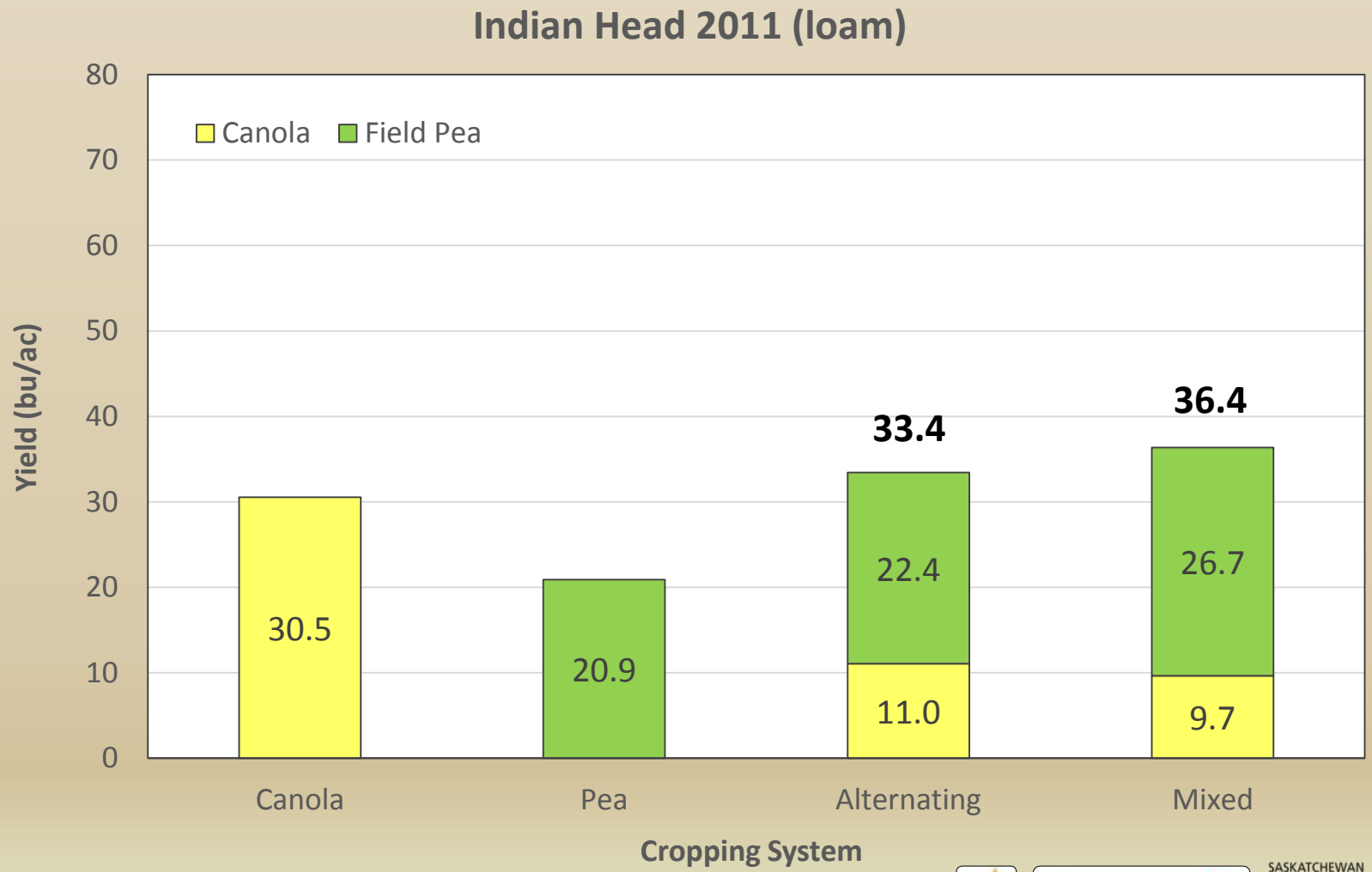
Indian Head Loam 2011 (Exp#1)
Grain Yield



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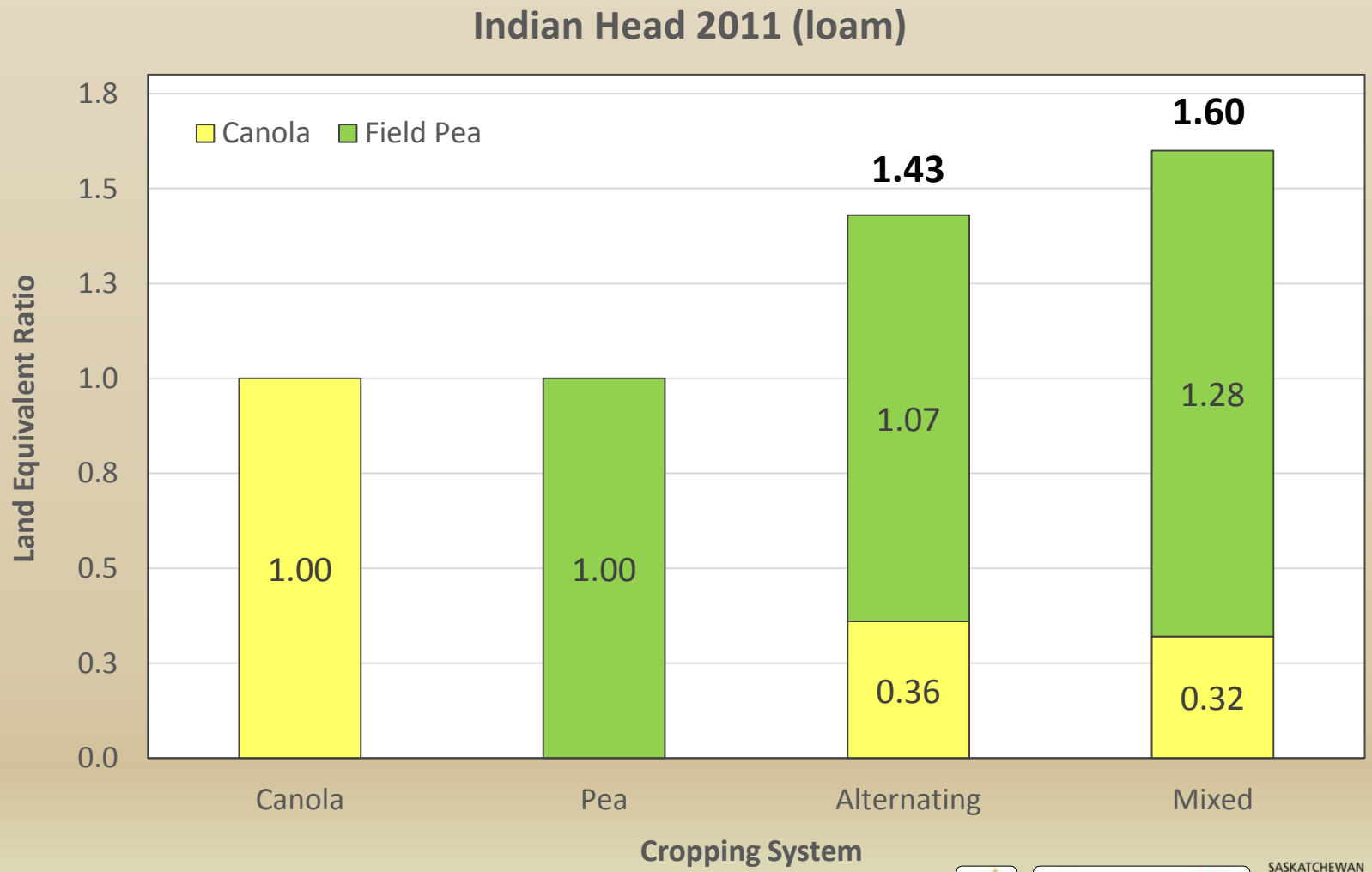
Land Equivalent Ratio



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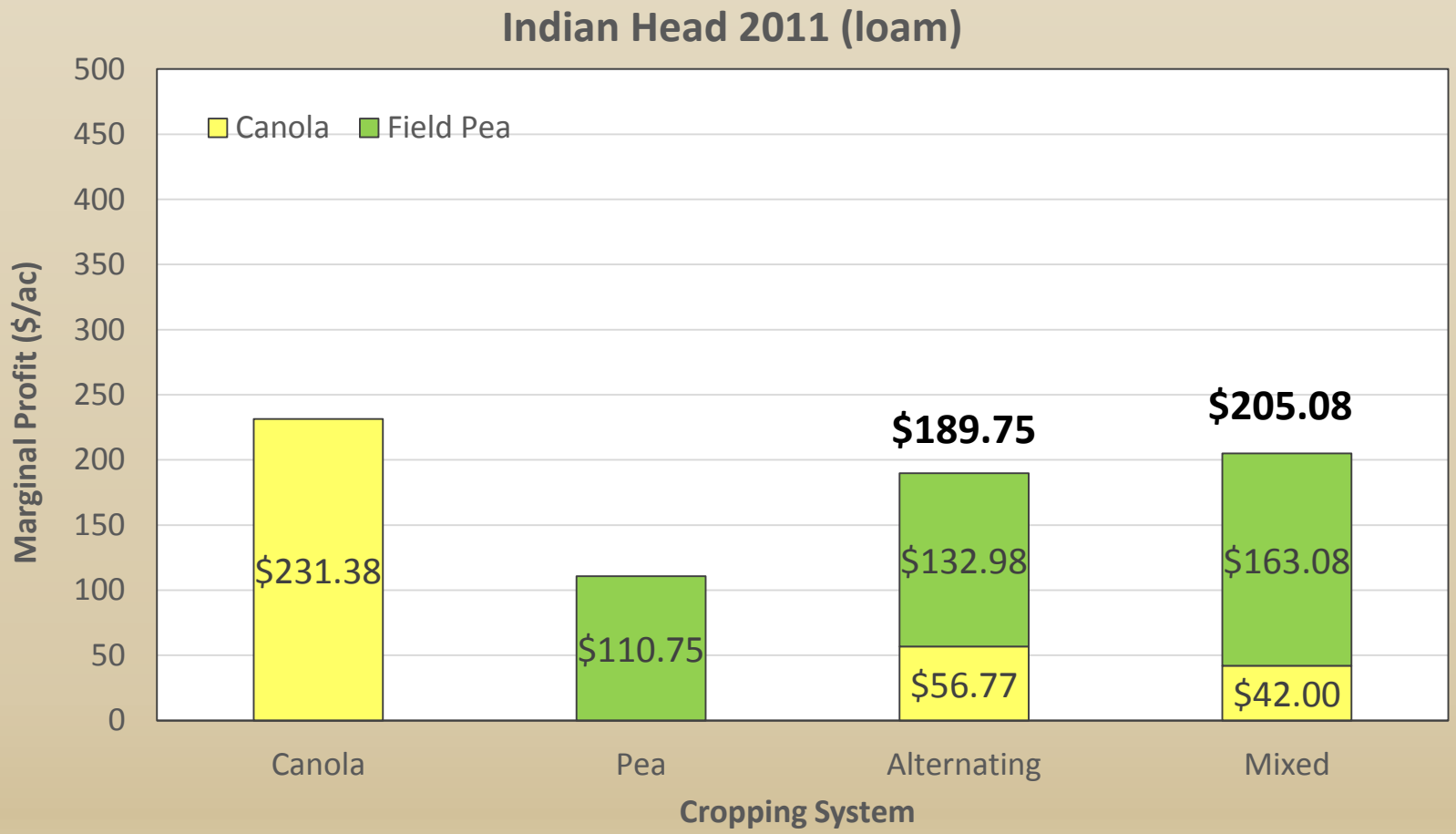


* Does not include all variable or any fixed expenses

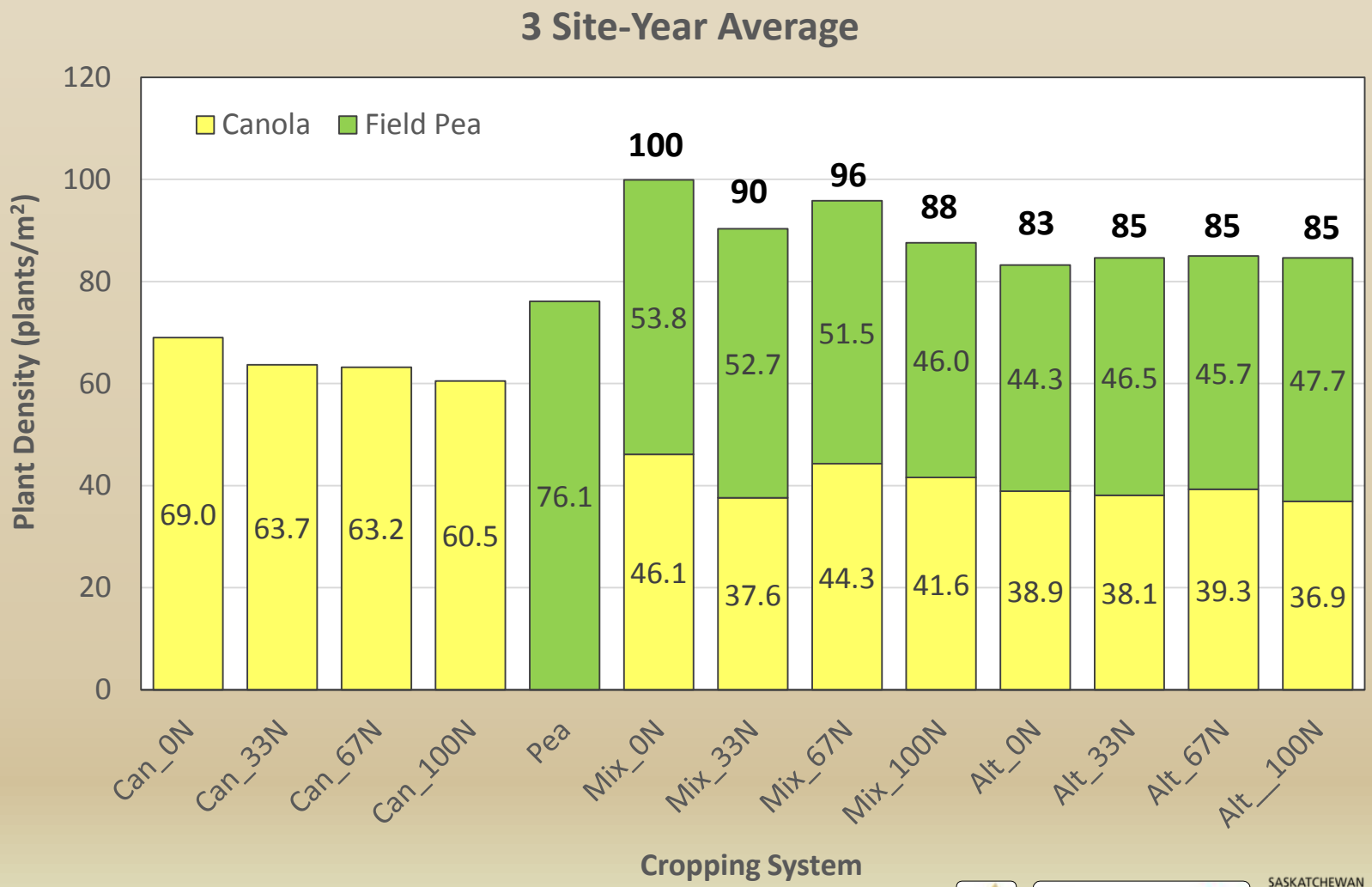
N Fertilizer X Row Orientation in Pea-Canola

Trial #2: Indian Head & Melita (2011-12)

#	Crop/Row Orientation	N Fertility
1	Canola Monocrop	0% (4 lb N/ac)
2	Canola Monocrop	33% (35 lb N/ac)
3	Canola Monocrop	67% (72 lb N/ac)
4	Canola Monocrop	100% (107 lb N/ac)
5	Field pea Monocrop	0%
6	Mixed-Row Intercrop	0%
7	Mixed-Row Intercrop	33%
8	Mixed-Row Intercrop	67%
9	Mixed-Row Intercrop	100%
10	Alternate-Row Intercrop	0%
11	Alternate-Row Intercrop	33%
12	Alternate-Row Intercrop	67%
13	Alternate-Row Intercrop	100%

- 2011-12 trials at Indian Head & Melita aimed to optimize N fertility for alternating vs mixed row pea-canola intercrops
- Intercrop seed rates were 67% of the rates used in the respective monocrops
- P, K and S rates constant across treatments, total N fertilizer rates varied as per protocol
- All urea was directed to canola rows (side-banded) in alternate-row treatments – thus these bands were twice as concentrated at any given rate compared to the monocrop or mixed row treatments

Row Crop Orientation X N Fertilizer Rate Plant Establishment (average)



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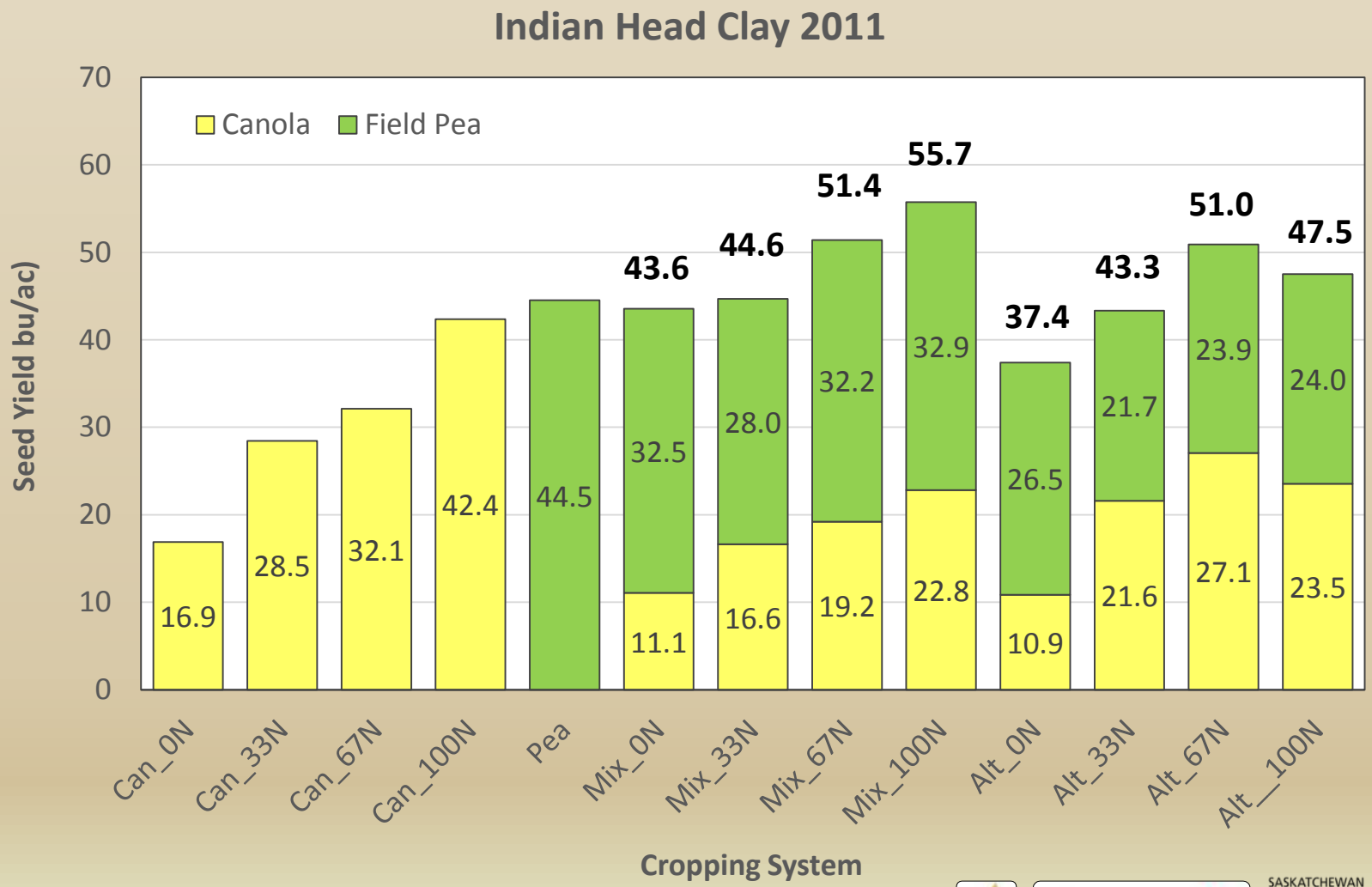
Row Crop Orientation X N Fertilizer Rate Seed Yield (IH-11)



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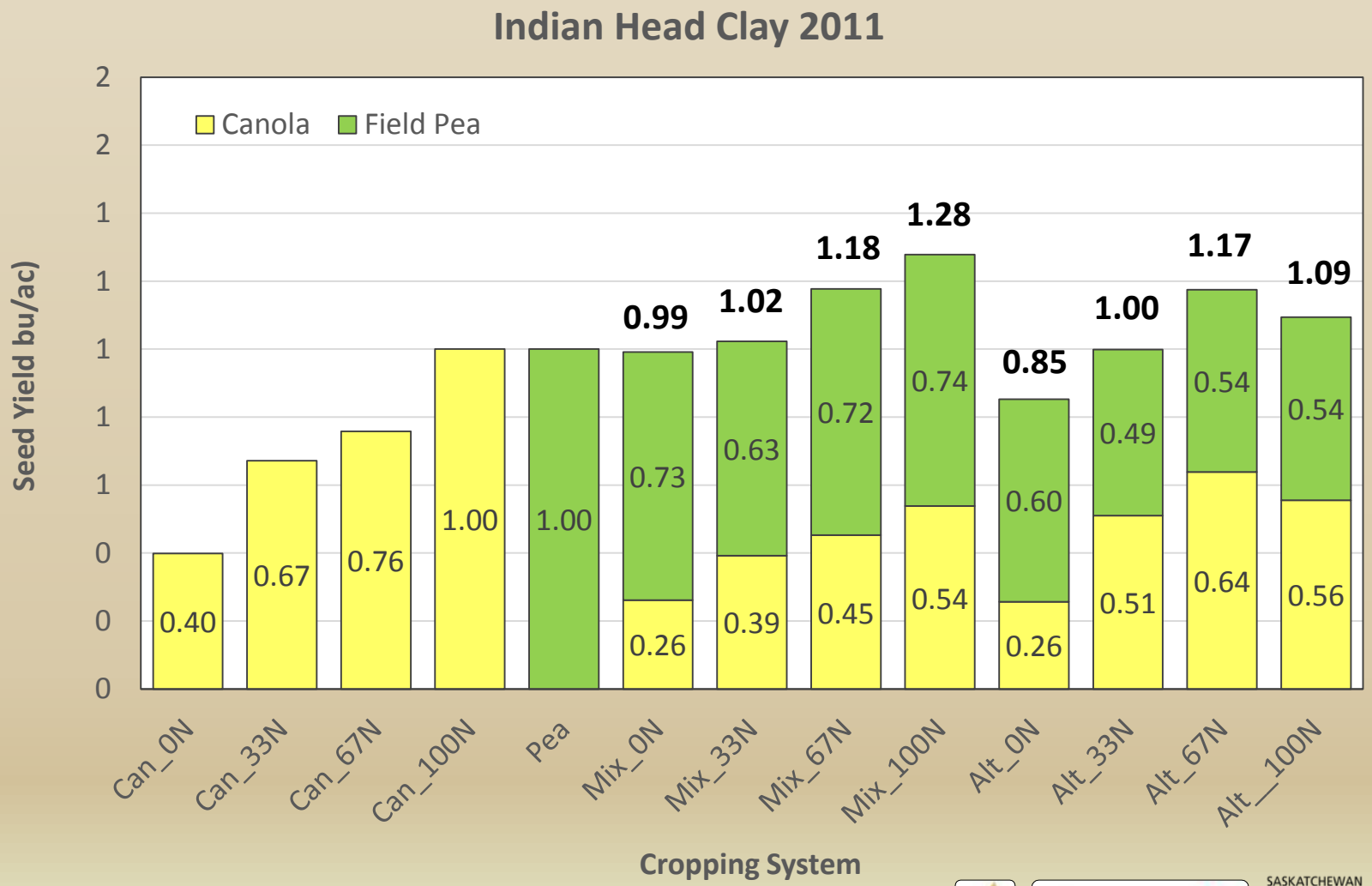
Row Crop Orientation X N Fertilizer Rate Land Equivalent Ratio (IH-11)



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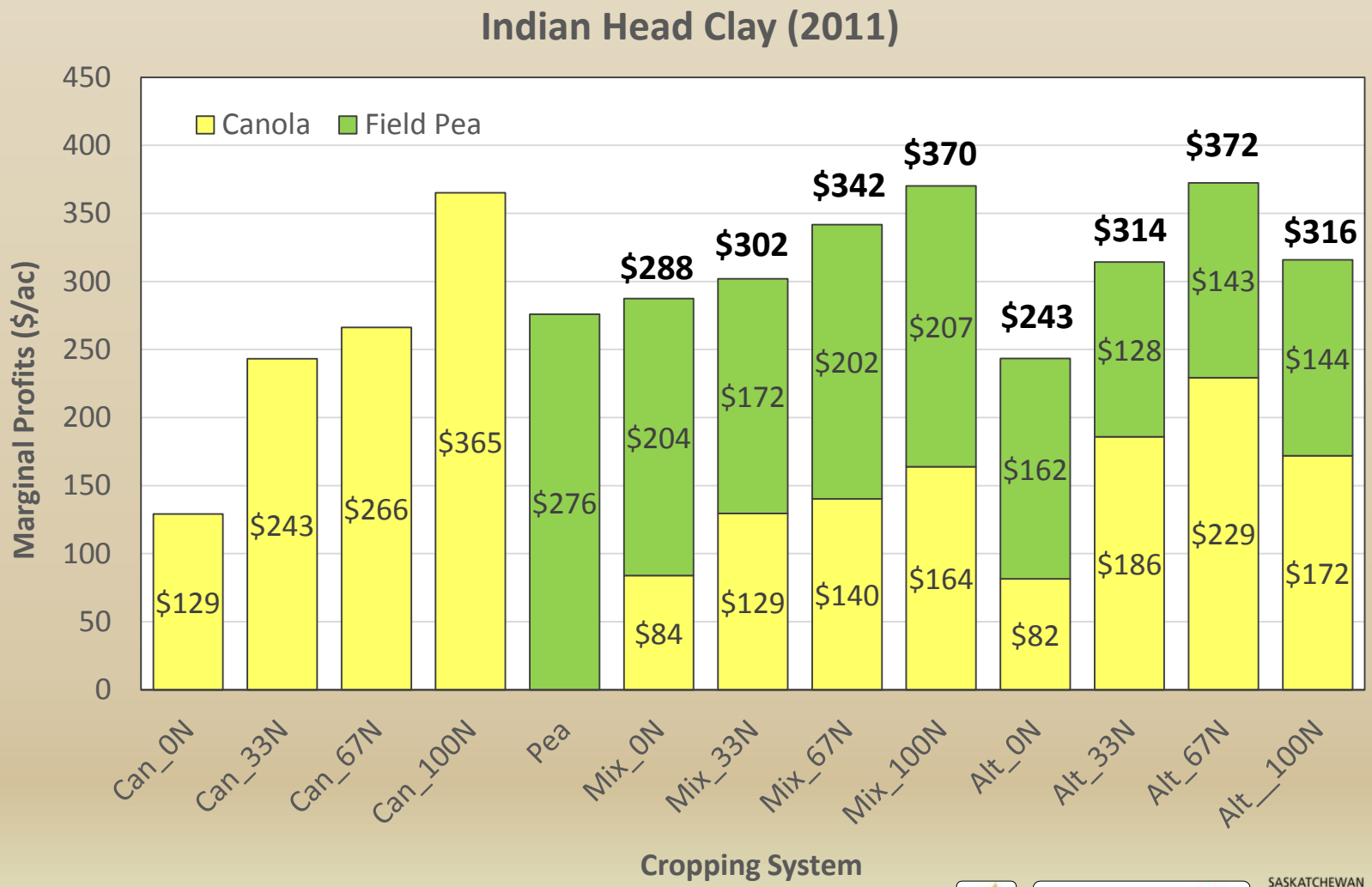
Row Crop Orientation X N Fertilizer Rate Marginal Profits (IH-11)



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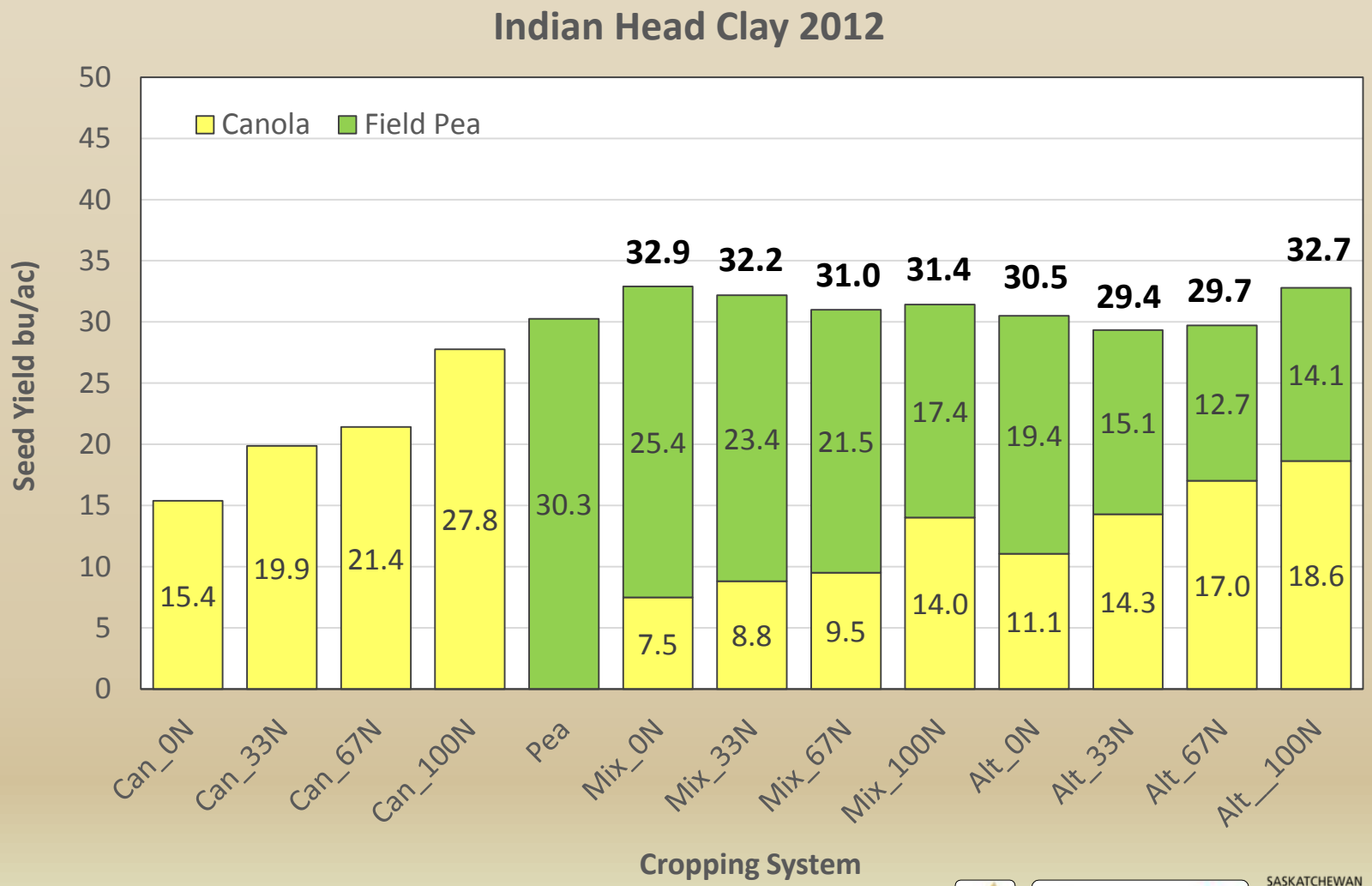
Row Crop Orientation X N Fertilizer Rate Seed Yield (IH-12)



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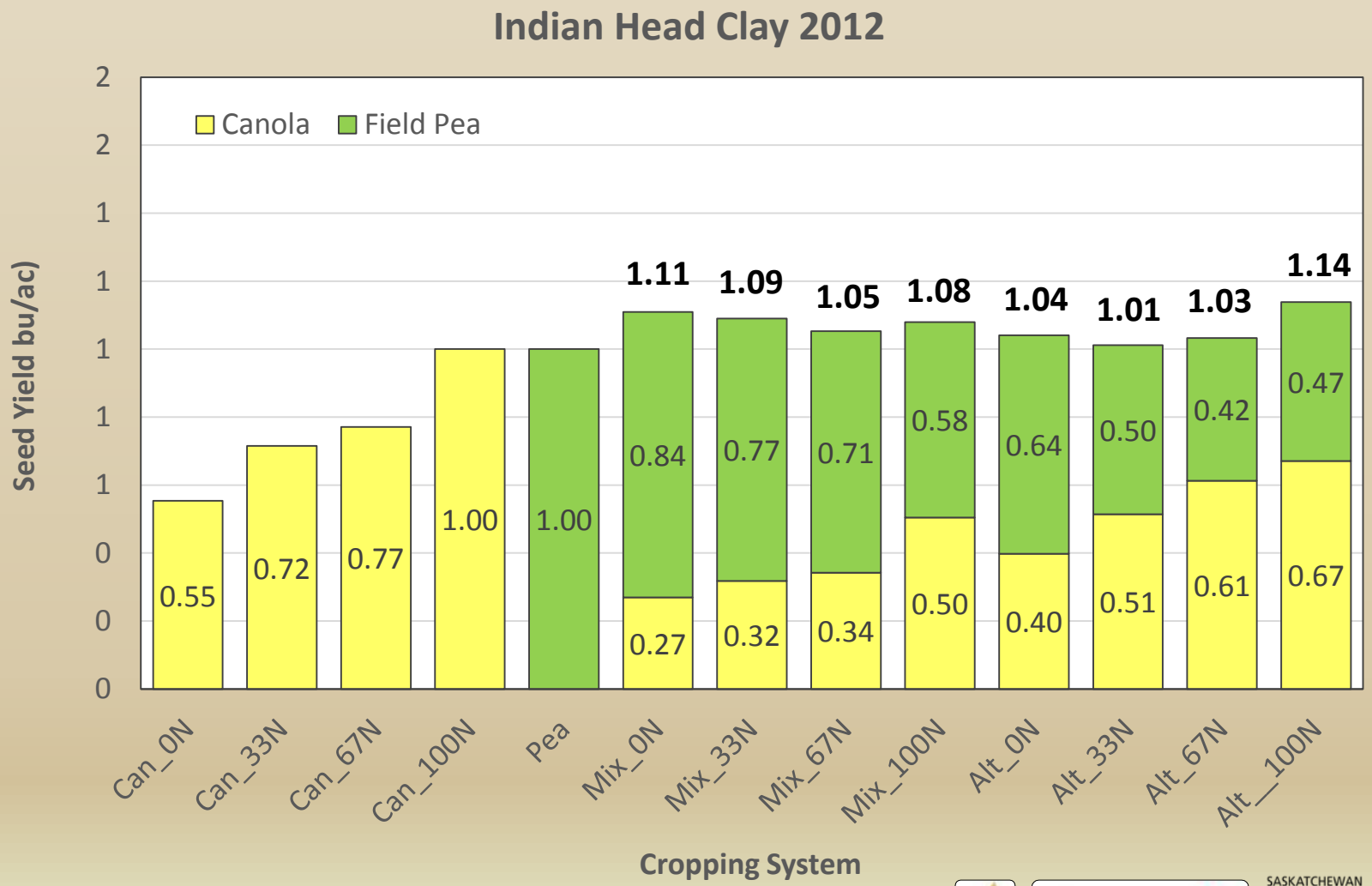
Row Crop Orientation X N Fertilizer Rate Land Equivalent Ratio (IH-12)



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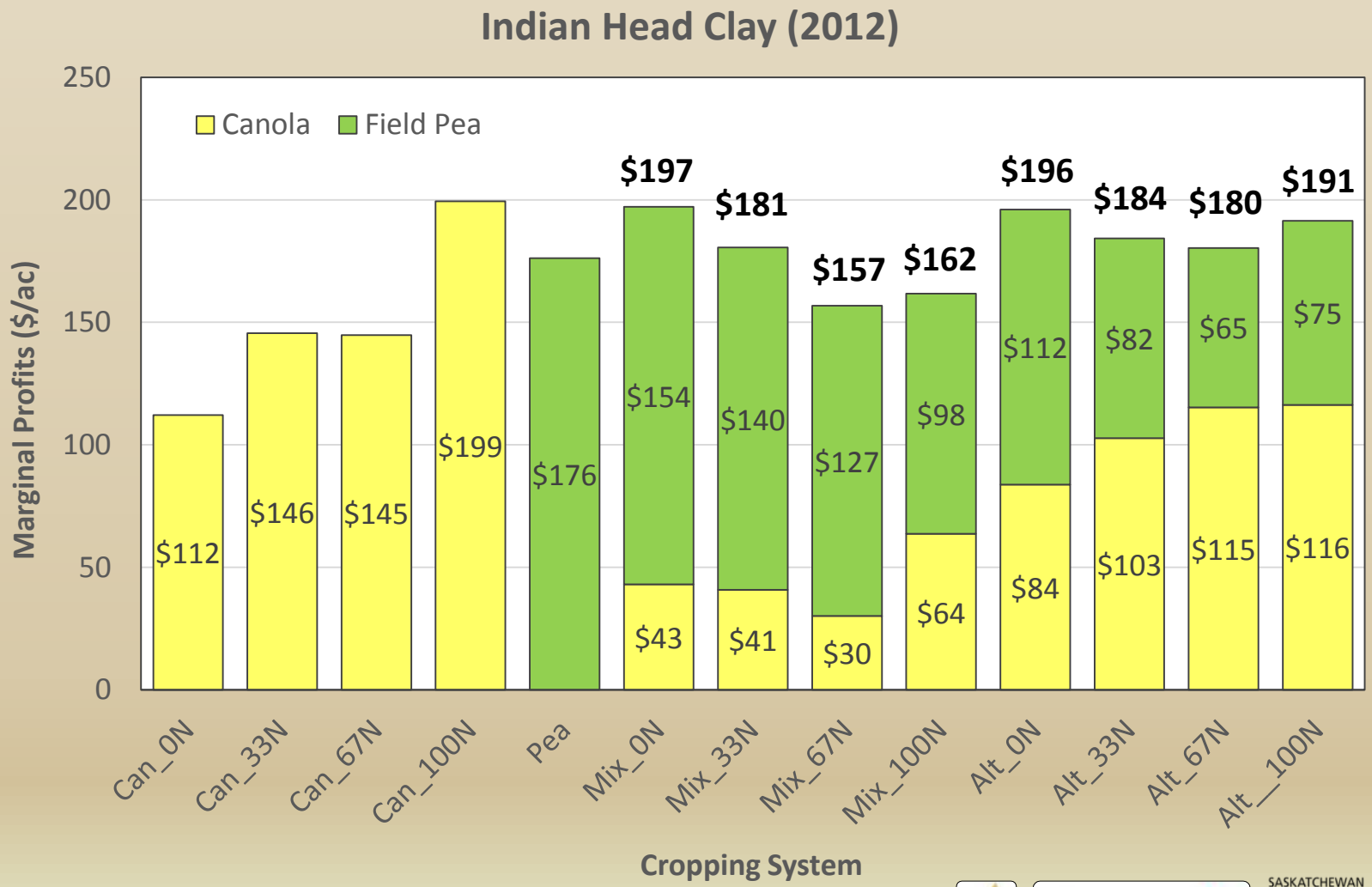
Row Crop Orientation X N Fertilizer Rate Marginal Profits (IH-12)



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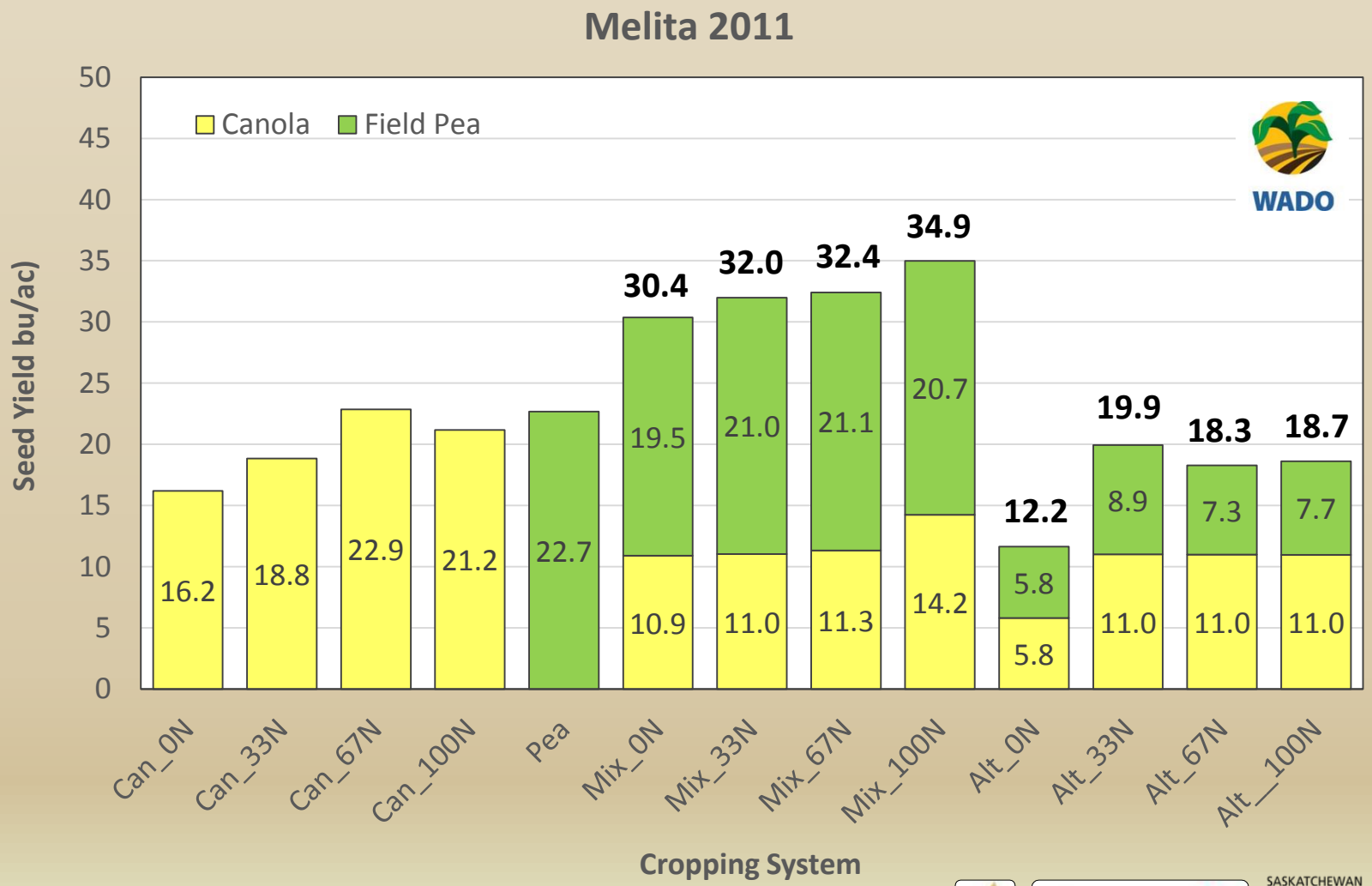
Row Crop Orientation X N Fertilizer Rate Seed Yield (MELITA-11)



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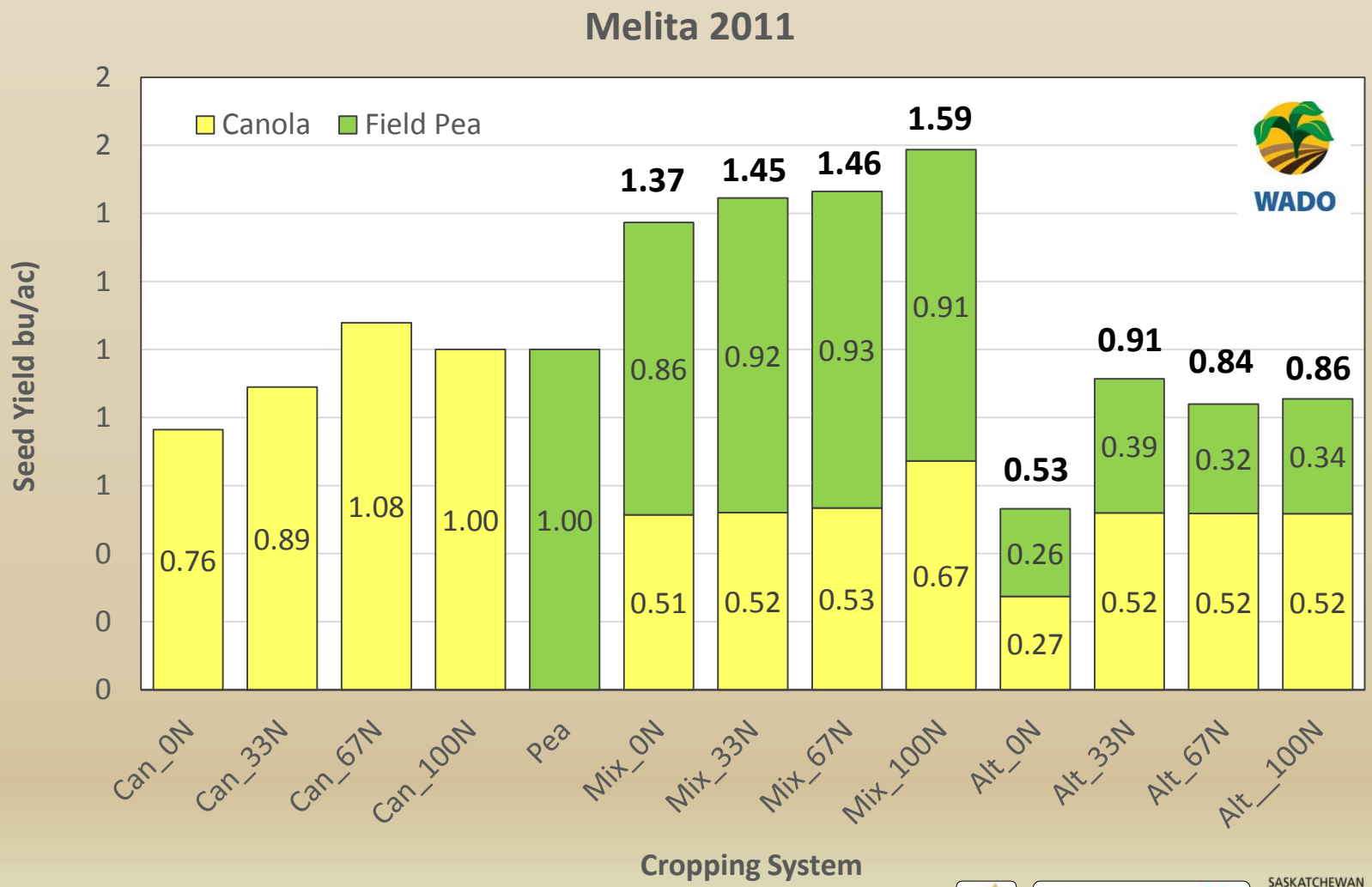
Row Crop Orientation X N Fertilizer Rate Land Equivalent Ratio (MELITA-11)



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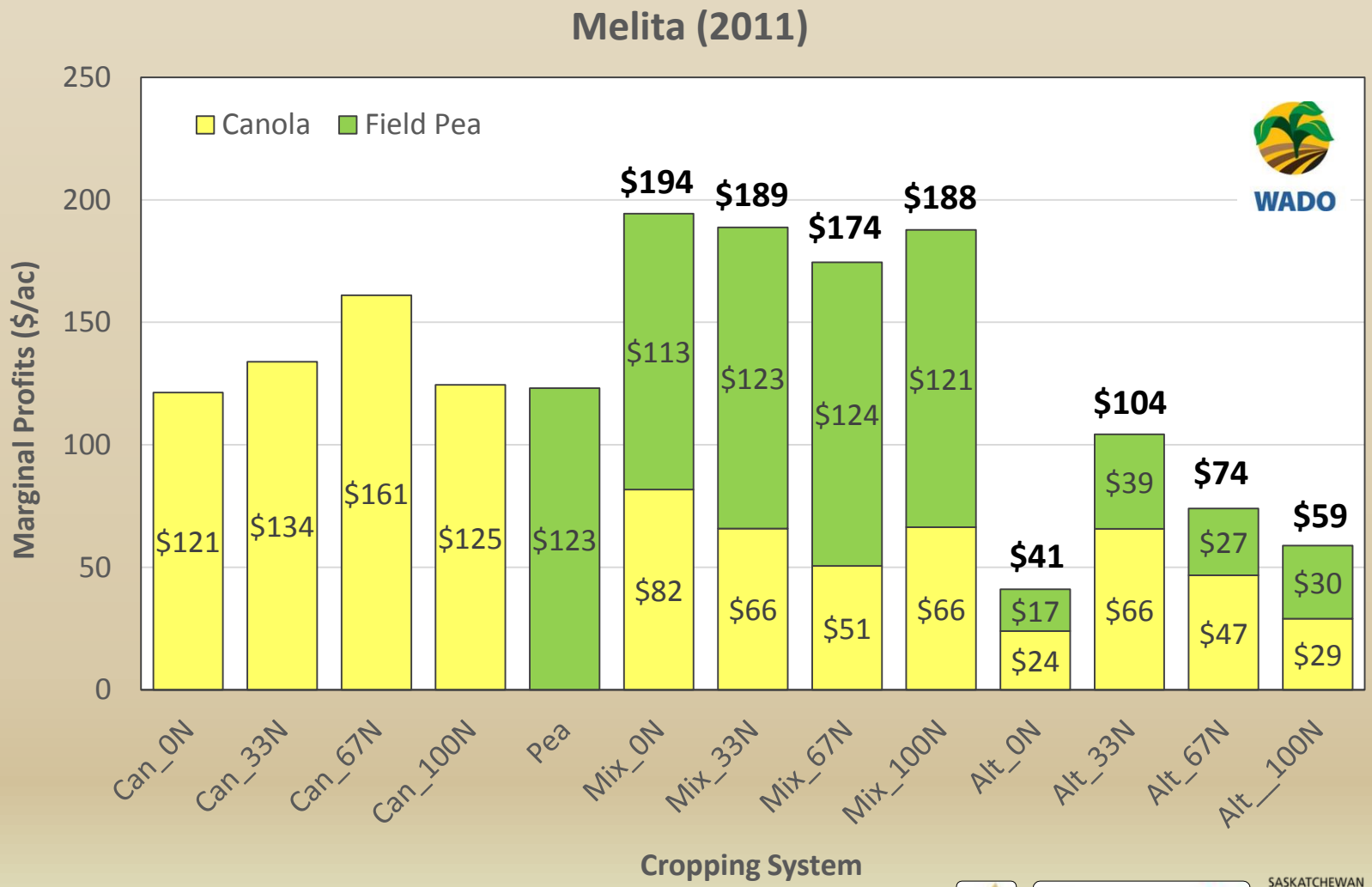
Row Crop Orientation X N Fertilizer Rate Marginal Profits (MELITA-11)



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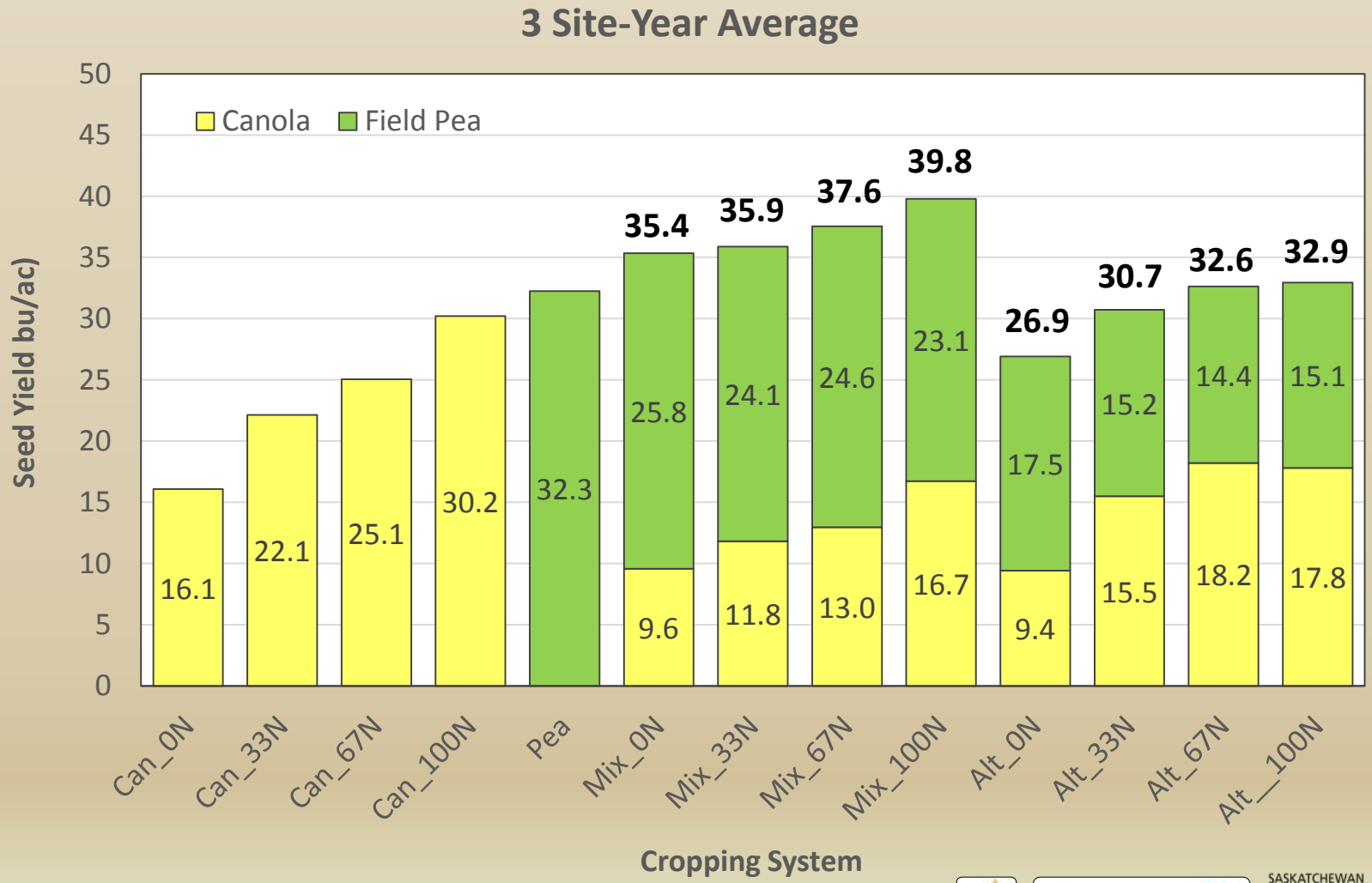
Row Crop Orientation X N Fertilizer Rate Seed Yield (average)



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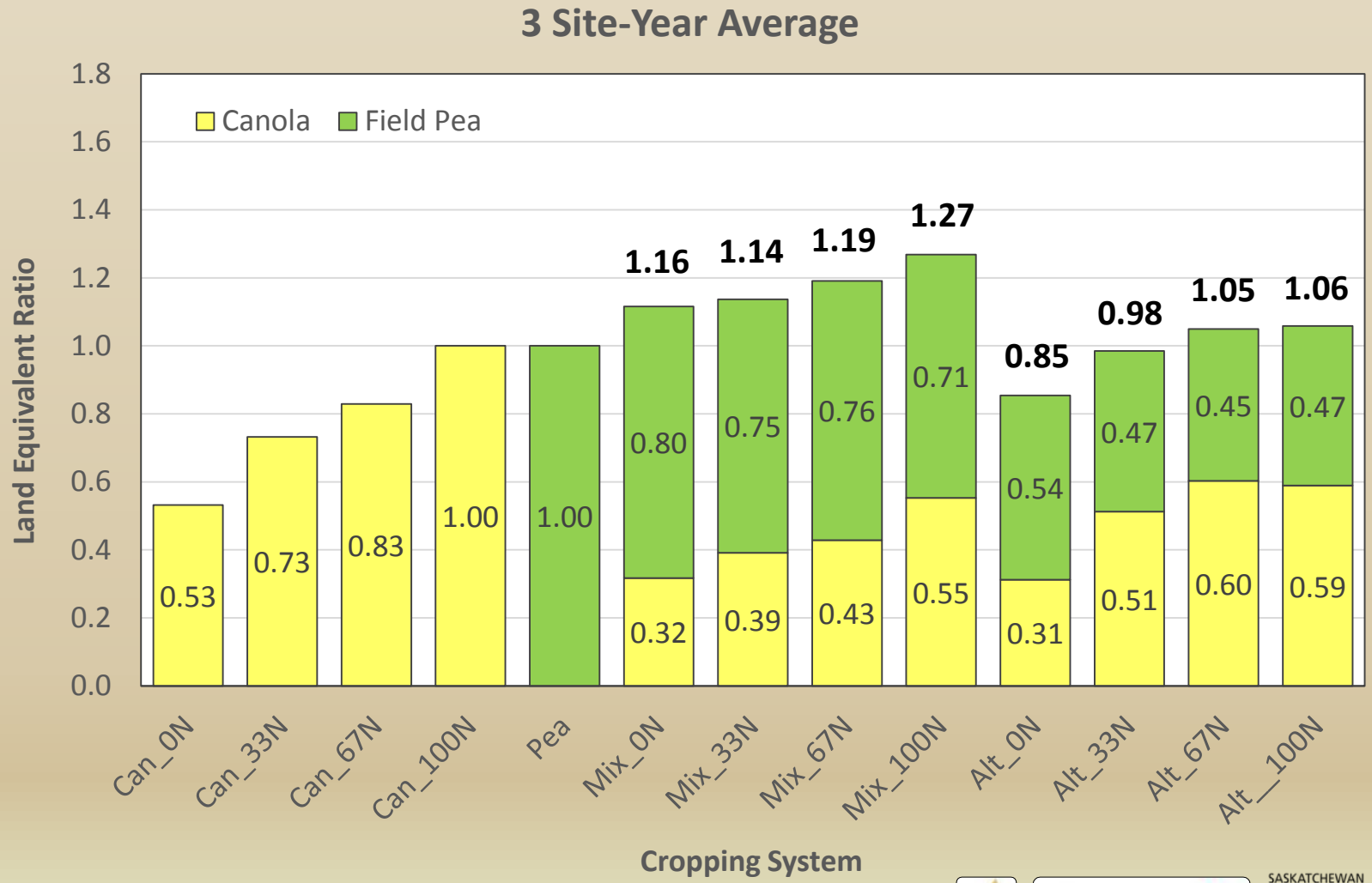
Row Crop Orientation X N Fertilizer Rate
Land Equivalent Ratio (average)



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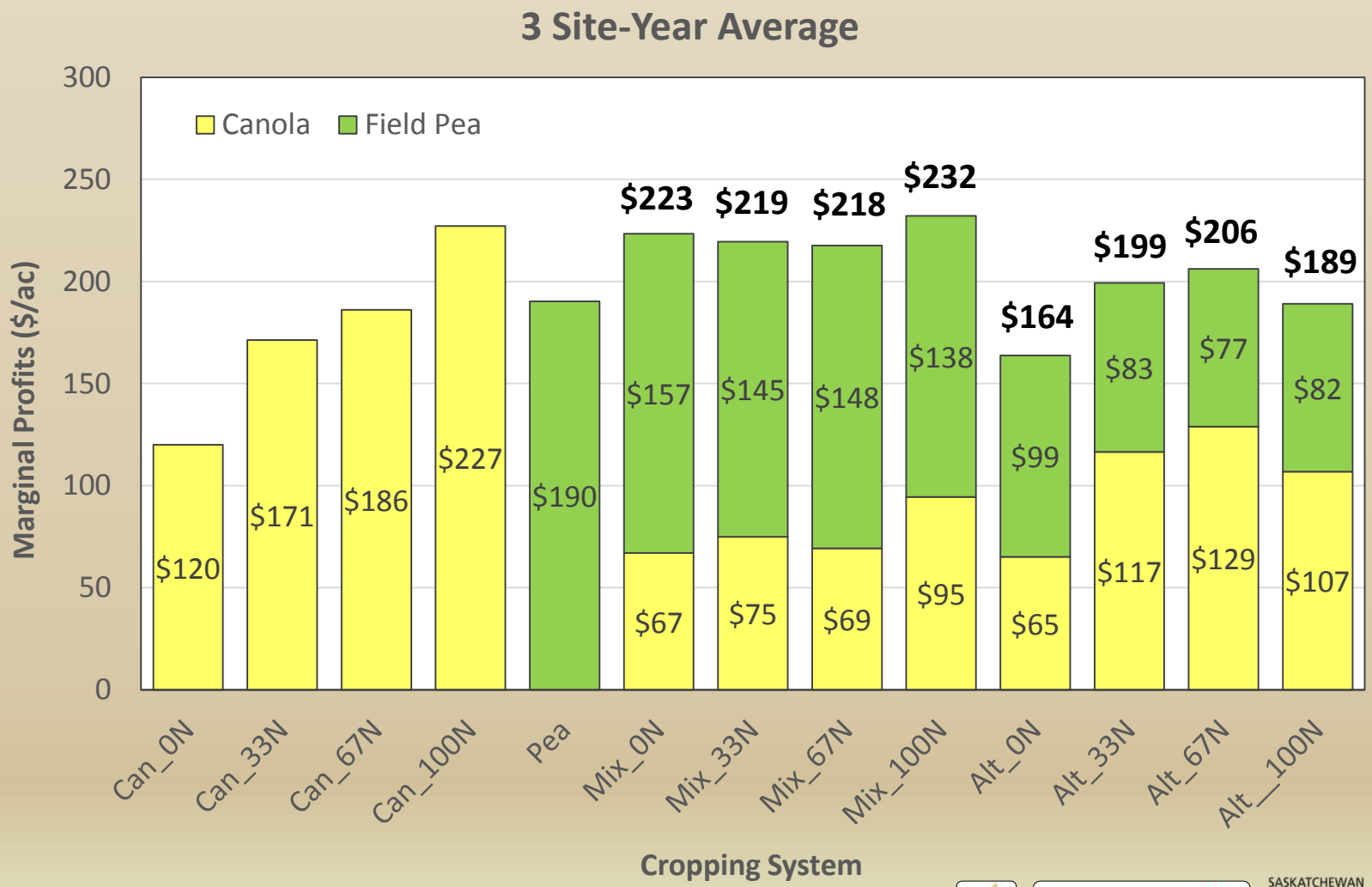
Row Crop Orientation X N Fertilizer Rate Marginal Profits (average)



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IHARF Pea-Canola Intercropping Project Highlights

- Yields of intercropped treatments were competitive, with LER consistently greater than 1 and as high as 1.6
  - Most consistent over yielding with mixed rows where an overall average LER of 1.19 was achieved compared to 0.99 with alternating rows – results varied across sites but alternating rows never performed better than mixed when both crops considered
- Relative profitability varied but intercrops were consistently competitive with marginal profits being either intermediate between the two monocrops, comparable to the more profitable monocrop or more profitable than both monocrop treatments
  - Across sites & N rates in experiment #2, marginal profits were lowest with monocrop canola ($176/ac), intermediate with alternating row intercrop ($190/ac), & highest with mixed row intercrop ($223/ac)
- As expected, increasing N fertility increased canola yields but sometimes at the expense of pea yields & profitability of intercrops relatively insensitive to N rate
  - Actual results likely to vary with commodity prices and environment

WADO Research Highlights

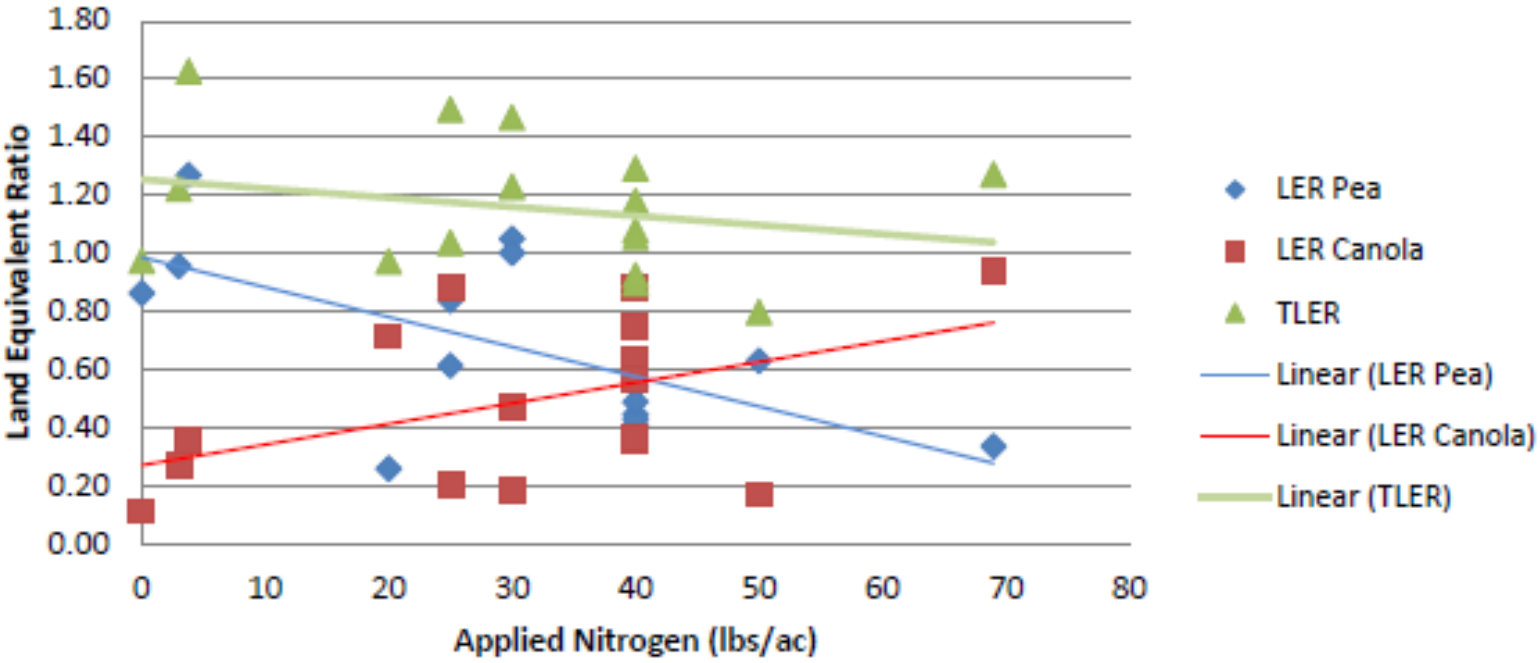

Figure 1: Land Equivalent Ratio (LER) of pea-canola components, and total yield with variable rates of nitrogen surveyed by WADO from 2007 to 2014 from 20 producer fields in Manitoba and Saskatchewan. TLER = Total Land Equivalent Ratio

Source: 2014. Scott Chalmers. WADO. Intercropping pea & canola based on row orientation and nitrogen rates

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WADO

WADO Research Highlights (2011-13)
Mixed, alternating, double & triple rows

Table 3: Trial treatment descriptions with their corresponding row orientation, seeding rate, nitrogen fertility level in both the canola row and overall field (plot) area including peas.

Trt	Crop Orientation	Crop Row and Nitogen Placement Arrangement* (underscore = row gap)	N rate (lbs/ac)		Seeding Rate (p/m^2)	
			Canola Row N equivalent	Overall Field	Canola	Pea
1	pea monocrop (check)	P_P_P_P_P_P_P	inoculated	0	-	75
2	pea monocrop (check)	Pn_Pn_Pn_Pn_Pn_Pn_Pn	inoculated	90	-	75
3	canola monocrop (check)	CN_CN_CN_CN_CN_CN	90	90	100	-
4	canola monocrop (check)	Cn_Cn_Cn_Cn_Cn_Cn	45	45	100	-
5	canola monocrop (check)	CNN_CNN_CNN_CNN_CNN_CNN	180	180	100	-
6	mixed rows	PCn_PCn_PCn_PCn_PCn_PCn	45	45	50	38
7	mixed rows	PCN_PCN_PCN_PCN_PCN_PCN	90	90	50	38
8	single rows	P_CN_P_CN_P_CN	90	45	50	38
9	single rows	P_CNN_P_CNN_P_CNN	180	90	50	38
10	double rows	P_P_CN_CN_P_P_CN_CN	90	45	50	38
11	double rows	P_P_CNN_CNN_P_P_CNN_CNN	180	90	50	38
12	triple rows	P_P_P_CN_CN_CN	90	45	50	38
13	triple rows	P_P_P_CNN_CNN_CNN	180	90	50	38

*P= Peas, C= Canola, n=45 lbs/ac Nitrogen, N=90 lbs/ac Nitrogen, NN=180 lbs/ac Nitrogen

Source: 2014. Scott Chalmers. WADO. Intercropping pea & canola based on row orientation and nitrogen rates

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WADO

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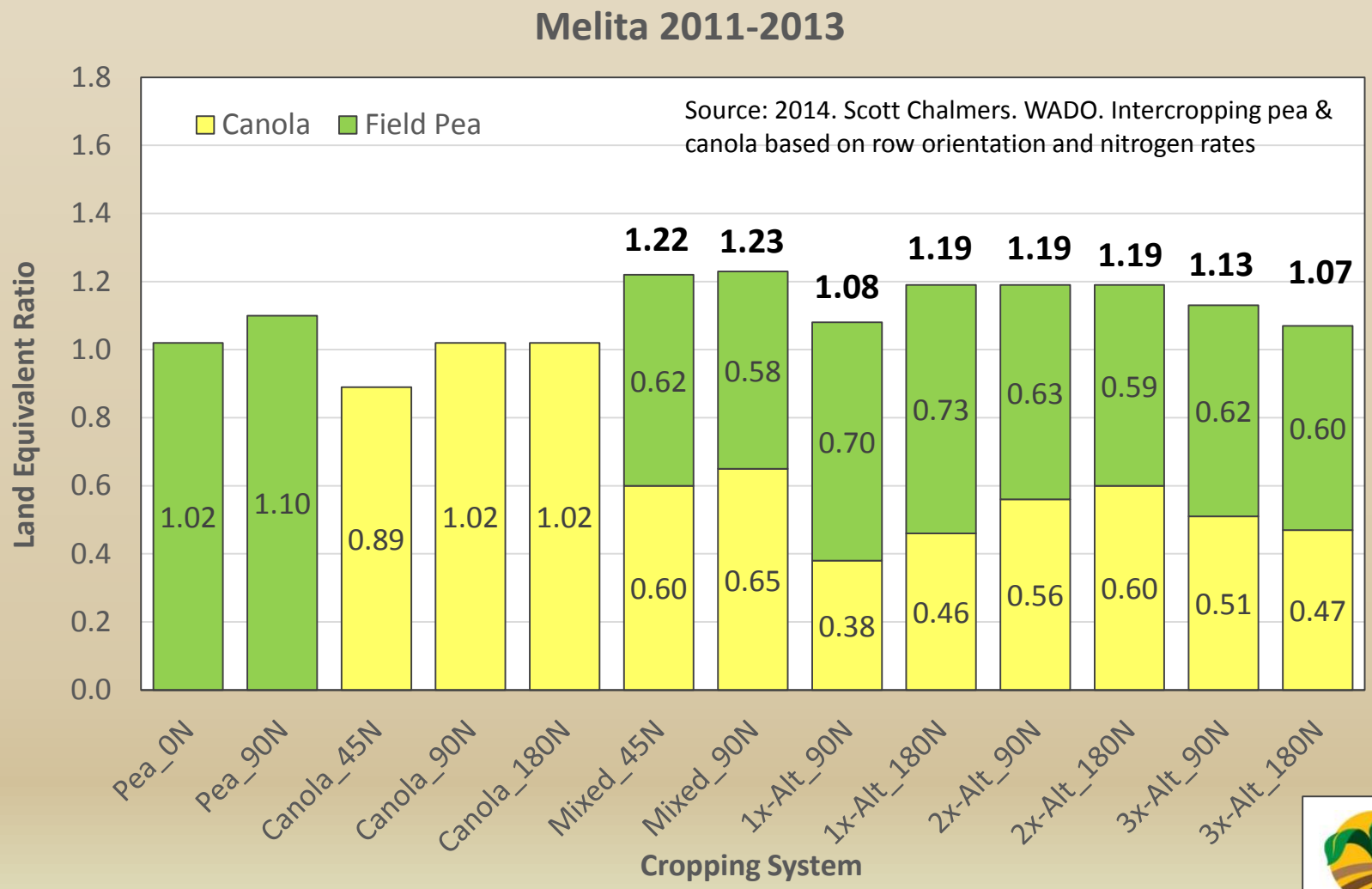

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WADO

WADO Research Highlights (2016-17)

N & P Fertility Treatments

#	Crop	lb N/ac	lb P_2O_5/ac
1	Pea (check)	0	30
2	Canola (check)	90	30
3	Pea – Canola (mixed rows)	0	0
4	Pea – Canola (mixed rows)	45	0
5	Pea – Canola (mixed rows)	90	0
6	Pea – Canola (mixed rows)	0	30
7	Pea – Canola (mixed rows)	45	30
8	Pea – Canola (mixed rows)	90	30
9	Pea – Canola (mixed rows)	0	60
10	Pea – Canola (mixed rows)	45	60
11	Pea – Canola (mixed rows)	90	60

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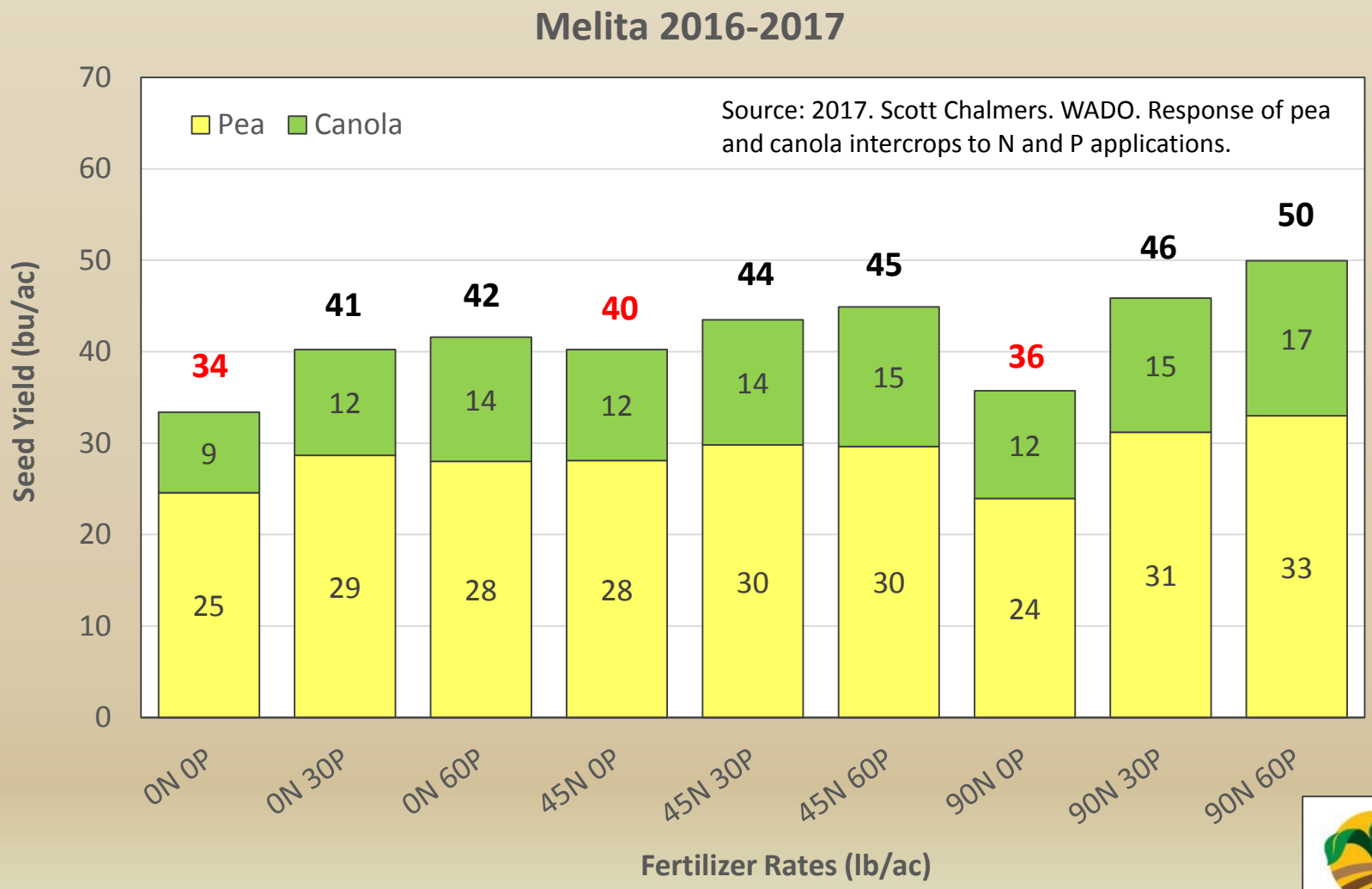
WADO Research Highlights (2016-17)

N & P Fertility Treatments (Yield)



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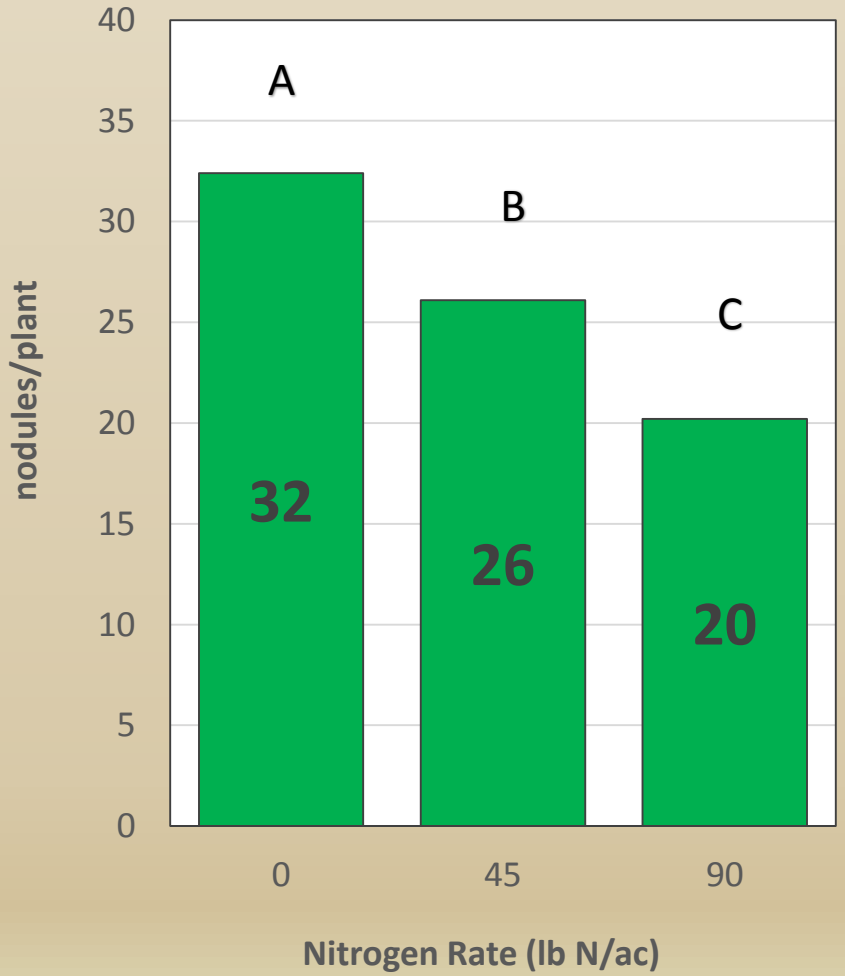
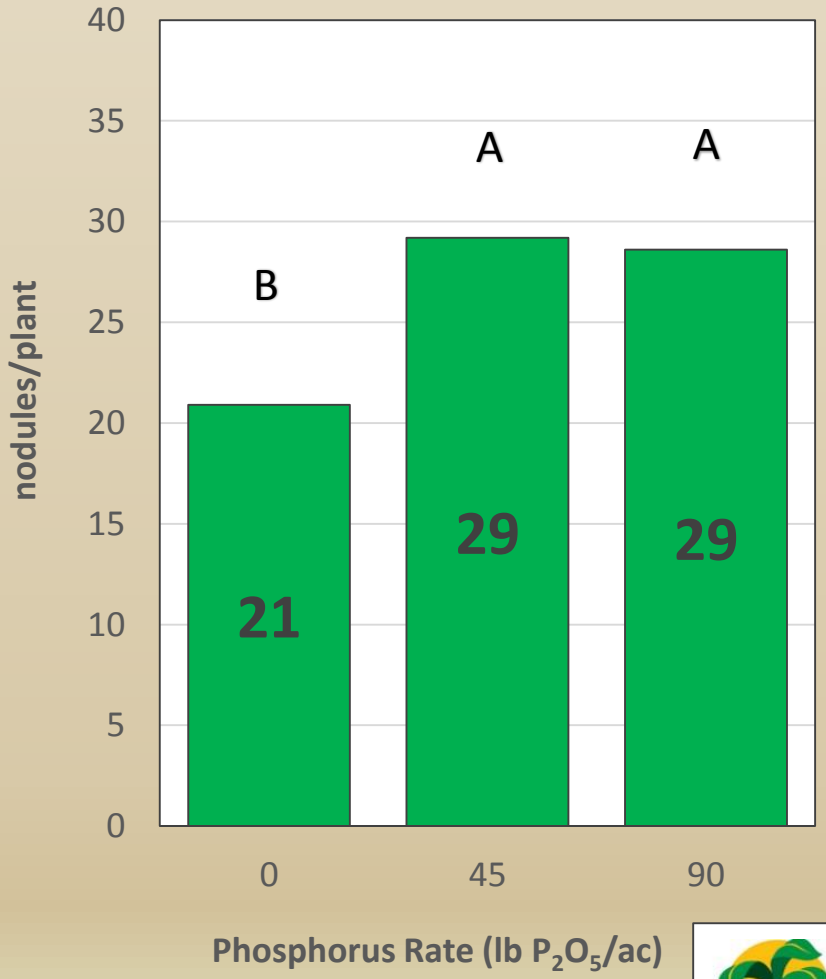
WADO Research Highlights (2016-17)

N & P Fertility Treatments (nodulation)





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Final Thoughts

- Small plot research is useful for improving and developing agronomic recommendations for intercropping; however, field-scale evaluations likely more suitable for demonstrating the true potential merits of the practice
  - Soil and environmental conditions are usually uniform in small plot trials
  - Overall benefits of intercropping (across entire fields) are potentially more likely to be realized across more variable landscapes
- Management of IHARF trials could have likely been fine-tuned for improved performance of intercropping. For example:
  - Deliver pea seed through fertilizer openers for deeper placement relative to canola
  - Resulting fertilizer placement issues potentially resolved with in-crop N application which is also less likely to inhibit nodulation than banding during seeding
  - Fungicide would have been beneficial for both monocrops and intercrops in some years; particularly for canola at Indian Head in 2012
  - Clearfield canola variety choices are limited and, despite fewer herbicide options, there may be a good fit for higher yielding, earlier maturing, shatter tolerant hybrids (i.e. L233P)

THANK YOU

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IHARF Winter Seminar & AGM
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