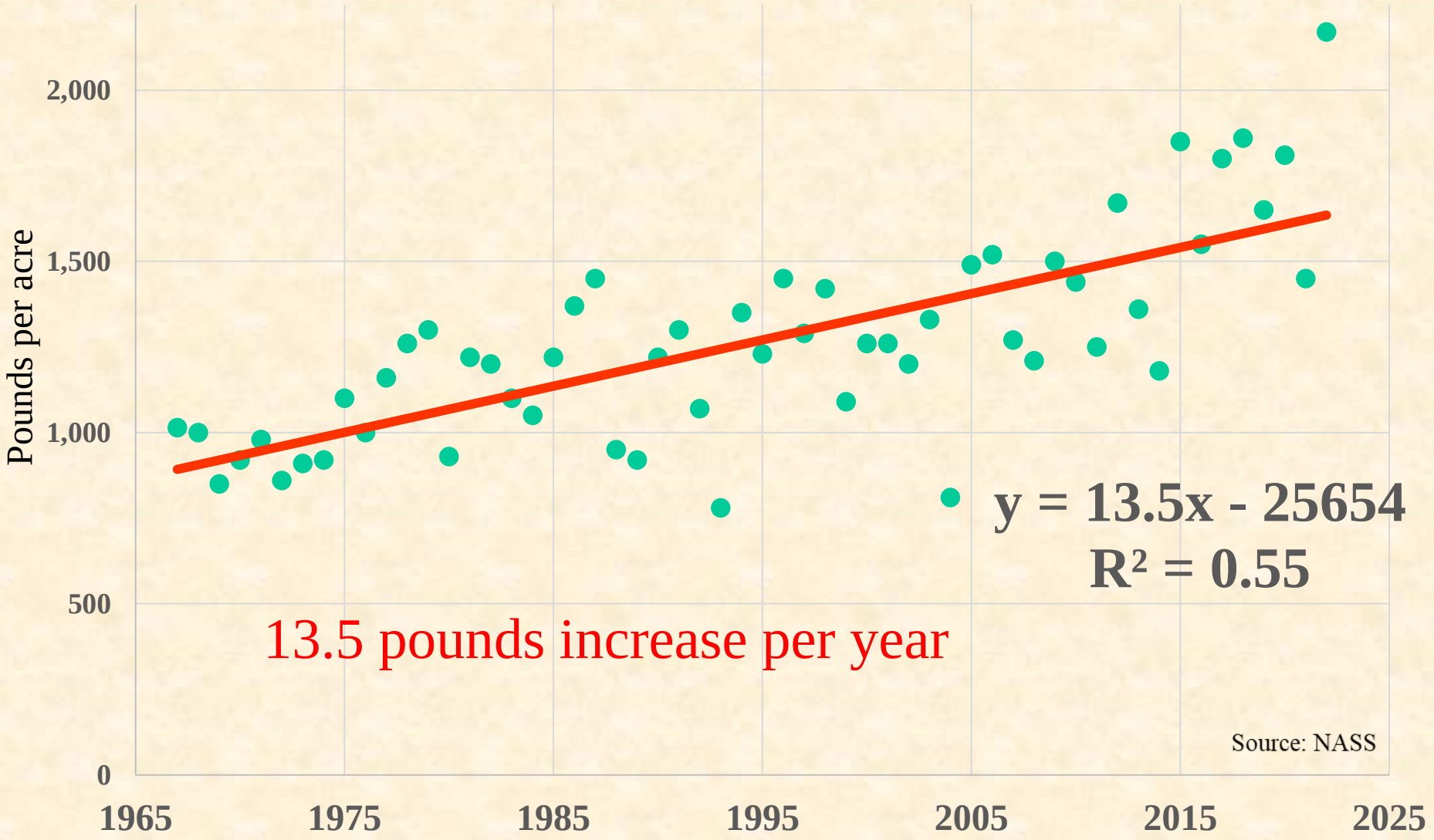
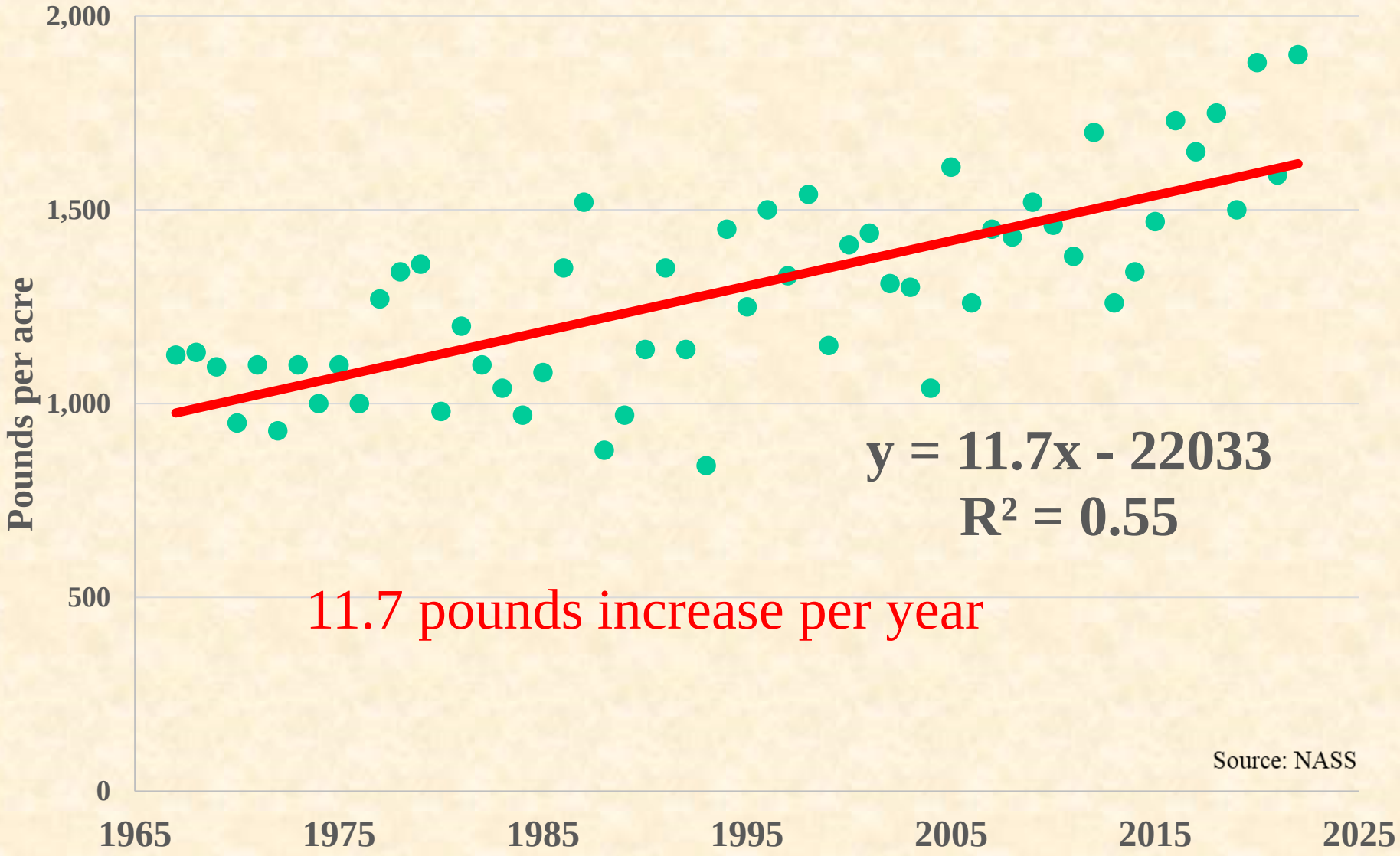
Observations about Sunflower Production

- Hans Kandel, hans.kandel@ndsu.edu
- North Dakota State University Extension Agronomist

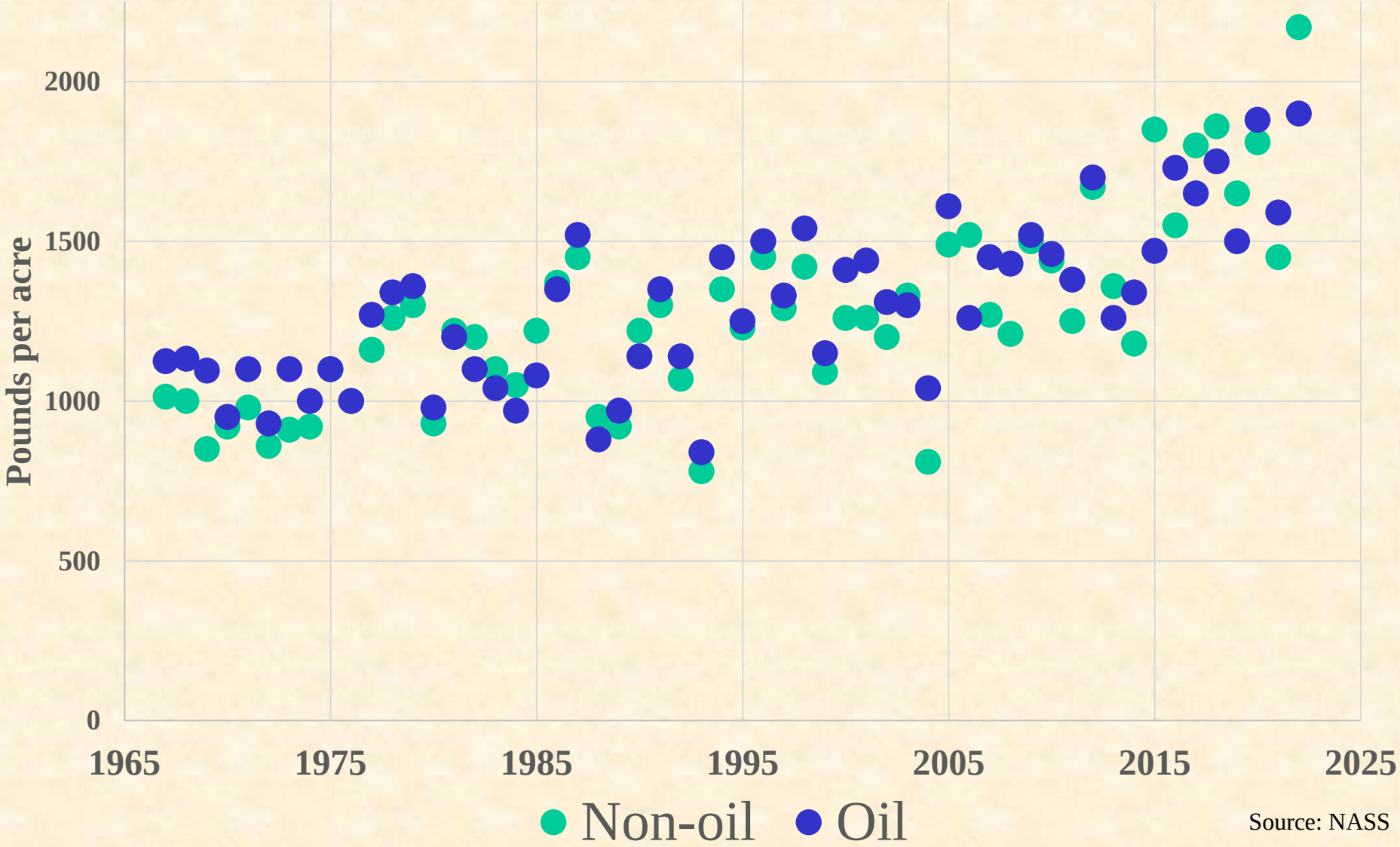
Average Farm Non-oil Sunflower Yield ND



Average Farm Oil Sunflower Yield ND

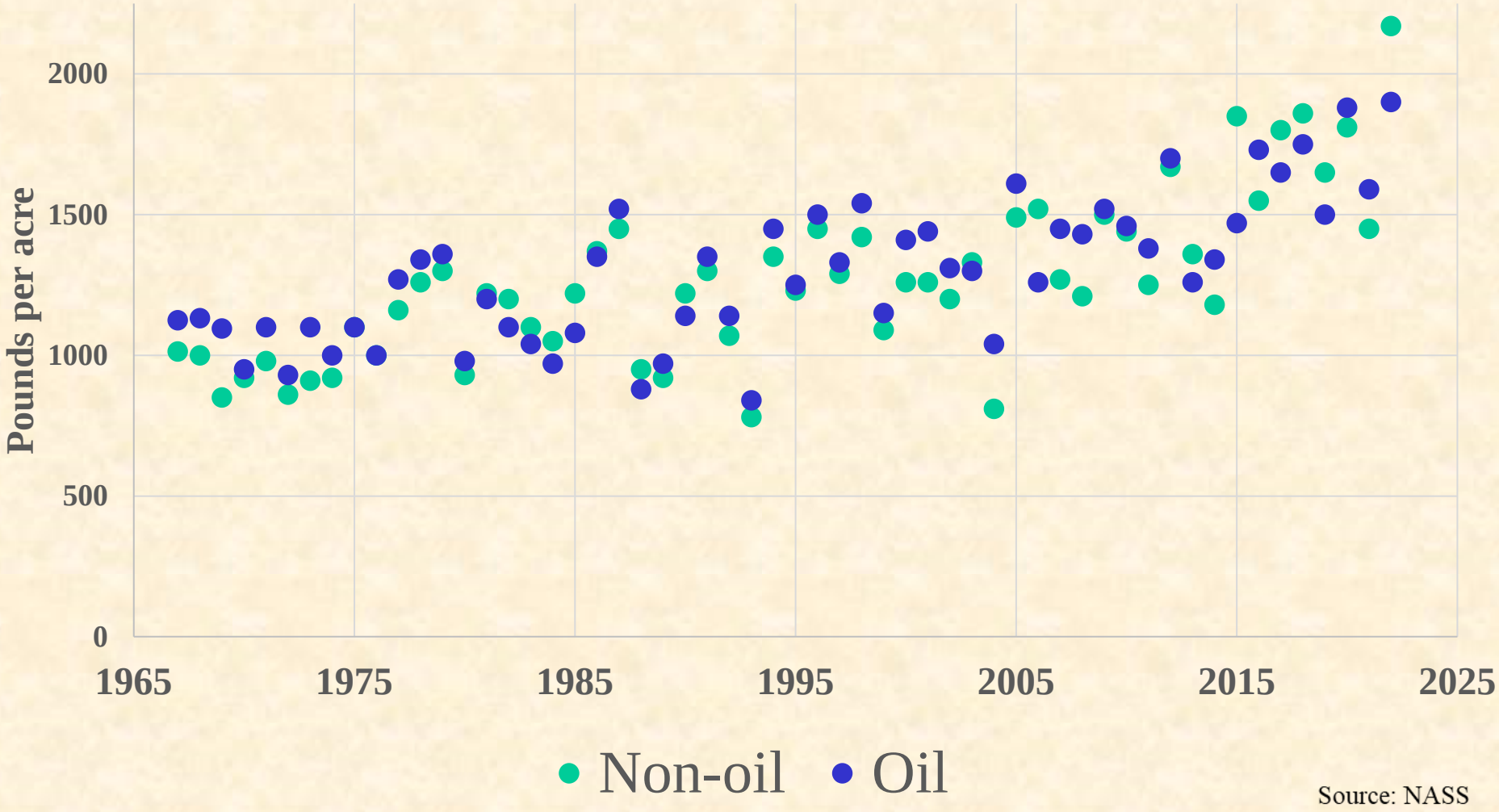


Average Farm Oil and Non-Oil Sunflower Yield ND



Source: NASS

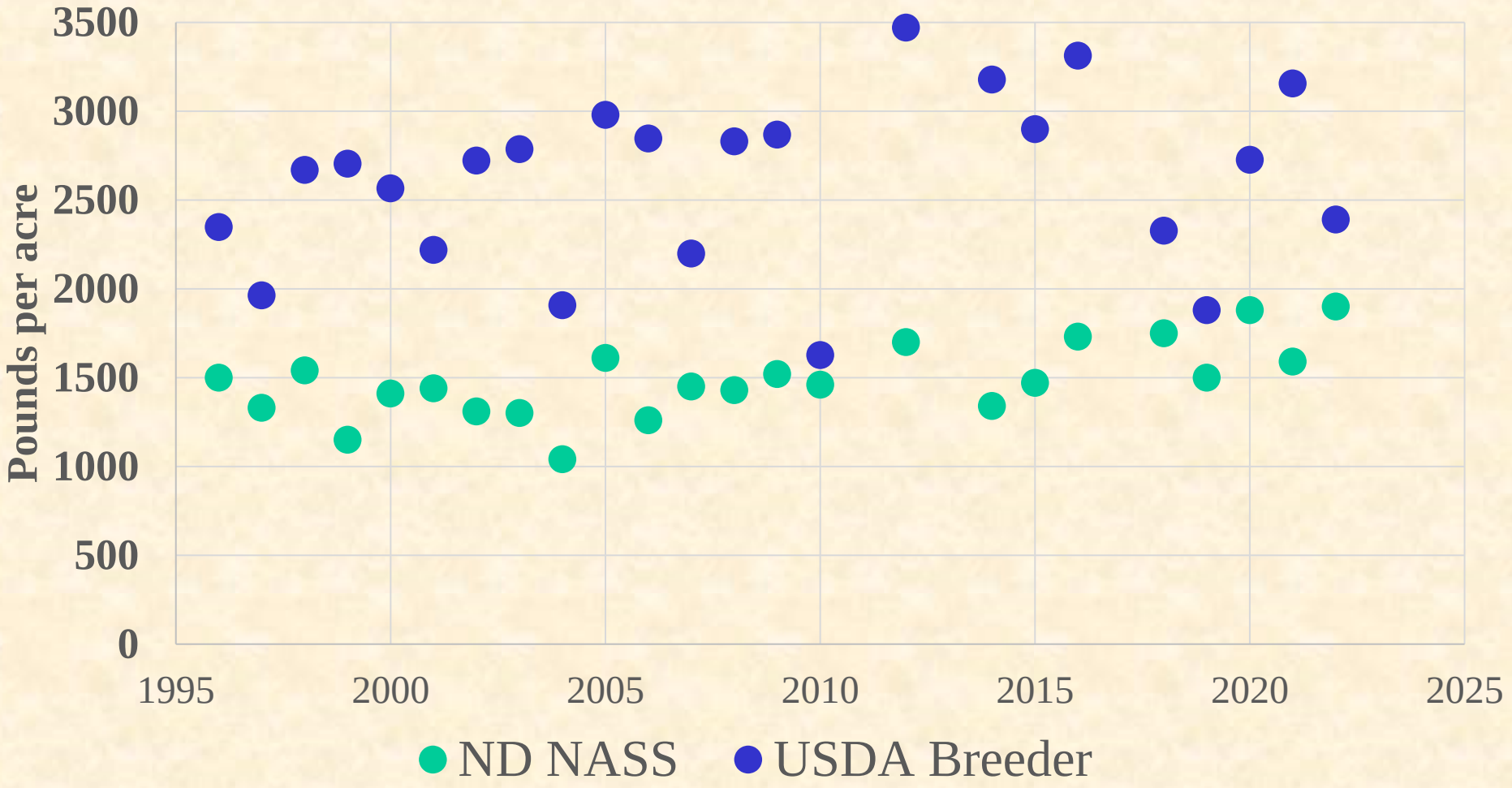
Average Farm Oil and Non-Oil Sunflower Yield ND



Source: NASS

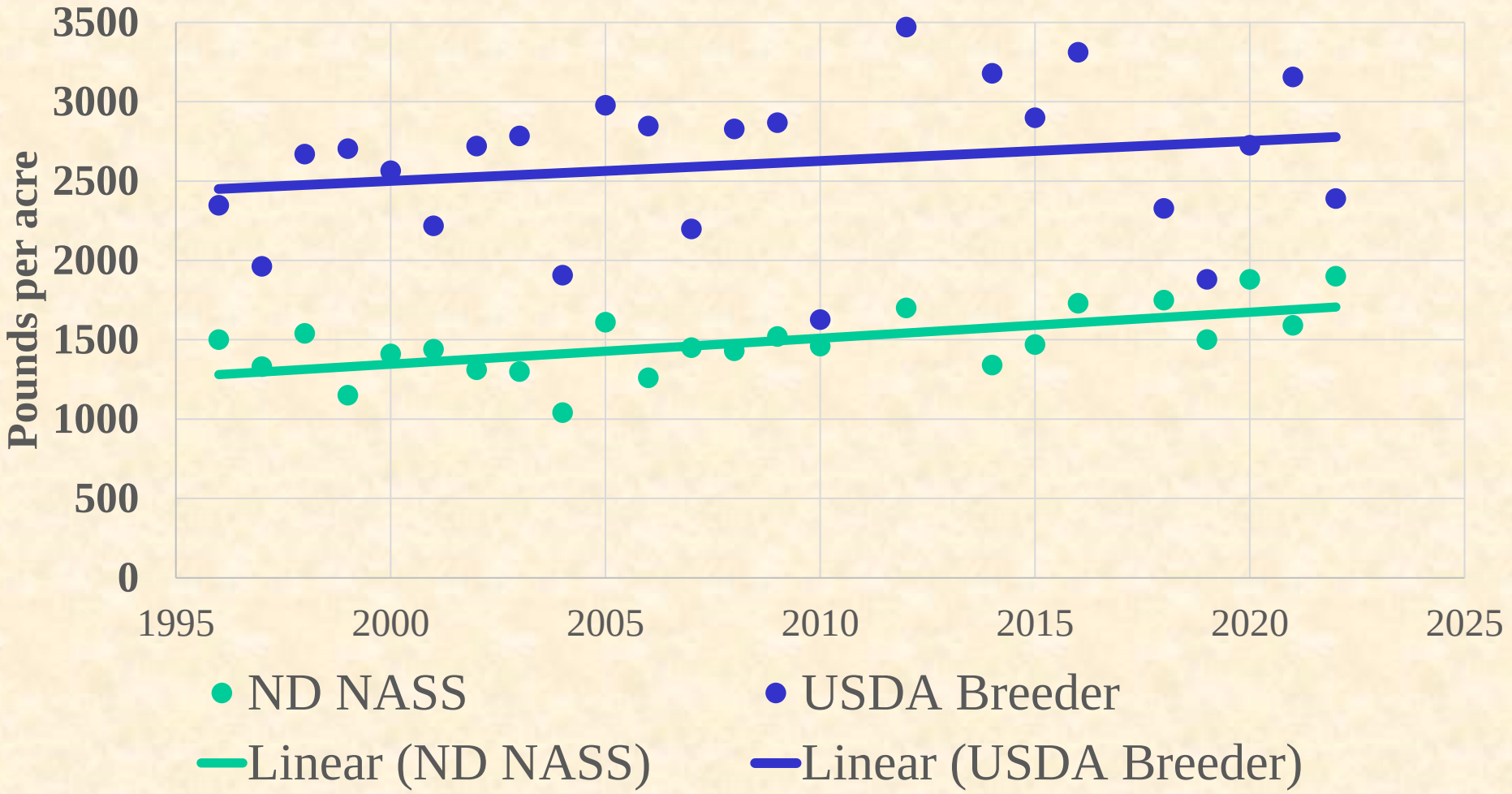
1264 lb/a 1298 lb/a

Average Farm Oil Sunflower Yield and average of breeder Oil Sunflower hybrid trial in ND



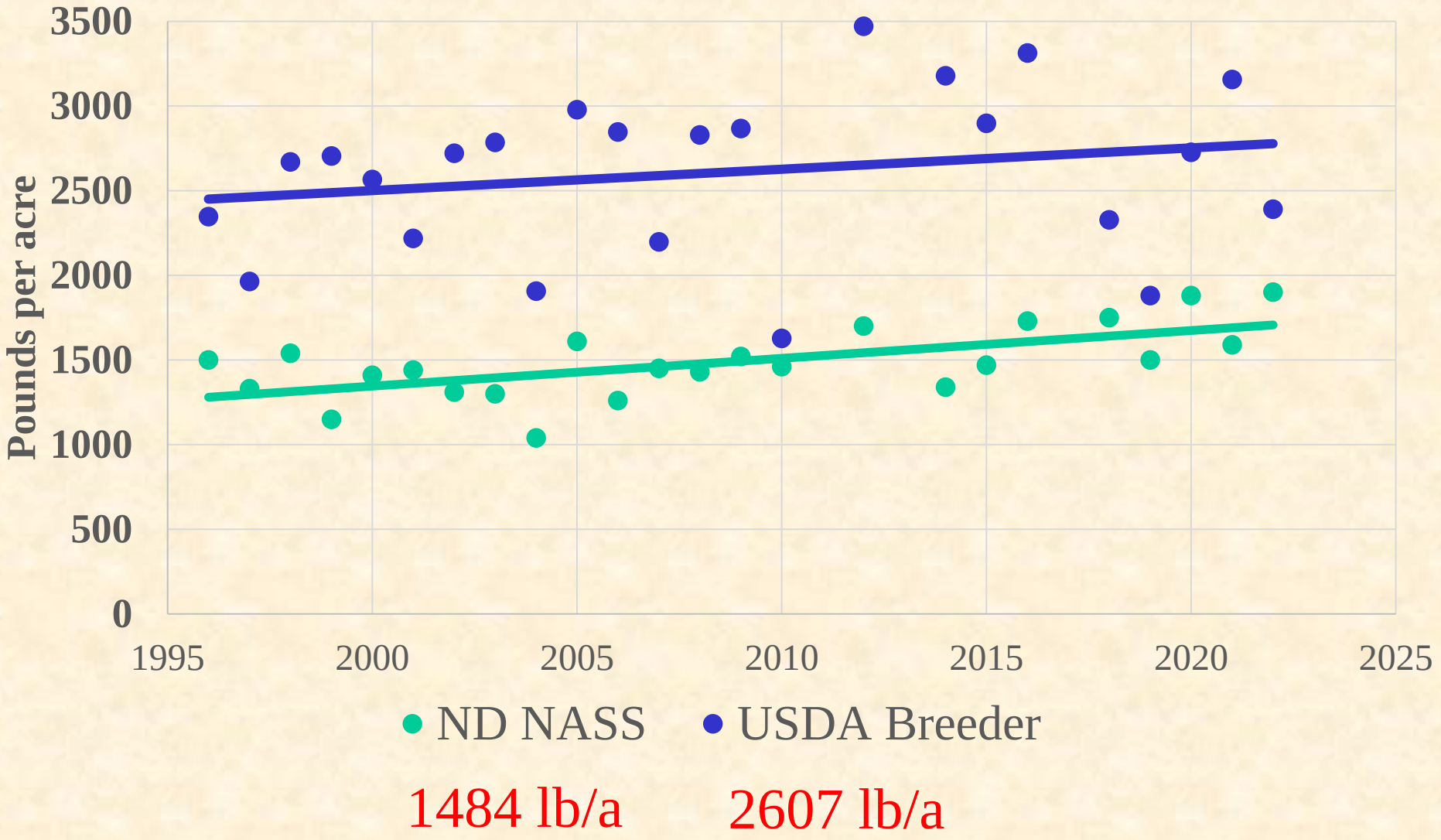
Source NASS, NDSU Hybrid trial results

Average Farm Oil Sunflower Yield and average of breeder Oil Sunflower hybrid trial in ND



Source: NASS, NDSU Hybrid trial results.

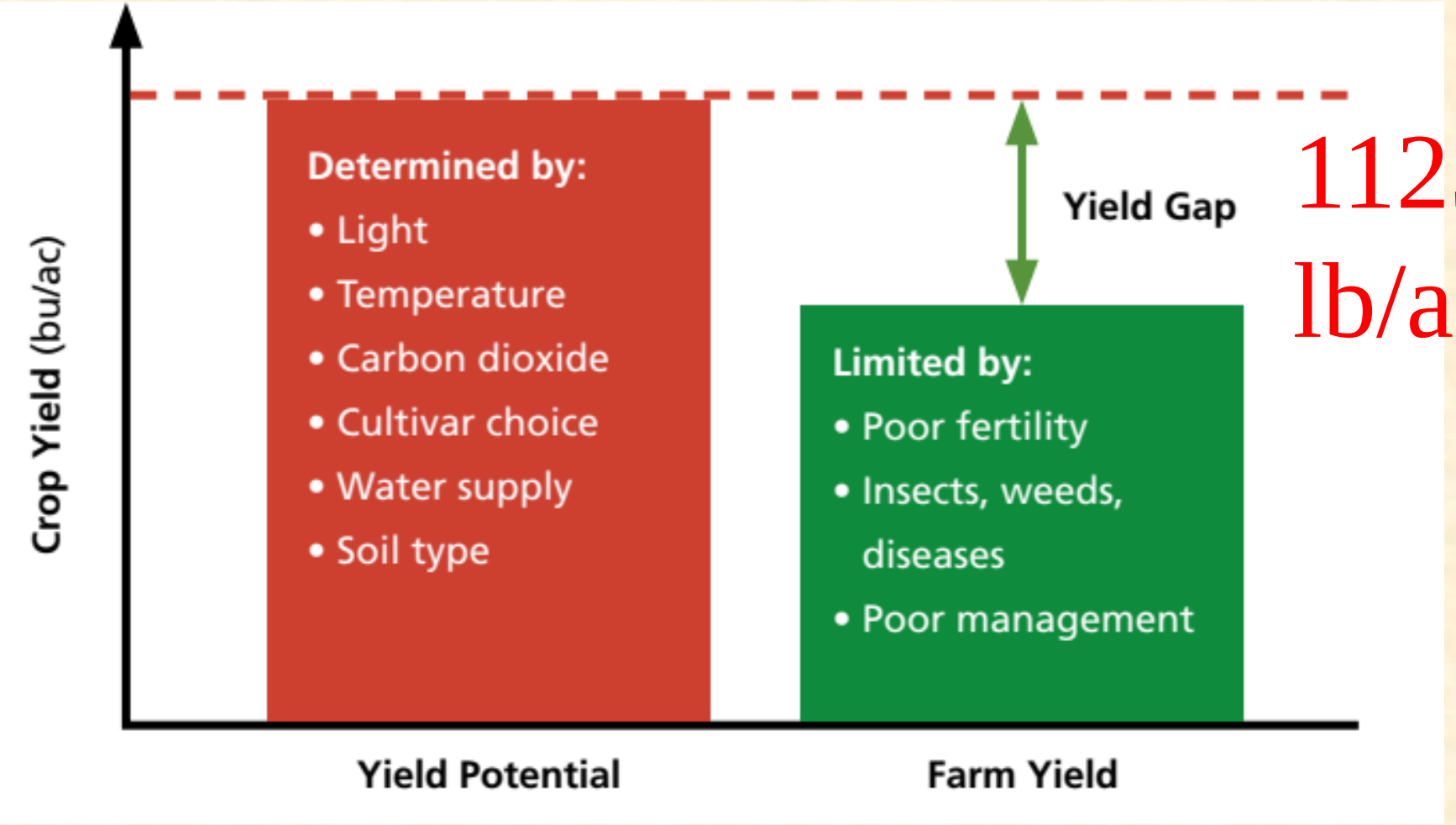
Average Farm Oil Sunflower Yield and average of breeder Oil Sunflower hybrid trial in ND



1484 lb/a 2607 lb/a

Source: NASS, NDSU Hybrid trial results.

North Dakota Yield Gap
Trials vs Farm

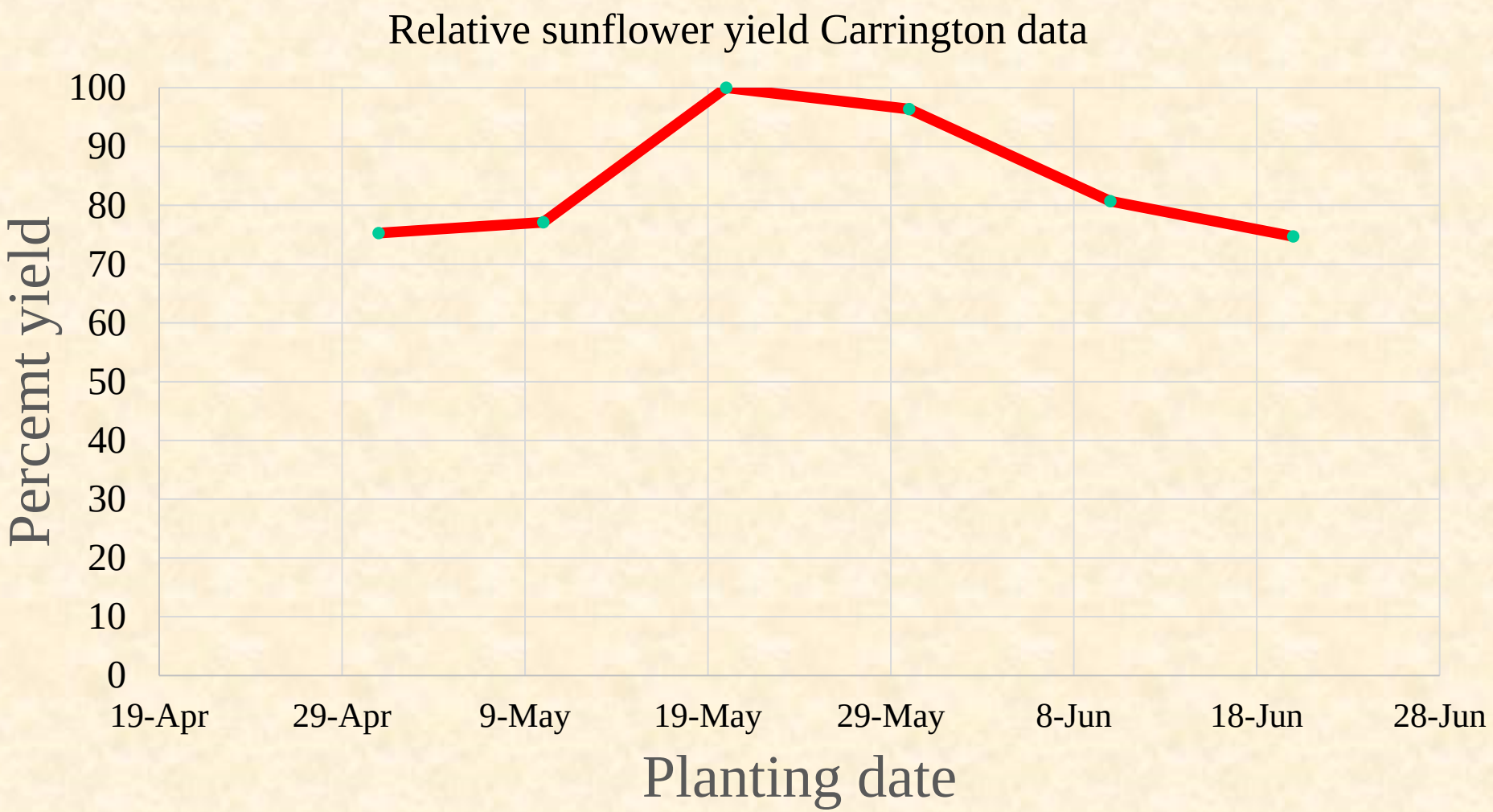


1123 lb/acre

Sunflower and available water

- 1 inch of water = about 140 lbs. yield per acre
- In a normal year; first 5 inches needed to get sunflower to point of seed production
- Example – 2022 Rainfall Carrington May – Sept about 12.8 inches
  - ~Assume 6 inches soil water at planting, 12.8 inch of rainfall during season ~18.8 inch total available – 5 inch for vegetative growth = 13.8 inch for seed production
  - Potential = 140 x 13.8 = ~ 1932 lbs. per acre
  - 2022 Carrington REC yield sunflower was 2,050 lbs. per acre

Yield and planting date



Hybrid Selection

- Non-oil type
- Oil type
- High Oleic (HO)
- NuSun (medium oleic)
- Traditional
- Herbicide type
- Clearfield
- Express
- Traditional

Estimate of Express vs Clearfield

- Estimate for 2023: 65% Express and 35% Clearfield
- The adaptation of Express has been on a steady increase and 2022 estimate was around 60-40 compared to Clearfield, it was closer to 50-50 just a few years ago.

Hybrid Selection

https://www.ag.ndsu.edu/varietytrials/variety-trial-results

A652-22

North Dakota
Sunflower

Variety Trial Results for 2022 and Selection Guide

Hans Kandel (North Dakota State University); Brent Hulke (Sunflower Unit, U.S. Department of Agriculture-Agricultural Research Service, Fargo); Mike Ostlie, Kristin Simons and Ezra Aberle (Carrington Research Extension Center); Bryan Hanson, Lawrence Henry and Richard Duerr (Langdon Research Extension Center) John Rickertsen and Michael Wells (Hettinger Research Extension Center); Eric Eriksmoen, Austin Kraklau and Jayden Hansen (North Central Research Extension Center, Minot); Gautam Pradhan, Christy Sperling, Justin Jacobs, Tyler Tjelde and Andrina Turnquist (Williston Research Extension Center)

Introduction

In North Dakota, an estimated 715,000 acres of sunflowers were planted in 2022. There were 221,000 more sunflower acres planted compared with 2021. Table 1 contains acreage data for the past 22 growing seasons as reported by the North Dakota Agricultural Statistics Service, U.S. Department of Agriculture.

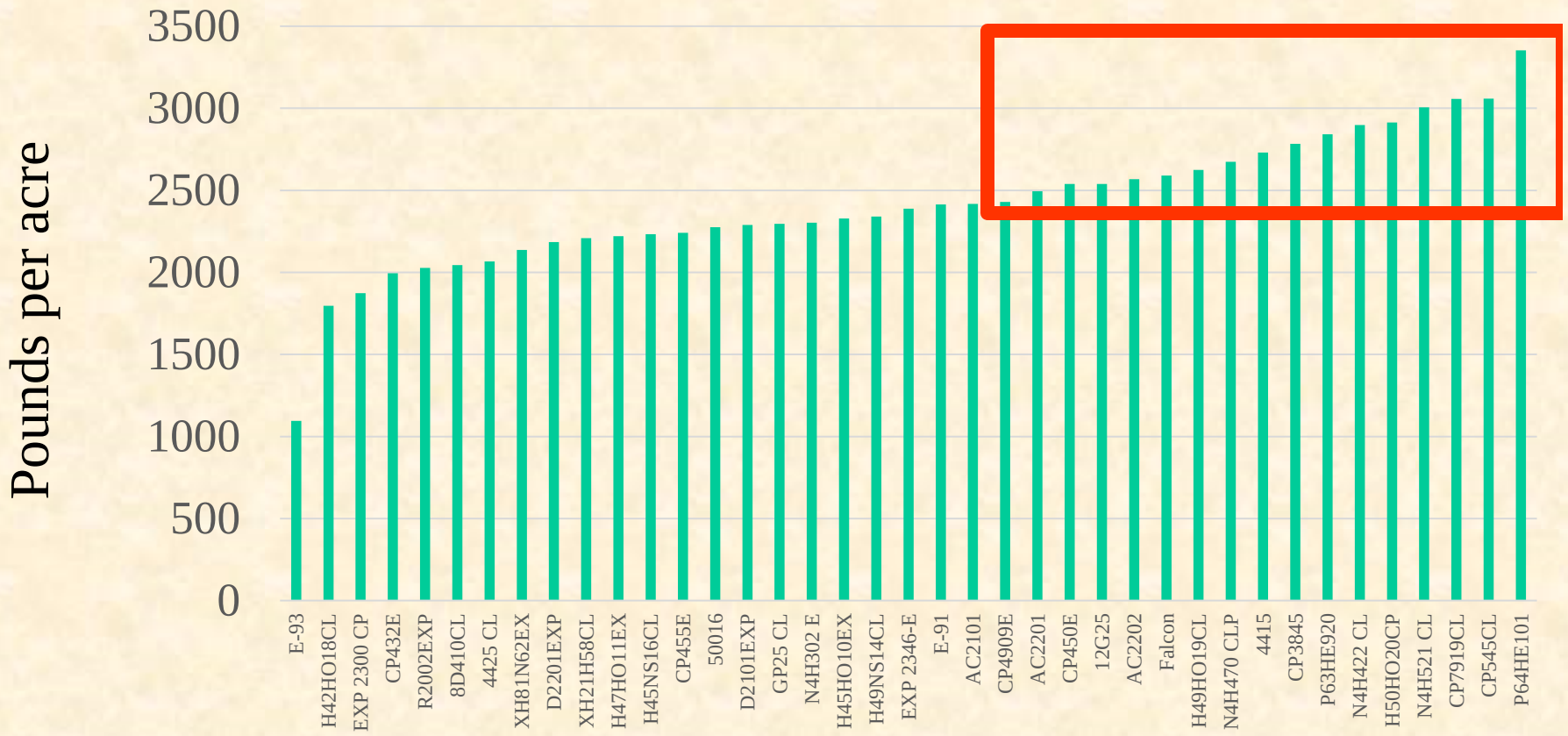
Table 1. Harvested Sunflower Acreage in North Dakota and Yield Per Acre 2001-2022.

Year	Oil Type	Yield	Non-oil Type	Yield
	(1,000 acres)	(lb/a)	(1,000 acres)	(lb/a)
2001	835	1,440	215	1,260
2002	1,105	1,310	210	1,200
2003	1,020	1,300	145	1,330
2004	660	1,040	130	810
2005	885	1,610	220	1,490

Fargo Sunflower Oil Hybrid Yield, 2022

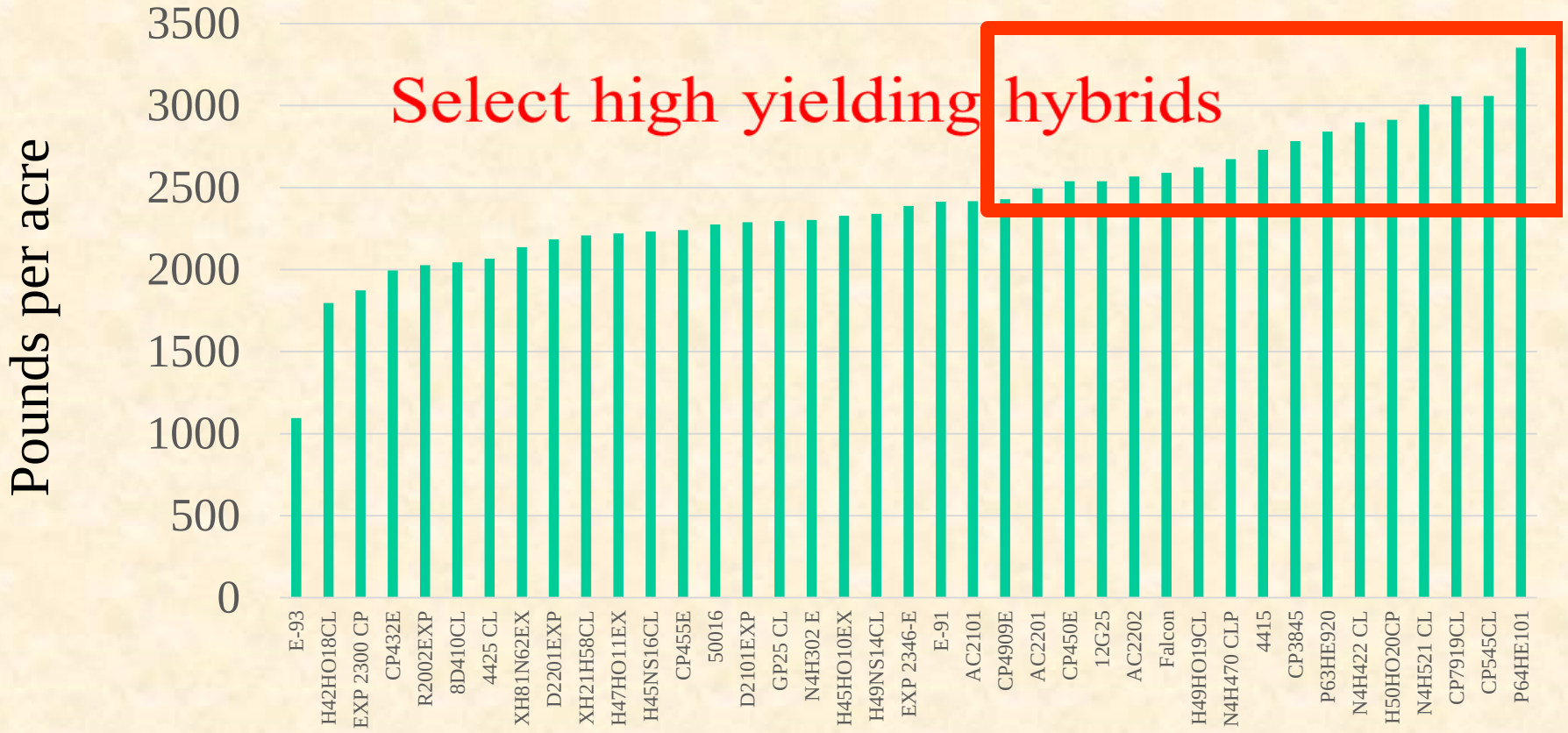
Source B. Hulke

Fargo Sunflower Oil Hybrid Yield, 2022



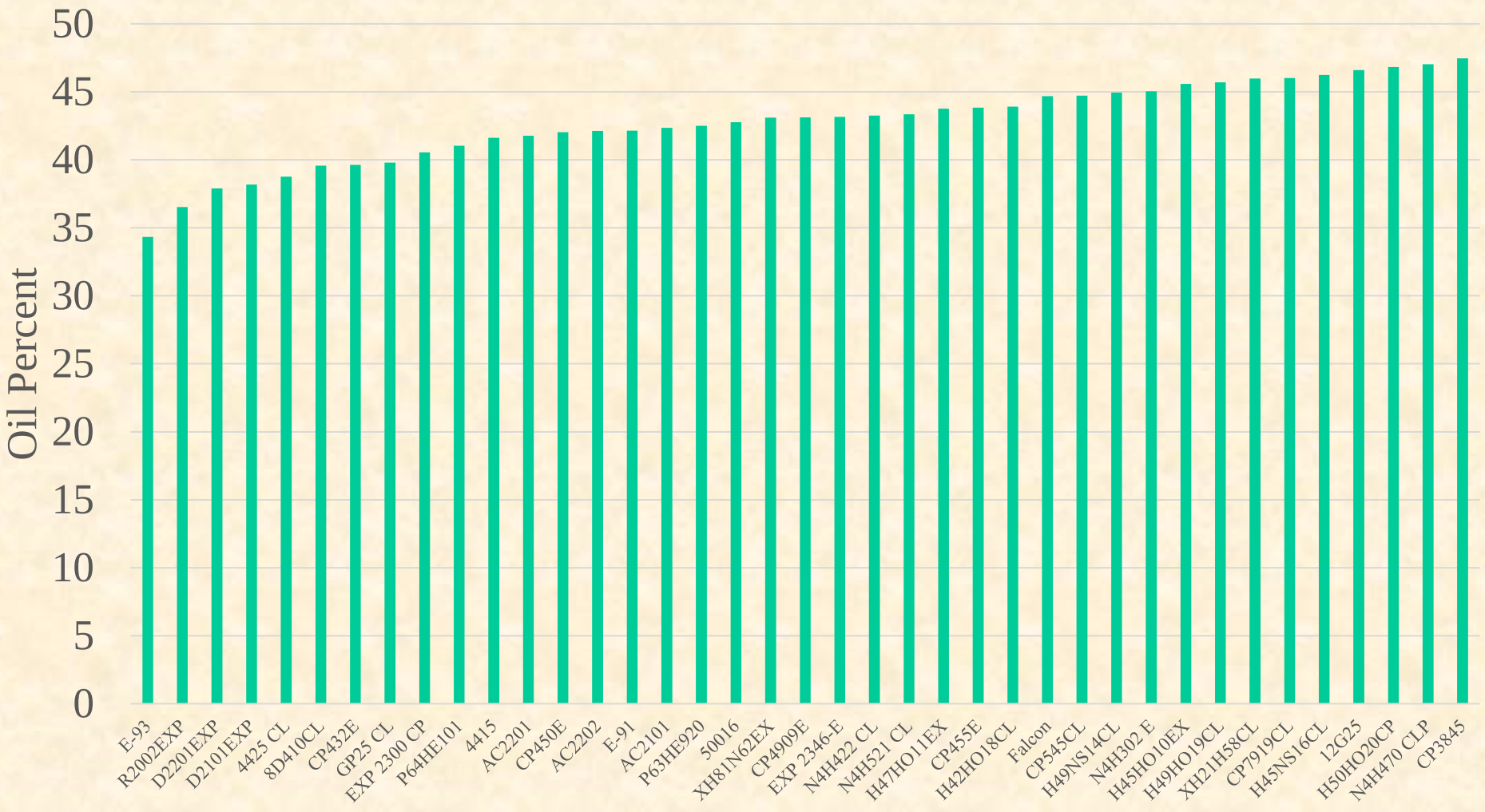
Source B. Hulke

Fargo Sunflower Oil Hybrid Yield, 2022



Source B. Hulke

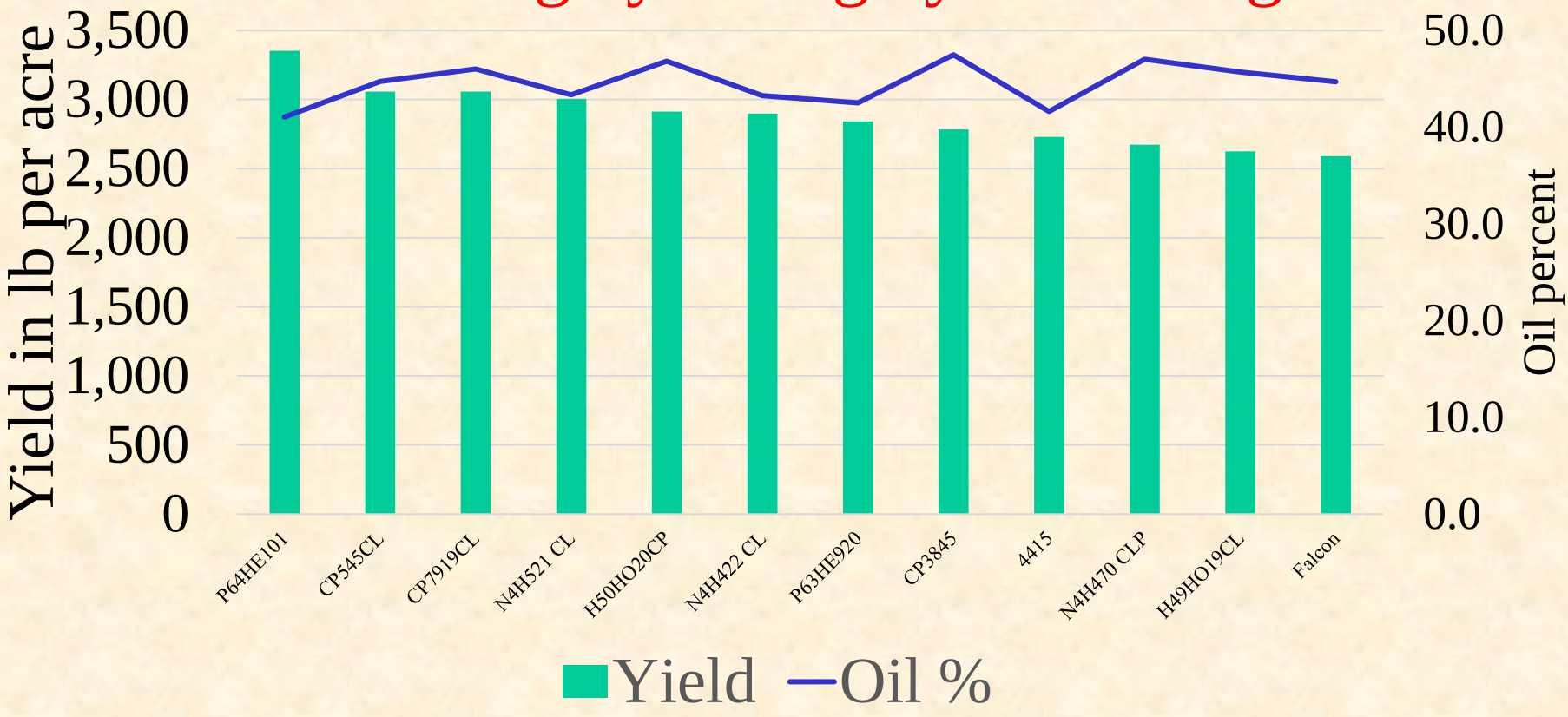
2022 Fargo Sunflower Hybrids (oil %)



Source B. Hulke

2022 Fargo Sunflower hybrids

Select high yielding hybrids + high oil



Source B. Hulke

NDSU Extension
13h ·

Have you seen our new Variety Trial Selection Tool?

We know variety selection can be challenging. With the new tool, you can compare varieties based on several factors. Put our research to work for your operation.

Use our tool to help you make an informed decision.
🌱NDSU Variety Trial Selection Tool >>> https://vt.ag.ndsu.edu/
#agriculture #research #agresearch #NorthDakota

- Variety selection tool available at vt.ag.ndsu.edu

vt.ag.ndsu.edu

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- ALL CROPS
- BARLEY
- BUCKWHEAT
- CANOLA
- CHICKPEA
- CORN
- DRY BEAN
- DURUM
- EINKORN
- EMMER
- FABA BEAN

Variety Trials

Year: All Years | County: All Counties | REC: All RECs | Location: All Locations

Compare	Title	Crop	Year	REC	Location	Site Description
	2022 - Sunflower - Oil - Minot - NCREC	Sunflower - Oil	2022	North Central REC	Minot	No-Till
	2022 Sunflower - Oil - Carrington	Sunflower - Oil	2022	Carrington REC	Carrington	Conventional
	[illegible]	Sunflower - Oil	2022	Langdon REC	Langdon	Conventional
	2021 Sunflower - Oilseed - Hettinger	Sunflower - Oil	2021	Hettinger REC	Hettinger	No-Till
	2021 Sunflower - Oilseed - Carrington	Sunflower - Oil	2021	Carrington REC	Carrington	Conventional
	2020 Sunflower Oil - Carrington	Sunflower - Oil	2020	Carrington REC	Carrington	Conventional
	2020 - Oil Sunflower - Carrington	Sunflower - Oil	2020	Carrington REC	Carrington	Conventional
	Sunflowers-Express Dryland Variety Trial - NDSU	Sunflower - Oil	2020	Williston REC	Williston	Conventional
	2020 - Oil Sunflower - Langdon	Sunflower - Oil	2020	Langdon REC	Langdon	Conventional
	Sunflowers-Clearfield Dryland Variety Trial - NDSU	Sunflower - Oil	2020	Williston REC	Williston	Conventional

Carrington 2022 data

2022 Sunflower - Oil - Carrington

LOCATION	REC	CROP	PREVIOUS CROP
Carrington	Carrington REC	Sunflower - Oil	Spring Wheat

PLANTING DATE	HARVEST DATE	SITE DESCRIPTION	RESEARCHERS
6/6/2022	10/19/2022	Conventional	Mike Ostlie

Yield reported as BLUEs (Best Linear Unbias Estimates).

Printable trial results and resources

2022sfoil (pdf)

Table Chart

Decimals 0

Variety	Brand	Trait	Oil Type	Days To Flower (days)	Days To Maturity (days)	Plant Height (in.)	Oil Content (%)	Test Weight (lb/bu)	Harvest Moisture (%)	Yield (lb/a)	Yield 2yr Previous	Yield Previous Year	Yield - 2 Year Avg
CP3845	CROPLAN	Conv	HO	64	117	60	43	29	6	1938	1358	958	1448
CP432E	CROPLAN	EX	NS	61	120	59	40	30	6	2137	1993	1148	1642
CP450E	CROPLAN	EX	HO	65	122	65	41	29	6	1600	1872	1312	1456
CP455E	CROPLAN	EX	HO	65	121	66	42	29	6	1751	1940	1154	1453
CP4909E	CROPLAN	EX	NS	66	118	63	42	30	7	1615	1531	1238	1427
CP545CL	CROPLAN	CL	NS	67	121	59	42	28	7	2191			--
CP5045CL	CROPLAN	CL	NS	67	120	62	43	29	7	2219	1441	1254	1736
CP7919CL	CROPLAN	CL	HO	66	122	63	42	28	7	2609	1589	1198	1903
AC2101	RAGT Semences	CP	HO	66	118	66	40	27	6	1753		949	1351
AC2201	RAGT Semences	CL	HO	66	122	68	41	29	7	1915			--
P63HE920	Pioneer Brand	EX	HO	66	120	62	41	31	6	1862			--

Carrington Oil 2022 selected hybrids

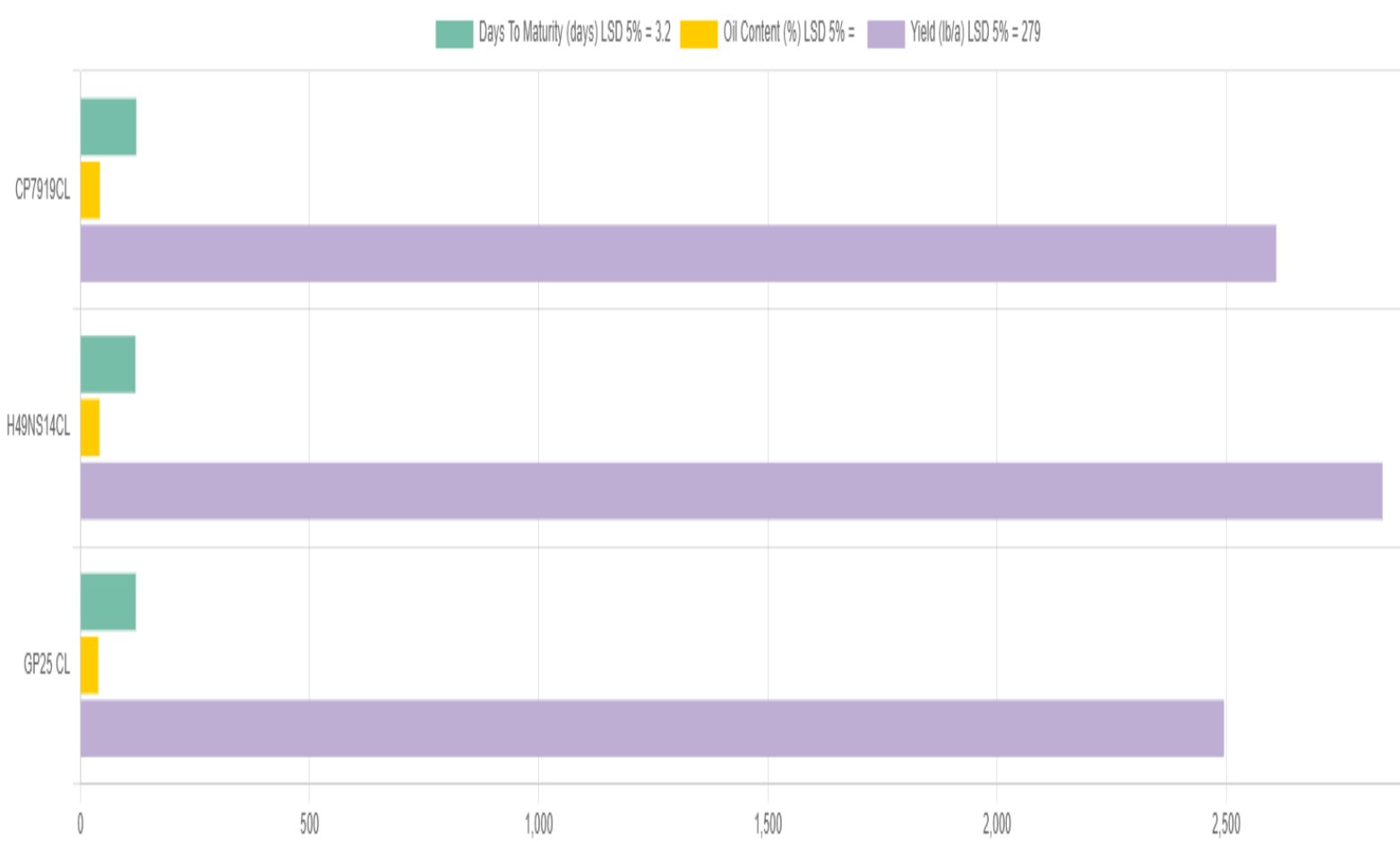
Table | Chart

Attributes to Chart

- [ ] All
- [ ] Days To Flower (days)
- [x] Days To Maturity (days)
- [ ] Plant Height (in.)
- [x] Oil Content (%)
- [ ] Test Weight (lb/bu)
- [ ] Harvest Moisture (%)
- [x] Yield (lb/a)
- [ ] Yield Previous Year
- [ ] Yield - 2 Year Avg

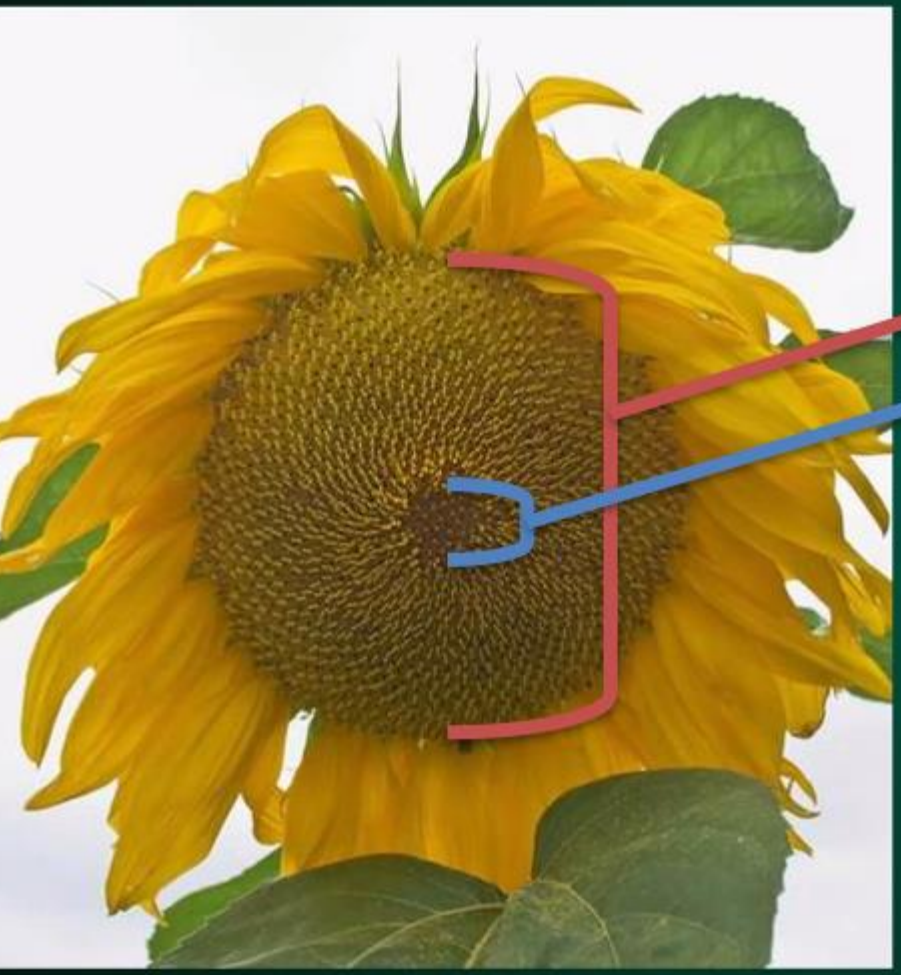
Varieties to Chart

- [ ] All
- [ ] CP3845



National Sunflower Association Survey: long term observations

Components Surveyed



Yield

- Harvestable Population
- Head Size
- Center Seed Set
- Seed Size
- Percent Good Seed
- Bird Damage*

Counting plants per acre

Measuring Head Diameter

Seed fill
seed size

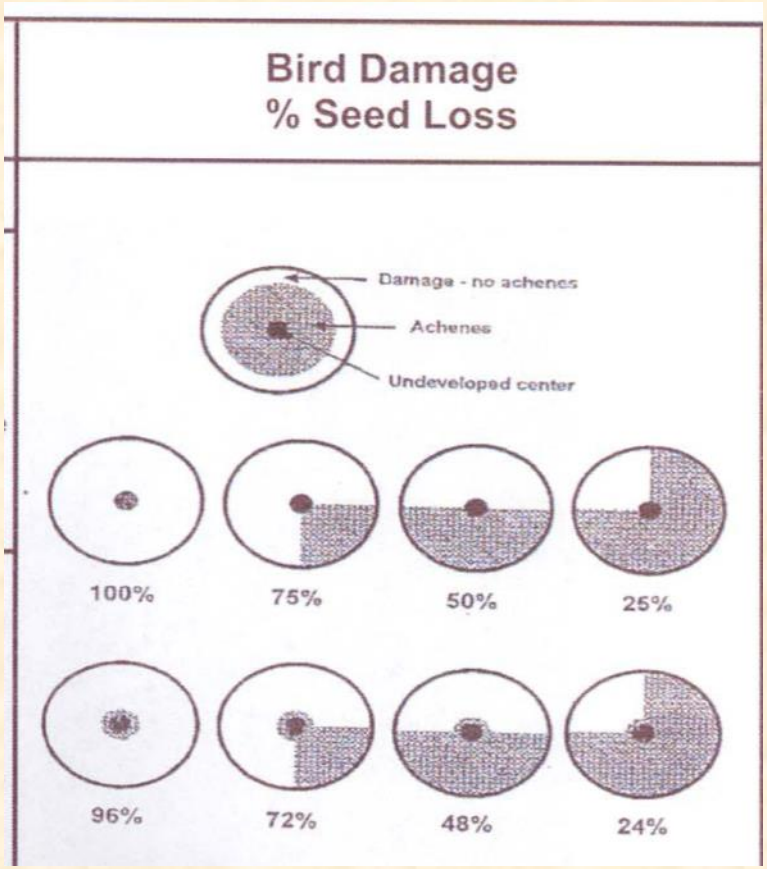
- Center Seed Set: If no seed in the center 1 inch of the head, multiply by 0.975; if no seed in the center 2 inch of the head, multiply by 0.95; if there is a hole in the center of the head, multiply by 0.90. You can adjust multiplier if the center seed set is in between 1 and 2 inches

An internal circadian clock controls the distinctive concentric rings of flowering in sunflowers.

At left is as sunflower head grown under normal conditions. Florets mature in concentric rings day by day. The flower head at right was grown with a disrupted circadian clock and its florets did not open in the correct pattern. (Harmer lab, UC Davis)

https://elifesciences.org/articles/80984

Bird damage/rubbing damage on the head



2022 Sunflower Yield and Management Practices

Team #_____ County _____ Field # _____ Oil (1) _____ Conf (2) _____.

GPS North_____ GPS West _____ Dryland (1) _____ Irrigated (2) _____.

Yield Data:		**Plants / Pop.**	**Head Diameter**	**Seed Size**	**% Good Seed**	**Center Seed Set**	**Previous Crop**
1st count							
2nd count							
Average							

Calculation:

2450 x	_____ x	_____ x	_____ x	_____ x	_____ x	_____ =	
	Plant Population multiplier	Head Diameter multiplier	Seed Size multiplier	% Good Seed	Center Seed Set	Bird Damage Multiplier	Est. Yield

Management Practices:

Row Spacing 20" or less - 1 _____ 21" or Greater - 2_____

Plant Population Multiplier:

Plants per 25 ft. of Row

Population	6”	12”	18”	22”	28”	30”	36”	Multiplier
10,000	3.0	6.0	8.0	9.5	13.4	14.4	17.2	.50
11,000	3.25	6.5	9.0	11.6	14.7	15.8	18.9	.55
12,000	3.5	7.0	10.0	12.6	16.1	17.2	20.7	.60
13,000	3.75	8.0	11.0	13.7	17.4	18.7	22.4	.65
14,000	4.0	8.5	12.0	14.7	18.7	20.1	24.1	.70
15,000	4.25	9.0	13.0	15.8	20.1	21.5	25.8	.75
16,000	4.5	9.5	13.75	16.8	21.4	23.0	27.6	.80
17,000	5.0	10.0	14.75	17.9	22.8	24.4	29.3	.85
18,000	5.25	10.5	15.5	18.9	24.1	25.8	29.3	.90
19,000	5.5	11.0	16.25	20.0	25.4	27.3	32.7	.95
20,000	5.75	11.5	17.25	21.0	26.8	28.7	34.4	1.00
21,000	6.0	12.0	18.0	22.1	28.1	30.1	36.2	1.05
22,000	6.25	12.5	19.0	23.1	29.5	31.6	37.9	1.10
23,000	6.5	12.25	19.75	24.2	30.8	33.0	39.6	1.15
24,000	7.0	12.75	20.75	25.3	32.1	34.4	42.5	1.20
25,000	7.25	14.25	21.5	26.3	33.5	34.4	43.1	1.25

Head Diameter – Measure the diameter of five average heads and determine the average.

In inches

Hd. Diam.	Mult.	Hd. Diam.	Mult.	Hd. Diam.	Mult.	Hd. Diam.	Mult.
3.5	.19	6.0	.64	8.5	1.09	11.0	1.54
4.0	.28	6.5	.73	9.0	1.18	11.5	1.63
4.5	.37	7.0	.82	9.5	1.27	12.0	1.72
5.0	.46	7.5	.91	10.0	1.36		
5.5	.55	8.0	1.00	10.5	1.45		

Seed Size: Remove several seeds approximately 2” from edge of the head and compare to the seed outlines below.

Descriptor	Light (L)	Medium Light (ML)	Medium (M)	Medium Heavy (MH)	Heavy (H)
Multiplier	0.8	0.9	1.0	1.1	1.2
Size					

Descriptor	Light (L)	Medium Light (ML)	Medium (M)	Medium Heavy (MH)	Heavy (H)
Multiplier	0.8	0.9	1.0	1.1	1.2
Size					

Side size	Wide	Length	Correction factor
	-----mm-----		
Light	4.2	7.3	0.8
Medium Light	5.2	7.8	0.9
Medium	5.8	8.9	1.0
Medium Heavy	5.8	9.9	1.1
Heavy	5.8	11.0	1.2

Calculation

Yield Calculation:							
2450 X	13,200 X	8.2 X	X	_____ X	_____ X	_____ =	_____lb. /A
	Plant Population Mutiplier	Head Diameter Multiplier	Seed Size Multiplier	% Good Seed	Center Seed Set multiplier	% No Bird Damage	**Calculated Yield**

Yield calculation	Plant Population	Head Diameter	Seed size		Center seed	No bird damage	Formula
Example	multiplier	multiplier	multiplier	% good seed	set multiplie	% ratio	
2450	0.66	1.03	1.1	0.99	0.985	0.98	1751

2021 NSA Survey Yield Limiting Factor

What was the number one and number two factor that limited yield?[1]

0. No problem
1. Birds
2. Disease
3. Drought
4. Uneven Plant Growth
5. Hail
6. Herbicide Damage
7. Insects
8. Lodging
9. Plant Spacing within the row
10. Weeds
11. other ----------

#1.____ **#2.____**

Most # 1 Limiting Factors 2011 - 2021
National Sunflower Surveys

	2011	2012	2013	2015	2017	2019	2021	Ave. 2011-2021
	----------Percent of the surveyed fields----------							
Plant Spacing	**18**	**18**	**26**	**13**	**19**	**16**	**10**	**17**

[1]Based on 155 fields in 2011, 211 (2012), 209 (2013), 201 (2015) and 172 (2017), 133 (2019), 164 (2021) = 1245 total since 2011.

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National Sunflower Surveys

	2011	2012	2013	2015	2017	2019	2021	Ave. 2011-2021
	--------Percent of the surveyed fields------							
Plant Spacing	18	18	26	13	19	16	10	17
Diseases	18	7	17	24	11	25	7	16

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	--------Percent of the surveyed fields------							
Plant Spacing	18	18	26	13	19	16	10	17
Diseases	18	7	17	24	11	25	7	16
Drought	8	29	15	11	31	2	51	21

[1]Based on 155 fields in 2011, 211 (2012), 209 (2013), 201 (2015) and 172 (2017), 133 (2019), 164 (2021) = 1245 total since 2011.

Most # 1 Limiting Factors 2011 - 2021 National Sunflower Surveys

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Plant Spacing	18	18	26	13	19	16	10	17
Diseases	18	7	17	24	11	25	7	16
Drought	8	29	15	11	31	2	51	21
Weeds	8	8	4	8	8	6	2	6

[1]Based on 155 fields in 2011, 211 (2012), 209 (2013), 201 (2015) and 172 (2017), 133 (2019), 164 (2021) = 1245 total since 2011.

Most # 1 Limiting Factors 2011 - 2021
National Sunflower Surveys

	2011	2012	2013	2015	2017	2019	2021	Ave. 2011-2021
	--------Percent of the surveyed fields------							
Plant Spacing	18	18	26	13	19	16	10	17
Diseases	18	7	17	24	11	25	7	16
Drought	8	29	15	11	31	2	51	21
Weeds	8	8	4	8	8	6	2	6
No Problem	14	13	11	11	9	8	9	11

[1]Based on 155 fields in 2011, 211 (2012), 209 (2013), 201 (2015) and 172 (2017), 133 (2019), 164 (2021) = 1245 total since 2011.

Solid Seeded Sunflower

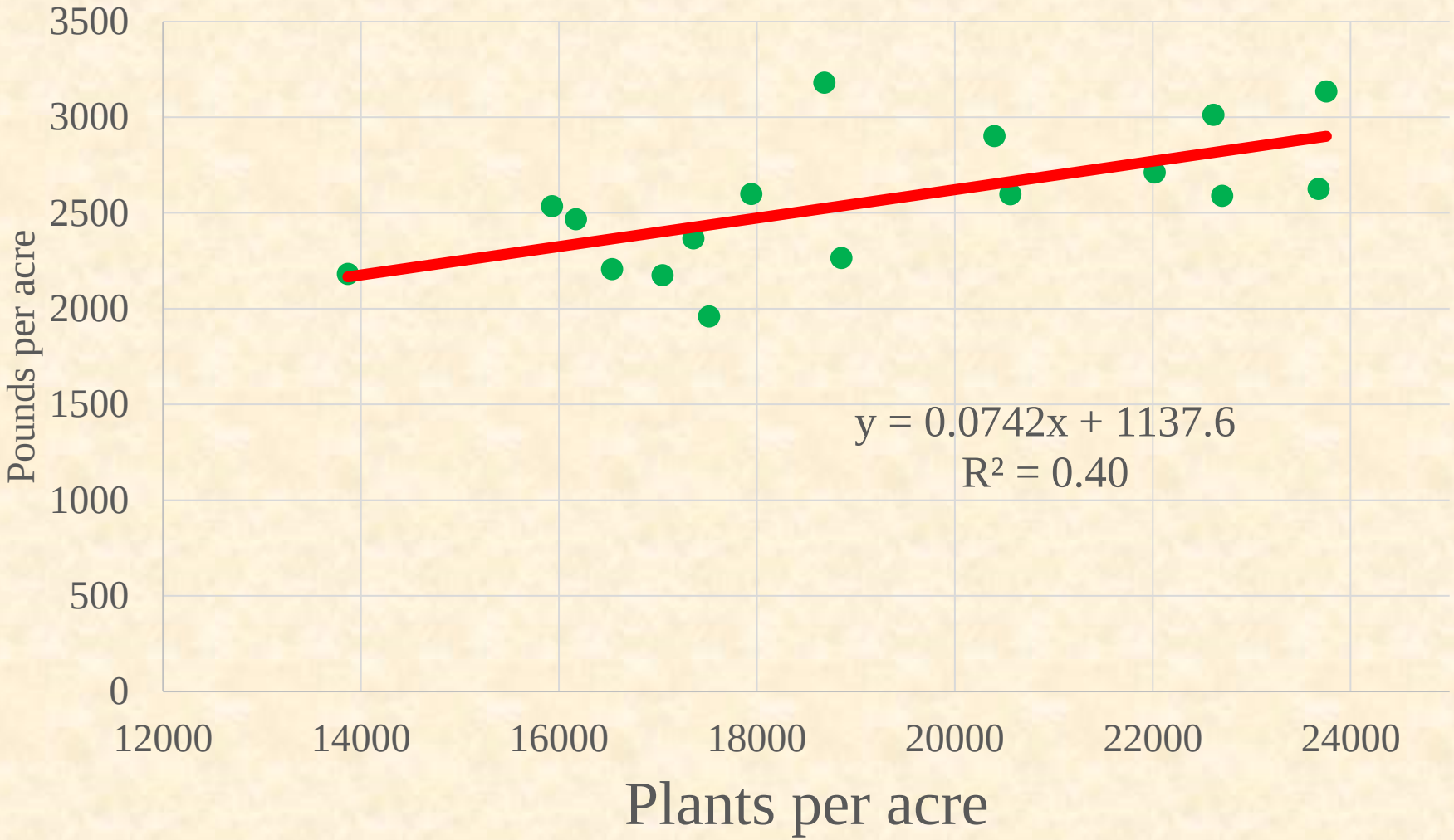
Plant Spacing Within Row

Sunflower Yield Vs. Plant Population
6 Locations, 12 Trials - Minnesota

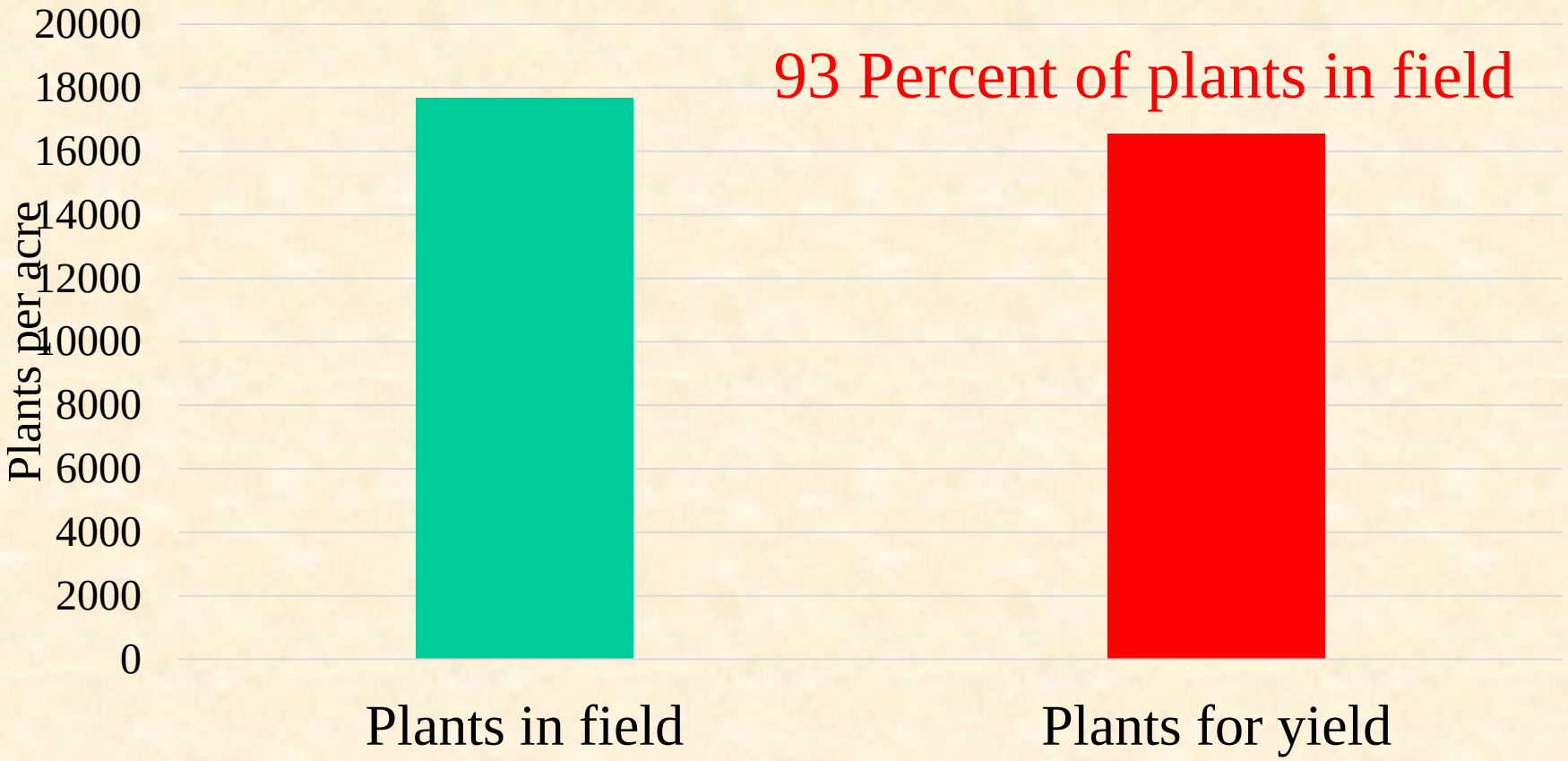
Plants/acre	Yield lb/a	Head Dia. inch	Head Moisture
7000	1643	11	43
10000	1985	9.8	34
15000	2276	7.9	25
20000	2511	7.9	22
25000	2628	7.1	20



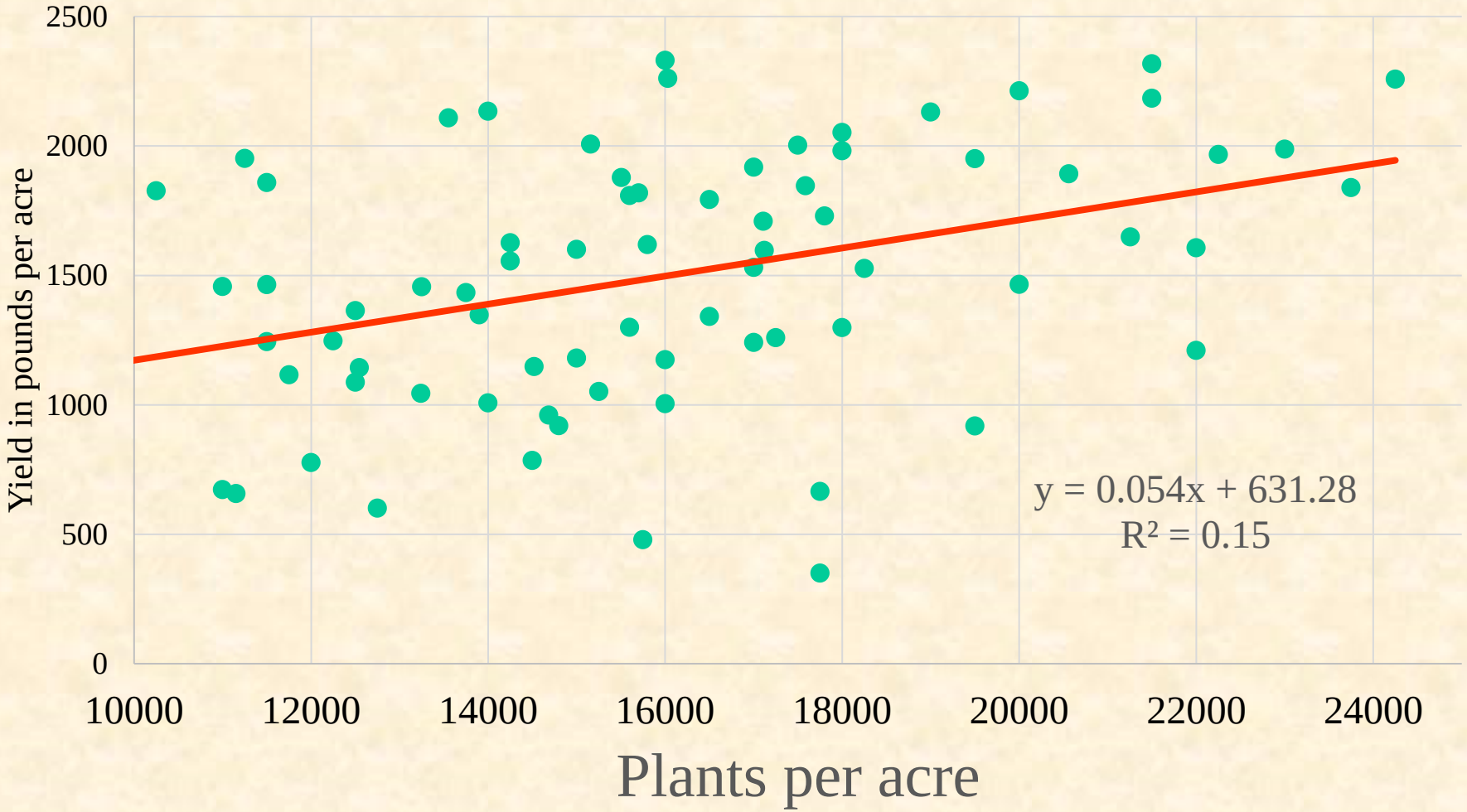
Irrigated Sunflower Williston 2021



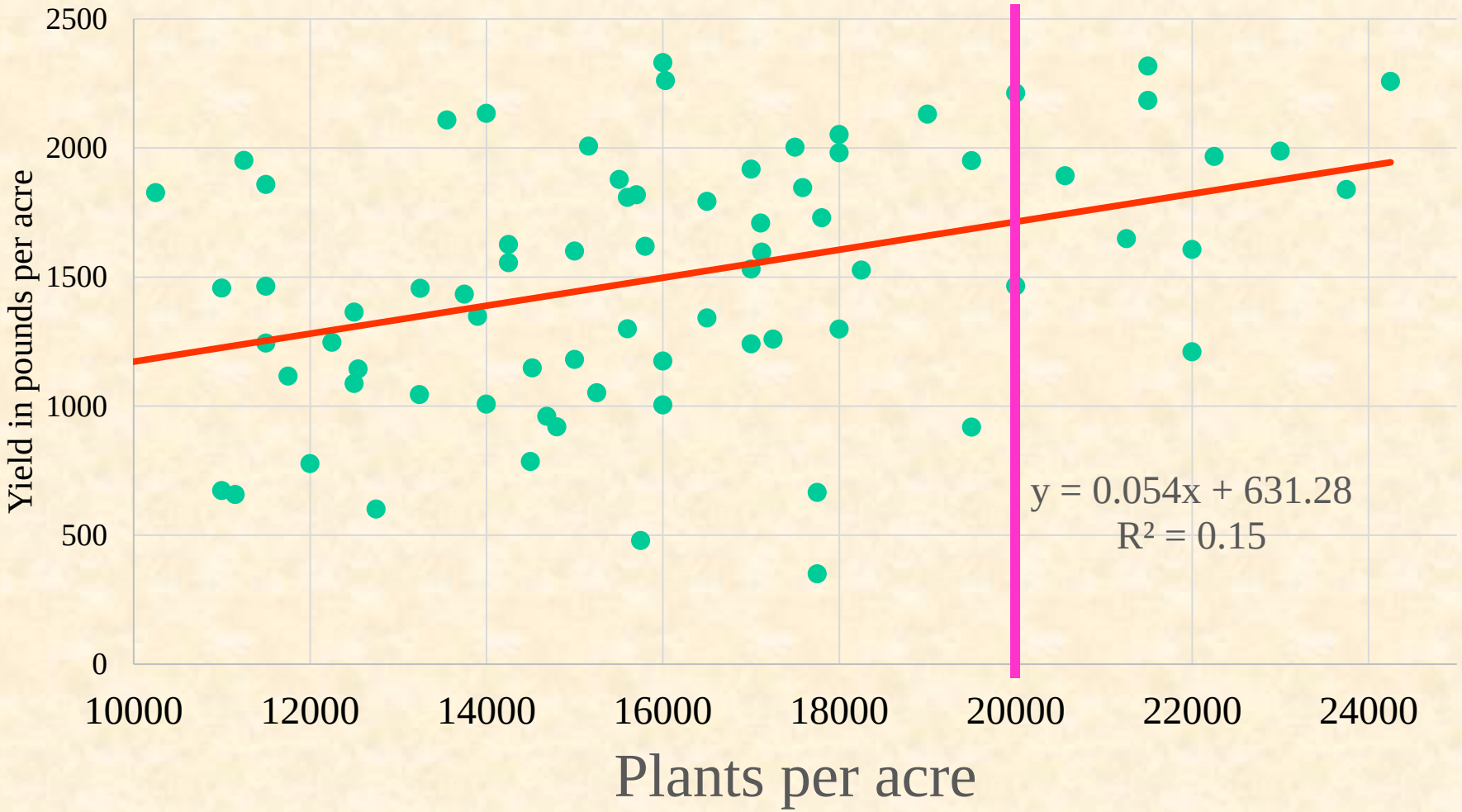
2021 ND sunflower survey plants per acre in field and contributing to yield



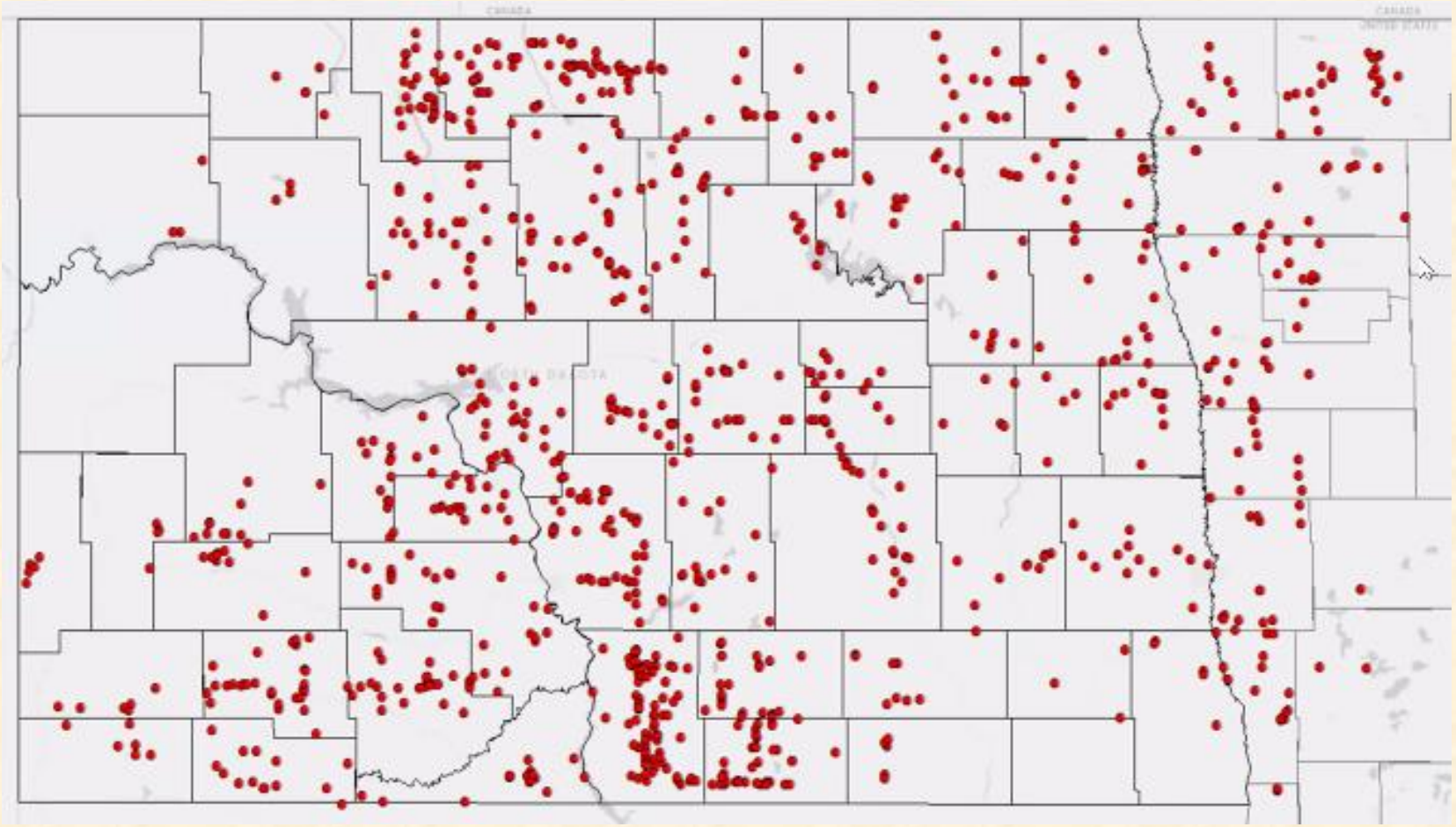
2021 ND survey sunflower plants per acre and yield



2021 ND survey sunflower plants per acre and yield



1003 surveyed fields in ND and MN 2006-2017



Source: B. Hansen

Average Yield of Limiting Factors

2006-2017

Limiting Factor	Yield (lb/ac)	No of Obs	P-value
None	2169	66	--
Birds	1332	51	<.0001**
Disease	1787	118	<.0001**
Drought	1575	66	<.0001**
Drown-out	1854	8	0.0934
Hail	1490	10	<.0001**
Herbicide	1123	1	0.0377*
Insects	1587	15	<.0001**
Lodging	1731	54	<.0001**
Plant spacing	1729	98	<.0001**
Weeds	1847	31	0.0033**
Uneven growth	1466	9	<.0001**

Source: B. Hansen

Average Yield of Limiting Factors

2006-2017

Limiting Factor	Yield (lb/ac)	No of Obs	P-value
None	2169	66	--
Birds	1332	51	<.0001**
Disease	1787	118	<.0001**
Drought	1575	66	<.0001**
Drown-out	1854	8	0.0934
Hail	1490	10	<.0001**
Herbicide	1123	1	0.0377*
Insects	1587	15	<.0001**
Lodging	1731	54	<.0001**
Plant spacing	1729	98	<.0001**
Weeds	1847	31	0.0033**
Uneven growth	1466	9	<.0001**

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Source: B. Hansen

Most # 1 Limiting Factors 2011 - 2021 National Sunflower Surveys

	2011	2012	2013	2015	2017	2019	2021	Ave. 2011-2021
	--------Percent of the surveyed fields------							
Diseases	18	7	17	24	11	25	7	16
No Problem	14	13	11	11	9	8	9	11

[1]Based on 155 fields in 2011, 211 (2012), 209 (2013), 201 (2015) and 172 (2017), 133 (2019), 164 (2021) = 1245 total since 2011.

Average Yield of Limiting Factors

2006-2017

Limiting Factor	Yield (lb/ac)	No of Obs	P-value
None	2169	66	--
Birds	1332	51	<.0001**
Disease	1787	118	<.0001**
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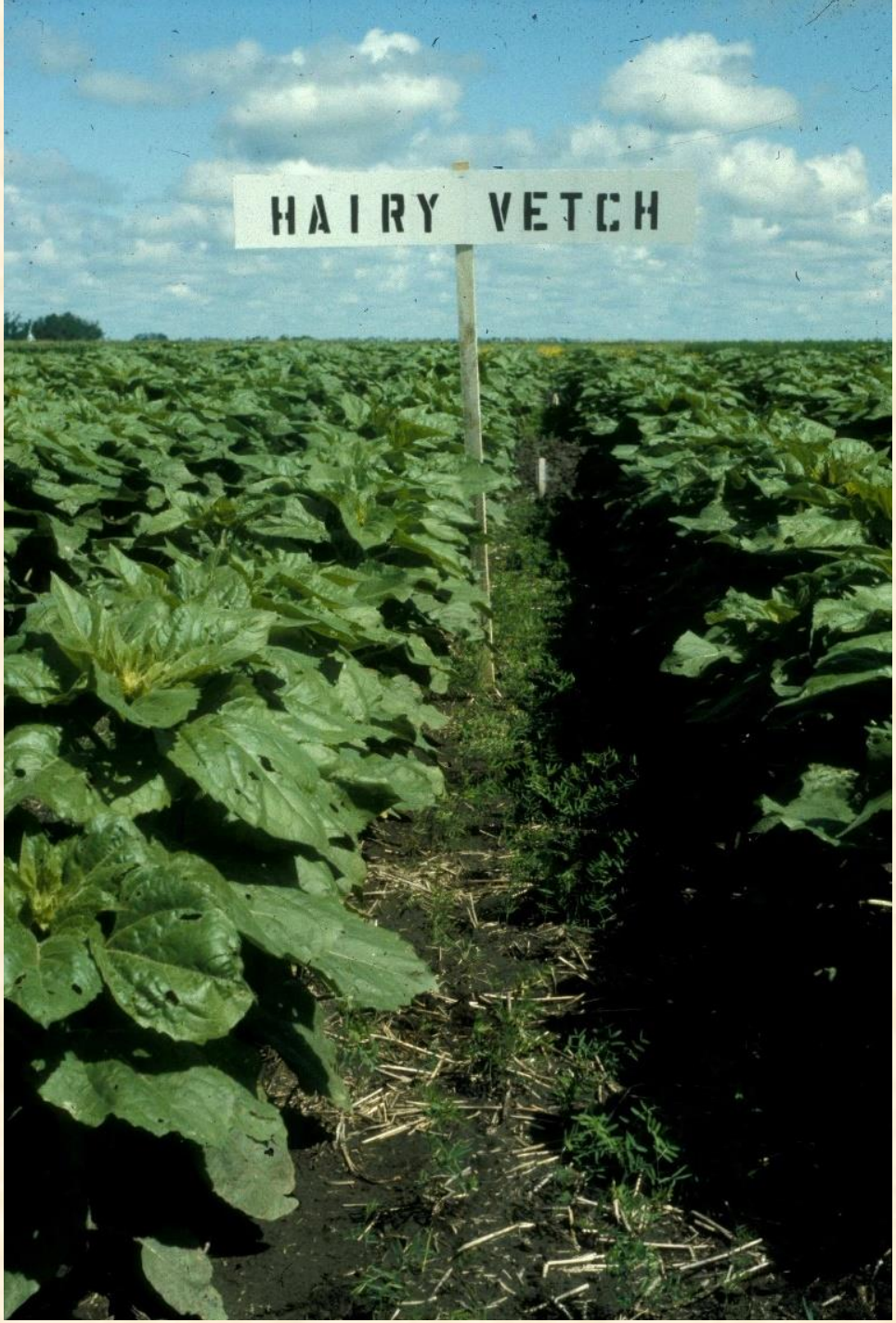
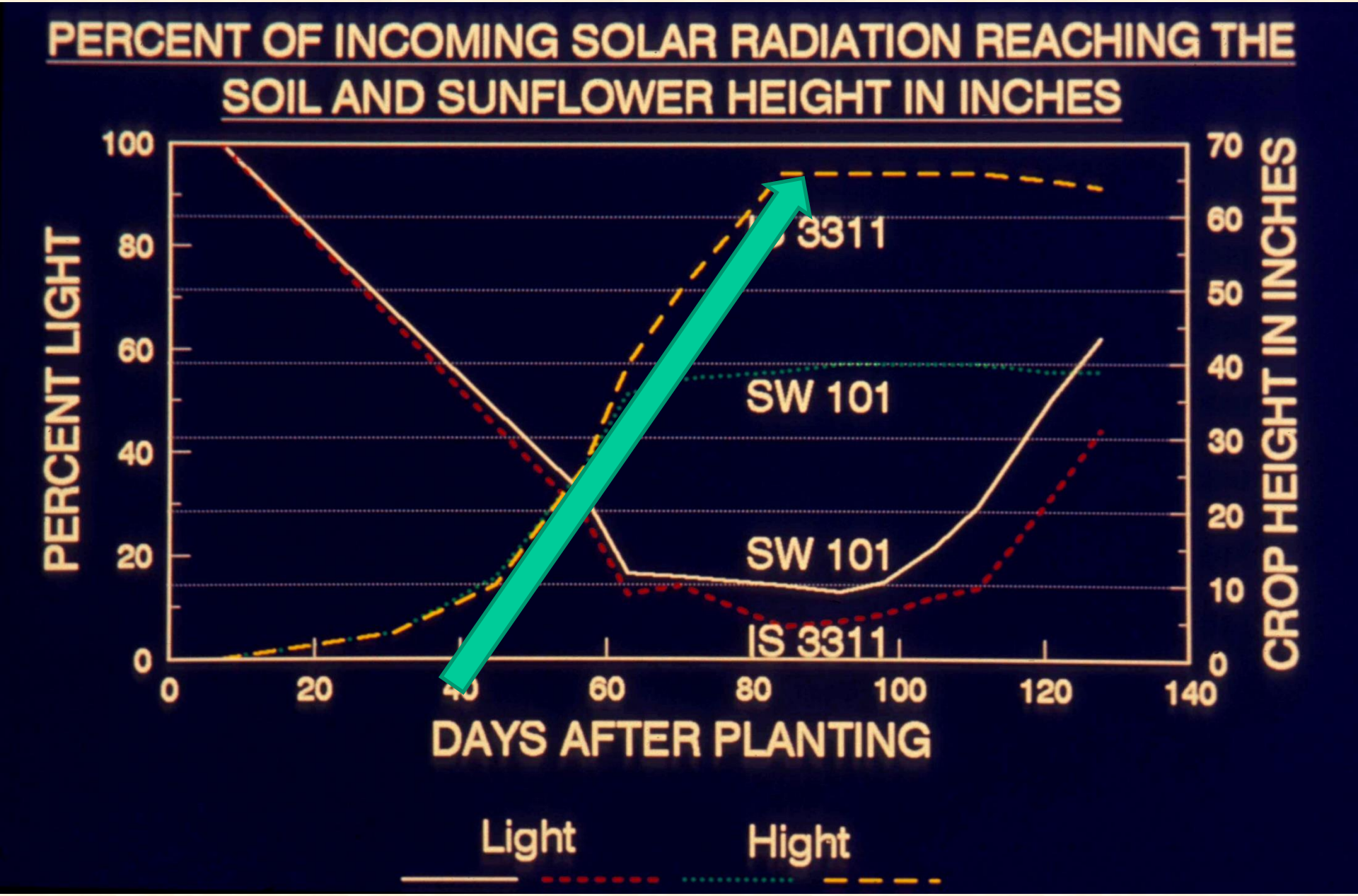
Source: B. Hansen

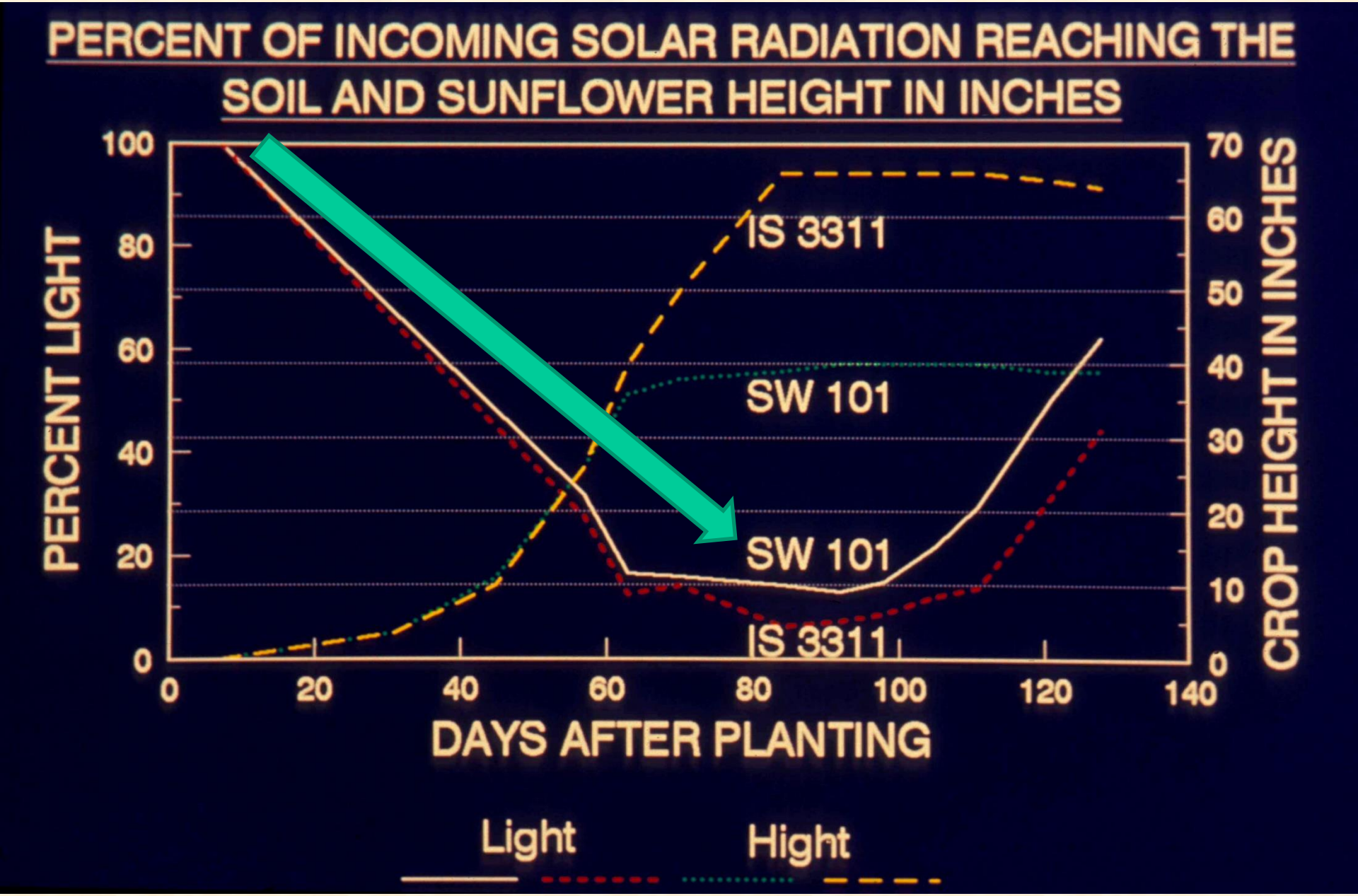
Soil Health, Improving Cover and Organic Matter

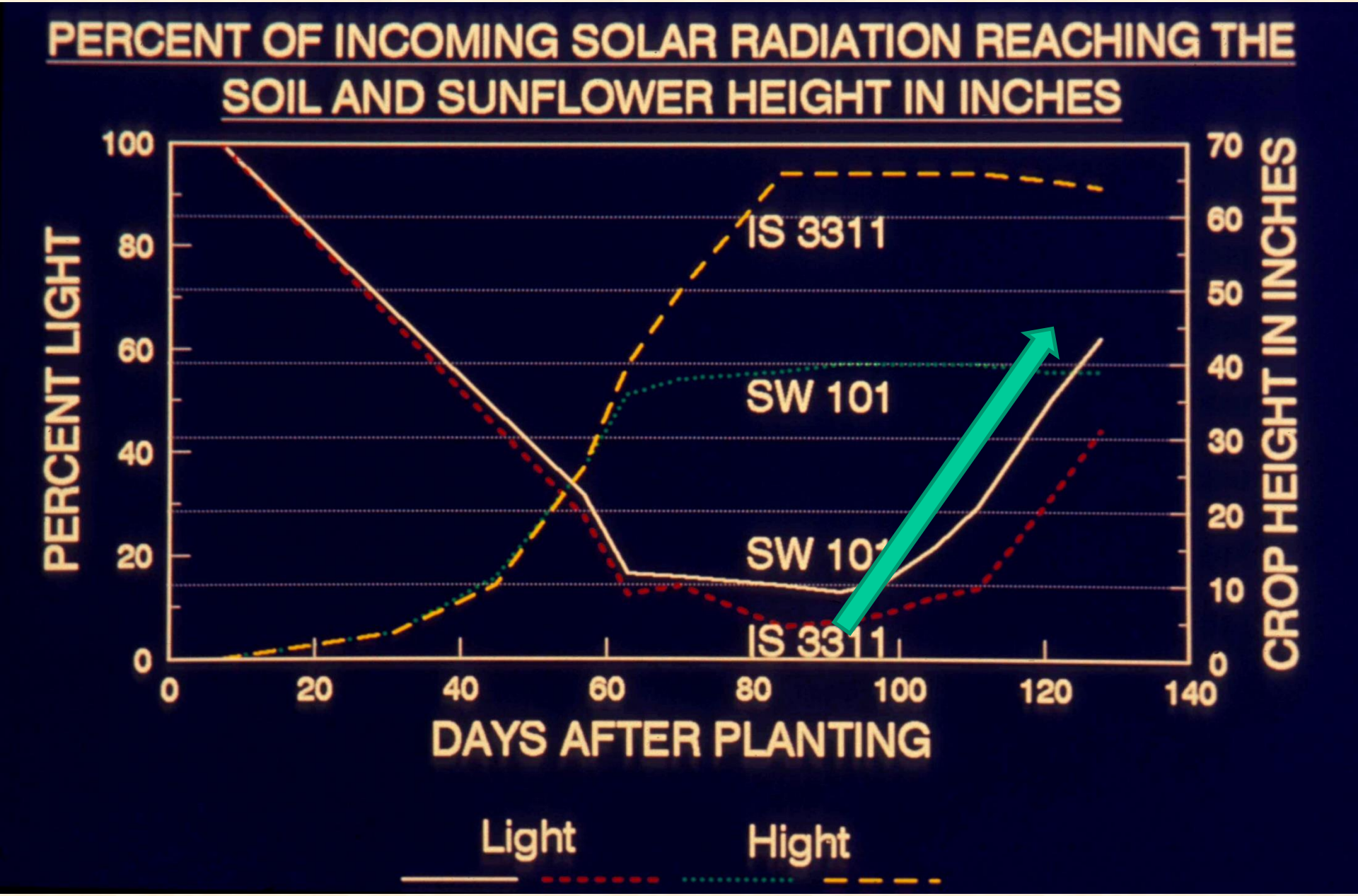
Interseeding cover crops into sunflower


BLACK LENTIL


HAIRY VETCH


PERCENT OF INCOMING SOLAR RADIATION REACHING THE SOIL AND SUNFLOWER HEIGHT IN INCHES
PERCENT LIGHT
CROP HEIGHT IN INCHES
100
80
60
40
20
0
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
DAYS AFTER PLANTING
3311
SW 101
SW 101
IS 3311
Light
Hight


PERCENT OF INCOMING SOLAR RADIATION REACHING THE SOIL AND SUNFLOWER HEIGHT IN INCHES
PERCENT LIGHT
CROP HEIGHT IN INCHES
DAYS AFTER PLANTING
IS 3311
SW 101
SW 101
IS 3311
Light
Hight
0
20
40
60
80
100
120
140
0
10
20
30
40
50
60
70


PERCENT OF INCOMING SOLAR RADIATION REACHING THE SOIL AND SUNFLOWER HEIGHT IN INCHES
PERCENT LIGHT
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100
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30
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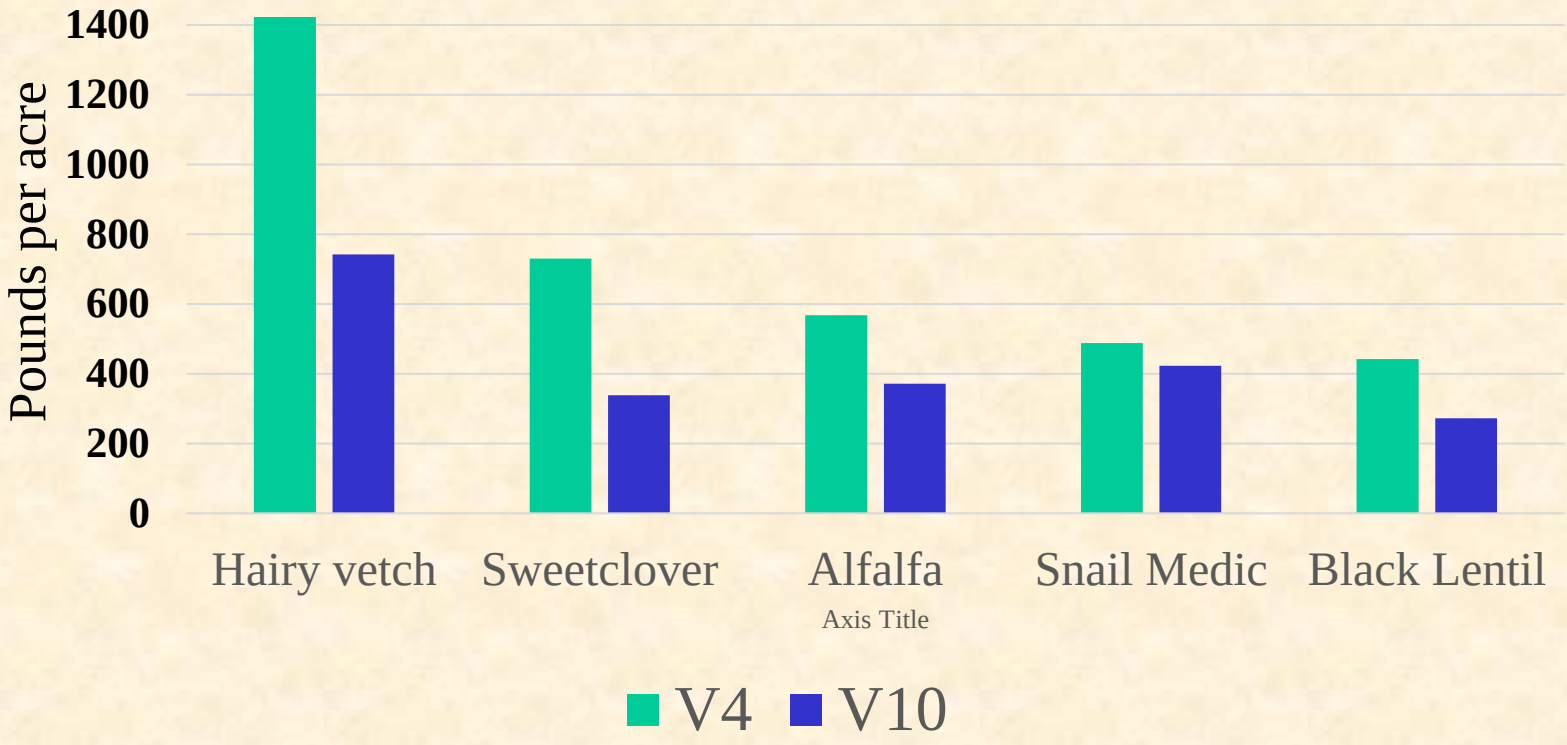
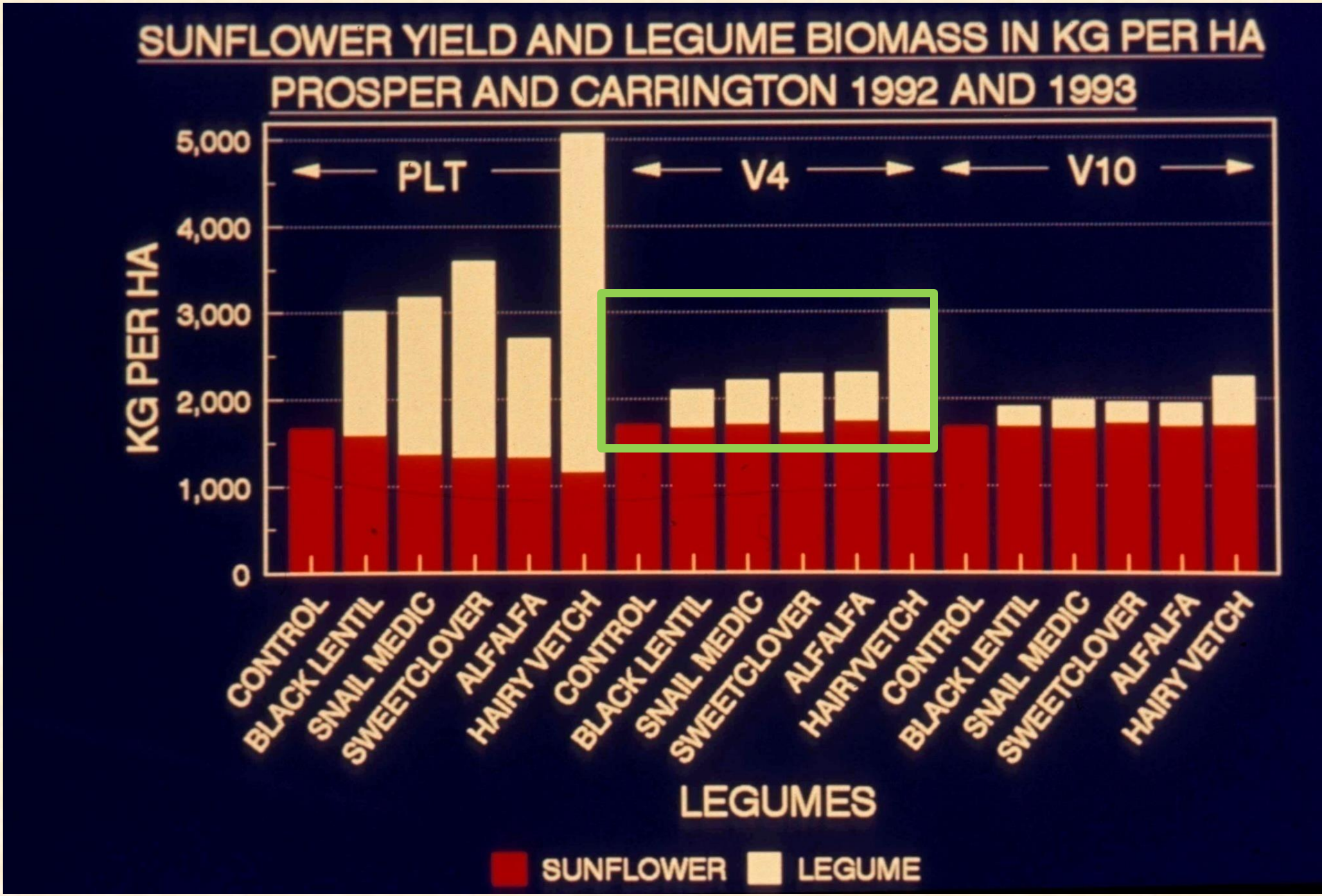
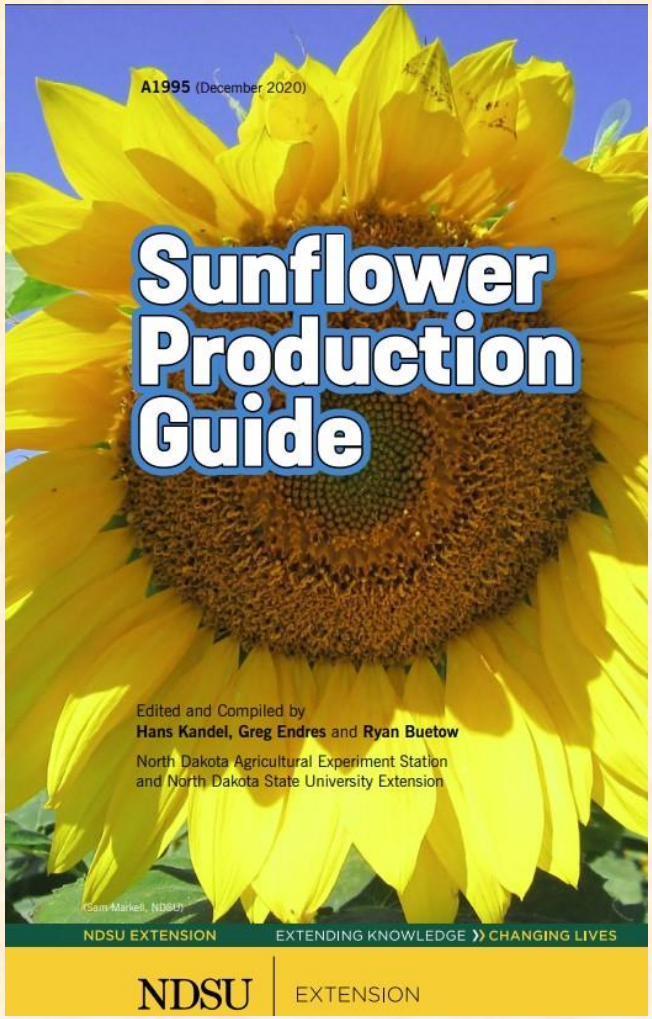
10
0
IS 3311
SW 101
SW 101
IS 3311
0
20
40
60
80
100
120
140
DAYS AFTER PLANTING
Light
Hight

Cover crop interseeded at sunflower growth stage V4 and V10




SUNFLOWER YIELD AND LEGUME BIOMASS IN KG PER HA
PROSPER AND CARRINGTON 1992 AND 1993
KG PER HA
5,000
4,000
3,000
2,000
1,000
0
PLT
V4
V10
CONTROL
BLACK LENTIL
SNAIL MEDIC
SWEETCLOVER
ALFALFA
HAIRY VETCH
CONTROL
BLACK LENTIL
SNAIL MEDIC
SWEETCLOVER
ALFALFA
HAIRYVETCH
CONTROL
BLACK LENTIL
SNAIL MEDIC
SWEETCLOVER
ALFALFA
HAIRY VETCH
LEGUMES
SUNFLOWER
LEGUME

www.ag.ndsu.edu/publications/crops/sunflower-production-guide



- Questions