Weed Management in Early Planted Soybean

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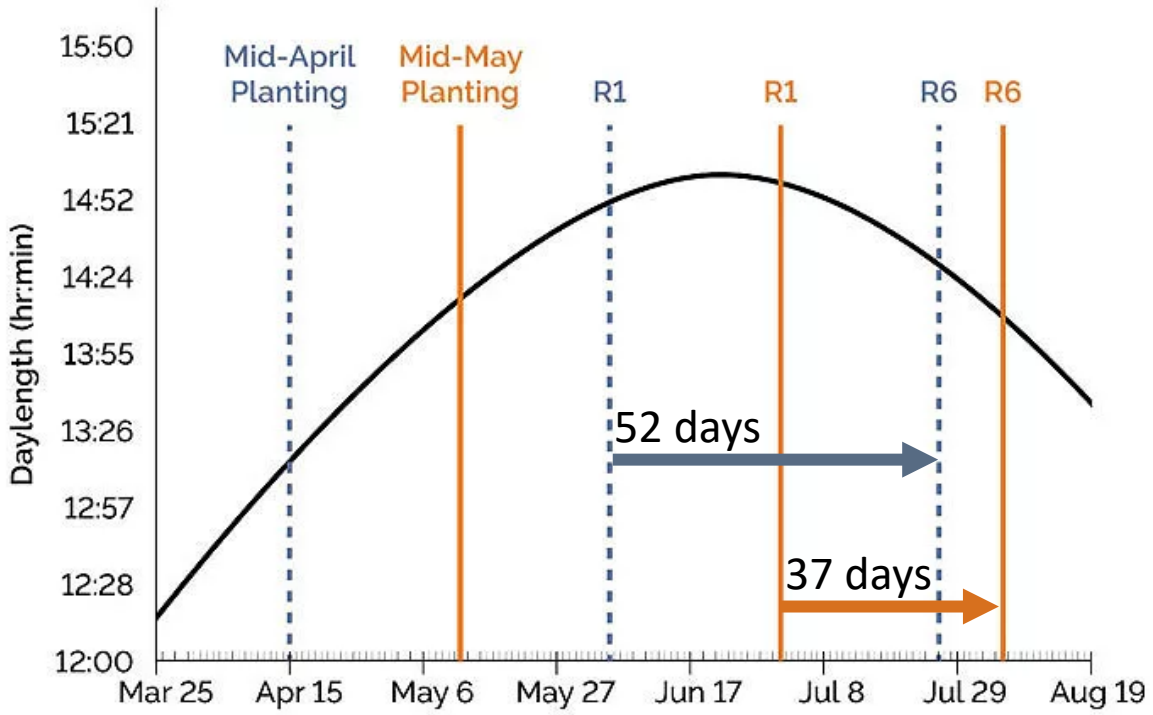
NCWSS 78th Annual Meeting

Introduction

- **Early planting**
  - Extended vegetative and reproductive stages = increased nodes, pods, seeds, and earlier canopy closure in the season[1,2,3]
  - Late April to early May planting in Indiana provides optimal yield potential [4]
  - Influence of soil moisture and temperature for germination[6]

Dates of R1 and R6 growth stages for soybeans planted in mid-April and mid-May at parallel 40.4 N[5]



1. Wilcox & Frankenberger, 1987
2. Pedersen & Lauer, 2004
3. Casteel, 2023
4. Robinson et al., 2009
5. Parker et al., 2016
6. Tyagi & Tripathi, 1983

Introduction

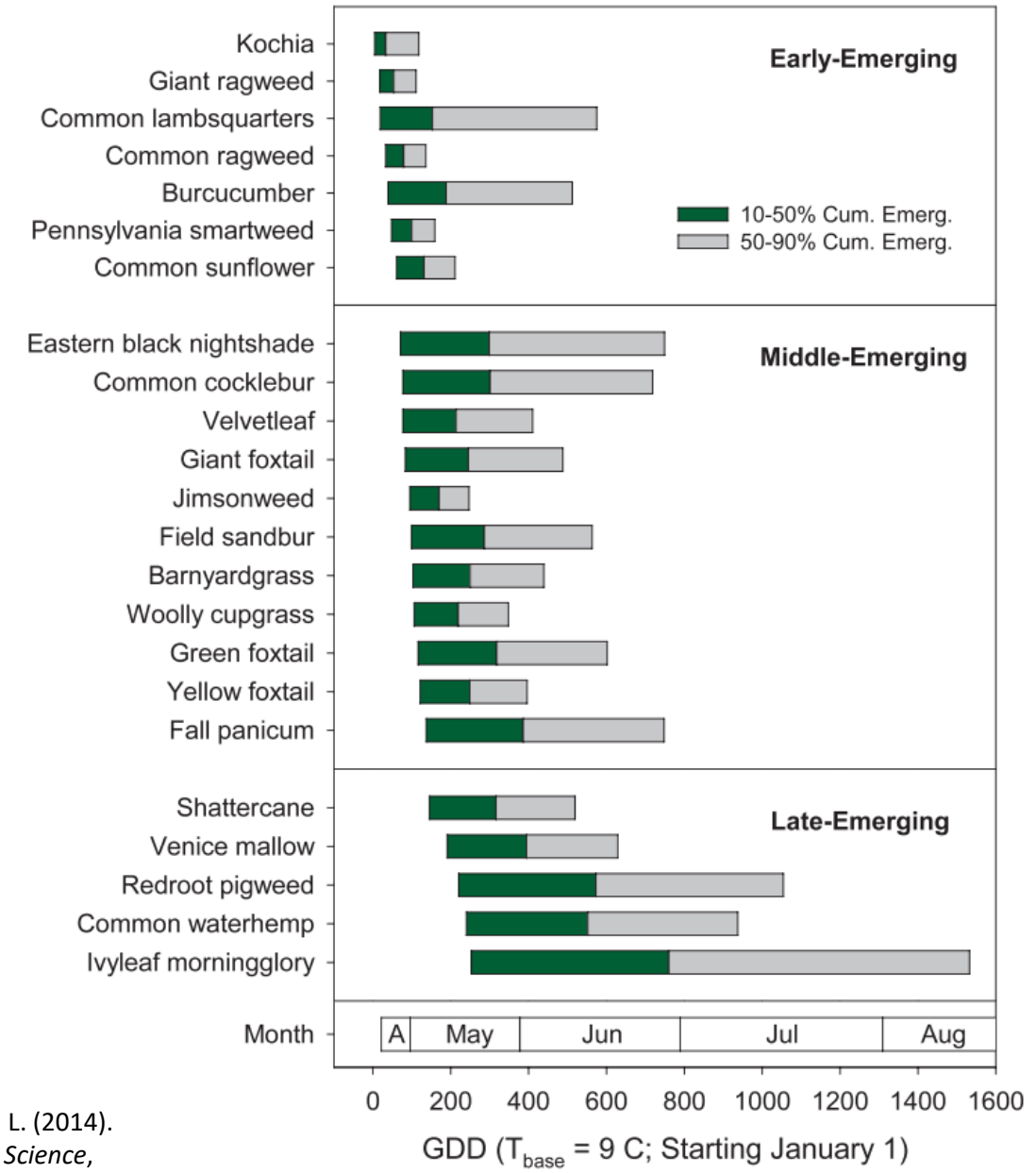
- **Potential risks**
  - Frost events
  - Injury from soil applied herbicides

Death of VC soybean after exposure to -2 °C. One week after exposure. Photo: Bob Nielsen

Comparison of a plot not receiving a PRE herbicide (left) and a plot receiving a PRE herbicide with flumioxazin (right). Photo: Purdue Weed Science

Introduction

- Optimal conditions for emergence
- Residual herbicide available over time



Werle, R., Sandell, L. D., Buhler, D. D., Hartzler, R. G., & Lindquist, J. L. (2014). **Predicting Emergence of 23 Summer Annual Weed Species**. *Weed Science*, *62*(2), 267–279. https://doi.org/10.1614/ws-d-13-00116.1

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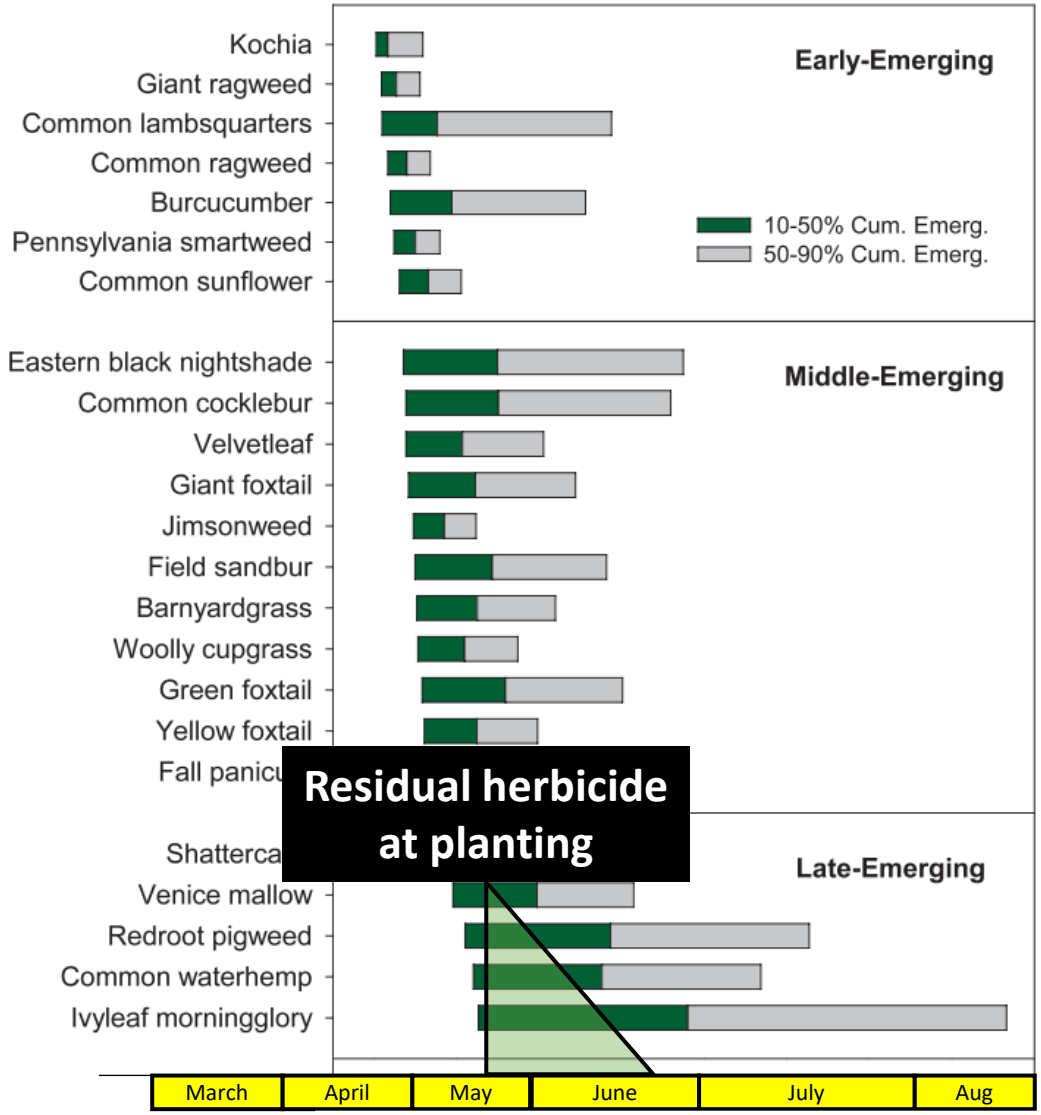

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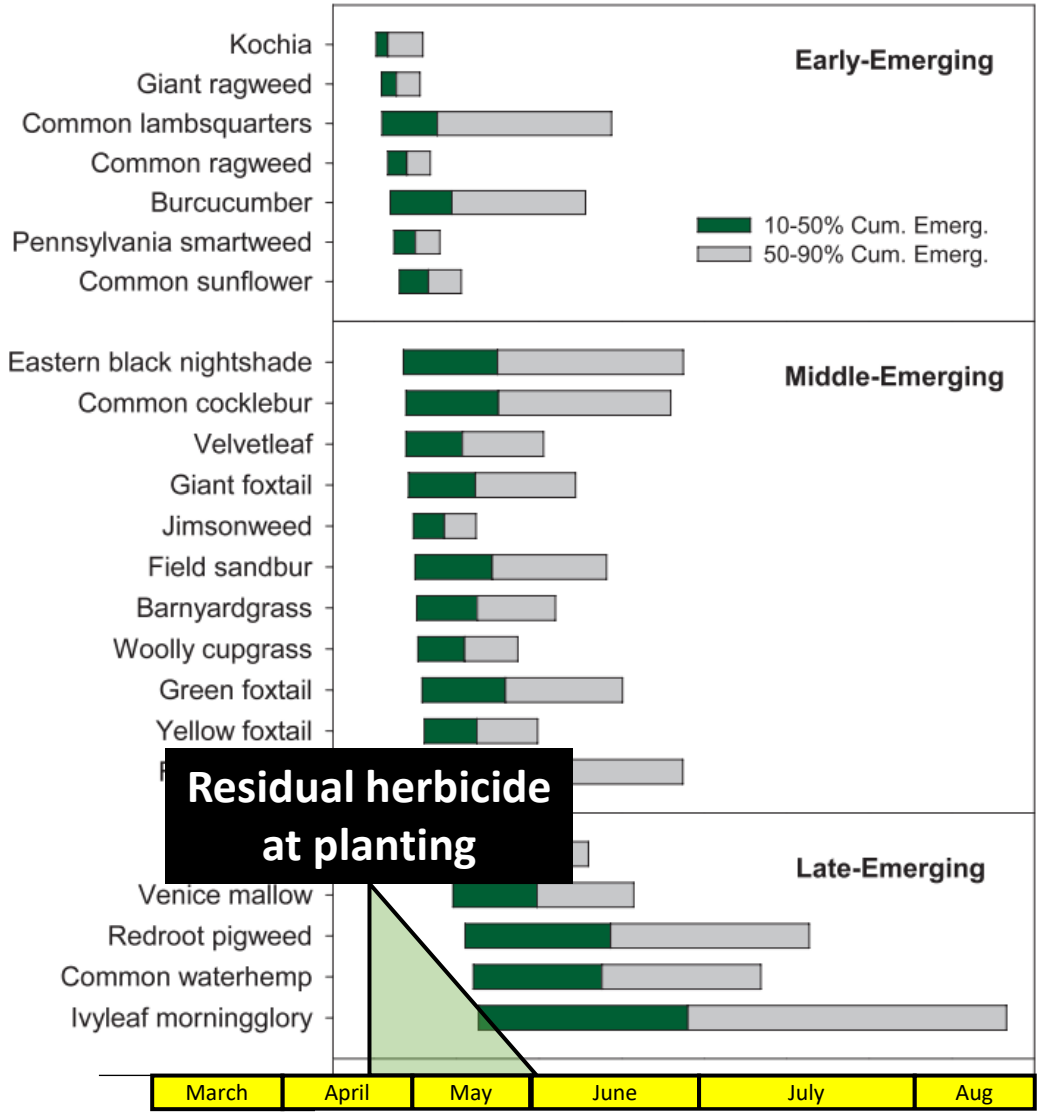

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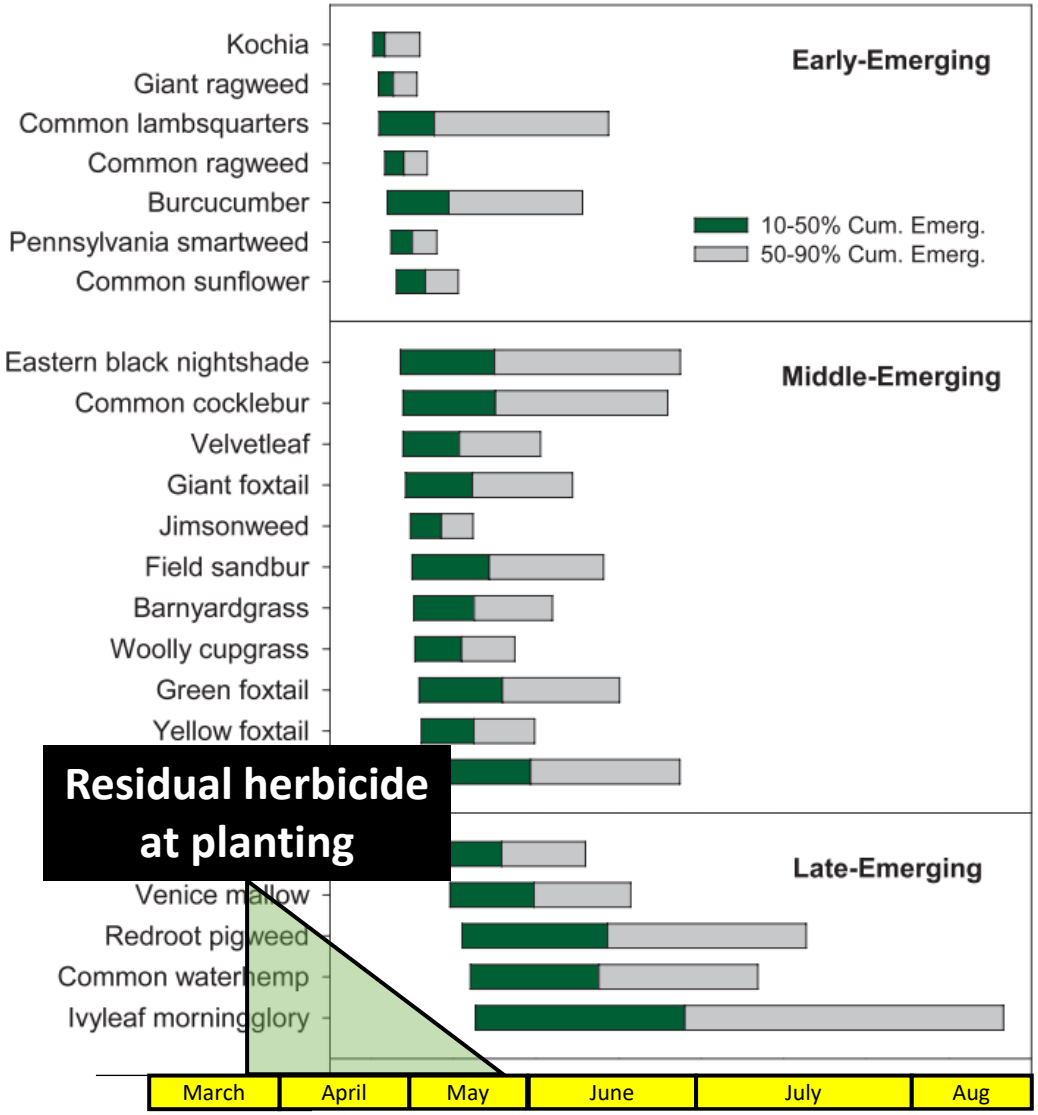

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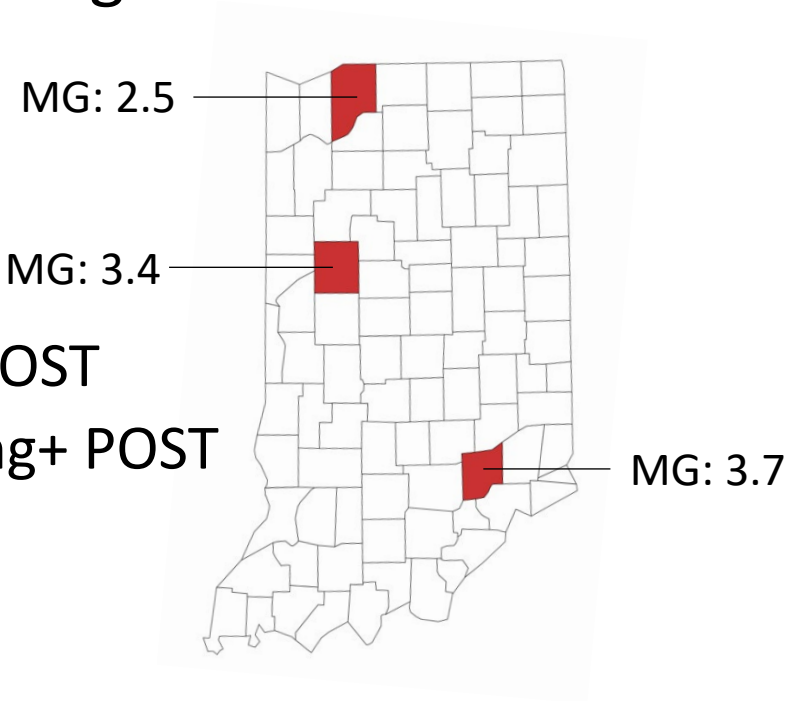
Hypotheses and Objective

- **Hypotheses:**
  - Earlier planting dates will result in greater soybean yield in comparison with later planting dates due to extended growing season
  - POST only herbicide programs will result in greater weed density in comparison with PRE + POST programs due the layer of residual herbicide
  - Early planting combined with preemergence herbicides will result in lower soybean stands due to crop injury
- **Objective:**
  - Evaluate the effect of planting dates and herbicide programs on soybean stand, weed density, weed biomass, and soybean yield

Materials and Methods

- Trial design
  - Northern, West-central, and Southeast Indiana
  - Randomized complete block design
- 12 treatments, 4 reps
  - 4 Planting dates
  - 3 Herbicide programs
    - Full rate PRE at planting + POST
    - Reduced rate PRE at planting+ POST
    - POST only



Materials and Methods

- Northern (N)
  - Conventional tillage
  - 6 x 91m plot
  - 76 cm row spacing
  - 346,000 ha^{-1} planting population
- West-central (WC)
  - No-till
  - 6 x 30m plot
  - 76 cm row spacing
  - 346,000 ha^{-1} planting population
- Southeast (SE)
  - Conventional tillage
  - 6 x 91m plot
  - 76 cm row spacing
  - 320,000 ha^{-1} planting population

	Northern	West-Central	Southeast
[1]Preplant burndown	x	14-Apr	x
Planting Date 1	30-Mar	13-Apr	13-Apr
Planting Date 2	12-Apr	5-May	26-Apr
[2]Planting Date 3	4-May	18-May	10-May
[2]Planting Date 4	19-May	30-May	25-May
[3]Planting Rate	346,000	346,000	320,000

[1]glyphosate 1260 ae/ha + 2,4-D choline 1070 g ai/ha + ammonium sulfate 2.5% V/V
[2]planting dates 3 and 4 for all sites receive a burndown application before planting
[3]seeds/ha

Herbicide Programs

	PRE		POST (g ai/ae ha^{-1})
	Reduced (g ai ha^{-1})	Full (g ai ha^{-1})	
Northern	pyroxasulfone 50 flumioxazin 39	pyroxasulfone 75 flumioxazin 59	glyphosate 1260 glufosinate 656
West-central	pyroxasulfone 34 flumioxazin 27 chlorimuron 7	pyroxasulfone 55 flumioxazin 43 chlorimuron 12	glufosinate 656 2.4-D choline 1070 glyphosate 1260
Southeast	pyroxasulfone 41 flumioxazin 32 chlorimuron 9	pyroxasulfone 61 flumioxazin 48 chlorimuron 13	glyphosate 1260 2.4-D choline 1070 pyroxasulfone 23

- All the POST applications with glyphosate, 2,4-D, or glufosinate are mixed with ammonium sulfate at 2.5% V/V
- Treatments with only POST application at southeastern site not included pyroxasulfone
- The southeastern site received an additional application of glufosinate following the initial POST application
- Post only programs at southeastern site was add a 2nd application with glufosinate 882 g ai ha^{-1}

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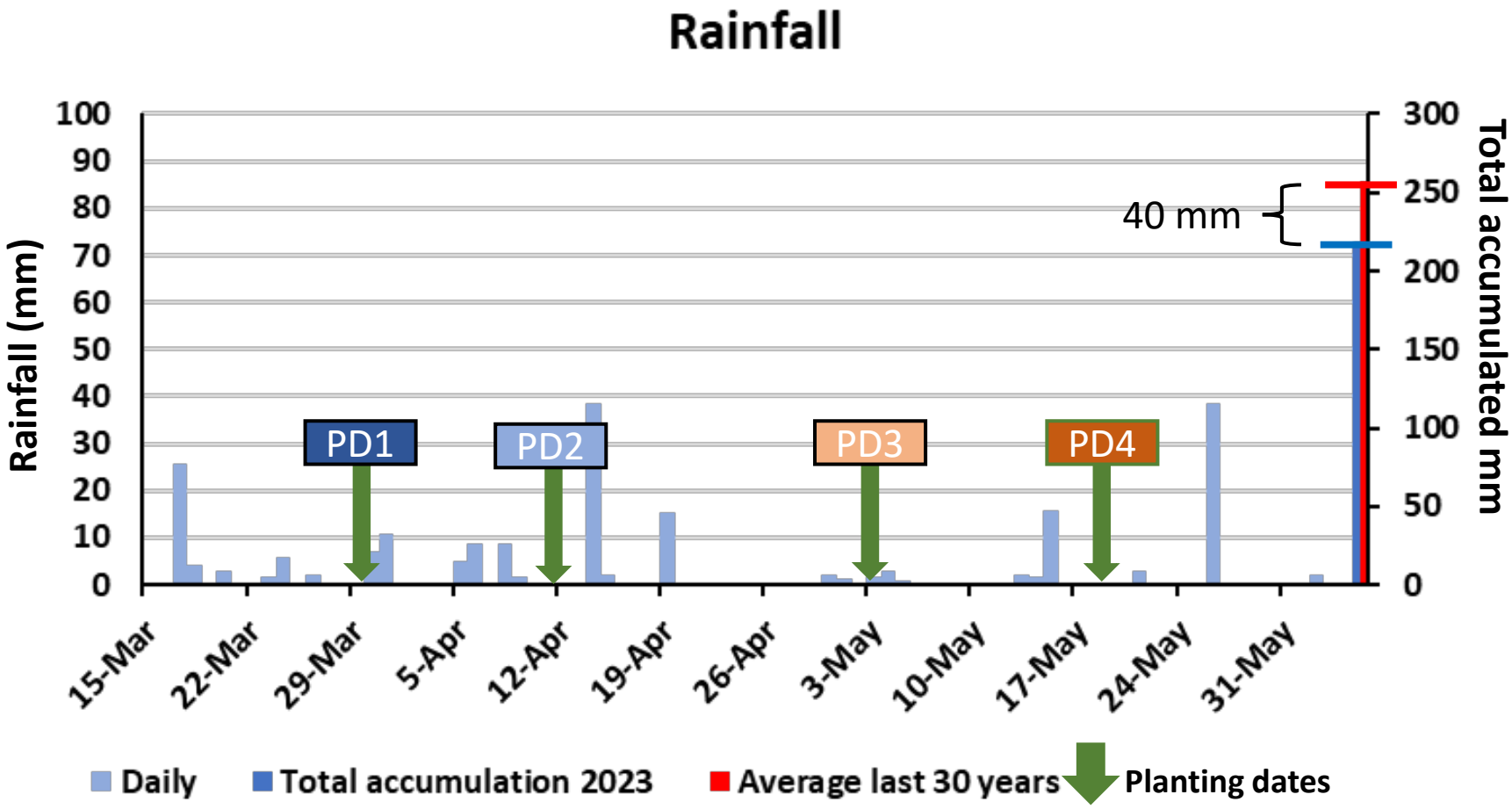
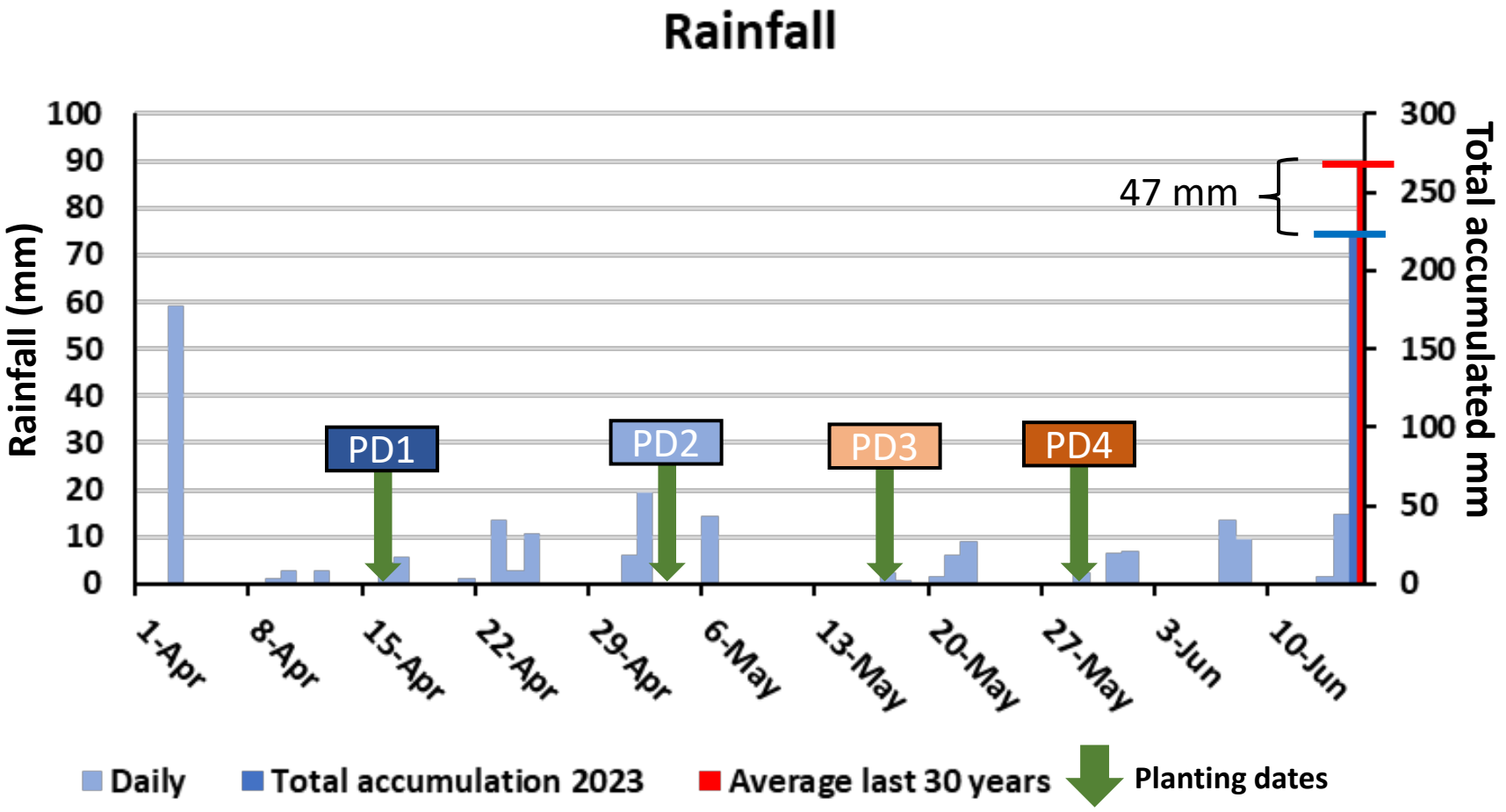
Soil and Weather Conditions
N IN



Sandy loam

(0-20 cm) **Sand:** 58% **Silt:** 28% **Clay:** 14% **OM:** 1.5% **pH:** 6.2

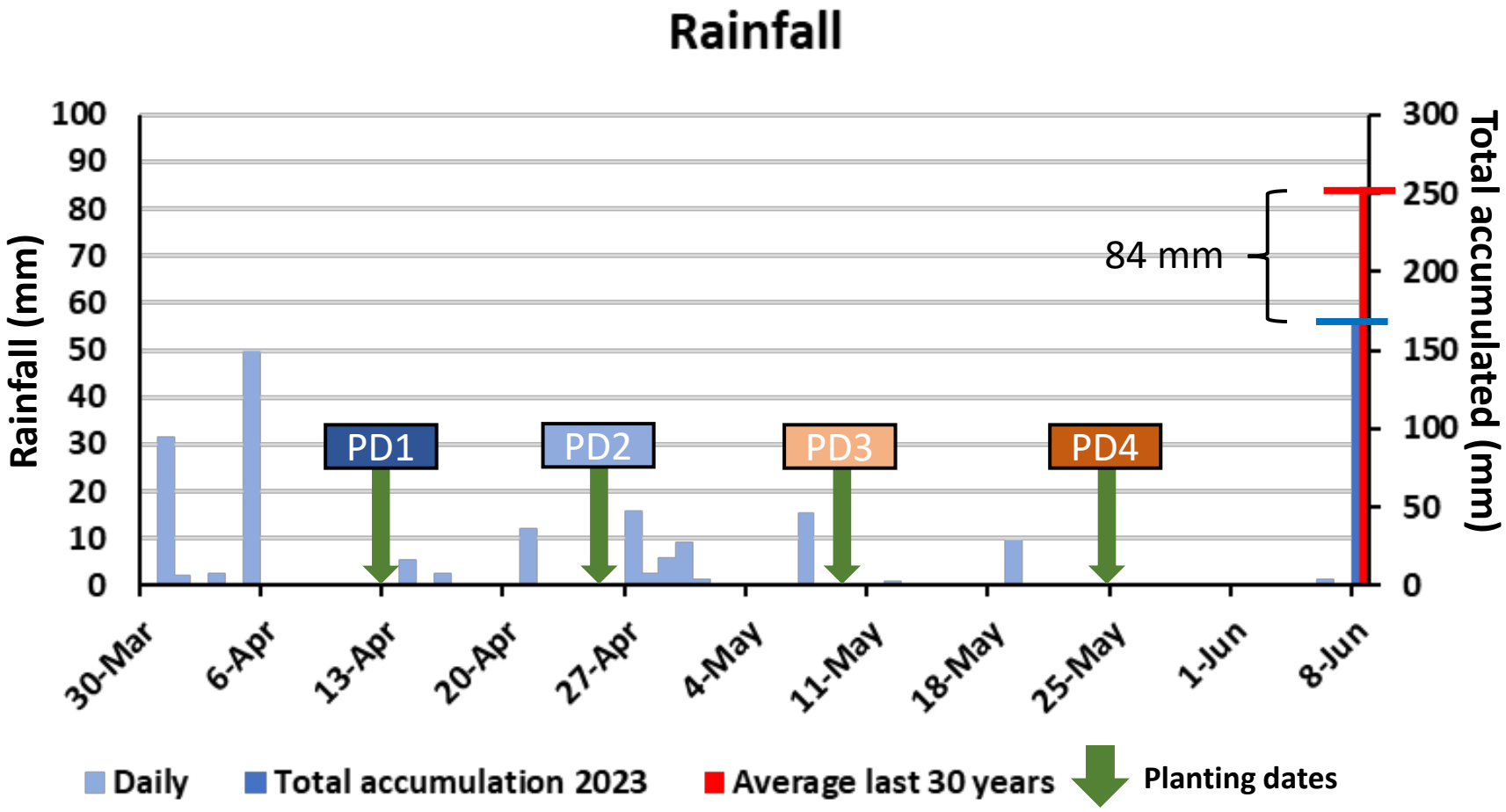
Soil and Weather Conditions
WC IN



Silt loam

(0-20 cm) **Sand:** 16% **Silt:** 64% **Clay:** 20% **OM:** 2.5% **pH:** 6.6

Soil and Weather Conditions
SE IN



Silt loam

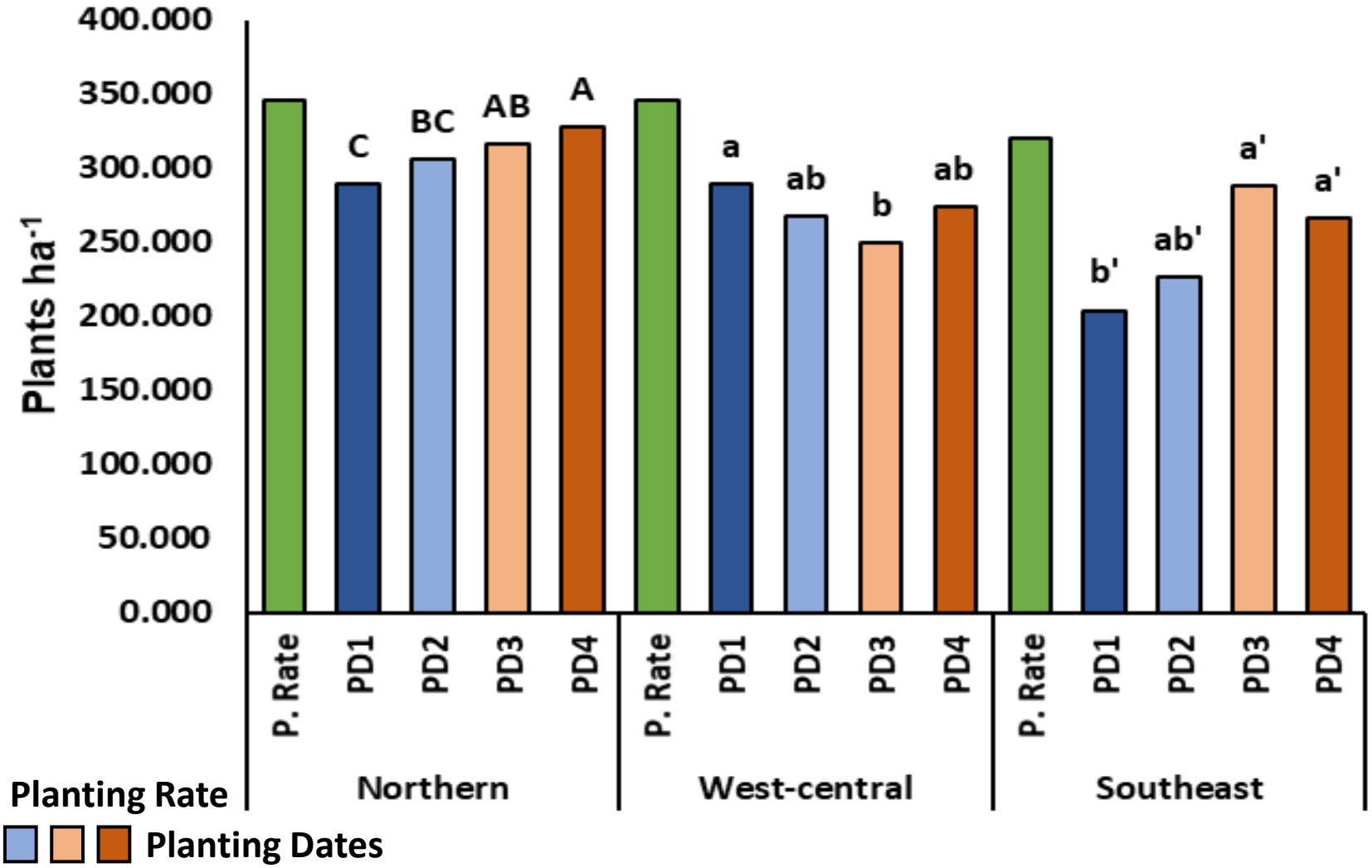
(0-20 cm) **Sand:** 18% **Silt:** 72% **Clay:** 10% **OM:** 1.6% **pH:** 5.9

Data Collection and Analysis

- Soybean stand counts at V3 stage
- Weed counts (plants m^{-2}) at 14 days after last POST application
- Weed biomass (g m^{-2}) of most predominant species
- Soybean yield (kg ha^{-1})
- Analysis of Variance (ANOVA) using “aov” function in R language (version 4.2.1) and mean separation with Tukey’s HSD test ($\alpha \leq 0.05$)

Results

Soybean Stand at V3 stage



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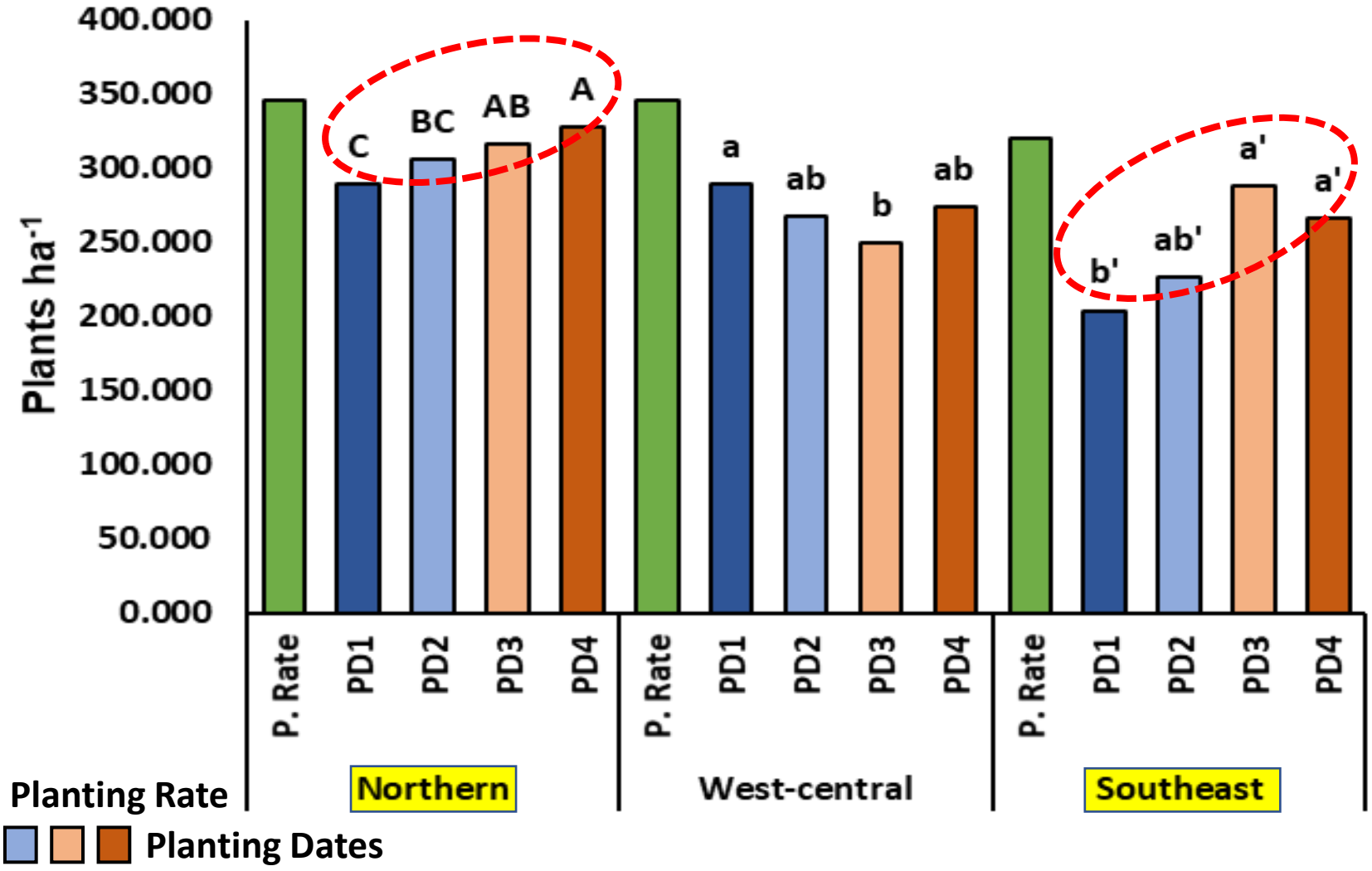

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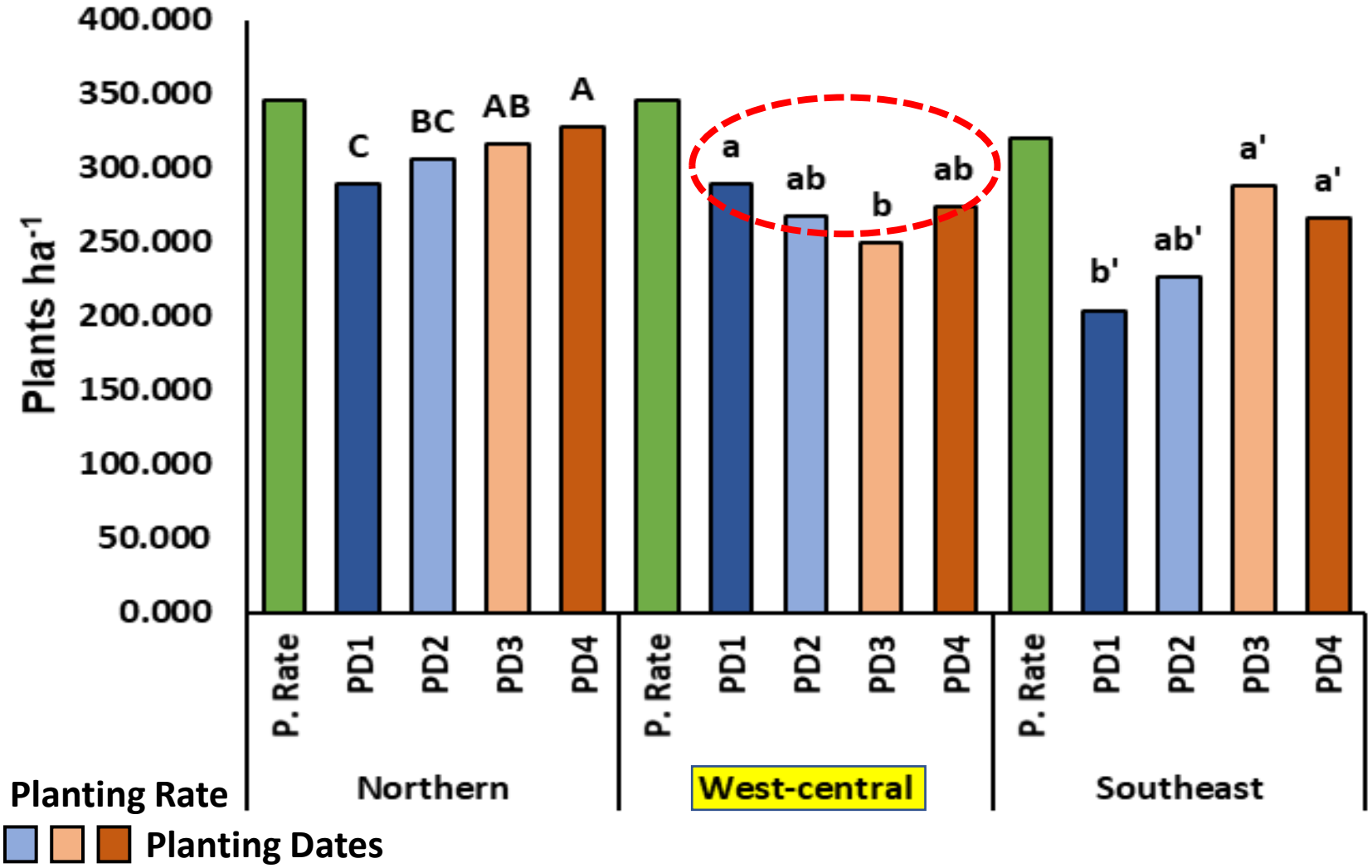

Weed Density & Biomass N IN

	Abutilon theophrasti				*Ambrosia trifida*			
Plants m^{-2} (14 DAT)	PD1	PD2	PD3	PD4	PD1	PD2	PD3	PD4
Full PRE	0.3b	0.3b	0b	0b	0.8	0.3	0	0
Reduce PRE	1.3b	0.3b	0b	0b	0.17	0.17	0	0
Only POST	3.6a	0.8b	0b	0b	0.8	0.3	0	0.3
$\bar{x}$	–	–	–	–	0.6A	0.3AB	0B	0.1AB

	Abutilon theophrasti				*Ambrosia trifida*			
Biomass g m^{-2} (14 DAT)	PD1	PD2	PD3	PD4	PD1	PD2	PD3	PD4
Full PRE	0.8bc	0.2bc	0c	0c	1.1	0.5	0	0
Reduce PRE	2.2ac	0.4bc	0c	0c	0.6	0.2	0	0
Only POST	14.0a	4.1ab	0c	0c	2.8	0.9	0	0.5
$\bar{x}$	–	–	–	–	1.3A	0.5AB	0B	1.3AB

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Weed Density & Biomass WC IN

Setaria faberi

Plants m^{-2} (14 DAT)	PD1	PD2	PD3	PD4
Full PRE	4.1	6.6	0	0
Reduce PRE	15.5	3.5	0	0
Only POST	6.7	12.5	0	0
$\bar{x}$	8.7a	7.5a	0b	0b

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Full PRE	0.8	0.1	0	0
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Weed Density & Biomass SE IN

Predominant weeds

Plants m^{-2} (14 DAT)	PD1	PD2	PD3	PD4
Full PRE	0b	1.2b	0b	0b
Reduce PRE	0b	0.5b	0b	2.8b
Only POST	4.3ab	26.0a	0b	0b
$\bar{x}$	–	–	–	–

Predominant weeds

Biomass g m^{-2} (14 DAT)	PD1	PD2	PD3	PD4
Full PRE	0	0.6	0	0
Reduce PRE	0	0.2	0	0.1
Only POST	0.3	1.1	0	0
$\bar{x}$	0.1ab	0.6a	0b	0b

Predominant weeds:
Carpetweed (*Mollugo verticillate)*
Yellow foxtail (*Setaria pumila)*
Waterhemp *(Amaranthus tuberculatus)*
Ivyleaf morningglory (*Ipomea hederacea)*

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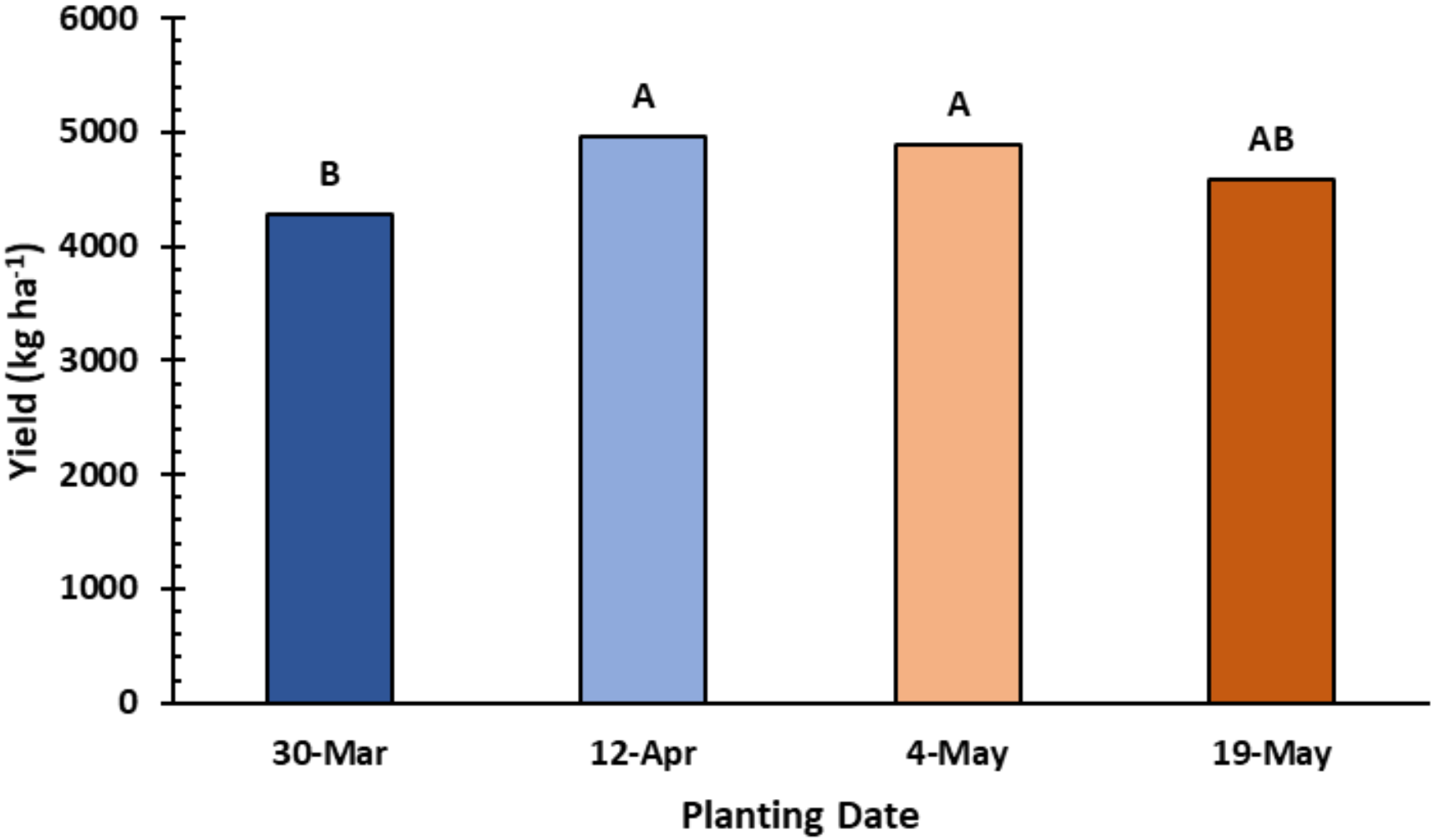
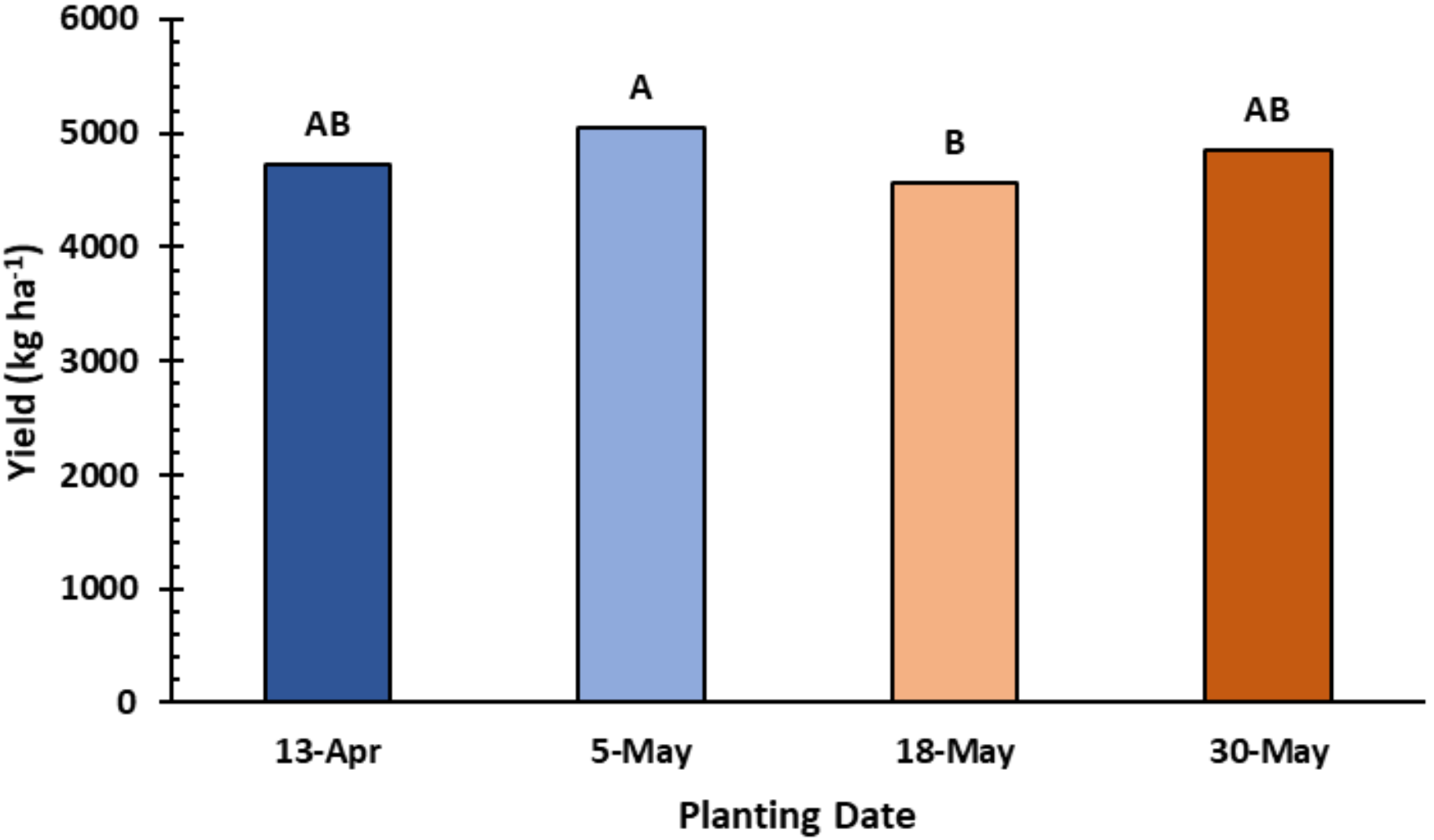
Soybean Yield N IN



Soybean Yield WC IN



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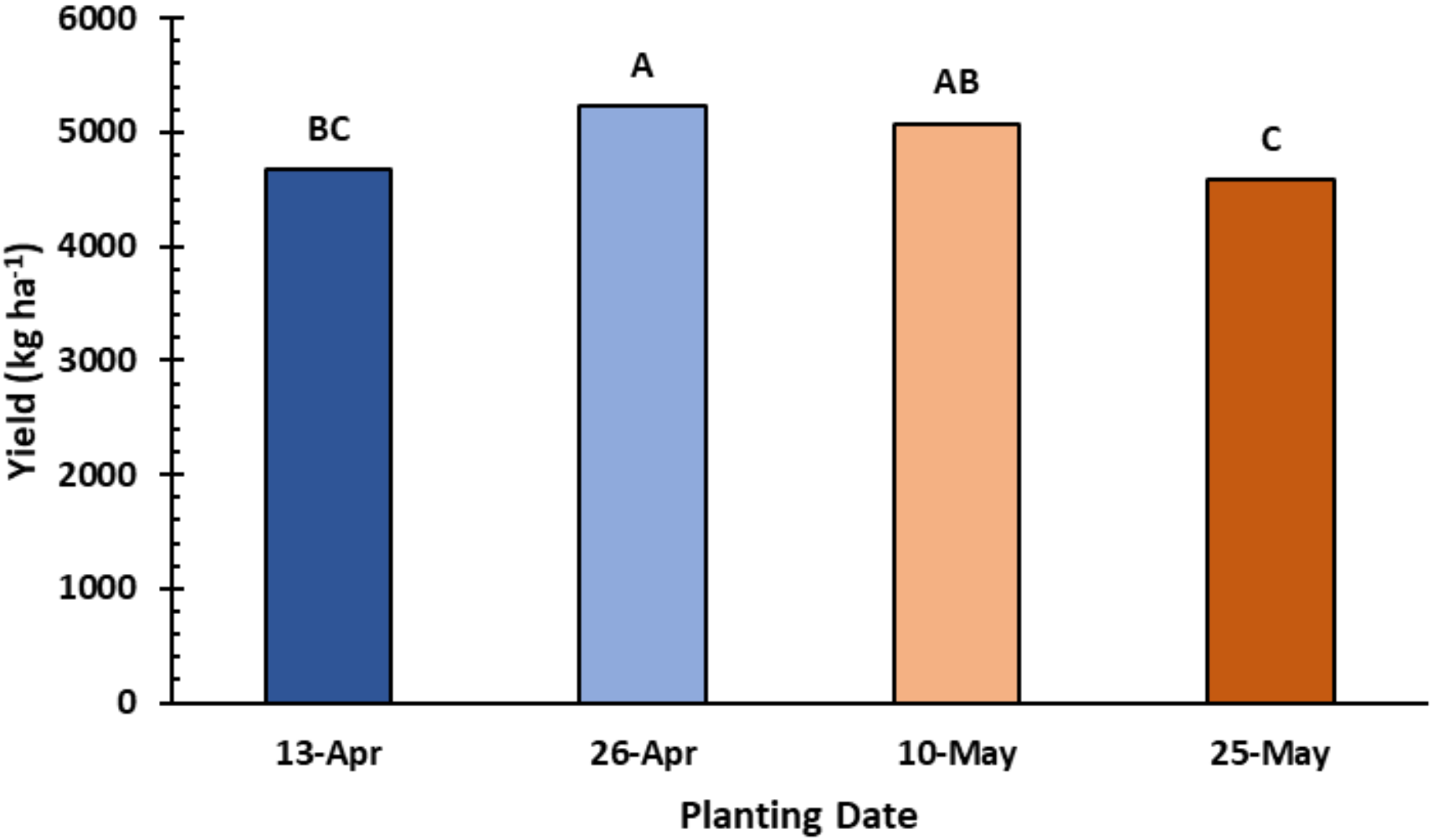

Conclusions

- Preemergence herbicides applied at cold temperatures didn’t reduce soybean stands
- Weed density tended to be higher in some early planting dates with treatments that did not have residual herbicides
- Soybean can compensate yield for the reduced plant population from different planting dates
- Soybean yield was affected by planting date, and the lack of rainfall during critical periods of crop development may have been the most decisive factor to reduce yield

Implications

- Herbicide program needs to be selected to the according most predominant weed species
- Reduced soybean stand by early planting does not necessarily result in reduced soybean yield if stands stay over 200,000 plants ha^{-1}

Future Research

- Repeat in 2024
- Continued investigation of the interaction of planting dates and herbicide programs on weed management and soybean yield
- Investigate the influence of temperature on preemergence herbicide degradation in different soil types

Acknowledgments

Thanks, Questions?