On-Farm Evaluation of Planter Downforce in Varying Soil Textures for Improving Cotton Emergence

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INTRODUCTION

- **Downforce** – applied to achieve desired seeding depth, to ensure proper seed-to-soil contact and ensure adequate soil compaction around seed

- Increased interest recently in selecting '**Optimal Downforce**' on the planters:
  - Crop emergence issues and yield impact due to inadequate downforce
  - Availability of advanced downforce control systems on planters

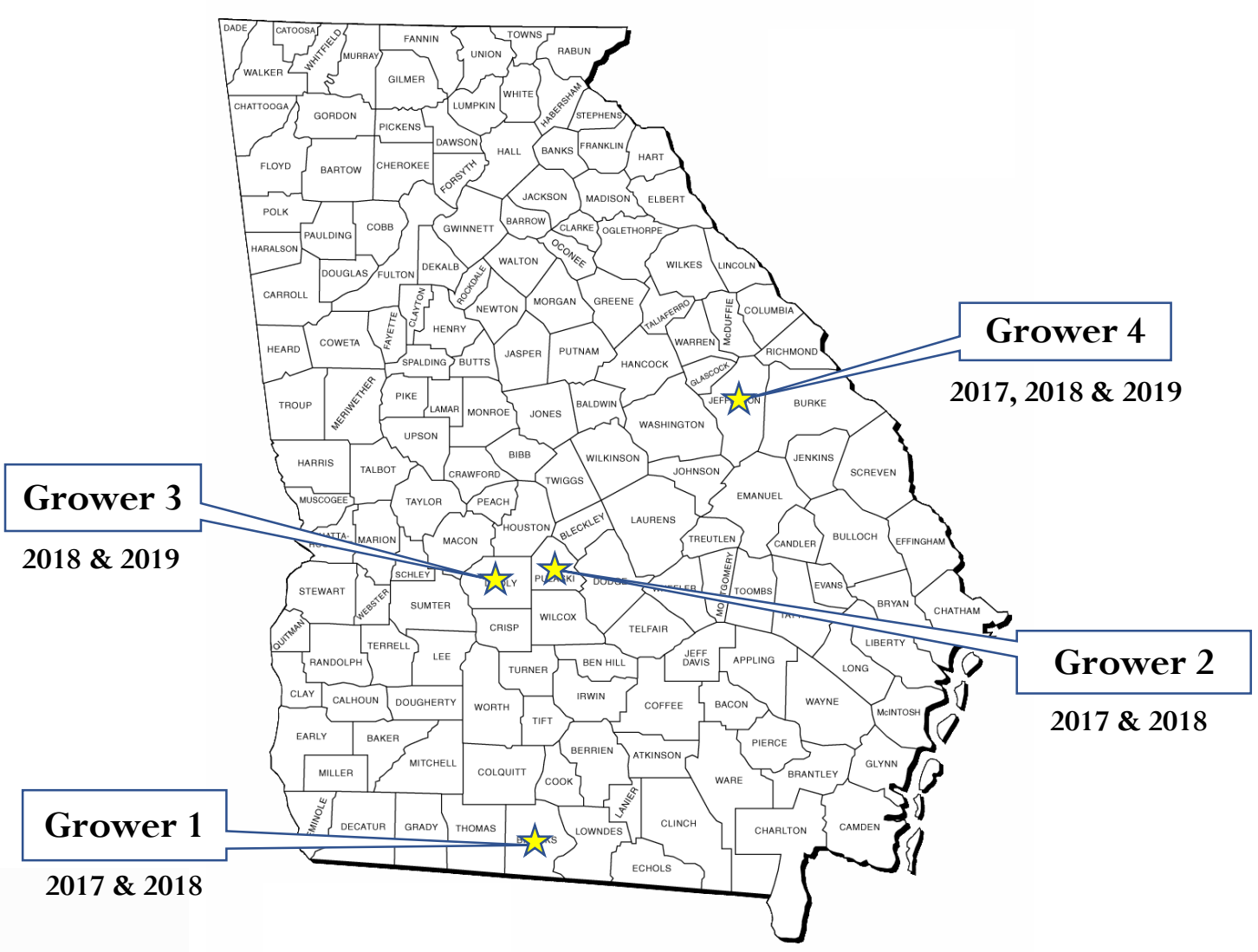
- Downforce requirements change with field conditions (soil type, texture, moisture etc.)

- **Challenge** – Selecting an optimal downforce in highly variable soil conditions within the field (especially in the Southeastern US)

OBJECTIVES

- Measure and quantify the prevalent soil variability in grower fields
- Evaluate different planter downforces, including grower preferred, in variable soil textures across the field

On-Farm Studies: 2017 - 2019



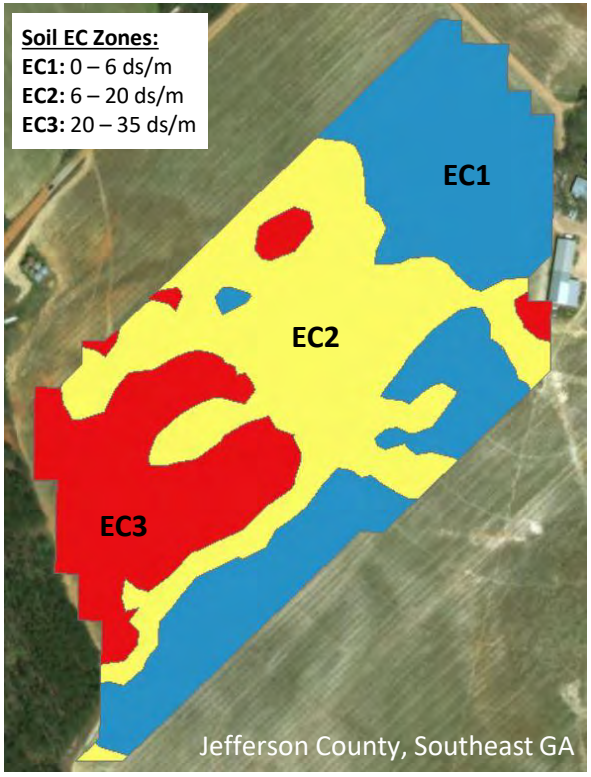
Within-Field Soil Variability

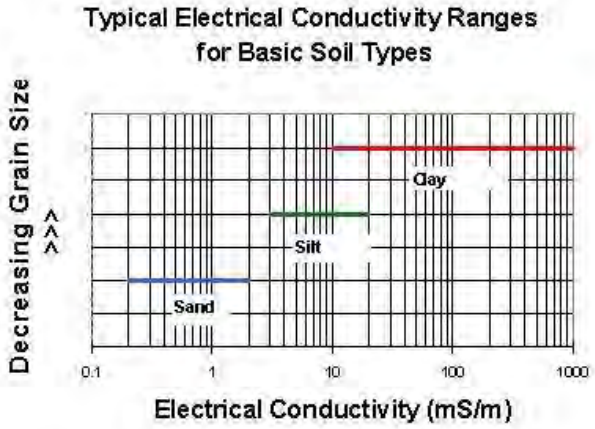
Mapping Soil Variability

Soil EC Data

Soil Types

Soil EC Zones





Planting & Data Collection

Treatments:

- Three EC zones (EC1, EC2 & EC3)
- Three Downforces (D1, D2 & D3)

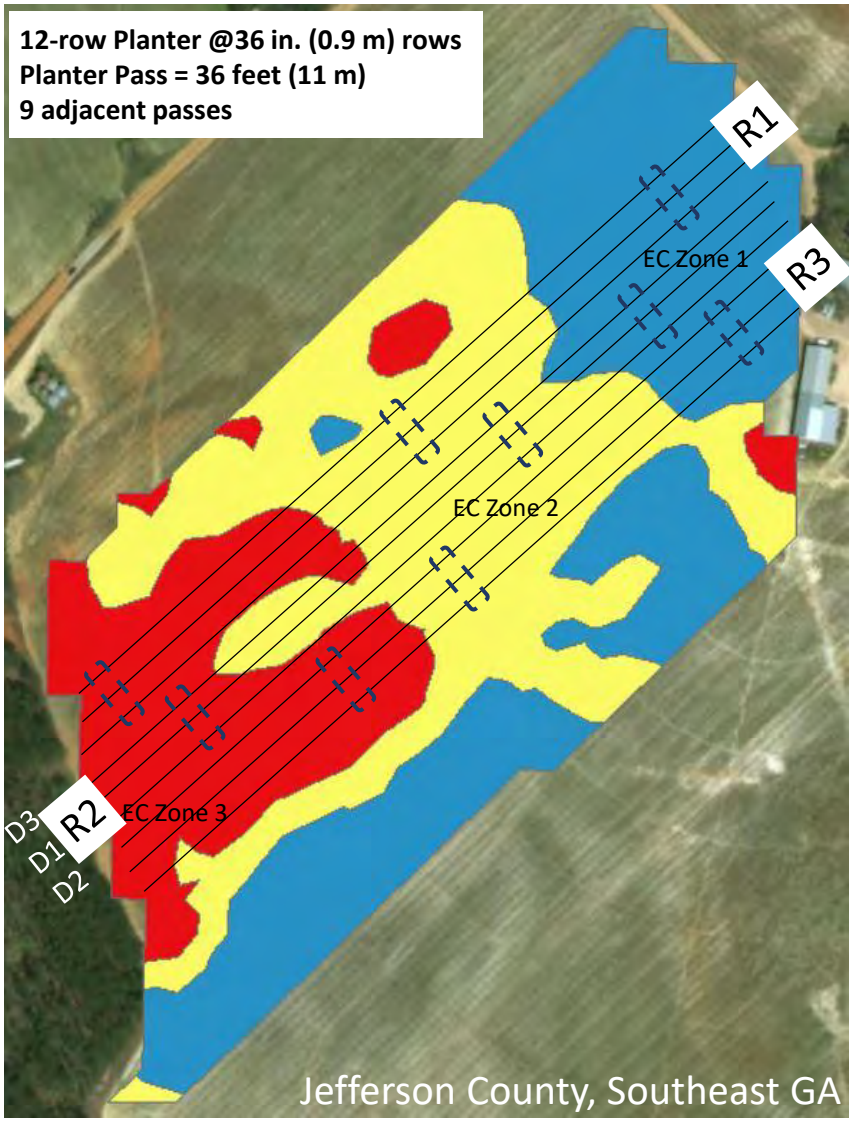
  D1: 50% lower than nominal

  D2: Nominal (Grower selected)

  D3: 50% higher than nominal
- Three Replications (R1, R2 & R3)
- Total 9 Randomized Passes

Data Collection:

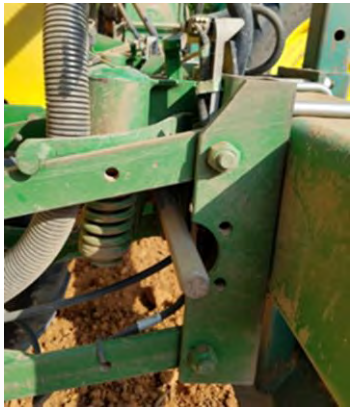
- Emergence data at 1, 2 & 3 weeks after planting (WAP)
- Stand counts in locations (25 feet) within each zone on 6 alternate rows

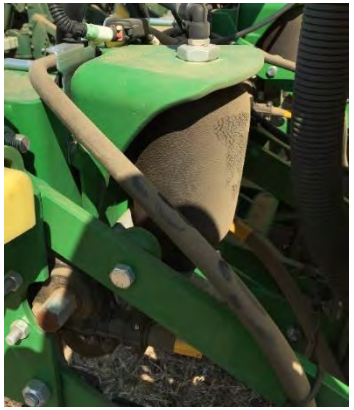


Planting Equipment

Downforce Systems & Selection

Grower	Year	Field ID	Downforce (N)	Downforce System on Planter
1	2017	17-1SW	0, 45 & 90	Pneumatic – manual control and monitor via inline pressure gauge
	2018	18-1SW	0, 50 & 100	
2	2018	18-2SC	0, 100 & 200	Hydraulic – control and monitor using in-cab display
3	2018	18-3SC	100, 200 & 300	Pneumatic – control and monitor using in-cab display
4	2018	18-4SE	0, 100 & 200	Mechanical (using springs) – manual adjustment and no monitoring
	2019	19-4SE	0, 100 & 200	





STATISTICAL ANALYSIS

Two-way ANOVA using $\alpha = 0.10$

Field18-1SW

Treatment Effect	Emergence (p-value)		
	1 WAP†	2 WAP	3 WAP
Soil EC	0.0469	0.0907	0.0764
Downforce	0.2823	0.2651	0.1645
Soil EC x Downforce	0.6241	0.5288	0.7271

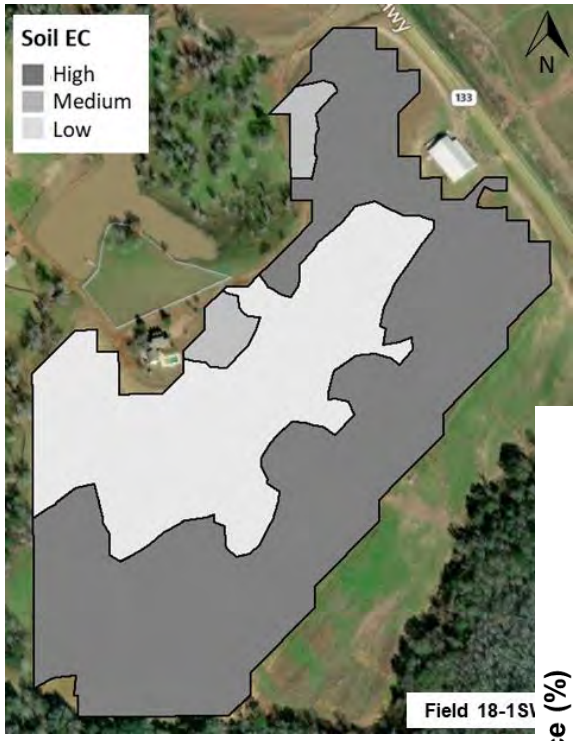
Field18-4SE

Treatment Effect	Emergence (p-value)		
	1 WAP†	2 WAP	3 WAP
Soil EC	0.2530	0.1964	0.1183
Downforce	0.3079	0.5175	0.2690
Soil EC x Downforce	0.0225	0.0505	0.0126

WAP† – Weeks after planting

Southwest GA - 2017

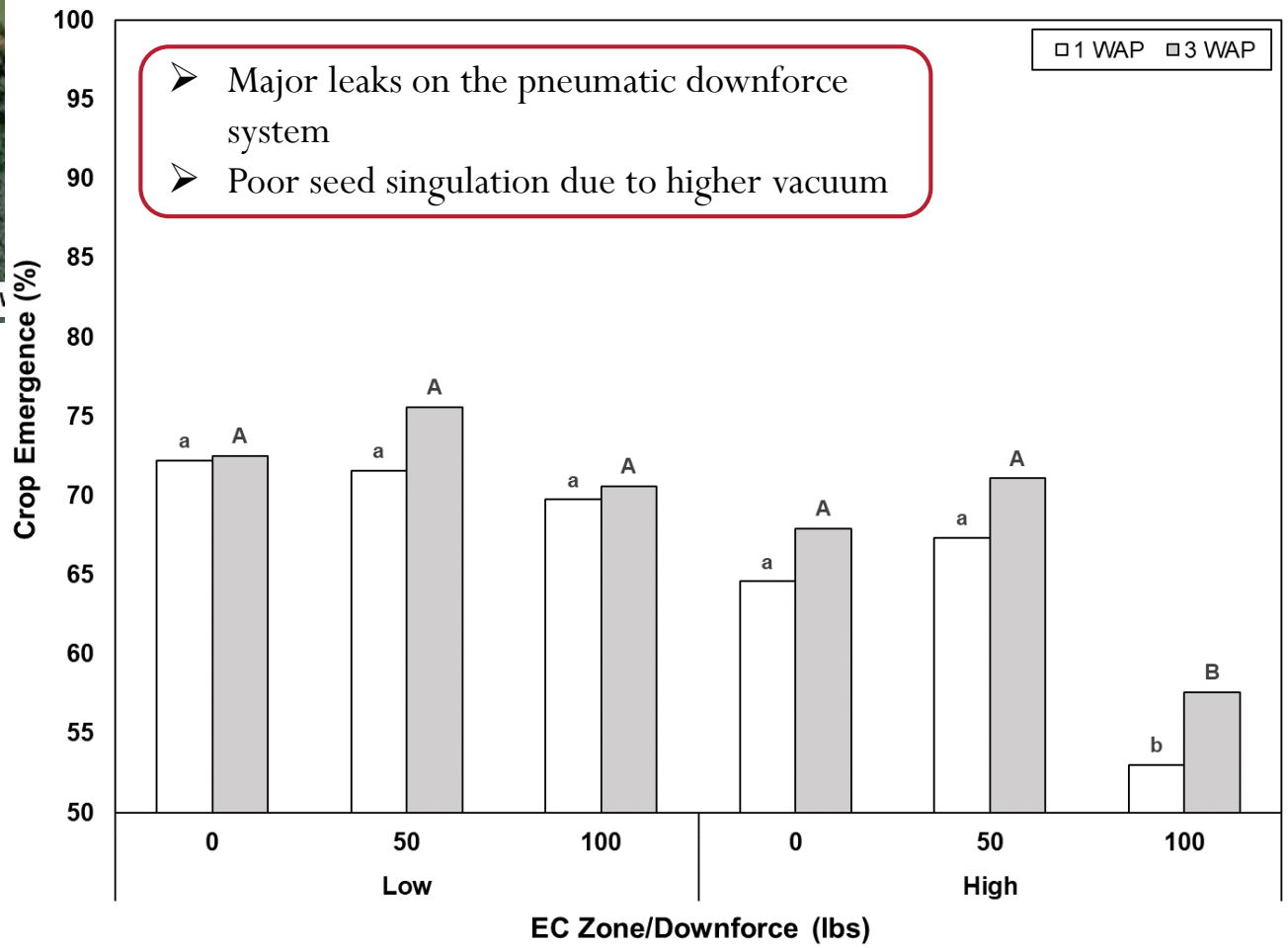
Grower 1



Strip-till – 1" Depth

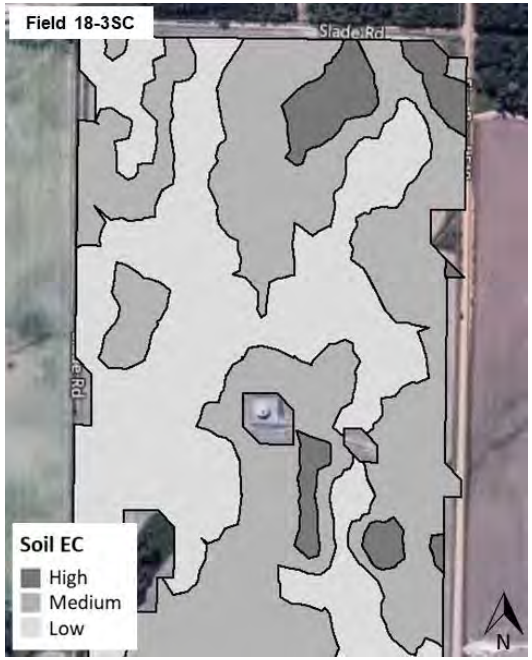
Pneumatic Downforce system (controlled and monitored using a pressure gauge)

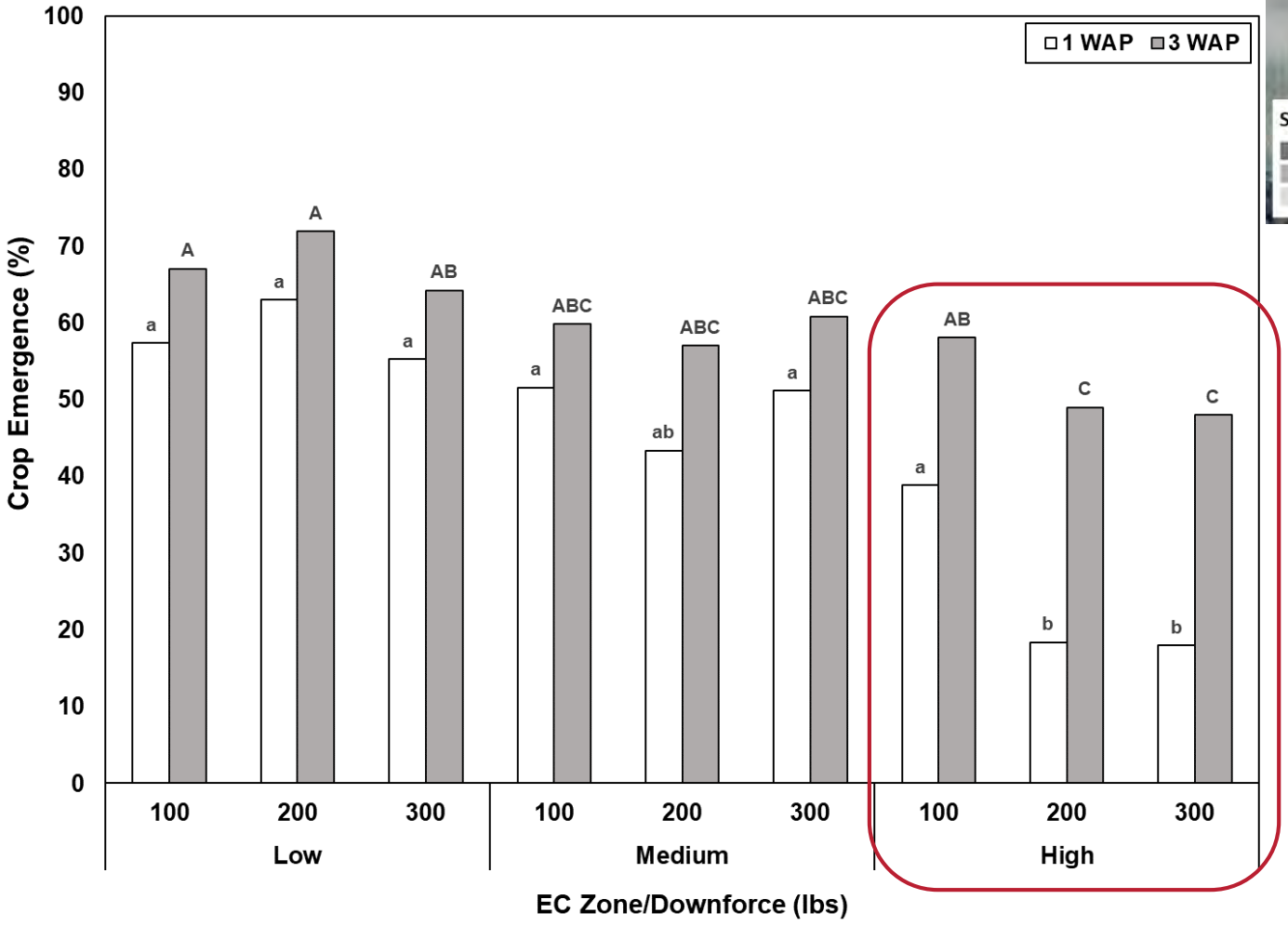
50 – 100 – 200 (lbs.)



Southcentral GA - 2018

Grower 2





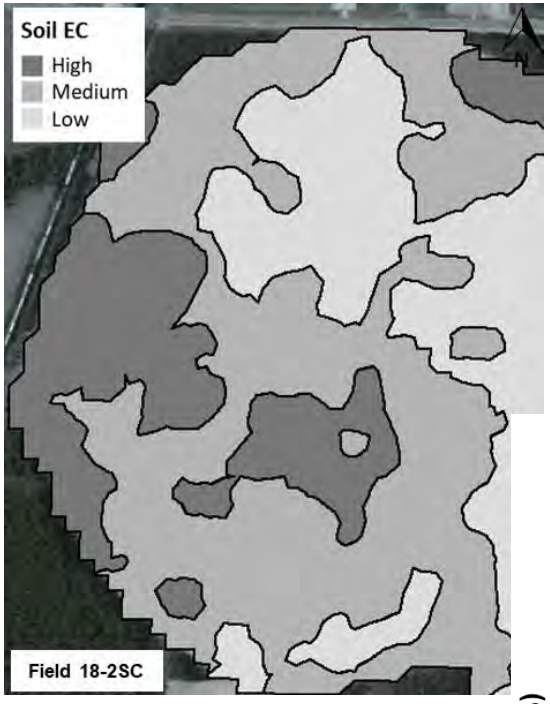
Strip-till – 1" Depth

Pneumatic Downforce system (controlled via display)

100 – 200 – 300 (lbs.)

Southcentral GA - 2018

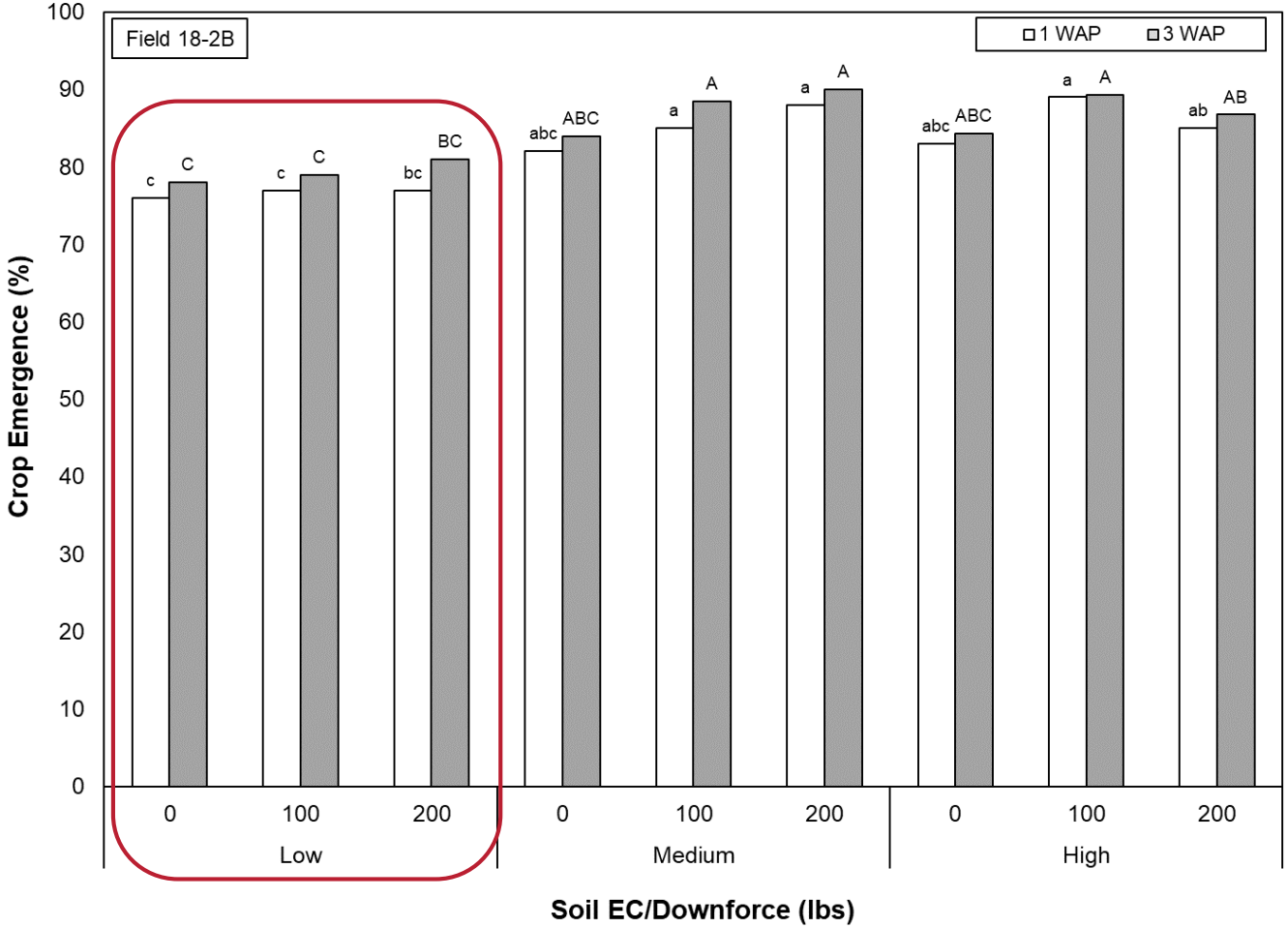
Grower 3



No-till – 3/4" Depth

Hydraulic Downforce system

(0 – 100 – 200 (lbs.)

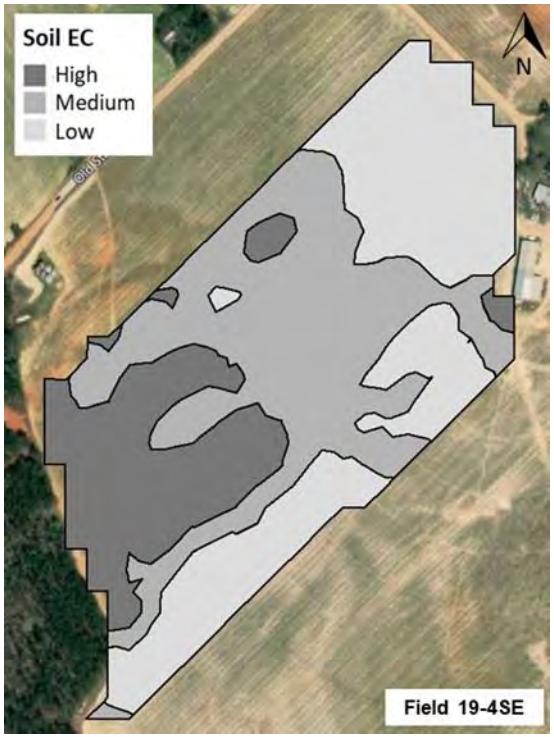


Southeast GA - 2019

Grower 4

Southeast GA - 2019

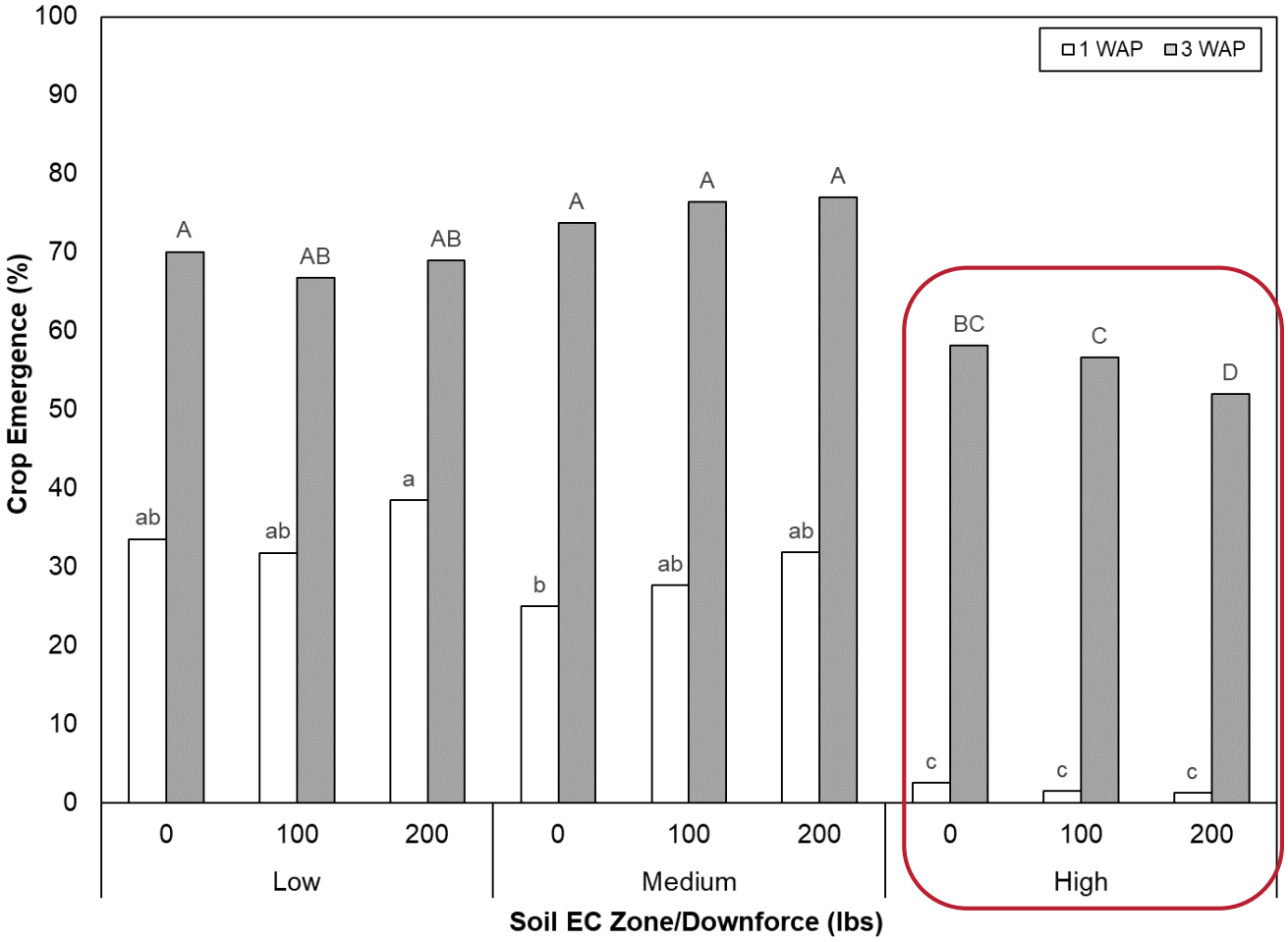
Grower 4



Conventional – 1" Depth

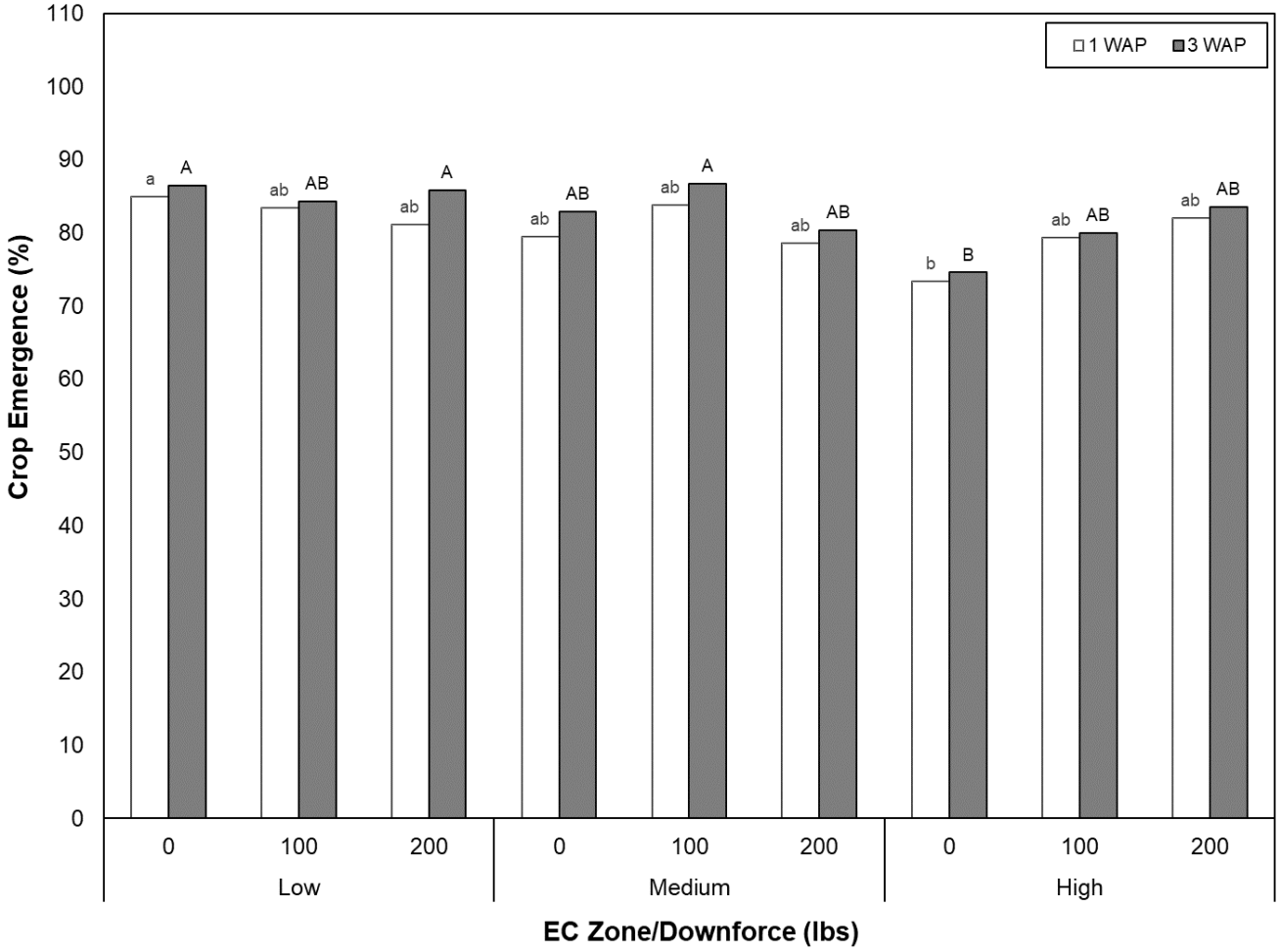
Manual Downforce system (utilizing mechanical springs)

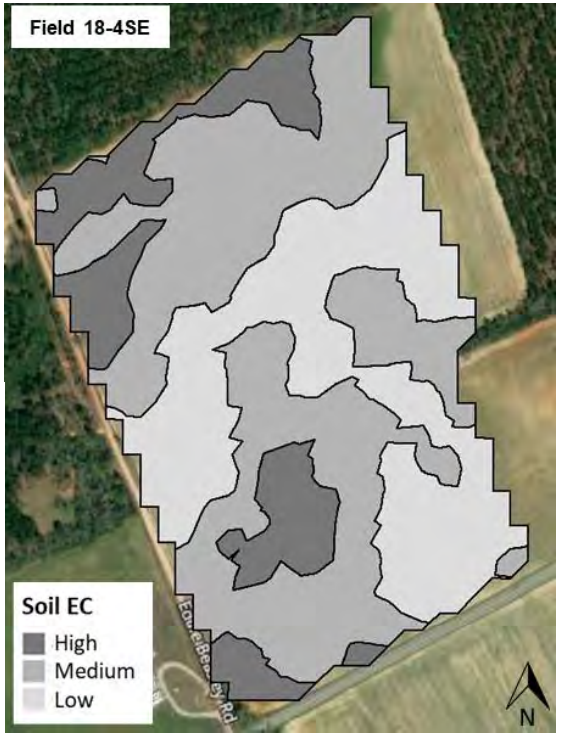
0 – 100 – 200 (lbs.)



Southeast GA - 2018

Grower 4





Conventional – 1" Depth

Manual Downforce system (utilizing mechanical springs)

0 – 100 – 200 (lbs.)

SUMMARY

- Soil texture affected crop emergence in three fields and soil EC x downforce interaction was significant in one field.
- Emergence reductions of 10% or greater were observed in heavy texture soils due to lack of sufficient planter downforce.
- In three out of six fields, the grower preferred downforce of 100 lbs was considered inadequate for planting in heavy soils.
- Active downforce systems may prove beneficial in fields with high soil variability by making on-the-go downforce changes.

Future Research: Better quantification of other soil properties such as soil moisture and hardness to quantify in-field variability.

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Thanks!