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

Grower 1
2017 & 2018

Grower 2
2017 & 2018

Grower 3
2018 & 2019

Grower 4
2017, 2018 & 2019
Within-Field Soil Variability
Soil EC Zones:
- EC1: 0 – 6 ds/m
- EC2: 6 – 20 ds/m
- EC3: 20 – 35 ds/m
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

12-row Planter @ 36 in. (0.9 m) rows
Planter Pass = 36 feet (11 m)
9 adjacent passes

Jefferson County, Southeast GA
# Downforce Systems & Selection

<table>
<thead>
<tr>
<th>Grower</th>
<th>Year</th>
<th>Field ID</th>
<th>Downforce (N)</th>
<th>Downforce System on Planter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2017</td>
<td>17-1SW</td>
<td>0, 45 &amp; 90</td>
<td>Pneumatic – manual control and monitor via inline pressure gauge</td>
</tr>
<tr>
<td></td>
<td>2018</td>
<td>18-1SW</td>
<td>0, 50 &amp; 100</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2018</td>
<td>18-2SC</td>
<td>0, 100 &amp; 200</td>
<td>Hydraulic – control and monitor using in-cab display</td>
</tr>
<tr>
<td>3</td>
<td>2018</td>
<td>18-3SC</td>
<td>100, 200 &amp; 300</td>
<td>Pneumatic – control and monitor using in-cab display</td>
</tr>
<tr>
<td>4</td>
<td>2018</td>
<td>18-4SE</td>
<td>0, 100 &amp; 200</td>
<td>Mechanical (using springs) – manual adjustment and no monitoring</td>
</tr>
<tr>
<td></td>
<td>2019</td>
<td>19-4SE</td>
<td>0, 100 &amp; 200</td>
<td></td>
</tr>
</tbody>
</table>
## Statistical Analysis

Two-way ANOVA using $\alpha = 0.10$

### Field18-1SW

<table>
<thead>
<tr>
<th>Treatment Effect</th>
<th>Emergence (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 WAP†</td>
</tr>
<tr>
<td>Soil EC</td>
<td>0.0469</td>
</tr>
<tr>
<td>Downforce</td>
<td>0.2823</td>
</tr>
<tr>
<td>Soil EC x Downforce</td>
<td>0.6241</td>
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</table>

### Field18-4SE

<table>
<thead>
<tr>
<th>Treatment Effect</th>
<th>Emergence (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 WAP†</td>
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<tr>
<td>Soil EC</td>
<td>0.2530</td>
</tr>
<tr>
<td>Downforce</td>
<td>0.3079</td>
</tr>
<tr>
<td>Soil EC x Downforce</td>
<td>0.0225</td>
</tr>
</tbody>
</table>

*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.)

- Major leaks on the pneumatic downforce system
- Poor seed singulation due to higher vacuum
Southcentral GA - 2018

Grower 2

Strip-till – 1” Depth

Pneumatic Downforce system (controlled via display)

100 – 200 – 300 (lbs.)
No-till – 3/4” Depth

Hydraulic Downforce system

(0 – 100 – 200 (lbs.))
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.
Thanks!