

Cornell Cooperative Extension
Cornell Vegetable Program

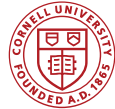


Unravelling the Intricacies of Outlook Herbicide Injury in Onion

Christy Hoepting, CCE Cornell Vegetable Program

Onion Pest Management Session at 2020 Empire Producers Expo
Syracuse, NY: January 15, 2020

Acknowledgements



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CVP Program Assistants:

- Emma van der Heide
- Sarah vande Brake



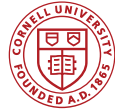
Outlook Injury



1st leaf stuck
in flag

Leaf-in-leaf, improper unfurling, looping

Outlook Injury

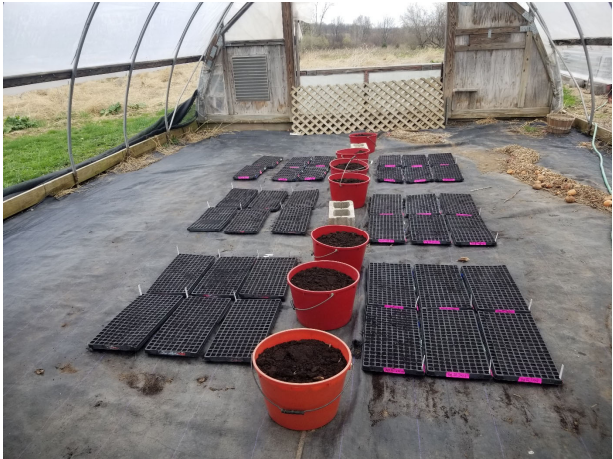


- In 2018, some growers noticed that “more than usual” Outlook injury (looping and stunting) seemed to occur in the variety “Montclair”
 - Differences observed “to the row”.

Trial Objective:

- To determine whether Montclair really is more susceptible to Outlook injury than other varieties

Seedling Bioassay: 200-cell plug trays in open side high tunnel, muck soil, watered not rainfall

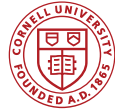


1st planting (36 trays, 3 reps)



1st & 2nd plantings (36 trays, 3 reps each)

Does **Variety** Affect Outlook Injury?



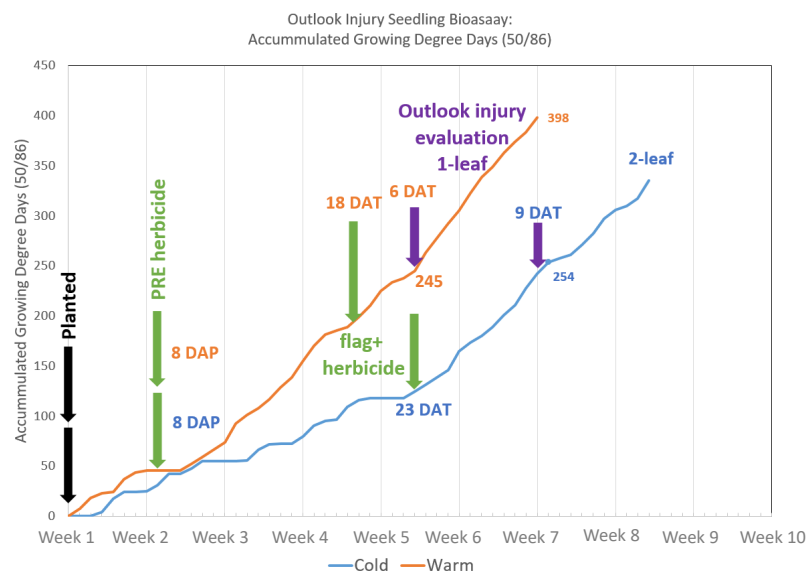
Catskill	105 days	Less vigorous
Braddock	107 days	Vigorous
Montclair	112 days	Vigorous

Does Temperature Affect Outlook Injury?



	Cold 1 st Planting	Warmer 2 nd Planting
Planting Date	Apr 14	May 4
PRE app	Apr 22 8 DAP	May 12 8 DAP
2nd PRE app	May 15 31 DAP/23 DAT (flag)	May 30 26 DAP/18 DAT (flag- flag+)

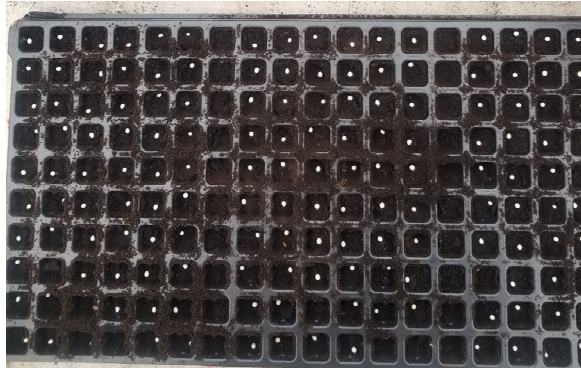
Does Temperature Affect Outlook Injury?



Does **Planting Depth** Affect Outlook Injury?



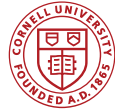
Shallow: ~0.25 inch



Deep: ~1 inch



Does **Timing of Outlook Application (PRE, Flag+)** and **Rate** Affect Outlook Injury?



Does **Outlook + Prowl** Affect Outlook Injury?

Treatment	Timing
Untreated	
Outlook 11 fl oz Outlook 11 fl oz	PRE flag
Outlook 21 fl oz	PRE
Prowl EC 2 pt	PRE
Outlook 11 fl oz + Prowl EC 2 pt Outlook 11 fl oz	PRE flag
Outlook 21 fl oz + Prowl EC 2 pt	PRE

Trays watered before
each spray was applied

Outlook Injury in Seedling Bioassay!



Not until 1st leaf stage



Saw this at flag – is this Outlook injury?

Results: Statistical Analysis P Values



Interaction between Herbicide x Planting Depth and Variety are most important factors.

Crop Stage	Flag Leaf				1-leaf		2-leaf					
Variable	% stand in advanced stage (1 st leaf start)		% of Perfect Stand		% Outlook Injury (looping)		Plant Health (% of Perfect)		Average Plant Mass (g)		% Outlook Injury (looping)	
Temperature	COLD	WARM	COLD	WARM	COLD	WARM	COLD	WARM	COLD	WARM	COLD	WARM
Planting Depth	0.0459	0.0105	0.1388	0.0511	0.0000	0.0089	0.2785	0.0702	0.0141	0.0429	0.1445	0.1038
Variety	0.0316	0.8636	0.0001	0.5136	0.0254	0.0266	0.1822	0.7322	0.0047	0.1795	0.0357	0.7622
Herbicide	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Herb x Depth	0.0005	0.0000	0.0000	0.0023	0.0002	0.0000	0.0000	0.0001	0.0001	0.0000	0.0547	0.1241
Var x Depth	0.4566	0.9417	0.2241	0.8127	0.3701	0.1880	0.5681	0.7490	0.4804	0.5362	0.2119	0.3366
Herb x Var	0.8466	0.7643	0.2317	0.6071	0.4879	0.7331	0.9523	0.9749	0.5917	0.8957	0.6810	0.3555
H x V x D	0.8935	0.6765	0.3060	0.4792	0.9996	0.7947	0.9969	0.9946	0.9494	0.9723	0.9225	0.8187

General Analysis of Variance Split-Split Plot Design, $\alpha=0.05$.

Results: Statistical Analysis P Values



Crop Stage	Flag Leaf				1-leaf		2-leaf					
Variable	% stand in advanced stage (1 st leaf start)		% of Perfect Stand		% Outlook Injury (looping)		Plant Health (% of Perfect)		Average Plant Mass (g)		% Outlook Injury (looping)	
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General Analysis of Variance Split-Split Plot Design, $\alpha=0.05$.



How do temperature and planting depth affect Outlook injury?

Results: Effect of Temperature on Outlook Injury?

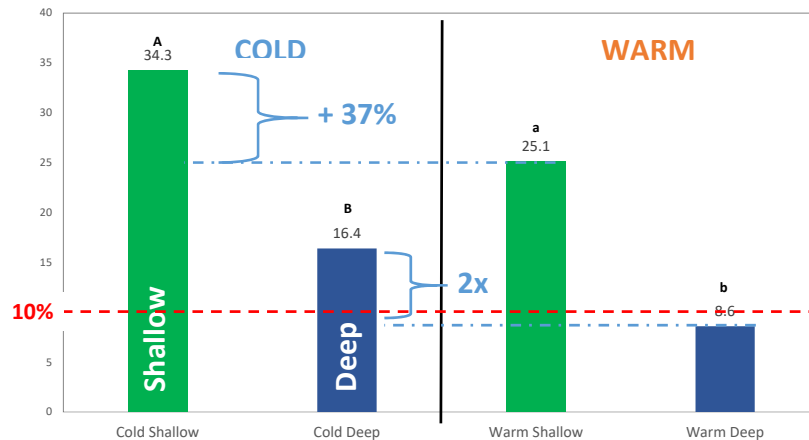
Outlook Injury (% Looping @ 1-leaf):

Effect of Temperature and Planting Depth (pooled across Herbicide & Variety)



Outlook Looping Injury (%) @ 1-leaf
Effect of **Temperature** and **Planting Depth**
Pooled Across Herbicide and Variety

Compared to warm soils,
Cold soils increased
Outlook injury by 37% to
double.



Results: Effect of Planting Depth on Outlook Injury

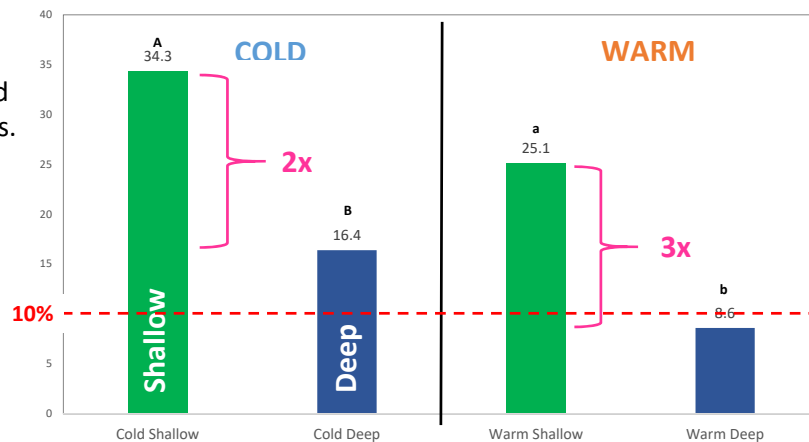
Outlook Injury (% Looping @ 1-leaf):

Effect of Temperature and Planting Depth (pooled across Herbicide & Variety)



Outlook Looping Injury (%) @ 1-leaf
Effect of **Temperature** and **Planting Depth**
Pooled Across Herbicide and Variety

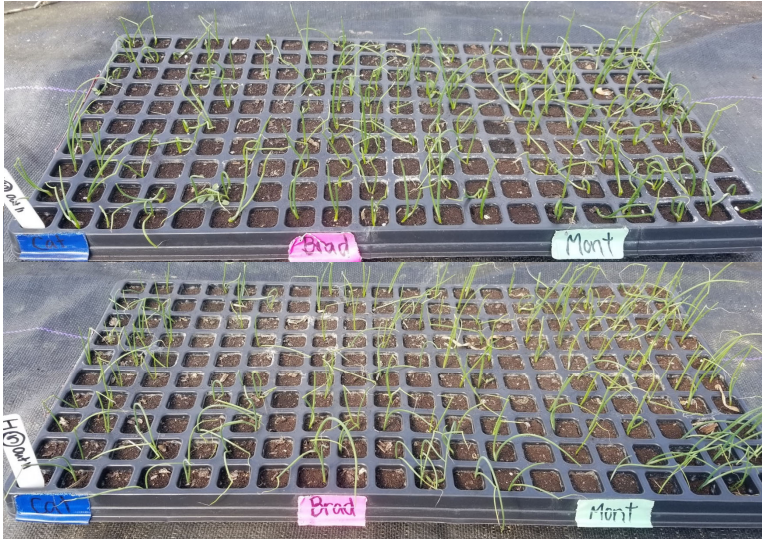
Shallow planting increased
Outlook injury by 2-3 times.



Results: Does **Planting Depth** Affect Outlook Injury?



COLD Outlook split (11 fl oz PRE/11 fl oz flag): 23/9 DAT (May 24; 1-leaf)



Shallow

Deep

How do temperature and planting depth affect Outlook injury?

COLD Temperature and **Shallow** planting depth **increased** Outlook injury



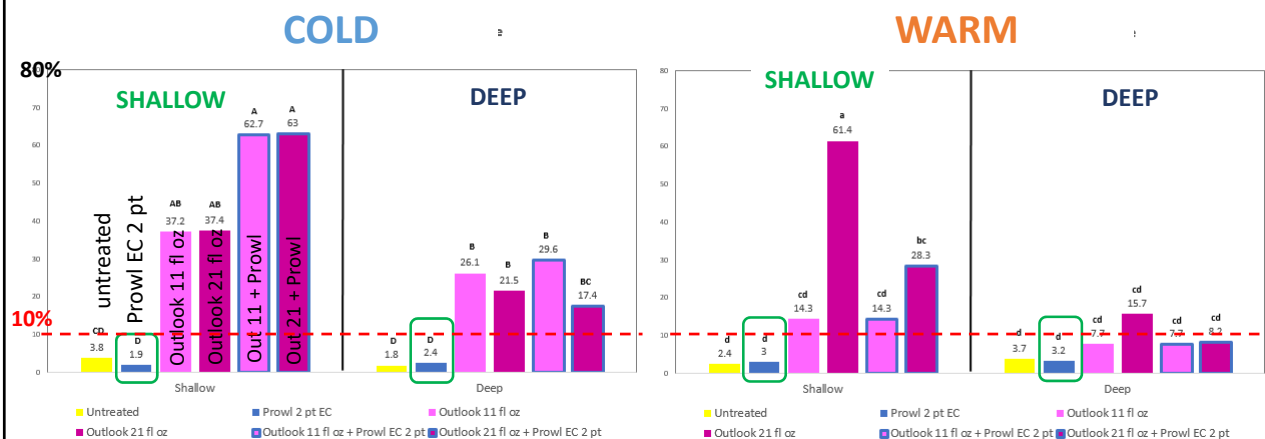
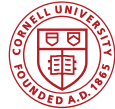


How does Outlook rate and combination with Prowl EC effect Outlook injury?

Results: Effect of Herbicide on Outlook Injury

Outlook Injury (% Looping @ 1-leaf):

Effect of Temperature, Planting Depth and Herbicide (pooled across Variety)

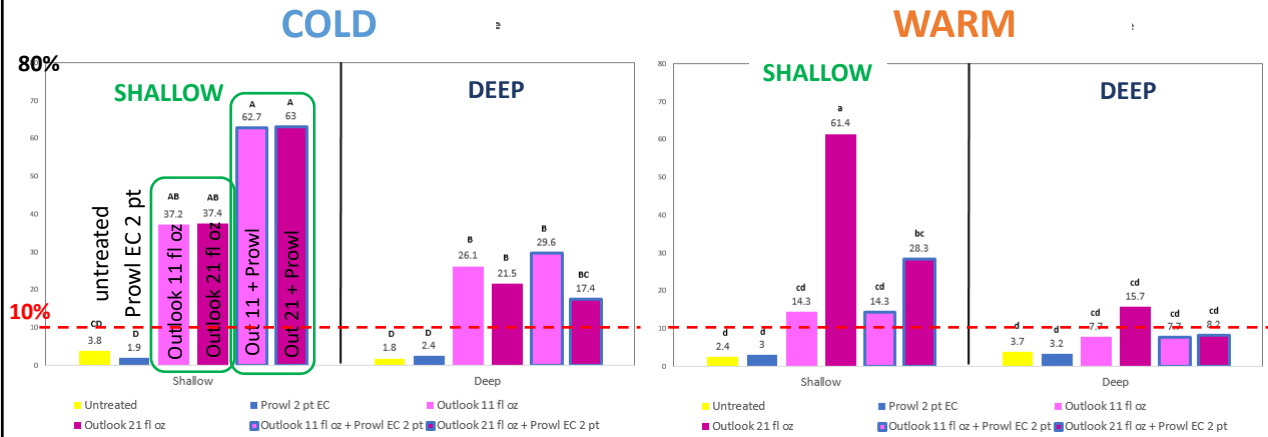


Prowl did not cause looping injury

Results: Effect of Herbicide on Outlook Injury

Outlook Injury (% Looping @ 1-leaf):

Effect of Temperature, Planting Depth and Herbicide (pooled across Variety)

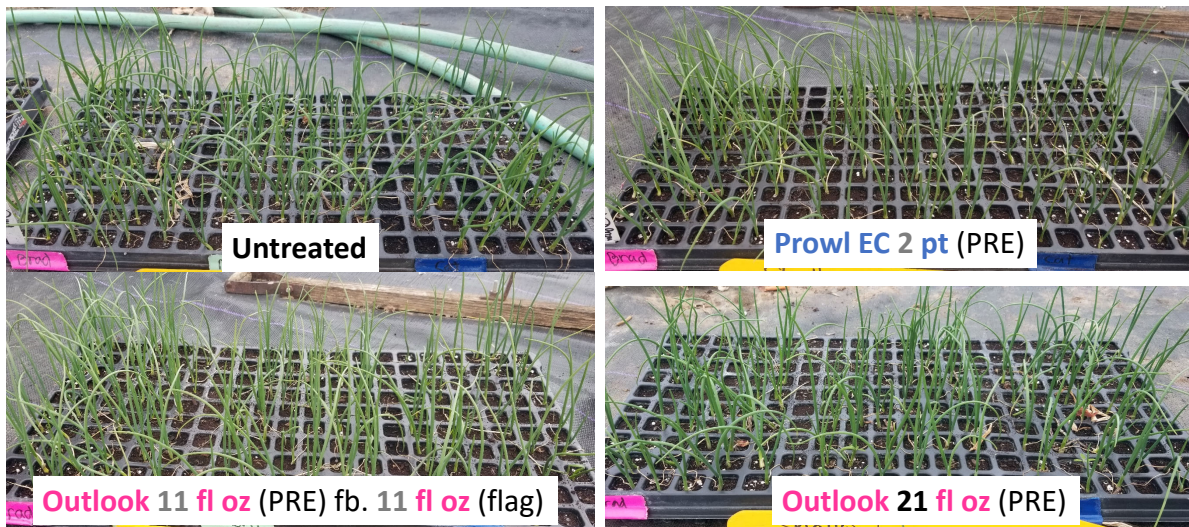


COLD SHALLOW: No difference between Out 11 and 21.

No difference between Out 11 + P and Out 21 + P.
Both caused more injury than Outlook alone.

Results: Does Herbicide Affect Outlook Injury?

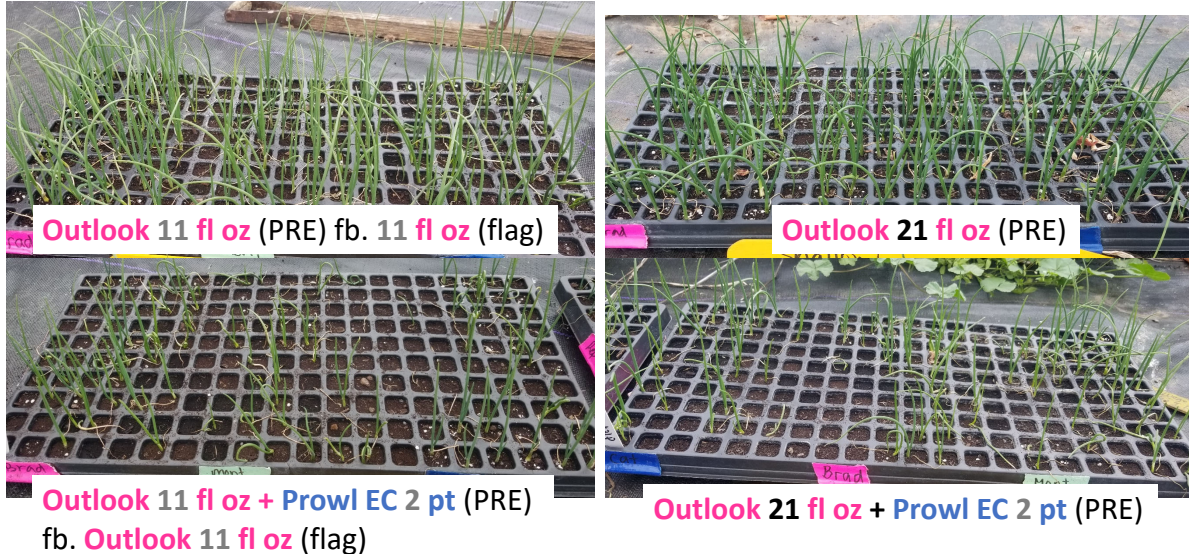
COLD Shallow: 44/21 DAT (Jun 5; 2-leaf)



Results: Does Herbicide Affect Outlook Injury?



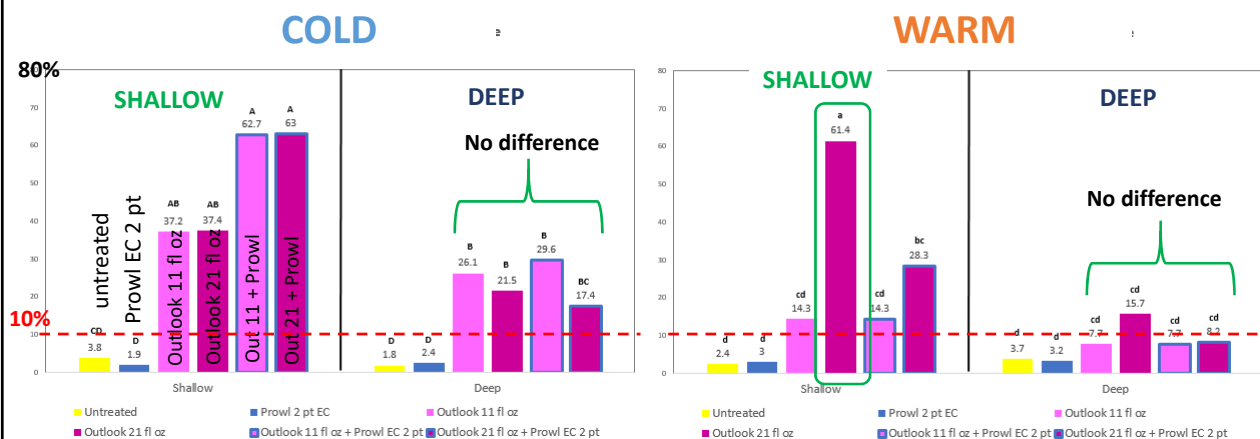
COLD Shallow: 44/21 DAT (Jun 5; 2-leaf)



Results: Does Herbicide Affect Outlook Injury?



Outlook Injury (% Looping @ 1-leaf): Effect of Temperature, Planting Depth and Herbicide (pooled across Variety)



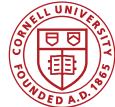
WARM SHALLOW: Outlook 21 significantly higher than all other treatments.

COLD and WARM DEEP: No difference between Outlook and Outlook + Prowl treatments.



How does Outlook rate and combination with Prowl EC effect Outlook injury?

- Full rate of Outlook and combos with Prowl EC increased Outlook injury when planted shallow.
- No significant differences when planted deep.



Is Montclair more susceptible to Outlook looping injury than other varieties?

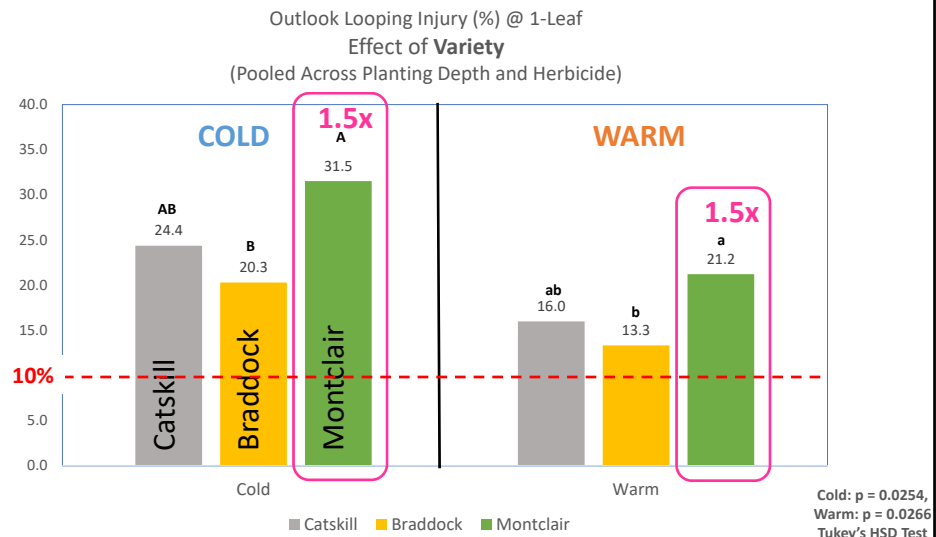
Results: Does **Variety** Affect Outlook Injury?

Outlook Injury (% Looping @ 1-leaf):

Effect of Temperature and Variety (pooled across Planting Depth & Herbicide)



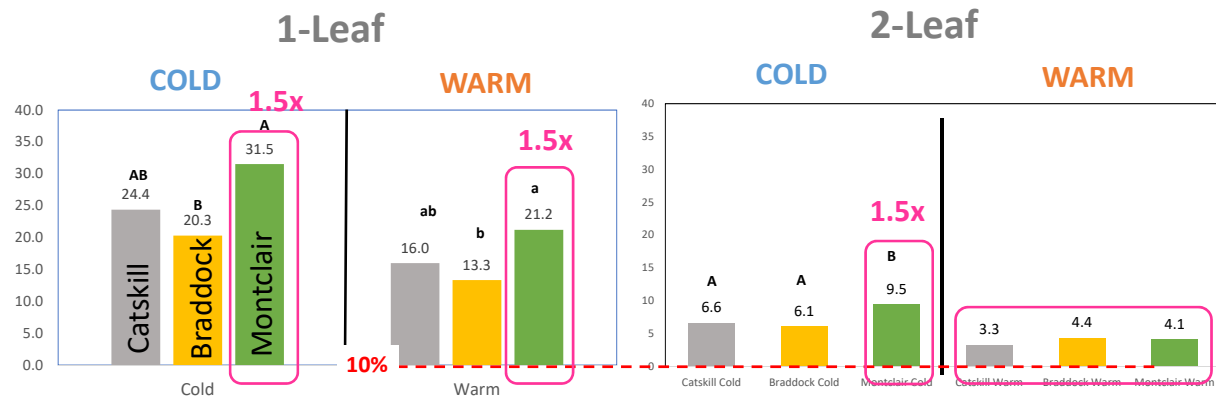
Montclair had ~ 1.5 times more Outlook injury than the other varieties.



Results: Does **Variety** Affect Outlook Injury?

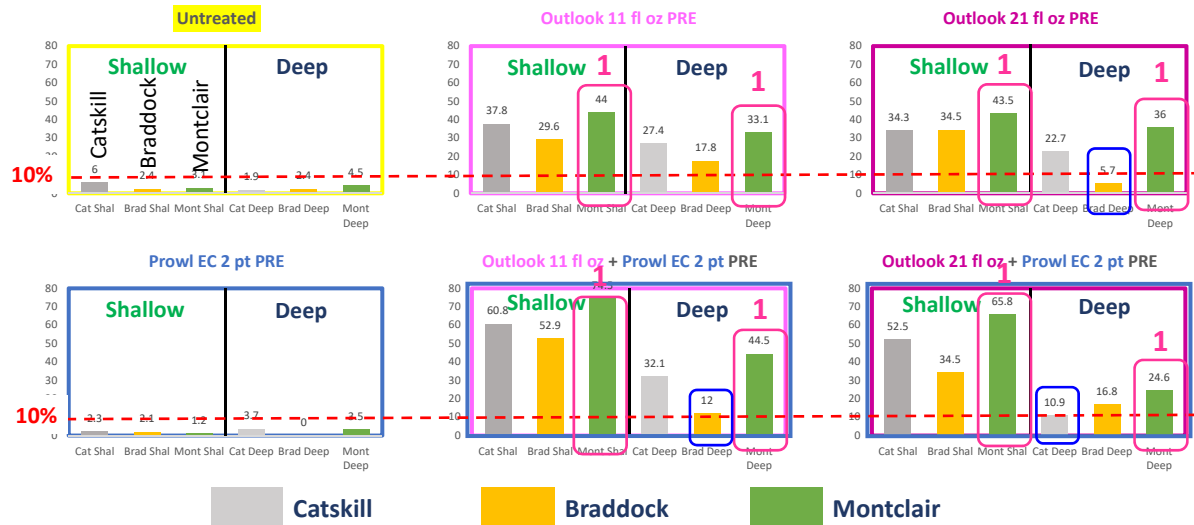
Outlook Injury (% Looping): 1- vs. 2-Leaf

Effect of Temperature and Variety (pooled across Planting Depth & Herbicide)

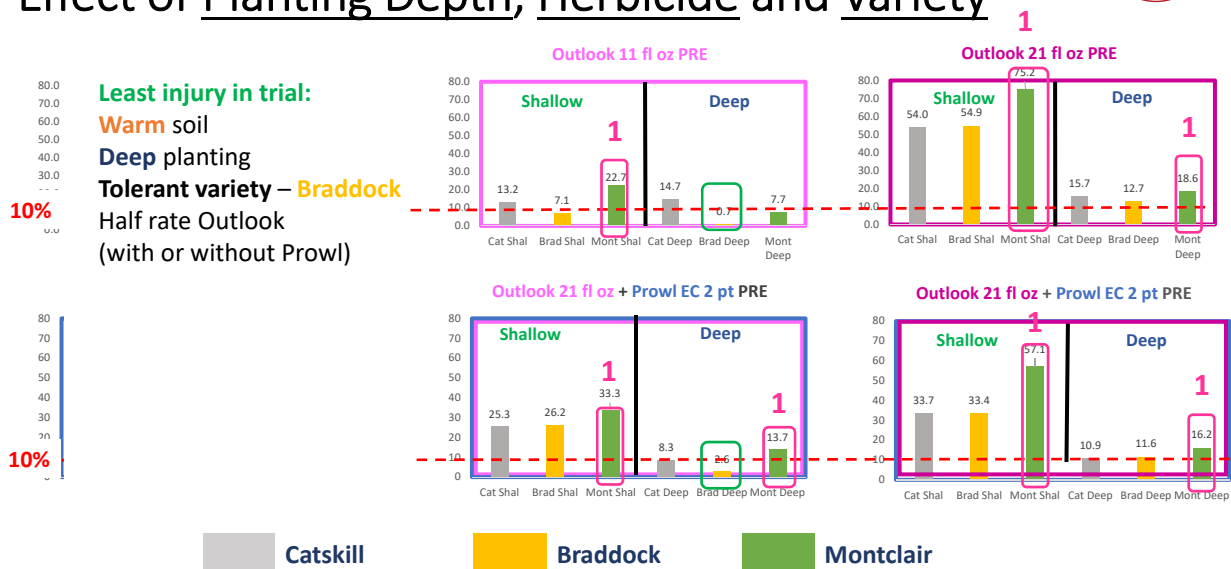


In **warm** soil, Montclair grows out of Outlook injury and looks the same as other varieties.

Outlook Looping Injury (%) @ 1-leaf): **COLD** Trial Effect of Planting Depth, Herbicide and Variety



Outlook Looping Injury (%) @ 1-leaf): **WARM** Trial Effect of Planting Depth, Herbicide and Variety



Results: Effect of Variety on Outlook Injury



COLD Shallow Outlook split (11 fl oz PRE/11 fl oz flag): 23/9 DAT (May 24; 1-leaf)



Catskill 105 less vigor



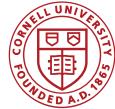
Braddock 107 vigorous



Montclair 112 vigorous

Is Montclair more susceptible to Outlook looping injury than other varieties?

Yes!





Can we just plant deeper to avoid Outlook injury?

At least in cold soil.

Results: Effect of Temperature on Plant Vigor?

Most Advanced Stage @ flag (% Start 1st Leaf):

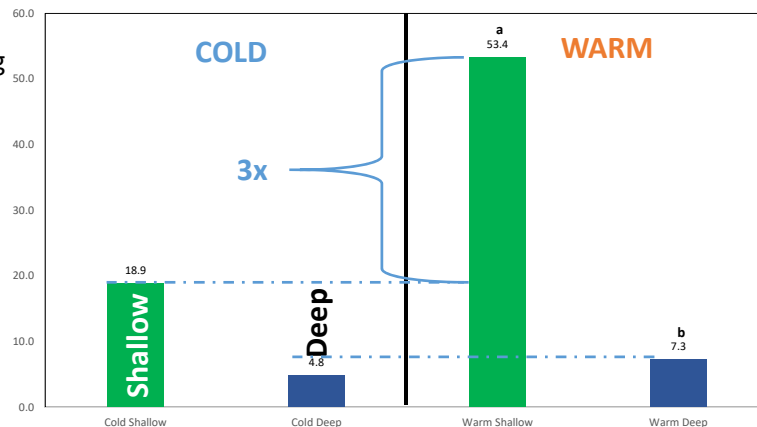
Effect of Temperature and Planting Depth (pooled across Herbicide & Variety)



Vigor (% of stand in advanced stage - 1st leaf start)
Effect of **Temperature** and **Planting Depth**
(Pooled Across Herbicide and Variety)

Compared to cold soil,
Warm soil shallow planting
depth had 3-times more
plants in advanced growth
stage.

No difference between
warm and cold in deep
planting.



Results: Effect of Planting Depth on Plant Vigor?

Most Advanced Stage @ flag (% Start 1st Leaf):

Effect of Temperature and Planting Depth (pooled across Herbicide & Variety)

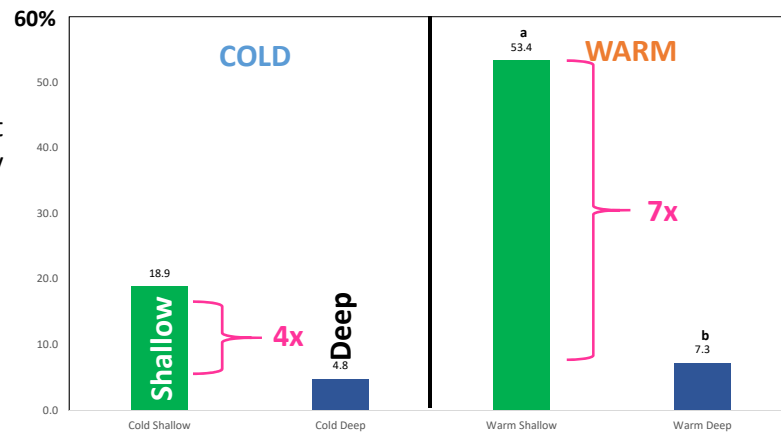


Vigor (% of stand in advanced stage - 1st leaf start)

Effect of **Temperature** and **Planting Depth**

(Pooled Across Herbicide and Variety)

Compared to deep planting, **Shallow** planting increased plant vigor by **4-7x**, especially under **warm** soil conditions.



Results: Effect of Planting Depth on Plant Vigor

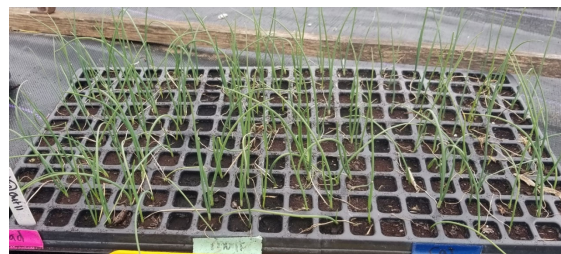


COLD Outlook split (11 fl oz PRE/11 fl oz flag): 44/21 DAT (Jun 5; 2-leaf)

Shallow



Deep



Results: Effect of Herbicide on Plant Vigor

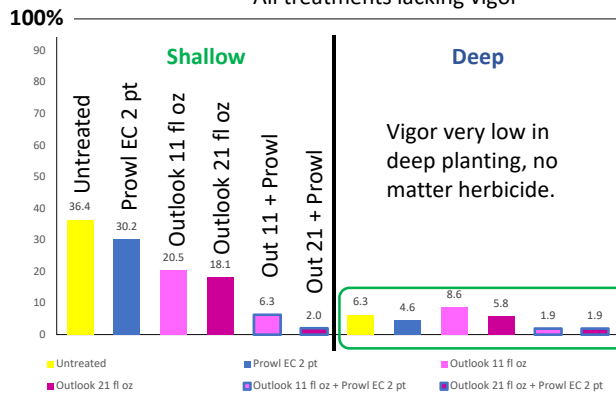
Most Advanced Stage @ flag (% Start 1st Leaf):

Effect of Temperature, Planting Depth and Herbicide (pooled across Variety)

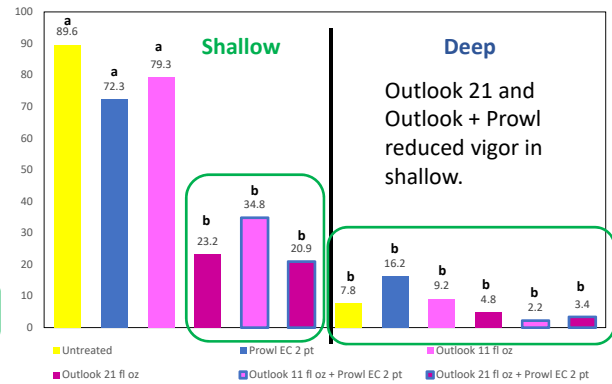


COLD - NO!

All treatments lacking vigor



WARM - Yes!



Results: Effect of Herbicide on Plant Vigor

Average Plant Weight (g) @ 2-leaf:

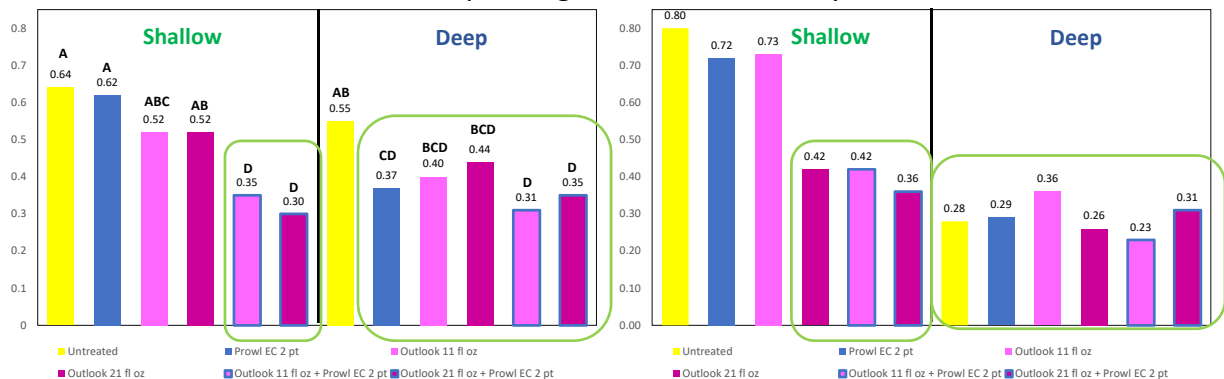
Effect of Temperature, Planting Depth and Herbicide (pooled across Variety)



COLD

WARM

In **shallow** planting, herbicide reduced yield



In **deep** planting, what plants make up for in reduced Outlook injury is lost in reduced vigor.



Can we just plant deeper to avoid
Outlook injury?

At least in cold soil.

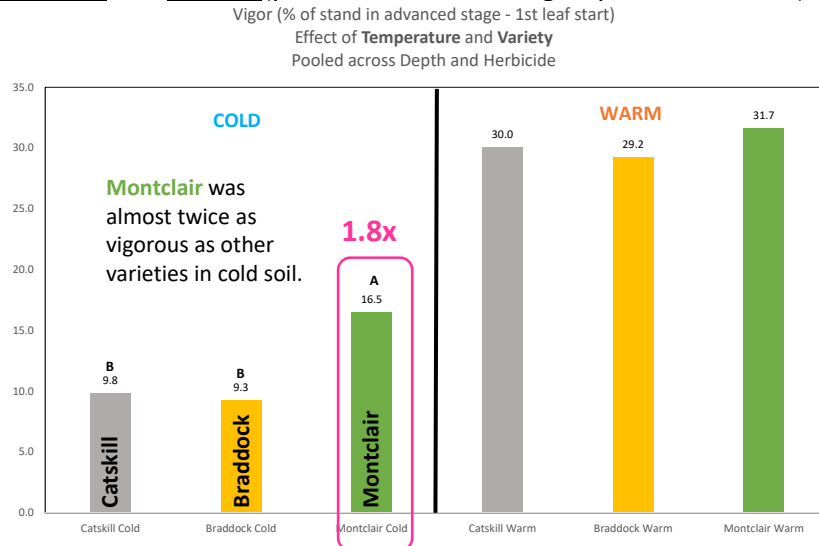
No!



Does Variety Affect Plant Vigor?

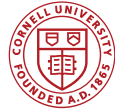
Results: Effect of **Variety** on Plant Vigor?

Most Advanced Stage @ flag (% Start 1st Leaf): Effect of Temperature and Variety (pooled across Planting Depth & Herbicide)

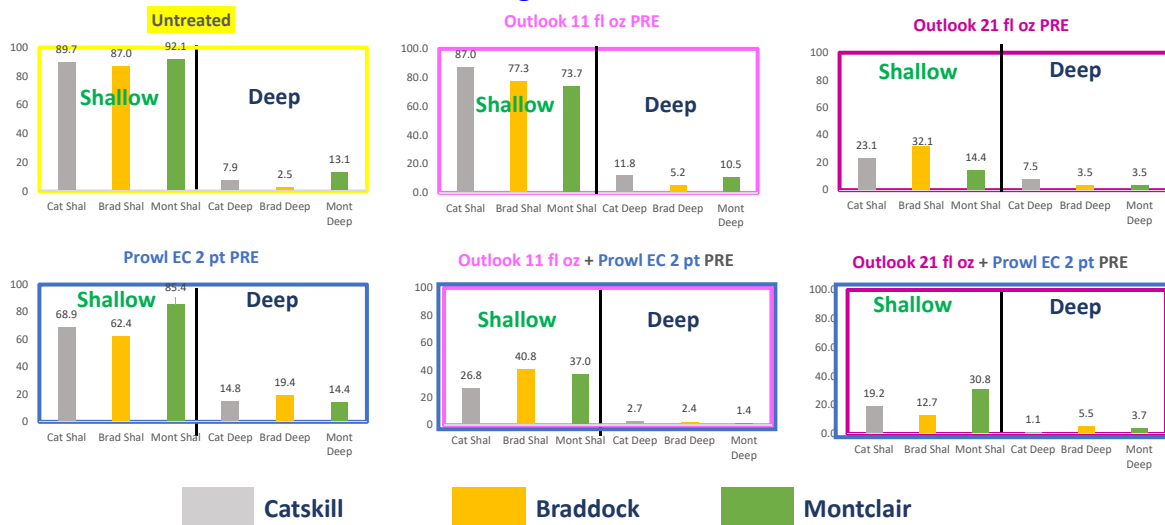


Most Advanced Stage @ flag (1st leaf start): **WARM** Trial

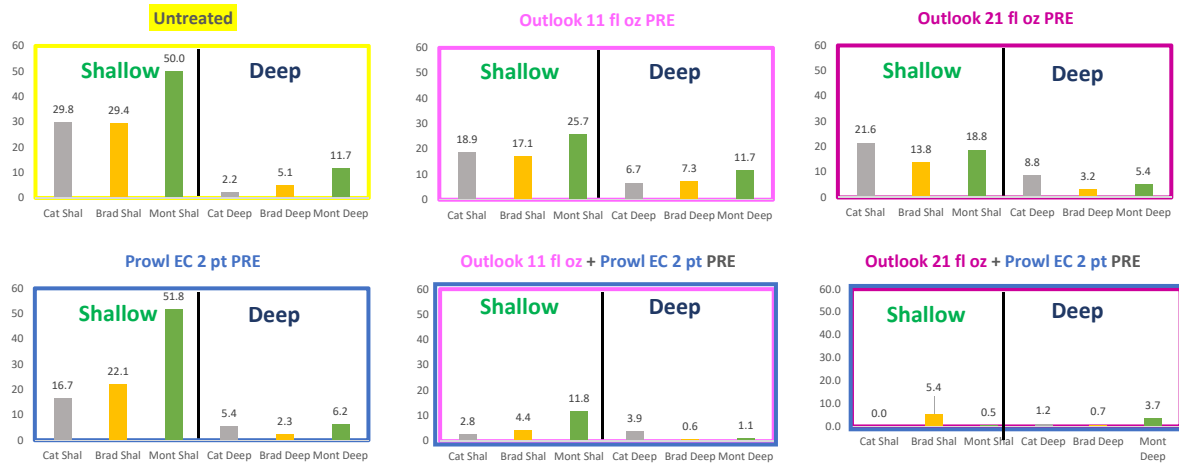
Effect of Planting Depth, Herbicide and Variety



No differences among varieties when soils are warm.

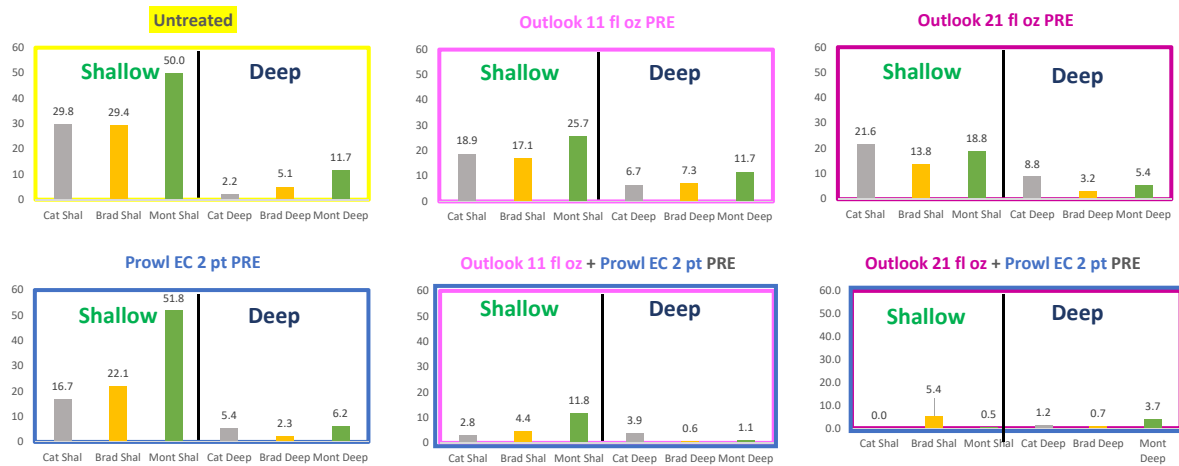


Most Advanced Stage @ flag (1st leaf start): COLD Trial Effect of Planting Depth, Herbicide and Variety



Vigor is poor in all treatments in all varieties when planted **deep**.

Most Advanced Stage @ flag (1st leaf start): COLD Trial Effect of Planting Depth, Herbicide and Variety



Cat Skil

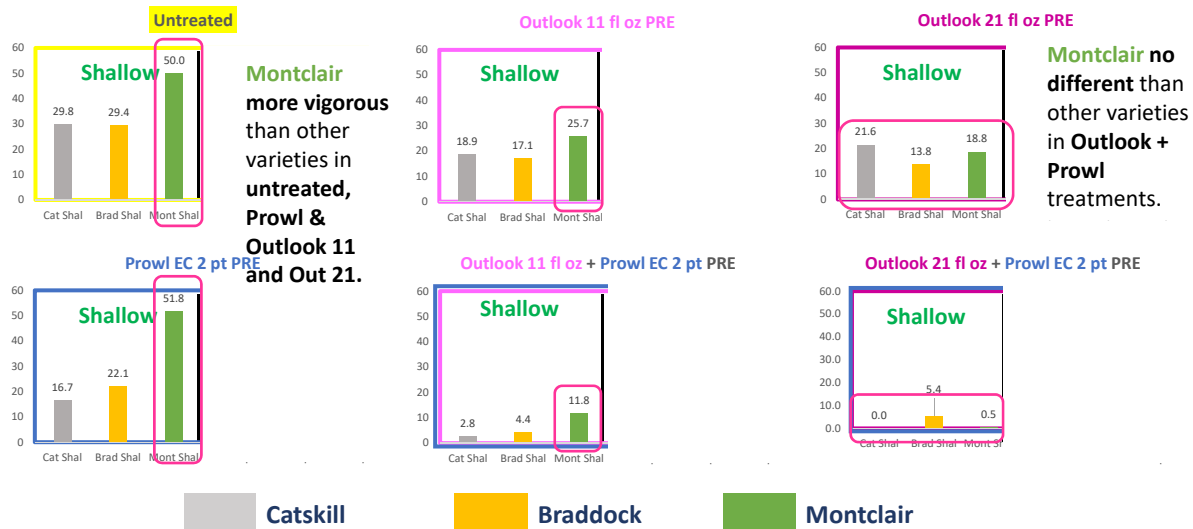


Braddock



Montclair

Most Advanced Stage @ flag (1st leaf start): COLD Trial Effect of Planting Depth, Herbicide and Variety

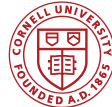


Does Variety Affect Plant Vigor?

Yes!

Only in cold soil. Not warm.

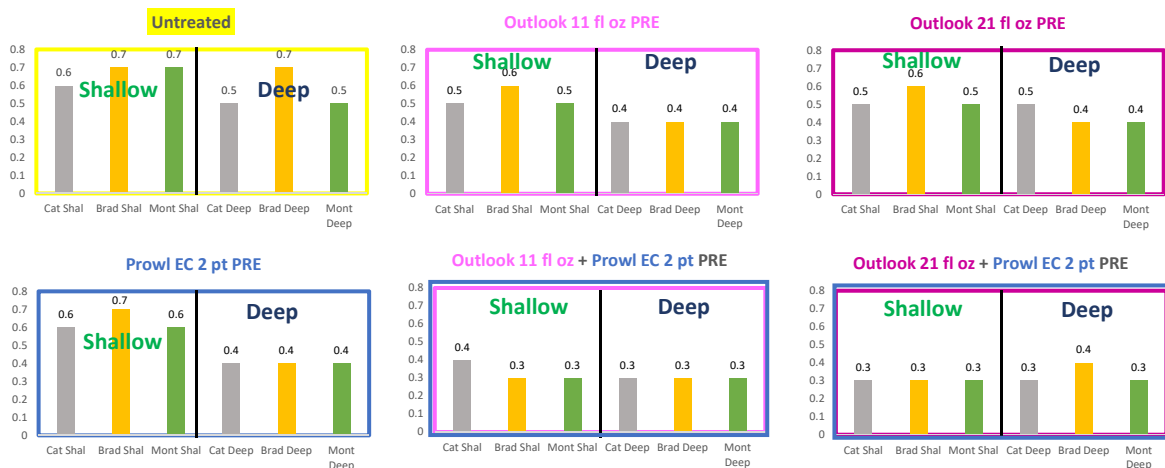
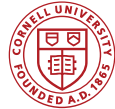
The variety that is most susceptible to Outlook looping injury (Montclair) is also the most vigorous, EXCEPT when planted shallow and treated with Outlook 21 and Outlook 21 + Prowl.





Did the Variety with the most Outlook
looping injury – Montclair suffer the most?

Average Plant Weight (g) @ 2-Leaf: COLD Trial Effect of Planting Depth, Herbicide and Variety

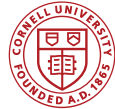


No differences among varieties in plant weight at 2-leaf.



Did the Variety with the most Outlook
looping injury – Montclair suffer the most?

No!



Does Outlook looping injury affect yield?

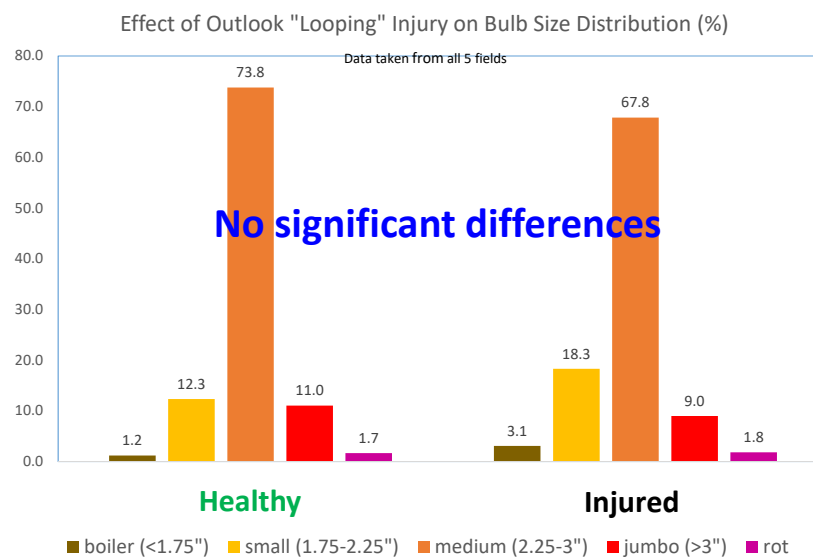
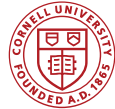
Field Trial – Case Study, 2019



Effect of Outlook Injury on Yield:

- Tagged 500 bulbs with **Outlook** injury and 500 bulbs without Outlook injury in 5 sets of 20 plants per field, 5 fields, c.v **Montclair**.
- Harvest and grade.

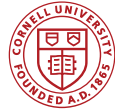
Results: Field Trial – Case Study, 2019 Bulb Size Distribution at Harvest





Does Outlook looping injury affect yield?

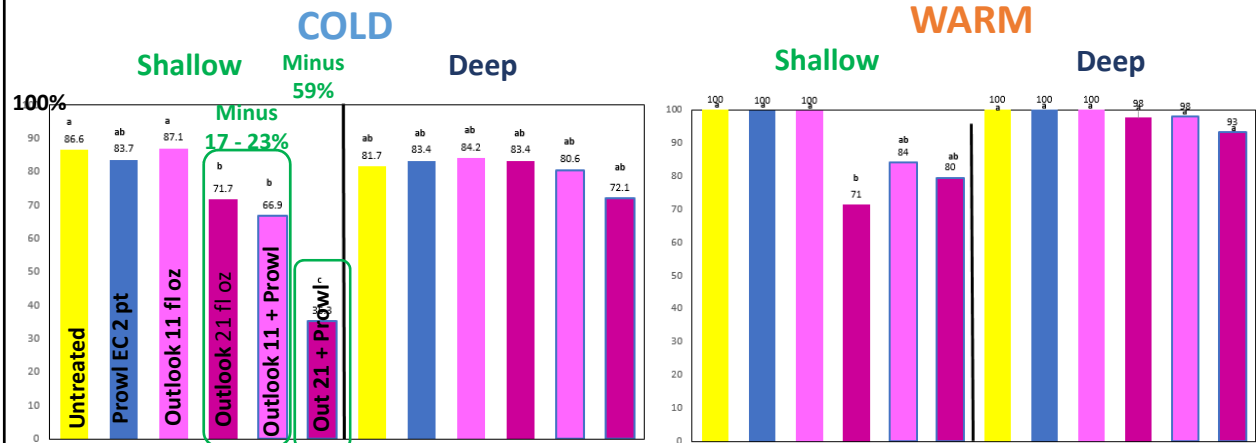
No!



What about the other kind of Outlook injury?

- Reduced Stand?

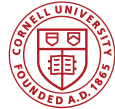
Stand (% of Planted) @ 1-leaf: Effect of Temperature, Planting Depth and Herbicide (Pooled Across Variety)



COLD Shallow: Outlook 21 and Outlook 11 + Prowl EC 2 pt significantly reduced stand by 17- 23%.

Outlook 21 + Prowl EC 2 pt significantly reduced stand by 59% (more so than other treatments).

Results: **Planting Depth** Affected Stand loss from Outlook + Prowl



COLD Outlook 21 fl oz + Prowl 2EC 2 pt PRE: 44 DAT (Jun 5; 2-leaf)

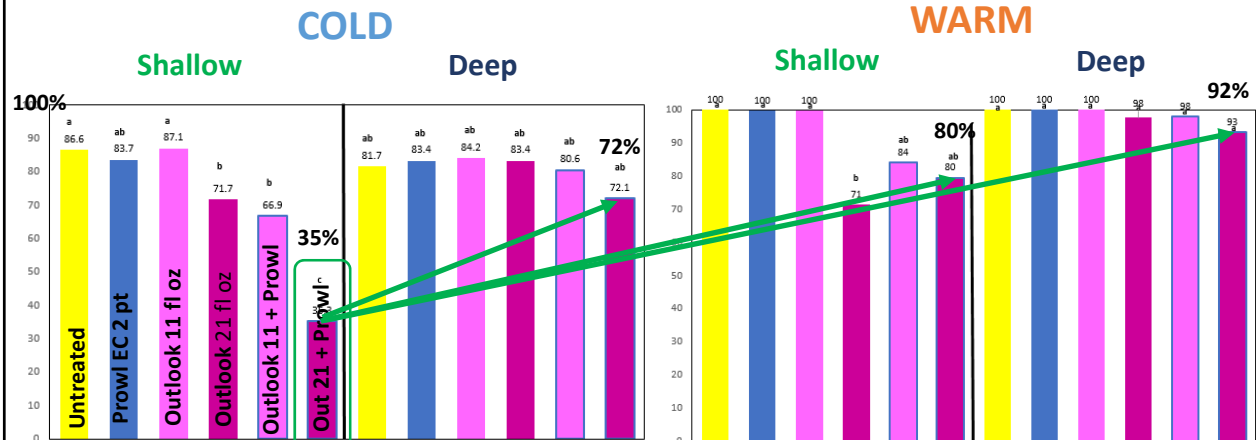


Shallow



Deep

Stand (% of Planted) @ 1-leaf: Effect of Temperature, Planting Depth and Herbicide (Pooled Across Variety)

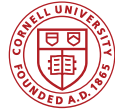


COLD Shallow Outlook 21 + Prowl EC 2 pt: Plant **Deep**: Significantly increase stand from 35% to 72%.

Warm Up: Significantly increase stand from 35% to 80%. **Warm Up & Plant Deep**: Significantly increase stand from 35% to 92%

What about the other kind of Outlook injury? Reduced Stand?

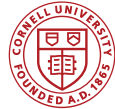
Deep planting in warm soil buffered a lot against reduced stand caused by Outlook + Prowl injury.





Can we plant deep to avoid reduced stand from Outlook+Prowl?

Yes!



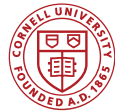
Summary

- Cold soils and shallow planting significantly increased Outlook injury
- Deep planting reduced Outlook injury significantly, but also reduced plant vigor significantly
- With deep planting, what plants made up for in reduced Outlook looping injury, they lost in reduced vigor
 - Deep planting to avoid Outlook looping injury is not necessary
- Outlook looping injury does not appear to be of concern
 - No difference in plant biomass at 2-leaf stage
 - No difference in yield in field case study
 - Variety with most Outlook looping injury was no different than other varieties at 2-leaf stage



Summary

- Does Outlook looping injury increase Chateau injury that may have detrimental consequences?
- Montclair had the most Outlook looping injury
- Montclair had the highest seedling vigor in cold soil, which was squashed by Outlook 21 + Prowl



Summary

- In cold soil, shallow planting increased stand loss caused by Outlook
 - Especially with full rate and when used with Prowl EC
 - Suspect Prowl H2O would be safer
 - Suspect separate apps of Outlook and Prowl would be safer
- Deep planting and warm soil significantly reduced stand loss over shallow planting in cold soil.
 - Deeper planting in cold soil may be beneficial.
 - What is the sweet spot to avoid both stand loss and reduced seedling vigor?
- Hope to continue this work...