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Final Report: National Watermelon Association
Examining the effects of planting date on *Fusarium* wilt and foliar disease incidence, and fungicide efficacy in Florida.

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Summary of Results:

- Early planted watermelons tended to have greater disease incidence and higher yield losses from *Fusarium* wilt compared to later planted treatment.
- Disease incidence and severity in direct inoculated plots compared to non-inoculated plots was about 2 times greater at both the Citra and Live Oak locations.
- Yields were reduced by more than half in early planted plots at both locations when plants were directly inoculated with *F. oxysporum* f. sp. *niveum*. However, in later planted plots yields were only reduced by 25% or less at both locations using the same inoculation method. Yield savings of 5,000 to 15,000 lb/A were observed in the later planting plots compared to the early planted plots.
- The impacts of a Proline® 480 SC were variable between the sites. Applications of the fungicide tended to reduce disease but no observable yield savings were apparent at the Citra location. However, disease was reduced and yields tended to be higher for this treatment in the Live Oak early planting date, but these trends were not significant.
- Anthracnose leaf spot was not observed in these trials for both planting dates.

Overall, this work indicates that *Fusarium* wilt had a greater impact on early planted watermelons (late February to early March) compared to late planted watermelons (late March to early April). Proline® impacts were not apparent in this trial except for early planting at Live Oak site. Further research is needed to better understand how weather and climate will effect *Fusarium* wilt incidence across the variation present in the pathogen's population.

Project Details:

Background: Fusarium wilt, caused by *F. oxysporum* f. sp. *niveum* (Fon) continues to be a problem for many watermelon producers. Highly aggressive Fon races (race 2 and 3) have been reported from Southeastern U. S. and are a concern for the watermelon producers. Management of this pathogen requires an integrated strategy that includes using cultural practices, cultivar resistance and chemicals. Current cultural practices (e.g. crop rotation) have not been as effective at managing this devastating disease and cultivar resistance is not currently available for races 2 and 3. While fungicides have shown some promise in managing this pathogen, their efficacy has been variable making their implementation difficult. Further management practices are needed to effectively control this disease. Since Fon is a cool season pathogen, there is a potential to use planting date for its management. As Fusarium wilt damage is mostly seen in the first 4-6 weeks after transplant, late planting in the spring may restrict the activity of the pathogen compared to early planting, and thereby reduce the yield loss.

Objectives :

1. To assess the impact of transplant date on *Fusarium* wilt disease incidence and total yield
2. To evaluate efficacy of prothioconazole (Proline® 480 SC) fungicide on *Fusarium* wilt and foliar fungal pathogen disease control in early and late planted watermelons

Work done: This research was carried out at Plant Science Research and Education Unit, University of Florida in Citra (PSREU), FL and Suwannee Valley Agricultural Extension Center, University of Florida in Live Oak, FL (SVAEC). The planting dates for Citra site were 28 Feb and 29 Mar while Live at Oak planting was done on 02 Mar and 05 April. Four weeks old seedlings grown in the greenhouse were used for transplanting after acclimatizing. Each experiment was conducted as a randomized complete block design with 4 replications and 6 treatments which included drip application of Proline and different Fon inoculation techniques with the appropriate checks. Beds were made using black plastic mulch. Each plot had a row length of 30-ft with 3-foot plant spacing and 8-foot row centers. Each block consisted of two rows. Gaps between plots were 10-foot and alleyways between four rows (two blocks) were 15-foot. Plots were inoculated with race 2 isolate of Fon either by adding 1g of infested grain inoculum directly into transplant hole or indirectly to four opposite holes two inches away from transplant hole.

The experiment consisted of six treatments: 1- un-inoculated control; 2-un-inoculated plots drip applied with Proline® one week after transplant; 3-direct inoculated control; 4-direct inoculated plots drip applied with Proline® one week after transplant; 5-indirect inoculated control; 6-indirect inoculated drip applied with Proline® one week after transplant. All plots were sprayed with chlorothalonil (1.5 pts/A) on a biweekly basis at 50 GPA. General plot maintenance was done following recommendations in the Vegetable Production Handbook of Florida (https://edis.ifas.ufl.edu/pdffiles/cv/cv29200.pdf). Fusarium wilt assessment began three weeks after transplanting by recording disease incidence, severity, and vigor and was continued on a weekly schedule for a total of 10 assessments. Marketable and unmarketable mature fruits were harvested, counted and weighed on two occasions for each trail. Harvests at Citra and Live Oak were completed on 21 June and 28 June, respectively. Weather data for the two locations was collected from the Florida Automated Weather Network (FAWN; https://fawn.ifas.ufl.edu/) which had stations located within 1 km of the plots.

Table 1 Weather information during the first six weeks of early and late planting

	Field Trial			
	Citra-Early	**Citra-Late**	**Live Oak-Early**	**Live Oak-Late**
Transplant Date	28 Feb	29 Mar	2 Mar	5 Apr
1st Harvest Date	6 Jun	14 Jun	12 Jun	19 Jun
2nd Harvest Date	14 Jun	21 Jun	12 Jun	28 Jun
Average Air Temp. (F°)	65.9	72.7	64.8	71.9
Average Soil Temp. (F°)	72.9	80.0	70.1	79.6
Average Bed Temp. (F°)	75.1	81.3	73.9	82.2
Total Rainfall	5.1	4.1	5.2	1.6

Outcomes:

Objective-1

Comparisons between non-inoculated and inoculated plots show that tranplant date did have an impact on Fusarium wilt incidence and yield at both locations, however this effect was not signficant ($P > 0.05$). Yield reductions ranging from 58 to 62% were observed in the early planted treatments, where as, they only ranged from 3 to 26% in the late planted plots (Fig. 1, Tables 2 to 5). Disease severity/incidence also showed a similar trend in both locations with overall disease ratings being less than 10% in the late planted plots (Fig. 2, Tables 2 to 5). Disease incidence and severity in the early planted plots ranged from 40 to 60% in the direct inoculated plots and 18 to 53% in the inderct inoculated plots. Despite the lack of significant differences between the treatments, it is apparent from these results that early tranplanted (late February to early March) watermelons are at a higher risk for Fusarium wilt development than later planted plots.

Objective-2

The application of Proline® did not have a significant effect on Fusarium wilt. However, a trend of increasing yields with the Proline® treated plots were noticed for the early planting at Live Oak site. The direct inoculated Proline® treated plots recorded 35% more yield compared direct inoculated control. The disease incidence of Proline® treatd plots was 35% less than the untreated check. Similarly, indirect-inoculated, Proline® treated plots gave 40% more yield than the indirect inoulated check.

Additional information

The early-planted seedlings in Live Oak were exposed to frost damage and therefore showed vigor loss. This may have confounded the effect of pathogen in inoculated plots. We did not observe significant anthracnose in both Citra and Live Oak sites.

Conclusion:

Though statistically not significant, there is a trend of less yield reduction in early planted (late Feb-early Mar) watermelon plots compared to late planted (late mar to early Apr) plots in relation to Fusarium wilt. Proline® effects were not noticeable in this trial, however, there was indication that the fungicide increased yield at Live Oak early planted site. These results indicate that transplant date will be a useful IPM strategy for Fusarium wilt, but further experimentation is needed to understand how the various races and isolates of the pathogen respond to this management technique.

Table 2. Citra (PSREU) early planting treatment averages for yield and disease incidence and severity.

Fungicide program	Marketable Yield (lb/A)^{x}	Disease Incidence (%)^{y,z}	Disease Severity (%)^{y,z}
1: Un-inoculated Check	24,597	12.5 c	6.8 c
2: Un-inoculated + Proline 480 SC @ 5.7 fl oz/A	27,831	20.0 c	20.0 bc
3: Direct inoculated check	9,112	60.0 a	56.3 a
4: Direct inoculated + Proline 480 SC @ 5.7 fl oz/A	9,341	50.0 ab	56.3 a
5: Indirect inoculated control	19,198	30.0 bc	31.3 b
6: Indirect inoculated + Proline 480 SC @ 5.7 fl oz/A	12,056	17.5 c	16.3 bc

^{x} Marketable yield for different fungicide programs were not significantly different according ANOVA test (*P* = 0.05).
^{y} Column levels not connected by same lowercase letter are significantly different according Student's t test (*P* = 0.05).
^{z} Disease incidence and severity as of April 21.

Table 3. Citra (PSREU) late planting treatment averages for yield and disease incidence and severity.

Fungicide program	Marketable Yield (lb/A)^{x}	Disease Incidence (%)^{x,z}	Disease Severity (%)^{x,z}
1: Un-inoculated Check	41,843	5.0	5.0
2: Un-inoculated + Proline 480 SC @ 5.7 fl oz/A	45,919	2.5	2.5
3: Direct inoculated check	30,924	10.0	10.0
4: Direct inoculated + Proline 480 SC @ 5.7 fl oz/A	29,076	10.0	10.0
5: Indirect inoculated control	39,656	2.5	2.5
6: Indirect inoculated + Proline 480 SC @ 5.7 fl oz/A	36,467	17.5	9.5

^{x}Marketable yield (*P*=0.08), disease incidence, and disease severity for different fungicide programs were not significantly different according ANOVA test (*P* = 0.05).
^{z} Disease incidence and severity as of May 19.

Table 4. Live Oak (SVAEC) early planting treatment averages for yield and disease incidence and severity.

Fungicide program	Marketable Yield (lb/A)^{y}	Disease Incidence (%)^{x,z}	Disease Severity (%)^{x,z}
1: Un-inoculated Check	35,688 a	15.0	15.0
2: Un-inoculated + Proline 480 SC @ 5.7 fl oz/A	35,371 a	27.5	27.5
3: Direct inoculated check	14,946 b	57.5	56.3
4: Direct inoculated + Proline 480 SC @ 5.7 fl oz/A	20,222 b	37.5	37.5
5:Indirect inoculated control	13,859 b	52.5	51.3
6: Indirect inoculated + Proline 480 SC @ 5.7 fl oz/A	19,814 b	47.5	45.3

^{x} Disease incidence (*P* = 0.059), and disease severity (*P* = 0.089) for different fungicide programs were not significantly different according ANOVA test (*P* = 0.05).
^{y} Column levels not connected by same lowercase letter are significantly different according Student's t test (*P* = 0.05).
^{z} Disease incidence and severity recorded on April 24.

Table 5 Live Oak (SVAEC) late planting treatment averages for yield and disease incidence and severity.

Fungicide program	Marketable Yield (lb/A)[x]	Disease Incidence (%)[x,y]	Disease Severity (%)[x,y]
1: Un-inoculated Check	36,526	0.0	0.0
2: Un-inoculated + Proline 480 SC @ 5.7 fl oz/A	35,213	0.0	0.0
3: Direct inoculated check	35,371	5.0	0.8
4: Direct inoculated + Proline 480 SC @ 5.7 fl oz/A	26,155	0.0	0.0
5: Indirect inoculated control	28,827	2.5	0.8
6: Indirect inoculated + Proline 480 SC @ 5.7 fl oz/A	27,265	2.5	1.3

[x] Total yield, marketable yield, disease incidence, and disease severity for different fungicide programs were not significantly different according ANOVA test ($P = 0.05$).

[y] Disease incidence and severity recorded on May 22.

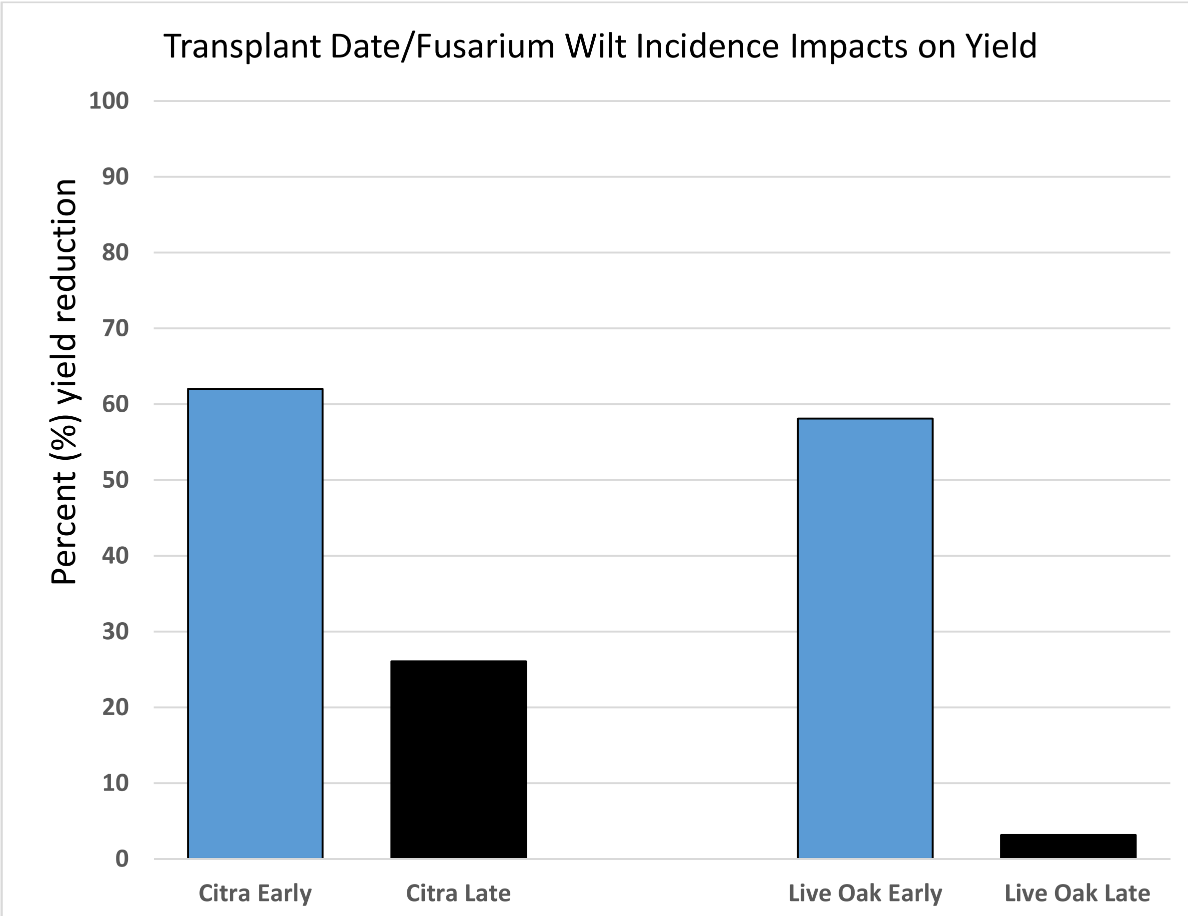

Fig. 1 Percent yield reduction based on a comparison between Fusarium wilt inoculated plots and the non-inoculated checks. The trials were conducted at the Plant Science Research and Education Unit in Citra, FL and the Suwannee Valley Agricultural Extension Center in Live Oak, FL. The transplant dates were Citra Early – 28 Feb, Citra Late – 29 Mar, Live Oak Early – 2 Mar and Live Oak Late – 5 Apr. First harvest dates at Citra were on 6 Jun early and 14 Jun late. Live Oak first harvest dates were 12 Jun - early and 19 Jun - late.

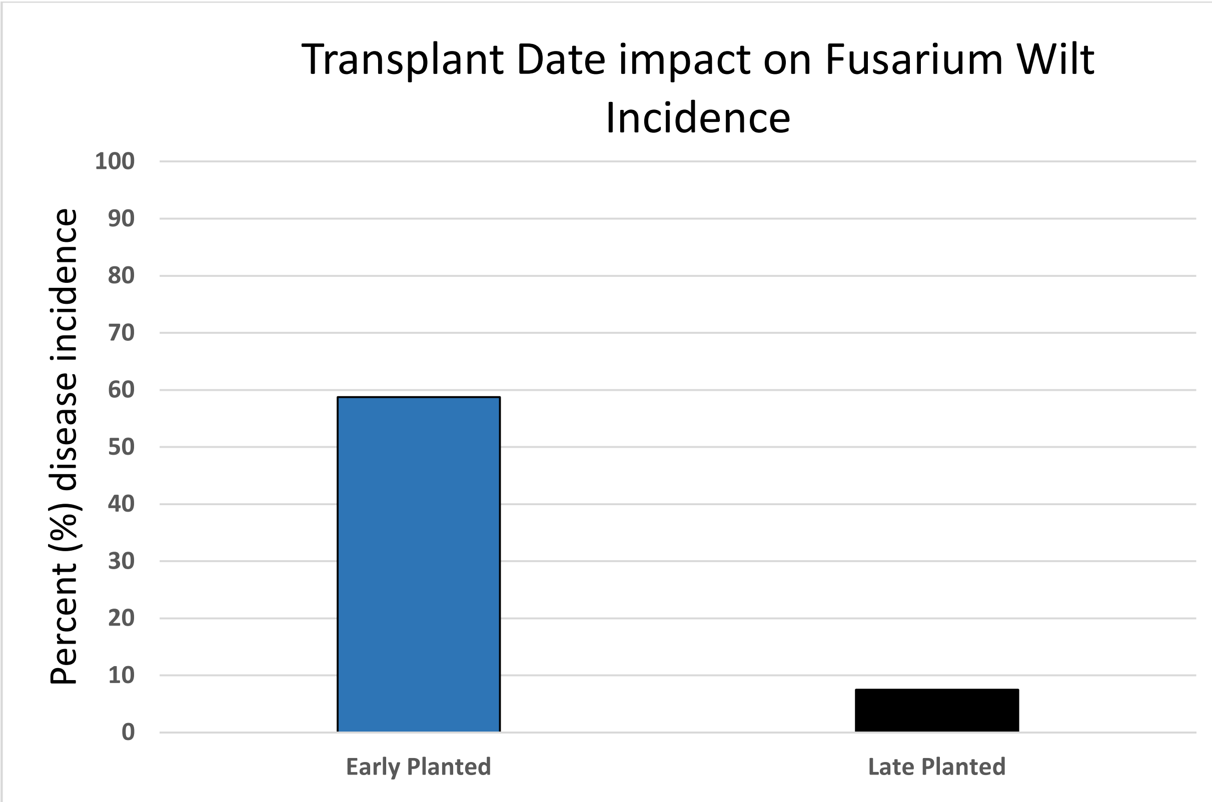

Fig. 2 Average percent Fusarium wilt incidence in inoculated plots compared to non-inoculated checks for early and late planting dates. The disease incidence of each planting date is the average of in PSREU (Citra) and SVAEC (Live Oak) experimental sites combined. The trials were conducted at the Plant Science Research and Education Unit in Citra, FL and the Suwannee Valley Agricultural Extension Center in Live Oak, FL. The transplant dates were Citra Early – 28 Feb, Citra Late – 29 Mar, Live Oak Early – 2 Mar and Live Oak Late – 5 Apr. First harvest dates at Citra were on 6 Jun early and 14 Jun late. Live Oak first harvest dates were 12 Jun - early and 19 Jun - late.