NC STATE EXTENSION

Evaluations of Modern Spray Nozzle Technology for Maleic Hydrazide Application

MC Vann, RNJ Roussos, CW Cahoon, & T Gannon
Department of Crop & Soil Sciences

G Ellington
Department of Biological & Agricultural Engineering

Introduction

- Continued emphasis on perfect sucker control
  - Reduce NTRM, hand suckering, and labor needs

- MH remains one of the keys to sustainable tobacco production in the US
  - $US 14.16/hour adverse wage rate

Modern Nozzle Technology

- Required use in new auxin-tolerant crops
- Numerous styles/brands approved for use
- Commercially available

1. High output (200 – 500 L/ha)
2. Ultra Coarse droplet size (> 650 µm)

Methods & Materials

- 3 environments in 2020 and 2021
- 11 treatments, including non-treated control
- RCBD w/factorial arrangement
- 1 row plot, 4 replications per site

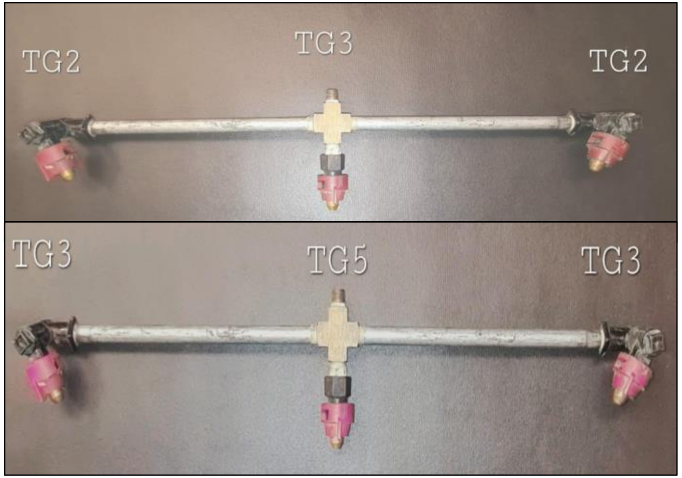
- Treatments applied after first harvest
- 2.5 kg MH ha^{-1}
- Operating pressure 172 – 207 kPa

- Plots harvested for yield, visual quality, and economic value
- After harvest, sucker number and green mass quantified from 10 plants
- % control determined relative to non-treated control
- 100 g lamina samples from cutter, leaf, and tip position

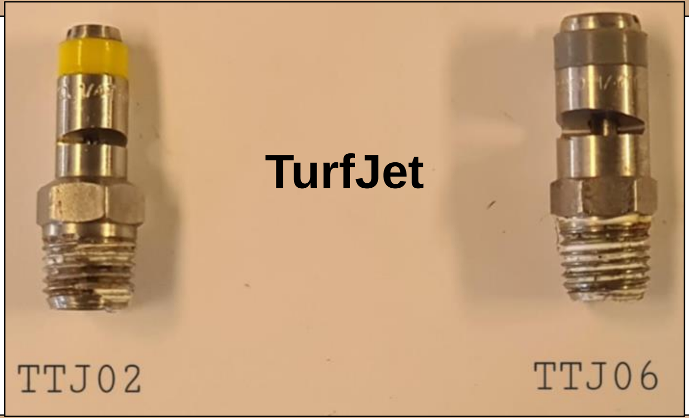
- Data analyzed using PROC Mixed in SAS 9.4.

Table 1. Study treatments including nozzle types selected, nozzle output and droplet size.

Nozzle type	Description and solution volume output	Angle	Droplet size
TG3-TG5-TG3	Grower Standard @ 467 L ha^{-1}	--	Coarse
TG2-TG3-TG2	Grower Standard @ 234 L ha^{-1}	--	Coarse
TG 8	Solid cone @ 467 L ha^{-1}	50°	Coarse
TG 6	Solid cone @ 234 L ha^{-1}	50°	Coarse
TDXL 11010-D	Air induction flat fan @ 467 L ha^{-1}	110°	Ultra Coarse
TDXL 11008-D	Air induction flat fan @ 234 L ha^{-1}	110°	Ultra Coarse
AITTJ-11015	Air induction turbo twinjet flat fan @ 467 L ha^{-1}	110°	Ultra Coarse
AITTJI-11008	Air induction turbo twinjet flat fan @ 234 L ha^{-1}	110°	Ultra Coarse
TTJ-1/4TTJ06	Turbo twinjet flat fan @ 467 L ha^{-1}	140 - 150°	Ultra Coarse
TTJ-1/4TTJ02	Turbo twinjet flat fan @ 234 L ha^{-1}	140 - 150°	Ultra Coarse
Topped, not Suckered	--	--	--



Standard 3-nozzle Arrangement



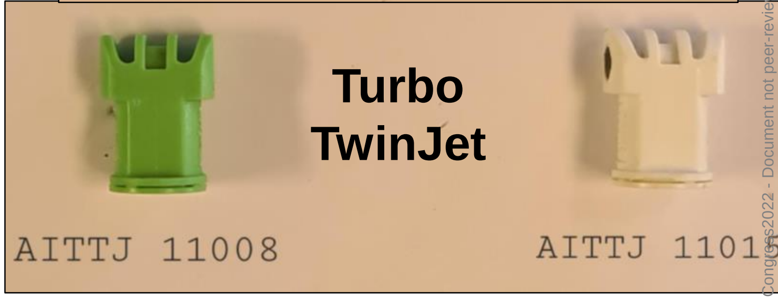


Table 2. Analysis of variance for the main effects of nozzle type (N) and solution volume (S) and the interaction of nozzle type × solution volume on tobacco sucker growth, cured leaf yield, visual quality, economic value per acre, and cured leaf maleic hydrazide (MH) residues in cutter, leaf, and tip stalk positions.

Parameter	Nozzle type (N)	Solution volume (S)	N × S
Sucker number per plant	0.640	0.626	0.773
Sucker mass per plant	0.121	0.476	0.150
Percent control	0.207	0.169	***0.039***
Yield	0.093	0.637	0.980
Quality	0.999	0.942	0.742
Value	0.596	0.326	0.452
MH Residue - cutter	0.121	***0.049***	0.263
MH Residue - leaf	0.064	***0.005***	0.330
MH Residue - tip	***0.034***	***0.014***	0.540

Table 3. Sucker number and mass per plant as influenced by the main effect of nozzle type and solution volume.[a] Data are pooled across three growing environments.

Main Effect	Sucker number	Sucker mass
Nozzle type	**number plant^{-1}**	**g plant^{-1}**
Solid cone (3-nozzles)	0.16 a	7.84 a
Solid cone (1-nozzle)	0.08 a	1.88 a
TurboDrop XL	0.15 a	4.69 a
Air Induction Turbo TwinJet	0.08 a	2.47 a
TurfJet	0.13 a	4.17 a
Solution volume (L ha^{-1})		
234	0.11 A	3.66 A
468	0.13 A	4.76 A

[a] Treatment means followed by the same lower or uppercase letter within the same column and main effect are not statistically different at the $\alpha = 0.05$ level.

Table 4. Cured leaf yield, visual quality, and economic value as influenced by the main effect of nozzle type and solution volume.[a] Data are pooled across three growing environments.

Main Effect	Yield	Quality[b]	Value
Nozzle type	**kg ha^{-1}**		**$US ha^{-1}**
Solid cone (3-nozzles)	3,620 a	85 a	14,238 a
Solid cone (1-nozzle)	3,634 a	85 a	14,270 a
TurboDrop XL	3,809 a	85 a	14,683 a
Air Induction Turbo TwinJet	3,623 a	85 a	14,280 a
TurfJet	3,731 a	85 a	14,615 a
Solution volume (L ha^{-1})			
234	3,696 A	85 A	14,530 A
468	3,671 A	85 A	14,305 A

[a] Treatment means followed by the same lower or uppercase letter within the same column and main effect are not statistically different at the $\alpha = 0.05$ level.
[b] Visual quality assessed on a scale of 1-100, with 100 being of the highest quality.

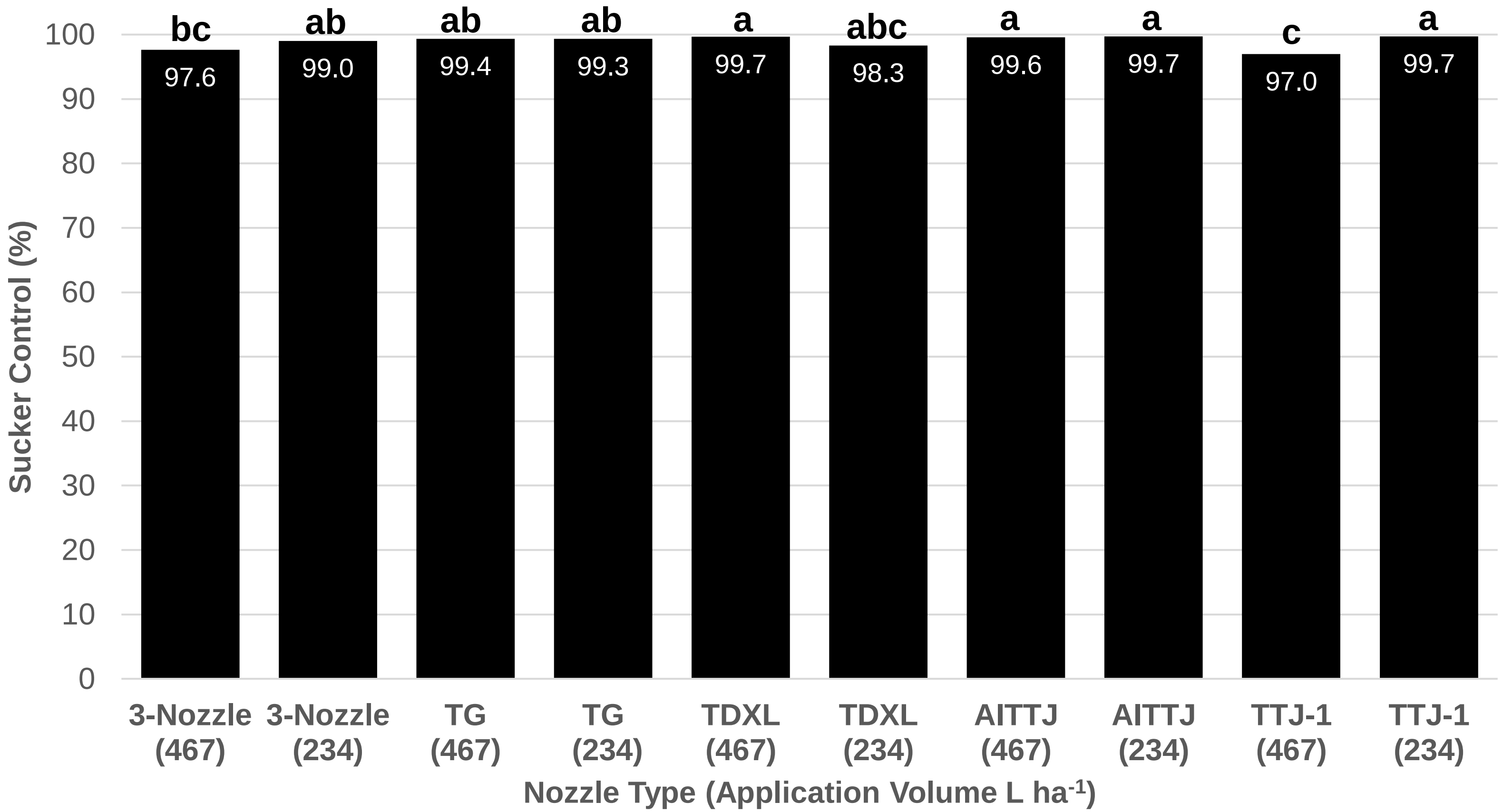


Figure 1. End of season sucker control as influenced by the interaction of nozzle type and solution volume. Data are pooled across three growing environments. Treatment means with the same letter are not significantly different at the α = 0.05 level.

Table 5. Maleic hydrazide residue response to the main effects of nozzle type and solution volume in Cutter, Leaf, and Tip stalk positions.[a]

Main Effect	Cutter	Leaf	Tip
Nozzle		mg kg^{-1}	
3-Nozzle	159 a	109 a	102 ab
TG	154 a	112 a	109 a
TDXL	162 a	101 a	102 ab
AITTJ	144 a	103 a	97 b
TTJ-1	154 a	95 a	96 b
Solution Volume			
234 L ha^{-1}	159 A	110 A	104 A
467 L ha^{-1}	150 B	98 B	97 B

[a] Treatment means followed by the same lower or uppercase letter within the same column and main effect are not significantly different at the $\alpha = 0.05$ level.

Conclusions

- Big Picture
  - Unlikely that new nozzles technologies will revolutionize MH application programs

- Small Picture
  - Large growers might consider using a small water volume in order to increase operating efficiency

Questions??

- Acknowledgements:
  - Japan Tobacco International
  - Robin Roussos
  - NC State Tobacco Agronomy Team
  - Border Belt and Oxford Tobacco Research Stations