THRIPS MANAGEMENT IN MID-SOUTH COTTON

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Abstract

Studies were conducted to evaluate the performance of commercial insecticide seed treatments against thrips infesting cotton seedlings. Thiamethoxam (Cruisier, Avicta Duo) and imidacloprid (Gaucho, Aeris) have been standards for thrips management for many years. In recent years the performance of thiamethoxam has declined substantially, particularly against tobacco thrips; the predominate thrips species infesting cotton in the Mid-South. In studies conducted during 2016, both Cruiser and Avicta Duo demonstrated less than satisfactory efficacy against thrips, which was similar to observations from previous years. Also in these studies Gaucho (imidacloprid) did not perform as well as Aeris (imidacloprid plus thiodicarb), which has become the standard insecticide seed treatment that includes a neonicotinoid component. Aldicarb (AgLogic) has been re-introduced in limited areas and was included in these studies also. Of the products tested, only AgLogic and Acephate applied as a seed treatment demonstrated performance similar to Aeris. However, all of the insecticides did result in higher yields than the control (fungicide only treatment). Studies were also conducted to evaluate potential alternatives to neonicotinoid seed treatments. These included Acephate and Verimark (cyantraniliprole) as a seed treatment and in-furrow spray, Sivanto as an in-furrow spray, and AgLogic. Aeris seed treatment was included in these studies as a standard comparison. In general, only Acephate applied as a seed treatment and AgLogic provided efficacy against thrips similar to the standard Aeris. With regard to yield, all of the insecticide treatments, except Sivanto and Verimark seed treatment, resulted in significantly higher yields than the control (fungicide only).

Introduction

There are several species of thrips that infest cotton seedlings. These include tobacco thrips, *Frankliniella fusca* (Hinds); western flower thrips, *Frankliniella occidentalis* (Pergande); flower thrips, *Frankliniella tritici* (Fitch); onion thrips, *Thrips tabaci* (Lindeman), and soybean thrips, *Neohydatothrips variabilis* (Beach). Tobacco thrips is typically the predominate species that infests cotton seedlings in the Mid-South (Stewart et al. 2013). Prior to the introduction of neonicotinoid seed treatments, thrips were managed with at-planting insecticides, with granular aldicarb (Temik 15G) being the standard. Following the removal of Temik from the market, growers have managed thrips almost exclusively with neonicotinoid seed treatments and supplemental foliar treatments. The two most widely used insecticide seed treatments for thrips management in cotton have been Gaucho (imidacloprid) and Cruiser (thiamethoxam), both are neonicotinoids. Recently less than satisfactory control of tobacco thrips has been observed with Cruiser (thiamethoxam) and elevated LC_{50} values (thiamethoxam and imidacloprid) have been reported for tobacco thrips collections from the Mississippi Delta (Darnell et al. 2016, Huseth et al. 2016). Also, there were reports of issues with imidacloprid during 2015. For the 2017 growing season, thiamethoxam will not be recommended for thrips control in Mississippi alone (Cruiser) or in combination with a nematicide seed treatment (Avicta Duo). An aldicarb product (AgLogic 15G) is currently available in certain regions of the Southeastern U.S., with plans for expanded availability in the future. During 2016 studies were conducted in Arkansas, Louisiana, Mississippi, and Tennessee to evaluate the performance of Cruiser and Gaucho seed treatments alone and in combination with their respective companion nematicide products (Aeris and Avicta), acephate seed treatment at several rates, and AgLogic 15G against thrips infesting cotton seedlings in the Mid-South. Studies were also conducted to evaluate potential alternatives to neonicotinoid seed treatments.

Materials and Methods

Studies were conducted during 2016 in Arkansas, Louisiana, Mississippi, and Tennessee to evaluate the performance of selected insecticide seed treatments against thrips in cotton. Treatments were arranged in a randomized complete block design with four replications. Phytogen 333 WRF cotton seed was used in all trials. Cotton seed were treated by Dr. Gus Lorenz. Seed treated with Cruiser or Avicta Duo received Dynasty CST (3.1 oz/cwt) fungicide, while seed for all other treatments received Trilex Advanced 300FS (1.6 oz/cwt) fungicide. Planting dates ranged from 5 May to 6 Jun.

Additional studies were conducted to evaluate at-planting insecticides as alternatives to neonicotinoid seed treatments for management of early season thrips infestations. These insecticides included acephate and cyantraniliprole (Verimark) evaluated as a seed treatment and an in-furrow spray, flupyradifurone (Sivanto) as an in-furrow spray, and aldicarb (AgLogic) as an in-furrow granule. Aeris seed treatment was included as a neonicotinoid comparison. Phytogen 333 WRF cotton seed was used in all trials. Cotton seed were treated by Dr. Gus Lorenz. Seed for all treatments received Trilex Advanced 300FS (1.6 oz/cwt) fungicide. Planting dates ranged from 4 May to 9 Jun.

In both studies thrips densities were determined by sampling 5 plants per plot at the 1, 2, 3, and 4 leaf stage using a modified whole plant washing procedure. Also, plant damage was also estimated at these timing using a 1 – 5 scale, with a rating of 1 = no damage and 5 = severe damage. Seed cotton yields were converted to lint yield based on 40% gin turnout. Data were subjected to ANOVA procedures, with means separated according to Fisher's Protected LSD.

Results

At the 1 leaf growth stage, all of the insecticide treatments, except Cruiser, Avicta Duo, and Gaucho reduced adult thrips densities compared to the fungicide only treatment (Table 1). All of the insecticide treatments, except Cruiser and Avicta Duo, significantly reduced densities of thrips immatures and total thrips compared to the fungicide only treatment. Also, all of the insecticide treatments, except Acephate (6.4 oz), Cruiser, and Avicta Duo, resulted in significantly lower damage ratings compared to the fungicide only treatment. AgLogic resulted in significantly lower damage ratings compared to all other treatments, except Aeris and Acephate (15 oz).

Only Acephate (all rates) and AgLogic reduced densities of thrips adults compared to the fungicide only treatment at the 2 leaf growth stage (Table 2). All of the insecticide treatments significantly reduced densities of thrips

immatures compared to the fungicide only treatment at the 2 leaf growth stage. Plots treated with Acephate (15 or 24 oz), Aeris, or AgLogic had significantly fewer thrips immatures compared to plots treated with Cruiser or Gaucho. All of the insecticide treatments significantly reduced the number of total thrips compared to the fungicide only treatment. Acephate (all rates), Aeris, and AgLogic resulted in significantly fewer total thrips compared to Cruiser or Gaucho. All of the insecticide treatments resulted in significantly lower damage ratings compared to the fungicide only treatment. Plots treated with Acephate (15.0 or 24.0 oz/cwt), Aeris, Gaucho, or AgLogic had significantly lower damage ratings compared to plots treated with Cruiser or Avicta Duo.

Only AgLogic reduced thrips adults compared to the fungicide only treatment at the 3 leaf growth stage (Table 3). All of the insecticide treatments, except Gaucho, significantly reduced densities of thrips immatures and total thrips compared to the fungicide only treatment. Acephate (15.0 or 24.0 oz/cwt) and AgLogic resulted in significantly lower densities of thrips immatures and total thrips compared to Cruiser, Avicta Duo, or Gaucho. All of the insecticide treatments resulted in significantly lower damage ratings compared to the fungicide only treatment. Cruiser resulted in significantly higher damage ratings compared to all other insecticide treatments, except Avicta Duo.

Plots treated with Acephate (24 oz), Cruiser, Aeris, or AgLogic had significantly fewer thrips adults compared to the fungicide only treatment at the 4 leaf growth stage (Table 4). All of the insecticide treatments, except Cruiser, significantly reduced densities of thrips immatures and total thrips compared to the fungicide only treatment. Only AgLogic resulted in significantly lower thrips immatures densities compared to Cruiser, Avicta Duo, or Gaucho. Acephate (15 or 24 oz), Aeris, and AgLogic resulted in fewer total thrips compared to Cruiser, Avicta Duo, or Gaucho. All of the insecticide treatments resulted in significantly lower damage ratings compared to the fungicide only treatment. Cruiser resulted in significantly higher damage ratings compared to all other insecticide treatments

All of the insecticide treatments resulted in significantly higher yields compared to the fungicide only treatment (Table 5). Yields ranged 1,171.8 to 1,353.3 lb lint / acre.

In studies evaluating alternatives to neonicotinoid seed treatments, there were no significant differences among treatments for numbers of thrips adults at the 1 leaf growth stage (Table 6). All of the insecticide treatments, except Sivanto, reduced densities of thrips immatures and total thrips compared to the fungicide only treatment (control) at the 1 leaf growth stage. Plots treated with Aeris or AgLogic (both rates) had significantly lower densities of immature thrips than plots treated with Verimark applied as a seed treatment or Sivanto. Also, plots treated with Aeris or AgLogic (both rates) had significantly lower densities of total thrips compared to plots treated with Sivanto or Verimark seed treatment. All of the insecticide seed treatments, except Sivanto, resulted in significantly lower thrips damage ratings compared to the fungicide only treatment.

At the 2 leaf growth stage, only Acephate (both application methods) and AgLogic (both rates) significantly reduced thrips adults compared to the fungicide only treatment (Table 7). All of the insecticide treatments, except Verimark seed treatment and Sivanto, resulted in significantly fewer immature thrips and total thrips compared to the fungicide only treatment. All of the insecticide treatments, except Acephate in-furrow, Verimark seed treatment, and Sivanto, resulted in significantly lower thrips damage ratings compared to the fungicide only treatment.

At the 3 leaf growth stage plots treated with Verimark in-furrow or Sivanto had significantly more thrips adults than the fungicide only treated plots (Table 8). Only Acephate seed treatment, Aeris, and AgLogic (both rates) resulted in significantly fewer immature thrips and total thrips compared to the fungicide only treatment. All of the insecticide treatments, except Sivanto, resulted in significantly lower thrips damage ratings compared to the fungicide only treatment. Plots treated with Acephate seed treatment, Aeris, or AgLogic (both rates) had significantly less thrips damage compared to plots treated with Acephate in-furrow, Verimark (both application methods), or Sivanto.

There were no significant differences among treatments for numbers of adult thrips, immature thrips, or total thrips at the 4 leaf growth stage (Table 9). Plots treated with Acephate seed treatment, Aeris, or AgLogic (both rates) had significantly lower thrips damage ratings compared to plots treated with Acephate in-furrow, Verimark seed treatment, or Sivanto.

Only AgLogic, Acephate seed treatment, and Aeris resulted in significantly higher yields compared to the fungicide only treatment (Table 10). Yields ranged 1,046.9 to 1,176.3 lb lint / acre.

Performance of thiamethoxam (Cruiser Avicta Duo) was similar to or less than that observed in previous studies (Cook et al. 2015, 2016). Prior to 2016, there was little difference in the efficacy of Gaucho (imidacloprid) compared to Aeris (imidacloprid plus thiodicarb) (Cook et al. 2015, 2016). However in the current studies, efficacy of Gaucho was lower than that of Aeris. The number of products available for thrips management in cotton is limited and alternatives to neonicotinoids are limited even more. Based on the current studies, acephate seed treatment (alone or in addition to a neonicotinoid) and AgLogic (depending upon availability) appear to be viable supplements or alternatives to neonicotinoid seed treatments. Verimark applied in-furrow performed similar to Acephate seed treatment, Aeris, and AgLogic, but is currently not labeled for use in cotton.

Table 1. Impact of selected seed treatments on densities of thrips adults, immatures, and total thrips and thrips damage at the 1 leaf growth stage.

		Thrips / 5 Plants			
Treatment	Rate	Adults	Immatures	Total	Damage Rating
Fungicide only	-	5.0a	7.2a	12.9a	1.7a
Acephate	6.4[1]	1.3d	0.8d	2.3d	1.3abc
Acephate	15.0[1]	1.3d	0.5d	2.0d	1.2cd
Acephate	24.0[1]	1.5d	0.9cd	2.9cd	1.3bc
Cruiser	0.375[2]	4.2abc	4.3abc	9.1ab	1.7a
Avicta Duo	0.525[3]	4.6ab	5.6ab	10.6ab	1.5ab
Gaucho	0.375[2]	3.8abc	2.4bcd	6.6bc	1.3bc
Aeris	0.75[4]	3.0bcd	0.4d	3.9cd	1.2cd
AgLogic 15G	0.75[5]	2.3cd	0.5d	3.3cd	0.9d
P>F		<0.01	<0.01	<0.01	<0.01

Means within a column followed by a common letter are not significantly different (FPLSD 0.05).
[1]oz product / cwt.
[2]mg AI / seed.
[3]mg AI / seed. Avicta Duo applied at the listed rate contains 0.375 mg AI thiamethoxam (Cruiser) and 0.15 mg AI abamectin.
[4]mg AI / seed. Aeris applied at the listed rate contains 0.375 mg AI imidacloprid (Gaucho) and 0.375 mg AI thiodicarb.
[5]lb AI / per acre, in-furrow granule.

Table 2. Impact of selected seed treatments on densities of thrips adults, immatures, and total thrips and thrips damage at the 2 leaf growth stage.

		Thrips / 5 Plants			
Treatment	Rate	Adults	Immatures	Total	Damage Rating
Fungicide only	-	8.0ab	40.0a	43.8a	2.6a
Acephate	6.4[1]	4.1cd	14.4bcd	18.2cd	1.8c
Acephate	15.0[1]	2.9d	10.4cde	12.8cde	1.5de
Acephate	24.0[1]	2.3d	8.6de	10.5de	1.5de
Cruiser	0.375[2]	9.7a	20.2b	27.4b	2.2b
Avicta Duo	0.525[3]	6.1bc	16.0bc	20.0bc	2.0bc
Gaucho	0.375[2]	7.8ab	21.2b	27.4b	1.5d
Aeris	0.75[4]	8.0ab	8.4de	15.8cde	1.3f
AgLogic 15G	0.75[5]	2.3d	6.6e	7.4e	1.3e
P>F		<0.01	<0.01	<0.01	<0.01

Means within a column followed by a common letter are not significantly different (FPLSD 0.05).
[1]oz product / cwt.
[2]mg AI / seed.
[3]mg AI / seed. Avicta Duo applied at the listed rate contains 0.375 mg AI thiamethoxam (Cruiser) and 0.15 mg AI abamectin.
[4]mg AI / seed. Aeris applied at the listed rate contains 0.375 mg AI imidacloprid (Gaucho) and 0.375 mg AI thiodicarb.
[5]lb AI / per acre, in-furrow granule.

Table 3. Impact of selected seed treatments on densities of thrips adults, immatures, and total thrips and thrips damage at the 3 leaf growth stage.

		Thrips / 5 Plants			
Treatment	Rate	Adults	Immatures	Total	Damage Rating
Fungicide only	-	7.1ab	33.3a	40.4a	2.7a
Acephate	6.4[1]	6.2ab	11.8cd	18.0cd	1.6de
Acephate	15.0[1]	5.1bc	5.2d	10.3de	1.4e
Acephate	24.0[1]	5.1bc	3.3d	8.4de	1.1f
Cruiser	0.375[2]	6.2ab	19.1bc	25.3bc	2.2b
Avicta Duo	0.525[3]	7.8a	19.2bc	27.0bc	2.0bc
Gaucho	0.375[2]	5.3bc	28.0ab	33.2ab	1.7cd
Aeris	0.75[4]	6.0ab	13.3cd	19.3cd	1.4ef
AgLogic 15G	0.75[5]	2.9c	2.5d	5.4e	1.5e
P>F		<0.01	<0.01	<0.01	<0.01

Means within a column followed by a common letter are not significantly different (FPLSD 0.05).
[1]oz product / cwt.
[2]mg AI / seed.
[3]mg AI / seed. Avicta Duo applied at the listed rate contains 0.375 mg AI thiamethoxam (Cruiser) and 0.15 mg AI abamectin.
[4]mg AI / seed. Aeris applied at the listed rate contains 0.375 mg AI imidacloprid (Gaucho) and 0.375 mg AI thiodicarb.
[5]lb AI / per acre, in-furrow granule.

Table 4. Impact of selected seed treatments on densities of thrips adults, immatures, and total thrips and thrips damage at the 4 leaf growth stage.

		Thrips / 5 Plants			
Treatment	Rate	Adults	Immatures	Total	Damage Rating
Fungicide only	-	9.4a	81.4a	90.8a	3.3a
Acephate	6.4[1]	7.5ab	35.9bc	43.4cd	2.1d
Acephate	15.0[1]	7.8ab	23.9cd	31.6de	1.9e
Acephate	24.0[1]	6.3bc	20.5cd	26.8de	1.7ef
Cruiser	0.375[2]	6.2bc	72.3a	78.5ab	2.9b
Avicta Duo	0.525[3]	8.1ab	50.5b	58.7bc	2.3cd
Gaucho	0.375[2]	7.8ab	49.7b	57.4bc	2.4c
Aeris	0.75[4]	6.8bc	25.5cd	32.3de	1.7ef
AgLogic 15G	0.75[5]	5.2c	13.3d	18.4e	1.6f
P>F		0.05	<0.01	<0.01	<0.01

Means within a column followed by a common letter are not significantly different (FPLSD 0.05).
[1]oz product / cwt.
[2]mg AI / seed.
[3]mg AI / seed. Avicta Duo applied at the listed rate contains 0.375 mg AI thiamethoxam (Cruiser) and 0.15 mg AI abamectin.
[4]mg AI / seed. Aeris applied at the listed rate contains 0.375 mg AI imidacloprid (Gaucho) and 0.375 mg AI thiodicarb.
[5]lb AI / per acre, in-furrow granule.

Table 5. Impact of selected seed treatments on cotton yield.

Treatment	Rate	lb Lint / Acre
Fungicide only	-	1,171.8b
Acephate	6.4[1]	1,331.2a
Acephate	15.0[1]	1,334.9a
Acephate	24.0[1]	1,339.7a
Cruiser	0.375[2]	1,272.2a
Avicta Duo	0.525[3]	1,353.3a
Gaucho	0.375[2]	1,316.0a
Aeris	0.75[4]	1,321.5a
AgLogic 15G	0.75[5]	1,336.0a
P>F		<0.01

Means within a column followed by a common letter are not significantly different (FPLSD 0.05).
[1]oz product / cwt.
[2]mg AI / seed.
[3]mg AI / seed. Avicta Duo applied at the listed rate contains 0.375 mg AI thiamethoxam (Cruiser) and 0.15 mg AI abamectin.
[4]mg AI / seed. Aeris applied at the listed rate contains 0.375 mg AI imidacloprid (Gaucho) and 0.375 mg AI thiodicarb.
[5]lb AI / per acre, in-furrow granule.

Table 6. Impact of selected at-planting treatments on densities of thrips adults, immatures, and total thrips and thrips damage at the 1 leaf growth stage.

		Thrips / 5 Plants			
Treatment	Rate	Adults	Immatures	Total	Damage Rating
Fungicide only	-	4.2	23.1a	27.3a	1.8a
Acephate ST	15.0[1]	2.5	11.7cd	14.1bc	1.3cd
Acephate IF	1.0[2]	3.4	9.7cd	13.3bc	1.3cd
Verimark ST	13.0[3]	3.9	14.5bc	18.3b	1.5bc
Verimark IF	13.0[4]	4.9	9.5cd	14.5bc	1.3cd
Sivanto IF	7.0[4]	5.4	21.4ab	27.0a	1.8ab
Aeris	0.75[5]	5.9	2.5e	8.3c	1.0d
AgLogic 15G	0.5[6]	2.8	6.8de	9.6c	1.3cd
AgLogic 15G	0.75[6]	2.8	6.4de	9.2c	1.2cd
P>F		0.09	<0.01	<0.01	<0.01

Means within a column followed by a common letter are not significantly different (FPLSD 0.05).
[1]oz product (wt) / cwt.
[2]lb product / acre, in-furrow spray.
[3]fluid oz product / cwt.
[4]fluid oz product / acre, in-furrow spray.
[5]mg AI / seed. Aeris applied at the listed rate contain 0.375 mg AI imidacloprid (Gaucho) and 0.375 mg AI thiodicarb.
[6]lb AI / per acre, in-furrow granule.

Table 7. Impact of selected at-planting treatments on densities of thrips adults, immatures, and total thrips and thrips damage at the 2 leaf growth stage.

		Thrips / 5 Plants			
Treatment	Rate	Adults	Immatures	Total	Damage Rating
Fungicide only	-	6.8a	23.8a	30.5a	2.2a
Acephate ST	15.0[1]	2.3c	3.0c	5.3cd	1.4c
Acephate IF	1.0[2]	3.6bc	9.1bc	12.6bc	2.0ab
Verimark ST	13.0[3]	5.6ab	20.9a	26.4ab	2.2a
Verimark IF	13.0[4]	6.6ab	8.3bc	15.0bc	1.9b
Sivanto IF	7.0[4]	7.5a	19.7ab	27.2ab	2.1ab
Aeris	0.75[5]	6.1ab	4.7c	10.8cd	1.4c
AgLogic 15G	0.5[6]	1.5c	2.6c	4.1cd	1.4c
AgLogic 15G	0.75[6]	1.2c	1.3c	2.5d	1.3c
P>F		<0.01	<0.01	<0.01	<0.01

Means within a column followed by a common letter are not significantly different (FPLSD 0.05).
[1]oz product (wt) / cwt.
[2]lb product / acre, in-furrow spray.
[3]fluid oz product / cwt.
[4]fluid oz product / acre, in-furrow spray.
[5]mg AI / seed. Aeris applied at the listed rate contain 0.375 mg AI imidacloprid (Gaucho) and 0.375 mg AI thiodicarb.
[6]lb AI / per acre, in-furrow granule.

Table 8. Impact of selected at-planting treatments on densities of thrips adults, immatures, and total thrips and thrips damage at the 3 leaf growth stage.

		Thrips / 5 Plants			
Treatment	Rate	Adults	Immatures	Total	Damage Rating
Fungicide only	-	4.0c	30.5b	34.5b	2.9a
Acephate ST	15.0[1]	4.0c	14.8cde	18.8cde	1.4d
Acephate IF	1.0[2]	4.2bc	25.4bc	29.5bc	1.9c
Verimark ST	13.0[3]	3.8c	24.6bc	28.4bc	2.5b
Verimark IF	13.0[4]	6.5ab	20.3bcd	26.8bcd	2.0c
Sivanto IF	7.0[4]	6.8a	44.9a	51.7a	2.8ab
Aeris	0.75[5]	3.8c	12.8de	16.7de	1.3d
AgLogic 15G	0.5[6]	2.9c	8.7e	11.6e	1.3d
AgLogic 15G	0.75[6]	2.1c	6.4e	8.5e	1.3d
P>F		<0.01	<0.01	<0.01	<0.01

Means within a column followed by a common letter are not significantly different (FPLSD 0.05).
[1]oz product (wt) / cwt.
[2]lb product / acre, in-furrow spray.
[3]fluid oz product / cwt.
[4]fluid oz product / acre, in-furrow spray.
[5]mg AI / seed. Aeris applied at the listed rate contain 0.375 mg AI imidacloprid (Gaucho) and 0.375 mg AI thiodicarb.
[6]lb AI / per acre, in-furrow granule.

Table 9. Impact of selected at-planting treatments on densities of thrips adults, immatures, and total thrips and thrips damage at the 4 leaf growth stage.

		Thrips / 5 Plants			
Treatment	Rate	Adults	Immatures	Total	Damage Rating
Fungicide only	-	3.8	13.3	17.1	3.2a
Acephate ST	15.0[1]	2.6	6.8	9.4	1.5de
Acephate IF	1.0[2]	3.4	11.2	14.6	1.9c
Verimark ST	13.0[3]	1.6	8.3	9.8	2.7b
Verimark IF	13.0[4]	2.2	11.2	13.9	1.8cd
Sivanto IF	7.0[4]	3.4	11.7	15.1	2.9ab
Aeris	0.75[5]	2.3	13.2	15.4	1.5de
AgLogic 15G	0.5[6]	1.2	6.4	7.6	1.4de
AgLogic 15G	0.75[6]	2.0	6.8	8.8	1.3e
P>F		0.08	0.33	0.21	<0.01

Means within a column followed by a common letter are not significantly different (FPLSD 0.05).
[1]oz product (wt) / cwt.
[2]lb product / acre, in-furrow spray.
[3]fluid oz product / cwt.
[4]fluid oz product / acre, in-furrow spray.
[5]mg AI / seed. Aeris applied at the listed rate contain 0.375 mg AI imidacloprid (Gaucho) and 0.375 mg AI thiodicarb.
[6]lb AI / per acre, in-furrow granule.

Table 10. Impact of selected at-planting treatments on cotton yield.

Treatment	Rate	lb Lint / Acre
Fungicide only	-	1,046.9cd
Acephate ST	15.0[1]	1,176.3a
Acephate IF	1.0[2]	1,119.6abc
Verimark ST	13.0[3]	1,059.2bcd
Verimark IF	13.0[4]	1,090.7a-d
Sivanto IF	7.0[4]	1,007.3d
Aeris	0.75[5]	1,139.5ab
AgLogic 15G	0.5[6]	1,157.0a
AgLogic 15G	0.75[6]	1,156.3a
P>F		<0.01

Means within a column followed by a common letter are not significantly different (FPLSD 0.05).
[1]oz product (wt) / cwt.
[2]lb product / acre, in-furrow spray.
[3]fluid oz product / cwt.
[4]fluid oz product / acre, in-furrow spray.
[5]mg AI / seed. Aeris applied at the listed rate contain 0.375 mg AI imidacloprid (Gaucho) and 0.375 mg AI thiodicarb.
[6]lb AI / per acre, in-furrow granule.

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