Tobacco Thrips and Peanut Response to Imidacloprid and Fluopyram

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Abstract

Tobacco thrips (*Frankliniella fusca* Hinds) can reduce peanut (*Arachis hypogaea* L.) yield if not controlled in many instances in North Carolina and Virginia. Systemic insecticides are often applied in the seed furrow at planting to suppress tobacco thrips and protect peanut yield. Foliar sprays of acephate are often made regardless of the insecticide applied at planting. Imidacloprid plus fluopyram is registered for use in peanut but information in the peer-reviewed literature is limited relative to effectiveness in suppressing tobacco thrips and whether or not a foliar application of acephate is needed when this product is used. Peanut injury caused by tobacco thrips was lower when phorate or imidacloprid were applied alone compared with imidacloprid plus fluopyram in 16 trials conducted in North Carolina and Virginia from 2014 through 2020. However, all insecticides applied at planting protected peanut from injury caused by tobacco thrips well enough to prevent yield loss compared with non-treated peanut. While acephate decreased visible injury caused by tobacco thrips, yield was not affected by acephate regardless

of the systemic insecticide applied at planting. Results from these trials indicate that that imidacloprid plus fluopyram offers adequate suppression of tobacco thrips to protect yield. Although acephate suppressed tobacco thrips, yield was not affected by acephate.

Introduction

Suppression of tobacco thrips, *Frankliniella fusca* Hinds, is important in North Carolina and Virginia to protect peanut (*Arachis hypogaea* L.) yield (Brandenburg et al., 2019; Herbert et al., 2007). Tobacco thrips can also vector *Tomato spotted wilt virus* (family *Tospoviridae*, genus *Orthotospovirus)* in peanut (Culbreath et al., 2003). Systemic insecticides are often applied in the seed furrow at planting to minimize injury caused by tobacco thrips (referred to as tobacco thrips injury) and incidence of tomato spotted wilt (Brandenburg et al., 2019; Culbreath et al., 2003; Herbert et al., 2007). When suppression is inadequate to prevent significant feeding injury, acephate is broadcasted within the first month after planting (Brandenburg et al., 2019). Nematodes can also be an economically important pest on coarse-textured coastal plain soils where peanut is grown (Jordan et al., 2017). Aldicarb suppresses both tobacco thrips and nematodes (Ahmed et al., 2017; Johnson et al., 1999), and is considered highly toxic to humans and the environment. Acephate, imidacloprid, and phorate are registered for thrips suppression only and do not control nematodes. A commercial product containing imidacloprid and the nematicide fluopyram has shown efficacy against both tobacco thrips and nematodes (Ahmed et al., 2017; Grabau et al., 2020). Peer-reviewed literature is limited on efficacy of this combination on tobacco thrips and nematode control in North Carolina and Virginia. In this Brief, we discuss results of research in these states comparing thrips injury and yield when imidacloprid plus fluopyram is applied in the seed furrow at planting compared with imidacloprid alone and phorate applied in this manner. We also determined the value, in terms of thrips injury and yield, of an acephate application broadcasted three weeks after planting.

Locations and Treatments

Experiments were conducted in North Carolina with 13 site-year combinations (referred to as trials) and Virginia (3 trials) from 2014 through 2020. The cultivar Bailey (Isleib et al., 2011) was planted at a rate of 5 seed/foot in conventionally-tilled, raised seedbeds (36-inch spacing) at a depth of 2 to 3 inches in row. Previous cropping sequences included at least 3 years of corn (*Zea mays* L.) or cotton (*Gossypium hirsutum* L.) planted prior to peanut. Production and pest management practices other than insecticides to control thrips were administered the same across all trials and were designed to optimize yield.

Treatments consisted of a factorial arrangement of four levels of in-furrow systemic insecticides applied at planting and two levels of acephate applied to peanut foliage 3 weeks after planting. Treatments applied in the seed furrow at planting included: 1) no insecticide, 2) imidacloprid (Admire Pro, Bayer CropScience, Research Triangle Park, NC) at 0.31 lbs ai/acre, 3) imidacloprid plus fluopyram (Velum Total, Bayer CropScience, Research Triangle Park, NC) applied 0.31 lbs/acre + 0.21 lbs ai/acre, respectively, and 4) phorate (Thimet 20G, AMVAC Chemical Corporation, Los Angeles, CA) applied at 0.50 lbs ai/acre. Treatment applied to peanut foliage included 1) no insecticide and 2) acephate (Orthene 97, Valent USA, Walnut Creek, CA) applied at 0.50 lbs ai/acre 3 weeks after planting. Imidacloprid and imidacloprid plus fluopyram were applied in 8 gal aqueous solution immediately after seed drop and before slit closure. Phorate was applied immediately prior to seed drop. A 15 gal aqueous solution using a compressed air backpack sprayer and a Spider Spray Trac high-clearance sprayer (LeeAgra, Inc., Lubbock, TX) were used to apply acephate in North Carolina and Virginia, respectively.

Data Collected

Visual estimates of thrips injury were recorded on an ordinal scale of 0 to 5 (0 = no damage, 1 = noticeable feeding but no stunting, 2 = noticeable feeding and 25% stunting, 3 = feeding with blackened terminals and 50% stunting, 4 = severe feeding and 75% stunting, and 5 = severe feeding and 90% stunting) 10 to 15 days after acephate was applied (approximately 31 to 36 days after planting. Tomato spotted wilt incidence was sporadic and did not exceed 5% for any experiment or treatment. The cultivar Bailey expresses resistance to tomato spotted wilt virus (Isleib et al., 2011), and yield response to insecticide treatments can likely be attributed to thrips control. Pods were dug and vines inverted based on pod mesocarp color (Williams and Drexler, 1981). Final pod yield was adjusted to 8% moisture.

Experimental Design and Statistical Analysis

The experimental design was a randomized complete block with 4 replications. Data for visual estimates of thrips injury and pod yield were subjected to ANOVA using the GLIMMIX Procedure in SAS 9.4 (SAS Institute Inc., Cary, NC) considering main effects of in-furrow insecticide, acephate application, and their interaction. Trials and replications within a trial were considered random effects. In-furrow insecticide treatments and acephate treatment were considered fixed effects. Means of significant main effects and interactions were separated using Fisher's LSD test at $\alpha = 0.05$.

Peanut Injury Caused by Tobacco Thrips

The main effect of in-furrow insecticide and acephate applied postemergence and their interaction were significant for thrips injury ($p \leq 0.0001$, Table 1). These respective main effects and interactions were significant for pod yield at $p = 0.0690$, $p = 0.2713$, and $p = 0.1116$ (Table 1). Thrips injury was higher when insecticide was not applied compared with insecticide applied to the seed furrow alone, acephate alone, or combinations of in-furrow insecticide and acephate (Table 2). When acephate was not applied, the order of decreasing thrips injury was imidacloprid plus fluopyram, imidacloprid, and phorate. When acephate was applied following in-furrow insecticides, injury was similar regardless of in-furrow insecticide treatment.

Influence of Insecticide Treatments on Peanut Yield

Fewer differences were noted for pod yield than tobacco thrips injury when comparing peanut response to in-furrow insecticides and acephate (Table 3). When pooled over acephate treatments, yield was similar when imidacloprid plus fluopyram, imidacloprid, or phorate was applied. Peanut yield was similar when acephate was applied (Table 2). Other research (Brandenburg et al., 2019) has shown similar control of tobacco thrips by imidacloprid and phorate and protection of peanut yield. In contrast to our results, Brandenburg et al. (2019) reported that acephate applied to peanut foliage often controls tobacco thrips adequately to prevent yield loss when insecticides are not applied at planting (Brandenburg et al., 2019). In contrast to our results, Brandenburg et al. (2019) reported that acephate increased yield above that of in-furrow insecticides alone. Anco et al. (2020) reported greater incidence of tomato potted wilt virus when imidacloprid was applied and negative impacts on peanut yield compared to phorate. In our study tomato spotted wilt incidence was low and sporadic and the cultivar used expresses resistance to this disease (Isleib et al., 2011).

Summary of Results

Results from this study indicate that while imidacloprid plus fluopyram is less effective in protecting peanut from thrips injury, protection was adequate to prevent yield loss. Also, while injury from tobacco thrips was reduced by acephate regardless of in-furrow insecticide, this reduction did not translate into yield increases. Collectively, these data suggest that imidacloprid plus fluopyram can be applied to achieve adequate tobacco thrips suppression to protect peanut yield. While not addressed in this research, imidacloprid plus fluopyram can suppress soil parasitic nematodes and protect yield; thus, nematode incidence is a factor when deciding if fluopyram may be beneficial. Although we did not sample nematode population, the rotations used in our trials (i.e., at least three years of corn or cotton without peanut) likely resulted in low and sporadic populations of soil parasitic nematodes. Similarly, tomato spotted wilt virus likely had a negligible impact on peanut yield in this study.

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Table 1. Analysis of variance visual injury caused by tobacco thrips and peanut pod yield as influenced by systemic insecticide applied in the seed furrow at planting and acephate applied postemergence 3 weeks after planting.[a]

	Visual injury caused by tobacco thrips		Peanut pod yield	
Source of variation	F ratio	P > F	F ratio	P > F
In-furrow insecticide	99.3	$\leq$0.0001	2.4	0.0690
Acephate postemergence	146.9	$\leq$0.0001	1.2	0.2713
In-furrow insecticide × Acephate postemergence	17.1	$\leq$0.0001	2.0	0.1116

[a]Data are pooled over 16 trials from 2014 through 2020.

Table 2. Visual injury caused by tobacco thrips as influenced by systemic insecticide applied in the seed furrow at planting and acephate applied postemergence 3 weeks after planting.[a]

In-furrow insecticide[b]	Acephate[c]	Visual injury caused by tobacco thrips[d]
		Scale 0 to 5
No	No	3.1 a
No	Yes	1.8 b
Imidacloprid plus fluopyram	No	1.8 b
Imidacloprid plus fluopyram	Yes	0.8 de
Imidacloprid	No	1.4 c
Imidacloprid	Yes	0.9 de
Phorate	No	1.1 d
Phorate	Yes	0.8 e

[a]Means followed by the same letter are not significantly different at $\alpha = 0.05$. Data are pooled over 16 trials from 2014 through 2020.

[b]Imidacloprid, fluopyram, and phorate applied at 0.31 lbs/acre, 0.21 lbs/acre, 0.50 lbs/acre, respectively.

[c]Acephate applied at 0.5 lbs/acre 3 weeks after planting.

[d]Visual estimates of thrips injury were recorded on an ordinal scale of 0 to 5 (0 = no damage, 1 = noticeable feeding but no stunting, 2 = noticeable feeding and 25% stunting, 3 = feeding with blackened terminals and 50% stunting, 4 = severe feeding and 75% stunting, and 5 = severe feeding and 90% stunting) 10 to 15 days after acephate was applied.

Table 3. Peanut pod yield as influenced by the main effect of systemic insecticide applied in the seed furrow at planting and the main effect of acephate applied to peanut foliage.

Insecticide treatment	Insecticide rate	Pod yield
	——— lbs/acre ———	
Systemic insecticide		
No insecticide	0	4,740 b
Imidacloprid plus fluopyram	0.31 plus 0.21	4,930 a
Imidacloprid	0.31	4,910 a
Phorate	0.5	4,850 a
Acephate applied to peanut foliage		
No acephate	0	4,830 a
Acephate	0.5	4,890 a

[a]Means followed by the same letter are not significantly different at $\alpha = 0.05$. Data are pooled over 16 trials from 2014 through 2020 and levels of the other treatment factor.