From 2013 to 2015, research was conducted to estimate the maximum expected residue levels for the insecticides cyantraniliprole and spinosad following application to flue-cured tobacco. Data were generated in order to assist industry in establishing Guidance Residue Limits for both compounds. The insecticides were applied to fields of tobacco at maximum rates in accordance with the labeled rates and the harvested/cured leaf was analyzed in a lab for chemical residues. The findings indicated that the expected residues on cured leaf would be low or not quantifiable under existing detection techniques.

**Additional key words:** crop protection agents, *Nicotiana tabacum* L., pesticide residue

### RESULTS AND DISCUSSION

Residues were below the limit of quantification (0.125 mg/kg) for cyantraniliprole in all environments. Alternatively, spinosad residues were detected and are reported by individual year and stalk position because of significant environment × treatment interaction. Where reported, primings 1 and 2 (Lug + Cutter) are combined and are represented in the “lower” stalk position, priming 3 (Leaf) is represented in the “middle” stalk position, and...
Table 1. Transplanting, pesticide application, and harvest dates at the LCPRS in 2013, 2014, and 2015.

| Event                  | LCPRS 2013 | LCPRS 2014 | LCPRS 2015 |
|------------------------|------------|------------|------------|
| Transplanting          | April 15   | April 29   | May 01     |
| Cyantraniliprole       | April 15   | April 29   | May 01     |
| Spinosad—first app. a  | May 15     | May 23     | May 26     |
| Spinosad—second app.   | May 25     | June 03    | June 05    |
| Spinosad—third app.    | June 04    | June 13    | June 16    |
| Spinosad—fourth app.   | June 13    | June 24    | June 26    |
| Spinosad—fifth app.    | June 28    | July 03    | July 07    |
| Spinosad—sixth app.    | July 03    | July 17    | July 20    |
| First harvest          | July 18    | July 21    | July 27    |
| Second harvest         | July 24    | July 31    | August 05  |
| Third harvest          | August 14  | August 27  | September 01 |
| Fourth harvest         | August 20  | August 27  | September 10 |

a app., application.

priming 4 (Tip) is represented in the “upper” stalk position (Table 2).

Cyantraniliprole. Cyantraniliprole was applied through 1 tray drench application at a rate of 0.02 L cyantraniliprole/tray or 0.99 L cyantraniliprole/ha, for a total of 197.51 g a.i./ha. Across all environments, cyantraniliprole residues were never greater than 0.125 mg/kg, which was the analytical limit of quantification, in any stalk position. The lack of quantifiable residues was not surprising given the single application of cyantraniliprole occurred prior to transplanting.

At present, CORESTA does not have an established Guidance Residue Limit (GRL) for cyantraniliprole (1). However, the U.S. Environmental Protection Agency (EPA), under the auspices of the Food, Drug and Cosmetic Act, has established cyantraniliprole tolerances for 39 agricultural commodities that include agronomic and horticultural products as well as livestock products and feed additives (4). This regulatory list includes food crops such as Vegetables–Leafy (nonbrassica, Group 4) and Brassica–Leafy Vegetables (Group 5B) (4), both of which are similar to tobacco in terms of plant morphology and harvested product. The Environmental Protection Agency has a defined tolerance of 20 and 30 mg/kg for Groups 4 and 5B, respectively (4). Although use patterns and application rates may vary to a small degree among these food crops and tobacco, the EPA determination of safety for cyantraniliprole states the following, “. . . there is a reasonable certainty that no harm will result to the general population or to infants and children from aggregate exposure to cyantraniliprole residues” (4). Therefore, when the residue results from this study are paired with the limits established by EPA, it seems as if there could be a wide range of acceptability to the tobacco industry.

It should be noted that foliar applications of cyantraniliprole were not evaluated in this study and it is likely that this application pattern could increase residues beyond those documented. Should the cyantraniliprole label for tobacco include foliar applications, further research will be warranted to quantify residues in treated leaves more accurately.

Spinosad. Spinosad was applied in 6 foliar applications at a rate of 224.66 g spinosad/ha/application (80.88 g a.i./ha/application), for a total of 1,345.66 g spinosad/ha (484.44 g a.i./ha). Residues greater than the limit of quantification were always detected in the lower stalk position but never in the middle or upper stalk positions (Table 2). Residues were greatest in 2014 most likely due to the shortest preharvest interval (PHI) documented in this study (4 days) (Table 1). Residues were numerically lower in 2013 and 2015 (Table 2) as the PHI was increased to 15 and 7 days, respectively (Table 1). The intent of the research program was to apply materials as often as possible and as close to first harvest as the label would allow. However, given the large number of applications (6 total) and required spray rotation (10 days between applications), the researchers were unable to sync the final spinosad application and first harvest consistently to obtain the minimum PHI presented by the chemical label (3 days). Despite this issue, the results gained from this study do offer the possibility that spinosad residues should be very low or undetectable when the label is followed precisely or when the PHI is increased beyond the 3 days required by the federal label.

As with cyantraniliprole, CORESTA does not currently have a GRL for spinosad (1). In December 2015, EPA revised the spinosad tolerance list for 15 commodities (5). Although there are few commodities on the list that reflect the morphology and cultivation of tobacco, tolerance limits for the compound typically range from 0.02 to 1.0 mg/kg (5). The EPA determination of safety for spinosad reads identical to that for cyantraniliprole, “there is a reasonable certainty that no harm will result to the general population, or to infants and children from aggregate exposure to spinosad residue” (5). Ultimately, it appears that the residues of spinosad in flue-cured tobacco should be low enough to avoid concern from industry, the U.S. Food and Drug Administration, or consumers.

CONCLUSION

In general, the residues of cyantraniliprole and spinosad were relatively low in comparison to other pesticides that are not evaluated in this study, but are currently labeled for use in tobacco production and have established CORESTA GRLs (1). It can also be referenced, specifically for spinosad, that use patterns of evaluated compounds were designed to maximize CPA.
applications and active-ingredient exposure to treated plants. As was previously mentioned, spinosad was applied 6 times in each environment evaluated in this study; however, applications made by commercial producers are often far less. Toennisson and Burrack (3) report that from 2013 to 2015, applications of spinosad-based insecticides on commercial farming operations ranged from a low of 0.8 applications per season in 2013 to highs of 1.1 applications per season in 2014 and 2015. The void between the goal of maximum exposure and practical application creates difficulty with predicting potential cured leaf residues expected from grower use patterns; however, it can be theorized that residues of both pesticides would be low or not quantifiable when used in accordance with their respective labels.

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