Volatility of GF-2726 as Compared with Other Auxin Herbicides

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Introduction

Auxin mimicking herbicides have been used for over 40 years in monocotyledonous crops for broadleaf weed control. However, volatilization and vapor drift are issues for the auxin herbicides 2,4-D and dicamba. Volatilization is considered the physical change of a liquid or a solid to a gas. The volatility of a herbicide is important when herbicide vapor causes economic losses to sensitive crops. Cotton and soybeans are some of the most sensitive agronomic crops to auxin herbicides and can cause extensive economic losses.

With the creation of auxin herbicide tolerant crops, the need for decreased volatility is essential to prevent injury to non tolerant crops. The main factor affecting herbicide volatility is the vapor pressure of the active ingredient. The vapor pressures of the three most widely used auxin herbicides for POST weed control are:

- 2,4-D Ethylhexylester 47.9 mPa
- 2,4-D acid 1.86 x 10^{-2} mPa
- dicamba acid 1.67 mPa

Herbicide vapor pressures above 1.33 x 10^{-5} Pa are more liable to exhibit volatility losses (Applied Weed Science 2nd ed., 1999). No noticeable volatility can be expected from compounds with a vapor pressure below 0.1 mPa (Guth et al., 2004). Of the 2,4-D formulations, the salt formulations, such as the amine salt, are considered nonvolatile compared to the ester formulations.

Previous research has reported that cotton grown in field conditions developed herbicide symptomology consistent with 4 x 10^{-3} and 2.0 x 10^{-3} the normal use rates of 2,4-D (0.53 kg/ha) and dicamba (0.56 kg/ha), due to volatilization, respectively (Sciumbato et al., 2004). While soybean exhibited symptomology with 1.6 x 10^{-1} and 1.0 x 10^{-2} the normal use rate of 2,4-D and dicamba, respectively (Sciumbato et al., 2004). In 2011, Dow AgroSciences developed a new quaternary ammonium salt formulation of 2,4-D. GF-2726 is a combination of this new salt with glyphosate and it may provide researchers and producers with a new lower volatile formulation of 2,4-D.

Hypothesis

The GF-2726 herbicide treatment will have decreased volatility and crop injury to sensitive crops compared to other common auxin like herbicides.

Objectives

Evaluate the volatility and movement of herbicide vapor of GF-2726 compared with 2,4-D amine salt, 2,4-D ester and dicamba diglycolamine salt (DGA) using cotton and soybean plants as a bioindicator

Materials and Methods

- Experiment was conducted at the Black Belt Branch Experiment Station in Brooksville, MS
- Plot size
  - 55 x 6.3 ft plot
  - 15 x 5 ft dome was placed over a row each of cotton and soybeans, in the center 15 ft of the plot
- Herbicide treatments
  - 2,4-D ester + Durango® DMA® (glyphosate) – 1.9 lb ae/a + 2 lb ae/a
  - 2,4-D amine + Durango® DMA® – 2.0 lb ae/a + 2 lb ae/a
  - G-2726 – 3.9 lb ae/a
  - Dicamba DGA + Durango® DMA® – 1lb ae/a + 2 lb ae/a
  - Untreated
- Each treatment was applied to 4 flats (2 x 1 ft) of soil wetted to field capacity
- Treated flats were placed between a row of cotton and soybeans in the center of the dome, and plastic sheeting was placed over the dome frame
- Treated flats and plastic sheeting were removed 24 hours after application
- Visual injury (%) was recorded for cotton and soybean on a per foot basis in both directions from the treated area

Figure 1. Example of dome frame orientation.

Figure 2. Example of treated flat filled with soil placed in center of dome.

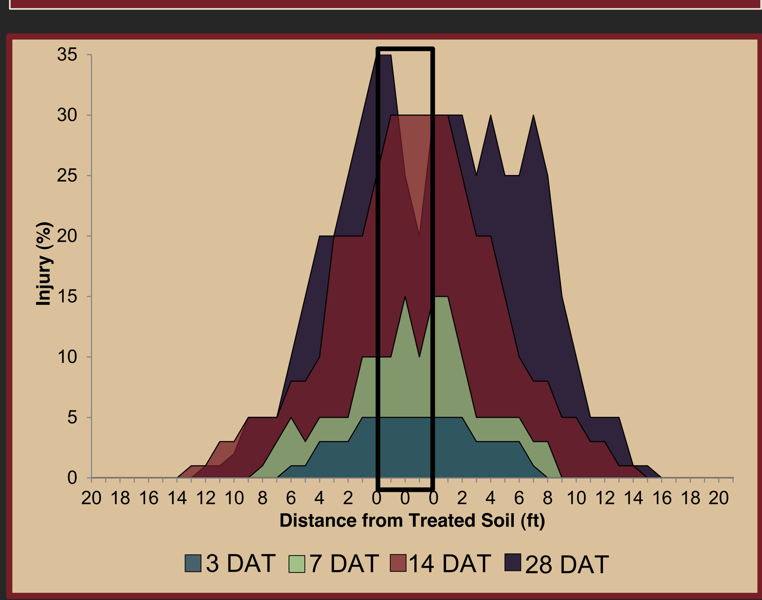

Figure 3. Cotton response to 2,4-D ester volatilization

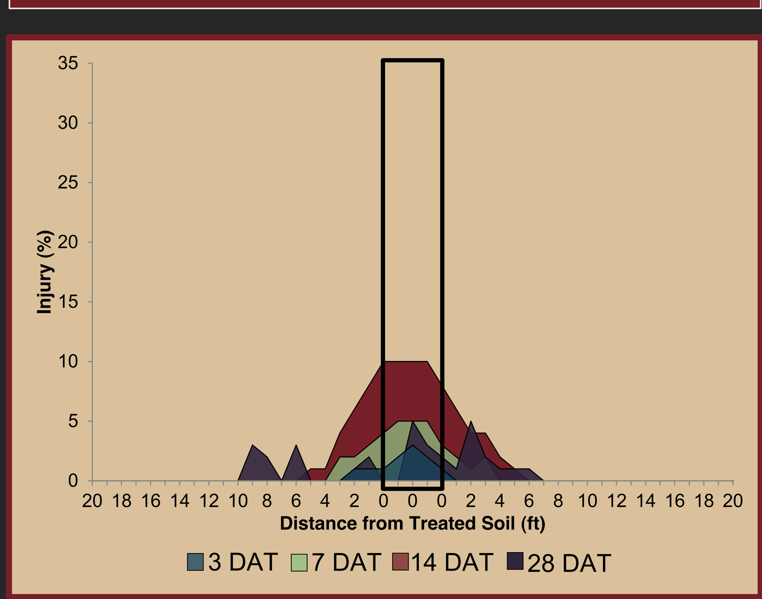

Figure 4. Soybean response to 2,4-D ester volatilization

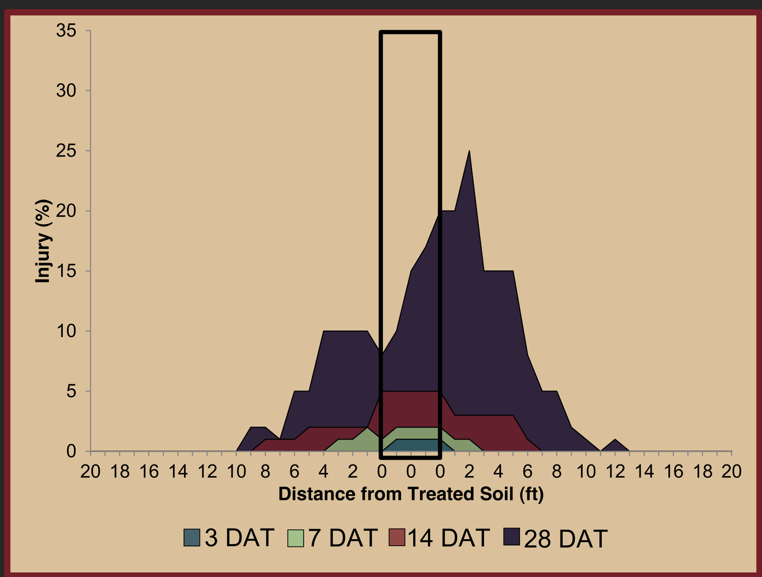

Figure 5. Cotton response to 2,4-D amine salt volatilization

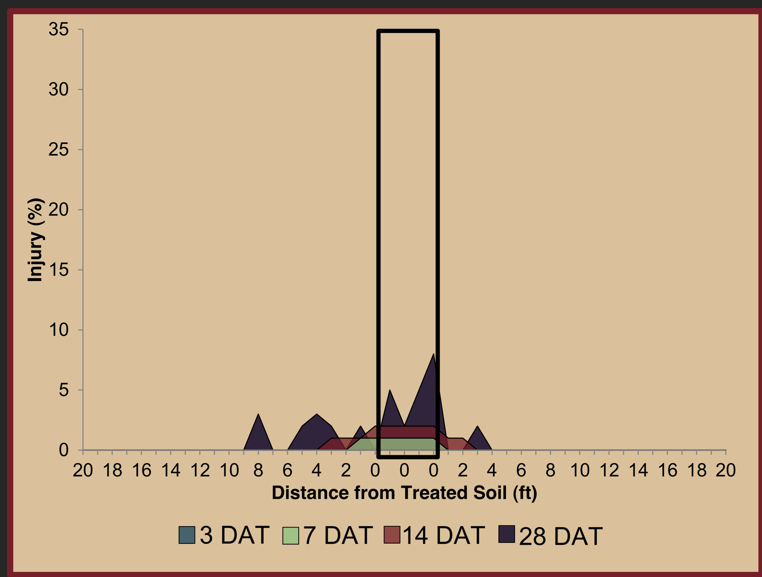

Figure 6. Soybean response to 2,4-D amine salt volatilization

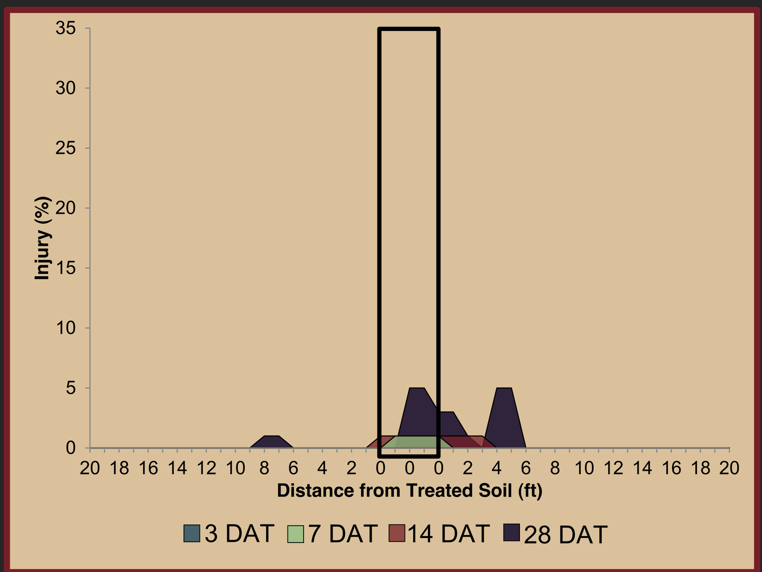

Figure 7. Cotton response to GF-2726 volatilization

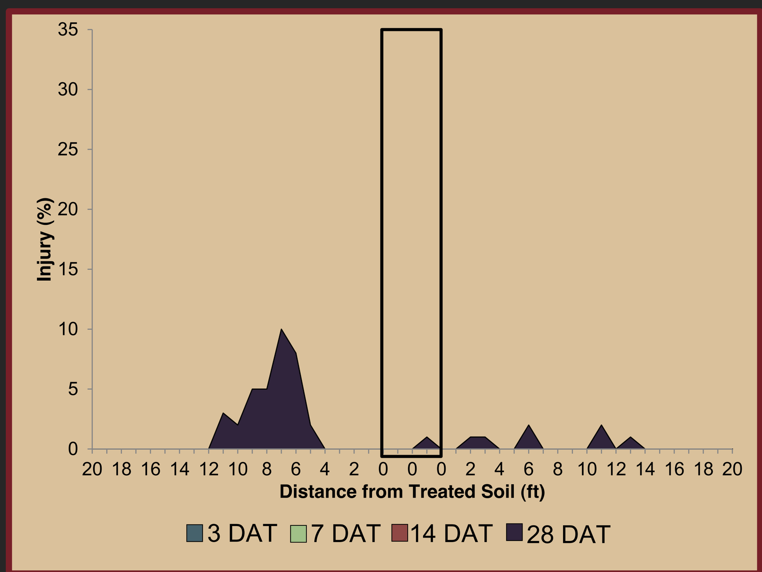

Figure 8. Soybean response to GF-2726 volatilization

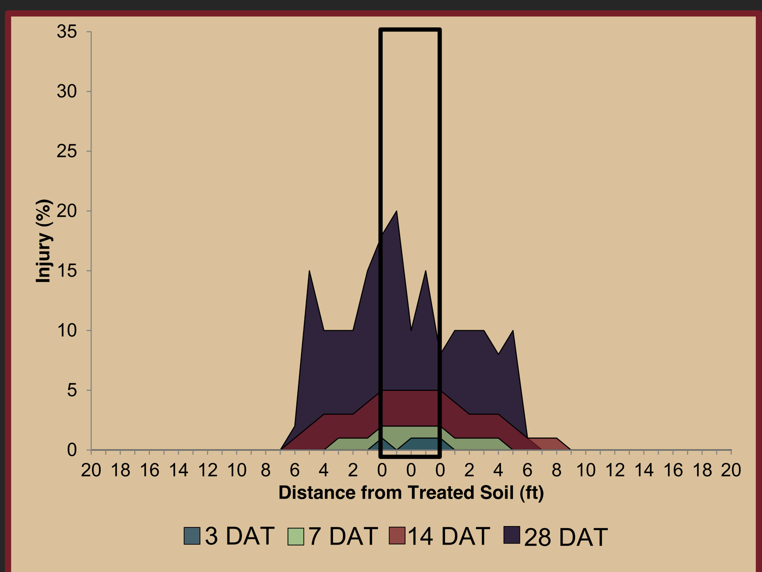

Figure 9. Cotton response to dicamba DGA volatilization

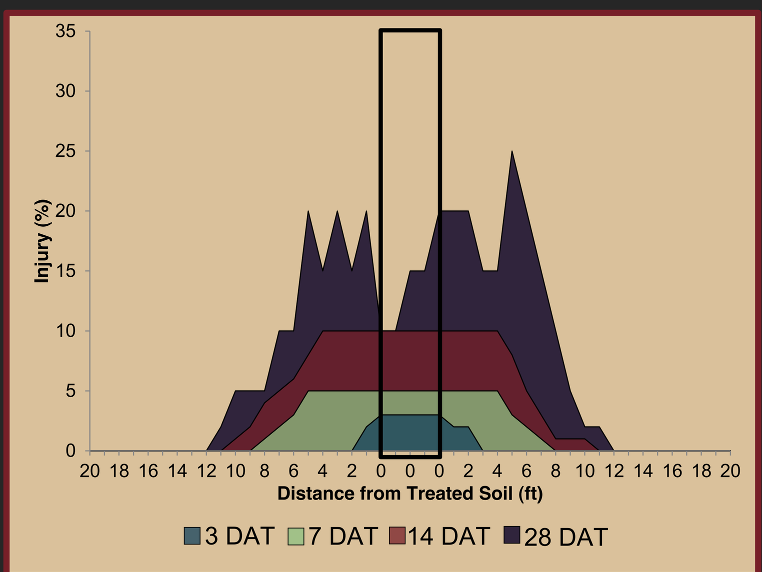

Figure 10. Soybean response to dicamba DGA volatilization

Results and Discussion

All treatments had injury in the treated soil area and vapor drift injury outside the dome treated area; however, GF-2726 had less injury than all other treatments. When comparing the formulations of 2,4-D, GF-2726 had less injury on soybeans and cotton than the amine salt and the ester formulations. Within the dome area, GF-2726 had less injury than the other treatments, with respect to cotton and soybean.

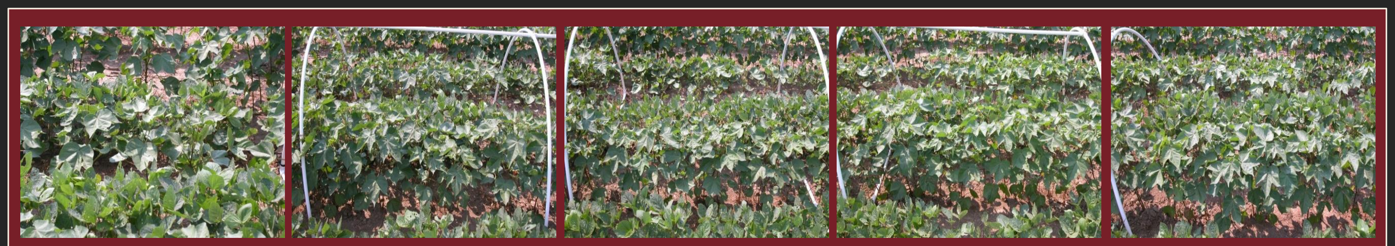

Figure 11. 2,4-D ester injury 3 DAT. Pictures from left to right: south of dome, south of treated area inside dome, treated area inside dome, north of treated area inside dome, north of dome.

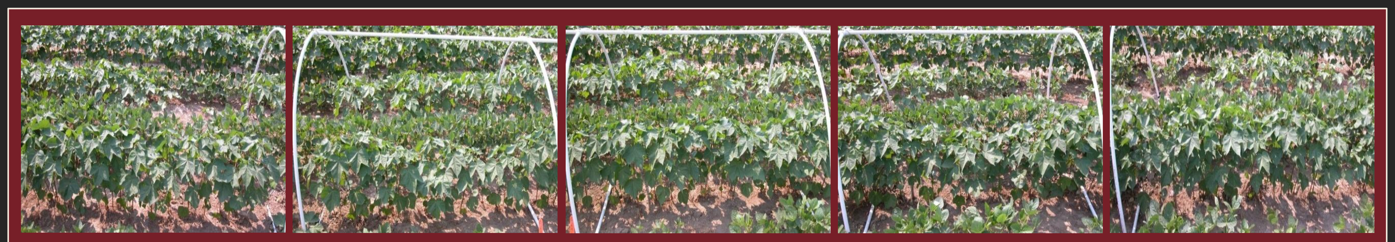

Figure 12. 2,4-D amine salt injury 3 DAT.

Figure 13. G-2726 injury 3 DAT.

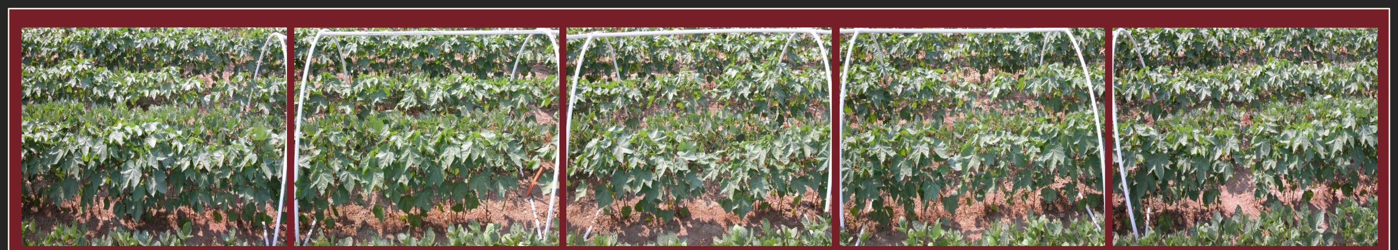

Figure 14. Dicamba DGA injury 3 DAT.

Figure 15. Untreated 3 DAT.

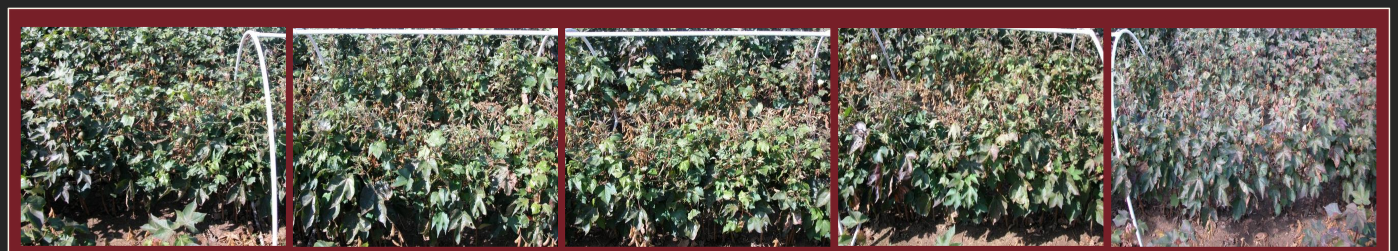

Figure 16. 2,4-D ester injury 48 DAT.

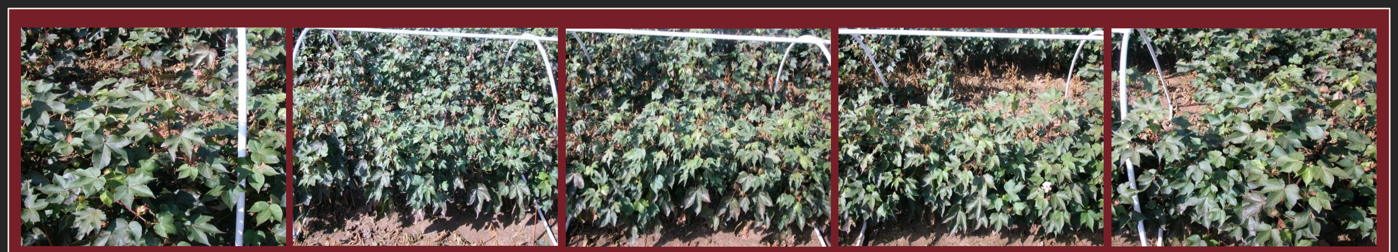

Figure 17. 2,4-D amine salt injury 48 DAT.

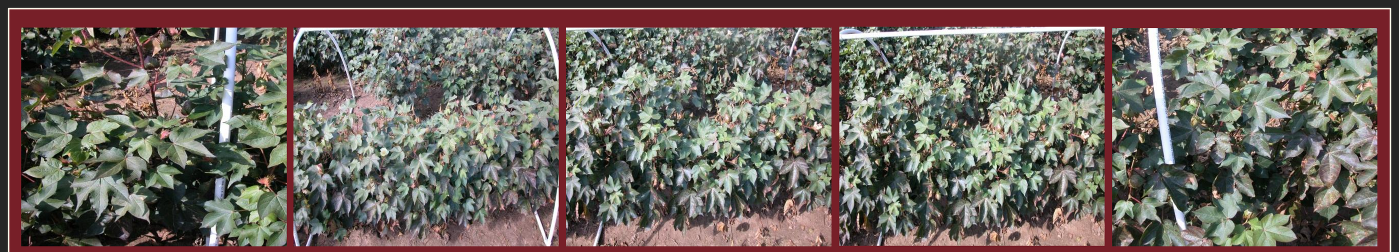

Figure 18. G-2726 injury 48 DAT.

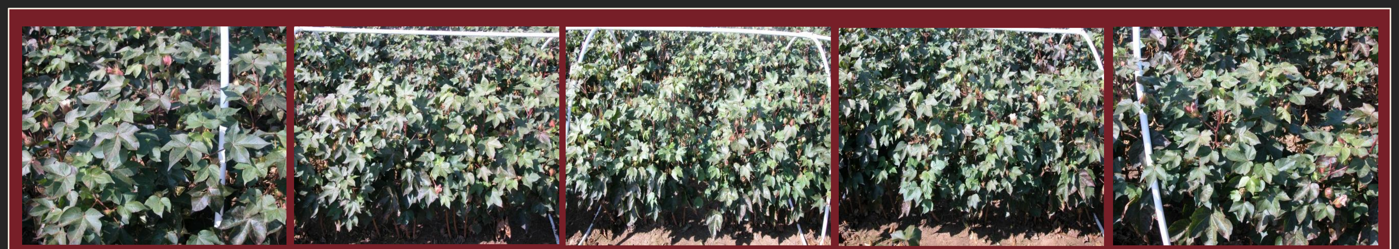

Figure 19. Dicamba DGA injury 48 DAT.

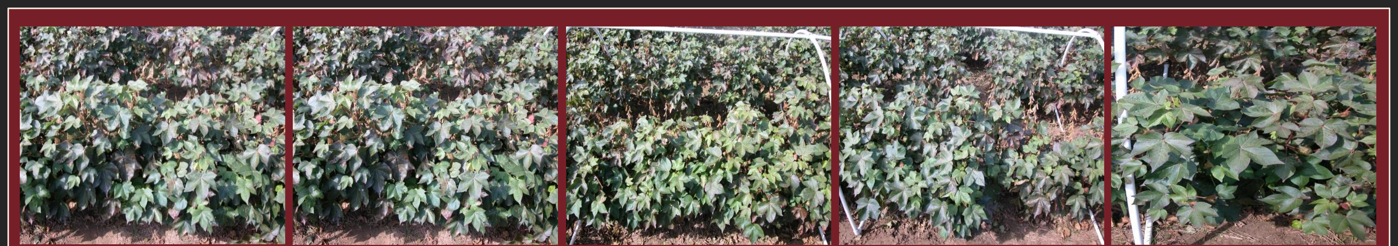

Figure 20. Untreated 48 DAT.

Conclusions

GF-2726 exhibited less volatility when compared to the other auxin herbicides 2,4-D ester, 2,4-D amine salt, and dicamba DGA.

Literature Cited

Guth, J.A., F.J. Reischmann, R. Allen, D. Arnold, J. Hassink, C.R. Leake, M.W. Skidmore, G.K. Reeves. 2004. Volatilisation of crop protection chemicals from crop and soil surfaces under controlled conditions – Prediction of volatile losses from physico-chemical properties. Chemosphere. 57:871-887.

Sciumbato, A. S., J.M. Chandler, S.A. Senseman, R.W. Bovey, and K.L. Smith. 2004. Determining exposure to auxin-like herbicides. II. Practical applications to quantify volatility. Weed Technol. 18:1135-1142.

Ross. M. A. and C. A. Lembi. Applied Weed Science, 2nd ed. 1999. Upper Saddle River, NJ: Prenctice Hall. p. 452.