# Growth Regulator Herbicide Damage on Tobacco (*Nicotiana tabacuum*)

*Introduction*

Non-crop vegetation managers rely on herbicides as one component of an effective integrated vegetation management program. Auxin-type, or growth regulator, herbicides are a mode of action based family of herbicides commonly used in non-crop vegetation management. This family of herbicides includes 2,4-D, aminopyralid, dicamba, and triclopyr and many others. When used in the correct and labeled manner, these products are an extremely safe and effective option for vegetation management. These products, effective on target weeds, are also effective in damaging desirable plants and crops. Minimal concentrations of active ingredient, like those present in a drift or off-target situation, can result in enough crop damage to render a crop unmarketable.

In the rights-of-way vegetation management industry, off-target crop damage, although infrequent when vegetation management products are used correctly, can occur through either physical drift or off target applications. Some products can even cause crop damage even if physical movement of the product occurs to a site before the crop is planted. Certain crops, such as tobacco, tomatoes, and grapes are especially sensitive to even the smallest concentrations of active ingredient of these products.

There is a lot of concern and misconceptions of about herbicide drift and subsequent crop injury. Some active ingredients, such as picloram, have the reputation of always causing severe crop damage, if not plant death. Others, such as 2,4-D, are considered much safer and will cause little damage to many species. The reality of the situation is somewhere between the above generalizations. Aminopyralid and aminocyclopyrachlor (KJM44 duPont) are new herbicides that are either on the market or soon will be. We have less experience with these products related to drift onto growing crops and onto fields before planting of crops. With these issues in mind, a trial was installed at the University of Kentucky College Agriculture Research Station in Lexington, KY (Spindletop Farm) to evaluate the potential of four growth regulator herbicides commonly used in non-crop vegetation management to cause damage to tobacco in a pre-plant situation.

*Methods and Materials*

Four herbicides, 2,4-D (Formula 40), aminopyralid (Milestone VM), dicamba (Banvel), and triclopyr amine (Garlon 3A), were screened at 2 rates and applied at 2 times before tobacco transplanting (Tables 1 and 2). The high rate was based on the rate normally used under Kentucky conditions. The lower rates were 1/10th of this normal rate and were selected in an attempt to mimic an off-target drift situation. The study site was a field that was prepared using standard tobacco production techniques. This included moldboard plowing, soil finishing, and a broadcast application of Spartan and Command 3 weeks preplant (WPP) at 8 fl oz / ac and 2 pts / ac, respectively. The field was also fertilized 3 WPP with 600 # / ac of 34-0-0 and 100 # / ac of 0-0-60. All of these standard preparation treatments were done to mimic a traditional tobacco planting.

Herbicide treatments were applied at one of two timings, 3 WPP, hereby referred to as the early treatments, and 4 days preplant (DPP), hereby referred to as the late treatments (5/13/2008 and 5/29/2008, respectively). Plots were 10' X 30' and herbicides applied at 20 GPA using a $CO_2$ powered sprayer mounted on an ATV. Four herbicides at 2 rates each at 2 timings plus 1 untreated check, for a total of 17 treatments, were installed in a randomized complete block design with 3 replications. Tobacco was set in the plots using a 2 row transplanter on June 2, 2008. The burley tobacco variety KT204 was used in this trial.

Data were collected 16, 37, 58, and 92 days after planting (DAP). Data collected included a vigor rating at every evaluation and an injury rating at every evaluation. Vigor ratings were taken on a 1 to 10 scale with 1 being extremely low vigor and 10 being a healthy and vigorous plant. Injury ratings were taken on a 1 to 10 scale with 1 being no damage and 10 being dead or extremely severe damage. Data were analyzed in ARM® software and treatment means were separated using Fisher's LSD at p = 0.05.

## *Results*

### Vigor

The untreated plots showed a decrease in vigor (i.e. < 10) at every evaluation (Table 1). This may indicate that, even though no herbicide solution was applied directly to the untreated plots, the close proximity and general topography of the treated plots influenced the growth of the untreated tobacco. All simulated drift treatments (1/10$^{th}$ normal rate) decreased vigor of the tobacco plants, some treatments being more severe than others. The Milestone at 0.7 fl oz / ac severely decreased vigor, regardless of timing. Full rates of 2,4-D, Banvel, Milestone, and Garlon 3A affected vigor of the tobacco plants with the late treatments having a higher degree of influence.

*Table 1: Treatments and plant vigor response (0 = complete loss of vigor, 10 = no apparent effect)*

| Treatment | Rate per acre | Vigor | | | |
|---|---|---|---|---|---|
| | | 16 DAP | 37 DAP | 58 DAP | 92 DAP |
| 2,4-D early | 2 qt | 6.3 ab | 6.0 ab | 7.3 a | 7.0 a |
| 2,4-D Late | 2 qt | 3.3 c-f | 4.7 a-d | 6.3 abc | 5.7 abc |
| 2,4-D early | 0.2 qt | 6.3 ab | 7.0 ab | 7.0 ab | 7.3 a |
| 2,4-D late | 0.2 qt | 5.7 abc | 5.3 abc | 6.0 a-d | 6.0 ab |
| Banvel early | 1 qt | 3.7 b-f | 6.0 ab | 6.0 a-d | 5.7 abc |
| Banvel late | 1 qt | 1.7 def | 2.3 de | 3.0 de | 3.7 bcd |
| Banvel early | 0.1 qt | 5.0 bc | 6.3 ab | 5.3 a-d | 6.3 a |
| Banvel late | 0.1 qt | 5.3 bc | 4.7 a-d | 5.3 a-d | 5.3 a-d |
| Milestone early | 7 fl oz | 1.3 ef | 1.3 e | 3.7 cd | 0.7 e |
| Milestone late | 7 fl oz | 1.0 f | 1.0 e | 0.0 e | 0.7 e |
| Milestone early | 0.7 fl oz | 4.0 b-e | 3.0 cde | 4.0 bcd | 3.3 cd |
| Milestone late | 0.7 fl oz | 3.7 b-f | 2.7 cde | 3.0 de | 3.0 de |
| Garlon 3A early | 2 qt | 4.0 b-e | 6.0 ab | 5.0 a-d | 6.3 a |
| Garlon 3A late | 2 qt | 1.3 ef | 4.3 bcd | 5.0 a-d | 5.3 a-d |
| Garlon 3A early | 0.2 qt | 4.7 bc | 6.0 ab | 6.0 a-d | 7.0 a |
| Garlon 3A late | 0.2 qt | 4.3 bcd | 6.3 ab | 5.3 a-d | 6.7 a |
| Untreated | | 8.3 a | 7.3 a | 7.0 ab | 6.7 a |

*Note: Treatment means followed by the same letter are not statistically different using Fishers LSD at p = 0.05. All treatments included a non-ionic surfactant at 0.2% v/v.*

Damage

As with plant vigor discussed earlier, untreated plots appeared to be damaged by their proximity to the treated plots (Table 2). The untreated check resulted in damage similar 2,4-D and Garlon 3A at the low rate tested at the early application 92 DAP. The Milestone treatments, whether early or late treatments and either rate tested, severely damaged tobacco at every evaluation. All treatments tested affected quality of the tobacco grown.

*Table 2: Tobacco damage and percent flowering plants (Damage: 0 = no damage, 10 = dead plant)*

| Treatment | Rate per acre | Vigor | | | |
|---|---|---|---|---|---|
| | | 16 DAP | 37 DAP | 58 DAP | 92 DAP |
| 2,4-D early | 2 qt | 4.0 def | 4.3 d | 3.7 cde | 4.0 def |
| 2,4-D Late | 2 qt | 4.7 c-f | 5.0 cd | 3.0 e | 5.7 b-e |
| 2,4-D early | 0.2 qt | 2.3 f | 2.7 d | 3.0 e | 4.3 c-f |
| 2,4-D late | 0.2 qt | 3.7 def | 5.0 cd | 3.7 cde | 5.7 b-e |
| Banvel early | 1 qt | 5.3 b-e | 5.0 cd | 4.3 b-e | 5.7 b-e |
| Banvel late | 1 qt | 7.3 ab | 8.3 ab | 7.0 ab | 6.3 bc |
| Banvel early | 0.1 qt | 3.3 def | 4.0 d | 3.7 cde | 5.0 c-f |
| Banvel late | 0.1 qt | 4.0 def | 5.7 bcd | 4.7 b-e | 6.0 bcd |
| Milestone early | 7 fl oz | 8.0 a | 9.0 a | 6.7 bc | 9.3 a |
| Milestone late | 7 fl oz | 8.0 a | 9.0 a | 10.0 a | 9.3 a |
| Milestone early | 0.7 fl oz | 5.7 a-d | 7.7 abc | 6.3 bcd | 7.3 ab |
| Milestone late | 0.7 fl oz | 7.0 abc | 8.3 ab | 7.0 ab | 7.7 ab |
| Garlon 3A early | 2 qt | 4.7 c-f | 3.3 d | 4.0 b-e | 4.7 c-f |
| Garlon 3A late | 2 qt | 8.0 a | 4.7 cd | 5.0 b-e | 5.7 b-e |
| Garlon 3A early | 0.2 qt | 3.7 def | 3.0 d | 3.3 de | 3.3 f |
| Garlon 3A late | 0.2 qt | 4.0 def | 3.7 d | 3.7 cde | 4.0 def |
| Untreated | | 3.0 e-f | 3.0 d | 2.7 e | 3.7 ef |

*Note: Treatment means followed by the same letter are not statistically different using Fishers LSD at p = 0.05. All treatments included a non-ionic surfactant at 0.2% v/v.*

*Summary*

There is no "safe" herbicide when discussing physical drift of the tested herbicides to soil before tobacco transplanting. No attempt was made in this trial to quantify the effect that the treatments would have on the marketability of the tobacco. The ratings used above, especially damage, show that all treatments would have decreased the marketability, if not rendered the final tobacco product unmarketable.

Products used in non-crop and invasive vegetation management are extremely safe to non-target plants when applied correctly. The data presented above is intended to show that when errors in application occur in proximity to unplanted tobacco fields that the potential for damage to the crop is great. Great care and vigilance should be employed when using any type of herbicide in areas where sensitive crops, such as tobacco, are known to exist.