Influence of nozzle spacing, boom height and nozzle type on the efficacy of glufosinate, dicamba, glyphosate and saflufenacil

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Introduction

One of the largest challenges in agriculture is weed management. Good weed control is highly correlated with the product and the application method. Application technology is a science that is focused on improving herbicide efficiency and weed management. It's important to understand the factors of an application in order to maximize the efficacy and reduce off target movement.

Objective

To determine which combinations of nozzle spacing, boom height, and nozzle type are most efficacious with glufosinate, dicamba, glyphosate, and saflufenacil when applied on common lambsquarters (*Chenopodium album L.*), velvetleaf (*Abutilon theophrasti Medik.*), grain sorghum (*Sorghum bicolor L.*), and Palmer amaranth (*Amaranthus palmeri S.*).

Materials & Methods

- Plants were treated at 10 – 15 cm in height
  - Common lambsquarters (*Chenopodium album L.*)
  - Velvetleaf (*Abutilon theophrasti Medik.*)
  - Grain sorghum (*Sorghum bicolor L.*)
  - Palmer amaranth (*Amaranthus palmeri S.*)
- Conducted using a 1.67 x 4.2 m single track three nozzle boom spray chamber (Figure 1)
- Applications were made using four nozzle types (Figure 2):
  - Air Induction XR flat fan spray tips (AIXR11004)
  - Turbo TeeJet wide angle flat fan spray tips (TT11004)
  - Turbo TeeJet Induction flat fan spray tips (TTI11004)
  - Extended Range flat spray tips (XR11004)
- Three different boom heights from the target:
  - 31, 46, and 61 cm
- Three nozzle spacing:
  - 38, 50, and 76 cm
- The four herbicides applied at 276 kPa using a carrier rate of 94 l ha^{-1} :
  - 286 g a.i. ha^{-1} glufosinate (carrier rate of 140 l ha^{-1})
  - 140 g a.e. ha^{-1} dicamba
  - 473 g a.e. ha^{-1} glyphosate
  - 37 g a.i. ha^{-1} saflufenacil
- After treatment, plants were arranged in randomized complete block in the greenhouse
- Droplet size measurements were made using a Sympatec HELOS-VARIO/KR laser diffraction system for each tank solution
- Data were subjected to ANOVA and means were separated using Fisher's Protected LSD test with the Tukey adjustment
- The project was replicated in space and time
- Dry weights were determined by cutting plants at 28 DAT and placing them in a dryer until a constant mass was observed

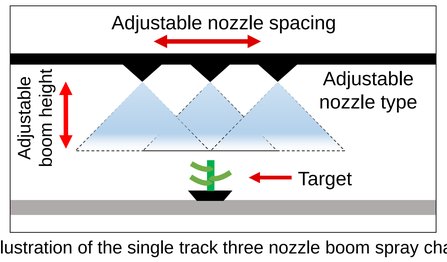

Figure 1. Illustration of the single track three nozzle boom spray chamber.

Figure 2. Illustration of the four nozzles used; From top to right: AIXR11004, TT11004, TTI11004 and XR11004

Results & Discussion

Table 1. Effect of nozzle spacing, boom height and nozzle type on the dry weight of common lambsquarters, velvetleaf, sorghum and Palmer amaranth using glufosinate, dicamba, glyphosate and saflufenacil.

Species	Herbicide	Significant factor/Interaction	Best treatment
Common lambsquarters	Glufosinate	Nozzle spacing	38 cm and 51 cm
	Dicamba	Nozzle spacing	38 cm
	Glyphosate	Boom height	61 cm
	Saflufenacil	Nozzle spacing*Nozzle type	XR11004*51 cm
Velvetleaf	Glufosinate	Boom height*Nozzle Type Nozzle spacing	TT*31 cm 38 cm and 51 cm
	Dicamba	Nozzle type Nozzle spacing	AIXR 38 cm
	Glyphosate	Nozzle spacing*Nozzle type	AIXR and TTI*38 cm
	Saflufenacil	-	-
Sorghum	Glufosinate	Nozzle spacing	38 cm and 51 cm
	Dicamba	-	-
	Glyphosate	-	-
	Saflufenacil	Nozzle type Nozzle spacing Boom height	XR and TTI 51 cm and 76 cm 30.5 cm
Palmer amaranth	Glufosinate	Nozzle spacing	38 cm and 51 cm
	Dicamba	-	-
	Glyphosate	Boom height	61 cm
	Saflufenacil	-	-

Figure 3. Velvetleaf sprayed with glyphosate using AIXR11004*38 cm spacing

Figure 4. Velvetleaf sprayed with glyphosate using TTI11004*38 cm spacing

Table 2. Spray droplet spectrum classification of the four nozzle types by herbicide treatments utilized in the current study. Categories are based on ASABE S572.1 guidelines.

Nozzle type	Glufosinate	Dicamba	Glyphosate	Saflufenacil
AIXR11004	Coarse	Very coarse	Very coarse	Very coarse
TT11004	Medium	Coarse	Medium	Medium
TTI11004	Ultra coarse	Ultra coarse	Ultra coarse	Ultra coarse
XR11004	Fine	Fine	Fine	Medium

Conclusions

- Amongst species tested, velvetleaf was the most affected by different nozzle types.
- Glufosinate applications are affected by nozzle type, nozzle spacing, and/or boom height depending on species.
- Applicators can benefit from this dataset by optimizing application to control troublesome weed species.
- Our work showed the complexity of the application process and future work is needed to continue to refine herbicide applications