Herbicide Tolerance Studies of Industrial Hemp (*Cannabis Sativa L.*) in Virginia

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Abstract

Industrial hemp (*Cannabis sativa* L.) is a multipurpose crop that is mainly cultivated for it's fiber and seed content. Hemp stalk can be used as a primary source in auto parts, textile items, industrial products, and building materials. Hemp seeds can be used as a source for human food, beneficial oils, animal feed, and cosmetic products. Though, industrial hemp is not considered a commercial crop in Virginia, information is needed on the mode of action and phytotoxicity of herbicides for varying hemp production systems. In 2017, Virginia Tech conducted greenhouse studies to assess a variety of herbicides and their impact on hemp productivity. Several herbicides with different modes of action were tested for their phytotoxicity to hemp.

Objectives

- To identify herbicides suitable for industrial hemp grain or dual-purpose production
- To assess aboveground biomass yield response to the application of herbicides with different modes of action

Rationale

- Generating information on the efficacy of various herbicides will be an important first step in determining their suitability as part of a management protocol
- This research also will help to determine the value of various agronomic practices such as herbicide application with respect to hemp fiber and grain yield.

Figure 1: Height of plants applied with post-emergent herbicides

Figure 2: Bleaching injury on hemp plant

Figure 3: Plants with no herbicide application

Figure 4: Signs of necrosis from pre-emergent herbicide

Figure 5: Plant with strong signs of necrosis from post-emergent study

Methods

- Monoecious cultivar ***Felina 32*** was chosen as the best candidate for this study.
- 14 pre-emergent (Table 1) and 14 post-emergent (Table 2) herbicides of interest were selected given their modes of action.
- For the pre-emergent herbicides, 10 seeds of ***Felina 32*** were sown into 3.78 L (1 gal.) pots with 8 replicates for each treatment.
- 120 seeds were planted into cone-tainers (1 seed per cone-tainer) for the post-emergent applications with 5 replicates per treatment.
- All pots and cone-tainers were filled with a (silt loam) Ross soil.
- Herbicides were applied using a spray chamber calibrated to deliver .5 L/ha spray volume with a TeeJet VS8002E nozzle at 206 kPa .
- All data was collected 8 weeks after herbicide applications.

Table 1: Pre-emergent herbicides

Treatment #	Trade Name	active ingredient	group #
1	Valor SX	flumioxazin	14
2	Spartan	sulfentrazone	14
3	Command	clomazone	13
4	Solicam	norflurazon	12
5	Classic	chlorimuron	2
6	Prowl H2O	pendimethalin	3
7	Zidua	pyroxasulfone	15
8	Dual II Magnum	S-metolachlor	15
9	Warrant	acetochlor	15
10	Outlook	dimethenamid	15
11	Reflex	fomesafen	14
12	TriCor	metribuzin	5
13	Karmex	diuron	7
14	Linex 4L	linuron	7

Table 2: Post-emergent herbicides

Treatment #	Trade Name	active ingredient	group #
1	Assure II	quizalofop	1
2	Poast	sethoxydim	1
3	Sandea	halosulfuron	2
4	Classic	chlorimuron	2
5	Harmony	thifensulfuon	2
6	Pursuit	imazethapyr	2
7	Sceptor	imazaquin	2
8	Staple	pyrithiobac	2
9	Buctril	bromoxynil	6
10	Basagran	bentazon	6
11	Reflex	fomesafen	14
12	Ultra Blazer	acifuorfen	14
13	Stinger	clopyralid	4
14	Linex 4L	linuron	7

Results

Table 3: ANOVA for Pre-emergent herbicides

Source	DF	Biomass (mg/pot)	Necrosis (%)
Trt	14	0.0076*	<.0001*
Year	1	<.0001*	0.0005*
Trt*Year	14	0.0233*	0.0351*

Table 4: ANOVA for Post-emergent herbicides

Source	DF	Biomass (mg/pot)	Necrosis (%)
Trt	14	0.084*	<.0001*
Year	1	0.6414	0.0116*
Trt*Year	14	0.0056*	0.9219

Figure 6: Biomass yield of Pre-emergent herbicides applications

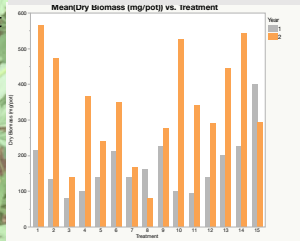


Figure 7: Biomass yield of Post-emergent herbicides applications

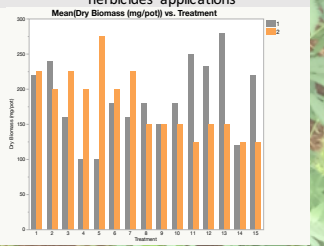


Figure 8: Necrosis % of Pre-emergent herbicides applications

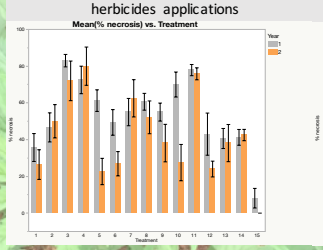
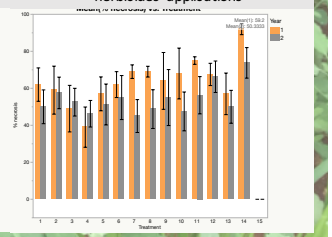


Figure 9: Necrosis % of Post-emergent herbicides applications



Summary

- There was a difference in aboveground biomass yield response to the application of herbicides with different modes of action for both studies.
- Year*Treatment interaction for necrosis % showed that there was difference within the pre-emergent study and no difference between years within the post-emergent study.
- Herbicides flumioxazin, clorimuron, pendimethalin, metribuzin, and linuron appear to be suitable pre-emergent herbicides for industrial hemp grain or dual-purpose production.
- Herbicides clorimuron, pendimethalin, bromoxynil, quizalofop, sethoxydim, and halosulfuron appear to be suitable post-emergent herbicides for industrial hemp grain or dual-purpose production.

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