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Can Topping and Harvest Time Affect Performance and Potentiality of Monoecious and Dioecious Hemp (*Cannabis sativa* L.) Varieties?

Alessandro Rossi[1], Silvia Tavarini[1], Luana Vagnoli[2], Jacopo Chini[2], Luciana G. Angelini[1]

[1] Dipartimento di Scienze Agrarie, Alimentari e Agro-ambientali, Università di Pisa, IT. Autore corrispondente: alessandro.rossi@agr.unipi.it
[2] Ricerche Sperimentali Montale s.r.l., Montale, Pistoia, IT

Introduction

Hemp is a versatile crop, from which a wide spectrum of agro-industrial products, such as textiles, bio-composites, pharmaceuticals, cosmetics and functional foods, can be obtained. Despite significant progress have been made on chemical and nutraceutical characterization of hemp products, the agronomic management practices for seed production remains insufficiently investigated. So, the aim of this work was to assess the effects of topping and harvest time on seed yield and cannabidiol content and composition of threshing residues in two hemp varieties.

Figure 1. Lateral branches produced by Carmagnola topped plants at 72 DAS

Materials and Methods

Field experiment: an open-field trial was setup at the experimental farm of DAFE (University of Pisa), comparing 2 hemp varieties: Futura 75 (monoecious) and Carmagnola (dioecious). Sowing was carried out on 07/04/2020 (seed rate of 45 kg ha^{-1}), in four plots (8 x 6 m) for each variety. N fertilization (50 kg N ha^{-1}) applied 44 days after sowing (DAS). Plants topped 40 cm from the ground 52 DAS.

Measurements and analysis:

- ❑ In pre-flowering stage (83 DAS), topped (T) and untopped (Ut) plants were sampled. Leaves were oven-dried at 40°C for CBD and CBDA determination;
- ❑ At maturity, 2 seed harvests performed at H1 (142 and 167 DAS for Futura 75 and Carmagnola respectively) and H2 (153 and 176 DAS for Futura 75 and Carmagnola respectively). Seed yield and yield components were evaluated;
- ❑ CBD and CBDA concentration was evaluated by HPLC in pre-flowering leaves and threshing residues;
- ❑ Data were subjected to 2-way ANOVA comparing: (i) harvest time (H1 and H2), topping (T and Ut) and their interaction for agronomic parameters; (ii) variety, topping and their interaction for CBD + CBDA concentration.

Results

Topping significantly decreased hemp total biomass in both varieties (up to -33% in Futura 75 and -38% in Carmagnola). In Futura 75, topping caused a reduction in seeds yield (SY), threshing residues (TR) (Table 1) and empty seeds percentage (from 29% to 22% in Ut and T plants). In Carmagnola no effect on SY or empty seeds (50% as mean value) was observed, while TR significantly decreased in topped plants. In both varieties, delaying harvest time induced a decrease in SY, mainly due to seed dehiscence. TR increased in H2 only in Futura 75.

Table 1. Effect of harvest time (H1 and H2) and topping (Ut and T) on seed yield (SY; Mg ha^{-1}) and threshing residues (TR; Mg ha^{-1}) in two hemp varieties.

	Futura 75				Carmagnola			
	SY		TR		SY		TR	
	Ut	T	Ut	T	Ut	T	Ut	T
H1	1.96 a	1.25 b	3.90	2.07	1.56	0.83	2.04	1.45
H2	1.46 ab	1.36 ab	4.63	3.51	0.42	0.58	2.12	1.52
Mean effects								
Ut	1.71 a		4.26 a		0.74		2.08 a	
T	1.13 b		2.79 b		0.70		1.49 b	
H1	1.60 a		2.99 b		0.94 a		1.74	
H2	1.41 b		4.07 a		0.50 b		1.82	

In Futura 75, topping did not affect CBD+CBDA concentration neither in the leaves nor in the threshing residues. In Carmagnola, topping increase CBD+CBDA concentration in pre-flowering leaves, while negatively affected CBDA+CBD in threshing residues (Figure 2).

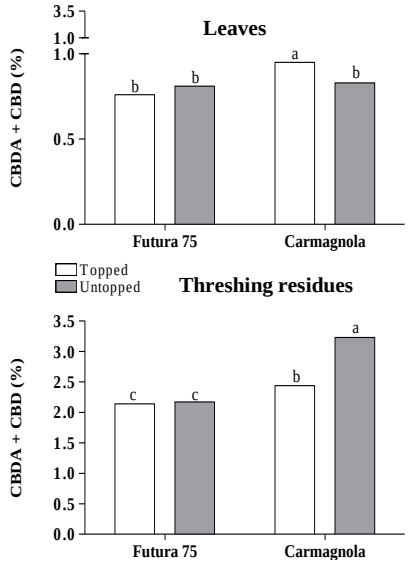

Figure 2. CBD + CBDA concentration in preflowering leaves and threshing residues as affected by topping in two hemp varieties.

Figure 3. Different height in topped (left) and untopped (right) Futura 75, 78 DAS.

Conclusions

The results obtained in this study showed, for the first time, the hemp response to topping and harvest time. In our climate, delaying the harvest time determined seed yield reduction, due to seed dehiscence, although a seed moisture reduction occurred. Regarding topping, a different behavior was observed in the two tested varieties: in Carmagnola this practice did not affect seed yield, while in Futura 75 a significant decrease was detected, with a related threshing residue reduction and a parallel HI improvement. Finally, our findings confirmed the possibility to exploit industrial hemp by-products (threshing residues and leaves) for obtaining CBD and CBDA rich extracts.

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