

## Combining cutting and herbicide application for *Ambrosia artemisiifolia* control

Kombination von Herbizidapplikation und Schneiden zur Bekämpfung von *Ambrosia artemisiifolia*

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DOI 10.5073/jka.2016.452.029

### Abstract

The effect on *Ambrosia artemisiifolia* (common ragweed) of combining cutting and herbicide application was studied in pot experiments in Germany and Denmark in 2013. Single plants of common ragweed were established in 2 L pots in glasshouses. Two cutting treatments were conducted: cutting to 10 cm height at the beginning of male budding (BBCH 51-59) and no cutting. Clopyralid (in Germany: Lontrel 600, in Denmark: Matrigon), mesotrione (in Germany and Denmark: Callisto) and glyphosate (in Germany: Clinic, in Denmark: Roundup Bio) were applied at 4 doses at three different timings: on the day of cutting, one week and two weeks after cutting. The plants were harvested 5 weeks after the last herbicide application. At both sites clopyralid and mesotrione had a low efficacy on common ragweed when applied on developed plants with only minor differences in efficacy at the three timings. Application after cutting improved the efficacy of clopyralid at both sites and of mesotrione in Denmark. In Germany glyphosate had a higher efficacy on non-cut plants in comparison to the cut plants, in Denmark it was *vice versa*. The highest dose of glyphosate provided higher control levels on developed plants than clopyralid and mesotrione at both sites. In Denmark the highest effects were obtained shortly after cutting with the maximum dose of each herbicide and declined with time between cutting and herbicide application. In summary the results demonstrated that herbicides can be applied shortly after cutting without loss of efficacy.

**Keywords:** *Ambrosia artemisiifolia*, clopyralid, common ragweed, cutting, glyphosate, herbicides, mesotrione

### Zusammenfassung

In Deutschland und Dänemark wurde in Gewächshausversuchen die Kombinationswirkung von Herbizid und Schnitt auf *Ambrosia artemisiifolia* (Beifußblättrige-Ambrosie) untersucht. Einzelpflanzen der Beifußblättrigen-Ambrosie wurden in 2 L Gefäßen im Gewächshaus angezogen. Zwei Schnittvarianten wurden durchgeführt: Schnitt der Pflanzen auf 10 cm Höhe zum Beginn der männlichen Blüte (BBCH 51-59) und kein Schnitt. Clopyralid (in Deutschland: Lontrel 600, in Dänemark: Matrigon), Mesotrione (in Deutschland und Dänemark: Callisto) und Glyphosat (in Deutschland: Clinic, in Dänemark: Roundup Bio) wurden mit 4 Dosierungen zu drei verschiedenen Zeitpunkten ausgebracht: am Tag des Schneidens, eine Woche und zwei Wochen nach dem Schnitt. Die Ernte der gesamten Pflanze fand 5 Wochen nach der letzten Herbizidapplikation statt. An beiden Standorten hatten Clopyralid und Mesotrione eine geringere Wirkung auf die ungeschnittenen Pflanzen, ungeachtet des Applikationszeitpunktes. Die Herbizidausbringung nach erfolgreichem Schnitt verbesserte die Wirkung von Clopyralid an beiden Standorten und von Mesotrione in Dänemark. In Deutschland war die Wirkung von Glyphosat auf die ungeschnittenen Pflanzen besser als auf die geschnittenen, am dänischen Standort war es umgekehrt. Glyphosat mit der maximalen Dosis hatte an beiden Standorten eine bessere Wirkung auf ältere Pflanzen als Clopyralid und Mesotrione. In Dänemark wurde die höchste Wirkung kurz nach dem Schnitt mit der maximalen Dosis und jedem Herbizid erreicht, diese Wirkung nahm ab, je später die Herbizidapplikation nach dem Schnitt erfolgte. Zusammenfassend lässt sich festhalten, dass die angewendeten Herbizide kurz nach dem Schnitt ausgebracht werden können, ohne dass ein Wirkungsverlust zu verzeichnen ist.

**Stichwörter:** *Ambrosia artemisiifolia*, Beifußblättrige-Ambrosie, Clopyralid, Glyphosat, Herbizide, Mesotrione, Schneiden

### Introduction

*Ambrosia artemisiifolia* (common ragweed) is an invasive alien species originating from North America that has been spreading in Central European countries during the second half of the 20th century. It can lead to severe negative impacts on public health, crop yield and biodiversity in a

country or region. Strategies to control and repress the plant with the aim to mitigate its impacts are therefore recommendable. Common ragweed is a very fertile and high productive plant in terms of seed production, especially dormant seeds can stay viable under beneficial conditions (KAZINCZI et al., 2008). A long-term strategy is the most favorite one, where the production of seeds is prevented. The application of herbicides is one of several strategies that can be carried out. In order to increase the efficacy, herbicide application can be combined with a cutting treatment, which was a result of the Euphresco project Ambrosia (HOLST, 2009). This combination can be applied on farmland, where common ragweed became a major weed and also on rural areas like roadsides, where in some countries permission must be applied for.

## Materials and Methods

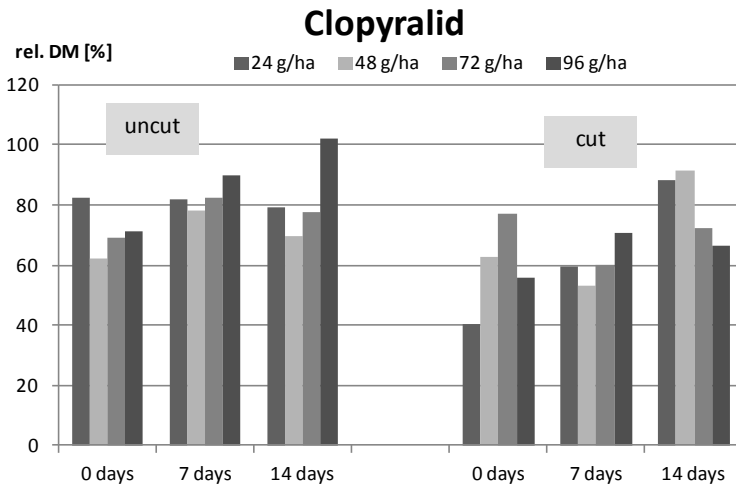
The effect on common ragweed of combining cutting and herbicide application was studied in pot experiments in Germany and Denmark in 2013. Single plants of *A. artemisiifolia* were established in 2 L pots at the beginning of March in glasshouses with a potting mixture consisting of field soil, sand and peat (2:1:1 weight per volume). Two cutting treatments were conducted: cutting to 10 cm height at the beginning of male budding (BBCH 51-59, reached at the beginning of June) and no cutting in order to detect the impact of cutting in this trial. On average cutting the plants at 10 cm height left very few leaves but all the stems of the side and main shoots.

Three active ingredients (a.i.) were selected which are known to be effective against dicotyledonous weeds: clopyralid (N=120 g a.i./ha), mesotrione (N=150 g a.i./ha) and glyphosate (N=1080 g a.i./ha), the corresponding herbicides were in Germany: Lontrel 600, Callisto and Clinic, in Denmark: Matrigon, Callisto and Roundup Bio, respectively. They were applied at 4 doses: 20%; 40%; 60%; 80% of the registered and recommended dose (N). An untreated control (without herbicide application) was established for the cut and non-cut treatments. The trial was conducted with three replicates per treatment. Herbicide application took place on three different timings: on the day of cutting, one week and two weeks after cutting (in Denmark it became 3 weeks due to technical problems with the sprayer). Herbicide preparations were applied using a mobile hand device sprayer (Germany) or a laboratory pot sprayer (Denmark) equipped with a boom fitted with two Hardi ISO F110-02 flat fan nozzles using a volume rate of ca. 300 l/ha. The plants were harvested 5 weeks after the last herbicide application. The plants were cut at the soil surface and fresh weight biomass was recorded. The plant biomass was dried at 80° C for 48 hours and dry weight biomass was recorded.

## Results

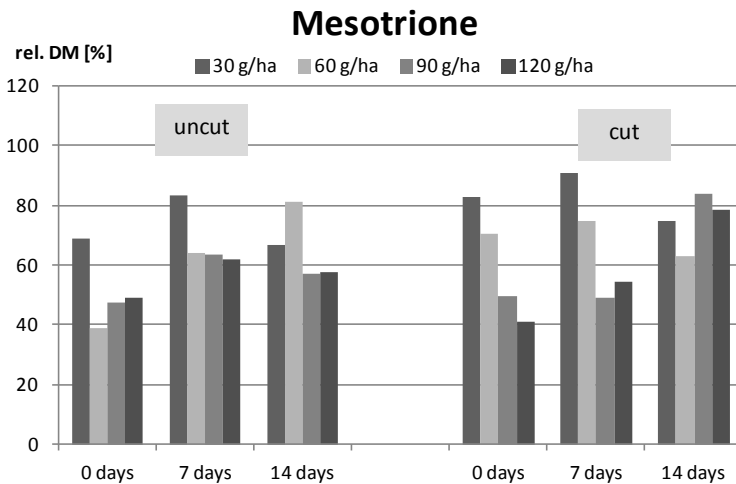
### Germany

In the trials conducted in Germany, clopyralid and mesotrione had a low efficacy on common ragweed when applied on non-cut plants with only minor differences in efficacy at the three timings. Application after cutting improved the efficacy of clopyralid (Fig. 1). In contrast the efficacy of mesotrione was not improved by cutting (Fig. 2). Glyphosate had a higher efficacy on non-cut plants in comparison to cut plants with almost no differences in the application timing (Fig. 3). Glyphosate provided higher control levels on developed plants with the maximum dose than clopyralid and mesotrione.



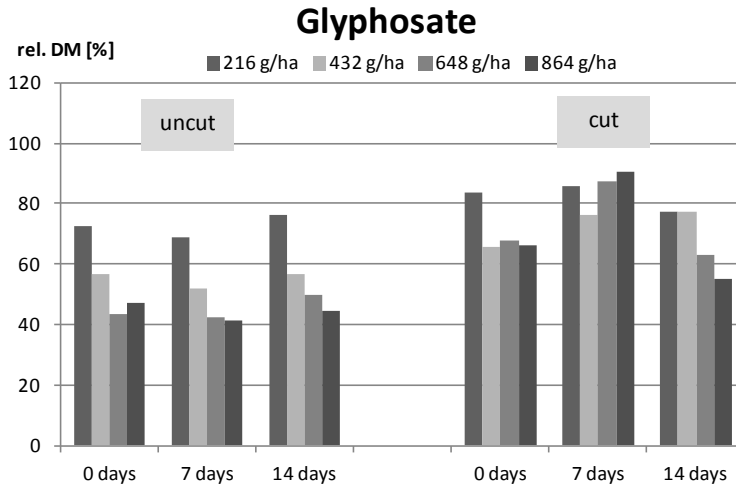
**Fig. 1** Relative dry weight of biomass (rel. DM) of common ragweed plants treated with 4 different doses of clopyralid in Germany. One group of the plants was cut at 10 cm height at day 0. Clopyralid was applied at 3 timings: 0, 7, 14 days after cutting.

**Abb. 1** Relativer Trockenmasseertrag (rel. DM) der Beifuß-Ambrosien in Deutschland mit 4 verschiedenen Clopyraliddosierungen. Eine Pflanzengruppe wurde am Tag 0 auf 10 cm Höhe geschnitten. Clopyralid wurde an 3 verschiedenen Tagen appliziert: 0, 7, 14 Tage bezogen auf die Schnittvariante.



**Fig. 2** Relative dry weight of biomass (rel. DM) of common ragweed plants treated with 4 different doses of mesotrione in Germany. One group of the plants was cut at 10 cm height at day 0. Mesotrione was applied at 3 timings: 0, 7, 14 days after cutting.

**Abb. 2** Relativer Trockenmasseertrag (rel. DM) der Beifuß-Ambrosien in Deutschland mit 4 verschiedenen Mesotriiondosierungen. Eine Pflanzengruppe wurde am Tag 0 auf 10 cm Höhe geschnitten. Mesotriion wurde an 3 verschiedenen Tagen appliziert: 0, 7, 14 Tage bezogen auf die Schnittvariante.

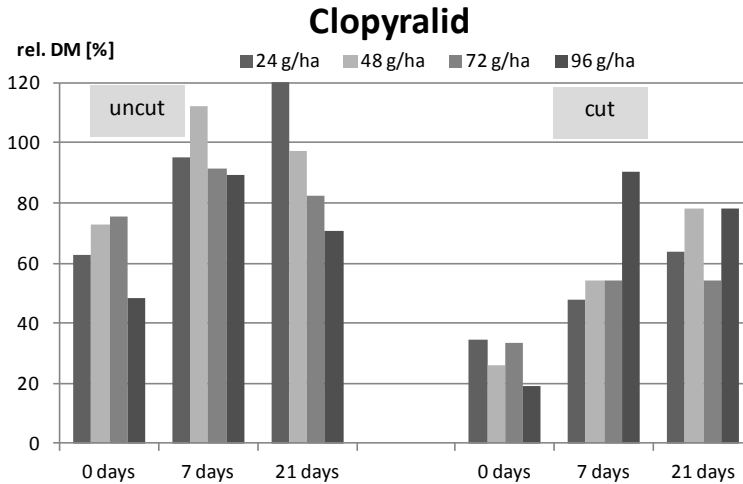


**Fig. 3** Relative dry weight of biomass (rel. DM) of common ragweed plants treated with 4 different doses of glyphosate in Germany. One group of the plants was cut at 10 cm height at day 0. Glyphosate was applied at 3 timings: 0, 7, 14 days after cutting.

**Abb. 3** Relativer Trockenmasseertrag (rel. DM) der Beifuß-Ambrosien in Deutschland mit 4 verschiedenen Glyphosatdosierungen. Eine Pflanzengruppe wurde am Tag 0 auf 10 cm Höhe geschnitten. Glyphosat wurde an 3 verschiedenen Tagen appliziert: 0, 7, 14 Tage bezogen auf die Schnittvariante.

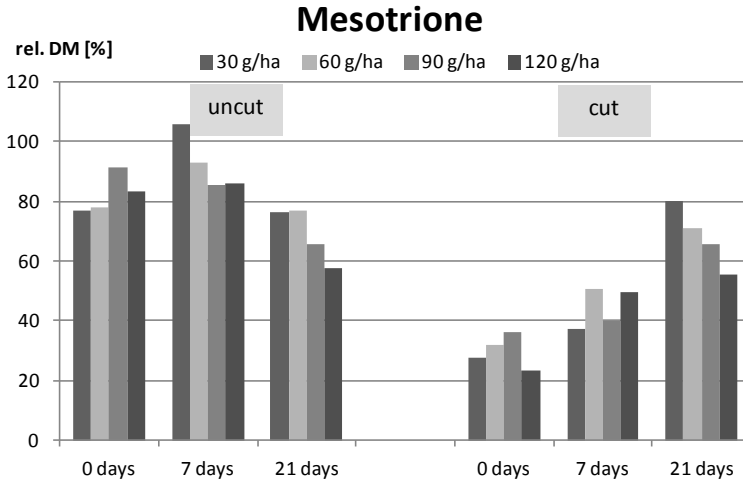
#### Denmark

In Denmark clopyralid and mesotrione had a low efficacy on common ragweed when applied on non-cut plants. The efficacy of clopyralid was highest at the first timing while there were only minor differences in efficacy of mesotrione at the three timings. Application after cutting improved the efficacy of both herbicides (Fig. 4-5). In general the applied doses of glyphosate provided higher control levels on developed plants than clopyralid and mesotrione (Fig. 6) and similar to the other herbicides the efficacy was higher on cut plants in comparison to the non-cut plants. For all herbicides the best effects were obtained shortly after cutting with the maximum dose of each herbicide and declined with time between cutting and herbicide application.



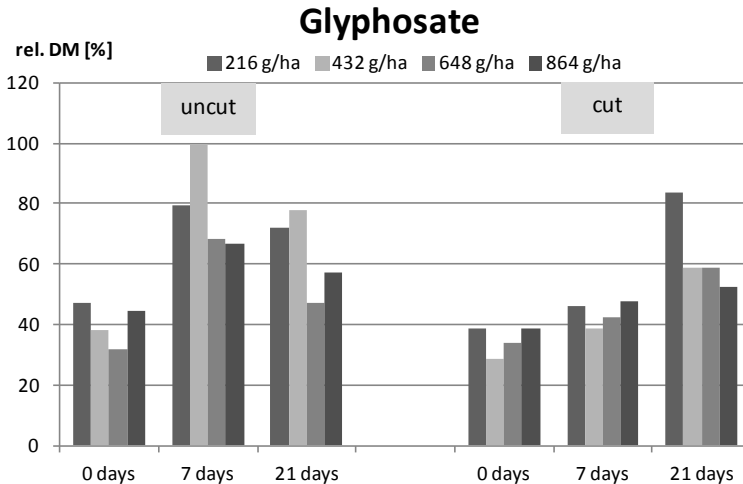
**Fig. 4** Relative dry weight of biomass (rel. DM) of common ragweed plants treated with 4 different doses of clopyralid in Denmark. One group of the plants was cut at 10 cm height at day 0. Clopyralid was applied at 3 timings: 0, 7, 21 days after cutting.

**Abb. 4** Relativer Trockenmasseertrag (rel. DM) der Beifuß-Ambrosien in Dänemark mit 4 verschiedenen Clopyraliddosierungen. Eine Pflanzengruppe wurde am Tag 0 auf 10 cm Höhe geschnitten. Clopyralid wurde an 3 verschiedenen Tagen appliziert: 0, 7, 21 Tage bezogen auf die Schnittvariante.



**Fig. 5** Relative dry weight of biomass (rel. DM) of common ragweed plants treated with 4 different doses of mesotrione in Denmark. One group of the plants was cut at 10 cm height at day 0. Mesotrione was applied at 3 timings: 0, 7, 21 days after cutting.

**Abb. 5** Relativer Trockenmasseertrag (rel. DM) der Beifuß-Ambrosien in Dänemark mit 4 verschiedenen Mesotriiondosierungen. Eine Pflanzengruppe wurde am Tag 0 auf 10 cm Höhe geschnitten. Mesotriion wurde an 3 verschiedenen Tagen appliziert: 0, 7, 21 Tage bezogen auf die Schnittvariante.



**Fig. 6** Relative dry weight of biomass (rel. DM) of common ragweed plants treated with 4 different doses of glyphosate in Denmark. One group of the plants was cut at 10 cm height at day 0. Glyphosate was applied at 3 timings: 0, 7, 21 days after cutting.

**Abb. 6** Relativer Trockenmasseertrag (rel. DM) der Beifuß-Ambrosien in Dänemark mit 4 verschiedenen Glyphosatdosierungen. Eine Pflanzengruppe wurde am Tag 0 auf 10 cm Höhe geschnitten. Glyphosat wurde an 3 verschiedenen Tagen appliziert: 0, 7, 21 Tage bezogen auf die Schnittvariante.

## Discussion

At both sites clopyralid and mesotrione had a low efficacy on common ragweed when applied on non-cut plants with only minor differences in efficacy at the three timings. Application after cutting improved the efficacy of clopyralid at both sites and of mesotrione in Denmark. This effect was also described by BOHREN et al. (2008) with glyphosate and clopyralid experiments on common ragweed. In Germany glyphosate had a higher efficacy on non-cut plants in comparison to the cut plants, in Denmark it was vice versa. Glyphosate provided higher control levels on developed plants with the maximum dose than clopyralid and mesotrione at both sites. The good efficacy of glyphosate against common ragweed was documented in other studies, too (e.g. GEHRING et al., 2008; SCHROEDER and MEINLSCHMIDT, 2009). In Denmark the highest effects were obtained shortly after cutting with the maximum dose of each herbicide and declined with time between cutting and herbicide application. In summary the results demonstrated that herbicides can be applied shortly after cutting without loss of efficacy.

## Acknowledgement

The authors wish to express her thanks to the European Commission, DG Environment for financial support (HALT AMBROSIA, 07.0322/2010/58340/SUB/B2). We also like to thank the Danish technicians Betina Bendtsen and Willy Rasmussen and in Germany Martina Kracht and Werner Lühr.

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