Post harvest seed ripening (pot experiment)

Gerhard Karrer

Institute of Botany, Department of Integrative Biology and Biodiversity Research,
University of Natural Resources and Life Sciences, Gregor Mendel Str. 33, 1180 Wien, Austria;
e-mail: gerhard.karrer@boku.ac.at

DOI 10.5073/jka.2016.455.13

Introduction

Machines used for mowing the shoulders and batters along any roads contribute most to the spread of common ragweed (Vitalos & Karrer 2009). Common practice of managing such habitat types is mowing or mulching few times a year whereupon leaving the biomass on the floor. Flowers on cut stems of many plants are able to develop further to a ripened stage. Therefore leaving the cut common ragweed plants on such places may not stop common ragweed from producing seeds and spread further. In this study we aim at testing the contribution of post-harvest seed ripening to the number of seeds left in habitats after cutting the invasive common ragweed.

Methods

In a cutting experiment, we studied the post-harvest ripening potential of flowers/young seeds of common ragweed cultivated at the Botanical garden of the University of Natural Resources and Life Sciences (Fig. 1). We cut branches at 5 developmental stages of female flowers (Fig. 2).

All cut branches were left on the soil surface for post-harvest ripening until end of autumn (Fig. 3). In December, the seeds yielded from the experiments were stored for 90 days at 4°C. After this stratification they were tested with regard to their germination capacity and dormancy/viability. Germination tests were run 2 times 4 weeks each term interrupted by second 5 months stratification. Seeds were germinated in petri dishes at 16/8 h darkness/light and 15/30°C. The TTC-test for viability of assumedly dormant seeds was done after the last germination trial (6 hours staining at 30°C in darkness, 1% Tetrazolium solution applied). Each treatment was tested with a subsample of 2 x 15 seeds except for those that yielded only 5 seeds each.

Fig. 1: *A. artemisiifolia* cultivated in pots

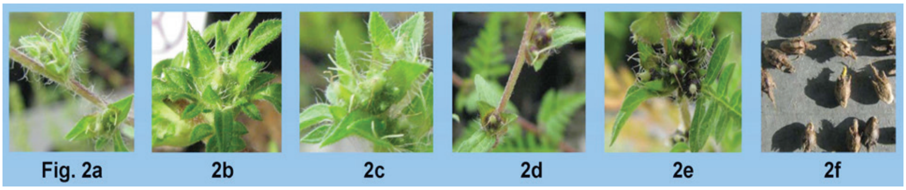

Fig. 2: Developmental stages of the female flowers of *A. artemisiifolia* in the post-harvest ripening test:

1) Young small flower with fresh whitish stigmas (Fig. 2a)

2) Flower at full size, soft, with dried stigmas (Fig. 2b)

3) Flower green and medium hard, can be compressed by fingers, capitulum with soft spines, stigma dry (Fig. 2c)

4) Flower greyish, hard and spiny, cannot be compressed by fingers; stigma dry (Fig. 2d)

5) Flower dark brown, hard, spiny, drops off when touched, stigma broken or vanished (Fig. 2e, f)

Fig. 3: *A. artemisiifolia* cut branches covered by a fine net to protect against seed predators

Results

All treatments produced at least some **ripened seeds**. Flowers cut at stages 1 and 2 (both with soft ovary) developed only 5 ripened seeds. In contrast, all ovaries cut at hard or near to hard stage (3 to 5) produced a lot of seeds that looked ripened (Fig. 4).

Flowers cut at stage 1 and 2 developed at least a few ripened seeds, probably because we overlooked few flowers that already reached stage 3 during harvest. The high number of ripened seeds in groups 3 to 5 indicates the high capacity of post-harvest ripening of common ragweed after finishing flowering and being cut off from resource supply.

The **test for germinability** (Fig. 5) provided rather different germination rates depending on the time available to finalize ripening. The few ripened seeds developed from stage 1 (cut at Aug. 18th) and 2 (cut at Sept. 9th) branches germinated by 60%. But this partition cannot be seriously interpreted because of the small sample size (n=5). Stage 3 branches (cut at Sept. 14th) provided seeds which germinated by 27%; stage 4 (cut at Oct. 1st) seeds already germinated at rates of 43%, and seeds that were cut at Nov. 15th germinated at the rather high rate of 87%. The latter differs significantly (p=0.0345, Tukey) from the germinability of seeds with less time left for post-harvest ripening.

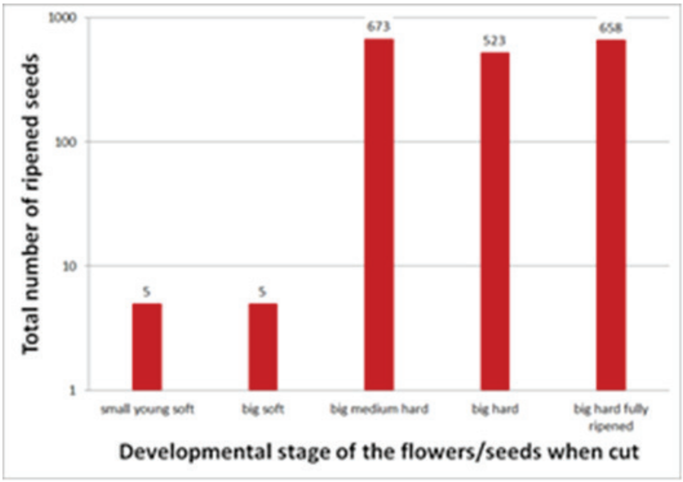

Fig. 4: Total number of ripened seeds developed from *A. artemisiifolia* branches cut at different developmental stages (log scale!)

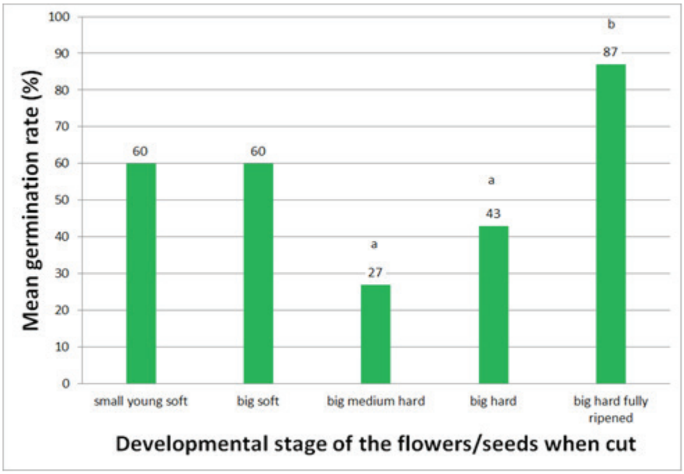

Fig. 5: Mean germination rates of ripened seeds developed from *A. artemisiifolia* branches cut at different developmental stages; stage 5 seeds differ significantly from seeds developed from branches at stage 4 and 3 (p=0.0345, Tukey); stage 1 and 2 rates cannot be interpreted seriously because of n=5.

TTC-test: The remaining non-germinated seeds were tested for viability. None of them showed to be viable.

Discussion

The traditional cutting regime of road shoulders in Middle Europe includes one or two cuts before summer (April to June), hardly any cut during summer (July and August) and one last cut in September or October. Vitalos & Karrer (2009) and Milakovic & Karrer (2010) showed that such cutting regime ends up in lots of viable seeds distributed by the mowers. It is evident that leaving cut plant biomass in September or October at the managed sites even promotes the fill-up of the soil seed bank (data not shown here) and enables further spread of common ragweed via branches with ripened seeds.

So far, post-harvest ripening of common ragweed seeds was underestimated, especially when control options like mowing were discussed (Simard & Benoit 2011). Mistakes like efforts to control common ragweed by cutting at the wrong dates get evident by the high number of viable/germinable seeds that developed from plants cut mid of September. Not only the vital resprouting capacity of common ragweed makes cutting at the wrong time rather inefficient but also leaving the cut plants in the field.

Our results indicate that the definition of seed ripening stages must consider also the hardiness of the ovaries which seem to be the best indicator for viability of young seeds.

The percentage of viable seeds (87%) within the treatment of obviously fully ripened seeds (nr. 5) is relatively high compared to other authors; i.e., Chauvel & Fumanal (2009) stated 80% as high percentage of viable seeds in populations without any stress.

Further spread of common ragweed to Northern Europe will be facilitated if the potential of producing ripened seeds earlier than given in the literature increases.

Managed populations of common ragweed obviously are able to produce viable seeds much earlier than given in the literature (Kazinczi *et al*. 2008a, b). From our results we expect the production of first viable seeds already in the second half of August (at least in the Pannonian region). Therefore, Karrer *et al.* (2011) recommend the removal and burning of any common ragweed biomass after cutting as of August.

Indeed, the post-harvest ripening potential turned out to be rather high in common ragweed. Seeds developed from inflorescences that were harvested at the beginning of September already showed germination rates of 25 to 50%. Thus it is evident that cut common ragweed biomass must be removed from habitats like road shoulders after mowing in autumn to prevent post-harvest ripened seeds from further spread and from filling up the soil seed bank. If removal of biomass is not accomplished cutting as a control measure against the invasive common ragweed is not sustainable.

References

Chauvel, B., Fumanal, B., 2009: Production de semences d'Ambrosia artemisiifolia L. en conditions limitantes. XIIIème Colloque International sur la Biologie des Mauvaises Herbes. Dijon (France) – 8 - 10 Septembre 2009. 465 -472. CD Rom N° ISBN 978-2-950550-17-0.

Karrer, G., Milakovic, M., Kropf, M., Hackl, G., Essl, F., Hauser, M., Mayer, M., Blöch, C., Leitsch-Vitalos, M., Dlugosch, A., Hackl, G., Follak, S., Fertsak, S., Schwab, M., Baumgarten, A., Gansberger, M., Moosbeckhofer, R., Reiter, E., Publig, E., Moser, D., Kleinbauer, I., Dullinger, S., 2011: Ausbreitungsbiologie und Management einer extrem allergenen, eingeschleppten Pflanze – Wege und Ursachen der Ausbreitung von Ragweed (*Ambrosia artemisiifolia*) sowie Möglichkeiten seiner Bekämpfung. Endbericht, BMLFUW, Wien. 315 pp. German version available from: https://www.dafne.at/dafne_plus_homepage/.

Kazinczi, G., Béres I., Novák R., Bíró K., 2008a: Common ragweed (*Ambrosia artemisiifolia* L.): A review with special regards to the results in Hungary: I. Taxonomy, origin and distribution, morphology, life cycle and reproduction strategy. Herbologia, 9(1): 55-91.

Kazinczi, G., Novák, R., Pathy, Z., Béres, I., 2008b: Common ragweed (*Ambrosia artemisiifolia* L.): A review with special regards to the results in Hungary. III. Resistant biotypes, control methods and authority arrangements. Herbologia 9(1): 119-144.

Milakovic, I. and Karrer, G., 2010: Influence of competing vegetation and the cutting regime on the population density and flowering characteristics of *Ambrosia artemisiifolia* L. – in: : Bastiaans, L., Bohren, C., Christensen, S., Gerowitt, B., Hatcher, P., Krähmer, H., Kudsk, P., Melander, B., Pannacci, E., Rubin, B., Streibig, F., Tei, F., Thompson, A., Torrensen, K., Vurro, M. Proceedings of the 15th European Weed Research Society (EWRS) Symposium, 12-15 July 2010, Kaposvar, Hungary, p. 200. Pannonia Print LTD. Budapest. ISBN: 978-963-9821-24-8.

Simard, M-J. and Benoit, DL., 2011: Effect of repetitive mowing on common ragweed (Ambrosia artemisiifolia L.) pollen and seed production. Ann AgricEnviron Med 18(1): 55-62.

Vitalos, M. & Karrer, G., 2009: Dispersal of Ambrosia artemisiifolia seeds along roads: the contribution of traffic and mowing machines. In: Pyšek, P. & Pergl, J. (Eds) Biological Invasions: Towards a Synthesis. Neobiota 8: 53–60.