

Visualizing growth of *Cirsium arvense* (L.) scop. for farmers

Visualisierung des Wachstums von *Cirsium arvense* (L.) scop. für Landwirte

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Abstract

Agro-ecological farming takes a significant shift in farmers' knowledge and behaviour. Video has become an important part of education and dissemination. Here, we present an instructional video development process for the visualizing of *C. arvense* growth.

The scientific literature on biology, distribution and control measures of *C. arvense* has been collected and pooled in an indexed database. The next step was to create a design document. The heart of the video development process is 'Storyboarding'. A storyboard is a graphic representation of how the video will unfold, scene by scene. After finishing the storyboard, a professional designer planned the onscreen visuals and recorded a first draft based on the storyboard. When the entire video is established, any gaps or lulls in onscreen visuals became clear.

Visualizing the spatial spread of *C. arvense* roots belowground will enable farmers and advisors to comprehend the growth and reproduction of *C. arvense*.

Keywords: Agroecological management, Canada thistle, Creeping perennial weeds, Dissemination, Instructional Video

Zusammenfassung

Agrarökologischer Landbau erfordert wesentliche Kenntnis- und Verhaltensänderungen der Landwirte. Videos sind zu einem wichtigen Bestandteil der Wissensvermittlung- und Weitergabe geworden. In diesem Beitrag stellen wir einen Prozess zur Entwicklung eines Lehrvideos für die Visualisierung des Wachstums von *C. arvense* vor.

Die wissenschaftliche Literatur über Biologie, Verbreitung und Kontrollmaßnahmen von *C. arvense* wurde recherchiert und in einer katalogisierten Datenbank zusammengetragen. Der folgende Arbeitsschritt war die Erstellung eines Entwurf- und Planungsdokuments. Das Herzstück des Videoentwicklungsprozesses ist die Erstellung eines Drehbuches. Das Drehbuch ist eine grafische Darstellung aller Szenen. Nach Fertigstellung des Drehbuchs plante ein professioneller Grafiker die visuellen Elemente auf dem Bildschirm und entwickelte erste Grafikentwürfe auf der Grundlage des Drehbuchs. Nach der Fertigstellung des vollständigen Videoentwurfs wurden alle Lücken und Mängel in den Visualisierungen deutlich.

Die Visualisierung der unterirdischen Ausbreitung von *C. arvense* wird es Landwirten und Beratern ermöglichen das Wachstum und die Reproduktion von *C. arvense* zu verstehen.

Stichwörter: Ackerkratzdistel, Agrarökologisches Management, Informationsvermittlung, Lernvideo, Wurzelunkräuter

Introduction

Environmental and social concerns demand a reduction of ploughing in organic (PEIGNÉ et al., 2007; VIAN et al., 2009; KRAUSS et al., 2010; GADERMAIER et al., 2012) and replacing glyphosate use in conventional farming (KUDSK & MATHIASSEN, 2020). Hence, novel integrated weed management practices for creeping perennial

weeds urge to exploit agro-ecological management. Nevertheless, moving to an agro-ecological system represents a significant change from the previous cultivation for conventional and organic farmers.

PELTONEN-SAINIO et al. (2020) proclaimed ‘winds of change for farmers’ and proposed knowledge sharing on future changes and coping measures.

Video has become an important part of education and dissemination. Meta-analyses have shown that technology can enhance learning (MEANS et al., 2009; SCHMID et al., 2014), and multiple empirical studies have shown that video, specifically, can be a highly effective educational tool (ALLEN MOORE & RUSSELL SMITH, 2012; KAY, 2012; STOCKWELL et al., 2015). Video can be particularly well suited to illuminating hard-to-visualize phenomena that are the focus of environmental and biology issues (DASH et al., 2016).

Here, we present an instructional video development process for the visualizing of creeping perennial weed growth by the example of *Cirsium arvense* (L.) scop. We are aiming to produce a novel *C. arvense* video which (i) support farmers with specific information on the spatial growth of *C. arvense*, (ii) allow exploring how management practices affect the growth and (iii) assist in understanding the consequences of different applications of disturbance and competition on field infestations.

Instructional Video Development Process

Figure 1 summarises the workflow of the instructional video development, including the steps (1) information gathering, (2) instructional design, (3) storyboarding, (4) visual design and (5) first draft animation.

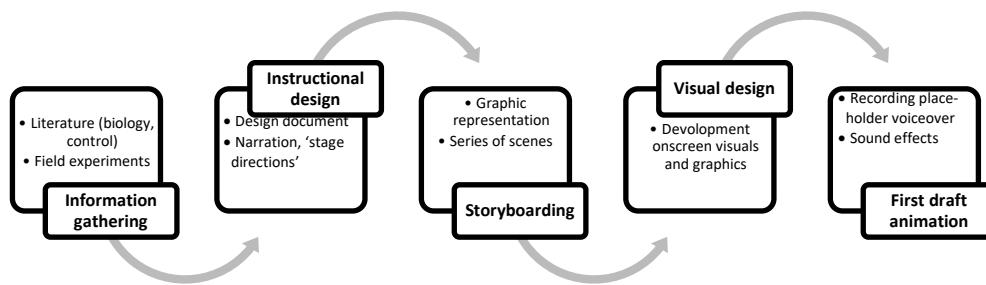


Figure 1 Instructional Video Development Process for the visualizing growth of *C. arvense*.

Abbildung 1 Entwicklungsprozess eines Videos für die Visualisierung des Wachstums von *C. arvense*.

Information gathering

We started by gathering available information on *C. arvense*. Scientific Literature (including grey resources) on biology, distribution and control measures of *C. arvense* has been collected and pooled in an indexed database. For biology and distribution, we focused (i) the belowground growth and (ii) the thistle reproduction. Creeping thistles have an expanded root system reaching 3m into the soil (TILEY, 2010), whereas creeping roots spread at a rate of 1 to 2m per year (TWORKOSKI, 1992).

We ranked the thistle reproduction according to their importance: (i) Plants grown from creeping root fragments, (ii) Remains of aboveground shoots and (iii) seedlings from seeds.

We further systemized the response of *C. arvense* to management practices. The focus has been on the effects of applying and combining disturbance and competition for agro-ecological management. The results are generated by the authors' two-year field experiments. Recommendations for improved management strategies have been developed.

Instructional design

The next step was to create a design document. We started by writing a script for the video. The script is similar to what might be written for a play, and it contains the narration and ‘stage directions’ indicating suggested scenes, actions, and other visual elements.

Storyboarding

A storyboard is a graphic representation of how the video will unfold, scene by scene (Tab. 1). The storyboard is a series of scenes that represent the individual shots planned for the video. It is made up of several squares with illustrations and pictures representing each shot, with notes about what’s going on in the scene and what is being said in the script during that shot. At this point, a visual designer was engaged for input on such elements as imagery and visual style. We fleshed out the ‘stage directions’ by grouping relevant content into various scenes. For each scene, we made a drawing to depict what occurs in the scene.

The ‘Frame Description’ describes the characters and images that will appear, as well as the actions that will occur (Tab. 1).

Table 1 Insight into the storyboard for the visualizing of *C. arvense* growth

Tabelle 1 Drehbuchauszug für die Visualisierung des Wachstums von *C. arvense*

Scene	Frame description	On screen representation	Voiceover
[1-2] 3 Belowground growth [4-7]	<p>Title: Below-ground growth</p> <p>Graphic: <i>C. arvense</i> with horizontal creeping roots</p> <p>Animation: approx. 1 sec. after display title and at starting voiceover ‘The main...’: (a) nutritious roots grow from creeping roots and belowground sprouts, the growth of nutritious roots starts immediately prior to the growth of the vertical belowground sprouts (b) adventitious buds form new belowground sprouts, below-ground sprouts grow from creeping roots to the soil surface, after emergence above-ground sprouts are visible</p> <p>Comments: Displaying the arrows and highlighting the elements in the image: „Creeping roots“, „adventive buds...“, „nutritious roots...“, „Belowground sprouts“</p>		<p>The main creeping roots run horizontally in the soil, while their main task being to store resources, at the same time being organs of vegetative reproduction.</p> <p>Adventitious buds form new nutritious roots penetrating deeply into the soil, in so doing the numerous nutritious roots serve as the organ of nutrition of the plant.</p>

The ‘On Screen’ representation contains the initial drawing developed by the designer. The ‘Voiceover’ contains the spoken narration of the piece. Table 1 gives insights into the storyboard for the visualizing of *C. arvense* growth. As an example, we illustrate scene 3 ‘Belowground growth’.

Visual design

Finishing the storyboard, the designer has read the script and planned the onscreen visuals. There are several critical elements to consider during this phase: (1) the graphics that will need to be created and how these graphics will interact with one another. (2) Once in a visual format, make sure that the progression or sequences make sense. (3) Frame each scene so that pertinent information is clearly illustrated and does not get lost among other on-screen elements.

First draft animation

Based on storyboard, a placeholder voiceover (VO) was recorded. The placeholder VO becomes the timing backbone upon which we build the first animatic. Once the timing of the entire video is established, any gaps or lulls in onscreen visuals became clear, and we could make changes to tighten the timing. Sound effects and cinematic background music have further been added at this step.

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References

- ALLEN MOORE, W., A. RUSSELL SMITH, 2012: Effects of video podcasting on psychomotor and cognitive performance, attitudes and study behaviour of student physical therapists. *Innovations in Education and Teaching International* **49** (4), 401–414, DOI:10.1080/14703297.2012.728876.
- DASH, S., U. KAMATH, G. RAO, J. PRAKASH, S. MISHRA, 2016: Audio-visual aid in teaching “fatty liver”. *Biochemistry and molecular biology education : a bimonthly publication of the International Union of Biochemistry and Molecular Biology* **44** (3), 241–245, DOI:10.1002/bmb.20935.
- GADERMAIER, F., A. BERNER, A. FLIEßBACH, J.K. FRIEDEL, P. MÄDER, 2012: Impact of reduced tillage on soil organic carbon and nutrient budgets under organic farming. *Renewable Agriculture and Food Systems* **27** (1), 68–80, DOI:10.1017/S1742170510000554.
- KAY, R.H., 2012: Exploring the use of video podcasts in education: A comprehensive review of the literature. *Computers in Human Behavior* **28** (3), 820–831, DOI:10.1016/j.chb.2012.01.011.
- KRAUSS, M., A. BERNER, D. BURGER, A. WIEMKEN, U. NIGGLI, P. MÄDER, 2010: Reduced tillage in temperate organic farming: implications for crop management and forage production. *Soil Use and Management* **26** (1), 12–20, DOI:10.1111/j.1475-2743.2009.00253.x.
- KUDSK, P., S.K. MATHIASSEN, 2020: Pesticide regulation in the European Union and the glyphosate controversy. *Weed Science* **68**, 214–222, DOI:10.1017/wsc.2019.59.
- MEANS, B., Y. TOYAMA, R. MURPHY, M. BAKIA, K. JONES, 2009: Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies. Centre for Learning Technology.
- PEIGNÉ, J., B.C. BALL, J. ROGER-ESTRADE, C. DAVID, 2007: Is conservation tillage suitable for organic farming? A review. *Soil Use and Management* **23** (2), 129–144, DOI:10.1111/j.1475-2743.2006.00082.x.

30. Deutsche Arbeitsbesprechung über Fragen der Unkrautbiologie und -bekämpfung, 22. – 24. Februar 2022 online

PELTONEN-SAINIO, P., J. SORVALI, J. KASEVA, 2020: Winds of change for farmers: Matches and mismatches between experiences, views and the intention to act. Climate Risk Management **27**, 100205, DOI:10.1016/j.crm.2019.100205.

SCHMID, R.F., R.M. BERNARD, E. BOROKHOVSKI, R.M. TAMIM, P.C. ABRAMI, M.A. SURKES, C.A. WADE, J. WOODS, 2014: The effects of technology use in postsecondary education: A meta-analysis of classroom applications. Computers & Education **72**, 271–291, DOI:10.1016/j.compedu.2013.11.002.

STOCKWELL, B.R., M.S. STOCKWELL, M. CENNAMO, E. JIANG, 2015: Blended Learning Improves Science Education. Cell **162** (5), 933–936, DOI:10.1016/j.cell.2015.08.009.

TILEY, G.E.D., 2010: Biological Flora of the British Isles: *Cirsium arvense* (L.) Scop. Journal of Ecology **98** (4), 938–983, DOI:10.1111/j.1365-2745.2010.01678.x.

TWORKOSKI, T., 1992: Developmental and Environmental Effects on Assimilate Partitioning in Canada Thistle (*Cirsium arvense*). Weed Science **40** (1), 79–85, DOI:10.1017/S004317450005699X.

VIAN, J.F., J. PEIGNE, R. CHAUSSOD, J. ROGER-ESTRADE, 2009: Effects of four tillage systems on soil structure and soil microbial biomass in organic farming. Soil Use and Management **25** (1), 1–10, DOI:10.1111/j.1475-2743.2008.00176.x.