

8. Introduction of Herbicide-Tolerant Crop Plants in Switzerland: Possible Impacts on the Environment and Agriculture

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Objective

The aim of the study is to evaluate possible impacts of herbicide-tolerant crop plants on the environment and on agriculture in the Swiss context, based on crop - herbicide combinations which are likely to be used in the near future. The three crops analyzed are oilseed rape, sugar beet and maize tolerant to the herbicides glufosinate and glyphosate. The study analyzes the following: impact on herbicide consumption (active ingredients), risks of dissemination of resistance genes, consequences for weed populations, impact on crop rotation, impact on the environment, economic aspects at crop level. The study is based on a comprehensive literature review and on a comparison between current weed management practices and "new systems", i.e. with herbicide-tolerant crops.

Results

The main changes on weed management practices induced by the new systems (see figures) are as follows :

Oilseed rape: in current weed management practices, a single herbicide application is made in pre- emergence. In the case of herbicide-tolerant oilseed rape (new system), since herbicide is applied at a later stage, weed populations can be observed and the situation can be assessed prior to herbicide application.

Sugar beet: the current average number of herbicide applications is 3 to 4 (split doses). With herbicide-tolerant sugar beet (new system), it is possible to control more developed weeds (e.g. dicotyledons with more than 2-4 leaves). Thus the number of herbicide applications can be reduced to 2-3.

Maize: in current weed management practices, one herbicide application can be sufficient. Sometimes, a second application may be required. With herbicide-tolerant maize (new system), the time of application as well as the number of treatments remains the same. In the presence of weeds which are difficult to control, the new system may have some advantages. The main interest of growing herbicide-tolerant maize lies in new possibilities for growing maize in mixed cropping (environmental advantages by reducing soil erosion).

Impacts on herbicide consumption, risks of dissemination of resistance genes and economic consequences of the new systems are shown in the table below:

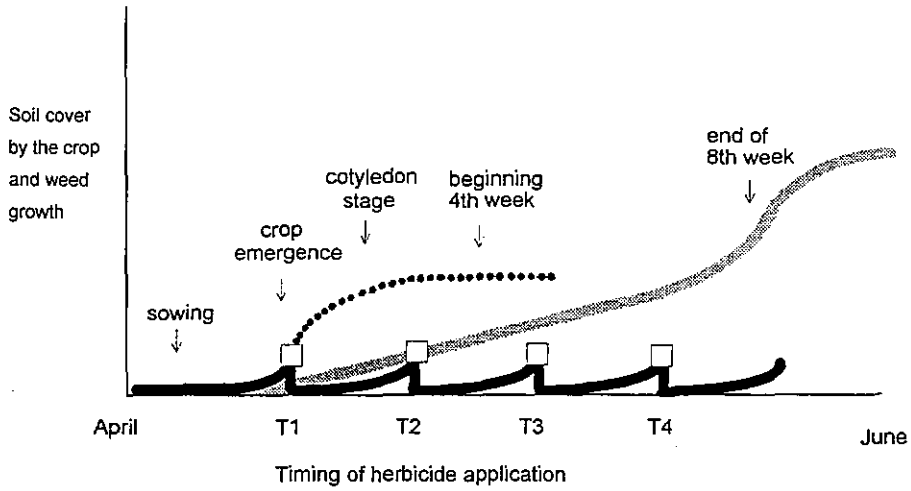
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Conclusion

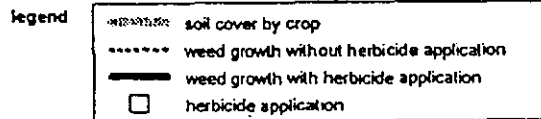
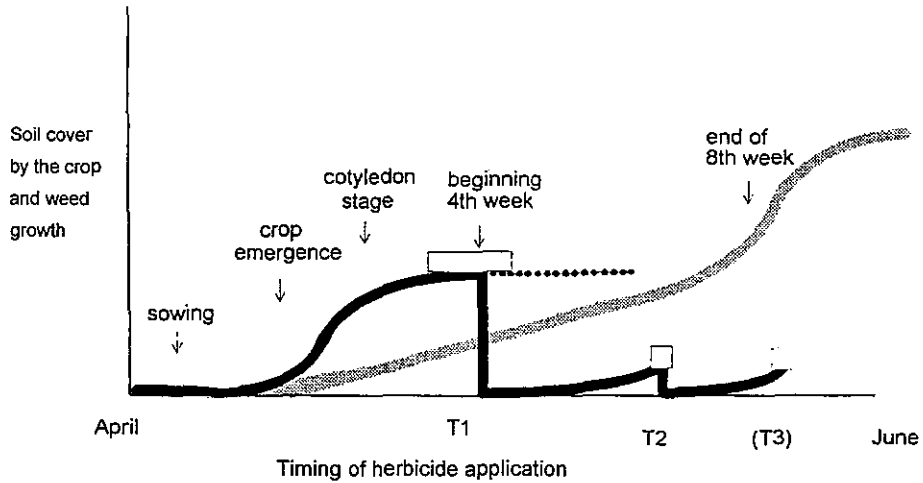
The new systems have some advantages but bear also some risks for the environment and for agriculture. Each new crop-herbicide combination must be assessed specifically, e.g. by using the analytical tool developed within the framework of this study, prior to decision-making. In future, the weed management strategy should aim at a diversification of active ingredients having a favorable environmental profile (i.e. systemic or contact herbicides, quick and complete degradation).

	Oilseed rape	Sugar beet	Maize
Can herbicide consumption be reduced?	Yes. The comparison indicates that the quantity of active ingredient applied can be substantially reduced in the new system	Yes. In the new system, both the number of applications and the total quantity of active ingredient applied can be reduced.	In general, no significant change in the quantity of active ingredient applied can be expected with the new system
Can the resistance genes be disseminated to wild species?	Yes, the risk of dissemination of resistance genes to other <i>Brassica</i> species exists. Consequence: appearance of new weeds (wild pseudo <i>Brassica rapa</i>), highly fertile and resistant to the given active ingredient used.	Yes, resistance genes can be transmitted from sugar beets to wild beets. This is not a problem in Switzerland (sugar beets in wide rotation, small area); in some regions of Europe, it could increase the already existing problem of weed sugar beets.	No. There is no such risk in Switzerland since no wild plants closely related to maize exist.
Is there an economic advantage?	Small economic advantage expected (mainly due to lower herbicide cost).	Estimated gain of 2 to 7% on gross margin (due to reduced number of applications and lower herbicide cost).	No economic advantage expected from the new systems.

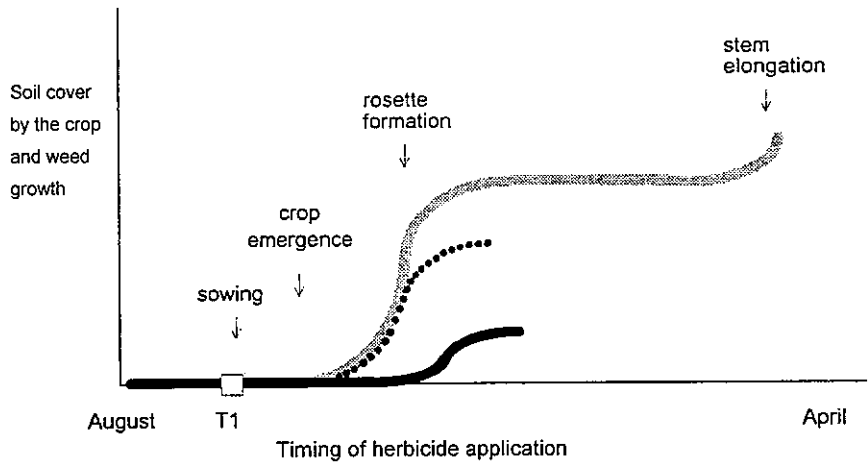
SUGAR BEET - current practices



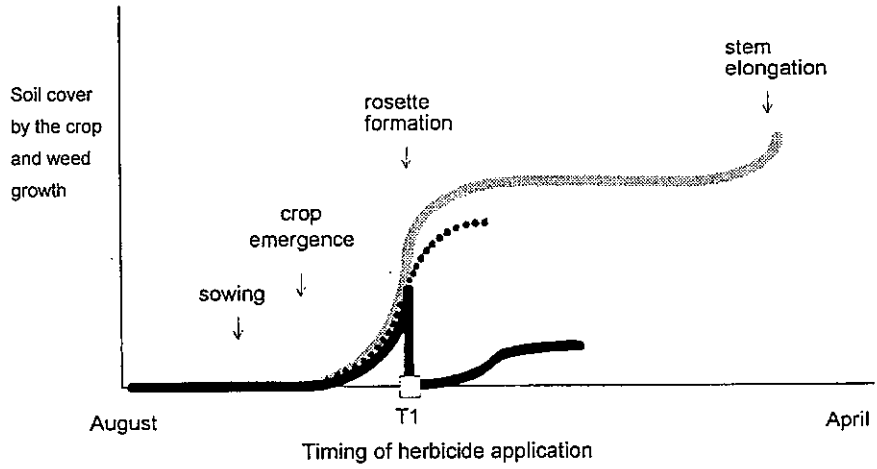
SUGAR BEET - new systems



OILSEED RAPE - current practices

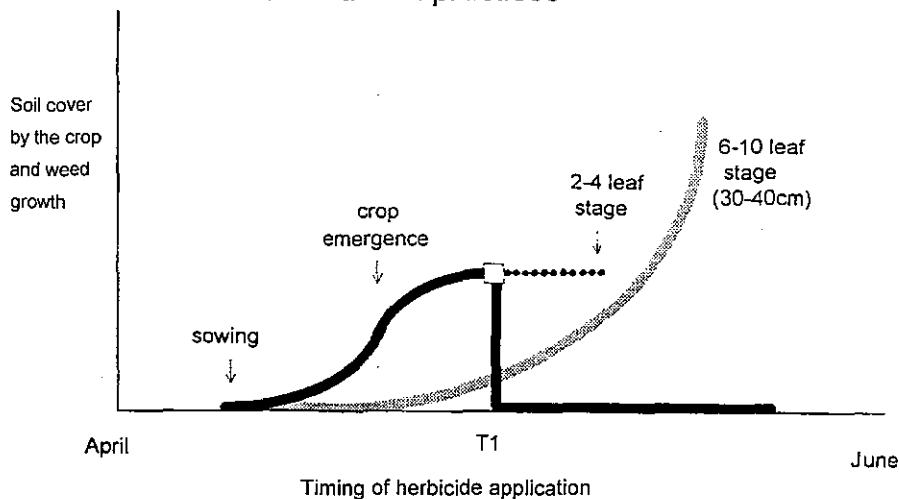


OILSEED RAPE - new systems

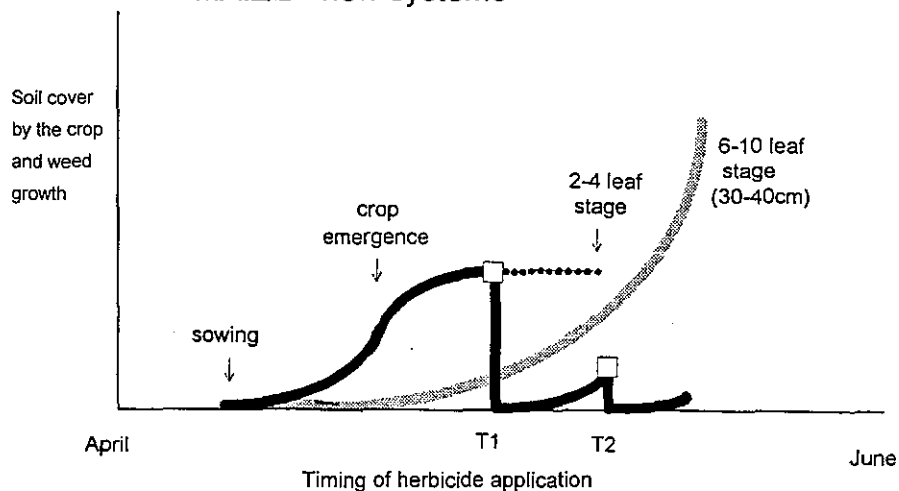


soil cover by crop	—
weed growth without herbicide application
weed growth with herbicide application	————
herbicide application	□

MAIZE - current practices



MAIZE - new systems



legend

	soil cover by crop
	weed growth without herbicide application
	weed growth with herbicide application
	herbicide application

