

Weeds and weed management in cabbages - a review

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The EWRS Working Group "Weed Management Systems in Vegetables" was established with the tasks of collecting and disseminating information and results on weeds and weed control strategies in vegetables, identifying gaps in knowledge and focusing new research projects. So far the working group have published reviews on onions (Tei et al., 1999a), tomatoes (Tei et al., 1999b; 2002b), carrots (Tei et al., 2002a) and peas (Uludag et al., 2003a; 2003b).

Information about key weeds, new weeds or species that have recently spread, effect of competition, weed management programmes in Integrated and Organic production, approved herbicides and those currently undergoing registration for use in cabbages grown under field conditions in Croatia (HR), Finland (FIN), Germany (D), Hungary (H), Italy (I), The Netherlands (NL), Poland (PL), Portugal (P), Slovenia (SLO), Spain (E), Switzerland (CH) and United Kingdom (UK) was collected.

In 2003, the world production of cabbages (i.e. headed cabbages, savoy cabbage, cauliflower, broccoli, Brussels sprouts and Chinese cabbage) was 66 millions of tons on 3.2 millions of hectares. In the surveyed countries cabbages crop surface is about 436000 ha (PL 47000 ha, I 37000 ha, E 34000 ha, UK 29000 ha, D 19370 ha, HR 11000 ha, NL 10800 ha, P 8500 ha, H 6200 ha, FIN 1320 ha, SLO 1000 ha and CH 500 ha). In all the surveyed countries more than 90% of the hectareage is treated with herbicides.

Information on organic production is very scarce: organic cabbages are about 5-10% of total production in H, less than 5% in SLO, about 3% in FIN and on few hundred hectares in UK.

The majority of the crop is transplanted but Chinese cabbage is commonly direct seeded. The season of planting is extensive involving sequential cropping from spring through to autumn. Row distance is 0.50 to 0.80 m with a planting density 2 to 6 plants m⁻² in relation to the species and the cultivar. Horticultural brassicas are usually grown on moisture retentive as well as free-draining soils (i.e. silty to silty-loam soils) but they can be also grown on heavy calcareous clay soils.

The weed communities are commonly very rich of species and their composition is highly variable in relation to climate, soil and crop period. The most important and frequent species are *Digitaria* spp., *Echinochloa crus-galli*, *Elymus repens*, *Setaria* spp., *Amaranthus* spp., *Chenopodium* spp., *Datura stramonium*, *Mercurialis annua*, *Polygonum* spp., *Portulaca oleracea* and *Solanum nigrum* in spring-summer crops and *Papaver rhoeas*, *Stellaria media*, *Cirsium arvense*, *Matricaria* spp., *Senecio vulgaris*, *Sonchus* spp., *Fumaria officinalis* and cruciferous weeds in autumn-winter crops.

Chenopodium spp. and *Galinsoga parviflora* are key weeds in H, PL, CH and I, *Urtica urens* in NL and UK (locally). *Cruciferae* species (i.e. *Capsella bursa-pastoris*, *Diploaxis erucoides*, *Sinapis arvensis*, *Thlapsi arvense*) are dominant species in FIN, UK, I and E. Further key weeds are: *Galium aparine* in some crop areas in UK; *Sonchus* spp. in CH; *Cyperus esculentus*, *C. rotundus* and *Rumex* spp. in P; *Alopecurus myosuroides*, *Lolium* spp., *Papaver rhoeas*, *Veronica* spp. in I.

IWM can control the most of weeds but some species are becoming important: *C. album* and *Polygonum* spp. in FIN; *U. urens* in NL; *Ambrosia artemisiifolia* in H; *Rorippa sylvestris* in CH; *Abutilon theophrasti*, *Panicum* spp., *Setaria viridis*, *Xanthium strumarium* in HR;

Amaranthus spp., *C. arvense*, *Convolvulus arvensis*, *Cruciferae* in SLO; *C. album*, *Cuscuta* spp., *G. parviflora* in P; *Calystegia sepium*, *Rumex* spp., *Sorghum halepense* in I.

Competitive ability of cabbages is generally greater in comparison with other vegetable crops (e.g. carrots, onions, salads, ...). Research findings show that no critical period of competition can be determined: a single weeding at 3-5 weeks after crop transplanting resulted in crop yield similar to those maintained weed-free throughout the growth cycle.

The availability of herbicides approved for use in the different crop species is very different among the surveyed countries. Taking into consideration only the "key" active ingredients, clopyralid is authorised in FIN, I and PL; metazachlor is approved in all the countries except in H and P; napropamide in HR, H, I, PL, SLO, CH, and under registration in FIN; oxyfluorfen in HR, I, PL, P and SLO; pendimethalin in HR, D, H, I, PL, P, SLO and E; pyridate in FIN, D, SLO, E and UK; propachlor in I, PL, E, CH, and UK; trifluralin in all the countries except in FIN, NL and SLO. A wide range of post-emergence graminicides is registered in all the countries except in PL for cauliflower, broccoli and Chinese cabbage.

Conventional weed control involves a soil incorporated pre-emergence/pre-transplanting treatment (trifluralin, napropamide) or non-incorporated pre-emergence/pre-transplanting treatment (pendimethalin, oxyfluorfen, propachlor, metazachlor) followed by one to two post-emergence/post-transplanting treatments (metazachlor, pyridate, clopyralid, propachlor, graminicides).

Trifluralin has a narrow spectrum of activity and it requires a moist tilth for optimum activity; moreover in dry seasons crop phytotoxicity may occur. Propachlor fails to control *Polygonum aviculare* and *Chenopodium album*. Pyridate may be applied to control *Galium aparine* in cabbage and Brussels sprouts while clopyralid to control *Cirsium arvense*, *Matricaria* spp., and *Sonchus* spp.

However, mechanical weed control (harrowing, hoeing, ridging) is often used to improve low effective chemical weed control.

IWM generally involves: 1) false seedbed technique followed by shallow harrowings or by glyphosate or gluphosinate-ammonium application; 2) pre-emergence or pre-transplanting treatment; 3) post-emergence inter-row hoeing or rotary cultivation combined with ridging for in-row weed control.

Both in conventional and integrated weed control, very early head cabbages and cauliflower can be grown in the open field under perforated polyethylene plastic flat cover or non-woven polypropylene to control insects.

Common strategy for organic production is: 1) false seedbed technique followed by shallow harrowing; 2) transplanting; 3) repeated inter- and intra-row mechanical control through the growing season sometime combined with ridging; 4) hand-weeding. Some growers also flame weeds under the cabbage leaves when crop plants are big enough. False seedbed for early cabbage production or for very late varieties seems not feasible. In organic growing of cabbages the use of plastic covers is more common than in conventional and IWM growing but it increases weed emergence and growth and the cultural costs because it must be removed before each mechanical weed control.

Further and more detailed information can be found in the WG web site www.agr.unipg.it/ewrsveg/

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