
PathOrganic - Identification of Critical Control Points for organic vegetable crops

Executive Summary

The aim of this work is the identification of Critical Control Points¹ (CCPs) for organic farms, which use manure for the production of organic lettuce, cabbage, carrots and spinach in Austria, Switzerland, Sweden, and Denmark. Due to the application of manure, vegetables are at risk to be contaminated with enteropathogens such as *Escherichia coli* pathogenic strains, *Salmonella enterica* serovar *Typhimurium*, *Campylobacter jejuni*, *Listeria monocytogenes*, and *Staphylococcus aureus*.

This work applies part of the principles and steps described for HACCP² to identify the CCPs. The steps described hereafter are reported in the course guidance document “HACCP in agriculture – Organic milk production” (van Veluw et al., 2008) and were adapted to the agricultural production of field vegetables.

The hazard analysis is based on the characteristics of the above mentioned enteropathogens and the agricultural practices applied by the organic farmers in the four countries when growing lettuce, cabbage, carrots, and spinach. The assessment of the actual agricultural practices uses the evaluation of interviews conducted with organic farmers growing these vegetables and using manure as fertiliser. In total 16 farmers in Austria, 16 farmers in Switzerland, 13 farmers in Sweden, and 9 farmers in Denmark were interviewed. In general terms, there is no agricultural practice common to the majority of organic farmers concerning the management of animal manure, fertilisation, irrigation, harvest and postharvest management when growing lettuce, cabbage, spinach, and carrots in Austria, Switzerland, Denmark, and Sweden.

¹ A Critical Control Point is a point, step, or procedure in food production at which *control* can be applied and, as a result, a food safety hazard can be *prevented, eliminated, or reduced* to an acceptable level.

² HACCP: Hazard Analysis and Critical Control Points system for the food chain. HACCP is a systematic preventive approach to food safety that addresses physical, chemical, and biological hazards as a means of prevention rather than finished product inspection. HACCP is used in the food industry to identify potential food safety hazards, so that key actions can be taken to reduce or eliminate the risk of the hazards being realized. HACCP can be applied to the whole food production chain and hence also to the primary food production at farm level.

Using the decision tree of the HACCP system, CCPs were identified for the primary production of organic field vegetables. Where appropriate, instead of CCPs were defined PRP-CPs³ or OP-PRPs⁴.

Process Step	Hazard identified	Details of practices that aggravate the hazard	Type of CP	PRP ⁵
Use of animal manure for fertilisation	Presence of enteropathogens in animal manure	-----	No CP	-----
Feed of farm animals (bovines), whose manure is used as fertiliser	Presence of high numbers enteropathogenic E. coli in bovine manure used for fertilisation due to inadequate feeding regime of the animals producing the manure. Numbers of enteropathogens in bovine manure rises with animal diet rich in concentrate such as grain, maize, maize silage.	Cattle feed with high content of maize / maize silage / concentrate (feeds high in carbohydrate)	No CP	-----
Storage of animal manure	Survival of enteropathogens in animal manure and compost with animal manure used for fertilisation due to inadequate storage conditions of the manure. Animal manure has high numbers of enteropathogens in fresh manure and if storage temperatures are low (i. e. <50°C in solid manure heaps), storage conditions are anaerobic, and if storage time is too short.	Temperature below 50°C of manure and biogas slurry during storage	CCP1	-----
		Short time of storage of animal manure, in particular slurry (liquid manure), prior to application		
		No turning of solid manure / compost pile during storage. No aeration/stirring of liquid manure during storage (anaerobic conditions)		
		Solid manure and liquid manure left uncovered (anaerobic conditions). Enhanced risk of contamination with faeces of wild animals.		

³ PRP-CP: Prerequisite Programme Control Point; Control Point covered by a Prerequisite Programme. It is a point, which needs continuous attention, but the risk can be controlled by general preventive measures, belonging to basic rules for hygienic and safe operation in a food company.

⁴ OP-PRP: Point already covered by an Operational Prerequisite Programme. Hazard, that normally is considered as 'generic', and thus managed by Prerequisite Programmes, that needs to be included in the hazard analysis at specific process steps. Its monitoring focuses on whether the Prerequisite Programme is implemented, and not on the hazard itself.

⁵ PRP: Prerequisite Programmes: Programmes that manage general preventive measures, belonging to basic rules for hygienic and safe operation in a food company For example Good Agricultural Practice, Good Hygiene Practice, etc.

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Process Step	Hazard identified	Details of practices that aggravate the hazard	CCP	PRP
Fertilisation practices/ Soil management	Exposure of vegetables to enteropathogens in the soil of vegetable fields due to inadequate fertilisation practices with animal manure. Enteropathogens are present in high numbers in soil shortly after fertilisation and can contaminate crop plants (through internalisation from soil to vegetable tissues or superficial contamination of leaves). If animal fertilisers are applied after planting, enteropathogens can be spread on vegetables.	Short time interval between application of fertiliser and planting/seeding	CCP2	-----
		Fertiliser application between planting and harvest		
		Short time interval between application of fertiliser after planting and harvest		
Fertilisation practices/ Soil management	Introduction of enteropathogens to soil by animal manure left on the surface of the soil (not incorporated to soil). From there enteropathogens can be splashed by rainfall or irrigation on the leaf surface of the vegetables and contaminate them. Introduction of enteropathogens by animal manure incorporated to soil enhances the percolation of enteropathogens with water, thus raising the risk of contamination of drain.	Controversial! Therefore no satisfying control measures could be defined	-----	-----
Site preparation: Prevention of contamination from wild animals and birds	Introduction of enteropathogens to the vegetable fields by faeces left by wild animals and birds visiting the plots	Plots visited by high numbers of wild mammals and birds	OP-PRP	Global GAP ⁶
Site preparation: Prevention of runoff and flooding	Introduction of enteropathogens to the vegetable fields by runoff from pastures with faeces and flooding	Vicinity of pastures, which are situated higher than the vegetable plots. No buffer grass strip or surface drainage channel in between	OP-PRP	Global GAP
		Vegetable fields near to surface waters. No buffer grass strip	CCP3	-----
Crop storage	Multiplication of enteropathogens on stored vegetables due to inadequate storage conditions	Storage without cooling from harvest day onwards	PRP-CP	

⁶ Global G.A.P.: Global Good Agricultural Practice.

(cont.)

Process Step	Hazard identified	Details of practices that aggravate the hazard	CCP	PRP
On farm processing	Introduction of enteropathogens through workers. No elimination of superficial enteropathogens through rinsing with clean water	No rinsing of vegetables at harvest with water with tap water quality	PRP-CP	Global GAP, ⁷ GHP ⁷
		Packaging in plastic bags combined with no cooling		
		No hygiene training of workers		
Irrigation practices	Introduction of enteropathogens to the vegetable fields by irrigation water contaminated with animal faeces. Introduction of enteropathogens to the surface of vegetable leaves by the splash of contaminated soil particles due to the use of sprinkler or spray irrigation systems, manual irrigation or rain.	Use of water not protected from contamination with faeces of <u>wild</u> mammals and birds	OP-PRP	Global GAP
		Use of surface waters for irrigation (e. g. streams, ponds, lakes), which are nearby to pastures / not protected from contamination with <u>farm</u> animal faeces	OP-PRP	Global GAP
		Use of sprinkler or spray irrigation systems, manual irrigation or rain, which splash soil particles on edible parts of vegetables	CCP4	-----

Literature

Van Veluw, K., F. Bodnar, C. Knight, R. Stanley, and C. Leifert (2008): HACCP in agriculture – Organic milk production. Course guidance document

⁷ GHP: Good Hygiene Practice

The CCPs identified are shown below along the flow diagram of the process steps of primary production of field vegetables.

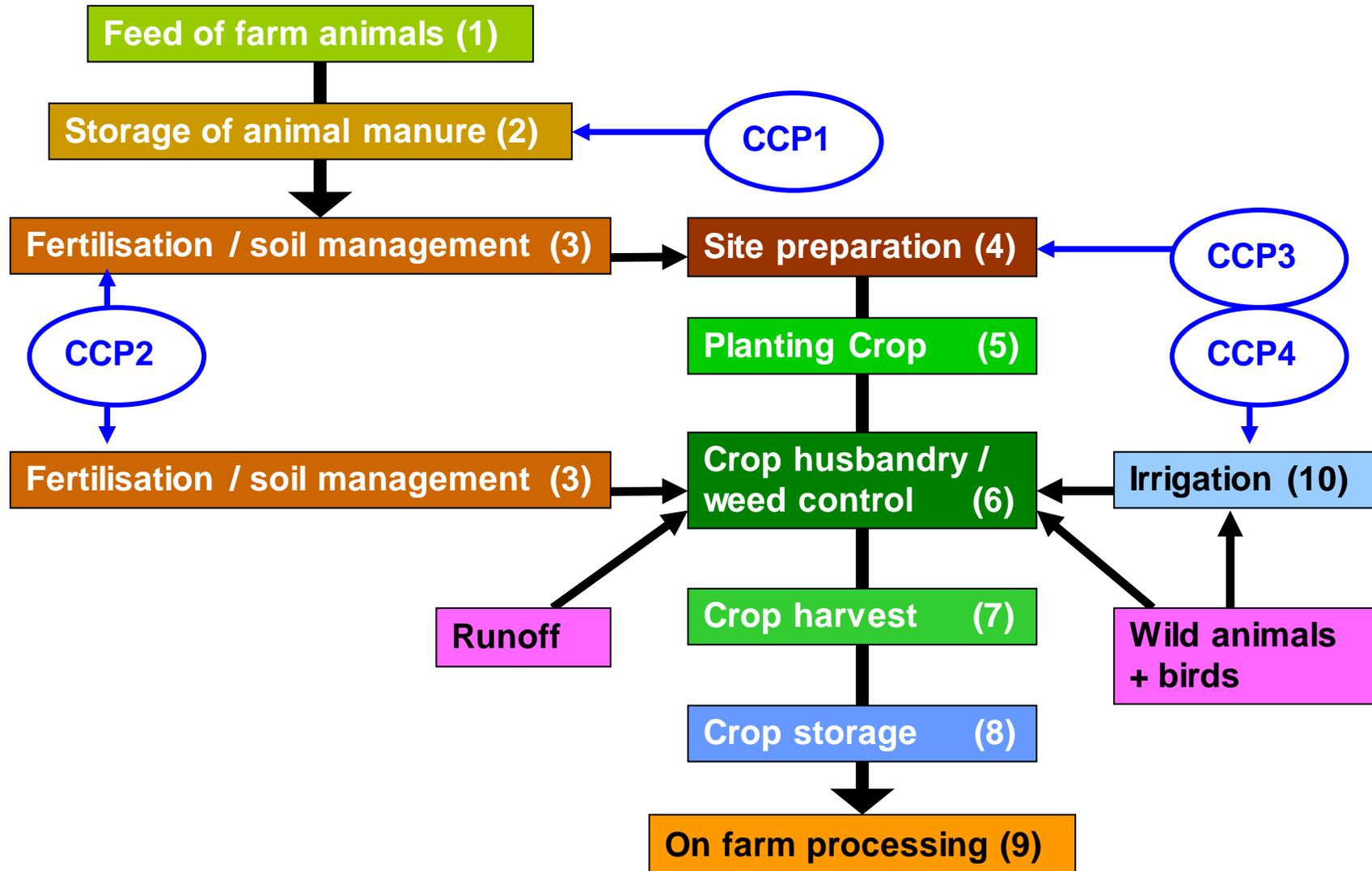


Figure 1: Flow diagram with process steps of primary production of field vegetable