Transport chains and seed spillage of potential GM crops with wild relatives in the Netherlands

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Preface

In support of its statutory obligations the Netherlands Commission on Genetic Modification (COGEM) has a budget for contract research, the aim of which is to improve the quality of its recommendations and observations concerning research on and trade in genetically modified organisms. In 2008-2009 COGEM commissioned three subprojects on admixture in the context of imports: I. Causes of admixture, II. Transport chains, and III. Monitoring feral populations. This report presents the results of subproject II, Transport chains, which was implemented by W.L.M. Tamis of the Institute of Environmental Sciences, Leiden University (CML) with the support of C.L.G. Groen (FLORON), S.H. Luijten (Institute of Biology, Leiden University (IBL)) and G.R. de Snoo (CML). Subprojects II and III were under the leadership of T.J. de Jong (IBL). Project quality was overseen by a supervisory committee comprising J.C.M. den Nijs (Institute for Biodiversity and Ecosystem Dynamics (IBED), chair), M. Bovers (COGEM, secretariat), M.M.C. Gielkens (Netherlands GMO Office (BGGO)) and A.J.W. Rotteveel (Netherlands Plant Protection Service). During this research there was frequent liaison with parties involved in the transport chains and it was their information that laid the groundwork for the present study. I would like to express my gratitude to the supervisory committee and all my contacts, especially N. de Schrijver (Bayer BioScience), for their constructive input. In the course of the research I had the brief pleasure of working with Sjoerd Peeters, who was on a traineeship at COGEM. Unfortunately he passed away in the autumn of 2008 at the age of twenty-eight. Finally, I would like to thank Nigel Harle for his conscientious translation of the report.

Wil Tamis
July 2009

Summary

Transport chains of potential GM crops in the Netherlands, in particular rape (*Brassica napus*), with a focus on spillage of seeds in the environment

At the request of the Netherlands Commission on Genetic Modification (COGEM) a study was conducted on the transport chains of potential genetically modified (GM) crops. The aim of the research was to improve understanding of the transport chains of seeds (and plants) in the Netherlands, in order to better estimate the likelihood of feral populations arising as a result of spillage during transhipment and transport operations. There was particular focus on rape (*Brassica napus*), because seeds of this species are imported in vast quantities, while at the same time it occurs as a wild plant in the Netherlands.

There are 15 potential GM crops 1) which have already been approved for global marketing or on which field trials have been carried out or are in progress, 2) which can potentially occur in the wild in the Netherlands or have related wild-growing species here, and 3) which are imported to the Netherlands or pass through the country in transit. Of these, five species were selected for further characterisation of transport chains within the Netherlands, viz.: rape, beet (*Beta vulgaris*), lucerne or alfalfa (*Medicago sativa*), poplar (*Populus* spec.) and bentgrass (*Agrostis* spec.). The transport chains of rape were investigated in particular detail, because this was the species on which most information was available and for which import volumes are by far the greatest. For results on the other crops the reader is referred to Appendix VI of this document.

There is great deal of ambiguity and confusion surrounding the terminology relating to 'rapeseed', and this issue is specifically discussed. In this document we shall use the terms 'rape' to refer to the botanical species *Brassica napus* and 'wild turnip' to refer to *B. rapa*, using 'rapeseed' in its commercial sense to cover the oil-rich seeds of both species. Rape is used in a range of applications, the most important of which are: 1) the production of vegetable oil, obtained by crushing the seeds, 2) in the form of 'oilcake' or 'meal' from the crushing process, used as animal feed, and 3) in the form of seeds included in pet food, particularly for birds and rodents. In the European Union and the Netherlands six different GM 'events' of rape (i.e. *B. napus*) are currently approved for marketing (not cultivation), all of which include tolerance to herbicides (glufosinate-ammonium or glyphosate). In terms of volume, imports of rape for oil production are the most important. In the Netherlands between 100,000 and 300,000 tonnes of rapeseed are imported annually for this purpose, but in 2007 this rose to 600,000 tonnes and in 2008 even to 1,800,000 tonnes. The bulk of this is sourced in other European countries, above all France and Germany. There is currently no information on imports of GM rape to the Netherlands. Virtually no rapeseed is sourced in North America, one of the world's main producing regions for GM varieties of this crop. A major fraction (90%) of the rapeseed destined for oil production is processed by two firms: ADM and Cargill, using hexane to extract the oil after crushing ('hot pressing'). Besides these two processors, we also considered the situation at several smaller crushing plants where the oil is extracted under high pressure ('cold pressing'). The rapeseed is brought onshore by coaster or inland barge and unloaded to a storage depot. From here it is transported to the crushing plant, where it is first cleaned and then pressed in a closed production process. Small quantities of rapeseed are used to produce 'birdseed' and rodent feed. Again the rapeseed is brought in by ship and unloaded to quayside storage from where it is later taken by

truck to the processing plant, but in this case the various cleaning and mixing steps are carried out in an open process. The main points where losses of rapeseed occur are during quayside unloading, overland (truck) transport to storage facilities (especially for the smaller crushing plants), and disposal of seed-cleaning waste. Besides being added intentionally to birdseed and rodent food, rapeseed may also be unintentionally present in the raw materials used by the pet-food industry (owing to admixture or contamination) and substantial quantities of rapeseed may consequently end up in the natural environment (when strewn outdoors), particularly in urban areas. Some of these raw materials for the pet-food industry are sourced in North America and this may therefore potentially constitute a “backdoor” for GM rape being introduced as an unintended contaminant (weed, storage, admixture) of these materials. Estimates of rapeseed losses along the transport chain vary from 0.1-0.3 percent to 2-3 percent. In 2008 and 2009 rape plants (i.e. *B. napus*) were found at several Dutch oil crushing plants. In addition, plants were also encountered at three train stations and one quayside terminal.

Finally, information was gathered on the quality control systems in force for the various transport chains, with particular focus on environmental criteria and, more specifically, losses of seed or plant material along these chains. In the wake of several recent scandals involving contaminated animal feed, a number of quality control systems have been elaborated by the industry to monitor food chains. These systems are geared to consumer protection, food safety and hygiene. In the Netherlands the General Inspection Service for Agricultural Seeds and Seed Potatoes (NAK) is charged with supervising the production of seed for sowing purposes, with approved products being awarded a certificate. In the Netherlands several agencies are involved in monitoring the quality of imports: the Plant Protection Service (PD), the Quality Inspection Service (KCB), the Food and Consumer Product Safety Authority (VWA), the Environmental Inspectorate (part of the Environment Ministry, VROM), and the NAK. In none of these quality control systems or inspection regimes does seed spillage feature as an issue of concern.

The report concludes with a number of recommendations aimed at filling some of the gaps in our knowledge (regarding other crops, import of GM crops, presence of seeds in oilcake and seed-cleaning waste from the crushing industry, and relative losses in the various steps, among other issues) and improving current procedures (inclusion of spillage in quality control systems and monitoring programmes, for example).

Samenvatting

Transportketens van potentiële GG-gewassen in Nederland, in het bijzonder van koolzaad (*Brassica napus*), met aandacht voor het morsen van zaden in het milieu

In opdracht van de Commissie genetische modificatie (COGEM) is een project uitgevoerd naar transportketens van potentiële genetische gemodificeerde (GG) gewassen. Doel van dat onderzoek was het verkrijgen van inzicht in de transportketens van zaden (en planten) in Nederland zodat de kans op verspreiding door verlies bij overslag en transport beter geschat kan worden. Hierbij is speciaal aandacht besteed aan koolzaad (*Brassica napus*), omdat dit veel wordt geïmporteerd en tevens in het wild in Nederland voorkomt.

Er zijn 15 potentiële GG-gewassen, waarvoor 1) er al wereldwijd marktvergunningen zijn, of veldexperimenten zijn of worden uitgevoerd, en 2) die in Nederland in het wild voor zouden kunnen komen of hier wilde verwanten hebben, en 3) die in Nederland geïmporteerd of doorgevoerd worden. Hieruit zijn vijf soorten geselecteerd voor nadere karakterisering van transportketens in Nederland, te weten: koolzaad, biet (*Beta vulgaris*), luzerne (*Medicago sativa*), populier (*Populus* spec.) en struisgras (*Agrostis* spec.). De transportketens zijn met name uitgezocht voor koolzaad, omdat hiervan de meeste informatie voorhanden was en er veruit het meeste van wordt geïmporteerd. Voor de resultaten van de overige gewassen wordt verwezen naar Bijlage VI van het rapport.

In Nederland wordt koolzaad tot het product ‘raapzaad’ gerekend, wat zowel koolzaad (*Brassica napus*) als raapzaad (*Brassica rapa*) omvat. Dit leidt mogelijk tot een ongewenste spraakverwarring. Koolzaad kent diverse toepassingen, waarvan de belangrijkste zijn 1) zaden voor olieproductie, 2) schroot, het afvalproduct van het persen van de zaden, voor veevoeder en 3) zaden voor voer voor met name vogels en knaagdieren. In de Europese Unie en Nederland zijn er op dit moment zes verschillende GG-events toegestaan van koolzaad, die herbicide tolerant zijn tegen glufosinaat-amonium of glyfosaat. In volume is de import van koolzaad en raapzaad voor olieproductie het belangrijkste. In Nederland wordt hiervan tussen 100.000-300.000 ton geïmporteerd voor olieproductie, maar in 2007 is dit 600.000 ton en in 2008 zelfs 1.800.000 ton. Het grootste deel van de import komt uit Europa, in het bijzonder Duitsland en Frankrijk. Er is geen informatie over de import van GG-koolzaad in Nederland. Er wordt vrijwel geen koolzaad of raapzaad geïmporteerd uit N-Amerika, een van de belangrijkste gebieden voor de productie van GG-koolzaad. Het grootste deel (90%) van het koolzaad of raapzaad voor de olieperserij wordt verwerkt door ADM en Cargill, waarbij de olie na persing wordt geëxtraheerd met hexaan (warme persing). Daarnaast hebben we een reeks kleinere olieperserijen in kaart gebracht. De olie wordt hier geëxtraheerd door hoge druk (koude persing). De zaden komen per coaster of binnenvaartschip aan, wordt opgeslagen, en vanuit de opslag getransporteerd naar de olieperserij, waar het eerst wordt geschoond en vervolgens geperst in een gesloten productieproces. Kleine partijen worden gebruikt voor de productie van vogel- en knaagdiervoer. Hierbij wordt het per schip aangevoerd, opgeslagen en vervolgens per vrachtauto vervoerd naar de fabriek. Hier vinden verschillende schonings- en mengingsstappen plaats in een open productieproces. De belangrijkste plekken waarbij verlies van zaden optreedt is bij de overslag van schip naar land, bij transport per vrachtauto naar de opslag (in het bijzonder bij de kleinere olieperserijen) en bij afvoer van het schoningsmateriaal. Door vervuiling of vermenging van koolzaad of raapzaad

in basisproducten voor de diervoederindustrie kunnen er aanzienlijke hoeveelheden hiervan (als strooivoer) in het milieu terechtkomen, met name in stedelijke gebieden. Een deel van deze basisproducten voor vogelvoer komt uit N-Amerika en hiermee is dit een mogelijke sluiproute voor de introductie van GG-koolzaad, dat als verontreiniging (onkruid, opslag, vermenging) meelift met deze basisproducten. Schattingen voor verlies van koolzaad of raapzaad tijdens de transportketen lopen uiteen van 0,1-0,3 procent tot 2-3 procent. In 2008 en 2009 zijn planten van koolzaad (*B. napus*) gevonden bij diverse olieperserijen. Daarnaast zijn ook bij drie stations en een overslagpunt planten van koolzaad (*B. napus*) aangetroffen.

Tenslotte is informatie verzameld over kwaliteitssystemen voor de verschillende transportketens, waarbij speciaal gelet is op milieu-eisen, in het bijzonder het verlies van zaad- of plantmateriaal gedurende de keten. In verband met enige schandalen met verontreinigd veevoer in het verleden zijn er door de betrokken sectoren verschillende kwaliteitssystemen voor ketens gemaakt. Deze systemen zijn gericht op de bescherming van de uiteindelijke consument, op voedselveilheid en hygiëne. Op de productie van zaaizaad houdt de NAK in Nederland toezicht. Eenmaal goedgekeurd krijgt het product een certificaat. In Nederland zijn er verschillende instanties betrokken bij de bewaking van de kwaliteit van de import: Plantenziektenkundige dienst, KCB, VWA, Ministerie van VROM, Milieu-inspectie en NAK. Bij al deze systemen en controles wordt geen aandacht besteed aan het morsen van zaad.

Het rapport wordt afgesloten met een aantal aanbevelingen gericht op een aantal hiaten in de kennis (bijv. de overige gewassen, de import van GG-gewassen, aanwezigheid van zaden in schroot en schoningsmateriaal, de hoeveelheden verlies in de verschillende stappen) en op verbetering van de procedures (bijv. meenemen van morsen in kwaliteitssystemen en controles).

Contents

1 Introduction

1.1 Background: spillage of seeds during transport

In 2005 the Netherlands imported 2,991 million Euro's worth of grains, seeds and pulses. Of this figure, € 1,356 million was accounted for by oilseeds, the bulk of which are used for vegetable oil production and animal feed (CBS-LEI 2006). Seed imports are mainly of soy, maize (corn), cotton and rape, genetically modified varieties of all of which are already grown on a large scale in a number of countries including the United States, Canada and China. Some of these genetically modified (GM) crops have already been approved for marketing in the Netherlands. They generally enter by way of the country's four main ports: Rotterdam, Amsterdam, Zeeland and Groningen. Following unloading and storage, the seeds are transported by truck or shipping vessel to processing industries such as crushing plants and animal feed facilities. Contamination of imports with GM crops has been demonstrated on repeated occasions. These GM crops may either be approved, and thus deemed safe, or unapproved. It is not only legal considerations of consumer choice and food safety that make contamination an important issue, but also environmental safety concerns. Losses during seed transhipment and transport may lead to these GM crops spreading. In the Dutch situation, some of the crops imported may become established in road verges, for instance, where they may persist as weeds and go to seed. Rape (*Brassica napus*) is a well-known example of a crop that is subject to regular spillage (Crawley & Brown 1995, Yoshimura *et al.* 2008). Meanwhile, the first finds of GM rape have been reported from areas where it is not in cultivation, including Japan (Saji *et al.* 2005, Nishizawa *et al.* 2009) and Belgium (e.g. AGD 2008a). As influx of seeds to the environment increases due to seed losses in transhipment and transport, it is by no means inconceivable that crops with a tendency to form feral populations may be able to persist for extended periods and perhaps even become naturalised. In that case, the species in question will be added to the 'Standard List of the Dutch Flora' (Tamis *et al.* 2004). As GM varieties of imported crops able to survive or flourish in the Dutch environment begin to make their appearance here, these may likewise escape and become established. This means the transgenes will then also migrate into the wider environment, even if they confer no selective advantage. This also has implications for the likelihood of stacking and out-crossing of transgenes in the natural environment as well as for the compulsory monitoring in force for cultivation, import and processing of these genetically modified strains.

1.2 Problem definition and research goal

The extent to which spillage and other losses indeed occur during transhipment and transport and whether this has already led to the establishment of feral populations of the plants in question is as yet unclear. This is why research is needed on the transport chain from quayside unloading to processing facilities, including the manner in which transport is organised, and the probability of product losses.

The aim of the present subproject is: *to improve understanding of these transport chains, in order to better estimate the potential risk of feral populations arising as a result of spillage during transhipment and transport operations.*

The following specific questions have been addressed:

- What crops are currently imported as seeds?
- What are the main (potential) GM import crops involving a risk of establishment? Are some of these already being imported as GM crops?
- What are the practicalities of import, transhipment, storage and transport to processing facilities?
- At what points in this chain do losses (spillage) occur and what is their magnitude?
- Have losses already led to feral populations becoming established?
- What risk procedures are in force for these transport chains and to what extent is consideration given to losses to the environment?

Rape (*Brassica napus*) features especially prominently in this study because this species is imported on a large scale and is on the 'Standard List of the Dutch Flora', indicating that the species can persist in the environment for at least several generations.

1.3 Methods and research products

As an initial step we sought to draw up a comprehensive list of the seeds currently imported to the Netherlands. Based on relevant criteria, from this list a number of crops were selected, GM varieties of which might possibly be imported to the Dutch market at some time in the future. Based on a series of interviews with representatives of the product boards concerned (Animal feed; Margarine, Fats & Oils; Grains, Seeds and Pulses), the country's main processing industries, the Ministry of Economic Affairs, Statistics Netherlands and the Agricultural Economics Research Institute (LEI), imports and mode of import were quantified for each of the selected crops (Appendix III). Use was also made of several import-export databases, including CBS/Statline. The points of entry to the country and transport routes to processors were then identified. A number of oilseed crushing plants were visited and their managers interviewed about the risk procedures in force, the potential for losses and the relative share of GM varieties in aggregate rapeseed imports. When rape plants were found flowering in the wild, plants and seeds were collected for the purpose of Subproject III.

1.4 Reading guide

Following this introduction, Chapter 2 provides information on the various types of seeds imported to the Netherlands. Based on relevant criteria, from these a number of crops were selected for characterisation of transport chains. Chapter 3 is a detailed account of the results obtained for rapeseed. Chapter 4 examines the quality control systems encountered. Chapter 5 presents conclusions and recommendations. A list of abbreviations is provided in Appendix I, and more detailed information on several issues in further appendices.

2 Import of seeds and selection of potential GM crops

2.1 Introduction

Which potential GM crops involve a risk of spillage or other losses and establishment of the species concerned in the Netherlands? To answer this question, it was first investigated which seeds and plants are imported to the country. This proved to yield insufficient data, though. The information retrieved has been included as Appendix IV. For this reason, attention then turned to the class of 'potential GM crops' and which of these might possibly cause potential risks in the Netherlands. From these a further selection of crops was then made, for which the transport chains were analysed.

2.2 Selection of seeds and crops for transport chain analysis

What crops count as 'potential GM crops' and which of these might potentially lead to potential risks in the Netherlands? To answer these questions three criteria were employed.

The first criterion used for identifying potential GM crops was the existence of marketing licenses or ongoing or completed field trials, both considered at the global level (data from COGEM). The reasoning here is that some of these (potential) GM crops might also in principle be imported to the Netherlands or grown or processed here. Our findings on licenses and field trials are presented in Appendix V. Certain sources were *not* used for the purposes of selection. Thus, the list provided in the document *Inperkingsmaatregelen bij activiteiten met genetisch gemodificeerde planten* ("Restrictions on activities with genetically modified plants"), dating from 2004, was not used, as this relates only to greenhouse trials. Nor was the list of 42 'high-risk species' drawn up by De Vries *et al.* (1992) used, as there is no clear explanation of the grounds on which these species were selected, for the list also includes crops like *Anthurium* that have no related species growing wild in the Netherlands. One key criterion used in the cited study is that species are not deemed 'high-risk' if the National Herbarium contains no hybrids between these wild species and their cultivated relatives. We reject this position, though, as hybrids are often very hard to identify and so are only rarely collected.

The second criterion employed in the present study was that the (potential) GM crops should also occur in the wild in the Netherlands or have wild-growing relatives here (at the genus level, so-called 'congeners'). To this end, use was made of the 'Standard List of the Dutch Flora' (Tamis *et al.* 2004).

Finally, for each of the (potential) GM crops satisfying both these criteria it was investigated whether the species is imported to the Netherlands (Trademap 2008). In the present context, the focus was on seeds and on plants for propagation, and not on fruit and vegetables for human consumption. If a (potential) GM crop is potentially able to establish itself in the Netherlands, but there is no trade in it, there will be zero risk. For certain GM crops the only trading information available is at a more aggregated level (under the heading 'Trees', for example).

Table 1. 'Potential GM crops' of relevance for the Netherlands: number of market approvals and field trials worldwide for crops with congeneric wild species growing in the Netherlands, with Dutch imports and exports in 2007. * = including *Brassica rapa*, but not including rape meal; ** no information, but only cut flowers; *** misspelled as *Agrostides* in customs description.

Scientific name of crop - customs description	Approved GM crop	Recent field trials	Old field trials	Import (tonnes)	Export (tonnes)
*Brassica napus**	15	97	30		
- rape or colza seeds				926,028	65,187
Beta vulgaris	3	6	9		
- sugar beet seed, for sowing				866	2
- salad beet seed or beetroot seed *Beta vulgaris* var. *conditiva*, for sowing				183	48
- fodder beet seed *Beta vulgaris* var. *alba*, for sowing				74	14
Medicago sativa	1	26	11		
- seeds, lucerne (alfalfa), for sowing				598	1081
Agrostis spec.	1	2	12		
- vetch seed, seeds of the genus *Poa*, cocksfoot grass *Dactylis glomerata*, and bentgrass *Agrostis****, for sowing				3,146	3,292
Chicorium intybus	1	-	1		
-witloof chicory, fresh or chilled				2,734	20,746
- chicory plants and roots (excl. chicory roots of the variety *Cichorium intybus sativum*)				0	1999
Prunus domestica	1	-	4		
- fresh plums				55,975	34,260
- apricot, peach/plum stones & kernels n.e.s., used primarily for human consumption (2006)				470	24
- trees, shrubs and bushes, grafted or not, of kinds which bear edible fruit or nuts (excl. vine slips)				232	7491
Populus spec.	-	35	14		
- outdoor trees, shrubs and bushes, incl. their roots (excl. cuttings, slips and young plants, and fruit, nut and forest trees)				7,904	140,971
- live forest trees				246	13,572
- outdoor rooted cuttings and young plants of trees, shrubs and bushes (excl. fruit, nut and forest trees)				473	4,652
Malus sylvestris	-	8	6		
- fresh apples				351,206	355,544
- for trees, see *Prunus domestica*					
Solanum nigrum	-	4	1	-	-
Brassica oleracea	-	-	10		
- cabbages and cauliflowers, fresh or chilled				67,965	174,549
- vegetable seed for sowing (excl. kohlrabi, etc.)				9,687	9,349
- kohlrabi seed *Brassica oleracea* var. *caulorapa* and *gongylodes* for sowing				28	25
Dianthus	14	-	-		
- fresh cut carnations and buds, suitable for bouquets, etc.				**	**
- seeds of herbaceous plants cultivated mainly for flowers, for sowing				752	424
Pinus spec.	-	48	7		
- see *Populus* spec.					

Continuation of Table 1.

Scientific name of crop - customs description	Approved GM crop	Recent field trials	Old	Import (tonnes)	Export (tonnes)
Lolium spec.	-	4	3		
- Italian ryegrass, incl. Westerwolds *Lolium multiflorum*, seed for sowing				6,548	5,901
- perennial ryegrass *Lolium perenne*, seed for sowing				9,213	23,127
Rosa spec.	-	4	2		
- roses, grafted or not				770	11,818
- fresh cut roses and buds, suitable for bouquets, etc.				**	**
Lactuca spec.	-	-	8		
- cabbage lettuce (head lettuce), fresh or chilled				18,487	28,366
- fresh or chilled lettuce (excl. cabbage lettuce)				33,994	53,569
- seeds for sowing, see *Brassica oleracea*					

Ultimately, a list of 15 'potential GM crops' emerged that might possibly be a potential risk for the Netherlands because they satisfy all the cited criteria (Table 1). From this list, five crops were then selected for analysis of transport chains: rape (*Brassica napus*), lucerne/alfalfa (*Medicago sativa*), beet (*Beta vulgaris*), bentgrass (*Agrostis* spec.) and poplar (*Populus* spec.). With this selection of crops we sought to include a variety of transport chains, thereby assuming that the chain for poplar is very different from that for rape, for example. With some of these crops it is only import of seed for sowing that is important. Although in principle import of GM sowing seed is only feasible in the case of approved species, implying no need to examine the transport chain, we considered it necessary to do so, for two reasons. The first is that there may be unintended cross-contamination, between GM and non-GM sowing seed of a particular crop, for example. Second, knowledge on the transport chain provides useful information in the context of general surveillance and monitoring.

3 Transport chain of rape (*Brassica napus*)

3.1 Introduction

Of the five crops selected for analysis of transport chains, it is above all rape that is imported in major quantities (cf. Table 1). It was also the crop on which most information was available and for these reasons it is the subject of a separate chapter. Many field botanists have difficulty distinguishing rape (*Brassica napus*) (also known as swede rape, canola (a particular group of cultivars), oilseed rape, etc.) from wild turnip (*Brassica rapa*) (also known as colza, turnip rape, birdseed rape, Polish rape, field turnip, field mustard, etc.). This is one of the topics under study in Subproject III (see Preface), which is examining the occurrence of rape and wild turnip in the wild in the Netherlands. In commercial circles there is confusion between the two species, too, however. This issue is discussed in § 3.2. In § 3.3 we turn to the various uses of rapeseed and to marketing licenses for GM rape in the Netherlands. Data on rapeseed imports are treated in § 3.4; these provide an indication of the scale of post-import transhipment, storage and transport. This forms the starting point for a discussion in § 3.5 of the various chains involved in the transhipment, transport and processing of rapeseed. In § 3.6, finally, an indication is given of where the greatest losses might potentially occur and observations to date of rape plants encountered in the wild.

3.2 Rape (*Brassica napus*) or wild turnip (*Brassica rapa*)?

In international trade and product classification schemes, the term 'rapeseed' is used to refer to the oil-rich seeds of several related plants known collectively as 'oilseed rape'. Of these, the most important are *Brassica napus* and *Brassica rapa* (specifically, the subspecies *oleifera*), both of which occur in the wild in the Netherlands and elsewhere in Europe and are known botanically as 'rape' and 'wild turnip', respectively. When cultivated as a root crop (subspecies *napobrassica* and *rapa*, respectively), the plants are referred to as 'swede rape' and 'turnip rape', yielding swedes and turnips, which today are used predominantly as fodder crops. Other cultivars are known by different names again. Unfortunately, this terminology is by no means standardised across scientific and commercial circles, and the terms 'rape', oilseed rape', 'rapeseed' and 'turnip' are in practice used to refer to a bewildering number of allied plants and products, which in the context of GM crops and the potential for escape and hybridisation is unfortunate. In the Netherlands the problem is further compounded by the fact that the generic name for the crops used commercially for rapeseed oil production, 'raapzaad', is also the botanical name for one of them: the wild turnip, while the vast bulk of the rapeseed processed in the country in fact derives from rape, known botanically as 'koolzaad'.

As stated, in international trade classification no distinction is made between these two kinds of 'oilseed rape'; see Table 1 and Table A in Appendix IV, where the reference is to "rape or colza seeds". In the Netherlands, too, the various parties involved in the oilseed rape transport chain use the term 'raapzaad' in this wider sense, thereby following the description of the Product Board for Animal Feed (PDV) cited in translation in Table 2. The Dutch product description runs largely parallel to the English-language description employed in European Union trade statistics; see Table 2. What is noticeable in this case

Table 2. Definition of the product 'raapzaad' or rapeseed according to the Netherlands Product Board for Animal Feed (PDV) and Eurostat classification. [ ] = correction of misspelling. Source: PDV (2009a), EU (2009).

PDV: "raapzaad

[*translated*] Seeds of rape Brassica napus L. ssp. oleifera (Metzg.) Sinsk. or Indian sarson Brassica napus L. var. glauca (Roxb.) O.E. Schulz and of wild turnip Brassica campe[s]tris L. ssp. oleifera (Metzg.) Sinsk. (minimum botanical purity: 94%)."

Eurostat: "rapeseed

Seeds of rape Brassica napus L. ssp. oleifera (Metzg.) Sinsk. or Indian sarson Brassica napus L. var. glauca (Roxb.) O.E. Schulz and of rape Brassica napa ssp. oleifera (Metzg.) Sinsk. (minimum botanical purity: 94%)."

is that the name "rape" is used to refer to both species, and that while an attempt has been made to use the current name for *B. rapa* this has, confusingly, been misspelled to "*napa*". At the same time, though, while the oilcake or meal from oil production is said to be derived from 'raapzaad', the material left after rapeseed harvest is referred to, now correctly, as 'koolzaad' straw. Two other details stand out: the wild turnip is still cited under an old, no longer valid, scientific name, and up to 6% admixture with another product is permitted. Such mixing with other products is apparently standard practice.

Surprisingly, many of the parties in the Dutch transport chain are unaware that the product names 'rapeseed' and 'raapzaad' encompass both wild turnip (i.e. Dutch 'raapzaad' *sensu stricto*) and rape (i.e. Dutch 'koolzaad'). There was sometimes even emphatic denial that information on 'rapeseed' or 'raapzaad' in fact generally refers to rape *sensu stricto*. The situation is compounded further by the international (i.e. English-language) nature of the rapeseed trade, for while the term 'oilseed rape' is a catch-all term for the oil-rich subspecies of the two plant species, it is also often used (by the general public, for example) to refer exclusively to rape (*B. napus*).

To avoid ambiguity, in this document we shall employ the terms 'rape' to refer to the botanical species *B. napus* and 'wild turnip' to refer to *B. rapa*, using the term 'rapeseed' (but not 'oilseed rape') in its commercial sense to refer to the oil-rich seeds obtained from both species and, by implication, the two plants themselves. It should be borne in mind, though, that the vast bulk of the rapeseed produced and processed in the Netherlands is *B. napus*, i.e. rape, and that the majority of GM rapeseed varieties also concern this species

3.3 Uses of rape (*Brassica napus*) and permitted GM events

This section examines the various applications of rape (and not wild turnip) and the GM rape 'events' currently approved for marketing in the Netherlands. Uses (i.e. product categories) of this species include: seed for sowing, seed for oil production and for

Table 3. Applications of rape (*Brassica napus*) in the Netherlands. + = present, (+) = marginally present, - = absent, ? = unknown.

product	domestic production	import
Sowing		
1. Seeds		
- for oil production	+	+
- for fields and road margins	+	+
- for feed and food (swedes)	(+)	?
Oil production		
2. Seeds (winter and summer cultivars, F1 hybrids) with low glucosinolate content		
- with high erucic acid content for industrial application	?	(+)
- with low erucic acid content for food, feed and fuel (biodiesel)	+	+
Feed production		
3. Seeds		
- for pet food (also disapproved materials)	+	+
4. Cake or meal, i.e. the waste from the seed-crushing process		
- for cattle (cows, pigs, poultry)	+	+
5. Straw, after harvesting of the seeds		
- for cattle housing	+	-
6. Roots (turnip)		
- for cattle (cows, pigs)	(+)	?
Food production		
7. Roots (swedes) or leaves		
- vegetables for human consumption	(+)	?

animal feed and pet food, and tubers (i.e. swede turnips, or swedes) for human consumption (Table 3). The bulk of the seed is used for oil production. A distinction is made between winter and spring rape, the former being sown in the autumn in regions with mild winters, the latter in spring in regions with harsher winters (like Canada, for example).

Yields of winter rape are higher than those of the summer type. Modern varieties are almost all so-called high-yielding F1 hybrids. Rapeseed contains two important classes of plant metabolites: erucic acids and glucosinolates, which in traditional cultivars are present in high levels. For human consumption and biodiesel production, however, it is essential that not too much of either group of compounds is present. Modern varieties have therefore been bred to contain low or zero levels of erucic acids and glucosinolates and are referred to as 'double-low' or 'double-zero' varieties. For certain industrial applications, varieties with a high erucic acid content are generally preferred. The residues from oil-pressing are processed into livestock feed. Depending on the process employed (§ 3.5) these residues are referred to as 'rapeseed (oil)cake' (from cold pressing) or 'rape meal' (from hot pressing). These by-porducts are in high demand because of their high protein content and, in the case of cold pressing, high oil content. The crop residues left after the seed pods are harvested is known as rape straw and is likewise processed in the fodder industry. Rapeseed also serves as one of the raw materials for production of pet food, in particular seed mixtures for birds (‘birdseed’). These may be batches procured primarily for this purpose or batches that have for some reason been rejected.

Certain ‘leafy’ varieties of rape are used as green manure on arable farmland, as well as a foraging crop for game (deer, etc.) and in ‘wildflower mixtures’ for verges and fields. Finally, certain varieties of the species are grown for the root crop known variously as swede, Swedish turnip, yellow turnip and rutabaga. The young leaves are also eaten as ‘spring greens’. Swedes used to be grown as both food and fodder, but today there is virtually no human consumption of this, one of the many ‘forgotten vegetables’. Swedes are often confused with turnips (which derive from wild turnip, *Brassica rapa*) and kohlrabi (a variety of cabbage, *Brassica oleracea*). Virtually every type of rapeseed imported to the Netherlands is produced domestically, too.

Table 4. Approved GM events of rape (*Brassica napus*) in the EU and the Netherlands; for further explanation, see text; gen. = genetic; * = hybrid system based on ♂-sterility and fertility restoration.

event	remark	transgenes
GT73	license for import and processing until 2017	glyphosate tolerance + 5 other gen. elements
Ms8xRf3	license for import and processing until 2017	glufosinate-ammonium tolerance + 6 other gen. elements (*)
MS1xRF1	license expired in 2007, but traces allowed for 5 years	glufosinate-ammonium tolerance + other gen. elements (*)
MS1xRF2	license expired in 2007, but traces allowed for 5 years	glufosinate-ammonium tolerance + other gen. elements (*)
Topas 19/2	license expired in 2007, but traces allowed for 5 years	glufosinate-ammonium tolerance + other genetic elements
T45	license in 2009 for import and processing until 2019 see text	glufosinate-ammonium tolerance + other genetic elements

In the European Union and the Netherlands six different GM ‘events’ of rape (i.e. *B. napus*) are currently approved for marketing (not cultivation) (Tab. 4). The licenses issued are all for import and processing, mainly for oil production. The ‘events’ are all characterised in showing herbicide tolerance to one or other of the active ingredients glufosinate-ammonium (5x; marketed by Bayer under names including ’Liberty’) or glyphosate (1x; marketed since 1970 by Monsanto as ‘Roundup’). Three events have transgenes giving male sterility. Events GT73 and MS8xRF3 were licensed under EU directive 2001/18EC for import and processing and the license remains valid until 2017. The events MS1xRF1, MS1xRF2 and Topas 19/2 were approved for use until 2006 under EU directive 90/220/EC (the precursor to EU directive 2001/18/EC), but the licenses have not been renewed and these products are to be taken off the market. There is a so-called 'transitional period' in force for potential unforeseen presence of these three varieties (to a maximum of 0.9%, for a period of 5 years from 2007). A sixth GM event, T45, was licensed in early 2009, but this will only be imported in very low quantities. This variety has already been phased out in Canada and its presence therefore will further decrease over time. So while T45 will not be intentionally imported, a license is mandatory to cover unintentional admixture.

3.4 Rapeseed import

3.4.1 General

The transport chain of rapeseed (i.e. rape and wild turnip seed) and of (potential) GM rape in the Netherlands starts with importation to the country. This is the subject of the present section. Information has been gathered on rapeseed imported as seed for sowing, as a feedstock for oil production and as rapeseed oilcake. The commercial data sources used and the problems in interpreting import and other trade statistics are set out in Appendix IV. After import to the Netherlands the crop is transhipped, stored and transported to processors, creating further scope for losses.

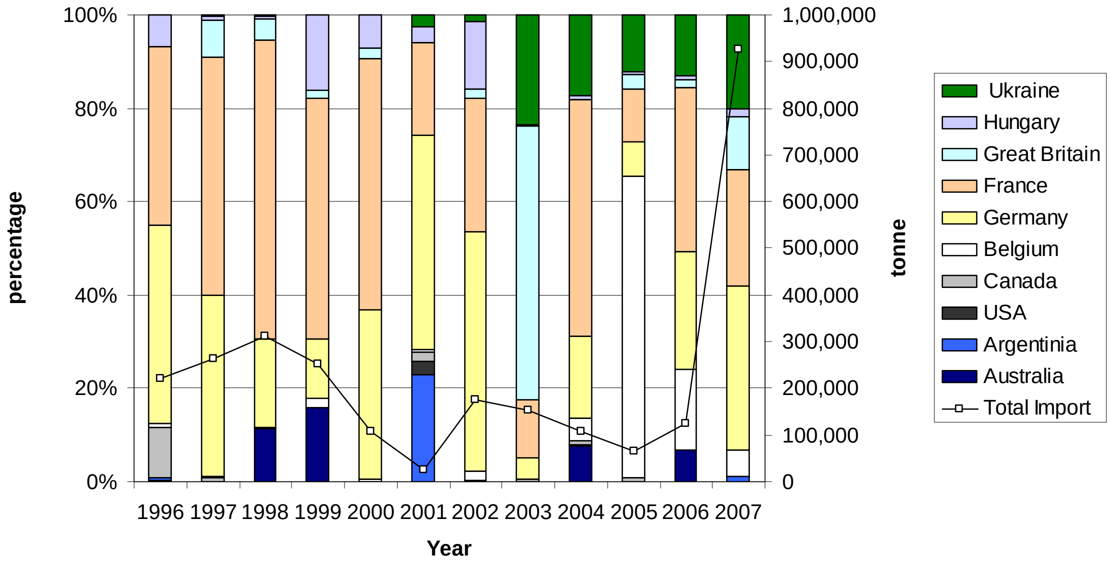


Figure 1. Import of rapeseed to the Netherlands, showing provenance (bar %) of imports and total import in tonnes (line); N.B. Ukraine also includes some small imports from other former USSR-states. Source: FAOstat 2008, CBS 2008.

3.4.2 Import of rapeseed to the Netherlands

Figure 1 shows the total tonnage of rapeseed (i.e. the seed of rape and wild turnip) imported annually to the Netherlands up to the year 2007. These data are for the sum total of seeds from the two plants, whether they are destined for use as sowing seed or as oilseed with a specifically high or low erucic acid content. Aggregate imports of rapeseed generally fluctuate between 100,000 and 300,000 tonnes, with a surge to 900,000 tonnes reported in 2007. This figure probably includes 300,000 tonnes of sunflower seeds, making 600,000 tonnes of imports in 2007 a more realistic value (pers. comm. MVO, 2008). The provisional statistics for 2008 once again point to a marked rise in imports, now up to 1,800,000 tonnes.

There are various reasons for the sharp growth in imports the past few years. One is that ADM, one of the Netherlands' largest oilseed processors, started using rapeseed in 2007 (pers. comm. MVO, 2008). Another is that the acreage devoted to this crop has declined in the Netherlands and across Europe. The main reason has to do with prices, though. Because of the fall in the crude oil price in 2008, there is less demand for biodiesel and the price of rapeseed has consequently slumped (e.g. AGD 2008b). In 2007 the rapeseed price was still fairly high, but so was the oil price. Imports of rapeseed far outstrip (by a factor 30,000) domestic output in the Netherlands, which totalled 3.5-12 tonnes between 2003 and 2007 (MVO 2008). Imports of rapeseed for sowing are also minimal compared with those destined for oil production. Between 1997 and 2008 the former totalled 100-700 tonnes, less than one-thousandth of aggregate imports (CBS 2008). According to the statistics, this figure for sowing seeds is made up entirely of low erucic acid rapeseed, or LEAR. The acreage set to rapeseed in the Netherlands itself requires around 200 tonnes of sowing seed (approx. 200 kg/ha). Imports of high erucic acid rapeseed, or HEAR (comprising both rape and wild turnip), for industrial processing are currently minimal compared with those of 'double-zero' varieties. During the past five years (up to and including 2008) between 2,000 and 9,000 tonnes of HEAR was imported annually, equivalent to less than 10% of total imports (CBS 2008). Just about all the rapeseed imported to the Netherlands and processed here thus currently consists of double-zero varieties. The vast bulk of these imports are from Europe, mainly from France and Germany, but in some years from the UK and Belgium, too. A growing share of imports now comes from Ukraine. There are sporadic imports from other continents: from South America and Australia in 1999 and 2001, for example. Only in 1996 were there any imports from North America. This topic will be returned to later. When it comes to the transport chain, there are numerous firms trading in batches of rapeseed, which can change hands many times in the course of transportation. As a result, there may be major anomalies in Dutch import and export data.

Between 1996 and 2003 annual imports of rape meal (from both rape and wild turnip) stood at around 500,000 tonnes. Since then these have grown to approximately one million tonnes. Of this figure, some 60-75% is accounted for by LEAR varieties. No rape meal is imported from North America (CBS 2008).

3.4.3 Import of GM rape to the Netherlands

How much do we know about imports of GM varieties of rape to the Netherlands? In trade statistics no distinction is made between GM and non-GM crop varieties. Although such information is cited on transport documents, this is trade information that may not be made public. An analysis of import of GM varieties in the Netherlands would require the cooperation of port authorities and firms. According to Canadian sources who have studied the port documents of the shipments in question, in recent years there have been no Dutch imports of GM rape from Canada, the world's leading producer of GM rapeseed (Canola Council 2008). According to several of the Netherlands' smaller and larger oil producers, too, there is no import of GM rape to the country (at least not in the past ten years).

A second source of information on imports of GM rape are import inspection authorities. To test for the presence of GM crops in imports, random checks are carried out by the Food and Consumer Product Safety Authority (VWA). There are two sides to these inspections: to check for unapproved GM varieties, on the one hand, and for correct labelling of approved GM crops, on the other. Rapeseed imports are not inspected by VWA, however, because these are not destined for food or fodder production, but for oil pressing. Neither is rape meal inspected by VWA, as this is rarely imported according to the agency (written statement VWA). Nonetheless, VWA did report one instance of mislabelling of an approved GM rape variety in 2007 (VWA 2008). Further enquiry revealed that it was a batch of 'canary seed' from North America containing 19% of an approved GM-event. If there is admixture of over 0.9% of a GM crop, this must be declared on the label.

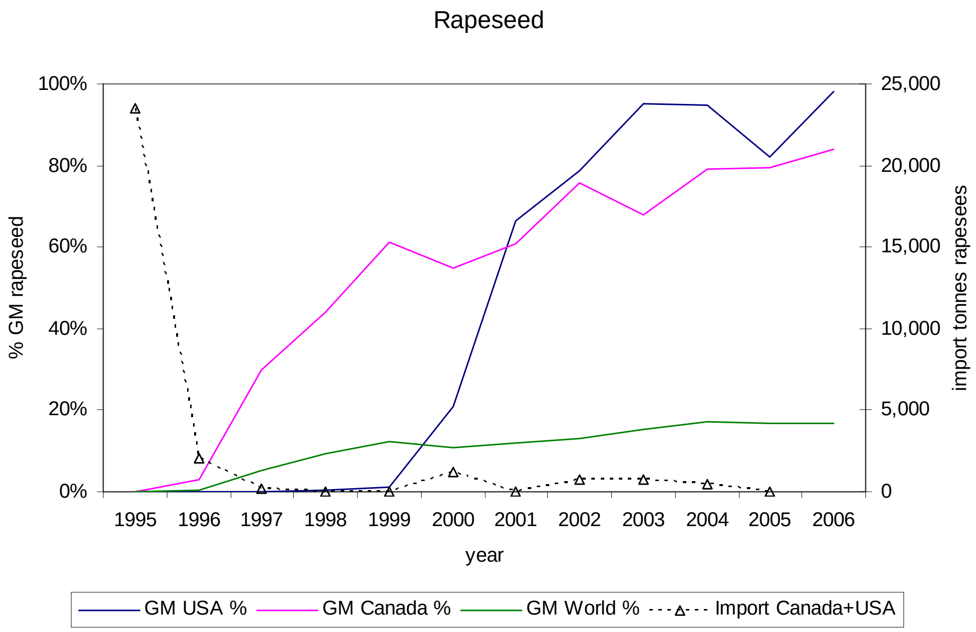


Figure 2. Dutch import (tonnes) of rapeseed from Canada and USA (right axis) and percentage of rapeseed crop acreage planted with GM varieties in North America (left axis). Source: ISAAA 1998, etc.

As part of provisions under the Netherlands' legislation on GMO (introduction to the environment) and the Carthagena Protocol, the Environmental Inspectorate (part of the Environment Ministry, VROM) also carries out limited checks on the presence of GMO. The Ministry of Agriculture, Nature and Food Quality (LNV) reported carrying out checks on several batches of sowing seed in 2001 to test for the presence of GM rape, but without any being found. At present, such checks are carried out exclusively on maize.

One final way to gain insight into the situation regarding import of GM varieties of rapeseed is to look at where the crop is sourced, for by far the bulk of the world's GM rapeseed comes from farms in North America. Figure 2 shows Dutch rapeseed imports from Canada and the USA, along with the share of these countries' rapeseed acreage set to GM varieties. As can be seen from the figure, after 1996 rapeseed imports from N. America declined to virtually zero following expansion of GM acreage in these countries. To the extent that rapeseed is imported from this region, this is with a so-called Hard IP certificate (cf. Chapter 4), under which the source of every batch can be traced all the way back to a specific farm plot. Thus, in 2007 a batch of non-GM rapeseed with this certificate was imported from N. America for production of birdseed in the Netherlands (written statement HPA). As described in the previous section, over the past 10 years there have been no imports of rapeseed meal from N. America.

3.5 Transport chains

3.5.1 General

This section focuses on where and how rapeseed and potential GM varieties thereof enter the Netherlands and the practicalities of its subsequent storage, transhipment, transport and processing. To this end, data was sought on the modes and scale of transportation and on transport routes. This information came from individual firms and does not show up in the statistics as such because of its commercially sensitive and confidential nature. Consequently, only qualitative information on modes and scale of transportation and transport routes could be obtained. The main transport chains are the trade chains taking the rapeseed to its various applications (§ 3.5.2). In addition, seed may be imported unintentionally (§ 3.5.3).

3.5.2 Trade chains

Sowing seed chain
Import of seeds for sowing is mainly by ship, in 25-kg bags or in sealed wooden cubic-metre crates. It is then transported by truck to seed (improvement) firms. There are around six major seed companies in the Netherlands: Syngenta, Barenbrug, Eurograss, Landbouwbureau Wiersum, Limagrain Advanta and Pioneer Monsanto/Dupont. These repack the seeds into smaller units, during which process a waste stream arises consisting of cleaning and other residues. Given their considerable market value, these small-volume packages (25 kg, or less following repackaging) are filled to precision. This would suggest that losses or admixture during transport are virtually ruled out.

Oilseed chain

Import of seeds for use in the oilseed crushing industry is virtually entirely in bulk and by shipping vessel. In the Netherlands these oilseeds are processed at seven operational crushing plants (Table 5, Figure 4). An eighth firm recently ceased operations (De Twentse Oliemolen, Haaksbergen). From the list in Table 7 it is not always clear where the companies have their actual operations, as it is only the town of registration that is reported. Noord Nederlandse Oliemolen, for example, has two production centres: at Harlingen and Farmsum, see Figure 4.

Table 5. Operational crushing industries using rapeseed for oil production. Source: written statement MVO; see also Fig. 4.

Company name	town of registration	characteristics
ADM Europoort B.V.	Rozenburg	large industry, hot pressing
Cargill B.V.	Amsterdam	large industry, hot pressing
Oudendijk Oils B.V.	Oudendijk	small industry, cold pressing
Bio Perserij Flakkee B.V.	Oostvoorne	small industry, cold pressing
Opek Nederland	Zeewolde	small industry, cold pressing
Noord Nederlandse Oliemolen B.V.	Zweins	small industry, cold pressing
Cooperatie Carnola B.A.	Venray	small industry, cold pressing

Figure 3. Oilseeds being unloaded from a large ocean-going vessel in the North Sea Canal near Amsterdam, showing oil production plant (within dashed yellow line). Reproduced with the permission of Cargill.

Besides these seven operational production facilities, there are another two that use seeds other than rapeseed for oil production. There are also six companies planning to use rapeseed (and other crops) for this purpose in the future (SenterNovem 2008). In addition, there are smaller oilseed presses at individual farms, which are used to process rapeseed, probably grown mainly locally, for personal use (biodiesel).

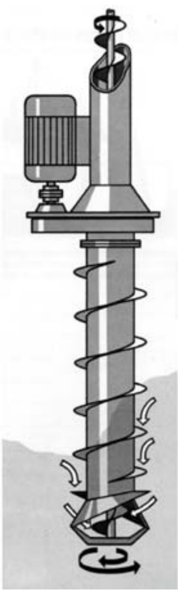
The two largest oilseed crushers in the Netherlands (Cargill and ADM) consume around 90% of all the rapeseed processed in the Netherlands (pers. comm. MVO). More detailed information on the share processed by each company is not publicly available. The distinction between large and small processors is important in the context of oilseed transport chains, because there are differences in both the chains and the processing technologies.

Fig. 4. Location of seed crushing industries using rapeseed in the Netherlands; large dot: Cargill and ADM, small dot: other companies. Source: written statement MVO.

The hot pressing process

The Netherlands' two main oil crushing industries are located in the ports of Amsterdam (North Sea Canal) and Rotterdam. All the incoming rapeseed is brought in by ship: either sea-going vessels and coasters (continental and intercontinental) or inland barges (continental); see Figure 3. There is essentially no difference between the way of import, mostly by large ships, from Europe or the other continents. This means around 90% of all the rapeseed comes on land in the ports of Rotterdam and Amsterdam. Further information on the practicalities of handling was obtained from one of the two larger companies, which stated that the rapeseed is unloaded mainly by crane, in sealed crates, and less frequently using a so-called Siwertell unloader, a screw conveyor in a sealed tube (Figure 5). The material is deposited on a conveyor belt that takes it to a quayside storage silo. From here, it is despatched by truck to a storage silo at the processing centre. Finally, the crop is taken from here for processing in a closed facility.

The rapeseed is first cleaned, with the seed-cleaning waste being disposed of as part of normal company waste (i.e. landfilled or incinerated, but not recycled). No information could be obtained on the percentage volume of this category of waste or its composition. The cleaned oilseed is then pressed in a sealed processing environment and the oil extracted using hexane in a process known as 'hot pressing'. The oil then undergoes a series of chemical refining steps. The solid matter remaining after pressing and oil extraction, the 'rape meal', is then sent to storage and transported by truck 'ex works' to the animal feed industry. The larger oil crushers process a range of other oilseeds besides rapeseed, including sunflower seeds. To what extent plant and machinery are cleaned between different batches of oilseed and what happens to any waste is unknown.



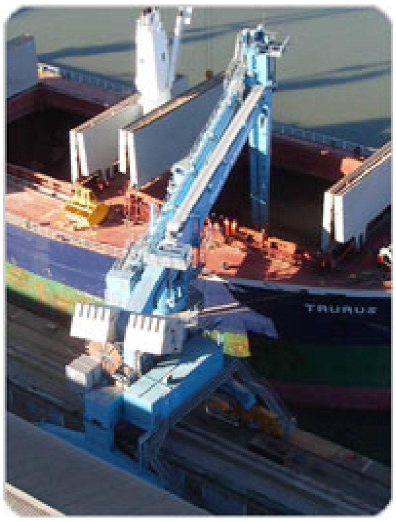


Figure 5. Right: A Siwertell screw unloader in action in Liverpool harbour unloading grain from a sea-going vessel; left: schematic view of screw unloader.

The cold pressing process

At the smaller oilseed crushing plants the process flowchart is much the same, but with one difference. Here the rapeseed is merely pressed, with no addition of chemicals, in a process known as 'cold pressing' (Figure 6). The following description derives from one of Europe's largest operators of the process, but as far as is known all the smaller Dutch crushers are likewise located at or near ports. The rapeseed is brought in mainly by inland barge or small coaster (approx. 2,500 tonnes). One of the smaller processors (Farmsum) only uses rapeseed grown in the Netherlands and in this case the crop is transported by road from the farm or co-op to the crushing plant. On arrival at the port the crop is transferred by crane to a quayside silo. From here it is despatched to the processing plant in sealed trucks on the public highway. At the plant the rapeseed is unloaded into storage silos. It is subsequently cleaned, with a fine and coarse fraction emerging from the process. The fines are used in several applications (including livestock bedding), while the coarse fraction is disposed of as part of the normal waste stream.

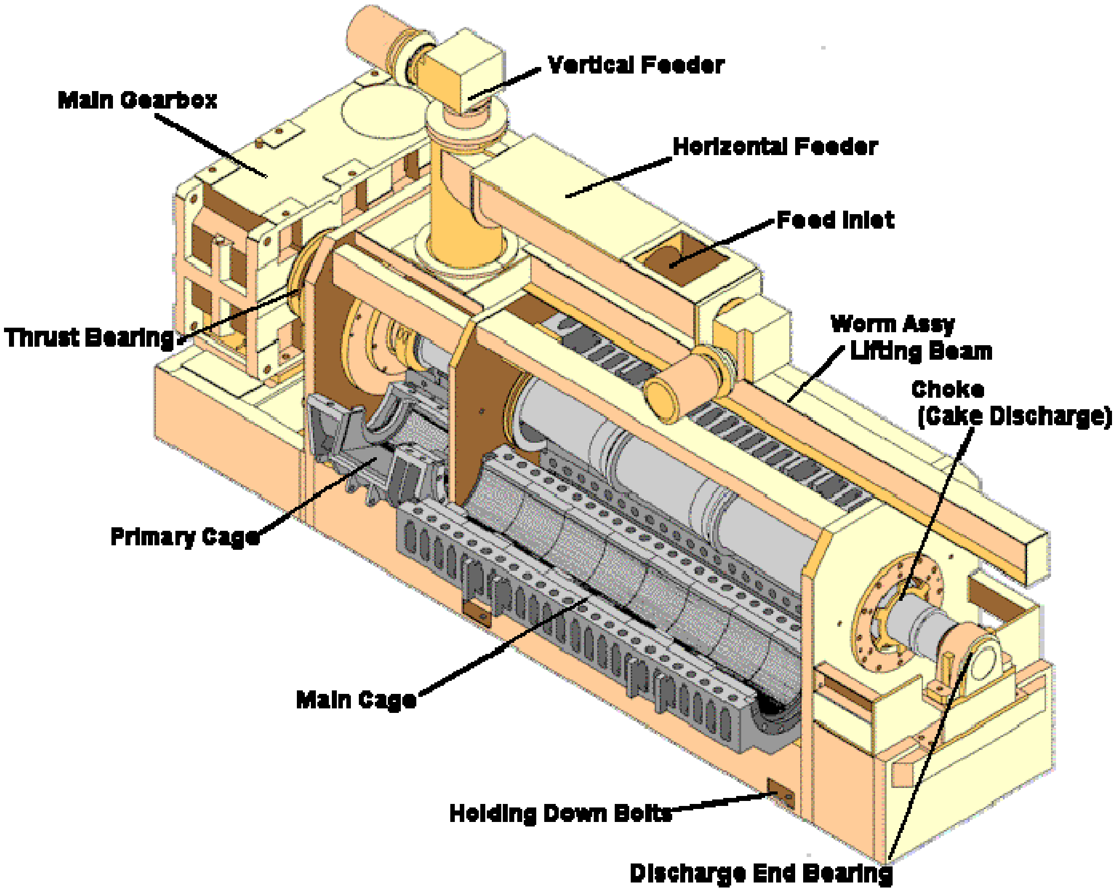


Figure 6. Example of an expeller or screw press, which uses mechanical means to extract a fluid, typically vegetable oil or fat from a solid feedstock like rapeseed.

No information was obtained on the percentage volume of the cleaning waste or the composition of the various fractions, but such information may be available on the fine waste fraction that is recycled. The cleaned feedstock is then fed into a closed pressing system. The 'oilcake' remaining as a residue from the pressing process is stored temporarily in a shed, from where it is taken by truck to the fodder industry.

Fodder chain

There are two constituents of rapeseed of importance for the production of animal feedstuffs: the seeds themselves and the rape meal and oilcake remaining after oil production. The meal and oilcake are transported by truck from the crushing plant to the fodder industry. There are around six major producers in the Netherlands: CEHAVE, de Heus, ForFarmers, Agrifirm, Hendrix Ltd and Nutreco. Truck transport is cost-efficient because this feed is a highly prized commodity. From the truck the meal is unloaded into a silo or bunker. A certain amount of rape meal is also imported, probably by ship, with subsequent transport by truck or inland barge.

The import of whole rapeseed for processing in pet food, in particular birdseed, is organised quite differently from the import of oilseed. The seed is shipped in bulk to one of the major ports and then unloaded and stored in silos (cf. Schuttelaer 2009). At these major quayside terminals, such as EBS in Rotterdam, a wide range of commodities are unloaded and stored. Because a certain amount of product always remains behind in the silo and on conveyor belts, contamination with the previously handled product can easily occur. From here the rapeseed is taken by truck to pet-food producers, where it is transferred to a silo or bunker. At these facilities the seeds undergo a variety of processes, in particular cleaning. For the production of birdseed and rodent food, this process is shown schematically in Figure 7. One essential difference from the oilseed pressing process is that it this is not a closed system, implying scope for losses at various stages (along

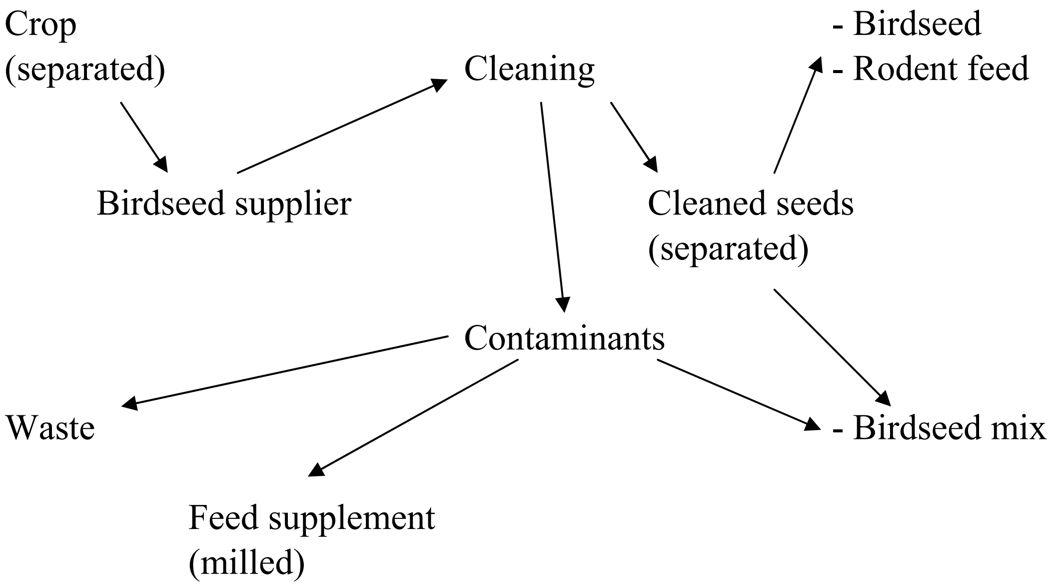


Figure 7. Simplified flowchart of processing of seeds used for production of pet food (source: Van Denderen *et al.* 2010).

open conveyor belts, for example). Organic matter from the cleaning process is often used for second-grade animal feed. Because of the numerous ingredients in pet food, production lines need to be frequently cleaned. The waste arising, along with regular processing waste (first and last sack), end up in the company's normal waste stream (destined for incineration or landfill). No information could be found on annual production of birdseed or rodent feed.

A separate issue is potential transport by rail and attendant losses at terminals and stations as well as along the track. It was striking that most of the parties in the production chain state there is virtually no rail transport of rapeseed rape, with the vast bulk being shipped by truck or vessel. Nonetheless, a number of field observations was made in 2008 and 2009 that indicate that this mode of transport may also be of significance for the Dutch situation vis-à-vis GM crops. Thus, rape plants (*Brassica napus*) were found at a rail terminal at Rotterdam port, pointing to the likelihood of international transport, whether incoming or outgoing. At the train stations of Wageningen (2008 and 2009) and Diemen and Woerden (2009), among others, dozens and hundreds of flowering rape plants were found, respectively. This is an issue that needs to be looked at in greater detail.

3.5.3 Unintentional chains: admixture, human error and contamination

There are also a number of routes by which (GM) rapeseed can enter the Netherlands unintentionally: admixture, human error and contamination.

In the first place, rapeseed can find its way into the country via unintentional admixture with a different product. In § 3.4.1 the example was cited of 19% rape of an approved GM variety being found in 'canary seed' destined for the pet food industry. In Table 2 we reported how the product traded as rapeseed, itself comprising both rape and wild turnip, may contain up to a maximum of 6% impurities. This is undoubtedly the case for other products, too, with a certain percentage of contaminant rapeseed or other crops being tolerated according to the product description. The extent to which this occurs in everyday practice is unknown. Admixture appears to be associated mainly with storage in silos, vehicles or vessels that previously held a different product. This issue is being investigated in a separate project (Schuttelaer 2009).

A second unintentional route is human error. During field trials in Belgium and Scotland in 2008, for example, inadvertent use was made of a GM rape variety (cf. AGD 2008, Independent 2008).

A final route by which rapeseed may be unintentionally imported is as a contaminant in other bulk products. This occurs, for example, when one or other of the species has been growing as a weed or volunteer in a cropped field, or was present as a neighbouring crop (see e.g. De la Fuente *et al.* 1999, 2006), allowing the seeds to be taken along as 'passengers' at harvest. In a study on the occurrence of contaminants in imports of bulk commodities (Van Denderen *et al.* 2010.) seeds of species from the genus *Brassica* have regularly been found. Table 6 shows the results for *Brassica* species originating from North-American samples. It should be noted that in the study cited only a limited number of samples from this continent were examined. In this table no distinction is made between wild turnip and rape, although this may be well possible based on seed size and texture of the seed coat.

Table 6. Presence of *Brassica* seeds as a weed in selected crop products from North America; source: Van Denderen *et al.* (2010). Sample size of each product is one.

Product	Origin	Species	No. of seeds/l
Linseed (*Linum usitatissimum*)	Canada	*Brassica napus/rapa*	692
		Brassica juncea	32
		Brassica nigra	24
Canary seed (*Phalaris canariensis*)	Canada	*Brassica napus/rapa*	188
		Brassica juncea	92
		Brassica nigra	80
Millet, white (*Panicum* spec.)	USA	*Brassica napus/rapa*	16

One suspects, though, that this is due also to the confusion between the two species, as personal experience shows that at 1-1.5 mm the seeds of wild turnip are markedly smaller than those of rape, which are 2-2.5 mm. There is a need for further research into the relationship between seed size and provenance (climate) and variety (e.g. winter vs. summer type). A litre of linseed (the seeds of the flax plant) from Canada may contain up to 700 seeds of rape or wild turnip. This means there is every likelihood of unintentional import from potential 'risk areas' (i.e. regions where GM varieties of rapeseed are grown), for a cubic metre of commodity may contain up to 700,000 "contamination" seeds! What proportion of the North American rapeseed cited in Table 7 concerns GM varieties is as yet unknown; this issue is being further investigated as part of Project III.

3.6 Seed spillage

3.6.1 General

In this section we consider the points in the transport chains described above where the greatest risk of spillage occurs (§ 3.6.2), the estimated scale of these losses (§ 3.6.3) and where rape plants were encountered in the course of the present study (§ 3.6.4). When asked about spillage during transport and processing, the various parties in the transport chains responded very differently: from a straightforward description of where and how much spillage occurs, to categorical denial of any losses at all.

3.6.2 Scope for spillage

According to the parties in the transport chain, in the sowing seed chain there is little if any spillage (only during cleaning), as only small batches are involved and these are carefully packaged to prevent losses and/or contamination and so on. These batches are ultimately used for sowing in the Netherlands or elsewhere.

In the oilseed and animal feed chain, spillage of seeds can occur at any point in the early part of the chain involving transhipment or transport. This is the case for:

* transfer from vessel to quayside storage silo (either within or outside the processing site);
* road transport from storage silo to production silo at the processing site, with loading/unloading at each end;
* disposal of seed-cleaning residues and waste arising during process changes.

The greatest losses of imported rapeseed are probably associated with bulk transhipment prior to the transport to the processing plant, i.e. at quayside facilities and storage depots. During unloading a certain fraction will end up in the harbour water. This issue has already been investigated in detail by Schuttelaer (2009). A smaller fraction of losses will probably occur along the roadside during transport from port to processing plant. The potential for spillage would appear to be greater at the smaller 'cold' oil-pressing plants than at the larger 'hot' crushers, because at the former there is more transport from storage to storage and plant. No information was found on the degree to which the survival chances of rape seeds differ between hot and cold pressing, but given the higher temperatures and the chemical extraction involved, these chances are likely to be much lower in the case of hot pressing. A certain part of the rapeseed in animal feed (in particular birdseed, etc.) will end up being introduced intentionally into the environment when it is strewn outdoors (and will in this sense be just like sowing seed), mainly in urban parks and gardens. It is assumed by parties in the transport chain that the oilcake and rape meal no longer contain any seeds. However, this is at odds with the experience that soybean meal, to take just one example, has been found to be contaminated with the seeds of numerous species (Van Denderen *et al.* 2010). It should be remarked, though, that these beans are far larger than the seeds known as rapeseed, which might mean that 'passenger' seeds in soybeans are likely to have a greater chance of survival. It is unknown whether and to what extent viable seeds of rape or wild turnip are present in the oilcake and other processing residues and where these eventually end up.

When rapeseed is unintentionally introduced as a result of admixture or contamination, losses have in fact already occurred, for the product is no longer in its intended supply chain. Such material may also end up in the environment via:
* disposal of seed-cleaning waste, and
* product usage (strewing of birdseed, for example).

As several of the basic ingredients of animal fodder are sourced in North America and the crops concerned may also contain rapeseed as a contaminant or as a (GM) admixture, this may well constitute a potential route for import of GM rape that is already relevant.

3.6.3 Quantifying seed spillage

As already emerged from the previous section, the actual scale on which losses occur depends on several factors, in particular:
* mode of product transfer (bulk unloading, crane-handling, other systems);
* mode of transport (e.g. sealed or open trucks);
* weather conditions (in particular, strong winds).

It was pointed out by all the parties in the chain that oilseed rape seed is round, small and hard and can easily bounce quite some distance or are further dispersed with help of the wind. Even when transport is in sealed truck there may be (minor) losses of seed (pers. comm. small-scale crusher). At a number of points in the transport chain and in processing the material is weighed so shipping documents can be verified. This is proprietary information and so cannot be disclosed, but it does provide potential scope for quantifying the degree of loss in the various links in the chain.

In the trade a number of figures are cited for losses for which standard allowance is made. For this reason oilseed rape suppliers always deliver a little more to avoid penalties for under-delivery. It is estimated that around half this additional volume is lost during transhipment and transport. The estimates given by those in the trade varied from 0.1-0.3 percent up to 2-3 percent. The lower estimates of 0.1-0.3 percent are based on impressions of the differences before and after weighing at the crushing plant. The higher estimates of 2-3 percent relate more to the animal feed industry, where seeds are processed in a more open system comprising various cleaning and waste stages. Proceeding from the figure of 600,000 tonnes for total imports to the Netherlands in 2007, 0.1 percent losses would imply a total of 600 tonnes of oilseed rape seeds ending up in the environment that year. As one kilo of oilseed rape contains approximately 310,000 seeds (each weighing around 3 mg; Van Denderen *et al.* 2010), this means that 186 billion (10^9) seeds found their way into the natural environment in 2007. This is equivalent to about 5,000 seeds per hectare per year across the entire Netherlands.

3.6.4 Field observations of rape plants along transport routes

Several field trips were held to two smaller rapeseed crushing plants (in Groningen and Friesland) in 2008 and 2009, to two closed crushing plants (at Utrecht and Haaksbergen) in 2009 and to one Rotterdam quayside terminal in 2008. During these visits, any rape plants observed growing in or around the facilities were also recorded, although by no means as a systematic survey. Observations of plants along overland supply routes (motorways, etc.) were also recorded.

In the spring of 2008 dozens of rape plants (i.e. *Brassica napus*) were encountered on the Rotterdam site, at a rail head and near the silos, there (observers: de Jong, Luijten and Groen). At the closed facilities at Utrecht (closed in 2002) en Haaksbergen (closed in 2007), respectively one large rape plant and no rape plants were observed in the *autumn* of 2008 (observer: de Jong). Along the supply route to the Groningen facility, which is also the road serving the port, dozens to hundreds of flowering rape plants were found in the spring of 2008 (observers: Luijten, Tamis). According to the facility's proprietor, these plants derived from seed carried off by the wind during loading and unloading operations. Given the plants' location and configuration, our own estimate is that these might also be transport losses. At the Friesland production site, many hundred rape plants were encountered in the spring of 2009, particularly around the facility's open-air supply tip (several dozen square metres) (observer: Tamis). These were older (perennial!) plants. Several taller rape plants were also found in the greenery along the route taken within the site. Such plants were not actively removed by the company. The grassy parts of the site were mown. As already mentioned in the previous section, rape plants were also observed in flower at a number of railway stations (observers: De Jong, Luijten en Tamis).

4 Quality control systems for transport chains: attention to seed spillage

4.1 General

In the course of this study various information was gathered on the quality control systems in force for the various chains or sub-chains. This information is summarised in the present chapter, with particular focus on the extent to which these systems address environmental concerns and, more specifically, loss of seeds or other plant material down the chain. Although this information does not strictly fall under the terms of the project, it is important enough to warrant discussion. In the following exposition, which is by no means exhaustive, we look successively at the quality control systems in force for supply chains, for certain specific products and for certain links in the chain, particularly supply lines to processors.

4.2 Quality control systems for food and feed chains and processors

In the wake of a series of past scandals involving contaminated animal feed (with dioxin, for example) a number of quality control systems were introduced by the various industries concerned. These supply chain systems are geared to protecting the final consumer, and thus to food safety and hygiene. None of these systems focus in any way on loss of seeds to the environment. The systems concerned are the following:

* TRUSQ: this is a quality control system set up by the fodder industry that is based on a list of so-called ‘double-green’ products: both the product and the supplier must be certified (TRUSQ 2008).
* GMP+: this is a quality control system created by the Netherlands Product Board for Animal Feed (PDV) that lays down requirements on issues like the cleaning of vehicles and handling equipment to prevent admixture and cross-contamination (GMP 2008). Organisations meeting the GMP+ criteria are awarded a certificate and can be looked up in an internet database (PDV 2009b).
* Hard IP: under this system, batches of agricultural products can be tracked all the way back to the plot on which they were grown. In this way streams of low vs. high erucic acid rapeseed are kept separate, for example (see e.g. Desquilbet & Bullock 2009).
* SAFEFEED: This quality control system is similar to TRUSQ; here, too, the product can be traced back to the plot on which is was grown.

Under all these systems, checks are carried out several times a year and there are financial penalties for companies found to be in default.

One well-known quality control system widely used in industry is HACCP (Hazard Analysis Critical Control Points), effectively an analysis of the most critical elements of the production processes meriting particular attention. One of the larger crushing plants has introduced its own HACCP system that also includes environmental criteria (on the risks associated with hexane, for instance). Loss of rapeseed during processing does not form part of this system, which has been patented and is therefore considered confidential company information.

4.3 Quality control systems for products

The production of sowing seed in the Netherlands is overseen by the General Inspection Service for Agricultural Seeds and Seed Potatoes (NAK). Once approved, a product is awarded a certificate known as a ‘plant passport’. In principle the same kind of certification criteria apply across the EU and in a further selection of 12 other countries including the USA and Canada. The latter two countries are obliged to undertake a ‘preshipment inspection’ prior to export. In the case of other non-EU countries the exporting government issues a plant health certificate, which is then checked on import by the receiving government. This means that, once certified in the exporting country, sowing seed may be imported without the need for additional certification in the Netherlands.

EU directives are in force for the packaging of seeds for sowing (EU 2008): 66/401/EEC on fodder plant seed, 66/402/EEC on cereal seed, 2002/54/EC on beet seed, 2002/55/EC on vegetable seed, 2002/56/EC on seed potatoes and 2002/57/EC on the seed of oil and fibre plants. This legislation on seed packaging will probably help reduce losses of sowing seed during transport operations. In the case of arboroculture (tree-growing) there is a certificate geared to product quality, which may also specify the required pesticide regime (pers. comm. Anthos 2009).

In the Netherlands various agencies are charged with monitoring the quality of imports:
- the Plant Protection Service (PD) and Quality Inspection Service (KCB), which monitors for the presence of quarantine organisms, but *not* in bulk commodities;
- the Food and Consumer Product Safety Authority (VWA), which monitors for the presence of unapproved GMO or errors in the labelling of products containing approved GMO. It is only products intended for human or animal consumption that are checked, and not industrial feedstocks such as those used for production of rapeseed oil;
- the Environmental Inspectorate, part of the Environment Ministry (VROM), which monitors field trials (whether or not imported materials are involved) for conformity with national legislation on GMO;
- the General Inspection Service for Agricultural Seeds and Seed Potatoes (NAK), which issues certificates for imported batches that are broken down into smaller units (monitoring of labelling).

Under none of these quality systems is there any focus on losses of seed.

4.4 Economic quality control systems

Besides the quality control systems in force for supply chains, company operations and products, there are also economic quality control systems in place in connection with standard contractual obligations and allocation of liability if these are not adequately met. One key element is obviously the contractual obligation to indeed deliver the specified quantity of the promised grade of commodity. If this is not the case, a financial penalty is generally imposed. It is therefore standard practice for suppliers to deliver a few percent extra (up to 5% more), as a certain fraction is inevitably lost during transport and transhipment as a result of admixture and spillage. These delivery terms (including quantitative margins) are included as a standard feature in example contracts such as those provided by the Royal Dutch Grain and Feed Trade Association (CvG 2008) and the Federation of Oils, Seeds and Fats Associations (FOSFA 2009).

4.5 Evaluation of quality control systems

In the transport chains of rapeseed there is no quantification *of seed losses* at critical points during transport, transhipment, storage and processing. This is also true for GM-rapeseed.

5 Conclusions and recommendations

5.1. General

The transport chains of a number of seeds, with potential GM-variants, imported to the Netherlands have been analyzed. The extent to which spillage and other losses occur during transport and whether this has already led to the establishment of feral populations of the plants in question is unclear. The aim of the study was to improve understanding of transport chains, in order to better estimate the potential risk of feral populations, possibly of GM-variants, arising as a result of spillage during transhipment and transport operations. Particular attention was paid to rape, *Brassica napus*, for several reasons: seeds of this species are imported in very large quantities, it is part of the Netherlands' wild flora, and GM varieties of this crop are produced overseas and commercially traded in this country. Conclusions of the research questions are presented in the next section and the recommendations which arise from these conclusions are presented in the last section.

5.2 Conclusions

5.2.1 Potential GM crops that might establish feral populations

Information on which plant species are imported as seeds (or plants) in the Netherlands is only scattered available. Proceeding from a list of potential GM crops based on data on field trials and marketing licenses worldwide, 15 species or genera were judged to pose a potential risk for escape and establishment in the wild in the Netherlands. From this set, five crops were selected for further study: rape (*Brassica napus*), beet (*Beta vulgaris*), alfalfa or lucerne (*Medicago sativa*), poplar (*Populus* spec.) and bentgrass (*Agrostis* spec.). The transport chain of the product traded as 'rapeseed', and by implication that of 'rape' could be analysed in detail. The information that could be found on the transport chains of the other crops was far less conclusive; a synopsis is presented in Appendix V.

5.2.2 Rapeseed transport chains

Confusion of names. The Dutch common name for rape (*Brassica napus*) is 'koolzaad' and for the related wild turnip (*Brassica rapa*) 'raapzaad'. However, the *B. napus* imported to the Netherlands is referred to in the transport chain as 'raapzaad'. This is confusing and may lead to mistakes, for instance when GM *B. napus* is not recognised as such because it is labelled 'raapzaad' or 'rapeseed'.

Applications and import. Rape has a large number of applications ranging from foraging crop for game, vegetable oil to pet food. By far the biggest import flow is destined for oil production. The Netherlands typically imports 100,000-300,000 tonnes of rapeseed a year for this purpose, but in 2008 this rose even to 1,800,000 tonnes. Most of these imports are from France and Germany. Six GM 'events' are currently approved for the EU market (only processing), all of which include resistance to herbicides. Imports from North America, where most rapeseed produced is GM, appeared to be negligible. Data on the import of GM crops was hard to obtain because there is no form of central registration and many organisations are reluctant to supply such data, as it may count as confidential company information and GM plants are still a 'sensitive' public issue.

The seeds are brought in by ship and stored in quayside silos. After storage here they are cleaned and crushed in a closed processing system either by using hexane to extract the oil ('hot pressing', 90%) or by crushing only using pressure ('cold pressing'). Small shipments of rapeseed are processed in 'birdseed' and rodent feed. These seeds are again brought in by ship and are then stored, transported by truck and later mixed with other seeds in a open processing system.

5.2.3 Occurrence of spillage and feral populations

Only qualitative information about when, where, and how much spillage occurred in the transport chains could be found. The bulk of the seed imported for oil pressing enters a closed processing system in which the only environmental risk presented is from seeds escaping to the environment during transport to the crushing plant. The processing of seed in pet food or animal feed, by contrast, probably does involve a greater environmental risk of seeds escaping to the wild, especially if seed mixtures are subsequently strewn outdoors. In addition, there is spillage of seeds along the transport chain from quayside to storage to truck to crushing plant. There was no information on the presence of viable seeds in the waste from cleaning operations or in the meal or cake from the crushing process. Estimates of overall losses range from 0.1-0.3 percent to 2-3 percent. If we take a conservative estimate of 0.1 percent spillage for 2007, then this would imply a total of 600 tonnes of oilseed rape seeds ending up in the environment that year, equivalent to about 5,000 seeds per hectare per year across the entire Netherlands.

Feral populations of rape (*Brassica napus*) have been found near several crushing plants. As several ingredients of pet food (other than rapeseed) originate in the US or Canada, this is a potential route by which GM rape present as a contaminant in these ingredients could enter the environment. Rape plants have also been found along railways, indicating that seeds are also probably lost from trains. This mode of transport is not cited by the companies involved in the rapeseed transport chain, however, and so may relate to international transport.

5.2.4 Transport chain quality control systems

Present quality control is geared to consumer protection, food safety and hygiene. Seed for sowing is under the supervision of the General Inspection Service for Agricultural Seeds and Seed Potatoes (NAK). Imports of products like rapeseed are monitored by several national agencies, including the Plant Protection Service (PD), the Quality Inspection Service (KCB), the Food and Consumer Product Safety Authority (VWA), the Environmental Inspectorate (part of the Environment Ministry, VROM) and NAK. In none of these quality control systems or inspection regimes does seed spillage feature in any way.

5.3 Recommendations

1) It is of interest to establish whether feral populations of rape are short-lived or have a more permanent nature. Since the places where most substantial losses occur are most likely to show the first initial populations, particularly these places should be identified and studied.
2) It is recommended to study the presence, number and viability of rape seeds in the meal and cake from the crushing process and in the waste from cleaning operations.
3) Rape finds (also) its way into the environment via birdseed mixtures and it should therefore be investigated whether this involves seeds of GM varieties, whether added intentionally to the birdseed or present because of GM rape growing as a weed or volunteer in fields of other crops in the region of origin.
4) Because information on certain crops was so hard to obtain, it is recommended that the relevant commodity board or industries also be involved in future projects of this kind. This is especially relevant for the other crops considered, such as beet, poplar, alfalfa and bentgrass, on which very little information could be found.
5) Because there are no data available on import of GM crops to the Netherlands other than the random checks carried out by the VWA on the presence of unapproved GMO and correct labelling of approved GMO, a further study of port documents is recommended so the import of GM crops can be quantified.
6) Use of the name ‘raapzaad’ (i.e. ‘rapeseed’) in the Dutch product chain should be abandoned and replaced by ‘koolzaad of raapzaad’ (i.e. ‘rape or wild turnip’). The potential confusion with other Brassica crops like *Brassica juncea* should also be investigated.

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Appendices

Appendix I Abbreviations

ADM	Archers, Daniels, Midland company
Agbios	Canadian company providing public policy, regulatory, and risk assessment expertise for products of biotechnology
BGGO	Netherlands GMO Office
B.V.	private company
CBS	Statistics Netherlands
CML	Institute of Environmental Sciences, Leiden University
FLORON	NGO for data collection and protection of Dutch wild plant species
COGEM	Netherlands Commission on Genetic Modification
EBS	European Bulk Services
EEG	European Economic Union
EG or EU	European Union
FOSFA	Federation of Oils, Seeds and Fats Associations
GG or GM	genetically modified
GMO	genetically modified organisms
GMP+	Good Manufacturing Practice
GS	see HS
HACCP	Hazard Assessment Critical Control Points
HS or HTS	Harmonized System of Trade Codes/Harmonized Trade System
IBED	Institute for Biodiversity and Ecosystem Dynamics
IBL	Institute of Biology, Leiden University
IP	Identity Preservation
KCB	Netherlands Quality Inspection Service
LEI	Netherlands Agricultural Economics Research Institute
LNV	Netherlands Ministry of Agriculture, Nature and Food quality
MVO	Netherlands Product Board for Margarine, Fats and Oils
NAK	Netherlands General Inspection Service for Agricultural Seeds and Seed Potatoes
NeVeDi	Netherlands Feed Industry Association
NPPOA	Netherlands Pure Plant Oil Association
OECD	Organisation for Economic Co-operation and Development
PD	Netherlands Plant Protection Service
PDV	Netherlands Product Board for Animal Feed
PPO	Applied Plant Research Institute
TRUSQ	cooperative alliance for food safety formed by seven Dutch and Belgian animal feed producers
USA	Unites States of America
VNG	Netherlands Grass Drying Association
VROM	Netherlands Ministry of Housing, Spatial Planning and the Environment
VWA	Netherlands Food and Consumer Product Safety Authority

Appendix II List of contacts (organisations)

ADM
Anthos
Bio Perserij Flakkee
Cargill
Comité van Graanhandelaren
Douane
Ecopark Harlingen
HPA
Joordens zaden
LEI
Min. van LNV
MVO
NAK
NAKtuinbouw
NeVeDi
NPPOA
Noord-Nederlandse Oliemolen
PDV
Plantenziektenkundige Dienst
Plantum
PPO-Lelystad
TRUSQ
VNG

Appendix III Information used in contacts with organisations in transport chains

Onderzoek naar transportketens van gewassen met (potentiële) GM-varianten

In opdracht van de COGEM (Commissie Genetische Modificatie) voert het CML (Centrum voor Milieuwetenschappen, Universiteit Leiden) en het IBL (Instituut voor Biologie, Universiteit Leiden) onderzoek naar het voorkomen van wilde populaties Koolzaad in Nederland. Koolzaad is een van de gewassen, waarvan een aantal GM (genetisch gemodificeerde) cultuurvarianten bestaan.

Een deel van dat onderzoek heeft betrekking op het in kaart brengen van transportketens, zodat de kans op verspreiding beter geschat kan worden. Het gaat hierbij op de eerste plaats om Koolzaad, maar ook om een aantal andere gewassen, waarvan GM-varianten bestaan en waarvan wilde populaties of verwanten in Nederland voorkomen. Het gaat om de volgende gewassen/soorten

- Koolzaad (Brassica napus)
  - veevoer
  - olie
  - zaaizaad
- Graszaad van het geslacht Agrostis (Agrostis spec.)
  - zaaizaad
  - evt. basiszaad voor vogelvoer?
- Populier (Populus)
  - jonge bomen
  - zaaizaad
- Luzerne (Medicago sativa) en
  - zaaizaad
  - luzernebrokken
- Biet (Beta vulgaris)
  - zaaizaad

Het gaat om de import van deze gewassen als zaden of planten (of producten waar nog hele zaden in voorkomen) en niet om de bewerkte producten (zoals Koolzaadolie of populierenhout).

De transportketen bestaat uit een aantal fasen:

1. import
2. overslag en opslag
3. transport
4. verwerking

Bij elke fase moet zoveel mogelijk kwantitatief voor Nederland in kaart worden gebracht: wat (welke producten), wie (sleutelorganisaties), waar, waarvandaan, wanneer, hoe, hoeveel, verlies tijdens transport, overslag en opslag/productie, verlies door afvalverwerking. Deze gegevens worden in eerste instantie kwalitatief verzameld door middel van interviews op zo kort mogelijke termijn. Hieruit moet blijken of en welke kwantitatieve informatie aanwezig is en of deze openbaar is.

Appendix IV Import of seeds and plants

Import, export and transit trade of products and registration

Import is het transport van producten van een buitenland naar Nederland en bij export is dit omgekeerd. Een derde categorie is de "in transito". Dit betreft transport door Nederland (doorvoer), van buitenland naar buitenland. Vanuit het oogpunt van mogelijke verliezen tijdens de transportketens zijn import en in transito van belang, omdat in beide gevallen overslag, opslag op en transport over Nederlands grondgebied kunnen plaatsvinden. De werkelijkheid van de import- en exportwereld is echter gecompliceerder. Het is goed om hier kort bij stil te staan om deze gegevens beter op hun waarde te kunnen inschatten. Import in Nederland wil nog niet zeggen dat de producten voor Nederland bestemd zijn en daar verwerkt worden. Het kan vervolgens weer worden geëxporteerd naar een land binnen of buiten de EU of worden getransporteerd naar een ander land binnen de EU. Omdat de EU één handelszone is zijn de import naar en export vanuit landen binnen de EU niet goed vast te stellen. Er kan ook transport plaatsvinden vanuit een andere EU-land naar Nederland, hetgeen niet altijd als import geadministreerd wordt. Bij "in transito" zijn er een aantal verschillende varianten, die verschillen in overslag, opslag en transport. De simpelste variant is dat de producten het transportmiddel (bijv. schip) niet verlaten. Er kan direct overslag plaatsvinden van het ene transportmiddel naar het volgende, of er kan tussentijds opslag plaatsvinden. De import in Nederland wordt geregistreerd door de douane. Deze informatie wordt verwerkt door het CBS (maar dus niet altijd voor binnen EU) en al deze informatie is terug te vinden in verschillende handelsdatases: (CBS 2008, ComTrade 2008, FAOStat 2008, TradeMap 2008).

Voor de registratie van de handel wordt gebruik gemaakt van een Geharmoniseerd Systeem (NL: GS, UK: HS): zie Tabel A voor een deel van de codering als voorbeeld. Deze codering is productgericht. De naamgeving van de producten is slechts deels te combineren met wetenschappelijke namen van gewassen. Een belangrijke beperking aan het systeem is dat alleen de producten die in grote hoeveelheden worden verhandeld individuele codes hebben, zoals voor Maïs of Soja. Veel producten betreffen combinaties. Zo wordt geen onderscheid gemaakt tussen raapzaad (Rape) en koolzaad (Colza) gemaakt, zie ook Tabel A. Een punt van aandacht is dat soorten, zoals raap- of koolzaad onder verschillende producten kunnen voorkomen, bijv. zowel bij:

- de zaden (Chapter 12 HTS: Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medicinal plants; straw and fodder),
- als bij de olie ervan (Chapter 15 HTS: Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes),
- als bij de restproducten, zoals schroot, ervan (Chapter 23 HTS: Residues and waste from the food industries; prepared animal feed).

Table A. Part of the HS trade codes (Source: HTS-USA, 2008, p. 738).

Harmonized Tariff Schedule of the United State
Annotated for Statistical Reporting Purpos

Heading/ Subheading	Stat. Suf-fix	Article Description	Unit of Quantity
1203.00.00	00	Copra	kg
1204.00.00		Flaxseed (linseed), whether or not broken	
	10	For sowing	kg
	20	For use as oil stock	kg
	90	Other	kg
1205		Rape or colza seeds, whether or not broken:	
1205.10.00		Low erucic acid rape or colza seeds	
	10	For sowing	kg
	20	For use as oil stock	kg
	90	Other	kg
1205.90.00		Other	
	10	For sowing	kg
	20	For use as oil stock	kg
	90	Other	kg
1206.00.00		Sunflower seeds, whether or not broken	
	20	For use as oil stock	kg
		For sowing:	
	35	For oil stock	kg
	40	Other	kg
		Other:	
		For human use:	
	61	In-shell	kg
	69	Other	kg
	90	Other	kg

Which seeds and plants are imported?

In H2 wordt de uiteindelijke selectie gepresenteerd van potentiële GM-gewassen voor Nederland. Om tot deze selectie te komen zijn verschillende bronnen en werkwijzen geprobeerd. In deze bijlage worden de resultaten van de werkwijze en bronnen die uiteindelijk niet tot de gewenste resultaten bleken te leiden.

Er wordt in Nederland veel verschillende gewassen geïmporteerd voor consumptie door mens en dier, en voor agrarische en industriële productie. Een belangrijke bron van informatie zijn de importgegevens. Deze informatie blijkt echter niet geschikt om een overzicht te krijgen van plantensoorten die worden geïmporteerd in Nederland. Deze handelsinformatie kan daarom het beste gebruikt worden om te checken of en hoeveel bepaalde soorten worden verhandeld. Uit een studie van Van Denderen (2008) is er kennis over welke zogenaamde "basiszaden" worden geïmporteerd voor de productie van vogelvoer bij een van de grotere vogelvoerproducenten in Nederland. Zo werden er in 2007 108 typen basiszaden ingevoerd, gebaseerd op 82 plantensoorten, zie Tabel B. Van Denderen onderzocht de aanwezigheid van "vreemde" zaden, die als verontreiniging meeliften met de basiszaden.

Table B. Seeds imported in 2007 by one major pet food industry in the Netherlands. ? = uncertainty about scientific name; - = unknown or not relevant.

Product (in Dutch)		scientific name	
seed	variety	genus	species
Anijs	-	*Pimpinella*	*anisum*
biet	-	*Beta*	*vulgaris*
Boekweit	-	*Fagopyrum*	*esculentum*
Boon	-	*Phaseolus*	*vulgaris*
Boon	azuki	*Vigna*	*angularis*
Boon	black eye	*Vigna*	*unguiculata*
Boon	duif	*Cajanus*	*cajan*
Boon	katjang idju/hijau	*Vigna*	*radiata*
Boon	kidney beans rood	*Phaseolus*	*vulgaris*
Boon	kidney beans wit	*Phaseolus*	*vulgaris*
Boon	wit	*Phaseolus*	*vulgaris*
Bosbes	rood	*Vaccinium*	*vitis-idaea*
Ceder	-	*Cedrus*	-
Chilipeper	-	*Capsicum*	*annuum*
Chrysant	-	*Chrysanthemum*	-
Cichorei	-	*Chicorium*	*intybus*
Cypres	-	*Cupressus*	-
Den	-	*Pinus*	-
Dille	-	*Anethum*	*graveolens*
Distel	-	*Cirsium/Carduus?*	-
Erwt	-	*Pisum*	*sativum*
Erwt	donker	*Pisum?*	*sativum*
Erwt	dunpeas	*Pisum?*	*sativum*
Erwt	geel	*Pisum?*	*sativum*
Erwt	groen	*Pisum*	*sativum*
Erwt	kikker	*Cicer*	*arietinum*
Erwt	maple peas	*Pisum?*	*sativum*
Erwt	peen	*?*	-
Erwt	winterpeas	*?*	-
Fenegriek	-	*Trigonella*	*foenum-graecum*
Gerst	-	*Hordeum*	*vulgare*
Gierst	-	*Panicum*	-
Gierst	geel	*Panicum*	-
Gierst	rood	*Panicum*	-
Gierst	tros	*Setaria*	*italica*
Gierst	wit	*Panicum*	-
Gierst	zand	*Panicum*	-
Gierst	zwart	*Panicum*	-
Grassen	-	*Poaceae*	-
Grondnoot	-	*Arachis*	*hypogaea*
Haver	-	*Avena*	*sativa*
Hazelaar	-	*Corylus*	*avellana*
Hennep	-	*Cannabis*	*sativa*
Jeneverbes	-	*Juniperus*	*communis*
Johannesbroodboom	-	*Seratonia*	*siliqua*

Product (in Dutch)		scientific name	
seed	variety	genus	species
Kanariezaad	-	*Phalaris*	*canariensis*
Karwij	-	*Carum*	*carvi*
Klaver	-	*Trifolium*	-
Komijn	-	*Cuminum*	*cyminum*
Komkommer	-	*Cucumis*	*sativus*
Koolzaad	-	*Brassica*	*napus*
Koolzaad/raapzaad	-	*Brassica*	*napus/rapa*
Koriander	-	*Coriandrum*	*sativum*
Kropaar + knaulgras	-	*Dactylus*	*glomerata*
Larix	-	*Larix*	-
Lijnzaad	-	*Linum*	*usitatissimum*
Lijnzaadbruin	-	*Linum*	*usitatissimum*
Lijnzaadgeel	-	*Linum*	*usitatissimum*
Lijsterbes	-	*Sorbus*	*aucuparia*
Linze	-	*Lens*	*culinaris*
Maïs	-	*Zea*	*mays*
Maïs	rood	*Zea*	*mays*
Maïs	wit	*Zea*	*mays*
Mariadistel	-	*Sylibum*	*marianum*
Mix	Juliennemix	-	-
Mosterd	bruin	*Brassica*	*juncea*
Mosterd	geel	*Sinapis*	*alba*
Mosterd	Oriental	*Brassica*	*juncea*
Negerzaad	-	*Guizotia*	*abyssinica*
Nigella	-	*Nigella*	-
Peper	-	*Piper*	*nigrum*
Perilla bruin	-	*Perilla*	*frutescens*
Perilla grijs	-	*Perilla*	*frutescens*
Perilla wit	-	*Perilla*	*frutescens*
Peterselie	-	*Petroselinum*	*crispum*
Pompoen	-	*Cucurbita*	-
Pompoen	geel	*Cucurbita*	-
Quinoa	-	*Chenopodium*	*quinoa*
Raapzaad	-	*Brassica*	*rapa*
Radijs	-	*Raphanus*	*sativus*
Rijst	-	*Oryza*	*sativa*
Roos	-	*Rosa*	-
Saffloer	-	*Carthamus*	*tinctorius*
Saffloer	wit	*Carthamus*	*tinctorius*
Selderij	-	*Apium*	*graveolens*
Sesam	-	*Sesamum*	*indicum*
Sla	wit	*Lactuca*	*sativa*
Sla	zwart	*Lactuca*	*sativa*
Slaapbol	-	*Papaver*	*somniferum*
Sorghum	rood	*Sorghum*	*bicolor*
Sorghum	wit	*Sorghum*	*bicolor*
Spar	-	*Picea*	-

Product (in Dutch)		scientific name	
seed	variety	genus	species
Spelt	-	*Triticum*	*spelta*
Spinazie	-	*Spinacia*	*oleracea*
Tabak	-	*Nicotiana*	*tabacum*
Tarwe	-	*Triticum*	-
Tarwe wit	-	*Triticum*	-
Teunisbloem	-	*Oenothera*	-
Thimotheegras	-	*Phleum*	*pratense*
Tuinkers	-	*Lepidum*	*sativum*
Tuinpeen	-	*Daucus*	*carota*
Ui	-	*Allium*	*cepa*
Venkel	-	*Foeniculum*	*vulgare*
Vlier	-	*Sambucus*	*nigra*
Walnoot	-	*Juglans*	*regia*
Watermeloen	-	*Citrillus*	*lanatus*
Wikke	-	*Vicia*	-
Zonnebloem	-	*Helianthus*	*annuus*

Kennis over welke soorten worden ingevoerd is namelijk niet alleen van belang vanwege het risico van verlies in de keten van GG-gewassen, maar ook vanwege het risico van de introductie van nieuwe soorten of exoten. Import via basiszaden voor vogelvoer is een van de belangrijke routes voor de introductie van exoten (Hanson & Mason 1985). Een andere benadering om zicht te krijgen welke plantensoorten geïmporteerd worden, is door na te gaan welke wilde plantensoorten commercieel verkrijgbaar of belangrijk zijn. We zijn hierbij uitgegaan van commercieel verkrijgbaar als de plant gekweekt wordt in Nederland (Plantago 2008) of als zaad en dan internatonaal (via de post) (B-and-T 2008). Voor de Nederlandse flora geldt, dat van alle in het wild voorkomende soorten 56% als tuinplant, sierheester of parkboom en 58% als zaad kan worden gekocht. In totaal kan bijna driekwart (73%) van de Nederlandse flora óf als plant óf als zaad worden gekocht. Hoekstra *et al.* (2006) stelden vast dat, afhankelijk van de definitie, ca. 83% van de Nederlandse flora een “crop-wild relative” (CWR) is. Vanwege het mogelijke grote belang voor de landbouw van de CWR zouden deze wilde verwanten van gewassen een betere bescherming moeten krijgen, aldus Hoekstra *et al.*.

Appendix V GM crops approved for the market and field trials with GM crops

Table C. Number of GM crops approved for global marketing in the Agbios (Canada) and OECD databases. * Included in *Brassica napus*; c = crop, (c)= former crop, w = wild, g = wild congener in the Netherlands.

Dutch crop name	Scientific name	No. of approvals Agbios	OECD	Crop/wild
Maïs	*Zea mays*	47	29	c
Katoen	*Gossypium hirsutum*	18	20	
Koolzaad	*Brassica napus*	15	15	c, w
Soja	*Glycine max*	9	10	
Tarwe	*Triticum aestivum*	7	0	c
Tomaat	*Solanum lycopersicon*	6	2	c
Rijst	*Oryza sativa*	5	2	
Aardappel	*Solanum tuberosum*	4	20	c
Anjer	*Dianthus caryophyllus*	3	14	g
Biet	*Beta vulgaris*	3	2	c,w
Pompoen	*Cucurbita* spec.	2	2	c
Tabak	*Nicotiana tabacum*	2	0	(c)
Chichorei	*Cichorium intybus*	1	0	c, w
Fioringras	*Agrostis stolonifera*	1	0	c, w
Linze	*Lens culinaris*	1	0	
Luzerne	*Medicago sativa*	1	3	c, w
Meloen	*Cucumis melo*	1	0	
Papaya	*Carica papaya*	1	2	
Pruim	*Prunus domestica*	1	0	c, w
Raapzaad	*Brassica rapa*	*	2	c, w
Vlas	*Linum usitatissimum*	1	1	c, w
Zonnebloem	*Helianthus annuus*	1	0	c
Total		132	129	

Table. D1 Number of field trials with GM crops worldwide in the period 2004-2007; remark: c= arable crop, w = wild species, g = wild congener in the Netherlands, * including 2 *Brassica rapa/napus*, source: COGEM.

Dutch crop name	Scientific name genus	species	Field trials n	%	Remark
Maïs	*Zea*	*mays*	899	42.9	c
Soja	*Glycine*	*max*	300	14.3	-
Katoen	*Gossypium*	spec.	139	6.6	-
Koolzaad	*Brassica*	*napus*	97*	4.5	c, w
Rijst	*Oryza*	*sativa*	94	4.5	-
Aardappel	*Solanum*	*tuberosum*	75	3.6	c
Tabak	*Nicotiana*	*tabacum*	71	3.4	-
Tomaat	*Solanum*	*tuberosum*	48	2.3	c
Tarwe	*Triticum*	spec.	29	1.4	-
Amerikaanse pijnboom	*Pinus*	*taeda*	28	1.3	g
Luzerne	*Medicago*	*sativa*	26	1.2	c, w
Pijnboom hybride	*Pinus*	*x rigitaeda*	20	0.9	g
Populier	*Populus*	spec.	15	0.7	c, w
Gerst	*Hordeum*	*vulgare*	15	0.7	c
Suikerriet	Saccharum	officinarum	14	0.7	-
Druif	*Vitis*	spec.	13	0.6	c
Pinda	*Arachis*	*hypogaea*	11	0.5	-
Grauwe abeel	*Populus*	*x canescens*	11	0.5	c, w
Eucalyptus hybride	*Eucalyptus*	x spec.	10	0.5	-
Other crops	see Table D2		183	8.8	c, w
Total			2097	100.0	

Table D2. Further information on category "Other species" from Table D1: number of GM field trials worldwide for; remark: c= arable crop, w = wild species, g = wild congener in the Netherlands, source: COGEM.

Dutch crop name	Scientific name genus	species	No. of field trials	Remark
Amerikaanse populier	*Populus*	*deltoides*	9	g
Erwt	*Pisum*	*sativum*	8	c
Bruine mosterd	*Brassica*	*juncea*	8	g
Appel	*Malus*	*sylvestris*	8	c, w
Zandraket	*Arabidopsis*	*thaliana*	6	w
Biet	*Beta*	*vulgaris*	6	c, w
Zwarte nachtschade	*Solanum*	*nigrum*	4	w
Raaigras	*Lolium*	spec	4	g
Roos	*Rosa*	spec.	4	g
Pruim	*Prunus*	spec	3	g
Ui	*Allium*	*cepa*	3	c
Fioringras	*Agrostis*	*stolonifera*	2	c, w
Bosbes	*Vaccinium*	spec.	2	g
Vlas	*Linum*	*usitatissimum*	2	c
Witte abeel	*Populus*	*alba*	2	c, w
Bermudagrass	*Cynodon*	spec.	1	g
Berk	*Betula*	*pendula*	1	c, w
Witte klaver	*Trifolium*	*repens*	1	c, w
Zwenkgras	*Festuca*	*arundinacea*	1	c, w
Walnoot	*Juglans*	spec.	1	g
Pepermunt	*Mentha*	*x piperita*	1	g
Zwenkgras	*Festuca*	*elatior*	1	g
Huttentut	*Camelina*	*sativa*	1	w
Kool	*Brassica*	*oleracea*	1	c, w

Table E. Number of field trials with GM crops worldwide before 2004 with crops (c) grown in the Netherlands or crops with wild (w) relatives in the Netherlands. Source: COGEM.

Dutch crop name	Scientific name		No. of field trials	Crop/wild
Aardappel	*Solanum*	*tuberosum*	60	c
Maïs	*Zea*	*mays*	53	c
Tarwe	*Triticum*	spec.	32	c
Koolzaad	*Brassica*	*napus*	30	c, w
Tomaat	*Solanum*	*lycopersicon*	19	c
Tabak	*Nicotiana*	spec.	18	c
Populier	*Populus*	spec.	14	c, w
Fioringras	*Agrostis*	*stolonifera*	12	w
Zonnebloem	*Helianthus*	spec.	11	c
Luzerne	*Medicago*	*sativa*	11	c,w
Kool	*Brassica*	*oleracea*	10	c, w
Biet	*Beta*	*vulgaris*	9	c, w

Dutch name crop	Scientific name		No. of field trials	Crop/wild
Sla	*Lactuca*	spec.	8	c, w
Meloen	*Cucumis*	*melo*	7	c
Gerst	*Hordeum*	spec.	7	c, w
Den	*Pinus*	spec.	7	c, w
Arabidopsis	*Arabidopsis*	spec.	6	w
Appel	*Malus*	*sylvestris*	6	c, w
Peer	*Pyrus*	*communis*	6	c
Walnoot	*Juglans*	spec.	5	c
Komkommer	*Cucumis*	spec.	4	c
Pruim	*Prunus*	spec.	4	c, w
Erwt/boon	?	?	3	c
Pompoen	*Cucurbita*	spec.	3	c
Aardbei	*Fragaria*	spec.	3	c, w
Raaigras	*Lolium*	spec.	3	c, w
Veldbeemdgras	*Poa*	*pratensis*	3	c, w
Framboos	*Rubus*	*idaeus*	3	c, w
Ui	*Allium*	*cepa*	2	c
Jute	*Canabis*	spec.	2	c
Bermudagras	*Cynodon*	spec.	2	w
Festuca	*Festuca*	spec.	2	c, w
Vlas/lijnzaad	*Linum*	spec.	2	c
Munt	*Mentha*	spec.	2	c, w
Roos	*Rosa*	spec.	2	c, w
Klaver	*Trifolium*	spec.	2	c, w
Struisgras	*Agrostis*	spec.	1	c, w
Wolfskers	*Atropa*	*bella-donna*	1	w
Haver	*Avena*	spec.	1	c
Berk	*Betula*	spec.	1	c, w
Mosterd	*Brassica*	*juncea*	1	c, w
Chicorei	*Cichorium*	spec.	1	c, w
Peen	*Daucus*	*carota*	1	c, w
Spar	*Picea*	spec.	1	c, w
Salie	*Salvia*	spec.	1	w
Zwarte nachtschade	*Solanum*	*nigrum*	1	w
Afrikaantje	*Tagetes*	spec.	1	c
Witte klaver	*Trifolium*	*repens*	1	c, w
Triticale	*Triticale*	spec.	1	c
Amerikaanse olm	*Ulmus*?	spec.	1	w
Bosbes	*Vaccinium*	spec.	1	w
Fescue (gras)	*Vulpia*	spec.	1	w

Appendix VI Transport chains of several other crops

Introduction

Besides rape (*Brassica napus*), information was also sought on the transport chains of several other crops, viz. lucerne, or alfalfa (*Medicago sativa*), beet (*Beta vulgaris*), bent-grass (*Agrostis* spec.) and poplar (*Populus* spec.). On these crops there proved to be far less information available than in the case of rape. For this reason the information found on these crops has been relegated to a brief presentation in this appendix. With the exception of lucerne none of these crops are transported in bulk, with only small batches generally involved. Although potential losses to the environment could not be charted in any detail, they may well be only limited, given the precision with which sowing seed or horticultural items are packaged and given the heat treatment to which lucerne pellets, in particular, are subjected.

Lucerne (*Medicago sativa*)

Agricultural cultivation of lucerne has already led to problems through widespread hybridisation (*Medicago x varia*) with the congener Sickle medick (*Medicago falcata*) in Switzerland (cf. Felber *et al.* 2007). Lucerne is used in a variety of ways, the most important of which in the Netherlands is as silage. In addition, it is used as 'green manure', as green fodder on cattle farms, and in seed mixtures for 'wildflower verges' and foraging areas for game. Lucerne seed for sowing derives almost exclusively from France and the Netherlands and is supplied by some three major seed companies. With respect to the transport, storage and transhipment of lucerne sowing seed, the same probably holds as for rapeseed used for sowing. The lucerne for the silage is grown on contract, harvested and delivered to drying plants. The acreage devoted to lucerne in the Netherlands, around 6,000 ha, is about three times greater than that currently planted to rape. Lucerne is harvested before 20% of the field is in flower. It cannot be ruled out, though, that some fraction of the field will already have flowered and set seed, certainly if the crop has been undergone several mowings, as is common practice in France (pers. comm. Den Nijs). The dried lucerne is used in two ways as animal feed: as bales of green fodder and as pellets. The latter are produced under high temperature and pressure. Because of transport costs, the bales of fodder are used in the direct vicinity of the drying plant. Pellets are either transported to other fodder producers or exported. The only import of lucerne is as pellets. The only lucerne import data gathered are on sowing seed (see Table 1, Chapter 2). There is a possibility of lucerne seeds still being present in the fodder bales, and therefore of potential loss of the latter during transport. With regard to the pellets, given the high production temperatures involved (400-800°C, under high pressure) the assumption is (pers. comm. VNG) that any lucerne seeds still present will have been effectively killed. Quantitative data are lacking, however. There are six drying plants in the Netherlands, supplying lucerne pellets to a similar number of major animal feed producers. Thanks to European subsidies, lucerne contracts are still profitable for Dutch farmers, but as these subsidies are to be phased out, prospects for domestic production of this crop are not rosy (LEI 2002, 2008). According to the Dutch trade association of driers (pers. comm. VNG, 2009) there is only limited import of lucerne pellets (20,000 tonnes) compared with domestic production (60,000 tonnes). In 2005/2006 the fodder industry imported 24,000 tonnes of grass/clover/lucerne meal, with domestic production of the same totalling 165,000 tonnes. In the fodder industry there are no data available on consumption of lucerne alone. In 2005/2006 aggregate Dutch consumption of raw materials for fodder totalled 12,425,000 tonnes, with imports accounting for 90% of this figure (PDV 2008). The sourcing of lucerne pellet imports was not the subject of further investigation. As stated, besides being processed in fodder, lucerne is also used as green manure and for sowing in 'wildflower verges' and game foraging areas. Although the seeds for this purpose are produced mainly in the Netherlands, some are imported. GM lucerne has not yet been approved for marketing in the EU.

Beet (*Beta vulgaris*)

The beet plant is grown for a variety of purposes, the most familiar being the sugarbeet, one of the Netherlands' main arable crops. A second important variety is the fodder beet fed to livestock. Finally, several varieties are grown for their leaves, which are eaten as 'greens'. The volume of beet seed imported for sowing purposes in 2007 is reported in Table 1 (Chapter 2). The origins of this seed were not investigated. Neither were imports of beet as a root crop or vegetable, although these are probably limited because of the high freight costs involved. Requests for information on the beet transport chain went unanswered. The main supplier is SES-Europe, located in Belgium. Most of the beet seed for sowing is sourced in Europe (northern Italy, southern France, Spain). Transport is in sealed wooden cubic-metre crates on pallets carried by ship or truck. Beet seed is also among the ingredients used in 'birdseed'; see Appendix IV. This will involve batches rejected for some reason or other. When it comes to transport and losses of beet seed in this fodder supply chain, the same will hold as for rapeseed. In addition, material rejected from the sowing seed chain is also supplied to the fodder industry, which processes them in pellets. There is no information on the extent to which these contain still viable seeds (including those of beet). The same general picture probably holds for imports of beet seed for sowing as described in the main report for rapeseed. GM beet has not yet been approved for marketing in the EU.

Bentgrass (*Agrostis* spec.)

The first instances have already been reported of herbicide-resistant GM bentgrass escaping from US golfing greens (see e.g. Reichman 2006). This species is used mainly for sowing sports fields, verges, golf courses and similar grassland. Once again, rejected batches may also find their way to the fodder industry. No specific import data are available, because trade statistics combine several species of grass (cf. Table 1, Chapter 2). One of the larger Dutch grass-seed producers estimates that around 200 tonnes of *Agrostis* grass-seed is imported from North America to Europe annually, of which approximately 15 tonnes ends up in the Netherlands. This is a particular variety of Common bent (*Agrostis tenuis*) known as Highland bent. The imported sowing seed is not inspected on entry to the Netherlands, but is accompanied by a US certificate. Dutch companies are leading players in global Agrostis grass-seed production, but operating elsewhere in Europe as well as in New Zealand. The grass-seed is imported in 25-kg PE bags in shipping containers. This is then repackaged by the five big Dutch grass-seed companies. Transport is by ship and then by truck, with essentially no difference from the sowing seeds of crops of like rape, beet or lucerne. For the processing of grass-seed in fodder the same holds as already reported for rapeseed and beet. GM beet has not yet been approved for marketing in the EU.

Poplar (*Populus* spec.)

The Environment Ministry (VROM) recently issued a license for trials with a Belgian GM poplar in the province of Zeeland (Volkskrant 2009, BGGO 2009). In the case of poplar we are concerned only with cultivation of so-called 'avenue trees' for use on roadsides and so on and for timber production. Poplars are propagated in two ways: from seed and by winter-grafting. The species is seldom sown from the minute seeds, but in such cases the seed is collected ‘in the wild’ and first raised under glass, only later being transferred outdoors. Most poplars are propagated by winter-grafting onto white poplar (*Populus alba*) stock. There are 5-10 traders in avenue trees in the Netherlands. Following initial propagation, the trees are matured by the country’s various avenue-tree growers. There are no import data available on poplar as such (cf. Table 1, Chapter 2). Seed of the related aspen (*Populus tremula*) is imported from the UK and Hungary, totalling some 1-2 kg a year. It is unknown how this is brought in. Cuttings are also imported from several countries, including Belgium (the world’s leading producer, with the greatest variety of clones). Transport is then overland, by truck. Once again, precise figures on import from other EU countries are anything but clear (there is no mandatory registration). There are no imports of any significance from outside the EU, at any rate. At the very most, there is small-scale air transport of cuttings (not seeds) from North America to the Netherlands for use in experimental programmes. The cuttings are then transported dry (without soil) in cardboard boxes.