Report of a Pest Risk Analysis

Pest:	*Diabrotica virgifera virgifera* Western Corn Rootworm (WCR)
PRA area:	Netherlands
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1. Initiation

1.1 Reason for doing PRA

Diabrotica virgifera virgifera (WCR), an EU quarantine organism, is spreading throughout Europe. Outbreaks have been reported from several EU countries. This PRA for the Dutch situation will be used for discussion on the topic of Diabrotica with the Ministry of Agriculture, Nature and Food quality and the corn growers in the Netherlands. In January 2006, this PRA report was updated.

1.2 Taxonomic position of pest

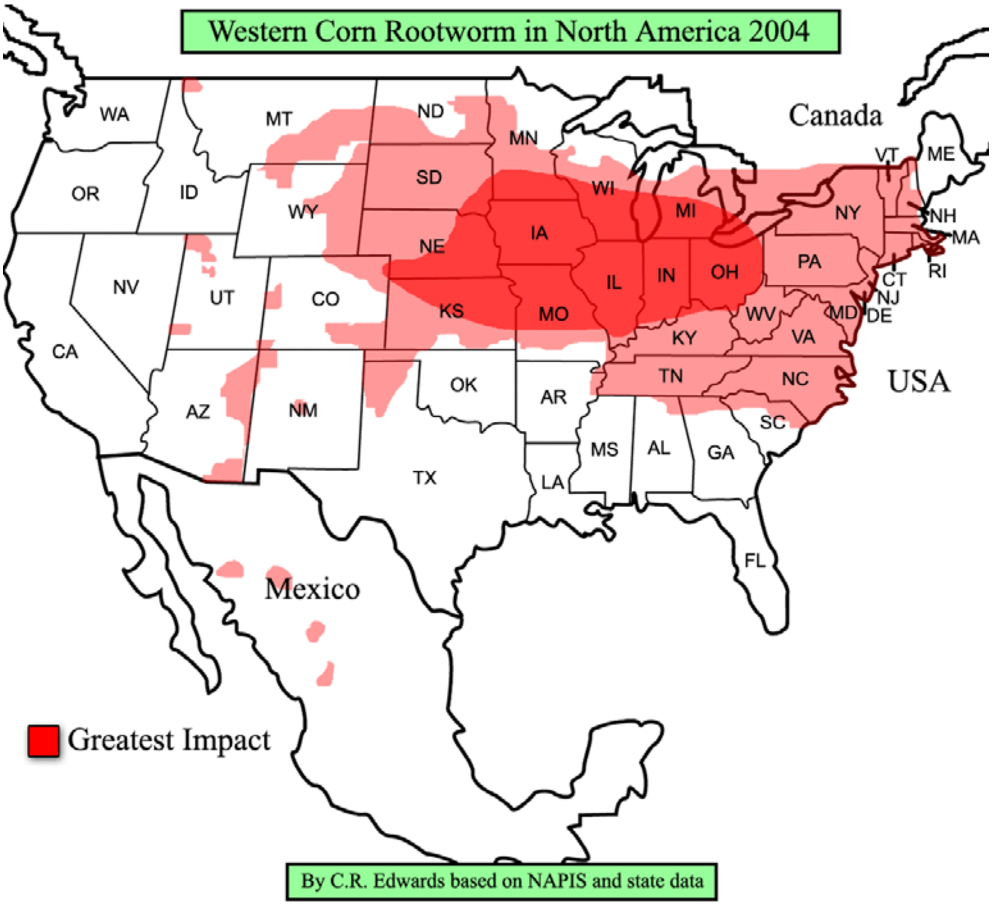
Scientific name: *Diabrotica virgifera virgifera* LeConte
Taxonomic position: Insecta: Coleoptera: Chrysomelidae
Common name: Western Corn Rootworm (WCR)

2. Probability of introduction in the Netherlands

2.1 Geographical distribution

WCR history in the USA

WCR is widespread in the USA and Canada (Fig 1). It also occurs in several Central-American countries. Already 3000 years ago, maize occurred in the southwestern part of the USA. Because *D. virgifera vigifera* (WCR) is (more or less) ecologically monophagous on corn, it is likely that the presence of this insect does not predate the presence of corn. However, WCR may have been present up to 3000 years in the USA. Before 1940, the subspecies was only known in the western part of the USA. In the 1940's, a dramatic eastward expansion began. The southern part of the USA did not become infested because of the warm winters. WCR needs a diapause to complete it's lifecycle, but when the winters are warm the diapause will not be induced (*Edwards, 2003*). The situation of *D. virgifera* in Canada and USA over the last 40 years, however, is a clear indication of the species' spread potential.



Update 2006: Fig 1. Spread map of WCR in the USA (2004).

In the USA, a WCR variant-type has developed. This variant-type has adapted to other crops than corn, such as soybean, sunflower and winter wheat. A study has been carried out to compare the genetic structure of the USA populations and the captured specimens in Europe. WCR-beetles were collected during the summer of 2000 from 23 sites in Eastern Europe and Italy and were analysed. There is, so far, no indication that the European WCR differs from the WCR genotype that is widespread in North America.

WCR history in Europe

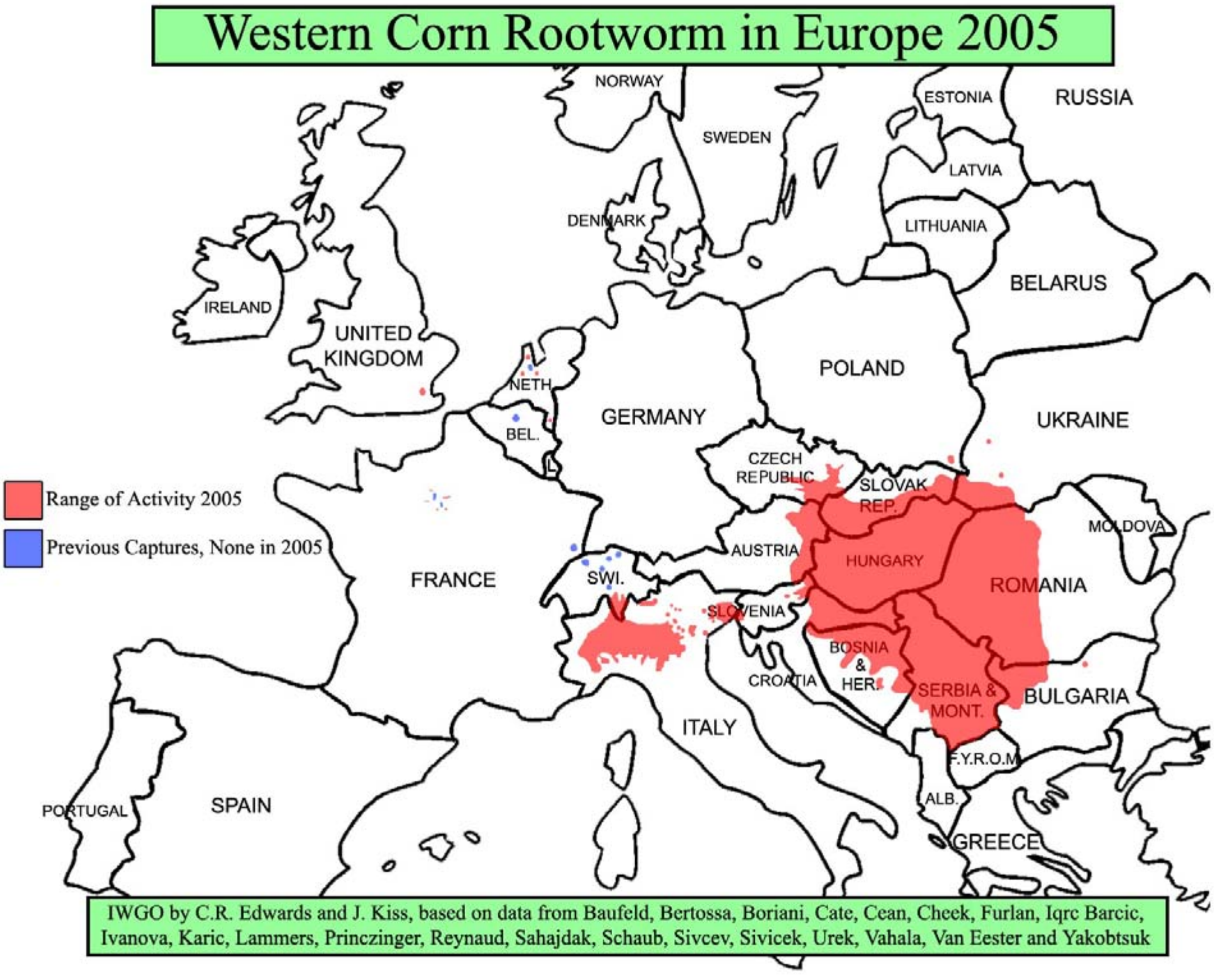
The first outbreak of WCR occurred in Belgrade in 1992. After the 1992 outbreak in Belgrade, WCR has spread naturally by 40 to 100 kilometres yearly (fig 1). The adults seem to move with weather features such as cold fronts (*Grant & Seevers, 1989*). Mated females are known to fly greater distances compared to males and virgin females (*Tollefson, 2002*).

Update 2006

After 1992, the species spread towards Bosnia and Herzegovina (first report in 1997 but probably present earlier), Bulgaria (first record in 1998), Croatia (first record in 1995), Hungary (first record in 1995). In 1998, it was trapped near Venezia airport (Marco Polo) in Italy, in this region of Italy an eradication programme is being carried out. Again in 2000, D. virgifera was caught in 2 new airports of Italy and Switzerland: in Milano (Malpensa) and Lugano/Agno. In 2001, it appeared that these two 'spot introductions' were in fact parts of an outbreak covering a rather large area in Ticino, Lombardia and Piemonte. Eradication is not envisaged in this area. A new outbreak was detected in 2002 near Aviano military airport in Friuli-Venezia-Giulia. In 2002, D. virgifera was also found for the first time in France near Roissy, Le Bourget and Orly airports (near Paris) and eradication measures are being taken. In 2003, new outbreaks were reported in France (in Alsace), in Belgium, in the Netherlands, and in United Kingdom, again near international airports. In 2004, the pest continued to spread in most areas where it was present. No new country was reported to be infested in 2004. In addition, in several areas where eradication and containment measures are being applied, D. virgifera was no longer found in 2004 (i.e: Alsace (in France), Netherlands, Swiss region at the north of the Alps). In areas near Paris airports (FR), Heathrow (UK), Zaventem (BE), Venezia (IT) and in Ticino (CH), only low numbers of beetles were caught (www.eppo.org). In 2005, WCR was caught on four locations in the Netherlands: two findings were done close to airports, two other findings along important secondary roads, approximately 15 km from a major airport. In three of these cases, only one beetle was caught, while in one case two beetles were trapped. In Poland, WCR beetles were captured on two locations (*EPPO, 2005*).

Update 2006

Recently, a genetic study was carried out on the variation of American and European WCR populations. In this study, micro-satellites were used as genetic markers and the analysis was done on European populations from five outbreak sites: Paris (detection date outbreaks: 2002 and 2004), Alsace (2003), Venezia (2000) and north-east Italy (2003). Comparison results with populations from the USA showed that only one outbreak originated from Central Europe: the outbreak in north-east Italy. The outbreaks near Paris (2002 and probably also 2004) and Venezia (2000) resulted from independent introductions from North America. The outbreak in Alsace originated from the Paris 2002 outbreak (*Miller et al, 2005*).



Update 2006: Fig 2. Spread map of WCR in Europe from 2005

2.2 Major host plants

Corn (*Zea* mays) is the only major host plant of WCR. Several other crops, such as sunflower, (winter) wheat and clover are mentioned in literature as secondary hosts, but no real damage has been observed in the field (*Fabaceae, Asteracea, Cucubitaceae*). However, feeding, egg laying and development of (some) adults is observed in several other plant species than maize, such as winter wheat and several grasses belonging to the *Poacea* (*Moeser & Vidal, 2003; Clark & Hibbard, 2003*), but little is known about the fertility of adults emerging from these secondary hosts.

2.3 Pathways for possible introduction

Experts agree that the first outbreak in Belgrade in 1992 most likely was caused by air traffic between the USA and Belgrade. The WCR occurrences in Italy and France can be explained by air traffic also, since the first specimens were caught just around the airport facilities.
Transportation of WCR beetles by maize products has never been observed, despite the fact that this has been studied. The transport of beetles by airplane most likely occurs at random. Beetles have been observed at night at airport facilities, probably attracted by the lights. Most cargo is loaded at night (*Edwards, 2003*). For the same reasons, it is also possible that WCR spreads by other means of traffic, e.g. trucks, passenger cars or boats. Especially trucks (adults) and military equipment (adults or larvae in soil) that (load and) drive through infested areas might be an important pathway, although this never has been observed.
After the 1992 outbreak in Belgrade, WCR has spread naturally by approximately 40 kilometres annually (fig 1). Larger spreading (80 – 100 km) distances are caused by summer storms, which literally *blow* the adults away.
In summary, there are four realistic pathways for possible introduction:

- Traffic by air
- Traffic by road
- Traffic by water
- Natural spread (40 – 100 km per year)

2.4 Establishment - climatic suitability of the Netherlands

Baufeld *et al*. (1996) evaluated the establishment potential of WCR in Germany, and concluded that the species could very probably establish. Reynaud (1999) estimated that both Germany and The Netherlands would be suitable for WCR-establishment. The border between Germany and Denmark would be the natural border for establishment.

The Dutch Plant Protection Service has carried out a CLIMEX-study in order to predict the possibility of WCR establishment in the Netherlands and other European countries. Results of this study show that WCR most likely is able to survive under the climatic conditions in the southern part of the Netherlands (Figure 4; *De Boer, 2002*). It is difficult to predict what the exact most northern region (barrier) will be where WCR is able to survive. The results of the CLIMEX-study show that the part of the Netherlands north of the river Rhine is unsuitable for WCR establishment. Roughly 85,000 ha of maize is grown in the 'northern part' of the Netherlands (Provinces of Friesland, Groningen, Drenthe, Overijssel, Flevoland and Noord-Holland). This is about 35 percent of the total maize area in the Netherlands.

Because of the difficulties of predicting the exact region of spread with a model, one should bear in mind that WCR establishment in the northern part of the Netherlands cannot be excluded! However, spread to – and establishment in even more northern European countries (Denmark) is not likely.

2.5 Establishment – possible lifecycle in the Netherlands

WCR has only one generation per year (*Krysan & Miller,* 1986). Overwintering of WCR takes place in the egg stage. Egg mortality is influenced by winter temperature and can reach 50% after 4 weeks at –10^{o} C or 1 week at –15^{o} C (*Chiang, 1973*). Long-term climatic data of the Netherlands (1991 – 2001) show that the mean temperature for January varies between –1.2^{o} C (1997) and 11.3^{o} C (2001). The overall average mean temperature for January is 4.0^{o} C. Therefore, in the Netherlands some egg mortality may occur, but most likely a high percentage of eggs will survive. In Germany, for a period of 25 years the lowest soil temperature (5 cm deep) observed was –13^{o} C for 1 day (*Baufeld & Enzian, 2003*). This contributes to the assumption that normally no significant egg mortality will occur in Western Europe.

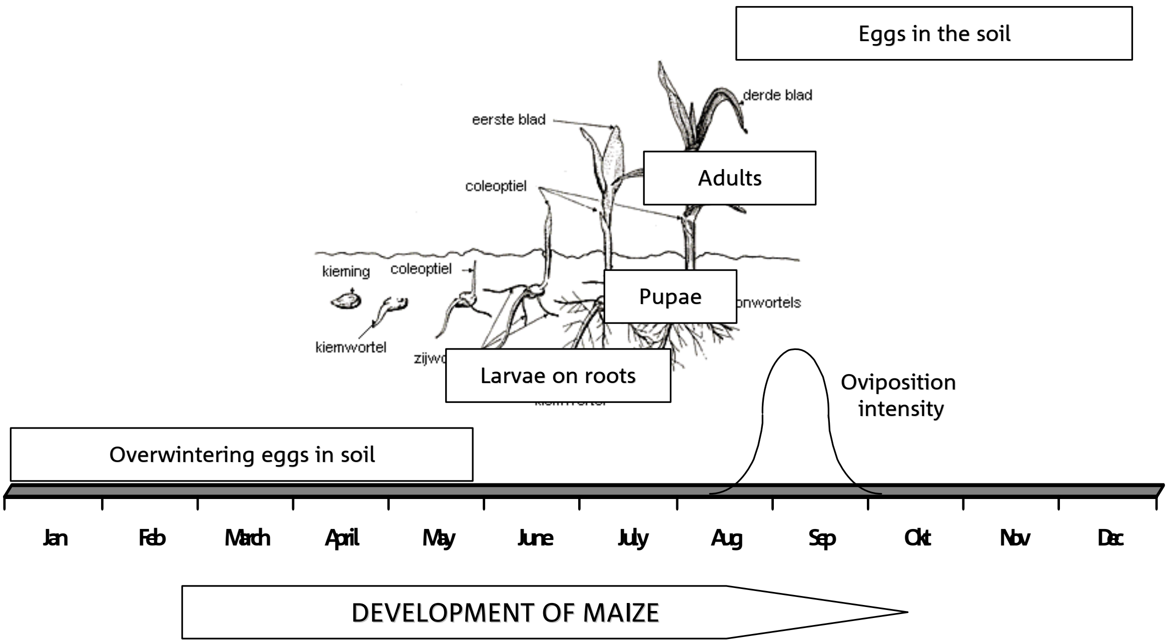


Fig 3. Possible lifecycle of WCR in the Netherlands

The lifecycle of WCR is adjusted to the development of its host plant; If the planting of maize is delayed, there is also a proportionate delay in occurrence of the larvae and thereupon also the hatching of the pupae and adults (*Bergman & Turpin, 1986*). Larvae hatch over a prolonged period of time: 2-4 weeks after the sowing of maize (May); they develop on and in the young roots, 5-15 cm deep in the soil. Then they move from the fine rootlets to the rootcore, which they invade by feeding on the tissues. Pupation takes place in the soil. Adults emerge 5-10 days after pupation. In the USA, emergence is observed from mid-July to mid-August between 1800-2200 degree days (*O'Day et al, 1998*). Climatic data from a ten-year period (1991 – 2000) show that the period of 1800-2200 degree days is more or less the same for The Netherlands (*KNMI*). Looking at these climatic data, adult emergence in the Netherlands can start from early July (1800 degree days) 'till the end of August (2200 degree days). The possible lifecycle of WCR is presented in figure 3.

When emerged, the adults move to the maize plant to feed on the leaves, pollen and young maize-grains. After feeding, the adults are able to lay eggs in the soil, generally in August-September. The females are known to be highly fertile, possible of laying about 1000 eggs (*Branson & Johnson, 1973; Hill,* 1975). However, normally only 20% of this potential number of eggs is laid, probably because of the dry and warm august month (*Toepfer & Kuhlmann, 2003*). Adults probably can be found until at least the end of September. If the development of the insect's life is delayed by low temperature, the chance arises that it cannot complete its life-cycle. Baufeld *et al* (1996) conclude that larval development under German weather conditions will take longer than in the USA because of the suboptimal temperatures, which are lower in Germany. They estimate that the larvae will pupate in July or August, but the population than still will be able to finish its lifecycle. Elliott et al (1990) conclude that the median life span of adult WCR beetles decreases with increasing temperature: 13.8 weeks at 19.5 ^{o}C and 7.9 weeks at 30.0 ^{o}C.

Conclusions - Probability of introduction in the Netherlands

- WCR has been observed on five locations in the Netherlands (one in 2003, four in 2005). In several of these case, only one beetle was caught despite intensive monitoring (**update 2006**).
- A genetic study has proven that several EU outbreaks of WCR originate from the USA (**update 2006**).
- After the 1992 outbreak in Belgrade, WCR has spread naturally by approx. 40 km / year on average
- There are four major pathways for possible introduction: natural spread, traffic by air, traffic by road and traffic by water.
- Feeding, egg laying and development of (some) adults is observed in several other plant species than maize, such as winter wheat and several grasses belonging to the Poacea
- Results of a Climex study show that WCR most likely is able to survive at least under the climatic conditions in the southern part of the Netherlands. Because of the difficulties of predicting the exact region of spread with a model, one should bear in mind that WCR establishment in the northern part of the Netherlands cannot be excluded.

3. Economic and environmental impact assessment

3.1 Corn growing in the Netherlands

In 2004, about 254 thousand hectares of corn was grown in The Netherlands, the largest part being silage corn (Table 1, **update 2006**). Besides silage corn, grain corn and corn-cob-mix a very small amount of sugar corn is produced in the Netherlands.

Table 1. 2004 area of silage corn, grain corn and corn-cob-mix in The Netherlands (ha) (**Update 2006**)

Province	Silage maize	Grain corn	Corn-cob-mix	Sugar maize
Drenthe	18231	490	219	0
Flevoland	3168	131	5	93
Friesland	16389	45	0	0
Gelderland	44304	2623	849	15
Groningen	7282	191	86	0
Limburg	13547	6389	831	40
Noord-Brabant	58818	10709	4225	56
Noord-Holland	4249	36	0	3
Overijssel	43667	1259	495	3
Utrecht	6473	65	9	6
Zeeland	4098	378	41	124
Zuid-Holland	4242	105	29	55
Total	**224,468**	**22,420**	**6,788**	**393**

Besides grass, silage corn is an important roughage source for especially (dairy) cattle. Most of this silage corn is used on the same farm where it is produced. Only a small amount of the total harvested corn is commercially traded to other farmers, most often within the Netherlands..

The grain corn is used as raw material for the processing industry. The grains are used for the production of starch, glucose, oil, snacks, paper, etc. Also the grain corn is added into fodder for cows, pigs and poultry. By-products of the starch and oil industry are also used as raw material for animal fodder. In the period of 1992 to 1996 about 60.000 to 90.000 tonnes of grain corn are produced annually (*LEI-DLO & CBS, 1998*). The grains of the corn-cob-mix crop are harvested and used as fodder for cattle.

High-risk areas

Growing corn as a monoculture is generally accepted as the main factor for increasing WCR populations and, as a result of this, higher yield losses. In monoculture fields WCR-larvae will find corn host plant material to feed on in May and June. Baufeld (*2002*) defined these so-called high-risk areas (HRA) for WCR as: *'Regions with more than 50% of arable land in corn'*. It is assumed that within these HRA's there are significant areas in monocultural corn.

In the Netherlands, 70% of corn was produced within high-risk areas in 2001. This is the highest percentage in comparison to Germany, Belgium, Luxemburg, France, Switzerland and Austria. In Figure 4, the high-risk areas for the Netherlands are presented. For every municipality in the Netherlands, the total amount of arable land is compared with the total area of corn (ha). If the total area of corn within a municipality is 50% or more of the total area of arable land, the municipality is defined as a high-risk area. Large areas of the provinces of Noord-Brabant, Utrecht, Gelderland, Overijssel and Friesland are defined as high-risk areas.

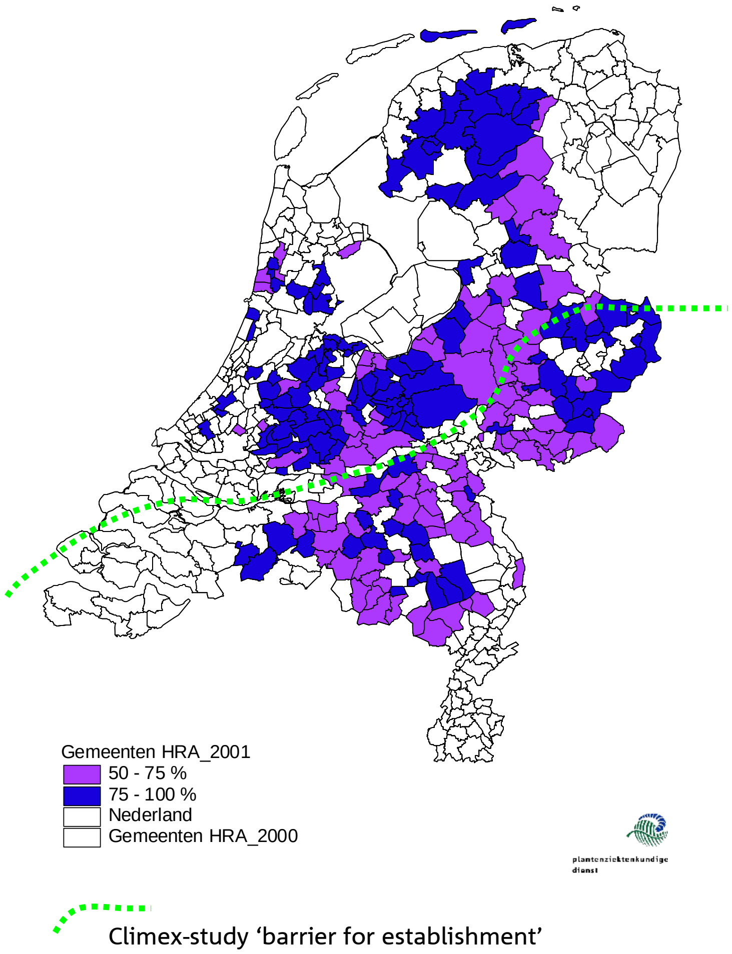
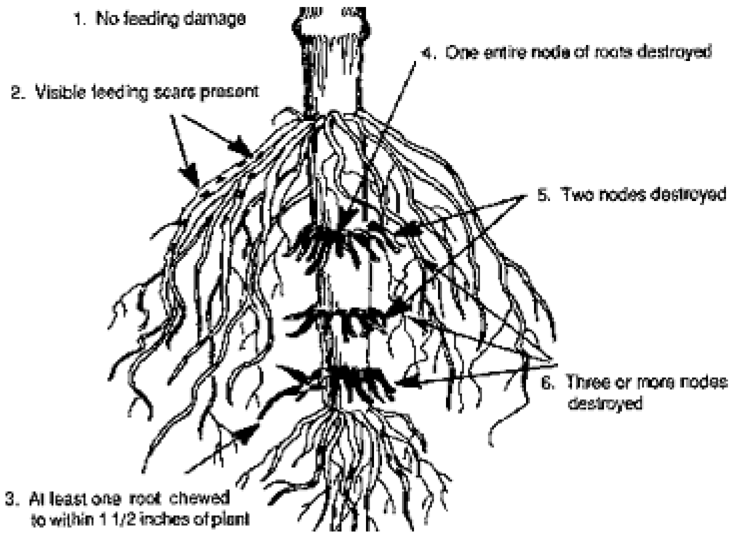


Fig 4. High Risk Areas for WCR in the Netherlands (2001).

3.2 Possible damage

WCR adult beetles can damage maize plants by interfering with the pollination process, resulting in reduced numbers of grain, but this is not very common. The most significant damage occurs from larvae feeding on the roots. The larvae are attracted to the corn roots by carbon dioxide given off by the roots. Larval damage can reduce the amount of water and nutrients supplied to plants, thus impacting yield. Additionally, extensive root damage makes plants susceptible to lodging. Plants that have fallen over are difficult to harvest, especially by machine, and harvest losses occur. In figure 4, the Iowa root damage scale is presented, which can give an indication of the damage level. A mean root rating around 3 (or more) results in economic loss.



Rating	Description of root system
1	No noticeable feeding damage.
2	Feeding scars present but no root pruning.
3	At least one root pruned, but less than an entire node of roots pruned.
4	At least one full node of roots pruned but less than two full nodes.
5	At least two full nodes pruned, but less than three full nodes.
6	Three or more full nodes of roots pruned.

Fig 4. Description of the Iowa State University 1 to 6 root damage scale.

3.3 Possible yield loss in the Netherlands

Yield losses can reach 10-40%, or in extreme cases even 90% (*Mc Bride, 1972; Spike & Tollefson, 1991*), but Calvin *et al* (2001) estimated yield losses for untreated fields in the north-eastern part of the USA to be as high as 6.5 %. Other data show yield losses of 10 to 13% as a result of corn rootworm infestations (*Apple et al, 1977; Pettey et al, 1968*). Schaafsma *et al* (2002) estimate a possible yield loss of 10% for German (climatic and growing) conditions. In this PRA, a possible damage range of 6.5% is assumed for the Netherlands if the Western Corn Rootworm is left untreated.

3.4 Possible economic impact in the Netherlands

Update 2006

If the entire maize crop in the Netherlands was infested by WCR and left unteated, the economic impact, at an assumed average damage level of 6,5% would be 14 million Euros / year. This is the impact at monoculture fields, approximately 70% of all maize fields in the Netherlands. It is assumed that the whole of The Netherlands is suitable for WCR establishment, although this is uncertain.

3.5 Possible environmental impact in the Netherlands

Looking at the environmental impact, applying insecticides is undesirable. Several tons of insecticide would be used annually if seed treatment would be applied. The amount of insecticides would increase if a certain percentage of the farmers would use soil insecticides instead of seed treatment. In the Netherlands, up to now only small amounts of insecticides are applied in the maize crop (table).

Total amount of chemicals applied in maize in the Netherlands (2000)

Treatment against	Total amount in tons
Insects and mites	1,1
Weeds	150,1
Wireworms	0,6
Others	10,8

Source: Centraal Bureau voor de Statistiek (CBS)

3.6 WCR as a vector for other pests

Diabrotica virgifera virgifera is able to transmit several viruses, namely Cowpea severe mosaic, Cowpea mosaic, Squash Mosaic en Maize chlorotic mottle (*Krysan & Miller, 1986*). At this moment, these viruses are only known to occur on the American continent. WCR-larvae can transmit the causal agent of the quarantine bacterial disease *Pantoea stewartii* (Annex II A I), a serious disease of sweetcorn.

Conclusions – Economic and environmental impact assessment

- In the Netherlands, 70% of corn is produced within high-risk areas. This is the highest percentage in comparison to Germany, Belgium, Luxemburg, France, Switzerland and Austria.

- The most significant damage occurs from larvae feeding on the roots, which reduces the amount of water and nutrients supplied to plants. Extensive root damage makes plants susceptible to lodging.

- A possible average yield loss of 6.5% is assumed for the Netherlands if WCR would be left untreated.

- If the Western Corn Rootworm was left untreated, this could result in an economic yield loss of €14 million (**update 2006**), although it is uncertain whether the whole of the Netherlands is suitable for establishment of WCR.

- Crop rotation is generally accepted as the most effective way to control the Western Corn Rootworm, but is from an business economic point of view less desirable compared to monoculture and less profitable than several other control measures (**update 2006**).

4. Pest Risk Management

4.1 Acceptability of risk

If WCR would establish in the Netherlands and be left untreated, this is expected to result in an average yield loss of 6,5% if left untreated, which corresponds to 14 million Euros annually. Dairy farmers have to purchase additional roughage (silage corn) and growers of grain corn and corn-cob-mix suffer from reducing amounts of marketable product. In 2003, this was considered unacceptable by stakeholders in the Netherlands (**update 2006**).

4.2 Pathway 'air- & road traffic' – Measures aimed at eradication

The major pathways are natural spread and traffic. An isolated outbreak caused by air, road or water traffic can be sufficiently eradicated if the outbreak is detected in an early stage, which makes a good monitoring system very important. Measures following EU Decision 2003/766/EC should be implemented after the finding. The potential costs of an eradication campaign depend on the sizes of the *focus area* and the *safety zone* and the total area of maize inside these zones. On the national level, the total costs also depend on the number of outbreaks. A study carried out by the Agricultural Economics Research Institute (LEI) indicated that eradicating WCR outbreaks remains cost-effective in the Netherlands for several years, even with an increasing annual number of outbreaks (*Westerman et al, 2005;* **update 2006**).

4.3 Pathway 'natural spread' – Measures aimed at containment

Natural spread of WCR could probably be stopped or significantly slowed down by implementing one of the following measures:

- Prohibition of growing corn in and just outside the borders of infested areas;
- Implementing crop-rotation systems for maize in and just outside the borders of infested areas.

Implementation of such measures on a large scale in the Netherlands is not cost-effective (*Janssens et al,* 2005; **update 2006**).

4.3 Control measures

In time, WCR can and probably will establish in the Netherlands. At a certain point it's no longer cost-effective to eradicate outbreaks and control measures should be implemented (by farmers). Several control measures can be applied, although some measures are currently not (yet) available:

- Seed treatment
- Soil treatment

- Crop treatment
- Crop rotation
- GMO cultivars
- Etc.

IPM-strategies could be implemented, such as the use of seed treatment, semio-chemical insect bait technologies, crop rotation, tolerant or resistant (GMO) cultivars, biological control.

In order to prevent the economic damage, various measures are possible such as applying soil insecticides, chemical seed treatment, crop spraying, crop rotation and cultivation of alternative fodder crops. A measure is only profitable if the total costs, including residual damage, are lower than the total costs in the situation where no measures are taken. The lower the damage levels, the less profitable the measures become. At a damage level of 6,5%, seed treatment is the only cost-effective measure. Crop rotation only becomes profitable at damage levels above 20%, levels which are not expected in the Netherlands (*Janssens et al, 2005*; **update 2006**).

4.4 Pest risk management – other points of interest

Monitoring

A good monitoring system is very important. In this way, an isolated outbreak of WCR can be detected in an early stage and eradication can be carried out. Once an outbreak is detected too late, WCR-establishment and population build-up may have occurred already. If this is the case eradication will be very difficult and time and money consuming. An example of early detection is the Veneto outbreak in Italy. Also in Italy an example of late detection is the Lombardia ‘outbreak’, where a containment strategy is being followed to stop or slow down further spread of the population.
Since 1997, monitoring is carried out in the Netherlands with pheromone traps in monoculture cornfields, mainly at high-risk locations.

Insecticides for controlling WCR-adults

To further decrease the risks for the environment and the user of the insecticide, the insecticides could be applied together with insecticide-baits made of ‘dry-cob-grits’, cornstarch or cereal meal impregnated with cucurbitacins (feeding stimulants). In the USA Invite EC has been developed. Invite EC is an inert, emulsifiable concentrate that is mixed with low levels of insecticides (less than 10%) to control adult WCR beetles. Invite EC contains a naturally occurring, EPA approved arrestant / feeding stimulant upon which the corn rootworm compulsively feeds. There are plans to market this product in Europe and South America (*Schröder, 2001*). However, Invite EC seems to have a toxic effect on non-target organisms (*Edwards, 2003*), so application should be thought over very well.

Biological control

Research is being carried out on the subject of biological control of WCR. CABI 'Bioscience' is studying which factors play an important role in the mortality of the larvae, pupae and adult stages of Western Corn Rootworm (WCR) in Hungary. Studying the diversity and function of natural enemies of Western Corn Rootworm in its area of origin in Central/South America has begun. The study aims to select specific biological control agents of 'Diabrotica' species for potential importation and establishment in Europe. In addition, preliminary studies will be carried out on the biology and ecology of specific natural enemies in its area of origin. So far, only *Celatoria compressa*, a tachnid fly originating from Mexico, is selected as a promising biological control agent. In Europe, no suitable natural enemies are detected.

Transgenic WCR-resistant cultivars

Monsanto, Pioneer Hi-Bred and Dow Agrosciences developed transgenic corn plants resistant to WCR larvae feeding. These commercial cultivars have a rootworm toxin-producing gene inserted into their genome. These genes are derived from *Bacillus thuringiensis*, a soil bacterium. The resulting Cry3Bb1 and 149B1 toxin is expressed in various parts of the plant including roots, leaves, silks and tassels. This toxin causes mortality by disruption of mid-gut cells in corn rootworm. However, significant numbers of larvae do survive to the adult stage (*Meinke, 2003*). So, the use of transgenic cultivars will only be of use in an IPM containment strategy, not for an eradication program. Registration of these cultivars in Europe is not expected in the near future (*Tinland, 2002*)

Sterile-male-technique

Elimination of pests in the field has been shown to be potentially successful *only* with the sterile-male-technique. However, in the case of *Diabrotica virgifera virgifera* research on this technique is discontinued, mainly because of the development of new containment measures, such as area-wide-management and transgenic corn varieties. It is doubtful whether or not the sterile-male-technique can be successful because of the huge potential numbers of Diabrotica-adults (millions per ha).

Conclusions – Pest Risk Management

- Potential annual costs for eradication programs depend on the sizes of the *focus area* and the *safety zones*, the total area of maize inside these zones and the annual number of outbreaks;

- An economic study indicated that eradicating WCR outbreaks remains cost-effective in the Netherlands for several years, even with an increasing annual number of outbreaks (**update 2006**);

- The major pathways are natural spread and traffic. An isolated outbreak caused by air or road traffic can be sufficiently eradicated if the outbreak is detected in an early stage. This means that a good monitoring system is very important;

- If WCR establishes in large areas in the Netherlands, control options by natural spread, eradication is impossible and not cost-effective the strategy should be to contain the pest. At that moment, eradication is not an option anymore.

- Only *Celatoria compressa*, a tachnid fly originating from Mexico, is selected as a promising biological control agent. In Europe, no suitable natural enemies are detected;

- Monsanto, Pioneer Hi-Bred and Dow Agrosciences developed transgenic corn plants resistant to WCR larvae feeding. Registration of these cultivars in Europe is not expected in the near future.

5. Conclusion of PRA

5.1 Acceptability of risk

An estimation of the potential economic yield loss for the Netherlands if the Western Corn Rootworm (WCR) was left untreated ranges from 14 to 28 million euros annually. In 2003, this was considered unacceptable by stakeholders in the Netherlands.

5.2 An estimation of the probability of introduction

After the 1992 outbreak in Belgrade, WCR has spread naturally by 40 to 100 kilometres annually. WCR has been observed on five locations in the Netherlands (one in 2003, four in 2005). In several of these case, only one beetle was caught despite intensive monitoring. Air- and or road traffic were the most likely pathways for entry.

Results of a Climex study show that WCR most likely is able to survive under the climatic conditions in the southern part of the Netherlands. Because of the difficulties of predicting the exact region of spread with a model, one should bear in mind that WCR establishment in the northern part of the Netherlands cannot be excluded.

5.3 An estimation of the potential economic and environmental impact

In the Netherlands, 70% of corn is produced within high-risk areas; areas with a significant amount of monoculture corn, which is favourable for WCR-establishment. This is the highest percentage in comparison to Germany, Belgium, Luxemburg, France, Switzerland and Austria.

If WCR was left untreated, a possible damage level of 6.5% is assumed for the Netherlands, mainly caused by larval feeding on the roots. These damages would result in a possible economic impact of €14 million annually.

5.4 Conclusions of the pest risk management options

An isolated outbreak caused by air, road or water traffic can be sufficiently eradicated if the outbreak is detected in an early stage. This means that a good monitoring system is very important. An economic study indicated that eradicating WCR outbreaks remains cost-effective in the Netherlands for several years, even with an increasing annual number of outbreaks. Once WCR establishes on a large scale, the strategy should be to control the species and avoid economic impact on the farm level. Several control options are available, such as seed treatment and crop rotation.

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