

## **Revision of Directive 91/414/EC**

- **the European seed industry's view on a future EU Regulation on Plant Protection Products and Seed Treatments**

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### **Content**

- I. Revision of Directive 91/414**
- II. ESA's demands for specific provisions for seed treatment**
- III. Introduction**
- IV. Basic information on treatment of seed with PPPs**
  - i. Definitions**
  - ii. Explanation of regulatory framework**
  - iii. Safety requirements and practice of application**
- V. Economic importance of seed treatment**
  - i. General**
  - ii. Example sugar beet**
  - iii. Example vegetable seed**

## Revision of Directive 91/414/EC

For many years, the seed and seed treatment industry has found itself at the crossroads of different European legislation, namely the different seed marketing Directives providing the legislative framework for the free movement of seed in the Common Market in the European Union, and Directive 91/414/EC concerning the placing on the market of plant protection products which is now being reviewed by the European Commission in order to propose a new Council and Parliament Regulation on this subject.

The European seed industry considers this review to provide the possibility for the long awaited first step in establishing a harmonised legislative framework governing the authorisation, application, trade and use of PPPs as seed treatments, in plant breeding and in seed production in the European Union.

It is our firm belief that both the authorisation itself as well as the use of authorised PPPs in plant breeding and as seed treatments should be supported, not hindered by new European legislation. It is an application which is beneficial to the environment and to public health, safe to workers and in particular to users of the final product, i.e. farmers and growers using treated seed.

The seed industry calls upon decision makers to assure that the new legislative framework will facilitate and encourage the development, authorisation and use of PPPs as STs by providing a consistent and cost-efficient specific approach.

We therefore urge the legislator to consider all possibilities to to this effect. Obtaining registrations of PPPs for use as a ST must be facilitated and that such registrations should be applicable to the entire European Union.

ESA therefore welcomes the Commission's approach to a further legislative harmonisation in this field but still considers a full harmonisation for PPPs being used as seed treatments as the seed industry's preferred option.

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### ESA Mission Statement

ESA is the voice of the European seed industry, representing the interests of those active in research, breeding, production and marketing of seeds of agricultural, horticultural and ornamental plant species.

Plants from seed are the origin of all food, provide innovative and environmentally friendly industrial products and beautify our landscape.

ESA's mission is to work for:

- ◆ effective protection of intellectual property rights relating to plants and seeds;
- ◆ fair and proportionate regulation of the European seed industry;
- ◆ freedom of choice for customers (farmers, growers, industry, consumers) in supplying seeds as a result of innovative, diverse technologies and production methods.

## **ESA's demands for an improved legislation on Plant Protection Products used for seed treatment and minor uses**

ESA supports an environmentally friendly and consumer safe agricultural production that is efficient, productive and possesses the necessary technology and tools to maintain and sustain a competitive position in the world.

We are convinced that a coherent and integrated EU policy on seed treatment and minor uses will benefit farmers as well as the environment and would contribute to achieve this. ESA therefore urges European decision makers to use Seed Treatments as a key tool to in achieving the policy goals formulated by the European Commission in its "Communication on the Thematic Strategy for the sustainable use of pesticides" and supplemented by the BiPRO study regarding its economic impacts.

Based on these general demands, ESA puts forward the following preliminary comments in view of the planned revision of Directive 91/414/EC:

- Overall goal of the EU's policy on plant protection products must be to have a sufficiently wide range of environmentally and consumer safe but equally effective products available to farmers and growers at affordable prices to combat all concrete and potential crop-pest problems.
- A revision of the current Directive 91/414/EC should be used to improve the authorisation process with the aim to speed up procedure(s), decrease costs and make the outcome of applications more predictable. This should include stringent timetables (with fixed deadlines per each step) as well as a final decision making procedure that does not allow for any deadlocks.
- Next to its impact on environmental safety and public health, any future legislation must in particular be assessed and judged in view of its impact on the competitiveness of European agriculture, security of food and feed supply and consequences for closely related industries such as the seed industry and seed treatment companies.
- For the seed industry, any revision must finally take proper account of the specific use of PPPs as seed treatments as well as of the issue of minor uses.
- Seed treatment applications and minor use authorisations are currently sidelined in the authorisation process. In comparison, they are discouraged by relatively low volumes of active ingredients / products concerned, by the relatively high administrative and financial burden to applicants, by the uncertainty of decision making and the risk of revocation of authorisations and the factual fragmentation of the EU's internal market due to largely different practice of implementation of the existing legislation in Member States.

- With the EU seed industry being a highly internationalised business which today operates in a truly common market and under the EU's seed marketing legislation and the EU's plant variety protection legislation, the lack of coherence and consistency with the current directive 91/414/EC and its application by Member States seriously damages business, creates additional costs and great legal uncertainty.
- To encourage the further research into and development of PPPs for use as seed treatments and to assure that also for minor uses a sufficient range of products will be available in the future, the current system based on individual authorisations on Member State level with a non-working mutual recognition provision must be greatly improved. ESA is of the opinion that seed treatment applications should be applied for and authorised EU-wide or at least for a large number of Member States ("zonal approach") to encourage companies to file these specific small scale applications.
- This encouragement could be based on a centralised procedure or on an automatic mutual recognition of national authorisations. Both approaches in principle could help to reduce application costs and uncertainties in decision making for applicants.
- PPPs that have been properly assessed and authorised should be allowed for marketing regardless of any products being authorised for the same or similar uses more recently and assessed as potentially better (e.g. possibly safer to the environment or public health). A compulsory substitution of authorised PPPs by more recent products will make investment more risky and recuperation of development costs very uncertain. There would also be a significant impact on the potential market (share) of generics.
- If still a certain substitution mechanism would ever be included in the new legislation, we consider it of utmost importance that comparisons must include authorisations of the respective PPP as a seed treatment and for minor uses. From ESA's point of view, authorisations as seed treatments or for minor uses should in any case be kept, even where the authorisation of the respective product for conventional applications may be revoked.

## Introduction

With this paper, ESA European Seed Association wants to provide policy decision makers, administrators as well as interested third parties with comprehensive information on the issue of plant protection products being used as seed treatments.

Background of the paper is the discussion at European as well as national level on the revision of the current legislation governing the authorisation of active substances and registration of their use in plant protection products.

It explains the numerous possible fields of application of seed treatments, their economic importance and environmental benefits and the way scientific knowledge forms the base of both the development as well as the authorisation process in order to assure effective and safe products and application methods.

Foremost, ESA wants to present decision makers with the actual problems the seed and seed treatment industry face with the current legislative framework and to make proposals how to improve this situation when amending the respective EU legislation.

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Seed is the starting point of all plant production. Throughout history, mankind has developed ever new and more sophisticated and different plant varieties with higher potential for yield, resistance to certain pests and pathogens and suitability for specific uses or areas of production. Naturally, with the seed containing all the genetic information needed for realising the inherent potential of these efforts, protecting this starting point of production and desired economic success has always been considered a valuable target for the plant breeding, seed production, farming and crop protection community.

For generations, farmers have tried to protect and improve their seeds against pests and diseases. To do so, they used different substances like ash, oils, salts or manure. Most of these “treatments” were either not at all or only partially effective. In any case, they failed to help breaking the cycles of infection and re-infection of seeds and plants.

Only at the end of the 19<sup>th</sup> century did the increasing knowledge and discoveries in chemistry and biology lead to the first developments of effective crop protection with the help of active substances. Since the beginning of this development, scientists considered the direct treatment of the seed itself as a particularly effective and efficient possibility to help bring about improved or even controlled plant growth, avoid or limit pests and diseases and with that to arrive at higher yields with comparably low input of active substances. With increasing knowledge and experience, the main problem –maintaining the ability of the seed to germinate as desired while at the same time protecting it against pests and pathogens- has been solved. Today, seed treatment is a key high-tech technology in modern sustainable seed and crop protection and improvement in both commercial farming and plant breeding.

The technology of seed treatment offers a wide area or applications with very different solutions for a variety of equally different practical problems in seed and crop production. Yet, what all these applications have in common is the approach to the desired results: a minimum of active substances being used, a safe and efficient way of application and making use of natural processes in putting the technology to work where needed and where most effective – directly on the seed.

## Basic information on seed enhancement

The seed industry is investing a lot of money in improving the genetics of its varieties by making the plants more resistant against all kind of diseases, by improving yields and by improving the final harvested product.

In addition, the seed industry also invests heavily in the physiological enhancement of seeds.

Seed can be enhanced in many different ways to improve the sowing, to improve the germination or to protect the seeds/plants after germination against all kind of diseases.

Enhancing seed includes

- a) Breaking certain seed dormancies by pre-germinating the seeds,
- b) Upgrading the seeds by removing non-, bad or slow germinating seeds,
- c) Coating seeds (pelleting, film coating) to improve the sowing of the seeds,
- d) Making seed free from seed born diseases,
- e) Adding additives to the seed that can stimulate or enhance the growth of the plant,

or

- f) By adding one or more crop protection compounds directly onto the seed to protect it during germination and/or to protect the plant itself during its growth, which in this paper will be called seed treatment.

In many cases several of these enhancement methods are combined to come to an optimal result.

In the following, the paper concentrates on seed treatments with plant protection compounds.

The seed and its development to a plant may be negatively affected by very different pests and diseases that are active in very varied environments. Classically, such diseases are differentiated into

- foliar diseases
- soil-borne diseases
- seed-borne diseases
- pests
- contaminants

To protect the seed and plants, the crop protection industry has developed a whole range of products targeting these plant health problems with very specific chemical and/or biological substances and applications against pests, diseases and contaminants.

Seed treatment therefore is more than applying chemicals on the seed rather than spraying the same chemical on the growing plants

Today, modern seed treatment very often allows the combination of different solutions to different problems into one technical application which is simple and in any case irreplaceable in any crop production – the sowing of the seed. With that, the technology uses and is based on existing farming procedures and does not require additional use of specific machinery in the field. It therefore also helps reducing potential problems with soil erosion and compression and can supplement, assist and benefit low-intensity farming practices like e.g. ploughless sowing, reduced soil preparation etc..

Still, with pests and pathogens constituting the major risk to seed and plant health, to crop development, crop quality and safety and yield protection, the treatment of seed with plant protection products is the main area of application. At the same time, due to the limited amount of active substances being used to achieve the desired result, it is also the area where the highest benefit, environmentally and in view of public health as well as economically, may be reaped.

## Explanation of regulatory framework and legal requirements

- **Plant Protection Products**

The authorisation of PPPs in the European Union is regulated by “Directive 91/414/EC of 15.07.1991 on the placing on the market of plant protection products”.

Together with a large number of accompanying Directives<sup>1</sup>, it provides for the establishment of a positive Community list of active substances, the use of which can be deemed in advance to be acceptable for human or animal health and the environment.

It establishes a system for the authorization by the Member States of different preparations containing the active substances in the positive list, in accordance with the requirements laid down in the Directive and according to uniform principles.

It also allows for the mutual recognition of acceptance by Member States, provided that the plant health, agricultural and environmental conditions are comparable in the regions concerned. This provision however is rarely used.

- **Seed Marketing**

The marketing of seed in the European Union is regulated by various crop specific seed marketing Directives laying down detailed rules as regards quality requirements, testing obligations etc.<sup>2</sup>. In order to be marketed, all seed must be of a clearly defined (distinct, uniform and stable DUS) plant variety. Testing and final authorisation for marketing is carried out on national level by respective competent authorities. Provided a new variety is accepted, it will be placed on a national catalogue of (agricultural or vegetable) plant varieties and may be marketed in the respective Member State (under condition that the quality requirements of the EU seed marketing Directives are met). Based on such national marketing authorisations, the plant varieties then automatically mount up to an EU Common Catalogue of (agricultural or vegetable) plant varieties which allows them to be marketed freely within the whole EU (automatic mutual recognition).

### ii. **Specific safety requirements and application practice related to treated seed**

Generally, with STs, only tiny amounts of Plant Protection Products are used to provide protection for large cropping acreages. The operator’s exposure is therefore very small and in practice restricted to trained specialists in the closed industrial systems of ST companies. Afterwards, the treated seeds are again professionally tested on elements like physical quality, germination potential and loading.

It must be emphasized that the application methods of seed treatments and its working environment cannot be compared to the regular (field) application systems used by growers and farmers. Seed treatment is a highly industrialized process in which safety and environmental issues are very well managed from start to finish:

- Products must be safety evaluated and authorised for seed treatment

Only products with approval for use as seed treatment (ST) may be applied. These products have been specifically evaluated for ST application(s) to minimize operator exposure.

- Treatment takes places under professional industrial conditions

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<sup>1</sup> E.g. on data requirements and uniform principles for chemicals and micro-organisms, standard phrases for special risk and precautions, numerous implementing measures and in particular a large number of guidance documents

<sup>2</sup> Directive 66/401 etc... include references

The treatment itself takes place by highly controlled industrial processes, in closed buildings and is carried out by well-trained professional specialists. Only appropriate seed processing equipment - including air exhausting systems and closed systems – are used to reduce workers risk exposure and the professional seed treatment industry is continuously developing and enforcing further clean working practices. PPPs are stored in a clean environment and are ideally used in closed transfer systems. This guarantees clean handling and limits direct contact with the products. Use of appropriate personal protective equipment (coveralls, gloves, apron, rubber boots, face visor, filter masks, respirator) represents standard in modern seed treatment plants.

- Workers protection and operator safety are part of the registration process

Worker protection is regulated by EU as well as national legislation and operator safety assessment is part of the product registration process. This includes identification of hazards inherent to products and assessment of risks associated with application of a PPP.

- Industry guidelines complement safety legislation

In addition, guidelines like “Seed Treatment Operator Safety Guidelines” (ISF) and “Seed Treatment – User Safety” (SeedTropex-Poster) complement legislation and help increasing awareness as well as establishing best practices.

Managers of the European seed treatment industry commit to support the highest standards of operation and safety at the plants, including continuous operator safety training, maintenance of high operating standards and keeping best working practice at the top of operators' minds.

## **VI. The economic importance of Seed Treatments for the Seed Industry**

### **i. General - the EU is (yet) the global leader in Seed Treatments**

In 2005, the seed treatment sector reached a value of approx. 1.100.000.000 EUR worldwide with the farm gate value of Seed Treatments in the EU estimated at 400.000.000 EUR (40%).

These seed treatment plant protection products can be segmented into 3 main categories:

- Fungicides, representing 50% of the seed treatment business: the protection against fungus diseases is one key target of seed protection. Most commercial seeds are treated with at least one fungicide substance.
- Insecticides, covering 40% of the seed treatment business: the volume of seeds treated is less than for fungicides but the business generated is high due to higher value of the technology.
- Mixtures of products of both fungicides and insecticides represent 10% of the total business.

The seed treatment business is predicted to increase globally at a 5% rate per annum. This is due especially to the increased use of insecticides in replacement of other technologies such as soil applied granules or early crop sprays.

Today, Western Europe represents about 36% of the total seed treatment business (North America 22%, Latin America 16%, Asia 3%).

The further growth rate in Europe is expected to be limited and well below the worldwide growth rate mainly because of the difficulty of maintaining authorisations and obtaining new ones due to a legislative framework that is unspecific and therefore unsuitable for seed treatments. This results in companies reducing related investment and innovation which means the EU's growth is not only smaller but effectively underperforms in comparison to other parts of the world.

Still, some major changes are expected in the business in the near future, especially with a replacement of some active ingredients by more recent technology.

### **Key economic data of the EU's seed industry**

The EU's seed market reached a value of more than 6.1 billion EUR in 2005<sup>3</sup> with an export turnover value of more than 2.75 billion EUR. These figures show the increasing globalisation of plant breeding and seed production resulting in shorter innovation cycles and increased efficiency both playing a major role in the EU farming sector's race for competitiveness.

In total, around 95% of all seed sown in Europe is treated with the one or the other seed treatment product or even combinations of products. The continuous growth up to today proves the sustainability and effectiveness of the technology; the potential growth in the future will therefore be related mainly to increased quality and performance rather than to an increased market share.

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<sup>3</sup> The figure does NOT include farm saved seed which for some crops reaches substantial volumes. As farm saved seed often does not reach the quality standards of regular certified or professional seed, seed treatment is a key technology to farmers making use of farm saved seed.

### iii. Example sugar beet

The global value of sugar beet seed is estimated to be between €500-€550m. EU25 represent 65% of this business. The rest of the sales are split between North America (12%), Eastern Europe (9%), MENA (8%), Asia (5%) and South America (1%)

In the EU, tremendous efforts have been placed on improving seed quality and genetics: it is the key factor explaining the high level efficiency of sugar production from sugar beet in the EU. It also explains the relative high value of seeds (with approximately €145/ha around 20% above the global average) which must be seen in conjunction with an average annual increase in yield of 1% related to cutting edge seed treatment technology alone.

In parallel, the seed treatment technology has developed involving the most advanced seed treatment processes and chemistry<sup>4</sup>. The value of PPP used in sugar beet is estimated at €90 mio (value at farmer level). This is 22% of the total seed treatment in EU 25. Sugar beet is the second largest crop for Seed treatment in EU after cereals and at the same level as corn.

All seeds marketed in Europe are treated with a fungicide to prevent mainly soil born diseases. However, insecticides represent close to 90% of the sugar beet seed treatment value.

The use of insecticides as seed treatment have significantly increased over the last 10 years due to their technical efficiency to prevent severe damages by soil pests as well as virus transmission by insect vectors (beet yellowing viruses transmitted by aphids). Today, close to 90% of the seeds planted in Europe are protected with an insecticide seed treatment: The intensity of use is different from one country to another, mainly depending on local pest pressure.

Example of insecticide Seed Treatment intensity in WEU (in % of seeds sold in the country):

- 100% ST: Austria, Czech Rep, Germany, Poland, Slovakia, Sweden, Finland, France
- 85% ST: Belgium
- 70-80% ST: Italy, Denmark, The Netherlands, UK
- 60% ST: Spain, Greece

This increased use of insecticide has resulted in improved efficiency of sugar beet cropping and in reduced use of active ingredient on this crop, as shown in the following table:

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<sup>4</sup> History of seed treatment use in Europe for sugar beet:

1980: Standard fungicide treatment was either thiram or ethyl mercury phosphate. Some carbamate insecticide treatments such as carbofuran or methiocarb were used.

1985: Tachigaren used as standard fungicide treatment against soil-borne diseases.

1990: New insecticide "Force" (tefluthrin) introduced and started to replace either older insecticides (Carbamates) or soil applied granules.

1991: Launch of a new family of insecticides seed treatment (neonicotinoids): Gaucho (imidacloprid) accelerated the rate of replacement of granules and early crop sprays with insecticides.

[Replacement of insecticide granules or soil-applied sprays by seed treatments - example UK:

In 1991 a total of 64% of the crop was treated with granules (62%) or soil-applied sprays (2%) with remainder untreated largely due to factors associated with inconvenience of application. By 2004 only 9% of the crop received a granular treatment while 78% was sown with a seed treatment.]

2001 to 2005: Increased use of insecticide seed treatment: Introduction of combination of active ingredients (Neonicotinoids + Force) in order to widen the spectrum of activity. Launch of new active ingredients such as Cruiser (thiamethoxam) and Poncho (Clothianidin)

## Effect of ST on the environment in EU sugar beet production

Without seed treatments, farmers would have to use e.g. pyrethroid sprays or carbamate granules to fight important pests/diseases. As such alternatives require higher dosage due their application technology, the effect to the environment is very significant (v. table below).

Crop	Target Pest/disease	Seed Treatment	Alternative	Difference of ai load to the environment
Sugar beet	Soil insects + early foliar pests	70 to 100 g active ingredient per ha (depending on active substance and seedling rate)	Soil granules: for example carbamate – 600g/ha	Minimum 500g active ingredient less per ha
Total environmental benefit for EU 25: (assumption: 1.9Mio ha sugar beet, 80% treated) 2.2mio ha				-760 tons active substance -880 tons

Further alternative solutions to some important plant health problems could come from improved resistances of new varieties, potentially in particular of genetically modified varieties (GMOs). Although the seed industry is constantly improving resistances of conventional (i.e. non-GMO) sugar beet varieties, these still require a combination with chemical plant protection products in order to sufficiently perform.

## Effect of ST on the economics of EU sugar beet production

1.9 mio ha production	2.2 mio ha
55 to harvest / ha	51 to / ha
36 EUR / to sales price	43,63 EUR/to
= 3.76billion EUR sales	4.880.000.000 EUR sales

Crop	Area sown	Value of seed	Value of ST	Value of crop
Sugar beet	2.200.000	240 – 330.000.000 mill <sup>5</sup>	165.000.000	4.880.000.000
		(= 110-150 EUR/ha)	(= 75 EUR/ha)	(= 2.225 EUR/ha)

Seed treatments have practically eradicated the common yellowing virus transmitted by aphids. Yield losses caused by this virus can reach levels of up to 50%. Furthermore, STs have helped to realise an additional yield potential of sugar beet of approx. 10%

Potential damage to EU sugar beet production if no treated seed is available could therefore reach 2.440.000.000 EUR p.a.

<sup>5</sup> Due to the different incorporated resistances, the range of the value of varieties is wide. Value might be even higher or lower respectively than the numbers used in this example.

#### iv. Examples of Vegetable Crops

- **Outdoor Vegetable Crops**

Over 95% of the seed of outdoor vegetable crops is sold as treated seed. These are mainly fungicides for the control of soil borne damping off seedling diseases and against seed borne diseases.

But increasingly, growers are also requiring insecticide seed treatments as a way of targeting a range of pests e.g. cabbage root fly and aphids.

The EU Seeds Regulations specifies the use of 'sufficiently healthy seeds'. In most outdoor vegetable crops this is only possible with the aid of seed treatments.

Today, seed treatments are irreplaceable to give seed the necessary protection; without them major crop losses will be unavoidable. It should also be considered that such crop losses in Europe might lead to imports from countries outside the EU with often very different and less stringent legislation on plant protection products altogether and with an increase in food miles.

#### **Effect of ST on the economics of selected EU outdoor vegetable production**

Crop	Area Sown (hectares)	Value of the seeds (Euros)	Production Value (Euros)
Brassica	100.000	65 million	1.480 million
Carrot	75.000	40 million	310 million
Onion	100.000	30 million	250 million
Lettuce <sup>6</sup>	100.000	50 million	1.120 million
		----- <b>185 million</b>	3.060 million

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<sup>6</sup> Example lettuce:

prepared lettuce remains one of the fastest growing sectors within the fresh produce industry. Mixed lettuce packs account for around 70% of the processed vegetable market.

Aphid control is vital because aphids will quickly establish colonies in the heart of plants. Aphids rapidly cause direct feeding damage and reduce produce quality. Lettuce growers need to produce crops free from visible damage in order to meet the requirements of the supermarkets and also of the consumer.

Seed treated with Gaucho (Imidacloprid) provides control of aphids almost until the end of the crop cycle. Without this seed treatment, the crop has to be sprayed every 4 to 5 days and with that will need an extra 10 or more field sprays with a significant increase in production costs.

2002/2003 saw an upsurge in Europe in the price per tonne and in the value per planted hectare. The hot summer stimulated demand and high temperatures caused many crop problems, including aphids.

The lettuce price reached Euro 1.200 per tonne with an average value per planted hectare of Euro 20.500.

Assuming an average marketable yield of 20 tonnes per hectare and a value of Euro 600 per tonne, in a good year the total crop value is around 1.1 billion Euros.

## Examples for effects of STs in selected outdoor vegetable crops:

If seed treatments were not available, there would be substantial increases in volume of pesticide inputs.

Crop	Target Pest/ disease	Seed Treatment ST	Alternative	Difference of ai load to the environment if no ST available
Brassica	Cabbage Root Fly	Chlorpyrifos Application rate 4.8 grams / hectare	Chlorpyrifos drench Sprayed at 2400grams / hectare	+ 240 tonnes
Carrot	Pythium species	Metalaxyl-M Application rate 1 gram / hectare	No real alternative Try soil application at 12000grams / hectare	+ 900 tonnes
Onion	Botrytis spp (neck rot)	Carbendazim or Thiabendazole Application rate 1gram / hectare	Field spray 1 to 7 times at 1000 – 7000g /hectare	+200 tonnes (up to 700 tonnes) (assuming 2 sprays min.)
Lettuce <sup>7</sup>	Aphids	Imidacloprid	Field spray	+ 15 to
<b>Total environmental benefit to EU 25:</b> (100K ha Brassica, 75K ha Carrot, 100K ha Onion, 100K ha lettuce)				min. - 1340 to <b>max.- 1840 to</b> active substance

<sup>7</sup> The figure refers to the application on only around 8.000 ha in UK, NL and D where the ST is currently authorised. Given the overall production of 100.000 ha in EU 25, the potential difference could amount to a max. of approx. 180 to..

aphicide coating: countries involved UK, NL, DE		Before intro of aphicide coating in 2000	After intro of aphicide coating in 2000	Remark
Acreage in ha		8000	8000	Mainly on Iceberg lettuce. UK + NL 75 % of the acreage, Germany about 15 %.
Total crop value in mio € x mio		317	317	
% crop loss because of aphids		20%	4%	IN UK enormous loss because of root aphid. In other countries mainly leaf aphids ( Nasonovia ).
Total crop loss in million €		63.4	12.68	
Difference for the growers in million € on 8.000ha	<b>50.32</b>			
Average number of aphicide applications		10	2	Before 2000 up to 18 applications at 100 gram pirimicarb in summer crops. After 2000: 1 time coated seeds + 1 field application. No field appl. for early crops.
Total input of active ingredient in kg or L per ha		2.65	0.7	0.6 l pirimicarb + 0.1 g imadachloprid
Total input of active ingredient in kg or L on 8.000 ha		21200	5600	
Environmental difference kg or l / ha in kg or liter	<b>15.600</b>			