Use of mulch sheets vs. other techniques to inhibit competitive vegetation in tree plantations in urban and natural environment

Layman's report

AMINAL, afdeling Bos & Groen
AMINAL, Instituut voor Bosbouw en Wildbeheer (IBW),
Wetenschappelijk en Technisch Centrum voor het Bouwbedrijf (WTCB)
Limburg Instituut voor Ecologie en Bosbouw (LISEC)
Chapter 1

General data
**HOOFDINDIENER**
AMINAL - afdeling Bos & Groen
Graaf de Ferraris-gebouw
Koning Albert II-laan 20 bus 8
1000 BRUSSEL
Contactpersoon: ir. Brenda Bussche (02/553.75.14)

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**AMINAL, INSTITUUT VOOR BOSBOUW EN WILDBEHEER**
Gaverstraat 4
9500 GERAARDSBERGEN
contactpersoon: ir. Jürgen Samyn (054/43.71.20)
jurgen.samyn@lin.vlaanderen.be

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**WETENSCHAPPELIJK EN TECHNISCH CENTRUM V/H BOUWBEDRIJF**
Violetstraat 21-23
1000 BRUSSEL
contactpersoon: Berthold Simons (02/502.66.99)

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**LIMBURG INSTITUUT VOOR ECOLOGIE EN BOSBOUW (LISEC)**
Craenevenne 140
3600 GENK
contactpersoon: ir. Lode Hubrechts (089/36.27.91)
Chapter 2

Results
General description of the project

Introduction

Within the framework of several afforestation and infrastructure planting projects it has been proven that the chances of survival of new plantings can decrease drastically as a result of vegetation competition. Especially grass mats (for example when planted in pasture) have a major influence on the vitality of young trees. Often these trees show traditional stress symptoms: little and small leaves, dieback of shoots, yellow - or browncoloured leaves as a result of respectively nitrogen or water deficiency. European tests have irrefutably shown that the growth and survival of young trees are influenced by the presence of competitive vegetation. Herbicides, like glyphosate, are for example frequently used to reduce this competition. It has been shown repeatedly that herbicides have the best result/price proportion. The large-scale use of such herbicides can lead to undesirable toxicological effects and the legislation in a lot of areas prohibits the use of these products. Although a lot is known concerning the immediate functioning of the product, there is still insufficient knowledge concerning the possible ecotoxicological effects of the residual products or of the potential additive or synergetic effects between these herbicides and other environment pollutants.

As an alternative the competitive vegetation can be mechanically suppressed. For this mulches are used. Traditionally loose materials, such as straw or bark are used. In France each year plastic sheets are used along 12000 up to 15000 km of road length. The use of polyethylene or polypropylene sheets is however more and more liable to critique. In this context the WTCB in association with LISEC a new product was developed: the Ecopla mulch sheet. This biodegradable sheet has been manufactured for 100% from waste products: paper silt of paper factories (paper silt, 45%), compost (45%) and fibres of old paper or textile (10%). The emulsion is pressed in an old cardboard factory on a role in several layers, each time with a different orientation of the fibres. Because of this the sheet is anisotropic and consequently stronger. The sheets have been patented in Europe, the United States and Canada.

The objective of the project is to evaluate several treatments in function of their efficiency to suppress competitive vegetation and improve the growth of young trees. The emphasis lies mainly on comparing mulch sheets with the traditional vegetation management techniques such as mowing and the use of herbicides. Of each method the advantages and disadvantages are examined by looking at:

- The impact on the growth;
- which negative (environmental) effects appear;
- what the cost of application and maintenance is.

These aspects are always related to the characteristics of the site and previous land use. The advantages and disadvantages of each treatment are compared with each other. The end assessment gives definite answer concerning the most suitable treatment at a given site and land use.
The tests took place in Huweynsbossen (Lichtervelde), Rhodesgoed (Kachtem), Triepen (Ninove) and Vinne (Zoutleeuw).

More data can also be found on the Internet site of the IBW:

http://www.ibw.vlaanderen.be

Section Forests, Site research, projects, EU LIFE tree mulch project.

The technical sheets of the used mulch products will be available as pdf products on the website.
Evaluation

Properties Ecopla and Unalit sheets

Photo 1. Ecopla 100 E sheets in the Huweynsbosse

Photo 2. Unalit 15 sheet
The degree in which a mulch sheet inhibits vegetation is strongly dependent on several factors. **The soil nutrient status** and **biotic life** of the soil on which the sheets are applied are very important parameters. On poor soils the decomposition starts more slowly, whereas the sheets on nutrient rich soils can be entirely digested in a few months. The way in which the sheet is produced is also important. Sheets which have undergone high pressure are more durable than less strongly pressurized sheets at the production process. In the extreme case where almost no pressure is exercised and the components are separately deposited, the decomposition starts very fast. In areas with a similar soil nutrient status the sheets degrade far more rapidly on ploughed ground than on grass vegetation (Lisec, 1992). Because the nutrient status and the soil composition of the sites in this project differed a lot from each other and the mulch sheets were only used on one land use situation (pasture or ploughed land) this could not be determined in this project.

The use of sheet mulches cannot prevent that a plantation will have a disorderly outlook. The sheets prevent competitive vegetation from growing around the tree base, but the rest of the plantation has not been protected. Weeds can grow luxuriantly in these unprotected areas. If the reserved diameter around the tree is sufficiently large (for example 1 m. diameter), this vegetation will not directly be a problem. Using too small sheets (a diameter of 50 cm or smaller) leads to competitive vegetation which can overgrow the plantation. Moreover in a number of cases a competitive vegetation is not wanted, irrespective of the fact if the trees suffer from them or not. At plantations along roads and in parks **the aesthetic effect** frequently plays a very large role. The use of mulch sheets is most likely not wanted then. Still one or several mowings per year are frequently necessary. If the aesthetic view of the plantation is important, then due to the pale colour the use of the sheets can be withheld. Although in the long run mosses, etc will grow on the sheets or the sheets become covered by the surrounding vegetation, this whitish colour does not solve this problem in the short term.

**The weight** of the mulch sheets is both an advantage and a disadvantage. The density fluctuates between 2 and 3 kilogrammes/m², as a result of which anchoring is almost never necessary. Also such a weight prevents that underlying vegetation would push the sheets upwards. Sheets of 1 m or larger in diameter weigh enough to make it difficult to bring them in the area and to place it around the tree.

After the transport to the area the sheets must be kept dry, because they would lose their rigidity. The sheets can become easily protected by laying a sail over the packs. With long-term storage an eye must also be kept on the humidity. In too wet surroundings the sheets become mouldy whereupon degradation then starts.

From the tests it becomes clear that 2 Ecopla sheets on each other (double) produce significantly higher growth in most of the cases in comparison with the trees treated with single sheets. The double sheets resist the degradation process somewhat longer, but the - frequently small - profit in height growth increase does not warrant a doubling of the cost.

The Ecopla’s are technically speaking better than the Unalit sheets. The latter are very frail and the removal and replacement of the central piece requires an extra operation. On a hard, uneven soil the Unalit sheets can break in pieces, as a result of which the weed prevention effect is mainly annulled. The centerpiece does not blow away if it is put back in reverse in the opening (Fig. 2).
Figure 2. Putting back the central piece of the Unalit tree sheet

The saw cuts are fairly broad (2 – 3 mm) and if these are not parallel the central piece can be clenched back into the opening, but generally the cuts did not run parallel. An uneven area can hamper putting back the central piece as well. The central piece is very light and pushes down most of the vegetation, but it can easy be pushed up by strongly growing plants (for example thistles), as a result of which an opening is created of 6.5 x 30 cm. A disadvantage to this is that competitive vegetation can grow unobstructed if the centerpiece cannot be put back (Photo 1).

Photo 1. The central piece at the top has blown away and vegetation can grow there unobstructed. The breach below has been made by mice

The more flexible Ecopla sheets are easy to place and afterwards no further operation is necessary. Thanks to the straight cut the 2 halves of the sheet connect perfectly against each other.
IPB Biplex

Properties IPB Biplex tree sheets

The sheets can be placed - thanks to the very low density - easily, but anchoring is a must. Because of the rigidity of the sheets they must be placed carefully around the trees. If the plate scour the bark, the cortex can be very rapidly damaged.

When using very rigid materials, the plantation must be monitored closely to examine if there is no damage due to in-growth. If such damage is seen then the sheets must be removed as quickly as possible. This damage can appear, according to the growth rhythm of the tree type, after a year (for example at common alder). The sheets were removed in the period September-October 2000, because the incisions did not work along the central opening. The three cm long flaps were too rigid and did not fold back as was meant to be. A lot of the Common alders and willow trees suffered from this. It makes no sense to increase the central opening diameter, because too many weeds around the tree base will establish themselves.

The many negative points of this type of sheet do not even outweigh a possible growth increase.
Properties Tradecc coconut mat

The density of the coconut mats (800 – 1000 g/m²) is so low that they can be spread easily on the site and they adapt themselves very well to the relief of the area. Just like the Ecopla sheets an incision is provided from the centre of the mat to the edge. The mats must be pinned down however on 4 points because they can blow away. For the anchoring in the test we used chestnut-pegs. Fixing the mats was very labour-intensive and time-consuming. The pegs were driven with a rubber hammer in the ground, but before that, breaches had to be made in the mats first with a knife. If this was not done the mat was pulled along into the soil. An alternative method for the anchoring is the use of metal staples. Motorising the anchoring process can save a lot of time and costs. If such a method is selected then the introduction of metal in the environment must be taken into account. The best anchoring method is shown in Fig. 3. At the suitable places (X) breaches are made with a knife, through which the pegs are driven.

Fig. 3 Anchoring points for fixing the mats

The pegs, that were provided with the mats, however were much too long. Instead of using pins with a length of 30 cm, 10 cm should suffice.
The incision had blown open at a number of mats and if it remains open vegetation carries on growing (Photo 6). It is important to lay the incision opposite of the dominating wind direction (therefore to the north-east here).

![Photo 6. Influence of the wind on the coconut mats](image)

The test in the Triepen supports the research of Davies (1987) in the sense that the use of plastic foils prevents water from evaporating. Because of this anaerobic conditions are created around the roots, as a result of which the trees can die.

### Properties bark

![Photo 7. Introduction of the tree bark in the wooden frame](image) ![Photo 8. The bark was transported with a tractor](image)

One of the largest problems of the use of tree bark in afforestations is the placement. Moreover also the composition of the mulch is very important. Where does the material come from and from which tree types? Does it concern fresh material or is the mulch already ripened? It is important that the mulch is sufficiently ripe so that tannins or other detrimental substances (for example in the wood and the bark of oak and chestnut) can rinse out before the material is spread around the tree, where it could have a detrimental effect on the roots. Insufficient ripened mulch can cause nitrogen deficiency with growth delay or mortality as a consequence. French research indicates also that possible problems with moulds might occur.

The bark in the trials was a mixture of poplar - and sprucebark. The bark was perhaps too fresh to be introduced around the trees. This can be a possible cause of the high mortality in the blocks treated with bark.
Properties glyphosate and dichlobenil

For the test Roundup® ultra (Monsanto) was used. The active ingredient of this product amounts to 360 g/l glyphosate. For the 12 treatments 5 litres product on 500 litres water were used. This means approximately 4 litres glyphosate per ha, such as it is used by the forestry service.

The dissolved herbicide was divided evenly in each test block by means of a tractor with nebulizer (Photo 9).

The herbicide was only applied on grass. After approximately one week the first results were already visible (Photo 10). After thirty days the entire grass vegetation was gone.

In Rhodesgoed the willow trees had already been planted, so that they had to be protected. This was realised by screening them with the body. Glyphosate has had no negative consequences on the trees.

Photo 9. Application of the glyfosate using a nebulizer

Photo 10. One and a half week after treatment. The green spots are thistles

Dichlobenil is granular and a canister was used to spread it in the blocks.

The application of both chemical methods went very smoothly and without difficulties. In Huweynsbossen the impact of these herbicides was similar with the control: reduced growth and reduced survival of trees. In Rhodesgoed the impact is, however, noticeable. Untreated willow trees do not grow or just a little, whereas the trees in the treated block are very vital. Around the foot of the treated Common alders and English oaks in Huweynsbossen soil cracks appeared. This was a consequence of heavy clay laying uncovered by vegetation and thus susceptible to dehydration. It also occurred near the other trees, but there the effect was less pronounced. The surface around the base of the majority of the trees was covered with a mulch sheets or with a mulch which was laid reversed on the soil (grass side down), as a result of which evaporisation was stopped. The blocks treated with herbicides had no such protection and the soil was exposed to direct radiation and transpiration (Photo 11).
The effect on the Common alders in Rhodesgoed is not clear. The treated trees grow better, but afterwards this seemed to be mainly a consequence of local soil conditions. The least growth had appeared in the block-system with a superficial clay layer.

Herbicides must be applied annually and sometimes several times per year. Because the first application generally happens at the planting, extra attention must be paid to not damage the trees.

The deterioration speed of the herbicides was examined by LISEC. The half time or DT50 (the time whereupon 50% of the product has disappeared) lies for glyphosate between 32 and 50 days and for dichlobenil between 20 and 33 days. After 105-198 days 90% (DT90) of glyphosate had disappeared. Dichlobenil was gone after 66 up to 111 days. These DT50 and DT90 confirm the values in literature.

Because of the decree of 21 December 2001 concerning reduction of chemical resources, the use of herbicides will no longer be possible, unless exceptions are permitted.

**Properties agricultural mower and brush cutter**

For the treatment an agricultural mower was used of 1.70 m. wide (Photo 12). The treatment happened in the month of June.
Vegetation was mowed in the month of June using Stihl brush cutters (Photo 13).

Mowing has merely an aesthetic impact. For an agricultural mower to be useable it is necessary that the tree rows are on a sufficiently large distance of each other, so that the tractor can drive through. With this type of mowing therefore only the vegetation between the tree rows is mowed. Vegetation continues to grow around the trees, exactly where the removal is most necessary.

The brush cutter allows to mow directly around the tree. The disadvantage of this is that once in a while the tree is also mowed.

The pollution as a result of combustion of fuel and oil was not measured in these trials.
Preparation of the cultivation

Impeding vegetation

The trees must be fully able to enjoy the nutrients and the water in the soil. It is therefore important to remove competitive vegetation or at least to reduce it. At plantations on slopes or at a planting with a low number of plants it has however been better to only eliminate the vegetation around the base of the tree to reduce the risk of erosion.

Cultivation in advance is very good to impede vegetation. Vegetation can also be mowed. However the root competition is not eliminated. The most powerful mower is the agricultural mower. Rapidly turning around hammers mash the vegetation into fine parts, as such even that the area undergoes a very superficial soil cultivation.

Table 1. Afforestation strategy in function of the end situation

<table>
<thead>
<tr>
<th>Situation</th>
<th>Possible methods</th>
<th>Time</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasture</td>
<td>Chemical</td>
<td>4 weeks before the soil cultivation in the autumn</td>
<td>Pulverisator</td>
</tr>
<tr>
<td></td>
<td>Pseudo-ploughing</td>
<td>end spring or beginning autumn</td>
<td>Harrow</td>
</tr>
<tr>
<td></td>
<td>To tear</td>
<td>end spring or beginning autumn</td>
<td></td>
</tr>
<tr>
<td>Recently treated soil without residues</td>
<td>Nothing</td>
<td>–</td>
<td>Pulverisator</td>
</tr>
<tr>
<td></td>
<td>Chemical</td>
<td>4 weeks before the soil cultivation in the autumn</td>
<td></td>
</tr>
<tr>
<td>Recently treated soil with residues</td>
<td>Agric. mower</td>
<td>End spring or beginning autumn</td>
<td>Agricultural mowing</td>
</tr>
<tr>
<td></td>
<td>Pseudo-ploughing</td>
<td>End spring or beginning autumn</td>
<td>Harrow, spade machine</td>
</tr>
</tbody>
</table>

Chemical

Because of the decree of 21 December 2001 concerning the reduction of chemical suppression resources this will no longer be possible, unless exceptions are permitted.

Pseudo-ploughing

Pseudo-ploughing involves a couple of disks (for example covercrop) which go only 15 up to 20 cm deep. The soil is not reversed with this technique, but competitive vegetation gets squashed. The soil is also levelled because of this and this technique also improves the soil structure. A special form of pseudo-ploughing is shredding grassland or pasture. The shredding is preferably carried out in 2 phases: the first time the grass is cut loose and during the second passage the plant rests are mixed with the soil.

Agricultural mowing

When afforesting ex-agricultural soils this type is to be avoided to inhibit the growth of competitive vegetation. It might even improve the growth of grass and thus increase the competition.

Agricultural mowing is a good technique for foresting an area, if it’s soon followed by some sort of soil cultivation. The mowing improves the quality of the future
cultivations by mixing the plant parts in a more homogeneous manner with the soil, with faster mineralisation as a result.

**Soil cultivation**

Soil cultivation is only a relatively few times applied in sylviculture. For afforestations of ex-agricultural soils it offers some unmistakable advantages. Treating the soil improves air- and water household. Water can better drain away on wet grounds and the soil becomes deeper permeated with oxygen. This will improve the tree growth. To ensure a good root development it is necessary to break hard or compact layers (plough sole, hard clay layer, etc.). Remaining plant rests are mixed with the mineral soil to stimulate the degradation of the organic matter. As described above, impeding vegetation is removed temporarily.

Soil cultivation is not always necessary, but dependent on the soil properties and presence or absence of competitive vegetation.

To afforest ex-agricultural soils the best method is ploughing. Here one can choose between full ploughing or ploughing in tracks. **Full ploughing** is the best, but also the most expensive solution. If opted to **plough in tracks**, then the tracks must be sufficiently wide. This is certainly important when competitive vegetation is present. Beside the advantages mentioned earlier, ploughing also reduces the manual plant labour thanks to the loose ground. Generally instead of ploughing most often the one chooses to drill plant pits. The drilling can be done manually or with the help of a tractor. In such cases the soil is very loose and consequently it’s easy to manipulate by the planter. Drilling can however also cause problems, particularly when the drill goes to deep (sometimes up to 70 cm deep). Because of this the possibility exists that the trees are too deeply planted if the planter goes carelessly to work. This can be solved by installing a **depth controller** on the drill.

For breaking through impenetrable layers (e.g. plough soles), **the deep plough** with one set of large plough shears behind a powerful tractor forms the solution. With this equipment one can go up to 50-70cm deep. These form of ploughs are to be used in the presence of hard, impenetrable layers.

Before drilling the plant pits the area needs again to be levelled. For this either an agricultural plough or spade machine can be used. Pseudo-ploughing only goes 15-20 cm deep.

In the case of strong slopes (> 15%) full ploughing must be avoided, to not pave the way to erosion. Here it is better to work in racks, which run parallel to the altitude lines. Also on dry sand grounds danger for wind erosion exists if a full ploughing is carried out.
Addendum

1. Assessment

a. Project

The project was approved in 1997 and would have taken place in Grimbergen (previous aviation site). Due to administrative problems with the acquirement of the site by the Flemish government, the team leaders decided to move to another site. The trouble at the time was that none of the available sites (property of the Forestry Administration) were easily reachable (unlike Grimbergen which was centrally positioned in Flanders) and/or that the soils were very heterogeneous.

The possibility that Grimbergen became available in 1998 remained and the team leaders waited to move the project to another location. Halfway 1998 it became obvious that Grimbergen would not become available anytime soon and the decision was made to set up the trials in West Flanders. In the second half of 1998 the team started up a pre-trial, which had several purposes. One was to scan the market for available products, another one was to test on a small scale several mulches (loose mulches made from papersludge and compost) and how that was applicable in forestry conditions.

The pre-trial quickly pointed out that those loose mulches were not applicable at all in forest plantations. The required machinery caused a lot of problems (soil compaction). Compared to other products, the loose mulches disappear too soon to be of any use (duration: a few months).

At the end of 1998 the trials were installed on 2 sites in West-Flanders. The constant rains at the end of 1998 and beginning of 1999 delayed the planting with a couple of months, but in March 1999 everything was planted. Starting then the trial was set up, the different products were applied and the measuring campaign started (including taking soil samples). Those campaigns were repeated each year.

b. Partners

The co-operation between the partners went smoothly. The Forestry Commission not only made the two sites available for the trials, but also provided labourers for the planting and application of the products. Furthermore the F.C. took care of the administration. The Institute of Forestry (IBW) and Lisec took care of the scientific aspect of the project: sampling, measuring, extra research (zoological inventory). The results from the Lisec (ecotoxicological research, soil research, zoological inventory) were always delivered in a timely fashion and in a clear report.

On demand of the Institute, after the first results from the pre-trial were known, WTCB changed the properties of the Ecopla sheets (straight cut instead of the jigsaw cut). This aided the labourers in applying the sheets a lot easier and at a faster rate.

Although the IBW has a lot of experience in analysing soils, the Lisec laboratories are specialised in determining plant available amounts of elements. Lisec has a very
good reputation regarding ecotoxicological studies. The labs of IBW do not have the necessary equipment for such analysis, nor the expertise.

2. Expected results

   a. Protection of trees

   Due to the new legislation regarding the banishment of herbicides in public domains (including forests managed by the Forestry Service) in Flanders, it was a must to find alternatives for the protection of trees against competing vegetation.

   From the pre-trial and the large scale trials it became evident that loose mulches (papermulch-compost mixtures and tree bark) are not of any use for forestry practices. Although the price of such materials is extremely low, other factors increase the price manifold: the required equipment to apply the materials, the rapid degradation of loose papermulch compost and the labour costs. Other negative environmental effects, such as soil compaction due to the use of extremely heavy machinery to disperse the materials, are another factor to take into account. Mulches such as these could be a very cheap alternative, but the many negative aspects counterbalance the cheap price.

   The biodegradable mulch sheets gave good results. This is valid for both types used in the trials (Ecopla and Unalit). From literature it would seem that this is also valid for comparable products. The main problem with this type of vegetation management is the price to acquire said products. The price of a mulch sheet of 1 m² is approximately 2.5 €. For small scale plantations this might be acceptable. However for forestry practices, where often 2000-2500 and sometimes even more trees are planted per ha, prices can become astronomical. One also has to take into account the costs from labour for applying the sheets on the field. From the financial part of the project it became apparent that mulch sheets are a very expensive solution. It’s also important to note that mulch sheets can not be applied everywhere. On sites with rich soils (loamy type for instance) the sheets will degrade at a very rapid pace (might be a matter of months). The sheets will function best on poorer soils, where the competition between the tree and the surrounding vegetation is often high.

   Non biodegradable mulches should be avoided for the fact that they do not degrade into environmental friendly products. Often these are plastic products (in the trials: IPB Biplex and the hybrid material Tradecc coir mat). Plastic (either polythene or polypropylene) is not biodegradable but degrades because of ultraviolet light. This means that small particles will remain behind, which is not very environment friendly. Even if one intends to remove the plastic sheets after a set period of time, it’s often difficult because the sheets will have deteriorated and picking them up will become very time- and labour-intensive.

   Mowing only has an aesthetical effect and does not reduce the impact from competition of weed.

   b. Recycling technology
The Ecopla sheets are being made in an ancient cardboard factory, St Leonard in Huizingen.

As a technology it is very interesting, as it uses waste materials and transforms it into a solid, useable product. The introduction on the Belgian market was rather slow in the past, because it was unknown by the masses and also due to lack of scientific information concerning the useability.

The LIFE project has shown that the sheets are indeed useable on poorer soils (longer durability), but once more, a high threshold is the price of the product.

The producers of the Ecopla sheet are currently working on reducing the price so that it can be applied on a larger scale. Up until now it’s not known if a reduction in price is possible.

c. Conclusion

The mulch sheets certainly do function as weed inhibitors. They increase both growth and chance of survival of the trees. However the current price of the products deters many from using them, as it is many times higher than the cost of a single tree. Only when a good balance can be found between the price of a tree and that of a mulch sheet will it be applicable in new plantations. Of course one has still to take into account the condition that mulch sheets can at the moment only be used on poorer soils.

3. Potential use

As of today mulch sheets and similar products are not being used on a large scale in forestry plantations. The main point of critique coming from potential users is the high price, which is certainly a threshold.

Another minor point of critique is how the sheets must be applied. It requires manual labour to deposit them around the trees. Where use of plastic or geo textiles can be mechanised, this is not the case for mulch sheets.

The mulch sheets however can certainly be used in parks, where often special species are planted. The cost of those, often these trees cost several times the price of a mulch sheet, does justify the use of mulch sheets.

4. Environmental effects

The mulch sheets, such as Ecopla and Uanlit, are completely bio-degradable and as such leave no residue behind after a set amount of time. This kind of product is the best in its line in terms of protection of the environment.

5. Transfer of technology

At this moment the Ecopla mulch sheets, as well as several other products are being tested as well abroad (France (by IDF) and the Ireland (Waterford Institute of Technology).
On the foreign market (France and the UK specifically) a lot of similar products are available (see added table). The specifications, usability and cost are approximately of the same order as the Ecopla sheets, all be it with differences in manufacturing and properties. Only a reduction of the cost of the end materials (the mulch sheets) will warrant their use for forestry practices. In order to be competitive with these other products, this will be a vital step. Otherwise introduction abroad will probably fail.

6. Dissemination activities

During the two information days all potential users were invited: different departments of the Ministry of the Flemish Community who are in charge of planting new forests (Forestry Commision, Nature, etc.), the services of cities and municipalities in charge of municipal forests and other similar organisations.

All information available on the information days (technical fiches included on the last information day in 2003) were also sent to all those mentioned above.

The IBW is developing a new website, which should be ready by May 2004. On the new site all the latest reports, fiches, etc, will be downloadable.

7. Relevance to the EU legislative framework

Many European countries are implementing a ban or a reduction on the use of herbicides in forests and in new forest plantations.

In many cases however, weed management remains a necessary step in the process of having a successful plantation. Sheet mulches offer an alternative, but due to the high cost involved it is –at the moment- not really applicable on a large scale. Until the costs of the end products are lowered or other, cheaper (but good) alternatives can be offered, the Ecopla sheets (and similar) products can only be used in small scale plantations, always keeping in mind the soil conditions.

8. Evaluation system

The evaluation and labeling system has undergone a major change. Several colleagues abroad have been contacted to undertake a new Action regarding Europe’s new policy on the use of herbicides in forests.

The main objective of this Action is to gradually reduce dependence on herbicides in Europe’s forests by developing alternatives that are based on sound forest management principles, recognise society’s need for the sustainable production of a wide variety of forest resources, and employ methods that are environmentally sound, socially acceptable, and economically viable.

The entire worked out proposal has been added as an extra addendum. Other countries showed interest as well in this Action, but so far we have yet been unable to realise the first meeting.
Memorandum of Understanding
for the implementation of a European Concerted
Research Action designated as
‘European Network for Forest Vegetation Management:
Towards environmental sustainability.’

The Signatories to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the Technical Annex to the Memorandum, have reached the following understanding:

1. The main objective of this Action is to gradually reduce dependence on herbicides in Europe’s forests by developing alternatives that are based on sound forest management principles, recognise society’s need for the sustainable production of a wide variety of forest resources, and employ methods that are environmentally sound, socially acceptable, and economically viable.

2. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at Euro 1.7 million in 2003 prices.

3. The Memorandum of Understanding will take effect on being signed by at least five Signatories.

4. The Memorandum of Understanding will remain in force for a period of four years, calculated from the date of first meeting of the Management Committee, unless the duration of the Action is modified.
Background

Introduction

A key to success in afforestation and reforestation is the protection of young seedlings from non-crop plant species (including some hardwoods, shrubs, grasses, and forbs). These fast-growing plants often kill or greatly suppress desired trees by competing with them for light, water, and nutrients needed to grow.

As a result, forest managers have used herbicides to suppress non-crop vegetation. Herbicides have been selected because of their effectiveness and relatively low cost compared to available alternatives. As afforestation and regeneration activities have increased during the past decade in Europe, forest herbicide use has increased proportionally. Therefore, proposed further increases in forestry activities during the next decade could lead to even greater usage.

However, the EU’s Fifth Environmental Action Programme (5EAP) set out a series of targets for the year 2000 including ‘the significant reduction in pesticide use per unit of land under production, and the conversion to methods of integrated pest control, at least in areas of importance for nature conservation’. Actions identified as necessary to reach the target are registration of sales and use of pesticides. Both of these have been addressed by Directive 91/414/EEC, which concerns the authorisation, placing on the market and use of pesticides in the EU. Between 1991 and 1995 sales of pesticides in EU countries fell sharply though this trend was reversed in 1996. In 1996 herbicides accounted for 39% of total weight of active ingredients of pesticides sold in the EU. In northern and central European countries herbicides tend to make up the largest group of pesticide sales.

Directive 91/414 on the authorisation, use and control of plant protection products insecticides, fungicides, herbicides etc. was adopted in 1991. It sets up a harmonised authorisation system for the active substances used in plant protection products at EU level. Member States may then approve products containing such EU agreed substances for use on their territory. The 1991 rules make EU authorisations of active substances subject to a positive outcome of safety evaluations, for which producers must present data.

At the time of adoption of Council Directive 91/414/EEC in 1991, there were over 850 such substances authorised for use in the Member States.

The current approach requires manufacturers to “defend” plant protection products, proving that their products reach the required safety standards. Most of the products to be withdrawn will be as a result of manufacturers declining to defend their products for economic or other reasons. To defend substances, the manufacturers have to notify their commitment to submit complete data packages to the designated authorities in the Member States and to the European Food Safety Authority. Defended substances may continue to be authorised until such time as the evaluations are complete and a decision is taken as regards the safety status of the product in question. As a result of this new approach a decision was already taken in July 2002 to withdraw 320 substances from the market in July 2003. The Commission aims to take decisions on all defended substances before the end of 2008, thus completing the
harmonisation of active substances allowed in pesticides in the EU. Thus by 2008 foresters may have to look to alternatives to herbicides for vegetation management.

It also must be emphasised that overall pesticide use in kg of active ingredient/ha does not necessarily reflect the potential impact on the environment, which is influenced by the properties of the different pesticides involved, the method of application and other factors. A better picture could be formed if data on use of individual active ingredients were available. This kind of information can be collected via direct surveys to forest managers and companies. At present only the Netherlands, Sweden and United Kingdom carry out regular direct surveys of farmers on use of pesticides, based on a representative sample of agricultural holdings. This could be applied to forest managers, which would allow the trends for herbicide use in the EU to be properly evaluated and highlighted. It would also be an important ingredient in developing indicators to measure the risk posed by herbicides to the environment.

Increased environmental awareness, coupled with the advent of Sustainable Forest Management and the Certification process, however has prompted public and industry concern over pesticide use in the forest. Unfortunately, adequate alternatives to herbicides do not currently exist for most of Europe’s forest conditions. Furthermore, abrupt reductions in herbicide use as is happening according to Directive 91/414/EEC, without the knowledge or technology to implement effective alternatives, will severely threaten our ability to protect the new forest and meet future wood supply needs.

OBJECTIVES AND BENEFITS

The main objective of this Action is to gradually reduce dependence on herbicides in Europe’s forests by developing alternatives that are based on sound forest management principles, recognise society’s need for the sustainable production of a wide variety of forest resources, and employ methods that are environmentally sound, socially acceptable, and economically viable.

The overall objectives of this Action can be accomplished through coordination within the fields of research, and education.

I. Research

Increased knowledge and better technology are vital to protecting the new forest plantations while reducing dependence on herbicides. Therefore, research is crucial to success of any vegetation management programme.

The research component of this Action program would involve the co-ordination of ongoing research and the initiation of common proposals for European funding to carry out new adaptive and/or fundamental research.

Adaptive research will provide information and technologies that will be directly applicable to the operations of managing forest vegetation. Liaison with the industry and other researchers in Europe will ensure that problems are identified and solutions are developed directly. Therefore, new information is met with acceptance and rapidly implemented in the field. No
research effort seeking alternatives to herbicides can be successful without a strong adaptive research emphasis.

However forest vegetation management is based on many related sciences, including biology, soil science, ecology, microclimatology, plant physiology, economics, engineering, and the social sciences. Long-term success in developing new and innovative approaches to managing forest vegetation is only possible by also advancing knowledge in these supporting sciences through fundamental research.

II. Education

New information and technology will be generated from coordination of the above research efforts. However, dependence on herbicides will be reduced only if there is a focused and coordinated effort to disseminate the information to those professionals that need it. In addition, the general public must develop a better understanding of how and why forest vegetation is managed.

The education programme will focus on two areas:

(i) Technological Transfer

The alternative vegetation management strategies developed through this Action will likely require a strong working knowledge of forest ecology and integrated pest management techniques. Rapid and successful implementation of these techniques and strategies will require that each Working Group develops a close relationship with the forest industry and forest managers throughout Europe.

Team members will accomplish this in their respective countries by;

- determining vegetation management problems and research priorities in conjunction with the forest industry;
- providing expertise for the forest industry on their vegetation management issues;
- working closely with other researchers to help design, implement, and coordinate adaptive research and demonstration projects in the field;
- conducting technology transfer activities on alternative vegetation management practices to the forest industry;
- assisting with the public education program.

Professional foresters will also have to be educated on these principles, as well as being continually updated on the latest discoveries and technologies.

This information will be transferred to professional foresters through:

- conferences and training sessions
- regular newsletters summarizing the latest research results
- demonstration areas, field tours and workshops, technical publications, video tapes, literature reviews and bibliographies, computer software.

(ii) Public Education
Public support of forestry practices is vital for forest managers to effectively manage the forest. Much of the public concern over many areas of forestry, especially the use of herbicides, has resulted from inadequate education about forestry practices. As alternatives to herbicides are developed and better herbicide application practices implemented through the alternative vegetation management efforts, it is imperative that the public learn of these advances.

It also is recognized that education is a two-way street. Forest managers and researchers must learn what the public wants and finds acceptable. Therefore, the Action team will seek to establish a dialogue with those who have a stake or interest in the management of forest vegetation.

A public education programme on vegetation management will include:

- interaction and cooperation with environmental groups and outdoor organizations
- brochures describing Action efforts, video tapes and articles explaining pertinent issues
- presentations about vegetation management at public meetings
- demonstration areas
- access to forestry experts on specific questions.

**Benefits of the Action**

**A key benefit of the action would be the establishment of a European forum for the management of forest vegetation, where co-operation of the main players in the forest industry in Europe together with the scientific institutions would give leadership and create networks in this research field to provide data and information for national forest services and the public.**

Give a comprehensive overview of the alternative management options for European forest vegetation

Give an overview on available data and stimulate new data acquisition on the different weed management strategies used in Europe

Create databases on the major invasive weeds of Europe and methods of current control

Initiate a common network of vegetation management research trials in Europe

Provide strategic information for possible European Commission frameworks

Advance the methodology for environmental, technical and economical evaluation of alternative weed management strategies

Initiate possible common proposals to European Community framework programmes for funding
Develop a network outside the EU with countries like New Zealand and Canada who have ongoing research in the vegetation management area.

**SCIENTIFIC PROGRAMME**

Cross-sectoral and multidisciplinary exchange of knowledge originating from ongoing research activities in Europe is an important aim of all Actions. In this Action specific topics in the forest vegetation management sector will be addressed. In order to do this working groups will be established. Because of the fast developing nature of forestry science, there is also a need to bring experts in particular areas together for exchange of ideas through seminars and conferences. These activities will be co-ordinated by the management committee of the Action.

Four workgroup areas have been identified.

(i) Treatments and alternatives
(ii) Forest ecosystem responses
(iii) Biological control
(iv) Society and vegetation management

The workgroups are outlined in more detail below. The terms of reference are outlined in Section D: Organisation.

(i) **Workgroup 1 - Treatments and alternatives**

To protect young forests, forest managers must have safe, environmentally sound, effective, cost-efficient, and socially acceptable techniques for managing non-crop vegetation. Development of non-chemical alternatives and better herbicide application technologies will be central to this effort.

Potential alternatives to current uses of herbicides include manual cutting, grazing animals, mulches, prescribed fire, mechanical equipment, alternative silvicultural systems, cover cropping, biological control agents, new applications systems for existing herbicides, and new herbicides.

**Specific issues of research for co-ordination** in this workgroups brief will include:

- developing strategies for harvesting and site preparation that will reduce the need for herbicides and other tending activities in young forests;
- developing and comparing non-chemical approaches for managing forest vegetation;
- comparing the cost, energy consumption, safety, and effectiveness of alternative and existing treatments;
- developing new application methods for existing herbicides that will:
  - increase environmental protection
  - reduce amounts used
  - increase effectiveness
  - reduce costs;
• testing new herbicides that are environmentally safe and offer opportunities to reduce amounts used;

• developing a database along with approaches for using the database to improve vegetation management prescriptions;

• developing demonstration areas that will exhibit alternative approaches to managing forest vegetation;

• standardising methods for evaluating vegetation management techniques.

(ii) Workgroup 2 - Forest ecosystem responses

In addition to economically and effectively controlling non-crop vegetation, new alternatives also must achieve longer-term forest management objectives. Therefore, it is imperative that we understand the effects of alternative treatments on desired tree species and other parts of the forest ecosystem.

Specific issues for Workgroup 2 will be to look at the current research in this area and to try and coordinate further efforts. The areas of research will include:

• quantifying the effects of non-crop vegetation and alternative treatments on the survival and growth of desired tree species;

• evaluating the impact of alternative treatments on biodiversity and habitats;

• identifying the role of non-crop vegetation in the forest ecosystem;

• developing better techniques to identify vegetation problems, leading to better prescriptions;

• improving knowledge of how alternative treatments can influence forest resources other than wood (such as recreation, water quality, fisheries, biodiversity);

• assessing the long-term impact of crop-tree damage from alternative treatments;

• developing demonstration areas that exhibit alternative and existing treatments.

(iii) Workgroup 3 - Biological control

Biological methods of controlling pests have been found to be effective, economical, and socially acceptable in agriculture, horticulture, and forestry. Little research, however, has been done to develop biological control methods for forest weeds. Fundamental research is needed to examine the potential for this technology in forest vegetation management.
Specific issues for this Workgroup would include looking at the current state of research in this area and the possibilities of further research into the development and testing of al or some of the following:

- fungal pathogens
- viral pathogens
- natural phytotoxins
- allelopathic plants
- bacterial pathogens
- herbivorous insects.

(iv) Workgroup 4 - Society and vegetation management

Since one of the main issues is the social concerns surrounding herbicides, it is imperative that efforts to develop new alternatives be guided by a better understanding of the social values and concerns surrounding vegetation management practices.

Specific issues for coordination in this area will include reviewing the following in the participating countries;

- relationships of vegetation management tools, tactics, and objectives to current economic and social values of the forest;
- surveys of social values and perceptions about forest vegetation management;
- methods for developing public involvement, consensus, and conflict resolution on vegetation management issues;
- public education methods to effectively communicate about forest management practices;
- ethical considerations surrounding forest ecosystem management.

Outcomes

Tangible outcomes are likely to be in the form of publications, or web based resources. The outcomes will cover:
- The current state of play in Europe in forest weed management practices
- An evaluation and survey of the major European forest weed species
- Evaluate forest ecosystem responses to different weed management techniques and regimes
- Answer the question – Is there a role for biological weed control?
- Ascertain whether the public are involved, and if not how can they become more involved in the weed management decisions in European forests

Intangible outcomes will include the development of networks and personal contacts within the research community, increased understanding of the underlying theme and the development of a basis for new, multidisciplinary research in the area of environmentally sustainable forest vegetation management practices.
As a final outcome the aim will be to publish a book picking up key themes identified during the Action.

**D. ORGANISATION**

The Management Committee will include both forest researchers, and scientists. The length of the Action is four years. A core group will be established including the Chairperson, the Vice-Chairperson and the WG-leaders.

In the first year the emphasis will be to develop the multidisciplinary aspects of the Action, including shared language and scientific platform. There will be two sessions including all participants in the first and final years. Four working groups will be established at the start of the first year. In years two and three there will be a single full meeting plus a meeting of each working group. Also in years two and four the will be a conference/workshop held at the same time as the full meeting. The working groups will be encouraged to use e-mail, internet and video conferencing as much as possible. However, they will meet independently of the main group once a year in addition to holding meetings associated with the main annual meeting of the full group. The main meetings will be used to provide delegates with an introduction to activities in the host country.

The following table indicates the structure:
The Action will examine the opportunity to establish a European-wide pilot research project in the area of Alternative forest vegetation management.

The detailed terms of reference, timing and operation of the working groups will be finalised after the first full meeting in the first year. Outputs from the groups will be decided in plenary, and will be tied into the final outputs of scientific publications, web based resources, and published guidelines.

The workgroups and their terms of reference are:

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<th>WG</th>
<th>Mandate</th>
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| 1  | *Treatments and Alternatives:* Forest vegetation management treatment alternatives as well as better application techniques for existing herbicides will be central to this theme.  
Outputs: Significant publication on European forest weed control alternatives.  
Direction for future research efforts. |
| 2  | *Forest Ecosystem Responses:* Direct and indirect effects of treatments on both the forest tree species and their associated flora and fauna. Survey of the major weed species affecting forestry in Europe.  
Outputs: Publication or web based resource on the major forest weed species in Europe. Guidelines for forest managers on the correct utilisation of weed management techniques so as to reduce the adverse impacts on the forest ecosystem. |
| 3  | *Biological Control:* The current state of play in this area. Is there potential for this type of alternative weed management.  
Outputs: Highlight potential possibilities for more extensive research. Possible publication or web based resource. |
| 4  | *Society and Vegetation Management:* Examine the current information in Europe regarding public perceptions of forest vegetation management practices.  
Outputs: Guidelines and methods for developing public involvement, consensus and conflict resolution on vegetation management practices |
E. Timetable

**Year One**

**First MC Meeting in Brussels**
- Establish communication infrastructure – Web Pages etc.
- Reporting procedures
- Explore Forest weed management priorities in Europe
- Agree intended outcomes
- Establish working groups.
- WGs hold first meeting
- Identify speakers and experts outside of the founding members

**Second MC Meeting**
- Report back on scope and degree of activity in participating countries
- WGs report on terms of reference, programmes and timetables.
- Keynote presentations on relevant topics agreed at Meeting 1
- Identify opportunities for case studies, pilot studies and short term scientific missions.

**WG1**
Herbicide treatments and alternatives

**WG2**
Forest ecosystem responses

**WG3**
Biological control

**WG4**
Society and Vegetation management practices
Year Two

WG1 Herbicide treatments and alternatives
WG2 Forest ecosystem responses
WG3 Biological control
WG4 Society and Vegetation management practices

Third MC Meeting and Conference/Workshop
- Reports from working groups
- Links with research outside Europe
- Gaps in research
- Opportunities for pilot study
- Agree production of European Forest Weed Management Alternatives - A systematic review, published or a WEB resource, of alternative forest weed management practice in participating countries
- CONFERENCE/WORKSHOP
  - Keynote speakers on the WG Topics and discussion documents
  - Posters
Fourth MC Meeting

- Reports from working groups
- Links with research outside Europe
- Review progress of working groups and dates for closure.
- National summaries
- Agree production of Forest Ecosystem Responses to Weed Management - Guidelines for forest managers - A publication or WEB resource on correct utilisation of weed management techniques that will benefit or enhance the forest ecosystem.
- Review communications
- Mid term review of the Action
Fourth Year

WG1 Herbicide treatments and alternatives
WG2 Forest ecosystem responses
WG3 Biological control
WG4 Society and Vegetation management practices

Fifth MC Meeting

- Reports from working groups
- Links with research outside Europe
- Review progress of working groups and agree dates and closure targets
- Agree production of remaining Outcomes:
  - Forest weed management – biological controls – publication or web based resource on possible biological controls.
  - Society and Vegetation management practices – methods for developing public involvement, consensus and conflict resolution on vegetation management practices. To include all working groups.

Final MC Meeting and Conference/Workshop

Final Reports from working groups

- Review progress of working groups and sign off outcomes.
- Final outcomes:
  - review of the Action and recommendations,
  - sponsored publication on key themes
- CONFERENCE/WORKSHOP
F. Economic Dimension

The following countries have actively participated in the preparation of the Action or otherwise indicated their interest: Ireland, United Kingdom, Denmark, France, Belgium, and Switzerland.

On the basis of national estimates provided by the representatives of these countries, the economic dimension of the activities to be carried out under the Action has been estimated, in 2003 prices, at roughly Euro 1.7 million.

This estimate is valid under the assumption that the 6 countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly. It is my understanding that at least eight other countries would be very interested in getting involved in this initiative, however to date I have been unable to verify their firm commitment.

G. Dissemination Plan

The Action will be supported by a web-site hosted by a member of the Management Committee. The website will include;

- Interim outputs from the Action.
- Working group summaries of their proceedings
- Presentations to the full meetings.

Researchers submitting original papers to working groups or full meetings will be encouraged to publish in scientific journals.

The Action envisages exploring the possibility of national research institutions participating in the publishing of some of the hard copy outputs jointly with the Action. This will ensure wide distribution and availability.

Two International Conference/Workshops will be held during the running of the Action. These will focus on the workgroup areas but to give them a more international outlook will have invited keynote speakers from outside the EU as well.
G. ADDITIONAL INFORMATION
Experts to date who have been contacted and are interested in proceeding with this Action.

Proposers

Dr. Nick Mc Carthy
Chemical and Life Sciences Dept.,
Waterford Institute of Technology
Cork Rd.,
Waterford
IRELAND

Dr. Paul Christensen
PC-Consult
Borupvej 102 B
DK-4140 Borup
DENMARK

Ian Willoughby
British Forestry Commission
Alice Holt Lodge,
Wrecclesham Farnham, Surrey GU10 4LH.
ENGLAND

Dr. Henri Frochot
Lerfob, UMR INRA-ENGREF
Equipe Croissance et Production
CR INRA de Nancy 54280 Champenoux.
FRANCE.

Dr. Alexandre Buttler
WSL, Antenne romande
Case postale 96
1015 LAUSANNE
SWITZERLAND.

Jürgen Samyn
Site Research
Instituut voor Bosbouw en Wildbeheer
Gaverstraat 4
B-9500 Geraardsbergen
BELGIUM