



**Kick-off-meeting of EC project 4F CROPS,  
Brussels,  
Belgium, 1-2.07.2008**

**INVOLVMENT OF INF IN  
4F CROPS PROJECT  
AND RENEWABLE RESOURCES  
IN POLAND**

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## **TASKS FOR INF IN SCOPE OF 4F CROPS**

### **Task 2.3 Yielding potential (CRES, INF)**

**Information on yields of non-food crops at a commercial scale:**

- **is limited**
- **refers only to a few popular crops.**

**A lack of credible data; the theoretical yields of certain crops tend to be much higher than the expected commercial yields.**



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## Survey of the yielding potential data of fibre crops

To survey of the yielding potential data will be collected from:

- previous EU and national funding projects.
- the literature
- the scientific results of relevant R&D institutions, in case of fibre crops from works of Institute of Natural Fibres, and
- the European Cooperative Research Network on Flax and other Bast Plants



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## How we will prepare final data

- The data will be elaborated, a draft review will be produced within 12 months.
- The review will be discussed during the second workshop of the project
- **Assessment: by Scientific Committee (experts from outside the consortium)**





## Yielding potential data responsible

- The task leader -CRES (crops for fuel)
- INF –crops for fibre production.





## ***Task 2.4 Raw materials characteristics (CRES, INF)***

Variations in scope of: chemical composition, fibres length, shape, moisture content, density, strength, etc. result in: problems to supply the relevant industries constantly with material of consistent quality.



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- **Crops will be categorised per end-use.**

- **For each end use the favourable characteristics will be listed**

- **the crops will be prioritised according to the degree of fulfilling.**

- **list will be finalised at the end of WP2.**



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- **Raw material characteristics will also be gained from the consortia of the of previous EU funded projects**
- **A list of crops suitable for each end use will be produced in month 12 reviewed in the 2nd workshop.**



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- **The task leader -CRES (crops for fuel)**
- **INF –crops for fibre production**



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# Industrial crops in Poland-synthesis

- ✓ **Oil Crops: oilseed rape, linseed**
- ✓ **Fibre Crops: flax and hemp**
- ✓ **Carbohydrate Crops: potatoes, cereals, sugar beet**
- ✓ **Speciality crops: medicinal plants, willow, natural dyestuffs and crop protection natural products.**

## **The major industrial crops**

- **sugar beet**
- **oilseed rape (Canola)**

**The main industrial products: alcohol and starch.**



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# INTRODUCTION

## ARABLE LAND

**About 13,666 thous. ha of  
arable land in Poland**



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## **ACRAGE OF MAJOR AGRICULTURAL CROPS FOR FOOD AND INDUSTRIAL APPLICATIONS**

- **10,815 thousand hectares**
- **Stronger increasing tendency is observed in case of industrial crops.**
- **Industrial crops occupy 7.2% of arable land: almost 40% - sugar beet, major cereals 61.1%, while potato 7.5 % [CSO].**



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## OIL CROPS

- **A major oil crop grown : oilseed rape (*Brassica napus L.*).**
- **In Poland grown only so called "00" cultivars-with low amounts of erucic acid and glucosinolans (winter and spring oilseed rape)**
- **Polish requirements for the glucosinolans and erucic acid are far stricter from those in force in the EU.**





## OIL CROPS

- **High importance of oilseed cake used as a high-protein component of fodder in Poland.**
- **The average yield of oilseed rape is 2.1 t/ha.**
- **Generally the whole crop is used in the food sector, mainly for vegetable oil and margarine**





## CULTIVATION AREA OF OILSEED RAPE IN POLAND



- The **potential** is approximately **2 million hectares**.
- The cultivation of oilseed rape: in about **30 thousand** out of 2 million farms in Poland.
- The **total harvested** amounts of oilseed rape seed in 2000-2003 were **958.1 thous.**— see table 1.
- Thus there are **reserves** that might be used for cultivation of oilseed rape for **fuel**.



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## **GROWING INTEREST IN THE PRODUCTION OF BIOFUEL FROM OILSEED RAPE**

- **The overproduction of food and increasing prices of mineral fuels has caused growing interest in the production of biofuel from oilseed rape.**
- **It is estimated: in 2004 about 6 thous. tons of esters was utilized.**

**It is equal to about 6 thous. tons of oilseed rape oil, applied for fuel.**

**Several research centres in Poland, usually with positive results, tested the oilseed rape fuel.**





# Biofuel production in Poland





**Table 2. Minimum share of biofuels and other fuels from renewable sources in the total consumption of liquid fuels (as per bioethanol and ethers or esters) which under the provisions of the Directive is supposed to increase steadily in the nearest future**

	2005	2006	2007	2008	2009	2010	By value typee
<b>Directive provisions – percentage of biocomponents</b>	<b>2.00%</b>	<b>2.75%</b>	<b>3.50%</b>	<b>4.25%</b>	<b>5.00%</b>	<b>5.75%</b>	<b>energy</b>
<b>Bioethanol</b>	<b>3,20</b>	<b>4,41</b>	<b>5,61</b>	<b>6,81</b>	<b>8,01</b>	<b>9,21</b>	<b>volume</b>
<b>ETBE (as per bioethanol)</b>	<b>6,82</b>	<b>9,37</b>	<b>11,93</b>	<b>14,49</b>	<b>17,04</b>	<b>19,60</b>	<b>volume</b>
<b>Ester</b>	<b>2,12</b>	<b>2,92</b>	<b>3,71</b>	<b>4,51</b>	<b>5,30</b>	<b>6,10</b>	<b>volume</b>



**ETBE. Ethyl tertiary butyl ether** Institute of Natural Fibres

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## Linseed (flaxseed) (*LINUM USITATISSIMUM* VAR. *OLEIFERA* L.)

**Linseed in Poland: 740 ha in 2003 [CSO].**

- ✓ **Linseed oil application:**
  - **numerous nutritional applications**
  - **for the production of paints and varnishes (as linseed oil is a fast-drying oil).**
    - ✓ **The demand for this application is 15,000-18,000 tons of refined linseed oil a year.**
    - ✓ **INF has conducted a research program in co-operation with other research centres on breeding new, highly efficient oil flax varieties, production of varnishes and oil varnish and new trends in linseed utilization.**
    - ✓ **INF produces: linseed oil, edible and pharmaceutical roasted linseed, flax preparation BIOFLAX. The products have got relevant certificates**



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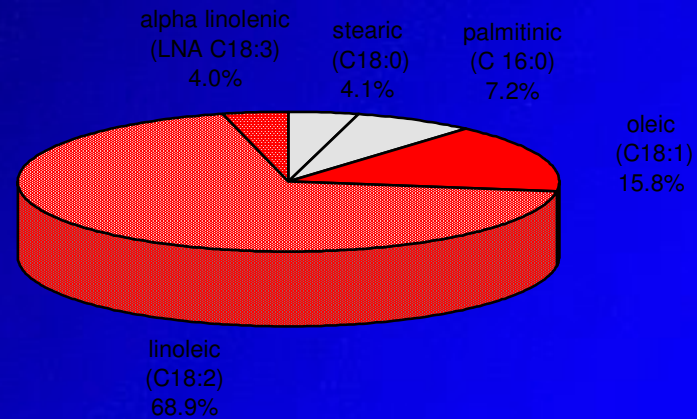
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# Fatty acids in flaxseed oil

## Linola oil

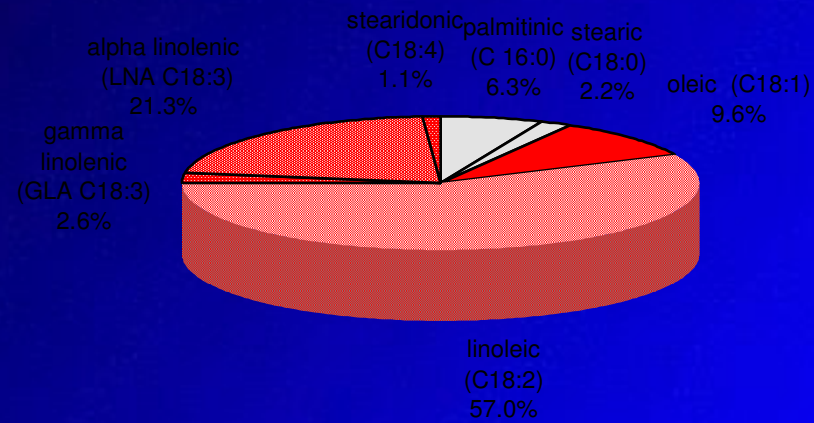


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# Fatty acids in hempseed oil

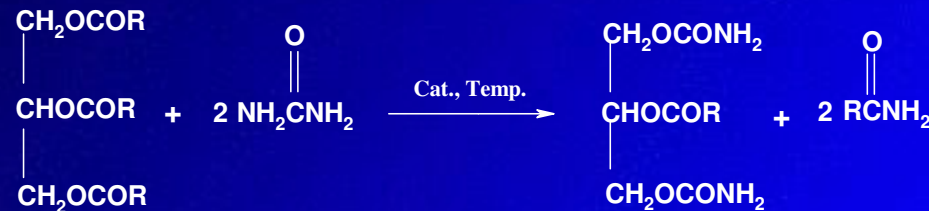




# NEW ECOLOGICAL MONOMERS AND POLYMERS FROM VEGETABLE OILS (1)

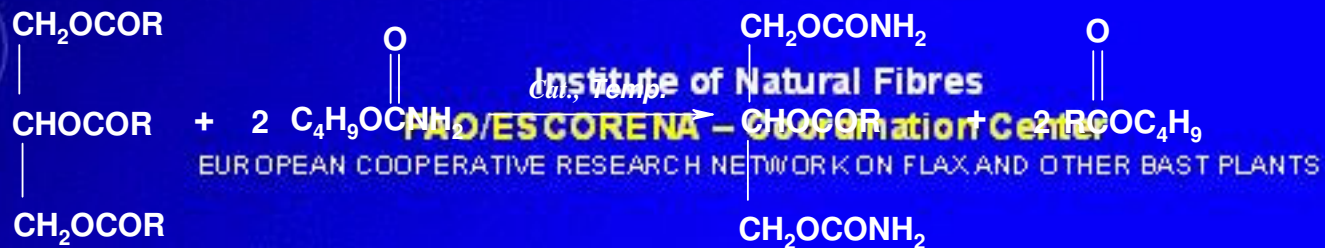
**Nitrogen-containing** monomers and polymers can be obtained from vegetable oils by their reaction with urea:

1. Direct method in heterogeneous system (monoglyceride dicarbamates and fatty acids amides are formed):



2. Indirect method consisting in a two-stage reaction in homogeneous system (monoglyceride dicarbamates and butyl esters of fatty acids are formed)

Where: R – fatty acid radical



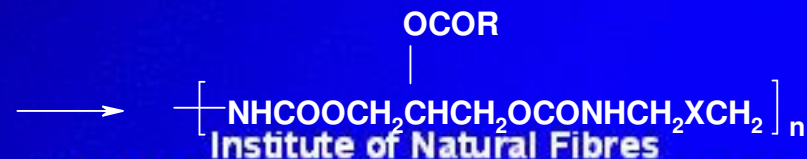
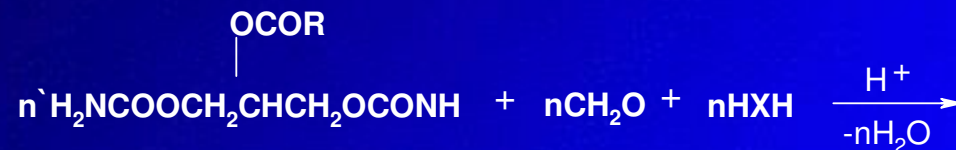
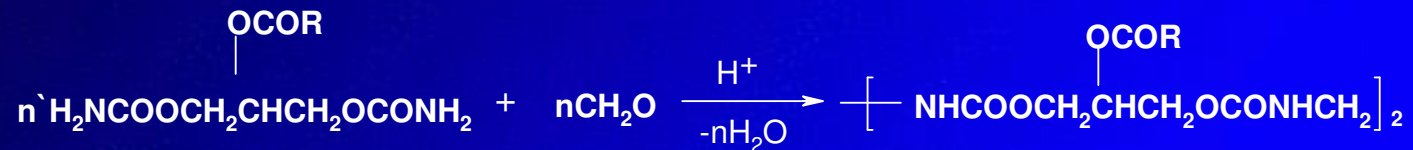


## NEW ECOLOGICAL MONOMERS AND POLYMERS FROM VEGETABLE OILS (2)

Monoglyceride discarbamates make a new valuable raw material for **polyurethane** synthesis ( polymethylene urethanes by reaction with formaldehyde) and a modifier of polycondensation resins, e.g:



Polyurethane foam based on flax oil



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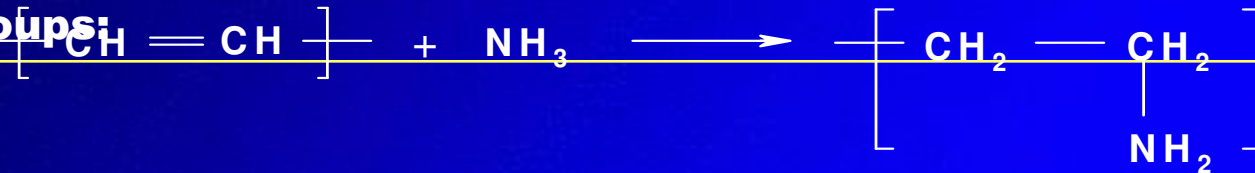
Where X is a remaining part of a condensation monomer (urea, melamine, phenol)



## NEW ECOLOGICAL MONOMERS AND POLYMERS FROM VEGETABLE OILS (3)

✓ Fatty acid amides, which are formed at the same time, are valuable Starting materials the manufacture of **surfactants**, while butyl esters of fatty acids are used as plasticizers and release agents.

✓ Addition of ammonia (which is formed by urea decomposition) to double bonds of unsaturated fatty acids present in vegetable oils result in the formation of amino groups:



In this way unsaturated fatty acids from vegetable oils can be converted into aminocarboxylic acids and the latter can serve for the manufacture of **polyamide**



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## Cosmetics made of linseed



- **Flaxseed: a herb for medical and cosmetic purposes.**
- **After mixing flaxseed oil with sesame oil and olive oil ancient Egyptians created a soothing and rejuvenating balm for skin and hair**
- **Flaxseed oil: applied in treatment of scalds, frostbites and care of dry, scaling skin with tendency for splitting .**
- **Both flaxseed and flaxseed oil smooth skin irritation , care about nails and hair preventing crushing and splitting up**

**Hydrophylic flax mucilage: excellent coating material, covering and anti-inflammatory in skin diseases.**

**Very strong hydrophylic properties-----it proves excellent in contracting and moisturizing skin**

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## FIBER CROPS

**The climatic conditions of Northern Europe allow for growing only two major fiber crops:**

- **Flax (*Linum usitatissimum* L.)**
- **Hemp (*Cannabis sativa* L.).**



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## Flax / Linen



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## HEMP RESEARCH IN POLAND

- **The leading research center involved in research on flax and hemp is the Institute of Natural fibers in Poznan (INF).**
- **The research topics conducted at INF cover research and development activities, from molecular biology, biotechnology, breeding and cultivation, through processing till final application opportunities.**



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## **HEMP *Cannabis Sativa***

- ✓ **Potential yield of hemp: 25 tons (comparable to yields of Miscanthus)**
- ✓ **The yield growth can be even higher when starting from *Cannabis gigantea*, which already in 1930s grew 9 m high.**
- ✓ **Yield: about 10 tons of dry mass per hectare**



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**1ha hemp = 10 tons dry mass**  
**1 ha of hemp extracts**  
**from air: 2.5 tons CO<sub>2</sub>**  
**from soil: aprox. 160g Cu**  
**aprox. 77g Pb**  
**aprox. 20- 23g Cd**

94 9 6





# HEMP (*CANNABIS SATIVA* L.)

- ✓ **Hemp has been grown and utilized in Poland for some 1000 years, i.e. from the very beginning of the Polish State.**
  
- ✓ **The list of cultivated crops cultivars includes three Polish fiber hemp cultivars:**
  - **Beniko,**
  - **Bialobrzeskie ,**
  - **Silesia**
  - **Tygra.**



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## POTENTIAL OF INDUSTRIAL HEMP IN POLAND

- Since 1995 the research on ***in vitro* tissue culture** growing.
- Polish cultivars of monoecious hemp are **resistant** to spring ground frosts, which enables early sowing – by the end of sowing time of spring small grains.
- One of the most promising potential **applications** of hemp is **pulp and paper production**.
- The annual hemp biomass production is **2.5 times higher than that of pine tree forest** (in Central European conditions).



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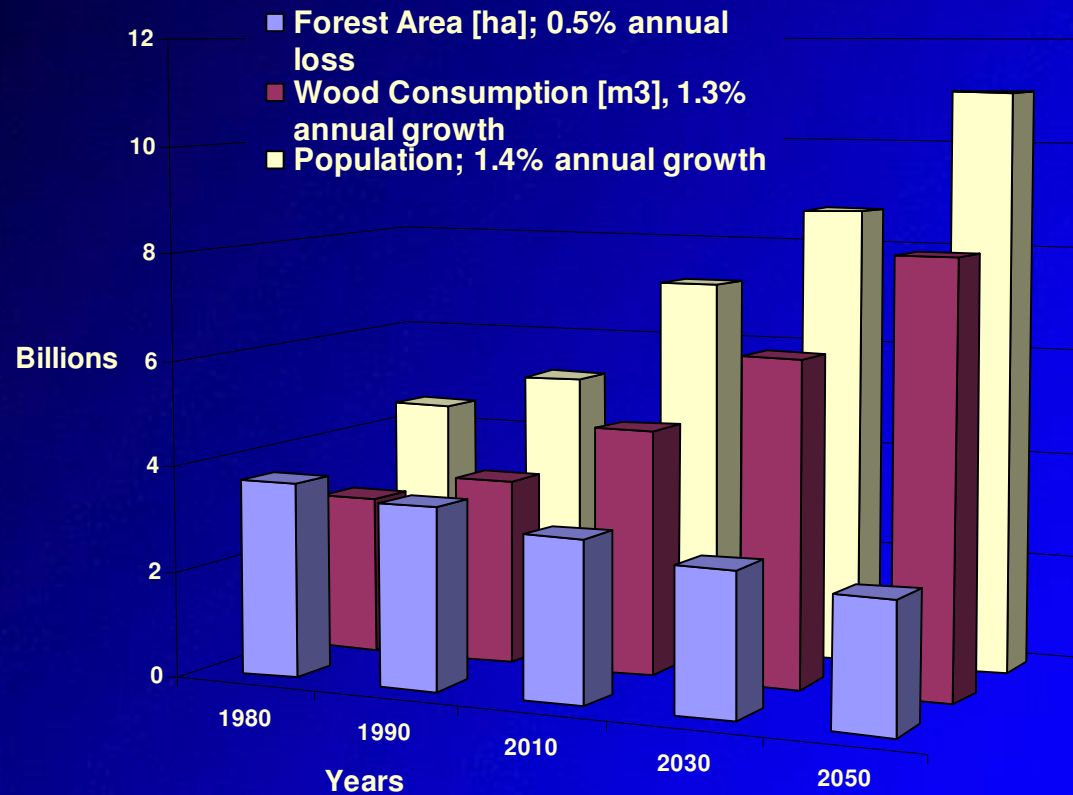
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# World Population, Forest Area and Wood Consumption, Years 1980 - 2050



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# HEMP *Cannabis Sativa*



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## ESSENTIAL OILS FROM HEMP

▪ **Hemp essential oil also shows bacteriostatic properties to Gram+ bacteria (Staphylococcus and Streptococcus). This effect is comparable to thyme oil. [1A]**

▪ **Essential oils for:**

❖ **cosmetic industry:**

▪ **additive for production of soap lotions, creams, shampoos, perfumes**

❖ **in aromatherapy**

❖ **component of insect repellents to protect people and cattle**

❖ **plant protection products manufacture (limonene and  $\alpha$ -pinene show insect repelling properties)**



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# FLAX AND HEMP MARKETS

## Markets for flax products cover:

- long and short fiber, so called cottonized fiber for blends,
- pure and blended,
- dry and wet-spun yarns
- woven and knitted fabrics.



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# Flax and hemp based composites





## Composite fire retardant particleboards produced from lignocellulosic particles of annual plants and mineral particles



**Flame retardant particleboard**



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# INSULATING BOARDS



**Insulating board  
made of hemp**



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# INSULATING HEMP BOARDS FOR BUILDING



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# HEMP SHIVES FOR ENERGY



**Briquettes  
(pellets) made of  
flax and hemp  
shives**



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## SHIVES FOR ANIMAL **BEDDING**

## AND NUTRITIVE MEDIUM FOR **MUSHROOMS**



The flax and hemp shives, after the special preparation, is also suitable as the nutrition for edible mushroom (*Pleurotus columbinus*)



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## **FUTURE FOR RENEWABLE RESOURCES IN POLAND**

**The significance of renewable resources, non-food applications of industrial crops in Poland is growing.**

**The developing recognition of ecological, health and comfort aspects of renewable resources, to replace the artificial once, contributes to the constant increase of the production and processing of industrial crops in Poland.**



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**THANK YOU  
FOR YOUR  
RENEWABLE**

**ATTENTION!!**



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