Future Crops for Food, Feed, Fiber and Fuel 4F CROPS

Coordination and support actions

Dipartimento di Scienze Agronomiche,
Agrochimiche e delle Produzioni Animali
Università degli Studi di Catania, Italy

Dipartimento di Scienze Agronomiche,
Agrochimiche e delle Produzioni Animali
Università degli Studi di Catania, Italy

WP1. Land Use in EU 27 (EC BREC)

Task 1.2 Evaluation of the restricting factors for the EU agriculture (UNI.CT, UNIBO)

WP2. Cropping possibilities (UNI.CT)

Task 2.1 Choice of the crops (UNI.CT, INIA, USASB)
Task 2.2 Rotation possibilities (UNIBO, NAGREF, UNINOVA)
Task 2.3 Yielding potential (CRES, INF)
Task 2.4 Raw materials characteristics (CRES, INF)
Task 2.5 Biotechnological improvement (AUA.bio)
Task 2.6 Cropping possibilities (UNI.CT)

Dipartimento di Scienze Agronomiche,
Agrochimiche e delle Produzioni Animali
Università degli Studi di Catania, Italy

Task 1.2 Evaluation of the restricting factors for the EU agriculture (UNI.CT, UNIBO)

Factors restricting EU agriculture, like the ones listed below, will be evaluated:

intensive cultivation of food crops, that requires huge water consumption in temperate climates and high input demands (fertilization, pesticides, etc) on one hand and on the other reduce the biodiversity and negatively affect the landscape and

climate change. According to predictions, in northern EU agriculture more crops species are expected to be cultivated with higher yields compared to the past, while in southern Europe there is a trend for shortage of the irrigated land and considerable decline in crop yields, due to reduction of the available water resources and increase of the temperatures. Marginalization and the effects on the land use will also be taken into consideration, as well as regional differences associated with traditional cropping systems (crops, growing methods, collection systems).

Dipartimento di Scienze Agronomiche,
Agrochimiche e delle Produzioni Animali
Università degli Studi di Catania, Italy





WP2. Cropping possibilities (UNI.CT)

The quality of land available for the growth of the non-food crops is limited by land suitability and the need to provide food and feed for an increasing population.

Given this completion for land, non-food crops will need to be assessed in terms of:

- *Choice of the crops*
- *Rotation possibilities*
- *Increased yielding per until of land area*
- *Desirable raw material characterisation*
- *Biotechnological improvement*

Dipartimento di Scienze Agronomiche,
Agrochimiche e delle Produzioni Animali
Università degli Studi di Catania, Italy

Task 2.1 Choice of the crops (UNI.CT, INIA, USASB)

Selection of appropriate crop species and genotypes for given locations to suit specific soil type and climate may be possible, but is at an early stage of understanding for some energy crops (or non-food crops) and is unlikely to provide the magnitude of productivity gains necessary to allow industry to develop (Sims *et.all*, 2006).

Many crop species are multipurpose in that they can be used to produce more than one (energy or another industrial product), for example hemp (both oil and soil biomass or oil and fibres) and cereals (ethanol and soil biomass from straw or ethanol and straw as a feed product).

Many of the most common fibre/fuel crops are already used for food and/or feed.

Oil crops: e.g. oilseed rape, linseed, field mustard, hemp, sunflower, safflower, castor oil, olive, etc.

Cereals: e.g. barley, wheat, oats, maize and rye

Starch and sugar crops: potato, sugar beets, Jerusalem artichoke and sugarcane

Cellulose crops: e.g. straw, wood, short rotation coppice

Solid energy crops or lignocellulosic crops: e.g. cardoon, sorghum, kenaf, reed canary grass, miscanthus, switchgrass, whole crop maize, and SRC willow, poplar and eucalyptus.

Dipartimento di Scienze Agronomiche,
Agrochimiche e delle Produzioni Animali
Università degli Studi di Catania, Italy

Task 2.2 Rotation possibilities (<u>UNIBO</u>, NAGREF, UNINOVA)

Crop rotations add diversity to farm operations and can help reduce risk, provide income stability, spread labour requirements, help control pests, and may add to efficient machinery use. Maintaining some flexibility within rotations to take advantage of price changes can help increase returns with little change in risk. When selecting a rotation, the long term viability of that rotation to reduce weed, insect and disease pressure, as well as its economic viability must be considered. A well developed plan which can be altered when necessary should always be followed. Otherwise, the desired crop sequence may be interrupted and the maximum benefits of the rotational effect will not be obtained. The following are important to consider when designing a crop rotation, regardless of location. They are: How will the previous crop affect subsequent crop production? Will the previous crop increase or decrease concerns in areas, like disease/insect/weed control management, soil moisture returns, seedbed preparation, harvest and planting schedule, frost risk, gross economic returns. In general terms, rotational benefits are maximized when crops from a common group do not follow each other in a rotation. A crop can be substituted for another of the same crop group in a rotation without destroying rotational benefits.

The efforts of this task will be focused on deciding which non-food crops to grow in rotation and along side with food crops, once the agronomic factors have been considered, so as to combine the resources of land, labour, management, and capital to provide the most farm profit, taken also into consideration environmental restrictions. Since these resources are scarce, maximizing returns to each resource is important.





Dipartimento di Scienze Agronomiche, Agrochimiche e delle Produzioni Animali
Università degli Studi di Catania, Italy

Task 2.3 Yielding potential (<u>CRES</u>, INF)

The concept of using plants as non-food feedstocks is not new, and despite considerable investment in research and development, little progress has been made on the introduction of such products into commercial market place. Therefore information on yields at a commercial scale is limited and refers only to a few cases of poplar plantation (Venendaal, R. *et.al,* 1997). As new non-food crops have not undergone the centuries of experimentation in field trials not to mention that these experimentation attempts were scattered as carried out in different time frames under different experimentation objectives and in most cases in small size field trials. As a consequence there is a lack of credible data as the theoretical yields of certain crops tend to be much higher that the expected commercial yields.

In order to survey the yielding potential of the new non-food crops data will be collected from previous EU and national funding projects. The consortium being partners or coordinators of such projects has access not only to reports but also to the assumptions made when elaborating the experimental results. The data will be elaborated and a draft review will be produced in 12. The review will be discussed during the second workshop of the project, by the participants of the workshop. Experts' judgements will also be sought by the stakeholders/experts from outside the consortium that will participate in the Scientific Committee.

The task leader will be CRES and INF will work on this task. More specifically, CRES will provide data for the crops that are dedicated for fuel, while INF will provide data for the crops dedicated for fibre production.

Dipartimento di Scienze Agronomiche,
Agrochimiche e delle Produzioni Animali
Università degli Studi di Catania, Italy

Task 2.4 Raw materials characteristics (CRES, INF)

The raw material characteristics can vary widely in terms of physical and chemical composition, size, shape, moisture content, bulk density, fibres length, etc. These variations can made it difficult (or costly) to supply the relevant industries with material of consistent quality year round.

In the frame of this task, crops will be categorised per end-use. For each end use the favourable characteristics will be listed and the crops will be prioritised according to the degree of fulfilling.
Raw material characteristics will also be sought in previous EU material funding projects where the consortium has access as well as in world literature. A list of crops suitable for each end use will be produced in month 12 reviewed in the second workshop like in the previous tasks. The list will be finalised at the end of WP2.

The task leader will be CRES and INF will work on this task. More specifically, CRES will provide data for the crops that are dedicated for fuel, while INF will provide data for the crops dedicated for fibre production.

Dipartimento di Scienze Agronomiche,
Agrochimiche e delle Produzioni Animali
Università degli Studi di Catania, Italy

Task 2.5 Biotechnological improvement (AUA.bio)

As previously stated, dedicated bioenergy crops (or non-food crops) are largely undomesticated and have not undergone the centuries that characterise our major non-food crops. Selection of appropriate crop species and genotypes for given locations to suit specific soil type and climate may be possible, but is at an early stage of understanding for some energy crops (or non-food crops) and is unlikely to provide the magnitude of productivity gains necessary to allow industry to develop (Sims *et.all*, 2006). Although breeding for some energy crops has already been attempted, there is limited breeding experience to date, mainly for energy crops. Therefore it is likely that large advances in bio energy crops yields can be expected over the next decades. New biotechnological routes as a result of the production of both non-genetically modified (non-GM) and GM plants are possible.

Although GM energy crop species will perhaps be more acceptable to the public than will GM food crops, there are still concerns with the potential environmental impacts of such plants. Hence, non GM plants for non-food uses, improved through biotechnological advances may finally become available to the growers.

In the frame of this task an overview of the plant breeding, selection and hybridization will be carried out in order to describe the state of the art for each non-food crops. In parallel, potentials for non-GM biotechnological improvement approaches for the selected future crops will be pointed out.

Dipartimento di Scienze Agronomiche,
Agrochimiche e delle Produzioni Animali
Università degli Studi di Catania, Italy





Task 2.6 Cropping possibilities (UNI.CT)

A relative ranking of the various cropping systems will be carried out, at regional level, in order to favor schemes with relatively high yielding potential which would allows co-existence with food crops in multi-cropping systems. Such schemes will have to be proven as economic viable and with low environmental pressures, but this kind of evaluation will be implemented in the following work packages.

Additional parameters that will be taken under into account during the technical but also the economic and environmental assessment is the logistics of the systems (harvesting/collection means, storage issues, pre-processing if necessary and transportation at plant gate)