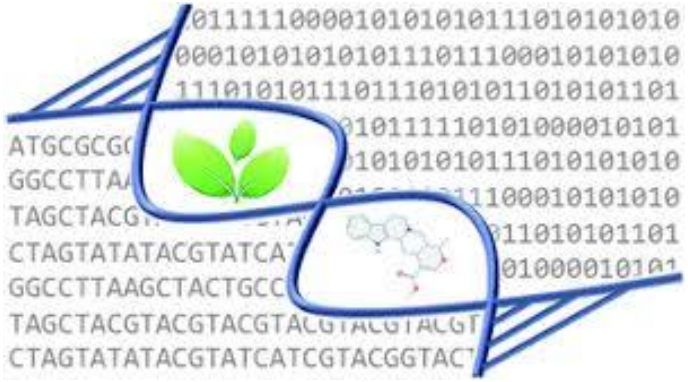
BIOINFORMATICS APPLICATION IN AGRICULTURE

PLANT GENOMICS

- **Objective -** To reveal the genetic and molecular basis of all biological processes in plants that are relevant to the species
- Plant genomics knowledge allow:
  - Efficient exploitation of plants as biological resources in the development of new varieties with improved quality and reduced economic and environmental costs
  - Development of new tools for plant diagnostics
  - Accumulation of information on plant characteristics of practical interest: resistance to pathogenic and abiotic loads, plant quality characteristics and reproductive characteristics determining the yield
  - Provision of measures for diagnosis of plant health and quality

PLANT GENOMICS

- **Main objectives of plant bioinformatics:**
  - To promote public access to all electronic data repositories
  - To provide a rational annotation of genes, proteins and phenotypes
  - To create and maintain electronic data exchange for plants as well as between plants and other organisms



CROPS

- Using bioinformatics tools, it is possible to derive the necessary information from the genome of specific plants
- The genome of two plant species is completely annotated:
  - Arabidopsis (*Arabidopsis thaliana*) - small size genome, reproduction and generating a new generation for 5 weeks, key feature: plant yields can be increased
  - Rice (*Oryza sativa*)

INSECT RESISTANCE

- Increased productivity and nutritional value of plants through incorporation of the desired genes
- Corn, cotton and potatoes have been made insect resistant through incorporation of *Bacillus thuringiensis* - a bacterial species which increases the soil fertility and protects the plants against pests
- use of Bt genes in the plants genome has made the agriculturists to use the insecticides in very little amount

BIOINFORMATICS IN PLANT SCIENCE

- Genome initiatives are under way for more than 60 different plant species
- The most important are those of the major food/feed crops, the grasses maize, rice, wheat, sorghum and barley; and the forage legumes soybean and alfalfa
- Plant genomics projects: to link seed stock and real genetic resources to virtual data on linkage and mapping data
- Useful web sites
  - UK CropNet (http://uk-crop.net)
  - the U.S. Agricultural Research Service (http://ars-genome. cornell.edu)
  - Organism-specific resources, e.g. MaizeDB (http://www.agron. missouri.edu)

MANAGING AND DISTRIBUTING PLANT GENOME DATA

- Plant sequence data have been accumulating from
  - Whole genome sequencing
  - Sample sequencing of bacterial artificial chromosomes (BACs)
  - Genome survey sequencing (GSS)
  - Sequencing of expressed sequence tags (ESTs)
- Molecular plant breeding:
  - To associate candidate genes, discovered in model species, with corresponding loci in crop plants
  - Routine use of computer models to:
    - formulate predictive hypotheses
    - create phenotypes of interest from complex allele combinations
    - construct those combinations by scoring large populations for very large numbers of genetic markers

MANAGING AND DISTRIBUTING PLANT GENOME DATA

- Rational plant improvement - implications of genomics with respect to food, feed and fibre production
- Genotype building experiments:
  - Information for the DNA polymorphism and sequencing in different plant varieties and cultivars
  - Analysis of the data for the polymorphism for a possible link with a quantitative trait of interest of the individual phenotypes (indirect markers) to be used in further selection purposes

CLIMATE CHANGE PERSPECTIVE

- Bioinformatics tools - required to predict the effect of global climate change on biological diversity and resources
- Collaborative actions of the use of modern DNA-techniques, novel macro-ecological predictive and null models, new climate change ensemble forecast models of species distribution, and powerful bioinformatics tools and statistics