CHAPTER ONE
INTRODUCTION

In 2008, oil prices reached their all-time record and, although the cost of crude oil has fallen substantially due to the global economic crisis, fossil fuels are still becoming increasingly expensive. Production of oil is already at its peak even according to the most optimistic scenario, and it seems therefore that we have already approached the limit of energy output using the existing technology (**Sorrell, 2009**).

Biofuels are commonly defined as fuels derived from renewable biological products and are often regarded as an attractive, "green" alternative to fossil sources of energy due to their potential contribution to lowering carbon dioxide emissions (**Pauly and Keegstra, 2008 and Williams *et al*., 2009)**. Biofuel crops have been identified and are at various levels of domestication and cultivar selection, while genetic and genomic resources for these species, including draft genome sequences and transformation protocols, are currently being developed. Major breakthroughs on the understanding of lipid metabolism and plant cell wall biosynthesis and structure are still needed to overcome low oil yields and the recalcitrance of lignocellulose, respectively, for efficient and cost-competitive conversion to biodiesel and other liquid fuels. However, despite its abundance and potential environmental benefits, the efficient and sustainable use of plant biomass for energy purposes remains a challenging endeavor, requiring major investments in science and technology **(Himmel *et al***., **2007** and **Schubert, 2006)**.

Renewable energy has gained renewed interest and funding recently due to high crude oil price, uncertainty in fossil fuel supply, and political and environmental issues associated with fossil fuels. The price of crude oil peaked above a record $120 per barrel, and putting greater pressure on creating a domestic and less expensive source of fuel. Biofuels are an attractive alternative as they have environmental benefits compared to fossil fuels, are renewable, and can be domestically produced. The two main categories of liquid biofuels for transportation are biodiesel and bioethanol. Biodiesel, which can be produced from any fat or oil through a relatively simple transesterification process, is easily incorporated into diesel engines with little or no modifications (**www.biodiesel.org**). Other advantages of biodiesel are that it yields 93% more energy than is invested in its production and produces less air pollutants than bioethanol and fossil fuels (**Hill *et al*., 2006**). However, one of the main disadvantages of biodiesel is that because the source is limited to seed crops, such as soybean and palm oil, it directly competes with food production.

The use of biotechnology for biofuel production is very attractive. Theoretically biofuel yields can be increased without a comparable increase in the amount of energy needed for production or cultivated and significant progress has been made using molecular biology in the past decade to increase the activity of enzymes and the microbes used for biofuel production. However, by many estimates, there is not enough arable land to produce sufficient biofuel feedstocks to replace more than 15% of transportation fuel using existing technologies (**Gressel, 2008**). The development of transgenic plants engineered for enhanced biofuel conversion is expected to be the most rapid and efficient solution, especially for the production of fuels from lignocellulosic biomass (**Gressel, 2008**).

Plant cell/tissue culture, also referred to as *in vitro*, axenic, or sterile culture, is an important tool in both basic and applied studies as well as in commercial application (**Stasolla and Thorpe 2011**). Different technology methods developed to transform plant cells utilized particle bombardment to physically shoot exogenous DNA into the plant cell (**Sanford, 2000**). Particle guns, the process often is called by other names such as micro projectile bombardment, particle bombardment, particle acceleration, or ballistics. Biolistics, is a commonly used method for genetic transformation of plants and other organisms. Millions of DNA-coated metal particles are shot at target cells or tissues using a biolistic device or gene gun.

Maize biologists have long awaited the development of an effective and efficient transformation method. Few plants share maize's importance to both agronomy and basic biology, and the ability to create transgenic maize easily and rapidly would be a tremendous advantage for both those trying to improve the agronomic characteristics of maize and those hoping to use transformation as a tool to explore fundamental questions about maize genetics and development, therefore, the main objective of the present research is to:

1- Evaluate the most suitable concentration of growth regulators for callus induction and plant regeneration from maize embryo,
2- Regenerate and high throughput callus for transformation,
3- Transform of COMT- antisense gene by particle bombardment to callus,
4- Screening the genetic transformation of this gene on the end products.