Journal of Energy Research and Environmental Technology (JERET)
p-ISSN: 2394-1561; e-ISSN: 2394-157X; Volume 5, Issue 2; April-June, 2018, pp. 35-37

http://www.krishisanskriti.org/Publication.html

Switch Grass–A Future Generation Bio-fuel and Carbon Sequester

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Abstract—*Fossil fuel burning cause release of green house gases in the atmosphere contributing to global warming, which is a serious concern for human well being. Biofuels can be the best alternatives of fossil fuels in coming time periods for lesser use of fossil fuels, more energy production, carbon sequestration and effective utilization of degraded lands in a cost reducing manner. Switch grass may be the good option in future production of biofuels.*

Biofuels are the organic compounds produced from plants, trees, animals and animals' residues by storing energy received from sun within them. These are renewable energy sources and used for 15% energy supply in the world. Biofuels can be the leading renewable energy sources and good alternatives to conventional fuels in future (Clark et al., 2013).

Three types of biofuels are*: First, Second and Third Generation biofuels. Sugars and oils are the sources of first generation biofuels, made from sugars or oils and represent the widely held biofuels presently being used. Second generation biofuels are made from sustainable feedstock. The term third generation biofuel refers to fuels taken from algae. Crops having potential to be used as biofuels are Soybean, Corn, Sugarcane, Sugar beet, Switchgrass, Jatropha etc. Biofuels have the capacity to replace agricultural land production of biomass into bio fuel. These fuels can be used where these are produced or at faraway place for their production.*

Bioenergy crops cultivation is adopted now a days to reduce emission of greenhouse gases (GHGs) from fossil fuels burning and to increase carbon sequestration in soil for agricultural sustainability for global food security i.e. why called as carbon neutral or carbon sinks.

1. INTRODUCTION

The studies on magnitude of actual reductions in carbon emission by these crops is still in progress and can be used to recognize the highly efficient bioenergy crops for achieving C sequestration targets along with production prospective.

Switchgrass (*Panicum virgatum*), a perennial grass native of Canada and the United States can be used to prepare ethanol. It is highly efficient, requires lesser agricultural inputs and convenient to plant from seed (McLaughlin and Kzsos, 2005; Parrish and Fike, 2005; Sanderson *et al*., 2007). Findings on Switchgrass affirmed its use as protector of land and water resources, carbon storage agent and provider of sustainable production systems leading to increasing monetary benefits along with environmental sustainability (McLaughlin and Walsh, 1998; McLaughlin *et al*., 2002).

Switch grass cultivation on marginal lands can increase ecosystem sustainability and profits of the farmers as justified by a research finding, revealing that 372 gallons per acre ethanol yield potential of switchgrass, similar to or more than corn (Varvel *et al*., 2008). The energy investment into switchgrass is about three and a half times lesser than the energy investment on corn. Cultivation of this grass provided 1.32 gigajoules of surplus energy after investment on cultivation, considering it as a net energy producer. One half lesser cost compared to corn makes it more suitable for ethanol production as well. Johnson *et al*., 2007 reported three times more farm income from switch grass as compared to corn crop. Biello,2008 reported almost 500% energy released back , whatever is used to produce it than maize where only 25% energy return is there. Liebig *et al*. (2008) conducted experiments for 5 years at different locations and found that switchgrass stored a huge amount of carbon in its biomass. Switchgrass' production potential more than 700% than its energy use was predicted by simulation model (Farrell *et al*., 2006).

Carbon sequestration having significant effect on soil fertility and greenhouse gas emissions, laeding to long-term sustainability of bioenergy crops' production. Sanderson (2008) reported increase in soil C content, of which almost 20% contributed by switchgrass. Corre *et al*.; (1999) and Garten & Wullschleger (1999) found an increase ranging from 25-72% and 22-43% in soil C respectively by switchgrass. Ocumpaugh *et al*. (2003) studied 20% enhancement in average soil carbon levels upto 30cm depth in soil from switchgrass. Sanderson (2008) and McLaughlin (1993) reported 30% increase in soil organic carbon. McLaughlin *et al*. (2002) calculated 0.78 Mg C ha^{-1} yr^{-1} storage in a simulation studies, however, Anderson-Texeira *et al*. (2009) reported 0.40–0.68 Mg ha^{-1} yr^{-1} increase in SOC by switchgrass as compared to maize cultivation and soil carbon reserves reduced by crop residue removal. Perennial grasses like Miscanthus and Switchgrass are source of energy and can be used as a climate mitigation tool for carbon sequestration in the soil–provided whole foliage is not harvested for energy production (Liz, 2014).

Eggelston *et al*. (2006) showed GHG (Green House Gas) mitigation potential of agriculture is 350–700 Mt C per year. As a fuel, ethanol produced from switch grass produced 94% lesser amount of GHGs as compared gasoline (Schmer *et al*., 2008). The emissions of CO_2 from switch grass are 1.9 kg C Gj^{-1} that is 11.9, 20.4 and 22.7 kg C Gj^{-1} lower as released from gas, petroleum, and coal, respectively (Lemus and Lal, 2005). Switchgrass has the potential to decompose slowly that could be useful for carbon sequestration (Shahandeh *et al*., 2011).

In comparison to wheat and maize, switchgrass has 16% more ability to recover applied N, thus act as N_2O emission saver (Bransby *et al*. ,1998; KimS & Dale, 2004; Adler *et al*., 2007; Kavdir *et al*., 2008). Zeri et al. (2009), in a study reported 75% lower Nitrous oxide release from switchgrass than miscanthus. Luo et al. (2010) showed that global warming potential (GWP) of switchgrass-ethanol was lower than that of crops like maize, sugarcane, flax etc. 44.8% and 28.2% more carbon sequestered by switchgrass cultivation than nearby fallow land as reported (Ma *et al*., 2000) and in another study, 3 t/ha/year higher SOC sequestration reported in switchgrass compared to corn (Zan *et al*., 2001). Andress, 2004 found that switchgrass sequestered 138.1 kg of CO2 /Mg of aboveground biomass.

A better understanding of green house gas emissions from fossil fuels and its impact on environment and agriculture can prove switchgrass, a biofuel of future for providing energy in a cleaner environment and climate a climate change mitigation tool.

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