Summary and Conclusion
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Lignocellulose (lignin, cellulose and hemicellulose) is the major structural component of woody and nonwoody plants make them a substrate of enormous biotechnological value. These huge amounts of residual plant biomass considered as “waste” can be potentially converted into various value added products namely biofuels, chemicals, cheap energy source for fermentation, improved plant stimulants and human nutrients. A very important factor in establishing cost-effective technology for bioethanol or biofertilizer is to use cheap, easily available lignocellulose.

Cyanobacteria are best model systems because of its ubiquitous distribution with surveillance of 3.5 billion years, oxygen evolving potential and its plant like phototrophic nature with simple growth requirements, which is not possible with heterotrophic bacterial and fungal systems. The other attribute of cyanobacteria is its diazotrophic nature. They are known for their ability to mineralize/degrade various pollutants such as naphthalene, organophosphorus, pesticides, lignin, phenol and xenobiotic such as synthetic dyes and lindane. Due to the bizarre nature cyanobacteria can be considered as the “architects of earth”.

As an initial step a potent cyanobacterium that could grow, immobilize and degrade lignocellulosics was identified. Among the 14 marine and fresh water
cyanobacteria screened, *O. annae*, a fresh water form was adjudged to be the best to grow with all the three lignocellulosic substrates.

Based on the effective immobilization of *O. annae* and the spectral studies in UV range from 200-340nm, coir pith with *O. annae* in the ratio 1:10 and *P. juliflora* and *L. camara* in the ratio 1:30 were found to be ideal for both release of phenolics and sugars. In view to reduce the cost for economic viability, experiments were carried out with different ‘N’ sources (BG11, NPK and Urea) both in laboratory and field conditions. Urea (0.1% w/v) supplemented medium showed encouraging results.

In addition, the presence of lignolytic enzymes (laccase, polyphenol oxidase and manganese independent peroxidase) and the hydrogen peroxide producing oxidases and their increase in activity on exposure to lignocellulosic substrates confirms the ability of *O. annae* to degrade lignin and release phenolics and sugars and prompted us to proceed further with urea alone.

From the agro-economic perspective the present study targeted on exploiting the uncanny ability of cyanobacteria to convert lignocellulosics for effective and efficient bioethanol and biofertilizer production. In view of producing bioethanol, the *O. annae* treated lignocellulosics (15th day) were subjected to thermochemical hydrolysis. The efficiency of bioethanol production by *Pichia stipitis* NCIM 3498 after detoxification by neutralization, overliming and overliming combined with activated charcoal were analyzed in untreated and *O. annae* treated lignocellulosics respectively. The ethanol produced at laboratory condition using *Pichia stipitis* NCIM 3498 was analyzed by gas chromatography and the fermentation efficacy was calculated. The ethanol productivity revealed that the common weeds, *P. juliflora* and *L. camara* could serve as effective source for ethanol production.

The diazotrophic cyanobacterial ability as plant growth regulator after treatment for 15 days with lignocellulosics (coir pith, *P. juliflora* and *L. camara*) as foliar spray were tested on *Tagetes erecta* a flowering cash crop. Of the concentrations tested (250, 500 and 1000ppm) *P. juliflora* followed by coir pith and *L. camara* at 500ppm respectively were ideal to increase both morphometrically and biochemically in the tested field condition (60 days).
The above findings demonstrate that freshwater cyanobacterium *O. annae* was found to be as efficient degrader of all the three lignocellulosic agro-based substrates. The organism could immobilize three lignocellulosics namely coir pith, *P. juliflora* and *L. camara* as substrates and release fermentable sugars for bioethanol production. In addition, the residual culture filtrate can be beneficially utilized as foliar spray for enhanced plant growth and productivity. Hence this cost-effective, ecofriendly, zero pollution lignocellulosic-based technology could be another lead for agro-economy development to India.