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Research Article

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Contributions of Biotechnology in Agriculture Combating Climatic Variations

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ABSTRACT

Climatic change has an enormous effect on economy which eventually depends upon the agricultural practices of any densely populated developing country. Human activities has produced global warming, disturbed the agricultural ecology for crop production challenging food security through salinity, adverse temperature, arid and saline soil condition and affected water precipitation leading to enhanced water use demand, dry land and hunger problems. Here we summarize the contribution of conservative and contemporary approaches of biotechnology involved in negative regulation of climatic fluctuations and their consequences by utilization of energy-efficient farming, plant tissue culture techniques and formulation of bio fertilizers, carbon sequestration with breeding for adaptive varieties, development of genetically advanced stress tolerant transgenic crops contributing in improved food security.

Keywords: *Conservative and Contemporary biotechnology, Global warming, Formulation of bio fertilizers, Carbon sequestration and Food security.*

INTRODUCTION

The problem of high temperature and sea level are the major threat for development of agriculture rural livelihood and as food security reported by (UNDP, 2007) & (IPCC, 2007). The agriculture sectors contributes both in affecting climatic fluctuation as well as gets influenced by climatic variations (Aydinalp et al., 2008). Previously, it has been reported greenhouse gases (GHG's) were produced through human activities as well as agricultural practices. The climatic fluctuations lead to global warming & extreme weather conditions such as droughts, heavy rainfall, thunderstorms, flood and cyclones which influence livelihood & economy causing poverty and economic loss (UNDP, 2002). The issues of loss of productivity before economic climatic tragedies, coping cost to overcome such calamities, loss of economy causing poverty and degradation of human opportunities has been reported by (UNDP, 2002). The environmental cop strains for agriculture & cultivation of crops includes 8.9 billion hectare waste land for cultivation globally because 19.8% soil are of poor quality,13.2% is extreme cold whereas 4.6% is highly steep with 2% wet.

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The fluctuations could damage crops and affect their yield significantly (Rosenzweig, 2002). GHG's such as CO_2, methane & nitrous oxide are emitted through flood rice's field, land conversion, production of livestock, nitrogen fertilizers and burning of biomass increases temperature of earth (Paroda, 2009) and contributes significantly in climatic change contributes significantly in climatic change. Drought is another consequence of climatic fluctuation and causes food security issues. The nitrogen supplementing fertilizers utilized for agriculture make release of nitrogen into water bodies or atmosphere. 13% of GHG's emissions produced through livestock production, pasture, crop land & food processing industries (Paroda, 2009).

The field of biotechnology could serve as source of large scale solution to climatic change solution. This may act as a connecting link science and ecology for maintenance of sustainability of agriculture to combat issues of food security, renewable energy, rapid growth of population and declining resources. In this review we seek and address contribution of problems in various ways that are explained in Table 1.

S.No.	Biotechnological Technique	Technical Application	References
1.	Zero-tillage practice	Reduction in use of artificial pesticides and fertilizers.	Powlson et al., 2011 Johnsona et al., 2007
2.	Use of Bio fertilizers&Bio pesticides.	Use of animal manures &reduction of chemical fertilizers.	Treasury, 2009
3.	Production of Bio-fuels	Production of Biogas,Bioethanol and Biogas	Theasury, 2009 Lybbert & sammer, 2010 Jain & Sharma, 2010
4.	Plant Tissue Culture(PTC)	Development of tolerant varieties of sunflower and millet.	Apse & Blumwald (2002)
5.	Development of Cross-breed varieties.	Development of drought resistant pearl millet	Ruane et al., (2008)
6.	Transfer of Drought tolerant genes	Abiotic stress such as drought tolerance varitieslike wheat,cotton,soybean tomato	Hong et al., 2000 Jaglo et al., 2001 Manavalan et al., 2009
7.	Development of Herbicide Resistant Genes.	Development of GMO's canola & soybean to spraying	Brimner et al., 2004 Kleter et al., 2009
8.	Development of Salt Tolerating Genes.	GM rice and tomato for abiotic stress.	Zhang& Blum wald , 2002
9.	Engineering of Heat Tolerating Genes.	GM *Brassica spp* against a biotic stress.	Jaglo et al., 2001 Zhu et al., 2001
10	Engineering of Nitrogen Fixing Genes,	Genetically improved strains of *Rhizobium spp.* for reduction use of chemical fertilizer .	Zahran 2001 Yan et al., 2008
11.	Resigning of Insect Resistant Genetically Engineered Varieties.	To reduce spraying of insecticides and pesticides for eggplant, maize cotton.Eg:Bt Cotton.	May et al., 2005 Bonny, 2008
12.	Design of Self Nitrogen GM Crops.	Development of N-efficient GM *Canola spp.* for carbon sequestration.	Johansona et al., 2007

DISCUSSION

Biotechnology field play a significant role for the consumers of food, farmers who produce and the food manufacturers who process it. Therefore, there must be a limitation for the over the use of such foods where transgenic crops and animals were used. There should be a special precaution to ensure the regulation so the transgenic commodities do not cause health risks and environmental threat.

The peculiar field of biotechnology can be used for the betterment of mankind society through development of qualitative, nutritionally rich, insect-pest and disease resistant crops with enhanced cost of production. Biotechnology utilizes artificial genetic engineering technique for facilitating the benefits to humankind.

CONCLUSION

Our chapter briefly explains the contributions of different methods & Biotechnological technologies to improve productivity of agriculture and food security issues developed because of climatic fluctuation. The field of biotechnology through carbon sequestration, reduction in over use of chemical fertilizers and pesticides with use of bio fertilizers and bio pesticides, genetically engineered modified crops with resistant genes against abiotic stress

and use of environmental friendly bio fuels. The approach using biotechnological methods will contributes in response to climatic change fluctuations via adaptation and mitigation.

REFERENCES

Apse, M. P., & Blumwald, E. (2002). Engineering salt tolerance in plants. *Curr. Op. Biotechnol*., *13*, 146-150.

Aydinalp, C., & Cresser, M. S. (2008). The effects of global climate change in agriculture. *Am-Euras J Agric Environ Sci 3*(5), 672–676.

Bandyopadhyay, A. K., Ray, R. R., & Ghatak, P. K. (2003). In proc: Effective utilization of buffalo milk for manufacturing dairy products. 4 th Asian buffalo congress, held at New Delhi from 25-28 Feb: 191.

Birthal, P. S., & Singh, M. K. (1995). Structure of rural income inequality: a study in western Uttar Pradesh. *Indian Journal of Agricultural Economics 50*(2), 168-175.

Bonny, S. (2008). Genetically modified gyphosate-tolerant soybean in USA: Adoption factors, impacts and prospects. *A review. Agro. Sustain. Dev*., *28*, 21 -32.

Brimner, T. A., Gallivan, G. J., & Stephenson, G. R. (2004). Influence of herbicide-resistant canola on the environmental impact of weed management. *Pest Manag. Sci*., *61*(1), 47-52.

Cockrill, W. R. (1994). Present and future of buffalo production in the world. Proceedings of the Fifth World Buffalo Congress, 27-30 June, Sao Paulo, Brazil.

FAOSTAT (2005). FAOSTAT Agriculture Data. Food and Agriculture Organization Statistics, Rome, Italy. http://faostat.fao.org/default.asp x.

FAO (2000). Water Buffalo: an Asset Undervalued, pp.1-6. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand. http://www.aphca.org/public ations/files/w_buffalo. pdf.

Hong, Z., Lakkineni, K., Zhang, K., & Verma, D. P. S. (2000). Removal of feedback inhibition of *delta*-pyrroline-5-carboxylate synthase results in increased proline accumulation and protection of plants from osmotic stress. *Plant Physiol*., *122*, 1129-1136.

IPCC (2007). Technical summary. Climate change 2007: impacts, adaptation and vulnerability. In: Parry, M. L., Canziani ,O. F., Palutikof, J. P., van der Linden, P. J., Hanson, C. E., (eds) Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change. Cambridge University Press, Cambridge pp 23–78.

Jaglo, K. R., Kleff, S., Amunsen, K. L., Zhang, X., Haake, V., Zhang, J. Z., Deits, T., & Thomashow, M. F. (2001). Components of Arabidopsis Crepeat/dehydration response element binding factor or cold-response pathway are conserved in *Brasicca napus* and other plant species. *Plant Physiol*., *127*, 910-917.

Jain, S., & Sharma, M. P. (2010). Prospects of biodiesel from Jatropha in India: A review. *Renewable and sustainable Energy Rev*., *14*(2), 763- 771.

Johanson, A., & Ives, C. L. (2001). An inventory of the agricultural biotechnology for Eastern and Central Africa region. Michigan State University. p. 62.

Johnsona, J. M. F., Franzluebbersb, A. J., Weyersa, S. L., & Reicoskya, D. C. (2007). Agricultural opportunities to mitigate greenhouse gas emissions. *Environ Poll*, *150*(1), 107-124.

Kleter, G. A., Harris, C., Stephenson, G., & Unsworth, J. (2008). Comparison of herbicide regimes and the associated potential environmental effects of glyphosate-resistant crops versus what they replace in Europe. *Pest Manage. Sci*., *64*, 479-488.

Lybbert, T., & Sumner, D. (2010). Agricultural technologies for climate

change mitigation and adaptation in developing countries: Policy options for innovation and technology diffusion. ICTSD-IPC Platform on Climate Change, *ATS Policy Brief 6*, (http://ictsd.org/i/publications/77118/).

Manavalan, L. P., Guttikonda, S. C., Tran, L. P., & Nguyen, H. T. (2009). Physiological and molecular approached to improve drought resistance in soybean. *Plant cell Physiol*., *50*(7), 1260-1276.

May, M. J., Gillian Champion, G. T., Dewar, A. M., Qi, A., & Pidgeon, J. D. (2005). Management of genetically modified herbicide-tolerant sugar beets for spring and autumn environmental benefit. *Proc. Biol. Sci*., *272*(1559), 111 -119.

Powlson, D. S., Whitmore, A. P., & Goulding, K. W. T. (2011). Soil carbon sequestration to mitigate climate change: A critical re-examination to identify the true and false. *Eur. J. Soil Sci*., *62*, 42-55.

Paroda, R. (2009). Proceedings of symposium on global climate change: imperatives for agricultural research in Asia–Pacific. Japan Asia Pacific Association of Agricultural Research Institutions, Tsukuba, p 31.

Rosenzweig, C. E., Tubiello, F., Goldberg, R., & Bloomfield, J. (2002). Increased crop damage in the US from excess precipitation under climate change. *Global Environ change 12*, 197–202.

Ruane, J., Sonnino, F., Steduro, R., & Deane, C. (2008). Coping with water scarcity in developing countries: What role for agricultural biotechnologies? Land and water Discussion Paper No. 7. Food and Agricultural organization (FAO). p. 33.

Treasury, H. M. (2009). Green biotechnology and climate change. Euro Bio, p. 12. Available online at http://www.docstoc.com/docs/150210 72/Green-Biotechnology - and Climate-Change.

UNDP (2007). Fighting climate change: human solidarity in a divided world. Human development report, 2007/08. Macmillan, New York.

UNDP (2002). Annual report. Macmillan, New York.

Jakhar, V., Vinayak, A. K., & Singh, K. P. (2017). Effect of Non-genetic Factors on Performance Traits of Murrah Buffaloes: Review *Int. J. Curr. Microbiol. App. Sci. 6*(11), 4248-4255.

Khedkar, C. D., Kalyankar, S. D., & Deosarkar, S. S. (2016) Buffalo Milk. In: Caballero, B., Finglas, P. and Toldrá, F., (eds.) *The Encyclopedia of Food and Health 1*, 522-528.

Yadav, A. K., Singh, J., & Yadav, S. K. (2017). Characteristic features of registered Indigenous Buffalo Breeds of India: A Review, *Int. J. Pure App. Biosci*. *5*(4), 825-831.

Yan, Y., Yang, J., Dou, Y., Chen, M., Ping, S., Peng, J., Lu, W., Zhang, W., Yao, Z., Li, H., Liu, W., He, S., Geng, L., Zhang, X., Yang, F., Yu, H., Zhan, Y., Li, D., Lin, Z., Wang, Y., Elmerich, C., Lin, M., & Jin, Q. (2008). Nitrogen fixation island and rhizophere competence traits in the genome of rootassociated *Pseudomonas stutzeri*A 1501. *Proc. Nat. Acad. Sci*., *105*(21), 7564-7569.

Zahran, H. H. (2001). Rhizobia from wild legumes: Diversity, taxonomy, ecology, nitrogen fixation and biotechnology. *J. Biotechnol*, *91*, 143-153.

Zhu, K. J. (2001). Plant salt tolerance. *Trends in Plant Sci*., *6*(2), 66-71.

Zhang, H. X., & Blumwald, E. (2002). Transgenic salt-tolerant tomato plants accumulate salt in foliage but not in fruit. *Nature Biotechnol*, *19*, 765- 768.