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NEWS AND VIEWS

Can microbes help crops cope with climate change?

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Agriculture is considered to be one of the most vulnerable sectors to climate change. The average temperature in the Indian sub-continent has risen by 0.57°C in the last 100 years and models project that it is likely to rise further to a maximum of 2.5°C by 2050 and 5.8°C by 2100. Besides high temperature, elevated CO_2, extreme rainfall events, more floods, cyclones, cold waves, heat waves and frost are other effects likely to be witnessed as a result of global warming. The irrigation requirement of crops in arid and semi-arid regions is estimated to increase by 10% for every 1°C rise in temperature. These factors are likely to cause serious negative impacts on crop growth and yields and impose severe pressure on our land and water resources.

Worldwide, extensive research is being carried out on crop and livestock systems for coping with climate change through development of heat- and drought-tolerant varieties, shifting the crop calendars, resource management practices such as zero tillage, improved methods of water harvesting and irrigation efficiencies etc. While most of these technologies are cost-intensive, recent studies indicate microorganisms can also be used to help crops cope with climate change in a cost-effective manner [1]. The most important abiotic stress factors that influence crops due to climate change include drought, heat wave, cold wave, chilling injury and flooding. Rhizosphere and endorhizosphere microorganisms are reported to help plants tolerate these abiotic stresses by a variety of mechanisms including modification of plant response at the gene level.

Timmusk and Wanger (1999) were the first to show that inoculation of *Paenibacillus polymyxa* confers drought tolerance in *Arabidopsis thaliana* through induction of a drought responsive gene ERD15 [2]. Last decade saw an explosion of publications reporting the beneficial effects of microorganisms such as *Pseudomonas*, *Bacillus*, *Arthrobacter*, *Pantoea*, *Burkholderia*, *Rhizobium* etc. in enhancing the tolerance of crops such as sunflower, maize, wheat, chickpea, groundnut, spices and grapes to drought, salinity, heat stress and chilling injury under controlled conditions [3, 4]. The introduced microorganisms in the rhizosphere enhance soil aggregation by production of EPS thereby improving the water availability to plants during dry periods [5], induce the synthesis of heat shock proteins and osmoregulants such as proline, glycine betaine, help in maintenance of cell membrane integrity [6], all of which contribute to improved stress tolerance in plants. The introduced organisms also form biofilms in the rhizosphere which protect plants from surrounding harsh environments. These researches open up new and exciting possibilities of utilizing microorganisms as inoculants for enhancing tolerance of plants to climate change induced abiotic stresses. These inoculants could form major component of the climate change ready technologies being developed globally to help agriculture and livestock production to cope with climate change. As many of such technologies are likely to have intellectual property value, this field offers immense opportunities for young and active researchers.

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References

1. Venkateswarlu B, Desai, S and Prasad, YG (2008) Agriculturally important microorganisms for stressed ecosystems: Challenges in technology development and application. In: Agriculturally Important Microorganisms Vol.1. Kachatou-

rians GG, Arora DK, Rajendran TP, Srivastava AK, (Eds.). Academic World, Bhopal pp 225–246

2. Timmusk S, Wagner EGH (1999) The plant growth promoting rhizobacterium *Paenibacillus polymyxa* induces changes in *Arabidopsis thalianan* gene expression: A Possible connection between biotic and abiotic stress responses. Mol Plant-Microbe Interact 12:951–959
3. Ait Barka E, Nowak J and Clement C (2006) Enhancement of chilling resistance of inoculated grapevine plantlets with a plant growth prompting rhizobacterium, *Burkholderia phytofirmans* strain PsJN. Appl Environ Microbiol 72(11): 7246–7252
4. Arshad M, Sharoona B and Mahmood T (2008) Inoculation with *Pseudomonas* spp. Containing ACC-deaminase partially eliminate the effects of drought stress on growth, yield and ripening of pea (*Pisum sativum* L.). Pedosphere 18(5):611–620
5. Sandhya V, Ali Sk Z, Grover M, Kishore N and B Venkateswarlu (2009). *Pseudomonas* sp. Strain P45 protects sunflowers seedlings from drought stress through improved soil structure. J Oilseed Res 26:600–601
6. Bano A and Fatima M (2009) Salt tolerance in Zea mays (L.) following inoculation with *Rhizobium* and *Pseudomonas*. Biol Fert Soils 45:405–413