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SHORT COMMUNICATION

PGR-Clim: Climate Atlas of Genetic Resources of Five Crops

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PGR-Clim is a web-based tool that provides an easy interface to access climate change (temperature and rainfall) atlases relevant to plant genetic resources management. The online tool combines climatic data with information on germplasm collection sites of five crops (sorghum, pearl millet, wheat, chickpea and pigeon pea) to predict future (2020 and 2050) climatic situations at germplasm occurrence sites. The tool allows users to choose a crop and visualize how climate is predicted to change over time and stimulate them to assess impacts and plan for measures of mitigation and adaptation.

Key Words: Climate change, Climate maps, PGR, web-based tool

Identification and utilization of plant genetic resources (PGR) with excellent adaptation potential is a prerequisite to facilitate development of climate smart crop varieties. Genebanks, major repositories of *ex situ* collections worldwide are expected to take measures to be climate-ready. Identification of pre-adapted germplasm for immediate direct use in varietal development and vulnerable areas for collection and conservation in the Indian context in five selected crops – wheat, pearl millet, chickpea, pigeon pea and sorghum has been reported (Archak *et al.,* 2014). However, climate maps in printed forms may not be accessible to everyone easily. In order to make the climate maps, for current and future, available to PGR researchers and policy makers, an online software tool called PGR-Clim was developed. Here we report development and utility of PGR-Clim.

For the purpose of easy designation of climate periods, *current* means years spanning 1950-2000; *2020* means years spanning 2010-2039 and *2050* means years spanning 2020-2049. Climatic data were obtained from the Worldclim database for current climate (1950-2000) and from UKMO HADCM3 Climate Model for near future (2010-2039). In order to find out areas most vulnerable to changing climate, the collection sites as putative sites for occurrence of diversity were mapped on current and future climate. Information on indigenous collections belonging to five target crops was mined from ICAR-NBPGR databases as well as documentations of Bioversity International collection missions (IBPGR database) or accessed via either ICRISAT database or GENESYS portal to obtain information on international collections of the target crops sourced from India and being conserved at locations other than National Genebank, NBPGR. Search resulted in a total of 38,126 accessions that had information on collection site. In all, spatial information was manually geocoded and was brought into GIS to prepare a geo-database for 10947 sorghum, 9499 wheat, 8220 pearl millet, 6167 pigeon pea and 3293 chickpea accessions.

The information at every stage of analysis was mapped employing the geospatial processing program ArcMap 10.1 (ESRI 2010). Indian map (2001 census) and soil map (National Atlas and Thematic Mapping Organization) were procured from a commercial source. Physiographical divisions were as per NBSS&LUP and soil taxonomy classification was as per USDA. Agro-ecological zones (AEZ) were as per National Institute of Hydrology, Roorkee. The web-based tool for visualizing the climate maps was developed following three-tier system architecture. The database was placed at bottom layer and was developed by using MSSQL Server 2012. The server side application layer was developed by using C# and the client side application layer was developed by using HTML, CSS and ASP.NET. Dynamic map viewing was established by employing Google maps.

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PGR-Clim is accessible at http://www.nbpgr.ernet.in:8080/climate/arcMap.aspx. The generic process of querying for maps is given below:

1. Select crop → Click on Get Map → View collection sites on India terrain map
2. Select crop → Select map variable (AEZ or Soil) → Click on Get Map → View collection sites on India AEZ or Soil map
3. Select crop → Select climate variable (Temperature or Rainfall) → Select time period (Current or 2020s or 2050s) → Click on Get Map → View collection sites on India temperature or rainfall map for Current or 2020s or 2050s

The map output (Fig. 1) provides a quick look at the changes in the areas covered by different temperature and rainfall patterns at different points of time. Climate

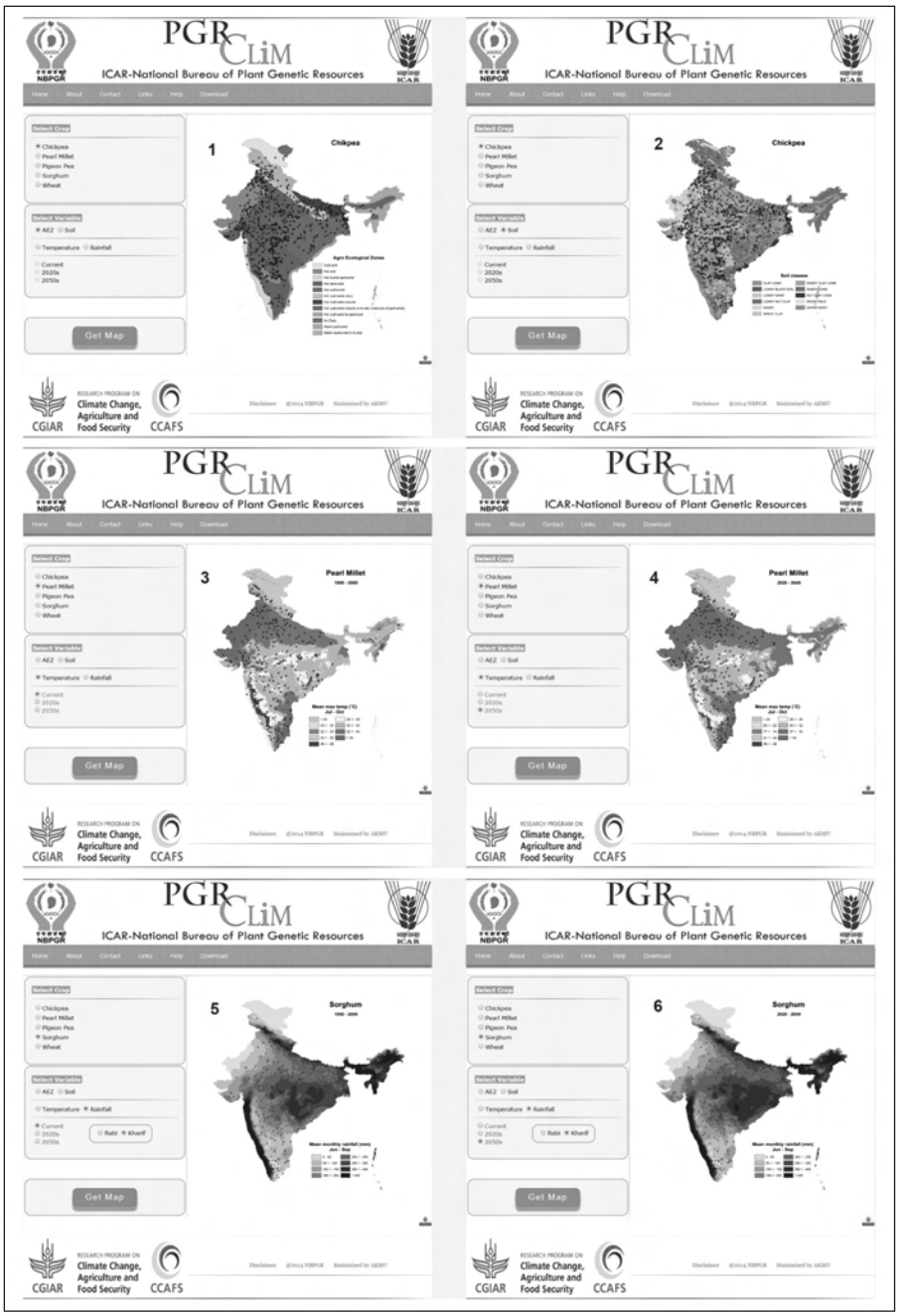

Fig. 1. Climate atlases generated by PGR-Clim. (1) Chickpea germplasm occurrence data on AEZ map; (2) Chickpea germplasm occurrence data on soil map; (3) Pearl millet current temperature atlas; (4) Pearl millet 2050 temperature atlas; (5) Sorghum current rainfall atlas; (6) Sorghum 2050 rainfall atlas

maps obtained on the PGR-Clim interface are only for visualization purpose. Users can download large (~2MB size) high resolution (5950×7700) jpeg images by clicking on the link at the right hand bottom of the maps.

PGR-Clim is interactive only at the level of accession map. This means by clicking on the points, genebank ID is displayed. However, the climate maps are not yet interactive. Users may have to download the high resolution climate atlases and mark the genebank IDs based on accession level map (first option) for further interpretation. It is expected that PGR researchers would make use of this tool in order to identify accessions that are climate resilient or areas that may go vulnerable due to changed climate. Addition of more crops and making the tool more interactive are future prospects of PGR-Clim.

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