Three P's Model For Designing Crop Against Climate Change

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Abstract: Climate is an important factor for agricultural production. The climatic change has potentially threatened the present sustainability in agriculture sector. Very high losses of agricultural production –including in production of food crops, are expected to occur, especially in Africa and South Asia. The impacts of climate change are already visible. A network of 15 centres of Indian Council for Agriculture Research (ICAR) has reported that apple production is declining in Himachal Pradesh due to inadequate chilling. The climatic change has potentially threatened the present sustainability and motivated for research in this direction during the last decade. As Uttrakhand hills are rich of diversity for fruit and various crops so this diversity can be utilised for designing the crop for climate change. Our paper includes the model by which the crop can be designed for future changes which include three main approaches: Pre-breeding, Predicted climate change simulation and pressurized invitro- selection. Pre-breeding is the art and science of identifying desired traits in otherwise unprepossessing and unpromising plants, often wild, and starting to incorporate them into modern varieties in the context of emerging stresses due to climate change. Pre-breeding is a vital step in the link between conservation and use of plant genetic resources. Thus it is first step for genetic enhancement of crop. The second step of designing the crop is possible climate change and third is invitro selection. This selection allows well suited genotypes to select for altered environment.

Index Terms: Climate change, Prebreeding, Predicted climate change, Pressurized invitro selection, Designing Crop, elastic variety, backcross breeding

1. INTRODUCTION

In recent time the considerable change in climate in all over the world produced an alarming threat to the crop sustainability. Although various breeding program like ecological breeding participatory breeding and ideotype breeding are on their way of development but outcome, with awareness in very low. Climate trends over the past few decades have been fairly rapid in many agricultural regions around the world, and increases in atmospheric carbon dioxide (CO_2) and ozone (O_3) levels have also been ubiquitous. The virtual certainty that CO_2 concentration will continue to trend in the future raises many questions related to food security, one of which is, whether the aggregate productivity of global agriculture will be affected? Over the next few decades, CO_2 trends will likely increase global yields by roughly 1.8% per decade. At the same time, warming trends are likely to reduce global yields by roughly 1.5% per decade without effective adaptation, with a plausible range from roughly 0% to 4%. (Lobell et.al). Not only context of CO_2 but also torrential rainfall, changes in sunshine hours, and lowest temperature in winters is also a major problem. To combat these effects of climate change a planned strategically development is required.

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2. MATERIAL AND METHOD

THREE P MODEL OR CROP DESIGNING MODEL

Today's bred varieties are requiring at least 7-8 yrs. In this time span the considerable climate change occur not only directly but indirectly also. It means that, change in climate not only in temperature, humidity, rainfall but also in the breeding behavior of insect's pests, their life span and stage and preference which indirectly affects the yield of crop plant. To avoid this contrast this model is been developed by which the varieties can be bred to minimize the effect for the changing environment. The 3P model consists of the 3P's that are P-Prebreeding, P- Predicted climate change, P- Pressurized invitro selection. This model consists of selecting the most relevant and ecological adapted landraces which is bred with an agronomically suitable/superior variety to extract their yield contributing and domestic characters into the desired germplasm. The next step is predicted climate change means the simulation is done for future climate. This is done by various methods such as (CCSM3) Community Climate System Model version 3. According to past 5 to 10 years data analysis ongoing pattern are analysed and the predicted change of next upcoming years is predicted. Although drastic change is difficult to predict but some factors like temperature variation, humidity level, rainfall cycle and soil temperature can be predicted. According to upcoming changes the objectives of breeding programme is set. The last third is pressurized invitro selection. It is most important to make a variety tolerant to various climate changes. In lue of this pressurized inviro selection is done in which conditions are made which a variety will face in near future. This invitro selection is done through tissue culture or in glass house. The detailed process is explained below:

2.1 PREBREEDING- AS AN INTIATIVE

Uttrakhand is full of diversity for various crops and the fruit plants. Thus it is important to utilise these diverse germplasm in crop breeding in which pre-breeding is foremost and important tool. Pre-breeding refers to all activities designed to identify desirable characteristics and/or genes from unadapted materials that cannot be used directly in breeding populations, and to transfer these traits to an intermediate set of materials that breeders can use further in producing new varieties for farmers. The adoption of pre-breeding facilitates the efficiency and effectiveness of crop improvement programmes by enabling increased access to, and use of, genetic variations conserved in gene banks. (Biodiversity International and GIPB/FAO, 2008). In simple words prebreeding is "Any manipulation of germplasm leading to domestication". In current past importance of pre-breeding is recognized. It is important to constantly enrich the genetic basis of the parent plant collection. These parent plants are used for variety breeding. This form of breeding results in plants with new characteristics, which can then be used for crossing in the variety breeding program. Pre-breeding is routinely applied in commercial breeding programs where desired traits are constantly sought and identified from source genotypes for use in cultivar development. Overall, prebreeding includes all activities directed at identification of desirable crop traits and/or genes, and their subsequent transfer into a suitable set of parents for further selection. The procedure identifies useful character(s) or genes that can be exploited in cultivar development (Ortiz, 1999).

Component of pre breeding
The activities required for prebreeding are:-

Germplasm characterization
The germplasm or landraces is first characterized for their adaptability and unique characters such as disease resistance, maturity time, male sterility etc. These characters are characterized and there stability is noted.

Crossing
The obtained best germplasm is crossed by agronomic superior variety to overcome the barrier for domestication. In this backcross breeding or simple crossing with selection is done.

Use as parent for future use
The obtained line can be used for future breeding line or as parent in the breeding programme.

2.2 PREDICTED CLIMATE CHANGE

To predict climate we use computer stimulation climate change by various computer based program or model to predict the level of changes. In this regards various method like CCSM3 are present which can be used. These methods require previous 10 years data of climatic parameters on which it works. This method can only predict the change regarded to environment but does not give the idea how crop will react to the changes. These require three component last 10 years climate data, computer stimulated climate programme and analyse of interaction of genotype with future environment.

2.3 PRESSURIZED INVITRO SELECTION

Plants, tissue or isolated cells of obtained cross can be cultured on tissue culture media. The isolated explants may be pollen if isolation of homozygous line is to done rapidly. If the drought tolerant is required any meristematic tissue is taken. According to objective such as (high temperature is limiting factor in future) heat tolerance the selection is done by creating such condition by certain substance, (for example, PEG) which is added to the substrate. The breeder then simply waits to see which plants or cells continue to grow well. The plants that pass this test can then be propagated in vitro. When they have grown roots and are hardened off, they are ready to be moved to the glasshouse or open field, where subsequent selection takes place.

3. FIGURES

Year	Activity
First year	Germplasm characterization and evaluation
Second year	Crossing in desirable genetic background
Third year	Selection for line for future use and prediction of future climate
Forth year	Invitro selection in various stress created by PEG, inoculums stress etc. And selection of resistant plant and field transplanting
Fifth year	Yield trails and best lines selected
Six year	Multilocation yield trails
Seventh year	Release for particular zones

4. CONCLUSION

ELASTIC VARIETY
The product of this type of methodology is elastic variety which means a variety finely tuned for minor and major climatic turbulence. These varieties contain changes in morphological characters, maturity timing, number of genes, and adaptation to local conditions. These varieties are most suitable for ecological breeding also. These varieties are similar to mega varieties in respect that these can tolerate a long range of environmental conditions. Unlike other breeding systems like ideotype breeding, participatory breeding, ecological breeding these all involve only two component, adaptation and selection of suitable traits. But this model not only accommodates these two components but also preparing for future changes. In most of long bred crops like sugarcane and tree species this model is very useful where the requirement is sometimes 15 years. Current trends in population growth suggest that global food production is unlikely to satisfy future demand under predicted climate change scenarios unless rates of crop improvement are accelerated .Although technique are available but the integration is still a problem. The better way to combat against climate change is to understand the changes their cause, effect and interaction. The model is consisting of all required parameters which can be used to develop elastic varieties.

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