Innovative Farming
-An International Journal of Agriculture

MODERN COWPEA BREEDING HELPS IN ADAPTING CLIMATE CHANGE

Popular Article

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KEY WORDS
Cowpea, breeding, climate

ARTICLE INFO
Received on: 07.11.2016
Revised on: 28.11.2016
Accepted on: 29.11.2016

ABSTRACT

Cowpea is multi-purpose crop because it is used as vegetable, grain, green manure, fodder and pasture crop. It provides strong support to the livelihood of small-scale farmers through its contributions to their nutritional security, income generation and soil fertility enhancement. Climate change poses a fundamental threat to the places, species and people's livelihoods. Crop yields of cowpea will be fall within the next decade due to climate change. Therefore, by using modern breeding methods and development of suitable cultivar will increase adaptation to climate change.

Introduction

Pulses bring formidable solution to the alarming problem of protein security of the world. Pulses occupy unique position in the world agriculture by virtue of their high protein content (23-25 %), starch content (60-67 %) and capacity of fixing atmospheric nitrogen. Pulses occupy 68.32 million hectare area and contribute 57.51 million tones to the world food basket. In India cowpea is cultivated as one of the leading legume vegetable crop, covering an area of 1.5 million ha, with an annual production of 0.7 million tonne and having productivity of 4.6 t/ha. Gujarat state occupies an area of 26883 ha, with an annual production of 2.85 LT and having productivity of 10.61 t/ha. Among various pulses, cowpea is one of the most important commercial legume crops. It is widely adapted and capable of producing seeds even in low land and semi-arid region. However, grain yield of this legume widely grown at different location. With all parts of the cowpea - young leaves, immature pods, immature seeds and mature dried grain - used for human consumption, cowpea offers a clear solution to the food, nutritional and economic insecurity experienced by small and marginal farmers. Low agricultural productivity contributes significantly to rural and urban poverty. Despite its economic and social importance in developing countries of the world, cowpea has received relatively little attention from a research standpoint. To a large extent it is an under-exploited crop where relatively large genetic gains can likely be made with only modest investments in both applied plant breeding and molecular genetics.

The threat of climate change and the expansion of desert areas are increasing. So, use of cowpea's genetic diversity and maximize the environmental tolerance of this important food source is necessary.

Suitability in arid region

Crop plants suited to arid regions are those that survive and produce in spite of arid or dry conditions. These plants vary in ability to tolerate aridity and in yields under arid conditions. Selection the right crops for arid regions might involve considerable experimentation in a particular region. This is followed by the development of suitable production systems.

Among the many constraints to cowpea productivity are drought, insect pests and low soil fertility. By using modern molecular breeding tools to breed for resistances to drought and economically-damaging insect pests (thrips, aphids and pod borer), one can increase the productivity. These traits have become increasingly important as climate change augments both the frequency and severity of drought and insect pest infestations. Identification of resistance genes and molecular markers for these genes greatly improves the efficacy and efficiency of breeding of varieties with both the desired agronomic and culinary traits.

Role of breeding methods

Most cowpea breeders employ backcross, pedigree or bulk breeding methods to handle segregating populations because cowpea is a self-pollinating species and varieties are pure lines. Higher grain yields and improved grain quality are the primary breeding objectives of nearly all programs. In addition, most breeders seek to incorporate a wide range of abiotic and biotic stress resistance or tolerance characters. The general strategy of most breeding programs is to develop a range of high yielding cowpea varieties adapted to different agro ecological zones that possess regionally preferred traits for plant type, growth habit, days to maturity and seed type.

When the desired variability is not found in the cultivated varieties or in the germplasm of cultivated species, then mutation breeding will be rewarding and it is commonly used in self pollinated crop like cowpea.

The use of marker-assisted selection and other molecular breeding systems for tracking single gene traits and quantitatively inherited characteristics will likely increase the overall efficiency and effectiveness of cowpea improvement programs in the foreseeable future and provide new opportunities for development of cowpea as a food staple and economic resource. Marker-assisted breeding technology for cowpea is based on finding genetic variability in cowpea that already exists in nature and that can then be brought into breeding programs. The crop maturation period is important because it allows these new varieties to cope with the changing cropping season length. Seed security for future plantings can also be a challenge for rural smallholder cowpea growers, especially during years of food insecurity, which often force households to consume grain being stored for next season's planting. To address this problem, production of large quantity of foundation seed of improved varieties to distribute to progressive cowpea seed growers for multiplication should be carried out that will improve their resilience to climate change.

Climate change is projected to have significant impact on agriculture. Agriculture is very much dependent on various facets of climate including temperature, rainfall, carbon dioxide content and their interactions. Therefore, it is necessary to develop crop varieties that are adapted to this scenario otherwise the farmers will suffer. The advancements in biotechnology and genomics should be efficiently utilized in developing improved cultivars. Genomics (including marker technology) has been making rapid progress even among often neglected legume crops. Linkage maps have been developed in several legume crops that could be effectively utilized in related crops if no data is available. Additionally, several QTLs (Quantitative Trait Locus) have been identified for important traits including yield, disease tolerance and drought tolerance. The identified QTLs could be utilized in backcross breeding program to transfer the desired traits into an adapted cultivar through marker assisted selection (MAS) and breeding.

In addition to these the modern breeding strategies for developing climate-resilient crop varieties, includes high-density genotyping, whole genome resequencing and precise phenotyping, doubled haploids (DH), genomics-assisted breeding (*e.g.,* genome-wide association studies, breeder-ready marker development, rapid-cycle genomic selection, marker-assisted recurrent selection) and crop modeling are particularly important.

Another important area of crop improvement is genetic engineering. This is particularly important for the improvement of those traits that are not amenable for conventional breeding. Identification of a gene, transfer and development of an improved cultivar is a tedious process and it requires proper management and careful planning. The development includes several steps including proof of concept, development phase and a regulatory phase. But definitely genetic engineering is a potential answer to deal with the changing climate for better agriculture.

These genetic sources of desirable traits have been used in hybridization programmes to generate several segregating populations, which were used to select plants with good combinations of target traits (high yield potential, resistance to biotic and abiotic stresses, and consumer preferences). Different breeding methods applicable to self-pollinated crops are employed in cowpea genetic improvement including mass selection and pure line breeding, pedigree selection, single seed descent, bulk selection, backcrossing, mutation breeding, and farmer-participatory varietal selection. Generally, combinations or modifications of these breeding methods are also adopted as necessary.

Conclusion

Future development of cowpea will also benefit from the application of knowledge being gained from basic genomics research on other legume crops and "model species". So, these types of effective modern breeding methods will facilitate breeding cowpea for future climate.

How to cite this article?

Himani B. Patel, A. I. Patel, S.N. Saravaiya and Prayagbhai Golakiya. 2016. Modern cowpea breeding helps in adapting climate change. *Innovative Farming*, 1(4): 183-185.