

The Importance of Minor Crops Genetics and domestication in Global Prospective

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Introduction

In the face of global challenges such as population growth, climate change, and environmental degradation, the world's food and nutrition security is under increasing pressure. While major staple crops like wheat, rice, and maize have long been the focus of agricultural research and development, the potential of minor crops to contribute to global food systems is often overlooked. Minor crops, also known as underutilized, neglected, or orphan crops, refer to a diverse array of plant species that have been traditionally cultivated and consumed by local communities, but have not gained widespread commercial popularity. These minor crops, which include cereals, legumes, vegetables, fruits, and tubers, hold immense promise in enhancing global food and nutrition security. They are often well-adapted to marginal environments, resistant to pests and diseases, and possess unique nutritional profiles that can complement the dietary needs of

populations around the world. Moreover, the genetic diversity harbored within minor crop species represents a valuable resource for future crop improvement, particularly in the face of the mounting challenges posed by climate change. Despite their importance, the genetics and domestication history of minor crops have received relatively less attention compared to major staple crops. This article explores the significance of minor crop genetics and domestication from a global perspective, highlighting the critical role they can play in building more resilient and sustainable food systems. By delving into the origins, genetic diversity, and adaptive traits of minor crops, as well as the latest advancements in their genetic research and improvement, this article aims to underscore the untapped potential of these overlooked plant species and the urgent need to invest in their conservation and utilization.

The Diversity of Minor Crops

Minor crops encompass a remarkably diverse array of plant species that have been cultivated and consumed by local communities around the world for centuries, if not millennia. These crops, which are often referred to as underutilized, neglected, or orphan crops, span a wide range of plant families, including cereals, legumes, vegetables, fruits, and tubers.

Some examples of minor crops include:

Cereals: Finger millet, pearl millet, teff, fonio, and sorghum

Legumes: Bambara groundnut, lablab bean, winged bean, and grass pea

Vegetables: Amaranth, moringa, spider plant, and African eggplant

Fruits: Baobab, tamarind, marula, and physalis

Tubers: Yam, taro, sweet potato, and cassava

These minor crops have their origins in diverse geographic regions, often in the centers of

origin and diversity for their respective plant

Genetic Resources of Minor Crops

The genetic resources of minor crops are a treasure trove of untapped potential for crop improvement and food system resilience. These genetic resources encompass a wide range of materials, including landraces, wild relatives, and cultivated varieties. Landraces are traditional crop varieties that have been developed and adapted by local farmers over generations through selection and cultivation in specific environmental and cultural contexts. Landraces often exhibit a high degree of genetic diversity and are well-suited to the local growing conditions, making them valuable resources for crop adaptation and resilience. Many minor crop landraces are maintained by smallholder farmers in their traditional farming systems, preserving the rich genetic diversity that has been accumulated over time. In addition to landraces, the wild relatives of minor crops represent another crucial genetic resource. These wild species are closely related to the cultivated forms and often harbor valuable traits, such as resistance to pests, diseases, and abiotic stresses, as well as unique nutritional or agronomic characteristics. The genetic diversity present in wild relatives can be

Domestication of Minor Crops

The domestication of minor crops is a fascinating and often understudied aspect of agricultural history. Unlike major staple crops, such as wheat, rice, and maize, which have been the focus of extensive research and documentation, the domestication histories of many minor crops remain relatively obscure. Nevertheless, the domestication of minor crops has played a crucial role in shaping the diverse food systems and traditional agricultural practices found around the world. These crops have been cultivated and selected by local communities for centuries, if not millennia, to meet their dietary, cultural, and livelihood needs. The process of minor crop domestication

Advances in Minor Crop Genetics and Genomics

In recent years, the field of minor crop genetics and genomics has witnessed a surge of

families.

tapped into through crop breeding and genetic improvement programs, helping to expand the genetic base of minor crops and enhance their resilience. Cultivated varieties of minor crops, including both traditional and modern breeding lines, also contribute to the overall genetic resources available for crop improvement. These varieties may possess desirable traits that have been selected for over time, such as high yields, improved nutritional quality, or adaptation to specific environmental conditions. Conserving and characterizing the genetic diversity within cultivated minor crop varieties is essential for identifying and utilizing valuable genetic resources for future breeding efforts. However, the genetic resources of minor crops face numerous threats, including genetic erosion, habitat loss, and the displacement of traditional farming systems by industrial agriculture. Concerted efforts are needed to conserve and sustainably utilize these invaluable genetic resources, ensuring that they remain available for future generations and contribute to the development of more diverse and resilient food systems.

has often involved the selection of desirable traits, such as reduced seed shattering, increased yield, and improved palatability, from the wild progenitor species. The adaptive traits and unique characteristics that have been shaped through the domestication of minor crops are invaluable resources for building more resilient and sustainable food systems. By understanding the domestication histories and genetic diversity of these overlooked plant species, researchers and breeders can leverage this knowledge to develop improved varieties that can better withstand the impacts of climate change, pests, and other environmental stresses.

advancements, driven by the growing recognition of the importance of these

overlooked plant species in addressing global food and nutrition security challenges. One of the key developments has been the rapid progress in genome sequencing and the development of genomic resources for minor crops. Advances in next-generation sequencing technologies have enabled the assembly and annotation of high-quality reference genomes for an increasing number of minor crop species. This genomic information has laid the foundation for a deeper understanding of the genetic architecture and evolutionary history of these crops, as well as the identification of genes and genetic markers associated with important agronomic traits.

Furthermore, the potential of genomic selection, a breeding approach that utilizes genome-wide molecular markers to predict the breeding value of individuals, has been

Unlocking the Potential of Minor Crops

As the world faces the daunting challenges of population growth, climate change, and environmental degradation, the untapped potential of minor crops has become increasingly recognized as a crucial component in building more resilient and sustainable food systems. One of the key areas where minor crops can make significant contributions is in enhancing yield, nutritional quality, and stress resilience. Many minor crop species possess valuable traits, such as drought tolerance, pest and disease resistance, and the ability to thrive in marginal environments. By leveraging the genetic diversity within minor crops and their wild relatives, researchers and breeders can develop improved varieties that are better equipped to withstand the impacts of climate change and other environmental stresses. For instance, the development of high-yielding, nutrient-dense varieties of minor cereals like finger millet, teff, and sorghum can help address the dual challenges of food security and malnutrition. These crops are often rich in essential vitamins, minerals, and bioactive compounds, making them valuable sources of nutrition for vulnerable populations. Unlocking their genetic potential can lead to the creation

explored in the context of minor crops. By harnessing the power of high-throughput genotyping and advanced statistical models, genomic selection holds promise for accelerating the genetic improvement of minor crops, particularly for complex traits that are challenging to improve through conventional breeding methods. These advancements in minor crop genetics and genomics have not only expanded our scientific understanding of these plant species but have also opened up new avenues for their genetic improvement and sustainable utilization. As research in this field continues to evolve, the integration of genomic information with other omics data and agronomic evaluations will further enhance our ability to harness the untapped potential of minor crops for the benefit of global food and nutrition security.

of more nutritious and climate-resilient food options. In addition to their role in food production, minor crops also hold immense promise as alternative sources of feed, fuel, and industrial products. Many minor crop species contain unique phytochemicals, oils, or other valuable compounds that can be utilized for a wide range of applications, from animal feed to biofuels to pharmaceuticals. Promoting the cultivation and sustainable use of these minor crops can diversify the range of products available, reduce reliance on a few dominant crops, and create new economic opportunities for smallholder farmers and rural communities. Realizing the full potential of minor crops, however, requires a concerted and collaborative effort at the global level. This includes strengthening international research networks and partnerships, supporting national programs and policies that prioritize the conservation and utilization of minor crop genetic resources, and raising awareness about the importance of these overlooked plant species among policymakers, development agencies, and the general public. By unlocking the potential of minor crops, we can work towards building more diverse, resilient, and sustainable food systems that can

better withstand the challenges of the future. This will not only contribute to global food and nutrition security but also support the

Global Initiatives and Collaborations

Recognizing the critical role that minor crops can play in addressing global food and nutrition security challenges, a growing number of international initiatives and collaborative efforts have emerged to support the conservation, research, and sustainable utilization of these overlooked plant species. One prominent example is the Consultative Group for International Agricultural Research (CGIAR), a global partnership of research organizations dedicated to transforming food, land, and water systems in a climate crisis. Within the CGIAR network, several research centers have established programs focused on minor crops, such as the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), which works on crops like sorghum, pearl millet, and finger millet, and the International Center for Agricultural Research

Conclusion

The diversity of minor crops represents a rich tapestry of plant species that have long been cultivated and consumed by local communities around the world. These often-overlooked crops span a wide range of plant families, from cereals and legumes to vegetables and fruits, each with its unique genetic resources, domestication histories, and adaptive traits. The genetic resources of minor crops, including landraces, wild relatives, and cultivated varieties, hold immense potential for addressing the pressing challenges of food and nutrition security, climate change, and environmental degradation. By leveraging this untapped diversity, researchers and breeders

livelihoods and cultural identities of the communities that have long relied on these valuable plant resources.

in the Dry Areas (ICARDA), which has a strong focus on underutilized legumes and cereals. These CGIAR centers collaborate with national agricultural research systems, universities, and other partners to conduct cutting-edge research on minor crop genetics, breeding, agronomy, and value chain development. They also work to conserve the genetic resources of minor crops through the establishment of gene banks and the promotion of on-farm conservation efforts. Another global initiative is the Crops for the Future (CFF) Research Centre, an international organization dedicated to promoting the research, development, and utilization of underutilized crops. CFF works to raise awareness, facilitate knowledge sharing, and support the integration of minor crops into sustainable food systems and value chains.

can develop improved minor crop varieties that are better equipped to withstand the impacts of pests, diseases, and abiotic stresses, while also enhancing their nutritional profiles and agronomic performance. Advances in minor crop genetics and genomics have laid the foundation for a deeper understanding of these plant species, enabling the identification of valuable traits and the development of more targeted breeding strategies. As these scientific breakthroughs continue to unfold, the integration of genomic information with other data sources, such as phenotypic and environmental data, will further enhance our ability to harness the potential of minor crops.