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Genetic Variability and Divergence in Wheat

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Abstract

This term paper is intended to assess genetic diversity and variability of wheat crop and its contribution for traditional and modern farming system in Ethiopia.. Genetic diversity refers to the variation of genes or entire genome within and between populations of organisms. The genetic diversity of wheat plant species depends on different factors i.e. ecological, geographical, breeding system & anthropogenic effects, selection methods and variety preference by user. Wheat is a major diet component due to the wheat plant's agronomic adaptability, ease of grain storage and ease of converting grain into flour for making edible, palatable, interesting and satisfying food. The first cultivation of wheat occurred about 10, 000 years ago, as part of the 'Neolithic Revolution', which saw a transition from hunting and gathering of food to settled agriculture. These earliest cultivated forms were diploid (genome AA) (einkorn) and tetraploid (genome AABB) (emmer) wheats and their genetic relationships indicate that they originated from the south-eastern part of Turkey. Ethiopia is one of the major center of diversity for many plant species with its more than 60,000 accessions of different crops maintained in its gene bank. Durum wheat (Triticum turgidum var durum Desf is among the most diversified crop species in Ethiopia accounting for about 12% (* 7000 accessions) of the national gene bank holdings. Traditionally, tetraploid wheats have been predominantly grown by the Ethiopian farmers, and currently occupy more land than hexaploid wheat. Tetraploid wheat has been under cultivation in Ethiopia for thousands of years, and has acquired a diverse set of characteristics that makes the country a center of diversity for that species. Even though breeding program is to promote genetic makeup of plant genetic diversity of crops renders more vulnerable to disease and insect epidemics and jeopardizes the potential for sustained genetic improvement over the long term.

Keywords: Plant genetic resource; Farmer's variety; Genetic diversity; Genetic divergence

Introduction

Wheat is one of the most widely cultivated crops in the world, covering an area of 219 million ha with a production of nearly 772 million t in 2017 (http://www.fao.org/faostat). Of the daily intake of humans, wheat provides 19% of the calories and 21% of the protein (http://www.fao.org/faostat). Wheat is a major diet component due to the wheat plant's agronomic adaptability, ease of grain storage and ease of converting grain into flour for making edible, palatable, interesting and satisfying food (Food and Agricultural Organization (FAO), 2002; Asif et al., 2005). Considering all wheat species, it is a major food crop and supporting 35% of the world population [1].

Ethiopia is one of the major center of diversity for many plant species with its more than 60,000 accessions of different crops maintained in its genebank Farmer varieties (FVs), which are often referred as 'landraces' are characterized a significant phenotypic variability. In Ethiopia, Wheat is an important staple food crop providing about 15 percent of the caloric intake for the country's over 90 million population , placing it second after maize and slightly ahead of teff, sorghum, and enset, which contribute 10-12 percent each. It accounts close to 17 percent of acreage of arable land and a fifth of all cereal food crops produced in the country in 2013/14 After South Africa, Ethiopia is the second largest wheat producer in sub-Saharan Africa [2]

Literature review

Origin and Cultivation

The first cultivation of wheat occurred about 10 000 years ago, as part of the 'Neolithic Revolution', which saw a transition from hunting and gathering of food to settled agriculture. These earliest cultivated forms were diploid (genome AA) (einkorn) and tetraploid (genome AABB) (emmer) wheats and their genetic relationships indicate that they originated from the south-eastern part of Turkey. proposed that wheat spread from western Asia, the primary centre of development, to Europe through the Caucasus and the Balkan Mountains and then to other parts of the world [3].

Traditionally, tetraploid wheats have been predominantly grown by the Ethiopian farmers, and currently occupy more land than hexaploid wheat. There are six types of Triticum species of which Triticum aestivum and Triticum turgidum are the most dominantly grown species in Ethiopia. Durum wheat is grown in Ethiopia since antiquity because of its wide adaptation to the different agro-ecology of the country, and resistance to biotic and a biotic stresses. considered Ethiopia as the center of origin for the crop, reported existence of adequate genetic diversity in landraces of durum wheat grown in the country. In Ethiopia, durum wheat is traditionally planted on heavy black clay soils (vertisols) of the highlands between 1800-2800 meters above sea level [4].

Wheat evolution and domestication

Domestication is the outcome of a selection process that results in the increased adaptation of plants or animals to cultivation or rearing and use by humans. Wheat is one of the earliest domesticated crop species which is primary cereal of temperate regions and the staple food for about 40% of the world's population (http://faostat.fao.org). Human beings have used wheat as food since prehistoric times and some of the evidence indicates that it was first used in a parched used cytogenetic methods and recognized that wheat species fall into three groups based upon their ploidy level [5].

The earliest archaeological records from domesticated einkorn are described). Einkorn was the staple crop of the Sumer populations and has been found in the excavated layers. Today, einkorn is a relict crop with only marginal economic importance. During the last 5,000 years, einkorn was largely abandoned and replaced by tetraploid and hexaploid wheats, which deliver higher yields.

Wheat wild relatives differ from their crop descendants in several phenotypic characteristics collectively referred to as the "domestication syndrome". Because of these phenotypic difference the wild relative varieties were not suitable for human consumption and trait modification of wild relatives necessarily required. In addition, the spread of the domesticated cereals out of the Fertile Crescent required the adaptation to new environments supported by newly arisen favorable alleles at critical genetic loci .

Conclusion

According to information assessed from different source, Plant genetic resources constitute the building blocks of all modern plant breeding. They form the raw material from which new varieties have been systematically bred to meet the growing need for more food. Preservation of wheat Plant genetic resources has a great role in wheat breeding programmes as characters of resistance and adaptation needed by breeders to solve acute problems exist in increasing wheat productivity. Wheat Landraces are the diverse populations to balance populations variable in equilibrium with both environment and pathogens and genetically dynamic that result in natural and artificial selections. In Ethiopian different wheat landraces are used for production including tetraploid and hexaploid species whereas tetraploid wheats are indigenous, and hexaploid wheats are probably a recent introduction. Tetraploid wheat has been under cultivation in Ethiopia for thousands of years, and has acquired a diverse set of characteristics that makes the country a center of diversity for that species. According to different study Modern plant breeding reduces crop genetic diversity. Many new cultivars are derived from crosses among genetically related modern cultivars and genetically more variable, but less productive, primitive ancestors are rarely included. Continuing of the cultivars by cross over the long term result in narrowing of the genetic base of breeding materials. With the extensive use of one or more closely related cultivars in large farm fields, crop uniformity in height, maturity and other phenotypic traits is evident strengthening the impression of genetic narrowing. Diverse sources types of germplasm important in improving crop yield, grain quality, and biotic and abiotic resistance. Diversity of wheat cultivars in farmers' fields is important not only for reducing the threat of disease epidemics and contributing to yield stability, but because local communities often value specific traits that may not be found among major commercial cultivars. Wheat landraces are better adapted than modern cultivars to changing climate conditions and to stress environments due to their population genetic structure, buffering capacity, and a combination of morpho-physiological traits conferring adaptability to stress environments. So conservation and preservation of wheat landrace is very crucial point for continuity and better selection for wheat variety for better quality, yield, and disease resistivity.

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