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ROLE OF PLANT GENETIC DIVERSITY CONSERVATION AND UTILIZATION

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Abstract: **Biodiversity refers to the diversity and variability of all kinds of life on Earth that are essential for human survival. Its conservation comprises the long-term preservation, use, and restoration of lost and damaged biodiversity using two basic and complementary strategies: in situ and ex situ. Genetic diversity is an important factor in broadening gene pools in any crop population and is critical to the success of yield improvement efforts. Plant breeders require genetic variety in order to generate improved crop types. Phenotypic, biochemical, and molecular genetic diversity studies are all possible. Understanding the genetic diversity, heritability, and genetic advance of features in any plant population is essential for any breeding effort. Determining genetic diversity and its interactions among breeding materials is crucial in agricultural development efforts. The characterization and evaluation of germplasm is required for the screening of desired genetic materials for genetic improvement programs. Two important factors in the emergence of new species have been identified: climate change and geographic isolation. Biotic processes like as competition and predation among themselves are further causes of germplasm variety and evolution. The most significant traditional instruments for analyzing variance among genetic materials are phenotypic features, and observable physical qualities are particularly important tools in genetic diversity research. For further advancements, plant breeding mostly relies on the genetic variety of cultivated and wild relatives working together. In plant phenotyping, researchers look at plant features for yield, quality, and resistance to biotic and abiotic issues. In plant breeding, genetic diversity and selection are two critical elements. The additive (heritable) and non-additive variance of each quantitative characteristic are important components of genetic variance (dominance and epitasis). As a result, it's critical to breakdown apparent phenotypic variation into heritable and non-heritable components utilizing appropriate genetic components including genotypic coefficient of variation, heritability, and genetic advancement. The sum of genetic variance in a species' genetic make-up is referred to as genetic diversity. Because genetic diversity provides adaption mechanisms to biotic and abiotic environmental stresses, as well as the potential to adjust genetic makeup in response to environmental changes, genetic variation is critical for a species' survival. Finally, plant genetic variation is becoming increasingly important in agricultural growth, leading to major improvements in morphological and agronomical characteristics. The intrinsic levels of genetic variety present in the species at the time, the velocity of evolutionary response, and adaptation to external conditions all influence selection for improvement. The ability of a species to adapt to new circumstances rises as its genetic variety grows. Animals with a wide genetic diversity are better prepared to confront challenges, especially as a result of climate change, when new pests and diseases emerge. The availability and accessibility of diverse genetic resources ensures the global food production network's long-term existence since agricultural plant development is connected with other scientific disciplines.**

Keywords: **Genetic diversity; Collection; Conservation; Vulnerability; Erosion.**

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1. INTRODUCTION

The diversity of living species (animals, plants, and microorganisms) as well as the ecological intricacies of land, sea, and other aquatic ecosystems are referred to as biodiversity. In other words, biodiversity refers to the variety and variability of all types of life on Earth that are essential to human survival (Borokini et al., 2010). The heritable components found inside and among plant species of current and potential commercial, scientific, or societal relevance are known as plant genetic resources. Genetic diversity is the variation in functional units of heredity within a species of plant, animal, or microorganism. The variety of species found in a specific geographic area is used to assess diversity and as a baseline for biodiversity protection. The variety of all of a region's or area's elements is commonly used to gauge the range of life forms found there, as well as all of its functional ecological processes (Borokini et al., 2010). Genetic variability refers to variation in a crop plant that may be ascribed to genes that code for certain traits and can be passed down from generation to generation (Acquaah G, 2009). Plant genetic diversity is a key component of agricultural progress as well as a major conservation goal (Harlan et al., 1971).

Biodiversity is beneficial to the environment and gives direct human advantages such as food, medicine, and energy. It's also utilized for pollution control, watershed protection, soil erosion control, and the prevention of extreme climate and catastrophic occurrences. Biodiversity, for example, provides a plethora of free benefits to society's core well-being worth billions of dollars every year (Dulloo et al., 2010). Agricultural biodiversity is an important part of biodiversity, with a stronger link to humanity's well-being and sustenance than other types. Over many centuries, traditional selection tactics have been employed to collect, use, domesticate, and produce food plant and animal species (Dulloo et al., 2010). Plant genetic resources are critical for the development of innovative crop varieties with high yield potential and biotic and abiotic stress resistance (Sajid et al., 2008). Crop improvement requires a thorough understanding of the genetic diversity of the genetic material (Warburton et al., 2008). The emergence of variances among individuals due to differences in their genetic composition and the environment in which they were fostered is known as genetic variability.

Genetic diversity is an important factor in broadening gene pools in any crop population and is crucial to the success of yield improvement efforts (Ndukauba et al., 2015). Plant genetic resources are plant genetic material that is valuable to present and future generations as a resource. Genetic resources were recognized as a common legacy of humanity that should be made freely available during an intergovernmental gathering convened under the auspices of the United Nations Food and Agriculture Organization (Reddy et al., 2006). Genetic diversity is the foundation for crop improvement (Hallauer et al., 2010). Knowledge of the nature and extent of variability and heritability in a population is one of the conditions for a successful breeding program in selecting genotypes with desirable traits (Dudley et al., 1969). The purpose of crop breeding efforts is to improve genetics in economically essential qualities while maintaining a suitable level of variability. To promote the genetic variety of local germplasm, it is necessary to assess the extent of existing genetic variances in genetic resources. Crop genetic diversity evaluation has a significant impact on crop development and conservation efforts (Assar et al., 2005).

Understanding germplasm genetic diversity is critical for making effective use of these genetic resources and creating suitable conservation measures (Grenier et al., 2004). The efficacy of any plant enhancement scheme is determined by genetic variety (Hajjar R and Hodgkin T, 2007). Genetic diversity benefits food, fiber, medicine, and industry by providing a varied range of resources (Teshome et al., 2015). It is not only a prerequisite for boosting yield and yield stability (Di Falco, S., and Perrings, C., 2003), but it is also the starting point for breeders to develop improved cultivars (Le Buanec B, 2005). It's also a prerequisite for species survival and adaptation in evolutionary terms (Rao V.R and Hodgkin T, 2002). Landraces, primitive forms, cultivars, introductions, weedy and wild cousins of crop species, and weedy and wild cousins of crop species are all examples of genetic variety in specific crops (Jarvis D.I and Hodgkin T, 1999). Plant communities with a wide genetic diversity are more likely to be conserved and used in breeding programs.

Understanding the genetic architecture of traits having immediate implications for plant breeding is crucial for successful utilization of genetic variation in plant breeding (Bernardo R, 2008). Natural mechanisms such as hybridization and recombination, mutation, and chromosomal number and structural changes can all contribute to genetic diversity. While certain types of variability are easy to detect and categorize into separate, non-overlapping groups, others occur on a continuum that cannot be divided into different categories (Acquaah G, 2009). At the morphological, biochemical, and molecular levels, genetic variety can be detected. Some genetic variants manifest as physical characteristics that can be seen (Ayana A and Bekele E, 1999). The phenotypic variance, or fluctuation of phenotypic values, is the overall variance, which is the sum of the genotypic and environmental variance components. The ability to analyze the relative relevance of various phenotypic determining factors, notably the role of heredity vs. environment, is made possible by splitting variations into components. Heritability of character refers to the relative influence of heredity in defining phenotypic value (Merila J, 1996). Genetic variety is required for agricultural improvement as well as the survival of crop plants in nature. It is self-evident that genetic variation offers potential for cultivar improvement with desired features, including traits that are wanted by both farmers and breeders. Genetic variation was used to meet subsistence food requirements in the early days of agriculture.

Climate-adapted cultivar development is a prominent topic among plant breeders these days, as climate variables fluctuate, putting crop plants' regular growth and development at risk. The availability of genetic diversity, which contributes in the production of climate-resistant cultivars, is directly linked to the existence of desired alleles. As a result of global climate change, drought stress is becoming more unexpected and severe, jeopardizing agricultural output and food security. Stress tolerance genetic diversity and production under stress can be increased by incorporating adaptable natural genetic variations into breeding strategies. Enhanced quality cultivars are preferred by farmers and breeders due to their genetic variety, which allows for large yields. Genetic variety is also crucial for the evolution of future species that are resistant to new diseases, insect pests, extreme heat, and cold. Genetic variety aids the formation of variations for specific qualities such as abiotic and biotic stress tolerance and quality improvement. One of the most serious environmental concerns, according to the Food and Agriculture Organization, is the loss of genetic variation (Smale et al., 2002).

Genetic diversity refers to the degree of genetic variation among crop species (Cardinale et al., 2012). Plant genetic resources are critical to global food security and agriculture, especially as the global population grows. Plant genetic resources are useful in every aspect of human activity because they provide a gene pool from which resistant and enhanced varieties can be developed. Increased crop production has been well documented, especially in the context of industrialized agriculture and the spread of superior, contemporary cultivars (Alston and Evenson, 2000). Plant genetic resources held in gene banks have also been analyzed and their costs and advantages calculated, particularly for commercial farmers (Koo et al., 2004). Plant genetic resources could thus help to maintain financial stability, particularly in developing and emerging nations where natural resources are the main source of income. Plant genetic diversity loss was once predominantly driven by natural processes, mostly as a result of climate change, and it still happens, but at a slow rate.

Genetic diversity improves a species' ability to adapt to changing environmental conditions. Genetic diversity refers to the variety of genetic traits (expressed or recessive) found within a species (between individuals and populations of the same species). This component of biodiversity is important because it allows populations to adapt to changes in the environment by allowing individuals with specific genetic characteristics to survive and reproduce within a group. Maintaining significant genetic diversity within populations is a conservation and management priority because it allows any population to adapt to a wide range of environmental changes. Plant Genetic Resources (PGRs) are essential for guaranteeing food security. Plant genetic resource conservation connects the genetic variability of a plant to its human use or exploitation. The study's purpose was to figure out how collecting and conserving genetic resources can aid genetic progress.

2. PLANT GENETIC RESOURCES COLLECTION AND CONSERVATION

2.1 Germplasm Collection

Germplasm collections have provided original materials for plant breeding and agricultural development. Because of their genetic diversity and the likelihood of occurrence of specific desirable genes, germplasm collections are useful targets for plant breeders and other biologists. The basic purpose of plant genetic resource collection is to obtain as much genetic variability as feasible in the smallest number of samples possible (Brown A.H and Weir B.S, 1983). The amount of information available on the types of genetic variation found in target taxonomic populations and their distribution in the target geographical region has an impact on the development of effective methods. When there is a paucity of information on the target species and the collection area, however, it may be prudent to plan an exploration voyage to gather such information (Allard R.W, 1970).

2.2 Conservation of Plant Genetic Resources

Biodiversity conservation is the management of human use of biodiversity for the greatest possible long-term benefit to current and future generations. As a result, biodiversity conservation encompasses the preservation, maintenance, sustainable use, restoration, and augmentation of biological variety (Borokini et al., 2010). For the benefit of human well-being, biodiversity conservation primarily focuses on genetic conservation with its multiple life-support systems (ecosystems) (Tisdell C.A, 2011). The natural world is losing biodiversity as a result of an ever-increasing human population and excessive resource usage (Cobb et al., 2016).

The primary goal of conservation is to reduce biodiversity loss while preserving ecosystem services, species, and genetic variety for future generations. In today's environment, a "One Plan Approach" to developing interdisciplinary conservation strategies that include both in-situ (in the wild) and ex-situ (in zoological institutions) management operations is becoming more important (Byers et al., 2013). The decline and extinction of biodiversity can be divided into two stages. The deterministic phase is characterized by human threats such as habitat loss, fragmentation, and degradation, direct exploitation of species, competition from foreign and native species, and persecution and slaughter as a result of human-animal conflicts. Threat mitigation failures characterize the deterministic phase, resulting in small, fragmented, and isolated remnant populations. These small remnant populations are then exposed to nonhuman hazards such as stochastic, genetic (genetic drift and inbreeding), and demographic factors.

Cattle overgrazing, landrace loss, lesser producing cultivars, pests and illnesses, global climate change, pollution (acid rain), and scientific understanding gaps on some biological resources have all been cited for rapid biodiversity loss (Borokini et al., 2010). Agriculture is one of the most important land uses with severe environmental repercussions because of increased fertilizer and biocides use, land drainage, irrigation, and the loss of a variety of biodiversity-rich landscape characteristics. Land use changes, the substitution of contemporary cultivars for traditional cultivars, agricultural intensification, population increase, poverty, land degradation, and environmental changes (including climate change) all pose significant risks to biodiversity (Dulloo et al., 2010). Biodiversity conservation provides economic, social, and cultural benefits. Many people's biological and cultural heritages depend on biodiversity protection, as well as the important components of healthy ecosystems that support economic and social growth.

Conservation biology is a branch of biology that studies the fate of populations characterized and identified by their genetic makeup. This distinct genetic makeup not only separates them from other populations, but also influences their ability to adapt to changing situations and, in the future, develop new species. Many conservationists think that genetic diversity protection is the cornerstone of all conservation efforts since genetic diversity is required for evolutionary adaptation, which is essential for any species' long-term survival (Schemske et al .,1994).

Biodiversity is recognized at three levels in international conservation policy: ecosystem, species, and genetic, and management should try to preserve all three (Convention on Biological Diversity, 2007). The application of genetics to understand and mitigate the danger of population and species extinction is known as conservation genetics. It covers genetic factors that cause rarity, endangerment, and extinction (inbreeding and loss of genetic diversity), genetic management to reduce these effects, and the use of genetic markers to aid in resolving taxonomic uncertainties in threatened species, understanding their biology, and wildlife forensics. Plant genetic resource conservation is the process of intentionally preserving the diversity of the gene pool with the goal of actual or potential use. Conservation aims to gather and maintain adaptable gene complexes for use now and in the future (Hammer K and Teklu Y, 2008). Breeders can obtain the raw materials they need to generate new kinds, and farmers can adapt their crops in response to changing environments and markets, thanks to the conservation of genetic resources.

To protect biodiversity, an integrated approach that balances in situ and ex situ conservation techniques might be adopted. Although both are crucial complimentary techniques for biodiversity preservation, ex situ conservation varies from in situ conservation in numerous respects. Ex situ conservation refers to the preservation of genetic materials outside of the "normal" environment in which the species evolved, with the goal of maintaining the material's genetic integrity at the time of collection, whereas in situ conservation (the preservation of viable populations in their natural surroundings) is a dynamic system that allows biological resources to evolve and change over time through natural sequestration (Dulloo et al., 2010).

Germplasm conservation is primarily concerned with ensuring the safe storage and preservation of germplasm from commercially significant plants (Gosal et al., 2010). By reducing the water content of agricultural crop germplasm, it is possible to store it for a longer period of time. However, current storage procedures make storing the germplasm of vegetative propagated plants extremely challenging. In vitro conservation approaches provide a number of advantages over in vivo conservation techniques, including reduced storage space and time, the preservation of endangered plant species, and the protection of plants in in vitro conditions (Engelmann F, 2011). In situ and ex situ conservation procedures are the two primary, complementary methodologies (Brutting, C, 2013).

2.2.1. Ex-situ Conservation

Ex-situ conservation refers to the preservation of biological diversity components outside of their natural habitat. Ex situ conservation is a method of preserving biological diversity outside of its natural environments by focusing on all levels of biodiversity, including genetics, species, and ecosystems (Borokini et al., 2010). Field gene banks, tissue culture, green houses, cryopreservation, and seed gene banks, to name a few, are examples of this. Crops can be reintroduced in regions where they have been lost due to environmental degradation, replacement, or war, and the stored materials are easily accessible, well-documented, defined, and evaluated, as well as being generally safe from external hazards.

Ex-situ conservation ('off site', 'out of place') refers to a range of conservation strategies that entail removing a target species from its natural environment. Along with in-situ conservation, it is one of two main conservation strategies. The main goals of ex-situ conservation are to save and maintain threatened genetic material, as well as to produce animals for reintroduction in situations where a species' native habitat is threatened. Among the several ex situ conservation approaches, seed storage is the most convenient choice for long-term protection of plant genetic resources. Seeds are desiccated to a low moisture content and stored at low temperatures (Hammer K and Teklu Y, 2008). For vegetative propagated and refractory seed species, living plants can be preserved in field gene banks and/or botanical gardens (seed that quickly lose viability and do not survive desiccation). Botanical gardens are recommended for the reproduction of uncommon species.

It is the process of relocating a portion of an endangered plant or animal's population from a threatened area to a new place, either in the wild or under human supervision. Ex-situ conservation, often known as off-site conservation, is the preservation of an endangered species away from its natural habitat. This method preserves the genetic information of cultivated and wild plant species in the form of in vitro cultures and seeds, which are subsequently stored as gene banks for future use. For endangered, primitive, and commercially valuable species, this sort of conservation creates a bank of genes/DNA, seeds, and germplasm, as well as a genetic information library (common garden archives).

It also encompasses disease, pest, and stress tolerance, as well as the restoration of endangered plant species in the ecosystem (cryopreservation). Ex-situ conservation is used for a variety of purposes, including rescuing threatened germplasm, producing material for conservation biology research, bulking up germplasm for storage in various types of ex situ facilities, supplying material for various purposes to remove or reduce pressure from wild collecting, growing species with recalcitrant seeds that cannot be maintained in a seed store, and making material available for conservation education and display.

2.2.2 In-situ Conservation

Conservation strategies that are adopted in the same location where the conservation goal (species, environment, or population) is encountered are referred to as in-situ ("on site") conservation. Although ex-situ and in-situ conservation have traditionally been viewed as separate conservation strategies, both are being used in tandem within regional conservation plans to achieve more successful biodiversity conservation goals. In-situ conservation measures are the most common method of conservation because they allow for the simpler protection of a higher number of ecological and evolutionary processes.

In situ conservation refers to keeping PGRFA's genetic diversity in its native habitat, whether that's in the wild, on a farm, or at home. The preservation of genetic resources in natural populations of plants or animals, such as forest genetic resources in natural populations of tree and animal species, is referred to as in situ conservation. In situ conservation is a method of protecting an endangered plant or animal species in its natural habitat. Ex situ conservation, on the other hand,

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refers to the transfer of endangered or uncommon species from their native habitats to protected places where they can be preserved. When in situ conservation isn't possible, it's a vital alternative.

In-situ conservation refers to the preservation of a species in its natural habitat, as well as the preservation and recovery of viable populations of species in their natural habitat. Ex-situ conservation makes it impossible to retain the natural process of evolution by keeping the material in the same place where it was discovered. The establishment and administration of natural reserves where species are allowed to remain in their habitats within a natural or adequately managed biological continuum is referred to as in situ conservation. Ex situ conservation methods are unsuccessful for wild relatives of agricultural plants and a variety of other crops, particularly tree crops and forest species, therefore this sort of conservation is essential (Hammer K and Teklu Y, 2008).

It allows species to be conserved in a way that allows them to evolve. "Genetic reserve conservation" and "on-farm conservation" are two basic principles and/or techniques of in situ conservation. Both are concerned with preserving genetic diversity in its native habitats/ecosystems; however, the former focuses on wild species in natural habitats/ecosystems, whilst the latter focuses on domesticated species in traditional farming systems. Genetic reserve conservation is a means of locating, controlling, and monitoring genetic variety in natural wild populations within defined areas designated for active, long-term conservation. On-farm conservation is the long-term management of the genetic diversity of locally developed crop varieties (land races), as well as associated wild and weedy species or forms, by farmers in conventional agricultural, horticultural, or agricultural systems. Farmers play a key role in this technique by selecting plant material that influences the evolutionary process and deciding whether or not to continue with a particular landrace.

2.3 Sustainable Utilization of Plant Genetic Resource

Plant genetic resources are safeguarded for use as food, medicine, fuel, fodder, and building materials. Conservation without use is pointless, according to (Hammer K and Teklu Y, 2008); on the other hand, utilization without conservation implies ignoring the genetic base needed by farmers and breeders alike to boost future production. In recent decades, people have become increasingly aware of the vast array of exotic or wild germplasm available. As a result of greater usage of this germplasm in breeding, yields of several crops have grown dramatically. Material stored in gene banks must be correctly recorded in order to be valuable. This includes passport data such as location, site characteristics, species, and cultivar name; characterization data such as highly heritable characteristics that can be used to distinguish one accession from another; and data evaluation such as yield, quality, phenology, growth habit, and pest, disease, and abiotic stress reactions.

2.4 Challenges facing Plant genetic resource conservation and utilization

2.4.1 Climate change

Climate change has a significant negative impact on the environment and plant genetic resources, causing regular disruptions such as drought, flooding, and disease. Changes in rainfall patterns and severe weather events are expected to impact crop output in several areas. Furthermore, rising sea levels result in the loss of coastal land and the incursion of saline water, leading in agricultural depletion (Pisupati B and Warner E, 2003). This will have an impact on the distribution of plant genetic resources and, most likely, their physiognomy.

2.4.2 Pollution

Pollution threatens soil and atmospheric biodiversity, including microbiological diversity, pollinator and predator variety, as well as microbial diversity. These resources are threatened by both genetically modified material pollution and the growing use of intellectual property rights (IPRs) to claim sole ownership of varieties, breeds, and genes, limiting access for farmers and other food producers. With over 1.2 billion people going to bed hungry right now, this loss of diversity is hastening the world's plunge into food poverty.

2.4.3 Population Growth and Urbanization

As the human population grows, machinery is developed to modify the natural environment to fulfill his demands, resulting in a suffocating demand for land and other natural resources for food, industry, shelter, and agriculture, eventually leading to habitat destruction and plant genetic resources loss. According to (Malik S.S and Singh S.P, 2006),

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food grain demand will exceed 250 million tons by 2020, necessitating an extra 72 million tons of food grains. As happened during the Green Revolution, this could lead to overexploitation of PGR. Social upheavals, such as wars and starvation, are linked to a high reliance on natural resources, which frequently leads to over-exploitation and the destruction of wild plant genetic resources.

2.4.4 Habitat Loss and Modification

Natural resource exploration and extraction have an impact on and alter the geophysical environment of the locations where they occur. The environmental impact of oil exploitation in Nigeria's Niger Delta region, according to the United Nations, contributes in no small part to the destruction of the fragile ecosystem, making it "one of the world's most severely petroleum impacted ecosystems and one of the five most petroleum-polluted environments in the world." They refuse to give in to their requests for adequate protection of their contaminated and deteriorating environment, which includes spills, deforestation, noise pollution, and other environmental effects as a result of oil drilling (Oluduro O and Oluduro O.F, 2012).

2.4.5 Diseases

Exploration and extraction of natural resources have an impact on and modify the geophysical environment of the areas where they take place. According to the United Nations, oil exploitation in Nigeria's Niger Delta region contributes significantly to the degradation of the fragile ecosystem, making it "one of the world's most seriously petroleum damaged ecosystems and one of the five most petroleum-polluted habitats in the world." They refuse to give in to their demands for sufficient care to their contaminated and deteriorating environment as a result of oil drilling; spillage, deforestation, noise pollution, and other environmental problems (Oluduro O and Oluduro O.F, 2012).

2.4.6 Alien Invasive Species (IAS)

Invading aliens, exotics, and non-indigenous species are all terms used to describe alien invasive creatures. Alien Invasive Species are species native to one area or region that have been accidentally or deliberately introduced into an area outside of their normal distribution, colonized, or invaded, posing a threat to biological diversity, ecosystems and habitats, and human well-being. IAS is the second most important threat to biodiversity after habitat loss. It is now similar to habitat loss as the primary cause of biodiversity loss on tiny islands (Butchart et al., 2004).

Invasive species may outcompete native species, suppressing or excluding them and causing significant ecological changes as a result. They have the power to influence the ecosystem's structure and species composition indirectly by altering the way nutrients are cycled through it (McNeely J, 2001). As a result of knock-on effects, entire ecosystems may be jeopardized. Alien invasive species may cause changes in environmental services such as flood control and water supply, water assimilation, nutrient recycling, conservation, and soil regeneration, due to the crucial role biodiversity plays in the preservation of vital ecosystem processes.

2.4.7 Replacement of Traditional Varieties with Modern Ones

Traditional conservation methods and other traditions have been vanishing in recent years. Climate change, pests and diseases, insufficient agricultural policies and development initiatives, and poverty all contribute to indigenous youth migration (with their knowledge, experience and customs of traditional Andean agriculture). The replacement of old varieties with modern, high-yielding, and genetically uniform varieties is the single most important source of genetic loss (Rosendal GK, 1995).

2.4.8 Genetic Vulnerability and Erosion

A widely planted crop is chronically sensitive to a pest, virus, or environmental risk due to its genetic makeup, which could result in widespread crop losses. This issue continues to be a major source of worry in a variety of crops and locations. The establishment and dissemination of the Ug99 race of wheat stem rust, which is susceptible to the vast majority of existing types, demonstrates the impact of genetic vulnerability (Pretorius et al., 200). Crop diversity and production system variation can help to reduce susceptibility and influence ecological stability. The cultivation of genotypes with favorable alleles/genes influencing intended agronomic features is based on the cultivation of genotypes with favorable alleles/genes influencing desired agronomic qualities, according to Genetic Improvement of Crop Plants (Prada, D, 2009). As a result of this process, genetic diversity is diminished. The genes determining key traits have less

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diversity than the gene pool of landraces and wild cousins since the majority of today's cultivated genotypes are descended from a small number of landraces (Bhullar et al., 2012).

2.4.9 Patent Rights for the Protection of Plant Varieties

Patents are the most effective type of intellectual property (IP) protection since they give the right holder the most control over the use of patented material by preventing farmers from selling or reusing seed they've grown, as well as other breeders from utilizing it. Although there is a gap between modern plant variety breeders' intellectual property rights and the rights of farmers who supplied the plant genetic resources from which such variants were primarily generated. Plant variety patents are available exclusively in the United States, Japan, and Australia. The number of rice patents issued each year in the United States has increased from less than 100 in 1995 to more than 600 in 2000.

In affluent countries, assigning IPRs to living beings is a relatively new practice. Plant varieties were initially protected (via plant breeder's rights or PBRs) in the second part of the twentieth century. Plant protection technologies arose as a result of the economic structure and circumstances of agriculture in the industrialized world at the time. All of these problems arise because people think about plants in terms of how much money they can make off of them rather than what they are. Artificial selection has resulted in the extinction of more than 90% of crop varieties in farmers' fields over the previous century.

3. CONCLUSION

Genetic resources are employed for a range of purposes, including genetic improvement, biodiversity conservation, mechanistic adaption studies, systematic and taxonomic investigations, environmental monitoring, epidemiology, and forensics, among others. Crop improvement is based on genetic diversity, which is mostly found in nature, both cultivated and wild, and, to a lesser extent, that which is introduced by controlled mutation. Genetic material from plants that has significance as a resource for current and future human generations is referred to as plant genetic resources. Originally, this concept was limited to crop plants and their wild relatives, but it is now commonly accepted that all plant species have the potential to be a valuable resource for humanity. Crop development programs require genetic diversity, heritability, and projected genetic progress in terms of crop grain production and yield components. Landraces, old and new cultivars, and other crop genetic resources are critical for crop improvement. Exploiting genetic diversity, which must be determined from field performance manifestations of the phenotypic, is the most important technique for plant breeding. The environment is largely responsible for the impacts of phenotypic variation.

Genetic diversity refers to the amount of genetic variation available among crop species for use in improvement projects. The success of a breeding effort is dependent on the availability of sufficient genetic diversity. Genetic diversity is essential for the development of superior variations in terms of production and other desired characteristics. It's also necessary for producing high-quality hybrids and desirable recombinants. The efficacy and efficiency of advances that could lead to higher food production are influenced by genetic diversity. In plant breeding, categorizing genetic variability into heterotic groups is critical for the development of strong and outstanding hybrids with commercially important characteristics. Genetic diversity helps to manage environmental stressors like as climate change, pests, and diseases. Enough genetic variation for golden crop enhancement is becoming a challenge as the genetic yield potential of the crop continues to expand.

Plant breeders are currently using genetic materials such as exotic non-adapted, exotic adapted, and existing genetic material as a source of novel alleles that safeguard and promote genetic gain through selection without knowing their genetic history as a source of novel alleles that safeguard and promote genetic gain through selection without knowing their genetic history. The importance of genetic diversity in ensuring food and nutritional security cannot be overstated. Crop improvement necessitates an in-depth knowledge of the genetic diversity of the genetic material. Effective selection is crucial in any crop improvement when there is enough genetic diversity for varied attributes. The study of agricultural cultivar genetic variability for diverse agronomical and morphological aspects is critical in allowing a number of promising cultivars to be selected. Genetic variety provides the foundation for the continued development of new and enhanced species.

Plant breeding is based on the presence of significant genetic diversity in order to address the highest genetic production potential of crops and the best use of this variation through selection for improvement. Plant breeding success is dependent on the availability of genetic variation. Plant breeding focuses on creating genetic variety and using proper selection techniques to improve quantitative and qualitative features. Sufficient genetic variation provides a range of choices from which to choose for agricultural plant improvement. Genetic variability determines the success of a successful plant breeding effort. Plant breeding necessitates a great deal of genetic diversity as well as effective selection. By using wild related species in conventional crosses, induced mutation can be employed to increase genetic variety, while wild related species can be used to obtain novel genetic features. Crop improvement is a critical procedure for dealing with the growing human population and changing climate. Crop improvement performance is determined by the amount of genetic variation present in genetic materials and the selection of genetically superior genotypes.

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