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ENVIRONMENTAL ADAPTATION BETWEEN FLEXIBILITY AND GENETIC STABILITY: A Review Article

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ABSTRACT

Environmental adaptation of plants is one of the most important biological processes that determines the ability of organisms to grow and survive in changing environments. Its Classification refers to a degree variation in genotypes to modify phenotypic to environmental conditions. This ability is not absolute, but rather linked to the ability of genotypes to express genes when its growth environments change. Adaptation can be in the form of contradictory or antagonistic environmental, or central adaptation, which reflects the delicate balance between genetic stability and adaptive flexibility. Observed that environmental-genetic adaptation does not represent a linear, curvilinear, or absolute exponential equation.

Traits are influenced by a range of environmental and genetic factors that interact with each other and are linked by a functional relationship. Adaptation mechanisms vary from one genotype to another depending on the environment. They may be facultative, or enhance positively or diminish negatively or specific traits. A modified vestigial effect, or address a specific function by inducing or inhibiting the growth of highly sensitive traits, leading to the differentiation or extinction of other traits. Genes can be regulated differently in response to environmental changes, this means that gene expression levels change in response to environmental pressures, leading to the emergence of new traits that help organisms adapt to specific environments.

Therefore, the study aimed to classify, explain environmental adaptations, determine the extent and manner of their influence on the performance of the genotypes when is above, below the critical limit, opposite, inverse and close to the general average.

Keywords: Genetic stability, environmental adaptation, natural adaptation, opposing adaptation, positive adaptation, negative adaptation.

INTRODUCTION

Environmental adaptation of plants is one of the most important biological processes that determines the ability of organisms to survive and thrive in changing environments, and refers to an organism's ability to modify its physiological,

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anatomical, and behavioral characteristics in response to environmental conditions [1, 13, 27]. However, this ability is not absolute, it is linked to the genotype and its ability to change with surrounding conditions [11, 17]. Hence, the paradox of genetic adaptation to the environment was recognized, and centrality, which reflects the delicate balance between genetic stability and adaptive flexibility. The impact of environmental adaptation and its types on genetic performance demonstrates that adaptation doesn't represent a linear, curved, or absolute exponential equation. There is a dialectic between genetic stability and the ability to adapt, as the traits expressed at specific stages of a genotype's development are controlled by a set of environmental factors that interact with each other on the one hand, and with the genotypes on other [23, 29]. More than one environmental factor may influence a given trait, or at the very least, there may be a single environmental factor that influences the expression of a set of traits [7, 20].

The biological system of any genotypes remains more complex, as it requires a more controlled environmental system to express gene expression [15]. Adaptation regulates the ability of the genotypes to control the expression of the traits most appropriate to changing growth conditions in response to the environmental changes necessary for specific metabolic processes in a given environment [12]. Adaptation mechanisms vary from one genotypes to another and according to the environment. Adaptation may occur through facultative or alternative adaptation to express different traits related to a specific function [24], or adaptation may occur through the increase, decrease, extinction, or the emergence of traits in a modified vestigial manner through the induction or inhibition of traits associated with a specific function. It is well known that negative changes in the ecosystem contribute to a degree of deterioration in phenotypic characteristics during environmental adaptation. However, its recurrence, even if minor, affects the biological system of genotypes, becoming an irreversible hereditary influence if inherited from one generation to the next [2, 6].

All adaptations at the level of phenotypic traits have no effect on future progenies and do not contribute to any percentage of changing the composition of the genetic material inherited by genotypes, even when planted in different environments [8 and 14]. This is unless they are exposed to changes in the genotypes, such as mutations, which are likely to occur. Understanding the laws of predicting the behavior of genetic constructs is important for designing resistant varieties or maintaining the biological diversity of derived genetic constructs to address environmental changes [17 and 22]. Mechanisms of opposing adaptation via gene regulation may be important in this field, as genes can regulate their gene expression differently in response to environmental changes, by changing gene expression levels in response to stresses, or as a result of genetic mutations that lead to the emergence of new traits that facilitate adaptation to specific environments [21, 28].

Opposing adaptation of genetic material may be a biological concept, referring to the ability of organisms to adapt above a critical threshold (positively) and oppositely below a critical threshold (negatively) to different environments by expressing unstable (variable) genetic traits. Central adaptation, on the other hand, refers to the ability of genetic material to stabilize through positive or negative adaptation to different environments around the point of origin (center), by expressing genetic traits that are stable and constant on average. Counter adaptation plays a partial role in the survival of organisms and their adaptation to environmental changes, due to the decline in their numbers or extinction, with the continued negative impact of different environments due to the presence of persistent counter adaptive traits. The phenotypic adaptation of a genotype depends on a broad genetic combination that controls its performance

through gene expression or gene silencing in a given environment [4]. These positive or negative genetic signals are then combined with the responsible growth hormones, which regulate the stages of genotype growth under different environmental conditions in a relatively stable manner [8]. Failure to control the influence of specific genes responsible for genotype adaptation will lead to the emergence of different adaptations to the controlled phenotype, as it is genetically and physiologically governed. Stable genotype performance can be ensured through hormonal control, by determining the number of genes that govern gene expression in proportion to the targeted environmental variables, or by cultivating genotypes in a fixed ecosystem, in different environments, season, or by applying different experimental treatments.

The major challenge facing plant breeders remains improving quantitative traits, due to the large number of genes that are difficult to combine in plants [16]. Also, the genetic action of these traits is of a secondary type that is greatly affected by the environment [3]. Therefore, what is known as genetic-environmental interference results in the presence of silent genes that express their action in environments other than the gene ecology? The emergence of specific traits of a genotype in a certain environment may be due to an epigenetic effect of a genetic effect that is silent or unclear in certain environments but appears under the influence of certain environmental factors [18]. The current study aimed to classify, interpret environmental adaptations and determine the extent and manner of their influence on the performance of the genotype based on the critical threshold or the general average of the genetic-environmental effect.

Classification of Environmental Adaptations

Environmental adaptations can be classified into several major and minor categories based on the level of influence on the performance of the genotypes.

First: General Classification of Environmental Adaptations

1– Natural Adaptation (NA)

Natural adaptation is one of the essential factors that contribute to improving the efficiency of living organisms and their ability to survive changing or harsh environmental conditions. This improvement leads to increased efficiency of wild models in utilizing vital resources such as water, nutrients, and light, which positively impacts growth and productivity [19]. It provides the genotype with a greater ability to withstand environmental stresses such as drought, salinity, and extreme temperatures, and maintains its physiological and productive stability across different environments. Natural adaptation may enhance the adaptive characteristics of genetic makeups (wild models) to specific natural environmental conditions (origins location), while reducing their ability to adapt productively in other environments [17]. This highlights the dialectic between genetic stability and environmental resilience (Figure 1). Phenotypes are highly productive in ideal environments such as fertile soils and well irrigation often fail when faced with drought or salinity.

Less productive wild phenotypes have greater environmental tolerance but are less productive under ideal conditions [5]. Furthermore, some genetic adaptations that are resistant to diseases in a particular environment may reduce their resistance to other diseases in different environments [6]. Genetic adaptations may confer resistance to salinity or drought but negatively affect other metabolic pathways, creating a discrepancy between the adaptability of phenotype and its fluctuating biological efficiency [9].

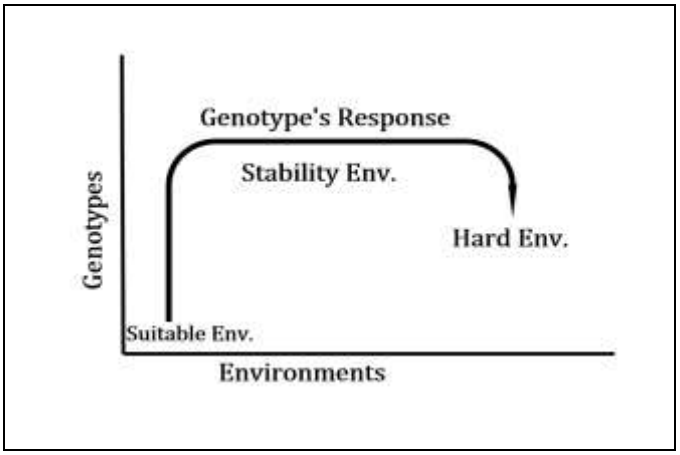


Figure 1: Natural Adaptation

2- Forced Adaptation (FA):

Different environmental conditions impose selective pressures that influence the irreversible adaptation of phenotypic traits, even if the influencing factor disappears. This is particularly true for structures that possess genetic plasticity, which allows them to express their phenotypic traits gradually and continuously, but in diverse ways depending on changing environmental conditions. In general, forced adaptations may occur either gradually or directly, but at varying rates and are often high in environments specific to certain types of genotypes. Forced adaptation is classified as:

2.1- Addition Adaptation (AA)

This is the emergence of traits that were not present in some genetic compositions when they are planted in environments other than their original environments. This includes the appearance of certain phenotypic, physiological, anatomical, and behavioral traits, whether positive or negative, above or below the critical threshold, in response to the conditions surrounding the genetic composition in that environment. This is while maintaining the genetic capacity for expression of some genetic compositions to restore some of these traits when planted in the original or similar environments. Thus, the process of trait change and restoration continues at a relatively stable fluctuating frequency within the genetic composition.

This is attributed to the influence of environmental-genetic interferences that affect the instability of gene expression for general traits in a given environment, and to changing environmental conditions that affect the internal structural, physiological, and anatomical characteristics that control the phenotypic performance of the genetic composition. This is provided that these changes occur before the genetic composition reaches below the critical growth stages, which lead to premature aging or premature death before maturity. Physiology of genotype, helps it to re-grow to reach the stage of reproduction, when returned to suitable environmental conditions, and with the repetition of this occurrence the genotype can adapt to any new environmental conditions that are relatively similar to it, depending on the ability of the genetic material to continue to express the gene for the same added variable traits.

2.2- Central Adaptation (CA)

It is the induction or stability of the genotype in environments toward the center (Figure 2), or general average (Models A and B), and away from the center (Model C). This central adaptation is used in stability analysis to help plant breeders determine the imprinting and stability of the genotype-environment relationship based on the average performance and trend of genotypes that have good adaptability when grown in a specific environment or environments. (CA) used to identify the most stable genotypes

and select those with high performance and productivity in diverse environments. The phenotype of any individual depends on both its genotype and environmental influences. The stable phenotypic performance of genotypes in different environments can be determined by the direction of genotype performance toward or away from the center, which represents the average of the environments, and the average performance of the genotypes in each environment or across all environments.

If the result is insignificantly different and close to zero, the genotype is considered stable in performance. Highly stable crop varieties are rarely desirable, as they tend to have low yields. Therefore, some plant breeders prefer to use average performance to evaluate varieties that maintain their phenotypic traits at a certain level of phenotypic and productive performance, as well as certain indicators of tolerance to environmental stresses and disease resistance. If the genotype's response to environmental changes does not differ from the general response of the variety average, it is called genetic equilibrium or genotype stability.

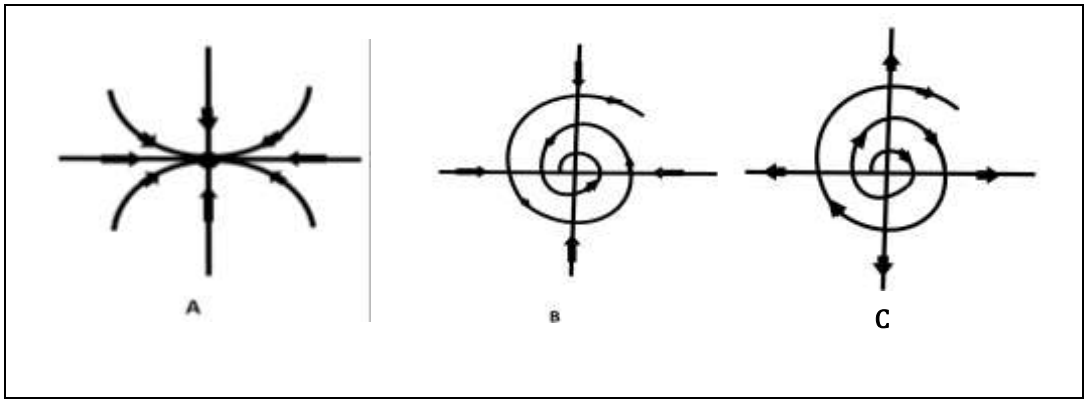


Figure 2: Central adaptation around the general mean or origin
A=adaption genotypes toward locations center, B and C= adaption genotypes out of locations center

2.3- Positive Adaptation (PA)

Genotypes adapt to their environment in a variety of ways, and the results of these adaptations may influence the evolution and persistence of traits by modifying various mechanisms. These may alter their growth patterns, modify their leaf structure, or alter their physiological processes. A suitable environment leads to the emergence of adaptations higher than the general average compared to less suitable environments (Figure 3).

Therefore, it is necessary to use environments and genetic compositions that minimize these negative adaptations as much as possible, or allow for an additional adaptation rate that is high or relatively high above the general average, provided that the genetic composition undergoes permanent genetic or physiological changes in response to ongoing environmental pressures, and with permanent expressions in its structural response to changing environmental conditions, as transformation of some traits of genetic compositions, such as the transformation of leaves into thorns or early or late flowering. In addition, other genetic compositions can increase and modify the efficiency of the metabolic process and absorption of nutrients based on the soil composition and the least availability of nutrients, to enhance their chances of survival and successful reproduction in diverse environments.

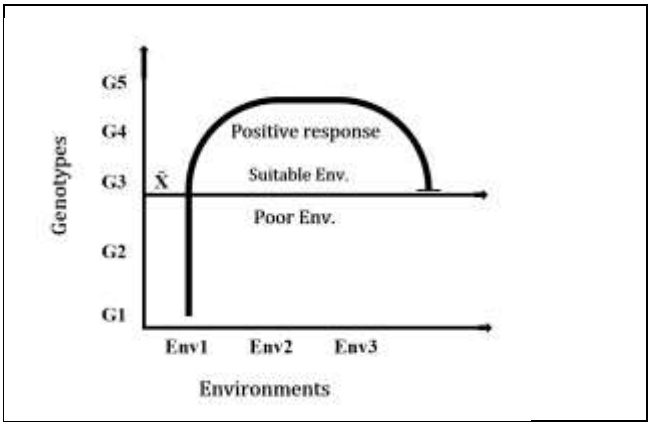


Figure 3: Positive Environmental Adaptation

3- Classification of Environmental Adaptation According to Contradiction Adaptation (CA)

It reflects low or high adaptation in the performance of some genotypes due to the inability of genotypes to express certain growth traits in certain environments, particularly the deterioration of traits responsible for the development of their growth and reproductive stages. This often results in a deterioration in the genotypes (Figure 4) or excessive growth to a state where growth is excessively vegetative, preventing reproductive growth due to increased dry matter accumulation in leaves and stems at the expense of the growth areas, leading to atrophy or incomplete reproductive outlets. Furthermore, the inability of some genotypes to defend themselves (Defense reaction) through one of the types of forced adaptation after reaching below the critical stages of deterioration leads to the death of some tissues or organs, or excessive death of tissues and organs most sensitive to harsh environmental changes (Defense through Hypersensitivity), such as the ovaries, especially the growth stages responsible for fertilization and reproduction, which may not complete their life cycle. Contradictory adaptation is classified into:

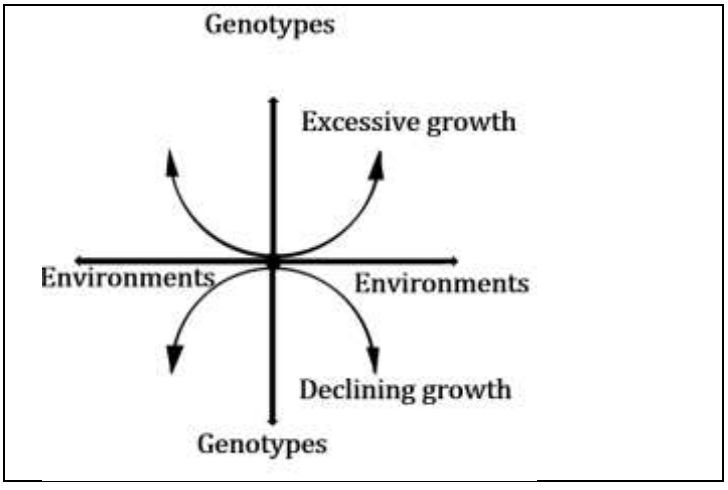


Figure 4: Contrasting Environmental Adaptations

3.1-Negative Adaptation (NA)

Through this negative adaptation, some sensitive genotypes kill some of their tissues as a rapid way to prevent the wilting of the remaining tissues and maintain their vitality as much as possible. This means that the extent of negative adaptation due to

harsh conditions will be limited to the most sensitive parts only, but it affects the growth rate below the critical limit (Figure 5) as a result of premature aging or tissue death or the parts most exposed to harsh environmental elements. Once some genotypes are exposed to high temperatures, negative adaptation occurs through the death of leaf cells and their separation from the stem to prevent increased transpiration, or an increase in cytoplasmic density occurs to increase the leaf's ability to withstand environmental stresses until it reaches critical stages and then dies. This occurs under the continued influence of unfavorable environmental conditions. Conversely, it occurs under the influence of ideal or suitable environmental conditions, as the genotypes remains alive due to its positive adaptation at its highest performance under the influence of optimal environmental conditions.

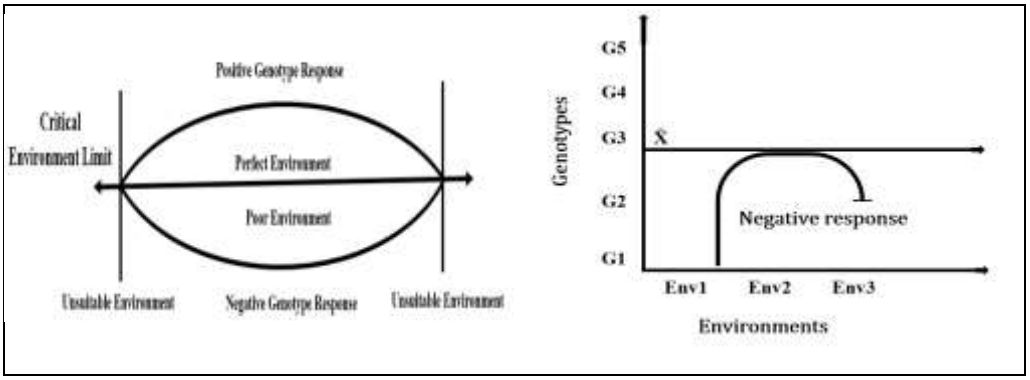


Figure 5: Contrasting adaptation, positive (above critical) and negative (below critical) to different environments through the expression of unstable (variable) genetic traits

3.2- Reverse Adaptation (RA)

The emergence of genotypes with high environmental compatibility for their phenotypic and behavioral traits, coupled with an expected decline below a critical threshold for the same traits in response to environmental conditions in another environment (Figure 6). Due to the impact of new, harsh environmental factors, the expression of genes controlling these traits declines. This is particularly true for changes in light and temperature, which directly impact the growth of most genotypes, which exhibit wide variation in their ability to photosynthesize and perform metabolic processes. This leads to a decrease in the rate of respiration and photosynthesis for most genotypes sensitive to environmental changes, leading to poor growth in most genotypes.

Harsh environmental factors may also alter gene expression in some genotypes through epigenetic modification mechanisms, which leads to changes in phenotypic traits. They can cause changes in the plant's DNA (DNA methylation) without altering the original gene sequence, altering how it functions. Some traits may exhibit a strong interaction between gene expression and the surrounding environment, negatively impacting the final expression of these traits. This can be due to increased or decreased activity of certain genes, which influence certain phenotypic traits of the genotypes. Environmental changes also lead to negative changes in the physiological gene expression of the genetic material, such as increased respiration rates, decreased photosynthesis rates, and deterioration of chloroplast membranes, which leads to the dwarfing and death of some genotypes before they reach reproductive growth stages.

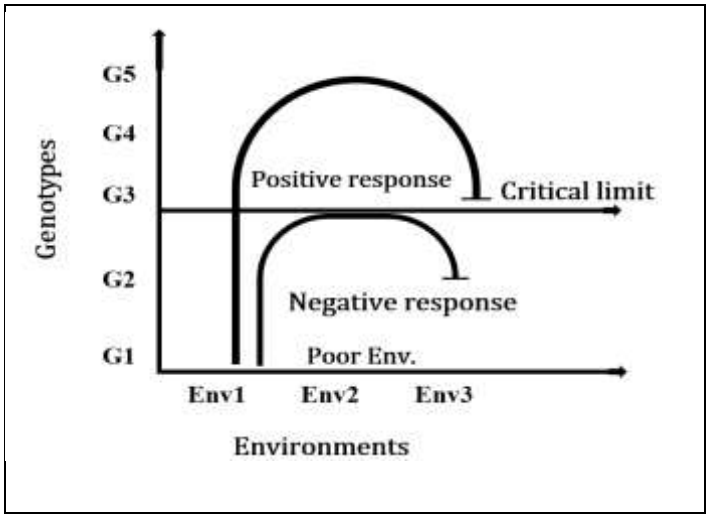


Figure 6: Additional adaptation, positive (above critical) and negative (below critical) to different environments through the expression of unstable (variable) genetic traits

3.3- Leanness Adaptation (LA)

This is the emergence of limited adaptive traits, this means that the original traits appear fully formed, but with weak growth, on the one hand, and stunting, on the other. Small leaves are produced, or some genotypes modify their original growth traits to new environments, resulting in the development of solid, woody stems or modified, spiny leaves, due to the synthesis of resin-like granules within the cytoplasm. This may result in the death of some cells, but their overall growth does not stop. Before reaching premature senescence or death, the genotype reaches the reproductive growth stage and physiological maturity. This type of adaptation occurs due to certain environments with harsh biotic and abiotic environmental stresses, as dead tissues are isolated from the living cells on which they partially depend for nourishment. The faster a genotypes ability to adapt its tissues, the more resistant it is, and vice versa.

4- Classification of Adaptation by Time Period

Environmental and genetic factors still slow adaptation. In the modern era, rapid climate change has become a major threat to the adaptation period, as the speed of climate change outpaces the genetic adaptation capacity of many organisms. This leads to the extinction of species that are unable to keep up with sudden shifts in temperature, food sources, or rainfall distribution patterns. Therefore, there is an increasing need for environmental protection programs and the preservation of genetic diversity to help species meet these challenges. The speed and stability of the environmental adaptation period is one of the most important biological processes that explains the duration required for the survival and maintenance of adapted traits, based on the ability of genotypes to survive in changing environments. It can be divided into two categories:

4.1- Slow Environmental Adaptation (SEA)

Slow adaptation is a gradual, long-term evolutionary adaptive phenomenon lasting several or hundreds of years (Figure 7), in response to environmental changes across successive generations. This type of adaptation relies primarily on gradual genetic change through natural or forced selection, developing new traits that enable species to meet the challenges of their new environment. This involves modifying genetic, physiological, or behavioral traits to suit new environmental conditions. The transmission of genetic traits to subsequent generations is one of the scientific mechanisms of slow natural adaptation, such as genetic mutation and the emergence of

random genetic changes that may give a genotype greater ability to survive. Genetic drift also occurs, which alters the gene frequency of genotypes with a narrow genetic base over time. Repeated selection and spatial isolation lead to the isolation of species communities and their independent evolution, enhancing adaptation to different local environments.

The same holds for drought-tolerant genotypes and salinity in desert environments and their ability to survive without water for extended periods. Some species also acquire an insulating waxy substance, a light color, and cytoplasmic density, enabling them to withstand low or high temperatures for multiple seasons. Or through the evolution of the CAM photosynthesis system to reduce water loss, with leaves modified into thorns to reduce evaporation over several years. Environmental stability is one of the most important factors influencing the slowness of environmental adaptation. The slower the environmental changes, the slower and more stable the adaptation. Genotypes with a longer growing season and limited genetic diversity adapt slowly to prolong their reproductive lifespan, requiring longer periods of adaptation. This is important for ensuring the stability of certain Genotypes in the face of long-term environmental changes and the emergence of new genetic structures over time, supporting stable ecosystems that rely on genetic and environmental integration.

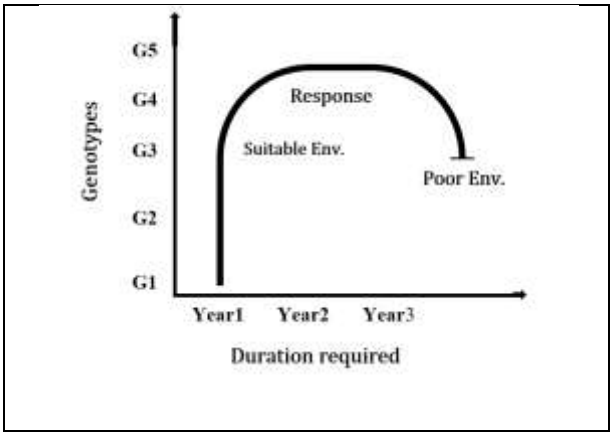


Figure 7: Slow Environmental Adaptation

4.2- Rapid Environmental Adaptation

Rapid environmental adaptation, from an ecological perspective, is the rapid restoration of an ecosystem's balance after a disturbance such as drought, pollution, or fire. From a biological perspective, it is rapid changes in genetic makeup over a relatively short period of time or over a few successive generations, in response to a sudden change in the growth and surrounding environmental conditions. This adaptation improves biological performance with the goal of survival and continuity.

This adaptation relies on the flexibility and rapidity of changes in the behavior of genetic material to confront new environmental changes. Some species are more capable of surviving sudden changes, allowing them to develop new adaptations in a short period of time by lengthening or shortening their growth period or modifying physiological functions. These are not superficial changes in the behavior of genotypes, but rather involve profound transformations in genetic composition and vital functions. The stability of ecosystems or agriculture in relatively homogeneous environments does not allow for rapid adaptation, but rather gradual adaptation. However, the acceleration of environmental changes (poor or unsuitable) may exceed the adaptive capacity of some derived genotypes, causing them to fail in their ability to produce and survive. This imposes the responsibility of deriving adapted genotypes in the shortest possible

time to protect the environment and maintain its balance on the one hand, and to confront the challenges of climate change on the other, while improving production in both quantity and quality. The speed of this adaptation varies according to environmental factors and the severity of natural pressures imposed on the genotypes. Some species may need days, seasons, or years (Figure 8), while others may need several generations to develop a new biological trait suitable for an entirely new environment. As is the case with acclimatization and environmental distribution tests for genetic compositions derived locally or introduced from abroad.

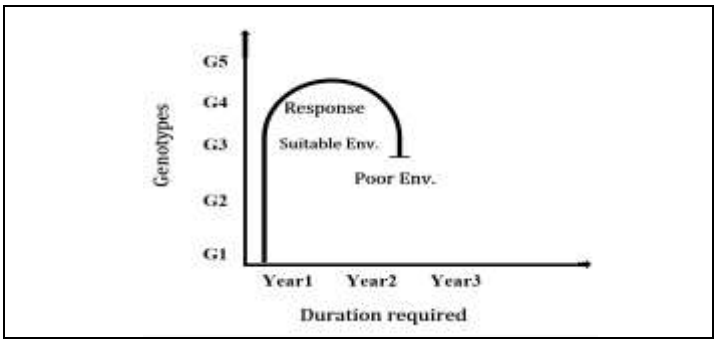


Figure 8: Positive and negative responses of genotypes in a narrow range of suitable and unsuitable environments

5- Unimportant Adaptation (UA)

This is an exaggerated and ineffective adaptation that is not beneficial to the ecosystem's size and its ability to influence the expression of phenotypic traits, to the point where such adaptation becomes ineffective or less beneficial. It can even reduce its vulnerability to environmental changes due to its detrimental effects on the health of the genotypes, such as inhibiting growth or excessive activation, such as elongation, vegetative growth, and increased green area, or delayed leaf senescence. This leads to a reduced genotypes and a reduced ability to survive in a changing environment. While its ability to survive may persist despite minor changes, it cannot survive large-scale environmental changes or long-term effects that lead to its death. It is impossible to achieve a beneficial adaptation to the genotypes without incurring a useless adaptation to a specific trait itself, but it maintains or preserves the biological balance, keeping it alive.

6- Contradictory Adaptation (CA)

The emergence of contradictory characteristics (Figure 9), where a dominant trait in a given environment turns into a recessive trait (trait 1 vs. trait 4), or a genetic advantage for a particular phenotypic trait in a given environment may become a disadvantage (trait 5 vs. trait 6) in another environment, and vice versa. It is a contradiction in the response of a genotype to the expected adaptive behavior of the genotypes when exposed to different environments.

Adapting to one environment decreases a genotype’s adaptability to others, and any improvement in a particular trait may be offset by a decline in another trait. This is the basis of environmental contradiction. The biological balance of dry matter accumulation is the natural growth of any genotypes. An increase in the leaf area in a given environment is offset by a reduction in leaf area in another environment for the same genotype. The same applies to plant height and increased vegetative growth at the expense of reproductive growth, which is offset by delayed or absent flowering, especially when exposed to insufficient light duration or intensity for flowering. As a result of the lack of temporal or physiological compatibility between the processes of emergence and differentiation, the transition from the vegetative meristem to the floral

meristem, and the delay in flowering and maturation due to these environmental changes or as a result of the influence of more favorable environmental conditions, contrasting adaptation may contribute to improving some adaptive growth traits and achieving a dynamic balance between vegetative growth and seed production in appropriate environments, thus enhancing the quality and quantity of production. From a genetic perspective, this improvement contributes to enhancing the stability of adaptive genetic traits and their efficient transmission to subsequent generations, which increases the ability of varieties to compete and survive within diverse ecosystems. Therefore, contrasting adaptation is essential to improving the adaptation of a growth trait, which is one of the most important strategic paths for achieving sustainable adaptation and ensuring survival in the face of ongoing environmental challenges.

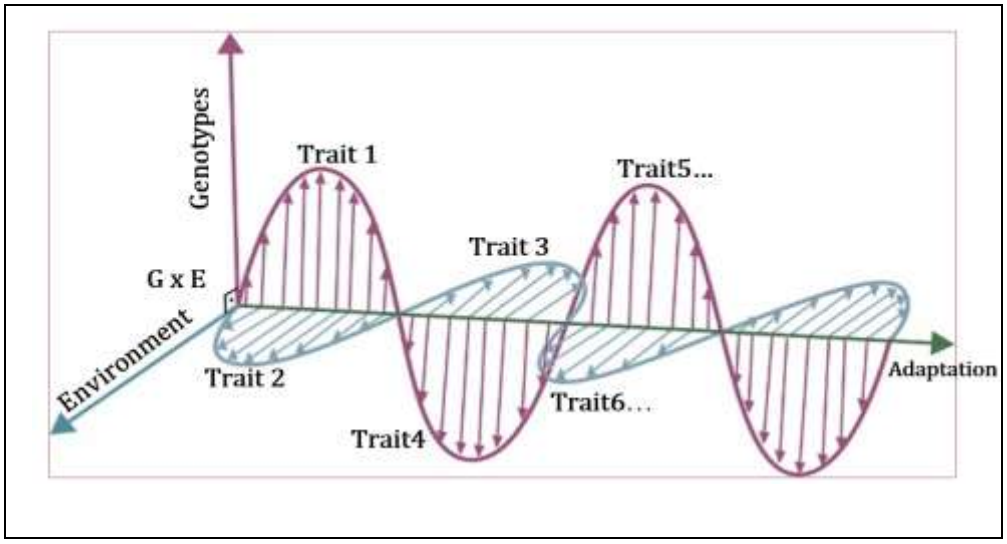


Figure 9: Contrasting adaptation of genotypes to different environments

Conclusions

1. The effect of environmental adaptation on genotype performance does not represent a linear, curvilinear, or absolute exponential equation.
2. The performance or traits of any genotype can be studied through facultative or alternative adaptation, or through the increase, decrease, or extinction of other traits, or their residual appearance, either by inducing or suppressing traits associated with the genotype's adaptation.
3. Changing environmental factors contribute to a degree of deterioration in phenotypic traits during environmental adaptation, but their recurrence, even if small, may become irreversible and significant if inherited from generation to generation.
4. Understanding adaptive paradox helps protect wild species and derived genotypes when climate changes in new environments and preserves the biodiversity of each environment.
5. Designing genotypes or varieties adapted to specific conditions (such as drought resistance) requires a balance between tolerance, productivity, and genetic stability.

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التكيف البيئي بين المرونة والاستقرار الوراثي: مقالة مراجعة

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الملخص

يعد التكيف البيئي من أهم العمليات الحيوية التي تحدد قدرة الكائنات الحية على النمو والبقاء في البيئات المتغيرة، وان تصنيفات التكيف البيئي تشير إلى مدى الاختلاف في قدرة التراكيب الوراثية على تعديل خصائصها الوراثية والمظهرية استجابةً للظروف البيئية المختلفة، وإن هذه القدرة لا تكون مطلقة، فهي مرتبطة بقابلية التركيب الوراثي على التعبير الجيني وتغير سماته عند تغيير بيئات نموها، سواء بشكل تكيف بيئي متناقض او متضاد، او ذات تكيف مركزي يعكس التوازن الدقيق بين الاستقرار الوراثي والمرونة التكيفية. ومن خلال دراسة تصنيف تاثيرات التكيف البيئي على اداء التركيب الوراثي.

لوحظ أن التكيف البيئي الوراثي لايمثل معادلة خطية أو منحنية او معادلة اسية مطلقة، كون الصفات تتاثر بمجموعة من العوامل البيئية والجينية التي تتداخل فيما بينها من جانب وترتبط بعلاقة وظيفية من جانب آخر، لذا تختلف اليات التكيف من تركيب وراثي لاخر حسب البيئات، فاما ان تكون تكيفات اختيارية او قد تكيفات رفع ايجابية او نقصان سلبية لجميع الصفات او لصفات معينة، وقد تظهر بشكل اثري محور او قد يعالج التكيف بوظيفة معينة عن طريق استحثاث او تثبيط نمو سمات حساسة جدا تؤدي الى تميز او اندثار صفات اخرى. تعتمد آليات التكيف المتضاد على تنظيم التعبير الجيني، إذ يمكن للجينات أن تُنظم بشكل مختلف استجابة للتغيرات البيئية، ويعني أن مستويات التعبير الجيني تتغير استجابة للضغوط البيئية، فتؤدي إلى ظهور سمات جديدة تساعد الكائنات الحية على التكيف مع بيئات معينة.

لذا هدفت الدراسة الى تصنيف وتفسير التكيفات البيئية وتحدد مدى وكيفية تاثيرها في اداء التركيب الوراثي عندما يكون اداء التركيب الوراثي اعلى من الحد الحرج او دونه وعندما يكون التكيف متضادا او عكسيا او قريبا من المتوسط العام.

الكلمات الدالة: التكيف البيئي، التكيف الطبيعي، التكيف المتضاد، التكيف الايجابي، التكيف السلبي

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