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Review

Plant Responses to Global Climate Change and Urbanization: Implications for Sustainable Urban Landscapes

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Abstract: Global warming has led to irregular precipitation patterns and various abiotic and biotic stresses, resulting in unforeseen consequences for wildlife. Plant species are particularly vulnerable to these global climate changes, struggling to adapt to the increasing stressors. Urban environments exacerbate these challenges, further hindering plant survival and growth. The declining number of climate- and urban-tolerant plant species is a direct consequence of escalating stresses. However, resistance breeding approaches coupled with environmentally friendly technologies like biostimulants offer hope by expanding the pool of adaptable species. Urban vegetation plays a vital role in mitigating the urban heat island effect, supporting mental well-being among residents, and preserving biodiversity. In this study, we comprehensively review recent research findings on these topics with a focus on publications from the past 5 years. Emphasizing stress-tolerant ornamental urban plants including trees and herbaceous species becomes crucial for establishing sustainable living practices. By incorporating resilient plant varieties into urban landscapes, we can enhance ecological balance while improving the overall quality of urban environments for both human inhabitants and wildlife populations.

Keywords: climate change; ornamental; urban; breeding; stress; resistance; abiotic; mental health

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1. Introduction

Global climate change presents a significant threat to the survival of natural ecosystems, which are dynamic and intricate systems influenced by various changes in environmental conditions. It profoundly impacts both abiotic and biotic factors, leading to alterations in elements such as heat waves, precipitation intensity, CO_2 concentration, and temperature. Over time, these changes contribute to the proliferation of new pests, weeds, and pathogens [1], imposing both biotic and abiotic stresses on plants. Urban plants offer a unique opportunity for studying plant physiology [2]. Moreover, urban agriculture is increasingly acknowledged as a vital and sustainable approach for adapting and mitigating climate change while also promoting mental well-being [3] (Figure 1).

Ornamental plants offer a multitude of ecosystem services crucial for the well-being of the population. They play a significant role in fostering and preserving biodiversity [4], while also enhancing the aesthetic appeal of both indoor and outdoor environments [5–7]. Urban green areas, in particular, represent a unique and valuable reservoir of biological diversity [8]. The presence of healthy urban vegetation greatly contributes to environmental improvement, leading to decreased temperatures and the sequestration of pollutants, thereby positively impacting human health [9,10]. Moreover, in the context of climate change, it is crucial to consider the urban heat island effect, a phenomenon where urban areas experience higher temperatures than their surrounding rural counterparts [11,12].

This effect significantly affects the quality of life for city dwellers [13] and exacerbates overall climate warming [14]. Additionally, it leads to an increased incidence of heat-related illnesses [11]. Interestingly, Meineke et al. [15] revealed that the intensity of the urban heat island effect varies within cities. Warmer urban centers experience more significant stress on trees, resulting in higher susceptibility to pests and diseases.

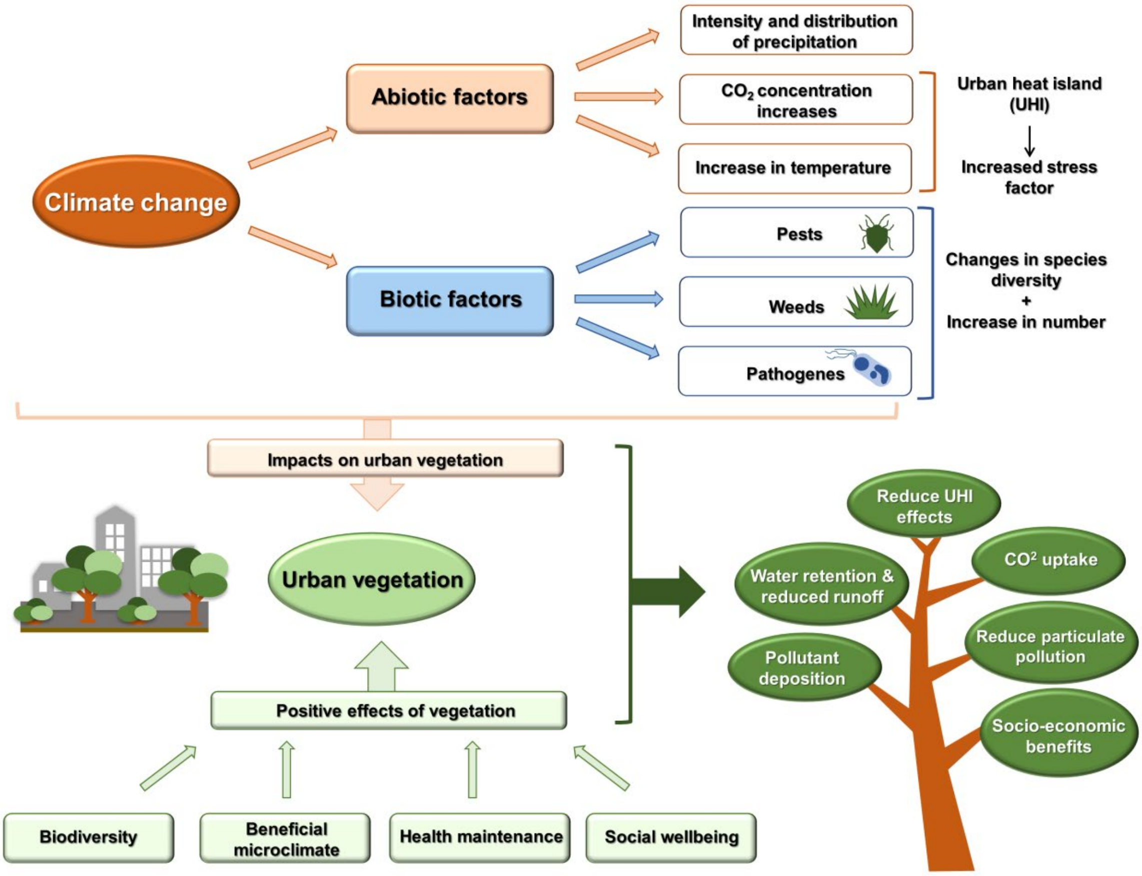

Figure 1. Relationship between climate change and urban vegetation.

Urban plants play a crucial role in safeguarding the mental health of the population. Establishing a connection with nature offers a wide range of physical, emotional, and social cognitive benefits, effectively reducing stress levels [16]. This positive impact is not limited to outdoor settings alone; even indoor plants contribute to enhancing mental well-being [17]. To ensure that this role is optimally fulfilled, the proper planting and placement of plants are essential. Barewise et al. [18] emphasized that choosing suitable locations is vital. For instance, in larger and deeper street bends, green walls are recommended, while shallow areas are better suited for open-crowned tree species. Interestingly, Wang et al. [13] found that for urban tree species during summer and autumn, the average width of the canopy positively correlates with the cooling range, while during winter, the density of green surface tree cover is negatively correlated with the cooling range. The cooling effects of urban green areas, particularly those filled with trees, are influenced by various factors such as plant type, canopy density, and park layout [19]. Understanding these elements allows urban planners to strategically design green spaces that not only enhance mental well-being but also contribute significantly to cooling the urban environment.

In recent decades, rapid urbanization has resulted in a concerning disconnection between people and nature, leading to various mental and physical health issues. The deterioration of air quality, accompanied by airborne dust pollution, poses a significant threat to human well-being and has even been linked to carcinogenic effects [20]. Moreover, the global prevalence of anxiety and depression has surged by 25% following the COVID-19 pandemic, making mental health a pressing public health concern in numerous countries [21]. In response to these challenges, there has been a growing focus on identifying green spaces that can have a positive impact on mental health. Hoyle et al. [22] demonstrated that residents tend to favor biodiverse and natural urban environments over regular, geometric shapes and meticulously tidy surfaces. Furthermore, research into ground-dwelling animals in urban green spaces managed in a close-to-nature manner reveals that such areas are better suited for creating a sustainable cityscape [23].

The visual characteristics of ornamental plants have a significant beneficial effect on human well-being [13], such as reducing blood pressure [24,25]. As urbanization continues to rise globally, it is accompanied by a surge in serious health issues like diabetes, high blood pressure, and depression. Consequently, optimizing the urban living environment becomes essential for city dwellers to combat the emergence of various physiological and psychological diseases [26,27]. Research has shown that flowering plants are particularly attractive to the population, with red emerging as the most popular color in two settlements in Iran. Blue and orange colors are also well-liked. Among the preferred taxa, tulips, roses, lilies, nettles, and crotons rank highly [28]. Furthermore, ornamental plants with colorful foliage, such as bamboo, have a significant stress-reducing effect, with colored varieties being more favored than green ones [13]. In the case of Primula vulgaris, bred varieties that exhibit greater phenotypic similarity to the base species ('Cottage Dream') were found to be more resilient to abiotic stress compared to highly distinct variants [29]. Surveys focusing on edible plants in the urban environment revealed that the most popular colors were polychromatic, followed by green and red. Participants in the survey showed a preference for salad and strawberries. These findings hold importance for future urban vegetation planning [30]. Biodiversity has been identified as playing a crucial role in enhancing mental health in urban forests. Given the significant impact urban landscape architecture has on the health of the population, including the alleviation of respiratory diseases, it has become increasingly important to consider these aspects [31]. Kończak et al. [20] demonstrated that leaves accumulate many pollutants, including Ti, Mn, Ba, Zn, Cr, and rare earth metals, through transport. Certain species like *Perthenocissus quinquefolia*, *Forsythia x intermedia*, *Betula pendula* 'Youngii', *Quercus rubra*, *Crataegus monogyna*, *Tilia cordata*, and *Acer pseudoplatanus* or *Platanus orientalis* have proven to be highly effective in phytoremediation processes.

In light of the aforementioned points, our objective was to conduct a comprehensive review study focusing on the examination of abiotic stress effects on urban ornamental plants. This study aims to provide an overview of the existing literature findings from the past five years, specifically highlighting the results achieved thus far. Additionally, we summarize the breeding objectives that have been pursued in this area, primarily concerning ornamental plants.

It is worth noting that the body of research dedicated to ornamental plants, particularly in relation to abiotic stress, is relatively limited when compared to other sectors within horticulture. Therefore, this study seeks to address this gap, providing valuable insights and filling a crucial void in the field of ornamental plant breeding, particularly in relation to climate change considerations.

2. Effects of Climate Change on Plant Development

Climate change has various suboptimal impacts on urban vegetation, particularly evident in the modification of plant phenological patterns. Urbanized environments, such as Beijing, have experienced phenological changes in species like *Prunus davidiana*, *Hibiscus syriacus*, and *Cercis chinensis*, with earlier spring phenophases and delayed autumn ones due to warming [32]. This acceleration of phenological phases has been observed in 385 plant species in Great Britain over the last decade, advancing by 4.5 days. Moreover, a global study by Pretsch et al. [33] highlighted faster growth rates in urban trees compared to rural ones. While climate change has not reduced biomass yield in in situ grasslands over the last

35 years, it has increased grain yield due to earlier phenological phases and faster growth rates, contributing to development. The accelerated phenological phases also lead to earlier seed harvest, proving significant and effective for seed production in drier years. However, the examination of phenological phases must account for the effects of stress on plants. Climate-change-induced growth in trees comes at a cost, as their lifespan decreases [33]. Assessing drought tolerance involves a critical examination of the root system [34] since roots are more exposed to multiple abiotic stresses than above-ground plant parts. Under abiotic stress, shifts in metabolite proportions occur between above- and below-ground plant parts. Decreased sunlight or nutrient excess leads to greater root development than shoot development. Various hormones and biochemical processes, including ethylene, ROS, and abscisic acid (ABA), are involved in regulating root growth under abiotic stress [35–37]. Understanding these complex interactions is vital for comprehending the full impact of climate change on urban vegetation and planning suitable strategies for resilience and adaptation.

According to the findings of Giordano et al. [38], it has been discovered that both sensitive and tolerant plants possess an inherent defense mechanism against abiotic stress. This defense mechanism encompasses various morphological changes, including an increase in leaf thickness and a decrease in stomatal density and growth. Additionally, physiological changes play a crucial role, such as the restoration of osmotic balance, stomatal closure, and the synthesis of antioxidant molecules and enzymes.

Furthermore, a multitude of studies have been conducted to explore the tolerance of ornamental plants towards abiotic stress. These studies have yielded significant results, shedding light on the capacity of ornamental plants to withstand and adapt to adverse environmental conditions. *Tagetes patula*, a widely recognized ornamental plant, exhibits adaptability to various climatic conditions. However, the shifting climate poses challenges, leading to significant deterioration in germination, growth, and the quality of essential oil when temperatures exceed 35 °C. To cope with abiotic stress, *Tagetes* deploys several mechanisms, such as increased antioxidant activity, cell redox to maintain homeostasis, and elevated lipid peroxidation of the cell membrane to preserve cell wall structure [39].

In the herbaceous species Echinacea purpurea, it was observed that the chlorophyll content exhibited a significant decrease of up to 37.3% compared to the control plants. Conversely, the carotenoid levels demonstrated a remarkable increase of up to 83%. This rise in carotenoids plays a vital role in mitigating oxidative stress by preventing the production of singlet oxygen, thereby minimizing the damage caused by this radical [40]. On the other hand, in the case of Nerium oleander, water stress induced an increase in the levels of ascorbate peroxidase and glutathione reductase enzymes. However, no significant activation of other tested antioxidant enzymes, such as SOD and CAT, was observed. These findings suggest that the latter enzymes are not directly involved in the plant's defense mechanism against water stress [41]. The impact of climate change is not limited to the phenological phases of mature plants but extends to those of juvenile ones, including germination, growth, and reproduction [42,43]. Abiotic stress inhibits essential physiological reactions in plants [44], and suboptimal temperature and water levels can disrupt vital life processes [45], potentially affecting fruit set. Prolonged high temperatures can also alter metabolic processes and induce cell disorganization [46]. Interestingly, mild stress can have a positive impact on fruit quality, activating the phenylpropanoid pathway and increasing the accumulation of bioactive compounds, thus enhancing crop quality [47]. Additionally, the microclimate surrounding plants undergoes modifications due to climate change [48]. Furthermore, climate change poses a threat to the genetic stock and in situ conservation of heritage ornamental plant varieties. Many species used in urban green spaces have low stress tolerance, such as certain rose varieties. However, for less frost-tolerant varieties, the warming climate may have positive effects [49]. The evolving climate highlights the importance of understanding and mitigating the effects of abiotic stress on ornamental and agricultural plants alike. Developing strategies to support resilience and preserve biodiversity, as well as adapting urban green areas to changing conditions, will be essential in sustaining the beauty and health of our landscapes amidst ongoing climate shifts.

3. Stress Effects Caused by Climate Change

Climate change is a complex and dynamic system of environmental changes that impact both abiotic and biotic factors [44,50]. Abiotic stress effects can significantly alter plant growth and viability indicators [51]. As plants constantly experience changing environments, they are exposed to various biotic and abiotic stresses (Figure 2) [52], necessitating adaptive responses [53] and the development of diverse coping strategies [54]. Adaptation to these stressors requires stress response mechanisms. Abiotic stress encompasses heat stress, drought, flooding, salt stress, nutrient deficiency, and UV stress, often affecting current urban vegetation in cities simultaneously [47]. In urban and peri-urban areas, abiotic stress emerges as the main limiting factor for plants [55,56], inducing various physiological and biochemical changes that jeopardize osmotic adaptation [57,58]. To combat abiotic stress in agriculture, advanced biotechnological methods and breeding approaches are essential. Abiotic stress can lead to crop yield reduction, with estimates ranging from 50% [47] to 70% [59]. Such yield reduction alters biochemical, morphological, and physiological processes in plants, serving as an adaptive survival mechanism [53,60]. Abiotic stress response is a multigenic trait, unlike biotic stress response, which is controlled by monogenic factors, making abiotic stress management more challenging in plants [61]. Successful plant breeding requires an understanding of the cellular, biochemical, and molecular changes occurring during stress [62]. In urban environments, plants respond to heat stress by upregulating the expression of genes encoding heat shock proteins (HSPs) through heat shock transcription factor (HSF) activation [63]. HSPs mainly regulate protein folding and facilitate the degradation of unfolded and denatured proteins, playing a prominent role in the abiotic stress response pathway [63,64]. Both abiotic and biotic stress result in the production of reactive oxygen species (ROS) in plant cells [65]. ROS have a dual function in abiotic stress response, as they can be toxic to cells while also acting as molecular signal transducers that trigger stress response [66]. Plants synthesize substances to neutralize ROS [67]. Antibiotic resistance is increasingly important, offering an essential approach to mitigating plant protection problems [68]. Substances such as nitrogen, potassium, calcium, and magnesium can reduce ROS toxicity by increasing the concentration of catalase, superoxide dismutase, and peroxidase in plant cells [69]. Understanding these stress responses and mechanisms is crucial for developing sustainable strategies to mitigate the adverse effects of climate change on plant health and agricultural productivity.

3.1. Air Pollution

Cities are major contributors to global carbon dioxide emissions, accounting for over 70% of the world's total. Research highlights the beneficial effects of increased carbon dioxide levels on climate change, including the promotion of biomass, leaf area, and dry mass growth [70].

Urban vegetation displays varying levels of tolerance towards pollutant gases. A study conducted by Barwise et al. [18] revealed that the presence of small-leaf species, trichomes, and furrows may indicate a higher degree of urban tolerance. However, Przybysz et al. [71] found no significant influence of trichomes and leaf size on the accumulation of bound dust in herbaceous plants. Hence, the selection of appropriate plant species becomes crucial in minimizing pollen emission and mitigating the impact of air pollutants on ecosystems. Among the harmful pollutants in urban environments, tropospheric ozone and nitrogen oxide pose particular threats to both the environment and human populations [72]. Urban trees and forests play a significant role as biological filters, effectively combating airborne dust particles (PM). This becomes especially important in densely populated urban areas. Studies conducted by Zhang et al. [73] and Dadkhah-Aghdash et al. [74] highlight the critical need for biological filtration provided by urban trees and forests in mitigating air pollution.

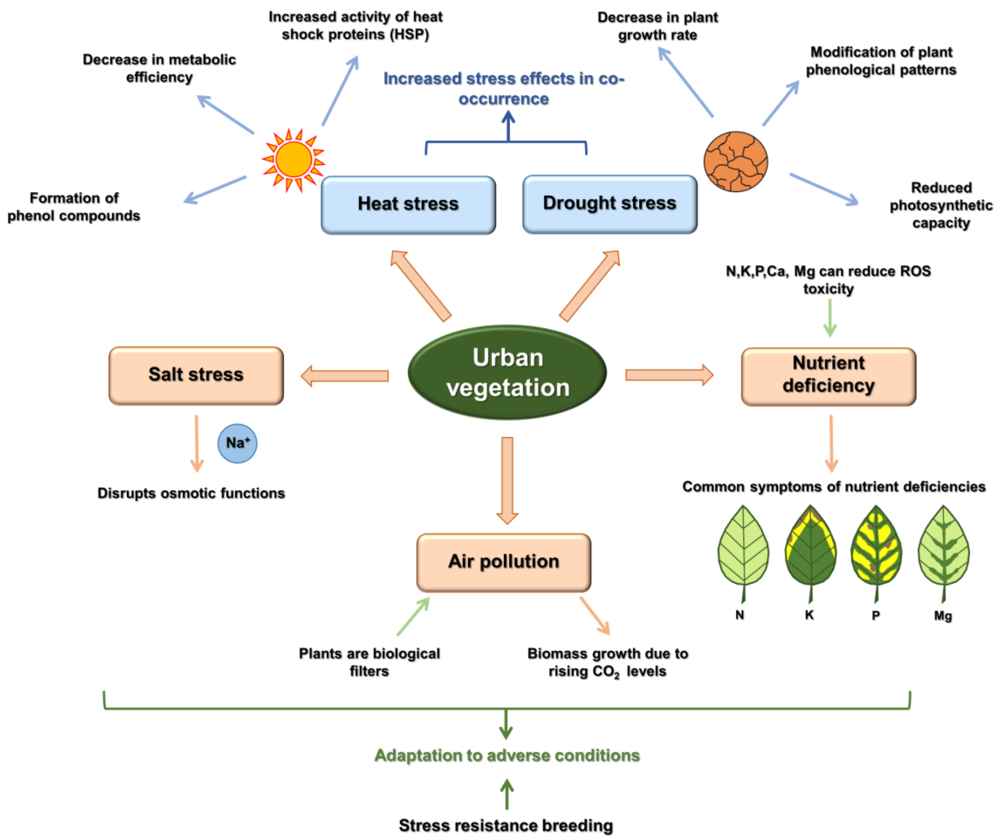

Figure 2. Major stress factors affecting urban vegetation.

Physiological aspects: Elevated carbon dioxide levels can lead to higher levels of phenols and ascorbic acid, which are instrumental in mitigating the impact of reactive oxygen species (ROS) [67,75]. Additionally, increased carbon dioxide levels influence arbuscular and ectomycorrhizal fungi, enhancing nutrient and water supply to plants and facilitating the functioning of plant-growth-promoting bacteria (PGPB) [76].

Urban aspects: These trees are recognized as eco-sustainable tools for monitoring and reducing air pollution [77]. Besides trees, urban herbaceous species also play a significant role in filtering harmful substances from the air. Species like *Achillea millefolium, Chenopodium album, Echium vulgare, Convolvulus arvensis*, and *Centaurea scabiosa* have proven effective in this regard [71]. Hubai et al. [78] investigated the toxicity of tomato plants in a simulated urban environment, revealing that the nutrient content increased at lower concentrations of chemical substances found in cities, with a decrease observed only at higher doses. Understanding the responses and adaptations of urban vegetation to various environmental stressors is critical for implementing effective strategies to promote sustainable urban development and enhance the quality of life for city dwellers. Incorporating nature-based solutions, such as planting appropriate vegetation, can significantly contribute to improving the air quality and overall environmental health in urban areas.

3.2. Drought

Among various abiotic stressors, drought stands out as having the most significant impact on soil fauna and plants [79–82]. Drought not only leads to reduced yields and metabolic distortions [83] but also has significant consequences on urban vegetation, affecting its growth and altering the composition of urban forests [84]. Forecasts suggest that the mortality of trees due to drought will continue to rise globally, posing health risks to urban trees and reducing ecosystem services, resulting in increased financial costs [85,86]. By 2070, climate change is projected to decrease the climatically suitable areas for 73% of the studied species in urban areas, with 18% of them experiencing a reduction by more than half [87]. Drought impacts the phenological phases of plants, leading to shortened phases and reduced carbon dioxide assimilation, ultimately affecting yields [88–90]. Perennials rely heavily on their ability to adapt to drought stress, showing morphological adaptations in the roots, stems, and leaves, as well as variations in water potential and absorption capacity [91–93].

Physiological aspects: Drought stress also affects leaf stomata functioning, resulting in reduced photosynthetic capacity and inefficient water use [94,95]. Elevated levels of reactive oxygen species (ROS) occur during stress, leading to oxidative damage and disruption of the antioxidant defense system in plants [95–99].

Urban aspects: In light of increasingly prolonged droughts due to climate change, afforestation becomes challenging as selecting appropriate seed sources based on current climate conditions becomes more difficult [100]. Ornamental plants employ specific adaptive mechanisms to cope with drought stress, including adjusting the root/shoot ratios, altering the leaf anatomy, reducing height, and limiting water loss [101]. The selection for abiotic stress resistance is vital for urban species [102]. Monitoring plant performance through hyperspectral imaging can aid in selecting more resilient and climate-resistant plants [103]. Drought stress can also impact the secondary metabolism of ornamental plants, such as *Lavandula angustifolia* and *Silybum marianum*, influencing the production of essential oils and other beneficial compounds [104,105].

In a study conducted by Asrar et al. [106], it was discovered that the inoculation of Antirrhinum majus seeds with mycorrhizal fungi resulted in an enhanced tolerance to drought stress. This finding highlights the beneficial role of mycorrhizal fungi in promoting drought resistance in plants. Similarly, Battacharyya et al. [107] observed a similar effect in plants such as *Petunia* spp., *Viola tricolor*, and *Cosmos* spp. when treated with extracts derived from *Ascophyllum nodosum*. The application of these extracts was shown to lead to an improvement in the drought stress tolerance of the aforementioned plant species. These studies underscore the potential of using mycorrhizal fungi and *Ascophyllum nodosum* extracts as strategies to enhance drought stress tolerance in various plant species. Understanding and promoting these adaptive strategies can play a significant role in developing more resilient and drought-tolerant urban vegetation, mitigating the adverse effects of climate change on city landscapes.

3.3. High Temperature

A considerable amount of research is currently dedicated to studying urban heat islands, high temperatures, and their impact on the viability of urban vegetation in settlements, leading to abiotic changes in the urban environment [108,109] highlighted that the frequency of heatwaves poses a stronger constraint on the optimal development of urban vegetation compared to the intensity of the heatwaves. High temperatures have detrimental effects on plants and ecosystems, with each Celsius degree increase causing yield reductions of up to 17%.

Physiological aspects: Heat stress leads to a decrease in plant growth rate and alters metabolic regulation [110]. During heat stress, cereal crops experience reductions in chlorophyll and grain-filling mechanisms; thus, preserving grain mass under heat stress can be indicative of heat tolerance [90]. The plant's response to heat stress includes an increase in carotenoid content, which acts as protection for chlorophyll against damage [74]. Heat stress triggers the production of phenolic compounds that can cause damage to cellular structures, affecting chloroplast shape, stromal lamellae swelling, and vacuole weight [69]. Many genes are activated, and specific metabolites play crucial roles in protecting against heat stress [62]. Incorporating these metabolites into plant development represents a significant solution for increasing salt stress tolerance (ascorbic acid, citric acid, glutathione, and melatonin) [37,111]. Heat stress can lead to protein denaturation, enzyme inactivation, increased fluidity of membrane lipids, and the generation of reactive oxygen species (ROS), while metabolites can form chelates with metals, providing protection against these damages [69,74]. To assess the damage caused by drought and heat stress, Aishwarya et al. [112] evaluated 36 plant species and observed that the combination of both stressors resulted in the most significant damage, followed by drought stress and then heat stress.

Urban aspects: Understanding the impact of these stressors on urban vegetation is crucial for developing strategies to mitigate their negative effects and ensure the survival of plant species in the face of global warming [113].

In Mediterranean environments, the selection of suitable plant species for urban vegetation in settlements affected by high temperatures in the future is of great importance. Feyisa et al. [114] conducted a study and identified *Olea europea, Robinia pseudoacacia*, and *Eucalyptus* spp. as suitable species for this purpose. By contrast, Cupressus and Grevillea species were found to be less suitable. These findings provide valuable insights into the choice of plant species for urban greening in high-temperature environments. Heat stress tolerance in ornamental peppers can be enhanced through the application of exogenous abscisic acid. Zhang et al. [115] demonstrated that the treatment with abscisic acid resulted in increased resistance to heat stress, accompanied by an elevation in chlorophyll content. This increase in chlorophyll content contributes to greater vitality and stress resistance in plants. Jiang et al. [116] investigated the role of the heat shock protein gene RcHSP70 in the heat tolerance of *Rosa hybrida* L. and *Nicotiana* spp. By introducing this gene into these species, the photosynthetic activity, which plays a crucial role in abiotic stress tolerance, was enhanced. Similarly, the insertion of the CmDREB6 gene into Chrysanthemum sp. led to increased heat tolerance in different varieties of the plant [117]. These studies highlight the significance of genetic modification and breeding techniques in enhancing heat tolerance in urban plants. Furthermore, Wang et al. [118] discovered the FaHsfA2c gene, which is associated with temperature tolerance, in *Festuca arundinacea*, a species commonly used as an ornamental plant. This finding underscores the importance of understanding the genetic mechanisms underlying temperature tolerance in urban plant breeding. Overall, the selection and breeding of plant species with high temperature tolerance has gained importance in recent years, particularly for urban environments. These advancements contribute to the development of resilient and thriving urban vegetation in the face of rising temperatures.

3.4. High Salt Concentration

Salt stress is a critical issue closely related to the harmful effects of climate change, leading to growth retardation and various physiological disorders in plants. An increase in the concentration of Na and Cl ions disrupts osmotic functions, mainly responsible for plant [119]).

Physiological aspects: With the expansion of salinized soils, the breeding of varieties tolerant or resistant to salt stress becomes increasingly urgent. Genome editing technologies offer promising opportunities for enhancing the salt tolerance of high-value ornamental crops like roses, gerberas, carnations, and chrysanthemums [120]. In the context of ornamental sunflowers, the use of Strigolactone (GR24) has been found to be effective in protecting against salt stress. It reduces the photosynthetic damage caused by salt stress, enhances biomass, and increases the leaf's osmotic and turgor potential [121]. Plants respond to salt and heavy metal stress by activating plasma-membrane- and vacuolar-membrane-localized transporters that import toxic elements into vacuoles and translocate into root tips and shoots. By contrast, under drought, cold, and heat stress, these transporters increase water and sugar levels in all plant organs [122]. Calcineurin B-like protein-interacting protein kinases (CIPKs) are involved in the formation of stress responses in plants.

Urban aspects: Many ornamental plants, which are also suitable for urban conditions, have a high salt tolerance or different mechanisms for salt stress tolerance. In the case of Lagerstroemia indica, the gene LiCIPK30 from Arabidopsis thaliana has been shown to enhance salt stress resistance, which suggests the potential for further investigation of the LiCIPK gene family to breed Lagerstroemia indica species suitable for saline and alkaline coastal areas [123]. As the area of salinized soils continues to expand, it is crucial to explore these genetic mechanisms to develop resilient plants for sustainable ornamental horticulture.

In the case of *Lobularia maritima*, it has been observed that even at a concentration as high as 100 mM NaCl, the root system and foliage development remain unaffected [124]. Similarly, Wang et al. [125] found that *Panicum virgatum* L. 'Northwind' also exhibits no adverse effects on its root system when exposed to NaCl. Álvarez and Sanchez-Blan [126] proposed a hypothesis regarding *Callistemon laevis*, suggesting that increased salt concentration does not allow salt ions to reach the above-ground parts of the plant from the roots. This mechanism may contribute to the plant's ability to cope with high salt concentrations. In the case of *Pelargonium hortorum*, Breś et al. [127] demonstrated that a high salt concentration of 130 mM does not significantly impact the chlorophyll content. However, it does lead to a notable increase in proline and anthocyanin content. These findings are consistent with observations in other species, where elevated levels of proline and anthocyanin are commonly associated with salt stress. These studies highlight the varying responses of different plant species to salt stress. While some species, such as *Lobularia maritima* and *Panicum virgatum*, exhibit resilience and are unaffected by high salt concentrations, others, like *Callistemon laevis* and *Pelargonium hortorum*, employ different mechanisms to mitigate the effects of salt stress. Understanding these species-specific responses is crucial for developing strategies to enhance salt tolerance in plants.

3.5. High Heavy Metal Concentration

The term "heavy metal" is used as an umbrella term, and the specific elements included under this category are determined based on their toxicological, physical, and biological effects [128]. Heavy metals pose a significant environmental problem due to their toxic nature and inability to biodegrade [129]. To address this issue, utilizing plants that have the ability to absorb and remove heavy metals from urban environments is crucial. Urban ornamental plants are particularly well-suited for this purpose, including various species of shrubs [130], herbs [131] and tree species [132].

Physiological aspects: From a physiological perspective, heavy metal stress can have negative effects on all stages of plant growth, ranging from seed germination to seed production [133]. Various strategies have been identified to enhance plant tolerance to heavy metal pollution, such as chelation, enzymatic defense systems (including phenols, flavonoids, essential oils, and alkaloids), and the regeneration of damaged proteins [134,135]. Additionally, ornamental plants can be suitable for phytoremediation, which involves utilizing plants to mitigate radiation contamination. These mechanisms play a vital role in maintaining the redox balance and stress tolerance in heavy metal-contaminated ornamental plants, underscoring the importance of comprehensively understanding these processes. However, it is worth noting that certain interactions between ornamental plants and heavy metals may lead to plant growth reduction and biomass reduction [133]. Thus, careful consideration of these factors is necessary when utilizing ornamental plants for heavy metal remediation purposes. Heavy metal pollution is a significant influencing factor for urban vegetation. Species like Agrostis stolonifera and Chrysanthemum carinatum are popular in urban lawns, but their copper tolerance is crucial due to the harmful effects of heavy metal exposure. Gladkov et al. [136] demonstrated the production of copper-tolerant types through cell selection, highlighting its importance as a method in resistance breeding. Moreover, genomic methods are also contributing to the development of more precise breeding techniques. Techniques such as transcriptomics, TILLING, homologous recombination (HR), allele research, and association mapping can be used to identify functional markers [137]. Incorporating miRNA, such as OsmiR393a from *Begonia* x *tuberhybrida*, has shown promising results in enhancing flower lifespan and improving water stress tolerance in transgenic lines [138]. These innovative genetic approaches offer valuable tools for developing urban vegetation that can withstand the challenges posed by heavy metal pollution and other environmental stresses. By employing these methods, urban landscapes can be enriched with resilient and aesthetically pleasing plant varieties.

4. Urban Biodiversity in the Light of Climate Change

With the rapid acceleration of urbanization, understanding how cities contribute to the preservation of biodiversity has become increasingly urgent [139]. Urban areas, being diverse and often alien to the ecosphere, expand rapidly, accommodating both modern ornamental plant varieties and original vegetation, which may include endangered plant species [139,140]. Herbaceous species also play a significant role in the urban ecosystem, and native species are found on urban brownfields, despite their aesthetic value sometimes being overlooked by city dwellers [141]. Urban vegetation faces various stress conditions, such as heat and drought [15], leading to the development of specific flora and fauna that can disrupt the ecological balance [140]. For example, higher microclimate temperatures near buildings can increase the survival rate of certain arthropod species, resulting in more damage in the following year [142]. The presence of exotic species in green areas may reduce arthropod diversity compared to native species [108]. Changes in microclimate due to drought also affect the composition of arthropod communities near trees [108]. Urbanization also impacts nocturnal insect populations due to increased artificial light, leading to ecological imbalances [143]. Preserving native plant species in urban environments can support the presence of insects, such as butterflies, and contribute to maintaining biodiversity. However, the trade in ornamental plants often focuses on novelty and exotic species, necessitating careful consideration of their stress resistance before introduction [144]. Urban plants provide crucial ecosystem services, including microclimate modification, flood and pollution mitigation, and biodiversity support [145]. They play significant roles in municipal, ecological, and social systems, though attention should be paid to selecting species that can withstand the urban climate [87,146]. In response to climate change, new ornamental plant species with higher stress tolerance are emerging, such as non-psychoactive decorative varieties of Cannabis [147]. Differences in urban stress tolerance exist among tree species, with some species, like *Acer campestre*, showing better adaptation to urban conditions than others [148]. In urban tolerance experiments, *Morus alba* exhibited medium tolerance, while *Salix babylonica* and *Ailanthus altissima* showed low stress tolerance in Tehran [74]. Overall, understanding and preserving biodiversity in urban environments is essential for promoting resilient and sustainable urban ecosystems in the face of ongoing urbanization and climate change challenges (Table 1).

Table 1. Advantages and disadvantages for the plants under study in an urban environment.

Plant Species	Advantages and Disadvantages in Urban Environments	References
Acer campestre L.	Great urban stress tolerance	Stratópoulos et al. [148]
Achillea millefolium L.	Filtering harmful substances from the air	Przybysz et al. [71]
Ailanthus altissima (Mill.) Swingle	Low urban stress tolerance	Dadkhah-Agdash et al. [74]
Antirrhinum majus L.	Increasing drought stress tolerance with mycorrhizal fungi	Asrar et al. [106]
Centaurea scabiosa L.	Filtering harmful substances from the air	Przybysz et al. [71]
Cercis chinensis Bunge	Earlier spring and delayed autumn phenophases	Luo et al. [32]
Chenopodium album L.	Filtering harmful substances from the air	Przybysz et al. [71]
Chrysanthemum carinatum Sch.Bip.	Low copper and heavy metal tolerance	Gladkov et al. [107]
Convulvulus arvensis L.	Filtering harmful substances from the air	Przybysz et al. [71]
Cosmos spp.	Increased drought stress tolerance using Ascophyllum nodosum extract	Battacharyya et al. [107]
Echium vulgare L.	Filtering harmful substances from the air	Przybysz et al. [71]
Eucaliptus sp. L'Hér.	High temperature tolerance	Feyisa et al. [114]
Hibiscus syriacus L.	Earlier spring and delayed autumn phenophases	Luo et al. [32]

Table 1. *Cont.*

Plant Species	Advantages and Disadvantages in Urban Environments	References
Lavendula angustifolia Mill.	Negatively affects the essential oil content	Saunier et al. [104], Zahir et al. [105]
Lobularia maritima (L.) Desv.	High salt stress tolerance	Hsouna et al. [124]
Morus alba L.	Medium urban stress tolerance	Dadkhah-Agdash et al. [74]
Olea europea L.	High temperature tolerance	Feyisa et al. [114]
Panicum virgatum L. 'Northwind'	High salt stress tolerance	Wang et al. [125]
Petunia spp. Juss.	Increased drought stress tolerance using Ascophyllum nodosum extract	Battacharyya et al. [107]
Prunus davidiana Carrière	Earlier spring and delayed autumn phenophases	Luo et al. [32]
Robinia pseudoacacia L.	High temperature tolerance	Feyisa et al. [114]
Salix babylonica L.	Low urban stress tolerance	Dadkhah-Agdash et al. [74]
Silybum marianum (L.) Gaertn.	Negatively affects the essential oil content	Saunier et al. [104], Zahir et al. [105]
Tagetes patula L.	Deterioration in germination, growth, and the quality of essential oil over 35 °C	Kumar et al. [39]
Viola tricolor L.	Increased drought stress tolerance using Ascophyllum nodosum extract	Battacharyya et al. [107]

5. Stress Resistance Breeding for Urban Climate

According to a report by Boutigny et al. [149] there are around 166 publications in the international literature related to the genetic modification of ornamental plants, with 15 of these publications specifically focusing on the stress resistance breeding of commercially important ornamental plants. Various breeding techniques, such as inter- and intraspecific crossing, mutagenesis, and in vitro mutagenesis and selection, have emerged in the field of ornamental plant breeding [150,151]. Identifying and utilizing ornamental plants tolerant to abiotic stress can reduce management costs in urban green areas while enhancing their aesthetic value [55,56]. Genetic markers, such as random amplified polymorphic DNA (RAPD) and simple sequence repeat (SSR) markers, are used to detect genetic variations related to stress tolerance. QTL research on stress-related genes also contributes to the field of science and promotes the process of resistance breeding for improved abiotic stress tolerance [152]. High-throughput genotyping approaches, like genotyping-by-sequencing (GBS), are also effective tools in resistance breeding. For example, orchids are continuously bred for their phenotypic properties and stress tolerance using GBS to identify SNP alleles [153,154]. Additionally, DNA methylation and microRNA research, related to epigenetics, are of great importance in understanding stress responses. MicroRNAs are small regulatory RNAs that negatively affect gene expression at the post-transcriptional level and play a significant role in stress-related gene regulation [155,156].

Amplified fragment length polymorphism (AFLP) in lavender species has shown potential for detecting similarities between cytogenetic properties and can be used to enhance stress tolerance in hybrids between species [157]. Similarly, significant cytogenetic and molecular studies have been conducted in the resistance breeding of geophytes among ornamental plants. The rapidly changing climate necessitates the creation of new stress-tolerant varieties, and advancements in cisgenesis and genome editing techniques have already facilitated progress in this direction [158]. Polyploidization is another effective breeding method to increase stress resistance in ornamental plants. Numerous studies have demonstrated that polyploid plants often exhibit greater vitality and abiotic stress resistance compared to non-polyploids [159]. Additionally, polyploidization can influence external properties such as flower size, color, cell size, and fragrance [160]. Colchicine treatment is a common and successful method for producing polyploids. Somatic cell induction is primarily used for polyploidy induction, but chimeras can also be created using this approach. Artificial chromosome duplication (ACD) is another promising technique for breeding ornamental and medicinal plants. Successful ACD protocols require careful consideration of various parameters, including genetic characteristics and the type of antimitotic agent (AMA) used [160]. These advanced breeding methods open up exciting possibilities for creating stress-tolerant and visually appealing ornamental plant varieties to adapt to the challenges posed by climate change.

Stress response in plants involves complex genetic and epigenetic regulatory mechanisms. Epigenetic mechanisms have been shown to play a crucial role in plant response to abiotic stress, with numerous components under epigenetic regulation [161]. RNA silencing mediated by small RNAs, such as miRNAs, also contributes significantly to the abiotic stress response [162]. miRNAs are small RNA molecules that regulate gene expression by forming a miRNA-induced silencing complex (MIRISC) and inhibiting translation [163]. Some miRNAs, like miRNA-169, miRNA-396, miRNA-159, and miRNA-393, have been found to play key roles in mitigating climate-change-related stress effects [164]. Protein ubiquitination, a post-translational modification, is another important mechanism involved in plant stress response and resistance [165]. Phytohormones, such as ABA, play significant roles in stress avoidance and adaptation by inducing stomatal closure and promoting root growth [37,166,167]. Additionally, nitration has been implicated in stress responses, warranting further research into NO signaling [168]. To enhance stress tolerance in ornamental plants, various breeding methods and genetic tests are available, including marker-assisted selection (MAS), hormones, osmoprotectants, marker-assisted backcrossing, haplotype-based breeding, and genomic forecasting approaches [79,169]. High-throughput technologies like phenotyping, genomics, proteomics, and metabolomics provide valuable insights into plant–environment interactions and the mechanisms responsible for resistance to biotic and abiotic stresses [170]. Furthermore, specific stress responses and resistance mechanisms may vary within species [171,172]. Understanding stress responses can be particularly useful for agriculture, as it can improve the taste and quality of fruit-bearing plants by enhancing secondary metabolic products [173]. Plant hormones, including jasmonic acid (JA), abscisic acid (ABA), ethylene, and salicylic acid, play vital roles in plant responses to biotic and abiotic stress and have been the subjects of extensive research [36,174]. With the advancement of nanotechnology, plant responses and defenses may be further improved, particularly with the use of JA as a stress control agent [175]. In addition to JA, abscisic acid (ABA), ethylene, and salicylic acid also play prominent roles in stimulating ion channels [97]. Collectively, understanding these complex regulatory mechanisms can help in developing transgenic abiotic-stress-resistant, high-quality, and high-yielding plants for the urban environment and agriculture.

6. In Addition to Breeding, There Are Other Possible Solutions for Increasing Urban Tolerance

In addition to resistance breeding, several other solutions can be employed to increase the stress tolerance of urban plants. One important approach is the management of urban green spaces, which can significantly impact the soil microbiome and biodiversity [176,177]. The use of plant-growth-promoting microbes (PGPM) and mycorrhizal fungi has been shown to enhance the growth and development of plants under stress conditions [178], making them valuable for nurseries and green roof vegetation. Seed treatment with these beneficial microorganisms is also a common practice [119]. Fungal species, in particular, have proven to be more effective than bacteria in alleviating stress in plants, especially under abiotic stress conditions. Endophytic bacteria have shown significant stress-alleviating effects, while epiphytic bacteria have a lesser impact [178]. Certain strains of plant-growth-promoting rhizobacteria (PGPR), such as *Pseudomonas poae* 29G9 and *Pseudomonas florescens* 90F12-2, have beneficial effects on ornamental plants, enhancing their quality and performance under drought stress and low nutrient conditions [179]. Therefore, these strains can be utilized to improve the stress tolerance of cultivated ornamental plants in urban environments. The rhizosphere, the region surrounding the plant roots, plays a vital role in defense against drought stress. Hormonal regulation, reactive oxygen species (ROS) signaling, osmoregulation, and induced systemic tolerance (IST) are among the mechanisms involved in stress responses in the rhizosphere [79]. ROS overproduction is a common occurrence in plants under stress conditions [67]. Biostimulants have also emerged as effective tools for addressing environmental challenges and promoting sustainable agriculture [180]. Companies are actively investing in the development of new biostimulant products and identifying bioactive molecules capable of inducing specific plant responses to abiotic stresses. These compounds, though often not fully characterized, are classified based on their role in plants [181]. Biostimulants have shown potential in increasing stress tolerance, as seen in the case of boric acid application at low temperatures, which enhances cold tolerance in sunflowers [80]. In the future, biostimulators will play an important role in plant cultivation in the context of climate change, as they strengthen the defense against abiotic stress effects and aid in plant protection against stress [182,183]. Apart from biostimulants, agronomic strategies like mulching and suitable plant associations can also be useful solutions to mitigate abiotic stress in urban environments [56]. These approaches collectively contribute to enhancing the stress tolerance of urban plants and promoting a sustainable and resilient urban green space.

7. Conclusions and Future Prospectus

Our modern world is facing numerous stressors that affect not only people and animals but also flora. Climate change, rising temperatures, droughts resulting from uneven precipitation distribution, and salt stress present significant challenges to global vegetation. The area and planning methods of urban green spaces have a direct impact on the health and comfort of urban populations. With increasing urbanization and shrinking living spaces, there is often a lack of sufficient urban vegetation, leading to detrimental effects such as the urban heat island effect. To ad184dress these challenges, understanding how plants cope with stress becomes crucial for developing modern agriculture. The genetic adaptation of plants has become increasingly important in light of climate change impacts on high-value species like grapes. Plant breeding plays a vital role in selecting applicable species with high tolerance and resistance to abiotic and biotic stresses suitable for urban planting. However, achieving harmony between agriculture and the environment requires collaboration among plant breeders, urban planners, and political decision-makers. Despite the progress made with initiatives such as urban gardens or green roofs aiming at ecological sustainability, their adoption rate remains low. Factors shaping the urban landscape will ultimately impact people's lives through plants. Developing climate change adaptation plans focused on enhancing resilience becomes essential. Climate change responses differ between temperate species, which shift phenological phases, and tropical species, which respond by spatial shifts. In future breeding efforts, landscape varieties may become significant in developing climate-resistant plant varieties. Further research should investigate interactions between ornamental plants in urban environments under abiotic stress influences to better understand their responses within this context. Environmentally friendly methods like using plant-growth-promoting microorganisms (PGPM) or biostimulators can strengthen plant organisms' resilience while improving plant–microbiome relationships, which increase stress tolerance levels. Optimizing microbiome levels and its relationship with flora can contribute to increased biodiversity—an essential aspect for establishing sustainability and creating a balanced ecosystem. Breeding species suitable for urban life and the use of environmentally friendly biostimulators can greatly reduce the harmful effects of environmental pollution and increase urban green areas in an energy- and cost-effective manner by better integrating them into the concept of green cities. Pesticides, especially insecticides and herbicides, greatly reduce the creation of a biodiverse cityscape. The use of species and varieties resistant to a changing climate can also increase biodiversity, especially if these species are considered to be bee pastures. It is worth considering this aspect in connection with breeding. The protection of animals and the appropriate design of their habitat can also be important. The presence of vertebrates and invertebrates brings with it the presence of pollinating insects. Therefore, the flowering of lawn surfaces and the use of biodiverse beds could be the initial step in the process. Furthermore, maintaining well-designed green spaces in urban environments can contribute to the mental health of the population. This, in turn, has economic implications as increased work efficiency can improve GDP. Vegetation plays a crucial role in creating a mentally healthier human world, which is increasingly needed. Thus, urban vegetation and green areas have the potential to mitigate climate change effects and create more livable cities. In conclusion, by recognizing the importance of plants in mitigating stressors on both ecological and human levels, we can strive towards a more sustainable future that prioritizes harmony between nature and urban development. The investigation of urban ornamental plants and abiotic stress effects in cities is a topic that can be continuously researched, and our goal is to continue exploring this topic in the future.

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References

1. Choudhary, J.R.; Tripathi, A.; Kaldate, R.; Rana, M.; Mehta, S.; Ahlawat, J.; Wani, S.H. Breeding efforts for crop productivity in abiotic stress environment. In *Augmenting Crop Productivity in Stress Environment*; Springer Nature: Singapore, 2022; pp. 63–103.
2. Calfapietra, C.; Peñuelas, J.; Niinemets, Ü. Urban plant physiology: Adaptation-mitigation strategies under permanent stress. *Trends Plant Sci.* **2015**, *20*, 72–75. [CrossRef] [PubMed]
3. Gustavsen, G.W.; Berglann, H.; Jenssen, E.; Kårstad, S.; Rodriguez, D.G.P. The Value of Urban Farming in Oslo, Norway: Community Gardens, Aquaponics and Vertical Farming. *Int. J. Food Syst. Dyn.* **2022**, *13*, 17–29.
4. Ciftcioglu, G.C.; Ebedi, S.; Abak, K. Evaluation of the relationship between ornamental plants–based ecosystem services and human wellbeing: A case study from Lefke Region of North Cyprus. *Ecol. Indic.* **2019**, *102*, 278–288. [CrossRef]
5. Gabellini, S.; Scaramuzzi, S. Evolving consumption trends, marketing strategies, and governance settings in ornamental horticulture: A grey literature review. *Horticulturae* **2022**, *8*, 234. [CrossRef]
6. Wani, M.A.; Nazki, I.T.; Din, A.; Iqbal, S. Floriculture Sustainability Initiative: The Dawn of New Era. *Sustain. Agric. Rev.* **2018**, *27*, 91.
7. Wani, M.A.; Din, A.; Nazki, I.T.; Rehman, T.U.; Al-Khayri, J.M.; Jain, S.M.; Lone, R.A.; Bhat, Z.A.; Mushtaq, M. Navigating the future: Exploring technological advancements and emerging trends in the sustainable ornamental industry. *Front. Environ. Sci.* **2023**, *11*, 1188643. [CrossRef]
8. Ilie, D.; Cosmulescu, S. Spontaneous Plant Diversity in Urban Contexts: A Review of Its Impact and Importance. *Diversity* **2023**, *15*, 277. [CrossRef]
9. Salmond, J.A.; Tadaki, M.; Vardoulakis, S.; Arbuthnott, K.; Coutts, A.; Demuzere, M.; Dirks, K.N.; Heaviside, C.; Lim, S.; Macintyre, H.; et al. Health and climate related ecosystem services provided by street trees in the urban environment. *Environ Health* **2016**, *15* (Suppl. S1), 95–111. [CrossRef]
10. Nowak, D.J.; Greenfield, E.J.; Hoehn, R.E.; Lapoint, E. Carbon storage and sequestration by trees in urban and community areas of the United States. *Environ. Pollut.* **2013**, *178*, 229–236. [CrossRef]
11. Leal Filho, W.; Icaza, L.E.; Neht, A.; Klavins, M.; Morgan, E.A. Coping with the impacts of urban heat islands: A literature based study on understanding urban heat vulnerability and the need for resilience in cities in a global climate change context. *J. Clean. Prod.* **2018**, *171*, 1140–1149. [CrossRef]
12. Birkmann, J.; Bach, C.; Vollmer, M. Tools for Resilience Building and Adaptive Spatial Governance. *Raumforsch. Raumordn.* **2012**, *70*, 293–308. [CrossRef]
13. Wang, X.; Dallimer, M.; Scott, C.E.; Shi, W.; Gao, J. Tree species richness and diversity predicts the magnitude of urban heat island mitigation effects of greenspaces. *Sci. Total. Environ.* **2021**, *770*, 145211. [CrossRef] [PubMed]
14. Hinkel, K.M.; Nelson, F.E.; Klene, A.E.; Bell, J.H. The urban heat island in winter at Barrow, Alaska. *Int. J. Climatol.* **2003**, *23*, 1889–1905. [CrossRef]
15. Meineke, E.K.; Holmquist, A.J.; Wimp, G.M.; Frank, S.D. Changes in spider community composition are associated with urban temperature, not herbivore abundance. *J. Urban Ecol.* **2017**, *3*, juw010. [CrossRef]
16. Fried, G.G.; Wichrowski, M.J. Horticultural therapy: A psychosocial treatment option at the Stephen D. Hassenfeld children's center for cancer and blood disorders. *Prim. Psychiatry* **2008**, *15*, 73–77.

17. Shoemaker, C.A.; Randall, K.; Relf, P.D.; Geller, E.S. Relationships between Plants, Behavior, and Attitudes in an Office Environment. *HortTechnology* **1992**, *2*, 205–206. [CrossRef]
18. Barwise, Y.; Kumar, P. Designing vegetation barriers for urban air pollution abatement: A practical review for appropriate plant species selection. *npj Clim. Atmos. Sci.* **2020**, *3*, 12. [CrossRef]
19. Park, J.; Kim, J.-H.; Lee, D.K.; Park, C.Y.; Jeong, S.G. The influence of small green space type and structure at the street level on urban heat island mitigation. *Urban For. Urban Green.* **2017**, *21*, 203–212. [CrossRef]
20. Kończak, B.; Cempa, M.; Deska, M. Assessment of the ability of roadside vegetation to remove particulate matter from the urban air. *Environ. Pollut.* **2020**, *268*, 115465. [CrossRef]
21. Pozo Menéndez, E. Greenery urban design for good mental health: Analysis of a vulnerable district of Madrid. In *Urban Design and Planning for Age-Friendly Environments Across Europe: North and South: Developing Healthy and Therapeutic Living Spaces for Local Contexts*; Springer International Publishing: Cham, Switzerland, 2022; pp. 291–309.
22. Hoyle, H.; Jorgensen, A.; Hitchmough, J.D. What determines how we see nature? Perceptions of naturalness in designed urban green spaces. *People Nat.* **2019**, *1*, 167–180. [CrossRef]
23. Tresch, S.; Frey, D.; Le Bayon, R.-C.; Zanetta, A.; Rasche, F.; Fliessbach, A.; Moretti, M. Litter decomposition driven by soil fauna, plant diversity and soil management in urban gardens. *Sci. Total. Environ.* **2019**, *658*, 1614–1629. [CrossRef] [PubMed]
24. Chiang, Y.-C.; Li, D.; Jane, H.-A. Wild or tended nature? The effects of landscape location and vegetation density on physiological and psychological responses. *Landsc. Urban Plan.* **2017**, *167*, 72–83. [CrossRef]
25. Simkin, J.; Ojala, A.; Tyrväinen, L. Restorative effects of mature and young commercial forests, pristine old-growth forest and urban recreation forest—A field experiment. *Urban For. Urban Green* **2020**, *48*, 126567. [CrossRef]
26. Colléony, A.; White, R.; Shwartz, A. The influence of spending time outside on experience of nature and environmental attitudes. *Landsc. Urban Plan.* **2019**, *187*, 96–104. [CrossRef]
27. Gong, P.; Liang, S.; Carlton, E.J.; Jiang, Q.; Wu, J.; Wang, L.; Remais, J.V. Urbanisation and health in China. *Lancet* **2012**, *379*, 843–852. [CrossRef] [PubMed]
28. Rahnema, S.; Sedaghathoor, S.; Allahyari, M.S.; Damalas, C.A.; El Bilali, H. Preferences and emotion perceptions of ornamental plant species for green space designing among urban park users in Iran. *Urban For. Urban Green.* **2019**, *39*, 98–108. [CrossRef]
29. Lewis, E.; Phoenix, G.K.; Alexander, P.; David, J.; Cameron, R.W.F. Rewilding in the Garden: Are garden hybrid plants (cultivars) less resilient to the effects of hydrological extremes than their parent species? A case study with Primula. *Urban Ecosyst.* **2019**, *22*, 841–854. [CrossRef]
30. Zhang, C.; Su, Q.; Zhu, Y. Urban park system on public health: Underlying driving mechanism and planning thinking. *Front. Public Health* **2023**, *11*, 1193604. [CrossRef]
31. Zhang, W.; Li, Z.; Cui, J.; Wang, L.; Liu, H.; Liu, H. Chinese young people's perceptions and preferences with regard to various edible urban plants. *J. Zhejiang Univ. B* **2023**, *24*, 359–365. [CrossRef]
32. Luo, Z.; Sun, O.J.; Ge, Q.; Xu, W.; Zheng, J. Phenological responses of plants to climate change in an urban environment. *Ecol. Res.* **2007**, *22*, 507–514. [CrossRef]
33. Pretzsch, H.; Biber, P.; Uhl, E.; Dahlhausen, J.; Schütze, G.; Perkins, D.; Rötzer, T.; Caldentey, J.; Koike, T.; Con, T.V.; et al. Climate change accelerates growth of urban trees in metropolises worldwide. *Sci. Rep.* **2017**, *7*, 15403. [CrossRef]
34. Wasaya, A.; Zhang, X.; Fang, Q.; Yan, Z. Root Phenotyping for Drought Tolerance: A Review. *Agronomy* **2018**, *8*, 241. [CrossRef]
35. Franco, J.A.; Banón, S.; Vicente, M.J.; Miralles, J.; Martínez-Sánchez, J.J. Root development in horticultural plants grown under abiotic stress conditions—A review. *J. Hortic. Sci. Biotechnol.* **2011**, *86*, 543–556. [CrossRef]
36. Waadt, R.; Seller, C.A.; Hsu, P.-K.; Takahashi, Y.; Munemasa, S.; Schroeder, J.I. Plant hormone regulation of abiotic stress responses. *Nat. Rev. Mol. Cell Biol.* **2022**, *23*, 680–694. [CrossRef]
37. Moustafa-Farag, M.; Elkelish, A.; Dafea, M.; Khan, M.; Arnao, M.B.; Abdelhamid, M.T.; El-Ezz, A.A.; Almoneafy, A.; Mahmoud, A.; Awad, M.; et al. Role of Melatonin in Plant Tolerance to Soil Stressors: Salinity, pH and Heavy Metals. *Molecules* **2020**, *25*, 5359. [CrossRef]
38. Giordano, M.; Petropoulos, S.A.; Cirillo, C.; Rouphael, Y. Biochemical, Physiological, and Molecular Aspects of Ornamental Plants Adaptation to Deficit Irrigation. *Horticulturae* **2021**, *7*, 107. [CrossRef]
39. Kumar, A.; Gautam, R.D.; Kumar, A.; Singh, S.; Singh, S. Understanding the effect of different abiotic stresses on wild marigold (*Tagetes minuta* L.) and role of breeding strategies for developing tolerant lines. *Front. Plant Sci.* **2022**, *12*, 754457. [CrossRef] [PubMed]
40. Darvizheh, H.; Zahedi, M.; Abbaszadeh, B.; Razmjoo, J. Changes in some antioxidant enzymes and physiological indices of purple coneflower (*Echinacea purpurea* L.) in response to water deficit and foliar application of salicylic acid and spermine under field condition. *Sci. Hortic.* **2019**, *247*, 390–399. [CrossRef]
41. Kumar, D.; Al Hassan, M.; Naranjo, M.A.; Agrawal, V.; Boscaiu, M.; Vicente, O. Effects of salinity and drought on growth, ionic relations, compatible solutes and activation of antioxidant systems in oleander (*Nerium oleander* L.). *PLoS ONE* **2017**, *12*, e0185017. [CrossRef]
42. Raza, A.; Mehmood, S.S.; Tabassum, J.; Batool, R. Targeting plant hormones to develop abiotic stress resistance in wheat. In *Wheat Production in Changing Environments: Responses, Adaptation and Tolerance*; Springer: Singapore, 2019; pp. 557–577.
43. Bhattacharya, A. *Physiological Processes in Plants under Low Temperature Stress*; Springer: Singapore, 2022; p. 734.

44. Chaudhry, S.; Sidhu, G.P.S. Climate change regulated abiotic stress mechanisms in plants: A comprehensive review. *Plant Cell Rep.* **2022**, *41*, 1–31. [CrossRef]
45. Hatfield, J.L.; Prueger, J.H. Temperature extremes: Effect on plant growth and development. *Weather. Clim. Extremes* **2015**, *10*, 4–10. [CrossRef]
46. Rai, A.; Kumar, R.G.; Dubey, R.S. Heat stress and its effects on plant growth and metabolism. In *Abitic Stress Tolerance Mechanisms in Plants*; Rai, G.K., Kumar, R.R., Bagati, S., Eds.; CRC Press: Boca Raton, FL, USA, 2018; pp. 203–235.
47. Francini, A.; Sebastiani, L. Abiotic Stress Effects on Performance of Horticultural Crops. *Horticulturae* **2019**, *5*, 67. [CrossRef]
48. Meineke, E.; Youngsteadt, E.; Dunn, R.R.; Frank, S.D. Urban warming reduces aboveground carbon storage. *Proc. R. Soc. B Biol. Sci.* **2016**, *283*, 20161574. [CrossRef] [PubMed]
49. Monder, M.J. Trends in the Phenology of Climber Roses under Changing Climate Conditions in the Mazovia Lowland in Central Europe. *Appl. Sci.* **2022**, *12*, 4259. [CrossRef]
50. Kumar, A.; Verma, J.P. Does plant—Microbe interaction confer stress tolerance in plants: A review? *Microbiol. Res.* **2018**, *207*, 41–52. [CrossRef] [PubMed]
51. Gonzalez-Dugo, V.; Durand, J.L.; Gastal, F.; Bariac, T.; Poincheval, J. Restricted Root-to-Shoot Translocation and Decreased Sink Size are Responsible for Limited Nitrogen Uptake in Three Grass Species under Water Deficit. *Environ. Exp. Bot.* **2012**, *75*, 258–267. [CrossRef]
52. Field, C.B.; Barros, V.R.; Mach, K.J.; Mastrandrea, M.D.; Van Aalst, M.; Adger, W.N.; Yohe, G.W. *Technical Summary Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*; IPCC: Geneva, Switzerland, 2014; pp. 35–94.
53. Balfagón, D.; Zandalinas, S.I.; Mittler, R.; Gómez-Cadenas, A. High temperatures modify plant responses to abiotic stress conditions. *Physiol. Plant.* **2020**, *170*, 335–344. [CrossRef]
54. Hussain, H.A.; Hussain, S.; Khaliq, A.; Ashraf, U.; Anjum, S.A.; Men, S.; Wang, L. Chilling and Drought Stresses in Crop Plants: Implications, Cross Talk, and Potential Management Opportunities. *Front. Plant Sci.* **2018**, *9*, 393. [CrossRef]
55. Francini, A.; Romano, D.; Toscano, S.; Ferrante, A. The Contribution of Ornamental Plants to Urban Ecosystem Services. *Earth* **2022**, *3*, 1258–1274. [CrossRef]
56. Leotta, L.; Toscano, S.; Ferrante, A.; Romano, D.; Francini, A. New Strategies to Increase the Abiotic Stress Tolerance in Woody Ornamental Plants in Mediterranean Climate. *Plants* **2023**, *12*, 2022. [CrossRef]
57. Ozturk, M.; Turkyilmaz Unal, B.; García-Caparrós, P.; Khursheed, A.; Gul, A.; Hasanuzzaman, M. Osmoregulation and its actions during the drought stress in plants. *Physiol. Plant.* **2021**, *172*, 1321–1335. [CrossRef] [PubMed]
58. Fedoroff, N.V.; Battisti, D.S.; Beachy, R.N.; Cooper, P.J.M.; Fischhoff, D.A.; Hodges, C.N.; Knauf, V.C.; Lobell, D.; Mazur, B.J.; Molden, D.; et al. Radically Rethinking Agriculture for the 21st Century. *Science* **2010**, *327*, 833–834. [CrossRef] [PubMed]
59. Noman, A.; Fahad, S.; Aqeel, M.; Ali, U.; Amanullah; Anwar, S.; Baloch, S.K.; Zainab, M. miRNAs: Major modulators for crop growth and development under abiotic stresses. *Biotechnol. Lett.* **2017**, *39*, 685–700. [CrossRef] [PubMed]
60. Hossain, A.; Maitra, S.; Pramanick, B.; Bhutia, K.L.; Ahmad, Z.; Moulik, D.; Aftab, T. Wild relatives of plants as sources for the development of abiotic stress tolerance in plants. In *Plant Perspectives to Global Climate Changes*; Academic Press: Cambridge, MA, USA, 2022; pp. 471–518.
61. Vinocur, B.; Altman, A. Recent advances in engineering plant tolerance to abiotic stress: Achievements and limitations. *Curr. Opin. Biotechnol.* **2005**, *16*, 123–132. [CrossRef] [PubMed]
62. Bhatnagar-Mathur, P.; Vadez, V.; Sharma, K.K. Transgenic approaches for abiotic stress tolerance in plants: Retrospect and prospects. *Plant Cell Rep.* **2008**, *27*, 411–424. [CrossRef]
63. Chauhan, H.; Khurana, N.; Agarwal, P.; Khurana, P. Heat shock factors in rice (*Oryza sativa* L.): Genome-wide expression analysis during reproductive development and abiotic stress. *Mol. Genet. Genom.* **2011**, *286*, 171–187. [CrossRef] [PubMed]
64. Singh, R.K.; Jaishankar, J.; Muthamilarasan, M.; Shweta, S.; Dangi, A.; Prasad, M. Genome-wide analysis of heat shock proteins in C4 model, foxtail millet identifies potential candidates for crop improvement under abiotic stress. *Sci. Rep.* **2016**, *6*, 32641. [CrossRef] [PubMed]
65. Zinta, G.; Khan, A.; AbdElgawad, H.; Verma, V.; Srivastava, A.K. Unveiling the Redox Control of Plant Reproductive Development during Abiotic Stress. *Front. Plant Sci.* **2016**, *7*, 700. [CrossRef]
66. Nadarajah, K.K. ROS Homeostasis in Abiotic Stress Tolerance in Plants. *Int. J. Mol. Sci.* **2020**, *21*, 5208. [CrossRef]
67. Mazid, M.; Khan, T.A.; Khan, Z.H.; Quddusi, S.; Mohammad, F. Occurrence, biosynthesis and potentialities of ascorbic acid in plants. *Int. J. Plant Anim. Environ. Sci.* **2011**, *1*, 167–184.
68. Mann, A.; Nehra, K.; Rana, J.; Dahiya, T. Antibiotic resistance in agriculture: Perspectives on upcoming strategies to overcome upsurge in resistance. *Curr. Res. Microb. Sci.* **2021**, *2*, 100030. [CrossRef] [PubMed]
69. Lipiec, J.; Doussan, C.; Nosalewicz, A.; Kondracka, K. Effect of drought and heat stresses on plant growth and yield: A review. *Int. Agrophys.* **2013**, *27*, 463–477. [CrossRef]
70. Gurney, K.R.; Romero-Lankao, P.; Seto, K.C.; Hutyra, L.R.; Duren, R.; Kennedy, C.; Grimm, N.B.; Ehleringer, J.R.; Marcotullio, P.; Hughes, S.; et al. Climate change: Track urban emissions on a human scale. *Nature* **2015**, *525*, 179–181. [CrossRef] [PubMed]
71. Przybysz, A.; Popek, R.; Stankiewicz-Kosyl, M.; Zhu, C.; Małecka-Przybysz, M.; Maulidyawati, T.; Mikowska, K.; Deluga, D.; Griżuk, K.; Sokalski-Wieczorek, J.; et al. Where trees cannot grow—Particulate matter accumulation by urban meadows. *Sci. Total. Environ.* **2021**, *785*, 147310. [CrossRef] [PubMed]

72. Oksanen, E.; Kontunen-Soppela, S. Plants have different strategies to defend against air pollutants. *Curr. Opin. Environ. Sci. Health* **2021**, *19*, 100222. [CrossRef]
73. Zhang, L.; Zhang, Z.; Chen, L.; McNulty, S. An investigation on the leaf accumulation-removal efficiency of atmospheric particulate matter for five urban plant species under different rainfall regimes. *Atmos. Environ.* **2019**, *208*, 123–132. [CrossRef]
74. Dadkhah-Aghdash, H.; Rasouli, M.; Rasouli, K.; Salimi, A. Detection of urban trees sensitivity to air pollution using physiological and biochemical leaf traits in Tehran, Iran. *Sci. Rep.* **2022**, *12*, 15398. [CrossRef] [PubMed]
75. Miliauskienė, J.; Sakalauskienė, S.; Lazauskas, S.; Povilaitis, V.; Brazaitytė, A.; Duchovskis, P. The competition between winter rape (C_3) and maize (C_4) plants in response to elevated carbon dioxide and temperature, and drought stress. *Zemdirb. Agric.* **2016**, *103*, 21–28. [CrossRef]
76. Compant, S.; Van Der Heijden, M.G.; Sessitsch, A. Climate change effects on beneficial plant–microorganism interactions. *FEMS Microbiol. Ecol.* **2010**, *73*, 197–214. [CrossRef]
77. Chaudhary, I.J.; Rathore, D. Dust pollution: Its removal and effect on foliage physiology of urban trees. *Sustain. Cities Soc.* **2019**, *51*, 101696. [CrossRef]
78. Hubai, K.; Kováts, N.; Teke, G. Effects of urban atmospheric particulate matter on higher plants using Lycopersicon esculentum as model species. *SN Appl. Sci.* **2021**, *3*, 770. [CrossRef]
79. Zia, R.; Nawaz, M.S.; Siddique, M.J.; Hakim, S.; Imran, A. Plant survival under drought stress: Implications, adaptive responses, and integrated rhizosphere management strategy for stress mitigation. *Microbiol. Res.* **2021**, *242*, 126626. [CrossRef]
80. Bozca, F.D.; Leblebici, S. Interactive effect of boric acid and temperature stress on phenological characteristics and antioxidant system in *Helianthus annuus* L. *South Afr. J. Bot.* **2022**, *147*, 391–399. [CrossRef]
81. Tanveer, M.; Shahzad, B.; Sharma, A.; Khan, E.A. 24-Epibrassinolide application in plants: An implication for improving drought stress tolerance in plants. *Plant Physiol. Biochem.* **2018**, *135*, 295–303. [CrossRef] [PubMed]
82. Vadez, V.; Kholova, J.; Medina, S.; Kakkera, A.; Anderberg, H. Transpiration efficiency: New insights into an old story. *J. Exp. Bot.* **2014**, *65*, 6141–6153. [CrossRef] [PubMed]
83. Reddy, A.R.; Chaitanya, K.V.; Vivekanandan, M. Drought-induced responses of photosynthesis and antioxidant metabolism in higher plants. *J Plant Physiol.* **2004**, *161*, 1189–1202. [CrossRef] [PubMed]
84. McClung, T.; Ibáñez, I. Quantifying the synergistic effects of impervious surface and drought on radial tree growth. *Urban Ecosyst.* **2018**, *21*, 147–155. [CrossRef]
85. Petruzzellis, F.; Tordoni, E.; Di Bonaventura, A.; Tomasella, M.; Natale, S.; Panepinto, F.; Bacaro, G.; Nardini, A. Turgor loss point and vulnerability to xylem embolism predict species-specific risk of drought-induced decline of urban trees. *Plant Biol.* **2022**, *24*, 1198–1207. [CrossRef]
86. Anderegg, W.R.L.; Anderegg, L.D.L.; Huang, C. Testing early warning metrics for drought-induced tree physiological stress and mortality. *Glob. Chang. Biol.* **2019**, *25*, 2459–2469. [CrossRef]
87. Burley, H.; Beaumont, L.J.; Ossola, A.; Baumgartner, J.B.; Gallagher, R.; Laffan, S.; Esperon-Rodriguez, M.; Manea, A.; Leishman, M.R. Substantial declines in urban tree habitat predicted under climate change. *Sci. Total. Environ.* **2019**, *685*, 451–462. [CrossRef]
88. Fatima, Z.; Ahmed, M.; Hussain, M.; Abbas, G.; Ul-Allah, S.; Ahmad, S.; Ahmed, N.; Ali, M.A.; Sarwar, G.; Haque, E.U.; et al. The fingerprints of climate warming on cereal crops phenology and adaptation options. *Sci. Rep.* **2020**, *10*, 18013. [CrossRef]
89. Brune, M. Urban Trees Under Climate Change. In *Potential Impacts of Dry Spells and Heat Waves in Three German Regions in the 2050s*; Climate Service Center Germany: Hamburg, Germany, 2016.
90. Hassan, M.U.; Rasool, T.; Iqbal, C.; Arshad, A.; Abrar, M.M.; Habib-Ur-Rahman, M.; Noor, M.A.; Sher, A.; Fahad, S. Linking Plants Functioning to Adaptive Responses Under Heat Stress Conditions: A Mechanistic Review. *J. Plant Growth Regul.* **2022**, *41*, 2596–2613. [CrossRef]
91. Álvarez, S.; Rodríguez, P.; Broetto, F.; Sánchez-Blanco, M.J. Long term responses and adaptive strategies of *Pistacia lentiscus* under moderate and severe deficit irrigation and salinity: Osmotic and elastic adjustment, growth, ion uptake and photosynthetic activity. *Agric. Water Manag.* **2018**, *202*, 253–262. [CrossRef]
92. Vinod, K.K. Stress in plantation crops: Adaptation and management. In *Crop Stress and Its Management: Perspectives and Strategies*; Venkateswarlu, B., Shanker, A.K., Shanker, C., Maheswari, M., Eds.; Springer: Dordrecht, The Netherlands, 2012; pp. 45–137.
93. Chen, J.-W.; Zhang, Q.; Li, X.-S.; Cao, K.-F. Independence of stem and leaf hydraulic traits in six Euphorbiaceae tree species with contrasting leaf phenology. *Planta* **2009**, *230*, 459–468. [CrossRef] [PubMed]
94. Driesen, E.; Van den Ende, W.; De Proft, M.; Saeys, W. Influence of Environmental Factors Light, CO_2, Temperature, and Relative Humidity on Stomatal Opening and Development: A Review. *Agronomy* **2020**, *10*, 1975. [CrossRef]
95. Lawlor, D.W.; Tezara, W. Causes of decreased photosynthetic rate and metabolic capacity in water-deficient leaf cells: A critical evaluation of mechanisms and integration of processes. *Ann. Bot.* **2009**, *103*, 561–579. [CrossRef] [PubMed]
96. Parvin, K.; Nahar, K.; Hasanuzzaman, M.; Bhuyan, M.B.; Fujita, M. Calcium-mediated growth regulation and abiotic stress tolerance in plants. In *Plant Abiotic Stress Tolerance: Agronomic, Molecular and Biotechnological Approaches*; Springer: Cham, Switzerland, 2019; pp. 291–331.
97. Rejeb, I.; Pastor, V.; Mauch-Mani, B. Plant Responses to Simultaneous Biotic and Abiotic Stress: Molecular Mechanisms. *Plants* **2014**, *3*, 458–475. [CrossRef]
98. Barnabás, B.; Jäger, K.; Fehér, A. The effect of drought and heat stress on reproductive processes in cereals. *Plant Cell Environ.* **2008**, *31*, 11–38. [CrossRef]

99. Maurino, V.G.; Flugge, U.I. Experimental Systems to Assess the Effects of Reactive Oxygen Species in Plant Tissues. *Plant Signal. Behav.* **2008**, *3*, 923. [CrossRef]
100. Kamakura, R.P.; DeWald, L.E.; Sniezko, R.A.; Elliott, M.; Chastagner, G.A. Using differences in abiotic factors between seed origin and common garden sites to predict performance of Pacific madrone (Arbutus menziesii Pursh). *For. Ecol. Manag.* **2021**, *497*, 119487. [CrossRef]
101. Toscano, S.; Scuderi, D.; Giuffrida, F.; Romano, D. Responses of Mediterranean ornamental shrubs to drought stress and recovery. *Sci. Hortic.* **2014**, *178*, 145–153. [CrossRef]
102. Sæbø, A.; Benedikz, T.; Randrup, T.B. Selection of trees for urban forestry in the Nordic countries. *Urban For. Urban Green.* **2003**, *2*, 101–114. [CrossRef]
103. Rejeb Ruett, M.; Junker-Frohn, L.V.; Siegmann, B.; Ellenberger, J.; Jaenicke, H.; Whitney, C.; Luedeling, E.; Tiede-Arlt, P.; Rascher, U. Hyperspectral imaging for high-throughput vitality monitoring in ornamental plant production. *Sci. Hortic.* **2022**, *291*, 110546. [CrossRef]
104. Saunier, A.; Ormeño, E.; Moja, S.; Fernandez, C.; Robert, E.; Dupouyet, S.; Despinasse, Y.; Baudino, S.; Nicolè, F.; Bousquet-Mélou, A. Lavender sensitivity to water stress: Comparison between eleven varieties across two phenological stages. *Ind. Crop. Prod.* **2022**, *177*, 114531. [CrossRef]
105. Zahir, A.; Abbasi, B.H.; Adil, M.; Anjum, S.; Zia, M.; Haq, I.U. Synergistic Effects of Drought Stress and Photoperiods on Phenology and Secondary Metabolism of Silybum marianum. *Appl. Biochem. Biotechnol.* **2014**, *174*, 693–707. [CrossRef] [PubMed]
106. Asrar, A.A.; Abdel-Fattah, G.M.; Elhindi, K.M. Improving growth, flower yield, and water relations of snapdragon (*Antirhinum majus* L.) plants grown under well-watered and water-stress conditions using arbuscular mycorrhizal fungi. *Photosynthetica* **2012**, *50*, 305–316. [CrossRef]
107. Battacharyya, D.; Babgohari, M.Z.; Rathor, P.; Prithiviraj, B. Seaweed extracts as biostimulants in horticulture. *Sci. Hortic.* **2015**, *196*, 39–48. [CrossRef]
108. Miles, L.S.; Breitbart, S.T.; Wagner, H.H.; Johnson, M.T.J. Urbanization Shapes the Ecology and Evolution of Plant-Arthropod Herbivore Interactions. *Front. Ecol. Evol.* **2019**, *7*, 310. [CrossRef]
109. Gao, S.; Chen, Y.; Li, K.; He, B.; Hou, P.; Guo, Z. Frequent heatwaves limit the indirect growth effect of urban vegetation in China. *Sustain. Cities Soc.* **2023**, *96*, 104662. [CrossRef]
110. Masouleh, S.S.S.; Aldine, N.J.; Sassine, Y.N. The role of organic solutes in the osmotic adjustment of chilling-stressed plants (vegetable, ornamental and crop plants). *Ornam. Hortic.* **2019**, *25*, 434–442. [CrossRef]
111. Godoy, F.; Olivos-Hernández, K.; Stange, C.; Handford, M. Abiotic Stress in Crop Species: Improving Tolerance by Applying Plant Metabolites. *Plants* **2021**, *10*, 186. [CrossRef] [PubMed]
112. Aishwarya, R.; Kumar, M. Urban Tree Carbon Density and CO_2 equivalent of National Zoological Park, Delhi. *Environ. Monit. Assess.* **2018**, *193*, 841.
113. Ashkiani, A.; Sayfzadeh, S.; Shirani Rad, A.H.; Valadabadi, A.; Hadidi Masouleh, E. Effects of Foliar Zinc Application on Yield and Oil Quality of Rapeseed Genotypes under Drought Stress. *J. Plant Nutr.* **2020**, *43*, 1594–1603. [CrossRef]
114. Feyisa, G.L.; Dons, K.; Meilby, H. Efficiency of parks in mitigating urban heat island effect: An example from Addis Ababa. *Landsc. Urban Plan.* **2014**, *123*, 87–95. [CrossRef]
115. Zhang, Z.; Lan, M.; Han, X.; Wu, J.; Wang-Pruski, G. Response of Ornamental Pepper to High-Temperature Stress and Role of Exogenous Salicylic Acid in Mitigating High Temperature. *J. Plant Growth Regul.* **2020**, *39*, 133–146. [CrossRef]
116. Jiang, C.; Bi, Y.; Zhang, R.; Feng, S. Expression of RcHSP70, heat shock protein 70 gene from Chinese rose, enhances host resistance to abiotic stresses. *Sci. Rep.* **2020**, *10*, 2445. [CrossRef]
117. Du, X.; Li, W.; Sheng, L.; Deng, Y.; Wang, Y.; Zhang, W.; Yu, K.; Jiang, J.; Fang, W.; Guan, Z.; et al. Over-expression of chrysanthemum CmDREB6 enhanced tolerance of chrysanthemum to heat stress. *BMC Plant Biol.* **2018**, *18*, 178. [CrossRef]
118. Wang, X.; Huang, W.; Liu, J.; Yang, Z.; Huang, B. Molecular regulation and physiological functions of a novel FaHsfA2c cloned from tall fescue conferring plant tolerance to heat stress. *Plant Biotechnol. J.* **2017**, *15*, 237–248. [CrossRef]
119. Majeed, A.; Muhammad, Z. Salinity: A major agricultural problem—Causes, impacts on crop productivity and management strategies. In *Plant Abiotic Stress Tolerance: Agronomic, Molecular and Biotechnological Approaches*; Springer: Cham, Switzerland, 2019; pp. 83–99.
120. Guo, J.; Shan, C.; Zhang, Y.; Wang, X.; Tian, H.; Han, G.; Zhang, Y.; Wang, B. Mechanisms of Salt Tolerance and Molecular Breeding of Salt-Tolerant Ornamental Plants. *Front. Plant Sci.* **2022**, *13*, 854116. [CrossRef]
121. Ahsan, M.; Zulfiqar, H.; Farooq, M.A.; Ali, S.; Tufail, A.; Kanwal, S.; Radicetti, E. Strigolactone (GR24) Application positively regulates photosynthetic attributes, stress-related metabolites and antioxidant enzymatic activities of ornamental sunflower (Helianthus annuus cv. Vincent's Choice) under salinity stress. *Agriculture* **2022**, *13*, 50. [CrossRef]
122. Gill, R.A.; Ahmar, S.; Ali, B.; Saleem, M.H.; Khan, M.U.; Zhou, W.; Liu, S. The Role of Membrane Transporters in Plant Growth and Development, and Abiotic Stress Tolerance. *Int. J. Mol. Sci.* **2021**, *22*, 12792. [CrossRef] [PubMed]
123. Yu, C.; Ke, Y.; Qin, J.; Huang, Y.; Zhao, Y.; Liu, Y.; Wei, H.; Liu, G.; Lian, B.; Chen, Y.; et al. Genome-wide identification of calcineurin B-like protein-interacting protein kinase gene family reveals members participating in abiotic stress in the ornamental woody plant Lagerstroemia indica. *Front. Plant Sci.* **2022**, *13*, 942217. [CrossRef]

124. Ben Hsouna, A.; Ghneim-Herrera, T.; Ben Romdhane, W.; Dabbous, A.; Ben Saad, R.; Brini, F.; Abdelly, C.; Ben Hamed, K. Early effects of salt stress on the physiological and oxidative status of the halophyte Lobularia maritima. *Funct. Plant Biol.* **2020**, *47*, 912. [CrossRef] [PubMed]
125. Wang, Y.; Sun, Y.; Niu, G.; Deng, C.; Wang, Y.; Gardea-Torresdey, J. Growth, Gas Exchange, and Mineral Nutrients of Ornamental Grasses Irrigated with Saline Water. *HortScience* **2019**, *54*, 1840–1846. [CrossRef]
126. Álvarez, S.; Sánchez-Blanco, M.J. Long-term effect of salinity on plant quality, water relations, photosynthetic parameters and ion distribution in *Callistemon citrinus*. *Plant Biol.* **2014**, *16*, 757–764. [CrossRef] [PubMed]
127. Breś, W.; Bandurska, H.; Kupska, A.; Niedziela, J.; Frąszczak, B. Responses of pelargonium (Pelargonium × hortorum LH bailey) to long-term salinity stress induced by treatment with different NaCl doses. *Acta Physiol. Plant.* **2016**, *38*, 26. [CrossRef]
128. Pourret, O. On the necessity of banning the term "heavy metal" from the scientific literature. *Sustainability* **2018**, *10*, 2879. [CrossRef]
129. El-Naggar, A.; Shaheen, S.M.; Ok, Y.S.; Rinklebe, J. Biochar Affects the Dissolved and Colloidal Concentrations of Cd, Cu, Ni, and Zn and their Phytoavailability and Potential Mobility in a Mining Soil under Dynamic Redox-Conditions. *Sci. Total Environ.* **2018**, *624*, 1059–1071. [CrossRef]
130. Barouchas, P.E.; Akoumianaki-Ioannidou, A.; Liopa-Tsakalidi, A.; Moustakas, N.K. Effects of Vanadium and Nickel on Morphological Characteristics and on Vanadium and Nickel Uptake by Shoots of Mojito (Mentha × villosa) and Lavender (*Lavandula anqustifolia*). *Not. Bot. Horti Agrobot. Cluj-Napoca* **2019**, *47*, 487–492. [CrossRef]
131. Goswami, S.; Das, S. Copper phytoremediation potential of *Calandula officinalis* L. and the role of antioxidant enzymes in metal tolerance. *Ecotoxicol. Environ. Saf.* **2016**, *126*, 211–218. [CrossRef]
132. Khan, A.H.A.; Kiyani, A.; Mirza, C.R.; Butt, T.A.; Barros, R.; Ali, B.; Iqbal, M.; Yousaf, S. Ornamental plants for the phytoremediation of heavy metals: Present knowledge and future perspectives. *Environ. Res.* **2021**, *195*, 110780. [CrossRef] [PubMed]
133. Asgari Lajayer, B.; Ghorbanpour, M.; Nikabadi, S. Heavy metals in contaminated environment: Destiny of secondary metabolite biosynthesis, oxidative status and phytoextraction in medicinal plants. *Ecoto.x Environ. Safe* **2017**, *145*, 377–390. [CrossRef] [PubMed]
134. Nakbanpote, W.; Meesungnoen, O.; Prasad, M. Potential of ornamental plants for phytoremediation of heavy metals and income generation. In *Bioremediation and Bioeconomy*; Elsevier: Alpharetta, GA, USA, 2016; pp. 179–217.
135. Antoniadis, V.; Levizou, E.; Shaheen, S.M.; Ok, Y.S.; Sebastian, A.; Baum, C.; Prasad, M.N.; Wenzel, W.W.; Rinklebe, J. Trace elements in the soil-plant interface: Phytoavailability, translocation, and phytoremediation—A review. *Earth Sci. Rev.* **2017**, *171*, 621–645. [CrossRef]
136. Gladkov, E.A.; Tashlieva, I.I.; Gladkova, O.V. Ornamental plants adapted to urban ecosystem pollution: Lawn grasses and painted daisy tolerating copper. *Environ. Sci. Pollut. Res.* **2021**, *28*, 14115–14120. [CrossRef] [PubMed]
137. Salgotra, R.K.; Stewart, C.N., Jr. Functional markers for precision plant breeding. *Int. J. Mol. Sci.* **2020**, *21*, 4792. [CrossRef] [PubMed]
138. Ho, T.; Pak, H.; Ri, S.; Kim, K.; Mun, N. Improvement of Water Stress Tolerance of Tuberous Begonia (Begonia × tuberhybrida) by OsmiR393a Gene Transformation. *J. Plant Sci.* **2021**, *9*, 257–265. [CrossRef]
139. Planchuelo, G.; von Der Lippe, M.; Kowarik, I. Untangling the role of urban ecosystems as habitats for endangered plant species. *Landsc. Urban Plan.* **2019**, *189*, 320–334. [CrossRef]
140. Avolio, M.L.; Pataki, D.E.; Trammell, T.L.E.; Endter-Wada, J. Biodiverse cities: The nursery industry, homeowners, and neighborhood differences drive urban tree composition. *Ecol. Monogr.* **2018**, *88*, 259–276. [CrossRef]
141. Schröder, R.; Kiehl, K. Ecological restoration of an urban demolition site through introduction of native forb species. *Urban For. Urban Green.* **2020**, *47*, 126509. [CrossRef]
142. Seaton, K.; Bettin, A.; Grüneberg, H. New ornamental plants for horticulture. In *Horticulture: Plants for People and Places*; Dixon, G., Aldous, D., Eds.; Springer: Dordrecht, The Netherlands, 2014; Volume 1, pp. 435–463.
143. Hart, E.; Miller, F.; Bastian, R. Tree Location and Winter Temperature Influence on Mimosa Webworm Populations in a Northern Urban Environment. *Arboric. Urban For.* **1986**, *12*, 237–240. [CrossRef]
144. Langevelde, F.; Braamburg-Annegarn, M.; Huigens, M.E.; Groendijk, R.; Poitevin, O.; Deijk, J.R.; Ellis, W.N.; Grunsven, R.H.A.; Vos, R.; Vos, R.A.; et al. Declines in moth populations stress the need for conserving dark nights. *Glob. Chang. Biol.* **2018**, *24*, 925–932. [CrossRef] [PubMed]
145. Blanusa, T.; Garratt, M.; Cathcart-James, M.; Hunt, L.; Cameron, R.W. Urban hedges: A review of plant species and cultivars for ecosystem service delivery in north-west Europe. *Urban For. Urban Green.* **2019**, *44*, 126391. [CrossRef]
146. Alizadeh, B.; Hitchmough, J. A review of urban landscape adaptation to the challenge of climate change. *Int. J. Clim. Chang. Strat. Manag.* **2019**, *11*, 178–194. [CrossRef]
147. Hesami, M.; Pepe, M.; Baiton, A.; Salami, S.A.; Jones, A.M.P. New Insight into Ornamental Applications of Cannabis: Perspectives and Challenges. *Plants* **2022**, *11*, 2383. [CrossRef]
148. Stratópoulos, L.M.F.; Zhang, C.; Häberle, K.-H.; Pauleit, S.; Duthweiler, S.; Pretzsch, H.; Rötzer, T. Effects of Drought on the Phenology, Growth, and Morphological Development of Three Urban Tree Species and Cultivars. *Sustainability* **2019**, *11*, 5117. [CrossRef]
149. Boutigny, A.-L.; Dohin, N.; Pornin, D.; Rolland, M. Overview and detectability of the genetic modifications in ornamental plants. *Hortic. Res.* **2020**, *7*, 11. [CrossRef] [PubMed]

150. Huylenbroeck, J.V.; Bhattarai, K. Ornamental plant breeding: Entering a new era? *Ornam. Hortic.* **2022**, *28*, 297–305. [CrossRef]
151. Suprasanna, P.; Jain, S.M. Biotechnology and induced mutations in ornamental plant improvement. In *II International Symposium on Tropical and Subtropical Ornamentals 1344*; ISHS: Leuven, Belgium, 2021; pp. 1–12.
152. Younis, A.; Ramzan, F.; Ramzan, Y.; Zulfiqar, F.; Ahsan, M.; Lim, K.B. Molecular Markers Improve Abiotic Stress Tolerance in Crops: A Review. *Plants* **2020**, *9*, 1374. [CrossRef]
153. Soorni, A.; Fatahi, R.; Haak, D.C.; Salami, S.A.; Bombarely, A. Assessment of Genetic Diversity and Population Structure in Iranian Cannabis Germplasm. *Sci. Rep.* **2017**, *7*, 15668. [CrossRef]
154. Chengru, L.; Na, D.; Junwen, Z. A Review for the Breeding of Orchids: Current Achievements and Prospects. *Hortic. Plant J.* **2021**, *7*, 380–392. [CrossRef]
155. Gahlaut, V.; Kumari, P.; Jaiswal, V.; Kumar, S. Genetics, genomics and breeding in Rosa species. *J. Hortic. Sci. Biotechnol.* **2021**, *96*, 545–559. [CrossRef]
156. Begum, Y. Regulatory role of microRNAs (miRNAs) in the recent development of abiotic stress tolerance of plants. *Gene* **2022**, *821*, 146283. [CrossRef] [PubMed]
157. Van Oost, E.; Leus, L.; De Rybel, B.; Van Laere, K. Determination of genetic distance, genome size and chromosome numbers to support breeding in ornamental Lavandula species. *Agronomy* **2021**, *11*, 2173. [CrossRef]
158. Marasek-Ciolakowska, A.; Sochacki, D.; Marciniak, P. Breeding Aspects of Selected Ornamental Bulbous Crops. *Agronomy* **2021**, *11*, 1709. [CrossRef]
159. Jafarkhani Kermani, M.; Emadpour, M. Application of polyploidization in breeding of ornamental plants. *Flower Ornam. Plants* **2019**, *3*, 77–89.
160. Niazian, M.; Nalousi, A.M. Artificial polyploidy induction for improvement of ornamental and medicinal plants. *Plant Cell Tissue Organ Cult.* **2020**, *142*, 447–469. [CrossRef]
161. Popova, O.V.; Dinh, H.Q.; Aufsatz, W.; Jonak, C. The RdDM pathway is required for basal heat tolerance in *Arabidopsis*. *Mol. Plant* **2013**, *6*, 396–410. [CrossRef] [PubMed]
162. Hu, J.; Manduzio, S.; Kang, H. Epitranscriptomic RNA Methylation in Plant Development and Abiotic Stress Responses. *Front. Plant Sci.* **2019**, *10*, 500. [CrossRef]
163. Sun, X.; Lin, L.; Sui, N. Regulation mechanism of microRNA in plant response to abiotic stress and breeding. *Mol. Biol. Rep.* **2019**, *46*, 1447–1457. [CrossRef]
164. Vakilian, K.A. Machine learning improves our knowledge about miRNA functions towards plant abiotic stresses. *Sci. Rep.* **2020**, *10*, 3041. [CrossRef]
165. Shu, K.; Zhou, W.; Chen, F.; Luo, X.; Yang, W. Abscisic Acid and Gibberellins Antagonistically Mediate Plant Development and Abiotic Stress Responses. *Front. Plant Sci.* **2018**, *9*, 416. [CrossRef] [PubMed]
166. Shinozaki, K.; Yamaguchi-Shinozaki, K. Gene networks involved in drought stress response and tolerance. *J. Exp. Bot.* **2007**, *58*, 221–227. [CrossRef] [PubMed]
167. Yang, X.; Jia, Z.; Pu, Q.; Tian, Y.; Zhu, F.; Liu, Y. ABA Mediates Plant Development and Abiotic Stress via Alternative Splicing. *Int. J. Mol. Sci.* **2022**, *23*, 3796. [CrossRef] [PubMed]
168. Mata-Pérez, C.; Begara-Morales, J.C.; Chaki, M.; Sánchez-Calvo, B.; Valderrama, R.; Padilla, M.N.; Corpas, F.J.; Barroso, J.B. Protein Tyrosine Nitration during Development and Abiotic Stress Response in Plants. *Front. Plant Sci.* **2016**, *7*, 1699. [CrossRef] [PubMed]
169. Schneider, L.M.; Adamski, N.M.; Christensen, C.E.; Stuart, D.B.; Vautrin, S.; Hansson, M.; von Wettstein-Knowles, P. The Cer-cqu gene cluster determines three key players in a β-diketone synthase polyketide pathway synthesizing aliphatics in epicuticular waxes. *J. Exp. Bot.* **2016**, *67*, 2715–2730. [CrossRef] [PubMed]
170. Nair, R.M.; Pandey, A.K.; War, A.R.; Hanumantharao, B.; Shwe, T.; Alam, A.; Pratap, A.; Malik, S.R.; Karimi, R.; Mbeyagala, E.K.; et al. Biotic and Abiotic Constraints in Mungbean Production—Progress in Genetic Improvement. *Front. Plant Sci.* **2019**, *10*, 1340. [CrossRef] [PubMed]
171. Qian, R.; Hu, Q.; Ma, X.; Zhang, X.; Ye, Y.; Liu, H.; Gao, H.; Zheng, J. Comparative transcriptome analysis of heat stress responses of Clematis lanuginosa and Clematis crassifolia. *BMC Plant Biol.* **2022**, *22*, 138. [CrossRef]
172. Franco, J.A.; Martínez-Sánchez, J.J.; Fernández, J.A.; Bañón, S. Selection and nursery production of ornamental plants for landscaping and xerogardening in semi-a rid environment. *J. Hortic. Sci. Biotechnol.* **2006**, *81*, 3–17. [CrossRef]
173. Oh, M.-M.; Carey, E.E.; Rajashekar, C.B. Regulated Water Deficits Improve Phytochemical Concentration in Lettuce. *J. Am. Soc. Hortic. Sci.* **2019**, *135*, 223–229. [CrossRef]
174. Raza, A.; Razzaq, A.; Mehmood, S.S.; Zou, X.; Zhang, X.; Lv, Y.; Xu, J. Impact of climate change on crops adaptation and strategies to tackle its outcome: A review. *Plants* **2019**, *8*, 34. [CrossRef]
175. Wang, J.; Song, L.; Gong, X.; Xu, J.; Li, M. Functions of Jasmonic Acid in Plant Regulation and Response to Abiotic Stress. *Int. J. Mol. Sci.* **2020**, *21*, 1446. [CrossRef] [PubMed]
176. Baruch, Z.; Liddicoat, C.; Cando-Dumancela, C.; Laws, M.; Morelli, H.; Weinstein, P.; Young, J.M.; Breed, M.F. Increased plant species richness associates with greater soil bacterial diversity in urban green spaces. *Environ. Res.* **2021**, *196*, 110425. [CrossRef] [PubMed]
177. Mills, J.G.; Brookes, J.D.; Gellie NJ, C.; Liddicoat, C.; Lowe, A.J.; Sydnor, H.R. Relating Urban Biodiversity to Human Health With the "Holobiont" Concept. *Front. Microbiol.* **2019**, *10*, 550. [CrossRef] [PubMed]

178. Pereira, J.M.; Vasconcellos, R.L.; Pereira, A.P.; Stürmer, S.L.; Silva, A.M.; Baretta, D.; Bonfim, J.A.; Cardoso, E.J. Reforestation processes, seasonality and soil characteristics influence arbuscular mycorrhizal fungi dynamics in Araucaria angustifolia forest. *For. Ecol. Manag.* **2020**, *460*, 117899. [CrossRef]
179. Nordstedt, N.P.; Chapin, L.J.; Taylor, C.G.; Jones, M.L. Identification of *Pseudomonas* spp. That Increase Ornamental Crop Quality During Abiotic Stress. *Front. Plant Sci.* **2020**, *10*, 1754. [CrossRef] [PubMed]
180. Ma, X.; Zhao, F.; Zhou, B. The Characters of Non-Coding RNAs and Their Biological Roles in Plant Development and Abiotic Stress Response. *Int. J. Mol. Sci.* **2022**, *23*, 4124. [CrossRef] [PubMed]
181. Bulgari, R.; Franzoni, G.; Ferrante, A. Biostimulants Application in Horticultural Crops under Abiotic Stress Conditions. *Agronomy* **2019**, *9*, 306. [CrossRef]
182. Monteiro, E.; Gonçalves, B.; Cortez, I.; Castro, I. The Role of Biostimulants as Alleviators of Biotic and Abiotic Stresses in Grapevine: A Review. *Plants* **2022**, *11*, 396. [CrossRef]
183. Wani, S.A.; Chand, S.; Wani, M.A.; Ramzan, M.; Hakeem, K.R. Azotobacter chroococcum—A potential biofertilizer in agriculture: An overview. In *Soil Science: Agricultural and Environmental Prospectives*; Springer: Cham, Switzerland, 2016; pp. 333–348.