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The Effect of Drought Stress in Some Vegetative Growth and the Physiological Characteristics and the Quality and Quantity Characteristics Yield of Some Leguminosae Family Plants

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Abstract: Drought stress is one of the types of non-biological environmental stresses that occurs when soil water decreases as a result of low rainfall, or when the loss of water by transpiration exceeds the absorption of water through the roots, and this directly leads to changes in the natural environment of the plant. The researchers found that treatment with drought stress has led to a decrease in the characteristics of vegetative growth, including the height of the plant (cm), the leaf area (cm^2) and the number of leaves(leaf.plant^{-1}) and dry weight of the total vegetative (gm) and absolute growth rate (g.day^{-1}) and decrease in some physiological qualities include chlorophyll content (mg. g^{-1}) soft weight leaves, while the concentration of proline (µg. g^{-1} soft weight), MDA content (mmol.g^{-1} soft weight) and α-tocopherol (µg.g^{-1}) increased, antioxidants SOD, CAT, POX, GPX increased in most studies, while quality and quantity of yield decreased when the plant was stressed.

Keywords: Drought stress, Proline, α-tocopherol, Superoxide dismutase (SOD), Catalase (CAT), Peroxidase (POD), Glutathione peroxidase (GPX), Malondialdehyde (MDA).

1. INTRODUCTION

Drought stress: is one of the types of non-biological environmental stresses that occurs when soil water decreases due to lack of rainfall or when the loss of water through transpiration exceeds the absorption of water through roots and this leads to changes in the natural environment of the plant directly and then changes in its physiological and biochemical work, stress is divided into three types:

1. Mild stress: The water stress of cells is reduced by very little hydro stress units (MPa).
2. Moderate stress: The water stress of the cells decreases to the range of 1.2- 1.5 (MPa).
3. Severe stress: The water stress of cells decreases by less than 1.5 MPa (1), drought stress is a process of water loss that leads to closing stomata and reducing gas exchange (2) and leads to reduced water content, reduced water stress of the leaf, loss of turgor, closure of stomata, lack of elongation and cell growth, as well as severe drought stress to stop construction, metabolic disorder and finally plant death (3).

Drought tolerance mechanisms

1. Drought escape is the main adaptation mechanism involving the rapid growth and development of the plant, legumes crops can escape drought by reducing their stress life by maintaining a high water effort in tissues, improving water absorption and reducing loss (4) drought escape occurs when physiological development corresponds to periods of soil moisture availability (5) growth in unspecified legume crops such as beans and cowpea and this mitigates the harmful effects short-term to stress drought (6).
2. Solute Accumulation: The accumulation of solute is a basic strategy to protect Osmo-protection and osmotic adjustment under drought stress, the accumulation of these substances is primarily in cells that had drought without interfering with large molecules, namely hydroxyl compounds such as polyhydric alcohols sucrose, oligosaccharides and nitrogen container compounds such as amino acids, proline, Polyamines and ammonium compounds (7). Osmo-protection mechanics are closely linked between non-toxic elements and a number of cellular components, while Osmotic adjustment mechanics help maintain turgor by maintaining the water content of cells (8).
3. Antioxidant defense: The production of Reactive Oxygen Species(ROS) is an initial response to drought plants and acts as a messenger to activate the defense mechanisms in the plant (9) under dry conditions produces ROS and accumulates such as hydroxide peroxidase, hydroxyl root, superoxide root and single oxygen, which cause damage to large molecules and cell composition (10). ROS acts as signal molecules in low concentrations and shows different responses under stress conditions, when it exceeds the level of defense mechanism causes ROS oxidation stress on proteins, fats and nucleic acids leading to a change in the essential characteristics of bio-molecules and cell death (11) regulates the enzyme and non-enzymatic components of the defensive mechanism of ROS in cells and maintains high concentrations of antioxidants or antioxidant enzymes that have been shown to be a response to dehydration (12,13). Enzymatic antioxidants include: Catalase (CAT), Superoxide dismutase (SOD), Glutathione peroxidase (GPX), Giutathione reductase (GR), Ascorbate peroxidase (APX), Dehydroascorbate reductase (DHAR), Mono Dehydroascorbate reductase (MdHAR) and Non-enzymatic antioxidants include: Phenolic, Carotenoids, Tocopherols and Ascorbate (14).
4. Hormone Regulation: Regulation of hormones (Gibberellin, cytokine, auxins, ABA, ethylene) all aspects of plant growth, and its development these plant hormones share the tolerance of dehydration (15) the concentrations of gibberellin, cytokines and auxins decrease in water deficiency while ethylene and ABA increase in plants (16).
5. Possible qualities for testing legumes resistance to drought: different characteristics have been used to detect drought tolerance, including smaller leaf area, root biomass, vegetative part, osmotic regulation, number of pods and weight of 100 grains, and among a number of factors that strongly share the tolerance of legumes to drought is the synthesis of roots, which is important for the drought resistance (17) this enables the plant to invest water efficiently from deeper soil layers under dry environments (18).

The effect of drought stress on the characteristics of vegetable growth:

water represents a key role in increasing plant height as it increases turgor pressure and shed pressure from inside and outside cells and without this pressure can not rectangular cells and represents the elongation of cells important factor in their growth and division and when drought occurs will work to negatively affect the reduction of plant height (19). (20) found a significant decrease in the height of *Vigna unguiculatau* plant when exposed to drought

stress, (21) found that there is a signifcant increase in the height of *Vicia faba* plant when irrigation increases compared to the control dependent on rainwater only. In a study conducted (22) on the chickpeas plant *Cicer arietinum*, drought has an effect on plant height compared to control. The results of (23) on *Vigna radiata* plant showed that the increase in the duration of the indecency significantly affected the decrease in the rate of plant height.
(24) confirmed that exposing of the cowpea plant to drought the capacity of the ring 30% led to a significant decrease in the height of the plant. The results (26) on *Arachis hypogaea* plant in the start stages of flowering and the pods showed that drought has a significant effect in reducing the values of the characteristic of plant height compared to control. (27) found that there was a decrease in the height of the cowpea plant when exposed to a 10 day drought, according to the president, the plant's genetic pattern compared to the treatment of control. In a study conducted by 28, the exposure of cowpea plant to a dry stress with a field capacity (75.50%) led to a significant decrease in plant height. (29) indicated a decrease in the height of the mung plant when exposed to the stress of drought 25 and 35 days after the seed. The leaf is an organ of the plant in which all photosynthesis events occur (31). (31) found a decrease in the leaf area of the cowpea plant when exposed to various drought periods. A study (32) on some genetic species of the cowpea plant showed that the leafy area of plants has decreased under moderate and severe stress compared to the treatment of control. (33) found that exposing the plant of *V. faba* plant to drought stress led to a decrease in the leaf area. (34) showed that there is a decrease in the leaf area of the plant of the cowpea when exposed to drought stress, especially in the vegetative and reproductive stage. In a study conducted on the plant of the beans exposed to the stress of severe and moderate drought and explained that the leaf area has decreased significantly. (26) was found that drought stress have an effect on the leaf area of *A.hypogaea*, where the leaf area decreased significantly in the branching stage, reaching 652.8 cm^2 /plant and in the process of starting flowers amounted to 510.8 cm^2 / plant compared to the control plants as the area of the leaf reached 706.3 cm^2/plant. (36) note that the stress of drought has reduced the leaf area of the cowpea plant. (37) found that when *Lens culinaris* were exposed to a 7-day drought stress, the leaf area decreased from 16.76 cm^2 to 13.63 cm^2 in control plants. (38) note reduced leaf area when exposing the mung plant to drought stress. (39) indicated a 50% reduction in the leaf area of the bean plant after being exposed to drought stress. The leaves are the most drought-sensitive parts of the plant and the speed of photosynthesis is influenced by the number of leaves and their structure in the stem (40). (41) found that the stress of drought caused a significant decrease in the number of leaves for the cowpea plant. (42) note that the spacing of irrigation periods from 7 to 14 days for the mung plant led to a significant decrease in the number of leaves. (43) confirmed a decrease in the number of leaves when exposing the cowpea plant to the stress of drought. (44) indicated a reduction in the number of leaves and an 18% reduction in the bean plant prone to drought stress. In the study (45) there was a marked decrease in the number of leaves for lentil plant when exposed to drought stress for 13 days and the number continued to decrease when stress lasted for 20 days. (46) proved a decrease in the number of leaves for bean plants under the stress of drought. (47) found a decrease in the number of leaves for the cowpea plant exposed to drought stress compared to the treatment of control. (48) note that the stress of severe and moderate drought has reduced the number of leaves in the cowpea plant. The dry weight of the plant is affected by the surrounding environmental conditions and since drought is one of the most dominant environmental factors, it has an important and direct effect on dry weight (49). The dry weight of the vegetable total reflects the value of nutrients collected in the parts of the plant above ground and the production of dry matter of the crop depends on the balance between

photosynthesis and respiration (50). (51) indicated a decrease in the dry weight of the total vegetable of *Vicia faba* plant significantly as the periods of the drought increased. In a study conducted by (52) on the peas plant, drought has an effect on reducing the dry weight of the plant. (20) note a significant decrease in the dry weight of the bean plant when exposed to drought stress. (41) showed that there is a decrease in the production of dry materials for the cowpea plant when exposed to the stress of drought. In a study on some peanut varieties, (53) found a decrease in dry weight 70 days after early drought, as well as the final dry weight decreased at harvest. In his study on the cowpea, he found that drought stress led to a clear reduction in dry weight. (24) proved that exposing the cowpea plant to drought stress led to a marked decrease in dry weight, especially when treated 30% field capacity. (54) note a decrease in the dry weight of the cowpea plant when exposed to a drought stress in the vegetable stage by 56% and the flower stage by 36.2%. (55) indicated a decrease in dry materials for soybean plants, 42.44% in moderate drought and 60.65% in severe drought, and further decreases by increasing the period of drought. Absolute growth rate is the efficiency of plant completion of biological processes any factor affects the appearance and physiological qualities of the plant will affect in the absolute growth rate (56). (57) has shown that the reason for the low absolute growth rate is the negative effect of the surrounding environmental conditions, the most important of which is drought. A study of (42) showed that when the irrigation periods of the mung plant diverged, the absolute growth rate decreased by 54.55%. According to (23), the growth rate of the mung plant has fallen to 0.0213 g.1 and by a decrease of 73.31% compared to the control treatment.

Effect of drought stress on physiological characteristics:
One of the most sensitive processes for drought stress in the process of photosynthesis (58) as the efficiency of photosynthesis and the work of stomata reduces and inhibits ruBisco's effectiveness as a response to drought (59). Measuring chlorophyll content helps evaluate the process of photosynthesis in plants, water is an influential factor in the synthesis of chlorophyll and can determine the content of chlorophyll, which means that plants that absorb water from the medium contain more water, leading to a high level of chlorophyll (27). (60) found that drought stress reduced the content of chlorophyll in the bean plant. (22) pointed out that exposing the chickpeas plant to the stress of drought in the vegetable stage and the flowers stage significantly affected the content of chlorophyll. In a study conducted on the cowpea plant exposed to drought stress, 61 indicated a decrease in the content of chlorophyll. In a study conducted on the cowpea plant exposed to drought stress, (61) noted the decrease in the content of chlorophyll. (62) indicated that drought stress has led to a decrease in the content of chlorophyll for the cowpea plant. (27) note that the content of chlorophyll has been affected by drought stress for a number of genetic patterns of the cowpea plant. (63) note that drought stress has clearly reduced the content of chlorophyll in some lentil varieties compared to the control treatment. (64) found that the severe and moderate stress exposed to the cowpea plant worked to reduce all components of photosynthesis stains compared to control. (65) proved that the value of chlorophyll decreased in the leaves of the cowpea plant exposed to drought stress by 44% compared to the treatment of control. (66) found that the stress of draught led to the reduction of the content of chlorophyll in the bean plant. (67) noted that the value of chlorophyll decreased when exposing the plant to drought stress. Proline is an amino acid that increases in plant tissue when it is stressed as a form of adaptation. The source of proline collected during drought stress is due to the synthesis of glutamate amino acid or aggregate due to a lack of oxidation and the reason for the lack of activity of the enzyme stimulating its oxidation proline dehydrogenase (68). (69) pointed out

that exposing the soybean plant to drought stress has led to the accumulation of a high percentage of proline. (70) found that there is an increase in the content of proline in the mung plant when exposed to drought stress. (71) found that the content of proline has increased by increasing the period of the drought stress of *Vicia faba* plant. (72) showed that there is an increase in the amount of proline for soybean plants in stress conditions compared to control. (73) indicated an increase in the levels of proline for the cowpea plant exposed to drought stress compared to the treatment of control. In a study conducted by (74) on the bean plant, it was found that when exposed to drought, it increased the amount of proline to the genetic patterns studied. (44) showed that there is a rise in levels of proline in the leaves of the bean plant at 105% when exposed to drought stress. The results of the study (75) showed that there is an increase in the content of proline by increasing levels of drought stress on *Vicia faba* plant. (76) found that exposing the mash plant to drought led to a clear increase in the content of proline by 156% after 24 hours and 524% after 48 hours. ROS causes lipid peroxidation and is measured by the term "MDA content", and according to a study (77) on two types of beans exposed to drought stress 7 and 14 days found to be an increase in MDA content. (78) found that the stress of drought has increased the level of lipid peroxidation on two types of cowpea plant. (61) proved that there is a marked increase in MDA content in some genetic patterns of bean plant when exposed to drought stress compared to control. In a study on chickpeas, (79) found that there was an increase in MDA content for some genetic patterns, while others showed no significant increase in MDA compared to control. (80) note that there is an increase in the content of MDA for four genetic patterns of chickpeas under drought stress, especially in the pre-flowering stage. In a study conducted on the plant, (33) found that there was an increase in MDA content by increasing drought stress treatments. In a study conducted by (81) on two varieties of chickpeas exposed to no drought stress there was an increase in the content of MDA for the two varieties. (82) note that MDA's concentration in bean leaves has increased significantly under the stress of severe and moderate drought. (64) found an increase in MDA content in lentil leaves on the seventh day of drought. (83) confirmed an increase in the content of MDA in the mung plant when exposed to a lack of water. α-Tocopherol compound found in plastids, an antioxidant that inhibits effective oxygen species and prevents the spread of lipid peroxidation by capturing lipid peroxyl radicals in thylakoid membranes (84). (85) found that when the peas plant was exposed to drought stress, vitamin E increased by 67%. (86) note that drought has slightly increased the α-Tocopherol. (87) an increase in α-Tocopherol was found by increasing the temperature during the drought period of the soybean plant. In a study conducted on the peas plant, a decrease in the effectiveness of POX, SOD and CAT antioxidants was found when exposing the plant to drought stress. In a study conducted by (77) on the bean plant, the effectiveness of SOD was found to have increased by 31% on the seventh day of drought and remained the same on the 14^{th} day, while CAT's effectiveness did not increase on day 7 and 14. (78) indicated an increase in the effectiveness of POX and CAT in the varieties of the cowpea plant by increasing the stress of drought. In his study on the soybean plant, he emphasized an increase in CAT effectiveness, POD and SOD efficacy. (88) found an increase in the effectiveness of SOD, CAT and GPX in a study conducted on chickpeas exposed to drought stress. A study (33) recorded a decrease in the effectiveness of SOD, CAT and GPX when the plant was exposed to drought stress. (35) found that there has been a marked increase in the effectiveness of CAT, SOD and POD enzyme by increasing levels of dry stress in *Vicia faba* plant. In his study on the plant of the cowpea, (89) explained that there has been an increase in the effectiveness of CAT, SOD and POX in plant leaves exposed to drought stress. In a study (90) on varieties of bean plant, it was noted that when exposed to drought, the plant increased the effectiveness of POX, SOD and CAT enzymes when the field capacity was 50% compared to control.

The effect of drought stress on the quality and quantity yield characteristics:
(91) explained that drought stress increased the accumulation of starch in the pods of some drought-resistant varieties of beans plant more than drought-sensitive varieties while there was a reduction in the content of starch in the leaves of the varieties established for drought during the process of filling grains and also noted the accumulation of sucrose in the immature pods of these varieties. (33) pointed out that the concentration of total dissolved carbohydrates in the plant of the peas has been reduced by increased stress of drought. (36) note that drought stress increased the content of total dissolved sugars by 5% in the cowpea plant compared to control. (92) found that a week-long drought increased dissolved sugars in lentils. (55) noted that severe stress reduced dissolved sugars by a small percentage while starch clearly decreased on the soybean plant. drought induces changes in a number of physiological and biochemical processes, including inhibition of protein synthesis (93). (70) found a decrease in protein content for a plant exposed to drought stress. (73) note a decrease in the protein content of the bean plant when exposed to drought stress 6 days. (94) confirmed that the protein content has decreased by increasing the treatment of drought weekly for the mung and cowpea plants. In a study (44) the protein content in bean seeds that the protein content in *P. vulgaris* seeds has decreased after being exposed to drought stress. (95) found that the protein content in the grains increased when exposing beans to drought stress in reproduction stage by 23.21% while in control 21.87%. (96) confirmed that the treatment of the bean plant by stressing drought has led to an increase in protein content. (38) indicated a decrease in protein content when the mung plant was exposed to drought stress. (67) found that exposing the mung plant to drought led to a decrease in protein content. (97) noted that there is a decrease in the number of pods for *Cicer arieyinum* and the number of grains and a decrease in the weight of grains and seed yield in plants that were irrigated only in the flowering stage compared to permanently irrigated plants. (98) found that some varieties of *V. unguiculata* recorded a marked decrease in seed yield in the case of drought stress compared to non-stressed plants and for two consecutive seasons. In a study conducted on the cowpeas, (99) explained that the seed yield decreased in stress-exposed plants compared to the treatment of control. In a study conducted by (73) on the plant of the cowpea, it was found that the stress of drought led to the reduction of the yield. (100) found a significant decrease in the yield of *L.culinaris* lentils when exposed to drought stress. (101) found a decrease in the number of pods for the cowpea plant and the number of seeds and thus a decrease in the yield when the plant was exposed to drought stress. (102) note that there is a clear decrease in the seed yield of the cowpea plant under the influence of drought stress accompanied by a significant reduction in all components of the yield. (103) found a decrease in the yield of the cowpea plant exposed to drought stress. (104) note that the cowpea plant cultured in rain fed conditions had a seed yield of 4.35 g. $plant^{-1}$ that were continuously irrigated 10.33 $g.plant^{-1}$. (105) noted that exposing the cowpea plant to drought stress led to a significant decrease in the length of the pods and the number of $seeds.pod^{-1}$ and the number of pods and yield compared to the treatment of control. In a study conducted (106) on lentils, it was found that drought stress had a clear effect on the decline in the yield. (34) found that there is a clear decrease in the number of pods and their weight, number of seeds and their weight in some types of cowpea when exposed to the drought stress in the vegetative and reproductive stage. (107) indicated a decrease in the yield and its components when exposing the plant of the cowpea to the stress of drought compared to the treatment of

control. (108) pointed out that the stress of 10 days of drought clearly reduced the number of horns and grains yield for the cowpea plant compared to the plants of control. (109) indicated a 70% decrease in the rate when *P.vulgaris* was exposed to drought stress. (110) confirmed that the drought has negatively affected the crop and its contents in the bean plant. (111) pointed out that drought reduced the number of pods for the plant and the number of grains per pod for the bean plant.

2. CONCLUSIONS

Treatment with drought stress has led to a decrease in the characteristics of vegetable growth and the resulting drought stress has caused an increase in the physiological characteristics.

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