# EFFECT OF SELENITE ON DROUGHT STRESSED RICE

(*Oryza sativa* L.)

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**A FINAL YEAR PROJECT SUBMITTED TO THE DEPARTMENT OF PLANT SCIENCE AND BIOTECHNOLOGY, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE (B.Sc.) DEGREE IN PLANT SCIENCE AND BIOTECHNOLOGY.**

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# CERTIFICATION

This is to certify that this report was carried out by Awoyemi Oluwatosin Oyeladun with the matriculation number PSB/14/2356 under my supervision in the Department of plant science and Biotechnology, Faculty of science, Federal University Oye-Ekiti, Ekiti State, Nigeria.

.....  10/04/19

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.....  10-04-19

HEAD OF DEPARTMENT  Date

DR, A.A AJIBOYE

# DEDICATION

This project is dedicated to the Most High God, the creator of heaven and earth, The One that was, The One that is , and The One that will forever be for His infinite mercy, grace, abundant provision, guidance, breakthrough and loving-kindness granted unto me.

This work is also dedicated to my parent and guardian.

# ACKNOWLEDGEMENTS

My sincere praise and appreciation will continually be directed to the Omnipotent, Omnipresence, Omniscience, ever faithful and the Most everlasting God for His supernatural, divine, miraculous and magnificent provision and guidance over me.

I also give heart-most gratitude to my mother and grandmother for their continuous prayers and support.

To my wonderful ever loving and caring guardian Mr and Mrs Akinpelu J. O, I say a very big thank you to you all for your persistent support spiritually, financially, mentally and in all facets of life from onset, May God keep both of you to eat the fruit of your labor.

To my ever understanding and loving supervisor, Mrs O.A David thanks for your patience and guidance throughout the project work, To my HOD Dr, A.A Ajiboye , Mr Ajewole and all lecturers in the department, thanks for your advice.

I also appreciate my ever supportive siblings Adebayo Olusola, Awoyemi Ajiboye, Temitope, Akinpelu Blessing, Damilola, Faith and my friend Afolami Ifeoluwa for their words of encouragement and financial support.

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# ABSTRACT

Drought is a period of dryness especially when prolonged or when there is occurrence of persistent abnormal moisture deficiency, although drought is natural but it can be induced artificially under a controlled environment. This study aimed at studying the effect of sodium selenite by studying their biochemical components and plant height. The seeds were collected at IITA (INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE), Ibadan, Nigeria. Soil was collected and dried for 4 days, 5kg of soil was used for the planting, three cultivars namely Nerica U4 ( B), Nerica U7(C) and Vandana (D) represented as RB, RC and RD respectively was primed for 10hours with sodium selenite at 3 different concentration of 0,50 and 100 mg/l, represented as S0, S50 and S100 and all treatment was subjected to different level drought stress represented as well-watered (D0) days, 4days (D4) and 8 days (D8). Plants were monitored till maturity. Plant Morphology, chlorophyll, antioxidants and MDA content were determined. The effect of selenite on rice was basically cultivar dependent. There were significance variations in plant height, anthocyanin, antioxidant enzymes and MDA content. Cultivar RB primed with 100mg/l selenite had the good growth performance, low MDA content and high CAT.

# CHAPTER ONE

## 1.0 INTRODUCTION

Drought which is simply described as a period of dryness especially when prolonged or when there is occurrence of persistent abnormal moisture deficiency. Although drought is a natural occurrence, it can also be induced artificially under a controlled environment. Drought is categorized as an abiotic stress and one of the major environmental factors that affect large areas globally. Plants have little defense mechanism to avoid or limit the extent of damage to which this stress can cause. Drought stress is a multidimensional stress and causes changes in the physiological, morphological, biochemical, and molecular traits in plants. Many plants have improved their resistance mechanisms to tolerate drought stress, but these mechanisms are varied and depend on the plant species. Typically, mechanisms involved in plant tolerance to drought follow a general plan maintaining cell homeostasis in water-deficit situations, which is possible by increasing the water inlet to the cells. Drought avoidance is other common drought resistance mechanism in annual plants. With this mechanism, escape from stress conditions is the main strategy for plant growth under drought condition. Plants retain the preceding abiotic stress memory that may help in attainment of tolerance to subsequent stresses. Several techniques have been developed to overcome some of this abiotic stress and improve the agricultural yield or products one of this techniques is seed priming. Seed priming which can be described as a controlled hydration techniques, is a pre sowing strategy for influencing development by modulating pre germination metabolic activity prior to emergence of the radical and generally enhances germination rate, it has been proven to be an effective and indispensable approach to enhance the emergence of seedling, vigor and stress tolerance to many filed crops including rice.

Seed priming is also described as a pre-sowing strategy for influencing seedling development by modulating pre-germination metabolic activity prior to emergence of the radical, and

generally enhances germination rate, substantially improves the stand establishment ( Jafar *et al.,* 2012), plant performance in the field ( Kazemi and Eskandari, 2012) and significantly improves plant water relations, chlorophyll content, root length, shoot length, seedling dry weight, membrane stability ( Farooq et al., 2013; Afzal *et* al., 2005). Plants raised from primed seed show vigorous start and greater stress tolerance primarily due to the efficient energy metabolism, osmotic adjustment, enhanced enzyme activation, and quick cellular defense responses, Priming with selenite is a modern technique that combine the positive effects of seed priming with an improved selenite supply which enhance plant tolerance against environmental stress.

However seed priming with various organic chemicals has elucidate synchronized germination owing to simply a reduction in the lag time of inhibition, build of germination enhancing metabolites, metabolic repair during imbibition and osmotic adjustment which resulted in vigorous root growth, shoot growth, improved plant water relation, chlorophyll contents and so on. Seed priming could be used to alleviate the depressive effect of drought stress, this can be influenced by many factors which include, priming methods, plant species and drought intensity.

Sodium Selenite which is an inorganic compound with the formula Na2SeO3 is a colorless salt and is the most common water soluble selenium compound, using it in plant treatment has improved the response to stress and increases their edible contents, Sodium selenite is present in some plant foods, meat and sea foods, Sodium selenite is an essential element and also a trace element, adding it to plants is convenient for bio-stratification.

## 1.1 JUSTIFICATION

As described earlier seed priming using sodium selenite under drought stress is quite helpful in improving the performance of drought subjected plants, although deficit water supply at any growth stage poses a detrimental effect on growth rate and the period of planting

## 1.2 AIM

- To Determine the influence of sodium selenite on growth of rice

## 1.3 OBJECTIVES

- To study the effect of sodium selenite on drought stress by studying their biochemical components
- To know the response of different cultivars of rice to drought stress at several level of treatments

# CHAPTER TWO

## 2.0 LITERATURE REVIEW

### 2.1 Seed Priming

Seed priming is a pre-sowing strategy for influencing seedling development by modulating pre-germination metabolic activity prior to emergence of the radical and generally enhances germination rate, substantially improves the stand establishment ( Jafar *et al.*, 2012), plant performance in the field (Kazemi and Eskandari, 2012) and significantly improves plant water relations, chlorophyll content, root length, shoot length, seedling dry weight, membrane stability ( Farooq *et al.*, 2013;Afzal *et al.*, 2005), root-shoot ratio (Moradi *et al.*, 2012) , plant height, biological yield, grain yield, yield attributes and harvest index of wheat under abiotic stress conditions ( Jafar *et al.*, 2012;Hassanein *et al.*, 2012).

Seed priming techniques includes hydro-priming (soaking in DW), osmo-priming (soaking in osmotic solutions of PEG, manitol, KCl, MN, Urea, NaCl) (Eivazi, 2012; Farooq *et al.*, 2013; Ghiyasi and Tajbakhsh. 2013), hardening with plant growth inducers (CCC, Ethephon, IAA) (Eivazi, 2012) and hormonal priming (Khan *et al.* 2009). Various priming agents including ascorbic acid, salicylic acid, kinetin, CaCl 2 , abscisic acid ( Jafar *et al.*, 2012;Khan *et al.*, 2012;Farooq *et al.*, 2013) and urea (Moradi *et al.*, 2012 ) frequently reported. However, seed priming with various organic chemicals had elucidated synchronized germination owing to simply a reduction in the lag time of imbibition, build-up of germination enhancing metabolites, metabolic repair during imbibition and osmotic adjustment (Farooq *et al.*, 2013), which resulted in vigorous root growth, shoot growth, improved plant water relation, chlorophyll contents and increased membranes stability because of reduced stress induced oxidative damage in primed seedlings (Farooq *et al.*, 2013). Many other reports had elucidated that seed priming with Ascorbic Acid and Salicylic Acid significantly improves

plant water relations, chlorophyll content, root length, seedling dry weight, membrane stability (Farooq *et al.*, 2013), root-shoot ratio (Moradi *et al.*, 2012) , total number of tillers, number of fertile tillers, plant height, spike length, number of spike, number of grains per spike, 1000-grain weight, grain and biological yields and harvest index of wheat under abiotic stress conditions ( Jafar *et al.*, 2012;Hassanein *et al.*, 2012)

Seed priming with polyethylene glycol regulating the physiological and molecular mechanism in rice (ORYZA_SATIVA L.*)* under nano-ZnO stress. The present study was designed to highlight the impact of seed priming with polyethylene glycol on physiological and molecular mechanism of two cultivars of ORYZA SATIVA L. under different levels of zinc oxide nanorods (0, 250, 500 and 750 mg L ). Plant growth parameters were significantly increased in seed priming with 30% PEG under nano-ZnO stress in both cultivars. Significant increase in photosynthetic pigment with PEG priming under stress. Antioxidant enzymes activities of superoxide dismutase (SOD), peroxidase (POD) and catalase (CAT) as well as malondialdehyde (MDA) contents were significantly reduced with PEG priming under nano-ZnO stress. Gene expression analysis also suggested that expression of APXa, APXb, CATa, CATb, CATc , SOD1 , SOD2 and SOD3 genes were down regulated with PEG priming as compared to non-primed seeds under stress. Seed priming with PAL (phenylalanine ammonia lyase) improved proteins and MDA contents, whereas, it lowered hydrogen peroxide contents. Furthermore, the priming improved the activities both of CAT and PAL; this is in line with the literature (Hu *et al.* 2006; Yuan-Yuan *et al.* 2010). This indicated that PAL priming could be used for the stimulation of salinity tolerance in maize. There are previous reports on enhanced activities of POD and SOD under the influence of seed priming in rice cultivars (Sun *et al.*, 2010; Goswami *et al.*, 2013). In the present case, the activity of SOD enzyme was more in primed seeds.

Osmopriming has been reported to enhance stress tolerance in germinating seeds, presumably by increasing their germination (e.g., mediating a more robust antioxidant system) (Chen and Arora, 2011). In agreement with the findings of Yuan Yuan et *al.* (2010) for rice (*Oryza sativa* L.), the effect of PEG priming on enhancing drought tolerance during germination was confirmed, but high concentrations of PEG (−0.8 MPa) had an inhibitory effect on germination.

## 2.2 Pomegranate Seed Germination and Dormancy

The accumulation of proline mainly occurred in the Beta amino Butyric acid primed (BABA) cultivar Vyttila 6 seedlings, indicating that this variety depend more on proline accumulation for countering the stressed condition. Proline accumulation in rice seedlings raised from primed seeds has already been reported by Sun *et al* (2010) and Mondal *et al* (2011). Sodium Chloride NaCl and PEG-6000 stress caused lipid peroxidation of bio-membranes which was evident from the increased MDA (malondialdehyde) content in seedlings raised from both primed and non-primed seeds under NaCl and PEG-6000 stress. This reduction in MDA content on BABA priming implies the role of BABA priming in reducing the lipid peroxidation of bio-membranes. The reduction in MDA content of seedlings raised from primed seeds has already been reported in rice (Sun *et al*, 2010; Ella *et al*, 2011; Goswami *et al*, 2013). After BABA priming, NR activity increases in all the three rice varieties. BABA priming caused the enhanced activities of POD and SOD in rice seedlings raised from primed seeds. There are previous reports on enhanced activities of POD and SOD under the influence of seed priming in rice cultivars (swami *et al*, 2013). In okra, seed priming results in higher activities of antioxidant enzymes in the seedlings (Sharma *et al*, 2014).

## 2.3 Drought Stress Memory and Drought Stress

Stress tolerance is achieved via two strategies. First, seed priming sets in motion many germination-related activities such as enhanced energy metabolisms, early reserve mobilization, embryo expansion, and endosperm weakening (Benamar *et al.*, 2003; Pandita *et al.*, 2007;Sung *et* al., 2008;Li *et al.*, 2010; Sun *et al.*, 2010; Chen and Arora, 2011) that facilitate the transition of quiescent dry seeds into a germinating state and lead to improvement of germination potential. Secondly, priming imposes an abiotic stress on seeds that represses radicle protrusion, but stimulates stress responses, inducing cross-tolerance.

## 2.4 Seed priming to alleviate salinity stress

It involved soaking of rice seeds in salty water thereby removing the floated as immature or as unfilled seeds with less endosperm and adapting/considering the sunken seeds as selected or best seeds as used by Zubairu *et al.* (2014) and Ella *et al.* (2011). These sorted seeds were later primed for six (6) hours prior to sowing in order to speed up the germination and quick establishment of the seedling (Sun *et al.*, 2010). Farooq *et al.* (2009) suggested that physiological changes produced by osmo-hardening enhanced the starch hydrolysis and made more sugars available for embryo growth which enhance germination. Sun et al. (2010) reported that optimal priming concentrations of PEG were 20% for Gangyou 527 (indica hybrid rice) and 10%–15% for Nongken 57 (conventional japonica rice). Even higher concentrations of PEG had negative effects on seed germination.

## 2.5 Dehydration stress and future challenges to crop production

Soil moisture deficit is a significant challenge to the future of crop production. Severe drought in parts of the U.S., Australia, and Africa in recent years drastically reduced crop

yields and disrupted regional economies. Even in average years, however, many agricultural regions, including the U.S. Great Plains, suffer from chronic soil moisture deficits. Cereal crops typically attain only about 25% of their potential yield due to the effects of environmental stress, with dehydration stress the most important cause. Two major trends will likely increase the frequency and severity of soil moisture deficits:

Osmopriming and hydropriming treatments are among the most important methods of priming. Hydropriming can increase tolerance to drought stress at the germination stage (Ashraf and foolad, 2005; Farooq *et al.*, 2006). Soltani *et al.* (2008) observed that with increasing water stress germination characteristics of cotton seeds includes, germination percentage, germination speed and seedling dry weight was reduced, but the rate of this decrease was lower for hydroprimed seeds. Osmopriming is a special kind of seed preparation that seeds treat with a solution containing chemicals with low osmotic potential like polyethylene glycol (PEG), mannitol and chemical fertilizer (such as urea, nitrate) (Ashraf and Foolad 2005).There are reports that osmopriming with urea, in addition to osmotic effects, have nutritional effects on germination and therefore enhance seed germination under stress condition (Al-Mudarsi and Jutzi, 1999;Mauromicale and Cavallaro, 1996).The duration and osmotic potential of priming solution have determining role on its effects (Akramian *et al*, 2008). Riazi and Sharifzadeh (2008) primed the seeds of three species of forage millet in different potential of PEG solution (-4 to 16 bar)during different priming time (3, 7 and 14 days), and observed that most positive effects of priming have occurred in the solution potential of -12 bar and priming duration of 7 days.

Although previous experiments have revealed some useful aspects of pre-sowing seed treatments on crop and pasture plants, but still is little information concerning the use and impact of hydro priming and osmo priming on germination of tall wheat grass. This study investigated the effects of priming temperature, type and osmotic potential of priming

solution, i.e. osmopriming with PEG and urea and hydro priming with distilled water, and priming duration on germination and early seedling growth indices of tall wheat grass under normal condition, on the basis of these results the effect of best priming treatments on the germination indices under drought stress condition were also investigated.

# CHAPTER THREE

## 3.0 MATERIALS AND METHODS

### 3.1 SEED COLLECTION AND SOIL PREPARATION

The materials used in executing the projects were, Cellophane bags, measuring cylinder, Loamy soil, Sodium selenite, 3 different cultivars of ORYZA SATIVA, Petri dishes, Plastic spoons

The seeds were collected at Africa Rice, International Institute of Tropical Agriculture (IITA), Moniya, Ibadan. The top soil sample used was collected around love ghetto hostel area, situated along Federal university Oye-Ekiti road, the soil was air dried for 4 days to get rid of moisture content and stop the action of microorganism in the soil. A soil of 5kg was used for the planting of the rice cultivars. The pots were watered with 1700ml to field moisture capacity. A germination test was carried out inside a Petri dish to ascertain the viability of the cultivars to be used, the cultivars used are

- Nerica u4 (B)
- Nerica u7 (C)
- Vandana (D)

The 3 different cultivars were represented as RB, RC and RD respectively. The cultivars were soaked in sodium selenite solution for 10 hours at 3 different concentrations of 0, 50mg/l and 100mg/l respectively, The 3 different selenite levels were represented as S0, S50 and S100, RC and RD respectively. The sodium selenite was thoroughly rinsed with distilled water after 10 hours of soaking (soaking was done inside the petri dish), the number of seeds soaked were 10 per petri dish. The seeds planted in the soil were also treated the same way as the one used for the germination test. Holes were made in the soil with a rod, the seed grains

were dropped inside the hole and seeds were planted, covered with the soil. The soils were watered till field moisture capacity immediately.

Two weeks after planting, the plants were subjected to different level of drought stress, the control were being well-watered (D0) days, 4days (D4) and 8 days (D8) level of drought stress (different cultivars, at different treatments was watered at different days (2, 4 and 8 days ) each drought level and the controls were replicated. Plants were monitored till maturity. Number of leaves and tillers, plant height, dry and fresh weight, grain yield, grain number were measured.

### 3.2 BIOCHEMICAL DETERMINATION

After 11 weeks of planting, leaves were collected for biochemical test such as Catalase (CAT), Superoxide dismutase (SOD), Ascorbate peroxidase, Malondialdehyde (MDA)

The methods for determining the aforementioned are explained below;

**Catalase (CAT)**

Catalase activity can be determined in the plasma using Aebi's method (Aebi, 1984). Fifty microliter of the sample wass added to a cuvette containing 450 µL of phosphate buffer (0.1M, pH 7.4) and 500 µL of 20 mM $H_2O_2$. Catalase activity was measured at 240 nm for 1 min using spectrophotometer. The molar extinction coefficient of $H_2O_2$, 43.6 M $cm^{-1}$ was used to determine the catalase activity. One unit of activity is equal to 1 mmol of $H_2O_2$ degraded per minute and is expressed as units per milligram of protein.

Calculation:

$$\text{Units/ml} = \frac{\Delta A/\text{min} \times d \times 1}{V \times 0.0436}$$

V x 0.0436

d = dilution of original sample for Catalase Reaction

V = Sample volume in Catalase Reaction (ml)

0.0436 = $\varepsilon^{mM}$ for hydrogen peroxide

1 = Total reaction volume

**Superoxide dismutase (SOD)**

This method was described by Mccord and Fridovich (1969) and can be applied for determination of antioxidant activity of a sample. To 200 µL of the lysate, 2.5 ml of 75 mM of Tris–HCl buffer (pH 8.2), 30 mM EDTA and 300 µL of 2 mM of pyrogallol are added. An increase in absorbance is recorded at 420 nm for 3 min by spectrophotometer. One unit of enzyme activity is 50% inhibition of the rate of auto oxidation of pyrogallol as determined by change in absorbance/min at 420 nm. The activity of SOD is expressed as units/mg protein.

**Calculation**

Increase in absorbance per minutes = $A_3 - A_0/2.5$

Where $A_0$ = absorbance after 30 seconds

$A_3$ = absorbance after 150 seconds

% inhibition = 100 – 100 x (increase in absorbance for substrate/increase in absorbance for blank)

1 unit of SOD activity was given as the amount of SOD necessary to cause 50% inhibition of the oxidation of adrenaline.

**Ascorbate Peroxidase**

APX (EC 1.11.1.11) activity was measured according to the methods of Nakano and Asada, 1981.The reaction mixture contained 50 mM potassium phosphate buffer (pH 7.0), 0.5 mM ascorbic acid,01 mM hydrogen peroxide, and 0.1 mL of enzyme extract in a total

volume of 1 mL. The concentration of oxidized ascorbate was calculated by the decrease in absorbance at 290 nm. The absorption coefficient was 2.8 mM−1 cm−1. One unit of APX was defined as 1 msmol mL−1 ascorbate oxidized min−1 (Hassan et al 2006)

**Determination of Lipid peroxidation**

Total amount of lipid peroxidation products present in the brain samples was estimated by the thiobarbituric acid (TBA) method which measures the malondialdehyde (MDA) reactive products according to the method of Ohkawa et al., (1979).

**Procedure**

To 0.5 ml of samples was added 0.5 ml of phosphate buffer (0.1 M, pH 8.0) and 0.5 ml of 24% TCA. The resulting mixture was incubated at room temperature for 10 min, follow by centrifugation at 2000 rpm for 20 min. To 1 ml of supernatant was added 0.25 ml of 0.33% TBA in 20% acetic acid and the resulting mixture was boil at 95°C for 1 hr. The resulting pink color product was cool and absorbance was read at 532nm.( Extinction coefficient of MDA, $\varepsilon 532 = 1.53 \times 10^5 M^{-1} cm^{-1}$)

**Chlorophyll and Total Carotene Determination**

Leaves samples were collected and extracted with absolute acetone, absorbance was measured at 648nm, 664nm and 470nm using spectrophotometer.

**Chlorophyll *a* ($C_a$), chlorophyll *b* ($C_b$), total chlorophylls ($C_{a+b}$) and total carotenoids ($C_{x+c}$):**

$$C_a = \frac{(13.36A_{664.2} - 5.19A_{648.6}) * 8.1}{DW} \qquad [mg\,g^{-1}dw]$$

$$C_b = \frac{(27.43A_{648.6} - 8.12A_{664.2}) * 8.1}{DW} \qquad [mg\,g^{-1}dw]$$

$$C_{a+b} = \frac{(5.24A_{664.2} + 22.24A_{648.6}) * 8.1}{DW} \qquad [mg\,g^{-1}dw]$$

$$C_{x+c} = \frac{(4.785A_{470} + 3.657A_{664.2} - 12.76A_{648.6}) * 8.1}{DW} \qquad [mg\,g^{-1}dw]$$

$$C_{a/b} - ratio = \frac{C_a}{C_b}$$

where: $A_{648.6}$ = Absorbance at 648.6 nm
$A_{664.2}$ = Absorbance at 664.2 nm
$A_{470}$ = Absorbance at 470 nm
DW = dry weight of plant tissue extracted (mg)

**Anthocyanin Determination**

Total anthocyanin content of the extract was determine by the pH differential method (Fuleki and Francis 1968, Wrolstad 1993).

Procedure

$$TACY = \frac{(\Delta A \times MW) \times DF \times 1000}{\varepsilon \times 0.1 \times 1}$$

where

TACY= Total anthocyanin expressed as mg of plant material

DF = dilution factor to expressed the extract on per gram of plant basis

$$TACY = \frac{(\Delta A \times MW) \times DF \times 1000}{\varepsilon \times 0.1 \times 1}$$

where

TACY= Total anthocyanin

MW = Molecular weight

DF = dilution factor to expressed the extract on per gram of plant basis

ε= molar absorbance coefficient

0.1= the conversion factor for per 1000 grams to 100 grams basis

## CHAPTER FOUR

# 4.0 RESULT, DISCUSSION, CONCLUSSION AND RECOMMENDATIONS

## 4.1 Growth of Rice

Cultivar Rc in all the treatments had a high significant value with or without drought stress however, selenite had little or no significant on the plant height of cultivar Rc at 4 weeks after planting. Cultivar Rb had the lowest plant height in all the treatments (fig 1). At 8 weeks after planting, selenite significantly increased plant height of cultivars Rb and Rc but had little or no effect on Rd (fig 2).

## 4.2 Level of Anthocyanin contents in selenite primed rice cultivars under drought stress

During severe drought stress D8, anthocyanin contents was increased in cultivars Rb and Rc treated with selenite. Selenite primed cultivars Rd and Rc were significantly high during mild drought stress D4. However, selenite significantly lowered anthocyanin contents of cultivar Rb during mild drought stress D4 and had little or no significant on cultivar Rd at D8 (fig 3).

## 4.3 MDA contents of drought stress rice cultivars as influenced by selenite

During drought stress, MDA content of cultivar Rc primed with or without selenite had a high significant difference compared with other treatments while the MDA contents of other treatments had no significant difference. However, it is important to note that MDA content of cultivar Rd were consistently low with or without selenite and drought stress (fig 4).

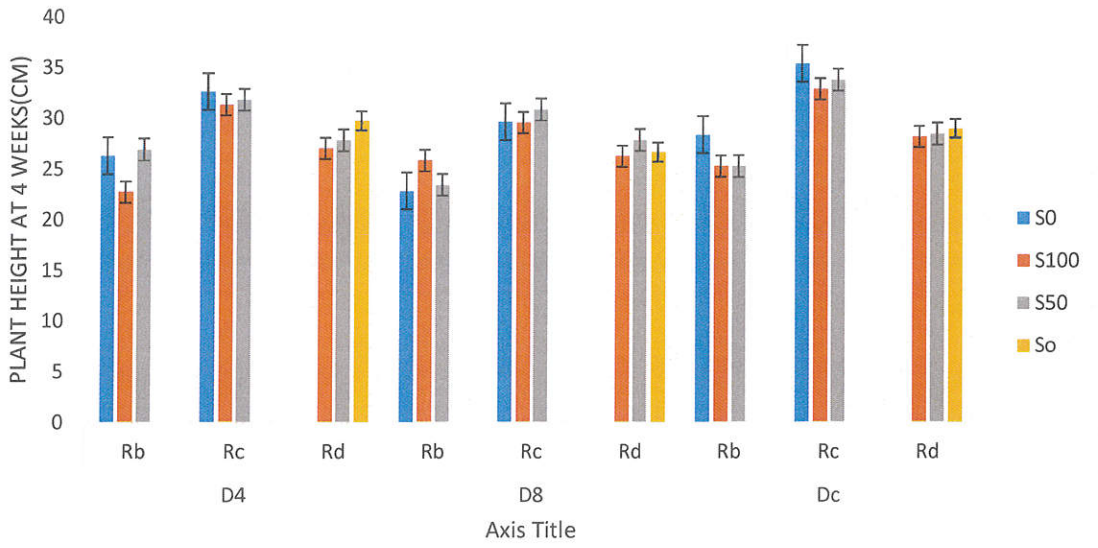



**Figure 1: Plant height at 4 weeks**

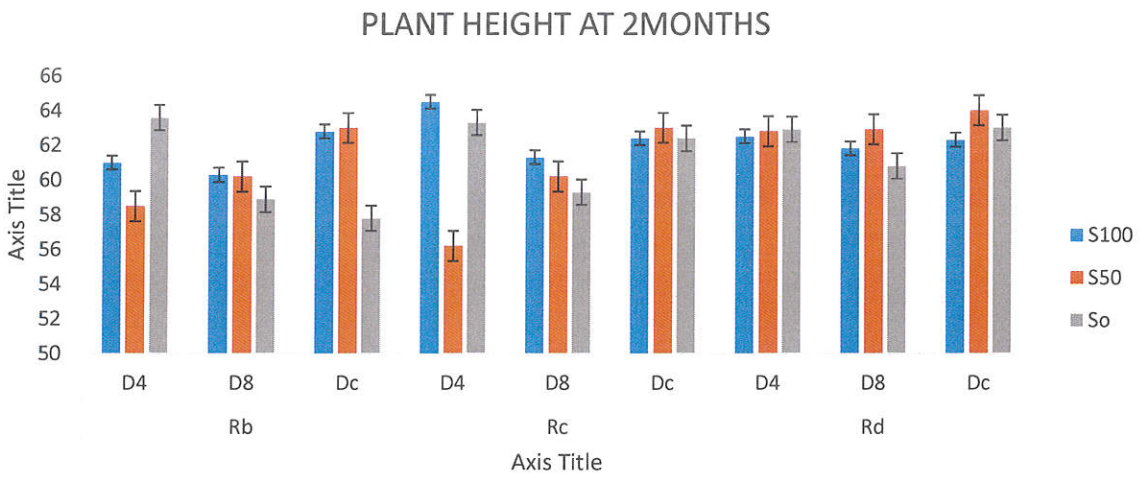



**Figure 2: Plants height at 8weeks**

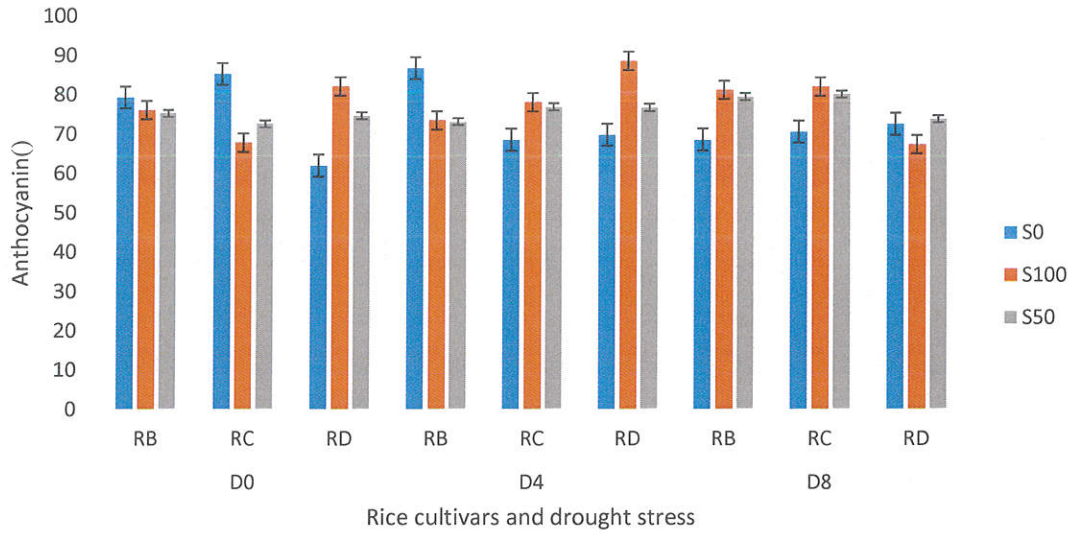



Figure 3: Level of anthocyanin content in selenite primed rice

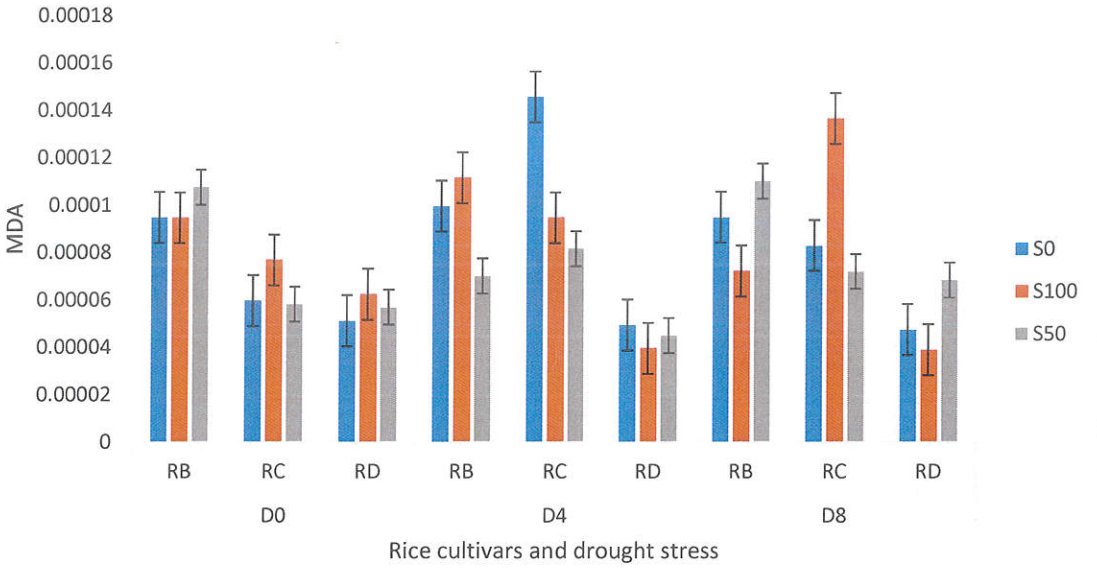



Figure 4: MDA content of drought stress rice cultivars as influenced by selenite

### 4.4 Antioxidant enzymes of selenite primed rice cultivars as affected by drought stress

Selenite 100mg/l significantly increased CAT in all the cultivars when there was no drought stress. When the drought stress was severe i.e.at D8, CAT activity of cultivar RB under 100mg/l of selenite was significantly high when compared with other treatments. Also, CAT activity increased as the drought stress increased in selenite primed cultivar RB. Other treatments showed no particular pattern in there CAT activities (fig 5).

Ascorbate peroxidase activities of selenite treated cultivar RB and RD increase as drought stress increased progressively. Selenite 100mg/l significantly increased the APX level in cultivar RB and RD under all levels of drought stress except for cultivar RB at S0 (fig 5).

### 4.5 Pigmentation of selenite primed rice cultivars as influenced by drought stress

Chlorophyll A of selenite treated rice cultivars were significantly high when the drought stress is severe i.e. D4. Rice primed with 50mg/l of selenite had the highest chlorophyll A contents in all the cultivars when there was no drought stress. There was an increase in chlorophyll A as the drought stress increased in cultivar RB without selenite. Cultivar RC primed with 50mg/l of selenite had a significant high Chlorophyll a when compared with other treatments. Chlorophyll B was reduced in cultivars RC and RD primed with selenite when drought stress was mild i.e. D4. Cultivar RC was significant higher than the other treatments, at severe drought stress i.e. D8, selenite increased the chlorophyll B content in cultivar RC whereas there was a decreased in chlorophyll B contents in cultivar RB (fig 6).

Total carotene found in cultivar RB treated with 50mg/l of selenite was significantly high than other treatments. All other treatments showed no significant difference in their total carotene with or without selenite and drought stress (fig 6).

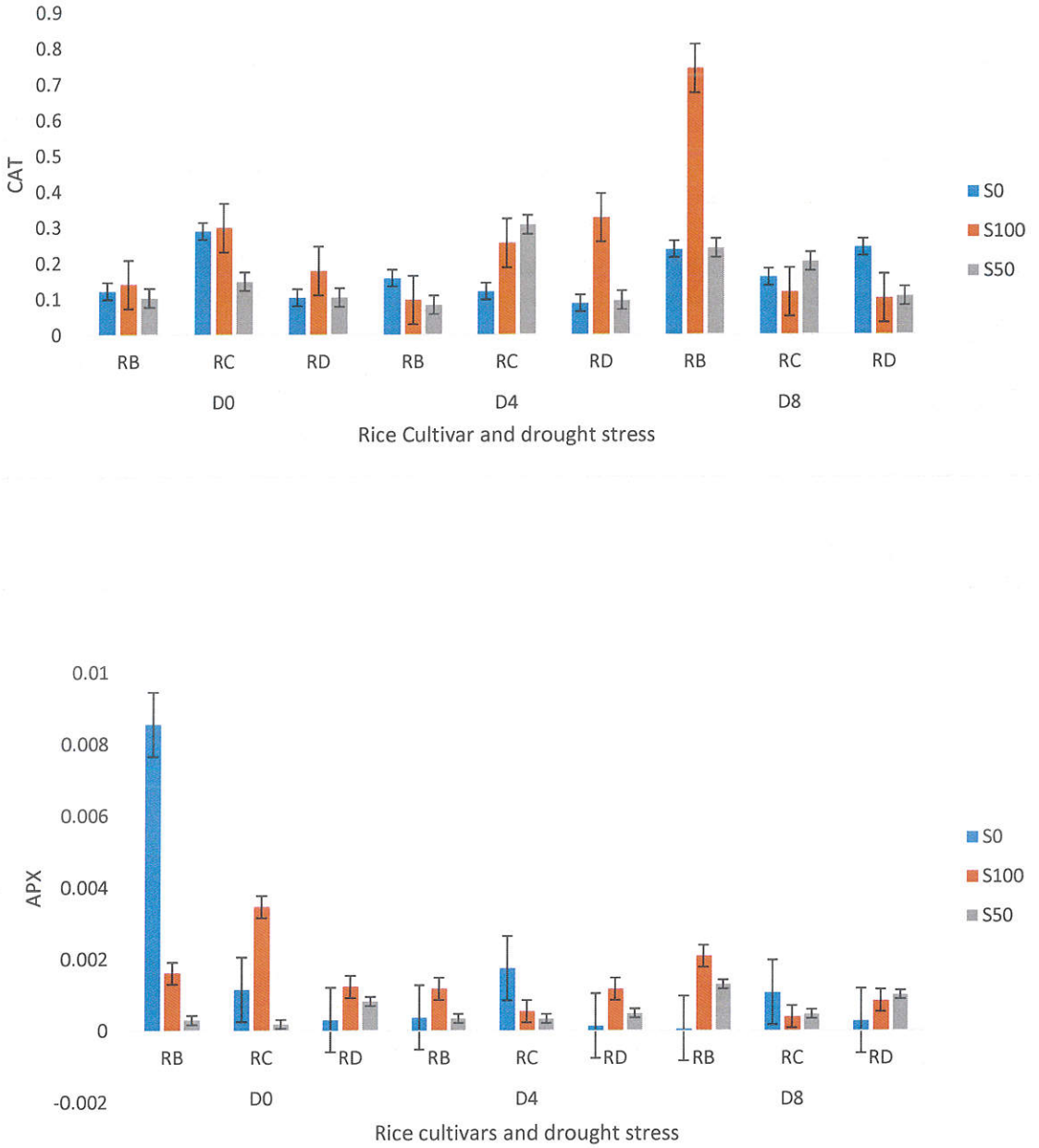
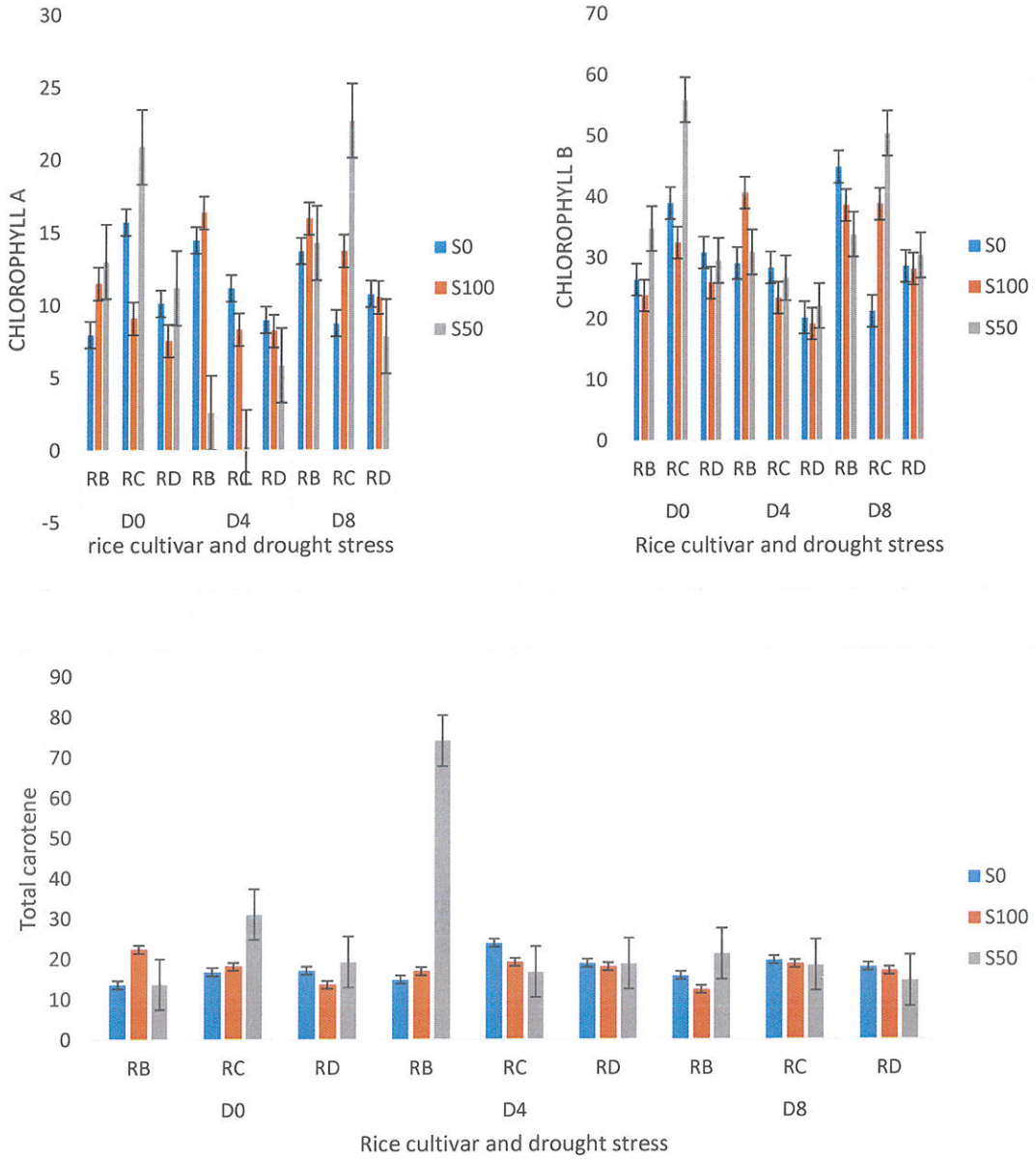



Figure 5: Antioxidants enzyme of selenite primed rice cultivars as affected by drought stress




sFigure 6: Pigmentation of selenite primed rice cultivars as influenced by drought stress

## 4.6 DISSCUSSION

There was an evidence increase in plants treated with selenite particularly on their growth, antioxidant property, and stress tolerance (Hart, 2005). Lipid per oxidation has been associated with damages provoked by some environmental stresses (Abdul jaleel. *2008)*

The level of antioxidant enzymes are higher in tolerant plant species than in sensitive ones under various environmental stress (Wang *jale et. all 2009))*

Selenite could significantly increase the antioxidant capacity of higher plant such as wheat, corn, soybean and rape and maintains the normal growth of plant (Wang *et., all 1996*; Nawaz., *et all* 2014). There was an evidence increase in plants treated with selenite particularly on their growth, antioxidant property, and stress tolerance (Hart, 2005).

According to the biochemical result, it can be deduced that different cultivars of rice respond differently to drought and selenite treatment based on level of selenite concentration and drought stress.

It is obvious that the cultivar without drought stress and selenite treatment was significantly the highest for the APX, this implies that with or without selenite and drought the APX content of all cultivars was not affected

The anthocyanin content was increased at when treated with 50mg/l of selenite for the three cultivars; this implies that selenite has effect on the anthocyanin content. The MDA content in cultivar C and D should that they are drought tolerant and selenite helps in the lowered the MDA content. The chlorophyll A and B contents of cultivar C at 50mg/l selenite was greatly increased, selenite also increased the carotene content of cultivar D at D4 Se 50mg/l which also confirm it's tolerant to drought stress. Selenite 100mg/l improved the activities of APX and CAT in all cultivars

## 4.7 CONCLUSION

Sodium selenite application can be used in the production of rice, to improve the oxidation, resistance to drought and prevent the yield loss caused by environmental factor

## 4.8 RECOMMENDATION

It is therefore recommended that further research should be carried out on the effect of selenite on plant yield and growth

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