*J. Agric. Sci Mansoura UniV., 33 (12): 8515 - 8524, 2008*

# PHYSIOLOGICAL AND BIOCHEMICAL EFFECTS OF UV-RADIATION AND SODIUM DODECYL SULPHATE (SDS) MUTAGENS ON GROWTH AND METABOLISM OF GARLIC PLANTS

**Hasaneen, M. N. A. and Reham A. M. Shams-Eldeen**
**Department of Botany, Faculty of Science, Mansoura University, Mansoura, Egypt.**

## ABSTRACT

The effects of enhanced $UV_A$ (320-380), $UV_C$ (280nm) and SDS, as mutagenic substances, on growth parameters and certain metabolic changes, during vegetative and flowering growth stages of garlic (*Allium sativum* var. Seds 40) were investigated. Root length, shoot length, fresh mass, dry mass accumulation and leaf area in garlic, treated with UV- radiation (A and C), and SDS (0.1 M and 0.3 M) as mutagenic substances, throughout the entire period of the experiment, showed significant variable changes below the control levels. Photosynthetic pigments (chl a, chl b, carotenoids, total chl a+b, and total pigment) contents of the variously treated garlic plants showed significant changes as compared with control plants throughout the duration of the experiment. The ratio of chl a / b showed variable changes in UV- and SDS- treated plants in relation to control. UV- absorbing compounds (total phenolic compounds and anthocyanins contents) of the UV- and SDS- treated garlic plants, showed significant increase above the control levels during vegetative and flowering growth stages. As compared with control nucleic acid levels, nucleic acid contents (DNA and RNA) of UV- and SDS- treated plants, at vegetative and flowering growth stages, showed significant decrease.

**Keywords:** $UV_A$ and $UV_C$ radiation, SDS, garlic, photosynthetic pigments, total phenolic compounds and anthocyanins, nucleic acids (DNA and RNA).

## INTRODUCTION

Several physiological and biochemical constituents in plant cells undergo drastic changes as a result of exposure of the plants to supplementary UV radiation or treatment of plant tissue with chemical mutagenic substances (Bronman and Teramura, 1993). These changes occur at relatively high doses of UV radiation whereas other effects and responses are manifested at a dose of about one magnitude lower (Strid *et al.*, 1997). In *Pisum sativum*, these low dose effects include increased ion permeability of the thylakoid membrane and alterations in the mRNA transcript levels of photosynthetic and defensive protein components (Kalbin *et al.*, 1997).

Comparable amounts of genetic variation were induced by chemical mutagenic material (EMS), gamma rays and UV- radiation, but larger responses to selection and realized heritabilities followed EMS treatment of *Arabidopsis thaliana* plants. The most extreme mutants for latenes were selected after EMS treatment and for plant weight after EMS and radiation treatment (Brock, 2007). These results support the hypothesis that mutagenic treatment by chemical mutagens or physical mutagens (UV- radiation), gives

rise to an increase in variance for quantitively inherited characters which can be utilized by selection.

Numerous studies have shown that exposure of plants to mutagenic materials, either chemical or physical can result in a wide variety of morphological alterations in higher plants (Burnes *et al.*, 2005). These morphological changes can be observed under controlled environmental conditions in growth chambers or greenhouse, where UV-emitting lamps provide the sole source of UV-radiation (e.g. reduced leaf area and shoot height), whole plant changes in morphology are the result of an inhibition in the elongation or expansion of individual organs (leaves and stems).

In addition it has been suggested that exposure to UV- radiation reduces plant growth vigor, chlorophyll contents, carotenoids, total protein content, nucleic acid content and increases the level of phenolic compounds and anthocyanins (Musil, 1996; Abdel-Aziz, 2008). Ultraviolet light inhibited the growth in four wheat cultivars (*Triticum aestivum* L.) and increased phenolic compounds and proline contents which were thought to protect cells against damage (Demir, 2000). Anthocyanins accumulate in young, expanding foliage of various plant species in response to UV- radiation exposure (Close and Beadle, 2003). Exposure to UV- radiation promotes the production of foliar anthocyanins (Lindoo and Caldwell, 1978), and it has been hypothesized that anthocyanins provide a UV sunscreen (Lee and Lowery, 1980).UV responsive anthocyanins production in a rice cultivar was associated with a specific phase of phenylalanine ammonia lyase (PAL) biosynthesis (Reddy *et al.*, 1994). They focused that the anthocyanins induction in rice seedlings is mediated exclusively by the UV- component of sunlight.

Thus, the aim of this work was to investigate further growth changes and metabolic responses of garlic plants treated with $UV_A$ ,$UV_C$, as physical mutagens and sodium dodecyl sulphate (SDS), as chemical mutagens, throughout the entire period of the experiment.

## MATERIALS AND METHODS

**Time course experiment:**

Homogenous bulblets of garlic (*Allium sativum* var. Seds 40) were used. The procedures of sterilization of bulblets, germination and growth of plants as well as the experiment set-up were the same as previously described by Shams-Eldeen (2008). After 14 days from the start of germination, the young vegetative plants were sub-divided into 6 subgroups, each of 5 pots, one of them was taken as initial, and the other 5 subgroups; one of them was left without treatment to serve as control and the other four subgroups, 2 were treated with 0.1M SDS and 0.3M SDS and the other 2 were exposed to UV- radiation day after day, for 2 hrs, with $UV_A$ (365 nm) and $UV_C$ (254 nm) throughout the duration of the experiment (Younis *et al*., 2008).

Samples for determination of growth parameters, photosynthetic pigments (chl a, chl b, and carotenoids), UV-absorbing compounds (total

phenolic compounds and anthocyanins contents), total protein content and nucleic acid content (DNA and RNA), were taken at vegetative and flowering stages after 35 days and 60 days from transplantation. Leaf area was measured by square-paper method (Hasaneen et *al*., 1994), fresh and dry masses measured after drying samples in an oven at $80^{O}C$ to constant mass.

Plant photosynthetic pigments (Chl a, Chl b, and carotenoids) were determined in leaves of the test plants at initial, vegetative and flowering growth stages, by the method of Metzner *et al*. (1965).

Determination of UV-absorbing compounds (total phenolic compounds and anthocyanins): The total phenolic compounds were extracted and analyzed using the method of Malik and Singh (1980). Anthocyanins were extracted from oven-dried, ground garlic tissue samples of plants, suspended in 10 $cm^3$ of acidified methanol and autoextracted at $0^{O}C$ for 72 hrs in the dark with continuous shaking. Extracts were centrifuged for 10 min at 50.000 g then the absorbance was measured at 530 and 657 nm for each supernatant using Spekol spectro-colorimeter (Mirecki and Teramara, 1984).

Determination of nucleic acids: DNA was determined colorimeterically by the method of Sadasivam and Manickam (1996). RNA content was determined colorimeterically by the method of Devi (2000).

The results were statistically analyzed using the least significant difference (L.S.D.) at 5% level (Snedecor and Cochrain, 1980).

## RESULTS AND DISCUSSION

**Changes in growth parameters:**

Treatment of garlic plants with 0.1M and 0.3M SDS induced significant variable decrease in shoot height, leaf area, fresh and dry masses through out the entire period of the experiment. On the other hand, root length of such treated plants showed significant increase. Exposure of garlic plants, at vegetative and flowering growth stages, to $UV_A$ and $UV_C$ radiation induces variable significant decrease in shoot length, leaf area, fresh and dry mass, whereas a significant increase in root length was apparent as given in (table 1).

In support of our results, Hamed (1990) and Hasaneen *et al*., (1994) stated that under hydroponic culture conditions, the response of faba bean, castor bean, and rice plants to mutagens varied with the conditions and with the time of exposure to the chemical mutagenic substance. Stimulation of root elongation occurred in such treated plants after three weeks from treatment date.

Different species have different responses to the level of UV radiation (Skorska, 1996). The negative effects of $UV_A$ and $UV_C$ radiation result in different morphological parameters. Exposure to $UV_A$ and $UV_C$ decreased length of plumule and dry matter accumulation (Zuk-Golaszewska *et al*., 2003). Dai *et al*. (1995) reported that after a few weeks of $UV_B$ exposure, leaf area and plant dry weight of rice were significantly reduced.

1

| | | | | | | |
|---|---|---|---|---|---|---|
| **$UV_C$** | 820.10* | 630.70* | 1450.80* | 1.30* | 539.40* | 1910.20* |

As consequence of SDS and UV-treatment, in the literature, inhibition of hormone regulation (Bronoman and Teramura, 1993), protein synthesis (kalbin *et al*., 1997) and pigmentation (Musil, 1996) has often been observed. These responses are presumably due to a direct or indirect effect of SDS and UV-radiation on the activity of some enzyme systems. Furthermore, plant growth is primarily related to cell division and cell enlargement, and both processes are known to be controlled by plant growth regulators. Thus, the inhibition in growth of garlic plants as a result of SDS and UV-radiation appears to be correlated with hormonal biosynthesis in the affected plants.

**Changes of photosynthetic pigments:**

Low and high concentrations of SDS induced significant changes in Chl a, Chl b, Chl a+b, carotenoids and total pigment contents of garlic plants at vegetative and flowering growth stages (table 2). UV-radiation (A and C) of garlic plants showed significant decrease in Chl a, Chl b, Chl a+b, carotenoids and total pigment contents throughout the entire period of the experiment. Chl a/b ratio showed variable comparable values in control as well as in the treated plants throughout the entire period of the experiment (table 2).

**Table 2: the effect of UV-radiation and sodium dodecyl sulphate (SDS) mutagens on metabolic changes; total pigments (mg100g$^{-1}$ fresh weight) of *Allium sativum* vegetative and flowering growth stages. Mean values are significantly different from control at P ≤ 0.05.**

| Parameter / Treatment | Chl a | Chl b | Chl a+b | Chl a/b | Cars | Total pigments |
|---|---|---|---|---|---|---|
| **Control** | 890.20 | 790.10 | 1680.30 | 1.13 | 415.70 | 2096.0 |
| **$UV_C$** | 810.60* | 715.60* | 1526.20* | 1.13* | 464.00* | 1990.2* |
| **0.1 M SDS** | 710.20* | 580.70* | 1290.90* | 1.24* | 390.20* | 1680.1* |
| **0.3 M SDS** | 710.20* | 580.70* | 1290.90* | 1.24* | 390.20* | 1680.1* |
| **Flowering Flowering stage** | | | | | | |
| **Control** | 865.10 | 745.10 | 1610.20 | 1.16 | 420.40 | 2030.60 |
| **$UV_A$** | 790.10* | 570.90* | 1361.00* | 1.38* | 569.10* | 1870.10* |
| **0.1 M SDS** | 791.10* | 586.00* | 1377.10* | 1.35* | 548.60* | 1796.00* |
| **0.3 M SDS** | 665.30* | 435.80* | 1101.10* | 1.53* | 556.60* | 1693.00* |

In this connection, Yao and Liv (2007) demonstrated that enhanced UV-radiation significantly decreased chl a, chl b, chl a+b and carotenoids contents of *Picea asperata* plants. A parallel changing trend in Chl a and Chl b resulted in no significant changes in Chl a/b ratio under enhanced UV-radiation. Furthermore, the decreased tendency of Chl content and chl fluorescence appeared parallel to the biomass reduction in plants. The decrease in chl a+b content was mainly attributed to the distruction of chl b, which is more sensitive to radiation than chl a (Yao and Liv, 2007).

Similar results were also reported in previous publications (Casati *et al*., 2002; Correia *et al*., 2005). The decrease of total chl content in the present syudy may be due to the decreases of $CO_2$, since $CO_2$ protects chl from photooxidative destruction (Sing, 1946).

Carotenoids exert their protective functions as antioxidants to inactive UV-induced radicals in the photosynthetic membranes (Gotz *et al*., 1999). In the present study, the decrease in content of carotenoids suggested that involved UV-radiation or SDS-treatment caused considerable oxidative stress (table 2) by the accumulation of reactive oxygen species (ROS) (Yao and Live, 2007).

**Changes in total phenolic compounds and anthocyanins content:**

In garlic plants treated with low and high concentrations of SDS or exposed to $UV_A$ and $UV_C$ radiation, at vegetative and flowering growth stages, total phenolic compounds and anthocyanins content were significantly increased in comparison with control (table 3).

**Table 3: the effect of UV-radiation and sodium dodecyl sulphate (SDS) mutagens on metabolic changes; total phenolic compounds (mg phenol eqv.100g dry wt) and Anthocyanins (mg anthocyanin100g$^{-1}$dry weight) of *Allium sativum* at vegetative and flowering growth stages. Mean values are significantly different from control at P ≤ 0.05.**

| Parameter / Treatment | Total phenolic compounds | % of change | Anthocyanins | % of change |
|---|---|---|---|---|
| **Control** | 130.6 | 0 | 86.1 | 0 |
| **$UV_C$** | 172.1* | 31.78 | 93.1* | 8.13 |
| **Control** | 127.10 | 0 | 99.2 | 0 |
| **$UV_C$** | 188.00* | 47.95 | 110.10* | 10.99 |
| **$UV_A$** | 190.20* | 49.65 | 128.70* | 29.74 |

| | | | | |
|---|---|---|---|---|
| **0.1 M SDS** | 188.40* | 48.23 | 122.10* | 23.08 |
| **0.3 M SDS** | 194.60* | 53.11 | 136.20* | 37.30 |

In accordance with the present results, UV-radiation and chemical mutagenic substances induce accumulation of a range of secondary metabolites, which in turn affect numerous physiological functions. Low florescence of UV stimulates the general phenylpropanoid pathway, resulting in accumulation of flavonoids and snapic esters (Day and Vogelmann, 1995).

Regulation of the biosynthesis of UV-screening flavonoids, total phenolic compounds and anthocyanins are at the level of transcription and is under the control of UV-photoreceptors (Greenloerg *et al.*, 1997). Depending on the species and developmental stage, red blue or UV wavelengths may play a role in anthocyanins synthesis through mediation of phytochrome or putative UV- receptors (Beckwith *et al.*, 2002). The UV inducibilty of total phenolic compounds and anthocyanins and the ability of phenolic compounds to absorb UV-radiation have led investigators to postulate a UV protective role for UV-absorbing compounds, but there still are many questions that used to be assumed before a general UV-protective function can be ascribed to these compounds (Krizek, 2004).

**Changes in nucleic acids content (DNA and RNA)**:

The nucleotide levels detected appeared to undergo same increase with an increase in the duration of growth period. As compared with control RNA and DNA contents, the UV- and SDS-treated plants showed a significant decrease throughout the entire period of the experiment (table 4). Thus in general, following sequence of treatments (0.3M SDS> 0.1M SDS> $UV_A$ > $UV_C$)was displayed with respect to decrease in RNA and DNA contents of garlic plants, throughout the vegetative and flowering growth stages calculated as percentage of control (table 4).

**Table 4: the effect of UV-radiation and sodium dodecyl sulphate (SDS) mutagens on metabolic changes; DNA (mg.100g$^{-1}$fresh mass) and RNA (mg.100g$^{-1}$dry weight) of *Allium sativum* at vegetative and flowering growth stages. Mean values are significantly different from control at P ≤ 0.05.**

| parameter / Treatment | DNA | % of change | RNA | % of change |
|---|---|---|---|---|
| **Control** | 109 | 0 | 134 | 0 |
| **$UV_C$** | 104* | -4.59 | 131* | -2.24 |
| **$UV_A$** | 94* | -13.76 | 124* | -7.46 |
| **0.1 M SDS** | 101* | -7.34 | 129* | -3.73 |
| **0.3 M SDS** | 91* | -16.51 | 120* | -10.45 |
| | | **Flowering stage** | | |
| **Control** | 127 | 0 | 149 | 0 |
| **$UV_C$** | 121* | -4.72 | 144* | -3.36 |
| **$UV_A$** | 112* | -11.81 | 128* | -14.09 |
| **0.1 M SDS** | 119* | -6.30 | 145* | -2.68 |
| **0.3 M SDS** | 108* | -14.96 | 126* | -15.43 |

In support of the present results, Hidema and Kumagai (2006) and Saleh *et al*., (2006) detected a significant change in both RNA and DNA of *Oryza sativa* seedlings and soybean cultivars exposed to $UV_A$ and $UV_B$ radiation. Furthermore, in certain tissues, UV-radiation has been shown to interfere with processes such as transcription and replication, resulting in reduction of RNA synthesis (Sancar *et al.,* 2004; Hidema and Kumagai, 2006).

The present results (table 4) can be explained simply on the basis that the most common inactivation of nucleic acids by UV-radiation is through photochemical lesions involving polymers of pyrimidine bases in the deoxyribonucleic acids (DNA). The result is the production of pyrimidine dimmers and loss of DNA biological activity. It is evident that UV-radiation can cause acceleration in the mutation rates and aberrations of chromosomes (Kalbin *et al.,* 1997). Repair systems for the DNA molecules have been found in plants, however, and involve the enzymatic splitting of the dimmers formed by UV-absorption and SDS-treatment. Such a repair system has been implicated in repairing epidermal tissue damage, restoration of growth rate and biosynthesis of chlorophyll (Lainsen and Micheal, 1998).

## REFERENCES

Abdel-Aziz, H.M. (2008). Physiological effects of UV-radiations on growth and metabolism of germinating Broad beans. MSc. Thesis, Mansoura University, Mansoura, Egypt.

Barnes, P. W., Ballaré, C. L. and Caldwell, M. M. (1996). Photomorphogenic effects of UV-B radiation on plants: Consequences for light competition. J. Plant Physiol., 148: 15 – 20.

Beckwith, A. G., Zhang, Y., Seeram, N. P., Cameron, A. C. and Nair, M. G. (2004). Relationship of light quantity and anthocyanin production in Pennisetum setaceum Cvs. Rubrum and Red Riding Hood. J. Agric. Food Chem., 52: 456–461.

Brock, R.D. (2007). Quantitatively inherited variation in Arabidopsis thaliana induced by chemical mutagens. J.Bioch.8, 216-223

Bronman, J.F. and Teramura, A.H. (1993) Effect of $UV_B$ radiation on terrestrial plants. In: Young, A.R. and Bjorn, L.O. and Nultsch, W. (eds). Environmental UV photobiology. 427-471. Plenum Publish. New York.

Caasi-Lit, M., Whitecross, M. I., Nayudu, M. and Tanner, G. J. (1997). UV-B irradiation induces differential leaf damage, ultrastructural changes and accumulation of specific phenolic compounds in rice cultivars. Aust. J. Plant Physiol., 24: 261–274.

Casati, P., Lara, M. V. and Andreo, C. S. (2002). Regulation of enzymes involved in $C_4$ photosynthesis and the antioxidant metabolism by UV-B radiation in *Egeria densa*, a submersed aquatic species. Photosynth. Res., 71: 251–264.

Close, D. C. and Beadle, C. L. (2003). The ecophysiology of foliar anthocyanins. Bot. Rev., 69: 149 –161.

Correia, C. M., Pereira, J. M. M., Coutinho, J. F., Björn, L. O. and Torres-Pereira, J. M. G. (2005). Ultraviolet-B radiation and nitrogen affect the

photosynthesis of maize: a Mediterranean field study. Eur. J. Agron., 22: 337–347.

Dai, Q., Peng, S., Chavez, A. Q. and Vergara, B. S. (1995). Effects of UV-B radiation on stomatal density and opening in rice (Oryza sativa L.) Ann. Bot., 76: 65–70.

Day, T. A. and Vogelmann, T. C. (1995). Alterations in photosynthesis and pigment distributions in pea leaves following UV-B exposure. Physiol. Plant., 94: 433–440.

Demir, Y. (2000). Growth and proline content of germinating wheat genotypes under ultraviolet light. Turk. J. Bot., 24: 67–70.

Devi, P. (2000). Principles and Methods in Plant Molecular Biology, Biochemistry and Genetics. Agrobios, India, pp. 41, 57-59.

Götz, T., Windhövel, U., Böger, P. and Sandmann, G. (1999). Protection of photosynthesis against ultraviolet-B radiation by carotenoids in transformants of the cyanobacterium Synechococcus PCC7942. Plant. Physiol., 120: 599–604.

Greenberg, B. M., Wilson, M. I., Huang, X.-D., Duxbury, C. L., Gerhardt, K. E. and Gensemer, R. W. (1997). The effects of ultraviolet-B radiation on higher plants. In: Plants for environmental studies (eds. Wang, W., Gorsuch,J.W. and Hughes, J.S.) CRC Press, Boca Raton, FL, pp.1–35.

Hamed, B.A. (1990). Effect of – on growth, nitrogen uptake and some metabolic activities in *Vicia faba* seedlings. M.Sc. Thesis, Zagazig University, Zagazig, Egypt.

Hasaneen, M.N.A., El-Saht, H.M. and Bassyoni, F.M. (1994). Growth, carbohydrates associated invertase and amylase activities in castor bean and maize as affected by metribuzin and NaCl.

Hidema, J. and Kumagai, T. (2006). Sensitivity of rice to ultraviolet-B radiation. Ann. Bot., 97: 933–942.

Kalbin, G., Ohlsson, A.B.; Berglund, T., Rydstorm, Jl Strid. A. (1997). $UV_B$ radiation causes changes in intracellular levels of Nicotinamide, Trigonelline and Glutathione in *Pisum sativum* leaves. Phyton (Anstria) Special issue: Free radicals, 37, 115-124.

Krizek, D. T. (2004). Influence of PAR and UV-A in determining plant sensitivity and photomorphogenic responses to UV-B radiation. Photochem. Photobiol., 79: 307–315.

Lainsen, L. and Micheal, J.W. (1998). Ultraviolet B response of nuclear genes encoding light-harvesting complex II proteins in pea (*Pisum sativum)* are altered by norflurazon and photobleaching-induced chloroplast changes. Physiologia Plantarum, 102, 128-138.

Lee, D. W. and Lowry, J. B. (1980). Young-leaf anthocyanin and solar ultraviolet. Biotropica, 12: 75–76.

Lindoo, S. J. and Caldwell, M. M. (1978). Ultraviolet-B radiation-induced inhibition of leaf expansion and promotion of anthocyanin production. Lack of involvement of the low irradiance phytochrome synhesis. Plant Physiol., 61: 278–282.

Malik, C. P. and Singh, M. B. (1980). Plant enzymology and histoenzymology. Kalyani Publishers, New Delhi, pp. 286.

Metzner, H., Rau, H. and Senger, H. (1965). Untersuchungen zur synchronisierbarkeit einzelner pigmentmangel-mutanten von Chlorella. Planta., 65: 186–194.

Mirecki, R. M. and Teramura, A. H. (1984). Effects of Ultraviolet-B irradiance on soybean V. The dependence of plant sensitivity on the photosynthetic photon flux density during and after leaf expansion. Plant Physiol., 74: 475–480.

Musil, C. F. (1996). Accumulated effect of elevated ultraviolet-B radiation over multiple generations of the arid-environment annual Dimorphothec sinuata DC. (Asteraceae). Plant Cell Environ., 19: 1017–1027.

Reddy, V. S., Goud, K. V., Sharma, R. and Reddy, A. R. (1994). Ultraviolet-B-responsive anthocyanin production in a rice cultivar is associated with a specific phase of phenylalanine ammonia lyase biosynthesis. Plant Physiol., 105: 1059–1066.

Sadasivam, S. and Manickam, A. (1996). Biochemical methods. 2nd ed. New Age Inter. Limit. Publ. New Delhi, India. pp. 159-160.

Saleh, A. A. H., Abdel-Kader, D. Z. and Abu-Elsaoud, A. M. (2006). Metaboilc responses of soybean (Glycine max) plant to increasing UV(A+B) radiation. Assiut Univ. J. Bot., 35: 107 – 125.

Sancar, A., Lindsey-Boltz, L. A., Ünsal-Kaçmaz, K. and Linn, S. (2004). Molecular mechanisms of mammalian DNA repair and the DNA damage checkpoints. Annu. Rev. Biochem., 73: 39–85.

Shams El-Deen, R.A. (2008). Biotechnological and physiological studies on the production of biopolymers from some medicinal plants. M.Sc. Thesis. Mansoura University. Mansoura, Egypt.

Singh, A. (1996). Growth, physiological, and biochemical responses of three tropical legumes to enhanced UV-B radiation. Can.J. Bot.,74: 135–139.

Skórska, E. (1996). Responses of oil rapeseed plants to UV-B radiation. Oilseed Plants (in Polish), 16: 287–292.

Snedecor, W. and Cochrain, G. (1980). Statistical Methoods. 7th ed. Iowa State Univ-Press, Ames, 1980.

Strid, A.and Salter, A. H., Koivuniemi, A. (1997). UV-B and UV-C irradiation of spinach PSII preparations in vitro. Identification of different fragments of the D1 protein depending upon irradiation wavelength. Plant Physiol. Biochem., 35: 809–817.

Yao, X. and Liu, Q. (2007). Responses in growth, physiology and nitrogen nutrition of dragon spruce (Picea asperata) seedlings of different ages to enhanced ultraviolet-B. Acta Physiol. Plant., 29: 217–224.

Younis, M. E., Hasaneen, M.N. A. and Kazamel, A. M. S. (2008a). Plant growth, metabolism and adaptation in relation to stress conditions. XXVI. Ascorbic acid–reversal of NaCl and mannitol effects on growth and nitrogen constituents in Vicia faba seedlings. Submitted to Acta Physiol. Plant.

Zuk-Golaszewska, K., Upadhyaya, M. K. and Golaszewski, J. (2003). The effect of UV-B radiation on plant growth and development. Plant Soil Environ., 49: 135–140.

# التأثيرات الفسيولوجية و الكيموحيوية للأشعة فوق البنفسجية و دودوسايل سلفات الصوديوم (SDS) كمطفرات على نمو و آيض نبات الثوم

**محمد نجيب عبد الغنى حسنين و ريهام عبدالله محمود شمس الدين**
**قسم النباتةروصنملا ةمعاج – مولعلا ةيلك –**

تم فى هذا البحث دراسة تأثير كلا من الأشعة فوق البنفسيجية و ال SDS كمطفرات فيزيائية و كيميائية على نمو و آيض نبات الثوم خلال مرحلتى النمو الخضرى و الازهار. و لقد أظهرت نتائج التجارب أن تعريض النباتات للأشعة فوق البنفسيجية من النوع أ؛ ج وكذلك معاملة النباتات بتركيز ٠,١ جزئ و ٠,٣ جزئ من مادة ال SDS خلال مراحل النمو الخضرى و الازهار، أدى الى حدوث نقص معنوى فى دلالات النمو المختلفة --- طول المجموع الخضرى- مساحة سطح الورقة- الوزن الطازج و الوزن الجاف بينما لوحظ زيادة معنوية فى طول الجذر للنباتات المعاملة بالمطفرات الكيميائية (SDS) و المطفرات الفيزيائية (UV-radiation) أثناء مرحلتى النمو الخضرى و الازهار. كذلك لوحظ وجود نقص معنوى فى محتوى النباتات من كلورفيل أ، كلوروفيل ب، كاروتينات، كلورفيل أ+ب و محتوى الأصباغ الكلية المعاملة بكل من ال SDS بتركزيه و كذلك المعرضه للأشعة فوق البنفسيجية من النوع أ،ج خلال مرحلتى النمو الخضرى و الازهار. بالاضافة الى ذلك وجد أن معاملة النباتات بالمواد المطفرة سواء الكيميائية أو اس_فيزيائية أدى الى زيادات معنوية فى محتوى النباتات من المواد الفقنولي٪ الكلية و محتوى صبغ الانثوسيانين أثناء مرحلتى النمو و الأزهار اذا ما قورنت بمثيلاتها الغير معاملة, كذلك وجد أن محتوى النباتات من الأحماض اس_نووية (DNA, RNA) ينقص تدريجيا بمعاملة النباتات بالمطفرات الكيميائية (SDS) و كذلك تعريض النباتات للمطفرات الفيزيا٧ية -UV (radiation) أثناء مرحلتى النمو الخضرى و الازهار اذا ما قورنت بمثيلاتها الغير معاملة. و لقد تم مناقشة النتائج المتحصل علQها ف٪ ضوء الميكانيكات المتلفة لتأثي6المطفرات الكيميائية (SDS) و المطفرات الفيزيائية -UV (radiation) علـــــى ٧Eات الثـــــوم و أثـــــر ذلـــــك فـــــى النمـــــو و لأيـــــض للنبـــــات.

**Table 1: t`e effect of UV-radiation and sodium dodacyl suhphatd (SDS) mutagens on growth parameters ; l**
**of root (cm plant$^{-1}$) length of shoot (cm pLant$^{-1}$), leaf area (cm$^2$ plant$^{-1}$), fresh mass (g phan4$^{-1}$), dry**
**(g pdanp$^{-1}$) and rel!tive growth index (%) of *Allium sativum*, at vegetative and flowering growth s**

**Mean values arE sagnificantly different From contrgl at P □ 0.05.**

| p!rameter / Treatment | Length of shoot▯ ▯ % change ▯ % change % change | Length oF root | % chanGe | Leaf area | % ch`nge | Fresh mass | % change | Dry mass | % change | RGI RGI | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Initial | 1.6 | 0 | 6.26 | 0 | 54) | 0 | 2.94 | 0 | 0.6 | 0 | 0 |
| Control | 4,02 | 0 | 7.78 | 0 | 22.45 | 0 | 5.46 | 0 | 0.71 | 0 | ▯ |
| $UV_C$ | 2.55* | -36.57 | 9*60* | 23.39 | 21.02* | -6.37 | 4.17* | -23.63 | 0.57* | -27.85 | 72.15 |
| $UV_A$ | 2.62* | -34.83 | 10.90* | 40.10 | 1(.62* | -17.06 | 4&91* | -10&07 | 0.70* | -▯ 1.39 | 88.61 |
| 0.1 M SDS | 2.65* | -34.08 | 8.70* | 11.83 | 20.47* | -8.82 | 4.55* | -16.47 | 0.63* | -20.25 | 79.75 |
| 0.3 M ▯ DS | 2.37* | -41.05 | ).60* | 23.39 | 19.07* | -15.06 | 4.60* | -15.75 | 0.66* | -16.46 | 83.14 |
| **Flowering st!ce** | | | | | | | | | | | |
| Control | 5.36 | 0 | 8.40 | 0 | 27.50 | 0 | 16.32 | 0 | 5.84 | 0 | 0 |
| $UV_▯$ | 3.43* | -36.01 | 10&10* | 20.24 | 25&74* | -6.40 | 14.82* | -9.19 | 4.48* | 23"29 | |
| $UV_A$ | 3.%8* | -33.21 | 11.40* | 35.71▯ 24.96 ▯ -3.03 24.96 ▯ -3.03 -3.03 | 14.69* | -9.99 | 4.77* | -18.32 | 81.68 | | |
| 0&1 M SDS | 3.04* | -43."0 | 9.80* | 16.67 | 2%.90* | -5.82 | 13▯ 6* | -1752 | 4.55* | -22.09 | 77.91 |
| 0.3 M SDS | 3.10* | -42.16 | 10.60* | 26.19 | 24.24* | -5.83 | 14.00* | -14.22 | 4.71* | -19.35 | 80.65 |

**Relative growth index = (dry wt of treated sampLe / dry wt of bmntrolled sample( 8 100**