Horticulture Research Journal, 1(1), 44:51, June 2023, ISSN 2974/4474

Evaluation of Some Tree Species Grown at Shubra El-Kheima Zone for Their Bearing to Air Pollution Based on Air Pollution Tolerance Index (APTI)

Abd El-Kader, E. M.* and E. N. El-Atrach*
*Timber trees Research Department, Horticulture Research Institute, Agricultural Research Center

ABSTRACT

Trees need to be in agreement with the surrounding environment to greatify their vital roles in urban air quality. The present study aimed to evaluate various tree species which represent the most widespread in streets of Shubra El-Kheima zone according to their tolerance to air pollution. Leaf samples of eleven tree species were collected from two sites; Shubra El-Kheima (represent polluted one) and Elqanater Elkhyeria (represent low air pollution site "as control site"). Four parameters were measured including total chlorophyll, pH, ascorbic acid and relative water content. APTI was approved to assess the plant tolerance to air pollution. Results indicated that there are differences among tree species in that parameters resulted in a variation in degree of tolerance to air pollution. Generally, *Dalbergia sissoo* was identified as tolerant species to air pollutants in Shubra El-Kheima zone according to APTI (14.05) followed by *Ficus benjamina*, *Albizia lebbec*k and *Ficus nitida*, which reached to12.04, 11.77 and 11.27, respectively and recommend to be planted as a dominant street tree. Concerning dust accumulation, tree species includes *Dalbergia sissoo*, *Albizia lebbeck*, *Tipuana speciosa*, *Ficus nitida*, *Ficus benjamina*, and *Ficus infectoria* are able to remove air dust and act as air filter which recorded 0.236, 0.222, 0.220, 0.194, 0.168 and 0.184 mg/cm^2, respectively. So, they could be used for a forestation in region in which the study was conducted and the corresponding cities especially in the north and west borders where the wind blows.

Key words: Air pollution tolerance index (APTI), Shura El-kheima, dust accumulation.

INTRODUCTION

According to United Nations Environment Program (2002), the Middle East, residents have always suffering from immoderate heat, dust storms, rare rainfall, and raucous geography; thus, air pollution has strong effects on people's lives in this region. Shubra El-Kheima is an industrial complex at the northern boundary of Cairo, Egypt. It has an area of about 30 km^2 and houses over 450 industrial plants of assorted sizes. Textile industry is the most obvious activity, followed by engineering, construction, chemical, petroleum and electrical industries. Emissions from these industries directly affect the air quality in the Greater Cairo area (Abdel Salam et al., 1980) as well as power planet for electric generation (Hereher et al., 2022).

Air pollution is a major risk factor for urban and industrial areas in the world especially developing countries (Sánchez-Chardi, 2016). Air quality is mostly determined by location, meteorological conditions, season, and human activity. So far, there are limited accurate inventory studies in the region. Transportation, biomass burning, domestic combustion, energy, and industry are the main anthropogenic sources of air pollution. Uncontrolled industrialization and rapid urbanization are known to cause serious problems, due to inadequate emission control and lack of stringent environmental regulations (Sánchez-Chardi, 2016). According to WHO (2016) air pollution is global problem and is responsible for one in every nine deaths annually while, urban vegetation plays a significant role in combating air pollution as well as trees that act as an important and cost-effective solution to combat air pollution.

There is barely any data available on plant species ranking upon tolerance to urban pollution, particularly vehicular pollution. The air pollution tolerance index (APTI) based on four measurements, namely total chlorophyll, ascorbic acid, pH and relative water content have been used for determination tolerance levels of these species. APTI has been extensively used to rank plant species in their order of tolerance to air pollution (Singh et al., 1991 and Raza, and Murthy, 1988). Previous parameters have to be determined in leaves because they are major air pollutant receptors (Panigrahi et al., 2014). Dust load on plant had been attributed to factors related to plant leaves, including the distinctive nature of the leaf (orientation, hairiness, form and size, surface texture, occurrence, petioles length), and others belonging to air current and its speed (Walia et al., 2019). The present investigation was carried out to assess APTI of dominant trees covering the busy crowded Shubra El-Kheima area to select the most tolerant species and recommended by using them as urban trees species.

MATERIALS and METHODS

1. Study Sites

The present research has been done in Shubra El-Kheima, (30° 128′61″ N to 1° 241′ 97″ E). It is one of the most polluted areas of Egypt and Elqanater Elkhyeria as a low air pollution (control) site (30° 11′ 36″ N 31° 08′ 13″ E).

Collection of Leaf Samples

Fresh fully mature leaf samples of selected eleven tree species (Table 1) grown in Shubra El-Kheima were randomly collected and analyzed for the following parameters. Samples were collected from trees of the same species grown in Elqanater Elkhyeria as a control (low air pollution site). Leaf samples were collected during October to avoid leaves fall down of deciduous tree as well as air pollutants reached their maximum levels according **to** Mostafa et al. (2018).

2. Measurement of Dust Accumulation

Dust load on the leaves were measured using the methods of Pandit et al. (2017). In brief, the collected leaf samples were first weighed on an electronic scale and their initial weights were recorded. Dust accumulated on the leaf surfaces was carefully brushed off and the samples were reweighed to obtain the final weight. The difference between them gave the amount of dust accumulation in mg. To calculate dust accumulation per unit area, the leaf areas of the samples were first measured

Dust accumulation (mg/cm2) = wf – wi/ A

wf = final weight of leaf; wi = initial weight of leaf; A = leaf area

3. Determination of the four physio-biochemical parameters:

In order to estimate the air pollution tolerant index (APTI) as an index denotes the ability of plant to withstand any pollution, the leaf samples were analyzed for relative water content (RWC%), pH of leaf extract, total chlorophylls and ascorbic acid contents using the methods of Prasad and Rao (1982), Moran (1982) and Sadasivam and Manickam (1996), respectively.

4. Air pollution tolerance index (APTI) calculation:

Finally, the four physio-biochemical parameters mentioned above were used for computing the APTI for the selected trees and shrubs using the equation proposed by Singh and Rao (1983):

APTI = [AsA (T. Chlo. + pH) + RWC] ÷ 10.

Where: AsA = ascorbic acid content (mg/100g f.w.), T. Chlo = total chlorophyll content (mg/g f.w.), pH of the leaf extract and RWC: relative water content (%).

According to APTI values, plant species can be categorized into sensitive, moderately tolerant (Intermediate) and tolerant, where APTI values were ranged from 1 to 100 by Begum and Harikrishna (2010), and sensitivity/tolerance degree of plants can be determined from the following APTI scale:

<1: very sensitive, 1-16: sensitive, 17-29: moderately tolerant and 30-100 tolerant.

5. Data analysis

Data were analyzed by two ways analysis of variance (ANOVA) and statistically analyzed using the program of SAS Institute (2009), followed by Duncan's New Multiple Range Test (Steel and Torrie, 1980) for means comparison.

RESULTS and DISCUSSION

Ascorbic acid

Ascorbic acid being an important antioxidant, it has a vital role in cell wall synthesis, defense, and cell division. It also plays an important role in photosynthetic process. So, it is used as a factor in the formula used to put a figure on APTI (Nwadinigwe, 2014). As shown in Table (1) the mean content of ascorbic acid in trees grown polluted area is significantly higher than its content in those grown in low-polluted area. *Dalbergia sissoo* recorded the highest significant ascorbic acid content. *Delonix regia, Ficus benjamina* and *Albizia lebbeck* descendingly arranged with significant differences after *D. sissoo,* whereas *Tipuana speciosa* contained the lowest one. In nine tree species of the eleven under investigation, ascorbic acid content in trees in polluted zone significantly higher than in low-polluted area. On the other hand, *Ficus infectoria* and *Tipuana speciosa* had opposite results. From the obtained results, it is obvious clear that the widest difference between trees of the same species grown in the two different sites was recorded for *Delonix regia* (3.15 fold) while, the narrowest range was recorded for *Ficus nitida* (1.12 fold). Ascorbic acid being an antioxidant, it induces the resistance of plants against air pollutants (Deepalakshmi et al., 2013). Plant species with high amount of ascorbic acid are considered to be tolerant to air pollutants (Keller and Schwager, 1977). Accordingly, *Dalbergia sissoo*, *Delonix regia* can be considered more resistant to air pollution. As mentioned by Sharma et al. (2016) ascorbic acid acts as first line defense against air pollution.

Table (1): Results of ascorbic acid and total chlorophyll of 11 tree species in polluted area versus low pollution area.

Species	Ascorbic acid mg/g			Total chlorophyll mg/g		
	Polluted site	Low pollution site	Mean	Polluted site	Low pollution site	Mean
***Ficus infectoria* Wild**	0.39 j	0.52 gh	0.45 E	1.76 g	2.36 c	2.06 D
***Ficus nitida* Thunb.**	0.65 e	0.58 f	0.61 D	2.05 f	3.42 a	2.74 A-C
***Ficus religiosa* L.**	0.51 h	0.38 j	0.45 E	1.69 gh	2.2g c-e	1.97 D
***Ficus benjamina* L.**	0.87 c	0.45 i	0.66 C	1.24 j	2.19 d-f	1.72 E
***Melia azedarach* L.**	0.54 f-h	0.39 ij	0.47 E	2.14 d-f	3.20 b	2.67 BC
***Azadirachta indica* A. Juss**	0.51 h	0.40 j	0.46 E	2.19 d-f	3.12 b	2.65 C
***Albizia lebbeck* (L.) Benth**	0.76 d	0.57 fg	0.66 C	1.30 j	1.61 hi	1.45 F
***Dalbergia sissoo* DC.**	1.43 a	0.71 d	1.07 A	1.52 i	1.76 g	1.64 E
***Delonix regia* (Hook) Raf.**	1.23 b	0.39 j	0.81 B	2.30 cd	3.22 b	2.76 B
***Peltophorum africanum* Sond**	0.3 9 j	0.32 k	0.35 F	2.21 de	3.42 a	2.81 A
***Tipuana speciosa* Benth.**	0.06 l	0.08 l	0.07 G	1.04 k	1.05 k	1.04 G
Mean	0.667 A	0.43 B		1.77 B	2.51 A	

Means followed by the same litter(s) are not significantly different at 0.5% level according to Duncan multiple range test

Total chlorophyll

Total chlorophyll is the most important indicator of plant health. As shown from data in Table (1) the mean content of chlorophyll significantly decreased in trees grown in polluted area than in low-polluted area. Generally, *Peltophorum africanum* contained the highest significant value of chlorophyll which was2.81 mg/g f.w, while *Tipuana speciosa* contained the lowest significant one where attained to104 mg/gf.w. As for data of interaction between tree species and location, *Tipuana speciosa* and *Ficus* nitida grown in low-polluted site recorded the highest significant concentration of chlorophyll (3.42 mg/g f.w). Exposing trees to air pollution resulted in reducing chlorophyll content ranging between 0.1 to 40 percent (approximately). Although the *Ficus nitida* tree recorded the highest content of chlorophyll when it was grown in a low-pollution environment, its exposure to pollution led to a decrease in its chlorophyll content by 40%. Otherwise, *Tipuana speciosa* trees recorded the lowest values of chlorophyll (104 mg/g f.w) content affected by pollution. Tree species that showed a high content of chlorophyll, which indicates their relative resistance to air pollution are *Delonix regia*, *Peltophorum sp.*, *Azaderachta indica*, *Melia azaderach* and *Ficus nitida*. Their chlorophyll contents are ranging from (2.31 to 2.05). This result according to Allen *et al*. (1987) opinion shows that the chlorophyll content reversely related with pollutant level because certain pollutants generally reduce the total chlorophyll content. Chandawat et al. (2011) reported that the chlorophyll contents of plants varied with the pollution level of the area, as well as the tolerance and sensitivity of the plant species. Santosh et al. (2008) reported that a high amount of chlorophyll in plants increases air pollution tolerance.

pH value

Mean of leaf extract pH of trees grown in polluted area trended to acidic value (6.27) whereas; the pH mean value of those grown in low-pollution area was slightly alkaline which reached to7.17. As for the mean effect of tree species regardless its location, pH value of leaf extract of *Tipuana speciosa* recorded the highest significant value (7.51), while leaf extract of *Melia azedarach* recorded the least significant one (6.01) then *Ficus nitida, Peltophorum sp Ficus religiosa, Delonix regia*, *Dalbergia sissoo*, *Albizia lebbeck, Ficus benjamina,* and *Azadirachta indica* tress recorded intermediate values which were 7.25, 7.20, 7.01, 6.29, 6.86, 6.24, 6.32, 6.26 and 6.11 respectively .

Concerning the interaction among plant species and level of air pollution significantly affected the pH value of leaf extract. From data presented in Table (2) it is clear that pH of leaf extract of each species grown in low-polluted site is significantly higher than that of the same species grown in polluted area except *Delonix regia* and *Peltophorum africanum.* which represented an opposite direction. The widest range between pH values of leaf extract of the same species that affected by air pollution was detected for *Ficus infectoria* and *Ficus religiosa*, while the narrowest range was recorded for *Tipuana speciosa* and *Delonix regia*. It clear from data in Table (2) that, *Peltophorum africanum*, *Tipuana speciosa*, *Delonix regia* and *Ficus nitida* grown in polluted site recorded pH values closed to normal (from 7.62 to 6.61). To understand the effect of air pollution on pH of leaf extract Zhen (2000) mentioned that when plants are facing air pollutants (especially SO_2), their cellular fluid would produce vast H^+ to react with SO_2, which enters through stomata and intercellular space from air, so that H_2SO_4 is produced and then leaf pH reduces. Also Zhang et al. (2013) described that the ability of plants to absorb SO_2 and NO_2 is positively related with leaf extract pH.

Relative water content (RWC)

Water content represents the physiological status of the plant so it is an important factor. The relative water content in a plant body helps in preserving its physiological balance especially, under stress conditions including air pollution stress (Dedio, 1975). Generally, plants grown in polluted sites shows reduced relative water content compared with the same species grown in low-pollution sites. As shown in Table (2) air pollution significantly reduced relative water content. The highest significant value of relative water content (89.33) was detected for *Ficus nitida* grown in low-pollution site whereas, the least significant one (41.60) was measured in *Delonix regia* grown in pollution site. The greatest effect of air pollution on relative water content was observed in *Ficus nitida* which was cleared by difference between trees grown in low-polluted site and polluted-site. While the narrowest difference which represent the least effect of air pollution was observed for *Peltophorum africanum* and *Delonix regia*. The importance of relative water content as a parameter for plant tolerance to air pollution is due to its role for the growth and physiological activities of plants (Jiang et al., 2010), and higher RWC is beneficial to maintain plant life processes and to overcome environmental adversity. Our results are in agreement with those of Ramakrishnaiah, and Somashekar (2003) who mentioned that the reduced relative water content indicates disturbed physiological status in the plants due to pollution.

Table (2): Results of pH and relative water content of 11 tree species in polluted area versus low pollution area

Species	pH			Relative water content		
	Polluted site	Low pollution site	Mean	Polluted site	Low pollution site	Mean
***Ficus infectoria* Wild**	6.20 g	7.82 ab	7.01 C	59.97 g	82.50 b	71.23 BC
***Ficus nitida* Thunb.**	6.61 f	7.89 a	7.25 B	56.53 hi	89.33 a	72.93 B
***Ficus religiosa* L.**	6.11 gh	7.73 ab	6.92 C	58.63 fg	81.63 b	70.13 C
***Ficus benjamina* L.**	5.51 j	7.01 d	6.26 E	61.30 fg	78.27 c	69.78 C
***Melia azedarach* L.**	5.31 k	6.72 f	6.01 F	51.47 jk	70.47 d	60.97 F
***Azadirachta indica* A. Juss**	5.92 hi	6.31 g	6.11 F	55.00 i	70.90 d	62.95 E
***Albizia lebbeck* (L.) Benth**	5.41 jk	7.23 c	6.32 D	66.67 e	78.83 c	67.60 D
***Dalbergia sissoo* DC.**	5.87 i	6.97 de	6.42 D	52.82 j	78.53 c	72.60 B
***Delonix regia* (Hook) Raf.**	6.99 de	6.74 f	6.86 C	41.60 l	49.30 k	45.45 H
***Peltophorum africanum* Sond**	7.62 b	6.79 ef	7.20 B	51.94 j	60.38 g	56.16 G
***Tipuana speciosa* Benth.**	7.40 c	7.61 b	7.51 A	63.33 f	87.60 a	75.47 A
Mean	6.27 A	7.17 B		56.62 B	75.25 A	

Means followed by the same litter(s) are not significantly different at 0.5% level according to Duncan multiple range test

Air Pollution Tolerance Index (APTI)

APTI is the ingrained quality of plants to combat air pollution stress, which is presently a primary concern, especially in industrial areas. Therefore, the APTI needs to be observed and scan in predominant species that are present in polluted and low-polluted areas (Rai et al., 2013). The APTI values calculated for each tree species in the two sites are presented in Table (3). The calculated APTI significantly affected by tree species as well as site location which represent air pollution level. Generally, APTI of plants grown in polluted site (Shbra El-Keima) is significantly less than that, of trees grown in Elqanater Elkhyeria. *Dalbergia sissoo* recorded the highest significant APTI value (14.95) which represents its tolerance to air pollution. On the other hand, *Tipuana speciosa* showed the least value (9.17) meanwhile, other trees recorded intermediate values. Comparison of various tree species in the same location cleared that *Dalbergia sissoo* grown in polluted site recorded the highest value of APTI. While *Melia azedarach, Peltophorum africanum* and *Tipuana speciosa* grown at the same location recorded the least ones, so it could be recommended that, up on this result, *Dalbergia sissoo*, *Ficus benjamina*, *Albizia lebbeck* and *Ficus nitida* are the most suitable tree sepsis for a forestation in Shubra El-Kheima compared with other species under investigation. To keep biodiversity of a forestation in the polluted site under study it can be recommended that using tree species which have APTI over than 10 in same condition.

Dust accumulation

Amount of the accumulated dust on leaf surfaces are presented in Table (3). Data show that dust accumulation significantly affected by tree species as well as site of investigation. The amount of accumulated dust on leaves of trees grown in polluted site (Shubra El-Kheima) reached 3.25-fold more than of those grown in low pollution site (Elqanater Elkhyeria). Various tree species under investigation grown in low pollution site had no significant difference in the amount of accumulated on leaf surfaces. The highest significant amounts of the accumulative dust (0.236 and 0.222 mg/cm^2) were weighted for *Dalbergia sissoo* and *Albizia lebbeck*, respectively grown in Shubra El-Kheima. While the lowest one (0.103 mg/cm^2) was detected for *Ficus religiosa* grown in the same site then other trees were in between. Verma, (2003) proclaim the dust-removing ability of the plant species was agreed with their foliar surface nature. The morphological characteristics which alone or in combination play a significant role in the interception of dust load from the ambience are: shape, size (leaf area in cm^2) and orientation of leaf on the main axis, surface nature (smooth/striate), the presence or absence of wax deposition. From results of our study it could be recommended that tree species showed high dust accumulation (ranging from 0.184 to 0.236 mg/cm^2) could be used as a forestation in industry towns. That tree species includes *Dalbergia sissoo*, *Albizia lebbeck, Tipuana speciosa*, *Ficus nitida*, *Ficus benjamina* and *Ficus infectoria*. Generally, assessing the dust removal capability of several common tree species needs investigations of their interaction with urban conditions, but such measurements and data are rarely available.

Table (3): Results of APTI and dust accumulation of 11 tree species in polluted site versus low pollution site.

Species	**APTI**			**Dust accumulation mg/cm^2**		
	Polluted site	**Low pollution site**	**Mean**	**Polluted site**	**Low pollution site**	**Mean**
***Ficus infectoria* Wild**	9.40 g-i	13.55 c	11.48 D	0.184 a-d	0.048 fg	0.116 A-C
***Ficus nitida* Thunb.**	11.27 f	15.47 a	13.37 B	0.194 a-c	0.062 e-g	0.128 A-C
***Ficus religiosa* L.**	9.85 g	11.96 e	10.90 E	0.103 d-g	0.035 g	0.069 C
***Ficus benjamina* L.**	12.04 e	12.01 e	12.02 C	0.186 a-d	0.060 e-g	0.123 A-C
***Melia azedarach* L.**	9.19 ij	10.91 f	10.05 F	0.127 c-f	0.044 fg	0.086 B-C
***Azadirachta indica* A. Juss**	9.66 gh	10.81 f	10.23 F	0.146 b-e	0.044 fg	0.095 A-C
***Albizia lebbeck* (L.) Benth**	11.77 e	12.96 d	12.36 C	0.222 ab	0.072 e-g	0.147 A
***Dalbergia sissoo* DC.**	14.05 b	15.84 a	14.95 A	0.236 a	0.064 e-g	0.149 A
***Delonix regia* (Hook) Raf.**	8.82 f	15.56 a	12.19 C	0.125 c-f	0.047 fg	0.084 BC
***Peltophorum africanum* Sond**	9.04 ij	10.86 f	10.23 F	0.129 c-f	0.041 fg	0.085 BC
***Tipuana speciosa* Benth.**	9.03 ij	9.30 h-j	9.17 G	0.220 ab	0.063 e-g	0.142 AB
Mean	10.37 B	12.66 A		0.170 A	0.052 B	

Means followed by the same litter(s) are not significantly different at 0.5% level according to Duncan multiple range test

REFERENCES

Abdel Salam, M. S.; Farag, S. A. and Higazy, N. A. (1980). Smoke concentration in the greater Cairo atmosphere. Atmospheric Environment, 15: 157-161.

Allen (Jnr), L. H., K.; Boote, L. and Jones, J. W. (1987). Response of vegetation to rising carbon dioxide. Global Biogeochemical Cycles, 1: 1-14.

Begum, A. and Harikrishna, S. (2010). Evaluation of some tree species to absorb air pollution in three industrial locations of south Bengaluru, India. E. J. Chem., 7: 151-156.

Chandawat, D.K.; Verma, P.U. and Solanki, H.K. (2011). Air pollution tolerance index of three spaces at cross roads of

Ahmedabad City. *Life Sci. Leaf*. 20: 935-943.

Dedio, W. (1975). Water relations in wheat leaves as screening test for drought resistance. Canadian J. Plant Sci., 55: 369-378.

Deepalakshmi, A.P.; Ramakrishnaiah, H.; Ramachandra, Y. L. and Radhika, R. N. (2013). Roadside plants as bio-indicators of urban air pollution. IOSR J. Environ. Sci. Toxic. and Food Tech. (IOSR-JESTFT), 3: 10-14.

Hereher, M.; Eissa, R.; Alqasemi, A. and El Kenawy, A. M. (2022). Assessment of air pollution at Greater Cairo in relation to the spatial variability of surface urban heat island. Environ. Sci. Poll. Res., 29: 21412–21425

Jiang, J.B.; Huang, W. J. and Chen,Y.H. (2010). Using canopy hyperspectral ratio index to retrieve relative water content of wheat under yellow rust stress. Spectroscopy and Spectral Analysis, 30: 1614–1618.

Keller, T. and Schwager, H. (1977). Air pollution and ascorbic acid. Europ. J. Forest Pathol., 7: 338– 350.

Moran, R. (1982). Formulae for determination of chlorophyllous pigments extracted with N, N-dimethylformamide. Plant Physiol., 69: 1376–1381.

Mostafa, A.; Zakey, A.; Monem, A. and Abdel Wahab, M. (2018). Analysis of the surface air quality measurements in the Greater Cairo (Egypt) metropolitan. Global J. Adv. Res., 5: 207–214.

Nwadinigwe, A.O. (2014). Air pollution tolerance indicate of some plants around AMA industrial complex in Enugu State, Nigeria. African J. Biotech., 13: 1231-1236.

Pandit, J.; Sood, A.; Bhardwaj, S. K. and Sharma, K. K. (2017). Seasonal variation of leaf dust accumulation and biochemical parameters of selected plant species alongside the national highway-7 in Sirmaur, India. Current World Environ., 12: 421-428.

Panigrahi, T.; Satpathy, J. K. and Panda, R. B. (2014). Effect of air pollutants on different plant species found in ITR Complex, Chandipur. Int. J. Green Herbal Chem., 3: 29-34.

Prasad, B.J. and Rao, D. N. (1982). Relative sensitivity of a leguminous and a cereal crop to sulphur dioxide pollution. Environ. Pollut., 29: 57-70.

Rai, P. K.; Panda, L.S.S.; Chutia, B.M. and Singh, M. M. (2013). Comparative assessment of air pollution tolerance index (APTI) in the industrial (Rourkela) and non-industrial area (Aizawl) of India: An Eco management approach. African J. Environ. Sci. and Tech., **7**: 944-948.

Ramakrishnaiah, H. and Somashekar, R. K. (2003). Higher plants as biomonitors of automobile pollution. Ecology, Environ. Conservation, 9: 337-343

Raza, S. H. and Murthy, M.S.R. (1988). Air pollution tolerance index of certain plants of Nacharam industrial area, Hyderabed. Indian J. of Botany, 11: 91-95.

Sadasivam, S. and Manickam, A. (1996). Biochemical Methods: New Age International (P) Litd., Publishers, 2nd ed., New Delhi, pp. 152-160.

Sánchez-Chardi, M. (2016). Biomonitoring potential of five sympatric *Tillandsia species* for evaluating urban metal pollution (Cd, Hg and Pb). Atmos Environ., 131: 352-359.

Santosh, K.; Prajapati, B. and Tripathi, D. (2008). Anticipated performance index of some tree species considered for green belt development in and around an urban area: A case study of Varanasi city, India. J. Environ. Manage, 88: 1343–1349.

Sharma, P.; Jain, R. and Ghosh, Ch. (2016). Role of ascorbic acid in imparting tolerance to plants against oxidizing pollutants. Inter. J. Sci. and Tech. Res., 5: 43-47.

Singh, S. K. and Rao, D. N. (1983). Evaluation of the plants for their tolerance to air pollution. Proceedings symposium on air pollution control held at IIT, Delhi, 218-224.

Singh, S. K.; Rao, D. N.; Agrawal, M.; Pandey, J. and Narayan, D. (1991). Air pollution tolerance index of plants. *J.* Environ. Management, 32: 45-55.

Steel, R. G. D. and Torrie, J. H. (1980). Principles and procedures of statistics. McGrow Hill Book Co., Inc., New York, P: 377-400.

United Nations Environment Program (2002). Air Quality and Atmospheric Pollution in the Arab Region. The United Nations Economic and Social Commission for Western Asia and the Unit. Nat. Environ. Prog. Regional Office for West Asia.

Verma, A. (2003). Attenuation of automobile generated air pollution by higher plants. Dissertation, (unpublished). Univ. of Lucknow.

Walia, K.; Aggarwal, R. K. and Bhardwaj, S. K. (2019). Leaf dust accumulation and its relationship with biochemical parameters of different plant species growing along national highway- 22. India. Int. J. Chem. Stud., 7: 1386-1390.

World Health Organization (WHO). (2016). Ambient air pollution: A global assessment of exposure and burden of disease.

Zhang, X.; Zhou, P.; Zhang, W.; Zhang, W. and Wang, Y. (2013). Selection of landscape tree species of tolerant to sulfur dioxide pollution in subtropical China. Open J. of Forestry, 3: 104-108.

Zhen, S.Y. (2000). The evolution of the effects of SO_2 pollution on vegetation. Ecol. Sci., 19: 59–64.

تقييم بعض أنواع الأشجار الناميه فى منطقه شبرا الخيمه من حيث قدرتها على تحمل تلوث الهواء بناءً على مؤشر تحمل تلوث الهواء (APTI)

عصام مصطفى عبد القادر و عصام الدين نجيب الأطرش

قسم بحوث الأشجار الخشبية – معهد بحوث البساتين – مركز البحوث الزراعية

يجب أن تتوافق الأشجار مع البيئة المحيطة بها لتعظيم دورها الحيوي في تحسين جودة الهواء في المناطق الحضرية. هدفت الدراسة الحالية إلى تقييم أنواع الأشجار المختلفة الأكثر انتشاراً في شوارع منطقة شبرا الخيمة طبقا لدرجة تحملهاً لتلوث الهواء. تم جمع عينات أوراق من ١١ نوعا من الأشجار من موقعين: شبرا الخيمة (تمثل منطقة ملوثة) والقناطر الخييرية (تمثل موقعًا منخفضًا لتلوث الهواء "كموقع للمقارنة"). تم قياس أربعة متغيرات تشمل الكلوروفيل الكلي، الأس الهيدروجيني، حمض الأسكوربيك والمحتوى النسبي للماء بالأوراق. تم حساب قيمة APTI لتقييم تحمل النبات لتلوث الهواء. أشارت النتائج إلى وجود اختلافات بين أنواع الأشجار حيث أدت هذه المعايير إلى تفاوت في درجة تحملها لتلوث الهواء. بشكل عام تعتبر *Dalbergia sissoo* أكثر الأنواع تحملا لتلوث الهواء في منطقة شبرا الخيمة وفقًا لقيمة APTI والتي بلغت ١٤.٠٥ يليها *Ficus benjamina* و*Albizia lebbeck* و*Ficus nitida* والتي وصلت إلى ١٢.٠٤ و ١١.٧٧ و ١١.٢٧ على التوالي ويوصى بزراعتهم كأشجار شوارع في تلك المنطقة. فيما يتعلق بتراكم الغبار، فإن أنواع الأشجار تشمل *Dalbergia sissoo* و *Albizia lebbeck* و *Tipuana speciosa* و *Ficus nitida* و*Ficus benjamina* و *Ficus infectoria* قادرة على إزالة غبار الهواء وتعمل كمرشح للهواء حيث سجلت ٠.٢٣٦ و٠.٢٢٢ و٠.٢٢٠ و٠.١٩٤ و٠.١٦٨ و٠.١٨٤ مجم/سم^{٢} على التوالي. لذلك، يمكن استخدامها للتشجير في المنطقة التي أجريت فيها الدراسة والمدن المماثلة خاصة في الجهتين الشمالية و الغربية حيث تهب الرياح.