Studies on Indoor Air Pollution: 6- Air Ions Evolution from Some Indoor Plants in Relation to Fertilization

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Abstract: We determined the effects of fourteen indoor plants and fertilization on negative air ion evolution. The study showed dramatic effects of both indoor plants and fertilization on negative air ion evolution. *Chlorophytum comosum variegatum, Chlorophytum comosum, Nephrolepis exaltata*, 'Bostoniensis', *Dracaena marginata* and *Dracaena fragrans* 'Massangeana' showed a favorable effect in this concern. The lowest plants in their evolution of air ions were *Ficus benjamina, Yucca aloifolia, Solenostemon scutellarioides (Coleus), Hedera helix, Syngonium podophyllum* and *Codiaeum variegatum*. On the other hand, fertilizing indoor plants increased their evolution of negative air ions.

Keywords: Air Ions, indoor plants, fertilization

INTRODUCTION

Air ions are short lived, lasting only minutes before they lose their charge. Their life-time is reduced by contacting walls or surfaces, or by interactions with pollutants or humidity in the air (Forney et al., 2001). The effect of air ions on the human being has been the subject of much debate. Commercial units are available which claim beneficial effects through the generation of negative air ions into the atmosphere. Conversely, it has been claimed that an excess of positive ions can cause discomfort and symptoms such as headaches and nausea in some people. Natural air ions may be produced by natural radioactivity and cosmic rays, waterfalls and plants. Natural ion balances could be altered in by man made environments such as in buildings or within vehicles, especially with the modern use of polymer materials which are prone to electrostatic charging to high voltages (Jun et al., 2003).

Many studies have proven that negative air ions (NAIs) have several positive influences on our psychological health. Exposure to NAIs reduces irritability, depression and tenseness, with increased calmness and stimulation (Terman et al., 1998). Fornof and Gilbert (1988) reported that indoor air ion levels affect the reactions of children to stressors.

The first biological impact of the air ions was recorded by Krueger and Reed in 1976. They found that these small air ions are biologically active. There is convincing evidence that air ions inhibit growth of bacteria and fungi and reduce the viable count of bacterial aerosols (Krueger and Reed, 1976; Forney et al., 2001; Fan et al., 2003 and Fan et. Al., 2007).

Negative gaseous ions were employed clinically with favourable therapeutic results. Exposure to a high concentration of negative air ions improves general health and acts as a normalising agent on a number of physiological parameters including the central nervous system (Boulatov, 2007).

Steffens (2002) concluded that indoor plants improve the air quality of rooms with little or no airflow. The indoor air quality (IAQ) deals with the content of interior air that could affect health and comfort of building occupants. The cheapest and the more sustainable effective method is introducing plants to reduce the levels of indoor air pollution, decreasing positive air ions and increasing negative air ions (Spengler et al., 2001; Ulrich, 2002 and Upchurch, 2008). Jovanic and Jovanic (2001) found that there were a correlation between air negative ions and chlorophyll content and photosynthetic efficiency.

The only scientific report dealing with generation of negative air ions (NAI) by plants was recorded by Tikhonov et. al., (2002) and Tikhonov et al., (2004). They classified plants to three groups: high, medium and low producers.

Until now there is no published record for production of air ions by indoor plants. The objectives of this study was to determine the differences between some common indoor plants in their evolution of air negative ions with or without fertilization using complete fertilizer of 19-19-19 NPK and trace elements.

MATERIALS AND METHODS

Healthy foliage indoor plants were selected from the nursery of the Horticulture Department, Suez Canal University. These plants were:

1. *Chlorophytum comosum*
2. *Chlorophytum comosum variegatum*
3. *Codiaeum variegatum*
4. *Cordyline terminalis*
5. *Dracaena fragrans 'Massangeana'*
6. *Dracaena marginata*
7. *Epipremnum aureum, marble queen*
8. *Ficus benjamina*
9. *Hedera helix*
10. *Nephrolepis exaltata, 'Bostoniensis'*
11. *Schefflera actinophylla, J.C. Scheffler*
12. *Solenostemon scutellarioides (Coleus)*
13. *Syngonium podophyllum*
14. *Yucca aloifolia*

Plants were grown at Suez Canal University Farm. Normal greenhouse conditions and normal agricultural treatments were applied.

Experimental Design: A field experiment was conducted in ornamental horticulture nursery on the Suez Canal University. The experiment was designed as a randomized, complete block with twenty eight treatment combinations, fourteen plant genera each applied with and without fertilization. Each of the twenty eight treatment combinations were replicated three times.

Fertilization Treatment: The fertilizer used was 19:19:19 NPK with trace elements in fast release form. Fertilizer was applied at a rate of 10 g / 20 cms pot in six split applications.

Air ion Measurements: At the end of the experiment, air ions evolved by either fertilized or non fertilized plants were recorded at early morning using "Air Ion Counter" of Alpha Lab, Inc. USA.

RESULTS AND DISCUSSIONS

The results in tables (1) show that the plant genera had a dramatic effects on the evolved air ions. Also there were a significant increases for the fertilized plants than the unfertilized.

Table (1): Negative air ions (x 10^3 NAI/cm^3) in relation to fertilization

Plants	**Negative air ions (x 10^3 NAI/cm^3)**	
	Unfertilized plants	**Fertilized plants**
Chlorophytum comosum	-968 bc	-990 a
Chlorophytum comosum variegatum	-970 abc	-990 a
Codiaeum variegatum	-118 j	-350 f
Cordyline terminalis	-910 d	-970 abc
Dracaena fragrans 'Massangeana'	-958 c	-975 abc
Dracaena marginata	-964 ab	-965 bc
Epipremnum aureum, marble queen	-330 fg	-430 e
Ficus benjamina	-126 j	-255 h
Hedera helix	-123 j	-450 e
Nephrolepis exaltata, 'Bostoniensis'	-968 bc	-990 a
Schefflera actinophylla, J.C. Scheffler	-310 g	-430 e
Solenostemon scutellarioides (Coleus)	-124 j	-180 i
Syngonium podophyllum	-123 j	-265 h
Yucca aloifolia	-125 j	-165 i
	-508 B	-600 A

Chlorophytum comosum variegatum, Chlorophytum comosum, Nephrolepis exaltata, 'Bostoniensis', Dracaena marginata and Dracaena fragrans 'Massangeana' showed a fovourable effect in this conern as indicated in Table (1). Meanwhile, the lowest plants in their evolution of air ions *were Ficus benjamina, Yucca aloifolia, Solenostemon scutellarioides (Coleus), Hedera helix, Syngonium podophyllum and Codiaeum variegatum.*

On the other hand, fertilization indoor plants increased their evolution of negative air ions. The increases were ranged between 0.01% *for Dracaena marginata and 265.85% for Hedera helix*

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دِراسات على تلوثِ الهواء الداخلي
٦- إنبعاث الأيونات الجوية مِنْ بَعْض النباتات المنزلية وعلاقتها بالتسميد

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استخدم في هذه الدراسة أربعة عشرَ نبات منزلي في تجربة عاملية العامل الأول هو نوع النباتات والثاني التسميد بالسماد المركب أو بدون تسميد. الهدف من الدراسة معرفة كمية الأيونات السالبة التي تطلقها النباتات المنزلية لكل سم٣ من الهواء، وهل تتأثر عملية إطلاق الأيونات بصحة النبات وتغذيته أم لا تتأثر. اتضح من الدراسة اختلاف النباتات في كميات الأيونات السالبة التي تطلقها في هواء الغرفة وكانت النباتات الأعلي هي: الكلوروفيتم الأخضر والمخطط (الفلانجيوم) والدراسينا ذات الحافة الحمراء والدراسينا عريضة الأوراق والفوجير. كانت النباتات الأقل في الإطلاق نباتات: فيكس بنجامينا و الكوليوس والهيدرا والساينجونيوم والكروتون واليوكا. أوضحت النتائج أيضا أن التسميد يرفع كفاءة النباتات في إطلاق الأيونات السالبة.