

Identifying Plant Preferences in the Indoor Spaces of Office Buildings from the Viewpoint of Employees: Tabriz City

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ABSTRACT

Indoor plants are increasingly used nowadays in office environments due to their psychological benefits and aesthetic values. However, there is no information about the preferences for indoor plants from the viewpoint of employees in the indoor spaces of these environments. The present study seeks to identify indoor plant preferences from the viewpoint of employees in various office departments and the impact of the green space of the office complex on these preferences. Since employees' preferences may vary in different workspaces, plants in the "management room", "employee department", "meeting room", "waiting room", "pantry" and "WC", are separately examined. Using a simulated visual questionnaire of office indoor spaces, the present study evaluates the preferences for 362 residents of two office complexes (with green space and no green space) in Tabriz, Iran, through "plant density", "physical body of the plant (leaf size, stem height, and plant color)" and "plant distance from the worktable". Data were analyzed by descriptive statistics and the Mann-Whitney U test. The results showed that employees generally prefer high vegetable density, short-stem, fine-leaf, flowered, and light-green plants at long distances from the worktable. However, these preferences vary in different parts of the office environment. Results showed a significant difference between the preferences for the two office complexes (with green space and no green space) regarding the plant color, the leaf size, and the plant type, emphasizing the importance of green space in the office complex. By introducing some plant species, the results can be used by designers to enhance the use of green space and optimize the quality of indoor space in office environments.

Keywords: Plant Preferences, Green Space, indoor Plants, Office Complex.

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1. INTRODUCTION

To achieve the desired efficiency in their work environment, individuals need favorable environmental conditions. More detailed planning in the physical conditions of office environments can increase employee satisfaction, effectiveness, and mental health (Ali, Chua, and Lim 2019; Voordt and Jensen 2023); otherwise, physical conditions can negatively affect the employee comfort and cause job anxiety (Nanda et al. 2020; Montacchini, Tedesco, and Rondinone 2017). The quality of office environments, as the second place of employees' lives in half a day, has a significant impact on their lives and performance even outside the work environment (Vanaki and Vagharseyyedin 2009; Aruldoss et al. 2022). Also, due to the human need to communicate with nature (Hurly and Walker 2019; Shah Hosseini, Kamal, and Maulan 2014), the use of indoor plants for people who spend most of their time in indoor spaces and have little to do with the outside environment, is very significant (Deng and Deng 2018).

2. PROBLEM STATEMENT

Several studies have investigated the impact of green space and vegetation in the work environment, indicating the importance of this issue. Using plants in the office environment can reduce work-related stress (Maric et al. 2021), increase concentration (LotTRUP, Grahn, and Stigsdotter 2013), mental health (Lei, Yuan, And Lau 2021), and increase employee performance (Sanchez et al. 2018; Bruno et al. 2023). The present study emphasizes the importance and necessity of communication with nature and green space, especially in the office environment. However, information about plant preferences is not available from the viewpoint of employees in indoor spaces.

Hence, the present study was conducted to examine this issue.

2.1. Research Background

Green space, ranging from parks and trees in urban space to indoor plants and even visual access to green space, has many positive benefits to humans, so it leads to mental stability (Lee et al. 2015), reduced depression and anxiety (Zhifeng and Yin 2021), increased preferences (Mangone et al. 2017), perceptions (Kim et al. 2018), mood improvement (Mcgrath 2015), and promoting consistent and sustainable behaviors (Guéguen and Stefan 2016). Interaction with green space also has physical benefits such as reduced obesity (Klompemaker et al. 2018), heart rate regulation (Park et al. 2017), and increased physical activity (VillaneUve et al. 2018). Past studies have examined people's preferences, green spaces, plant density (Choi et al. 2016), stem height (Lee et al. 2014), leaf size (Kendal, Williams, and Armstrong 2008), plant type (Hardy et al. 2000), plant color (Shah Hosseini et al. 2023), and distance from the worktable (Holmes and Stevens 2012) (Table 1). Also, since environmental features of people surrounding environment affect their preferences (Mousavi Samimi and Sadraei Tabatabaei 2022), and the presence of plants affects the visual quality (Polat and Akay 2015), green space seems to affect the visual preferences in the indoor space. Exposure to flowers and plants in the indoor space has a similar effect on interaction with nature, as it reduces stress (Lee et al. 2015), increases the quality of life (Dravigne et al. 2008), creativity (Dravigne et al. 2008), relaxation (Ikei et al. 2014), and leads to better perceiving the indoor space and improving the aesthetic values of the environment (Hosseini et al. 2021).

Table 1. Plant-Identified Factors based on Theoretical Literature

Examined Factors	Plant Density	The Plant's Physical Body				Distance from Worktable
		Plant Color	Stem Height	Leaf Size	Plant Type	
Source	(Suppakittpaisarn et al. 2019; Kim and Lee 2022)	(Ma, Hauer, and Xu 2020)	(Du et al. 2021)	(Mousavi Samimi and Shahhosseini 2021)	(Hami and Tarashkar 2018)	(Holmes and Stevens 2012; Toyoda et al. 2020)

2.2. Research Objectives

The primary objective of this study is to identify plant preferences in the indoor spaces of office complexes from the viewpoint of employees based on the density and physical body of the plants (leaf size, stem height, flower, and plant color) and distance from the worktable in different office spaces (management room, employee department, meeting room, waiting room, pantry, and WC). The impact of the presence of green space in the office complex on the preferences

for indoor plants has been examined from the viewpoint of employees.

- Research Hypotheses

1. Employees prefer different plants in different indoor office spaces.
2. The green space of the office complex has an impact on employee preferences for indoor plants.

- Research Questions

- 1-How much plant density and what kind of plant body?

2. How does the green space of the office complex affect the preferences for indoor plants from the viewpoint of employees?

3. METHODS

Several studies have examined the impact of the climates on the growth of plants and green spaces (Yu et al. 2018). Iran is a habitat for a variety of plants (Soltanifard and Jafari 2019) thanks to having highly diverse climates (Sharafati, Nabaei, and Shahid 2020). Most parts of Tabriz have a dry climate (Eslam 2017) and natural plants in the form of pasture plants (Abizadeh and Zali 2013). To obtain more detailed information and to examine the impact of the green space of the office complex on the preferences for indoor plants from the viewpoint of employees, two complexes with green space (electricity distribution company) and the other without green space (Atlas Commercial Complex) located in Tabriz District 1

Iran were selected as the study areas (Fig. 1).

3.1. Procedure

According to the obtained information, the number of employees of the two studied office complexes was reported to be about 6060 people, and the number of participants in the research was calculated at 362 people using Cochran's formula (Cochran 1977), with an error level of 5%. After the pre-test, the reliable questionnaire was distributed in the summer of 2021 and the respondents were selected using a convenience random sampling method (181 people in each complex) to answer the questionnaire in two complexes. People participating in the survey do not include people under the age of 18, due to having different preferences (Lyons 1983) and people with a history of education and artistic activities, due to their expertise and experience (Wohlwill and Kohn 1976).

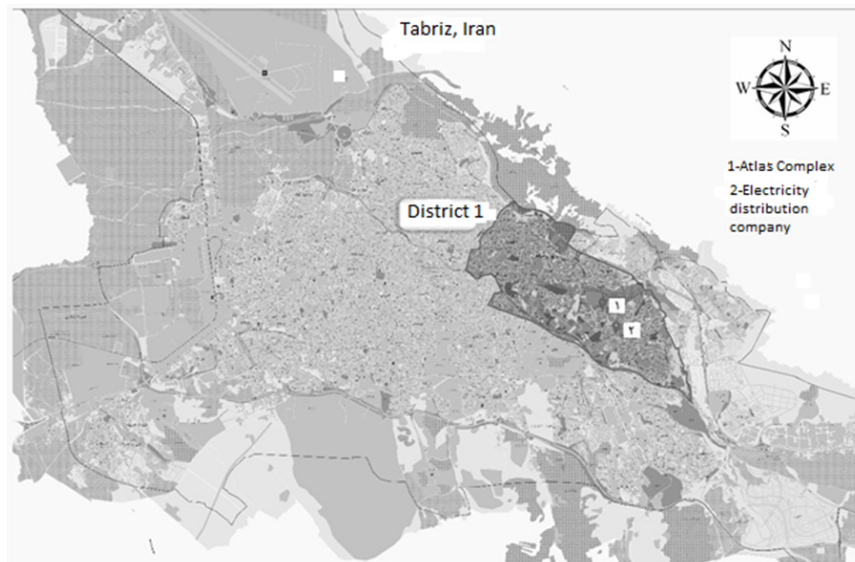


Fig. 1. Study Area, Tabriz, Iran
(www.Google maps)

3.2. Questionnaire Structure

Due to the validity of using images to conduct visual studies (Gandy and Meitner 2007; Alizadeh Asli et al. 2023; Shah Hosseini et al. 2021), the developed questionnaire includes two parts of a visual questionnaire to evaluate plant preferences from the viewpoint of employees in the indoor spaces of the complex and demographic information of employees. The visual questionnaire consists of 136 images simulated by 3Dmax 2022-Vray 5.2 Software and includes different spaces of an office unit (pantry, WC, management room, waiting area, employee department, and meeting room). In each space, the variables of "leaf size", "stem height", "plant color", "plant type", "plant density", and "plant distance from

the worktable" were examined. Due to the lack of a worktable in the pantry and WC spaces, the factors of "plant distance from the worktable" were not investigated in these two spaces. Previous studies show that green plants are preferred over other plants (Lee et al. 2014). For this reason, dark and light green colors were examined in this study. The visual questionnaire was submitted to the respondents in the form of a 34-page album (4 images on each page) and the respondents selected the image they preferred among all 4 images. The environment designed for each of the examined spaces was constant and only the plants were changed. Neutral colors (cream, white, and gray colors) (Mousavi Samimi and Shah Hosseini 2021) were used in design and decoration

so the minds of the respondents were not involved in other influencing factors and consider the plants used in the indoor space in selecting their desired image. Figure 2 illustrates a page of the image questionnaire

that shows the investigation of the preferred plant density in the management room by 4 images (no plants, low, medium, and high plant density in the management room).

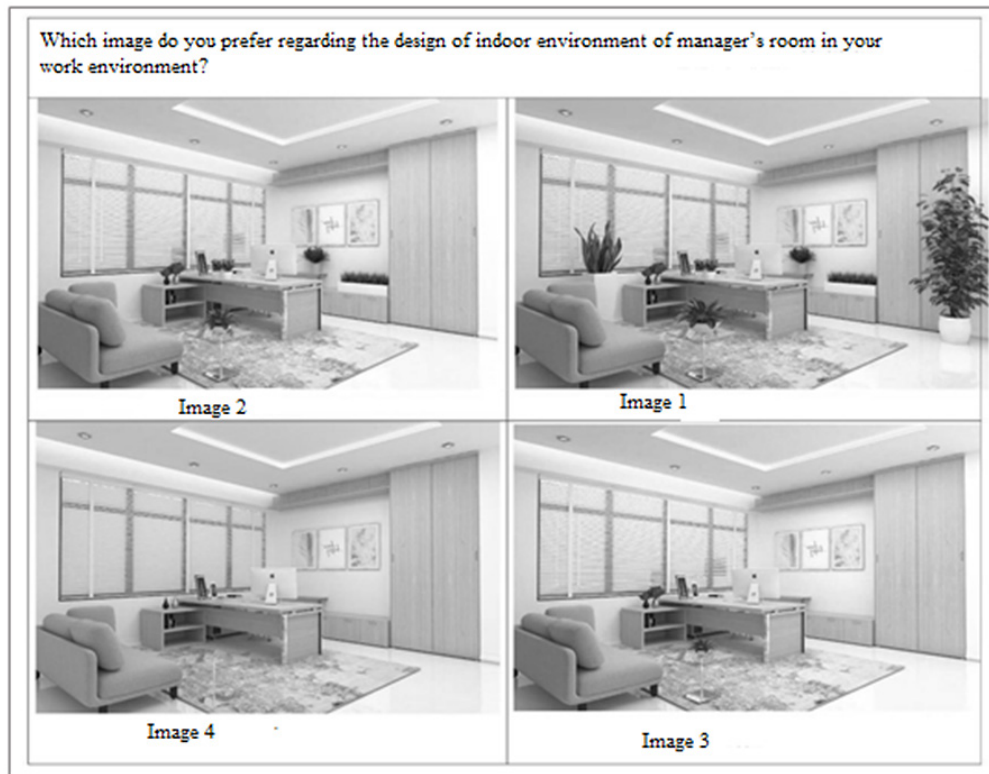


Fig. 2. One Page of the Visual Questionnaire; Investigating Preferred Plant Density in Management Room

3.3. Data Analysis

Since Cronbach's alpha coefficient is above 0.7 for all research components and has adequate reliability, the obtained data were statistically analyzed in SPSS 26 software. The Kolmogorov-Smirnov test was significant for all data ($P=0.000$), so the data distribution is not normal with 95% confidence and non-parametric tests should be used. First, to identify plant preferences from the viewpoint of employees in office indoor spaces, the frequency of data and the corresponding percentage were measured by descriptive statistics. Then, the difference between the plant preferences for employees in the two complexes was investigated using the non-parametric U-Mann-Whitney test.

4. RESULTS

The present research led to the identification of the preferences for indoor plants in different office spaces from the viewpoint of employees and the impact of the green space of the office complex on the preferences for indoor plants, which are described in detail below.

4.1. Preferences for Indoor Plants in Different Office Spaces from the Viewpoint of Employees

The results obtained by examining the frequency of data indicate that employees prefer plants with a high density (35%) for employee room, (38%) for meeting room, (53%) for waiting room, low density (33%) for pantry, WC (34%), and "medium density" for management room (40%). Regarding the physical body of the plant, they prefer light green (40%) and flowering (36%) plants for employee room, small-leaf (41%) plants for meeting room, light green (45%) and short-stem (46%) plants for waiting room, dark green (46%) and small-leaf (44%) plants for pantry, long-stem (42%) and flowering (50%) plants for WC, and light green (45%), long-stem (42%), and small-leaf (44%), flowering (53%) plants for management room.

The distance from the worktable was examined in the employee room, meeting room, waiting room, and management room. The results show the preference for "long distance" for the employee room (53%) and the meeting room (41%), low distance for the waiting room (35%), and medium distance for the

management room (34%). Generally, regardless of the type of indoor space, employees prefer high-density, short-stem, small-leaf, flowering, and light green plants with a long distance from the worktable. The results show that preferences for plants are

different from the viewpoint of employees in different indoor spaces of the office environment (Table 2, Fig. 3), indicating the confirmation of the first hypothesis of the study (Employees prefer different plants in different indoor office spaces).

Table 2. Preferences of Indoor Plants from the Viewpoint of Employees in Office Spaces

Space	Density	The Plant's Physical Body												Distance from Worktable		
		Plant Color			Stem Height			Leaf Size		Plant Type						
	High Medium Low	Light green Dark green Both	Long stem Short stem Both	Broad-leaved Fine-leaved Both	flowering Non-flowering Both	low medium High										
Employee Room	high (35%)	light green (40%)	both (42%)	both (41%)	Flowering (36%)	high (53%)										
Meeting Room	high (38%)	both (44%)	both (43%)	fine (41%)	both (39%)	high (41%)										
Waiting Room	high (53%)	light green (45%)	short (46%)	both (42%)	both (36%)	low (35%)										
Pantry	low (33%)	dark green (46%)	both (51%)	fine (44%)	both (40%)	-										
WC	Medium (34%)	both (57%)	tall (42%)	both (47%)	flowering (50%)	-										
Management Room	Medium (40%)	light green (45%)	tall (42%)	fine (44%)	flowering (53%)	Medium (34%)										

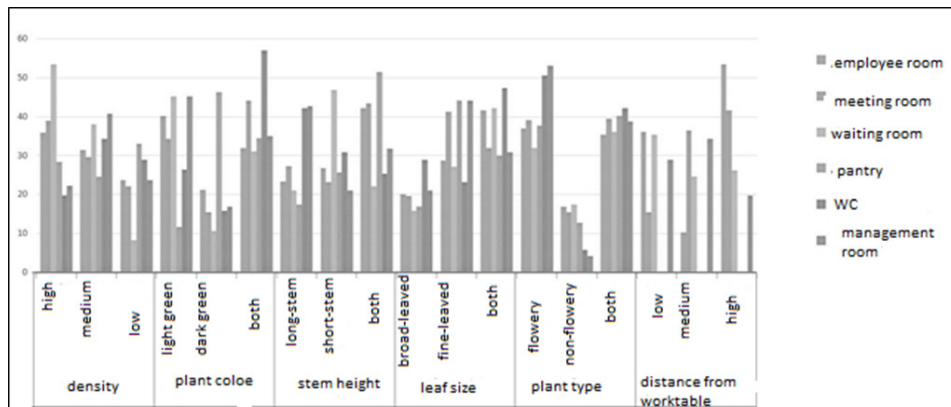


Fig. 3. Preference for Indoor Plants from the Viewpoint of Employees by Different Office Spaces

4.2. The Impact of the Green Space of the Office Complex on the Preferences for Indoor Plants from the Viewpoint of Employees

To examine the impact of the green space of the office complex on the preferences for the employees regarding the indoor plants of the office, the U-Mann-Whitney test was used due to the non-normality of the data. The results showed a significant difference between the preferences for the two groups ($Z = -2.38$, $P = 0.17$). Therefore, the second hypothesis

of the research (it seems that the green space of the office complex affects the preferences for employees regarding indoor plants) is confirmed. To obtain more accurate information, the U-Mann-Whitney was performed for the variables separately (Table 3). According to the table below, the Z values related to the variables of plant color, leaf size, and plant type are above 2, indicating a significant difference between the preferences for the mentioned components for office indoor spaces from the viewpoint of employees in the two complexes.

Table 3. The Results of the U-Mann-Whitney Test for Indoor Plant Variables

Factor	Density	Plant Color	Stem Height	Leaf Size	Plant Type	Distance from Worktable
z-value	-0.845	-2.486	-0.061	-4.272	-3.593	-1.719
sig	0.398	0.13	0.951	0.000	0.000	0.086

5. DISCUSSION

Increasing studies are conducted on the impact of the environment on people's preferences (Polat and Akay 2015; Wang, Zhao, and Liu 2016; Wilkie and Clements 2018). In this regard, researchers have investigated the impact of green and natural elements on preferences for people, both in outdoor or urban environments (Bonthoux et al. 2019; Hwang et al. 2019; Shah Hosseini, Kamal Bin MS, and Bin Maulan 2015) and in indoor spaces (Van Den Bogerd et al. 2018). Different plant preferences for employees for different spaces of an office unit are in line with a similar study regarding the preferences for vegetation in the streets, indicating the different preferences for vegetation in different types of outdoor spaces (Bonthoux et al. 2019). Regarding the density of plants in the office indoor environment, employees preferred high-density plants. Similar results have been reported in other studies, both in indoor and outdoor spaces (Wang, Zhao, and Liu 2016; Mousavi Samimi and Shah Hosseini 2021). The color of plants also significantly affects the formation of preferences (Polat and Akay 2015), so green plants are more preferred than other plants (Lee et al. 2014). Thus, the present study investigated the preference between light and dark green. Results showed that light green color is preferred more. A combination of long-stem and short-stem plants was preferred, indicating that people in office indoor spaces, like urban environments, prefer diverse plants (Polat and Akay 2015).

The results of a study regarding the preferences for green spaces in the urban environment indicate the effect of the appearance of plants on people's diverse plant preferences (Kendal, Williams, and Williams 2012; Chenyang, Maruthaveeran, and Shahidan 2022). Regarding leaf size preference, small or fine leaves are preferred, which is not consistent with a recent study that revealed a combination of fine and broad leaves is preferred (Mousavi Samimi and Shah Hosseini 2021). Its reason might be different studied performance and land use. Also, flowering plants were preferred over non-flowering plants in office spaces. This result has been confirmed in past studies (Rahnema et al. 2019). In studies that investigated the effect of flowering and non-flowering plants on landscape preferences, flowering plants were preferred more (Kuper 2020a, b; Waliczek, Byrne,


































and Holeman 2018). Based on the results obtained, a large distance between plants and the worktable is preferred by employees. However, recent studies have not shown a relationship between the distance of indoor plants and employee preferences (Han 2021; 2019). This inconsistency can be due to the existence of cultural differences (Baharuddin and Sharifudin 2015).

6. CONCLUSION

The present study was conducted to investigate the preferences for indoor plants from the viewpoint of employees based on leaf size, stem height, plant color, plant type, plant density, and the distance of plants from the worktable. Based on the results, employee preferences for indoor spaces in office complexes are different. The use of plants preferred by employees in the indoor office environment can lead to more communication between employees with green space and nature and optimize the quality of the indoor environment. Access to the green space preferred by employees can lead to a sense of belonging in the work environment and ultimately increase the satisfaction, and work efficiency of employees. The use of plants has a great impact on the quality of indoor spaces. In addition to having a climatic role, it brings happiness, and physical and mental relaxation to employees, and provides the conditions for increasing their tolerance threshold. Watching plants in the indoor environment significantly reduces the fatigue and stress of employees.

Table 4 shows some suggested plants for different parts of the office space. To complete the results, the effect of the green space of office complexes on the preferences for indoor plants from the viewpoint of employees was mentioned. It indicates the need to pay more attention to the green space of office buildings and identify the density, color, stem height, leaf size, and plant type because they affect the preferences for employees in the indoor space. Given the information obtained from this study, it is possible to design more appropriate office environments to increase the relationship between humans and nature and increase the level of employee preferences, so paying attention to the results of this study can lead to the creation of various plans using of plants in the architecture of indoor office spaces.

Table 4. Suggesting the Use of Indoor Plants based on the Preferences for Employees in Office Spaces

Name of Office Spaces		Employee Room				
Name of Indoor Plant	Lilium	Viburnum Opulus	Magnolia	Hosta	Locust Robinia	Viola
Image of Indoor Plant						
Name of Office Spaces		Meeting Room				
Name of Indoor Plant	Polypodiopsida	Desert Privet	Spider Plant	Callisia	Orchids	Lucky Bamboo
Image of Indoor plant						
Name of Office Spaces		Waiting room				
Name of Indoor Plant	Viola	Hosta	Locust Robinia	Magnolia	Spider Plant	Desert Privet
Image of Indoor Plant						
Name of Office Spaces		Pantry				
Name of Indoor Plant	Zanzibar Gem	Tropaeolum Majus	Pelargonium	Jasmine	Azaleas	Lavender
Image of indoor plant						
Name of Office Spaces		WC				
Name of Indoor Plant	Spathiphyllum Wallisii	Jasmine	Ipomoea Tricolor	Ceropegia	Tulip	
Image of Indoor Plant						
Name of Office Spaces		Management Room				
Name of Indoor Plant	Fuchsia Species	Jasmine	Chamelaucium Uncinatum	Fritillaria		
Image of Indoor Plant						

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CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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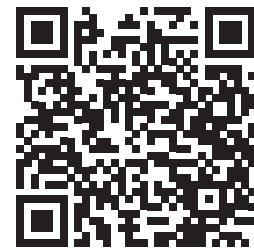
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