RESULTS AND DISCUSSION

1- Effect of plant materials - as a modifying-element on air temperature in the garden

1) Effect of trees:

Table (1) shows the effect of six genera of trees on the air temperature during August (1988) in the Faculty of Agriculture, Moshtohor. The comparison aimed to study the influence of the shape, size, texture and growth habit of the tree. The Bermuda grass air temperature under the *Ficus nitida* tree reached 37.5°C, while at 20 m apart from the same tree the temperature reached 39.9°C. Thus it is clear that the *Ficus nitida* tree reduced air temperature by 2.4°C compared to *Grevillea robusta* tree which reduced the air temperature by 1.49°C. Although the air temperature beneath *Grevillea robusta* tree lowered the air temperature to 35.63°C compared with 37.8°C under *Cassia nodosa* tree and 37.5°C for *Ficus nitida* tree. Thus it could be concluded that *Ficus nitida* was more effective on reducing the air temperature in the garden compared with other trees.

In fact the effect of trees to modifying of air temperature in the garden depends upon the shape and

Table (1): Effect of trees, lawns and soil evaporation on modifying air temperature in the garden.

Trees and its condition		Area m^2	Air Temp. in shade	Temp. full sun	Diff. in °C	Share of low. or soil	Soil mas.
<u>Ficus nitida</u>	grown	18.84	37.50	39.90	2.40	1.60	17.33
<u>Cassia nodosa</u>	above	21.72	37.80	40.00	2.20	1.50	16.77
<u>Grevillea robusta</u>	lawns	10.75	35.63	37.12	1.49	4.38	18.93
<u>Cosimiroa edulis</u>	grown	22.89	36.50	40.22	3.75	1.28	18.91
<u>Jacaranda ovalifolia</u>	above	7.45	39.22	40.85	1.63	0.65	5.51
<u>Taxodium distichum</u>	soil	14.51	35.75	39.00	3.25	2.50	16.89
Sand walk		-	41.50				3.48
Room in the face of Cosimiroa		-	29.27				-
Other room in the same loca.		-	32.50				-

Air temperatures measurement was recorded at 10 cms above ground at (2-3) P.m. in August 1988.

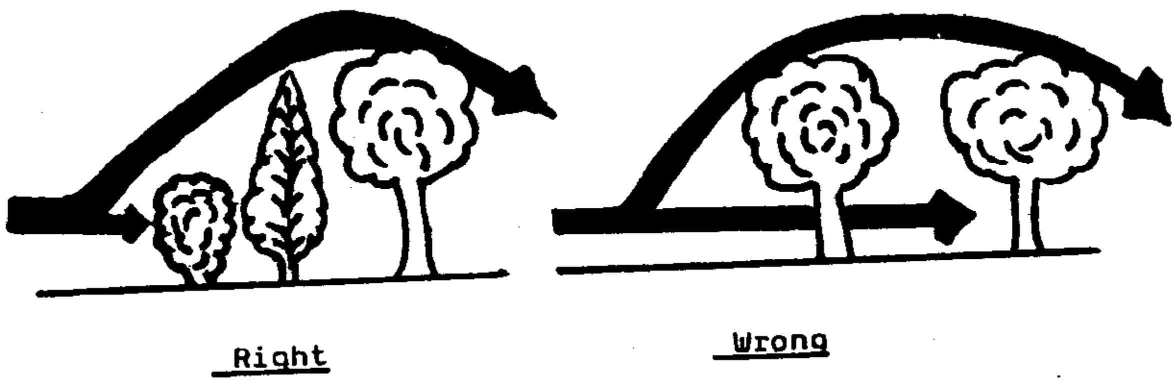


Fig.(1) The efficincy of trees in minimizing the hot dry air temperature.

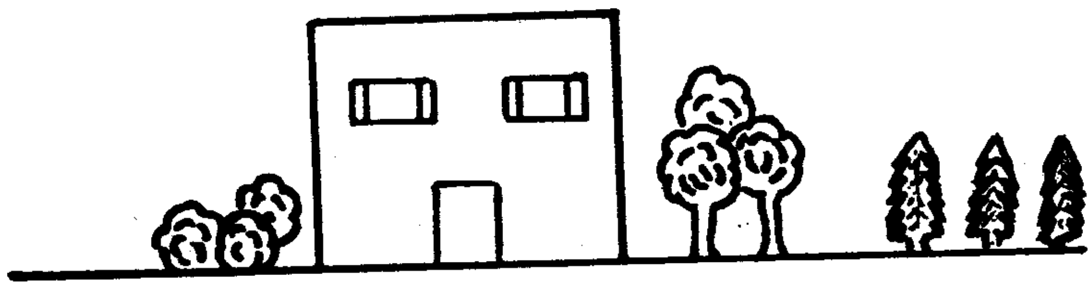


Fig.(2) Dimension of Thuja orientalis would be very difficult to incorporate into overall design.

size of the tree and its canopy area and height. For example the concerned Cassia nodosa tree had horizontal dropping branchs covers an area of the garden space, about 21.72 m^2. Similar effect was noticed with Ficus nitida tree which had a uniformed shape and occupies 18.84 m^2 from the space of the garden. In this respect, Grevillea robusta tree with its narrow spir shape and occupies 10.75 m^2 only from the garden space and realized less reduction in air temperature. The effect on air temperature depended on the area created by top growth of the tree which prevents sun rays to flow under the trees. Trees of course, intercept most solar radiation which arrives at the top of the tree.

Generally, it could be concluded that there is a positive correlation between the increase in leaf area and tree foliage and the variation in the temperature in the garden. It seems better to use a combination of different genera of trees which posses varied canopies in garden landscape in arid zone areas to minimize the effect of heat (Fig. 1).

As regard, Casimiroa edulis occupies 18.9 m^2 from the space of the garden, it has the ability to decrease air temperature more than other trees since it decreased the air temperature by 3.75°C, while Taxodium distichum tree, which occupies 16.89 m^2 from the space of the garden, decreased the air temperature by 3.25°C.

In this meantime , Jacaranda ovalifolia tree, which occupies 7.45 m^2 from the garden space, decreased the air temperature in the garden by 1.63°C.

It is well known that large tree intercept most of solar radiation arriving at the top of the canopy, on contrast with the narrowly spir shaped trees which intercept less of solar radiation. It is clear that the ground surfaces under trees are more cool due to reducing the amount of energy reaching these surfaces.

However, in landscape design of the gardens especially those in hot areas, it is better to use different genera of trees in a vertical and horizontal wavy system to reach both modifying air temperature and to beautify the spot. Scattering individual tree should be avoided (Fig.1)

Generally, the results agree with those of Lanphear (1971) who measured differences of 5.56°C between the air temperature in open city parks and the nearly very crowded districts and concluded that trees reduced air

Table (2): Comparison between atmospheric temperature under shade and full sun locations.

Plant and its location		Air temp. °C
Jacaranda ovalifolia "El-Haram"	in Oct.	25.3
Asphalt between two trees st.	1987	32.4
Pinus halepensis "Moshtohor"	in Nov.	20.0
Ficus elastica var decora "Moshtohor"	1987	23.2
Dry sand walk		30.8

* Pinus, Ficus temp. measurement recorded throught 5 days at 10 cms above ground at (2) P.m.

Table(3)Effect of lawn on reducing atmospheric temperature.

Plant and its location		Air temp. °C
Irrigated lawn "Moshtohor"	in Nov.	23.8
Dry lawn in "Moshtohor"	1987	27.2
Dry sand walk "Moshtohor"		30.8
Lawn in El-Horia garden	in April	24.5
Lawn in El-Tahrir square	1988	29.0
Asphlat El-Tahrir square		30.5

temperature along city streets at almost by (1.2°C). Mastalerz and Oliver (1974) reported that trees intercept some of the solar radiation arriving at the top of its canopy so as to allow some of sun rays to take its way (penetrate) through it below the ground.

On the other hand, sometimes two trees may occupy the same canopy area in the garden, but the effect of each one of them to modify air temperature is different that could be due to number of branchs and leaves together with the method of branching and the canopy of each tree and their transpiration ability as shown in Table (1). Cassia nodosa and Casimiroa edulis were 21.72 m^2 and 22.89 m^2 in the garden space respectively, but, Cassia nodosa reduces air temperature only by 2.40°C compared with 3.75°C by Casimiroa edulis tree. In this concern, Leonard (1972) estimated that an adequately irrigated group of trees could reduce air temperature by 5.7°F on a hot, dry day. Also, Cassia nodosa had less foliage distance than Casimiroa edulis, thus it could be concluded that foliage distance could play some role in modifying the garden temperature.

On the other side, Table (2) shows the effect of some genera of trees. Pinus halepensis, Ficus elastica var decora and Jacaranda ovalifolia on the air garden temperature during October and November (1987). The comparison aimed to study the influence of needle leafed trees, broad leafed and fine leafed trees on air garden temperature. The lower air temperature recorded under Pinus halepensis tree was 20°C compared to 30.8°C for dry sand passes in the same location (in the face of Horticulture Department of Moshtohor), while air temperature below Ficus elastica tree recorded 23.2 °C, but needle leafed tree (Pinus) reduced air temperature as 10.8°C compared with 7.6°C for broad leafed (Ficus elastica), this may be due to the structure of needle leaf and their transpiration ability. Norman (1980) reported that needle foliage of Coniferous evergreens absorbs much of sun light falling upon it and consequently are effective in modifying the air temperature in the garden.

Also, Table (2) shows the effect of Jacaranda ovalifolia on air temperature in El-Haram street during October (1987), Jacaranda trees (fine leafed tree) reduced air temperature by (7.1°C) than asphalt open area between two trees which recorded 32.4°C compared to 25.3°C under Jacaranda trees as all deciduous trees, are very effective elements for regulating air temperature in the garden. Since they reduce temperature in summer, when sunlight is most intensive and let sunlight through their bare branchs during winter to warm the surrounding area. Similar results were attained by Columbus (1981), who reported that shade air temperature is reduced by 4.4°C than open air.

Provided shade: The garden do not only depend upon the trees, but also from garden buildings which could be created by constructing some kinds of shady locations in the garden. In this respect, as shown in Table (1) indoor temperature recorded 32.5°C during August (1988) compared with 41.5°C in outdoor, thus it is clear that building reduced air temperature by about 9°C in August. It was found also that air temperature in the other room which faces Casimiroa tree recorded only 29.27°C compared with 32.5°C in the other rooms and 41.5°C in outdoor. Such reduction in temperature was mainly due to the well organization between the building and the surrounded trees. These results are in agreement with Moffat and Schiler (1981) who found that shading of trees could result in a reduction of interior temperature as much as 6.67°C lower than outside temperature.

Everyone appreciates the cooling effect provided by a light breeze on a hot summer day. In designing residential landscapes it is important to consider the direction from which winds blow in various seasons of the year, the effect of these winds have on human comfort and how these winds can be controlled by careful placement of landscape plant material.
As well as the efficiency of trees in minimizing the hot day temperature they can act better in reducing the effect of wind velosity. In this concern, trees may be chosen and included in the garden design to act as windbreaks. The wind direction alteration creates a small area on the widward side of the windbreak and a larger area on its leeward side that is protected from the full force of the wind. The extent of the leeward protection is related to the height and length of the windbreak . As wind passes over or around a windbreak, turbulent eddy currents that are of lower velosity than the main windstream may be created at the windbreak's edges. For example trees that are impenetrable to wind create a strong vacum on their protected leeward sides which tends to suck the obstructed windstream in to the protected zone. This reduces the level of leeward protection afforded by

the windbreak. Thus, the objectives of windbreak design are: (1) to acheive enough height to create protection for the desired distance on the leeward side of the windbreak; and (2) to achieve enough penetrability to reduce the effects of eddy currents and the leeward vacum yet still afford the desired of wind protection. In the distribution of trees for windbreak the type of growth of the tree must be considered as well as their extend to the ground (Fig. 1).
Also, the species within a windbreak's width should be varied to create rough windbreak edges.

On the other side, trees could be chosen in the lanscape design to realize the wind channels. Whereas windbreaks are designed to block wind, wind channels are designed to promote and guide wind circulation. This is accomplished by deflecting wind currents into specified locations. Materials must be fairly impenetrable to deflect the wind, but they must be oriented so that this deflection is funnelled into a desired area without a substantial decrease of initial velocity. Evergreen trees with dense foliage extending to near the ground (e.s. Cupressus) could be planted such that the branches of one mature plant will overlap with those

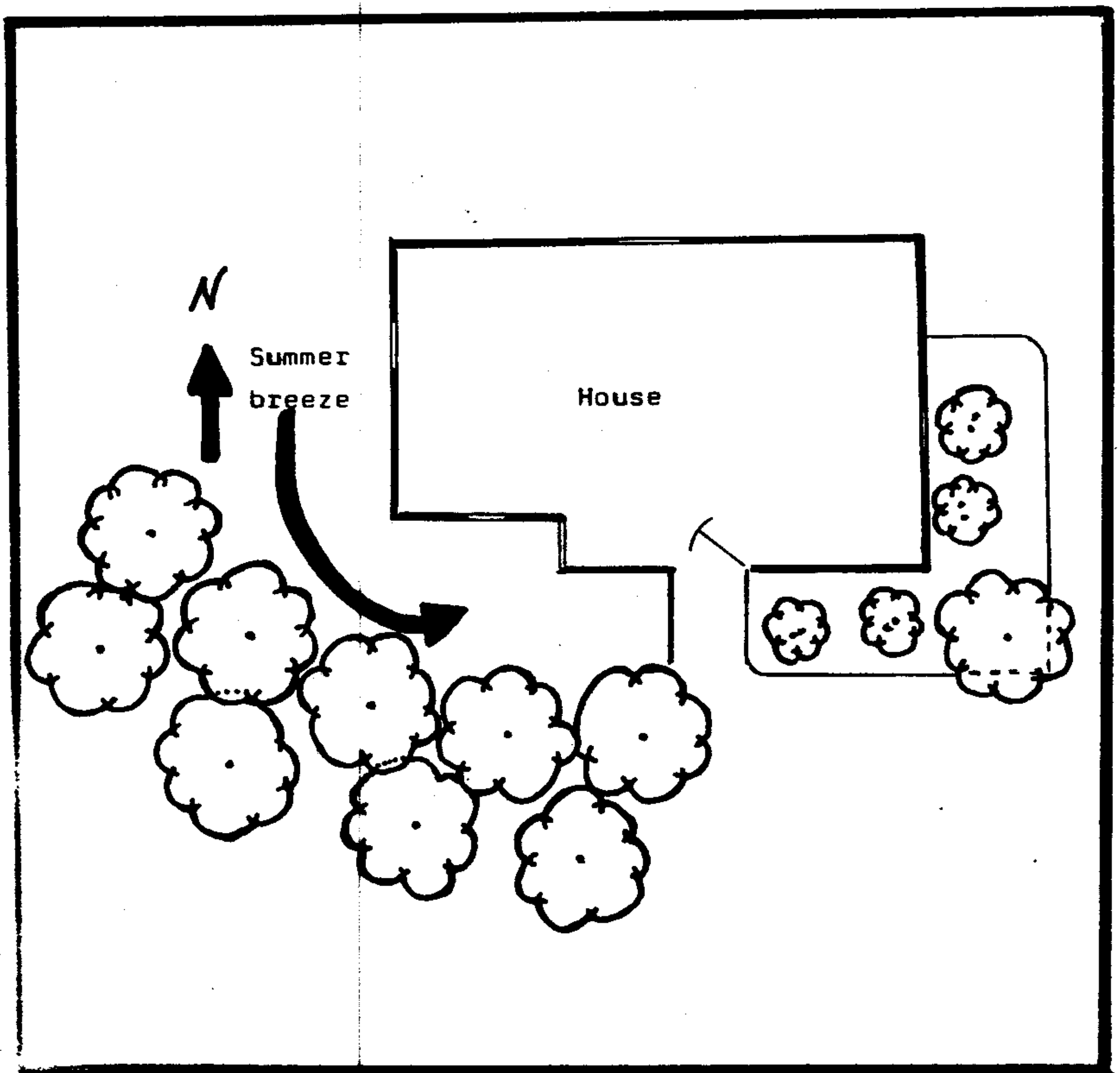


Fig.(3) Planting the trees in South West side of the building will curves the Northely Summer breeze to the South side of the building and also act as a Wind barrier for hot sandy winds during May and April.

of its neighbor. By canting the alignment of these trees to the South West or by planting the trees in a line that curves gradually to the South West, a northerly summer breeze in Egypt can be captured and directed into the other wise windless area on the south side of the building (Fig. 3).

This also will act as a wind barrier for hot sandy winds (during April). However, in all cases the trees must be well chosen to suit the place and to be organized in a way which permit the feeling of spaciousness. In the landscape that is characterized by a dominance of low spreading materials the exaggerated vertical dimension of Thuja orintalis, L. would be very difficult to incorporate into overall design Fig. (2).

The design of a successful temperature, and wind velosity control devices requires an understanding to the physical priniples of wind control as well as the proper height and foliage density.

2) Effect of lawns:

Table (3) shows the effect of lawn on reducing air temperature in different locations in Moshtohor during August. The highest air temperature was found with lawn its soil moisture about 16.77%, while the lowest air temperature was recorded with lawn its soil moisture about 18.93%. Thus Bermuda grass lawns share by 1.5°C in the first location and by 4.38°C in the second location . This could be partially to the effect of soil moisture of the lawn. The lawn effect in reducing the air temperature is due to the evaporation cooling effect, as well as to irrigation of lawns and consequently increasing soil moisture. Due to water evaporation a reduction in temperature by about 3.4°C was attained as shown in Table (3).

In this regard, Mastalerz and Oliver (1974) reported that if the soil moisture is readily available to plant, a major share of the absorbed energy is consumed in transpiration and the evaporation cooling effect could be very significant, for each gram of water evaporated into the atmosphere absorbs 583 calories of heat. Soulier (1977) reported that one hectar evaporates 4000-5000 tons of water per year. Lacking water for transpiration from lawn growing in dry soil let it behaves like synthetic turf.

A comparison between the effect of natural lawns and synthetic one was reported by Buskirk et al., (1971) who reported that surface temperature of synthetic truf

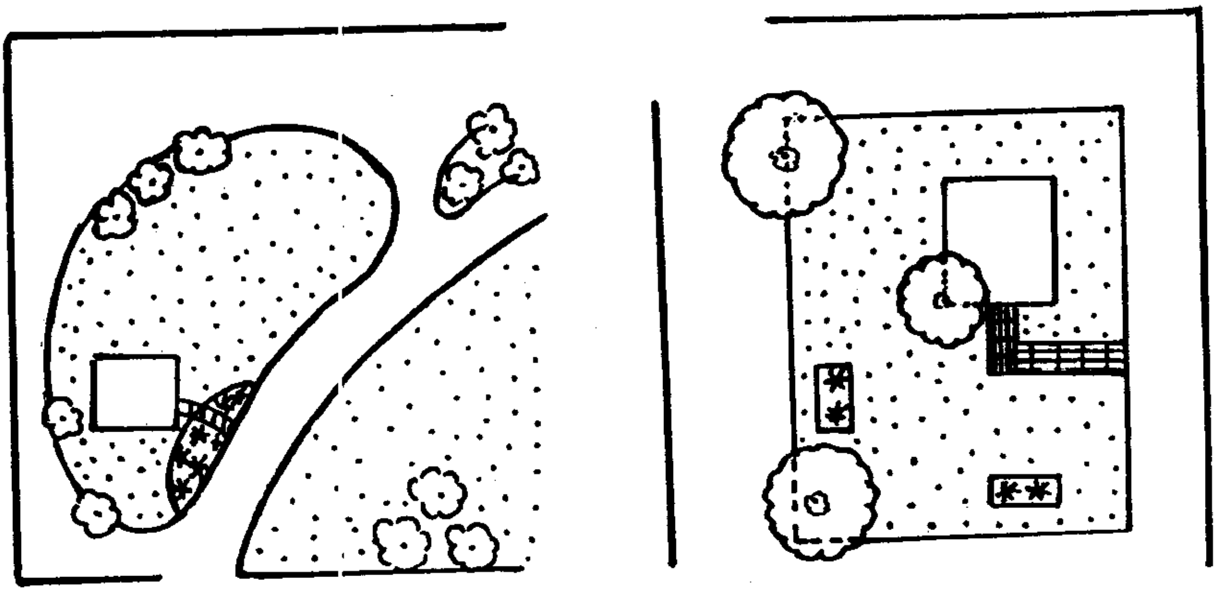


Fig.(4) Trees should be distribute in corner garden in both formal and informal gardens. The lawn should be bounded with trees,shrubs and flower borders.

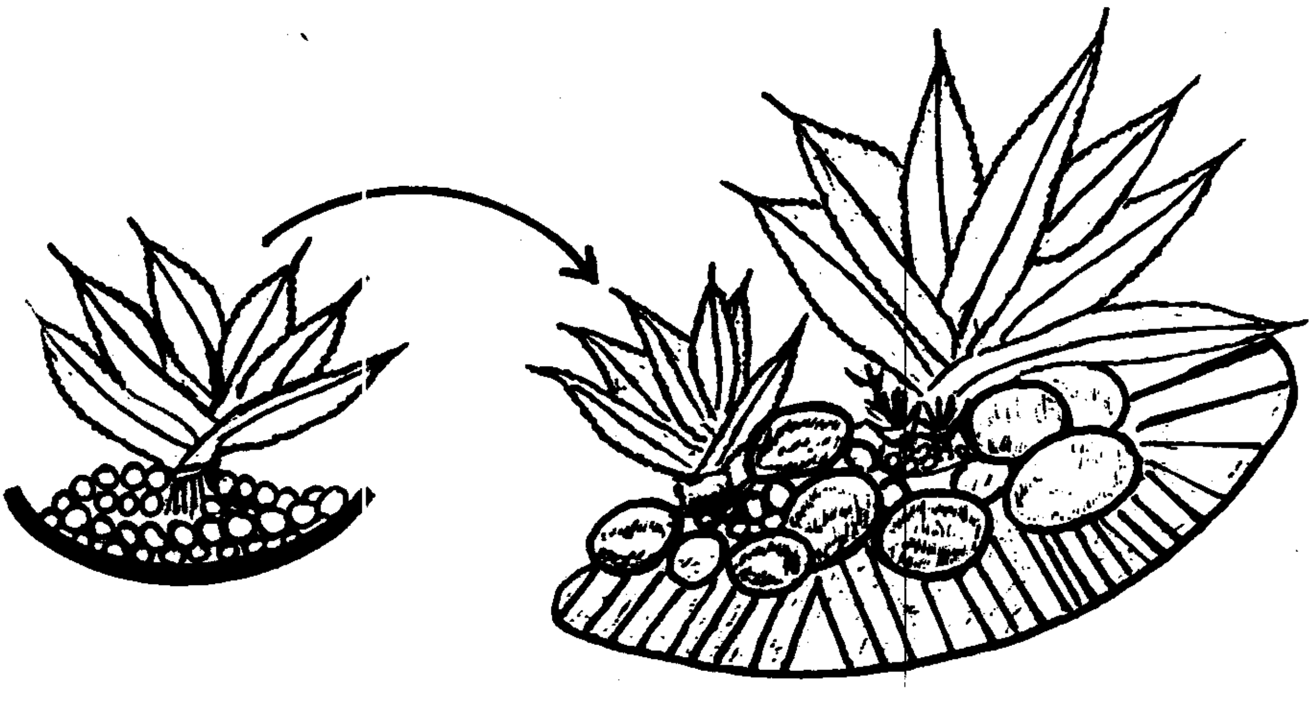


Fig.(5) shows the intercorperated of succulent plants between the pocket medium of lava rocks.

increased to 140°F or 60°C on a clear day (air temperature of 76°C or 24.4°C), whereas the maximum temperature of natural grass was 90°F about 32°C.

On the other side, data presented in Table (3) show the differences in air temperature recorded in Tahrir square and El-Horia garden on April, 12th, 1988. It was found that air temperature (1 m. above the soil) asphalt surface was 30.5°C compared to 29°C on the lawn in the same location. That is to say that the lawn decreased air temperature; the difference is 1.5°C due to evaporative cooling capability of the lawn. Similar results were noticed in Horia garden, air sand passages recorded 27°C, whereas the uncovered lawn in the same garden recorded 24.5°C, thus lawns decreased air temperature by 2.5°C. These results agree with those of Lanphear (1971) who measured differences of 10°F about 2.8°C between the air temperature in open city parks and nearly crowded business districts.

A question raises in the mind of the landscape designers in hot areas, how to combine the lawns with tree locations in order to provide the best results of both scenery and mild weather. According to the above results of trees and lawns effects, the lawn should be bounded with trees, shrubs and perhaps occasional flower borders, but not broken up by them. Fig. (4).

II. RELATIONSHIPS BETWEEN HEDGES AND LANDSCAPE GARDENING

1) Thuja orientalis (The oriental Arborvitae)

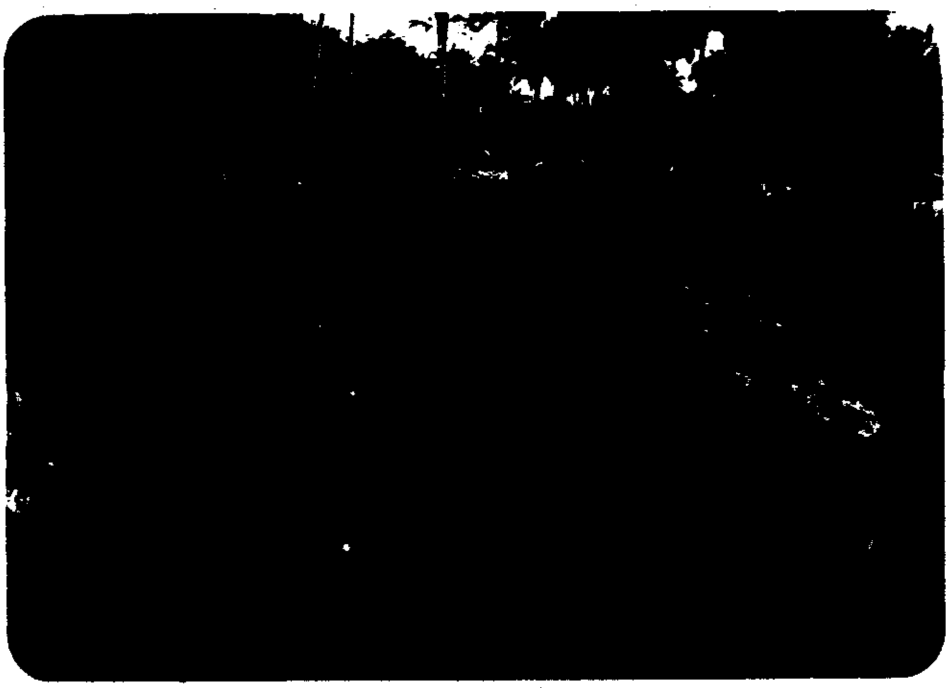
It is an attractive tree much used because of its dense, vertically arranged foliage, distinct from the other forms. It makes a good looking pyramid shape that could be used as focal, ideal lawn spciment in full sun location and for small formal landscaping as well as a hedge tree.

Photo (6) shows Thuja hedge in 1983, the hedge consists of two perpendicular living walls of greenery, the first one running from North to South with 10.80 m long and 1.90 m in width. Thus, this hedge is exposed to East direction in one side and the West from the opposite side. The other living wall of greenery is 9.85 m in length and 1.90 m in width and exposed to the North direction.

1.1- Effect of short level trimming at 70 cms above the ground:

Table (4) shows the effect of orientation and trimming level on the vegetative growth of Thuja hedge. As shown in the compartive data , short trimming (South

Photo(6)shows Thuja orientalis hedge with the gap areas between shrubs in November 1983.



Photo(7)shows general top head view of Thuja orientalis hedge in November 1988.

Table (4): Effect of orientation and trimming level of *Thuja orientalis* hedge characters.

Trim. height	Orien-tation	Gap length cms	H.V.G. cms	W.Sh. cms	T.C. cms	B.S. cms	Gap area m
70 cms	West	18.3	64.17 b	40.50 bc	199.69 c	4.65	0.160
	East	20.5	63.83 b	37.75 c	190.58 d	4.63	0.179
	North	19.0	64.33 b	37.17 c	188.48 d	4.00	0.181
	South	17.1	65.17 b	41.58 ab	201.25 bc	4.05	0.149
90 cms	West	16.4	80.83 a	43.00 ab	208.12 bc	3.25	0.192
	East	16.7	79.50 a	43.25 ab	210.50 a	2.14	0.196
	North	16.1	80.50 a	41.75 ab	208.20 ab	4.32	0.204
	South	14.6	81.00 a	43.33 a	210.60 a	3.64	0.189

* Gap length = Length of gap between two trees 10 cm above soil.
* H.V.G. = Height of vegetative garment per tree .
* W.Sh. = Width of trees at 30 cms above the soil.
* T.C. = Tap circumference of tree.
* B.S. = Branching starting above soil.
* Data tested according to Duncan's multiple 1% range test.

orientation) resulted in the highest vegetative growth as 65.17 cms height while the East one reached 63.83 cms. Similar effect was noticed with the South and West orientations. The increase ranged between 10.15% over that of the East tree width.

The least width was with the hedge exposed to North and East as 37.17cms and 37.75cms per tree respectively. The top circumference of the North and East orientation were 88.5 cms and 190.6 cms respectively, while, for the West and South it was as 199.7 cms and 201.3 cms respectively.

The results agree with Edmond et al., (1964) who reported that the hedge growing in shade will make less growth than the part growing in sun location.

On the other hand, as shown in Table (4) the gap area one of the important defects which appears in some hedges and of course such gaps delay the establishment of the hedge was influenced due to the trimming level.

East and North directions of hedges trimmed 70 cms above ground showed larger gaps as compared to the two other directions Table (4).

Thus it could be concluded that Thuja orientalis hedges could be oriented in the South or West direction of the garden and to be planted preferably at 60 cms distance inbetween.

When a tree of Thuja orientalis was grown in the West direction and subjected to short trimming it had huge measurment, data showed an average of 9 principal branches and 36 shoots compared to 10 principal branches and 32 shoots for that grown in the East direction.

Also, the principal trunk, from the plants grown in the West direction recorded 28 cms circumference and an average of 10.44 cms per shoot, compared to 26 cms and 10.32 cms respectively for the plant grown in Eastern direction.

Similar trend of differences are presented in Table (4) i.e. the fresh weight of the hedge tree from the West direction weighed 4719 gms compared to 4221 gms for that from East direction.

1.2- Effect of high level of trimming at 90 cms above the ground:

Data in Table (4) show similar trend of results due to high trimming level as that of short one.

Besides, all planting directions under tall trimming increased the width of growth, i.e. tall trimming recorded 43.00 cms width compared to 40.50 cms for the same direction subjected to short trimming.

Generally, the top circumference of plants trimmed at the higher level increased than those of the short one despite of the direction.

However, the gap areas found in the hedge subjected to high trimming were larger than under short trimming treatment. From this study it could be recommended that Thuja should be shortened to a minimum to enhance branch formation and consequently decrease gaps formation.

Edmond et al., (1964) found that pruning young plants reduced the number of growing points and this increased the supply of available nitrogen and other essential elements to the growing points which promoted the vegetative phase of the plant.

Generally, it could be concluded that gap area which is formed between East or North side in both short or tall trimmed plants are more deaper than in the other directions.

On the other hand , when the hedge was used as a background to a flowering herbaceous plants, competition took place and reflected badly on the growth of the hedge. This conclusion hold true with what reported by Bailey (1914) who mentioned that a perfect hedge requires permenant care.

2- **Ficus nitida**

Ficus nitida is the most important street tree in Egypt, also it could be trimmed to establish hedges in gardens.

Data in Table (5) indicated that Ficus nitida hedges oriented in South, North and West directions recorded high vegetative garments as 107.0, 103.0 and 104.0 cms respectively while East side treatment recorded less vegetative garment of 93.3 cms height.

Regarding the width of the hedge tree, both South and West sides increased the width by 33.5% and 30.5% over East side which recorded 116.3 cms width.

Photo (8) shows general view to South side of Ficus nitida hedge in November (1983), growth was under furnish stage, gap areas were considerably large. Photo (9) shows the same side of hedge in May (1984), in which gap areas appeared narrower than the previous view.

Data present in Table (5) show that the largest circumference of the tree top was noticed with the South side direction as 524.7 cms followed by the West one as 514.2 cms.

Table (5): Effect of orientation build of *Ficus nitida* hedge characters.

Character / Orientation	Gap length cms.	H.V.G cms.	W. Sh. cms.	T.C. cms.	B.S. cms.	Gap area m^2
North side	35.46	103.0	130.8	443.0	7.52	0.461
East side	46.90	93.3	116.3	419.0	16.79	0.715
West side	40.80	104.5	151.8	514.2	6.54	0.214
South side	43.24	107.0	155.3	524.7	4.85	0.138

* Gap length = Mean length of gaps between two trees. at 10, 30, 60 cm level, above the ground.
* H.V.G = Height of vegetative garment per tree.
* W.Sh. = Wide of tree in 60 cm above the ground.
* T.C. = The top circumferences of tree.
* B.S. = Branching starting above the soil.

Photo(8)shows Ficus nitida hedge and large gap areas between trees exposed to South direction in November 1983.

Photo(9)shows over head view to Ficus nitida hedge in May(1984) while gap areas appeared more closer.

Photo(10)shows one dug Tree from low East direction of Thuja hedge in 29/11/1987.

- P.N.The branching start.

Photo(11)shows Ficus nitida hedge in Oct.1987,in which gap areas acpeaed more smaller than the previous view(photo 8)

While, the smallest one was with the plant grown at the East direction which resulted in 419.0 cms.

The latest treatment was coincided with the largest gap as 49.9 cms length and 0.715 m^2 areas.

The length to the starting point of branching in the East side direction was 16.79 cms compared to 4.85 cms for South side.

It could be concluded that the data for *Ficus nitida* took similar trend of the *Thuja orientalis* , South and West direction were the best.

On the other hand, increasing planting distance has a negative correlation with the rate of hedge furishing in the garden , also the pyramidicaly hedge form (thick at the base and tapered at the top) could allow more sunlight to the base of the hedge specially at the North and East side directions.

3- *Lantana camara*

Lantana camara is an evergreen shrub which carries different tones of coloured flowers . The plant is used in formal hedges.

Table (6): Effect of seasonal pruning on, number, length diameter of principal stems and shoots and gap length of <u>Lantana camara</u> hedge.

Character \ Treatment	Frequent pruning	once/year pruning
Number of principal stems	6.00	4.00
Number shoots per plant	82.00	32.00
Mean length of shoot cms	55.50	136.25
Stem diameter cms	4.88	11.23
Shoot diameter cms	1.73	8.25
Gap length cms	6.72	29.17
Leaves fresh Wt. in gms	655	6105

* Gap length = Mean length of gap between two shrubs at 10 cms above ground.

Frequent pruning reduced the total amount of shrub growth,(as shown in Table 6) which recorded the height to 55.50 cms compared to 136.25 cms for the shrubs pruned once/year. Pruning once/year stimulates the lower growth at the end of the growing season compared with the frequent pruning.

The frequent pruning also increased shoot number to 82 compared to 32 shoots for pruning once/year, but the diameter of each of the 82 shoots showed contrary results since in the first case the diameter 1.73 cms compared to 8.25 cms for the second one.

Edmond _et al_., (1964) suggested that pruning increases the supply of available nitrogen and other essential elements to the growing points which in turn increases the vegetative growth.

Photos (12,13)show the comparison between frequent pruning and that of once/year after 9 years from its planting. As shown in Table (6) the hedge once annually pruned gave 4 stems per shrub with 11.23 cms average diameter per stem, compared to 6 stems with average diameter of 4.88 cms per stem for the low hedge.

Photo(12)shows general view to seasonal pruning hedge of *Lantana camara* at May (1984)

Photo(12a)shows general view to once /year pruning hedge of *Lantana camara* at May (19[illegible]).

Photo(14)shows the view of the low hedge of <u>Duranta plumeri var variqata</u>,whereas growth rate was very slow.

Photo(14a)shows the previous view after planted by <u>Pelargonium zonale</u>

On the other hand, treatment of low hedge produced compact hedge compared to that trimmed once/year. It is clear that, the base shoots grew and formed large branches, which touch the soil and produce new shoots, resulting in fewer gap and compact growth.

Photo (13) shows the view of the low hedge of Malvaviscus arboreus during 1988. This hedge formed throughout 5 years and made a very good low flowering wall which occupied 19.4 m^2 from the area of the garden and occupied as much as 9.7 m^3 from the garden space giving a splendid surface flowering wall.

These data confirm that the suitable planting distances as 40 cms inbetween the shrubs was very effective on the growth rate to reach a compact hedges from this shrub.

In this connection, Beddall (1952) reported that flowering hedges have other advantages beside those of beauty over the formal hedges.

On the other side, Duranta plumeri var varigata which was planted in 1980, at 40 cms distances with transplants of 15 cms height, also, could be used as a colour low hedge. This hedge extended from North to South direction, but its growth rate was very slow.

However, in order to overcome this problem, Pelargonium zonale was planted in the gaps of hedge to complete its beauty (Photo 14).

On this ground, it could be emphasized that some flowering perennials could help in creating a lovely scenery when corporated with a slow growing hedge especially at the starting years.

As shown in Photo (3) the view of an established hedge of "garden d'Annevoie" in Namur, Belgium, where the well maintenance and separation of flowering beds from hedge gave promising effects on the rate of hedge establishment.

III. CONTRIBUTION OF SUCCULENT PLANTS IN THE GARDEN UNDER STUDY

1) Contribution of succulent plants in primary stage:

Photo (15) shows the North side of a succulent garden under construction in the Faculty of Agriculture of Moshtohor, one year after planting date in 1982. The largest types of succulent (tall columnar cereus) *Lophocereus shotti* and *Opuntia vulgaris* are used as a sculpture-like, against the trees.

As shown in Table (7) the tall cereus had two columnar branches of 12.5 cm diameter and 146 cm height. A Cereus plant occupied about 0.086 m^2 from the area of succulent garden, and it shared 0.125 m^3 of the garden space.

As regards *Opuntia vulgaris* it had a woody long trunk of 174 cms height. In this regard, it was placed singly and was surrounded by a small constructed circle. It occupied 0.490 m^2 from the area of succulent garden and shared by 0.284 m^3 from the garden space. On the woody trunk and carrying the smooth gray flatted joints the yellow flowers appear during early Summer. Clark

Photo(15)shows the North side of the Succulent garden under construction in Moshtohor(November 1983).

Photo(16)shows the South side of Succulent garden under construction in Moshtohor(November 1983).

(1983) reported that Opuntia plant takes position of vast area when the conditions are favourable for its growth.

As shown in Photo (16) <u>Agave sisalana</u> occupied a good position in the succulent garden, the large sword leafed give a bold and agressive appearance, during this stage nineteen sword leaves were reached. The plant is about 60 cms height and filled 0.502 m^2 from the area of succulent garden and sharing by 0.10m^3 in the garden space as a single speciment.

Photo (16) shows the South side of the succulent garden in Floriculture department of Moshtohor after one year from its planting , <u>Agave americana</u> var <u>marginata</u> was planted in two opposite side (West and East).

In West side it produced 21 sword leaves of 60 cms height. The plant occupied 0.358 m^2 from the area of the garden and about 0.072 m^3 from the garden space.

In the opposite side the other <u>Agave americana</u> plant occupyied 0.307 m^2 from the area of the succulent garden and shared 0.059 m^3 in the garden space bearing 23 large yellow edged leaves.

Table (7): Contribution of succulent and cacti plants in their primary stage in a succulent garden under construction.

Character / Plants	Leaf No.	Plant diameter cm	Length of plant cm	Area occupies cm^2	Size in garden space m^3
* Agave americana var marginata	21	67.5	60.0	0.358	0.072
** Agave americana var marginata	23	62.5	57.5	0.307	0.059
Agave sisalana	19	80.0	65.0	0.502	0.109
Lophocereus shotti	2 branch	12.5	146.0	0.086	0.125
Euphorbia heteracantha	2 level	45.0	58.0	0.159	0.031
Yucca glauca (East side)	14	46.5	48.0	0.170	0.027
Yucca aloifolia (West side)	20	52.0	64.0	0.212	0.045
Opuntia vulgaris	--	79.0	174.0	0.490	0.284

* Agave americana var marginata which in West side of garden.

** Agave americana var marginata which in East side of garden.

On the other hand, Photo (15) shows two small Yucca plants in symmetrical location , the first one Yucca aleifolia in the West side with 20 pointed sharp green leaves on a single trunk of about 64 cm height and occuping about 0.212 m^2 from the area of the succulent garden and sharing by about 0.045 m^3 in the garden space. Although, it has small height in the garden but it is very attractive, on the another side (East direction) Yucca glauca producing 14 white edged leaves and occuping 0.170 m^2 from the area of the garden sharing by 0.027m^3 in the garden space giving well picturesque view. Euphorbia was planted in the center of the succulent garden with a height of about 58 cms and occupied 0.159 m^2 from the garden area sharing by 0.031 m^3 in its space.

In fact, the development of succulent plants after one year from planting did not arrive to show up in the garden.Most of those plants occupied only about 2.284m^2 from the area of the succulent garden while this large number of mixed genera and species of succulents gave very attractive combinations and with the small globular species of Echinocactus reaching to a very effective completion with other lava rocks. All those combinations

Table (8): Contribution of succulent and cacti plants in maturity stage in the succulent garden.

Plants \ Character	Leaf No.	Plant diameter cm	Length of plant cm	Area occupies cm^2	Size in garden space m^3
* Agave americana var marginata	46 - 22	203	210	3.235	2.264
** Agave americana var marginata	54 - 30	215	219	3.629	2.649
Agave sisalana	51 - 27	228	236	4.081	3.210
Lophocereus shotti	2 branch	48	289	0.181	0.174
Euphorbia heteracantha	5 level	130	270	1.327	1.194
Yucca glauca (East side)	154-136	192	159	2.894	4.601
Yucca aloifolia (West side)	112-97	115	205	1.038	2.128
Opuntia vulgaris	--	155	320	1.886	6.035

** Agave americana var marginata which in West side of garden.

** Agave americana var marginata which in East side of garden.

*** Leaf No. = Leaves number before and after thinning.

should be more admirable when the plants reach their maturity and complete growth.

2- Contribution of succulent plants in maturity stage:

Photo (17) shows the view of South side of the succulent garden in May (1987), no doubt that the scene of the garden completely changed than the first one.

With *Agave sisalana* the plant occupied 4.081 m^2 from the area of the garden creating 3.210 m^3 from the garden space. In fact Agaves species occupied 8.123 m^3 from the space garden and became more effective as picturesque elements. While, *Yucca glauca* plant (in East side of garden) grew slowly, however the trunk become little longer and produced its white flowers near the top of the plant. These flowers still in their beautiful blooming moreover 3 small aerial plant appeared above the curving stem producing foliage in a condensed way so as to add very marvellous appearance as arching shape.

On the other side (West side) *Yucca aloifolia* plant gave 112 sharp green leaves with single trunk occupying a small area of 2.128 m^3 from the space of the garden.

In fact, Yucca looking like palms gave a bold and agreeable appearance in the succulent garden.

Photo (17) shows the view of South side of the Succulent garden in May 1987.

Photo (18) shows the other side of the Succulent garden in May 1987.

Plant organization in this spot, started by larger plants from Opuntia and Cereus which were considered as a frame for the landscape picture, and torch cacti,yucca, agaves were planted after that around Opuntia and Cereus in order to complete its combination.

In conclusion it could be noticed clearly that every plant created its single naturalistic picture at their mature stage.

The size of the succulent plants at their mature stage became large enough, to attract the attention of garden visitors, visitors look will transfer from a plant to another. The visitors could look attentively at every charming shape. They permit themselves to spend more time to follow up such attractive appearance, which is mainly a function of the garden and the plant this is clear when Photos (17), (18) if well examined.

The shape of succulent plants depended upon the types of generative points which demonstrate the growth habit of succulent plants if the distances and design are well organized. For example as shown in Photos (15, 16) the open view and vista appeared because the design contained low globular plants which grow regularly in spaces.

Thus, a termenology of an open design of succulent garden could be mentioned here, such design allow the eyes to look through it.

Whereas the plants in Photo (18) seemed to be very crowded, their growth screened the center where the rapid growth gave an exciting landscape subjects. In this concern, thinning succulent plants in the maturity. stage allow sunlight to interfere between the plants and enable the grower to show up their beauty and their ornamental role in the garden.

On this ground, the establishment of the succulent garden need continuous looking after and good maintenance in order to have a perfect scenery at all time.

Generally, it could be concluded that many of succulent and cactus plants could be used to make an excellent succulent garden, although taking several years before their beauty and glorious scenery is recognized in the garden . However , they can create a suitable combination in the first stage of their growth, while their scenery in golden stage will be more agreeable than in the first stage of growth.

IV. THE EFFECT OF PLANT ORIENTATION ON THE PLANT GROWTH AND SIGHT APPEARANCE

Shady site has definite advantages, especially for some plants which require partial shade for healthy growth.

The comparison between the growing of some garden plants materials in shady or sunny locations was undertaken i.e. Salvia splendens, Senecio doria, Dracena draco, Hybrid Tea Roses and Agave americana var marginata.

1- Salvia splendens, Ker-Gawa

Data in Table (9) and Photos (19, 20) show the effect of shade and sunlight on the growth of Salvia splendens plants, it is clear that the plants grown in full sunlight were taller than those shade by 32%. Leaf area increased under sunlight by 19% than shaded plants.

The increase in leaf area due to sunlight reflected on increasing the stem diameter to 0.39 cms compared to 0.20 cms for the stems of plants grown in shade. The increase was also true with the leaf thickness (Table 9).

Table (9): Effect of shade and sunlight on vegetative, flowering and chemical content in <u>Salvia splendens</u>.

No.	Treatment / Character	Shade	Sunlight
1	Mean Height of plant cms.	136.33	167.83
2	Mean leaf area cm^2	12.33	14.67
3	Mean stem diameter cms	0.20	0.39
4	Mean thickness of inflorescence mm.	0.36	0.38
5	Mean length of inflorescence mm.	12.38	18.04
6	Mean weight of inflorescence gms.	3.95	5.68
7	Mean inflorescence per plant.	4.80	9.00
8	Nood no. of inflorescence.	14.40	20.98
9	Spot cover area in the garden m^2	0.58	0.92
10	Dry weight % gms	11.32	14.38
11	Total carbohydrate in leaf.mgs./1gm.	0.75	2.17
12	Chlorophyll A content. mgs./1gm.	1.10	1.14
13	Chlorophyll B content.mgs./1gm.	0.63	0.66
14	Carotene content.mgs./1gm.	0.23	0.42

*Total Carbohydrate= mgs./1gm.inleaves (dry weigh)

** Chlorophyll A,Band Carotene = mgs./1gm. in leaves (fresh weight)

Photo(19)shows Salvia splendens plant grown under shade conditions condition (1000 Foot/ candles),the plant occupy little small area in the garden.

Photo(20)shows Salvia splendens plant grown under full sunlight condition(12000 Foot/candles),the plant occupy large spot cover area with healthy growth.

Similar increases are noticed with the dry weight and Chlorophyll content in the plants grown in full sunlight. The increases could be attributed to the more Carbohydrates synthesis and accumulation in leaves under sunlight as shown in Table (9) where the total Carbohydrate content reached 2.17 mgs. compared to 0.75 mgs. for shade treatment. Carbohydrate assimilation depends upon the rate of photosynthesis which was affected with higher light intensity.

The increased fresh and dry weights, Carbohydrates and Chlorophyll Content under sunlight condition affected the flowering. The length and weight of stem inflorescences were increased under sunlight by 45.72% and 43.80% above the shade condition respectively.

Photos (19, 20) and Table (9) show the number of inflorescences and node numbers of the inflorescences which increased in sunlight by about 87.50% and 45.69% respectively.

The results are in agreement with those of Zimmer *et al*., (1982) who found that *Salvia splendens* cvs

Johnnisfeuer and Carabinies grown in short days (10 hr.) had a delayed flower development compared with long days and also the number of nodes increased significantly.

It could be concluded that light in the garden could determine the growth and development of Salvia in the garden, <u>Salvia splendens</u> may be grown under shade garden conditions and it will show some ornamental growth under those conditions , but the plant will occupy a smaller area in the garden, about 0.581 m^2. Whereas the plant under sunlight will occupy about 0.916 m^2 from the ground area of the garden, hence the number of plants needed to blossom in the garden bed, borders and or in combinations with other plants has to be perfectly calculated depending on the position in sun or shade, all other factors influencing the growth have to be well considered.

Table (10): Effect of shade and sunlight on vegetative, flowering and chemical content in Hybrid Tea Roses.

No.	Character / Treatment	Shade	Sunlight
1	Mean Height of plant cms.	121.60	150.40
2	Mean Length of branch cms.	45.30	59.50
3	Mean Leaf area cm^2	11.06	11.92
4	Mean weight of leaves gms.	0.88	1.41
5	Mean No. of branch per plant.	2.81	3.90
6	Mean branch thickness cm.	0.84	0.89
7	Mean thickness of leaf mm.	0.26	0.35
8	Mean No. of flowers per plant.	1.60	3.00
9	Mean No. buds per plant.	1.00	1.60
10"	Mean flower diameter cms.	5.00	6.40
11	Spot cover area in the garden m^2	0.48	0.64
12	Dry weight % gms	29.24	33.78
13	Total carbohydrate in leaf mgs./1gm.	0.90	1.27
14	Chlorophyll A content. mgs./1gm.	0.91	1.08
15	Chlorophyll B content. mgs./1gm.	0.55	0.61
16	Carotene content. mgs./1gm.	0.36	0.40

*Total Carbohydrate =mgs./1gm.(in leaves dry weight)

** Chlorobhyll A,B and Carotene =mgs./1gm.(in leaves fresh weight)

2- **Hybrid Tea Roses**

Table (10) shows the effect of shade and sunlight on the vegetative growth and flowering of Hybrid Tea Roses in the garden. Rose plants grown under sunny location increased in their height by 23.7% above those grown under shade conditions. The mean length of the branch increased by 31.3% and the number of branches increased by 38.8% when the roses were grown in full sunlight with no effect on the branch thickness.

Under full sun light intensity, slight increase in the leaf area was noticed, while both fresh weight and leaf thickness were noticeably increased by 60% and 35.7% respectively over shaded plants.

These results are in agreement with those of James (1984) who found that Rose plants do best when grown under full sunlight or at least under six hours or sun during the day . However , they may be grown in shade, but in this case they become more susceptible to attack by mildew and thrips than when grown under full sunlight.

The recorded dry weight percentage, Table (10) for the plants of the sunny location was 33.78 gms compared to 29.24 gms for shady one. The total Carbohydrate content gave similar trend of results.

On the other hand, little increase was noticed in Chlorophyll A, B and Carotene content in the leaf of plants grown under full sunlight as 1.08 mgs Chlorophyll A, 0.61 mgs Chlorophyll B and 0.40 gms Carotene respectively and under the shade conditions the values were 0.91 mgs, 0.55 mgs and 0.36 mgs respectively. The increases of Chlorophyll A, B and Carotene under full sunlight recorded 18.18%, 11.5%, 11.29% over the values of the shade treatments, respectively.

Table (10) shows that the plants grown in full sunlight produced 3.0 flowers per plant with a diameter of about 6.4 cms compared to 1.6 flowers per plant with diameter of about 5.0 cms under shade . The increases valued 87.5% and 28% over the lower light intensity treatment.

Calculating the number of Hybrid Tea Roses plants needed to cover 10 m^2 in a sunny location, it was found to be 15.7 plants compared to 20.7 shrubs needed to fulfill the same effect under shade conditions. Since every shrub occupied about 0.955 m^3 from the sunny space in the garden compared to 0.587 m^3 for shady space.

Consequently a flowering border of (10 m^2) area content Hybrid Tea Roses will create about 14.995 m^3 (15.7 x 0.955) from the garden space in a sunny location compared to 12.15 m^3 (20.7 x 0.587) in the shaded one. The flowering surface will cover about 3.014 m^3, (6.4 x 3 x 15.7) in the sunny location compared to 1.656 m^3 (5 x 1.5 x 20.7) in shaded one.

According to James (1984) the flowering surface area will increase if the front border includes Floribunda roses which are very effective when planted in group.

Table (11): Effect of shade and sunlight on vegetative, flowering and chemical content in <u>Senecio doria</u>.

No.	Treatment / Character	Shade	Sunlight
1	Height of plant cms.	54.64	37.56
2	Mean leaf diameter cms.	35.62	21.34
3	Mean diameter of Peduncle leaf cms.	1.17	0.84
4	Mean thickness of leaf mm.	0.94	0.74
5	Spot cover area in the garden m^2	1.33	0.58
6	Dry weight percentage gms.	22.20	21.67
7	Total carbohydrate in leaf. mgs./1gm.	1.87	1.05
8	Chlorophyll A content. mgs./1gm.	0.71	0.54
9	Chlorophyll B content. mgs./1gm.	0.43	0.31
10	Carotene content .mgs../1gm.	0.24	0.22

* Total carbohydrate = mg/1 gm. in leaves (dry weight)
** Chlorophyll A, B and carotene = mg/1 gm. in leaves(fresh weight)

3- **Senecio doria**

Data in Table (11) show that shaded plants of Senecio doria had a great agreeable growth than those in full sunlight . The shaded plants recorded 54.64 cms plant height compared to 37.56 cms under sunlight condition.

The similar effect was noticed with leaf diameter where the shade treatment produced 35.62 cms diameter leaf compared to 21.34 cms diameter, leaf the decrease under sunlight position was about 66.9%.

Some investigators suggested explanation to this case such as Laetsch (1974) who reported that analysis of tissues from sun and shade ecotypes of the same species has revealed vast differences in amounts of the enzyme ribulose 1 , 5-diphosphate carboxylase. On leaf area basis there was ten times of the enzyme in the shaded leaves than the leaves in the sun location.

On the other side, increasing the growth led to an increase in the area needed for shade plant in the garden. The area needed was 1.33 m^2 compared to 0.58 m^2 for each plant in the sunlight location.

As for the diameter of leaf peduncle , the shade treatment increased it by 39.8% over that grown under full sunlight. Similar trend is observed with blade thickness (Table 11).

However, Lewis (1972) reported that shade leaves are generally thinner and have a large surface area than sun leaves. Badawy et al., (1987) reported that 70% shade gave the best performance to growth of Chamaedorea elegans.

Some investigators explained the ability of shady plants to use little amount of light. Spoehr and Smith (1936) reported that a single layer of Chloroplasts absorbs about 30 per cent of light falling upon it , absorpation in the second layer is reduced to 20 per cent, and in one the fourth to 10 per cent, but deeper layers of Chloroplasts absorb very little light.

Lewis (1972) reported that shady leaves are able to make efficient use of small amounts of light, they are more efficient in their use of incident light.

Hall (1982) reported that shade plants are able to grow where the irradiance seldom rises above 1 per cent of full sunlight and their problems are binded by the selective absorpation of wavelength useful in photosynthesis by upper vegetation canopies.

Table (11) shows the effect of shade and sunlight exposure on the dry weight percentage , total Carbohydrate, Chlorophyll A, B and Carotene contents of Senecio doria leaves. There is a slight increase in the dry weight percentage due to the shade treatment, this slight increase may be due to the ability of shady leaves plants to maintain a net uptake of carbon dioxide under low light intensities than sun leaves. Similar conclusion reported by Coombs (1973).

As shown in Table (11) the total Carbohydrate increased in the shade treatment since it gave 1.87 (mgs/1 gm), where the sunlight treatment recorded only 1.05 (mgs/1 gm).

The increase which valued 78.29% could be attributed similarly as before to the ability of shady plants to utilize low light intensities, more efficiently than sun lower.

The shade plants reach their compensation point earlier in the day. On the other hand, Coombs (1973) concluded that the shady leaves have the effect of increasing photosynthesis in relative to respiration.

Data in Table (11) show an increase in Chlorophylls (Aand B)content in shady leaves which recorded 0.71 and 0.43 mgs./1 gm. compared with 0.54 mgs. and 0.31 mgs. for sunny ones.

Generally, the total Chlorophyll content increased in shade leaves treatment than that of the sunlight,the amount of increase valued 29.25% above sunlight treatment which recorded 1.06 mgs as total Chlorophyll content.

Black (1973) explained the mechanism of photosynthesis in shade plants, he suggested that photosynthesis in shade plant is saturated at light intensities about one third of those required for saturation of sun leaves of C_4 plants , since they possess more Chlorophyll per unit area , shade leaves can not be limited by inability to absorb sufficient light.

On the other hand, shade plant which grow in sunlight make more respiration than in shade conditions, therefore the size of these plants is smaller than those growing under shade conditions.

Photo (22) shows general view of <u>Dracaena</u> <u>draco</u> plant after 1 year from its planting in sunny location, it has 4 suckers around the trunk in September 1983.

Table (12): Effect of shade and sunlight on vegetative growth and chemical content in **Dracaena draco**.

No.	Treatment / Character	Shade	Sunlight
1	Height of plant cms.	340.00	410.00
2	Mean leaf length cms.	103.00	120.40
3	Trunk circumberence cms.	80.00	135.00
4	Mean branch circu. cms.	20.50	53.33
5	Branch No. per plant.	2.00	3.00
6	Mean leaf width cms.	6.67	7.50
7	No. of crown divisions per plant.	0.00	11.00
8	No. of suckers per plant.	0.00	4.00
9	Spot cover area in the garden m^2	8.05	10.75
10	Dry weight percentage gms	22.79	24.80
11	Total carbohydrate in leaf. mgs./1gm	1.05	1.88
12	Chlorophyll A content. mgs./1gm.	0.49	0.53
13	Chlorophyll B content. mgs./1gm.	0.23	0.26
14	Carotene content. mgs./1gm.	0.84	0.86

* Trunk circumberence at 10 cms above level of soil.
** Total Carbohydrate =mgs./1gm.in leaves(dry weight)
*** Chlorophyll A,B and Carotene =mgs./1gm leaves(fresh weight)

4- Dracaena draco

Photo (22) shows a general view of Dracaena draco plant after 1 year from its planting in a sunny location, the suckers appeared around the trunk of plant after 8 months from planting in the garden.

Photo (23) shows Dracaena draco with a single trunk when grown under shade in the lath-house. Photo (24) shows the later development of Dracaena draco and its suckers after 2 years from the date of planting in the garden.

Date in Table (12) show the effect of shade and sunlight on the vigorous growth of Dracaena draco plant in the garden.

The plant height under sunny conditions recorded 410 cms compared with 340 cms for the shaded plant. While the length of trunk under sunny conditions increased by 20.6% over that of the shady one.

Similar effect was noticed as regards of the trunk circumference which recorded 135 cms. (10 cms above soil level) under sunlight condition compared with 80 cms for shade treatment.

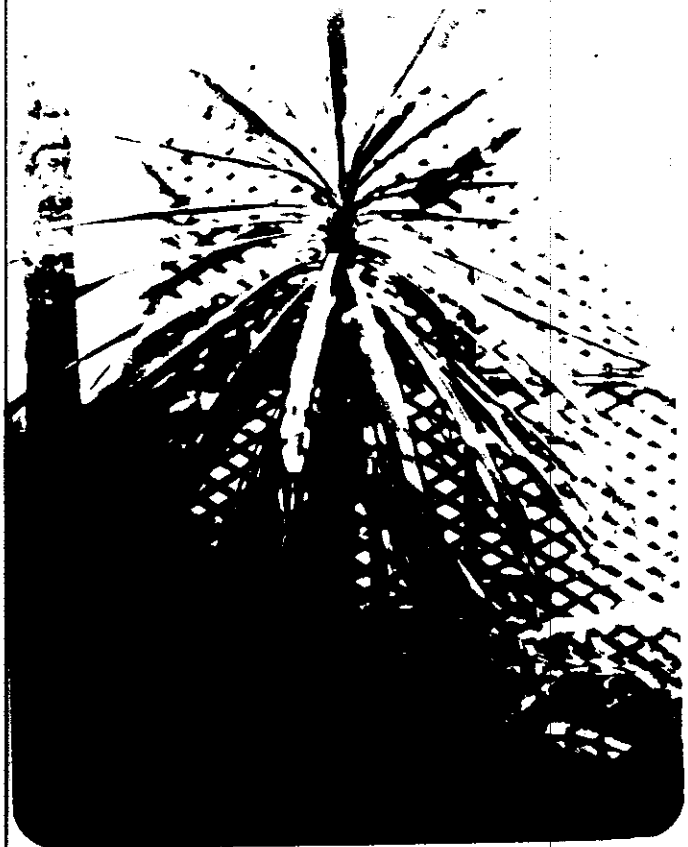


Photo (23) shows Dracaena draco with single trunk grown under shade of lath-house conditions (950 foot/candles) in September 1983.

This effect reflected on the branch circumference which recored 53.33 cms per branch under sunlight conditions compared to 20.50 cms per branch for shaded location.

The effect of sunny locations did not only extend on the trunk length and branches diameter but also it influenced the crown of the plant.

Data in Table (12) show that the leaf length of sunny plant recorded 120.4 cms compared with 103.0 cms for shaded plants. The increase of sunny leaf length is about 16.67% over the shady treatment. The same effect is noticed on the leaf width, where the sunlight treatment gave 7.50 cms compared with 6.67 cms for shaded leaves.

Table (12) shows the effect of shade and sunlight on the dry weight percentage, total Carbohydrate percentage and Chlorophyll A, B and Carotens contents. In this respect, little increase is noticed in the dry weight percentage in sunny plant as 24.80% compared to 22.79% for the shady treatment.

In concern of total Carbohydrate content, leaves of sunlight treatment recorded an increase in the amount of total Carbohydrate content as 1.88 mg compared to 1.05 mg for shade treatment.

On the other side, Photo (24) and Table (12) show the increases in the number of sukers around the trunk of Dracaena draco growing in sunny locations, besides having eleven sprouts.

In fact, the habit growth of Dracaena draco shrub planted in sunny location is compeletly different from that grown in the shade.

In this respect Dracaena draco occupied not only 10.75 m^2 from the sunny area in the garden but also created a strong focal point in the garden. Thus it could be used as tall shrubs of 410 cms to furnish strong orientation upward to the sky.

In the mean time this plant could be used in shady places in the garden, to realize another ornamental effect suitable for shady location.

Photo (24)shows the shape of <u>Dracaena draco</u> and its suckers after 2 years from planting in the garden.

Photo(25)shows the shape of *Agave americana* var *marginata* grown under 800Foot/candles ,the growth had unattractive scenery with large twisting leaves.

Photo(26)shows healthy shape growth with less twisting leaves to Agave *americana* var *marginata* grown under full sunlight conditions.

5- *Agave americana* var *marginata*

Table (13) shows the effect of shade and sunlight on the vegetative growth of *Agave americana* var *marginata*.

Sunlight conditions increased the height of plant to 184 cms compared with 140 cms for the shaded plant.

On the other side, all the other vegetative chracters increased with sunny treatment than the shaded *Agave americana* var *marginata* treatment. In this respect, leaf number was 48 for the sunny treatment compared with 20 leaves for the shade treatment.

The mean length of the leaf reached 142.33 cms in the sunny location compared with 125.83 cms for the shade position. Whereas the leaf width was 18.38 cms compared with 10.14 cms for shaded plants.

It is well known that agavaceae plants could tolerate adverse conditions, but their scenery will be affected by the environmental conditions.

Data in Table (13) concerning the effects of shade and sunlight on the dry weight, total Carbohydrate and Chlorophylls A, B and Carotene content in the leaves of

Table (13): Effect of shade and sunlight on vegetative growth and chemical content in <u>Agave americana</u> var <u>marginata</u>.

No.	Treatment / Character	Shade	Sunlight
1	Height of plant cms.	140.00	184.00
2	Mean leaf No. per plant.	20.00	48.00
3	Mean leaf length cms.	125.83	142.33
4	Mean leaf width at 33th spines cms.	10.14	18.38
5	Mean leaf thickness at 33th spines cms	0.32	0.48
6	Leaf curved per plant.	18.00	3.00
7	No. of clear spines per leaf.	46.00	53.00
8	Spot cover area in the garden m^2	4.16	6.61
9	Dry weight percentage gms.	11.06	13.86
10	Total carbohydrate in leaf.mgs./1gm.	1.13	2.85
11	Chlorophyll A content .mgs./1gm.	0.08	0.06
12	Chlorophyll B content.mgs./1gm.	0.03	0.03
13	Carotene content.mgs./1gm.	0.025	0.022

* Total Carbohydrate =mgs./1gm.in leaves(dry weight)

**Chlorophyll A,B and Carotene =mgs./1gm.in leaves (fresh weight)

Agave americana var *marginata* show clearly that, dry weight percentage increased under sunlight conditions to 13.86 compared with 11.06 for shaded plants.

On the other hand sunlight treatment produced the highest content of total Carbohydrate as 2.85 mgs compared with 1.13 mgs. for the shade location.

The habitat of Agave is the arid zone in which they grow in full sunlight. The plant under the similar conditions is able to photosynthesis in higher rate as compared in places with low light intensities.

Spoehr, (1949) reported that, cacti plant cell had polysaccharides and also pentosans. He added that the reduction of free water content of cacti plants cell below a certain point resulted in the conversion of polysaccharides , with low imbitions capacity into pentosans . The latter have a high hydration capacity especially when mixed with nitrogenous substances , the action having the force for regulatory adjustment. Since the change is irreversible, the pentosans result in permanent succulence.

Mac Dougal and Spoehr (1948) reported that the thickness of succulents cell wall resulted from the accelerated conversion of the polysaccharides into their anhydrides.

It was found that Agave plant accupied about 4.156m^2 from the garden area, whereas this plant occupied only 2.32 m^3 from the garden space compared with 3.90 m^3 for that in the sunny treatment.

As shown in Photo (25) Agave americana var marginata could be choosen to be planted in the garden to create intresting focal points in the sunny corners, but, if the spot is exposed to continuous shade, the growth will be less beautiful and the leaves will be twist.

Generally, it could be concluded that light is one of the most important factors which determine the vigorous growth of Agave americana var marginata . In this respect, the beauty of those plants and striking growth depends upon the amount of sunlight to which they are exposed to. It is recommended to grow Agave americana plants in sunny locations of the garden where they are more effective and agreeable when exposed to sunlight for long time.

V. LANDSCAPING IN THE MONUMENTS' PLACES

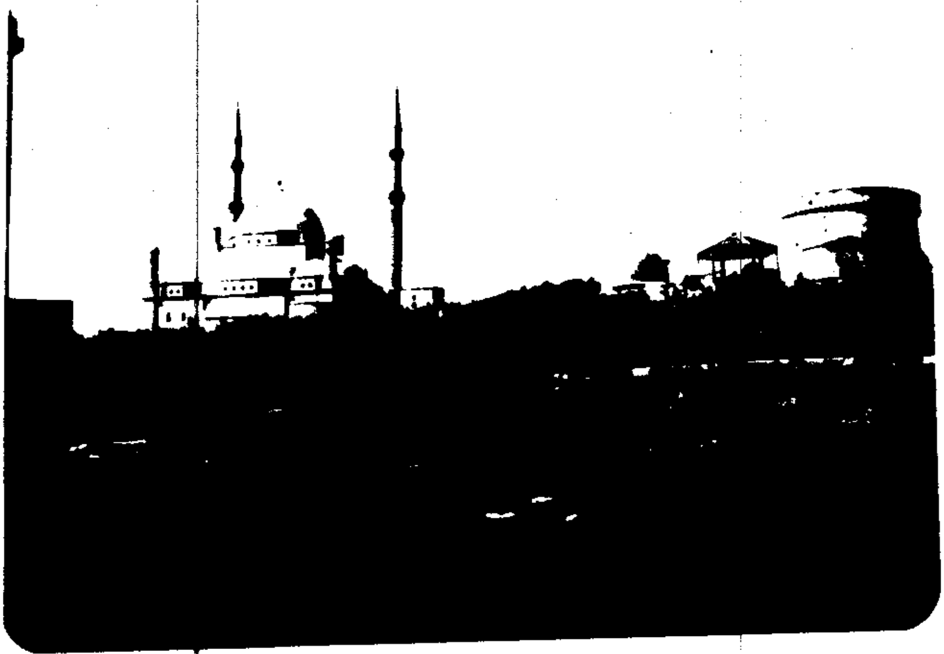
Landscape design has an important role in creating sensuous sights for foreyard and backyards of the touristic areas. In this respect landscape design in such area is ruled by many aspects, the historieal ground and the style of buildings (Soulier, 1977).

Plant materials chosen for such places have to connect the evidences of the historical excitement and tourism expectation with the ornamentation of the area.

Also, several considerations must be understood before designing and planning such places i.e.what to choose from plant genera and where to lay out them? What to choose is dependent on the recreation of the plant in the spot (the form, colour, shade, etc ...), but where to lay out is connected with their use and for which purpose, as well as their vertical and horizontal effects in the garden and on the buildings. In this respect, the landscape design harmonizes the buildings with the plant materials used.

Evaluation of Citadel Garden

Planting the garden of the Citadel started in (1985), vegetation has been used to surround the building of the



Photo(27)shows general view of the front Citadel , from side of Salah Salem street.

Photo(28)shows the same location after planting in March 1989

Citadel by gardens and emphasize their beauty and historical importance.

Photos (27 and 28) show the general view of the front Citadel gardens, there, three circular hedges from different general were used as background for the front green area and the circular bed.

The hedges were as following; the first one is Acalypha wilkesiana, Muell which circulated a formal garden, the second one is Hibiscus rosa sinensis, L which extended at 5.52 m. around the first one, and the third hedge is Nerium oleander, L. 6 ms around the second hedge.

Acalypha wilkesiana, Muell consisted a low foliage colouring hedge in the front of the formal garden. However, the beauty of the colouring hedge not only lies in its neat trimmed appearance but also in its attractive foliage colours.

In our opinion, the two other hedges will loose their function when the first one will be well established.

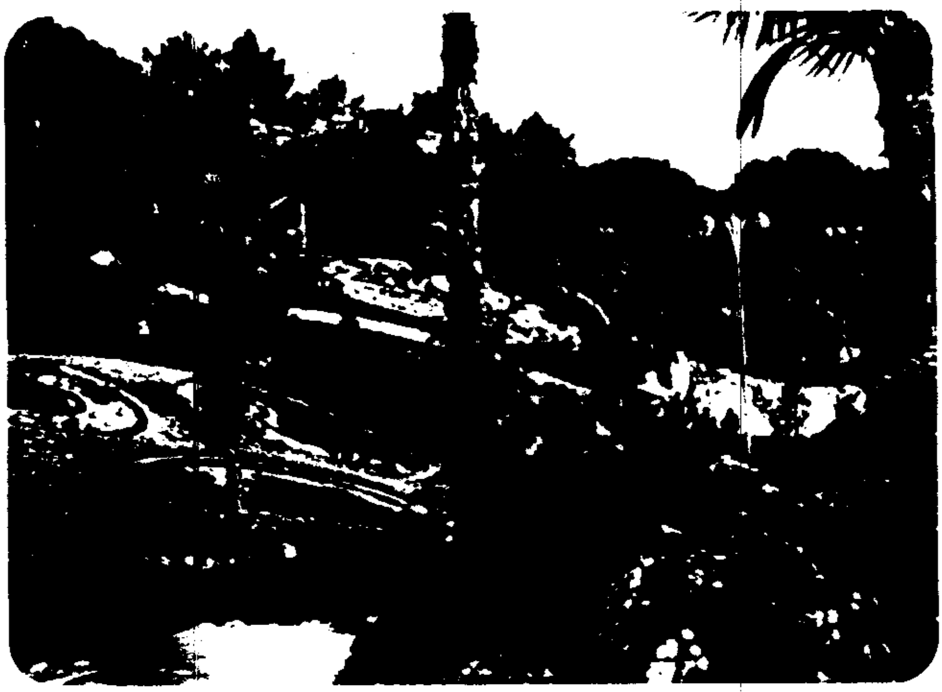
As shown in Post card(1)it is better-to grow only one low hedge in the sloping public gardens. This case will give an open vista.

Photo (27) shows the round formal garden from the side of Salah Salm street. In fact, this view needs particular attention in terms of the arrangement of this space, the view lacks beauty. There are two suggestions for orientation of this spot. The first one, is that, it is well known that open spaces are normally exposed to sun and daylight for longer time, therefore, such spaces may be designed as follows:

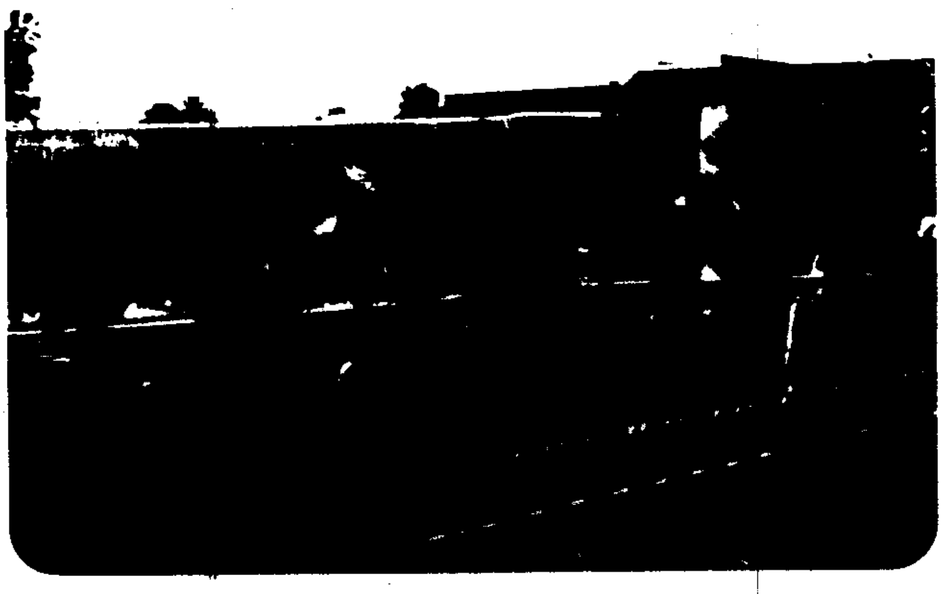
(1) Formal beds garden: As shown in Figure (4) some herbaceous flowering plants with Rosa polyantha can be used to definite the space as formal garden , and Acalypha low hedge between a lawn area and the formal beds will limit the space without any physical barrier or alteration of view into and from the implied space.

(2) Succulents and cactus plants are suggested to create a formal bedding design , since , many of succulent plants are very attractive and ornamentaly when grown either as single specimens in groups of one class or when different genera and species are grown together in mixed planting patterns (Linda, 1970).

-Palm trees could be suggested , they could complete the historical panorama of the Citadel gardens,



Post-card(1)shows lawns and low hedge with charming Palms of winter garden in Zaragoza Espain.



Photo(29)shows view of fan young Palms under nursery conditions in Citadel gardens.

many designers think only of the palms in terms of its decorative function. However, in the ancient history of gardening, it held even loftier positions.

As shown in Photo (29) palms have picturesque plant form which realize a very attractive combination with the historical area.

On the other hand, lawns making is not enough to define all Citadel gardens , its design could be completed by laying out other groups of plant material at various garden location as shown in Photos (30, 31, 32 and 33) using Coniferous evergreen trees with mass of deciduous trees as opposed to be scattered throughout the design, the two types complete each other by bringing out each other's best qualities . However , the deciduous plants appear attractive enough during Summer and disappear during Winter because they will lack their leaves.

From an opposite point of view a design which contains only Coniferous evergreen vegetation is going to be dull because its colour is two heavy and dismal; planting deciduous or Coniferous trees alone give little

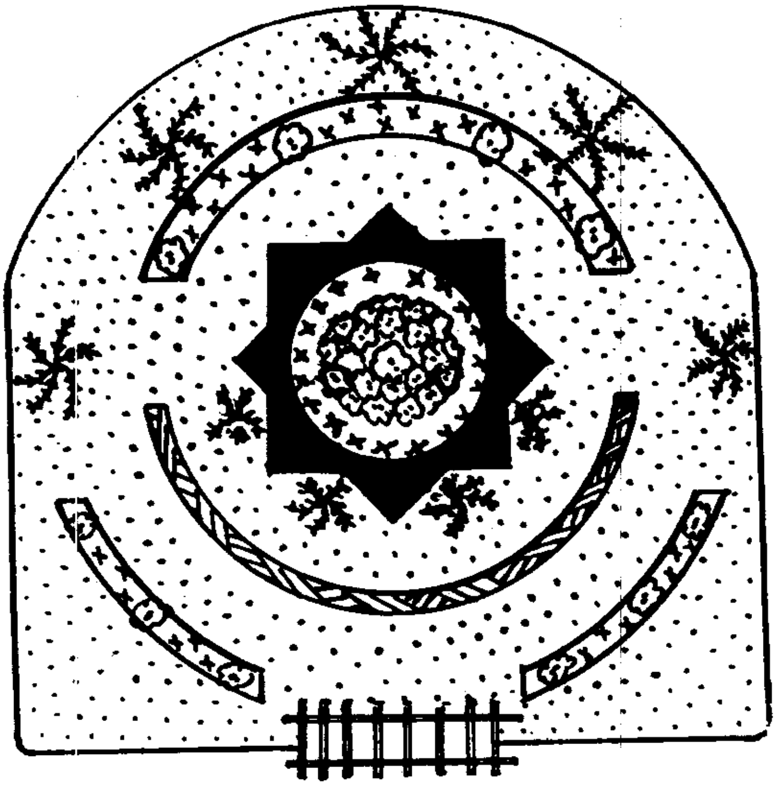
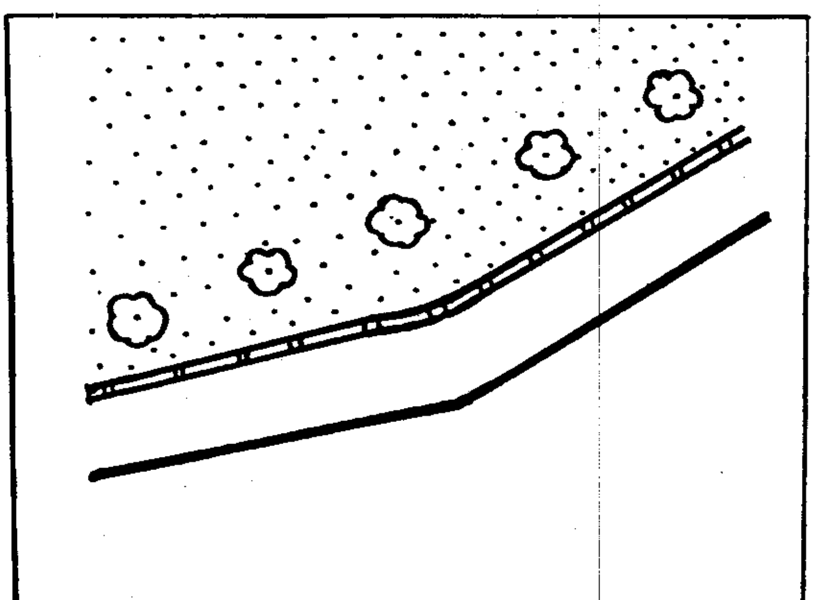
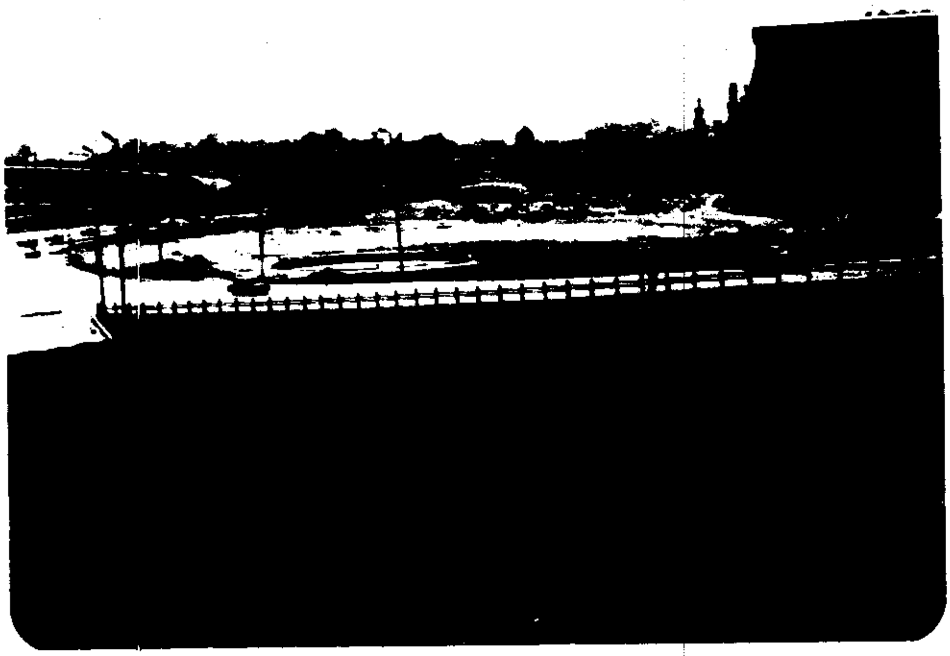


Fig.(4) shows a design for formal beds which lay out in the front Citadel gardens.



Fig(6) shows a design of public road with an established lawn surrounded by wood paling.



Photo(30)shows the location of the new pool which is suggested to complete the design of Citadel gardens.

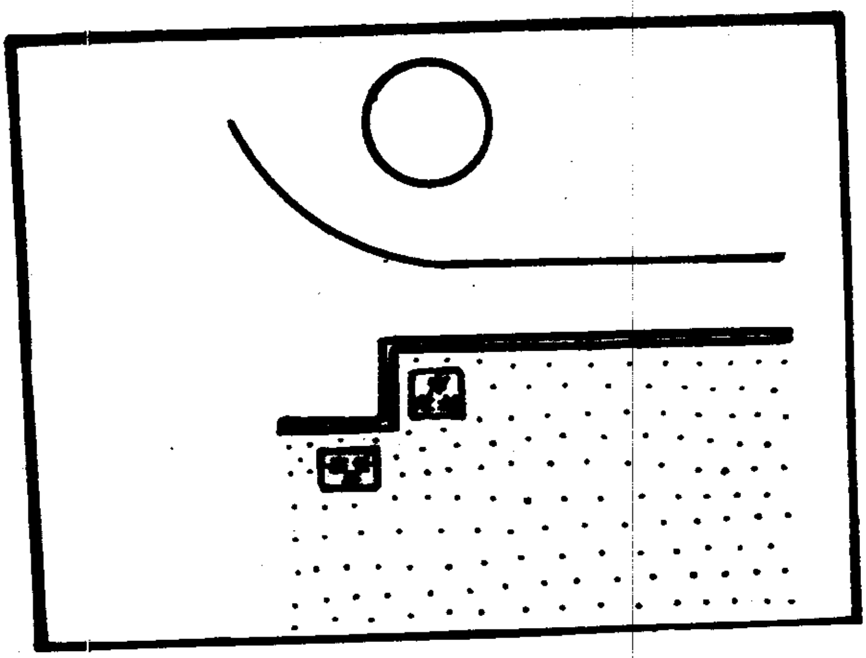
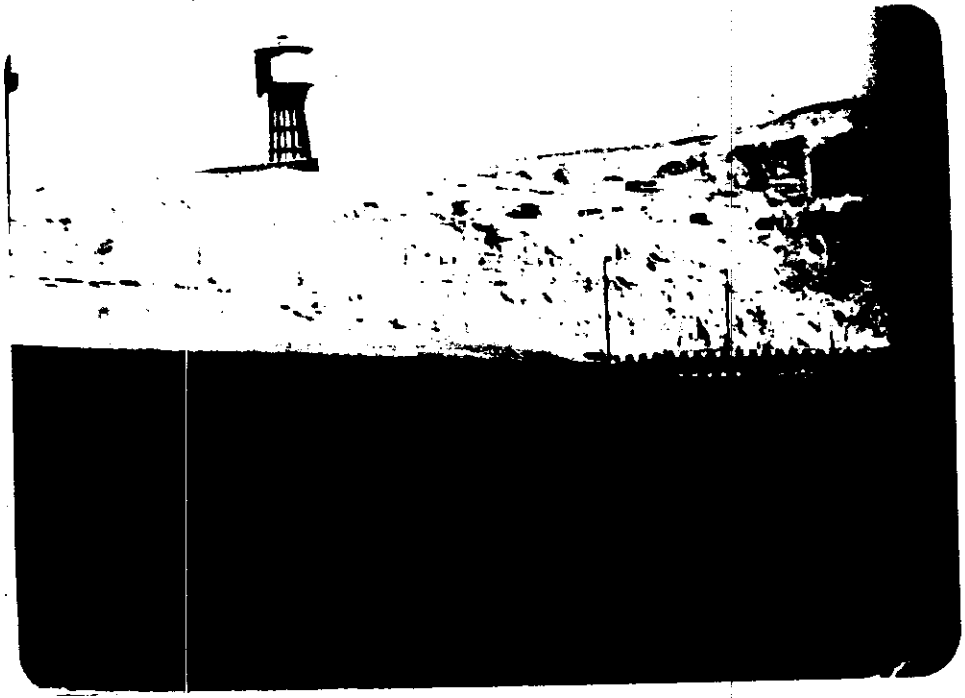


Fig.(8)Design line should be in harmonize state with the other garden elements.



Photo(31)shows a contrast view between the established green open lawn and the white rocks of the tile.

Photo(32) shows public road and establish lawn surrounded by formal Ficus nitida trees.

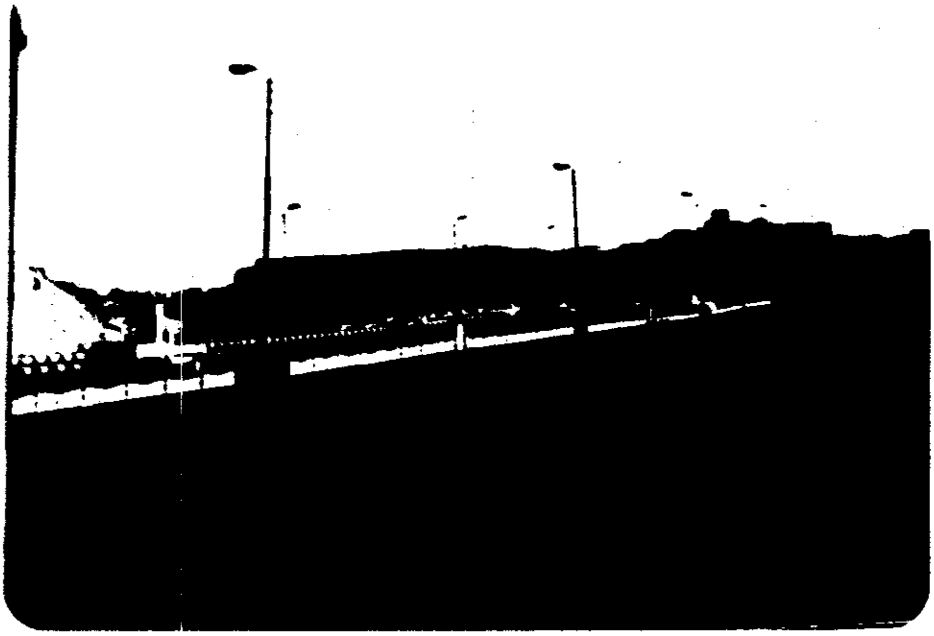
effect. Thus it is very important to plant both deciduous and coniferous evergreen plants to eliminate those

Some investigators suggested some reports to decrease maintenance in the garden Neel and Will (1978) suggested that the new cv Pittosporum ferrugineum (a vigorous shrub which bears clusters of golden fruits during Februry-April) for landscape use in areas receiving minimal maintenance. Grigor'EV (1985) recommended Pinus halepensis, P. nigra var caramanica and Tamarix spp for landscaping on the West coast of Cerimea favoured.

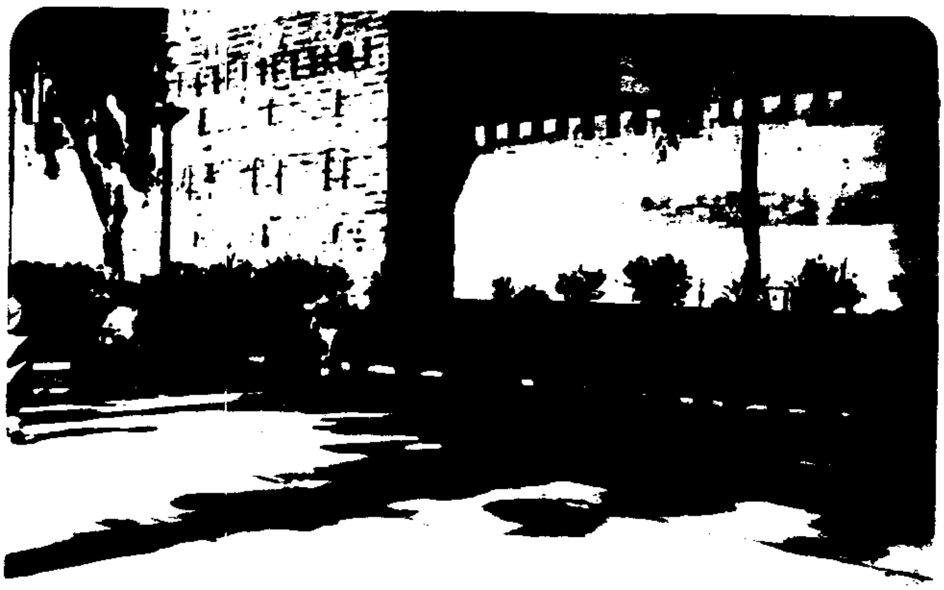
Woo (1986) reported that a survey of 100 plots in the area around the capital of Korea Republic during the last 10 years showed that the attempts to stabilize slopes and improve the view with ornamental trees were generally unsuccessful.

Photo (32) shows a public road with an established lawn surrounded by white paling which is creating a degree of privacy within it, and formal evergreen street trees.

Photo (33) shows large side from the high , olden Citadel wall which is parallel with Salah Salm street,



Photo(33)shows large side from high Citadel wall, the width of lawn is agreeable to create a mixed border in the face of Citadel walls.



Photo(34)The combination between plant material and sitting area showing the effect of tree shade.

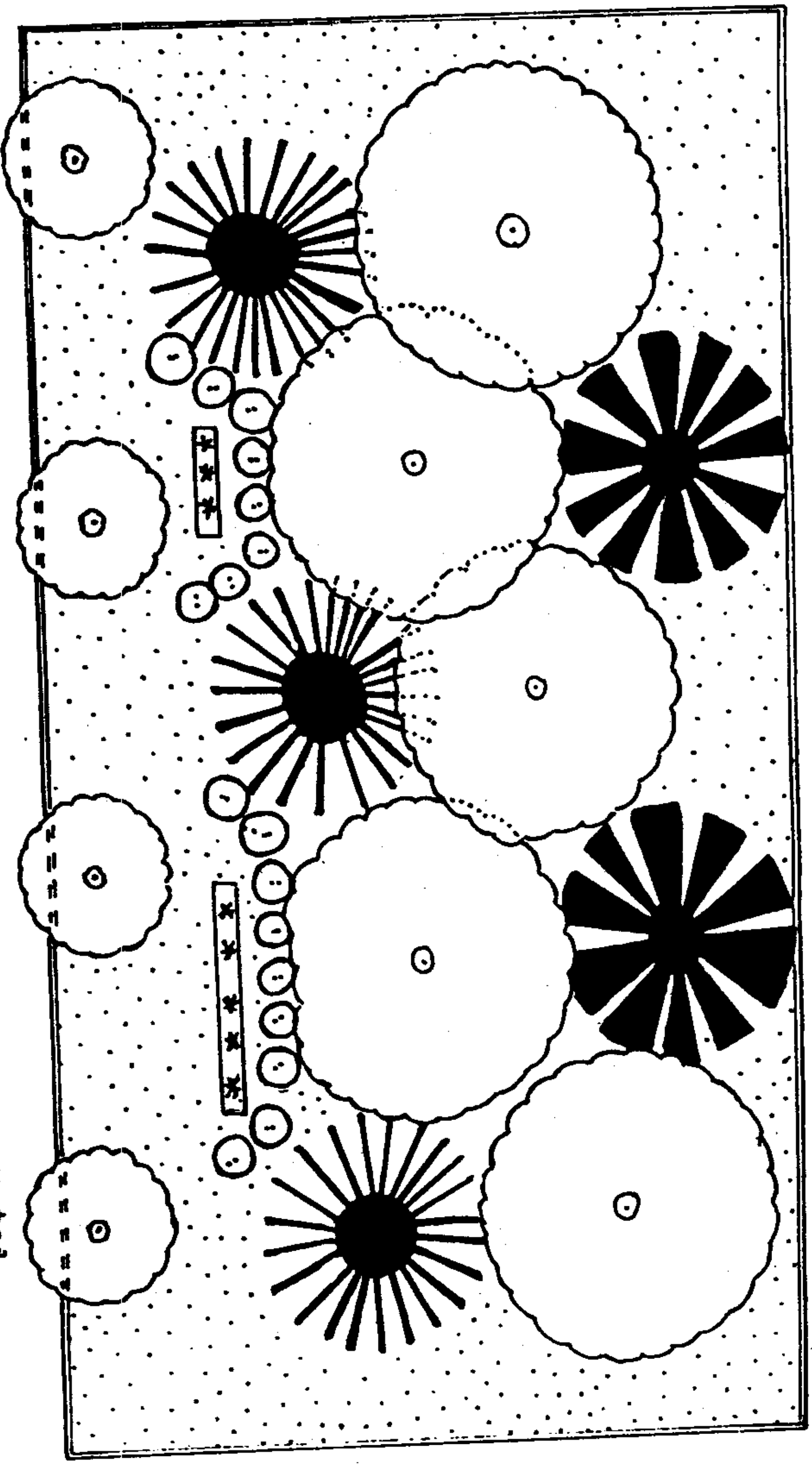


Fig. (5): Shows mixed border facing Citadel building as suggested.

the width of lawn in this spot is agreeable to create a mixed border facing the Citadel wall(after leaving the protection zone near the wall) which will complete the design and give it a cast of which happens when the mixed border including evërgreen, decidous trees and flowering shrubs.

The deciduous plants have several distinct functions in exterior spaces, it is a dynamic element in the design, wherever it is located as it has four distinct seasonal appearances and characteristics that directly affect qualities of border design. The deciduous trees are the "utility" plant in design, it has a wide application, some of them are selected for distinct their form, flower colour or Autumn foliage colour and some examples of deciduous plants that have notable flowers that contribute to their usefulness in the landscape are Cassia nodosa and Bauhinia variegata

In arranging the different plants in this border (Fig. 9), the taller growing kinds should generally be placed in the center of the group and the lower species along the border being graded from the highest to the lowest level. The reason for this arrangement is that lower plants would be killed by the shade and moreover would not be seen, but one should avoid to uniform a slope.

Role of landscape architect in the monuments place:

While many laymen and artists think that landscaping is only a decorative art and planting is value only in so far as the foliage hides some ugly foundation and soften hard lines or relieves bare spaces, screens some unsightly view, but the beauty of a landscape is dependent largely on the green plants as trees, shrubs, lawns and other plants materials which fulfil a number of roles in the landscape other than decoration and ornamentation.

Also, it plays a role to solve a number of environmental problems as clearing air, retain moisture in soil, prevent erosion and modify air temperature . In other words, landscape architect with plant materials completely changes the characteristics of our cities, which began to start actively again. In fact, the duty of the landscape architect is to demonstrate the monuments places in a very beautiful form, without any harmful effect or changing its essential characteristics.

The problem of ground water which increases due to excess of irrigation and drainage water is very harmful to monumental buildings and constructions such as the Citadel. The damage may be due to the high concentrations of salts which may interact with the walls and basements of these priceless buildings and monuments and cause their cracking and falling. In fact, it is a very difficult and also expensive to modify its effects after its attack. Thus, the drainage of garden water is more important than gardening establishment in this locations. Some points should be studied to overcome such problem, ground slope, water supply, water drainage and level of the ground water in this locations.

In this concern Davidson and Roberst (1984) suggested 3 systems of gardens drainage, open ditches, stone drains, piped drains. Perhaps the one of them could be used arround all the buildings of the Citadel.

In order to protect the constructions of Citadel, the landscape designer left large area surrounding all the Citadel, nothing will equal the loss of such treasures which are considered an important wealth to humanity.

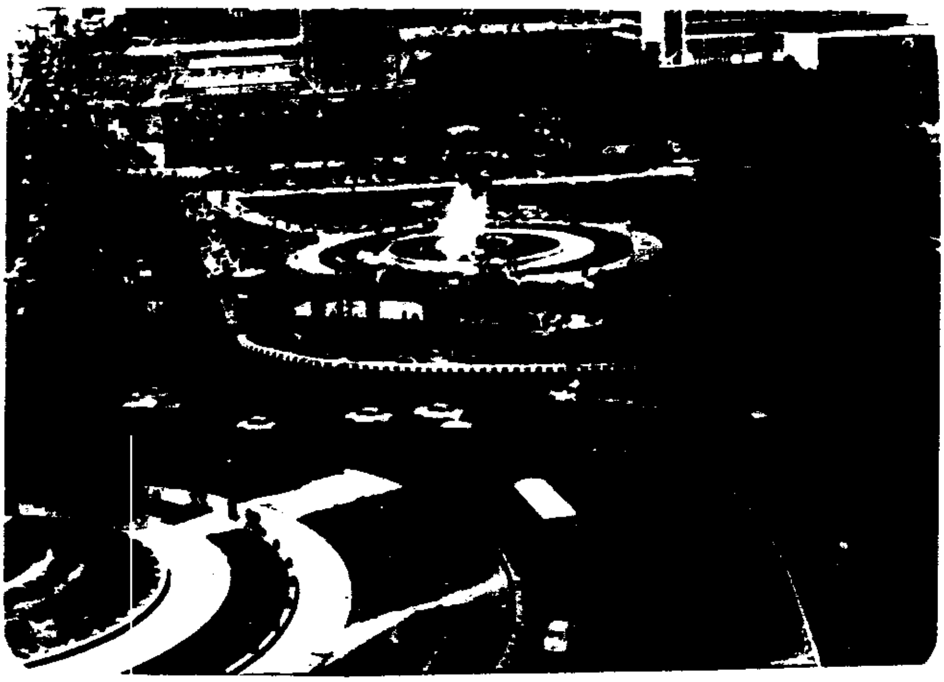
VI. EVALUATION THE DEVELOPMENT OF TAHRIR SQUARE GARDEN

Almost international public squares are planned with future regard to overcome the problems of traffic and to facilitate the flow of vehicles crossing this square especialy in rush hours. But Tahrir square one of the most important squares in the center of Cairo was designed in short run planning when Cairo was designated to be inhabited with a maximum of 4 million person. Nowadays, the inhabitants in Cairo exceeded 12 million persons. Therefore, most of Cairo streets and public squares are usually blocked especially at the peak of rush periods hours. Norman (1980) reported that the professional landscape designer must not only study the short-term effect of the design, but also the long-term one.

The changes in the statements are shown in Photos 35, 36, 37, 38 and 39, 40, 41 for years of 1964, 1981, 1983, 1985 and 1988 respectively.

Photo (35) shows the view of Tahrir square in 1958, the main elements consisted of large green area in an open design which included a large pool with its

Photo(35)shows Tahrir square during 1964 where the high monument base surrounded with a radial symm-etrical garden and formal carpet garden facing Tahrir adminstrative building.



Photo(36)shows Tahrir square during 1981, with the Tahrir fountain .

beautiful fountain display. This spot of square garden should be seen from different situations surrounding it as Nile Helton hotel, the Egyptian Museum and the other great buildings.

Although, the square contained large green area in 1958, but this area was divided into many parts, so that it seemed to be smaller than its actual area. Comparing with similar green area which is designed in the international squares of faw courts and the arch of "Palais du Cinquantenaire" in Brussel Belgium a great difference could be observed.

Photos 35 and 36 show the other side of Tahrir square in 1964 and 1981 where the high monument base in different level surrounded with a radial symmetrical garden with organized small shrubs, they might be more effective if they were little shorter. It could be noticed that flower beds were prepared to be replanted from season to season.

Photo 38 shows some flower beds planted by herbaceous plants in order to add more beautiful colour to the design. Marble vases were placed around the statue base to give the balance and suitable proportion between the height of the statue base and the total extention of the square. There was a formal carpet garden with a sitting area surrounded by small palms arround the space as shown in Photo (36).

It seems that such place was unsuitable in this spot; the sitting area should be calm. There are two established public gardens laidout on the other side of Nile bank, which could be used for rest, sitting.

The trees in Tahrir square as shown in Photo (37) had agreeable maintenance. While, Photo (38) shows the complete view of the other side of Tahrir street trees in 1983 their growth seemed better than the other groups of plant materials.

Generally, the large and intermediate trees could be freely used to provide shade in the streets. Trees are desirable plant materials for streets landscaping, since they provide shelter from sun burn in Summer to the walkers besides their effects on ornamanting the Cities.

On this concern, Lucas (1969) reported that trees are more tolerant to negligence. Soulier (1975) reported that, every car demands 10 trees to clean the town air from pollution, while every bus demands 100 trees to the same purpose

Photo(37)The green area decreased in Tahrir square during 1983 and public bus station occupied the large green area.

Photo(38)shows the ugly view of Tahrir square during 1985 where all the plants died and became in a bad statement.

Photo (39) shows the ugly view of Tahrir square in 1985 where the large green area, formerly facing the Egyptian Museum, disappeared when replaced by the public bus terminal station. The green area around the pool deteriorated some plants died and others dried.

The new direction of replanting Tahrir square gardens in 1988 depending upon the modern landscape lines which use smooth curving lines with large green area in complement cases with sitting paved area laidout around the pool in different levels so as to be used day and night. The area is supplied with white lamps light to extend garden usage.

Modern lines and shape were used to layout annual and other aceous beds in order to add beautiful colouring to the garden design. Some plants are used together in raised beds of flowers surrounding the pool.

On the other hand, Tahrir pool and its fountain were used in this design as focal points, with a jet forcing water in forms coincided with light reflected in different colours to add more beauity to the spot especially at night. On this ground, using of water element in this spot is successful. In this concern, Helmut (1950),

Photo(39)shows Tahrir square 1988 where the designer used smooth curving lines and large green area.

Photo(40)shows Tahrir square garden during 1988 where large green area in complement cases with paved area around the pool.

Olgyay (1963) and Byron (1976) mentioned that using water element in the garden, add new beautiful element to garden design . While, Norman (1980) reported that all fountain jets are effectively used as focal points in water garden design.

According to Keller (1971); Dochinger (1973) plant materials reduce the level of noise to some extent in the town by scattering sound waves. Also, Buskirk _et al_., (1971), Cook and Van Hoverbeke (1971), Lanphear (1971), Mostalerz and Oliver (1974) mentioned that plant materials could be used to modify air temperature through transpiration.

Thus, green area must increase in our life we have to stop the distruction of plant material which are the lung of the town.

VII. CRITICISM STUDIES IN THE GARDENS

1- Screening the unattractive elements in the garden:

Photo (42) shows unattractive element (box of electricity) in the garden , the designer surrounded it by small evergreen Coniferous trees, but the height of these shrubs are not enough to separate this element from other garden components. A little higher trees could be used to conceal this view, tall evergreen trees are the most successful for establishing a permanent wall of vegetation that prevents this view throughout the year. In this regard the designer has to consider the effects of plant material in both short term and long-term lanscape.

Thus, in order to establish an effective vegetative screen the designer must analyze the points through which the viewer overlook the senery.

Photo(41)shows established green area in Tahrir square garden during 1988.

Photo(42) Hedge plantion facing the Citadel wall is a great monumental mistake,the monument constrcution must dominate all other design elements.

Photo(42)shows the bad screening of unattractive element (box of electricity) in the garden.(Gembloux,Belgium)

Photo(43) shows the bad case of Agha-Khan garden before its revegetation.

Photo(44) shows side of the established lawn after its planting (Agha-Khan garden in winter 1987)

P.N. Lawn edging is not complete.

2- Agha-Khan garden in Shoubra:

There is an increasing demand for green areas in our cities. However, except Ismailia, the buildings replaced the green areas and public gardens of the different cities. Also, some of our public gardens were neglected and became in a bad state and need intensive maintenance to return them in better condition. In this respect Agha-Khan gardens which reached a bad state due to negligence, was renewed and the view changed to the better.

Photo (43) shows the previous bad case of Agha-Khan garden before its revegetation. Biles of dust and other residueals were on the lawns which disappeared, some of the trees and shrubs died and others were in their way except some which tolerated the bad conditions.

Photo (44) shows a side of the new established lawn after its maintinance. It clear that the plan to create a lawn without flowering beds included in order to increase the paradox spacious of lawn.

Also the designer edged the lawn by using short annual plants as Viola tricolor L., Tropaeolum majus, and Tagetes patula for garden colouration. The garden became more beautiful and was changed completely after its restablishment.

Photo (45a) shows the other side where number of plam trees in full maturity stage were planted beside the Roystonea regia with its white trunk.

The structure provided the building with an attractive and striking appearance, the tall erect trunk added beauty especially near the Nile side. The plam in such case is not just to offer greening but also to give connection to all surrounding.

The seasonal changing in the colouring of the background will add different colouration due flowering of Poinciana regia Boj trees and will be woody in Winter. The background of South direction of Agha-Khan garden is formed from evergreen trees which surround "Happyland Casino". The designer surrounded the garden by an iron frame and low hedge, this system allows an extention to look through the garden besides its protection. Thus the garden became a part of the general landscape area.

The garden maintenance can not be done only by the plant materials but also with the good looking of the prevailing garden constractions and by keeping them always in

Photo(4 5)Palms in garden create dignity among the other plant material(in Agha-Khan garden)

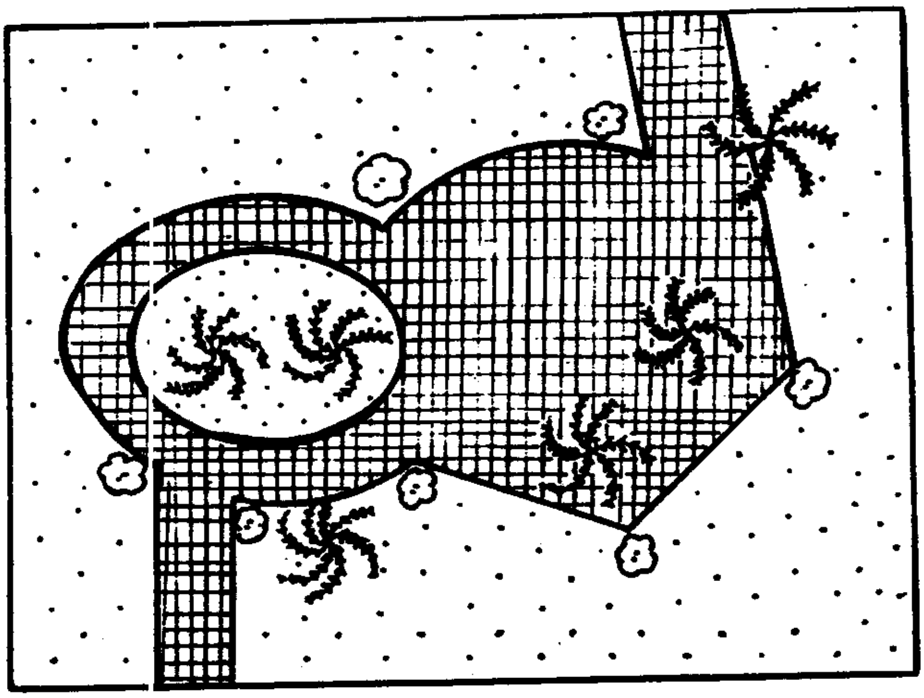
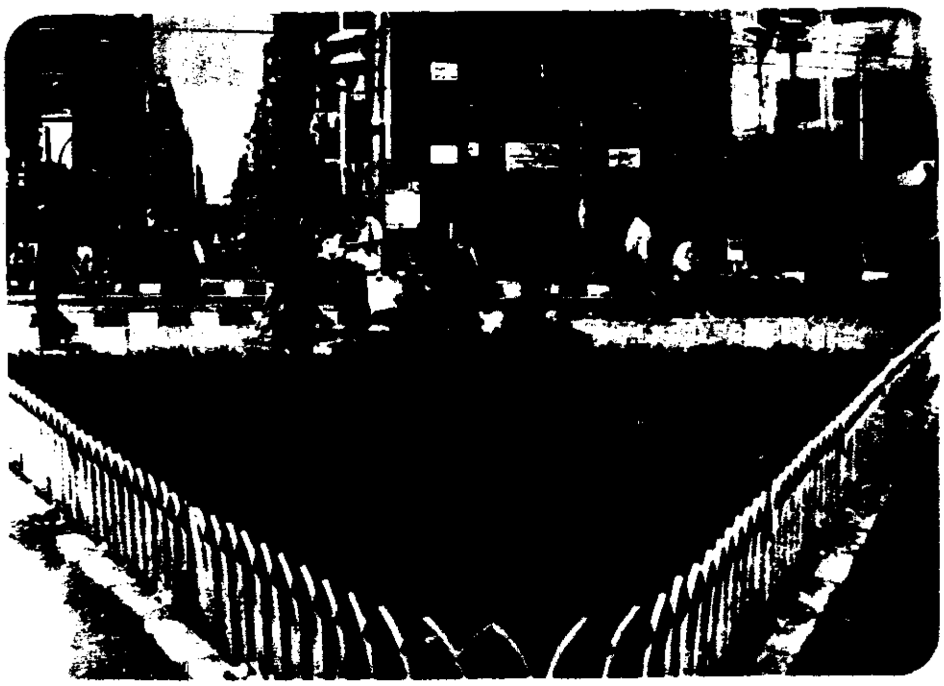


Fig.(11) shows the design of the previous view of palms in Agha-Khan garden.

good condition. As for the Photo (45b), it shows the general view Agha-Khan garden entrance, it consist of a large central arch about (5.5 m.) height, beside two archs, one in every side about (3.80 m.) in height, of course the modern entrance is charmy and it provides a good indication to what included in the garden.

Photo(46) shows poor establishment and primitive design.



Photo(47)shows the same location after redesigning in one triangle lawn surrounded by suitable iron frame.

3- Evaluation of some green area in Cairo streets:

Photo (46) shows a general view to a crossing island of road formed as triangle shaped , the disigner divided this area to three small triangle areas which lead to decrease the paradox size of lawn , such partition may lead to poorer maintenance of these spots which turn to appear as an ungley sight . It is also noticed the sharp edges of the bed corners may cause some troubles for well maintenance, the organization of this spot clearly shows that their is no balance between green area and asphalt paths which reflected on the extention vast of the lawn which seems to be smaller than its real area.

In such cases the desinger must coordinate the shape of the total area with the other canons of design.

Photo (47) shows the same location after correction in one big triangle lawn which created a larger green area. Fig. (12) shows another proposal to similar cases.

Photo (45b) General view to Agha-Khan garden entrance after recreation.

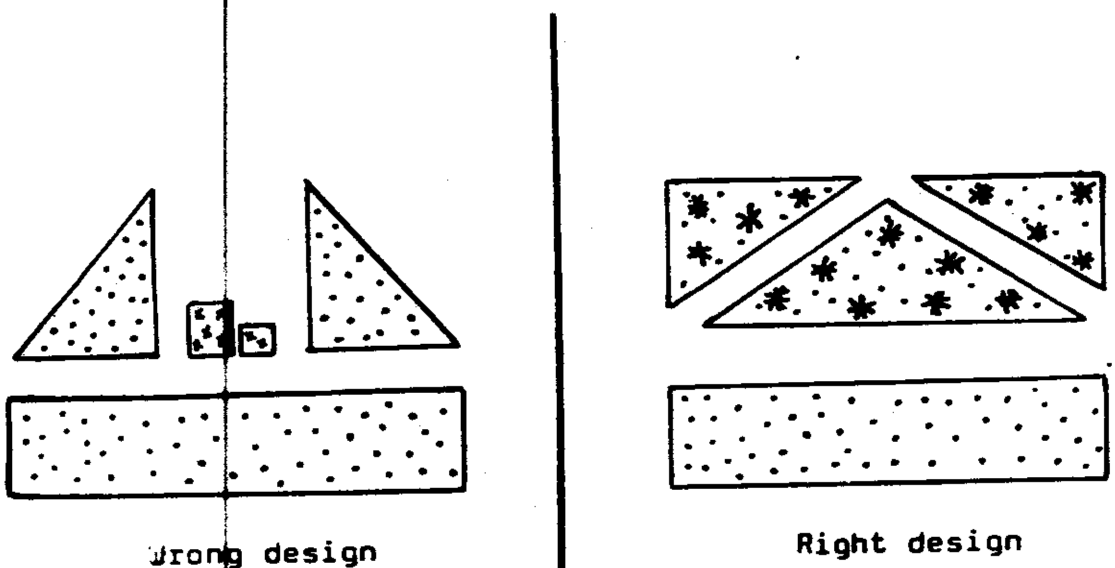


Fig.(12) Crossing island of road should be designed in harmonized shace.

Due to many distructions of many plant materials in the town the green colour decreased.

The lawn plants, could play an effective role in the town decaration as well as the modifying of air temperature and restricting pollution. The good lawns are very desirable in the public squares as well as for the road side.

Moreover, shrubbery borders using Nerium oleander, Hibiscus sp may add much to parks especially in El-Corniche gardens.

Photo (48) shows a general view of one of shading street trees in El-Haram street during October (1987), nodoubt that street trees are valuable natural resource for improving the function and appearance of the urban environment. The usual method of street planting is the double-row system on sides of the street. Trees are planted in the urban environment, under unfavourable conditions to other plants which can not tolerate compact dry soil, and dry, an atmosphere containing gaseous air pollutants.

Photo(48)shows a view of shaded street planted in cubing , in order to recive the necessity water,nutrients and other requirments needed for their natural growth.

Photo(49)shows the view of trunk shade tree surrouned by paving area,it could grow under water stress.

In this concern, some of trees are suitable to urban conditions, Hay (1977) mentioned that, Acer rubrum, Acer saccharum, Quercus rubra, Quercus alba, Pinus strublus, Pinus resinosa are relatively resistant to So_2, O_3 and HF gaseous air pollutions. Kochev and Alexiev (1979) added that the young plants suffered relatively less damage than older ones, also symptoms were less visible in spring and Conifers were less resistant than deciduous species.

Ficus nitida trees can play an important role in pollution tolerance.

Impens and Delcarte (1980) reported that Robinia pseudacacia popules are the most suitable trees which could be grown for ornamenting the streets for urban planting in Brussels. Chylarecki (1986) reported that conifers have generally been little used for urban situations in Poland.

On this ground choosing the proper trees for street ornamentation must be well considered.

Photo (49) shows the view of surrounding shade trees trunks by paving layer, that could lead them to grow under water stress coincided with high temperature specially during summer. These unfavourable conditions lead to loose many young trees. Thus, street trees must be placed between the cubing in order to receive necesary water requirments , nutrients which needed for their natural growth. Hamilton (1978) reported that street trees fertilization by 3 lb dolomitic limestone + 3 lb 10 : 10 : 10 NPK increased shoot growth.

Wagar (1986) suggested that moisture stress during summer become considerably less in trees grown under catchment surfaces due to simulating roofs and pavements and indicating that extra moisture could be stored for landscape trees arid climates.

Generally, town trees and green lawn are the lung of the town. Thus wide boulevards in towns must be planted by four rows of trees in order to reduce the town air pollution.

In this case, it is generally desirable for all of trees to be of the same kind and age, specially those relatively resistant of to town pollution. Also, street trees clean town atmosphere from the dust, Keller (1971) found that 1 acre from beech forest removed 27.6 tons of dust from the atmosphere. While, Dochinger (1973)

Photo(50)shows raised beds of flowers in Bab-El look square in Cairo (Mistakes in both horizontal and vertical constructions also in the level of copping .

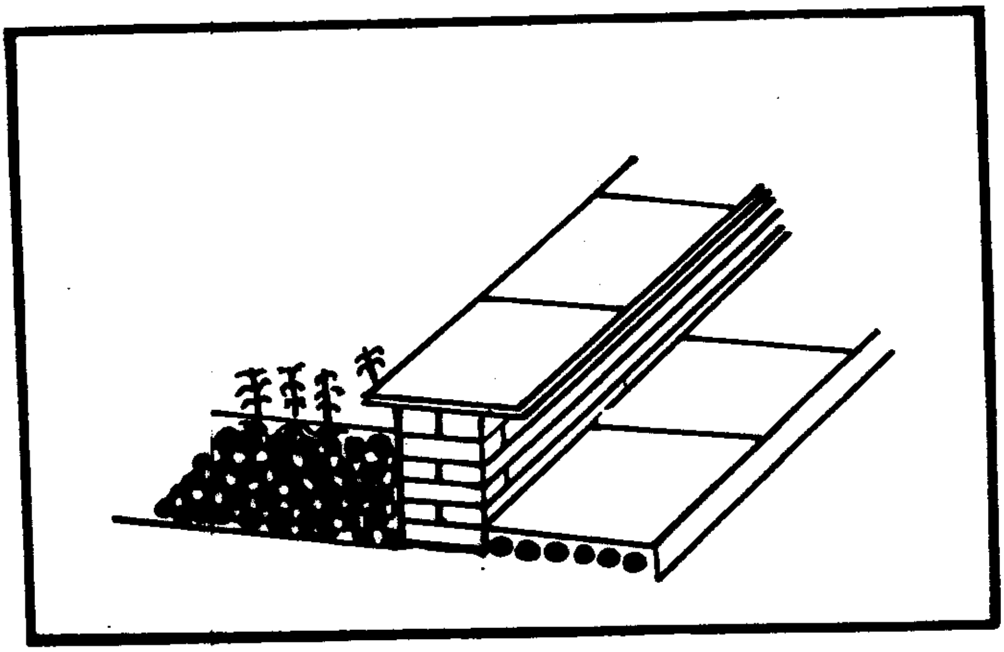


Fig.(13) Right construction on horizontal , vertical anc copping levels of raised bed of flowers.

indicated that Conifers will reduce dust fall by 25% compared to only 8% removed by the hardwood canopy. However, smaller particulates that remain suspended in the atmosphere for long periods, hardwood collected 11% of these particles compared to 18%.

However, using raised beds is a good mean to solve the problem of flower colouration in public square gardens if the size and the plants included are well designed.

As show in Photo (50) the raised beds used in some public squares as in Bab-Ellouk square in Cairo might be recommended to give an agreeable area and a beautiful case.

Generally, it could be concluded that town green area do not only provide feeling of beauty and remined to the greatness of designer , but also act as oxygenator and minimize pollution and heat in town and garden. The actual progress of people in every country is measured by the amount of green area per person.