Experimental Findings on Four O'clock Plant (*Mirabilis Jalapa*)

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Abstract- ***This paper explains the experimental findings on a Four o'clock plants (*Mirabilis jalapa*). The plant was in Texas USA and the flowers were blooming at about 4 pm of Texas standard time. The seeds of it were brought to India and plants were raised from those seeds. The first observation is that the flowers from these plants started blooming at the Indian standard time of 4 pm. The second experimental finding is that when the bud was plucked from the flower at 3 pm, the flower bloomed at 6.30 pm. The third experimental finding was that the blooming pattern was exactly same even on rainy and cloudy days. The fourth experimental finding is that when the whole plant is kept inside the house without exposing to sunlight, then also the flowers bloomed at 4 pm. These results are explained and analyzed. The paper also highlights the scope for further work regarding these experiments.***

Indexed Terms- Adjusting to local time, Flower blooming, sensing elements, Sunlight.

I. INTRODUCTION

Sunflower tracks the Sun with the help of biological clock. [1]- [3]. There are many flowers blooming at specific times. In fact, for each hour there are many flowers blooming.

1.1 Flower clock

Carl Linnaeus [4], a Swedish botanist observed over a number of years that certain plants constantly opened and closed their flowers at particular times of the day and these times varying from species to species. Hence one could deduce the approximate time of day according to which species had opened or closed their flowers. Arranged in sequence of flowering over the day, they constituted a kind of floral clock or horologium florae, as Linnaeus called it in his Philosophia Botanica (1751, pages 274-276).

The exact reason for such an act of flowers is not yet perfectly known, but the blooming flowers follow such timings [5]. There is one big flower called Brahma kamala in India with biological name as Saussurea obvallata, which blooms at late night.

II. EXPERIMENTAL DETAILS

- *Experiment-1*

Checking the blooming times:
The best part is that the plant which was blooming at 4 pm in Texas local time adjusted its blooming time to Indian local time of 4 pm. Repeatedly all plants raised from those seeds adjusted to local time. Most of the flowers bloomed between 4.pm and 4.15 pm. Here, the starting times of blooming are considered. The flower will take about 30 to 45 minutes to bloom fully from starting time. The duration of the last flower to bloom on that day was at 5 pm. So, there is a duration of one hour for all the flowers of that day to start blooming from 4pm to 5 pm. But no flower will start before 4pm and after 5pm. The results are in figure-1.

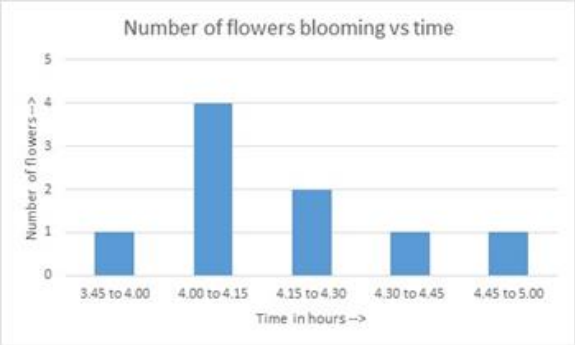

Figure 1 Number of flowers blooming with time

- *Experiment-2- separating the bud from the plant.*

I plucked one of the bud at 3pm, which is one hour before blooming and placed it in little water.

Figure 2 Flower bud separated from plant

It started blooming at 6.45pm. That means about 2 hours and 45 minutes delay compared to normal blooming time.

Figure 3-Flower blooming at 6.45 pm

- *Experimet-3. When there was only diffused light.*

It was a cloudy and rainy day.

Figure 4 Cloudy day

The intensity of sunlight from 10 am in the morning to 5 pm in the evening was almost the same. There was no indication of the exact position of the Sun due to thick cloud. On that day, the flowers started blooming at 4 pm. The first flower started at 3.59 PM, as in figure -5.

Figure 5 Started blooming.

There was no change in pattern of blooming times of flowers. About 70% bloomed flower is shown in figure-5.

Figure 6 Flower at about 4.30 pm

- *Experiment-4- keeping the plant in dark*

Figure 7 Plant kept inside the house.

I kept the whole pot plant inside the house. There was no sunlight even through windows as I had placed thick dark curtains. Again, first flower bloomed at 4pm. No change in overall phenomenon.

Figure 8 Blooming at about 4 pm.

Figure 9. Seed formation.

Seed formation rate was observed as about 80%.

Figure 10 Seeds.

That means, for every 10 flowers bloomed, 8 were resulting in seed formation.

III. DISCUSSIONS

In experiment -1
How the plant was able to sense the local time? Where was the sensing element? This cannot be genetically stored memory inside the seed because it has adjusted to new local time. There must be sensing element in the plant itself. It must be flower, leaf, stem or a combination.

In experiment-2,
To eliminate the flower as the sensing element, I plucked one of the bud at 3pm. Blooming of the flower was at 6:45 pm. This nearly 2 .45 hours delay
The likely reason: It was due to the reason that for blooming of the flower, hydraulic pressure is required. When it is in the plant, the plant will push that required hydraulic pressure at the required time and therefore it was blooming at 4 pm. But since I have plucked it, the required hydraulic pressure was not there. Even though I have kept it in water, pressure was not there. Hence there was a delay in blooming of the flower.

In experiment 3.
The full cloud cover and rain never altered the blooming times of the flowers. So, it is not sensing the direction of the Sunlight, like Sun dial. This will be justified in a better way by the next experimental result.

In experiment 4.
When I kept it inside the house, there was absolutely no possibility of sensing the direction of the Sunlight. Hence we can't assume that the leaf is sensing the Sunlight and accordingly adjusting the flowers bloom.

Possibility-1
We have to assume that as and when the plant was growing, it slowly graduated its circadian clock to the local timer 4 o'clock and so the cycle of the plant is adjusted to that particular time zone [6]. Hence without sensing the time every day, it can bloom at 4 o'clock with its own biological clock.

Possibility-2
Some flowers like what is called as Brahma Kamala in India blooms after Sunset normally after 8pm even at 12 o'clock midnight. It clearly demonstrates that it is not sensing Sunlight every day.

Will it be sensing something else other than the Sunlight every day?
If it is other than sunlight then the only question is that the gravity of the Sun. Gravitational force of the Moon on the surface of the Earth is 2.2 times to that of Sun because Moon is very near to the Earth compared to the Sun. Therefore, when we assume gravity as sensing factor, we have to take the combined gravity effect. The position of the Moon every day will be different at 4 o'clock, but that of the Sun will be almost the same. So, the combined gravity of Sun and Moon will be totally different on each day and there is no chance of plant sensing the gravitational force to fix the biological time. To get the clarity between whether it is stored "as and when the plant was growing" or it will be sensed almost every day, I have suggested further work. For this, the plant itself has to be transported to another country which is having a local time nearly 4 to 5 hours ahead or behind of the present country. As an example, since I did the experiment in India, we can transported to United Kingdom, which is five and half hours behind the Indian local time. There are two possibilities.

1. Very quickly transporting through the flight within few hours to the new country and see how long will it take to adjust it to the local 4 o'clock time of that country, if at all it adjusts.
2. We can gradually move it with help of a boat or ship so that it will take 2 to 3 days to reach the other country are even more. Whenever we reach at 4 pm local time during transportation in the sea each day, we have to see whether the flower blooms there at local 4 pm or not. If it is blooming at local time of 4 pm even when it is being transported, then definitely we can conclude that there is a sensing element and it is sensing 4 pm locally every day and very precisely.

Why it is blooming at that particular time it's 4pm? Experiments can also be conducted to know the exact reason. Butterfly or some such insects which are very much required for pollination, will be very less after 4 pm because maximum time for all these butterflies to fly normally is from 9 am in the morning to nearly 5 pm in the evening.
When the flower completely blooms at 5 pm in the evening and it will stay till next day 1pm in the morning, it will hardly receive the butterflies right from 9 am to 1pm. What exactly is the idea? Flowers blooming at late evening or night and closing early in the morning where pollinating agents like butterfly and other insects are less at night compared to the regular ones during the day.

The seed formation rate was almost 80%. Most of the flowers are becoming seeds. That means it has successfully getting pollinated almost without fail. This is one of the thing that should be further studied by keeping the plant inside the house during one night from the previous day to the next day and see whether it forms a seed or not.

CONCLUSIONS

The plants will adjust to local time with some unknown sensing element or parameter. The objective of blooming at a particular time is to be investigated.

SCOPE FOR FURTHER WORK

The plant along with the pot should be transported to some other country with some 4 to 5 hours of standard time difference and the same type of experiments are to be carried out. The reason for blooming late in the evening is also to be analyzed.

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