THE VARIATIONS IN PLANTS GROWTH WITH RESPECT TO CHANGE IN CONCENTRATION OF DIFFERENT IONS PRESENT IN SOIL

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ABSTRACT

Plants have this amazing ability to grow from its different parts. Some plants do not need to grow from the seeds; they can grow from the stem or leaves. For this study Brahma Kamal *(Saussurea obvallata)* has been taken, which can grow from a very small part of its leaf. Basil *(Ocimum sanctum)* and Lily *(Lilium)* has been grown from small saplings and bulb of lily. This is done for the period of almost four months i.e. from April to July. Each plant is grown in three different pots with different soil combinations with waste obtained from the college science laboratories consisting different ions in different concentrations. It has been found that these three plants have shown the variation in growth with respect to its height, number of leaves, flowering period, soil pH, soil moisture, soil temperature, light intensity.

These soil combinations helped us to know about the specific requirement of the plants to be grown with different variation in their morphology. Root plays a vital role to absorb essential nutrients from soil and provides nourishment to the plants. This work helped to realize the importance of the waste available from the science laboratories.

KEY WORDS: Science laboratory, soil combination, plant growth, nutrients, earthen pots

INTRODUCTION

Brahma Kamal *(Saussurea obvallata)* mainly grows in cold climate. It can grow from its roots as well as leaves. It is a xerophytic plant, also called as Orchid Cactus. Basil *(Ocimum sanctum)* can grow from seeds, has medicinal property. Lily *(Lilium)* can grow from bulb and seeds. As we know roots are very important for the plant growth as Brahma Kamal *(Saussurea obvallata)* is a xerophytic plant can survive in harsh climatic condition. Basil *(Ocimum sanctum)* has tap root or fibrous root depending upon the plant nature that it is monocotyledon or dicotyledon and can not sustain in very harsh climate. Lily *(Lilium)* can store water in the bulbs so even if the climate is not suitable for the growth, it will keep on growing very slowly.

Different combination of soil mixed with solid and liquid waste obtained from chemistry and biology laboratories, has provided essential nutrients for plant growth and helped for their comparative study of growth and to understand the importance of roots for plant growth in extreme conditions. These wastes are obtained when the experiments are over in the laboratory as solid products formed in preparation of chemical reactions, mixture of different liquid solvents which is used in the experiment which can be thrown away in the sink very easily. Along with the waste obtained after the experiments, the chemicals which are expired and are either oxidized or reduced due to exposure with air and moisture will also be used as laboratory waste. These waste contains different ions such as Na^{+}, K^{+}, Fe^{2+}, Mn^{2+}, phosphates, carbonates, sulfates, sulfites, nitrites, nitrates, carbonates, halides, salts of different metals such as copper, zinc, iron, calcium, aluminium and many more. Liquid wastes also consist of aqueous, halogenated and non-halogenated waste consisting of dissolved ions of different salts. Plants require essential ions and minerals for their growth and these ions are easily available in the waste obtained from laboratory. As the science laboratory waste is used, it helped towards the contribution to reduce pollution.

OBJECTIVES

1. To reduce pollution.
2. To know how important the roots are for plants growth and survival.

3. To study plant growth, grown in different combinations of soil with solid and liquid waste obtained from the science laboratory.

LITERATURE REVIEW

The research was done during 2012-13 at the Department of Floriculture and Landscaping, OUAT, Bhubaneswar. Five varieties of Asiatic hybrid lilies *viz*., New Wave (V1), Orange Matrix (V2), Alaska (V3), Nov Cento (V4) and Mount Negro (V5) were taken for the research purpose. Observations were made including various vegetative, floral and bulb characteristics under the local agriculture climatic condition.

Field trials were done using different fertilizers with equal concentration of nutrients. It was used to determine the growth parameters of tomato plant using different fertilizers. Six plots were made using different fertilizers, Chemical fertilizers, Farm Yard Manure (FYM), Vermicompost, Farm Yard Manure mixed with Chemical fertilizers and Vermicompost mixed with Chemical fertilizers. One plot was kept as control without using any of these fertilizers. Observations were made and it has been found that the tomato grown in the plot added with Vermicompost and Chemical fertilizers has shown 73% better yield of fruits than control. Plot with Farm Yard Manure mixed with Chemical fertilizers showed better results with respect to weight of leaves, dry weight of leaves, dry weight of fruits, number of branches and number of fruits per plant.

The experiment was conducted to observe the effects of cadmium (Cd) on biochemical, physiological and cytological parameters of Capsicum annuum L. treated with five different concentrations (20, 40, 60, 80 and 100 ppm) of the metal. It has been observed that shoot–root length, pigment and protein content decreased with increasing Cd concentrations.

This research was also conducted in a similar way by keeping one control for each plant and using different combinations of soil with solid and liquid waste obtained from science laboratory to study their effect on plant growth.

RESEARCH METHODOLOGY

Brahma Kamal *(Saussurea obvallata)*, Basil *(Ocimum sanctum)*, and Lily *(Lilium)* were collected from the garden of the college and planted in three different pots with different soil combinations with solid and liquid waste obtained from science laboratories of college. Three set for each plant was made. Each pots soil was combined with variable amount of liquid and solid waste to make the soil more fertile and one set was grown in normal soil along with these combinations. Brahma Kamal *(Saussurea obvallata)* was planted by using its leaf. Seeds of Basil *(Ocimum sanctum)* were sown in soil. Lilies *(Lilium)* were planted using bulbs of lilies.

All plants were watered at definite intervals of time. Observations of Brahma Kamal *(Saussurea obvallata)* and Lily *(Lilium)* were made after every fifteen day, which includes soil color, soil pH, soil temperature, soil moisture, plant height, number of leaves, flowering period, color of leaves, width of leaves, light intensity absorbed by plants. Observation of Basil *(Ocimum sanctum)* was first done after every fifteen days, later on every seven days.

All combined data was used for the comparative study of each plants growth with respect to change in climate, change in soil pH, types of root present in these plant.

ANALYSIS

Difference in their growth was observed and recorded after seven and fifteen days. Normal soil looked reddish brown in color. Soil combined with solid and liquid laboratory waste appeared brown in color.

As Brahma Kamal *(Saussurea obvallata)* is a xerophytic plant, can retain water in its body and survive in extreme conditions. It showed slow and steady growth in all the three pots (Table 1, Graph 1) at high temperature and started to grow faster since June. Growth in normal soil was fast, but when all three were compared, Brahma Kamal *(Saussurea obvallata)* planted in a soil combined with solid chemical waste showed a difference in leaf width with a broader leaf than the other two (Table 2, Graph 2).

Basil *(Ocimum sanctum)* showed very slow growth in the month of April and withered in the month of May, replanted again in June (Table 3, Graph 3). It showed better results this time.

Lily *(Lilium)* also showed slow and steady growth in summer retaining water in their bulbs to provide the nourishment to the plants for their growth. There was a difference seen with leaves shape and size in all three pots (Table 4, Graph 4). One planted in normal soil has broader leaves. Lily planted in soil combined with liquid waste showed slowest growth among them with shorter and slender leaves. Lily planted in soil combined with solid waste shown longest and more slender leaves. Flowering occurred first in liquid waste soil followed by solid waste soil. No flowers were seen with normal soil.

Soil temperature was measured by 110^0C laboratory thermometer. 3-Way pH meter was used to measure soil pH and soil moisture. Height of the plants were measured by using measuring tape.

Table 1: Comparative study of soil and plant growth parameters for Brahma Kamal

Plant Name	Brahma Kamal in Normal Soil					Brahma Kamal in Normal Soil with Solid Waste					Brahma Kamal in Normal Soil with Liquid Waste				
No. of Days	**Soil pH**	**Soil Temp (°C)**	**Soil Moisture**	**Plant Height (cm)**	**No. of Leaves**	**Soil Ph**	**Soil Temp (°C)**	**Soil Moisture**	**Plant Height (cm)**	**No. of Leaves**	**Soil pH**	**Soil Temp (°C)**	**Soil Moisture**	**Plant Height (cm)**	**No. of Leaves**
Day 1	7.2	28	5	15.5	1	5.9	31	9	9.2	1	7	32	6	14	1ssss
Day	7.1	29	8.8	15.9	1	6.9	29	8.8	9.7	1	7.4	32	6.2	15.4	1

15															
Day 30	7	31	8.8	16.5	2	7.1	30	6.8	10	2	7	32	7.8	15.6	2
Day 45	7.4	29.8	7.8	16.2	2	7.2	26.5	8.8	10.2	2	7.5	27	7	16.6	2
Day 60	7.2	25	8.2	16.3	2	7.3	24.5	6.8	10.3	2	7.1	24.5	8.8	16.6	2
Day 75	7.5	22.5	7.1	16.5	2	7.5	22.5	7.1	10.3	2	7.8	22.5	7.1	16.7	2
Day 90	7.7	23.2	7.7	16.5	2	7.7	23	7.8	11.5	2	7.6	22.8	7.1	16.7	2
Day 105	7.2	23	9	16.5	2	7.6	24	8.2	11.5	2	7.6	22.2	9.2	16.7	2
Day 120	7	22.5	9.5	16.7	2	7	22.2	8	11.6	2	7.1	22.5	9.3	16.8	2

Graph 1: Variation in physical properties of soil and Brahma Kamal Plant

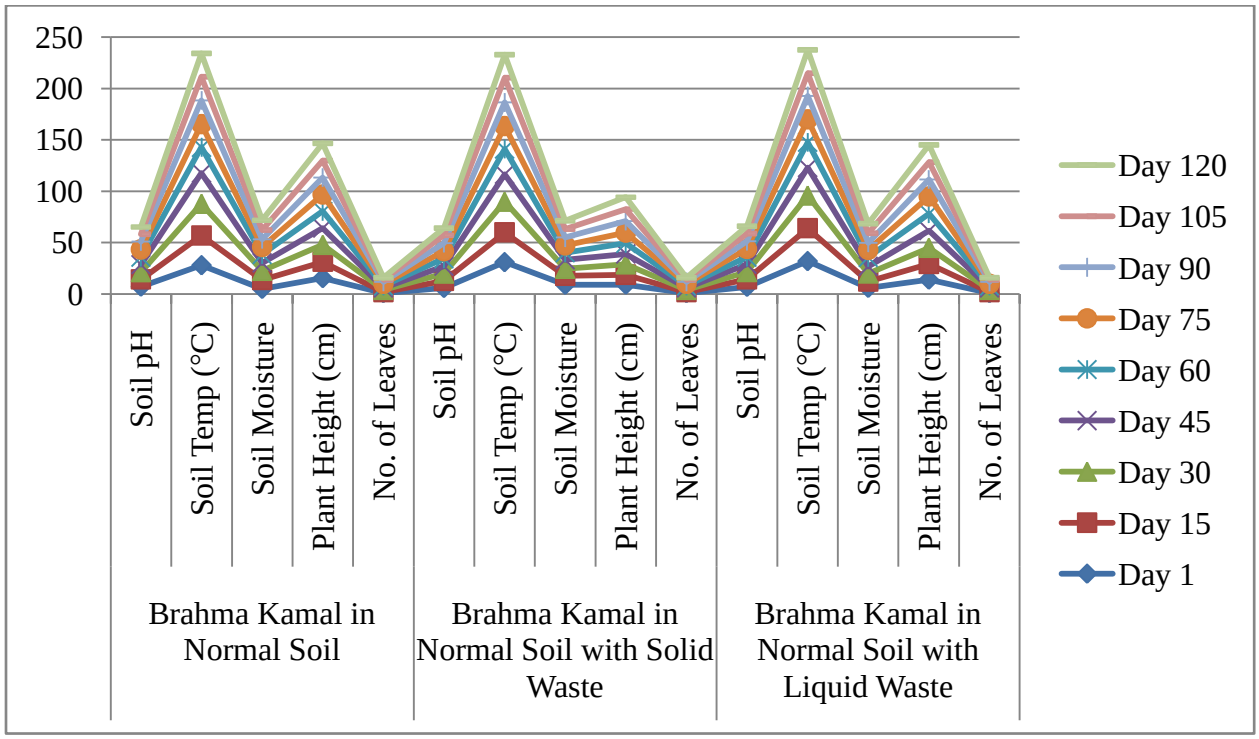


Table 2: Height of Second leaf of Brahma Kamal Plants

Brahma Kamal	Height in Normal Soil	Height in Normal Soil with Solid Waste	Height in Normal Soil with Liquid Waste
Day 30	4.1	7.6	3.9
Day 45	11.2	9.7	7.5
Day 60	15.3	11.3	11.2
Day 75	19	16.5	12.4
Day 90	23	19.4	14.8
Day 105	24.5	22	16
Day 120	25.5	23.2	16.3

Graph 2: Comparison of Second leaf of Brahma Kamal Plants

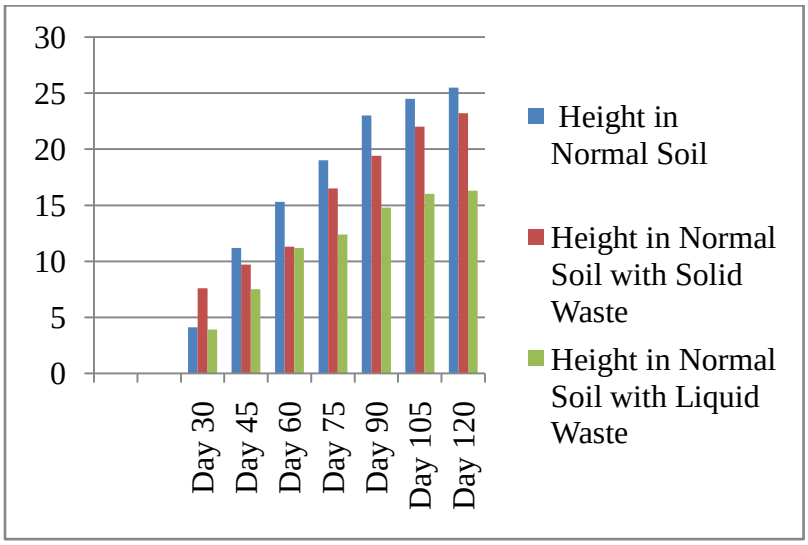


Table 3: Comparative study of soil and plant growth parameters for Basil

Plant Name	Basil in Normal Soil					Basil in Normal Soil with Solid Waste					Basil in Normal Soil with Liquid Waste				
No. of Days	**Soil pH**	**Soil Temp (°C)**	**Soil Moisture**	**Plant Height (cm)**	**No. of Leaves**	**Soil pH**	**Soil Temp (°C)**	**Soil Moisture**	**Plant Height (cm)**	**No. of Leaves**	**Soil pH**	**Soil Temp (°C)**	**Soil Moisture**	**Plant Height (cm)**	**No. of Leaves**
Day 15	6.3	31	8	seeds	0	6.8	33	9.5	seeds	0	5.9	31	9.5	seeds	0
Day 30	6.8	32	8.8	No saplings	0	6.8	30.5	9.5	No saplings	0	6.3	32.5	8.5	No saplings	0

Day 45	7	32.5	8.8	0.2	6	6.9	31	10	0.1	10	7.1	32.5	7.5	0.3	14
Day 60	7	25.5	5.8	0.4	Dried	7.1	31	7.5	0.3	Dried	7.2	31	6	0.5	Dried
Day 74	7.2	26	5.2	3	6	7.1	26	7.8	3.1	7	7.2	25.5	7.9	3.3	6
Day 81	7.8	27	4	3.2	6	8	26.5	6.9	3.2	7	7.8	26.5	7.2	4	9
Day 88	7.8	24.8	5.8	3.8	12	7.6	25	6.3	4.5	11	7.7	24.8	8.2	5	14
Day 95	7	23	8.5	4.5	20	7	23	9	4.8	13	7.1	23	9	8	22

Graph 3: Variation in physical properties of soil and Basil Plant

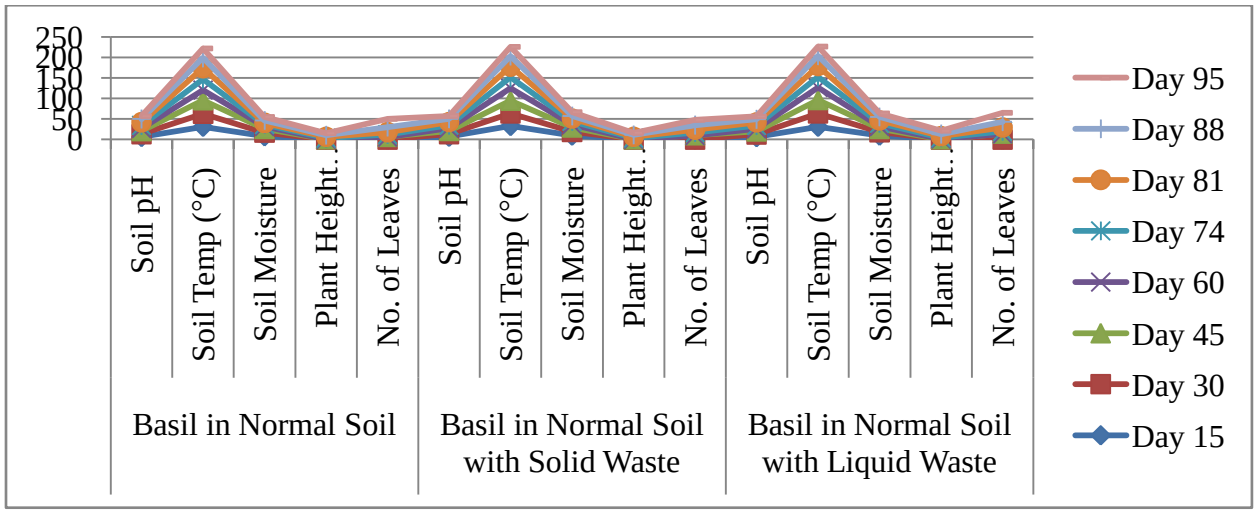
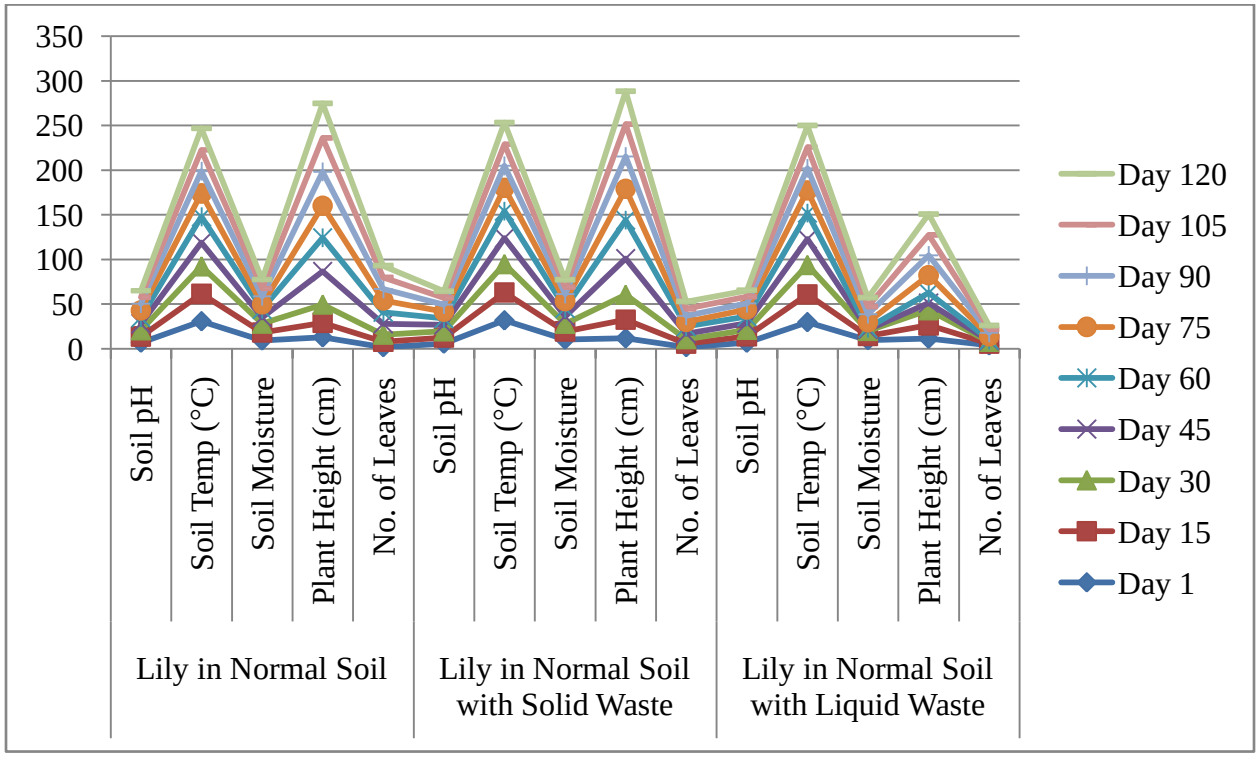


Table 4: Comparative study of soil and plant growth parameters for Lily

Plant Name	Lily in Normal Soil					Lily in Normal Soil with Solid Waste					Lily in Normal Soil with Liquid Waste				
No. of Days	**Soil pH**	**Soil Temp (°C)**	**Soil Moisture**	**Plant Height (cm)**	**No. of Leaves**	**Soil pH**	**Soil Temp (°C)**	**Soil Moisture**	**Plant Height (cm)**	**No. of Leaves**	**Soil pH**	**Soil Temp (°C)**	**Soil Moisture**	**Plant Height (cm)**	**No. of Leaves**
Day 1	7	31	9.5	13	2	5.9	32	10.5	11.9	2	6.9	30	9.9	11.5	4
Day 15	6.9	30.5	9	16.3	6	6.8	31	9.2	20.9	4	7.2	31	4.5	15	2
Day 30	7	31	9.8	20.4	8	7	32	8.5	27.9	5	7.3	33	5.8	16.8	2
Day 45	7.2	26.5	6.8	36.9	12	7.2	29	8.2	40.5	6	7.4	29	1.2	8	1
Day 60	7	29	9.2	38	13	7	30.2	9	43	8	7.5	29	2	11.5	1
Day 75	7.8	26	5.5	35.5	13	7.8	26	8.1	35	5	7.8	25.5	6.2	19.5	4
Day	7.7	24.8	9	38	13	7.8	24.5	7.8	36	7	6.9	24.5	9	22.4	4

90															
Day 105	7.3	24	8.9	38.2	13	7.7	24.5	7.8	36.5	8	7.6	24	8.8	23	4
Day 120	7	24	9.8	38.5	13	7.3	24.2	8.2	36.8	8	6.8	24	9.8	23.2	4

Graph 4: Variation in physical properties of soil and Lily Plant



CONCLUSION

From these experiments we conclude that growth rate of plants varies not only with the type of soil but also with the type of ions required for their growth because the fertility of soil depends on the type of ions/minerals present in it. In the present case the

variation of soil fertility depends on the combination ratio of science laboratory waste, water and normal soil.

LIMITATIONS/SCOPE FOR FUTURE WORK

Though this methodology can be applied to all types of plants but considering the number of tests and analysis to be carried, it is not possible to apply it to all plants at a stretch. Hence we have selected one from each category for the present research purpose. We are trying to analyze the variation in growth rate of plants with variation in the type and combination ratio of soil.

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