

# Growth Response of *Brassica rapa* on the Different Wavelength of Light

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**Abstract**—This study was done to determine what wavelengths of light affects the vegetative growth of *Brassica rapa* grown in pots in urban area. Quasi-experimental method was used in this study. *Brassica rapa* seedlings were exposed to different colors of light (white blue green, yellow and red) eight hours in the evening for two weeks of vegetative growth. The leaf size, number and color of leaves were monitored. Data was analyzed using ANOVA-single factorial. Result of the study revealed that plants exposed to white color gave the highest length, width and average number of leaves after fourteen days, followed by plants in treatment 3 (green light), treatment 2 (blue light), treatment 4 (yellow light), the least in treatment 5 (red light). Base on the result of the study white colored fluorescent bulb is recommended as supplementary lighting to *Brassica rapa* grown in pots in urban areas.

**Index Terms**—*Brassica rapa*, growth response, wavelength of light

## I. INTRODUCTION

Vegetable is one of the main ingredients in Asian dishes, thus vegetable production is an old industry in the region. However, due to tremendous increase in human population, shortage in land to be used for vegetable production posed an alarming phenomenon especially in urban places. Some areas are blessed with enough natural sunlight year-round that growers do not need to supplement with artificial light. However, if one wishes to grow vegetable in pots in urban areas, wherein insufficient sunlight is a problem some artificial source of lights could be used. *Pechay* / *Pak Choi* (*Brassica rapa*) belongs to genus of cabbage. It is also known as one of the oldest green vegetables in Asia. *Brassica rapa*, has been selectively cultivated to produce a plant that has an exceptionally short life cycle (30-45 days). By providing ideal (albeit unnatural) conditions of perfect nutrition and continuous light, one can observe germination, leaf formation, budding, flowering, and seed development in a few weeks rather than a few months [1]. The edible part is its leaves. Its length varies from 10 to 30 cm. [2]. *Pechay* is often used in stews and soups. It isn't tasty by itself, so it needs some salt and other flavor to be added. Meals with *Pechay* (*Brassica rapa*) is often completed with other vegetables and fish or meat. The raw leaves has a nutritional value per 100 grams as follows; Energy 20 kcal/kg; Carbohydrates is 3.2 g., dietary fiber 1.2 g., Fat .2 g., protein 1.2 g., vitamin C 27 mg. and sodium 9 mg. [3]. This study determines what wavelength of light affects the vegetative growth of *pechay*

grown in pots in urban area. In detail it explains that when plants are grown in different wavelengths, the size, number and color of the leaves was affected.

## II. MATERIALS AND METHODS

### A. Materials

This research employed quasi-experimental method using five treatments. Each treatment has 5 potted plants composed of 3 sample plants per pot. Each datum per sample plant where added to 2 data from two sample plants per pot. The average where computed and entered as one data per pot. Plants in all treatments were exposed to sunlight during daytime and to different colored fluorescent lights for eight hours during night time for two weeks. Treatment 1, *pechay* exposed to white colored fluorescent light; treatment 2, *pechay* exposed to blue colored fluorescent light, treatment 3, *pechay* exposed to green colored fluorescent light, treatment 4, *pechay* exposed to yellow colored fluorescent light and treatment 5, *pechay* exposed to red colored fluorescent light. To obtain accurate result, each treatment used 5 pots and 3 samples plants per pot. Three healthy leaves were selected per sample plant to obtain its length and width.

### B. Methods

*Brassica rapa* seeds were germinated following the recommended practice. A day before pricking out the seedlings for transplanting, the seedbed was moistened thoroughly. *Brassicca rapa* were planted in pots after 15 days germination. One pot has 3 sample plants. The average initial length of three sample plants per pot were collected and entered as one datum per pot in the Table. Plants were watered 10 “ml.” for the first 3 days. Additional 5 ml. of water was administered every three days, depending on the response of the plants, but equal amount of water was administered in every plant, using graduated cylinder. To control pests and diseases, the use of contact insecticide available in the market was done. It was sprayed following the prescribed dosage of the manufacturer. During day time plants were exposed to sunlight. When it is already evening improvised partitions made of illustration board was installed. Five pots with 3 samples plants per pot (per treatment) were enclosed using improvised partition walls. Fluorescent light were covered with different coloured cling wraps and were installed 1 foot away from the tallest plant in each treatment. The duration of exposure is eight hours, which means fluorescent lights were switched on at around 10:00 P.M and switch off at around 6:00 AM, the following day.

### C. Data Gathered

The data gathered were collected from 3 sample plants per

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pot and each treatment represents 5 pots. Each datum per sample plant where added to 2 data from two sample plants per pot. The average where computed and entered as one data per pot. Thus, one data per pot was reflected in the Table. These data include the average initial length and width (in “mm.”) of the leaves from the base of the petiole to its apex, final length and width (in mm.) of the leaves, per samples, per pot and per treatment, average leaves formed after fourteen days and the color of the leaves after two weeks of vegetative stage.

### III. RESULTS

#### A. Average Initial Length of *Brassica rapa* Leaves in mm

Table I shows the average initial length, per treatment Plants in Treatment 1 had a mean length of 14.8 mm. Plants in treatment 2 had a mean length of 14.7 mm, plants in treatment 3 with 14.6 mm, treatment 5 with a mean length of 14.2 and the least plants in treatment 4 with 14 mm mean length. Analysis of variance was employed to determine degree of significance. These differences were however, statistically insignificant which means all plant samples were treated equal on the start of the study.

TABLE I: AVERAGE INITIAL LENGTH OF *BRASSICA RAPA* IN MM

	T1	T2	T3	T4	T5
Pot 1	19	14	15	14	16
Pot 2	13	14	14	13	13
Pot 3	14	14.5	12	13	14
Pot 4	16	15	16	17	15
Pot 5	12	16	16	13	13
Total	74	73.5	73	70	71
Mean	14.8	14.7	14.6	14	14.2

#### ANOVA

S.V	S.S	D.F.	M.S	F	P-Value	F crit
Between Groups	2.36	4	0.59	0.18	0.95	2.87
Within Groups	63.6	20	3.18			
Total	65.96	24				

TABLE II: AVERAGE INITIAL WIDTH OF *BRASSICA RAPA* IN MM

	T1	T2	T3	T4	T5
Pot1	14	14	14	12.5	16
Pot 2	15	14	15	14	13
Pot 3	13.5	14	13.5	13	15
Pot 4	15	15	16	15	13
Pot 5	14	13	15	16	13
Total	61.5	60	73.5	70.5	70
Mean	12.3	12	14.7	14.1	14

#### ANOVA

SV	SS	df	MS	F	P-Value	F crit
Between Groups	1.74	4	0.43	0.37	0.83	2.87
Within Groups	23.8	20	1.19			
Total	25.54	24				

#### B. Average Initial Width of *Brassica rapa* Leaves in mm

Table II presents the average initial width of the leaves, per treatment was taken. Plants in Treatment 3 had a mean width

of 14.7 mm. Plants in treatment 4 had a mean width of 14.1 mm, plants in treatment 5 with a mean width of 14. Plants in treatment 1 had a mean width of 12.3 mm. The least, plants in treatment 2 with 12 mm mean width. Analysis of variance was employed to determine degree of significance. These differences were however, statistically insignificant which means all plant samples were treated equal in terms of the width of the leaves, on the start of the study.

TABLE III: AVERAGE FINAL LENGTH OF *BRASSICA RAPA* IN MM

	T1	T2	T3	T4	T5
Plant 1	47	36.5	48	33	35
Plant 2	39	37	42	34	33
Plant 3	42	41	37	37	29
Plant 4	43	40	37.5	42	45
Plant 5	41	36	41	43	29
Total	212	190.5	205.5	189	171
Mean	42.4	38.1	41.1	37.8	34.2

#### ANOVA

S.V	S.S	D.F.	M.S	F	P-Value	F crit
Between Groups	156.3	4	39.09	2.8	0.053	2.87
Within Groups	277.1	20	13.85			
Total	433.4	24				

#### C. Average Final Length of *Brassica rapa* Leaves in mm

Table III expresses the average final length, of the leaves per treatment. It was measured after 14 days from transplanting. *Brassica rapa* were on their vegetative stage. Plants in Treatment 1 had a mean length of 42.4 mm. Plants in treatment 3, 41.1 mm, plants in treatment 2 with a mean length of 38.1 Plants in treatment 4 with 37.8 mm and the least plants in treatment 5 with 34.2 mean length. Analysis of variance was employed to determine degree of significance. These differences were however, statistically insignificant. However if we noticed, plants in treatment 1 (white fluorescent light) gave the highest mean length of the leaves. Fluorescent lighting is used as artificial light in plant growth chambers and extends day length for plants grown in greenhouse conditions. Cool white fluorescent is efficient for most crops. Peas grown in growth rooms, were affected by ethylene which was produced by the ballast chokes present in fluorescent light [4]. Clear light or white light is made up of all of these colors of light, white light is ideal for plant growth. Beans grown under the clear light bulb grew the highest out of the plants compared with the red, blue and yellow light [5]. The wavelength that influences the vegetative growth of the plant is from 400-520 nm. Which is consists of green, violet and blue bands [6].

#### D. Average Final width of *Brassica rapa* Leaves

Table IV shows the average final width of the leaves. Plants in Treatment 1 had a mean width of 35.4 mm. Plants in treatment 3 had a mean width of 32.1 mm, plants in treatment 2 with a mean width of 31.4. Plants in treatment 4 had 30.8 mm mean width. The least was in treatment 5, with 27.6 mm mean width. Analysis of variance was employed to determine degree of significance. These differences were however, statistically insignificant. A study on bean plants can attest to this result. Beans grown under the red light grew significantly smaller in leaf size. Since clear light or white

light is made up of all of these colors of light, white light is ideal for plant growth. It will always have some color that will be absorbed, regardless of the type of plant [7]. Similar finding was obtained on the study about Light quality on Lettuce plant. It showed that blue light inhibited shoot production while red light either had no effect on lettuce plants [8].

TABLE IV: AVERAGE FINAL WIDTH OF *BRASSICA RAPA* IN MM

	T1	T2	T3	T4	T5
Plant 1	34	32	27.5	31	29
Plant 2	36	28	31	29	27.5
Plant 3	29	31	35	27	28
Plant 4	43	35	39	35	29.5
Plant 5	35	31	28	32	24
<b>Total</b>	177	157	160.5	154	138
<b>Mean</b>	35.4	31.4	32.1	30.8	27.6

ANOVA

S.V	S.S	D.F.	M.S	F	P-Value	F crit
Between Groups	115.2	4	28.8	1.6	0.23	3.05
Within Groups	270.5	15	18.03			
Total						

TABLE V: AVERAGE LEAVES FORMED AFTER 14 DAYS

Treatment Number	Average number of Leaves
1	3.6
2	3.4
3	3.5
4	3.3
5	3

#### E. Average Leaves Formed and Color of the Leaves after 14 Days

Table V, presents the average leaves formed after fourteen days. Treatment 1 (white light) had the highest average leaves produced (3.6), followed by treatment 3 (green light) has 3.5 leaves formed, treatment 2 (blue light) 3.3 leaves, treatment 4 (yellow light) has 3.4 and the least plants in treatment 5 (red light) has an average of 3 leaves formed. Colors that don't have a high wavelength have a high level of energy to grow. Thus, plants in white color had the highest tendency to generate more cells in the foliage of beans [9].

After fourteen days of observation, plants in all treatments exhibit healthy color green, except for plants in treatment 5, wherein some leaves appear distorted crunchy and burned. Bean plants expose to red light became brownish in appearance, after 10 days of bean growth. It had spots on the leaves that felt crunchy and dried up. The stem was thin and the plant appeared to droop, almost as though the stem wasn't strong enough to hold it up. Green light is more efficiently transmitted through the plant body and acts as a signal to tissues not directly exposed to the light environment. Therefore, the supplemental green light enhances biomass accumulation in the above-ground part of the plants, and also affects chlorophyll and carotenoid synthesis, thus improving the color of leaves [10].

#### IV. CONCLUSION

Base on the result of the study white colored fluorescent light is recommended as supplementary lighting to *Brassica*

*rapa* grown in pots in urban area. The researcher would like to recommend a follow-up study on increasing the number of hours of plant exposure to different colours of fluorescent light to obtain a significant result. An in-depth study should be conducted exposing greenhouse plants to different colours of fluorescent light and determining its effect not only in vegetative stage of the plant but up to flowering phase as well.

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