

A COMPARATIVE STUDY OF THE GROWTH AND YIELD PERFORMANCE OF CUCUMBER SATIVUS ON EHA-AMUFU SOIL AMENDED WITH FERTILIZER, POULTRY AND GOAT MANURE

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Abstract

This experiment was aimed at comparing the growth and yield performance of Cucumber (*Cucumis sativus*) in Federal College of Education Eha-Amufu, Isi-Uzo Local government Area of Enugu State using the soil amended with fertilizer, poultry and goat manure. The parameters studied include: length of the stem, number of leaves, number of flowers and number of fruits produced respectively. The researcher used meter rule in obtaining the data for this work which if put into considerations will immensely improve the production of cucumber in Eha-Amufu and Isi-Uzo Local Government Area as a whole. The site for the experiment was divided into four rows A,B,C and D respectively with a spacing of 60cm between the sterol. Forty five cucumber seeds were sown on the ridges made and forty 40 out of the 45 seeds germinated. The population under study were 32 stands out forty 40 stands. Eight (8) stands were selected from each nutrient respectively. The row A was amended with fertilizer, row B was attended with poultry manure, rowC with goat manure while D was the control experiment. The result collected from the above data showed that row A which were amended with fertilizer performed best in the experiment. The researcher also advice the cucumber farmers at Eha-Amufu area to use fertilizer to amend the soil because it contains the highest nutrients needed for the plant growth and yield in the area.

Cucumber (*Cucumis sativus*) which belong to the guard family Cucurbitaceae is a creeping vine with its roots in the ground and grows up trellises. The plant has large leaves that form a canopy over the fruits. The fruit of the Cucumber is roughly cylindrical, elongated with tapered end and may be as large as 60cm (24ins) long and 10cm (3.9ins] in diameter. Having an enclosed seed and developing from a flower, botanically speaking; cucumber is classified as accessory fruit. Much like tomatoes and squash they are often perceived, prepared and eaten as vegetables. Cucumber usually contains 9% water and is a typical leguminous crop with bacteria root-nodules. It is both a food crop and cash crop and yield is abundant if properly cared for. Cucumber plant is annual. They have intermediate trailing vines with angled, hairy stems bearing triangular-ovate, and acute three lobed leaves. Most cucumber varieties require pollination. Thousands of lives of honey bees are annually carried to cucumber flowers just before it blooms for this purpose. Cucumber may also be pollinated with bumble bees and several other bee species.

Symptoms of Inadequate Pollination Include: Fruit abortion if not well pollinated. Partially pollinated flowers may develop fruit that are green and develops normally near the stem and, are pale yellow and withered as the blossom ends. Cucumber can be grown successfully in many types of soil.

The preferred soil is loose, well drained and well supplied with organic matter and plant nutrient element (loamy soil). It works well in organic matter such as well rooted manure or compost used before planting.

The performance of any crop in terms of yield is dependent on the availability of essential ingredients like water, oxygen, light intensity, organic and inorganic manure (organic manure composed mainly of waste and residue from plants and animals). They supply organic matter and plant nutrients to the soil and are also important for soil protection and conservation.

An average dry farm yard manure contains about 2% Nitrogen, 1.7% Potassium and 0.4% Phosphorus. In the cultivation and production of cucumber, both organic and inorganic manure can be used. Cucumber thrives best at a relatively high temperature of 65 K. 75° F being the ideal temperature range. The plants do not tolerate a frost and since it is a quick-growing crop, it must be well supplied with moisture and plant nutrients throughout the growing season.

Statement of Problem

In Nigeria today Cucumber is of great importance but farmers are still faced with a lot of problems concerning its production in terms of its yield, improving the quantity and quality of the fruits and its preservation. Some of these problems could be caused by certain factors such as poor climatic conditions in some parts of the country like excessive rainfall and inadequate sunshine, weeds, insects, cucumber beetles, aphids, mites, pickle worms, bacterial wilt, Powdery and downy mildew, angular leaf spot etc. With the application of goat manure, fertilizer and poultry manure, the improvement of the humus content of the soil is achieved. Organic and inorganic manure increases the yield performance of the crop but when in excess causes damage to the crop. Many Nigerian farmers are very poor and cannot afford the purchase of those types of manure for larger production of the crop. Therefore, the problem of this study is to compare the growth and yield performance of cucumber in Eha-Amufu soil amended with fertilizer, poultry or goat manure.

Purpose of the Study

The purpose of this study is to compare the growth and yield performance of cucumber (*Cucumis sativus*) using different types of soil amendments, (goat manure, poultry manure and fertilizer). The objectives therefore include to determine:

- the differences in the growth rate of cucumber (*Cucumis sativus*) using goat manure poultry manure and fertilizer on Eha-Amufu soil.
- the effects of the three forms of soil amendments (goat and poultry manure and fertilizer) on the yield performance of the crop.
- the factors that affect the growth and yield performance of the crop (Cucumber) and to what extent.

Significance of the Study

The findings of this study would be essential to the farmers to reduce some of the problems facing the farmers in cultivation of *Cucumis sativus* in Eha-Amufu. With the knowledge of the best type of soil used in cultivating *Cucumis sativus*. Farmers in Eha-Amufu will now be able to determine the good method of growing this crop (cucumber) bearing in mind that the application of goat manure poultry manure and fertilizer will increase its production or yield performance. There will be adequate weeding and harrowing to ensure proper penetration of water in the farm land. Having adopted all

these methods, there will be high crop yield for the farmers to sell and obtain their income. Its investigation will also benefit others like Government, Traders Civil servants etc if well researched. Government should help an equip farmers on the measure to take in the production of cucumber. Cucumber as a fruit, acts a roughages and aids in the digestion of food substances. Cucumissativus is also rich in number of essential vitamins, including vitamin which is also known as the clotting vitamin.

The investigation of this study will also be beneficial to other researchers as it will provide the need for further researches in other species of plants.

Scope of the Study

The study determines the effects of goat manure, poultry manure fertilizer on the growth and yield performance of cucumber (*Cucumissativus*) in Eha-Amufu soil. The application of these three forms of manure (goat manure, poultry manure and fertilizer) on Eha-Amufu soil will increase the soil fertility and may reduce the acidic nature of the soil thereby improving the growth and yield performance of the crop (*Cucumissativus*).

Research Question

The following research questions were formulated the guide the study.

- i. What are the factors affecting the growth and yield performance of Cucumber using fertilizer?
- ii. How does inadequate supply of organic manure (goat manure) affects the growth and yield performance of Cucumber?
- iii. What are the difference in the growth and yield performance of cucumber using poultry and fertilizer?

Research Hypothesis

The following research hypotheses were formulated and tested at .05 level of confidence

- i. Poor climatic condition have negative effect on cucumber production on Eha-Amufu soil.
- ii. Adequate sunshine favors the yield of cucumissativus.
- iii. Adequate supply of organic manure such as poultry or Goat manure affects the growth and the yield performance of cucumissativus positively.
- iv. There is a significance different in the growth and yield of cucumber using fertilizer and poultry manure.

Literature Reviews

According to Lomy (2010) Cucumber originated from India where many varieties have been observed from *Cucumishystrix*. It believed to have been at least 300 years under cultivation by the Greeks or Romans. Records on cucumber cultivation revealed that it appeared in France in the 19th century, in England in the 14th century, and in North America by the mid-16th century, Marilyn (2010) noted that cucumber originated from India and evidence indicated that it has been cultivated in Western Asia for 3000 years ago. Cucumber spread to Greece, Italy' and later into China. It was probably introduced into order parts of Europe by the Romans. The records of cucumber cultivation appear in France in the 19th century, England in the 14th century and in North Africa by the mid-16th century.

Environmental Requirement

Temperature: According to Blando (2012) cucumbers are warm season plants which should be grown in temperatures ranging from 65°-75°Fahrenheit, ideally not exceeding 90°. The soil temperature must be at least 60° for cucumber seeds to properly germinate. The plant is highly susceptible to injury from the cold, and extended period of temperatures below 55° causing chilling injury which includes symptoms such as decay, water-soaked spots and pitting. Kimberly (2010) explained that even if the plant cucumber is exposed to ideal weather condition and watered approximately and if the soil is poor, the plant will not thrive.

Soil: Defazzio (2014) noted that the soil should be medium textured, neither too light nor sandy soil. Except if irrigation or the proper water requirement is provided, they will dry up during the mid-Summer months. A heavy wet soil, on the diseases problems. Heavy soil also tends to produce later crops. Kimberly (2010) explained that even if the plant cucumber is exposed to ideal weather conditions and watered appropriately, and if the soil is poor, the plan will not thrive.

Sunlight: According to Blando (2012) cucumbers will grow best when planted in full sun. Cucumber plant that do not get enough sunlight are more likely to produce an overall low yield. Therefore, it is best to plant them in areas that get at least 8 hours of direct sunlight each day.

Soil nutrient: According to Defazzio (2014) cucumbers are heavy users of organic materials and produce better when fed with organic fertilizer. He also reported that a balanced fertilizer should be used if the soil is deficient in the necessary elements. This should include a minimum of 5% nitrogen and about 20% of such organic materials as ground-up cotton seed, dried blood, dehydrated manures, bone and fish –meal etc.

The Scientific Classification of Cucumber

According to Marilyn (2010) cucumbers are classified as follows:

Kingdom	-	Plantae
Order	-	Cucurbitales
Family	-	Cucurbitaceae
Genus	-	Cucumis
Species	-	sativus
Binomial name	-	Cucumis sativus

Varieties of Cucumber: According to Kocyan (2011) cucumber varieties are as follows: Slicing, Pickling and Burp less.

Slicing: Cucumbers grown to eat fresh are called slicing cucumbers. They are mainly eaten in the unripe green form, since the ripe yellow form normally becomes bitter and sour.

Pickling: Cucumber can be pickled for flavor and longer shelf life. Although, any cucumber can be pickled, commercial pickles are made from cucumbers specially bred for uniformity of length to diameter ratio and lack of voids in the flesh.

Burpless: Burp less Cucumbers are sweeter and have a thinner skin than other varieties of cucumber and are reported to be easy to digest and to have a pleasant taste. They can grow as long as 2 feet (0.61m), nearly seedless and have a delicate skin.

Nutritional Value: According to Marie (2013) cucumber is packed with a lot of vitamins and minerals. A warm, weather vegetable, cucumbers have a refreshing taste and can be easily added to salads to provide extra nutritional and crunching texture. Cucumbers are low in calories making them

an excellent nutritional choice. The fruits are ideals for health, as they do not contain any cholesterol or fat but are high in fiber content and water. The fiber content in cucumber is essential for helping the body in the digestion of food, and giving the body enough time to absorb essential nutrients. Cucumber is rich in a number of essential vitamins including vitamin K, also known as the clotting vitamin which helps in blood clotting. Cucumbers are also rich in potassium. Potassium helps the body in the conduction of electricity and is essential to smooth muscle movement and regular healthy digestive process. Potassium also helps to regulate the amount of sodium in the blood, helping to keep the sodium level low and thus lowering the risk of developing high blood pressure (BP) and other cardiovascular complications. Also cucumber contains vitamin C which is capable of preventing heart disease, cancer, and other chronic diseases. It is robust in vitamin A, which is essential for good sight and fights off infections Marie (2013). Solanki (2013) reported that cucumbers are low in saturated fat, have no cholesterol and contain very low amount of sodium. They have around 95% of water which is a great way of increasing the fiber, and water intake. There is high content of vitamin A, B6 and C present in the flesh of cucumber.

Economic Importance: According to Payal (2013) the water content of cucumber aids in the functioning of the kidney by promoting urination. Cucumber help in cooling effect and so are used in soothing the eyes. Cucumber also displays diuretic cooling and cleansing effects. These effects are beneficial to the skin. The high water content, vitamin A, B and C and the presence of minerals like magnesium, potassium, manganese and silica made up of cucumbers are essential parts in skin care. He also noted that digestive problems like heartburn, acidity and even ulcers can be cured by the daily consumption of fresh cucumbers juice. These benefits of cucumber are available due to its dietary fibers which drive always the toxins from the digestive system and hence promote the digestive processes. Daily consumption of cucumber can be regarded as a remedy for constipation. Payal also observed that a lesser known, but much effective benefits of cucumber is attributed to its seeds. Cucumber seeds are considered as natural remedies for the elimination of tape worms from the intestinal track. Another lesser known benefit is show in its healing attribute in relation to the disease of the urinary bladder and the kidney. The water content of cucumbers aids in the functions of the kidney by promoting urination. In fact, cucumber is the best natural diuretic because of its water content.

The fiber in the cucumber peels help in digestion and cleaning of the bowels. Due to the presence of vitamin K, cucumber increases bone strength by boosting bone mass building activity. It is a natural diuretic that flushes out the waste and toxins from the body, thus keeping it healthy. Cucumber is also great for the skin as it helps in reducing the swelling and skin irritation it reduce under eye puffiness, heals sun burns, and relaxes the skin. It can be consumed fresh added to salads or made into juices. In India, Dosakai which is a variant of cucumber, is widely used in curries and stews.

Research Design

The research design used for this study was experimental research design.

Materials and Method

Preparation of Site and Planting

The site for the experiment was cleared on 28th July, 2017 using cutlass and rake. The small portion of the land used for the experiment was prepared by tilling it with hoe. After the land has been cleared, it

was left for 5-7 days before cultivation to allow the grasses to dry. Eight (8) ridges were made on 2nd August 2017. The ridges were labeled differently thus-Ridges A , Ridges B ,Ridges C and Ridges D respectively. The experimental ridges were labeled A for fertilizer, B for poultry manure, C for goat manure and D for ordinary soil (control).

Manure Application

The ridges labelled A were amended with fertilizer (NPK), ridges B were supplied with poultry manure while ridges C were treated with goat manure and ridges D which was the control was without soil amendment.

Population for the Study

In this experiment, 45 cucumber seeds were sown on the ridges made, 38 out of the 45 seeds germinated. The population under study was 32 stands out of the 38 Eight (8) stands were selected from each nutrient respectively.

Weeding

Weeding was done with small hoe and cutlass to keep the site free from weeds. And to prevent those pests that could be inhabited by the weeds. The first weeding was carried out on 12th of August, 2017 while the second one was done on 18th September, 2017.

Experimental Procedure

The procedures focused on the measurement of the length of the stem, width of the leaves, 'number of the leaves, tendrils flowers had fruits. Thus the parameters were also taken three weeks after germination each as length of the stem, width of the leaves, number of the leaves, and tendrils. After four weeks of germination, the number of flowers produced were taken. The material used for the measurement was meter rule, and the site was visited at the appropriate times to ensure proper recording of the plants and to check whether there is any pest and disease attack noticed on the plants. Also watering of the plants was done a week after germination since the amount of rainfall was inadequate. The watering of the plant lasted for eight (8) days before it began to rain again. The plant (cucumber) started growing and spreading out its leaves, and tendrils. The stand from fertilizer, poultry, goat manure and control ridges produced flower which later gave rise to the, Fruit the flowers later fell off as the fruits were developing. The plant produced many 'flowers but not all the flowers bear fruits. This may be as a result of the change in climatic condition and the plant (cucumber) has the ability of shedding off some of its flower when in excess (Kocyan, 2011). This enable the plant to have enough nutrients to its proper growth and high yield.

Among all the ridges used for this experiment, the ridge for fertilizer produced more flowers and so have more fruits followed the one amended with poultry manure, goat manure and finally the control (ridge without any soil amendment). This showed that the best nutrient for growing cucumber in Eha-Amufu soil is fertilizer. This was as a result of its high nitrogenous contents which helped in improving the nutrient level of Eha-Amufu soil.

Secondly, fertilizer easily gets dissolved even when there is 'little rainfall and this feature gave it the advantage of being the best source of nutrient for growing cucumber.

Method of Data Collection

Observations and recordings were done using 'eight (8) stand of cucumber plants on each of the different ridges containing different nutrient, that is, eight stands from fertilizer (ridge A) eight (8) stands from poultry manure (ridge B), eight (8) stands from goat manure (ridge C) and eight (8) stands from control soil without any amendment (ridge D) and subjected to the followed measurement.

- **Leaves of the Plants:** The number of the leaves of the plant (cucumber) were determined by simply counting. The width of the leaves were also measured using meter rule.
- **Length of Stem:** This length of the stem of cucumber plant were also measured using meter rules and values obtained were recorded in centimeters.
- **Flowers:** The number of flowers produced by the cucumber plant were determined by simple counting and the cucumber fruits produced were counted too.

The data collected were used to compare the growth and yield performance of cucumber plants in the eight (8) ridges with different nutrients, fertilizer, poultry, goat manure and control experiment which is clay/loamy soil.

Limitation of the Study

Pest, Disease and Control

The following are different pests that attacked the cucumber while in the farm:

- Striped cucumber beetle
- Bounded cucumber beetle
- Spotted cucumber beetle
- Aphids
- Snails and Slug

After fifty days of germination, it was observed that the fruits began to rot and this was caused by fungus, bacteria and insect attacks. The fungus: *Rhizoctonia Solani* caused belly rot (fruit rot) and the disease was favored by warm, humid condition.

The symptoms noticed include: Yellow/brown discoloration on fruit, water soaked spots on the side the fruits in contact with the soil, brown mold growing on rotting areas. Its control measure include tilling soil deeply prior to planting and using plastic mulching to create a barrier between the fruits and the soil; application of appropriate protective fungicides when plants begin to vine.

The bacteria causes the fruit to be soft (rot). Some of the symptoms include distinct water-soaked appearance and pronounced softening of the surrounding tissue. As the decay progresses, the fruit tissue become extremely soft and often collapses, losing its original form and quality. The disease can be controlled by avoiding bruising and injury on the fruits.

Data Presentation and Analysis

The data collected from the field were analyzed using frequency and mean methods

The following are the vegetative parameters used in the data presentation and analysis.

- Length of the stem
- Number of leaves
- Width of the leaves
- Number of flowers
- Number of fruits produced

Eight stand of cucumber were selected at randomly from each nutrient (ridge) for the experiment

Table 1: The Length of the Stem of Cucumber after Three Weeks of Germination

Seed	1	2	3	4	5	6	7	8	Total	Average
Nutrients										
Fertilizer N.PK	20cm	13.2cm	14cm	13.5cm	8.5cm	16cm	17,cm	18cm	120.2cm	15.0cm
Poultry manure	14cm	16cm	15.5cm	16cm	9.5cm	9.5cm	18cm	11cm	109.4cm	13.7cm
Goat manure	15cm	13cm	8.5cm	7.6cm	10.2cm	9.4cm	17cm	15cm	95.7cm	12.0cm
Control	12cm	6cm	13cm	11cm	12cm	6cm	16cm	15cm	91cm	11.4cm

From the table above, it showed that cucumber plant grown on the soil emended with fertilizer produced the highest height (length of the stem) of 120.2cm when compared with the height of cucumber plant grown on the soil amended with poultry manure with the height of 109.4cm and goat manure 95.7cm. the control experiment, that is cucumber grown on soil not amended with any soil nutrient showed the least growth in length of the stem of 91cm.

Table 2: The Number of Leaves of Cucumber after Three Week of Germination

Seed	1	2	3	4	5	6	7	8	Total	Average
Nutrients										
Fertilizer N.PK	6	3	4	4	3	5	5	5	35	4.4
Poultry manure	4	5	5	5	3	2	5	4	33	4.1
Goat manure	4	3	3	2	4	3	5	4	28	3.5
Control	3	2	3	3	4	2	5	4	26	3.2

In table II, the soil amended with fertilizer had the highest number of leaves than that of the soil emended with poultry and goat manure respectively. The control experiment had the least performance in terms of the number of the leaves because no nutrient was applied on it.

Table 3: The Width of the Leaves of Cucumber after Three Weeks of Germination

Seed	1	2	3	4	5	6	7	8	Total	Average
Nutrients										
Fertilizer N.PK	17.2cm	11.3cm	12.3cm	13cm	17.5cm	16,5cm	8.8cm	18cm	114.6cm	14.cm
Poultry manure	14.5cm	12.5cm	16.5cm	15.4cm	10.2cm	12.2cm	11.9cm	8cm	100.3cm	12.5cm
Goat manure	10.4cm	7.3cm	13.2cm	11.9cm	11cm	9cm	13.3cm	13.3cm	89.4cm	11.2cm
Control	11.7cm	12.3cm	7cm	10cm	8cm	10cm	9.2cm	11cm	79.2cm	9.9cm

From tables 3, the control experiment had the lowest width of 79.2cm where as the soil amended with fertilizer had the highest width of 114.6cm followed by the soil amended with poultry manure 100.3cm and the soil amended with goat manure which had the width of 89.4cm.

Table 4: The Number of Flower Produced after Four Weeks of Germination

Seed	1	2	3	4	5	6	7	8	Total	Average
Nutrients										
Fertilizer N.P.K	5	4	3	4	3	5	6	6	36	4.5
Poultry manure	3	4	3	5	2	2	6	3	28	3.5
Goat manure	4	3	2	2	3	2	5	3	24	3
Control	2	1	3	2	2	0	4	3	17	2.1

This table above indicated that cucumber grown on soil amended with fertilizer produce the highest number of flower 36 when compared with cucumber grown on soil amended with poultry manure 28 and goat manure 24. The least was the cucumber grown on soil with no nutrient which had the total number of flower 17.

Table 5: The Number of Fruit of Cucumber Produced after Six Weeks of Germination

Seed	1	2	3	4	5	6	7	8	Total	Average
Nutrients										
Fertilizer N.P.K	6	4	3	4	3	6	4	2	32	4.00
Poultry manure	3	2	1	4	2	3	1	2	18	2.25
Goat manure	2	1	3	2	1	0	2	3	14	1.75
Control	0	1	3	0	2	1	2	2	11	1.37

The table above indicated that the cucumber grown on soil amended with fertilizer produced the highest number of fruits 32 when compared with that grown the soil amended with poultry manure which had 18 fruits and goat manure which had 14 fruits. The least was the cucumber grown on soil with no amendment which had 11 number in fruits. The result obtained from the investigation showed that fertilizer did best in the production of dark greenish leaves, length of the stem, number of leaves, width of the leaves, number of the tendrils, number of flowers and fruit production. Therefore, fertilizer provides reasonable output in fruit production and also is essential for the growth and developmental processes.

Discussion

From the data obtained and analysis of the result made it was observed there is significance differences in terms of the growth and yield perform once between the cucumber grown on the soil amended with fertilizer, poultry, goat manure and the one without amendment (control). Fertilizer provided the best condition for the growth and yield performance of cucumber. It did not only provide the best nutrient, but also produced the greatest number of fruits thirty two (32). There was a significant

difference between the growth and yield performance of cucumber grown on soil amended with poultry manure with total number of eighteen (18) fruits and goat manure with fourteen (14) number of fruits and that of the cucumber grown on the soil amended with fertilizer with total number of thirty two (32) fruits. Also table I and II indicated that cucumber grown in the soil amended with fertilizer showed more elongation of stem, and increased number of leaves in the plant. The plants treated with fertilizer provided dark green coloured leaves with a broad length of the stem.

Conclusion

In conclusion, the result showed that cucumber does not perform very well with high yield on Eha-Amufu soil treated with poultry or goat manure as in the soil treated with fertilizer (N.P.K). The researcher therefore suggested that cucumber farmers in Eha-Amufu should make use of inorganic manure especially the N.P.K. in the farming of cucumber to boost the growth and yield performance of the crop.

Recommendation

The effect of different organic manure like farmyard, compost manure and inorganic manure like urea in growing of cucumber in Eha-Amufu soil should also be investigated.

Cultivation of cucumber using different chemicals like fungicides, insecticides and herbicides to improve the growth of the crop should be encouraged.

References

- Blandon M.J. and Kimberly, A.U. (2012). Climatic Condition: University of California Agriculture and Natural resources: Cucumber Production in California.
- Defazio, S.D, Benneth, J.I, and Faith, WL (2014): Uta State University Co-operation extension: Cucumber: N.C. State University, Co-operation extension: Vegetable Pollination.
- Doijode, S.D. (2012). *Seed storage of horticultural crop city of publication* Haworth Press, ISBN I-56022-901-2P.281.
- Doolittle, S.P (2011). The Mosaic disease of Cucubits. United State, Department of Agriculture *Bulletin* 879,69pp.
- Gallitelli D. (2012). The Ecology of cucumber Mosaic virus and sustainable agriculture, *virus Research* 71:9-21.
- Marie (2013). Comparative study on Nutritional composition of three cucumber varieties. *Pakistan Journal of Nutritional* 19 905-908.
- Marilyn N.U. and LomyP.D. (2010). Origin of Cucumber: Rejasthan Agricultural University, Bikaner. Under Teraizone of West Benyal. *Indian Journal of Horticulture* 65 (3): 353-355.

- Payal (2013). Cucumis Sativus fruit-potential anti oxidant anti-hyaluronidase, and antiel a state agent. *Arch Dermatol Res.* 303 (4): 247-252.
- Renner, S.S; Schaefer, H. Kocyan, A. (2011). "Phylogenetics of cucumis (Cucubitaceae): cucumber (C. Sativus) belongs in an Assian/Australian clade far from melon (C. Melo) BMC. *Evolutionary Biology* 7:58 doi. 10.1186/1471-2148-7-58. PMC 3225884.PMID 17425784.
- Solanki (2013). Cucurbitacin: Ancient compound shadding new light on cancer treatment. *Scientific World Journal.* 10:413-418