



A REVIEW ON THE BENEFITS, TECHNIQUES, CONSTRAINTS AND SOLUTIONS TO CUCUMBER PRODUCTION IN SOUTHEASTERN NIGERIA

OKPANI, F.M.¹, ORJI, K.O.^{2*} AND UMEKWE, P.N.¹

¹Department of Horticulture and Landscape Technology, Akanu Ibiam Federal Polytechnic, Unwana-Afikpo, Ebonyi state, Nigeria

²Department of Agronomy, Michael Okpara University of Agriculture, Umudike, Abia state, Nigeria

ABSTRACT

Cucumber [*Cucumis sativus* (L.)] is a fruit crop that is of the family, Cucurbitaceae together with watermelon, sweet melon, fluted pumpkin, broadleaf pumpkin, muskmelon, summer squash and gourds. It is a vine crop that originated from India and is cultivated worldwide today. It is a trailing, annual herbaceous crop that possesses extensive adventitious roots and four –angled stems with hairy, un-branched tendrils. Cucumber is one of the main in-between meals of the southeastern Nigeria as it is being incorporated in their cropping systems by many farmers. The medicinal importance of cucumber ranges from having diuretic effect, reduction of constipation and hypertension through hydration properties. Cucumber is a short duration crop that matures between 8 and 12 weeks after cultivation depending on the variety. It requires an annual rainfall of about 1500 – 2000 mm and temperature that ranges between 20 and 25 °C to thrive with sandy loam having a pH range between 5.5 and 6.7. [34; 35]. It can also be grown with irrigation during dry season and in areas with low annual rainfall. It can also be cultivated and produced in the greenhouses. Production of cucumber in southeastern Nigeria is faced with several challenges such as pests and diseases, poor funding, poor enlightenment, and poor storage facilities. So, in view of the above identified setbacks, the following have been given as panacea to these setbacks which include accessibility to credit facilities, organizing seminars and workshops, provision of adult education and high-quality seeds.

Keywords: Benefits, cucumber, production, problems and panacea.

Correspondence: orji.kalu@mouau.edu.ng, 07065223591

INTRODUCTION

Cucumber (*Cucumis sativus* L.) belongs to the family of crop plants called Cucurbitaceae and is thought to be one of the oldest vegetables that has been cultivated by man for over 3000 years [1, 2]. It is believed to have originated from India. The crop spread from India to other parts of the world, but precisely in 1940's, it was introduced into West Africa by the Europeans [3]. Today, cucumber is cultivated in many parts of West Africa including Nigeria. Cucumber is cultivated in commercial quantity in various parts of Nigeria and is also largely consumed in various parts of the country and relished across various ethnic groups.

Cucumber is a climbing annual herb with an extensive, shallow root system. Stems are four –angled and hairy with un-branched tendrils. The leaves are triangular, oval, 7-20 cm in length and have sharply pointed tips. The flowers are yellow, 3-4 cm in diameter with male flowers predominating. The female flowers are usually single and are borne on short, thick pedicels. The pendulous fruits are variable in shape and size. The flesh is pale green and many white seeds are produced by each fruit.

Nutritionally, cucumber is a rich source of vitamins and minerals [4]. Cucumber forms an important ingredient in salads and can also be sliced into stew in tropical regions. Fruits are also eaten alone or

served with groundnut or other vegetables. Cucumber regular consumption helps in the burning of excess fat in the body thereby keeping man in shape and healthy too due to the low-calorie content of cucumber. The nutritional value of cucumber fruit per 100 g of edible cucumber is shown in Table 1 below.

Medicinally, cucumber is well known for its diuretic effect and thus can serve as an active drug for secreting and promoting flow of urine. [5] reported that cucumber can be very useful to those with either high or low blood pressure due to its high content of potassium (50-80 mg/100 g). Additionally, the juice of cucumber is good for the treatment of gastric, hyperacidity and duodenal ulcers [6]. Young and unripe cucumber fruits are usually used as cooked vegetable made into Chutney [7]. Cucumber is also good for those who suffer constipation.

Interestingly, cucumbers can be processed into beauty products like facial cleanser, facial scrub, among others. They can also be processed into fresh products like pickles, kimchi or as beverages like juice [8]. Cucumber production is a very lucrative business since it reaches maturity stage rapidly.

Table 1: Nutritional value of cucumber fruit/100 g of edible cucumber

Energy	12 calories
Protein	0.6 g
Fat	0.1 g
Carbohydrate	2.2-3.6 g
Dietary fiber	0.5 g
Calcium	14 mg
Magnesium	15 mg
Potassium	124 mg
Phosphorus	24 mg
Vitamin A	45 IU
Vitamin B1	0.03 g
Vitamin B2	0.02 g
Niacin (vitamin B3)	0.3 g
Vitamin C	12 mg
Iron	0.3 mg
Sodium	5 mg
Zinc	0.2 mg

Source: (USDA, National Nutrient Data Base, 2014).

PRODUCTION/AGRONOMY

Cucumber is adapted to warm climates, but will grow at lower temperatures than melons. The optimum temperature range is from 20 - 25°C. Water requirement is high, but high humidity encourages the development of leaf diseases and may affect flower production. Soils should be well drained with a high organic content. Sandy loams with a pH of 5.5-6.7 are generally suitable for early -maturing crops. Elevations of up to 1200 m are suitable for most cultivars [9]. A high light intensity increases the production of the number of male flowers whereas a lower light level encourages the formation of more female flowers [10]. Shading is sometimes beneficial and can protect crops from damage by high winds. Each species of vegetables has specialized environmental requirements which must be met for good growth and production. Optimum day and night temperatures are 30°C and 18-21°C, respectively. In addition, soil temperature, fertility and moisture must be adequate. Intemperate countries, it is grown in green houses and only during hot summers can it be grown in the open.

Cucumber could be propagated through direct seeding or transplanting after nursery operations. Transplanting is best done when the ground is still wet enough to support the seedlings after transplant. [11] reported that cucumber can be grown as monocrops or as intercrops with other arable crops or citrus seedlings, *Carica papaya*, etc. In intercropping cucumber with other crops like pawpaw, it is important to introduce the cucumber before the time of flowering for better nutrient use efficiency and delayed introduction reduces vigour [12, 13].

Staking is very necessary on the field in order to improve yield. Staked cucumber crops performed better than non-staked ones [14]. Intra-row spacing of 50 cm-100 cm is recommended [15]. Pruning is also needed as it helps to increase light penetration in the farm and reduce build-up of pests and diseases. A spacing of 50 cm x 50 cm is recommended for cucumber cultivation in Nigeria. With pruning, a yield of 571.87 kg/ha was obtained while no pruning produced a yield of 301 kg/ha as spacing of 50 cm x 50 cm gave yield of 581.59 kg/ha. A planting distance of 50 cm x 100 cm produced a yield of 291.78 kg/ha while 100 cm x 100 cm spacing gave 437.04 kg/ha [16].

Pest and Disease Management

Pests and diseases which affect cucumber production in Nigeria include Cucumber mosaic virus and Downy mildew [17]. The variety and type of agrochemical used has strong influence on the reduction of insect pest infestation and severity [18]. Control measures include manual weeding, chemical and physical control measures. These include farm hygiene, manual eradication (depending on farm size) and use of agrochemicals such as ethion and imidacloprid. Weeding can be done 2-3 times before harvest. Inadequate weeding frequency reduces yield significantly [19]. It can also serve as weed control if planted as an intercrop. On the other hand, intercropping of cucumber with Turmeric and Ginger can suppress Cucumber Mosaic Virus [20], while pendejera, turkey berry, devil's fig, pea eggplant, platebrush or susumber (*Solanum torvum*) and tree marigold, Mexican tounesol, Mexican sunflower, Japanese sunflower or Nitobe chrysanthemum (*Tithonia diversifolia*) can suppress nematodes in cucumber production [21]. Bush tea (*Hyptis suaveolens*) and centro or butterfly pea (*Centrosema pubescens*) extracts can also be used for control of cucumber beetles [22].

Irrigation

Supplemental irrigation may be needed from time to time depending on available soil moisture. Twenty percent water deficit is recommended for cucumber production [23]. Under greenhouse condition, 12.9 L of water is adequate [24]. In most cases, production of cucumber is under rain-fed condition. Different methods used for irrigating cucumber in Nigeria include sprinkler and drip irrigation. Others are use of watering can for small scale production. Irrigation during flowering needs to be done with caution to avoid flower abortion. Irrigation in small scale cucumber farming is recommended in the early hours of the day or evening time to avoid high loss of moisture due to evapo-transpiration.

Mulching

Haruna *et al.* [25] stated that mulching is also an excellent practice for the conservation of soil water. The main objectives of mulching are weed control; conservation of soil moisture, reduction of insect and disease problems and modification of soil temperature [26]. Mulching is a non-chemical weed control crop production technique which is effective alternatives to herbicides [27]. Mulch decrease irrigation requirements of cucumber plants compared to without plastic mulch [28]. High yield can be achieved altering micro climatic conditions, such as by using black polyethene mulch in early season production as it increases surface soil temperature whereas silver black mulch is more appropriate for hot weather planting and production as it lowers surface soil temperature [29].

CONSTRAINTS TO CUCUMBER PRODUCTION IN SOUTHEASTERN NIGERIA

Cucumber production in Southeastern Nigeria is constrained by a lot of factors. In the course of reviewing this work, five major factors militating against cucumber production in Southeastern Nigeria were identified as follows:

Storage problem

The major constraint to the production of cucumber within the Southeastern Nigeria is storage problem. Cucumber like every other vegetable is highly perishable in nature due to its much water content that favours agents of spoilage and this makes long term storage very difficult. Usually, cucumber fruit is enjoyed when it is still fresh and dark green, once it turns pale green or yellow, there is normally a slump in the price thereby resulting in market glut. [30] noted that adequate storage of agricultural commodities has a very important role to play in enhancing the shelf life of the produce and thus offer the commodity for sale in a phased manner to avoid unnecessary market glut and concomitant price slump.

High cost of improved seeds

High cost of improved cucumber seeds is another important constraint to cucumber production in southeastern Nigeria. Farmers in the agro-ecology depend so much on their own recycled seeds which are less resistant to pests and diseases attack, respond less to fertilizer application and generally do not give high yields. Moreover, the improved seeds of cucumber are costly when compared to other crops' seeds, due to importation costs. Consequently, an average farmer may not afford the improved seeds for planting due to its cost. Currently, for instance, an improved 50g cucumber seed is sold at #9, 500 (\$26.51).

Inadequate capital

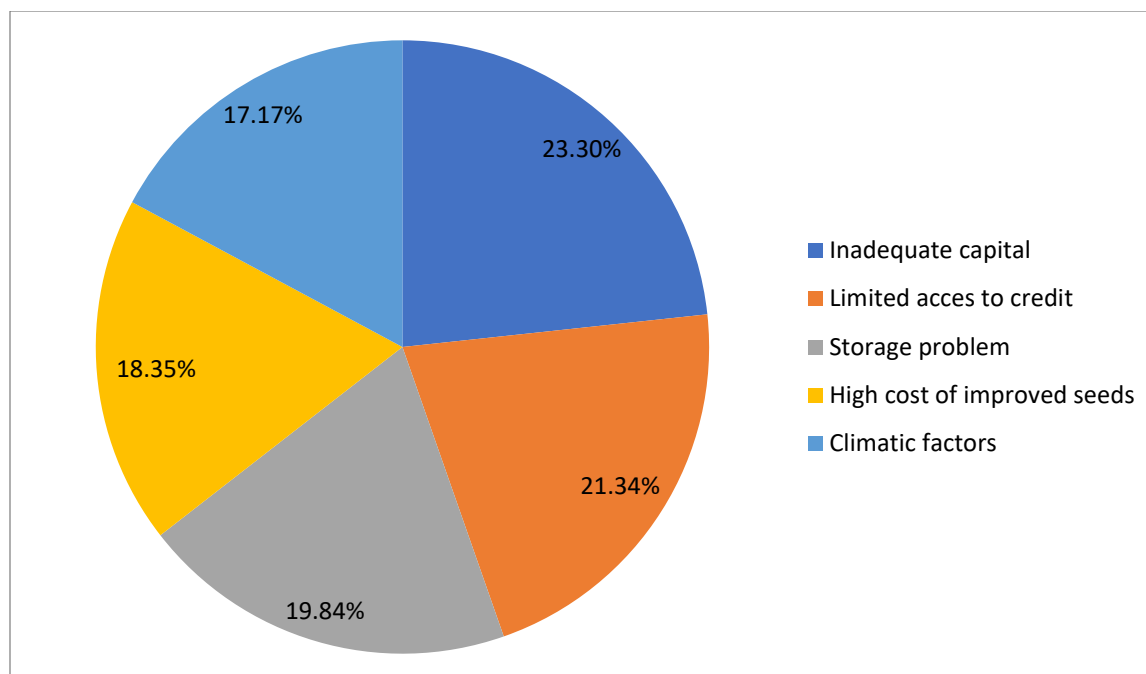
Commercial cucumber farming needs adequate financing to achieve the structure needed to generate profit [31]. The capital needed goes into many areas such as; construction of standard greenhouses since the crop is mostly grown under greenhouse conditions, irrigation facilities, labour, staking materials, construction of adequate storage structures in view of the nature of the fruit, and pests and diseases control as well as management [32].

Inadequate of enlightenment on climatic factors

Inadequate knowledge and enlightenment on the part of the farmers on the environmental requirements of cucumber, also militate against cucumber production in the Southeastern Nigeria because majority of the farmers are aged and used traditional methods of production. Climatic factors are very important factors that affect crop production. Each crop has specialized environmental requirements (such as temperature, rainfall, soil type, soil pH, wind speed and velocity, etc.) which must be met for good growth, development and production. Cucumber for instance requires a warm climate with optimum temperature for growth at about 30°C. The optimum night temperature is 18-21 °C while the minimum temperature for its development is 15°C. At temperature less than 10°C, growth stops while at 0 °C all plants perish [33]. However, high light intensity is needed for optimum yields. Low relative humidity results in high plant evapo-transpiration due to the large leaf area culminating to low yields. Sufficient irrigation is, therefore, required in such cases. Conversely, high relative humidity facilitates the occurrence of leaf diseases and may affect flower production. In addition, pests and diseases of cucumber are usually high during rainy seasons. Cucumber downy mildew for example is very common in Nigeria, and it is in fact one of the main diseases that negatively affect cucumber production in Southeastern Nigeria.

Limited access to credit

Access to agricultural loans has been positively linked to agricultural productivity on several studies. Yet this vital input has eluded smallholder farmers in southeastern Nigeria. Banks with large loan funds are generally difficult for smallholder farmers to access. Problems with collateral and high interest rate appear to frequently screen out most potential rural smallholder beneficiaries. In addition, agricultural loans are often short-term with fixed repayment periods, a loan structure that is not suitable for annual cropping or livestock production.



Source: [34].

Figure 1: Pie chart representing the major constraints of cucumber production (in percentage) in Southeastern Nigeria

SOLUTIONS TO IMPROVE CUCUMBER PRODUCTION

i. Creating awareness

Awareness should be created on the procedures for obtaining loans from commercial banks and low interest rates should be placed on the loans through the government support. This concerted capital injection through agricultural loans and credit facilities will go a long way in assisting commercial production of cucumber in the agro- ecological zone.

ii. Organizing seminars and workshops

Extension workers should from time to time organize seminars and workshops to enlighten the farmers and consumers on the agronomic production packages and importance of cucumber. Organizing seminars and workshops by the extension workers will go a long way in reducing most of the constraints militating against the yield, production efficiency and income of the farmers. [35] and [36] noted that technical and commercial education broadens the knowledge of farmers and enables them to farm intelligently, accurately and efficiently, leading to increased yield, productivity and farm income.

iii. Avoiding post-harvest losses

Post-harvest losses can be avoided by timely harvesting of cucumber, by separating deformed fruits from healthy fruits, and by establishing adequate storage facilities. Avoiding postharvest losses will help to minimize the perishability nature of cucumber thereby extending the

shelf life, marketability and availability of cucumber all year round.

iv. Provision of improved seeds

Improved seeds should be made available at affordable prices to the farmers. It is suggested that the Nigerian Institute for Horticultural Research and Training, Ibadan (NIHORT), with vegetable crop production as core mandate, should collaborate with growers, breeders and other stake holders to ensure availability of high quality seeds at affordable prices to farmers thereby promoting increased cucumber production [37] The availability of the improved planting materials at affordable prices to the farmers will enhance better production and productivity of the crop.

CONCLUSION

The production of cucumber especially in Southeastern Nigeria has suffered untold setbacks as a result of some factors militating against it. These factors can be redressed through the provision of sufficient improved seeds at affordable prices and provision of low-interest loans to genuine cucumber farmers.

RECOMMENDATIONS

From the review carried out on the benefits, techniques, constraints and solutions to cucumber production within the five states that make up Southeastern Nigeria, the

researcher made the following recommendations to the farmers:

- Agricultural extension workers should advise farmers to plant cucumber between April and June. This is because timely planting of cucumber is important in order to have optimum yield.
- Cucumber should be harvested between 55 to 60 days after planting. This is when the fruits will be uniformly dark green in colour with a noticeable wax deposit on the surface. The wax prevents moisture loss from the cucumber during transport and in the days leading up to purchase. In addition, fruits are generally at their eating quality when the skin is uniformly dark green. Although, some cultivars may naturally produce a lighter green colour fruit. The fruit should not be allowed to turn yellow, yellow fruits are over mature.
- Farmers should store cucumbers at room temperature and ensure that cucumbers are kept away from foods that produce ethylene gas, such as bananas or tomatoes, or they will spoil quickly. Storing at room temperature is important because cucumbers are sensitive to temperatures below 10 °C and last longer when stored at room temperature.
- . If stored below 10 °C, they are prone to developing “chilling injury” including water-soaked areas, pitting and accelerated decay.
- Farmers should not wash harvested cucumber until they are ready to either consume or sell them. This is because moisture causes the cucumbers to rot even faster, especially when exposed to heat, high humidity, or dramatically fluctuating temperatures.
- Government should offer free adult education to farmers to enable them possess thorough knowledge and skills of cucumber production.

REFERENCES

1. ADETULA, O. & DENTON, L. (2003). Performance of vegetative and yield accessions of cucumber (*Cucumis sativus* L.). Horticultural Society of Nigeria (HORTSON) *Proceedings of 21st Annual Conference* 10-13 Nov, 2003.
2. OKONMAH, L.C. (2011). Effects of different types of staking and their cost effectiveness on the growth, yield and yield components of cucumber (*Cucumis sativus* L.) *International Journal of Agricultural Science*, **1**(15): 292-295.
3. SINNADURAI, S. (1992). *Vegetable Cultivation*. Asempa Publishers, Advent Press Accra. pp 166-170.
4. EIFEDIYI, E.K. & REMISON, S.U. (2009). Growth and yield of cucumber (*Cucumis sativus* L.) as influenced by farmyard manure and inorganic manure. *Journal of Plant Breeding and Crop Science*, **2**(7): 216 – 220.
5. KASHIF, W., MUHAMMAD, S. J., ABU, B. & MEHWISH, K. (2008). Effects of Different Levels of NPK on the Growth and Yield of Cucumber (*Cucumis sativus*) Under the Plastic Tunnel. *Journal of Agriculture and Social Sciences*, **5**(3): 97 – 101.
6. ERNESTINA, P. (2001). Cucumber. <http://www.earthnotestripod.com/cucumber.html>.
7. GRUBBEN, G.J.H. (1997). Tropical Vegetables and their Genetic Resources. International Board of Genetic Resources 197-199.
8. DUKE, J. (1997). *The green pharmacy*. St. Martin's Press, New York.
9. RICE, C., RYMAL, K., CHAMBLISS, O. & JOHNSON, F. (1981). Chromatographic and mass spectral analysis of cucurbitacins of three *Cucumis sativus* cultivars. *Journal of Agricultural Food Chemistry*, **29**: 194–196. doi: 10.1021/jf00103a051.
10. RICE, C., RYMAL, K., CHAMBLISS, O. & JOHNSON, F. (1981). Chromatographic and mass spectral analysis of cucurbitacins of three *Cucumis sativus* cultivars. *J. Agric. Food Chem.* **29**, 194–196. doi: 10.1021/jf00103a051.
11. OLAMIGAN, A.A. & FAGBOYIDE, J.A (2006). Soil nutrient balance in sweet orange intercropped with some arable crops. *Journal of Plant Nutrition*, **30**: 335-350
12. OLUBODE, O.O. (2012). Component interactions and nutrient dynamics in pawpaw/cucumber mixtures in a pawpaw-based cropping system. *Nigeria Journal of Horticultural Science*, **17**: 33-44.
13. AJAYI, A.J. (2020). Effect of time of sowing okra into cucumber on growth, yield and crop mixture productivity.
14. MOUPEOLA, T.O., AJIBOL, A.A.T., ABUDULRAFU A.M., DIXON H.G. & AKINLEYE O.C. (2016). Effect of organic fertilizer and different staking methods on growth and yield of cucumber (*Cucumis sativas*). *Proceedings of 34th Annual Conference of Horticultural Society of Nigeria*. Pp 420-427.

15. YADUMA, J.J., MUDI E, I., AFOLAYAN, S.O., IDRIS, B.A., JIBRILL, A., IGWE, H.C., ALEWADOILE, S., SHUAIBU, S.M., HAMISU, H.S., HUDU, A.H., IDRIS, A.U., KUDI D. & HUDU, M. (2020). Productivity of cucumber (*Cucumis sativus* L.) varieties under different rates of poultry manure at Bagauda, Kano State, Nigeria. *Proceedings of 38th annual conference of Horticultural Society of Nigeria*. Pp 628-633.
16. AKINPELU, E.A., AKINFASOYE, J.A. & OGUNLETI, D.O. (2011). *Proceedings of 29th Annual Conference of Horticultural Society of Nigeria*. Pp 169-173.
17. CHINATU, L.N., ONWUCHEKWA, C.B. & OKORONKWO, C.M. (2017). Assessment of yield and yield component of cucumber (*Cucumis sativus* L.) in Southeastern Nigeria. *International Journal of Earth Science and Agriculture*, 3(1): 35-44.
18. PTIAN, O.O.R., JINADU, G.M., SHODUNKE, O.K., FILANI, C.O. & ADEWOLE, M.M. (2013). Influence of varietal difference and pyrethroid insecticides on the population densities of cucumber insect pests, *dacus* spp. and *bactrocera* invadens (Diptera: *tephritidae*) and fruit damage. *Nigeria Journal of Horticultural Science*, 18: 69-77.
19. MBAH, M.C., ANIEKWE N.L. & ATU, A.O. (2011). Effect of weed management on the growth and yield of cucumber (*Cucumis sativus* L) inter cropped with maize (*Zea mays* L) in Abakaliki, Nigeria. *Proceedings of 29th Annual Conferences of Horticultural Society of Nigeria* Pp 269-271.
20. KAYODE, A.B., AMINU-TAIWO, B.R. & OJO, O.D. (2020). Determination of the pathological effect of cucumber mosaic virus infection in turmeric and ginger. *Proceedings of 38th Annual Conference of Horticultural Society of Nigeria* Pp 634-641
21. IZUOGU, N.B., BABA, H. & OKELADE, O.O. (2017). Nematical potential of two botanicals in the management of root knot nematodes (*Meloidgyne incognita*) infecting two varieties of cucumber (*Cucumis sativus* L). *Proceedings of 35th Annual Conference of Horticultural Society of Nigeria* Pp. 1032-1036.
22. YUSSUF, S.Y., MUSA, A.K., HAMID, A.A., BABARINDE, S.A., ALAO, F.O. & OYESIYI, A.O. (2017). Efficacy of aqueous and ethanolic extracts of *Hypis suaeolens* and *Centrosema pubesens* on spotted Cucumber beetle *Diabrotica undecimpunctata* (Cleopectera: *chrysomelidea*) of cucumber. *Proceedings of 35th Annual Conference of Horticultural Society of Nigeria*, 1048 -1054.
23. EMEGHARA, U.U., ONWUEGBUNAM, D.O., OGUNTUYI, M.J. & BALA, U.J. (2013). Varietal response of cucumber (*Cucumis sativus*) to irrigation water deficit levels at Afaka, Kaduna. *Proceedings of 33rd Annual Conference of Horticultural Society of Nigeria*. Pp 493-500.
24. AWOBONA, T.A., ADEDAPA, J.O., BOLAJI, O.W., IJAH, A.A., OGUNSANWO, J.A., ZAKKA, E.J. & RIDWAN, A.H. (2020). Evaluation of water use efficiency, growth and yield of cucumber (*Cucumis sativus* L.) under greenhouse conditions. *Proceedings of 38th Annual Conference of Horticultural Society of Nigeria* Pp 362-367.
25. HARUNA, I.M., PETER, N.L., IBRAHIM, A. & UMAR, H.S. (2013). The productivity of cucumber (*Cucumis sativus*) as influenced by different mulching materials and planting spacing. *Proceedings of 33rd annual conference of Horticultural Society of Nigeria* Pp 561-569.
26. OLSEN, J.K. & GROUNDNER, R.K. (2001). Alternatives to polytechnic mulch film-a field assessment of transported materials in capsicum (*Capsicum annum* L.). *Australian Journal of Experimental Agriculture*, 41(1): 93-103.
27. AWODOYIN, R., OGBEIDE, F. & OLUWOLE, O. (2007). Effects of three mulch types on the growth and yield of tomato (*Lycopersicon esculentum* Mill) and weed suppression in Ibadan, Rainforest-savanna Transition zone of Nigeria. *Tropical Agricultural Research and Extension*, 10: 53 -60.
28. ABDRAHBO, M., FARAG, A., & HASSANEIN, M. (2009). Irrigation requirements for cucumber under different mulch colours. *Egyptian Journal of Horticulture*, 333-346.
29. JABRAN, K. (2019). Use of mulches in Agriculture: Introduction and Concepts. In: *Role of Mulching in Pest Management and Agricultural Sustainability, Springer Briefs in Plant Science*. DOI: 10.1007/978-3-0302230-4-1.
30. JEFFERY, C. (2001). Cucurbitaceae In: P. Hanett (ed.), *Mansfeld's Encyclopedia of Agriculture and Horticultural Crops* 31: 1550-1557. Springer verlag
31. WILCOX, G.I., OFFOR, U.S. & OMOJOLA, J.T. (2015). Profitability of cucumber (*Cucumis*

- sativus* L.) production in Tai Local Government Area of Rivers State. *Journal of Advanced Studies in Agriculture, Biological and Environmental Sciences*, **2**(3): 1-6.
32. UMEH, O.A. & ONOVO, J.C. (2015). Comparative Study of the Germination and Morphological Characteristics of Four Cucumber (*Cucumis sativus* L.) Genotypes In Keffi, Nasarawa State, Nigeria. *International Journal of Current Research in Bioscience and Plant Biology*, **2**(7): 43-46.
 33. KHURANA, A.J. & SINGH, M.B. (2001). Optimum temperature for the germination of seed. *Journal of Applied Ecology*, **6**: 71-78.
 34. UMEH, O.A. & OJIAKO, F.O. (2018). Limitations of cucumber (*Cucumis sativus* L.) production for nutrition security in Southeastern Nigeria. *International Journal of Agriculture and Rural Development*, **21**(1): 3437 – 3443.
 35. ADINYA, I.B. (2001). Factors influencing labour utilization in small scale cassava production: A case study of Uyo Agricultural Zone of Akwa Ibom State. Unpublished M.Sc. Dissertation, University of Uyo, Akwa Ibom State, 69pp.
 36. IDIONG, I.C., AGOM, D.I. & OHEN, S.B. (2006). Comparative analysis of technical efficiency in swamp and upland rice production system in Cross Rivers State, Nigeria 20th Annual National Conference of Farm Management Association of Nigeria, Federal College of Forestry, Jos Plateau State, Nigeria. 18th-21st September, pp. 425-432.
 37. UMEH, O.A., NGWUTA, A.A., ONYISHI, G.C., ANYANWU, C.P. & ONOVO, J.C. (2017). Application of Molecular tools in breeding cucumber (*Cucumis sativus* L). *International Journal of Agriculture and Rural Development*, **20**(2): 3175-3180.