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Review Article



Some factors affecting the yield and quality of banana: A Review

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Abstract

As a result of considering banana as one of the fruit crops that contribute to a large and important role in the economy of many countries in addition to its nutritional value for humans, so the importance of studying it and knowing the most important reasons affecting its productivity and quality was its advancement as a crop that occupies a great position in international trade. It was found that many factors that affect this crop, such as the environmental conditions, represented in high or low temperature, air humidity, and wind, in addition to the soil factor. Furthermore, to the use of good practices represented in the selection of high-yielding varieties, appropriate cultivation distances for varieties used, balanced fertilization, and appropriate disease as well as pest resistance methods. In addition, irrigation methods are consistent with the conditions of cultivation. All these factors contribute effectively to increasing crop productivity and improving its quality.

Keywords Environmental Conditions, Distances, Irrigation, Diseases, Varieties, Fertilization

Introduction

Good nutrition is one of the keys to maintaining health. As bananas are one of the most important fruit crops that are beneficial to health, rich in nutrients, source of energy, and contains some vitamins such as A,B6,C (EL-Shenawi, 2000; Khalid-Harathi and Rasid Al-Yahyai, 2009).

Banana is considered the famous fruit crop in tropical and subtropical regions of the world. Where the productivity areas can be arranged in decreasing order as follows: Asia, Africa, South America, Central America, Carabean, Oceania, Europe, and Northern America (Shahbandeh, 2021). However, India, Indonesia, Brazil, and Ecuador are the highest production countries in the world, respectively, with a total yield of about 54.94% of global production which represents about 116 million tons in 2019 according to (FAO, 2020). For fast-growing bananas, the plants require a full supply of water and nutrients. In this connection, Kumar and Jayakumar (2001) investigated the low productivity problems of the banana crop. While Smithson et al., (2001) and Yu et al., (2017) pointed that the reason for low productivity level is due to the ignorance of farmers to the best source of fertilizer, the right

method, right timing, and the right rate of application. While, El-Fouly, (1995) indicated the importance of optimizing nutrition according to testing soil and leaf analysis to obtain the specific fertilizer recommendation. On the other hand, Zhou et al., (2001) added that the cause of the decline in production is related to crops, yield potentials as well as environmental factors.

Factors affecting banana production

Environmental Conditions

Under tropical and subtropical climates with good soil conditions (Panis and Thinh, 2001; El-shenawi et al., 2008; Ashraf et al., 2018 and Sarrwy and Hasan, 2021) reported that bananas can be cultivated well and obtained highly yield. In these cases, good cropping practices and pest-harvest management help in producing the superior banana quality required.

Environmental factors based on survey data of banana growers (Altaee, 2020) are one of the most important factors affecting the growth and frutation of bananas are the climate factors

such as light, water, rainfall, temperature, air relative humidity, and wind which affecting yield performance of banana farms in various ways and soil factors, which they influence how crops grow and develop.

Climatic factors

Heat and humidity factors are one of the most important climatic factors affecting the production and fruiting of

bananas, hence banana plants spread in the tropical region characterized by high temperatures and high atmospheric humidity throughout the growing season.

. In addition, the temperature is varied in different phases of banana growth as shown in Fig.1 (Karienyé and Kamiri, 2020).

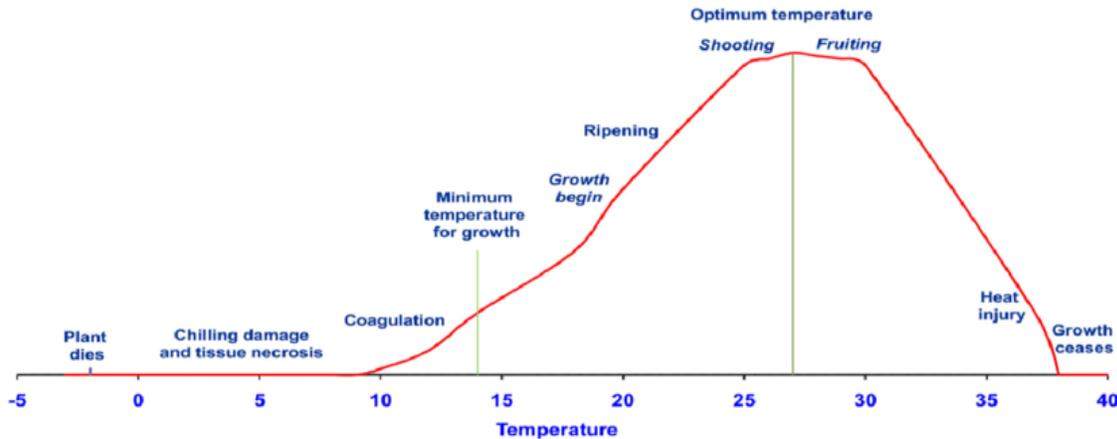


Fig.1 Relation between temperature and growth processes in banana culture (Source: Karienyé and Kamiri , 2020)

The availability of proper humidity helps to reduce the temperature rise above its appropriate rate. The low humidity of less than 60% for long hours during the day leads to dry leaves, crop damage, and fruit cracking, whereas increased atmospheric humidity of more than 90% leads to the spread of fungal diseases, and the best atmospheric humidity for the growth of banana plants is 75%. Also, exposure of banana plants to extreme winds is a harmful factor in banana production, resulting in mechanical damage, such as rupture of leaves and roots, breaking of false legs and sobatats, as well as physiological damage resulting in water imbalance in the plant, leading to the wilting and dryness of leaves, as well as dry fruits that are incompletely growing, while fully grown fruits distort and deteriorate their characteristics.

Soil factor

The selection of the appropriate soil for banana cultivation is one of the most important factors specific to the success of its cultivation due to the rapid growth of plants and its requirement for a large radical group capable of absorbing the largest amount of elements necessary to form a strong vegetation growth necessary to produce a good crop with good fruit properties

Planting distances

It is evident that there is less competition between plants within the optimal plant density (Odeke et al., 1999). This could be achieved by minimizing mutual shading and overlapping of root zones. In addition, bunch weight, cluster

and finger size directly affect by plant spacing. In this regards, it is cleared that the highest finger weight, length, total soluble solids (TSS%) and total sugars % were produced from plant spaced at 3 *4m with three plants per hole. On the other hand, high density spacing of banana do lead to poor plant growth and low yields due to competition for sunlight and nutrients while heavy bunch and good yield are possible under 3m x 3m with two plants/hole.

Irrigation

There are many factors that affect the productivity of bananas. The irrigation is considered one of them, where banana is more sensitive to moisture stress than any other fruit crops. Many investigators cleared that the yield and quality of fruits can be declined due to lack of water (Das et al., 2018) while, Hasan and Sirohi, (2006) reported that drip irrigation contains one of the modern irrigation methods that save water use and control its quantity for plants with high efficiency. The application of fertilizer along with irrigation water is fairly a new technology. It does not only help in increasing nutrient use efficiency but also provides essential elements directly to the active root zone thus minimizing losses of expensive nutrients which ultimately helps in improving yield and quality of the banana crop.

Diseases

Banana cultivation is facing many challenges that lead to reduce productivity such as diseases particularly fusarium wilt. However, Gonzales et al., (2003) was found in

Colombia that banana variety, Grand Nain was resistant to diseases. Furthermore, [Robinson, \(1993\)](#) showed the same with all cultivars of the Cavendish bananas with Panama diseases. In Egypt, it is stated that the local varieties such as Zeef, Grand Nain, and Canary were sensitive to pests and diseases. In addition, they found that the two first cultivars had a stronger defense system against disease more than the last one because of their significance for antioxidant enzymes activity. Moreover, increased accumulation of proline in the same first cultivars may be an adaptation to compensate for the energy for growth, survival and thereby help plants tolerate the different stress. These results are in harmony with those obtained by [Chandrasekhar and Sandhyarani \(1996\)](#).

Varieties

With regard to varieties, [Rezk et al. \(2008\)](#) found that they differ among themselves in their ability to absorb nutrients and thus in their productivity. While [Ahmed et al., \(1998\)](#) mentioned that these differences are mainly due to genetic factors. In addition, to differences among the varieties in terms of quality at maturity. Where, [Das et al., \(2018\)](#) showed that Grand Nain bananas have a shelf life that is much longer than the Robusta. In comparing the growth and fruiting of Williams and Cavendish, [Ahmed et al., \(1998\)](#) found that growth aspects were greater in Williams than in Cavendish bananas. However, a slight variation happened between such two varieties towards their content of N, P and K. On the other side, Scientist showed that Zeef and Grand Nine varieties were significantly higher in growth parameters such as plants length and several functional leaves than Canary cultivar. In addition, the same results were found in productivity parameters where Zeef trees and Grand Nine were significantly higher than Canary such as total yield, bunch weight, bunch length finger length, and diameter.

Fertilization

Many researchers have confirmed the importance of fertilization for plants, whether mineral or organic. In terms of organic fertilization, [Abd-Naby and Gomaa, \(2000\)](#) and [Abd-Naby, \(2000\)](#) reported using chicken manure or compost in banana fields induced a positive effect and similar results to the recommended dose of mineral nitrogen. Moreover, [Donnell, \(1973\)](#) showed that humic materials may also increase root growth like auxins. From another point, [Russo and Berlyn, \(1990\)](#) cleared that the application of humic acid particularly in alkaline soil, includes increasing nutrients uptake, tolerance to Drought. In addition, [Purchase, \(1997\)](#) clarified that the reason for the usefulness of humic acids is due to the fact it contains sulfur, nitrogen, phosphorus, and some metals such as Ca, Mg, Cu, Zn, etc., As for, mineral fertilization. Researcher suggested that banana plants require large amounts of macronutrients, that is phosphate, nitrogen, and potassium with the lack of fertilizer application lead to losses in yield and quality. In this connection, [Moreira, \(1999\)](#) emphasized that nitrogen nutrient acts directly on vegetative growth, emissions and the development of shoot plants and increases the amount of dry matter in plants. For another point, it is well known that P plays a role in the

intermediate of cellular respiration, photosynthesis, energy storage, and transfer ([Zhang et al., 2014](#)). Furthermore, [Mustaffa and Kumar, \(2012\)](#) mentioned that P is essential for root growth and rhizome development, as P deficiency results in low plant development and stunted bunches. Whereas [Attia et al. \(2009\)](#) cleared that root development is granted by nutrients uptake, adequate P doses besides increasing water. According to obtained results of [Lessa et al., \(2012\)](#), he stated that P can affect the liquid photosynthetic rate and its deficiency may reduce plant growth, but total P content in the soil promotes rapid plant growth. On the other side, the effect of adding potassium fertilizer to banana cultivation achieves positive indicators on the crop and its quality, these may be attributed to its effect on the biosynthesis of proteins and carbohydrates. The vegetative growth, yield, and fruit quality of Grand Nain banana obtained a good result by [Saad and Atawia \(1999\)](#) when using potassium fertilizer with rate 800 gm K₂O /plant/year. Furthermore, [Ghana and Mite\(1993\)](#) ; [Ram and Bose, \(2000\)](#) cleared that the positive effect of micronutrients on height and girth was accompanied zinc application which enhanced the synthesis of auxins in the plants and copper application which also activates several enzymes in plants and helps chlorophyll synthesis and involve in carbohydrate besides the protein metabolism. On the other hand, [Yadav et al., \(2010\)](#) indicated the importance of micronutrients application on the growth and crop duration of banana cv. Grand Nain. In addition, [Kumar and Jeyakumar \(2001\)](#) observed that increases in pseudo stem girth, associated with a combination spray of ZnSO₄ (0.5%), FeSO₄ (0.2%), CuSo₄ (0.2%) and H₃BO₃ (0.1%) timed 3, 5 and 7 months after planting. Consequently, [Nofal, \(2004\)](#) and [El-Fouly et al. \(2012\)](#) summarized how to face the challenge that leads to reduce productivity and quality by using balanced fertilization with consideration macro and micronutrients based on the results of soil tests and plant analysis.

[Tandon and Muralidharudu \(2010\)](#) showed that the nutrient depletion in banana production systems is very high, due to the large amount of nutrients exported through bunches. This will result in an unsustainable system if the amounts removed are not offset by soil fertility replenishing means.

Conclusion

It can be concluded from this study that there are many aspects affecting the productivity and quality of banana crop, which must be taken into consideration. On the average, the results indicate that a mean temperature of about 27°C with mean RH of approximately 77% will lead to good banana production. Despite the usefulness of banana, its productivity is declining in recent decades; a condition which has been attributed to soil nutrient depletion, pests, diseases and fluctuations in weather pattern. Therefore, there is an overwhelming and urgent need to put in place mechanisms that will improve banana productivity and promote societal adaptation to a future climate change condition. Bananas require considerable amounts of Nitrogen and Potassium (NK) to maintain high yields. Drought, water logging

condition and inadequate sun light cause crop damage and low yield.

Conflict of Interest

The author hereby declares no conflict of interest.

Consent for publication

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