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INCREASING THE MICRONUTRIENTS QUALITIES OF FRESH VEGETABLES USING AGRONOMIC MANAGEMENT

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Abstract
Several disparate studies have identified vegetables as an essential part of plants that contributes immensely to health and well-being, and they are both provitamins A sources. Improved yields are critical for improving food availability and income generation, which can be used to purchase more food and expand diet diversity. The improved nutrient content is essential for households' nutrition access and availability. As established in the literature, micronutrients are critical for improving health. The present study aimed to examine the effect of agronomic treatment on the micronutrients of vegetables. The result indicated that IRWH revealed the best-performing agronomical approach to improving yields for vegetables. This is significant because many households prefer vegetables daily as green leafy vegetables.

Keywords: *Vegetables, fluted pumpkin, bitter leaf, scent leaf, agronomic, micronutrient*

INTRODUCTION

Vegetables are ubiquitous parts of everyday food, reflecting any plant life or product, widely regarded as fresh edible portions of certain herbaceous plants' roots, stems, leaves, flowers, fruit, or seeds. These plant parts are consumed raw or cooked in various ways, usually as a savory dish instead of a dessert. Vegetables appear to be an essential part of the diet in every culture. It is the cornerstone of healthy diet recommendations and a crucial food plan (Wallace et al., 2020). Vegetables comprise essential nutrients (minerals and vitamins), including fiber, chiefly required for health and well-being. In common parlance, vegetables are herbaceous plants' raw, consumable parts like roots, leaves, stems, and fruits. (Damen et al., 2007). Previous studies have described vegetables as a balanced diet and an essential basis for nutrition (Boeing et al., 2012; Dennis et al., 2016; Knecht et al., 2015; Okyay et al., 2004; Ogunleye et al., 2010; Yafetto et al., 2019). Scholars have pointed to vegetables as a momentous dietary product needed for human sustenance and daily life (Jana et al., 2020; Liu, 2013; Nti et al., 2011; Slavin & Lloyd, 2012), which has witnessed a substantial increase in production in recent decades (Hess & Sutcliffe, 2018).

Research has noted that regular vegetable intake is essential in promoting health and managing body weight (Aughinbaugh, 2015; Dukhi & Taylor, 2018; Myton et al., 2014; Rudra et al., 2019; Ziaei et al., 2020). Dietary guidelines in numerous societies include endorsements for vegetables because of their relevance as a source of vitamins, minerals, and dietary fibers (FAO-WHO, 2017). They are commonly associated with reducing the risk of many illnesses (Deribe & Mintesnot, 2016; Hung et al., 2015; Pennington & Fisher, 2009; Septembre-Malatere et al., 2018; Ülger et al., 2018). They are also a source of bioactive mechanisms that act through a range of vital means for the appropriate functioning of the body (FAO-WHO, 2017).

Vegetable consumption has been linked to improved health in numerous studies. (Asaduzzaman & Asao, 2018; Baidya & Sethy, 2020; Chen et al., 2007; Dhruv et al., 2019; Pal & Molnár, 2021). However, other studies have found a correlation between the consumption of vegetables and certain microbial infections. (Alemu et al., 2018; Balali et al., 2020; Machado-Morreira et al., 2019; Snyder & Worobo, 2018). Indeed, the primary vectors of vegetable contamination are the soil, the introduction of domestic compost as fertilizer, organic fertilizer, and indecorous management during harvest and postharvest. (Amaechi et al., 2016; Hassibur et al., 2016; Rajwar et al., 2016; Tsado et al., 2015). Vegetables play a significant role in human nutrition by providing vitamins, minerals, and dietary fiber. Many biologically active, non-nutritive secondary metabolites known as phytochemicals with disease-fighting properties can be found in plant foods, including fruits, vegetables, herbs, and grains. Polyphenols, pigments (like carotenoids), and glucosinolates are a few of these phytochemicals that may have nutritional value. While many vegetables are primarily consumed in their raw state, others are consumed considerably in their processed state.

In Nigeria, vegetables are widely produced and consumed. Many vegetables, such as fluted pumpkin, scent leaf, and bitter leaf, are widely available in markets and represent a viable business opportunity for many people (Ibeawuchi et al., 2015). Bitter leaf (Vernonia amygdalina) is one of many leafy green Nigerian vegetables used for culinary and medicinal purposes. As the name implies, a bitter leaf (Vernonia amygdalina) tastes bitter. The fluted pumpkin is a native vine that belongs to the cucurbit family. Although the fruit is not edible, the leaves are a famous green soup, and the seeds are high in protein. Fluted pumpkins (Telfairia occidentalis) grow well in poor soil and are drought tolerant, making them an excellent choice for any Nigerian. Scent leaf is a native plant with sweet-smelling leaves that is a welcome addition to the Nigerian herb bed. Scent leaf (Ocimum gratissimum), also known as African blue basil or clove basil, is commonly used to flavor yam dishes, stews, and pepper soup. Among the agricultural products for which there is a continuing and expanding demand by markets are vegetables. Thus, a more innovative approach is needed to enhance vegetable production in Nigeria.

Fluted pumpkin, scent leaf, and bitter leaf are among the African indigenous vegetables recommended to alleviate food and nutrition insecurity in many societies. The vegetable is rich in micronutrients, including iron and vitamin A, with prevalent deficiencies. The increased occurrence of floods, especially in the Niger Delta regions, has further reduced crop yields and quality and could result in undesirable implications such as lowering the nutritional value of crops. This reduction in nutrition could lead to worsening malnutrition in poor households. Reducing malnutrition is an important SDG (2) goal of improving undernutrition. Adopting climate-smart technologies (CSTs) could improve the household's vegetable farming capacity to respond to these challenges, maintain or increase production levels, and improve crop quality properties, possibly positioning themselves to enter the value chain. The exploration of resources of smallholder farmers and how they can use them to improve the micronutrients of their vegetables informed the identification of agronomic management to increase vegetable micronutrients.

In-field rainwater harvesting (IRWH) is an agronomic practice where rainfall runoff is captured between alternate crop rows and stored in basins. Water collected in the basins infiltrates deep into the soil beyond the surface evaporation zone. Following the construction of a basin, the farmer will not apply any form of tilling, and a crust forms on the runoff strip, enhancing runoff. Mulch can be placed in the basins further to reduce water losses through evaporation from the soil surface and to create a more relaxed cropping environment. The stored rainwater is used productively to grow various grain and vegetable crops for household consumption. Thus, the IRWH technique is sustainable and contributes to climate change adaptation through increased plant available water, buffering during dry spells, increased yields, and better rainwater productivity enabling food production. This technique combines the advantages of water harvesting, no-till, and basin tillage to stop ex-field runoff on high clay soils (van Rensburg et al., 2012). The present study examined the effect of agronomic practice (IRWH) on the micronutrient of vegetables.

Materials and Method

Applicable agronomic practices in smallholder farms in Omoku, River State, Nigeria, were implemented and demonstrated in selected communities and school gardens to determine the effect of agronomic treatments on nutrient levels of fluted pumpkin, scent leaf, and bitter leaf. These vegetables were selected because they are significant sources of provitamin A and minerals. Further, the smallholder farmers involved in the study were familiar with the practices. Purposive sampling was used to select farms in which experiments were carried out. Conventional tillage (CON) with an application of inorganic fertilizer (Fert) served as the control (CON + Fert), which was compared with an agronomic practice of in-field rainwater harvesting (IRWH) technique. At planting, all the plots were irrigated to ensure good seedling establishment. All treatments were cultivated under dryland rain-fed conditions.

Sample Harvesting and Freeze-Drying

Vegetables are highly perishable during and after harvesting if subjected to unfavorable conditions, especially unsuitable storage conditions. To eliminate these during harvesting, Ziploc bags, cooler boxes, and ice cubes were used to preserve the vegetables from the field to the laboratory. The vegetables were harvested randomly from each garden. Immediately after harvesting, the vegetables were placed in Ziploc bags labeled according to the treatment farm. The Ziploc bags of each vegetable type were then placed in a cooler box with ice cubes. The vegetables were immediately transported from the field to the laboratory for nutritional analysis. Upon delivery at the laboratory, the vegetable samples were washed with deionized water to remove dirt on their surfaces and were then left to dry at room temperature (approximately 25 ◦C). After that, each vegetable sample was cut into slices of approximately 100 g and stored in a freezer at −20 ◦C. Finally, the dried samples were milled.

The raw samples were analyzed for proximate composition, mineral elements, and provitamin A content following standard and reference methods. The proximate composition of the vegetable samples was determined according to the methods of the Association of Analytical Chemists (AOAC, 2011). The total mineral content (ash) was determined by the combustion method (AOAC, 2011). The provitamin A content of the samples was determined by high-performance liquid chromatography (HPLC) using the procedures described in (Musemwa et al., 2018).

Result

As stated earlier, the study aimed to investigate the effect of agronomic treatments on the nutrient levels of different vegetables, focusing on micronutrients provitamin A and iron, and zinc. The conventional tillage with fertilizer application (CON + Fert) and in-field rainwater harvesting was compared.

Table 1: shows the effect of agronomic treatment on the proximate composition and level (concentration) of individual mineral elements of different vegetables

Sample	Treatment	Ash	Zn	Fe
	CON+Fert	6.74%	28.20mg kg-1	267.37mg kg-1
Fluted pumpkin	IRWH	9.84%	33.12mg kg-1	357.21mg kg-1
	CON+Fert	7.62%	22.42mg kg-1	357.21mg kg-1
Scent leaf	IRWH	10.17%	36.25mg kg-1	557.18mg kg-1
Bitter leaf	CON+Fert	6.36%	29.31mg kg-1	142.10mg kg-1
	IRWH	11.73%	11.06mg kg-1	100.28mgkg-1

CON = conventional tillage; IRWH = in-field rainwater harvesting; Fert = inorganic fertilizer.

The effect of agronomic treatment on the total mineral content (ash), iron, and zinc concentrations of fluted pumpkin, scent leaf, and bitter leaf was examined. It was observed that IRWH resulted in a higher concentration of total mineral content (ash) (9.84%), zinc 28.20mg kg-1, and iron 357.21mg kg-1in fluted pumpkin relative to the control (CON + Fert) (6.74%), 28.20mg kg-1, and 267.37mg kg-1 respectively. Also, the result showed that the IRWH treatment significantly increased the scent leaf's ash, zinc, and iron concentrations (26.17%, 36.25mg kg-1, 557.18mg kg-1). Furthermore, a significantly higher concentration of ash (11.73%) was observed in bitter leaves cultivated under IRWH relative to the control (6.36%). On the other hand, the control experiment indicated that bitter leaf had significantly higher zinc and iron concentrations compared to the experimental vegetable samples.

Discussion

The present study aimed to examine the effect of agronomic treatment on the micronutrients of vegetables. The result indicated that IRWH revealed the best-performing agronomical approach to improving yields for vegetables, particularly for fluted pumpkin and scent leaf. This is significant because many households prefer vegetables daily as green leafy vegetables. They are both provitamins A sources. Improved yields are critical for improving food availability and income generation, which can be used to purchase more food and expand diet diversity. The improved nutrient content is essential for households' nutrition access and availability. As established in the literature, micronutrients are critical for improving health (Prentice et al., 2019; Venn, 2020).

Conclusion

The outcomes demonstrated that IRWH represents an agronomical practice that can be used to control the zinc and iron levels of vegetables. The results also show that agronomic practices impact the provitamin A content of the vegetables under investigation. The study's overall findings show that agronomic practices impact the nutrient levels of various vegetables, including the total mineral content (ash) and the concentrations of iron, zinc, and provitamin A. As long as other push and pull factors for market access are in place, the improved yields of the IRWH indicate promising prospects for market-based production for small farmers. The increased yields increase the household's access to food and raise the utilization and availability pillars of the food and nutrition security pyramid. More research with more vegetable types and treatment combinations is required to establish the best farming practices using the cutting-edge technologies established in the current study.

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