

## BIO-BACTERICIDAL ACTIVITIES OF BOTANICAL OIL EMULSIONS ON BACTERIAL FRUIT BLOTCH (*Acidovorax citrulli*) DISEASE OF WATERMELON VARIETIES

<sup>1</sup>Phoebe, A. O\*, <sup>2</sup>Tunwari, B. A. & <sup>3</sup>Olawuyi, P. O.

<sup>1</sup>Department of Biological Science, Federal University of Wukari, Nigeria

<sup>2</sup>Department of Crop Production and Protection, Federal University of Wukari, Nigeria

<sup>3</sup>Department of Plant Science, Modibbo Adama University, Yola, Nigeria

\*Corresponding Author: [ajipheobi@gmail.com](mailto:ajipheobi@gmail.com)

### ABSTRACT

Watermelon (*Citrullus lanatus*) production in Nigeria is threatened by bacterial blotch, caused by *Acidovorax citrulli*, especially under warm and humid conditions. This study evaluated the effects of three watermelon varieties (Kaolack, Sangria, Local) and six plant-material oil emulsions [garlic oil, jatropha oil, neem oil, mixed emulsion (jatropha + garlic + neem), Streptomycin (chemical check), and untreated control] on bacterial blotch, climatic variation, and agronomic performance in Wukari, Taraba State during 2020 and 2021. Field trials were arranged in a randomized complete block design with three replications. Data were collected on disease incidence and severity, plant height, branches and leaves per plant, fruit number, fruit weight, and yield. ANOVA revealed significant main effects of variety and emulsion treatments on disease severity, vegetative growth, and yield, while their interaction was not significant. Sangria consistently showed lowest bacterial blotch severity and highest yield, followed by Kaolack, whereas the Local variety was most susceptible. Neem and garlic oil emulsions were as effective as Streptomycin in reducing disease severity and improving yield. Disease severity correlated positively with rainfall and humidity, confirming climate as a driver of epidemics. The results suggest that combining resistant varieties with neem or garlic oil emulsions offers a sustainable alternative to chemical control.

**Keywords:** Bacterial fruit blotch, Botanical Oil Emulsions, Watermelon Varieties, Incidence, Severity

### INTRODUCTION

Watermelon is a major horticultural crop in Nigeria valued for its nutritional and economic benefits. Despite the importance of watermelon, bacterial blotch remains poorly managed in Taraba State. Farmers rely heavily on susceptible local varieties and chemical control, which is costly and environmentally unsustainable. There is limited empirical evidence on the performance of improved varieties and botanicals under local conditions, leaving a research gap in sustainable disease management strategies for smallholder.

Bacterial blotch caused by *Acidovorax citrulli* is an emerging threat in the humid savannah zone, reducing marketable yield. Climatic variability, particularly rainfall and humidity, further exacerbates outbreaks. Conventional control with antibiotics such as Streptomycin is unsustainable due to concerns of resistance and residue. Plant-based bio-pesticides (neem, garlic, jatropha) represent promising alternatives with antimicrobial properties. Evaluating their efficacy across varieties under Wukari's agro-climatic conditions is essential for integrated, eco-friendly disease management.

The study provides scientific evidence on varietal tolerance to bacterial blotch in Wukari, and demonstrates the effectiveness of eco-friendly oil emulsions as alternatives to Streptomycin. It also links climatic variation with disease pressure, supporting forecasting models, and further offers practical recommendations for integrated disease management and sustainable watermelon production. These aim to evaluate the effect of watermelon varieties (Kaolack, Sangria, Local) and botanicals oil emulsions (garlic, jatropha, neem, mixed) on bacterial blotch severity, agronomic traits, and yield.

## **MATERIALS AND METHODS**

### **Study Location and Duration**

The trials were conducted at the Teaching and Research Farm, Federal University Wukari (07°51'N, 09°47'E), during the 2020 and 2021 rainy seasons.

### **Experimental Design**

The experiment was a factorial arrangement (3 × 6) in a randomized complete block design (RCBD) with three replications. Factor A = varieties (Kaolack, Sangria, Local). Factor B = treatments (Garlic oil emulsion, Jatropha oil emulsion, Neem oil emulsion, Mixed emulsion, Streptomycin, Control).

### **Varieties and Plant Material Sources**

Seeds of Kaolack and Sangria were obtained from certified suppliers; Local variety was farmer-saved. Garlic, neem, and jatropha seeds were locally sourced. Oils were extracted via cold pressing and emulsified with 1% Tween-80.

### **Emulsion Preparation and Application**

To obtain Neem seed oil, or Jatropha seed oil or Garlic oil emulsion, seeds of either neem, jatropha or garlic bulb (sliced) were air-dried and later oven-dried, in order to remove every moisture trace that might remain and then pounded separately into fine powders. The powder of each plant material (250 g) obtained was soaked in one liter of petroleum ether and placed on a shaker for about 72 hours. Using a muslin cloth, the mixture was filtered and the cake kept. Each filtrate obtained was made to undergo distillation to separate the oil obtained from either of the neem, jatropha seed and garlic powder from the solvent. To obtain neem, jatropha or garlic oil emulsion, 60 g bar soap was dissolve in 500 ml of water, and then thoroughly mixed with 1 litre each of either neem, jatropha or garlic oil. After that each was diluted with 15 litres of water and applied. Frequency: applied at 14-day intervals starting 2 weeks after planting. Method: foliar spray using a knapsack sprayer.

To prepare Neem oil - *Jatropha* oil - garlic emulsion (Mixed emulsion, 200 ml Neem oil, 200 ml *Jatropha* oil, 200 g garlic and 50 g ordinary bar soap was used. The bar soap was sliced and dissolved in 500 ml Luke warm water. 500 ml of the soap solution was poured in 200 ml neem oil slowly and was stir vigorously to get a good emulsion. This was followed by 200 ml *Jatropha* oil slowly and also stirred vigorously to get a good emulsion. Garlic extract was finally mixed in the neem- *Jatropha* oil - soap emulsion. It was diluted to obtain a one-liter stock solution by adding 1 liter of water. 9 litres added to get 10 liters of 2 % Neem oil -*Jatropha* oil -garlic emulsion, (Sathya and Karthikeyan 2022).

### **Pathogen Isolation and Inoculation**

*Acidovorax citrulli* was isolated from infected leaves and cultured. Bacterial suspensions ( $10^6$  CFU/mL) were sprayed on plants at 3 WAP to ensure uniform infection.

### **Agronomic Practices**

Field spacing: 1 m × 1 m. Fertilization, weeding, and irrigation followed local recommendations.

### **Data Collection:**

Data collected included: Disease incidence and severity (0–5 scale), Plant height (cm), branches/plant, leaves/plant, Number of fruits/plant, average fruit weight (kg), yield (kg/ha), and Climatic variables (rainfall, humidity, temperature).

### **Data analysis:**

ANOVA was performed; mean separation by Duncan's New Multiple Range Test (DMRT). SE and CV were reported. Correlation analysis assessed relationships between climatic variables and disease parameters.

## **RESULTS**

### **Effect of Watermelon Varieties on Bacterial Fruit Blotch Disease (*Acidovorax citrulli*)**

In Table 1, Sangria significantly had lowest disease severity (15–20%) and highest yield (24–26 t/ha). Kaolack was moderate (severity 28–35%; yield 18–20 t/ha). Local was most susceptible (severity 40–55%; yield 12–14 t/ha).

### **Effect of Botanicals Oils Emulsions on Bacterial Fruit Blotch Disease (*Acidovorax citrulli*)**

Neem and garlic significantly reduced severity by ~60%, comparable to Streptomycin. *Jatropha* and mixed emulsions were moderately effective. Control plots have highest severity. Neem and Garlic oil were most effective in disease suppression, comparable to Streptomycin. *Jatropha* and mixed emulsions were moderately effective (In Table 1,).

### **Effect of Varieties and Botanicals Oils Emulsions on Bacterial Blotch and Growth/Yield Traits**

The study in In Table 1, further revealed significant differences among the three watermelon varieties (Sangria, Kaolack, and Local) in their response to bacterial blotch (*Acidovorax citrulli*) across 2020 and 2021. Sangria consistently exhibited the lowest disease severity (8.5%) and highest agronomic performance (plant height 180 cm,

branches 5.4, leaves 69, yield 13,000 kg/ha), followed by Kaolack, while the Local variety was highly susceptible (33.6% severity, 138 cm height, 3.5 branches, 45 leaves, 7,450 kg/ha yield). This indicates that varietal resistance is a critical factor in reducing disease impact and enhancing productivity.

### Climate:

Severity positively correlated with rainfall ( $r = 0.72$ ) and humidity ( $r = 0.68$ ), negatively with temperature ( $r = -0.41$ ). Disease pressure was higher in 2021 due to higher rainfall.

**Table 1. Effects of Varieties and Plant Material Oil Emulsions on Watermelon Bacterial Blotch (*Acidovorax citrulli*) at 7 Weeks after Planting in 2020 and 2021 at Wukari**

Variety	Severity (%)	Plant Height (cm)	Branches/plant	Leaves/plant	Yield (kg/ha)
Sangria	8.5 <sup>a</sup>	180.0 <sup>a</sup>	5.4 <sup>a</sup>	69 <sup>a</sup>	13,000 <sup>a</sup>
Kaolack	17. <sup>b</sup>	162.0 <sup>b</sup>	4.6 <sup>b</sup>	62 <sup>b</sup>	10,650 <sup>b</sup>
Local	33.6 <sup>c</sup>	138.0 <sup>c</sup>	3.5 <sup>c</sup>	45 <sup>c</sup>	7,450 <sup>c</sup>
<b>Emulsion Treatment</b>					
Streptomycin	7.8 <sup>a</sup>	181.5 <sup>a</sup>	5.6 <sup>a</sup>	71 <sup>a</sup>	13,450 <sup>a</sup>
Neem oil	9.0 <sup>a</sup>	178.0 <sup>a</sup>	5.4 <sup>a</sup>	69 <sup>a</sup>	13,000
Garlic oil	10.2 <sup>a</sup>	175.0 <sup>a</sup>	5.2 <sup>a</sup>	67 <sup>a</sup>	12,700 <sup>a</sup>
Mixed emulsion	14.8 <sup>b</sup>	165.0 <sup>b</sup>	4.5 <sup>b</sup>	60 <sup>b</sup>	10,900 <sup>b</sup>
Jatropha oil	18.5 <sup>b</sup>	156.0 <sup>b</sup>	4.0 <sup>b</sup>	55 <sup>b</sup>	9,800 <sup>b</sup>
Control	34.9 <sup>c</sup>	142.5 <sup>c</sup>	3.3 <sup>c</sup>	44 <sup>c</sup>	7,150 <sup>c</sup>
SE	0.80	1.18	0.12	1.18	47.1
CV(%)	17.3	6.5	6.2	7.0	5.2

Means followed by different letters differ significantly at  $P \leq 0.05$  using New DMRT

### DISCUSSION

Neem and garlic oil emulsions were the most effective treatments in reducing bacterial blotch severity, performing comparably to Streptomycin (chemical check). Mixed emulsions (Jatropha + Garlic + Neem) and Jatropha oil alone were moderately effective, while control plots recorded the highest disease severity. The antimicrobial effects of neem are mainly due to azadirachtin and related limonoids, which inhibit bacterial growth and spore germination (Isman, 2017). Garlic contains allicin and sulfur compounds with broad-spectrum antibacterial activity (Kabara, 2010), explaining its efficacy. The moderate effect of Jatropha may result from its phorbol esters, which have limited antibacterial activity (Oparaeke, 2006). These results align with studies by

Akinbode and Ikotun (2008), demonstrating significant disease suppression in tomato using plant extracts.

The variety  $\times$  emulsion interaction was not statistically significant, suggesting that the ranking of varieties remains consistent across treatments. Sangria performed best irrespective of treatment, while the Local variety remained the most susceptible. This indicates that combining tolerant varieties with botanicals provides a reliable disease management strategy.

Reduction in disease severity corresponded with improved vegetative growth and yield. Sangria treated with neem or garlic emulsions produced the tallest plants, most branches and leaves, and the highest yields. Conversely, Local plants under control conditions were stunted and produced low yield. These observations confirm that healthier plants, with minimal pathogen stress, maintain better photosynthetic efficiency and assimilate more resources toward growth and fruiting (Agrios, 2005). The superior growth and yield of Sangria can be attributed to its genetic tolerance, which limits bacterial colonization and preserves photosynthetic capacity, allowing better vegetative development and fruit production (Agrios, 2005). Similar observations have been reported by Sowley *et al.* (2014), who noted significant variability in resistance to *A. citrulli* among watermelon genotypes, and Walcott (2003), highlighting the susceptibility of farmer-saved local varieties.

Disease incidence and severity were positively correlated with rainfall ( $r = 0.72$ ) and relative humidity ( $r = 0.68$ ), and negatively correlated with temperature ( $r = -0.41$ ). The higher disease pressure in 2021 is consistent with increased rainfall and prolonged leaf wetness during the season. These results corroborate previous findings that *A. citrulli* epidemics are favored by warm, humid conditions (Hopkins, 1991; Gitaitis & Walcott, 2007). Climatic variability must therefore be integrated into forecasting and management strategies for bacterial blotch.

The findings demonstrate that using a combination of resistant varieties (Sangria) and eco-friendly plant oil emulsions (neem or garlic) can effectively reduce bacterial blotch while enhancing growth and yield. This strategy reduces reliance on Streptomycin, minimizing the risk of antibiotic resistance and environmental contamination (Gitaitis & Walcott, 2007). Moreover, it provides smallholder farmers in Wukari and similar savannah agroecologies with a sustainable, low-cost disease management option.

## **CONCLUSION**

The present study inferred that Sangria is the most tolerant variety, while Local is most susceptible. It was also noted that Neem and garlic emulsions are effective, eco-friendly alternatives to Streptomycin, and Climatic variables significantly influence disease severity. Integrated management (resistant variety + plant emulsions) is recommended for Wukari. Further trials are hereby recommended for scalability on smallholder farms.

**Conflict of Interest:** The Authors declares no Conflicts of Interest.

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