

Field Management of the Different Manifestations of Bacterial Blight of Cotton Induced by *Xanthomonas axonopodis* pv. *malvacearum* Using Plant Extracts and Streptomycin

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ABSTRACT

The study was conducted in Yola and Jalingo to evaluate the efficacies of some selected plant materials (*Bolanite aegyptiaca*, *Eucalyptus camaldulensis* and *Citrus aurantium*) at 50 % concentration in comparison with Streptomycin on the various manifestations of bacterial blight disease of cotton in the field. The experiment was laid in a Completely Randomized Design replicated three times. Generalized Linear Model (GLM) procedure of statistical analysis was used to analyse the data collected and means separated using Duncan Multiple Range Test (DMRT). Effect of the plant extracts on seedling blight revealed a highly significant difference ($p \leq 0.01$) with Streptomycin recording the lowest mean value of 2.21 % followed by *E. camaldulensis* (3.07 %) and *B. aegyptiaca* (4.35 %) while the Control recorded 8.89 %. The result further revealed that Streptomycin and extract of *B. aegyptiaca* were able to reduce the black arm phase of the disease from 59.02 % to 31.43 % and 28.46 % in Yola and from 54.62 % to 26.73 % and 20.93 % in Jalingo respectively. Furthermore, the result on vein blight showed a highly significant difference ($p \leq 0.01$) between plant extracts in the two locations. For instance, in Yola, Streptomycin and *E. camaldulensis* both gave the lowest mean values of 45.19 % while the Control gave the highest mean value of 63.84 %. However, in Jalingo, lowest mean value of 38.39 % was recorded by Streptomycin followed by 41.21 % recorded by *B. aegyptiaca* while the Control treatment recorded the highest mean of 51.89 %. It was observed from the findings of the study that the plant materials have a promising prospect of field management of the various manifestations of the disease, sometimes being at par with the standard antibiotic.

KEY WORDS: Bacterial blight, Manifestations, Plant Extracts, Management

INTRODUCTION

Cotton (*Gossypium* spp.) is the World's leading textile fibre and an important oil and food crop. The sufficient production of cotton for meeting the fibre requirements of the World's exploding population is now universally realized (Shazia *et al.*, 2010). However, Bacterial angular leaf spot caused by *X. axonopodis* pv. *malvacearum* has become an increasing impediment to cotton production worldwide (Abdo-Hasan *et al.*, 2008). Black arm, which is the manifestation of the disease on the branches, is the main cause of yield loss though it also causes stand loss and loss of vigour at the seedling stage (Akello and Hillock, 2002). In Nigeria, estimated annual yield losses of about 10-20 % have been reported (Nahunnaro, 2005). The use of resistant varieties is an economical option for disease management but currently none of the high yielding commercial varieties has a durable resistance against the disease (Hussain *et al.*, 1985; Rashid and Khan 1999).

At present, the quickest and most effective management of plant diseases and microbial contamination in several agricultural commodities is generally achieved by the use of synthetic pesticides (Sbragia 1975; Agrios 1997) but their indiscriminate use and application has caused health hazards in animals and humans due to their residual toxicity (Ambridge and Haines 1987; Annon. 1998). In recent years, the Western world has banned a large number of them due mainly to their undesirable attributes such as high and acute toxicity, long degradation periods, accumulation in the food chain and an extension of their power to destroy both useful and harmful pests (Barnard *et al.*, 1997). Disease management through plant extracts has been reported by different workers in different crops (Mukhtar *et al.*, 1994; Mughal *et al.*, 1996) but little is known about the antibacterial effects of plant extracts against bacterial blight of cotton. This study was therefore initiated with the aim of assessing antimicrobial effects of some plant extracts on the various phases of the bacterial blight disease on the field.

MATERIALS AND METHOD

The study was carried out in 2014 cropping season at Yola (latitude 9^o 11 and 9^o 19 N and longitude 12^o 20 and 12^o 31 E) (Adebayo and Tukur, 1999) and Jalingo (latitude 8.89^oN and longitude 11.37^oE) (TADP, 2010). A Completely Randomized experimental Design with three replications was used for the experiment in the two locations. The cotton variety was allocated to the main plots while the plant extracts and the antibiotic to the sub plots. The plots measure 4 m x 2 m.

Source of Cotton Seed: SAMCOT-12 variety, which is moderately resistant to bacterial blight pathogen, was used in the experiment and the seed was procured from the Institute of Agricultural Research (IAR), Samaru, Zaria.

Collection and Preparation of Plant Extracts: Streptomycin and *C. aurantium* were obtained from Jimeta market while *B. aegyptiaca* soft bark and *E. camaldulensis* leaves were sourced from within the environment of Modibbo Adama University of

Technology, Yola.

Fresh bark of *B. aegyptiaca* weighing about 200 g was macerated well using mortar and pestle after which 500 ml of distilled water was added to it and allowed to stand for 24 hours. The suspension was then filtered using a muslin cloth and 50 % concentration was prepared by dissolving 50 ml of the stock solution into 100 ml distilled water and kept in glass bottle until used.

The fresh leaves of *E. camaldulensis* were thoroughly washed with tap water and 200 g was macerated using mortar and pestle. 500 ml distilled water was then added to it and allowed to stand for 24 hours. Muslin cloth was used to filter the suspension and 50 % concentration was prepared by dissolving 50 ml of the original solution into 100 ml distilled water. This was then kept in clean bottle.

The Citrus fruits were peeled and the juice squeezed by hand. The juice was then sieved with a muslin cloth and 50 ml of the juice was dissolved into 100 ml distilled water which gave a solution of 50 % concentration and was preserved aseptically in glass bottle.

Data Collected

Percentage (%) boll rot: The average number of rotten bolls from ten (10) randomly selected and tagged plants in each plot was monitored and recorded till harvest. The percentage boll rot was then calculated thus:

$$\text{Percentage boll rot} = \frac{\text{Number of rotten bolls per plant}}{\text{Total number of harvestable bolls per plant}} \times 100$$

Incidence of vein blight, boll blight and black arm: This was determined by counting the number of infected plants with such manifestations and later expressing them as percentage of the total number of plants assessed in each plot thus:

$$\text{Percentage Incidence} = \frac{\text{Number of infected plants}}{\text{Total number of assessed plants}} \times 100$$

The parameters collected were subjected to analysis of variance using the Generalized Linear Model (GLM) procedure of statistical analysis. Duncan Multiple Range Test (DMRT) at 5 % level of probability was used for means separation.

RESULTS

Result on the effects of plant extracts on seeding blight, vein blight and black arm in Yola and Jalingo is presented in Table 1. The effect of plant extracts on seedling blight revealed a highly significant difference ($p \leq 0.01$) with Streptomycin recording the lowest mean value of 2.21 % followed by *E. camaldulensis* (3.07 %) and *B. aegyptiaca* (4.35 %) while the Control recorded 8.89 %.

A highly significant difference ($p \leq 0.01$) was revealed between the plant extracts in the two locations on vein blight. In Yola, Streptomycin and *E. camaldulensis* both gave the lowest mean values of 45.19 % while the Control gave the highest mean value of 63.84 %. However, in Jalingo, lowest mean value of 38.39 % was recorded by Streptomycin followed by 41.21 % recorded by *B. aegyptiaca* while the Control treatment recorded the highest mean of 51.89 %.

On black arm, result in Yola revealed that Streptomycin recorded a highly significant ($p \leq 0.01$) lower mean value of 40.47 % followed by *B. aegyptiaca* with 42.22 %. The Control recorded the highest mean value of 59.02%. It further revealed that in Jalingo location, Streptomycin recorded 40.02 % low followed by *B. aegyptiaca* (43.19 %). The Control recorded 54.62 %, being the highest value.

Incidence of boll blight, boll rot and yield in both locations is presented in Table 2. On boll blight, effects of plant extracts in Yola revealed that *B. aegyptiaca* recorded a lower mean value of 19.72 % followed by *C. aurantium* with 22.13 %. Furthermore, in Jalingo location, *B. aegyptiaca* gave a lower mean value of 21.26 % followed by *E. camaldulensis* with 24.17 %. The Control treatment in the two locations recorded higher means of 28.17 % (Yola) and 30.08 % (Jalingo).

A highly significant difference ($p \leq 0.01$) was observed between the plant extracts in both locations on boll rot. *E. camaldulensis* recorded a low mean value of 2.71 % and *B. aegyptiaca* 4.44 % in Yola while in Jalingo, *B. aegyptiaca* recorded 3.72 % and *E. camaldulensis* 5.60 %. The Control recorded 10.19 % and 11.49 % in Yola and Jalingo respectively.

Results on yield revealed a highly significant difference ($p \leq 0.01$) between the plant extracts in both locations. In Yola for instance, *B. aegyptiaca* recorded 537.69 kg ha^{-1} followed by *E. camaldulensis* with 451.341 kg ha^{-1} . However, in Jalingo, *B. aegyptiaca* recorded 507.03 kg ha^{-1} and *E. camaldulensis* recorded 462.73 kg ha^{-1} . Streptomycin recorded the highest mean values of 681.44 kg ha^{-1} (Yola) and 681.44 kg ha^{-1} (Jalingo) while the Control recorded the lowest mean values of 296.53 kg ha^{-1} (Yola) and 278.57 kg ha^{-1} (Jalingo).

Table 1: Mean Effects of Plant Extracts on Seedling Blight, Vein Blight and Black Arm in Yola and Jalingo

Plant Extracts	Location					
	Yola			Jalingo		
	Seedling blight (%)	Vein blight (%)	Black arm (%)	Seedling blight (%)	Vein blight (%)	Blackarm (%)
<i>C. aurantium</i>	6.51 ^b	48.76 ^b	47.05 ^b	7.95 ^b	46.70 ^b	47.97 ^b
<i>B. aegyptiaca</i>	3.07 ^d	45.56 ^c	42.22 ^c	4.44 ^{cd}	41.21 ^{cd}	43.19 ^{bc}
<i>E. camaldulensis</i>	4.35 ^c	45.19 ^c	43.77 ^{bc}	5.74 ^c	43.51 ^{bc}	45.15 ^b
<i>Streptomycin</i>	2.21 ^d	45.19 ^c	40.47 ^c	3.58 ^d	38.39 ^d	40.02 ^c
Control	8.89 ^a	63.84 ^a	59.02 ^a	10.11 ^a	51.89 ^a	54.62 ^a
Mean	5.01	49.71	46.51	6.36	44.34	46.19
CV	24.62	13.18	12.97	29.86	14.80	13.51
Prob. of F.	≤0.0001	≤0.0001	≤0.0001	≤0.0001	≤0.0001	≤0.0001

Means with the same letter(s) in the same column are not significantly different at $p \leq 0.01$ or $p \geq 0.05$ according to DMRT

Table 2: Mean Effects of Plant Extracts on Boll Blight, Boll Rot and Yield in Yola and Jalingo

Plant Extracts	Location					
	Yola			Jalingo		
	Boll blight (%)	Boll rot (%)	Yield (Kgha ⁻¹)	Boll blight (%)	Boll rot (%)	Yield (Kgha ⁻¹)
<i>C. aurantium</i>	22.13 ^{ab}	7.35 ^b	375.77 ^{bc}	25.17 ^{ab}	8.42 ^b	353.53 ^{bc}
<i>B. aegyptiaca</i>	19.72 ^{ab}	4.44 ^c	537.69 ^{ab}	21.76 ^b	3.72 ^d	507.03 ^{ab}
<i>E. camadulensis</i>	23.84 ^{ab}	2.71 ^d	451.34 ^{bc}	24.17 ^{ab}	5.60 ^c	462.73 ^b
<i>S. sulphate</i>	15.76 ^b	1.88 ^d	681.44 ^a	17.75 ^b	3.25 ^d	655.10 ^a
Control	28.17 ^a	10.19 ^a	296.53 ^c	30.08 ^a	11.49 ^a	278.57 ^c
Mean	21.92	5.32	468.55	23.78	6.50	451.39
CV	61.36	33.65	52.51	40.14	29.72	46.83
Prob. of F.	≤0.1496	≤0.0001	≤0.0001	≤0.0162	≤0.0001	≤0.0001

Means with the same letter(s) in the same column are not significantly different at $p \leq 0.01$ or

$p \geq 0.05$ according to DMRT

DISCUSSION

The plant extracts proved their efficacy on the various manifestations of the bacterial blight. In both locations for instance, Streptomycin, *B. aegyptiaca* and *E. camaldulensis* were found to be very effective in reducing the incidence of seedling blight, vein blight, boll blight and boll rot, though at varying levels. This difference could probably be explained by a reason of variation in the concentration of the active substance(s) they contain, depending on the plant species. The findings from the study is similar with that of Opara *et al.* (2013) who reported that plant extracts have proved to be as effective as standard synthetic pesticides such as antibiotics and fungicides and were even in some cases at par with these conventional chemicals usually used in disease reduction. The phytochemical efficiency of the plant parts used in the study could likely mean that they contain some secondary metabolites such as alkaloids, tannins, phenols, saponins, flavinoids and glycosides by which they ineffectuate target pathogens which they establish contact with them. This is in line with earlier work by Amadioha, (2004) who reported that greater effectiveness of plant extracts may be due to inherent chemical constituent or bioactive ingredients which contain anti-bacterial polyphenolic compounds.

Effectiveness of Streptomycin and other antibiotics, singly or in combination with other chemicals, was also confirmed by earlier workers (Islam *et al.*, 2003; Ahmad *et al.*, 2005; Jagtap *et al.*, 2012). It was noted from the result that yield increase varied depending on the efficacy of the different plant extracts on severity of the various disease manifestations. It can therefore be concluded that the plant extracts, especially *B. aegyptiaca* and *E. camaldulensis* have the potentials to manage the various manifestations of the bacterial blight disease of cotton on the field with a consequent increase in seed cotton yield. This was demonstrated in their ability of being as effective as the standard antibiotic in suppressing the disease in its various manifestations. The comparative advantage of the plant extracts over the antibiotic being cheaper and with limited environmental hazards. Therefore, further trials are recommended to explore ways that will enhance their capabilities and ease of usage for cotton farmers against bacterial disease.

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