Allium fistulosum Crude Extract and Irrigation as Alternative Management of Tomato Bacterial Wilt in Greenhouse

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Introduction

❖Tomatoes are the second most important vegetable crop in Kenya after potato. The crop can grow in many agro-ecologies with increased climatic risks.

❖Because of the high market demand, the crop is a major source of income for smallholders farmers - 80%; consumed as salad, Juice or cooked with other meals

❖Major challenge to tomato production is the prevalence of diseases mainly bacterial wilt caused by *Ralstonia solanacearum pathogen* in soil and water – this is moisture sensitive yield loss of up to 100% in greenhouse production systems

❖Control is mainly by use of chemicals - adverse effects on the environment and accumulation of chemical residues on produce and crop rotation

❖Research on use of plant extracts in control of tomato bacterial wilt is still limited. Findings of this research will contribute to scientific knowledge of disease control to improve tomato productivity and environment sustainability

Study Objectives

Overall objective

To contribute to improved tomato yields and quality by developing an integrated, sustainable and environmental sound approach for management of bacterial wilt disease

Specific objectives

1. To determine the effects of different concentrations of *Allium fistulosum* crude extract on inhibition of *Ralstonia solanacearum In-vitro*

2. To determine the effects of different concentrations of *Allium fistulosum* crude extract and irrigation levels on bacterial wilt incidence and severity in greenhouse grown tomato

Materials and Methods

Study site:

KALRO- Kakamega - altitude 1585 m above sea level; mean temperatures - 22 °C; mean rainfall - 1850 mm; soils are ferralsols and acrisols (Jaetzold and Schmidt, 2012)

Laboratory Isolation and culture of *Ralstonia solanacearum* pathogens

- Roots and stems of diseased tomato were cut into 1 cm portions – prepared, incubated and well separated virulent colonies were observed (Kumar *et al.*, 2017)

Antibacterial activity

- Antibacterial activity of *Allium fistulosum* was detected by paper disc diffusion method of

(Teng *et al.*, 2010); Inhibition zones around the paper discs were measured using a

vernier caliper

Greenhouse study

❖A raised nursery bed was prepared to a fine tilth

❖Planting drills were made and panted with Sodagar F1 seedlings

❖The nursery was managed keenly by watering on daily basis

❖Seedlings were transplanted in pots at 3 to 4 leaf stage

Experimental Design and Treatments

Laboratory studies

❖ CRD with 3 replications

❖ Treatments;
- ❑ Control (distilled water)
- ❑ Positive control (Greencop at a rate of 50 g/20 L)
- ❑ *Allium fistulosum* concentrations of 5%, 10%, 15% and 20%

❖ Each replicate consisted of 6 petri dishes giving a total of 18 petri dishes

❖ The experiment was repeated once

Growth data: Plant height; number of branches; internodes; stem collar diameter; aays to 50 % flowering

Disease data: disease incidence; disease severity

Experimental Design and Treatments

Greenhouse studies

❖ CRD with 3 replications

❖ Treatments; *Allium fistulosum* (different percentages + different water levels of 0.5; Greencop 50g /20L + Water Level of 2L (positive control)

  ❑ *Allium fistulosum* crude extract of 20 % and 15 % concentrations - used in greenhouse experiment

  ❑ Irrigation levels - based on the daily water requirement for greenhouse grown

❖ Each replicate therefore consisted of 10 experimental units with each represented by 5 pots

Laboratory data: Diameter of zone of inhibition for growth of *Ralstonia solanacearum* pathogen

Data collected was subjected to ANOVA at 5% level of significance; Tukey's HSD test at 5% level of significance means was used separation; Proc GLM of SAS version 9.1 was used in the analysis the data

Results and Discussions

Table 1: Treatment means in millimeter (mm) for diameter of zone of inhibition of growth of _Ralstonia solanacearum_ pathogen

Treatments	Trial one	Trial two
20%	11.467a*	11.500a*
15%	10.833b	10.700b
10%	10.533b	10.467b
5 %	10.100 c	9.867 c
Positive control (Greencop)	9.500c	9.367c
Negative control (sterile distilled water)	5.8000d	6.033d

*Means within a column followed by the same letter are not significantly different (P≤0.05, Tukey's HSD test)

Table 2: Effect of *Allium fistulosum* crude extract concentrations and irrigation levels on for bacterial wilt disease incidence in %

Treatments	Trial 1					Trial 2				
	14dat	28dat	42dat	56dat	70dat	14dat	28dat	42dat	56dat	70dat
-ve +2L	91.7a*	83.3a*	75.0a*	66.7a*	58.3a*	75.0a*	75.0a*	75.0a*	66.7a*	58.3a*
+ve +2L	50.0b	50.0b	41.7b	41.7b	33.3b	50.0b	50.0b	41.7b	41.7ab	33.3ab
15%+2L	33.3bc	25.0c	25.0bc	25.0bc	25.0bc	33.3bc	25.0c	16.7bc	16.7bc	16.7bc
15%+1.5L	33.3bc	25.0c	25.0bc	25.0bc	25.0bc	25.0cd	25.0c	8.3c	8.3c	8.3bc
15%+1L	25.0bc	25.0c	25.0bc	16.7cd	16.7bcd	25.0cd	25.0c	8.3c	8.3c	8.3bc
15%+0.5L	25.0bc	25.0c	16.7cd	8.3cd	8.3cd	25.0cd	16.7cd	0.0c	0.0c	0.0c
20%+2L	25.0bc	25.0c	8.3cd	0.0d	0.0d	25.0cd	16.7cd	0.0c	0.0c	0.0c
20%+1.5L	25.0bc	16.7cd	0.0d	0.0d	0.0d	16.7cde	0.0d	0.0c	0.0c	0.0c
20%+1L	25.0bc	8.3cd	0.0d	0.0d	0.0d	8.3de	0.0d	0.0c	0.0c	0.0c
20%+0.5L	16.7c	0.0d	0.0d	0.0d	0.0d	0.0e	0.0d	0.0c	0.0c	0.0c

*Means within a column followed by the same letter are not significantly different (P≤0.05, Tukey's HSD test)

- Presence of high content of active compounds is known to offer an inhibitory effect of growth of pathogens
- They include enzymes, sulphur-rich compounds, steroid alkaloids, glycol-alkaloids, saponins and antioxidants (Alemu *et al.*, 2013)
- Highest disease incidence and severity was recorded under control treatments
- This was due to absence of active ingredients (allicin and sulphur volatiles) contained in in extract responsible for combating thriving of the disease

Table 3: Effect of *Allium fistulosum* Crude Extract Concentrations and Irrigation Levels on Bacterial Wilt Disease Severity (scale of 0-5)

Treatments	Trial 1					Trial 2				
	14dat	28dat	42dat	56dat	70dat	14dat	28dat	42dat	56dat	70dat
-ve +2L	4.0a*	3.7a*	3.0a*	3.0a*	3.0a*	3.3a*	3.3a*	3.0a*	3.0a*	3.0a*
+ve +2L	1.7b	1.3b	1.0b	1.0b	1.0b	1.3b	1.3b	1.0b	1.0b	1.0b
15%+2L	1.3b	1.0b	1.0b	1.0b	1.0b	1.3b	1.0bc	1.0b	0.7bc	0.7bc
15%+1.5L	1.0b	1.0b	1.0b	1.0b	1.0b	1.0bc	1.0bc	0.7bc	0.3bc	0.3bc
15%+1L	1.0b	1.0b	1.0b	0.7b	0.7b	1.0bc	1.0bc	0.3bc	0.0c	0.0c
15%+0.5L	1.0b	1.0b	0.7bc	0.0c	0.0c	1.0bc	0.7bc	0.3bc	0.0c	0.0c
20%+2L	1.0b	1.0b	0.3bc	0.0c	0.0c	1.0bc	0.7bc	0.0c	0.0c	0.0c
20%+1.5L	1.0b	0.7bc	0.0c	0.0c	0.0c	0.7bc	0.0c	0.0c	0.0c	0.0c
20%+1L	0.7b	0.0c	0.0c	0.0c	0.0c	0.3bc	0.0c	0.0c	0.0c	0.0c
20%+0.5L	0.7b	0.0c	0.0c	0.0c	0.0c	0.0c	0.0c	0.0c	0.0c	0.0c

*Means within a column followed by the same letter are not significantly different (P≤0.05, Tukey's HSD test)

Conclusion and/ Recommendations

❖Concentrations of *Allium fistulosum* crude extract inhibits bacterial wilt *In-vitro* with the highest zone of inhibition diameter of 11.467 mm being recorded on use of 20% concentration of *Allium fistulosum* crude extract

❖Concentrations of *Allium fistulosum* crude extract and irrigation levels reduces bacterial wilt incidence and severity in greenhouse

❖Farmers using greenhouse for tomato production in Kenya can use a combination of 20% concentration of *Allium fistulosum* crude extract with half a litre of irrigation water per plant per week as alternative management for *Ralstonia solanacearum*

❑Crude extract is environmental safe

❑Use of irrigation is climate smart

❖Future Studies should base on determining the concentration of allicin in *Allium fistulosum* crude extract that can be able to reduce bacterial wilt disease incidence and severity in the field

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