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Bactericidal effects of some local plant ashes against bacterial wilt diseases of tomato (*Solanum lycopersicon*) varieties

***[1]Opara, Emma Umunna and [2]Bassey, Inemesit Ndarake**

[1]Department of Plant Health Management, Michael Okpara University of Agriculture, Umudike, Nigeria.
[2]Department of Botany and Ecological Studies, University of Uyo, Nigeria

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A study was carried out in Michael Okpara University of Agriculture, Umudike, Abia State to determine the response of six different tomato varieties to common bacterial wilt disease of tomato (*Solanum lycopersicon*) both in field and culture. The experiment was laid out in Complete Randomized Block Design (CRBD). The treatments employed were wood ash material and aqueous extract. Data obtained from the pot experiment showed that var plumpty had the highest disease severity (1.97) followed by the var sahel (1.83), var local (1.55), var GS12 (1.27) and var RFT 732216 (1.27) while var tylka had the least disease severity (1.00). From the field work, percentage disease incidence data obtained showed that saw dust ash (628.90) and wood ash (555.07) proved to be more effective at P>0.05 while oil palm bunch ash (495.10) was less effective. From the laboratory experiment, results obtained showed that *Vernonia amygdalina (*0.66) and *Azadiracta indica* (0.57) were more effective in inhibiting the radial growth of the bacterial pathogen of tomato in culture (P>0.05) while *Chromoleana odorata* (0.51) was least effective. From this trial conducted it was observed that aqueous extracts of *Azadiracta indica* , *V. amygdalina,* on one hand and wood ash and saw dust on the other hand were found to have some bactericidal effect on bacterial wilt diseases of tomato therefore may serve as alternative to pesticides use by farmers in the South East agro ecological zone.

Key words: Variety, bacterial wit, radial growth, inoculation, incidence, severity, ash.

INTRODUCTION

Bacteria wilt occurs widely in the humid tropical South Eastern and South South regions of Nigeria and is usually caused by a soil-borne, vascular bacterial pathogen, known as *Ralstonia* (*Pseudomonas*) *solanacearum* (Yabuuchi *et al*., 1995; Kelman, 1998). A devastating disease, bacterial wilt limits the production of solanaceous crops such as tomato, pepper, egg-plant, tobacco and potato as well as other important crops like peanut, banana, ginger and geranium. Approximately, 450 crops species have been reported as hosts of this pathogen (Grimault *et al*., 1994; Swanson *et al.,* 2005*).* Bacteria wilt causes significant damage on many important crops under disease favorable weather conditions

*Corresponding Author: E-**mail**: euopara22@gmail.com
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(Doan and Ngunyen, 2005). Similar to bacteria wilt is the *Fusarium* wilt, in each case the pathogen can remain active in soil for many years, the wilt pathogen enters the tomato plant through the root hairs and then goes into the main plant and throughout the plants vascular systems, blocking the movement of water and nutrient (Sahim *et al*., 1996). Wilting symptom occurs in warm humid weather when air and soil temperatures are high. Bacterial wilt begins as a yellow flagging of branch shoot and leaves. Wilting progresses upwards and many first appear only on one side of the plant. Stem of infected plants shows brown streaking within the vascular tissue just under the green outer tissue. Infected leaves turn yellow, wilt and die (Sorenson and Barker, 1983).

In time past control of the wilt diseases, starts with Cultural Methods such as avoidance of planting in poorly drained and unfertile soils can be used to reduce the disease, proper rotation with non-susceptible crops like maize and rice helps to control the diseases since they are soil borne. Plants from disease free areas, healthy crops and those treated with streptomycin also help to control bacterial diseases. Following adoption of bactericides attention diverted and farmers used chemicals in the control of bacterial diseases with protective and curative action. For instance, Nickel-bis applied at 180-240g/10 acre as foliar spray with protective action, which has both curative and protective action against *Pseudomonas* spp and *Erwinia* spp, probenazol at 2.4-3.2kg/ha is effective against bacterial wilt disease and bronopol which is effective as a seed treatment bactericide, Dicloran and metam-sodium can also be used in the control of bacterial disease (Singh, 1998; Chukwu *et al.,* 2010). However, all these pesticides usage has some environmental consequences (Stoll, 2000). Therefore, main objective of this study was to find out some alternatives to synthetic bactericides and fungicides applications in soil treatments for plant disease management as well as crop yield enhancement with natural and locally available materials that are environmental friendly.

MATERIALS AND METHODS

Field Experiment

The experiment was conducted at Research and Training farms of Michael Okpara University of Agriculture, Umudike, which is located on latitude $5^{o}29'$ North and longitude $7^{o}32'$ East and an altitude of 122m above sea level. It is situated in the rain forest zones of South East of Nigeria with an average annual rainfall of 1916mm, temperature $19^{o}C$ to $35^{o}C$ and a relative humidity of 76%. The experimental design was a Randomized Complete Block Design (RCBD) with three replicates and the total land area covered was $20m^2$ x $20m^2$ and each plot measuring $3m^2$ by $3m^2$.

Soil Sterilization and Nursery

The top soil for nursery was collected from Eastern farm of Michael Okpara University of Agriculture, Umudike, and then put into a cut drum. It was moistened and covered and heated until it reached a temperature of $80^{0}C$ and maintained at this temperature for up to 20 minutes before it was allowed to cool down to $27^{0}C$. The soil was mixed with sandy soil to improve its porosity, then poultry dropping was added thus making the mixture of poultry, sandy and top soil a ratio of 1:2:3 respectively. The seeds varieties used were sourced from Sygnta Seeds Company©; Ikeja Lagos,Nigeria. They were: G12, Sahel, Tylka RFT 732216, Plumpty and Local variety. About 36 seeds of each tomato seed variety were sowed in the nursery and the tomato seedlings were transplanted three weeks later from the nursery pots and the seedlings were placed in the soil at the depth of about 4cm, spaced 50cm by 50cm.

Application of plant Ashes in the Field

The three different plant ashes applied were: wood ash, saw dust ash and oil palm bunch ash. The plant materials were collected, dried and burnt to ashes first and allowed to cool and then 10g of each plant ash was applied at the base of the tomato seedlings and data collected two weeks later. Weeding of the farm plots was done manually two weeks after transplanting (WAT) and repeated every two weeks interval. Other agronomic and cultural operations were performed.

Pot Experiment

The pot experiment was laid in a completely Randomized Design (CRD) with three replications. The tomato seedlings were transplanted two weeks after planting from the nursery to the pot at the depth of 4cm and a total of 18 pots were used.

Preparation of Bacterial Inoculum

The bacterial suspension was obtained from the pure colonies by adding 5ml of sterile distilled water onto the colony culture and the inoculum suspension formed adjusted to 10^{7}-10^{8} cells or colonies per mill (cfu/ml) using a haemocytometer (Jones *et al*., 2000).

Artificial Inoculation

Two weeks after transplanting the tomato seedlings were inoculated using the prepared bacterial inoculums within the range of 10^{7}-10^{8} cfu/ml. Plants were inoculated by spraying the bacterial suspension in the evening using a hand atomizer, the leaves and emerging shoots were all sprayed until there was a runoff. The seedlings were imme-

diately covered with a transparent polythene bags to improve relative humidity and avoid drying of the inoculated pathogens. This was later kept under shade for 48 hours so that the inoculum can incubate and later observed fpr seven days on the occurrence and progress of wilt disease symptoms.

Data Collection

The growth and yield parameters were collected based on the following: plant height (cm),stem diameter (cm), number of branches, number of leaves, number of flowers, number of fruits, Seed weight(g), fruit weight (g)
Disease Severity: Disease severity was recorded weekly and this was done based on the scale of 0-6 (Opara and Wokocha, 2008) as follows:
0-Leaves without spot; 1- one or two spots on leaves; 2- 10% of the leaves covered with spots; 3- 25% of the leaves covered with spots; 4- ½ (50%) of the leaves covered with spots; 5- 2/3 (75%) of the leaves affected; 6- The entire leaf area affected.

Laboratory Experiment

Isolation of Pathogen: The plant materials were collected from infected tomato leaves and fruits samples from the field. Isolation from disease sample was carried out by scrapping a small piece of infected spots or lesion from the leaves and fruits with sterile scalpel. The tissue was washed thoroughly three times in sterile distilled water and allowed to stay for 30 minutes before culturing. A loopful of bacterial suspension was streaked on nutrient agar in Petri dishes and allowed to stay for 24-48 hours. A pure culture was obtained by sub-culturing for two more times.

Preparation of Plant Extracts: The plant extracts used were neem (*Azadirachta indica*), siam weed (*Chromoleana odorata*) and bitter leaf (*Vernonia amygdalina*). The plant materials were sourced from Michael Okpara University of Agriculture, Umudike and its environment. The plant materials collected were washed and air dried and weigh into 20g before grinding with hand grinding machine into powdery form. The powdered plant materials were suspended into 100ml of sterile water, stirred and allowed to stand in water for 24 hours using sterile conical flask after which the suspension of each plant extract was filtered using cheese cloth and the suspension was later used as the plant extract, (Stoll,, 2000).

Preparation of Culture Media: The medium that was used in bacterial culture was nutrient agar. This was prepared by weighing out 6.25g of readymade nutrients agar powder (Baco©) into a conical flask and dissolved in 250ml of sterile water. The mixture was thoroughly shaken and heated to melt over an oven and then autoclaved at 120^{o}C for 30 minutes. This was followed by the dispensing of 15ml of the nutrients agar medium into Petri-dish after it has cooled down to 45^{o}C and allowed to solidify, then the culture plates were kept upside-down in an oven at 30-33^{o}C to allow the moisture to dry. Prior to inoculation of the bacterium the chamber was surface sterilized with 70% absolute ethanol. After which pure single colonies of bacterium were inoculated on the nutrient agar medium and kept in an incubator at 28^{o}C for 48 hours. Pure culture was however obtained by sub culturing two or three more times.

Bacterial Isolation from infected Seed: The seed samples were surface sterilized with 1% sodium hypochlorite for 1 minute and washed three times with sterile water to remove the sodium hypochlorite on the seeds, 30 seeds of each sterilized variety were cultured onto a sterile medium (nutrient agar), using a flamed forceps, kept in the inoculation chamber for 24 hours to incubate. The experiment was repeated three times for consistency. The bacterial suspension was sub-cultured onto the nutrient agar (NA) in Petri-dishes by streaking, using flamed wire-loop and allowed to incubate at 30^{o}C for 48 hours. This was repeated several times to obtain pure colonies. 2.5ml of the filtered plant extract was mixed with 2.5ml of sterile water in a syringe; a drop of sterilized plant extracts was suspended on the inoculated culture medium to observe its effect on the radial growth of the bacteria.

RESULTS AND DISCUSSION

Field Experiment

Treatment with Plant Ashes: Data obtained from the plants treatments ashes, showed that all three treatments were effective in controlling the bacterial wilt disease of *Solanum lycopersicon* when compared with the untreated control (Table 1).

Anti-bactericidal effect of Ashes on the Disease Severity of Six the Tomato Varieties
Data obtained showed that there were significant differences on the disease severity on the varieties tested (P>0.05). However, var Tylka (1.00) recorded the least disease severity and the best control, followed by var GS 12 (1.24), var RFT732216 (1.23), while the poorest in control was var plumpty (1.97) which recorded the highest values (Table 2).

Effect of Ash Constituents on Growth and Yield Performance of Tomato (plant height)

From the plant height data obtained (Table 2) it showed that the three ashes used differed from each other significantly (P> 0.05) but performance were better than

Table 1: Effect of Some Ashes on plant height (cm) of Six Tomato Varieties

Varieties	**Oilpalm-bunch ash**(cm)	**Wood ash**(cm)	**Sawdust ash**(cm)	**Untreated Control**
Tylka	75.37	81.00	48.57	35
RFT732216	77.77	75.20	64.10	37
PLUMPTY	62.43	60.10	60.43	32
GS12	56.47	53.23	48.00	26
SAHEL	56.23	60.33	46.67	25
LOCAL	56.00	50.23	43.57	20
LSD (0.05)	19.06	14.71	18.73	11.05

Table 2: Effect of Ashes of plant material on Stem diameter (cm) on Six Tomato Varieties

Varieties	**Oil palm bunch ash**	**Wood ash**	**Saw dust ash**	**Untreated Control**
TYLKA V_1	2.87	2.74	2.47	1.5
RFT732216 V_2	2.47	2.30	2.30	1.7
PLUMPTY V_3	2.47	2.30	2.21	1.2
GS 12 V_4	2.57	2.510	2.50	1.6
SAHEL V_5	2.37	2.20	2.22	1.5
LOCAL V_6	2.53	2.30	2.57	2.0
LSD (0.05)	NS	0.42	NS	0.05

untreated. Oil palm bunch ash (19.05cm) and that of saw dust (18.73cm) proved to be more effective while kitchen wood ash (14.72cm) was less effective. For oil palm bunch, var RFT 73221 (77.76cm) gave the highest plant height followed by var TYLKA (75.36cm) and then var Plumpty (62.43cm) while var GS 12 (56.47cm), var Sahel (56.23cm) and var Local (56.00cm) had the least values. For wood ash, data obtained showed that var Tylka (81.00cm), gave the highest plant height (60.33) and var Plumpty (60.10cm) while var local (50.23cm) and var GS12 (53.23cm) had the least values. While for saw dust ash treatment, the result showed that var RFT732216 (64.10cm) had the best plant height followed by var plumpty (60.43cm), then var Tylka (48.57cm) and var GS12 (48.00cm) while var Sahel (46.67cm) and var Local (43.56cm) had the least values.

Effect of Ash Constituents on Stem Diameter of Six Tomato varieties

For stem diameter, results obtained in Table 3 showed that oil palm bunch ash (0.54cm) and saw dust ash (0.54cm) did not differ significantly at P<0.05 while wood ash (0.49cm) significantly differed from others. For oil palm ash, the result showed that var_1 Tylka (2.87cm) had the highest value followed by var_4 GS 12 (2.57 cm) and var_6 local (2.53 cm). While var_2 RFT732216 (2.46 cm), var_5 Sahel (2.37 cm) and var_3 plumpty had the least stem diameter.

For wood ash, var_1 Tylka (2.73 cm), gave the highest value at P>0.05 stem diameter followed by var_4 GS 12 (2.51 cm) while var_6 local (2.30 cm) var_2 RFT732216 (2.30 cm) var_3 plumpty (2.30cm) and var_5 Sahel (2.21 cm) had the least stem diameter. For saw dust ash, var_6 local (2.57cm) had the highest stem diameter followed by var_4 GS 12 (2.50 cm), then var_1 Tylka (2.67), while var_3 Plumpty (2.10 cm), var_5 Sahel (2.22 cm) and var_2 RFT 732216 had the least values.

Effect of Ashes of plant materials on Number of Leaves of six Tomato Varieties

From the trial (Table 3), all the three treatment used were all significantly different from each other at P<0.05). Although saw dust ash (2.4362) had the highest number of leaves, followed by oil palm bunch ash (1.7978), then wood ash, (1.5999). For oil palm bunch ash (1.79), var_1 Tylka (14.53), had the highest number of leaves at p >0.05 followed by var_2 RFT732216 (12.56) and var_5 Sahel (12.67) while var_3 Plumpty (11.57); var_4 GS 12 (11.57) and var_6 local (11.33) had the least values. For wood ash (1.59), var_1 Tylka had the highest value at P>0.05

Table 3: Effect of Ashes of plant materials on Number of Leaves of Six Tomato Varieties

Varieties	Oil palm bunch ash	Wood ash	Saw dust ash	Untreated Control
TYLKA V_1	14.53	15.53	13.00	9.5
RFT732216 V_2	12.57	11.67	11.67	7.7
PLUMPTY V_3	11.57	11.10	11.10	6.2
GS 12 V_4	11.57	11.10	11.10	7.6
SAHEL V_5	12.57	12.23	10.63	8.5
LOCAL V_6	11.33	11.87	9.67	6.0
LSD (0.05)	1.7978	1.5999	2.4362	1.05

followed var_5 Sahel (12.23) while var_2 RFT732216 (11.67), var_6 local (11.87), var_3 plumpty (11.57) and var_4 GS 12 (11.10) which were not significantly different from each others. However, recorded the least number of leaves. For saw dust ash, data obtained showed that var_1 Tylka (2.62) recorded the highest value at p>0.05 then var_2 RFT732216 (11.67), var_4 Plumpty (11.10), var_4 GS 12 (11.10) while var_6 local (9.67) and var_5 Sahel (10.63) had the least values.

Effect of Ashes of plant materials on Fruit Weight of Six Tomato Varieties

From the data obtained (Table 4) the three treatment used are all significantly different from each other at P>0.05. Although saw dust ash (607.15) recorded the highest value followed by wood ash (538.25) then oil palm bunch ash (473.71).

For oil palm bunch, data obtained showed that var_5 Sahel (1033.30) recorded the highest fruit weight, followed by var_4 GS 12 (966.71), then var_3 plumpty (6333.30) and var_6 local (453.30) while var_1 Tylka (106.7) and var_2 RFT732216 (1.66.70) recorded the least fruit weight.

For wood ash (538.25) data obtained indicate that var_4 GS 12 (900.00) had the highest value followed by var_3 plumpty (700.00) var_5 Sahel (633.30), var_2 RFT732216 (366.70), var_6 local (266.70) while var_1 Tylka (93.30) recorded the least fruit weight.

For saw dust ash, (607.15) the result obtained showed that var_5 Sahel (900.00) had the highest value, followed by local (666.70) var_4 GS 12 (633.30) , then var_3 plumpty (426.70) while var_1 Tylka (290.00) and var_2 RFT 732216 (286.70) had the least values.

This is similar to the work done by Osai *et al.(* 2013) which reported that the use of ash from readily available agricultural by-product (plantain inflorescence) was investigated as a potential measure for this disease. Different concentrations of plantain rachis ash were tested in-vitro for this effect of the growth, sporulation and spore germination of the causal fungus (*Phoma sorghina*). In a repeated green house experiment using artificial spray inoculation and field experiments using natural infection, plantain rachis ash consistently suppressed the growth and sporulation of the pathogen and reduced leaf spot disease

Effect of Some Plant Extracts on Disease Incidence of Six Tomato Seed Variety

For disease incidence (32.16) the data obtained in Table 5 showed that the six tomato varieties were not significantly different at P>0.05. However, var_2 RFT732216 recorded the highest value followed by var_5 Sahel (85.80) var_1 Tylka (84.43) and var_6 local (84.43) while var_4 GS 12 (79.87) and var_3 plumpty (72.20) recorded the least disease incidence.

For bitter leaf, (0.66) the result obtained showed that they are significantly different at (p>0.05). Although var_6 local (1.93) had the highest value followed by var_3 plumpty (1.73), then var_4 GS 12 (1.43) and var_5 Sahel (1.40) while var_2 RFT732216 (1.03) and var_1 Tylka (1.07) recorded the least values. For Siam weed (0.51) the data obtained indicate that they are not significantly different from each other. However, var_5 Sahel (1.87) recorded the highest value followed by var_3 plumpty (1.67), var_4 GS 12 (1.57) while var_6 local (1.47), var_1 Tylka (1.47) and var_2 RFT732216 which are significantly different from each other recorded the least value .For Neem (0.57) the data obtained showed that they are significantly different from each other at P>0.05. However, var_3 plumpty (2.03) recorded the highest value followed by var_6 local (1.87), var_4 GS 12 (1.80) and var_1 Tylka (1.50) while var_2 RFT732216 (1.13) had the least values.

This is similar to the work done by Arikpo *et al.* (2014) which reported that plant extracts have been recorded and shown to have significant activities again rot-causing organisms in fruits and other plant products (Bankole and Adebanjo, 1995). Also the use of extracts from higher plants in the control of a wide range of fungai disease that infect crops plants have been reported by previous researcher (Kurucheve *et al.,* 1997).

Table 4: Effect of Ashes of plant material on Fruit Weight of Six Tomato Varieties

Varieties	Oil palm bunch ash	Wood ash	Saw dust ash	Untreated Control
TYLKA V_1	473.71	538.25	607.15	201.05
RFT732216 V_2	166.70	366.70	286.70	107.7
PLUMPTY V_3	633.30	700.00	426.70	106.2
GS 12 V_4	966.70	900.00	633.30	207.6
SAHEL V_5	1033.30	633.30	900.00	208.5
LOCAL V_6	433.30	266.70	666.70	226.0
LSD (0.05)	106.70	93.30	290.00	96.5

Table 5: Effect of Some Plant Extracts and Disease Incidence on Six Tomato Seed Varieties

Varieties	Disease incidence%	Bitter leaf	Siam weed	Neem	Untreated Control	Untreated Control
TYLKA V_1	84.43	1.07	1.47	1.50	1.5	201.05
RFT732216 V_2	97.80	1.03	1.47	1.13	1.7	107.7
PLUMPTY V_3	72.20	1.73	1.67	2.03	1.2	106.2
GS 12 V_4	79.87	1.43	1.57	1.80	1.6	207.6
SAHEL V_5	85.80	1.40	1.87	1.63	1.5	208.5
LOCAL V_6	84.43	1.93	1.47	1.87	2.0	226.0
LSD (0.05)	NS	0.6635	NS	0.574	0.05	96.5

Effects of Plant extracts on the Growth and Yield Performance of Six Tomato Varieties

Result on combined effects of plant extracts on yield performance are summarized in Table 6. For instance, on the stem diameter (0.88cm) at (P>0.05), data obtained showed no significant difference. Although, var_3 plumpty (3.43) had the highest value, followed by var_5 Sahel (3.17cm), var_2 local (3.10cm), var_2 RFT732216 (3.03cm) while var_4 GS12, (2.90cm) and var_1 Tylka (2.70cm) had the least values (Table 6).

Results obtained from the effect on number of branches (2.46) at (P>0.05), showed that the values were significantly different. However, var_6 local (6.93) had the least value followed by var_3 plumpty (7.27), var_1 Tylka (8.100), var_4 GS12 (8.50) while var_2 RFT732216 had the highest value (Table 6).

Result obtain from the number of leaves (2.48) at (P>0.05), showed that the values had no significant difference. Although var_1 Tylka (10.37) had the least value followed by var_6 local (10.60), var_5 Sahel (11.60); var_3 plumpty (11.60) while var_4 GS12 (11.77) had the highest value.

Result obtained from number of flowers (2.19) at (P>0.05), showed that the value had no significant difference. However var_2 RFT733316 (6.23) had the least value followed by var_4 GS12 (6.43), var_5 Sahel (723) var_3 plumty (7.43) while var_1 Tylka (8.100) and var_6 local (8.33) had the highest values (Table 6).

Result from number of fruits (2.19) at (P>0.05) showed that the values differed significantly, Sahel (1.67) had the least value followed by var_3 plumpty (1.70), var_6 local (2.67), var_4 GS12 (2.70) while var_1 Tylka (4.00) and var_2 RFT732216 (5.33), had the highest values. In the case of fruit weight (35.04) at (P>0.05). Showed that the values had no significant difference, however var_4 GS12 (16.63) had the least value followed by var_5 Sahel (19.73), var_1 Tylka (29.07), var_2 RFT732216 (30.67) while var_3 plumpty (44.53) and var_6 local (47.83) recorded the highest values (Table 6).

While from seed weight (0.1726) at (P>0.05), showed that the values differed significantly var_2 RFT732216 (1.40) and var_5 Sahel (1.40) recorded the least values, followed by var_3 plumpty (1.50), var_4 GS12 (1.5000), var_6 local (1.50) while var_1 Tylka (1.60) recorded the highest value (Table 6).

This is similar to the work done by Osai *et al.* (2013) which reported that the use of ash from readily available agricultural by-product (plantain inflorescence) was investigated as a potential measure for this disease. Different concentrations of plantain rachis ash were tested in-vitro for this effect of the growth, sporulation and

Table 6: Combined Effects of Plant extracts on the Growth and Yield Performance of Six Tomato Varieties

Varieties	Disease severity	Plant height	Stem diameter	No of branches	No of leaves	No of flowers	No of fruit	Seed weight	Fruit weight
TYLKA V_1	1.00	39.37	2.70	8.10	10.37	8.10	4.00	1.60	29.07
RFT 732216V_2	1.27	43.77	3.03	9.93	11.27	6.23	5.33	1.40	30.67
PLUMPTY V_3	1.97	38.03	3.43	7.27	11.60	7.43	1.70	1.50	44.53
GS 12 V_4	1.24	32.87	2.90	8.50	11.77	6.43	2.70	1.50	16.63
SAHEL V_5	1.83	38.87	3.17	9.17	11. 60	7.23	1.67	1.40	19.73
LOCAL V_6	1.55	32.03	3.10	6.93	10.60	8.33	2.67	1.50	47.83
LSD(0.05)	0.7848*	9.5291*	NS	2.455*	NS	NS	3.6557*	0.1726*	NS

*= Significant
NS= Non significant

Table 7: Weather Records in Umudike During The field Experimental period (2013 cropping Season)

Months	Mean rainfall (mm)	Mean temp (^{O}C)	Sunshine (Hr)	R /H (%)
January	37.70	28.00	6.2O	54.50
February	12.16	28.70	4.50	61.00
March	5.10	28.70	5.00	69.00
April	10.31	28.20	4.80	71.50
May	29.13	27.60	5.70	76.00
June	21.76	26.70	3.90	81.00
July	15.58	25.80	2.20	81.00
August	15.80	26.10	2.30	80.50
September	17.66	26.30	2.10	72.00
October	13.20	26.90	4.30	78.50
November	12.44	27.40	4.70	75.00
December	12.97	26.60	6.20	67.50
Total	266.85	327	51.90	786.50
Mean	22.23	27.25	4.33	65.54

spore germination of the causal fungus (*Phoma sorghina*). In a repeated green house experiment using artificial spray inoculation and field experiments using natural infection, plantain rachis ash consistently suppressed the growth and sporulation of the pathogen and reduced leaf spot disease.

Effect of weather records on disease

The weather data obtained (Table 7) showed change in disease severity in relation with change in weather condition during the field experimental period (2003) cropping season. this is attributed to a number of environmental and climatic factors and also the active ingredient content of each material used e.g. tomato was planted in the month of April 2013, with rainfall 10.31mm, temperature 28.20^{0}C sunshine 4.80Hr,relative humidity 71.50% with least disease severity.

In the month of May, rainfall 29.13mm, temperature 27.60^{0}C, sunshine 5.70Hr relative humidity 76.00% with the highest disease severity. In the month of June, rainfall 21.76mm,temperature 26.70^{0}C, sunshine3.90Hr and

relative humidity 81.00%, with moderate disease severity.Tomato is a warm season crop it requires warm and cool climate. The crop is highly affected by adverse climatic condition. It requires different climate range for seed germination, seeding growth, flower and fruit set, and fruit quality (Donelly, 2008) temperature below 10^0C and above 38^0C adversely affects plant tissues, thereby slow down physiological activities. It thrives well in temperature of 10^0C to 30^0C and optimum relative humidity of 60-80%.Tomato is sensitive to low light condition, requiring a minimum of 6 hours of direct sunlight for flowering (Villarreal, 1980).

Etebu *et al.* (2013) reported that the cultivation of tomato in the South-South region especially Bayelsa and Delta states is faced with serious constraints, because the states are situated in the heart of the tropical rainfall region with its low topography. Another constraints is the fact that the states witness a greater period of rainfall (April to November) which does not support the growth of this heat loving crop.

Result of Artificial Inoculation on potted plants

The results obtained from the plant height (9.53) at P>0.05 showed that the values were significantly different. However, var_6 local (32.03) had the least value followed by var_4 GS12 (32.87), var_3 plumpty (38.03), var_5 Sahel (38.87), var_1 Tylka (39.37). While the var_2 RFT732216 (43.77) had the highest values

CONCLUSION

The test plant ash materials and aqueous extracts used in this study which are commonly found locally, could be used for the control of bacterial disease of tomato. For field experiment, it was observed that wood ash and saw dust ash were superior to the other treatment because of their least disease incidence Although all the plant extracts significantly reduced bacterial disease of tomato but neem (*Azadirachta indica*) was superior to the other treatments because of their ability to inhibit the growth of bacterial disease.. It is recommended that *A. indica, V. amygdalina*, wood ash and saw-dust ash can be used as a control of this tomato disease by farmers.

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