Comparative Efficacy of J*atropha curcas* and some Selected Botanical Pesticides in suppressing Virus disease in Cowpea [*Vigna unguiculata (l.) walp*]

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Abstract

Potted experiment was carried out to compare the efficacy of the use of aqueous leaf extracts of *Jatropha curcas* and some other botanicals used as pesticides in suppressing virus disease in cowpea plants (cv. Ife –brown), that were mechanically inoculated with cowpea mottle virus (CM_eV) isolate. The experiment was designed in a complete randomized fashion with three replications and was carried out between August and October 2011. The results of the experiment showed that the botanicals used as insecticides were effective in suppressing virus disease incidence by preventing supra infection on virus inoculated cowpea. The suppressive ability of the biopesticides resulted in the plants exhibiting less susceptibility to the virus pathogen. In addition, the treated plants manifested improved growth and yield attributes compared with the plants that were not sprayed with any of the biopesticide. Comparatively, the highest virus disease reduction and the best growth and yield indices were recorded in the cowpea plants that were treated with *Jatropha* curcas leaf extract as biopesticide. The results of this study indicated that the botanicals used as biopesticide caused a significant reduction in virus incidence on cowpea and aqueous leaf extract of *J. curcas* was the most effective in this regard. The use of aqueous leaf extract of *Jatropha curcas* could therefore proof an alternative to chemicals in virus disease control.

Key words: Virus disease control, cowpea, biopesticide, Jatropha curcas, Allium sativum, Capsicum frutescence, Vernonia amygalina, Cowpea mottle virus, Inoculation.

Introduction

Cowpea *Vigna unguiculata (L.)* originated in Africa and it became an integral part of traditional cropping systems throughout Africa, particularly in the semiarid region of West African savanna (Steele, 1972) is one of the most economically and nutritionally important indigenous African grain legumes produced throughout the tropical and subtropical areas of the world (Gowda *et al*., 2000). Nigeria is the world's largest producer, consumer and importer, of cowpea (Grubben and Denton, 2004). Yield losses of up to 87% and the complete loss of the crop in Northern Nigeria has been attributed to infection by viruses (Raheja and Leleji, 1974; Shoyinka *et al*.,1997). The use of plant products/extracts have been found to be effective against a wide range of pathogens and a number of plant materials have been explored as sustainable alternatives for controlling insect vectors of plant pathogens (Bowers and Locke, 2004). The current global research efforts now supports the development of plant products with proven crop protection potentials compared to the use of chemicals which may be toxic to both the plants and environment and their user friendliness as control agents. Approximately 20% of the world plants have been subjected to pharmacological or biological test and it could be said that natural products of plant origin are important source of constituents that could be developed into drugs, dyes, fragrance and pesticides (Hamburger and Hostattman, 1991). The objective of this study therefore, was to compare the efficacy of aqueous extracts of leaves of *Jatropha curcas* and some other botanicals in suppressing virus disease incidence in cowpea.

Materials and Methods

The experimental design was a complete randomized block design (CRD) with three replications. Two cowpea seeds each were sown per plastic buckets (10 litre) which had been filled with sandy-loam soil that was previously steam-sterilized at 121°C for 60 minutes. The two plants in each pot were mechanically inoculated at 14 days after planting with cowpea mottle virus isolate obtained from the International Institute of Tropical Agriculture (IITA) Ibadan. The inoculation process was according to the procedures of Balogun (2000). The insecticidal treatments were *Allium sativum* (garlic), *Capsicum frutescence* (Chilli pepper), *Vernonia amygalina* leaf (bitter leaf), and *Jatropha curcas* leaf (psychic nut). The insecticidal preparations was done by grinding 5 grams of each botanical into thick paste and then 45ml of distilled water added to collect aqueous form of the crude extract. The control plants had no insecticidal treatments but water sprays. The biopesticides were prepared 30 minutes before each spray regime. The insecticides were applied to the plants 2weeks after mechanical inoculation with the virus and at 2weeks interval thereon until the onset of podding. Each treatment (which was replicates thrice), had 5pots with at least two plants in each pot. Data were collected weekly from the second week after inoculation. Data collected were on number of leaves per plant, number of leaves with virus disease symptoms, plant heights, leaf area, number of pods per plant, pod weight per plant (g) and seed weight per plant (g). Percentage virus disease incidence per plant (% D.I) was calculated by the following method as proposed by Allen *et al*. (1983).

$$\% \text{ D.I} = \frac{\text{Total number of virus symptomatic leaves per plant}}{\text{Total number of leaves per plant}} \times 100$$

All the collected data were statistically subjected to analysis of variance (ANOVA) using the GENSTAT Discovery Edition 3 and treatment means compared using the new Duncan's Multiple Range Test at 5% level of probability (P≤0.05).

Results and Discussion

Percentage disease incidence

Table 1 shows the treatment effect on percentage disease incidence. It can be seen that at the 2nd week of data collection, treatment with *J. curcas* (1.4%) and *A. sativum* (1.6%) produced the lowest disease incidence. On the other hand, treatment with *C. frutescence* (4.1%) and *V. amygalina* (3.5%) were similar to the control that produced the highest disease incidence (3.6%). At the 3rd week of observation treatment with *J. curcas*. produced the significantly lowest diseases (2.3%), followed by *A. sativum* (3.9%), *V. amygalina* (4.8%) and *C. fru tescence* (5.2%). This same trend was observed through to the 7th week. This shows that the use of botanicals as pesticides significantly reduced virus incidence. The result also showed that *J. curcas* leaf extract was the most effective in suppressing virus incidence. The compounds that have been isolated from *J. curcas* leaves include the flavonoid apigenin and its glycosides vitexin and isovitexin, the sterols stigmasterol, β-D-sitosterol and its β-D-glucoside (Chhabra *et al.*, 1990). These compounds are recognized to be biologically active, and induce systemic acquired resistance (SAR) against pathogens in plants (Siegrist *et al*., 2000) by exerting antimicrobial activity through different mechanisms (Igbinosa *et al.*, 2009). It could therefore be suggested that these compounds found abundantly in *J. curcas* leaves could be responsible for the induced resistance to viruses that was observed in this study.

Growth parameters

Tables 2, 3, 4 and 5 show the effect of treatments on growth parameters such as plant height, number of leaves and leaf area. Table 2 showed that at 1st week of observation, plant heights were similar irrespective of the treatment. However from the 2nd to the 7th week, the results showed that plants treated with botanical pesticides were significantly taller than the control. By week 7, *J. curcas* treated plants were the tallest (27.6cm), followed by *A. sativum* (22.6cm), the control had the significantly shortest plants (15.6cm). The effect of treatment on number of leaves (table 3) showed that from the 2nd to the 7th week, significant differences existed among them. The highest number of leaves were recorded for *J. curcas* treatment. By the 7th week ,the number of leaves per plant was 30, this value was twice the number of leaves on the control plants. Leaf area was also significantly influenced by the treatments (table 4). By the 2nd week *J. curcas* and *A. sativum* had the significantly highest leaf area (15.4cm^2 and 15.1cm^2 respectively), while the other three treatments were not significantly different from each other. At the 7th week however, the control plants had the significantly lowest leaf area (15.6cm^2), while *J. curcas* had the significantly highest (32.7cm^2), followed by *A. sativum* (23.5cm^2), *V. amygalina* (20.4cm^2) and *C. frutescence* (17.4cm^2). These results showed that growth parameters were inhibited by virus infection especially in the control. Pio-Ribeiro *et al*.(1978), had indicated that viruses interact synergistically to produce severe reduction in growth attributes. Plant growth promotion is usually due to the improvement of plant resistance to biotic stresses such as pathogens and vectors (Epstein, 1999). The botanicals that were used particularly *J. curcas* improved the growth attributes and this could be as a result of growth hormones present in the botanicals. *J. curcas* leaves have been reported to contain steroid sapogenins, alkaloids, the triterpenae alcohol, 1-triacontanol and a dimer of a tripene alcohol (Neuwinger, 1994). These hormones play a favourable role in the growth and development of plants (Engelberth *et al.*, 2001).

Yield Attributes

Table 4 shows the effect of treatments on some yield indices. At the onset of pod formation (4th week), there were significant differences for all the treatments. *J. curcas* treatment had the significantly highest numbers (4.3). At the 5th week, although *J. curcas* still had the significantly highest number of pods (7.6), the values were not significantly different for the treatments with *V. amygalina* (3.7) and *C. frutescence* (2.8). At the end of pod formation (7th week), number of pods was significantly highest for *J. curcas* (17.2), followed by *A. sativum*(12.4), *V. amygalina* (10.0) and *C. frutescence* (7.6). The control had the significantly lowest number of pods (2.8). As with the other parameters, pod weight per plant and seed weight per plant was significantly highest in the *J. curcas* (21.1g and 15.3g), followed by *A. sativum* (17.1g and 12.7g), *V. amygalina* (10.8 and 6.1), *C. frutescence* (6.6g and 3.8g) and the significantly lowest pod and seed weight per plant in the control (3.0g and 1.8g). Green and Kim (1991) had reported that viruses altered the metabolism of plant cells causing the plants to grow abnormally; a condition that causes both decreased yield and visible symptoms. Awasthi *et al.* (1987) had suggested that virus inhibition by the use of botanicals as insecticide occurred through an alternation in the host physiology that inhibited virus multiplication in the cells. Botanicals have been reported to act as a repellent as well as antifeadent for vectors (Awasthi and Rizvi 1999). It could therefore be inferred that the botanical pesticides improved yields by acting as insect vector repellent and by conferring acquired resistance thereby preventing supra – infections by some other viruses.

Conclusion

This study concludes that the use of botanicals as biopesticides resulted in virus disease suppression and ultimately increase yields in cowpea. *Jatropha curcas* offered the best control and looked the most promising. However field experiments to further confirm the result is in progress.

Table 1: Effect of the treatments on percentage disease incidence

Insecticide	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7
Allium sativum (garlic)	0	1.6b	3.9c	6.5c	11.1a	10.1d	10.7cd
Capsicum frutescence	0	4.1a	5.2b	7.8b	9.3b	12.9b	13.2b
Vernonia amygalina	0	3.5°	4.8bc	6.9c	9.1b	11.2bc	11.8c
Jatropha curcas	0	1.4b	2.3d	3.7d	5.0a	7.1e	8.0e
Control	0	3.6°	7.8a	8.5a	11.0a	13.1a	13.6ab
S.E	0	0.3	0.43	0.48	0.65	0.61	0.53
L.S.D	0	0.6	0.89	0.98	1.3	1.2	1.1

Means with the same letter (s) within each column are not significantly different at 0.05 level using Duncan's Multiple Range Test.

Table 2: Effect of the treatments on Plant height

Insecticide	Wk 1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7
Allium sativum (garlic)	7.6	12.2 b	16.2b	19.5b	21.5b	22.6b	23.3b
Capsicum frutescence	7.6	9.6c	11.5d	13.5d	15.7d	16.8d	17.7d
Vernonia amygalina	7.6	11.7 b	14.4c	16.7c	18.7c	19.9c	20.7c
Jatropha curcas	7.8	15.1a	20.9a	24.6a	27.7a	28.6a	28.8a
Control	7.8	8.4d	9.9e	11.6e	14.0e	15.6e	16.2e
S.E	0.20	0.38	0.49	0.42	0.49	0.58	0.61
L.S.D	0.42	0.77	1.0	0.85	0.99	1.2	1.24

Means with the same letter (s) within each column are not significantly different at 0.05 level using Duncan's Multiple Range Test.

Table 3: Effect of the treatments on number of leaves

Insecticide	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7
Allium sativum (garlic)	3.5	9.3b	13.6b	17.8b	19.7b	22.6b	23.7b
Capsicum frutescence	3.6	4.8d	6.9d	9.0d	12.1d	14.5d	15.6d
Vernonia amygalina	3.7	7.3c	10.0c	13.0c	16.4c	18.8c	20.6c
Jatropha curcas	3.5	11.7a	16.9a	21.0a	24.6a	28.4a	29.8a
Control	3.7	4.4d	6.2e	7.4e	10.7e	13.6d	14.6d
S.E	0.20	0.24	0.29	0.34	0.35	0.43	0.53
L.S.D	0.41	0.48	0.58	0.70	0.71	0.87	1.1

Means with the same letter (s) within each column are not significantly different at 0.05 level using Duncan's Multiple Range Test.

Table 4: Effect of the treatments on leaf area

Insecticide	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7
Allium sativum (garlic)	11.1	15.1a	17.7a	20.4b	22.5b	23.5b	23.5b
Capsicum frutescence	10.9	12.2 b	13.0bc	14.8d	16.8d	17.3d	17.4d
Vernonia amygalina	10.7	11.6 b	13.7b	17.5c	19.9c	20.3c	20.4c
Jatropha curcas	10.4	15.4a	18.2a	24.3c	26.8a	32.5a	32.6a.8°
Control	10.6	11.4 b	12.2c	13.3e	15.0e	15.4e	15.6e
S.E	0.27	0.48	0.44	0.50	0.53	0.51	0.52
L.S.D	0.55	0.97	0.89	1.0	1.1	1.0	1.0

Means with the same letter (s) within each column are not significantly different at 0.05 level using Duncan's Multiple Range Test.

Table 5: Effect of the treatments on some yield parameters

Insecticide	No pods/plt Wk4	No pods/plt Wk5	No pods/plt Wk6	No pods/plt Wk7	Pod wt/plt (g)	Seed wt/plt (g)
Allium sativum (garlic)	2.5b	6.4b	9.6b	12.4b	17.1b	12.7b
Capsicum frutescence	0.5d	2.8c	4.6d	7.6d	6.6d	3.8d
Vernonia amygalina	1.2c	3.7c	6.9c	10.0c	10.8c	6.1c
Jatropha curcas	4.3a	7.6a	14.0a	17.2a	21.1a	15.3a
Control	0.2d	0.4d	1.8e	2.8e	3.0e	1.8e
S.E	0.31	0.48	0.45	0.26	0.6	0.34
L.S.D	0.64	0.98	0.92	0.92	1.2	0.69

Means with the same letter (s) within each column are not significantly different at 0.05 level using Duncan's Multiple Range Test.

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