**ORIGINAL RESEARCH REPORT** **NIGER. J. PLT. PROT. 37(2) 31-40 (2023)**

# EFFECT OF SAND PAPER (*Fiscus exasperata)* AND SODOM APPLE (*Calotropis procera) LEAF EXTRACTS* ON FUNGAL ORGANISMS ASSOCIATED WITH DISEASE OF MUSTARD IN ISHIAGU, EBONYI STATE

**[1]*YEKINI, B. A; [2]AFOLABI, C. G; [3]GANIYU, S. A; [2]FILANI, C. O. AND [4]OYELEYE, A. D**

[1]Crop Research Programme, Institute for Food Security, Environmental Resources and Agricultural Research (IFSERAR), Federal University of Agriculture, PMB 2240 Abeokuta Ogun State, Nigeria.
[2]Department of Crop Protection, Federal University of Agriculture, PMB 2240 Abeokuta Ogun State, Nigeria.
[3]Department of Agronomy, Federal University of Kashere, PMB 0182, Gombe State, Nigeria.
[4]Department of Agricultural Technology, Federal College of Agriculture, Moor Plantation, Ibadan, Oyo State, Nigeria
*Corresponding author: yekiniba@funaab.edu.ng

## SUMMARY

**Effect of two aqueous plant extracts were tested on fungal organisms associated with diseased mustard at Central Laboratory, National Root Crops Research Institute (NRCRI), Umudike, Abia State. The diseased mustard seedlings were sourced from an existing experimental field during 2022 cropping season at Teaching and Research Farm, Federal College of Agriculture, Ishiagu, Ebonyi State, Nigeria. Aqueous leaf extracts from *Fiscus exasperata* and *Calotropis procera* were used to inhibit the growth of the mycelial fungus at 0.5,1.0 and 1.5 w/v concentration levels in a Completely Randomised Design and replicated three times. Data collected were subjected to Analysis of Variance (ANOVA) using Minitab Version 17 and the means were separated using Tukey test at P<0.05. The results revealed five fungi organisms belonging to four genera were isolated which includes *Trichoderma* species, *Fusarium oxysporum*, *Sclerotium species, Fusarium solani* and *Alternaria* species. The results showed that *Fusarium solani* had the highest percentage of occurrence (32.56 %), followed by *Alternaria* species (25.58 %) while *Trichoderma* species had the least (4.65 %). The inhibitory effect of *C. Procera* ranged from 3.73 to 93.39 % with *Fusarium solani* and *Trichoderma* species respectively across the three concentration levels. Similarly, the inhibitory effect of *F. exasperata* ranged from 2.33 to 89.59 % with *Fusarium solani* and *Trichoderma* species respectively across the three concentration levels. Therefore, the potentials of *these two* aqueous extracts on the inhibition of mycelial growth of fungal organisms associated with mustard diseases are worthy. This study showed the prospect of *Fiscus exeparata and Calotropis procera* in the control of fungal disease of mustard and a possible alternative to chemical pesticides.**

**Key words:** Antifungal, *Fiscus exeparata, Calotropis procera, Mustard diseases*

**Mustard** (*Brassica juncea,* L.) belongs to the family *Brassicaceae* and is the third most important oilseed crop in the world after soybean (*Glycine max*) and palm (*Elaeis guineensis*) (18). It is an annual

plant that originates from the Mediterranean region (21). Brown mustard has been reported to be grown as a leafy vegetable in Western and Southern Africa, known as 'laulau' in Nigeria, 'mpiru' in Malawi and 'tsunga' in Zimbabwe (4). It is a winter-spring plant that may be produced in short cycles, typically in rotation with other cereal crops, with the potential for second crop cultures (15). Mustard is an annual plant with broad leaves and yellow flowers that grows up to 100 cm tall and has a relatively short growing season of 85-95 days. The yellow blooms, which bloom from May through June, have four petals. Mustard crops include edible oilseeds (31), fast-growing salads (30), sauces, fodder, and green manure (24). Toxic heavy metals can be extracted from soil by the plant (23). Young seedling leaves, which are high in vitamins A, C, and E, are edible as fresh and flavourful salad leaves and have blood purifying properties (30). Due to its high protein and oil content and low starch content, mustard seed has substantial agronomic utility (6). The seeds are highly disinfectant and can be used to preserve food (30). Also, as a result of its powerful antibacterial activity, its essential oil can be utilized to preserve goods (29).

Sand paper tree (*Fiscus exasperata*) is commonly known as "Ewe Ipin" in Yoruba and is widely spread in West Africa Forest re-growth. *Fiscus* is a genus of about 800 species and 2000 varieties of *Fiscus* of woody trees, shrubs and vines in the family *Moraceae* occurring in most tropical and subtropical forests worldwide (16). The potential antimicrobial activity of *Fiscus* species has been extensively reported in many investigations (27). In Nigeria, young leaves of *F. exasperata* are prescribed as a common anti-ulcer action, as anti-diabetic, lipid lowering and antifungal activities (36). The activities of leaf extract of *F. exasperata* against some pathogenic organisms have been extensively investigated (11; 28). Sirisha *et al.,* (34) reported the antifungal activities of the leaves of *F. exasperata*.

*Sodom apple (Calotropis procera*) belongs to the family *Apocynaceae* and is an invasive shrub, 2.5 m to 6.0 m tall adapted to poor soils (17). It is native to the arid regions of tropical Africa, India and Middle East (10). The species produces fruit all year round, and its seeds germinate with an enormous facility (7). The high potential of *C. procera* to invade pristine or economic important areas is of much concern, as it is also very difficult to eradicate (9;26). The antimicrobial activity of the leaf extracts of *C. procera* was evaluated and the inhibitory effect of extract of *C. procera* against *Candida albicans* was also observed (33). The antimicrobial activity of *Calotropis procera* was evaluated against pathogenic bacteria, *Staphylococcus aureus* and *Pseudomonas aeruginosa,* and one pathogenic fungus, *Candida albicans* (22). The antifungal activities of aqueous extract of *Calotropis procera* was determined against *Epidermophyton flocosum* and *Tricophyton gypseum* using agar diffusion techniques (25). The antimicrobial effect of ethanol, aqueous and chloroform extracts of leaf and latex of *C. procera* were studied on *Aspergillus niger, Aspergillus flavus, Microsporium boulardii* and one yeast *Candida albicans* using agar well diffusion and paper disk methods (20).

Infectious plant diseases are well known to account for a large share of health problems, particularly in underdeveloped nations. Many antimicrobials have developed resistance in microorganisms, posing a significant therapeutic challenge in the treatment of infectious disorders (14). This resistance has grown as a result of the indiscriminate use of commercial

antimicrobial medicines frequently used to treat infectious illnesses in plants. This circumstance forced scientists to look for new antimicrobial compounds in unexpected places, such as medicinal plants (19). Hence, the present study was carried out to investigate the effect of two aqueous plant extracts on mycelial growth of fungal organisms associated with mustard disease on the field.

## MATERIALS AND METHODS

**Research Location**

These experiments were conducted at Central Laboratory, National Root Crops Research Institute (NRCRI), Umudike, Abia State, Nigeria.

**Source of the two plants tested**

The Sand paper (*Fiscus exeparata)* and Sodom apple (*Calotropis procera)* leaves were source from Amagu community, Ishiagu Ebonyi State

**Source of diseased mustard seedlings**

The diseased mustard seedlings were sourced from an existing experimental field during 2022 cropping season at Teaching and Research Farm, Federal College of Agriculture, Ishiagu, Ebonyi State, Nigeria.

**Preparation of Potato Dextrose Agar (PDA)**

The Potato Dextrose Agar (PDA) was prepared by weighing 39.0 g of PDA powdered; this was poured into sterile Distilled water (SDW) in a conical flask and made up to 1.0 litre. The flask was swirled gently to allow dispersion of the PDA powder in the added water. The PDA medium contained in the conical flask were plugged with cotton wool and covered with aluminium foil paper this was later sterilized in an autoclave at 121 for 15minutes. The sterilized medium was subsequently allowed to cold to 45 and streptomycin at the rate of 20ml/L (PDA) were added and poured aseptically into 9cm diameter Petri dishes, covered and allowed to solidify.

**Isolation and identification of fungi associated with mustard seedlings**

Each sample of diseased mustard seedling showing symptoms were collected from an existing experimental plot were washed in clean water and sections of about 1cm in diameter were cut from the tissue, using sterilized scalpel, at the interface between healthy and infected portions of the sample. The pieces of the tissue were surface sterilized with 1% sodium hypochlorite for 2 minutes, and rinsed in 5 sections of the cleaned sample were plated out on potato dextrose agar (PDA). The inoculated Petri dishes were incubated at 28±2 for 5 days and observed daily for fungi development. The various fungi isolated from each of the samples were sub-cultured by transferring hypha tips from the colony edges to fresh PDA plates using a flame sterilized mounted needle to obtain a pure culture, and incubated at 28 . Cultures were identified using identification keys describe by Barnett and Hunter (8).

**Determination of fungal frequency of occurrence**

The most prevalent fungi in the study sample were identified by the frequency of occurrence of each of the isolated fungus from the infected tissue obtained from a particular treatment. This was determined by recoding the number of times each fungus was encountered. It was calculated using the formula below;

$$\text{Frequency (\%)} = \frac{\text{Number of isolates}}{\text{Total number of fungi occurrence}} \times 100$$

***Preparation of plant extract***

Fresh fully expanded leaves of *Fiscus exeparata* and *Calotropis procera* were washed thoroughly with water and soaked in a 1 % solution of sodium hypochlorite for 2 minutes, rinsed severally with sterile

distilled water. Three different aqueous extract concentrations were prepared by weighing 5, 10 and 15 g of the leaves on a Mettler-Toledo AG balance, AB104, Switzerland, and blended in a Eurosonic, ES210, Great Star, Asia, blender and 100 ml of sterile distilled water added for 12 hours. Extract concentrations of 0.5, 1.0 and 1.5 % were obtained. All the extracts were allowed for 12 hours to settle, sieved through four layers of sterile cheese-cloth and kept in the refrigerator until used.

**Effect of aqueous plant extract on fungal mycelia growth**

The method of Amadioha and Obi (3) was used to determine the effect of the aqueous extract on fungal growth using completely randomized design (CRD) with three replications. This involved creating four-equal sections on each petri-dish by drawing two perpendicular lines at the bottom of the plate, the point of intersection indicating the centre of the plate. This was done before dispensing PDA into each of the plates. One ml of each extract concentration was dispensed per petri dish and 9 ml of molten PDA were added to prepare a PDA-extract mixture with corresponding 0.5, 1.0 and 1.5 % w/v extract concentrations (32). The plates were gently rotated to ensure even dispersion of the extracts. The agar-extract mixtures were allowed to solidify and were used for the inhibition of mycelia growth of the tested fungi. A disc (4 mm diameter) of the pure culture of each isolate about 7 days old were placed on the extract just at the point of intersection of the two lines drawn at the bottom of the Petri dish. The negative controls were set up using blank agar plates (no extract) and the positive control consisted of the fungicide Mancozeb (ethylene bisdithiocarbamate) which were prepared according to manufacturer's directions by mixing 0.5 g in 100 ml of sterile distilled water. Three replicates' plates of PDA-extract per isolate were incubated at 27 and radial growth were measured daily for 7 days. Colony diameter were taken as the means along two directions on two perpendicular lines drawn on the reverse of the plates. Fungi toxicity of the extract were recorded in terms of percentage colony inhibition and calculated according to the formula by Egbontan *et al*. (13):

$$M_p = \frac{M_1 - M_2}{M_1} X\ 100$$

Where $M_p$ is percentage reduction of mycelial growth, $M_1$ is mycelial growth in Petri dish and $M_2$ is mycelial growth in Petri dish containing extract.

**Data analysis**

Data collected were subjected to Analysis of Variance (ANOVA) using Minitab software version 17 and the significant means were separated using Tukey test at $P < 0.05$.

## RESULTS

**Fungi isolated, plant parts and percentage of occurrence**

The results of the study revealed various fungi organisms isolated from different diseased mustard seed plant parts. *Trichoderma* species, *Fusarium oxysporum, Fusarium solani and Sclerotium species* were isolated from the diseased plant root. *Sclerotium species*, *Fusarium oxysporum* and *Alternaria* species were found recovered from the leaves while *Alternaria* species and *Fusarium solani* were isolated from the diseased mustard stem (Table 1). Five fungi organisms belonging to four genera were isolated which includes *Trichoderma*

species, *Fusarium oxysporum*, *Sclerotium species, Fusarium solani* and *Alternaria* species. The results showed that *Fusarium solani* had the highest percentage of occurrence (32.56 %), followed by *Alternaria* species (25.58 %) while *Trichoderma* species had the least (4.65 %).

**Table 1: Fungi isolated, plant parts and percentage of occurrence**

| S/N | Fungi isolates | Part isolated | Number of occurrence | Occurrence (%) |
|---|---|---|---|---|
| 1 | *Trichoderma* species | Roots | 2 | 4.65 |
| 2 | *Sclerotium* species | Roots, Leaves | 6 | 13.95 |
| 3 | *Fusarium oxysporum* | Roots, Leaves | 10 | 23.26 |
| 4 | *Alternaria* species | Leaves, Stem | 11 | 25.58 |
| 5 | *Fusarium solani* | Roots, Stem | 14 | 32.56 |

**Effect of aqueous plant extract of *Calotropis procera* on fungal mycelia growth**

Table 2 revealed the inhibitory effect of aqueous plant extract of *C. procera* on fungal mycelia growth of fungal organisms associated with mustard on the field. The results showed a significant difference among the treatments and the levels of concentrations. At 5 % concentration level, *Fusarium oxysporum had the highest mycelia inhibition (*23.61%), followed by *Trichoderma* species *(*20.53 %) while *Fusarium solani had the least mycelia inhibition (*3.73 %). At 10 % concentration level, *Trichoderma* species *had the highest mycelia inhibition (*45.24 %) while *Fusarium solani had the least mycelia inhibition (*6.13 %). Similarly, the mycelial inhibition at 15 % concentration levels followed the same patterns. However, the fungicide showed a high level of inhibition with different fungi organisms and at different levels except *Trichoderma* species at 15 % concentration that were not significantly different with the fungicide.

**Table 2: Effect of aqueous plant extract of *Calotropis procera* on fungal mycelia growth**

| S/N | Treatments | 5 % | 10 % | 15 % | Fungicide |
|---|---|---|---|---|---|
| 1 | *Trichoderma* species | 20.53ab | 45.24a | 93.39a | 97.92a |
| 2 | *Sclerotium* species | 13.80b | 27.89b | 40.57c | 91.45b |
| 3 | *Fusarium oxysporum* | 23.61a | 36.54ab | 48.70b | 91.95b |
| 4 | *Alternaria* species | 14.23b | 18.87c | 23.58d | 93.87ab |
| 5 | *Fusarium solani* | 3.73c | 6.13d | 14.70e | 94.58ab |
| | CV (%) | 49.06 | 53.18 | 64.29 | 4.16 |

Means in the same column followed by different alphabets are significantly different ($P < 0.05$) using Tukey.

**Effect of aqueous plant extract of *Fiscus exasperata* on fungal mycelia growth**

Table 3 revealed the inhibitory effect of aqueous plant extract of ***F.*** *exasperata* on fungal mycelia growth of fungal organisms associated with mustard on the field. The results showed a significant difference among the treatments and the levels of concentrations. At 5 % concentration level, *Sclerotium species had the highest mycelia inhibition (*27.27 %), followed by ***Alternaria*** species *(*15.67 %) while *Fusarium solani had the least mycelia inhibition (*2.33 %). At 10 % concentration level, ***Alternaria*** species *had the highest*

*mycelia inhibition (*45.10 %) while *Fusarium solani had the least mycelia inhibition (*9.43 %). The mycelial inhibition at 15 % concentration levels ranged from *Fusarium oxysporum to Trichoderma* species *with the values of 54.53–89.59 % respectively*. However, the fungicide showed a high level of inhibition with different fungi organisms.

**Table 3: Effect of aqueous plant extract of *Fiscus exasperata* on fungal mycelia growth**

| S/N | Treatments | 5 % | 10 % | 15 % | Fungicide |
|---|---|---|---|---|---|
| 1 | *Trichoderma* species | 14.39b | 25.33b | 89.59a | 95.76a |
| 2 | *Sclerotium* species | 27.27a | 38.93a | 89.53a | 92.70a |
| 3 | *Fusarium oxysporum* | 7.20c | 37.40a | 54.53b | 84.80a |
| 4 | *Alternaria* species | 15.67b | 45.10a | 59.70b | 90.57a |
| 5 | *Fusarium solani* | 2.33d | 9.43c | 30.00c | 93.18a |
| | CV (%) | 67.01 | 43.11 | 36.64 | 7.26 |

Means in the same column followed by different alphabets are significantly different ($P < 0.05$) using Tukey.

## DISCUSSION

The isolation and identification of the fungal organisms from diseased mustard revealed five common fungi organisms. The fungal isolates were *Sclorotium species*, *Alternaria species, Fusarium oxysporum, Fusarium solani* and *Trichoderma* species. These fungi have been reported on several economic plants in Nigeria, such as *Fusarium oxysporum* reported on tomato (37), *Sclorotium species* on mustard and groundnut (38), *Fusarium solani on maize (35) and Trichoderma* species on tomato (5). Yekini *et al.* (39) reported that *A. niger, A. flavus, Fusarium oxysporum*, *Alternaria* species, *Penicillium* species, and *Rhizopus stolonifer on mustard seed*. Aqueous extract of *Fiscus exasperata* significantly inhibited the mycelia growth of the isolated fungus. This supports the findings of Durugbo *et al.* (12), who discovered that extracts of *Fiscus* species greatly inhibited the growth of *A. flavus, A. niger, Botryodiploidia theobromae, F. oxysporum, F. solani, Penicillium chrysogenum, P. oxalicum, and Rhizopus stolonifer* mycelial growth. Similarly, Ajala *et al.* (2) reported that antimicrobial properties of *F. exasperata* dependent on type of organism and extract concentration. *F. exasperata's* antifungal properties may be attributed to chemical elements such as ficusamide, furanocoumarins, (S)-(_) oxypeucedanin hydrate, (R)-(_) oxypeucedanin hydrate, and bergapten (5-methoxypsoralen) found in the plant (1). ***Similarly,*** aqueous leaf extract of *C. procera* at 5.0, 1.0 and 1.5 % concentration levels significantly inhibited the mycelia growth of all the five fungal organisms isolated from diseased mustard plant. Kareem (20) reported the antimicrobial effect of ethanol, aqueous and chloroform leaf extracts of *C. procera* on *Aspergillus niger, Aspergillus flavus, Microsporium boulardii* and one yeast *Candida albicans* using agar well diffusion and paper disk methods. The antimicrobial activity of the leaf extracts of *C. procera* was evaluated against *Candida albicans* and inhibitory effect was observed (38).

## CONCLUSION

The use of *Fiscus exasperata* and *Calotropis procera leaf extracts in* the management of mustard diseases gave a relative value for all the organisms when compared with the systemic fungicide. The potentials of *these two* leaf extracts on the inhibition of mycelial growth of fungal

organisms associated with mustard diseases are worthy. It further buttresses the potential of natural plant products in the management of fungi disease of mustard on the field.

## *LITERATURE CITED*

1. **Adesope, A.A., Ajala, O.O., Idumah, F. O. and Koyejo, O. A. (2006).** Evaluation of the fibre characteristics of *Ficus exasperate* Valh. In: Popoola, L. (eds). Forestry at crossroads in Nigeria. Proceedings of the 31st Annual Conference of the Forestry Association of Nigeria, Makurdi, Benue State, Nigeria. Forestry Association of Nigeria Ibadan, Nigeria. Pp. 25–29.
2. **Ajala, T.O., Olusola, A.J. and Odeku, O.A. (2020).** Antimicrobial activity of Ficus exasperata (Vahl) leaf extract in clinical isolates and its development into herbal tablet dosage form. *Journal of Medicinal Plants for Economic Development*, 4(1):1-18.
3. **Amadioha, A. C. and Obi V. I. (1999).** Control of anthracnose disease of cowpea by *Cymbopogan citratus* and *Ocimum gratissimum. Acta Phytopathol. Entomol. Hung. 34*: 85-89.
4. **Anyaoha, C.O. Orkpeh, U. and Fariyike. T. A. (2015).** Morphological characterization and preliminary evaluation of four Breeding lines of *Brassica juncea* (mustard seed) in Nigeria. *Continental Journal of Agricultural Science.* 9(1): 8 – 13.
5. Azarmi, R. Hajieghrari, B. and Giglou, A. 2011. Effect of Trichoderma isolates on tomato seedling growth response and nutrient uptake. *African Journal of Biotechnology* 10(31):5850-5855.
6. **Balke, D. T., and Diosady, L. L. (2000).** Rapid aqueous extraction of mucilage from whole white mustard seed. *Food Res. Int.* 33:347–356.
7. **Barbosa, N.P.U. Almeida-Cortez, J.S. and Fernandes, G.W. (2007)**. Uma estranha na paisagem. *Ciência Hoje*, 41:70-72.
8. **Barnett, H. L. and Hunter, B. B. (2006).** *Illustrated* Genera of Imperfect Fungi. 4th Edition, American Phytopathological Society Press, St. Paul, 218 Pp.
9. **Barreto, R.W.; Evans, H.C. and Pomella, A.W.V. (2009).** Fungal pathogens of *Calotropis procera* (rubber bush), with two new records from Brazil. *Australasian Plant Pathology*, 28(2):126-130.
10. **Brandes, D. (2005).** *Calotropis procera* on Fuerteventura. Germany, Technical University Braunschweig. Available at: http://www.biblio.tu-bs.de/geobot/calotropis.pdf.
11. **Buniyamin A. A., Eric, K. I. and Fabian, C. A. (2007)**. Pharmacognosy and Hypotensive. *Drug Resource* 64(6):543-546
12. **Durugbo, E. U., Oyetoran, B. O. and Oyejide, N. E. (2012).** Vegetation inventory of the redemption camp, Ogun state,

Nigeria; Evaluation of medicinal plant resources and strategies for conversion. *Journal of Biological Science.* 12: 34-42.

13. **Egbontan, A. O., Yekini, B. A., Dada, O. A., Oyeleye, A. D., Olejeme, O. C. and Sanusi, O. O. (2020).** Fungitoxicity of some tropical ash against seedborne pathogens of sunflower (*Helianthus annuus* L.). *Nigerian Journal of Plant Protection*. 34(2):27-38.
14. **Evans, W.C. (2006).** Trease and Evans' Pharmacognosy. W.B. Saunders Company Ltd, London.
15. **Falasca, L. S., and Ulberich, A. (2011).** "Argentina's semiarid lands aptitude to cultivate non-traditional species for biodiesel production," in Biodiesel: Blends, Properties and Applications, eds J. M. Marchetti, and Z. Fang (New York, NY: Nova Science Publishers, Inc), 123–150.
16. **Hamed, M. A. (2011).** Beneficial effect of *Fiscus religiosa* Linn. on high fat induced hypercholesterolemia in rats. *Food Chemistry,* 129:162-170.
17. **Ismail, M. A. (2002).** Physiological growth analysis of the life-history of *Calotropis procera* (Ait.) Ait. F. *Qatar University Science Journal*, 12:94-100.
18. **Kant, L., and Gulati, G. C. (2002)**. Inheritance of components of horizontal resistance to *Alternaria brassicae* in Indian mustard. *Journal of Oilseeds Research*, 19(1):17-21.
19. **Karaman I, Sahin F, Gulluce M, Ogutcu H, Sengul M, Adiguzel A. (2003).** Antimicrobial activity of aqueous and methanol extracts of *Juniperus oxycedrus*. *J. Ethnopharmacol.* 85(2-3):231-235.
20. **Kareem S.O, Akpan I, and Ojo O.P. (2008).** Antimicrobial Activities of *Calotropis procera* on Selected Pathogenic Microorganisms. *African J. Biomed Res.* 11(1):105-110.
21. **Katepa-Mupondwa, F., Gugel, R. K., and Raney, J. P. (2005).** Genetic diversity for agronomic, morphological and seed quality traits in *Sinapis alba* L. *Can. J. Plant Sci.* 86:1015–1025.
22. **Khalil A, Dababneh B.F, and Al-Gabbiesh A.H. (2009)**. Antimicrobial activity against pathogenic microorganisms by extracts from herbal Jordanian plants. *Journal of Food, Agriculture and Environment.* 7(2):103-106.
23. **Kos, B., Grèman, H., and Leštan, D. (2003).** Phytoextraction of lead, zinc and cadmium from soil by selected plants. *Plant Soil Environ.* 49:548–553.
24. **Krsti´c, D., ´ Cupina, B., Antanasovi´c, S., Eri´c, P., Èabilovski, R., and Manojlovi´c, M. (2010).** Potential of white mustard (*Sinapis alba* L. subsp. *alba*) as a green manure crop.

Crucif. *Newslett*. 29:12–13.

25. **Kuta, F. A. (2008)** Antifungal effects of *Calotropis procera* stem bark on *Epidermophyton flocosum* and *Trichophyton gypseum*. *Afr J Biotechnol.* 7(13):2116-2118.
26. **Melo, M.M.; Vaz, F.A.; Gonçalves, L.C. and Saturnino, H.M. (2001)**. Phytochemical study of the *Calotropis procera* (Ait.), in goats feeding: clinical effects and biochemical parameters. Revista *Brasileira de Saúde e Produção Animal*, 2(1):15-20.
27. **Murti, K. and Kumar, U. (2011)**. Antimicrobial activity of *Fiscus benghalensis* and *Fiscus racemosa* roots. *American Journal of Microbiology,* 2:21–24.
28. **Odunbaku, O.A., Ilusanya, O. A. and Akasoro, K. S. (2008)**. Antibacterial activity of ethanolic leaf extract of *Fiscus exasperata* on *Escherichia coli* and *Staphylococcus albus*. *Science Research. Essay* 3:562–564.
29. **Peng, C., Zhang, T., Zhao, G., and Wang, S. (2013).** Analysis on fat–soluble components of Sinapis semina from different habitats by GC–MS. *J. Pharm. Anal.* 3:402–407.
30. **Rahman, M., Amina Khatun, A., Liu, L., and Barkla, B. J. (2018)**. Brassicaceae mustards: traditional and agronomic uses in Australia and New Zealand. *Molecules,* 23:231.
31. **Raney, J. P., Rakow, G., and Olson, T. (1995).** "Development of low erucic, low glucosinolate *Sinapis alba*," in Proceedings of the 9th International Rapeseed Congress, Cambridge, 416–418.
32. **Sangoyomi, T. E. (2004).** *Post-Harvest Fungal Deterioration of Yam (Dioscorea rotundata Poir) and its control*. Thesis. International Institute of Tropical Agriculture. Ibadan, Nigeria. 179pp.
33. **Sehgal R, Arya S, and Kumar V. L. (2005).** Inhibitory effect of extracts of latex of *Calotropis procera* against Candida albicans. A preliminary study. *Indian J. Pharmacol.* 7(5):334-335.
34. **Sirisha, N., Sreenivasulu, M., Sangeeta, K. and Chetty, C. M. (2010).** Antioxidant Properties of *Fiscus Species*: A Review. *International Journal of Pharmacy and Technological Research,* 2(4): 2174-2182.
35. **Sobowale A. A., Olayele O. M., Ayinde O., Ogbe G. E. (2022)**. Characterisation and Divergence of Fusarium Species in Certain Varieties of *Zea mays* L. *International Journal of Science and Research*. 11(7):662-679.
36. **Sonibare, M. O, Isiaka, A. O, Taruka, M. W, Williams, N. S., Soladoye, M. and Emmanuel, O. (2006).** Constituents of *Fiscus exasperata* leaves. *Natural product communications* 23-26pp.
37. **Yekini, B. A; Afolabi, C. G; Kehinde, I. A. and Enikuomehin, O. A. (2014).** Reaction of Naturally

Infected Tomato Genotypes to Fusarium Wilts under Tropical Conditions. *Nigerian Journal of Plant Protection*. 28(1)*:* 81-90.

38. **Yekini, B. A; Anaele, U. M; Awoyemi, S. O; Nwosu, E. C and Adeoti, A. O. (2019).** Influence of soil amendments in the management of stem rot (*Sclerotium rolfsii*) of groundnut (*Arachis hypogaea,* L.) in Ishiagu. *Nigerian Journal of Plant Protection*. 33(2): 62-71.

39. **Yekini, B. A; Egbontan, A. O; Alade, O. D and Nwawuisi, J. U. (2022).** Viability and seedborne fungi associated with mustard seed (*Brassica nigrum*) in South-eastern, Nigeria. The Bioscientist Journal. 10 (1):18 -27.