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COMPARATIVE EFFECT OF LEAF POWDER OF ERYTHRINA SENEGALENSIS DC ON SITOPHILUS ZEAMAIS MOTSCHULSKY AND PERCENTAGE GERMINATION OF TREATED MAIZE GRAINS

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ABSTRACT

The comparative study of effects of different concentrations (g) of leaf powder of *Erythrina senegalensis* on maize weevil (*Sitophylus zeamais Motschulsky*) and percentage germination of treated grains at 336 hours (14 days) was carried out. Mortality and % mortality of weevils increased with time of exposure, up to 336 hours after treatment (HAT). Analysis of Variance (ANOVA) on these parameters indicated significant difference (P<0.05) of the effect of different concentrations of the plant extract over the control (0.0g). Similarly, there were significant reduction (P<0.05) in weight loss and grain perforation with increase in level (g) of leaf extract at 336 HAT. Weevil perforation index (WPI) revealed the highest protective potential of 13.64 and 22.73 for 10.0g and 8.0g (w/w) levels respectively at 336HAT. Germination test of treated grains at this period showed no significant difference (P>0.05) in % germination at 72 and 120 hours after planting (HAP), and significant difference (P<0.05) at 96 HAP, indicating the effectiveness of the leaf powder of *Erythrina senegalenses* as a good potential seed-dressing option, thus ensuring a sustainable preservation of planting stock with an eco-friendly strategy.

KEY WORDS

Erythrina senegalensis, maize weevils, mortality, grain perforation, germination.

In Africa, maize remains a major energy and staple food, which is particularly valued for its calorific, fiber, protein and minerals, widely grown by smallholder farmers (Onuminya *et al.,* 2018). Stored maize grains is faced with huge quantitative and qualitative loses (Edelduok *et al*., 2015). These loses in the tropics have been thought to be due to bruchids infestation (Swella and Mushobozy, 2009; Musundire *et al.*, 2015). Other factors range from development of resistance by target insect (Hanandli, 2004), adverse effect of natural enemies (Jansay, 2000), high cost of procurement and application of pesticides (Abolusoro, 2001), increasing documentation of negative environmental and health impact coupled with stringent environmental regulation of pesticide handling (Ismaan, 2008) etc. The synthetic pesticides are composed of halogenated hydrocarbon, organophosphates, carbamates endosulphondimethoate, malathion, etc (Joshi *et al*., 2004). The non-biotic pesticide use on agricultural crops was revised and restricted by European legislations (Reg. C.E. 369/2005 and 1095/2007). This was consequent upon the fact that halogenated pesticides and its allies have ozone layer depleting tendency, hence banned after 2005 and 2015 in developed and developing countries (Imamura *et al*., 2008; Zouhar *et al*., 2009). It becomes imperative therefore, to develop a renewed interest and paradigm shift to plants and plant products which is the contemporary alternative (Lalita and Srivastava, 2008).

Recently, the environmentally safe and biodegradable natural products of plants have been considered as alternative sources in the control of insects of public health importance (Maia and Moore, 2011). Natural products contain a range of bioactive compounds (Ruikar *et al*., 2012) and related commercial insecticides are commonly perceived as "safe" in comparison to synthetic repellents (Maia and Moore, 2011). Some plants extracts have been reported bioactive against maize bruchids (Adedire and Ajayi., 1996), powder, extract of dried garlic and lemon (Opareke and Dike, 1996), powdered extracts of dried vegetative parts of neem (Chomini *et al*, 2006; Aliyu *et al*., 2019). *Xylopia aethiopica* (Dunal) powder (Chomini *et al*, 2010a), Cashew Nutshell powder (Chomini *et al*., 2010b), Garlic (*Allium sativum*) bulb and bulb coat powder (Ishaya *et al*., 2021). *Erythrina senegalensis* DC (Fabaceae) is a leguminous thorny shrub or small tree with common names that include coral tree (English) and minjirya (Hausa, Nigeria). The leaves, stem and root bark have medicinal uses against wide range of illnesses such as malaria, gastrointestinal disorders, fever, dizziness, secondary sterility, diarrhea, jaundice, nose bleeding and pain (Togola *et al*., 2008; Kone *et al*., 2011). Information on the phytochemical composition of *E. senegalensis* and its insecticidal properties are still sketchy. This therefore informed and stimulated the present effort.

MATERIALS AND METHODS OF RESEARCH

The leaves of *E. senegalensis* (Coral plant) sourced from parent plant in the Federal College of Forestry, Jos (latitude 9°56'; N 8°53'E) with average annual rainfall of 14600-14800mm and average annual temperature range of 10-320C (Akin, 2002). The materials were shade-dried for 3 weeks, pulverized into fine powder, carefully sieved (using 1mm fine mesh) and bottled until use. 0.0, 2.0, 4.0, 6.0, 8.0 and 10.0g of the leaf powder as treatments per 100g of maize grain (w/w) previously cleaned and disinfected for 72 hours by keeping in deep-freezer as 12^{o}C (Chomini et al., 2006; Swella and Mushobozy, 2009) were introduced into sterilized kilner jars. The jars and their contents were manually shaken for 3 minutes to achieve thorough mixing of gains and extracts before allowing it to settle for 1 hour. Thereafter, 30 teneral adult weevils *Stiophilus zeamais* (Motach) obtained from the insect culture of entomology laboratory, Federal College of Forestry, Jos, were introduced into each jar. The jars were lined with muslin cloth and covered with perforated lids. The set-up in four replicates was arranged in a completely randomized design in the laboratory under ambient temperature of 26℃ and 40% relative humidity.

Parameters on % mortality at 48hour interval for 14 days, grain weight loss and perforation at 336 hours after treatment (HAT), using weevil perforation index (WPI) as described by Fatope et al (1995) and Chomini, et al, 2010a, obtained as follows:

$$\text{WPI} = \frac{\text{\% perforation of treated grain}}{\text{\% perforation of control grain}} \; X \; 100\%$$

After 336 HAT, 10 viable grains were randomly selected per replicate per treatment and sown into polythene pot (14cm x 11cm x5cm), previously filled with a mixture of top soil, river sand and cowdung, in a ratio 1:1:1 and sieved (Kareem et al, 2002). The polythene pots with sown grains were arranged in a CRD in the College Nursery. Watering was done twice daily (with 0.5 L of water).

Percentage germination was determined from the daily germination count, using the relationship below (Kareem *et al*, 2002).

$$\text{\% germination} \; = \frac{\text{No of germinated grain}}{\text{Total No. of grain sown}} \; X \; 100\%$$

Data obtained were subjected to analysis of variance to determine their significant difference. Significant means were separated using least significant difference (LSD) approach.

RESULTS AND DISCUSSION

Mortality and percentage mortality of maize weevils increased significantly (P<0.05) with concentration of plant extract as well as time of exposure. At 48 HAT, only 8.0g/100g and 10.0g/100g had above 60% mortality, by 240 HAT, all treatments attained more than 80% mortality except the control. This trend continued up to 336 HAT, when all treatments recorded 100% mortality except the control (Table 1). This result is in line with over 90% mortality of storage pest recorded by Oparaeke and Dike (1996); Chomini et al. (2010a); Martin *et al*, (2010), Chomni *et al*. (2010b) at 10 days, 12 days, 96 hours and 12days after treatment respectively, using powders of different plant parts.

Table 1 – Effects of *Erythrina senegalensis* leaf powder on mortality and % mortality

Conc. of leaf extract (g)	48	96	144	192	240	288	336
0.0	1.00^{a}(3.33)	1.78^{a} (5.84)	1.75^{a}(5.84)	1.75^{a}(5.84)	1.75^{a}(5.84)	2.25^{a}(7.50)	2.25^{a}(7.50)
2.0	4.50^{b} (15.00)	9.50^{b}(31.67)	14.00^{b}(46.67)	17.25^{b}(57.50)	24.25^{b}(80.83)	28.00^{b}(93.33)	30.00^{b}(93.33)
4.0	6.75^{c}(22.50)	12.50^{c}(34.17)	17.75^{c}(59.17)	20.75^{c}(69.17)	27.50^{c}(91.67)	29.25^{bc}(97.50)	30.00b^{c}(97.50)
6.0	9.75^{d} (32.50)	20.00^{d}(66.67)	24.00^{d}(80.00)	26.25^{d}(89.17)	29.50^{cd}(98.33)	30.00^{c}(100.00)	30.00^{b}(100.00)
8.0	20.00^{e} (66.67)	24.25^{e}(97.50)	26.75^{e}(89.17)	28.50^{de}(95.00)	30.00^{d}(100.00)	30.00^{c}(100.00)	30.00^{b}(100.00)
10.0	22.00^{f} (73.35)	29.25^{f}(97.50)	29.50^{f}(98.33)	30.00^{e}(100.00)	30.00^{d}(100.0)	30.00^{c}(100.00)	30.00^{d}(100.00)
LSD	1.87	2.25	2.46	2.26	2.26	1.75	2.67

Note: Mean followed by the same letters are not significantly different (P=0.05) values in parenthesis represent % mortality.

Table 2 – Effects of *Erythrina senegalensis* leaf powder on grain of perforation, weevil

Conc. of leaf extract (g)	Mean No. of Selected grain	Mean % of perforated grain	Weevil perforation index (WPI)	Mean weight loss (g)
0.0	100	5.50^{a}	50.00	7.70^{a}
2.0	100	3.00^{ab}	54.55	5.30^{a}
4.0	100	2.50^{ac}	45.45	2.20^{a}
6.0	100	2.25^{bc}	40.90	0.70^{b}
8.0	100	1.25^{cd}	22.73	0.20^{c}
10.0	100	0.75^{e}	13.64	0.11^{d}
LSD		1.58		0.02

*Note: Mean followed by the same letter are not significantly different (P=0.05) * NPI value <50 indicates positive protectant effect while value reveals negative protectant ability.*

Percentage grain perforation and weight loss significantly (P<0.05) related inversely to the concentrations of *Erythrina sengalensis* leaf powder extract(ESLPE), which seemed to reveal its protective tendencies at different levels. This supported earlier observations by Chomini et al. (2010a) indicating weight loss reduction of cowpea with leaf powder concentration increase of *Xylopia aethiopica*. This was confirmed by the findings of Aliyu et al. (2019). Weevil perforation index (WPI) showed a progressive reduction with increased concentration of leaf extracts. An index value less than that of the control (WPI = 50), indicates positive protection, while relatively lower values showed better effect (Chomini et al., 2006) (Figure 1). There was a positive correlation between the WPI and mean weight loss, which is a reflection of the protective efficacy of the leaf powder (Table 4). Similar trend with *Xylopia aethiopica* was reported by Chomini et al (2010a) and Aliyu et al (2019). Phytochemical constituents of the plant have been reported to confer natural protection against pathogens, insects, and vertebrates (Ibrahim et al. 2010; Huang, Q. et al., 2018). The leaves of *E senegalensis* had been screened for the presence of tannins, anthraquinone, cardiac glycosides, saponins, steroids, carbohydrates (Rwang et al., 2016) while Osuntokun et al. (2016), reported the presence of saponins, flavonoids, phylate, alkaloids, phenol, tannin and oxalate. Tannins have been reported to repel and negatively affect insect metabolism when consumed (Huang et al., 2018). Rattan (2010) opined that alkaloids are lethal to insect pests, while Acheuk and Doumandji-Mitiche (2013), reported grain/seed protectant properties of flavonoids.

Table 3 – Effects of *Erythrina senegalensis* leaf powder on % germination o treated maize grains at 336 hour after treatment (HAT)

Conc. Of leaf extract (g)	Hour After Planting		
	72	96	120
0.0	12.50^{a}	55.00^{a}	92.5^{a}
2.0	7.50^{a}	55.00^{a}	95.00^{a}
4.0	12.50^{a}	45.00^{ab}	92.50^{a}
6.0	15.00^{a}	52.50^{ab}	87.5^{a}
8.0	30.00^{b}	55.00^{a}	97.50^{a}
10.0	15.00^{c}	42.00^{b}	87.5^{a}
LSD	1.05	1.02	1.30

Note: Mean followed by the same letters are not significantly different (P=0.05).

Table 4 – Correlations between Weevil perforation index (WPI) and Mean Weight Loss (MWS)

N		WPI	MWL(g)
WPI	6	1.000	
MWL (g)	6	0.770	1.000

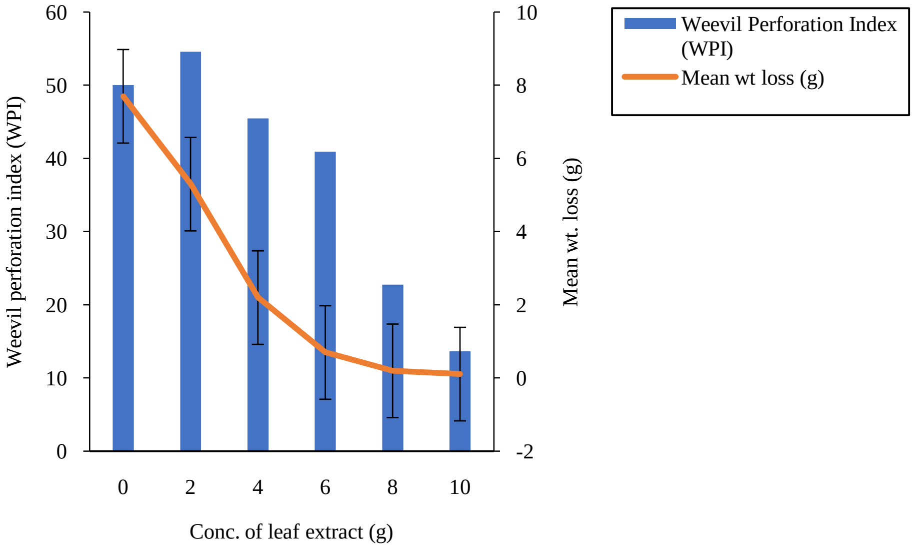

Figure 1 – Effects of *Erythrina senegalensis* leaf powder on WPI and Mean Weight Loss

At 96 and 120 hours after planting (HAT), treated grains under 0.0g/100g, 2.0g/100g and 8.0g/100g concentrations had the highest % germination. The % germinations were significant ($P<0.05$) at 72 and 96 HAP, and not significant ($P>0.05$) at 120 HAP, where there was over 85% germination across the treatments (Table 3). This corroborated previous findings Gorindan et al (2010), positing that no negative effect on germination of treated maize and pulse grains treated with neem and mahogany extracts, and black gram (*Piper nigrum* L) powder respectively. The optimal %germination of 97.5% was obtained under 8.0g/100g concentration on the leaf extract, thus, elucidating the effectiveness of the leaf powder as a good seed-dressing option, which could enhance preservation of planting stock.

CONCLUSION

The study revealed high potential of leaf powder of *E. senegalensis (L)* against maize weevils at high concentration of extract, resulting in low grain damage, thereby preserving the viability integrity of the treated maize grains.

REFERENCES

1. Abulusoro, S.A. (2001). Efficacy of some plant materials for the control of cowpea Bruchid, Callo sobruchus maculates (Fab) JAT 9:1-6.
2. Acheuk, F., Doumandji-Mitiche, B. (2013). Insecticidal activity of alkaloids extract of Pergularia tomentosa (Asclepiadaceae) against fifth instar larvae of Locusta migratoria cinerascens (Fabricius 1781) (Orthoptera: Acrididae). International Journal of Science and Advanced Technology, 3(6), 8–13.
3. Aliyu A. U, Muhammad. I. H, M. S. Babura. (2019). "Insecticidal Effects of Stem Bark Powder of Azadirachta Indica and Leaf Powder of Eucalyptus camaldulensis on Weevils of Stored Maize Grains. International Journal of Research - Granthaalayah, 7(10),180-190. https: //doi.org/10.5281/zenodo. 3 522216.
4. Chomini, M.S., Samndi M.E., Akalusi, M.E., Okoiyele, L.O., Nwakwushue, F.N, and Karma, I.B. (2006). Insecticidal effect of leaf, steam bark and seed kernel powdered extracts of Neem (Azadirachta india A. Juss) Agent maize weevil (Sitophilus zemais, Motchulsky). Nigeria Journal of Botany 19(2) 348-352.
5. Chomini, M. S., Okoiyele, L.O., Chomini, A.E and James, J.D. (2010a). Efficacy of Xylopia aethiopica (Dunal) poweder in the control of Cowpea Bruchids (Callosobruchus maculatus (FAB)). Nigerian Journal of Botany. 23 (2) 235-244.
6. Chomini M. S., M.E Akalusi, M.C Okonkwo and H. Musa (2010) Effects of Cashew Nutshell powder. Extract on Callosobruchus maculatus (F) in stored cowpea (Vigna unguiculata (L) walp. Nigerian Journal of Botany. 23 (2) 245- 252.
7. Edelduok E.G., Akpabio E.E., Eyo J.E., Ekpe E.N. 2015. Evaluation of the insecticidal activities of cotyledon powder of melon, Citrullus vulgaris Schrad against the maize weevil, Sitophilus zeamais (Motsculsky). Journal of Biopesticides and Environment, 1:50-57.
8. Ewefe, F.K., Armasaon, J. Larson and B.J.R. Philogene (1996). Biological activity of extracts from traditionally used Nigerian Plants against European corn borer Ostrinia nubilali. Entorologia expectation et Applicata 80:531-537.
9. Fatope, M.O., Mann, A. and Takeda Y. (1995). Cowpea weevil bioassay: A simple prescreen for plant with grain protectant effects: International Journal of Pest Management 41:44-86.
10. Govindan, K. and Jeyarajan, S. N. (2009). Insecticidal activity of twenty plant powders on mortality, adult emergence of Sitophilus oryzae L. and grain weight loss in paddy. Journal of Bio-pesticides 2(2): 169-172.
11. Govindan, K, S. N Jerayajan and P. M.M. David (2010). Glyash – Excellent filler for black pepper, piper nigrum dust formulation against Callosobruchus maculates (F). Journal of Biopesticides 3 (1 special issue) 320 – 324.
12. Han, Z. and Li, F. (2004). Mutation in Acetylcholinesterase associated with insecticide resistance in the cotton Aphid, Aphis gossypii Glover. Insect Biochemistry and Molecular Biology 34:397-405.

13. Huang, Q. et al (2018). Potential and challenges of tannins as an alternative to in-feed antibiotics for farm animal production. Animal Nutrition, 4:137– 150.
14. Ibrahim, T. A.; Ibo, Dada; A., Adejare R. (2010). Comparative phytochemical properties of crude ethanolic extracts and physicochemical characteristics of essential oils of myristical fragrans (nutmeg) seeds and zingiber officinale (ginger) roots. Electronic Journal of Environmental, Agricultural & Food Chemistry. 9(6): 1110-1116.
15. Igbokwe, G.E., Anagonye, C. O and Obiudu, I.K. (2006). Journal of Natural and Applied Sciences. 2 (1) 12-15.
16. Imamura, T., M. Murata and A. Miyanoshita (2008). Biological Aspect and Predatory Abilities of Hemipterans. Attacking stored-product Insects. JARd 42(1): 1- 6.
17. Isman, M.B. (2000). Plant essential oils for pest and disease management. Crop protect 19:603-608.
18. Ishaya, M.1., John, W.C., Oke, O., Chomini, M.S., Oladejo, A.O., Ihum, T.A., Olorundare, O.O., Ukanyirioha, C.J., Ayorinde, J.O. and Sikiru, G.K(2021). Comparative effects of garlic (Allium sativum) bulb and bulb coat powder on maize weevils (Sitophilus zeamais). Russian Journal of Agricultural and Socio-Economic Sciences (RJOAS), 8 (116), 91-95. https://DOI10.18551/rjoas.2021-08.10
19. Jansen, J.P. (2000). A 3-year field study on the short-term effects of insecticides used to control cereal Aphids on plant dwelling predators in winter wheat. Pest manage sciences. 56:533-539.
20. Joshi, S and Virklamath, C.A. (2004). The sugar cane woolly Aphid, Cantuvainna lanigers, Zehutrner (Hemiptera: Aphidae) its biology, pest status and control. Current Science 87 (3): 35-39.
21. Kareem, I.A., M.S. Chomini and B. I. Mohammed (2002). Effects of pregermination treatment and early growth studies of Dearium microcarpum and the nutrient status of its fruit. Journal of Sustainable agricultural resources 3L51-55.
22. Kone et al., 2011) Kone WM, Solange KE, Dosso M. Assessing Subsaharian Erythrina for efficacy: traditional uses, biological activities and phytochemistry. Pak J.Biological Sci. 2011; 14(10):560-571.
23. Lalita Gupta and Meera Srivastara (2008). Effect o Withnia somnifera extracts on the mortality of Callosobruchus chinesis L. Journal of Biopesticides 1 (2): 190 – 192.
24. Maia MF, Moore SJ. Plant-based insect repellents: A review of their efficacy, development and testing. Malar J 2011; 10: S11.
25. Martin, J. Rathi and S. Gopatakrishnan (2010). Insecticidal activity of methanolic pooled fractions of Lantana wightiana Wall. Journal of Biopesticides 3 (1 special issues), 282 – 285.
26. Olmo, L.R.V., M.F.D.F, Da Silva, E. R. Fo., P.C. Viera, J.B. Fernandes, A. C. Pinheiro and E. F. Vilela (1997). Limonoids from leaves of Khaya senegalensis. Phytochemistry. 44 (6): 1157-1161.
27. Onuminya, T.O., Agboola,O.O. and Ezeribe, S.R.(2018). Insecticidal evaluation of some botanical powders as stored maize grain protectants against Sitophilus zeamais (Motschulsky) (Coleoptera: Curculionidea); a concern for postharvest loss. Annals of West University of Timişoara, ser. Biology, 2018, vol. 21 (2), pp.157-164.
28. Oparaeke, A. M. and M.C. Dike (1996). Comparison of garlic and lemon grass products in the control of Callosobruclius maculates F (Coleoptera: Bruchin) on stored cowpea grains. Nigeria Journal of Entomology 13:73-80.
29. Osuntokun O. T., Ajayi, A.O., Olorunnipa, T.A., Thonda, O.A. and Taiwo, O.V.(20). Phytochemical screening and antimicrobial properties of partially purified ethyl acetate extracts of Erythrina senegalensis leaf and bark against selected clinical isolates. Journal of Medicinal Plants Studies 2016; 4(3): 259-269.
30. Rattan, R. S. (2010). Mechanism of action of insecticidal secondary metabolites of plant origin. Crop Protection, 29, 913–920.
31. Ruikar AD, Pawar PV, Sen A, Phalgune UD, Puranik VG, Deshpande N R. Larvicidal potential of Mimusops elengi against Aedes aegypti (L) and Culex quinquefasciatus (Say). J Vector Borne Dis 2012; 49: 111–13.

32. Rwang, P.G., Fabiyi, J.P., Suleiman, M. and Mercy, K.P.(2016). Evaluation and Phytochemical Analysis of Prosopis africana and Erythrina senegalensis Used against Immature Stages of Schistosoma haematobium. European Journal of Medicinal Plants 13(1): 1-9.
33. Swella, G.B. and D. M. K. Mushobozy (2008). Comparative susceptibility of Different legumes seeds to infestation by cowpea bruchids (Callosivruchus maculates (F). (Coleoptera: Chrysomelidae) Plant Protect Sci. 45 (1): 19-24.
34. Togola et al., 2008 Togola A, Austarheim I, Theis A, Diallo D, Paulsen BS. Ethno-pharmacological uses of Erythrina senegalensis: a comparison of three areas in Mali, and link between traditional knowledge and modern biological science. J Ethnobiol. Ethnomed. 2008; 4:6. DOI: 10.1186/1746-4269-4-
35. Yusuf, S.R. B.I. Ahmed and B. Galadima (2006). Control of Stiophilus zeamais Mots. Adults Population and damage on grain maize (Zea mays L B. two plant product compared with pirimiphos methyl in Adepoju and Okuneye P.B. (eds). Proceedings of 20th Annual National Conference FAMAN. FRIN, Federal College of Forestry, Jos. 18th – 21st September, 2006 Pp 621 – 624.
36. Zouhar, M. Donda, O. Lhotsy D and Pavela R. (2009). Effect of plant essential oil on mortality of the stem mematode (Ditylenchus dissali). Plant protect sci. 45 (2) 66-73.