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Biotermiticidal Activity of *Jatropha gossypifolia* Linn. plant extract against *Odontotermes obesus* (Isoptera: Termitidae)

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Abstract: ***Termiticidal potential of methanol and aqueous leaves extract of Jatropha gossypifolia Linn. were studied against Odontotermes obesus. The plant leaves were dried, powdered and extracted with methanol and aqueous solvent in soxhlet apparatus for 24 hrs. The 20 termites were exposed to various concentrations from 9.0 to 14.5 mg/ml) of methanol and of aqueous plant extract of Jatropha gossypifolia and percent mortality were recorded after 24 hrs.***
The termiticidal activity of leaves extract of Jatropha gossypifolia were (LC_{10} = 9.8220 mg/ml, LD_{50} = 10.093, LC_{90} =12.667 mg/ml) in methanol and (LC_{10} = 11.984, LC_{50} = 13.195, LC_{90} =14.531 mg/ml) in aqueous solvent respectively. Results revealed that the mortality was increased with increasing in concentration of the plant extracts.
The methanol solvent extract of Jatropha gossypifolia showed higher termiticidal property against Odontotermes obesus. Statistical variance, 95% confidence limits and regression equations are presented.
Keywords: Termiticide, Odontotermes obesus, Jatropha gossypifolia.

I. INTRODUCTION

Indian white termite, *Odontotermes obesus Ramb*. is highly destructive polyphagous insect pest, lives in huge mounds and feeds on cellulose material an almost anything which contains carbohydrate. It causes economic damage to commercial wood, fibers cellulose, sheets, papers, clothes, woolens and mats, and woody building material and infests green standing foliage, cereals stored in godown. The majority of the termites are controlled by using chemical insecticides such as chlordane, cypermethrin, hydroquinone, and indoxacarb have been used. Due to their longer residual persistence and higher toxic effect, that harm the environment, humans and many beneficial organisms. Thus, it is pivotal and well accepted that other control methods such as physical prevention, cultural actions and organic and environmentally friendly compounds are essential for termite's management.

With a greater awareness of hazards associated with the use of synthetic pesticides there has been an increase need to explore suitable alternative method for termite control. Farmers use different plant material to protect their crops from termites. Natural products in their crude form or plant extract provide unlimited opportunities as termiticide. Plant derived pesticides are eco-friendly, non-toxic to non-target organisms, non-persistent in nature, besides they do not promote drug resistance (Liu *et al.* 2000). Plants are rich sources of natural substances that can be utilized in the development of environmentally safe methods for insect control (Sadek, 2003). A broad range of plants are toxic, repellent, or have some antifeedant properties several of which were regarded as insecticides (Bläske and Hertel, 2001; Ganapaty *et al.*, 2004, Boulogne *et al.*, 2012; Raina *et al.*, 2012; Addisu *et al.*, 2014). Kasseney *et al.*, 2016 studied the effect of plant extracts on the survival rate of termites, *Macrotermes subhyalinus* and *Trinervitermes geminatus* (Wasmann). Upadhyay *et al.*, (2010, 2012) reported the efficacy of *Capparis deciduas* and its mixtures against *Odontotermes obesus*. Almeida *et al.*, investigated the plant essential oils and their thirteen major active chemical constituents for termiticidal activities against *Heterotermes sulcatus*. Osipitan and Oseyemi (2012) have evaluated the insecticidal effect of three plant extracts including *Citrus sinensis, Theobroma cacao, Tithonia diversifolia* and *Anacardium occidentale*, against *Macrotermes bellicosus*. They found that the aqueous extract of these plants not only caused the mortality of tested termites, but also showed an important repellency to them. The repellent effect of extracts from few tropical plants on termite has also been reported by Maistrello *et al.*, (2011); Osipitan *et al.*, (2013) and Acda, (2014). Patel and Narasimhacharya (2017) examined the anti-termite potential of four plant species namely, *Achyranthes asapera, Sida acuta, Syzygium cumini* and *Terminalia arjuna* against *Odontotermes obesus*. Nagare and Pardeshi (2019a; 2019b) studied the anti-termite potential of plant extracts of *Semicarpus anacardium* and *Argemone mexicana* against Indian white termite, *Odontotermes obesus*.

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This paper reports the results of research on the termiticidal effect of methanol and aqueous extracts of *Jatropha gossypifolia* against Indian white termite, *Odontotermes obesus.*

Jatropha gossypifolia Linn. (Family: Euphorbiaceae) is small shrub plant belonging to family Euphorbiaceae. It is distributed in the Gujrath and Maharashtra region of India. *Jatropha gossypifolia* is a well-known medicinal plant with wide range of pharmacological potential. Antimicrobial, antidiabetic, hepatoprotective, antioxidant, anti-inflammatory (Yerramsetty *et al*., 2013). The family Euphorbiaceae is the largest family among the Angiosperms. Euphorbiaceae family is rich source of secondary metabolites such as alkaloids, cyanogenic glycosides, diterpenes, glycosylates, tannins and triterpene.

Vasakorn *et al.,* (2011) reported the toxicity of ethanol leaf extracts of *Jatropha gossypifolia* and Melia azedarach against the larvae of the noctuid pest, *Spodoptera frugiperda* and found strong synergistic effect.

Bashir and Shafie (2013) showed the insecticidal and antifeedant efficacy of Jatropha oil extract against the desert locust, *Schistocerca gregaria.* Ashamo and Odeyemi (2001) tested petroleum ether extracts of eight indigenous plants as grain protectant against the maize weevil, *Sitophilus zeamais.*

Bhagat *et. al.,* (2011) showed the insecticidal properties of three Jatropha species against stored grain pests, *Corcyra cephalonica* and *Tribolium castaneum* and identified the plant compound, α-sitosterol. *J. gossypifolia* oil was found to be most toxic to the *C. cephalonica* and *T. castaneum* with LC_{50} values of 2.17 and 1.08 mg, respectively.

There are no reports available on the biological activities of *Jatropha gossypifolia* against Indian white termite, *Odontotermes obesus*.

Therefore, the present study was undertaken to evaluate the termiticidal activities of methanol and aqueous solvent extracts against *Odontotermes obesus.*

II. MATERIALS AND METHODS

A. Plant Materials

The leaves of *Jatropha gossypifolia* were collected and were properly identified from taxonomist. The leaves were washed three times in tap water and rinsed with distilled water, the excess water was soaked and leaves were separated and dried in shade. The dried leaves material was powdered in domestic grinder and stored in air tight container in refrigerator till further use. From the stock 50 g of powdered was extracted with 1000 ml of aqueous and methanol solvent using Soxhlet apparatus for 24 hrs. separately.

B. Termites

Odontotermes obesus were collected from nearby farms of Chhatrapati Sambhajinagar and brought to the laboratory. Traps were maintained in plastic jar containing moist soil. Active and healthy termites were used for the study within four days after field collection.

C. Termiticidal bioassay

The termiticidal effects of the plant extracts were tested on termites by using a 'no-choice' feeding test. Various concentration (9.0 to 14.5 mg/mL) of methanol and aqueous solvent extract of *Jatropha gossypifolia* were applied to Whatman No. 1 filter papers and allowed to air dry completely and were placed in petri plates under laboratory conditions. These treated filter papers were given as feed and 20 active termites, *Odontotermes obesus* were released in each experimental and control petri plates. Three replications were conducted. The percent mortality was calculated after 24 h and the observed data was subjected to probit analysis (Finney, 1947; Busvine, 1971). Filter paper treated with solvent alone was used as a control.

III. RESULTS

The toxic effect of leaf extract of *Jatropha gossypifolia* was evaluated against *Odontotermes obesus*. The numbers of dead *Odontotermes obesus* were counted after 24 hrs at (9.0, 9.5, 10.0, 10.5 and 11.0 mg/mL) and (12.0, 12.5, 13.0, 13.5, 14.0 mg/mL) doses of methanol and aqueous extract of *Jatropha gossypifolia* respectively. The total percent mortality was observed after 24 hrs, and then the corrected mortality was calculated using Abbott's formula and the results are presented. The results showed that, the mortality increases with increase in concentrations (Figure and Tables).

The results of probit analysis for the estimation of LD_{10}, LD_{50}, LD_{90}, variance, 95% confidence limits and regression equation at 24 h for the mortality of Indian white termite, *Odontotermes obesus* are presented in Table-2.

The termiticidal bioassay in methanol solvent extracts, LD_{10} = 9.8220 mg/ml, LD_{50} = 10.093 mg/ml and LD_{90} = 12.667 mg/ml and in aqueous extract of *Jatropha gossypifolia* was, LD_{10} = 11.984 mg/ml, LD_{50} = 13.195 mg/ml and LD_{90} = 14.531 mg/ml respectively. Among the various estimate of regression based probit analysis, the $\chi 2$ values for the regression coefficients showed homogeneity to the data.

TABLE 1

Percent mortality of Indian white termite, *Odontotermes obesus* treated with methanol and aqueous leaf extracts of *Jatropha gossypifolia*.

Sr. No.	Dose in mg/ml	No. of insects used	% Mortality after 24 hrs. (Methanol)	% Mortality after 24hrs. (Aqueous)
1.	Control	20	00	-
2.	9.0	20	15	-
3.	9.5	20	30	-
4.	10.0	20	40	-
5.	10.5	20	65	-
6.	11.0	20	85	-
7.	11.5	20	100	-
8.	12	20	-	10
9.	12.5	20	-	20
10.	13	20	-	40
11.	13.5	20	-	60
12.	14	20	-	85
13.	14.5	20	-	100

TABLE 2

LD_{10}, LD_{50} and LD_{90} values with variance, 95% confidence limits and probit analysis parameters for Indian white termite, *Odontotermes obesus* after 24 h of treatment.

Solvent	LD_{10}	LD_{50}	LD_{90}	Variance	95%CL		Regression equation	χ^2 (Degree of freedom)
					Lower	Upper		
Methanol	9.8220	10.093	12.667	0.544547	0.4422	2.4502	Y= 20.9324x-16.0357	4.3403
Aqueous	11.984	13.195	14.531	0.001069	1.0566	1.1842	Y= 30.6171x -29.3054	2.8814

FIG.-1

Regression and provisional lines for *Odontotermes obesus* exposed to methanol leaf extract of *Jatropha gossypiifolia* after 24 h.

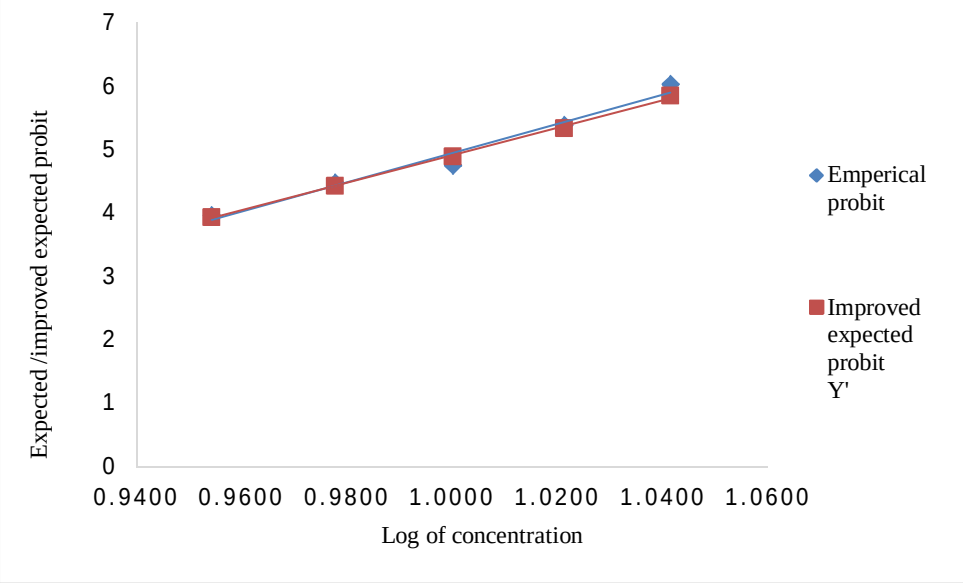
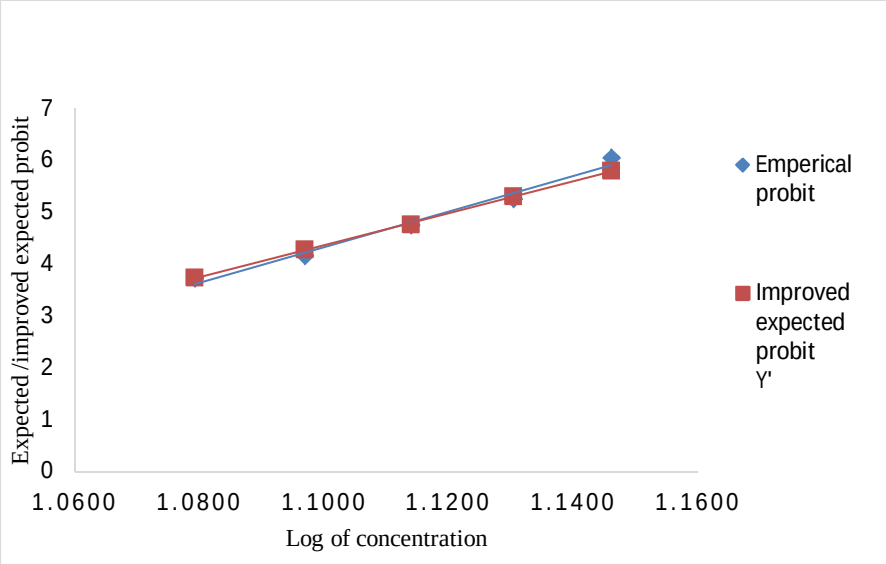


FIG 2
Regression and provisional lines for indian white termite, *odontotermes obesus* exposed to aqueous leaf extract of *jatropha gossypiifolia* after 24 h.



IV. DISCUSSION

Indian white termite, *Odontotermes obesus* is one of severe destructive pest which causes economic damage to commercial wood, fibers, paper sheet, clothes, woolens and mats and seriously infests agricultural crops and forest products.

In the present study, we have tried to control termite infestation in the farm ecofriendly by applying methanol and aqueous plant extract of *Jatropha gossypifolia*. Our results show that *Jatropha gossypifolia* possess bio-termiticide potential.

In insect-plant interactions, insects often have unique adaptation to their host plants in locating and selecting the plants by the use of chemical, visual and mechanical cues (Schoonhoven *et. al.*, 1998). According to Mustaparta (2002), unsuitable plants are avoided by detection of other chemical cues; such chemical substances may have repellent or toxic properties against insects. Based on this principle, botanical pesticides are invented and utilized for control of insect pests. Crude extracts from the leaf, stem, root and seeds of various plant species have been reported to possess antifeedant, insecticidal, and/or growth inhibitory properties (Ekesi, 2000).

Patel and Narasimhacharya (2017and 2024) reported the anti-termite potential of four plant species, *Achyranthes aspera*, *Sida acuta*, *Syzygium cumini* and *Terminalia arjuna* also isolated the termiticidal compounds from Lantana camara L. against *Odontotermes obesus*. The anti-termite potential of each extract revealed that among the plants examined, *T. arjuna* stem methanol extract exhibited the highest termiticidal potential (74.67%) followed by *S. cumini* leaf and stem methanolic extracts(70% ,67% respectively). Aqueous extract of *A. Aspera* was found effective against termites and exhibited 56% mortality over a period of 48hrs. The hexane dried leaf extracts of *Tagetes erecta* and the hexane extracts of *Flourensia cernua* were reported to possess termiticidal activity against Formosan subterranean termite, *Coptotermes formosanus* and *Reticulitermes sp.* (Elango *et al.*, 2012; Tellez *et al.*, 2001). Pal *et al.*, (2013) tested antitermite responses of leaves of *Cordia dichotoma* extracted with methanol and fractionated with different solvents at different dilutions i.e. (0.5%, 1%, 2%) against *Odontotermes obesus.* The 2% ethyl acetate extract possesses highest antitermite potential. Ethanol extract of Sappan (*Caesalpinia sappan*) has a significant potential in the control of termites at 30% concentration (Acero et al., 2018). Nisar et al., (2020) determined the comparative effect of termiticides and plant extracts on mortality and tunnel formation of Odontotermes obesus results showed that Bifenthrin as most effective treatment among chemicals while among plant extracts Dodonaea viscosa was found most effective having lower LT_{50} values.

Verma *et al.*, (2016) investigated the termiticidal effect of *Tagetes erecta* and *Citrus sinensis* oil against termite, *Odontotermes obesus*. The plants reviewed show good insecticidal properties against termites Verma *et al.*, (2009). Shiberu *et al.*, (2014) resulted seven botanical were antitermite property in Ethiopia. Aqueous extracts of tobacco leaves, *Nicotiana tabacum*, Birbira seeds, *Militia ferruginea* and Endod leaves, *Phytolacca dodecandra* were achieved 100% mortality after 24 hours.

The finding of the present investigation revealed that, the leaves extract of *Jatropha gossypifolia* possesses remarkable termiticidal activity against *Odontotermes obesus*.

The LD_{10} = 9.8220 mg/ml, LD_{50} = 10.093 mg/ml and LD_{90} = 12.667 mg/ml in methanol and LD_{10} = 11.984 mg/ml, LD_{50} = 13.195 mg/ml and LD_{90} = 14.531 mg/ml in aqueous leaf extract of Jatropha gossypifolia are recorded whereas methanol solvent extract was more effective than aqueous extract of J. gossypifolia. The study needs further investigation to find out active ingredients responsible for termiticidal properties of *Jatropha gossypifolia* and to reach any final recommendations.

V. ACKNOWLEDGMENTS

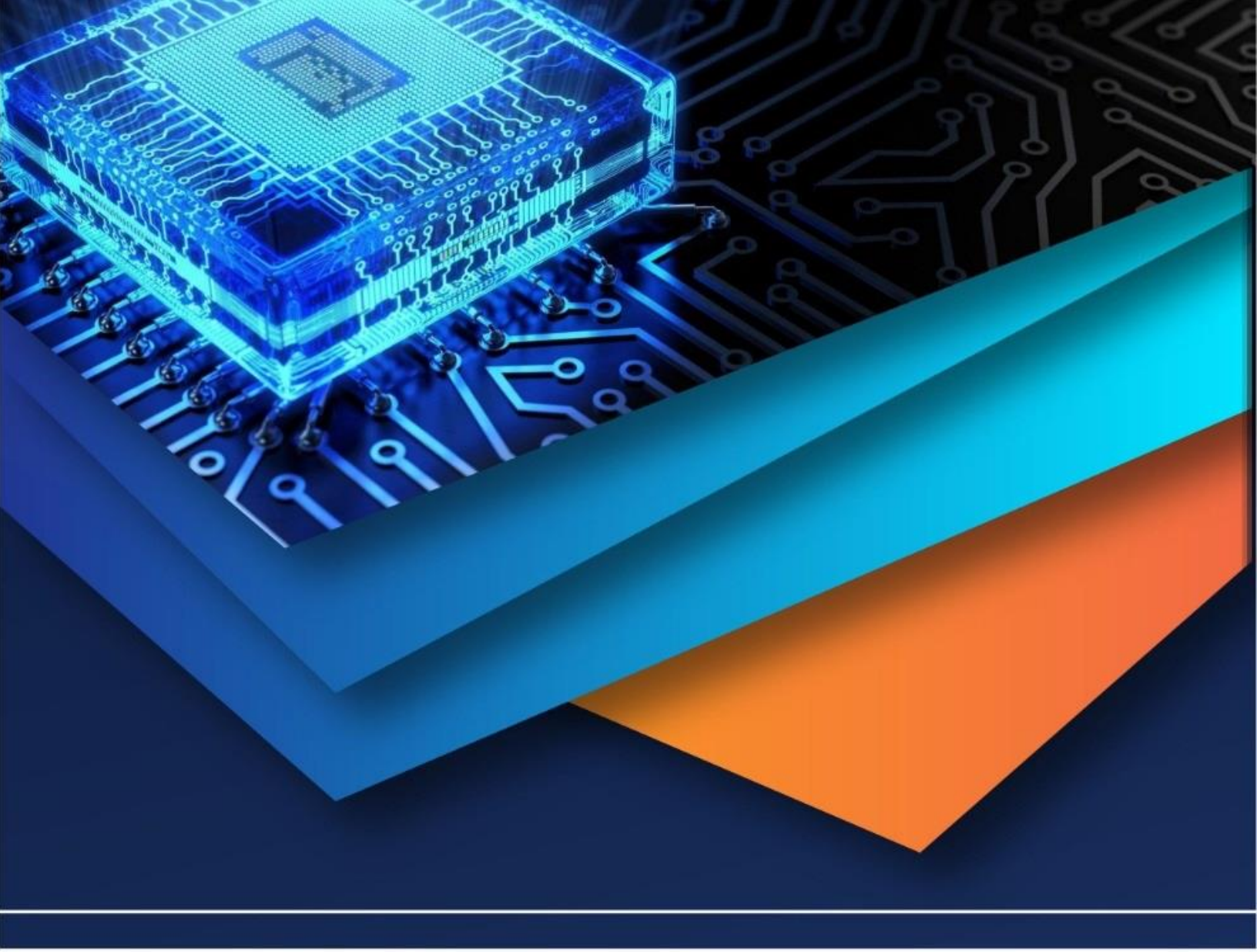
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