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The Insecticidal Efficacy Of Leaf Powders Of Medicinal Plants *PHYLLANTHUS NIRURI LINNAEUS* and *AZADIRACHTA INDICA A.JUSS* on the Management of the Storage Grain Pest *RHYZOPERTHA DOMINCA (FABRICIUS), (COLEOPTERA:BOSTRICHIDAE)*, Found in *TRITICUM AESTIVUM*

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Abstract: ***Cereals dominate the food expenditures in India. Apart from the many challenges in the production sector; another challenge faced by farmers is to protect these cereals from storage grain pests. R. dominica is a major pest of wheat and rice around the world. Both larvae and adult produce frass and cause weight losses by feeding on grains. R. dominica infestation can reduce rice to dust, and can cause serious damage to wheat. Use of chemical pesticides and fertilizers have caused negative impact on environment by affecting soil fertility, water hardness, development of insect resistance, genetic variation in plants, increase in toxic residue through food chain and animal feed thus increasing health problems and many more .In the present study leaf powders of medicinal plants Azadirachta indica and Phyllantus niruri have been used against insect pest R.dominica by analaysing the effect of these two plant powders on the mortality rate and repellency rate. And through the study it has been found that A.indica showed more efficacy against R.dominica and also it can be considered as a safer alternative for synthetic pesticides . This study was to investigate the properties of medicinal plant components, for their safety and efficacy. A synthetic insecticide are either not easily available to most farmers or they cannot afford them. The use of natural medicinal plants like Azadirachta indica and Phyllanthus niruri which can be easily grown by such farmers, should be encouraged.***
Keywords: Rhzopertha dominica, Biopesticides, Azadirachta indica, Phyllanthus niruri, insecticides.

I. INTRODUCTION

Cereals play a pivotal role to satisfy the global food demand of growing population, particularly in developing nations where cereal-based production system is the only predominant source of nutrition and calorie intake [1, 2]. India, being blessed and enriched with a diverse agro ecological condition, ensuring food and nutrition security to a majority of the Indian population through production and steady supply particularly in the recent past, is the second largest producer of wheat worldwide [3-5].The cereal is one of the cheapest sources of energy, provides a major share of protein (20%) and calorie intake (19%) from consumption. Wheat is accessible across the country and consumed as various processed forms from prehistoric times [3]. The current major challenges facing future wheat product on in India are increasing heat stress; dwindling water supplies for irrigation; a growing threat of new virulence of disease such as wheat rusts and leaf blight; continuous adoption of rice- wheat system on around 11 million hectares; changes urbanization patterns, and demand for better quality wheat [6].

Apart the challenges faced in the production of wheat another big task for farmers is to protect these products from storage grain pests. There are a number of storage grain pests that infests on cereals by causing damage to it qualitatively and quantitatively *Rhyzopertha dominica* is one such storage grain pest that cause serious damage to cereals especially to wheat[7] *R. dominica* is a major pest of wheat [8-9]and rice around the world. Both larvae and adult produce frass and cause weight losses by feeding on grains. *R. dominica* infestation can reduce rice to dust [10]. Modern methods of stored wheat grain protection from insect pests strive towards optimizing the use of different techniques and methods within integrated pest management (IPM) programs. One of the methods of integral grain protection is the application of natural originating insecticides [11].

Use of chemical pesticides and fertilizers have caused negative impact on environment by affecting soil fertility, water hardness, development of insect resistance, genetic variation in plants, increase in toxic residue through food chain and animal feed thus increasing health problems and many more.

This has made it essential to introduce measures which can harness foresaid challenges. Use of Biopesticides and Biofertilizers can play a major role in dealing with these challenges in a sustainable way. Biopesticides are biochemical pesticides that are naturally occurring substances that control pests by nontoxic mechanisms. Biopesticides are living organisms (natural enemies) or their products (phytochemicals, microbial products) or byproducts (semiochemicals) which can be used for the management of pests that are injurious to plants. They pose less threat to the environment and to human health[12].

In spite of the wide-spread recognition of insecticidal properties of plants, few commercial products obtained from plants are in use and botanicals used as insecticides presently constitute only 1% of the world insecticide market [13]. *A. indica* has certain distinct advantages over most of the other commercially used plants as natural pesticides. Among the natural products, one of the most promising natural compounds is Azadirachtin, an active compound extracted from the *Azadirachta indica* A. Juss (neem) tree (Family- Meliaceae) whose antiviral, antifungal, antibacterial and insecticidal properties have been known for several years. Azadirachtin is active in nearly 550 insect species[14]. Most importantly an active ingredient of neem known as NLGP has now evolved as a potent immunomodulatory agent [15], thus making it an ideal agro-medicinal plant. This unique attribute of neem makes it an ideal bio-pesticidal agent, as it does not cause non-specific toxicity to mammals [16].

P. niruri is a field weed and its genus Phyllanthus comprises of 600-700 species with minor distinguishing features among them. In Indian ayurvedic system *P. niruri* plant extract is used as a medicine and is recommended for Bronchitis, Anaemia, Leprosy, Asthma, Urinary disorders etc., *P. niruri* is low toxic, and it showed toxicity to batrachians and fishes when extract is alcohol and water based. It is very less toxic to mammals[17].

II. MATERIALS AND METHODS

Collection and Culture of insects: The cereal pest, *R. dominica*, commonly called as lesser borer were obtained from naturally infested wheat from one of the Public distribution centers found in Palakkad, Kerala. It was found out that the 5kg package of wheat grain bought from the PDC was having a considerable amount of infested *R. dominica* in it. This package was kept under room temperature and assured relative humidity. After 48 hours some amount of infested wheat grain along with the insect pest were transferred into a closed glass jar. This jar also kept in room temperature in relative humidity was assured.

Collection of medicinal plant leaves: Fresh leaves of selected plants (Table:1) were collected from Palakkad district and used against pest of cereals.

Table:1 - Medicinal Plants

Botanical Name	Common Name	Vernacular Name	Family Name
Phyllanthus niruri	Stone breaker	Keezharnelli	Phyllanthaceae
Azadirachta indica	Neem	Neem	Meliaceae

Preparation of plant leaf powders: The fresh leaves of selected plants were collected, washed and shade dried and the dried leaves were ground into fine powder using an electric grinder, and it was passed through a sieve and retained in separate containers **.**

A. Experimental Design

Fine plant powders were added separately to 5 containers each which have infested wheat grains in it. Control consisted of infested cereals only; without the plant powders. A completely randomized design with 7 replicates was used for each plant powders, exactly five number of *Rhyzopertha dominica* adults were introduced in each container. Duration of each trial was set to 24 hours. In the 5containers, plant powders were added in a gradually increasing concentration such as 1g, 2g up to 5g . After 24 hours the dead insects were removed and the percentage of mortality of insect were recorded. Along with the analysis mortality ; repellency of the storage grain insect pest R.dominica were also analysed by adding 10 R.dominica insects in 5 pairs of containers and into the first 5 containers leaf powders of Azadirachta indica and into later 5 containers; leaf powders of Phyllanthus niruri were added in gradually increasing concentration.After 24 hrs repellency of Rhyzopertha dominica were analysed . All experiments were performed in 7 replicates and data are the mean, ± SD. Data were subjected to single factor ANOVAalso.

III. RESULT

The trials of *Phyllanthus niruri* leaf powder on *Rhyzopertha dominica* has been estimated by Sum of the value, Mean value and standard deviation from the Mean value. It has been found that the mortality rate of *R. dominica* was recorded highest (27) in the container where the concentration was 5g. Likewise, it is realized that whenever the concentrations was high the mortality rate of *R.dominica* recorded was also the highest. The least mortality rate was recorded in 1g(8). The standard deviation from the mean value was in moderate. It is found that there is some noticeable variation of mean value i.e.,1.14, 1.29, 2.29, 2.86 and 3.86 for the increasing concentrations 1g, 2g, 3g, 4g and 5g respectively (Table:2).

The trails of *Azadirachta indica* leaf powder on *Rhyzopertha dominica* has been estimated by sum of the value, mean value, and standard deviation from the mean value. It has been found that the mortality rate of *R. dominica* was recorded highest (32) in the container where the concentration is 5g. Likewise, it is realized that whenever the concentration was high the mortality rate of *R. dominica* recorded was also the highest. The least mortality rate was recorded in 1g (7). The standard deviation from the mean value was in moderate. It is found that there is some noticeable variation of mean value i.e., 1, 1.29, 2.29, 3.14 and 4.0 for the increasing concentrations 1g, 2g, 3g, 4g and 5g respectively (Table:3).

On the assay of repellency of R.dominica to both the medicinal plants *A.indica* and *P.niruri* a repellency range 6.28±0.69, 6.71±0.69, 7 ±0.75, 7.57 ±0.49, 8.42 ±0.49 (*A.indica)* and7.14±0.63, 7.85±0.63, 8.28±0.69, 8.57±0.49, 8.57±0.34(*P.niruri*) was observed in the concentrations 1g,2g,3g,4g and 5g respectively.(Table:5).

Single factor Anova of the mortality rate of *R. dominica* upon treating with leaf powders *Phyllanathus niruri* and *Azadirachta indica* were analyzed in which the p- value obtained as 8.08Eˆ-10and 5.28E-12, f- value obtained as 28.40 and42.94, f critical value obtained as 2.699 and 2.69 respectively(Table:2.1&4) (Table:3.1&4).

Single factor Anova of the repellency rate of *R. dominica* upon treating with leaf powders *Phyllanathus niruri* and *Azadirachta indica* were analyzed in which the p- value obtained as 2.58E-05 and0.000156 , f- value obtained as 10.14 and 8.048, f -critical value obtained as 2.69 and 2.69 respectively(Table:5&6).

The comparative analysis of the mean values, ±SD, variances and the Anova of the leaf powders *Phyllanthus niruri* and *Azadirachta indica* were studied (Table:4&Fig:3). From the observations of trials of each plant species *Azadirachta indica* found to be influencing more on the mortality rate and repellency of *Rhyzopertha dominica* in cereals when compared to *Phyllanthus niruri*.

IV. TABLES

Table :2- Trials done on *Rhyzopertha dominica* to detect the mortality rate against *Phyllanthus niruri* in wheat

Days	Concentration				
	1g	2g	3g	4g	5g
DAY -1	1	1	2	2	3
DAY-2	1	1	2	3	3
DAY-3	1	1	2	2	4
DAY-4	1	2	3	3	4
DAY-5	2	2	2	3	5
DAY-6	1	1	3	4	4
DAY-7	1	1	2	3	4
MEAN	1.14	1.29	2.29	2.86	3.86
±SD	0.38	0.49	0.49	0.69	0.69

Table: 2.1 - Analysis of Variance of *Phyllanthus niruri* on the mortality rate of *R.dominica* in wheat

Groups	Count	Sum	Variance
1g	7	8	0.14
2g	7	9	0.24
3g	7	16	0.24
4g	7	20	0.48
5g	7	27	0.48

Table :3 -Trials done on *Rhyzopertha dominica* to detect the mortality rate against the leaf powder *Azadirachta indica* in wheat.

TRIALS	CONCENTRATION				
	1g	2g	3g	4g	5g
DAY-1	1	1	2	3	4
DAY-2	1	1	2	2	3
DAY-3	1	1	2	3	4
DAY-4	1	2	3	3	4
DAY-5	1	1	2	3	5
DAY-6	1	2	2	4	4
DAY-7	1	1	3	4	4
MEAN	1	1.29	2.29	3.14	4.0
±SD	0	0.49	0.49	0.69	0.58

Table:3.1 - Analysis of Variance of *Azadirachta indica* on the mortality rate of *R. dominica* in wheat.

Groups	Count	Sum	Variance
1g	7	7	0
2g	7	9	0.24
3g	7	16	0.24
4g	7	22	0.48
5g	7	28	0.33

Table :4 - Comparative analysis of Mean value along with results of ANOVA of two leaf powders *P.niruri* and *Azadirachta indica*.

Sl.No.	Samples	Mean values					p-value	f-value	f-critical value
1	*Phyllanthus niruri*	1.14	1.29	2.29	2.86	3.86	8.08E-10	28.41	2.69
2	*Azadirachta indica*	1.0	1.29	2.29	3.14	4.0	5.28E-12	42.94	2.69

Table : 5-Repellency of R.dominica to leaf powders of medicinal plants P.nirui and A.indica

Name of the leaf powder	Concentration	No.of Insects used	Repellancy
Phyllanthus niruri	1g	10	6.28±0.69
	2g	10	6.71±0.69
	3g	10	7 ±0.75
	4g	10	7.57 ±0.49
	5g	10	8.42 ±0.49
Azadirachta indica	1g	10	7.14±0.63
	2g	10	7.85±0.63
	3g	10	8.28±0.69
	4g	10	8.57±0.49
	5g	10	8.57±0.34

Table :6 - Comparative analysis of results of single factor ANOVA of two leaf powders *P.niruri* and *Azadirachta indica*.

Name of plant	F-value	P-value	F-critical value
Phyllanthus niruri	10.14	2.58E-05	2.689628
Azadirachta indica	8.04878	0.000156	2.689628

V. DISCUSSION

Rhyzopertha dominica is a primary pest which causes damages to stored cereals such as corn, grain, rice, wheat, sorghum, tubers, and starch-containing substrates and packaging made from wood. They not only cause losses in terms of quantity but also affect quality during storage period through their feeding activities [18]. *R. dominica* causes economic losses to stored cereals. The damage occurs due to weight deterioration by producing frass from damaged cereals, bad odours due to insect secretions and reduction of nutrient contents. These results in cereals that are unfit for human consumption reduce essential amino acids and also reduce germination ability ([19]-[21]).This insect has a different preference for cereals which determines the level of cereal susceptibility in storage([22]-[23]). The susceptibility dissimilarity occurs in various varieties of wheat and rice([24]-[25]). Several methods have been used to determine the susceptibility of stored cereals, such as measuring quantitative damage by calculating the percentage of frass and also insect biological parameters such as the level of development, fecundity, and life duration of adult insects [26]

A study investigated the response of *R. dominica* to powders and extracts of *Azadirachta indica* and *Piper guineense* seeds in stored wheat grains. These plants have been investigated to be effective in protecting cowpea and maize seeds from infestation by cowpea bruchid, *Callosobruchus maculatus* and *Sitophilus zeamais* respectively([27]-[31]).

Botanical insecticides affect only target insects, not destroy beneficial natural enemies and provide residue-free food and safe environment. We, therefore, recommend using botanical insecticides as an integrated insect management program which can greatly reduce the use of synthetic insecticides [32].

The corrected per cent mortality of adults of *R. dominica* at 60 days after treatment indicated that neem seek kernel powder and red chilli fruit powder (5.0%) gave the maximum protection i.e. 10.00 and 8.75 per cent, respectively[33]. Two medicinal plants Giloe, *Tinospora cordifolia* (woody parts) and Jangli Imli, *Phyllanthus niruri* (whole plant) were tested. The efficacy of plant powders at different rates (0.25, 0.50, 1.0 and 2.0%) was assessed on both least susceptible and highly susceptible variety. *P. niruri* was found more effective as compared to *T. cordifolia* in reducing the progeny beetle emergence both in case of least and highly susceptible varieties [34].

Among different botanicals tested, neem leaf powder protected maize from weevils. It caused high adult weevil mortality, reduced progeny emergence and low % grain damage similar to the standard insecticide, spinosad. Treatments such as custard apple, turmeric and tulsi also caused high adult weevil mortality after 7 days of application. The overall results indicated that neem was very promising biopesticide than any other treatments[35].

VI. CONCLUSION

This study was to investigate the properties of medicinal plant components, for their safety and efficacy. A synthetic insecticide are either not easily available to most farmers or they cannot afford them. The use of natural medicinal plants like *Azadirachta indica* and *Phyllanthus niruri* which can be easily grown by such farmers, should be encouraged. A satisfiable range of mortality rate was noticed in *A. indica* and *P.niruri* powders of all concentrations. Among the *A.indica* , 5g of concentration was recorded higher mortality of *R.dominica*. Likewise Among *P.niruri* 5g of concentration was recorded higher mortality of *R. .dominica.* But on a comparative analysis between the leaf powders of *A. indica* and *P.niruri*. *Azadirachta indica* brought the higher mortality rate of *R.dominica* than *P.niruri*. On the assay of repellency; *R.dominica* was more repellent to Azadirachta indica than Phyllanthus niruri,However the higher rate of repellency was observed in highest concentrations of these two leaf powders .

The above results on both mortality and repellency indicates that the leaf powders of *Azadirachta indica* might be very effective on the management of *Rhyzopertha dominca.* Therefore the present study proves the possibility of using medicinal plant leaf powders as an effective insecticide on the management of the storage grain pest *R.dominica* of wheat.This study also proves that medicinal plant Phyllanthus niruri can be considered in applying as an insecticide as it shows satisfiable range of mortality of R.dominica ,and the insect also showed repellency to it and p.niruri ;from recent studies proved that it has no toxic effects on mammals.Hence plant powders of A.indica and P.niruri can be considered as a safer and effective alternative for synthetic insecticides.

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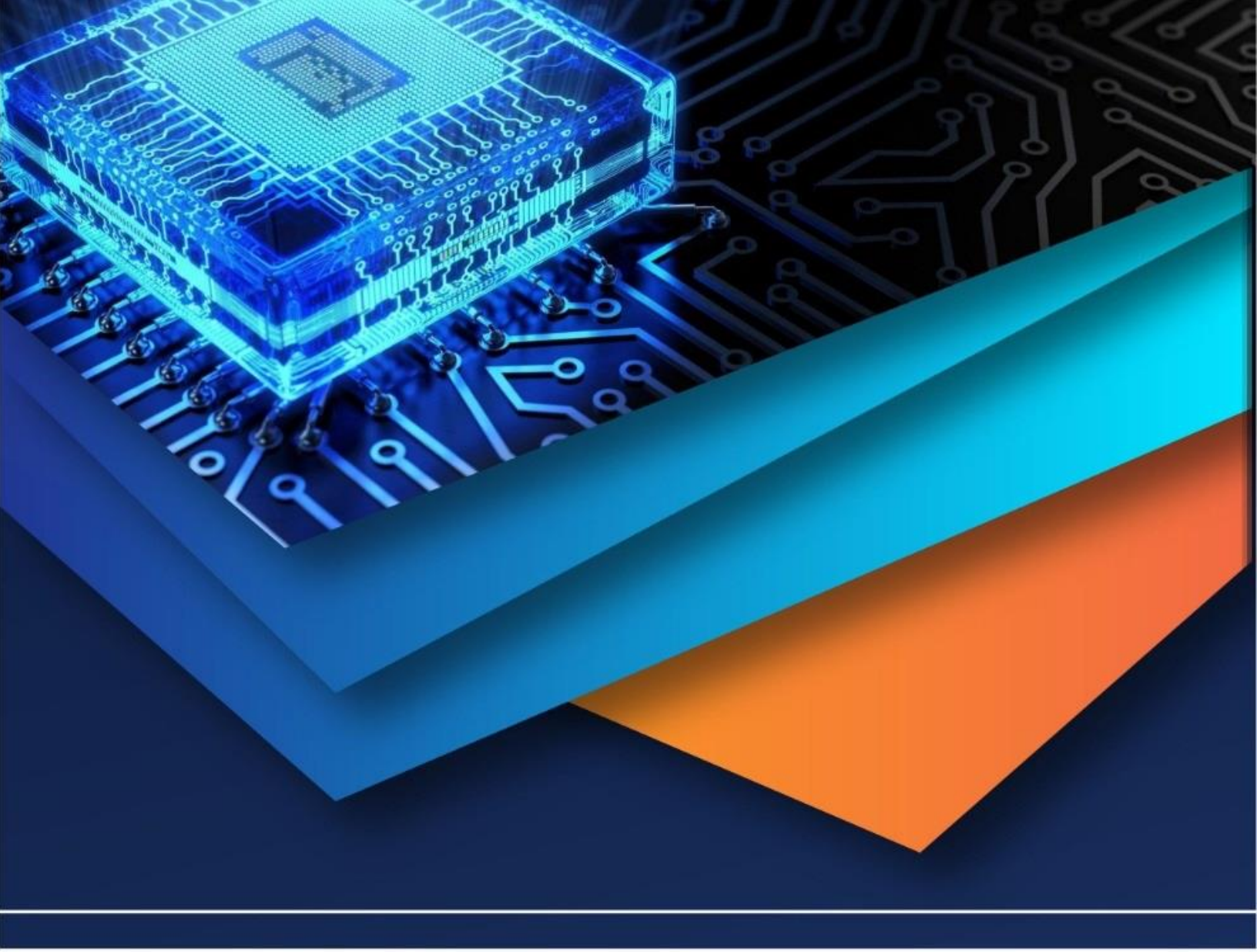

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