SUMMARY OF REPORT OF WORKDONE

Title of Minor Research project: **Studies on growth, development and management of cereal pest, *Sitophilus sp.***

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INTRODUCTION

Wheat is the most proteinaceous grain consumed in developing countries. It is produced in Nagpur, Chandrapur, Amravati and Wardha districts of Vidarbha region. The excess produce is stored in large volumes before and after processing, and then supplied to the different parts of Maharashtra and other states. Wheat, being easily acceptable and highly consumable as staple food in many forms, is stored for long time as national and international bufferstock of food stuff and used during national calamities. Provision of food has always been a challenge facing mankind. A major cornerstone in this challenge is the competition from insect pests, particularly in the tropics and sub-tropics where the climate provides a highly favourable environment for wide range of insects, massive efforts are required to suppress population densities of the different pests in order to achieve an adequate supply of food. It is well established fact that lot of effort have been put for the production of "every single grain" but this is of no use if the produced seeds are not saved for future use, which recalls the proverb "a grain saved is a grain produced". This depend mainly on how we protect the grains from quantitative and qualitative loss during storage. Hence the present study

entitled "Studies on Growth, Development, Infestation and Management of Cereal Pests, *Sitophilus sp*. and *Tribolium sp*. " has been carried out to investigate the growth and development, influence of environmental factors on growth, development , infestation and management strategies to lessen the damage caused.

OBJECTIVES

The above study was carried under the following objectives:-

1. To undertake the survey of different grocery stores and evaluate the incidence of pest.
2. To evaluate the loss occurred due to infestation of insect pest.
3. To study the life stages of pest during storage.
4. To study the behavioural response of pests to different chemicals and botanicals.

METHODOLOGY

Survey and Sampling

Selection of insect pest and cereal host for study

Maintenance of culture and studies on growth and development

Morphological Studies

Pest management:

Use of botanicals and chemical insecticides used for evaluation against *S. oryzae*

Preparation of dosages/ inoculums :

Leaf powders

Insecticidal Bioassays

Preparation of extracts and its Application

Grain with Egg plugs using Acid fuchsin stain.

Estimation of weight loss

Behavioural Bioassays

Fumigant Toxicity Test:

Biochemical estimation:-

Bacteriological Examination

Results

Incidence of store grain pest

A survey was conducted in Gondia city (M.S.) at grocery stores to evaluate the population and diversity of insect species diversity amongst the widely consumed cereals. During survey, it was found that wheat was more infested with diverse insect pest sps. with 95.63% Coleopteran pests (37.57 % *Sitophilus* sps., followed by 34.51% *Tribolium* sps.) and 4.37% Lepidopteran insect pests.

Grain loss:

To assess loss in stored commodities, monthly sample collection of the widely used varieties namely Lokwan and Sharbati cultivars of wheat *Triticum aestivum* and Kalimuch, Basmati , Suvarna and H.M.T cultivars of rice *Oryza sativa*, during the period June 2009-June 2010. From the collected samples, it was observed that wheat cultivars were more prone to insect infestation as compared to the rice varieties. The infestation in wheat was 5.12 % in the month of November while in rice it was only 2.8 %. During survey and preliminary evaluation it was observed that being primary pest, *Sitophilus* spp. more responsible mainly for quantitative loss in wheat grain, hence further detail study was undertaken.

Life cycle of *Sitophilus oryzae*

To study the biology of the rice weevils, *Sitophilus oryzae* was reared in the laboratory at room temp. Possessing immense potential of fecundity, the rice weevil breeds almost all the year round in the climatic conditions of Gondia (Maharashtra, India). It was observed that females took near about 5 days for attaining sexual maturity and the incubation period was 4 days after which , the egg hatched to produce first instar. The first instar stage took 5 days and moulted into second instar with slightly larger in size and took again 4 days and then transformed into thirth and then fourth instar larva. The fourth instar larva took 4 days and enters into pupation in the same excavated cell. It remained for two days and then after ecdysis emerged as adult making hole in the grain. The first life cycle took 34 days including 5 days of oviposition and about 7-8 generations completed in a year.

The period required to complete the one life cycle in *Sitophilus oryzae* varied with influence of different seasons. During post monsoon, the cycle took 30 days in (during Aug.-Sep), in winter the cycle completed in 56-63 days, and in summer, it took about 30-40 days. The development of the rice weevil was faster during monsoon and post monsoon months as compared to both winter and summer cycles suggesting the role of variation in the temperature and humidity on growth and development of the rice weevil.

It has been found that *S. oryzae* bread throughout the year except during April - June as the temperature exceeds 38º C. Eggs are laid everyday during spring, summer and rainy season but during winter egg laying is sporadic and about 90 % of the eggs laid are fertilized. Since only one larva enters the grain and develop as adult. If more than one egg is laid on a single grain, only one survives as others become victim of cannibalism. The duration of egg, larva and pupa is

prolonged during the winter months, but no hibernation period occurs and oviposition continued throughout the year.

The single female laid about 49-126 eggs within 10 days after mating. They took 4-7 days for hatching and then the first instar took 3-9 days, second instar 4-7 days and third instar took 4-8 days and pupal period was 4-10 days and completed its life cycle between 26-56 days.

The overlapping generations occurred and the rice weevil completed 7-8 generations in a year.

Population trend of rice weevils, *Sitophilus oryzae*

The study of growth of population was studied on wheat grains in the laboratory and about 7 generations of *S.oryzae* was observed . The maximum population was during the October-November i.e. during F4 generation. During winter the population decreased, and again increased during early summer (February – March). With the increasing fecundity during early summer, the population once again increased in the F7 generation,hence during this period only 7 generations get completed and most of the weevils died due to high temperature in summer. The females' percentage was more during the winter months whereas during the early summer more males were bred. In the year 2010, the number of weevils got reduced during winter cycle and only 78% of the weevils survived as compared to 92-96% during monsoon season. In the year 2011, the population of beetles in summer and monsoon cycle was lower as compared to 2010 cycle and completed 7 generations. The population of the weevils reduced to negligible with the rise in temperature in the last week of month of April.

Biology of *S. oryzae*

Oviposition :

The female adult before egg laying inspected the grain for their suitability and moves over the surface several times examining it thoroughly by means of the tip of the proboscis and the antenna. While excavating the cavity with the help of its elongated proboscis, the insect retains a firm attatchment by clasping the surface chiefly with the spines on the distal ends of the tibias and then laid single egg in the excavated hole using ovipositor.

Eggs:

The eggs of rice weevil are opaque, shining, white, ovoid to pear shaped in form, widest below middle, bottom broadly rounded, neck at the top with a small protuberance that fits into a cap or plug which cements into place. Eggs measured about 0.65-0.70mm in length and 0.28-0.29mm in width. The incubation period 3-5 days varied with varying temperature.

Larvae: After hatching the larva feeds rapidly, moulted three times at more or less regular intervals. Thus, 4 larval instars are found with increasing size of head capsule. The fully grown larva constructs a pupal cell with frass, waste material and larval secretion and after construction the larva becomes sluggish, lengthens out and loses its plump appearance to enter into prepupal cell which eventually gets converted into pupal form.

. **Larval instars of *S. oryzae* showing width of head capsule.**

Sr. no.	Larval Instar	Width of head capsule
1.	First stage	0.22 mm
2.	Second stage	0.32 mm
3.	Third stage	0.48 mm
4.	Fourth stage	0.64 mm

Pupa:

The beak and appendage formation and colouration takes place during this stage, pupa gets transformed into adult during due course of time.

Adult:

The adult weevil is 2.1-2.8mm in length, dull brown in colour, thorax densely pitted with round punctures, and the elytra are marked with four reddish spots.

The morphological characters useful for sexual dimorphism are less obvious.The ultrasructure of adults of *S. oryzae* have been studied using scanning electron microscopy (SEM) and dissecting binocular, which showed clearly the details of rostrum, feeding apparatus, composed eyes, antennae , thoracic legs and genitals. The differences between the two sexes have been studied and discussed in detail.

Management of *S. oryzae* :

Based on the initial survey carried out on among small scale farmers in the Deori region of Gondia district on the traditional use of plant materials as pesticides in farm storage facilities, it was revealed that only few plant species are either currently used by farmers or being used by farmer's grand parents against different species of post harvest storage pests. The leaf powders of Neem , bael, curry-patta, ram tulsi, shyam tulsi and lemon grass and oils such as castor oil, linseed oil and Mustard oil were screened for their insecticidal activity against the, *Sitophilus oryzae* and compared with chemical insecticides such as Grainphos and Parad.

Leaf powder

All the plant powders and indeginous oils were found to be effective in controlling the growth,reducing population and infestation level by *S. oryzae.* Neem , bael, curry patta leaf powder along with mustard oil being the most promising.

The result of different leaf powders indicated that 0.3 gm of *A. indica* was effective on Sharbati as well as Lokwan cultivar, where as *M. koeinigi* gave similar effect at 0.6 gm concentration. The powder of *A. marmelos* was effective at 1.2 gm and resulted into 90 to 100 % mortality .

Grain damage, weight loss and adult emergence were taken into consideration to decide the susceptibility of wheat to *S. oryzae* and the percentage is converted into a percent weight loss**.**

When *A. indica* powder 1.5 gm/50 gm was used, infestation and grain damage reduced significantly and the infestation and damage was reduced to 0% in Lokwan cultivar where as 0.05% in Sharbati .

The leaf powder of *O. sanctum* reduced the loss considerable in both Lokwan and Sharbati varieties. However with *M. koenigi* the loss reduced only in Sharbati rather than Lokwan where ever with grains 1.8 gm/ 50 gm , the infestation and loss was increased in Lokwan than in Sharbati.

A. marmelos leaf powder could not give positive effect when used in 0.3, 0.6and1.2gm/50gm rain in Sharbati but reduced the infestation and loss by ¼ from initial 0.3 to 1.5 gm concentration. With *C. citrates* leaf powder no significant reduction in both the quality was observed .

Oil

In other experiment different oil concentration were tried and result indicated that mustard oil was very effective in reduction of infestation and resulting high reduction in weight loss in both

the cultivars, Lokwan as well as Sharbati . During storage, in both the grain varieties, damage was lowest with *Brassica* oil and *A. indica***.** Reduction in grain infestation and loss was also observed with Linseed oil although the reduction was not significant as compared Mustard oil. However Castor oil gave better at higher concentration and reduced population but still not significantly effective as compared to mustard oil .

Chemical insecticides:

Both Parad and Grain phos were found to be effective even at the lower concenterations.

Insecticidal bioassays:

Study was conducted to the insecticidal action of three locally available plant extract namely *A. indica, A. marmelos, M. koenigi* against wheat weevil, *S. oryzae*. Following the fumigation, adult mortality and growth inhibition, repellency test. *A. indica* and mustard oil extract were noted to be highly effective while *A. marmelos, M. koenigi* were not effective when fumigated against weevil for 11 to 12 hours. Wheat treated with powder extract of *A. marmelos, M. koenigi* exhibited a low mortality.

Significantly highest repellency rating during two hour of exposure was noted from the mustard oil then *A. indica* which gave a similar repellency with the treated control. These effects were significantly different over powder *M. koenigi* and *A. marmelos* (L). *S. oryzae* were repelled by extract with a comparable degree to that of *A. indica* extract, significantly reduced the number of insects. A loss in bioactivity was observed in *A.indica* extract. This is not surprising since it is known that Azadirachtin- the major insect repellent compound found in *A. indica,* is susceptible to photo degradation, which also ensures its environmental no persistence .

The residual effect of *A. indica* extended to the range from three to seven days by addition of antioxidants such as lecithin.

Protein Estimation:

The level of body protein pattern of weevils have been analyzed using SDS PAGE at adult stage and protein bands obtained in treated were compared to control. The amount of protein present in weevils was in very low amount. The protein estimated from whole body of *S. oryzae* showed a significant variation in the protein concentration. The protein concentration increased in the treated weevils with different oil and powder as compared to control.

Bacterial Examination:

The bacterial colonies found on plating the haemolymph of live and dead rice weevils on agar-medium revealed the presence of Gm +ve bacillus and Gm – ve bacillus sp.

The bacterial colonies also obtained from healthy and infested wheat grains revealed the presence both of Gm +ve and Gm – ve bacillus and cocci.

CONCLUSION

Thus the results of this study using dried powder of neem leaf, bael and curry and oil of mustard and/or castor suggests that the infestation of rice weevils, *S. oryzae* in the stored wheat grains and in already infested stored wheat grains could be minimized using neem leaf powder and its oil significantly without giving any residual effect on human due to consumption of wheat grain.

FUTURE SCOPE

The interesting finding of the present study was the dissimilar performance of different grain protectants against the test insect as well on different varieties of stored food. The similar

concentration resulted into different level of protection against the pest in two different varieties. This might be due to the difference in morphology of grains, texture, dust deposition and degree of adherence to the kernel which influenced the efficacy of different materials. Thus, the recommendation of doses for grain protection should be prescribed based on the variety of the commodity.

The ethano botanical use of these botanicals in ample quantities along with few selected chemical insecticides in small quantities will help the farmers to save the grains and relish their hard work and thus will reduce the suicide attempts of the farmers.

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