IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 11, May 2025
Impact Factor: 7.67

# Comparative Study of Natural and Chemical Pesticides of Sorghum Grain

**Kadam Sakshi Anant, Kalunke Anjali Laxman, Jalatkar Shivani Sanjay**
**Kakde Tejas Rohidas, Mr Munde G. A.**
**Aditya Diploma Institute of Pharmacy, Beed**

**Abstract**: *Sorghum is a vital cereal crop susceptible to pest infestation during storage, leading to significant yield losses. Traditional pesticides pose environmental and health risks, necessitating exploration of safer alternatives. This study compares the efficacy of natural compounds, including neem, turmeric, and asafoetida, with boric acid, a commonly used chemical pesticide, for sorghum grain protection. Neem, turmeric, and asafoetida possess insecticidal properties, while boric acid is known for its effectiveness against a wide range of pests. A series of experiments were conducted to evaluate the effectiveness of these compounds individually and in combination against common sorghum grain pests such as weevils and moths. Results indicate that both natural pesticides and boric acid significantly reduce pest infestation levels compared to untreated sorghum grain samples. This study underscores the potential of natural compounds as effective alternatives to conventional chemical pesticides for sorghum grain protection. Further research is done to optimize the formulation and application methods of natural pesticides for widespread adoption by sorghum farmers, promoting sustainable pest management practices in agriculture. However, a comparative analysis reveals that the natural pesticide formulation, particularly the combination of neem, turmeric and asafoetida exhibits comparable efficacy to boric acid in controlling pest infestation in sorghum grain. Moreover, the natural pesticide formulation demonstrates favorable attributes in terms of safety for human consumption and environmental impact presenting a sustainable alternative to chemical pesticides.*

**Keywords**: Sorghum grain, natural pesticides, neem, turmeric, asafoetida, chemical pesticide, boric acid, pest control, stored grain protectant, sustainability, agricultural practices, comparative analysis, environment-friendly, etc

## I. INTRODUCTION

**Pesticides:**

A pesticide is defined as a chemical agent used to destroy or control pests. The root word is the Latin word "cida" which means to kill. The generic term "pesticides" can apply to a wide spectrum of chemicals, including insecticides, rodenticides, herbicides, fungicides, biocides, and similar chemicals.

Pesticides have been extensively investigated since the 1960s, and their chemical properties, toxicological properties, and fate and transport are well known.

**Natural Pesticides:**

Natural pesticides are pesticides that are made from things found in nature. They may be made from minerals, plants, minerals, or microorganisms. Experts have found that these natural pesticides don't remain in the environment as long as synthetic pesticides. They're considered less toxic and more environmentally safe than many synthetic pesticides.

Examples: neem, pyrethrum, diatomaceous earth, spinosad, rotenone, garlic, B. thurigiensis, cinnamon, essential oil products, etc.

**Chemical Pesticides:**

Chemical pesticides are synthesized in laboratories using artificial processes designed to specifically target and control pests.


DOI: 10.48175/IJARSCT-27246

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 11, May 2025
Impact Factor: 7.67

Chemical pesticides may persist in the environment longer and can have broader ecological impacts due to their synthetic nature and complex chemical composition. Chemical pesticides may pose potential health risks to humans and animals due to their synthetic nature and sometimes toxic ingredients.
Examples: Malathion, parathion, DDT, etc.

**Natural pesticides in stored grain food:**

During the offseason, when fresh food is not available, humans have to consume stored grain food. Unfortunately, these stored grains are later infested with many pests. Stored grain pests generally feed on grain, bore into the kernel and then destroy the germ portion, cause heat and then deterioration in huge losses mainly due to nutritional depletion and reduction in market value besides contamination by their excretory products, that can be extremely hazardous to human health.
To mitigate losses caused by pests, effective pest management strategies should be implemented throughout the grain production, handling, and storage processes. This may include proper sanitation, use of natural or synthetic pesticides, implementation of integrated pest management (IPM) practices, and regular monitoring of stored grain conditions to detect and address pest infestations promptly.

**Stored sorghum grain:**

Stored sorghum grain refers to sorghum that has been harvested and preserved for future use. Sorghum is a cereal grain that is commonly used for food, feed, and industrial purposes. Proper storage of sorghum grain is essential to maintain its quality and prevent spoilage. This typically involves keeping the grain in a cool, dry place with adequate ventilation to prevent moisture buildup and the growth of mold and fungi. Additionally, protecting the grain from pests such as insects and rodents is important to prevent contamination and loss. Various storage methods, including silos, bins, and bags, can be used depending on the scale of production and available resources.
Grain sorghum is relatively tolerant to insect feeding. Higher seeding rates and ability to tiller make stand losses to soils insect. Likewise, sorghum is very tolerant of defoliation. However, insects that prevent seed set or cause direct damage to seed can produce serious loss, because the crop does not have time to compensate by producing new florets and setting seed. The crop's inherent tolerance of injury means treatment thresholds are usually high. But recent strong commodity prices for sorghum justify monitoring for insect pests and use of insecticides when pest populations exceed treatment thresholds.
Sorghum can tolerate some stand loss without affecting yield. The higher seeding rates allow sorghum to withstand up to 15 percent stand loss. However, soil insect damage often is not uniform and is concentrated in certain areas. Losses in those spots can be severe. Soil insecticides are not routinely used at planting in grain sorghum. However, if one or more of the above conditions exist, it is appropriate to consider the use of an at-planting insecticide or seed treatment. The best way to apply an at-planting granular insecticide on grain sorghum.

**NEEM:**

Neem, scientifically known as Azadirachtaindica, has been revered for centuries for its diverse medicinal and agricultural properties. Originating from the Indian subcontinent, neem has gained global recognition as a natural pesticide due to its potent insect-repellent qualities. The primary action of neem includes antimicrobial, antioxidant, anti-inflammatory, immunomodulatory, antidiabetic, anticancer, insecticidal and repellant properties and hepatoprotective effects. Overall, the diverse pharmacological activities of neem make it a valuable medicinal plant with various therapeutic applications.

**Bioactive compounds of Neem-As natural pesticides:**

Neem-based pesticides harness the power of neem's active compounds, such as azadirachtin, nimbin, and nimbidin, to deter pests while posing minimal harm to beneficial organisms and the environment
This eco-friendly alternative has garnered attention for its effectiveness in controlling a wide range of pests while promoting sustainable agricultural practices.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 11, May 2025
Impact Factor: 7.67

Neem as insecticidal and pesticidal acts on insects by repelling them, by inhibiting feeding, and by disrupting their growth, and reproduction. Neem-based formulations do not usually kill insects directly, but they can alter their behavior in significant ways to reduce pest damage to crops and reduce their reproductive potential. The neem is considered as an easily accessible, eco-friendly, biodegradable, cheap, and non-toxic biopesticide which control the target pests.

Collect fresh leaves from plant and dry the min shade, directly mix in food grains and sealed the container in which grains are stored. It is safe, cheap and effective method.

Neem-based products are essential in stored grain protectant including insects that commonly infest sorghum. It can be applied as a coating on the grains or used in various formulations to protect against insect damage during storage.

**TURMERIC**

Curcumin is the chemical constituent of turmeric. Turmeric is one of most essential spices all over the world with a long and distinguished human use particularly in the Eastern civilization and can be considered in this regard. This is basically a spice with the subtle flavor which is obtained from the dried and grounded rhizomes of the plant. The rhizomes are yellowish to orange tuberous juicy stems that are formed below the ground at the base of the plant consisting of the mother rhizomes with the primary, secondary, and even tertiary fingers. Turmeric has been found effective in controlling certain agricultural and animal pests due to the presence of a variety of bioactive constituents that interfere with insect behavior and growth.

The name comes from Arabic kurkum meaning "turmeric". Turmeric (Curcuma longa) is rhizomatous herbaceous perennial plant of the ginger family, Zingiberaceae. It is thought to have arisen by selection and vegetative propagation of a hybrid between the wild turmeric (Curcuma aromatica), native to India, Sri Lanka and the eastern Himalayas and some other closely related species. Turmeric is a sterile plant, and does not produce seed. Curcuma (Cúr-cu-ma) is a genus of about 80 accepted species. Turmeric it is known to be one of the oldest spices that have been used in India since ages. That is why it is alsc known as, Indian Saffron'. It is used as condiment, dye, drug and cosmetic in addition to its use in religious ceremonies. It includes antioxidant, antirheumatic, antimutagenic, antitumor, antivenom, antibacterial, antifungal, antiviral, nematocidal and hemagglutinating activities.

Turmeric cultivation is basically confined to South East Asian countries such as India, Sri Lanka, China, Indonesia, Australia, Africa, Peru and the West Indies. India is one of the largest producers of turmeric in the world (93.7% of the total world production) and is cultivated in 150,000 hectares in India.

**Bioactive compounds of Turmeric-As natural pesticides:**

Turmeric is a low growing shrubby species. Its various plant parts contain different types of bioactive materials which have insecticidal, pesticidal or insect repellent activity. Turmeric extracted oil were identified as turmerone and ar-turmerone. The compounds present in rhizomes are 1,8- Cineole, alpha-Terpineol, Ar-Termerone, Ascorbic acid, Azulene, Beta-Carotene, Beta-sesquiphellandrene, Barneol, Caffeic acid, Caprylic acid, Cinnamic acid, Curcumin, Guaiacol, Isoboreol, p-Coumaric acid, p- Cymene and p-methoxycinnamic acid. The bioactive compounds with insecticidal or pesticidal activity are present in the form of essential oil, those are alpha-Penene, beta-Pinene, Caryophyllene, Eugenol and Limonene. O-Coumaric acid and protocatechuic acid are extracted from leaf of C. Ionga. Curcumin (diferuloylmethane) (34% is responsible for the yellow colour, and comprises curcumin I (94%), curcumin II (6%) and curcumin II (0.3%) and it is the most active chemical which acts as natural pesticides.

**Method of extraction of Curcumin from Turmeric Plant:**

The rhizomes of turmeric were ground to a fine powder in a grinder. A weighed amount of turmeric powder was extracted separately with acetone, petroleum ether and ethanol on Soxhlet's extraction apparatus each for eight hours. The extracts were concentrated on rotary evaporator and finally made solvent free in vacuum desiccators.

Rub the grains gently with turmeric powder and shade dried for half an hour before storage. Turmeric can be used in raw form for protection. Its strong smell and insecticidal properties keep the insects away from sorghum grains. This treatment gives a long-lasting protection from the pest attack and equally safe for consumption.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 11, May 2025
Impact Factor: 7.67

**ASAFOETIDA:**

Asafoetida, also known as "hing" or "devil's dung," is derived from the resin of the roots and stem of Ferula assa-foetida, a perennial herbaceous plant native to the deserts of Iran and Afghanistan.

The resin is extracted by making cuts in the roots and stems of the plant, which then release a milky sap that solidifies into a gum-like resin when exposed to air. This resin is then processed into the powdered form commonly used in cooking and traditional medicine. Asafoetida has been used for centuries in Indian cuisine and traditional medicine for its flavor and medicinal properties.

**Bioactive compounds of Asafoetida -As natural pesticides:**

Asafoetida contains several bioactive compounds that have been studied for their potential use as natural pesticides. One such compound is called ferulic acid, which has been shown to possess insecticidal properties against certain pests. Additionally, compounds like umbelliferone and coumarin found in asafoetida have also demonstrated insecticidal and repellent effects against various pests. These natural compounds offer an alternative to synthetic pesticides, promoting ecofriendly pest management strategies.

**BORIC ACID AS PESTICIDE:**

Boric acid and its sodium borate salts are pesticides that we can find in nature and many products. Borax is one of the most common products. Boric acid and its sodium salts each combine boron with other elements in a different way. In general, their toxicities each depend on the amount of boron they contain. Boric acid and its sodium salts can be used to control a wide variety of pests. These include insects, spiders, mites, algae, molds, fungi, and weeds.

Introducing boric acid as a pesticide in sorghum involves incorporating it into the storage environment or directly applying it to the sorghum grains to control insect infestations. This can be achieved through various methods such as dusting, mixing boric acid with sorghum grains, or using boric acid-treated baits or traps. Proper application techniques and dosage are crucial to ensure effective pest control.

Natural pesticides offer several advantages over chemical pesticides:

**Environmental Safety:**

Natural pesticides are derived from natural sources such as plants, minerals, and microorganisms, making them less harmful to the environment compared to synthetic chemicals.

**Biodegradability:**

Natural pesticides tend to break down more easily in the environment, reducing their persistence and potential for bioaccumulation in the food chain.

Reduced Risk of Harm to Non-target Organisms:

Natural pesticides often have a more targeted mode of action, minimizing the risk of harming beneficial insects, wildlife, and humans.

**Resistance Management:**

Due to their complex compositions, natural pesticides may pose less risk of pests developing resistance compared to chemical pesticides, which often rely on single active ingredients.

**Safer for Human Health:**

Natural pesticides are generally considered safer for human health as they have lower toxicity levels and are less likely to leave harmful residues on food crops.

**Organic Farming Compliance:**

Many natural pesticides are permitted for use in organic farming systems, helping farmers meet organic certification requirements.

**Sustainable Pest Management:**

Incorporating natural pesticides into integrated pest management (IPM) strategies can contribute to sustainable pest control practices by reducing reliance on synthetic chemicals and promoting ecological balance.

Overall, the use of natural pesticides aligns with principles of sustainability, environment-friendly, and human health protection.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 11, May 2025
Impact Factor: 7.67

## II. LITERATURE REVIEW

A compcomparative review of natural and chemical pesticides for sorghum grain protection reveals that natural pesticides, like those derived from neem, turmeric, and asafoetida, can be effective alternatives to chemical pesticides. While chemical pesticides offer rapid control and broad-spectrum efficacy, natural options generally have fewer environmental impacts and are safer for human consumption. However, natural pesticides may require more frequent application and could have a slower action, making them less suitable for immediate crisis situations.

**Comparative Efficacy:**

Studies have shown that natural pesticides, particularly those using plant extracts like neem, turmeric, and asafoetida, can be comparable to boric acid in controlling pests in sorghum grain.

Some research also suggests that certain sorghum varieties, due to their natural VOCs and HIPVs, can offer resistance to certain pests, potentially reducing the need for pesticides.

**Integrated Pest Management**

Natural Pesticides:

Advantages: Safer for human consumption, fewer environmental impacts, and sustainable pest management practices.

Disadvantages: May require more frequent application, slower action, and potential for lower efficacy compared to chemical pesticides.

Comparative Efficacy:

Studies have shown that natural pesticides, particularly those using plant extracts like neem, turmeric, and asafoetida, can be comparable to boric acid in controlling pests in sorghum grain.

Some research also suggests that certain sorghum varieties, due to their natural VOCs and HIPVs, can

Integrated Pest Management (IPM):

IPM is a globally accepted strategy for sustainable agriculture, incorporating natural pest control methods alongside other practices.

The shift towards ecologically sustainable Agro-Eco System Analysis (AESA) based IPM emphasizes the relationship between pests, their natural enemies, and other environmental factors.

## III. MATERIALS AND METHOD

Materials: Neem powder, Turmeric, Asafoetida, Xanthan gum, etc

Method: Direct compression method.

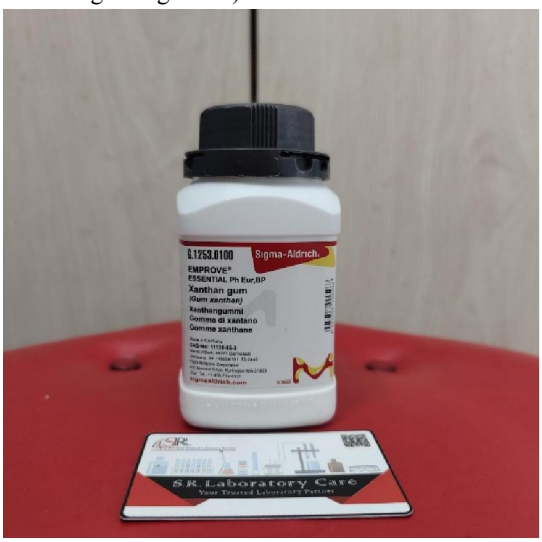
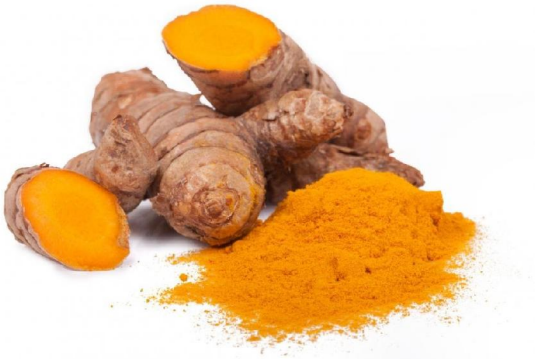
Tablets were directly compressed from powder blend of neem, turmeric and asafoetida. Xanthhan gum was used as binding agent.

## IV. FORMULATION AND CHARACTERIZATION:

Formulation table:

| Sr. No. | Ingredients | Quantity(mg) |
|---|---|---|
| 1 | Neem powder ( fig .no. 1 )  | 300 |

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 11, May 2025
Impact Factor: 7.67

| | | |
|---|---|---|
| 2 | Xanthan gum fig .no .2)<br>  | 100 |
| 3 | Turmeric (fig.no. 3 )<br>  | 50 |
| 4 | Asafoetida ( fig . No. 4)<br>  | 50 |

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 11, May 2025
Impact Factor: 7.67

**MORPHOLOGICAL TESTS**

| | |
|---|---|
| Weight | 50 mg |
| Shape | Roubd |
| Colour | Greenish |

## V. RESULT AND DISCUSSION

The container in which formulated natural tablet and boric acid powder were kept, showed no growth in pesticidal effects. Hence, natural pesticides are cheap, easily available,less toxic, sustainable and less toxicity tonon target species comparing to boric acid i.e. chemical pesticide providing harmful effects to human as well as on environment.

First Month:

Fig no . 5 Sorghum

Fig. No. 6 . Sorghum + Boric Acid

Fig. No. 7Sorghum + Neem Tablet

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 11, May 2025
Impact Factor: 7.67

Second Month:

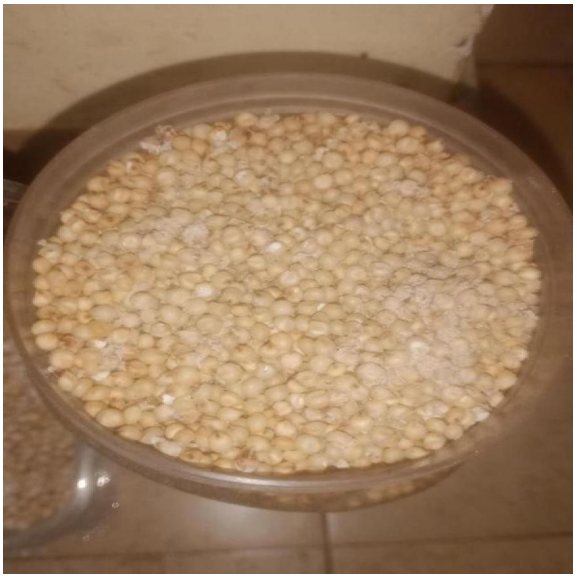


Fig no 8 Sorghum

Fig no.9.Sorghum + Neem Tablet

Fig. No. 10Sorghum + Boric Acid

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 11, May 2025
Impact Factor: 7.67

Third month:

Fig .No 11Sorghum + Boric Acid

Fig.no.12Sorghum + Neem Tablet Sorghum

## VI. CONCLUSION

In conclusion, the comparative analysis of natural pesticides and boric acid as chemical pesticides reveals that both options have their advantages and limitations. Natural pesticides, derived from plant extracts or microbial sources, offer environmentally friendly solutions with minimal harm to non-target organisms. However, their efficacy and stability might vary, requiring frequent applications and careful consideration of application methods. On the other hand, boric acid, while effective against a wide range of pests, poses risks to humans and pets if ingested in large quantities. Its long-term environmental impact is also a concern. Ultimately, the choice between natural pesticides and boric acid depends on factors such as effectiveness, safety, and environmental impact, and should be made based on specific pest management needs and considerations.

## REFERENCES

[1]. Sood R. (2020). Asafoetida (Ferula asafoetida): A high-value crop suitable for the cold desert of Himachal Pradesh, India. Journal of Applied and Natural Science, 12(4): 607-617.
[2]. D. N. KAMBREKAR', C. P. MALLAPUR, D. SAGAR³ AND S. SINGH J. Farm Sci., 35(3): (304-318) 2022
[3]. Wagner de Souza Tavares, Silvia de Sousa Freitas, Geisel Hudson Grazziottib, Leila Maria Leal Parente, Luciano MoraisLiãod, José Cola Zanuncio. Industrial Crops and Products 46 (2013) 158-164
[4]. Katagi, Abhishek and Malashetti, Ishwaree R. (2014). Use of plant products for safe and economic storage of food

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 11, May 2025
Impact Factor: 7.67

grains. Adv. Res. J. Crop Improv., 5 (1): 53-56

[5]. Boadu, K. O., Tulashie, S. K., Anang, M. A., Kpan, J. D. 2011. Production of natural insecticide from Neem leaves (Azadirachtaindica). Asian J. Plant. Sci. Res. 1 (4):33-38.
[6]. Christos A. Damalas
[7]. Department of Agricultural Development, Democritus University of Thrace, 682 00 Orestiada, Greece. POJ4(3):136-141 (2011)
[8]. KripaAdhikari, Sudip Bhandari l, DikshyaNiraula and Jiban Shrestha. 2020, Vol. 1, No. 2, 100-117
[9]. Rajesh Gadewar, VipinBabhulkar, PrachiLambat, Ashish Lambat, Ramesh Parates and SanjivCharjan. IJRBAT, Vol. V, Issue (1), Jan.- 2017.
[10]. Christos A. Damalas. POJ 4(3):136-141 (2011)
[11]. SubashSingh.Journal of Entomology and Zoology Studies 2017, 5(3): 1873-1885.
[12]. Sajjad Ali, Muhammad Sagheer, Mansoorul Hassan, Muneer Abbas, Faisal Hafeez, Muhammad Farooq, Dilbar Hussain, Muhammad Saleem and Abdul Ghaffar. Journal of Entomology and Zoology Studies.JEZS 2014: 2 (3)
[13]. Bappa Ghosh, 1 Narayan Kamble, 1. Arijita Bhattacharyya,
[14]. ChandrasekarKandaswamy, 2 and Kaushik Banerjee 1. Journal of AOAC INTERNATIONAL, 103(6), 2020.
[15]. Petacci, F et al. Phytochemistry and quantification of polyphenols in extracts of the Asteraceae weeds from Diamantina, Mir Gerais State, Brazil. Planta Daninha 30, 9-15 (2012).
[16]. Tavares, W. S. et al. le chemical exploration of Dimorphandramollis (Fabaceae) in Brazil, with emphasis on insecticidal respons A review. J. Sci. hd. les. 73, 465-468 (2014).
[17]. Asawalam, E. F., Emosairue, S. O., &Hassanali, A. (2008). Essential oil of Ocimumgrattissimum (Labiatae)
[18]. Sitophilus zeamais (Coleoptera: Curculionidae) protectant. African Journal of Biotechnology, 7(20).
[19]. Abid, R. A. M. S. H. A., & Butt, S. A. B. A. (2015). Repellent activity of cardamom, ginger and nutmeg against certain insect pests. Int. J. Zool, 5(6), 1-6.
[20]. Bachrouch O, Jemaa MB, Chaieb J, Talou I, Marzouk T, Abderraba B. Insecticidal activity of Pistacialentiscus essential oil on Triboliumcastaneum as alternative to chemical control in storage. Tunisian J of Plant Protec 2010; 5:63-70.
[21]. Chander H, Ahuja DK, Nagender A, Berry SK. Repellency of different plant extracts and commercial formulations used as prophylactic sprays to protect bagged grain against Triboliumcastaneum. J Food SciTechnolMys 2000; 37:582- 585.
[22]. Mona F, Aziz AE, Sayed YAE. Toxicity and biochemical efficacy of six essential oils against Triboliumconfusum (Coleoptera: Tenebrionidae).. Egypt Acad J BiolSci 2009;2(2):1-11.
[23]. Adnan, S. M., Uddin, M. M., Alam, M. J., Islam, M. S., Ka- shem, M. A., Rafii, M. Y., & Latif, M. A. (2014). Man- agement of mango hopper, Idioscopusclypealis, us- ing chemical insecticides and neem oil. The Scien- tific World Journal, Article 709614.