International Journal of Education and Science Research Review
Volume-11, Issue-2 March-April-2024 E-ISSN 2348-6457
(Peer-Reviewed, Open Access, Fully Refereed International Journal) P-ISSN 2349-1817
www.ijesrr.org Impact Factor - 7.02 Email- editor@ijesrr.org

TO STUDY INDIGENOUS AQUEOUS PLANT EXTRACTS AGAINST MAJOR INSECT PESTS

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ABSTRACT

In Nanital, rice is mostly grown during the Kharif season. The damage caused by insect pests is one of the main problems limiting the state's rice production, among other factors. Insecticides and pesticides are widely used today due to the population's rapid growth and the increased demand for food. Fertile lands are becoming infertile as a result of these hazardous chemicals' detrimental effects and biomagnifications, which are continuously poisoning our ecosystem. Research on plant products over the past few decades has demonstrated that botanical pesticides are a viable and environmentally responsible part of the Integrated Pest Management System. For more than a century, botanical pesticides have been used in agriculture to reduce insect and disease-related losses in field crops and food grain storage facilities. Because they are safe for natural enemies and biodegradable, these natural botanical products are garnering more attention globally. Commercial neem formulations and neem derivatives have been thoroughly tested against insect pests of rice among botanical pesticides.

KEYWORD: Rice, Insecticides, Botanical, Agriculture, Century, Environmentally

1. INTRODUCTION

Insects continue to cause significant crop losses for rice producers in Asia, even with the use of insecticides and other management measures. Because of their low cost, ease of availability, and immediate suppression of the pest population, farmers in Nanital typically prefer synthetic organic insecticides that require a high rate of application. However, the careless application of these artificial insecticides to eradicate pests disrupted the natural ecosystem, resulting in a rebound of pests, contamination of the environment, and unfavorable impacts on organisms that are not the target of the pests, including their natural adversaries (Kiritani, 1979). Therefore, it's time to adopt an eco-friendly strategy for a safe and healthy environment. However, in recent years, there has been an increasing focus on using botanicals to manage insect pests. Because they are harmless for the environment and excellent at managing pests, these botanical pesticides are among the promising insecticides that have gained favor recently. Even if there are a lot of botanical pesticides now recognized, it's crucial to understand how successful they are in controlling pests. Finding the best botanical pesticides that are both affordable and have the least negative impact on the population of natural enemies is therefore essential. On the one hand, the IPM (Integrated Pest Management) module also uses native plant extracts to speed up pest control. Researchers are becoming more interested in using locally available plants for pest control since they are safe, viable, and promising for the future of the economy and environment. Vermicompost, biofertilizers, and biopesticides are among the first organic inputs being used in Nanital. The government and Nanital's Department of Agriculture have made action in recent years to guarantee a greater supply of non-chemical pesticides and fertilizers. Despite the fact that utilizing biopesticides and farm manures is becoming more and more frequent in domestic gardens, organic farming does not involve the commercial production of crops.

According to Schoenly et al. (1998), the paddy agro environment, which is categorized as man-made wetlands, is distinguished by intricate food web interactions among different biotic components of the rice ecosystem that preserve animal population balance through biological management. Predators, parasites, and infections are examples of biological control agents that subtly suppress a variety of pests in the rice ecosystem.

Understanding the significance of these natural enemies of different rice insect pests is also crucial for creating an efficient control plan. Recognizing the existence of natural enemies begins with keeping a list of them. Natural enemies of rice pests were reported by numerous workers. However, in order to repair incomplete or occasionally wrong entries, such an inventory needs to be updated and reviewed on a regular basis. Furthermore, long before rice was grown in its current form, these "friends of the rice farmers" were linked to rice pests (Shepard et al., 1987). Farmers, however, are ignorant of the role that natural enemies play in controlling the population of pests. Many different biological control techniques are currently being used around the world, but they all aim to increase pest mortality by growing the number of natural enemies. When little or no insecticides are applied, the species richness and abundance of predator populations are typically higher than those of pest populations (Way and Heong, 1994). Nevertheless, there is still much to learn about the richness of insects linked to rice crops, and much more research is needed in this area. An inventory of parasitoids and predators was collected from several rice-growing regions in the Nanital valley districts for the current study. Since site-specific factors may influence each species' settlement, the diversity of these arthropod groups was also examined from various rice ecosystems in the valley (Kim, 2009). Since this is the first study of its kind in the state, it would create baseline data on the species richness, abundance, and distribution of parasitoids and predators that could be linked to surveys and conservation efforts. It would also be able to evaluate variations from one location to another, under various management systems, or from the present to the future. Therefore, the following goals have been pursued while keeping all the points and gaps in mind.

2. REVIEW OF LITERATURE

Bakar and Khan (2016) demonstrated how the diversity of insect pests and natural enemies is impacted by the phases of rice growth and pest management techniques. Among the four stages of rice growth—seedling, early tillering, maximum tillering, and panicle initiation—the maximum tillering stage had a greater diversity of insect pests, but the reproductive stage had more natural foes. In comparison to the chemically sprayed area, a greater variety of insect pests and natural foes were seen in the untreated and solely perching fields, respectively.

Acosta et al. (2017) made an effort to comprehend the variety of insects found in rice and connected them to the vegetative, reproductive, and seedling phenological stages of rice farming. The findings of this experiment showed that the presence of entomophagous organisms in the field was positively influenced by leaf vegetation. Similarly, more phytophagous and entomophagous insects were found in the vegetative stage of the rice plant than in the other two stages. Suhel et al. (2017) assessed the variety and abundance of insect pest species in a boro rice crop. Three stages of rice growth—the seedling, tillering, and heading stages—were considered. Certain insect pests, such as hoppers, were found to be common in all three stages among the pest species that were documented. While rice bugs were more prevalent during the heading stage, rice hispa was more prevalent at the tillering stage.

During the seedling, tillering, and heading stages of the rice ecosystem, Rahman et al. (2017) documented the diversity and abundance of beneficial insects and spiders. While damselflies, ground beetles, and spiders were prevalent during the tillering stage alone, ladybird beetles were shown to be the most important and prevalent natural adversary from tillering until harvest. According to Siregar et al. (2017), as the plant progressed from the early tillering stage to the ripening stage, the overall insect number, richness, and evenness dropped.

To determine the relative population of insect pests and their predators on Boro rice at two distinct stages—the tillering stage and the panicle initiation stage—Bakar and Khan (2018) carried out a study. It was discovered that among predators, the damselfly and dragonfly populations were at the tillering stage, while the parasitization population was larger during the reproductive stage. In a similar vein, the populations of rice yellow stem borer and hopper insects were larger during the tillering stage than those during the reproductive stage. The potential of insect natural enemies in the Jharkhand rice environment was assessed by Yadav et al. (2018). It was discovered that some predators varied depending on the crop's stage. Dragonflies, damselflies, and coccinellids were more prevalent during the vegetative stage. During the crop's reproductive stage, other insects such as cicindellids, staphylinids, and mirids were more prevalent.

3. OBJECTIVES OF THE STUDY

1. To evaluate certain indigenous aqueous plant extracts against three major insect pests (leaf folder, case worm and green plant hopper).

4. RESEARCH METHODOLOGY

In order to determine the impact of seven (seven) commercial biopesticides—Pestoneem (Azadirachtin 1500ppm @ 1500 ml/ha), Shakti (Azadirachtin 300ppm @ 2500 ml/ha), Margosom (Azadirachtin 300ppm @ 2500 ml/ha), Multineem (Azadirachtin 1500ppm @ 2500 ml/ha), Achook (Azadirachtin 1500ppm @ 1500 ml/ha), Maple ternim (E-M Formulation 2000ml/ha), Uro-insecticide (Cow- urine + Vitex trifolia @ 7500 ml/ha), and one standard check insecticide, Thiamethoxam (25 WG @ 200g/ha)—as well as well as an untreated control (water spray) on the predatory populations of spiders and coccinellid beetles found in the experimental field.

With three replications and three sprays spaced 15 days apart, the experimental field was set up using Randomized Block Design (RBD). A one-month-old seedling of the paddy variety was moved into a 5 x 4-m2 plot with 15 x 20 cm between each other. For the trial, every agronomic procedure was adhered to.

Ten randomly chosen hills in each plot were observed for spider and coccinellid beetle populations one day prior to each spray and three, seven, ten, and fifteen days following each spray.

STUDY AREA:

Four locales in the valley districts of Nanital, Uttarakhand, were the sites of the current study. A distance of roughly 20 to 40 kilometers separates each locality from the others. Below is a quick explanation of the study locations.

LOCATION AND BOUNDARY:

One of the border states in the northeastern region of the country is Nanital. Its overall area is 22327 square kilometers. over 80% of the state of Nanital is topologically made up of mountain and hill ranges, with a tectonic valley in the middle.

It was once an ancient lake that filled up and was raised to its current location, with the remaining portion of the lake still occupying the southern part of the valley. Despite making up only 8% of the state, 70% of the population lives in the Nanital Valley, which has an average elevation of 790 meters above mean sea level (Anonymous, 2015).

5. RESULT AND DATA INTERPRETATION

Table 5.1. Showing the Shannon- Wiener diversity index (H'), Dominance Index (Berger-Parker dominance index) and Evenness (E) of hymenopteran communities in paddy ecosystem of four study sites (during *Kharif* season July- November).

MONTH	DIVERSITY INDEX (H')				BERGER PARKER DOMINANCE (D)				EVENNESS (E)			
	SITE 1	SITE 2	SITE 3	SITE 4	SITE 1	SITE 2	SITE 3	SITE 4	SITE 1	SITE 2	SITE 3	SITE 4
JULY 2023	1.04	0.45	1.50	0.75	0.40	0.64	0.26	0.56	0.61	0.77	0.83	0.84
AUGUST 2023	1.65	1.46	1.53	1.47	0.20	0.33	0.21	0.31	0.53	0.58	0.75	0.58
SEPTEMBER 2023	1.70	1.48	1.78	1.63	0.20	0.26	0.10	0.12	0.57	0.60	0.60	0.68
OCTOBER 2023	1.40	1.07	0.85	1.22	0.25	0.33	0.50	0.37	0.64	0.70	0.54	0.52

NOVEMBER 2023	0.74	0.58	0.80	0.78	0.48	0.40	0.50	0.53	0.67	0.88	0.71	0.68
JULY 2024	0.40	1.06	0.45	0.71	0.70	0.52	0.64	0.56	0.71	0.62	0.77	0.65
AUGUST 2024	1.30	1.20	1.60	1.31	0.34	0.32	0.24	0.21	0.40	0.51	0.67	0.76
SEPTEMBER 2024	1.57	1.18	1.34	1.12	0.33	0.40	0.30	0.31	0.43	0.61	0.60	0.46
OCTOBER 2024	1.25	1.07	1.38	1.06	0.34	0.47	0.36	0.36	0.54	0.48	0.63	0.54
NOVEMBER 2024	0.56	1.08	0.58	0.80	0.51	0.37	0.42	0.43	0.86	0.63	0.88	0.72

September 2023 for the first cycle and August 2024 for the second year Kharif season had the most diversity (1.48), respectively, at Site 2. In contrast, July 2023 (0.45) for the first cycle and July 2024 (1.06) for the second cycle had the lowest index.

With regard to Site 3, the first Kharif season's highest hymenopteran diversity was noted in September 2023 (1.78), while the lowest was noted in November (0.80). For the second year Kharif season, the month of August 2023 had the highest diversity (1.60), while the month of July 2024 had the lowest (0.45).

For Site 4, the month of July 2023 had the lowest diversity (0.75), while the month of September 2023 had the highest diversity (1.63). In the second year of the Kharif season, August 2024 saw the most diversity (1.36), while July 2024 saw the lowest (0.71).

Table also included the Hymenoptera dominance index. In Site 1, the dominance index reached its highest value (0.48) in November 2023 and its lowest value (0.20) in August 2023 during the first year. The month of July 2024 saw the highest dominance (0.70) of Hymenopteran species during the second annual cycle, while the month of September 2024 saw the lowest value (0.33).

In contrast, Site 2's first and second Kharif seasons saw the highest domination in July 2023 (0.64) and July 2024 (0.52). Nonetheless, the first season's minimum index was 0.26 in September 2023 and the second season's was 0.32 in August 2024.

during Site 3, the months of October and November 2023 had the highest dominance index value of 0.50, while the month of September 2023 saw the lowest value (0.10) during the first crop season. For the second year, the month of July 2024 had the highest dominance index (0.64), while the month of August 2024 had the lowest (0.24).

Morishita's Similarity Index

a) Natural enemy

Table provided Morishita's index of similarity for total natural enemies. The overall natural enemies similarity index between Sites 1 and 2 revealed a higher similarity value (0.83) in September 2023 and a lower value (0.67) in July 2023 for the first year. In the second year, the month of August 2024 saw the highest similarity value (0.85), while the month of October 2024 saw the lowest (0.73).

For the first study period, the similarity index between Sites 1 and 3 revealed that the month of September 2023 had the most similarity (0.78), while the month of July 2023 had the lowest similarity (0.72). August 2024 had the greatest value (0.77) during the second year of the study period, while October 2024 had the lowest value (0.70).

Table 5.2. Showing the Morishita's index of similarity of total natural enemies species in four study sites

Month	Site 1 vs			Site 2 vs		Site 3 vs
	Site 2	Site 3	Site 4	Site 3	Site 4	Site 4
JULY 2023	0.67	0.72	0.73	0.75	0.60	0.76
AUGUST 2023	0.80	0.76	0.75	0.72	0.73	0.75
SEPTEMBER 2023	0.83	0.78	0.74	0.78	0.80	0.77
OCTOBER 2023	0.77	0.73	0.76	0.72	0.78	0.73
NOVEMBER 2023	0.68	0.74	0.73	0.70	0.77	0.80
JULY 2024	0.80	0.72	0.70	0.73	0.61	0.55

AUGUST 2024	0.85	0.77	0.70	0.77	0.68	0.75
SEPTEMBER 2024	0.83	0.73	0.68	0.78	0.74	0.78
OCTOBER 2024	0.73	0.7	0.67	0.68	0.73	0.73
NOVEMBER 2024	0.76	0.76	0.76	0.63	0.68	0.68

For Sites 1 and 4, the highest similarity value of 0.76 was recorded in October 2023 for the first study cycle and November 2024 for the second. Nonetheless, the months of July and November of 2023 showed the lowest resemblance, with the same similarity index value of 0.73 for the first year. However, the month of October 2024 had the lowest similarity (0.67) for the following study period.

When comparing Sites 2 and 3, a higher similarity (0.78) was noted in September 2023 and September 2024, respectively. During the first year of the investigation, November 2023 had the lowest similarity (0.70). The month of November 2024 had the lowest similarity in the subsequent cycle as well (0.63).

The range of similarity between Sites 2 and 4 was 0.60 to 0.80, with the highest similarity occurring in September 2023 (0.80) and the lowest in July 2023 (0.60). Similarity between Sites 3 and 4 was determined to be between 0.55 to 0.80. The month of November 2023 had the most similarity (0.80), while the month of July 2024 had the lowest (0.55).

Spider

Table displayed the similarity value determined for the spider group. The similarity between Sites 1 and 2 reached its highest value (0.84) in September 2023; however, the second study cycle's July 2024 saw the highest similarity (0.87). November 2023 had the lowest similarity (0.65) for both years, while November 2024 had the lowest (0.71).

Table 5.3. Showing the Morishita's index of similarity of spider species in four study sites

Month	Site 1 vs			Site 2 vs		Site 3 vs
	Site 2	Site 3	Site 4	Site 3	Site 4	Site 4

JULY 2023	0.83	0.80	0.78	0.84	0.71	0.78
AUGUST 2023	0.83	0.86	0.83	0.83	0.81	0.86
SEPTEMBER 2023	0.84	0.85	0.83	0.85	0.85	0.85
OCTOBER 2023	0.77	0.85	0.82	0.83	0.82	0.85
NOVEMBER 2023	0.65	0.84	0.77	0.75	0.80	0.83
JULY 2024	0.87	0.74	0.75	0.70	0.70	0.58
AUGUST 2024	0.85	0.85	0.74	0.81	0.73	0.78
SEPTEMBER 2024	0.83	0.68	0.65	0.80	0.77	0.77
OCTOBER 2024	0.82	0.81	0.76	0.70	0.70	0.72
NOVEMBER 2024	0.71	0.81	0.83	0.56	0.67	0.75

The months of August 2023 and August 2024 had the highest similarity (0.86) between Sites 1 and 3 in both study years. However, the first-year study period's July 2023 and the second-year study period's September 2024 showed the least resemblance (0.80) and 0.68, respectively. The index reached its highest value (0.83) between Sites 1 and 4 during the first study period in August and September of 2023 and the second study period in November of 2024. For the first and second study periods, it was determined to be lowest in November 2023 (0.77) and September 2024 (0.65), respectively.

6. CONCLUSION

Among the diverse flora and fauna found in the rice field are natural enemies, which are crucial to the ecosystem's long-term viability. This study is the first to examine the distribution and diversity of natural enemies (parasites and predators) in rice fields. The Berger-Parker dominance index, Shannon-Weiner diversity index, Evenness index, and Morishita's index of similarity were used to assess the natural enemies' community structure. The species diversity of natural enemies likewise reached its peak as the crop growth stage progressed. The two-year data analysis revealed that the dominance index ranges from 0.18 to 0.33 and the diversity index (H') of natural enemies peaks in August and September across all research sites. These months may have the highest diversity of all natural enemies because of the high temperatures, relative humidity, and rainfall, which encourage the growth of insect populations and their natural enemies.

Subsequent investigation revealed that the diversity index ranges and spiders were respectively. The months of August and September had the highest spider diversity indices across all research sites, with values ranging from 1.83 to 2.16. Prey densities and crop growth stages may be to blame.

When it came site had the most diversity, with a diversity value of 2.10 in August. The microclimatic conditions that are in place, the stage of the crop, and most importantly, the availability of water in and around the fields, could be the cause of this. More uniformity in the distribution of was noted in all research regions throughout the months of September, October, and November. In contrast to other corresponding times, Site 4's July showed maximum evenness (0.98) during the second year of the inquiry. This suggests a more uniform distribution of the species in the corresponding study sites during that specific month. These two categories of predators were chosen for the current research because they are the most significant and prevalent beneficial insects present in several guilds of the rice ecosystem, especially spiders, and because they prey on different stages of the life cycles of different insect pests.

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Volume-11, Issue-2 March-April-2024 E-ISSN 2348-6457 P-ISSN 2349-1817
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