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VARIATIONS OF SAP TRAPS FOR DETECTING PESTS OF RICE (*Oryza sativa* L.) IR NUTRI ZINC VARIETY BY HAZTON PLANT SYSTEM IN SUNGGAL, NORTH SUMATRA, INDONESIA

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ABSTRACT

Rice (*Oryza sativa*) is the main food commodity for Indonesians and provisioning around 35.3 million tons in North Sumatra, Indonesia. In 2022, the harvest area in North Sumatra was 385,405 ha where the productivity was 50.76 quintal/ha and the production was 2088,584 tons. Rice production is greatly influenced by cultivation practices, plant varieties, and pest and disease attacks on rice plants. This study aimed to measure the diversity and functional role of local insects in agroecosystems at various locations and habitat types Serbajadi Village and Hamparan Perak Village, Sunggal District, Deli Serdang Regency, North Sumatra, Indonesia from May to August 2023. This research used purposive random sampling with five replicates utilizing a variation of five saps, namely rubber sap (*Hevea brasiliensis*), jackfruit sap (*Artocarpus integra*), sapodilla (*Manilkara zapota*), papaya sap (*Carica papaya*), and jatropha sap (*Jatropha curcas*) with the Hazton planting system. A total of 8805 individual insects were successfully collected. The highest from rubber latex (*H. brasiliensis*) which recorded eight orders, 29 families, and 2369 individuals, while the lowest number of insects was on *J. curca*s plant (JS) with eight orders and 29 families, as many as 1159 individuals. The functional status of insects was identified, namely herbivores, pollinators, predators, parasitoids, and scavengers. The richness index of rubber sap (R'=7.77), jackfruit sap trap (R'=7.73), sapodilla sap trap (R'=7.47), papaya sap trap (R'=7.10), and jatropha sap was R'= 7.05. The evenness index value consists of (E=0.88 for rubber sap; E=0.55 for jackfruit sap; E= 0.98 for sapodilla sap and papaya sap, and E=0.97 for jatropha sap), and, the diversity index varies from H' =2.98, 1.88, 3.30, 3.30, and 2.27, respectively. From the data, sap trap variance will support biological control enhancing natural pest suppression and reducing insecticide.

Keywords: Diversity, insects, IR Nutri Zinc, variance sap, paddy

ABSTRAK

Beras (*Oryza sativa*) merupakan komoditi makanan utama bagi penduduk Indonesia sekitar 35.3 juta tan di Sumatera Utara, Indonesia. Pada tahun 2022, kawasan penuaian di Sumatera Utara adalah 385,405 Ha di mana produktiviti adalah 50.76 kuintal/Ha dan pengeluaran adalah 2088,584 tan. Pengeluaran padi sangat dipengaruhi oleh penanaman, varieti tanaman, serta serangan perosak dan penyakit terhadap tanaman padi. Kajian ini bertujuan untuk mengukur kepelbagaian dan peranan fungsi serangga tempatan dalam agroekosistem di pelbagai lokasi dan jenis habitat Kampung Serbajadi dan Kampung Hamparan Perak, Kecamatan Sunggal, Kabupaten Deli Serdang, Sumatera Utara, Indonesia dari Mei hingga Ogos 2023 menggunakan penyelidikan secara purposif rawak ini. Variasi lima getah iaitu dari getah (*Hevea brasiliensis*), getah nangka (*Artocarpus integra*), getah sapodila (*Manilkara zapota*), getah betik (*Carica papaya*) dan getah jarak (*Jatropha curcas*) dengan sistem penanaman Hazton. Sejumlah 8805 individu serangga telah berjaya dikumpulkan yang tertinggi daripada *H. brasiliensis* yang mencatatkan lapan order, 29 famili dan 2369 individu, manakala bilangan serangga terendah adalah pada tumbuhan *J. curcas* iaitu sebanyak lapan order dan 29 famili iaitu sebanyak 1159 individu. Status kefungsian serangga dikenal pasti di darat menggunakan lima jenis getah iaitu herbivor, pendebunga, pemangsa, parasitoid, dan pemangsa. Pengiraan indeks kekayaan terdiri daripada, (R'=7.77), perangkap getah nangka (R'=7.73), perangkap getah sapodila (R'=7.47), perangkap getah betik (R'=7.10) dan getah jarak (R'=7.05). Kemudian nilai indeks keseragaman terdiri daripada (E=0.88 untuk getah getah; E=0.55 untuk getah nangka; E= 0.98 untuk nira sapodilla dan getah betik, serta E=0.97 untuk getah jarak), manakala indeks kepelbagaian adalah berbeza-beza, H' =2.98, 1.88, 3.30, 3.30 dan 2.27, masing-masing. Daripada data, varians perangkap getah akan menyokong kawalan biologi yang meningkatkan penindasan perosak semulajadi dan mengurangkan racun serangga.

Kata kunci: Kepelbagaian, serangga, Zink Nutri IR, sap varians, padi

INTRODUCTION

Rice (*Oryza sativa*) is the main food commodity consumed by more than 70% of Indonesia's population. In 2022, milled dry grain (GKG) reached 35.3 million tonnes in North Sumatra. In 2022, the harvest area in North Sumatra is 385,405 ha, with the productivity of 50.76 ku/ha and production was 2088,584 tons. The main pests on rice plants include mice, rice stem borers, and brown planthoppers. Several other pests that have the potential to damage rice plants are white-backed planthoppers, green planthoppers, stone spear worms, armyworms, leaf folders, and palm grasshoppers (Baehaki 2019; BPS 2024; Rustam et al. 2024).

Farmers have used various methods to control pests (Horgan 2017). Chemical control using pesticides has a negative impact by damaging the environment as well harm the human health (Rindra 2015). The mechanical control uses traps with rubber, known as sticky traps. Plant sap is a thick liquid that comes out of stems, leaves, flowers, stalks, or fruit after the plant has been treated. Some sap can be tested on the field to trap insects. The sap produced by this plant can be toxic and can act as a repellent for insects. The sap contains several compounds such as proteolytic enzymes which are produced over 2-3 months (Galih 2017).

The implementation of an appropriate rice planting system is expected to reduce farmers' production costs in an effort to increase their farming income. One of the government's recommendations for farmers is the implementation of the Hazton planting system. It is estimated that with the Hazton planting system, rice productivity can increase by setting a planting pattern of 25-30 stems/holes. In this way, the number of rice tillers and grains will be greater, so that rice productivity can increase compared to other planting methods. Meanwhile, planting seeds in large quantities aims to prevent stress during transplanting, reduce the formation of excessive offspring, ensure productive offspring come from the parent plant, and promote rapid land coverage to minimize the need for weeding (Agricultural Research and Development Agency 2015).

The varieties used in this rice planting system are the New Superior Varieties (VUB) Inpari IR Nutri Zinc, including early maturing varieties with resistance to pests and diseases, brown planthoppers, biotype 1, biotype 2, and susceptible to biotype 3. It is recommended to be planted in irrigated rice fields at an altitude of 0-600 m above sea level, and also relatively adaptive in swamplands (Agricultural Research and Development Agency 2021).

The tools used are a combination of yellow trap devices and rubber plant experiments, which serve as a substitute for adhesive. Sap plant has the potential to become an alternative adhesive material (Suhendar & Firzana 2024). Plant sap is a thick liquid that exudes from the stems, leaves, flowers, stalks, or fruit when the plant is treated. Some types of sap can be tested in the field to trap pest insects, as they contain compounds that are toxic to certain pest species (Galih 2017). The sap tested not only acts as an adhesive to trap insects, but some sap-like rubber latex and papaya latex also have unique characteristics and distinctive odors that attract insects. A field study is done to evaluate the effectiveness of various plant saps as an insect control mechanism for pest traps. The saps being tested include rubber latex from *Hevea brasiliensis*, jackfruit sap from *Artocarpus heterophyllus*, papaya sap from *Carica papaya*, and castor sap from *Ricinus communis*. The objective of this study is to identify the most effective sap-based trap for managing pests in rice fields.

MATERIALS AND METHODS

Sampling Locations and Traps

This research was carried out on rice fields planted with New Superior Variety Rice Inpari IR Nutri Zinc in Paya Bakung Village and Serbajadi Village, Hamparan Perak District, Deli Serdang, North Sumatra, Indonesia (3ºN 37'41", 98ºE 33'4"). The study utilized traps across five plots, each containing 450 ml of different saps: rubber latex (*Hevea brasiliensis*), jackfruit latex (*Artocarpus integra*), sapodilla sap (*Manilkara zapota*), papaya sap (*Carica papaya*), and Jatropha sap (*Jatropha curcas*). The research area measured 12 x 16 meters per plot, with four sizes of pitfalls used in the experimental setup (as illustrated in Figure 1).

Insects Sampling

The sampling was conducted from June to August 2023. Sampling of insects at each trap point, diagonally designed with a size of 20 x 20 m, totaling five plots, each plot using five traps, consisting of rubber sap (*H. brasiliensis*), jackfruit sap *(A. integra*), sapodilla sap *(M. zapota*), papaya sap (*C. papaya*), and jatropha sap (*J. curcas*) as many as eight observations (Figure 1) below. From the research plot plan above, a total of four location points were installed with the sap trap, ie. red color is rubber latex, yellow indicates jackfruit sap, blue indicates papaya sap and green color indicates distance sap.

Sampling was carried out by observing and collecting insects caught at each trap installed. Sampling insects carried up to eight times observations with a time of once-a-week observation. Sampling was carried out in two phases, namely the vegetative phase of the plant and the generative phase, which is for phase vegetative starts 37 days after planting (dap), 43 dap, 49 dap, and 55 dap. The phase generative starts from 61 dap, 67 dap,73 dap, and 79 dap. Samplings were carried out at 07.00-09.00 am, and the collection was carried out up to eight times replication into five plots.

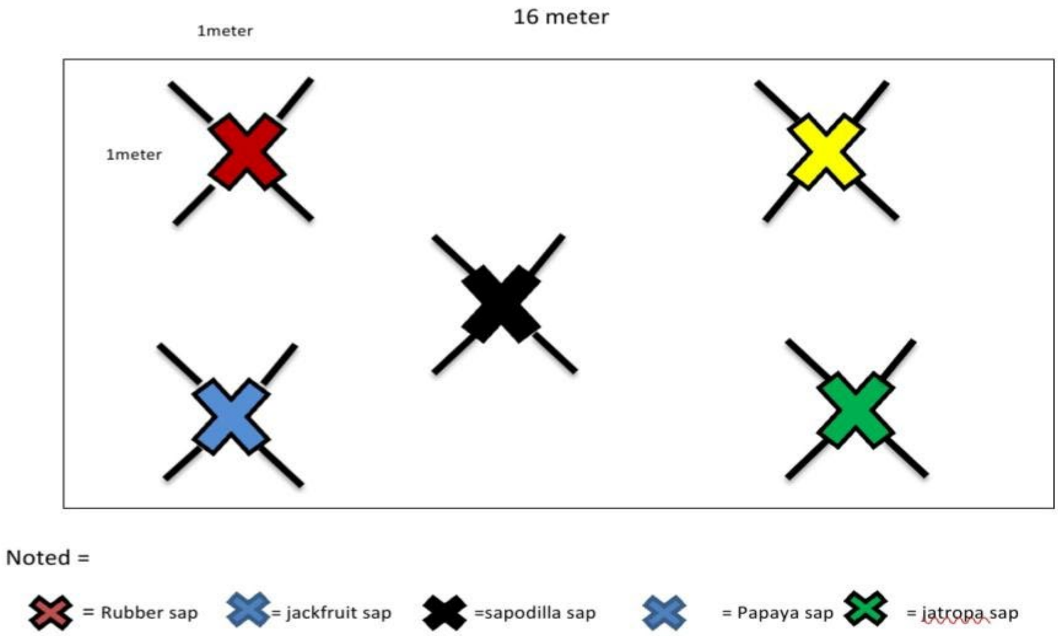

Figure 1. Utilization of traps for controlling paddy pests

Sap Traps

a. Rubber latex (Hevea brasiliensis)

Rubber latex (*H. brasiliensis*) is often called latex. Latex contains 25-40% crude rubber and 60-75% serum. Raw rubber material contains 90-95% pure rubber, 2-3% protein, 1-2% fatty acids, 0.2% sugar, and 0.5% salts from Na, K, Mg, Cn, Cu, Mn, and Fe (Sukandar et al., 2017). The rubber sap trap used in this study was constructed from a square plastic sheet measuring 30 x 15 cm, attached to a stake 60 cm in height, which was adjusted to match the height of the rice plants. To enhance insect attraction, the traps were modified with a yellow background. Each trap was then coated with 450 ml of rubber latex (*H. brasiliensis*). The rubber sap was tapped in the morning to ensure freshness when applied to the traps.

b. Jackfruit Sap (Arthocarpus integra)

Jackfruit sap (*A. integra*) contains several compounds, namely pectin, cellulose, flavonoids, saponin, and tannin. This compound functions as an anti-microbial, anti-inflammatory, antioxidant, anti-cholinergic, anti-diabetic, modulating effect, immune system, inhibitory, estrogen regulatory protothesis, and inhibition of melanin biosynthesis which has been studied in pharmacological research, in plant parts. Pectin and cellulose function as adhesives and can maintain the stability of tissues and cells (Sivagnanasundaram 2018). This rubber sap trap is made from square plastic measuring 30x15 cm, attached to a 60cm high stake, and then adjusted to the height of the rice plant. The trap was modified with a yellow background to attract insects, then the plastic was smeared with 450 ml of jackfruit sap (*A. integra*).

c. Sapodilla sap (Manilkara zapota)
Sapodilla sap (*M. zapota*) contains phenolic compounds, tannins, and saponins. The saponin compound in sapodilla fruit can be used as a trap for pests or insects because of its toxic nature. Sapodilla sap is elastic because it contains gutta, arabine, calcium, glucose, and water. This rubber sap trap is made from square plastic measuring 30x15cm, attached to a 60 cm high stake, and then adjusted to the height of the rice plant. The traps were modified with a yellow background to attract insects, then the plastic was smeared with sapodilla sap (*M. zapota*) as much as 450 ml per trap. After installing the sap trap, the insects caught in the trap are observed.

d. Papaya sap (Carica papaya)
Papaya sap (*C. papaya*) is a source of the enzyme papain (a type of protease) which is known and widely used in various industries such as meat tenderizers, detergents, the food industry, the photography industry, and as an active ingredient in skin cleansing creams. Papaya sap can cause itching when it comes into contact with the skin. We can also find the nature of plant sap which can cause itching in several plant saps that are often used in everyday life (Nugroho 2018). The sap of the papaya plant has two advantages, namely the smell and the papain content. The smell produced by the sap of the papaya plant is very distinctive and strong. Purnomo and Amalia (2017) stated that adding the smell produced by the sap can keep vector insects away from the host plant. According to (Juleha et al. 2022), this rubber sap trap is made from square plastic measuring 30x15 cm, attached to a 60cm high stake, and then adjusted to the height of the rice plant. The traps were modified with a yellow background to attract insects, then the plastic was smeared with 150 ml of papaya (*C. papaya*) sap per trap. After installing the sap trap, the insects caught in the trap are observed. Observations were made at 07.00-09.00 am, and observations were made up to eight times.

e. Jatropha sap (Jatropha curcas)
The chemical contents of castor oil sap include Leaves which contain saponins, flavonoids, tannins, and polyphenolic compounds. The stems of the jatropha plant contain saponins, flavonoids, tannins, and polyphenolic compounds. The sap contains 11-18% tannins, flavonoids and alkaloid compounds, saponins, and a type of toxic protein called Curcuma. This rubber sap trap is made from square plastic measuring 30x15 cm, attached to a 60 cm high stake, and then adjusted to the height of the rice plant. The traps were modified with a yellow background to attract insects, then the plastic was smeared with 450ml of jatropa sap (*J. curcas*) per trap. After installing the sap trap, the insects caught in the trap are observed. Observations were carried out at 07.00-09.00 am, and observations were carried out up to eight times.

Data Analysis
Observation Variables
The number and types of insects caught, collected, identified, were calculated according to the group and the respective families of each insect at each observation. Absolute frequency value, frequency relative, absolute density, and relative density of each observation. Otherwise, knowing the number of insect populations caught that have been identified then you can calculate the absolute frequency value, relative frequency, absolute density, and relative density of each observation according to the formula Mueller-Dombois and Ellenberg (1974): Absolute density (AD) absolute density shows the number of insects determined on the stated habitat. Absolute Frequency (AF) shows how many times the value is repeated in the data vector. Relative Frequency (RF) is the absolute frequency of the event divided by the total number of events. It represents the proportion of a particular data category present in a data vector.

Shannon diversity index (H') of insect species and was calculated using equations as shown by (Shannon and Weaver 1949). The Shannon Weiner index (H') is a quantitative measure that reflects how many different types (such as species) there are in a dataset, and simultaneously takes into account how evenly the basic entities (such as individuals) are distributed among those types. Simpson's Dominance Index (D) as shown by (Simpson 1949) is a measure of diversity that takes into account both richness (the number of species per sample) and evenness (abundance of the different species making up the richness of an area). Margalef's Species Richness Index (R1) as shown by (Clifford & Stephens 1975), is the simplest measure of biodiversity and is simply a count of the number of different species in a given area calculated

RESULTS AND DISCUSSION

A. Diversity of Insects

Table 1 below describes the inventory of insects found in rice plantations based on the use of five plant sap traps, consisting of rubber latex (RS) (*H. brasiliensis*), jackfruit plant sap (JS) (*A. integra*), sapodilla plant sap (SS) (*M. zapota*), papaya plant sap (PS) (*C. papaya)* and the sapodilla sap (JS) of *J. curcas* plant. From Table 1, it is recorded that the highest number of insects was found on rubber latex *H. brasiliensis* (RL) with eight orders and 29 families, 2369 individuals, while the lowest number of insects were on *J. curcas* (JC) plants with eight orders and 29 families, as much as 1159 individuals.

Table 1. Insect inventory in rice plantations. Noted: RL=Rubber latex, JS=Jackfruit plant sap (JS), sapodilla plant sap (SS), papaya plant sap (PS), *Jatropha curcas* plant (JS)

No	Order	Family	Species	RL	JS	SS	PS	JS
1	Coleoptera	Coccinellidae	*Harmonia actomaculata*	60	105	106	36	44
2		Chrysomelidae	*Chironomus* sp.	28	58	54	47	54
3		Carabidae	*Aphionea nigrafasciata*	66	94	49	17	43
4		Staphylinidae	*Paederus* sp.	60	84	50	55	32
5	Diptera	Muscidae	*Musca* sp.	49	97	50	48	42
6		Drosophilidae	*Condylostylus* sp.	25	33	57	46	42
7		Mycetophilidae	*Mycetophila* sp.	77	101	65	54	68
8		Tipulidae	*Tipula* sp.	53	66	58	29	47
9		Cullicidae	*Anopheles* sp.	110	122	76	78	22
10		Cecidomyiidae	*Apidoletes* sp.	57	49	96	20	42
11		Tachinidae	*Tachinid* sp.	60	77	21	45	36
12		Ceratopogonidae	*Culicoides* sp.	89	64	80	45	48
13		Chironomidae	*Chironomus* sp.	408	162	76	61	78
14	Hemiptera	Alydidae	*Leptocorisa oratorios*	400	225	84	62	73
15		Pentatomidae	*Scatiophara* sp.	65	60	51	30	45
16		Coreidae	*Riptortus* sp.	79	50	29	25	25
17		Coriscidae		64	80	69	23	30
18		Delphacidae	*Nilaparvata* sp.	93	79	83	41	35
19		Cicadellidae	*Nephotettix* sp.	55	66	44	39	23
20	Hymenoptera	Vespidae	*Vespula* sp.	79	87	66	27	31
21		Mymarydae	*Coenagrionida* sp.	74	63	64	61	53

22		Apidae		69	64	51	33	36
23	Lepidoptera	Crambidae	*Sciporpaga* sp.	36	54	49	37	20
24		Noctuidae	*Agrotis ipsilon*	16	50	29	40	13
25		Pyralidae	*Cnaphalalocrocis* sp.	98	86	101	36	65
26		Hesperiidae	*Pelopidas* sp.	16	44	31	38	22
27	Orthoptera	Acrididae	*Atractomorpha crenulate*	26	56	79	32	16
28	Odonata	Coenagrioidae	*Agriocnemis* sp.	38	77	47	70	58
29		Libellulidae	*Chaetocnema* sp.	19	45	45	44	16
		Total		2369	2298	1760	1219	1159

The results showed that rubber latex traps (*Hevea brasiliensis*) showed that the highest number of insects collected belonged to the family Chironomidae (408 individuals), followed by the Alydidae with the species *Leptocorisa oratorius* (400 individuals). In contrast, the lowest number was from the order Lepidoptera, Noctuidae, with the species *Agrotis ipsilon* (16 individuals). The jackfruit sap trap (*Artocarpus integra*) recorded the highest number of insects from the order Hemiptera, family Alydidae, with the species *Leptocorisa oratorius* (225 individuals). In contrast, the lowest number of insects captured was from the order Diptera, family Drosophilidae, genus *Condylostylus* (33 individuals). The sapodilla sap trap (*Manilkara kauki*) recorded the highest number of insects from the order Coleoptera, family Coccinellidae, with 106 individuals. The species *Leptocorisa oratorius* was also recorded with 106 individuals. In contrast, the lowest number of insects was from the family Tachinidae (*Tachinida* sp.), with only 21 individuals captured. The papaya sap trap (*Carica papaya*) recorded the highest number of insects from the order Diptera, family Culicidae, with the species *Anopheles* sp. (78 individuals). In contrast, the lowest number was from the order Coleoptera, Carabidae, with the species *A. nigrofasciata* recorded only 17 individuals. The results from the castor sap trap (*Jatropha curcas*), shows that the highest number of insects was recorded from the order Diptera, family Chironomidae, with 78 individuals of *Chironomus* sp. In contrast, the lowest number was from the order Lepidoptera, family Noctuidae, with 14 individuals of *Agrotis ipsilon*.

B. Absolute Density (AD), Absolute Frequency (AF), Relative Density (RD) and Relative Frequency (RF).

The research findings indicate that the Absolute Density (AD) and Relative Density (RD) of insects varied across different sap types used in rice fields, with the highest is the rubber plant sap. The highest AD and RD for rubber plant sap were observed in the order Hemiptera, specifically in the family Alydidae, with an AD of 408 and an RD of 17.22%. In contrast, the lowest values were recorded in the family Noctuidae, with an AD of 16 and an RD of 0.67. For rice fields treated with jackfruit sap, the highest AD and RD were also found in the family Alydidae, with an AD of 225 and an RD of 9.79%. The lowest values were observed in the family Drosophilidae, with an AD of 33 and an RD of 1.43%.

For rice with papaya latex absolute density and relative density. The highest is in the Culicidae family with a value of KM = 78 and RD = 6.39%, while the lowest is in the family Carabidae with a value of AD = 17 and RD= 1.39%. Otherwise, rice with castor sap has absolute density and relative density. The highest is in the Chironomidae family with a value of AD= 78 and RD = 6.72% while the lowest is in the family Trygonidae with AD = 16 and RD = 1.38%. Absolute Frequency (AF), Relative Density (RD), and Relative Frequency (RF) can be seen in Table 2.

Table 2. The Absolute Density (AD), Absolute Frequency (AF), Relative Density (RD) and Relative Frequency (RF) for each sap trap

No	Ordo	Famili	Genus	GK	KM	KR	FM	FR	GN	KM	KR	FM	FR	GS	KM	KR	FM	FR	GP	KM	KR	FM	FR	GJ	KM	KR	FM	FR
1	Coleoptera	Coccinellidae	*Coccinella*	60	60	2,533	6	2,941	105	105	4,569	7	3,333	106	106	6,023	7	3,6649	36	36	2,9532	6	3,68	44	44	3,796	4	2,5316
2		Chrysomelidae	*Discladispa*	28	28	1,182	5	2,451	58	58	2,524	8	3,81	54	54	3,068	5	2,6178	47	47	3,8556	5	3,07	54	54	4,659	5	3,1646
3		Carabidae	*Ophuonea*	66	66	2,786	6	2,941	94	94	4,091	8	3,81	49	49	2,784	6	3,1414	17	17	1,3946	4	2,45	43	43	3,71	7	4,4304
4		Staphylinidae	*Paederus*	60	60	2,533	6	2,941	84	84	3,655	6	2,857	50	50	2,841	4	2,0942	55	55	4,5119	6	3,68	32	32	2,761	3	1,8987
5	Diptera	Muscidae	*Musca*	49	49	2,068	7	3,431	97	97	4,221	7	3,333	50	50	2,841	7	3,6649	48	48	3,9377	6	3,68	42	42	3,624	6	3,7975
6		Drosophilidae	*Condylostylus*	25	25	1,055	7	3,431	33	33	1,436	5	2,381	57	57	3,239	7	3,6649	46	46	3,7736	7	4,29	42	42	3,624	7	4,4304
7		Mycetophilidae	*Mycetophila*	77	77	3,25	8	3,922	101	101	4,395	8	3,81	65	65	3,693	8	4,1885	54	54	4,4299	6	3,68	68	68	5,867	7	4,4304
8		Tipulidae	*Tipula*	53	53	2,237	8	3,922	66	66	2,872	7	3,333	58	58	3,295	7	3,6649	29	29	2,379	6	3,68	47	47	4,055	5	3,1646
9		Cullicidae	*Anopheles*	110	110	4,643	8	3,922	122	122	5,309	8	3,81	76	76	4,318	7	3,6649	78	78	6,3987	8	4,91	22	22	1,898	3	1,8987
10		Cecidomyiidae	*Apidoletes*	57	57	2,406	7	3,431	49	49	2,132	8	3,81	96	96	5,455	8	4,1885	20	20	1,6407	2	1,23	42	42	3,624	4	2,5316
11		Tachinidae	*Tachinid*	60	60	2,533	8	3,922	77	77	3,351	8	3,81	21	21	1,193	4	2,0942	45	45	3,6916	6	3,68	36	36	3,106	5	3,1646
12		Ceratopogonidae	*Culicoides*	89	89	3,757	8	3,922	64	64	2,785	8	3,81	80	80	4,545	6	3,1414	45	45	3,6916	5	3,07	48	48	4,142	6	3,7975
13		Chironomidae	*Chironomus*	400	400	16,88	8	3,922	162	162	7,05	7	3,333	76	76	4,318	7	3,6649	61	61	5,0041	6	3,68	78	78	6,73	8	5,0633
14	Hemiptera	Alydidae	*Leptocorisa*	408	408	17,22	7	3,431	225	225	9,791	7	3,333	84	84	4,773	5	2,6178	62	62	5,0861	5	3,07	73	73	6,299	6	3,7975
15		Pentatomidae	*Scatiophara*	65	65	2,744	8	3,922	60	60	2,611	8	3,81	51	51	2,898	8	4,1885	30	30	2,461	5	3,07	45	45	3,883	6	3,7975
16		Coreidae	*Riptortus*	79	79	3,335	7	3,431	50	50	2,176	7	3,333	29	29	1,648	7	3,6649	25	25	2,0509	6	3,68	25	25	2,157	6	3,7975
17		Coriscidae		64	64	2,702	6	2,941	80	80	3,481	7	3,333	69	69	3,92	7	3,6649	23	23	1,8868	5	3,07	30	30	2,588	5	3,1646
18		Delphacidae	*Nilaparvata*	93	93	3,926	7	3,431	79	79	3,438	7	3,333	83	83	4,716	6	3,1414	41	41	3,3634	5	3,07	35	35	3,02	3	1,8987
19		Cicadellidae	*Nephotettix*	55	55	2,322	8	3,922	66	66	2,872	7	3,333	44	44	2,5	7	3,6649	39	39	3,1993	7	4,29	23	23	1,984	5	3,1646
20	Hymenoptera	Vespidae		79	79	3,335	7	3,431	87	87	3,786	8	3,81	66	66	3,75	7	3,6649	27	27	2,2149	5	3,07	31	31	2,675	6	3,7975
21		Mymarydae	*Coenagrionida*	74	74	3,124	8	3,922	63	63	2,742	7	3,333	64	64	3,636	8	4,1885	61	61	5,0041	8	4,91	53	53	4,573	8	5,0633
22		Apidae		69	69	2,913	8	3,922	64	64	2,785	8	3,81	51	51	2,898	7	3,6649	33	33	2,7071	5	3,07	36	36	3,106	6	3,7975
23	Lepidoptera	Crambidae	*Sciporpaga*	36	36	1,52	7	3,431	54	54	2,35	7	3,333	49	49	2,784	7	3,6649	37	37	3,0353	6	3,68	20	20	1,726	6	3,7975
24		Noctuidae		16	16	0,675	6	2,941	50	50	2,176	8	3,81	29	29	1,648	6	3,1414	40	40	3,2814	7	4,29	13	13	1,122	5	3,1646
25		Pyralidae	*Cnaphalalocrocis*	98	98	4,137	8	3,922	86	86	3,742	7	3,333	101	101	5,739	8	4,1885	36	36	2,9532	3	1,84	65	65	5,608	5	3,1646
26		Hesperiidae	*Pelopidas*	16	16	0,675	6	2,941	44	44	1,915	6	2,857	31	31	1,761	6	3,1414	38	38	3,1173	6	3,68	22	22	1,898	5	3,1646
27	Orthoptera	Acrididae	*Oxya*	26	26	1,098	6	2,941	56	56	2,437	7	3,333	79	79	4,489	6	3,1414	32	32	2,6251	5	3,07	16	16	1,381	4	2,5316
28	Odonata	Coenagrioidae	*Agriocnemis*	38	38	1,604	7	3,431	77	77	3,351	7	3,333	47	47	2,67	6	3,1414	70	70	5,7424	7	4,29	58	58	5,004	7	4,4304
29		Libellulidae	*Orthetrum*	19	19	43,18	6	2,941	45	45	1,958	7	3,333	45	45	2,557	7	3,6649	44	44	3,6095	5	3,07	16	16	1,381	5	3,1646
30		TOTAL		2369	2369	142,4	204	100	2298	2298	100	210	100	1760	1760	100	191	100	1219	1219	100	163	100	1159	1159	100	158	100

The calculation of the highest absolute density (AD/KM=408 individuals) and relative density (RD/KR=17.22%) from order Hemiptra, Family Alydidae used by rubber latex, while the lowest is in the Noctuidae family with a value of AD/KM = 16 individuals and RD/KR 0.67%. Meanwhile, in rice fields with jackfruit plant sap, the highest absolute density and relative density were in the Alydidae family with values of AD/KM = 225 and RD/KR = 9.79%, while the lowest was in the Drosophilidae family with values of AD/KM = 33 and KR = 1.43%. For rice with sapodilla sap, the absolute density and relative density are highest in the Pyralydae family with values of AD/KM = 101 and RD/KR = 5.73%, while the lowest is in the Tachnidae family with values of AD/KM = 21 and RD/ KR = 1.19%. For rice with papaya latex, the highest absolute density and relative density are in the Cullicidae family with values of AD/KM = 78 and RD/KR = 6.39%, while the lowest is in the Carabidae family with values of AD/KM = 17 and RD/KR = 1.39%. For rice, The distance between the absolute density and the highest relative density is in the Chironomidae family with a value of AD/KM = 78 and RD/KR = 6.72%, while the lowest is in the Trigonididae family with a value of AD/KM = 16 and RD/ KR = 1.38%. Based on the data obtained, the Hemiptera is the largest population in rice fields. This is under research by Sukandar (2017) which states that the insects caught were mostly water insects on planted land, the highest being Hymenoptera. The functional status of insects is explained in Table 3. AF/ FM (asbsolute frequency); RF/FR (relative frequency); Total individuals; RL, rubber latex (GK), JS, jackfruit plant sap (GN), SS, sapodilla plant sap (GS), PS, papaya plant sap (GP), JS, jatropha plant (GJ).

Table 3. Functional status of insects collected using five sap traps

Order	Family	Function Status	Rubber Sap	Jackfruit Sap	Sapodilla Sap	Papaya Sap	Jatropha Sap
Coleoptera	Coccinellidae	Predator	60	105	106	36	44
	Chrysomelidae	Herbivor	28	58	54	47	54
	Carabidae	Predator	66	94	49	17	43
	Staphylinidae	Predator	60	84	50	55	32
Diptera	Muscidae	Scavenger	49	97	50	48	42
	Drosophilidae	Herbivor	25	33	57	46	42
	Mycetophilidae	Predator	77	101	65	54	68
	Tipulidae	Herbivor	53	66	58	29	47
	Cullicidae	Pollinator	110	122	76	78	22
	Cecidomyiidae	Herbivor	57	49	96	20	42
	Tachinidae	Parasitoid	60	77	21	45	36
	Ceratopogonidae	Pollinator	89	64	80	45	48
	Chironomidae	Scavenger	400	162	76	61	78
Hemiptera	Alydidae	Herbivor	408	225	84	62	73
	Pentatomidae	Herbivor	65	60	51	30	45
	Coreidae	Herbivor	79	50	29	25	25
	Coriscidae	Herbivor	64	80	69	23	30
	Delphacidae	Herbivor	93	79	83	41	35
	Cicadellidae	Herbivor	55	66	44	39	23
Hymenoptera	Vespidae	Predator	79	87	66	27	31
	Mymarydae	Predator	74	63	64	61	53
	Apidae	Predator	69	64	51	33	36
Lepidoptera	Crambidae	Herbivor	36	54	49	37	20
	Noctuidae	Herbivor	16	50	29	40	13
	Pyralidae	Herbivor	98	86	101	36	65
	Hesperiidae	Herbivor	16	44	31	38	22
Orthoptera	Acrididae	Herbivor	26	56	79	32	16
Odonata	Coenagrioidae	Predator	38	77	47	70	58
	Libellulidae	Predator	19	45	45	44	16
Total			**2369**	**2298**	**1760**	**1219**	**1159**

C. Calculation of Biological Index

The biological indices were calculated by the number and types of insects caught, the Margalef species richness index (R') values, the Evenness index (E), and the Shanon-Weiner diversity index (H') are presented in Table 4.

Table 4. Calculation of biological indices

	Rubber Latex	Jackfruit Sap	Sapodilla Sap	Papaya Sap	Jatropha Sap
Richness (R')	7.77	7.73	7.47	7.10	7.05
Evenness (E)	0.88	0.55	0.98	0.98	0.97
Diversity (H')	2.98	1.88	3.30	3.30	2.27

The calculation of the Species Richness Index revealed high insect richness in rice fields treated with different sap traps. The values were rubber sap traps (R' = 7.77), jackfruit sap traps (R' = 7.73), sapodilla sap traps (R' = 7.47), papaya sap traps (R' = 7.10), and Jatropha sap traps (R' = 7.05). This value shows that insect richness in a rice field is in the High category, which greatly determines the number of species in a community, influenced by the number of individuals. Tarihoran & Siregar (2020) stated that if the Margalef species richness index is greater, it is certain that the diversity index will also be higher. The species richness index will be higher in communities with more species than in communities with few species. Thus, the more species identified, the higher the species richness. Table 4 shows that the Species Evenness Index (Evenness) varies (E=0.88 for rubber latex; Rubber Distance). This value shows that the evenness of insects in one rice field in rubber latex, sapodilla sap, papaya latex, and jatropha latex is in the high category, while in the jackfruit latex, the insect evenness is classified as medium. Then, the diversity index (Diversity Shannon-Wiener)(H') varies from 1.88 to 3.30. From the table data above, we can see that of the four saps, only sapodilla sap (*M. zapota)* contains saponin. This is by Hanum's (2019) statement which states that sapodilla sap contains saponin in the fruit, stems, and leaves of the plant used by trapping for pests in the paddy plantation.

In rubber latex, the composition of the latex material can be divided into two components. The first component is the part that disperses or emits the ingredients contained evenly, which is called serum. Non-rubber ingredients that dissolve in water, such as proteins, mineral salts, enzymes, and others are included in serum. The second component is the dispersed part, consisting of rubber granules surrounded by a thin layer of protein. Non-rubber materials, which are relatively small in quantity, apparently have an important role in controlling the stability of the properties of latex and rubber (Peiris 2017).

For the jackfruit plant (*A. heteropillus*) it is the main source of morin dihydro morphine, cyanomaclurin, artocarpin, isotropin, artoarpin, artocarpus, artoarpetin, norartocarpetin, and heterophylla (Riandy 2018). All parts of the jackfruit tree contain sticky white sap produced from special secretory cells called laticifers. Latex is an aqueous emulsion that contains many interradients such as lipids, pectin resin, sugars, proteins, including proteolytic enzymes. According to Anneahira (2013), the sap of the papaya plant (*C. papaya*) contains papain. The papain content in the sap of the papaya plant has a catalytic enzyme, namely a proteolytic enzyme. Proteolytic enzymes found in the sap of the papaya plant can break down protein.

As reported by (Juleha et al. 2022) and Jomot (2023), the results of the study showed that giving papaya leaf extract had a significant effect on the number of trapped rice snails. Giving 80 g of papaya leaf extract had a significant effect on the number of trapped rice snails. Provision of papaya leaf extract (*C. papaya*) with a concentration of 4% (P1) effectively controlling the *S. litura.* Jatropha plant sap has chemical contents including leaves which contain saponins, flavonoids, tannins, and polyphenolic compounds. The stems of castor oil plants contain polyphenolic compounds. The sap contains 11-18% tannins, flavonoids, and saponins (Maruni et al. 2022).

CONCLUSIONS

The variety of sap traps (rubber, jackfruit, sapodilla, papaya, and jatropa) can be an effective and safe insect control solution in paddy plantations in Northern Sumatera. The sap trap will support biological control enhancing natural pest suppression and reducing insecticide.

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Conflict of Interest
The authors declare that they have no conflict of interest.

Ethics Declarations
No ethical issue is required for this research

Authors' Contributions
Ameilia Zuliyanti Siregar (AZS) contributed methodology, writing original draft, visualization, analysis data, reviewing and editing. Henny Herwina (HH) contributed to to formal analysis, writing, investigation and supervision. Indah Trisnawati Dwi T (ITD) contributed to conceptualization, resources, supervision, and reviewing. All authors read and approved the final manuscript.

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