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COLLECTION AND IDENTIFICATION OF INSECT PEST DIVERSITY ON THE GRAM CROP DURING THE RABI CROP SEASON AT GAYA (HQ)

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ABSTRACT :

Gram (*Cicer arietinum L.*), an essential rabi pulse crop in India, is particularly vulnerable to insect pest infestations during both pre-harvest and post-harvest phases. This study sought to evaluate the diversity, quantity, and seasonal variations of insect pests impacting gramme crops throughout various regions of Gaya, Bihar. Quadrate sampling and diverse trapping techniques (e.g., light traps, pitfall traps, netting, and hand picking) were employed for weekly observations across four agro-zones (East, West, North, and South) during the 2016–2017 rabi season.

Sixteen insect pest species were documented, with Helicoverpa armigera (Gramme pod borer), Aphis craccivora (Aphids), Agrotis ipsilon (Cutworm), and *Callosobruchus spp.* (Pulse beetle) recognised as the most detrimental to chickpea crops. The largest pest densities were recorded in the East and South zones, presumably attributable to favourable meteorological circumstances and inadequate storage techniques. Seasonal fluctuations in insect populations shown a substantial correlation with temperature and humidity. The results furnish essential baseline data for formulating localised Integrated Pest Management (IPM) strategies, with the objective of reducing crop losses, improving productivity, and fostering sustainable chickpea farming in the area.

KEY WORDS: Integrated Pest Management (IPM), Diversity, Helicoverpa armigera, Humidity

INTRODUCTION :

Gram (*Cicer arietinum* L.), widely referred to as chickpea, is a significant pulse crop grown in the areas like Bihar. Gaya is a significant chickpea-producing district in Bihar, attributed to its advantageous agro-climatic conditions. Not with standing its significant nutritional and economic worth, the productivity of gram is frequently impeded by the incursion of several insect pests that assault the crop at multiple stages from early vegetative

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development to maturity, and even post-harvest during storage. These pests diminish both the quantitative yield and the quality of the produce, resulting in substantial economic losses for farmers. The degree of pest infestation in chickpeas is influenced by environmental conditions, agricultural techniques, and the effectiveness of pest management employed by farmers.

In the pre-harvest phase, chickpeas are susceptible to various insect pests, including the pod borer (*Helicoverpa armigera*), aphids (Aphis craccivora), cutworms, and leaf miners. *H. armigera* is regarded as the most devastating, potentially resulting in yield losses of 30–40%. Aphids are infamous for their sap-siphoning behaviour and their role in the propagation of plant viruses. These pests directly harm plant tissues, diminish photosynthetic capacity, and impair plant vitality throughout essential growth stages, including flowering and pod development. During the post-harvest period, the gram crop is susceptible to storage pests, particularly bruchid beetles like *Callosobruchus chinensis* and *Callosobruchus maculatus*. These pests invade stored grains by depositing eggs on the seed coat; the emerging larvae penetrate the seed and consume it internally, making the grains unsuitable for consumption or sale. Under inadequately managed storage conditions, losses attributed to *Callosobruchus* spp. may surpass 50–70%. These storage bugs thrive in warm and humid conditions, prevalent in conventional rural storage systems. Gram crops face a wide array of pest challenges that vary across regions and stages of the crop. According to Singh *et al.* (2015), *Helicoverpa armigera* is one of the most destructive pests during the flowering and podding stages, causing up to 30–40% yield loss. Aphids (*Aphis craccivora*) have also been reported to cause significant damage by sucking sap and transmitting viruses; Kumar & Rai (2017). Ali, M., & Kumar, S. (2001). Elucidates the biology of the gram pod borer, a notable pest affecting pulses, as examined at IIPR. The document is a technical bulletin from IIPR, outlining a decade of study on pulses. Ali and Ahmed (2016) examines the population dynamics of insect pests and their natural antagonists in chickpea cultivation. The focus would be on identifying the most prominent pests during various seasons and examining the correlation between their populations and the availability of beneficial insects that prey on or parasitize them. The study presumably seeks to offer insights for enhanced pest management tactics in chickpea agriculture. The population dynamics of the *Helicoverpa armigera* pod borer, a chickpea pest studied by Chatar *et al.,* investigated the temporal fluctuations of the insect

population on chickpea crops. Das and Mandal (2021) examines the effects of several insect pests on chickpea yield in Eastern India. The study likely evaluates the efficacy of various pest management measures in diminishing pest populations and mitigating yield losses. Natural enemies of *Helicoverpa armigera* (Hubner) on chickpea reported by Devi, N. S.; Singh, O. H.; Devjani, P.; and Singh, T. K., (2002), examines the identification and comprehension of the natural adversaries of the chickpea pod borer, *Helicoverpa armigera*, in India.

The study presumably investigates biological control methods that can assist in managing this economically important insect, recognised for inflicting considerable harm to chickpea crops. Population dynamics of the gram pod borer (*Helicoverpa armigera*), concentrated on the pest's population variations in correlation with the crop's phenological phases and climatic conditions. Dwivedi and Tiwari (2018) examines the significance of IPM in pulse crop cultivation and its capacity to enhance yields and farmer income. The study underscores the necessity for Integrated Pest Management techniques, particularly in view of escalating insect issues and the effects of climate change on pulse crops. The authors underscore the transition to sustainable agriculture practices and the significance of Integrated Pest Management (IPM) in realising this objective. The study paper "Studies on Population Dynamics of Gram Pod Borer *Helicoverpa armigera* (Hubner) on Chickpea (*Cicer arietinum* L.)" by Gautam *et al.,* (2018) examines the variations in the population of the *Helicoverpa armigera* pest on chickpea crops. The study examines the temporal fluctuations of the pest population and their correlation with environmental conditions.

This work is significant because, although insect pests of gram have been extensively researched throughout several regions of India, localised data on pest variety and prevalence particular to the Gaya region during the Rabi season is scarce. The distribution and population dynamics of pests are particularly distinctive to regions, influenced by variations in climate, agricultural practices, and pest adaptation. A thorough and location-specific survey is crucial for identifying pest species, assessing their relative abundance, and estimating the date of their peak activity. This knowledge is essential for formulating efficient Integrated Pest Management (IPM) strategies that are environmentally sustainable and economically feasible.

METHODOLOGY:

On the premise of these goals, expectant Bristol Devotee ought to ensure its essentials among materials and methods that are formerly laid protocols. Sampling of a few insect pest species should be done on random basis in rabi cropping season. Key locations in different zones of Gaya urban area (at least 10 sites for each zone: South, North, East and West) with various trapping systems types including light traps, pitfall hole drops also manual assortment /netting etc.

Random sampling of the different insect pest varieties has to be done during the rabi crop season. Selected sites of different zones of Gaya urban area (at least 10 sites in each zone – South, North, East and west) by different trapping methods like; L.E.D Light Traps, Pit fall traps, by picking, by netting etc. An ecological provenance trial for scientific purposes will be sampled within specific quadrates randomly, only. The significant four zones of classification followed in all the study sites located within 7–10 km of Gaya Urban area. Weekly sampling plan in rabi crop seasonal shall be maintained at the gram cultivation area by this experiment. Insect pest species of each site is sampled data in the form a tradition scheduled plan which was compiled and it will process for statistical analysis.

Quadrate Sampling

Quadrate sampling method is usually used in ecology/ biodiversity to estimate and understand the abundance, distribution as well as diversity of the organisms, this method especially used for the plants and slow-moving animals, within a defined locality. A "quadrate" mechanism refers to a square or rectangular division of a plot of known measurement, which is randomly or systematically organised within the study area. Followed by observation and record has to made reference to the species within the defined plots. Further, collected data to estimate according to the characteristics and corelate with the whole area.

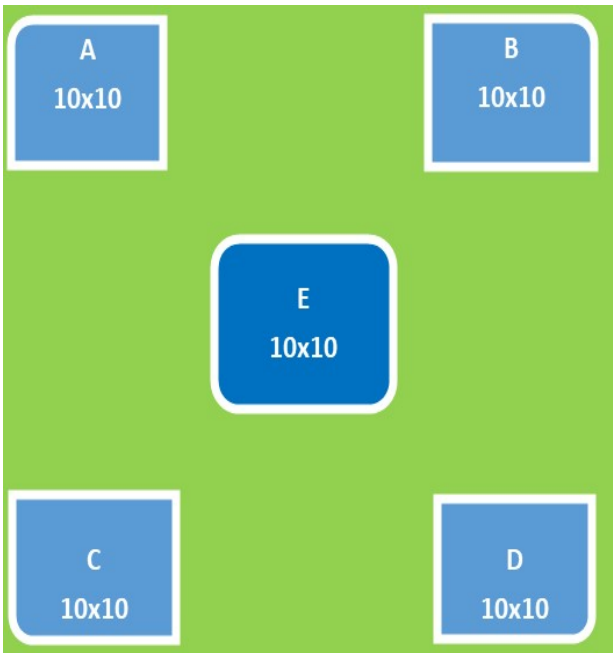
Sampling Location

As mentioned, to the design of my project, I have divided my research area into four different zones of Gaya which are as: North, South, East and West. These parts were selected based on geographical distributions. Outskirts of Gaya town for the further investigation of insect pests Biodiversity of gram crop, field were selected and ask permission from the local farmers. About ten different fields were selected for the quadrate sampling with in one Km. radius of the experimental area. East zone refers: **Budhgere**, village under Manpur block, 24.7973° N, 85.0724° E, about eight Km. far from district headquarter.

West zone refers: **Kastha**, village under Paraiya block 24.8096° N, 84.9271° E, around eight Km. far from district headquarter. North zone refers: **Chakand** village is a panchayat under Gaya Sadar block 24.8854° N, 84.9947° E, around ten Km. far from district headquarter. South zone refers: **Sahdeokhap,** village is a panchayat under Bodh Gaya block 24.8854° N, 84.9947° E, around thirteen Km. far from district headquarter.

Steps in Quadrate Sampling:

40 X40 = 1600 sq ft.



1. **Define the Study Area:** First, choose the experimental plot which is around 40x40 ft. where, I want to collect and estimate the insect pest species or population density. Each quadrate will cover around 200 plants.

2. **Select Quadrate Size and Placement Strategy :** After the selection of experimental plot, quadrates can be placed randomly or systematically, or along a transect line to avoid bias. I have divided the plot into five quadrates which is 10 x10 ft. the quadrates have been arranged four corner of the experimental plot and one within the center of the plot. Followed by different trapping methods have been adopted like; Light Traps, Pit fall traps, by picking, by netting etc.

3. **Sampling schedule:** The experimental weekly sampling schedule will be maintained in rabi crop season at gram cultivating field of Gaya.

4. **Taxonomic identification and Count Organisms:** Repeatedly every week from each quadrate of the sampling sight has been monitored, collected organisms was count carefully and estimate the number of individuals of each species found within each quadrate. Multiple quadrates sampling is ensured to improve the accuracy to estimates the experiment and account for the

variation within the experimental area. Further, taxonomic identification of the collected samples has been made and generation of data have been furbished in the tabular form to evaluate the collected data according to the design of the project plan.

OBSERVATION:

Prior to the follow the work plan, I have to fulfil some preliminary work to perform my said objective. I started to identify to perform my experiment as per defined as per the said project entitled and took permission with the local farmers to perform my work. There after selected land/ field has been framed in quadrats to achieve the target. Same activity had been done with all four zone (East, West, South and North) out skirt of Gaya, to estimate the presence of insect pests. However, the quadrate sampling method had followed for field collection during the pre-harvested gram cropping season only. The post harvested stored crop had been observed to the storage house of farmers. Meteorological study has concurrently been conducted to correlate the presence of insect pests with the rabi crop. This study is to document pest diversity impacting gram in Gaya and promote the implementation of enhanced pest control strategies to increase chickpea productivity and quality in the region. Considering the economic importance of pulses in Indian agriculture and nutrition, such research is essential for guaranteeing food security and enhancing farmer welfare.

Table 1, reveals the collected and identified family of insect pests of rabi crop, tabular data represents the rabi crop season from Nov to March which is pre harvested gram crop field, followed by April to Sep. for post harvested/stored chick pea/ Bengal gram of rabi crop. Around 16 families of insect pest were collected and identified. Collection method has been furbished in the methodology like: by hand picking, net trapping, LED pit fall etc. the collected insects are commonly known as: Rice stem borer, Greenleaf hopper, Brown plant hopper, Grasshopper, Yellow stem borer, Gram pod borer, Army worm, Blister beetle, wheat stem borer, Spotted pod borer, Aphids, Cutworm, Hairy caterpillar, Tobacco leaf eating caterpillar, Whitefly and Bean weevil/ Pulse beetle. Among all the 16 types, 15 types were found during pre-harvested gram crop season which is known as Rabi crop season, and 1 type is found in post harvested of crop or on the stored grains. However, quantity of the collected samples was varied according to divided zones of experimental area. It may due to diversity in the climatic condition (Humidity & Temperature) and flora. But among all 16, I found only four types

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Table :1. Showing over all insect pests collected from the Gaya during the Rabi crop season

SL. No.	Common Name	Scientific Name	Family	Order
1	Striped rice stemborer	*Chilo suppressalis*	Crambidae	Lepidoptera
2	Greenleaf hopper	*Nephotettix virescens*	Cicadellidae	Hemiptera
3	Brown plant hopper	*Nilparvata lugens*	Delphacidae	Hemiptera
4	Grasshopper	*Hieroglyphus banian*	Acrididae	Orthoptera
5	Yellow stem borer	*Scirpophaga incertulas*	Pyraustidae	Lepidoptera
6	Gram Pod borer	*Helicoverpa armigera*	Noctuidae	Lepidoptera
7	Armyworm	*Mythimna separata*	Noctuidae	Lepidoptera
8	Blister beetle	*Zonabris pustulata*	Meloidae	Coleoptera
9	Wheat stem borer	*Sesamia inferens*	Noctuidae	Lepidoptera
10	Spotted pod borer	*Maruca testulalis*	Pyraustidae	Lepidoptera
11	Aphid	*Aphis craccivora*	Aphididae	Hemiptera
12	Cutworm	*Agrotis ipsilon*	Noctuidae	Lepidoptera
13	Hairy caterpillar	*Spilosoma obliqua*	Arctiidae	Lepidoptera
14	Tobacco leaf eating caterpillar	*Spodoptera litura*	Noctuidae	Lepidoptera
15	Whitefly	*Bemisia tabaci*	Aleyrodidae	Hemiptera
16	Bean weevil/ Pulse beetle	*Callosobruchus*	Chrysomelidae	Coleoptera

of insect pests were identified as gram crop insect pests, are as: Gram pod borer, Cut worm, black aphids and Bean weevil/ Pulse beetle.

Table 2; indicates insect pest collected and observed from the East Zone Budhgere, village under Manpur block, 24.7973° N, 85.0724° E, about eight Km. far from district headquarter. Around 10 types of insect pests were collected and identified which are Rice stem borer, Greenleaf hopper, Army worm, Gram pod borer, Cut worm, Aphids, wheat stem borer, Yellow stem borer and Grasshopper. AV. Data representing of each collected insect pests during the rabi crop season from Nov to March are as (07.65, 05.62, 06.01, 31.79, 03.86, 53.80, 09.87, 13.74, 09.81 & 09.43) respectively. Whereas, the chick pea damaging insect pests were identified as Gram pod borer, Cut worm and Aphids. The incidence of all three insect pests related to gram with in the East zone of Gaya was observed during the rabi crop are as 31.79, 03.86 & 53.80.

Figure A, B, C & D Showing Insect Pest Collection and Observation in Gram Crop on The Different Zones of Gaya

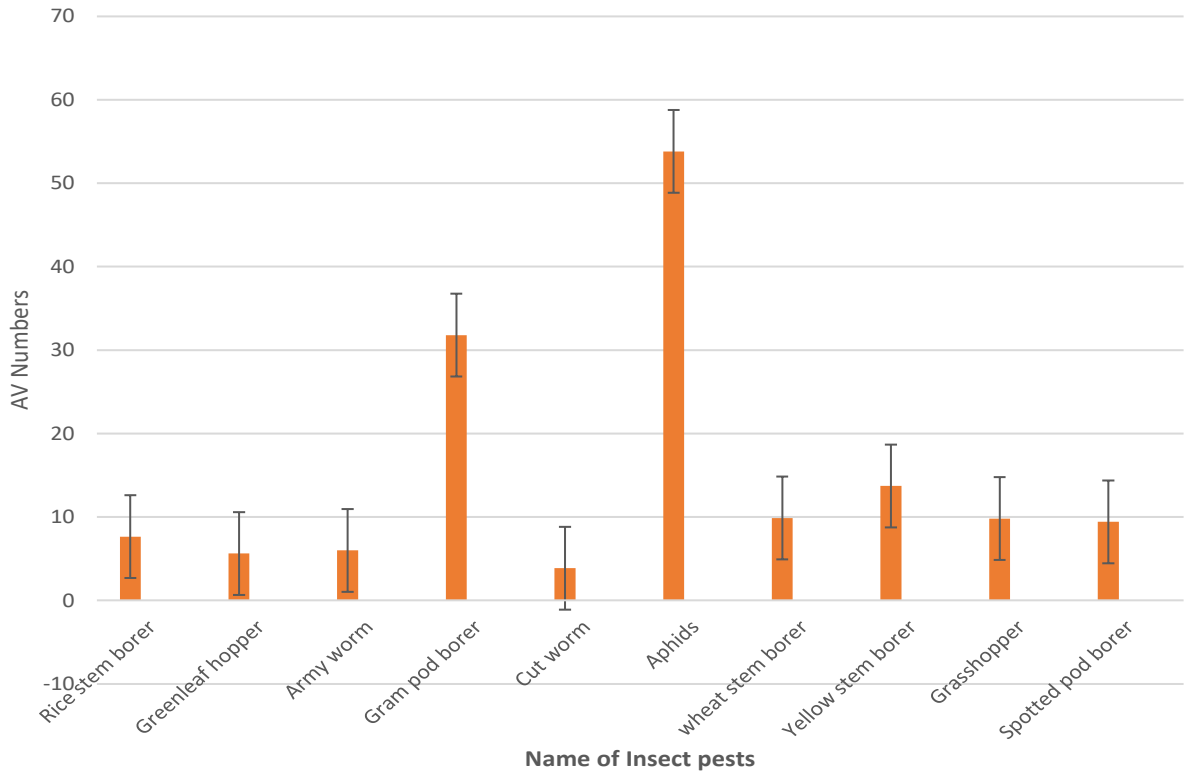
Same as Table 3; indicates insect pest collected and observed from the West zone refers: Kastha, village under Paraiya block 24.8096° N, 84.9271° E, around eight Km. far from district headquarter. Around 09 types of insect pests were collected and identified which are Greenleaf hopper, Army worm, Gram pod borer, Cut worm, Whitefly, wheat stem borer, Yellow stem borer and Grasshopper. AV. Data representing of each collected insect pests during the rabi crop season

Table: 2. Showing insect pest collected and observed from the East Zone Budhgere, village under Manpur block, 24.7973° N, 85.0724° E, about eight Km. far from district headquarter.

Sl.No	Common Name of Insect Pest	AV. No. of Insect Pests Found					
		Nov	Dec	Jan	Feb	Mar	AV. No. of Insects
1	Rice stem borer	12.20	15.10	08.21	02.76	00.00	07.65
2	Greenleaf hopper	10.10	05.90	03.45	07.56	01.12	05.62
3	Army worm	06.88	04.55	02.00	07.95	08.68	06.01
4	Gram pod borer	10.44	30.78	42.23	55.33	20.21	31.79
5	Cut worm	08.90	07.88	02.56	00.00	00.00	03.86
6	Aphids	50.90	80.78	76.90	60.46	00.00	53.80
7	wheat stem borer	00.00	06.66	12.32	14.56	15.81	09.87
8	Yellow stem borer	40.03	28.71	00.00	00.00	00.00	13.74
9	Grasshopper	10.12	12.00	12.91	08.50	05.55	09.81
10	Spotted pod borer	05.55	15.50	17.23	08.90	00.00	09.43

from Nov to March are as (05.97, 06.51, 50.42, 04.09, 13.93, 10.97, 19.2 and 10.02) respectively. Whereas, the chick pea damaging insect pests were identified as Gram pod borer & Cut worm. The incidence of all two insect pests related to gram with in the west zone of Gaya was observed during the rabi crop are as 50.42 and 04.09 only.

Table 4; corresponding insect pest collected and observed from the North zone refers: Chakand village is a panchayat under Gaya Sadar block 24.8854° N, 84.9947° E, around ten Km. far from district headquarter. Around 10 types of insect pests were collected and identified which are Greenleaf hopper, Army worm, Gram pod borer, Cut worm, Whitefly, wheat stem borer, Yellow stem borer, Grasshopper and Blister beetle. AV. Data representing of each collected insect pests during the rabi crop season from Nov to March are as (05.49, 06.49, 33.81, 04.38, 12.73, 10.92, 06.29. 10.23 & 02.96) respectively. Whereas, the chick pea damaging insect pests were identified as Gram pod borer & Cut worm. The incidence of all three insect pests related to gram with in the East zone of



Histogram of Table 2 reflecting Showing insect pest collected and observed from the East Zone Budhgere, village under Manpur block, 24.7973° N, 85.0724° E, about eight Km. far from district headquarter.

Table: 3. Showing insect pest collected and observed from the West zone refers: Kastha, village under Paraiya block 24.8096° N, 84.9271° E, around eight Km. far from district headquarter.

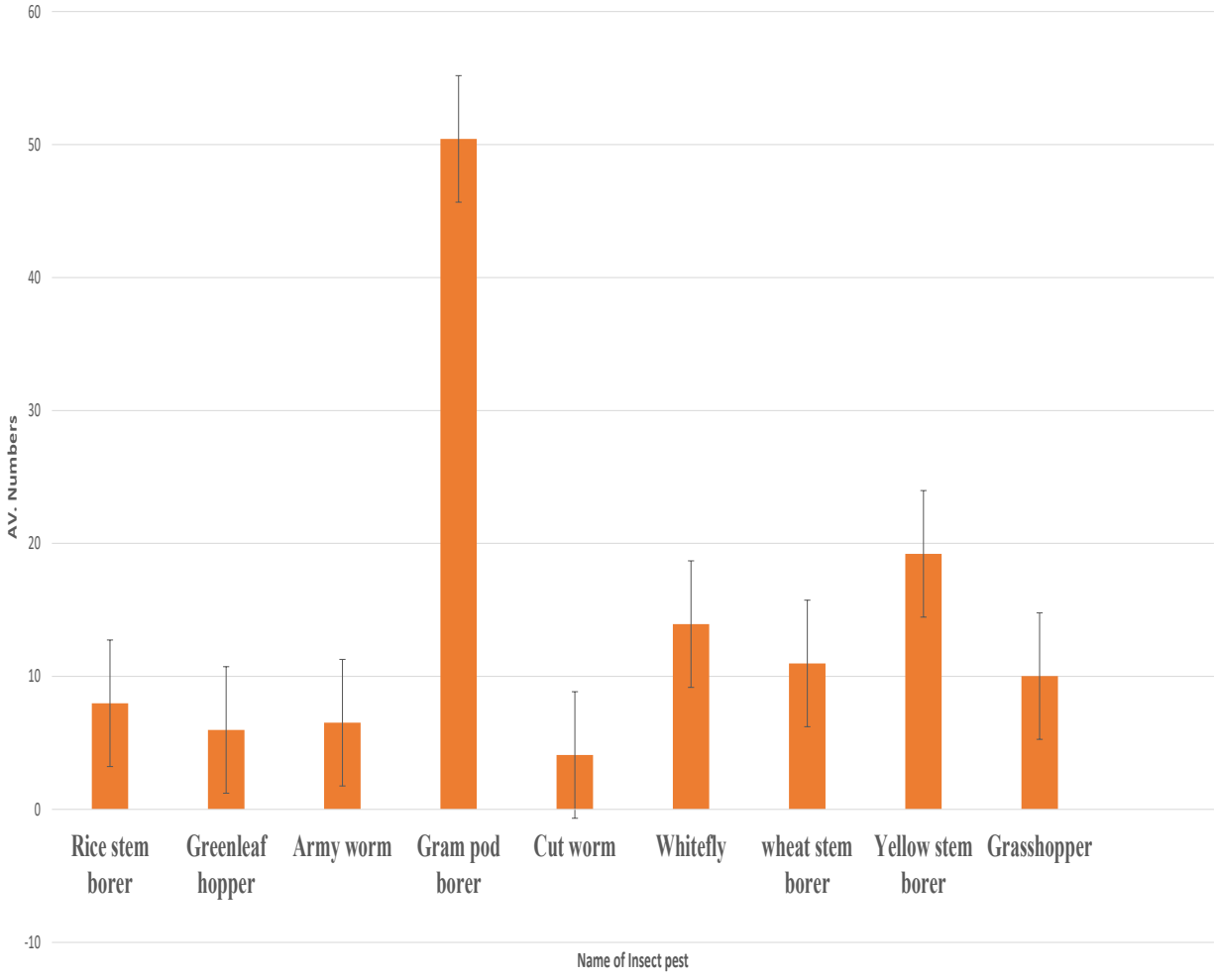
Sl.No	Common name of Insect Pest	AV. No. of Insect Pests Found					
		Nov	Dec	Jan	Feb	Mar	AV. No. of Insects
1	Rice stem borer	14.00	13.90	07.22	04.80	00.00	07.98
2	Greenleaf hopper	08.43	07.92	02.44	09.65	01.44	05.97
3	Army worm	06.90	05.00	02.97	08.92	08.76	06.51
4	Gram pod borer	08.89	35.18	31.46	42.80	42.80	50.42
5	Cut worm	09.82	07.62	03.01	00.00	00.00	04.09
6	Whitefly	15.67	18.00	27.33	08.67	00.00	13.93
7	wheat stem borer	01.10	05.96	14.00	17.50	16.31	10.97
8	Yellow stem borer	52.87	43.22	00.00	00.00	00.00	19.21
9	Grasshopper	12.82	11.00	15.43	07.10	03.76	10.02

Gaya was observed during the rabi crop are as 33.81 and 04.38.

Table 5; corresponding insect pest collected and observed from the South zone refers: Sahdeokhap, village is a panchayat under Bodh Gaya block 24.8854° N, 84.9947° E, around thirteen Km. far from district headquarter. Around 11 types of insect pests were collected and identified which are Bean weevil/ Pulse beetle, Blister beetle, Spotted pod borer, Whitefly, Army worm, Gram pod borer, Cut worm, Tobacco leaf eating caterpillar, Brown plant hopper, Aphids and wheat stem borer. AV. Data representing of each collected insect pests during the rabi crop season from Nov to March are as (11.43, 02.39, 08.11, 09.69, 07.79, 39.72, 04.45, 02.75, 03.24, 14.18 & 07.74) respectively.

The East and South zones exhibited greater pest diversity and density, indicating a necessity for focused pest management techniques in these regions.

This study offers foundational data crucial for the formulation of Integrated Pest Management (IPM) strategies adapted to local circumstances. The research identifies region-specific pest risks and their seasonal trends, facilitating informed decision-making to enhance chickpea productivity, reduce losses, and promote sustainable agriculture in the Gaya region.



Histogram Table 3 reflecting Showing insect pest collected and observed from the West zone refers: Kastha, village under Paraiya block 24.8096° N, 84.9271° E, around eight Km. far from district headquarter.

Whereas, the chick pea damaging insect pests were identified as Gram pod borer, Cut worm & Aphids. The incidence of all three insect pests related to gram with in the East zone of Gaya was observed during the rabi crop are as 39.72, 04.45 & 14.18.

Table: 4. Showing insect pest collected and observed from the North zone refers: Chakand village is a panchayat under Gaya Sadar block 24.8854° N, 84.9947° E, around ten Km. far from district headquarter.

Sl.No	Common name of Insect Pest	AV. No. of Insect Pests Found					
		Nov	Dec	Jan	Feb	Mar	AV. No. of Insects
1	Rice stem borer	14.50	14.60	10.90	03.21	00.00	08.64
2	Greenleaf hopper	08.22	04.34	03.90	07.78	03.21	05.49
3	Army worm	08.33	05.21	04.11	06.47	08.33	06.49
4	Gram pod borer	09.54	23.18	44.23	57.90	34.21	33.81
5	Cut worm	09.98	07.72	04.23	00.00	00.00	04.38
6	Whitefly	17.80	20.00	19.77	06.09	00.00	12.73
7	wheat stem borer	00.05	07.80	16.01	18.52	12.23	10.92
8	Yellow stem borer	20.90	10.55	00.00	00.00	00.00	06.29
9	Grasshopper	15.55	12.90	17.23	05.50	00.00	10.23
10	Blister beetle	04.00	06.90	03.90	00.00	00.00	02.96

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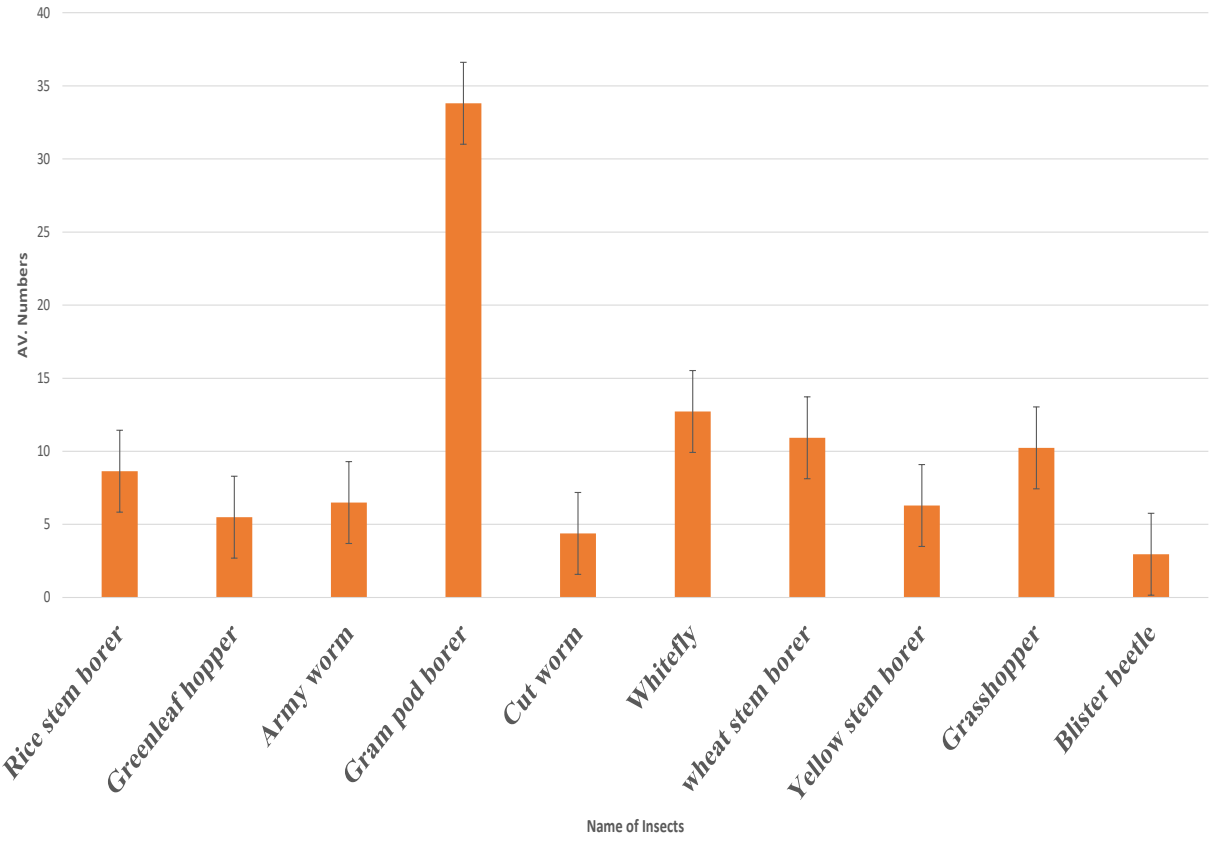

Histogram of Table 4 reflecting Showing insect pest collected and observed from the North zone refers: Chakand village is a panchayat under Gaya Sadar block 24.8854° N, 84.9947° E, around ten Km. far from district headquarter.

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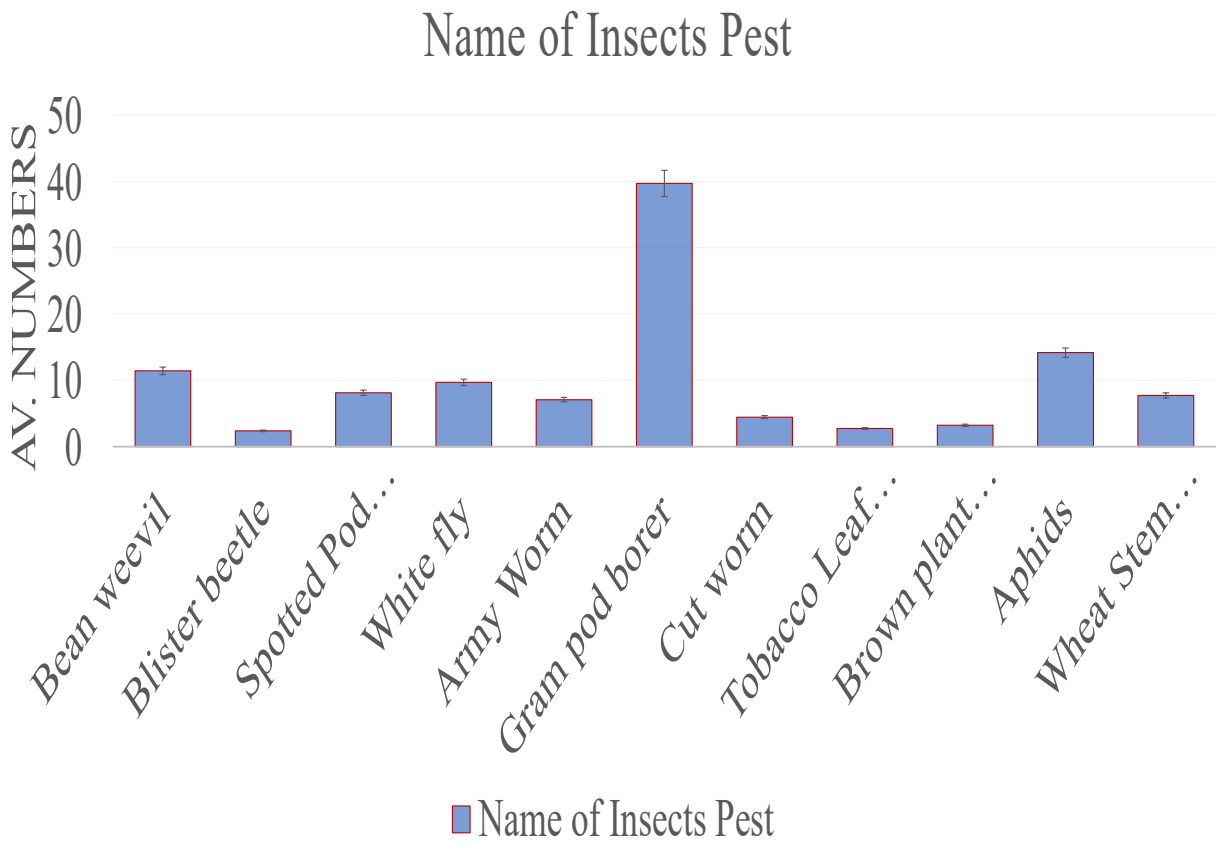
Table: 5. Showing insect pest collected and observed from the South zone refers: Sahdeokhap, village is a panchayat under Bodh Gaya block 24.8854° N, 84.9947° E, around thirteen Km. far from district headquarter.

Sl. No	Common name of Insect Pest	AV. No. of Insect Pests Found					
		Nov	Dec	Jan	Feb	Mar	AV. No. of Insects
1	Bean weevil/ Pulse beetle	14.50	12.00	09.78	15.90	05.00	11.43
2	Blister beetle	02.09	07.40	02.50	00.00	00.00	02.39
3	Spotted pod borer	06.21	12.56	07.29	14.50	00.00	08.11
4	Whitefly	20.89	15.56	12.01	00.00	00.00	09.69
5	Army worm	07.18	06.50	05.00	09.15	07.64	07.09
6	Gram pod borer	22.40	38.62	45.20	59.50	32.90	39.72
7	Cut worm	09.00	08.89	04.36	00.00	00.00	04.45
8	Tobacco leaf eating caterpillar	05.88	03.90	04.00	00.00	00.00	02.75
9	Brown plant hopper	10.10	06.12	00.00	00.00	00.00	03.24
10	Aphids	00.00	00.00	25.50	45.40	00.00	14.18
11	wheat stem borer	00.00	05.60	02.50	15.90	14.70	07.74



Histogram of Table 5 reflecting Showing insect pest collected and observed from the South zone refers: Sahdeokhap, village is a panchayat under Bodh Gaya block 24.8854° N, 84.9947° E, around thirteen Km. far from district headquarter

CONCLUSION :

This study emphasises the varied insect pest populations impacting gramme crops during the Rabi season in various regions of Gaya, Bihar. Sixteen insect pest species were identified, with *Helicoverpa armigera* (Gramme pod borer), *Agrotis ipsilon* (Cutworm), *Aphis craccivora* (Aphids), and *Callosobruchus* spp. (Bean weevil/Pulse beetle) being the most significant and detrimental to chickpea crops. The peak infestations occurred during the pre-harvest period, with a significant presence of storage pests in the post-harvest phase.

Environmental factors, including temperature and humidity, along with inadequate storage procedures, greatly influenced pest prevalence and dissemination.

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