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A suvrey report on vegetable pests in Narayan Nagar, Charkhet, district Nainital, Uttarakhand India

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Abstract
Vegetables are an essential source of carbohydrates, minerals, vitamins, dietary fibre and other nutrients along with health promoting factors [7]. There are so many factors that spoil vegetables such as microorganisms, enzymes, air, light, insects, rodents, parasites, and temperature. Uttarakhand is blessed with diverse agro-climates zones with distinct seasons, making it possible to grow wide range of vegetables. The vegetable production rate in Uttarakhand was reported at 1,789.300 tons in 2022. This records a decrease from the previous number of 1,812,840 ton for 2021. Low intake of vegetables and fruits causes about 31% of ischaemic heart disease and 11% of stroke across the world, and if these two important food items are consumed properly about 2.7 million lives can be saved each year [6]. Mostly all types of vegetables are attacked by pests all over the world due to climatic change. Some are spoiled by diseases. This study presents current survey on vegetables pests and associated problems at the study site. The most dominated insect pest belongs to order Coleoptera followed by Lepidoptera, Hemiptera, and Diptera. This describes pests control by several methods and insecticide and techniques. This study aims towards the insect pest management without the use of chemicals insecticides and promoting the use of biological controls instead of chemical compound [1].

Keywords: Nainital, pesticide, insect, pest, IPM

Introduction
This study aimed to understand the diversity of vegetable crop pest in Char khet, District Nainital, Uttarakhand and In view of providing a clearer picture on insect pests and consolidating the data. This data can help farmers and they can understand what factors could create threats and opportunities. It is an important question because if we successfully analyse pest so this help to identify what factors could change in the future. Pest analysis is also useful for understanding the whole market environment. Doing business gets harder the more risks or threats there in the market.

Insect
Insects are everywhere. They are the most common creatures on our planet. Insects are eating what seems to be a limitless supply of food. A lot of insects are omnivores and they can eat a host of foods including plants, fungi, dead animals, decomposing organic matter or almost everything in their environment. The others are the specialists in the food they eat, which means that survival may have depended on just one plant or part of a single plant. There are two main types of crop damage caused by insect pests which is related to their mode of feed ing. The damage to plant materials caused by biting or chewing is the first. The second is damage due to sucking of the plant sap from the phloem (or xylem) system or from general tissues of foliage, roots or fruits [4]. There's nearly every conceivable habitat out there where insects can be found. Insects are so diverse in size, shape, colour, biology and life history that studying them is an absolute delight. Insects are also decomposers. Every year we describe more than 7,000 new species. Important reasons for their success It is: the ability to live in and adapt to diverse environments, high reproductive potential, consumption of a variety of foods with different flavours and characteristics; it can escape quickly from its enemies [3]. Dead animals and plants can accumulate in our environment, which is a mess if there are no insects to help with the decomposition and disposal of waste. They cycle nutrients, pollinate plants, disperse seeds, maintain soil structure and fertility, control populations of other organisms, and provide a major food source for other taxa.

Pests
The term pest derived from French word 'peste' and Latin term 'Pestis' meaning plague or contagious disease, particularly used for creatures that damage crops, livestock, and forestry. In 1967 this term was introduced by R.F. Smith and R. van den Bosch. Pest is any animal which is noxious, destructive or troublesome to man or his interests and which harms man or his property significantly or is likely to do so. A pest is any organism that spreads disease, causes destruction to agriculture and harmful to human concerns [7]. Pests are causing farmers to suffer economic loss because of increased production costs.
Because of the rapid poisoning and absorption of pesticide residues into water sources, it also causes sickness in humans as well as problems for the environment [5]. In vegetable crops it is estimated that 30 % of the loss will be caused by insects, which includes white flies, beetles, aphids, fruit borers, stoneworms, grasshoppers, leaf hoppers, mealy bugs and termites [2]. Chemically administered insect

repellents are the most effective and popular way of dealing with insects under a protected cultivation system. There are so many factors that spoil vegetables such as microorganisms, enzymes, air, light, insects, rodents, parasites, and temperature.

Categories of pests: Based on occurrence the following are pest categories

- **Regular pest:** frequently occurs on crop- close association e.g. brinjal fruit borer.
- **Occasional pest**: infrequently occurs on crop- no close association. e.g. Mango stem borer.
- **Seasonal pest:** occurs during a particular season every year. e.g. red hairy caterpillar on groundnut.
- **Persistent pest:** occurs on a crop throughout the year and it is difficult to control e.g. chilli thrips.
- **Sporadic pest:** pest occurs in isolated localities during some period e.g. coconut slug caterpillar.

Pest can be monophagous (those feeding on 1 or more plant species within a genus), oligophagous (are restricted to feeding on 2 or more genera in a family or closely related families), polyphahgous (feeding on species from two or more plant families.

Material and methods

Line of work: Tenure of 8 months (November 2022- June 2023) were selected to understand the diversity of vegetable crop pest in Char khet, Nainital, Uttarakhand.

Description of the area of research

Fig 1: Map of study area

Climate of the study area

Study area -This place is 8.5 km far from Nainital. Which is situated Nainital nearby narayan nagar. It is located at a distance of 315 km from the national capital of New Delhi. Nainital is famous for Naini Lake, greenery, many more lakes, temples. This place is located at 29°23′N 79°25′E in Nainital district in Uttarakhand. Nainital yearly temperature is 21.5°C (70.7°F) and it is -4.47% lower than India's averages.

Sampling methods: Survey and surveillance

Pests were observed and collected by handpicking and sweep sampling method. Regular field surveys were carried out at the interval of week. Field observations were made to once or 2 times in a week during good weather conditions. Insects were observed and captured with the help of camera. Data was collected through sampling methods, random survey. Random survey was done to record insect species. The study was based on the primary data collected during the survey and secondary data collected through various available and published resources.

Sources of information and data collection

- Primary data collection
- Secondary data collection

Primary data collection: Primary data were collected with the help of semi-structures questionnaire [8]. The questionnaire was developed to gather all the relevant information required to meet the specific objectives. It was done by field visiting and interviewing the respondents personally. Besides these, interaction with the key informant and observation were also used as other important tools for this study. Photographs were also taken during visit.

Fig 2: Researcher on field

Table 1: Average outcome of the questionnaire

S.No.	Particulars	Average outcome
1.	Which types of vegetables are commonly grown	Root vegetables and leaf vegetables
2.	Sowing and harvesting period of these vegetable crops	Sowing period - October to April Harvesting period- January to June
3.	Loss by pest(insect)	20-30%
4.	Do you use pesticides on your crops	Yes
5.	If yes what are they	Malathion, thiamethoxam, M-45 etc.
6.	Do you know about organic farming	12%-yes, 88%-no

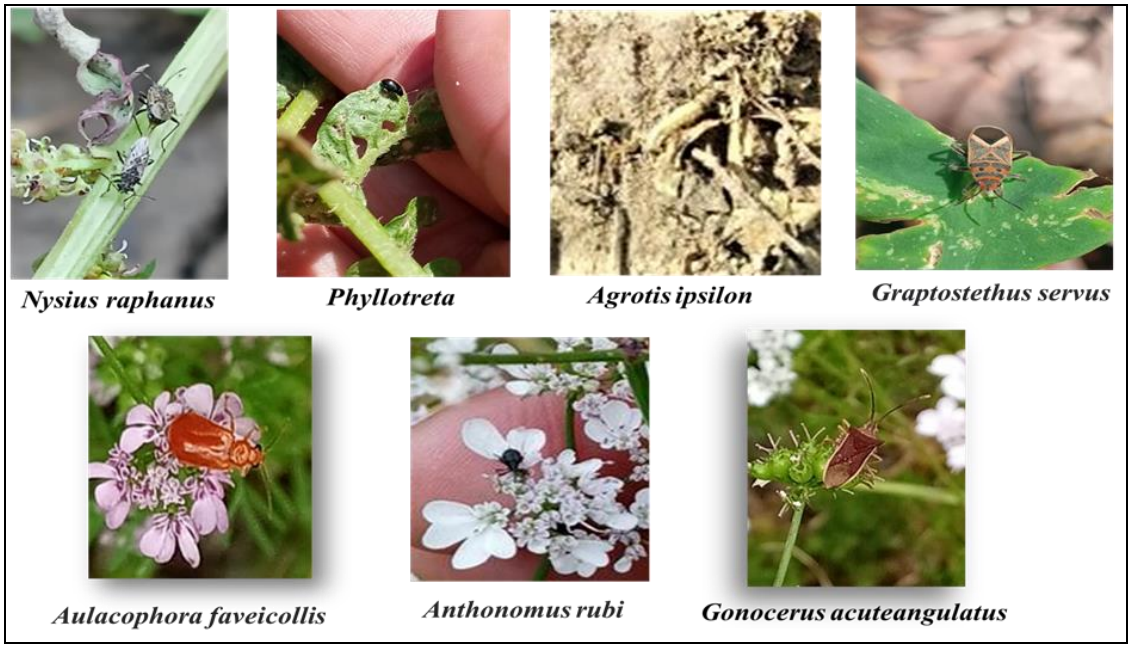

Fig 3: Images of vegetable pests.

Table 2: Vegetables, pests and pesticides

S.No.	Name of vegetables	Pests in vegetable crops	Pesticides used by farmers at study site
1.	*Solanum tuberosum* (potato)	flea beetle	Thia methoxam
2.	*Daucus carota* (carrot)	Cutworms	Neem extract
3.	*Pisum sativum* (pea)	Aphid	Carbonyl
4.	*Colocasia esculenta* (taro root)	Boxelder bug	Metalaxyl
5.	*Coriandrum sativu* (coriander)	Aphid	M-45
6.	*Spinacia oleracea* (spinach)	Cutworms	M-45

Secondary data collection or identification of insect pests

Secondary data collection from books, journals, research paper, proceeding, magazines and annual publications of different institutions and related document was extensively used for collection of secondary data. The key characters used for identification were colour, size of insect, using photographs insect were indentified in the field with the reference to insect identification literature, and other internet references.

Result and discussion

I found 10 species (214 individuals) in my study area, which belongs to the order – Coleoptera, Hemiptera, and Lepidoptera. I also found some non-pest insect in my study area which is Lady bird/bug, love bug and bees. Here, more farmers use urea s a fertilizer while very few farmers use cow manure. The damage in cultivation at this place occurs during winter time because of dew. Cultivation done during summer and rainy time because the summer season here lasts for a very short time, Whereas the raining season lasts for a very long time, due to which the vegetable get plenty of water. The farmers are completely dependent on the rain water because there is no other source of water and no facilities of water here in the other season. That is why cultivation can be done here only for 3-6 months.

Table 3: Identified pests on study area.

S.no.	Order	family	*Scientific name*	No. of indidvidual
1	Coleoptera	Curculionidae	*Anthonomus rubi*	18
2	Coleoptera	Chrysomellidae	*Aulacophora faveicollis*	22
3	Coleoptera	Chrysomellidae	*Phyllotreta*	42
4	Coleoptera	Scarabaeidae	*Holotrichia sp*	16
5	Hemiptera	Lygaeidae	*Graptostethus servus*	23
6	Hemiptera	Lygaeidae	*Nysius raphanus*	40
7	Hemiptera	Coreidae	*Gonocerus acuteangulatus*	20
8	Hemiptera	Pyrrhocoridae	*Dysdercus cingulatus*	15
9	Lepidoptera	Noctuidae	*Agrotis ipsilon*	8
10	Lepidoptera	Pieridae	Pieris brassicae	10

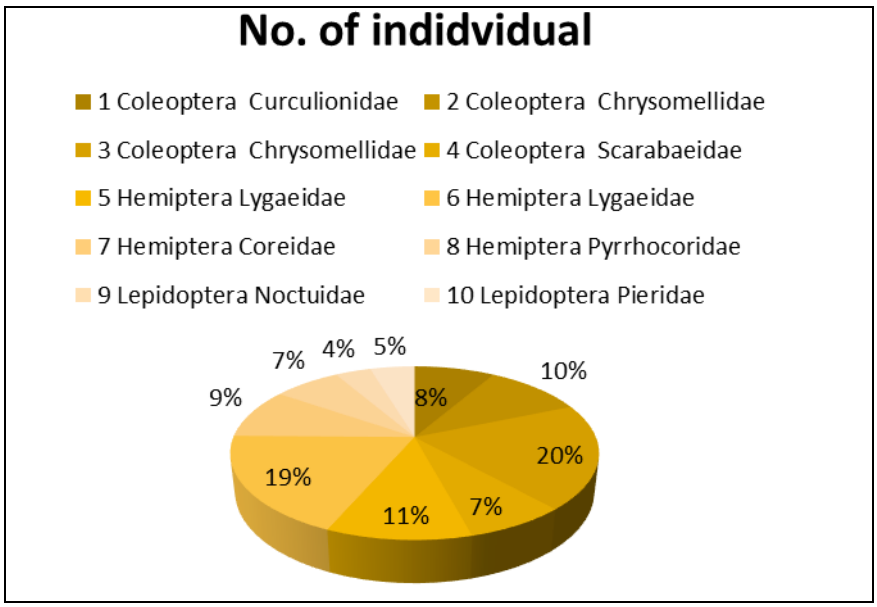

Chart 1: Percentage of vegetable pests in the study area.

Table 4: Shannon index

S.no.	Order	family	*Scientific name*	No. of indidvidual	Pi	LnPi	PiLnpi
1	Coleoptera	Curculionidae	*Anthonomus rubi*	18	0.08411215	-2.475604257	-0.208228395
2	Coleoptera	Chrysomellidae	*Aulacophora faveicollis*	22	0.102803738	-2.274933562	-0.233871675
3	Coleoptera	Chrysomellidae	*phyllotreta*	42	0.196261682	-1.628306397	-0.319574153
4	Coleoptera	Scarabaeidae	*Holotrichia sp*	16	0.074766355	-2.593387293	-0.193898115
5	Hemiptera	Lygaeidae	*Graptostethus servus*	23	0.107476636	-2.230481799	-0.239724679
6	Hemiptera	Lygaeidae	*Nysius raphanus*	40	0.186915888	-1.677096561	-0.313475993
7	Hemiptera	Coreidae	*Gonocerus acuteangulatus*	20	0.093457944	-2.370243741	-0.221518107
8	Hemiptera	Pyrrhocoridae	*Dysdercus cingulatus*	15	0.070093458	-2.657925814	-0.186303211
9	Lepidoptera	Noctuidae	*Agrotis ipsilon*	8	0.037383178	-3.286534473	-0.122861102
10	Lepidoptera	Pieridae	Pieris brassicae	10	0.046728972	-3.063390922	-0.143149109
No. of individuals(N)				214			
Richness(S)				10			
Shannon-Wiener index of diversity (H)				2.182604538			

Conclusion

This study found 10 insect species of 8 families and 3 orders in the study area. The highest abundance of insect pest was from the family *Chrysomelidae.* The least abundance of insect pest was from the family *Noctuidae.* For the management of insect pest, most of the farmers use chemical pesticides in this area. Chemical pesticides used in this study area are Malathion, Thia methoxam, Carbonyl, M-45, Metalaxyl. Very few farmers used protective clothing or other safety measures during pesticide application. The reason for not using protecting measures is lack of knowledge, not having safety equipment and not having knowledge of IPM (Integrated pest management). So, it is important to provide them training on IPM. Here, more farmers use urea s a fertilizer while very few farmers use cow manure. The damage in cultivation at this place occurs during winter time because of dew. Cultivation done during summer and rainy time because the summer season here lasts for a very short time, Whereas the raining season lasts for a very long time, due to which the vegetable get plenty of water. The farmers are completely dependent on the rain water because there is no other source of water and no facilities of water here in the other season. Cultivation is done at this place mostly during rainy season, because there is no facility of water here. Most of the vegetables drug up and perish due to lack of water if they are planted in any season other than the rainy season.

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