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Survey for the incidence of diamondback moth *Plutella xylostella* (L.) and natural enemies in Chittoor district of Andhra Pradesh

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Abstract

The Diamondback moth (DBM), *Plutella xylostella* (L.) is the major insect pest in brassica growing regions of world and Indian subcontinent. The survey on the incidence of DBM and natural enemies was done in five mandals of Chittoor and a mandal in Visakhapatnam District of Andhra Pradesh during *Rabi* seasons of 2017-18 and 2018-19. The per cent infestation per field, per cent infestation per plant and per cent damage in curd was recorded. The highest per cent of damage was noticed in Konganapalle village (87.00%) and Cheldiganipalle village (83.00%) of Kuppam mandal in *Rabi* 2017-18 and 2018-19 respectively. The minimum damage per cent of 15.50 and 16.50 during *Rabi*, 2017-18 and 2018-19 respectively in Chintapalle mandal of Visakhapatnam District. The infestation of DBM (100%) observed in every field followed by aphids, tobacco caterpillar and leaf webber. The infestation of natural enemies were also recorded, highest per cent incidence of Braconids (*Cotesia plutellae*), followed by coccinellids and syrphids were noticed.

Keywords: Diamondback moth (*Plutella xylostella*), Braconids (*Cotesia plutellae*), per cent incidence, cauliflower

1. Introduction

Cauliflower (*Brassica oleracea* var. botrytis) is found to be native of Eastern coast of the Mediterranean region (Manchali *et al.*, 2012) [1]. It forms an important component of diet because of it is rich in Vitamins (Vitamin A-2µg, Vitamin C-60mg, Vitamin E-0.20mg, Folate-55µg and Dietary fibre-2.20g) and Nutrients (Indole-3-carbinol-Anti-carcinogenic, Glucosinolates-Sulphur containing compound, Carotenoids-protecting the skin and eye health) (Hedges and Lister, 2006; Manchali *et al.*, 2012) [2, 1]. The yield and quality of the crop is affected by number of pests like Diamondback moth (*Plutella xylostella*), Tobacco caterpillar (*Spodoptera litura*), Leaf webber (*Crocidolomia binotalis*) and aphids (*Brevicoryne brassicae* L.). Among all the pests the management is mainly concentrated towards DBM, because of its distribution, short life cycle and resistance to insecticides made them as major insect pest affecting the crop (Weinberger and Srinivasan, 2009; Zhou *et al.*, 2011) [3, 4].

In Andhra Pradesh the area and production were 2,410 ha and 32,200 tonnes respectively in 2016-17 (indiastat.com) [5], and Chittoor is the major growing area of cauliflower and cabbage. Hence, the roving survey was conducted in *Rabi*, 2017-18 and 2018-19 to study the incidence of various insect pests and their natural enemies affecting cauliflower and also a region from High Altitude Tribal Zone (Chintapalle) of Visakhapatnam District was also selected for the survey.

2. Materials and Methods

The roving survey was conducted on cauliflower crop in five mandals of Chittoor district of Andhra Pradesh viz., Ramasamudram, Punganur, Gangavaram, V. Kota and Kuppam and Chinthapalli region (High Altitude Tribal Zone) of Visakhapatnam District during *Rabi* seasons of 2017-18 and 2018-19.

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2.1 Selection of villages

Based on data obtained from Horticultural Department regarding area of cruciferous

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vegetables grown, in each mandal two villages were chosen. In each village two farmer fields were selected for survey.

2.2 Nature and source of data

In each village, based on crop availability the farmers were surveyed on pesticides (insecticides, fungicides and herbicides) usage pattern. Frequent interaction was done with farmers as per standard proforma and obtained information on name of the varieties of cauliflower, fertilizers used, major pests reported, pesticides used including type of formulations of pesticides to control different pests, trade name, pesticide application methods and frequency of spraying.

2.3 Collection of data

In each cauliflower field, the number of *P. xylostella* infested plants and total number of plants 2.5 m² were recorded in five randomly selected sampling units. In each farmer field, the observations were made on 25 plants. On each plant three leaves (top, middle and bottom) were selected and data on number of leaves damaged per total number of leaves were recorded. If the crop is in the curd formation stage, damage in the curd was also recorded.

$$\text{Per cent infested plants} = \frac{\text{Total number of plants infested}/25 \text{ plants}}{\text{Total number of plants observed (25)}} \times 100$$

$$\text{Per cent infestation on leaves/plant} = \frac{\text{Total number of leaves infested}}{\text{Total number of leaves observed}} \times 100$$

3. Results and Discussion

3.1 Incidence of DBM, *P. xylostella* on cauliflower in different mandals of Chittoor district of Andhra Pradesh during rabi, 2017-18

The per cent infested plants by DBM in Sivani kuppam, Konganapalle and Cheldiganipalle villages of Kuppam mandal were 84.00, 87.00 and 80.00, whereas the per cent infestation per plant was 32.40, 45.31 and 36.00 respectively. The infested curd were 45.00 and 12.00 per cent in Sivani

kuppam and Konganapalle respectively, where as in Ramasamudram mandal the per cent infested plants were 79.00, 82.00 and 80.00 and per cent infestation per plant was 35.03, 32.36 and 30.00 in Chembakur, Balijapalle and Opireddiganipalle villages respectively, the infested curds were noticed in only one village *i.e.*, Opireddiganipalle with 23.00 per cent curd damage (Table 1).

In V. Kota mandal, the damage per cent in field was varied from 76.00, 77.00 and 75.00 and infestation per plant were 32.06, 28.62 and 26.53 per cent in villages of Kaigallu, Gandlapalle and Baireddipalle and the cauliflower curd damage was reported only in village Kaigallu with 21.00 per cent damage, however in Punganur, the per cent infested plants were varied from 74.00, 77.00, 75.00 and infestation per plant was 21.67, 35.30 and 24.60 in villages of Somala, Chowdepalle and Mettimanda respectively. The damage of curds observed in one village Chowdepalle with 55.00 per cent infestation (Table 1).

In Gangavaram mandal, the per cent infested plants per field 78.00, 74.00 and per cent infestation per plant was 24.00, 28.60 in villages Keelapatla and Kothapalle respectively. The infestation of curd per plot was 18.00 per cent in Keelapatla, whereas in Chintapalle, the infestation per cent in field were 16.00, 15.00 and per cent infestation per plant were 8.50 and 6.50 in Pentapadu and Chowdepalle villages respectively (Table 1).

The mean per cent DBM infested plants in field and per cent infestation per plant were mentioned in Table (3). The mean per cent DBM infested plants was highest in Kuppam (83.66%) mandal followed by Ramasamudram (80.33%), V. Kota (76.00%), Punganur (75.33%), Gangavaram (74.50%) while the lowest per cent infested plants was recorded in Chintapalle mandal (15.5%) and the per cent infestation per plant also followed similar trend and the maximum per cent infestation per plant was noticed in Kuppam (37.90%) followed by Ramasamudram (32.46%), V. Kota (29.07%), Punganur (27.19%), Gangavaram (26.30%) and the lowest infestation was observed in Chintapalle mandal (7.50%).

Table 1: Locations of survey in Chittoor district of Andhra Pradesh during rabi of 2017-18 and 2018-19

District	Mandal	Village	Coordinates (latitude, longitude)
Chittoor	Kuppam	Cheldiganipalle	12.928099, 78.467068
		Konganapalle	12.9352710, 78.4241150
		Sivani kuppam	12.9330764, 78.4374680
		Nalagampalle	12.793700, 78.358799
	Ramasamudram	Chembakur	13.4293990, 78.4131180
		Balijapalle	13.4427570, 78.4196540
		Opireddiganipalle	13.5577737, 78.6037381
	V. Kota	Kaigallu	13.0691190, 78.5605720
		Gandlapalle	12.989401, 78.4840206
		Baireddipalle	13.0709613, 78.5816652
	Punganur	Somala	13.4842760, 78.7659060
		Chowdepalle	13.4623020, 78.7552250
		Mettimanda	13.457884, 78.744484
	Gangavaram	Keelapatla	13.239566, 78.779433
		Kothapalle	13.237853, 78.757724
Visakhapatnam	Chintapalle	Pentapadu	17.8574370, 82.3290620
		Chowdepalle	17.8915313, 82.3459189

3.2 Incidence of DBM, *P. xylostella* on cauliflower in different mandals of Chittoor district of Andhra Pradesh during rabi, 2018-19

The per cent damage by DBM in different mandals of Chittoor district during 2018-19 was mentioned in Table 2. The per cent infested plants were 81.00, 79.00 and 83.00 and the per cent infestation per plant was 45.50, 39.30 and 40.31

in Nalagampalle, Konganapalle and Cheldiganipalle villages of Kuppam mandal. The infested curd were noticed in Konganapalle and Cheldiganipalle with 24.40 and 26.30 per cent damage, whereas in Ramasamudram mandal the per cent damage in field were 78.00, 80.00 and 76.00 and per cent infestation per plant was 31.50, 30.70 and 28.40 in Chembakur, Balijapalle and Opireddiganipalle villages

respectively and the infested curd damage was observed in only Opireddiganipalle with 30.25 per cent damage.

In Kaigallu, Gandlapalle and Baireddipalle villages of V. Kota mandal, the per cent damage of plants were 75.00, 69.00 and 72.00 and the per cent infestation per plant was 33.60, 26.70 and 28.20 respectively and cauliflower curd damage noticed in only Baireddipalle village with 26.00 per cent damage, however the per cent damage in Punganur mandal were 82.00, 85.00 and 84.00 and per cent infestation per plant was 36.40, 35.55 and 31.20 in Somala, Chowdepalle and Mettimanda villages respectively. The per cent curd damage was 23.45 per cent in Chowdepalle village.

The per cent damage infested plants in Keelapatla and Kothapalle villages were 70.00 and 73.00 and the per cent infestation per plant was 25.00 and 27.00 Gangavaram mandal. The infested curd observed in Keelapatla village with 21.20 per cent. The lowest per cent damage of 14 and 17 was recorded in Pentapadu and Chowdepalle villages of Chintapalle mandal. The cauliflower curd damage was not observed in Chintapalle mandal (Table 2).

The mean per cent DBM infested plants were observed to be maximum in Punganur mandal followed by Punganur (83.66%) followed by Kuppam (81.00%), Ramasamudram

(78.00%), V. Kota (72.00%) and Gangavaram (71.50%) and the minimum infestation in Chintapalle (%) mandal, similarly the highest per cent infestation per plant observed in Kuppam (38.37%) followed by Punganur (33.78%), Ramasamudram (30.20%), V. Kota (29.50%) and Gangavaram (26.00%) and the minimum infestation in Chintapalle (4.77%) mandal (Table 4).

The per cent damage per plot in different village was in the range of 84.00 to 14.00 per cent. The per cent incidence and damage reported during the survey are confirmatory with the studies of Lingappa *et al.* (2004) [6], who reported that loss caused by incidence may vary from 30 to 100 per cent, Sandur (2004) [7], and Uthamasamy (2011) [8], also confirms that DBM was found to be the major pest among 92 per cent farmers, causing around 50 per cent loss in India. The Chintapalle region (HAT Zone) has recorded lowest mean DBM incidence during both seasons of survey 15.50 and 16.50 during *rabi*, 2017-18 and 2018-19 respectively, this may be due to the use of local varieties, crop diversification (Talekar *et al.*, 1986) [9], farmers were growing the cole crops in a very small area as part of subsistence farming and no use of synthetic insecticides, hence incidence of resistance and resurgence cases are not often.

Table 2: Incidence of DBM, *P. xylostella* on cauliflower in different mandals and villages of Chittoor district of Andhra Pradesh during *rabi*, 2017-18

Mandal	Village	Variety/hybrid	Stage of the crop	Survey month	Per cent infested plants	Per cent infestation/plant	Infestation of curds
Kuppam	Sivani kuppam	Unnati	Partly Harvested	Dece. I FN	84.00	32.40	45.00
	Konganapalle	Dhawal	Curd formation	Dece. I FN	87.00	45.31	12.00
	Cheldiganipalle	Unnati	Vegetative	Dece. I FN	80.00	36.00	-
Ramasamudram	Chembakur	Dhawal	Vegetative	Dece. II FN	79.00	35.03	-
	Balijapalle	Dhawal	Vegetative	Dece. II FN	82.00	32.36	-
	Opireddiganipalle	Dhawal	Curd formation	Dece. II FN	80.00	30.00	23.00
V. Kota	Kaigallu	Dhawal	Curd formation	Jan I FN	76.00	32.06	21.00
	Gandlapalle	Dhawal	Vegetative	Jan I FN	77.00	28.62	-
	Baireddipalle	Dhawal	Vegetative	Jan I FN	75.00	26.53	-
Punganur	Somala	Dhawal	Vegetative	Jan. II FN	74.00	21.67	-
	Chowdepalle	Dhawal	Most Curd harvested	Jan. II FN	77.00	35.30	55.00
	Mettimanda	Dhawal	Vegetative	Jan. II FN	75.00	24.60	-
Gangavaram	Keelapatla	Dhawal	Curd formation	Feb. I FN	75.00	24.00	18.00
	Kothapalle	Dhawal	Vegetative	Feb. I FN	74.00	28.60	-
Chintapalle	Pentapadu	Shubha	Vegetative	Nov. II FN	16.00	8.50	-
	Choudepalle	Shubha	Curd formation	Nov. II FN	15.00	6.50	-

*-Per cent infested plants mean of 25 plants per plot

Table 3: Incidence of DBM, *P. xylostella* on cauliflower in different mandals and villages of Chittoor district of Andhra Pradesh during *rabi*, 2018-19

Mandal	Village	Variety/hybrid	Stage of the crop	Survey Month	Per cent infested plants*	Per cent infestation/plant	Infestation of curds
Kuppam	Nalagampalle	Dhawal	Vegetative	Dece. I FN	81.00	35.50	-
	Konganapalle	Dhawal	Curd formation	Dece. I FN	79.00	39.30	24.40
	Cheldiganipalle	Unnati	Curd formation	Dece. I FN	83.00	40.31	26.30
Ramasamudram	Chembakur	Dhawal	Vegetative	Dece. II FN	78.00	31.50	-
	Balijapalle	Dhawal	Vegetative	Dece. II FN	80.00	30.70	-
	Opireddiganipalle	Dhawal	Curd formation	Dece. II FN	76.00	28.40	30.25
V. Kota	Kaigallu	Dhawal	Vegetative	Jan I FN	75.00	33.60	-
	Gandlapalle	Dhawal	Vegetative	Jan I FN	69.00	26.70	-
	Baireddipalle	Dhawal	Curd formation	Jan I FN	72.00	28.20	26.00
Punganur	Somala	Dhawal	Vegetative	Jan. II FN	82.00	36.40	-
	Chowdepalle	Dhawal	Curd maturity	Jan. II FN	85.00	35.55	23.45
	Mettimanda	Dhawal	Vegetative	Jan. II FN	84.00	31.20	-
Gangavaram	Keelapatla	Dhawal	Curd formation	Feb. I FN	70.00	25.00	21.20
	Kothapalle	Dhawal	Vegetative	Feb. I FN	73.00	27.00	-
Chintapalle	Pentapadu	Shubha	Vegetative	Nov. II FN	14.00	5.55	-
	Choudepalle	Shubha	Curd formation	Nov. II FN	19.00	4.00	-

*-Per cent infested plants mean of 25 plants per plot

Table 4: Mean per cent infestation of cauliflower by *P. xylostella* in different mandals of Chittoor district during 2017-18 and 2018-19

Mandal	rabi, 2017-18		rabi, 2018-19	
	Per cent infested plants*	Per cent infestation/ plant	Per cent infested plants*	Per cent infestation/plant
Kuppam	83.66	37.90	81.00	38.37
Ramasamudram	80.33	32.46	78.00	30.20
V. Kota	76.00	29.07	72.00	29.50
Punganur	75.33	27.19	83.66	33.78
Gangavaram	74.50	26.30	71.50	26.00
Chintapalle	15.5	7.50	16.50	4.77

*-Per cent infested plants mean of 25 plants per plot

3.3 Incidence of natural enemies in farmer fields in rabi, 2017-18 and 2018-19

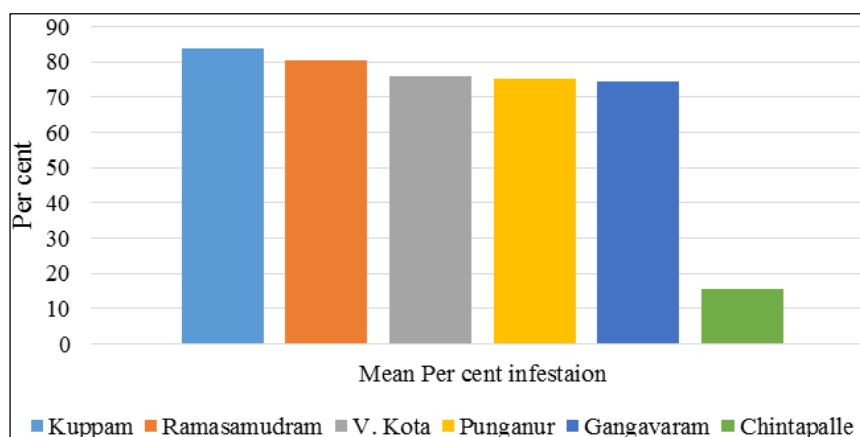
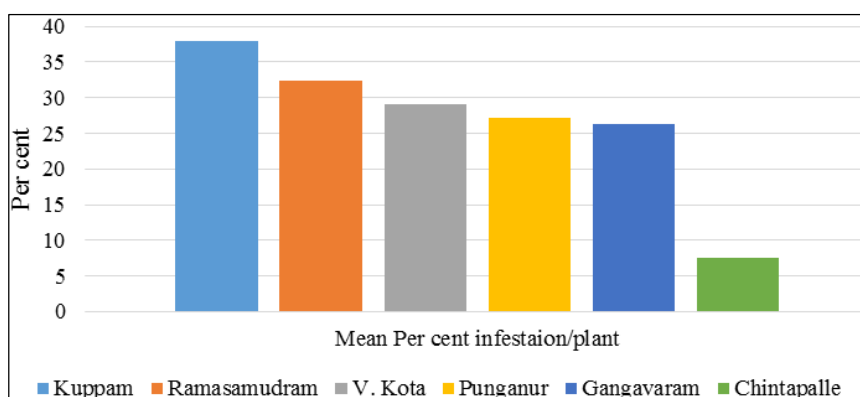
The highest per cent incidence was observed in natural enemy, braconid (*Cotesia plutellae*) (100.00%) followed by coccinellids (60.00%) and syrphids (56.66%) during rabi, 2017-18, whereas in rabi, 2018-19 similar trend was observed with highest incidence of braconid (100.00%) followed by coccinellids (56.66%) and syrphids (50.00%) (Table 5).

The observations by Badjena and Mandal (2005) [10], on seasonal incidence, revealed the incidence of pests like aphids (*Brevicoryne brassicae* (L.)), tobacco caterpillar (*Spodoptera*

litura), leaf-webber (*Crocidolomia binotalis*) and DBM (*P. xylostella*) and also reported natural enemies like coccinellids (*Coccinella repanda*, *Cheilomenes sexmaculata*, *Micraspis discolor* and *Coccinella septempunctata*) and two species of syrphid fly (*Ischiodon scutellaris* and *Eumerus albifrons*) were noticed in the cauliflower fields. Chelliah and Srinivasan (1986) [11], observed the braconid parasitoid, *Apanteles* (*Cotesia*) *plutellae* as a major parasitoid which accounts for 72 per cent of the parasitization. The incidence of pests and natural enemies reported during survey similar to the above mentioned studies.

Table 5: Incidence of insect pests and natural enemies in cauliflower crop of sample farmer fields during rabi, 2017-18 and 2018-19

Particulars		rabi, 2017-18 (n=30)		rabi, 2018-19 (n=30)	
S. No	Insect pests	Frequency	Percentage	Frequency	Percentage
1	Diamondback moth (<i>Plutella xylostella</i>)	30	100.00	30	100.00
2	Tobacco caterpillar (<i>Spodoptera litura</i>)	17	56.66	18	60.00
3	Leaf webber (<i>Crocidolomia binotalis</i>)	4	13.33	3	10.00
4	Aphids (<i>Brevicoryne brassicae</i> L.)	26	86.66	27	90.00
Natural enemies					
6	Braconid (<i>Cotesia plutellae</i>)	30	100.00	30	100.00
7	Syrphids	17	56.66	15	50.00
8	Coccinellids	18	60.00	17	56.66

**Fig 1:** Mean per cent infestation of DBM during rabi, 2017-18**Fig 2:** Mean per cent infestation of DBM per plant during rabi, 2017-18

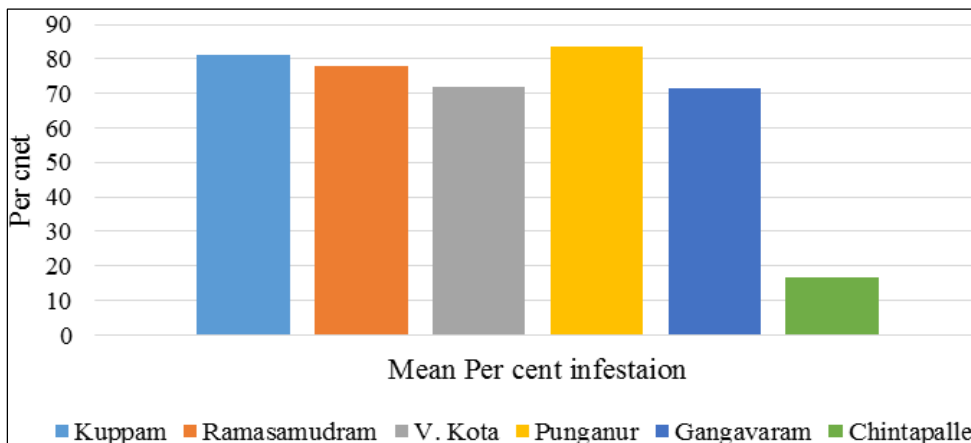


Fig 3: Mean per cent infestation of DBM during rabi, 2018-19

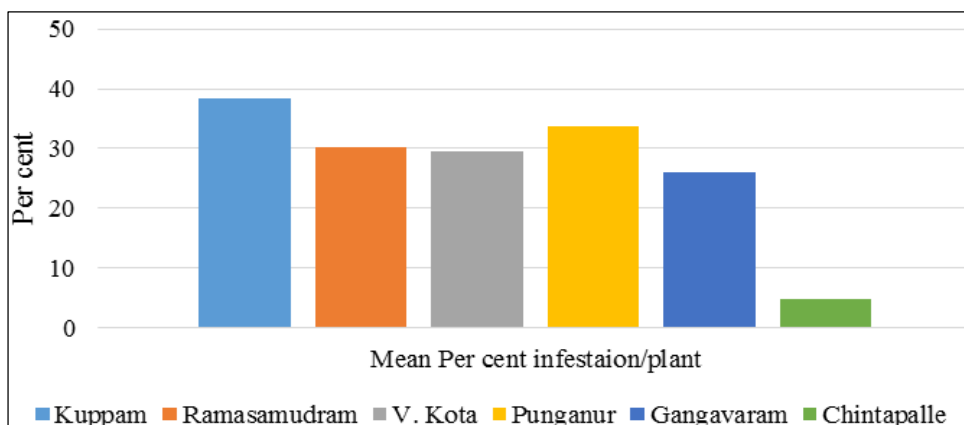


Fig 4: Mean per cent infestation per plant of DBM during rabi, 2018-19

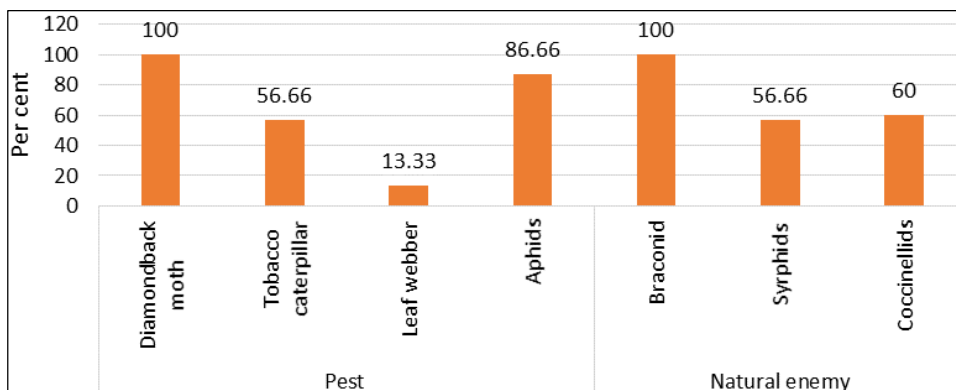


Fig 5: Per cent infestation of pest and natural enemies during rabi, 2017-18

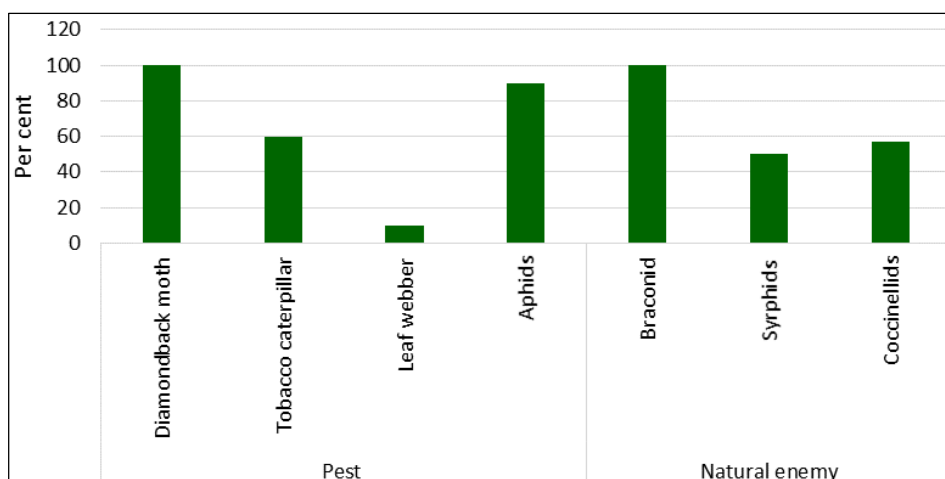


Fig 6: Per cent infestation of pest and natural enemies during rabi 2018-19

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