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Survey on incidence and insecticide usage for management of *Maruca vitrata* (Geyer) in major blackgram (*Vigna mungo* (L.) Hepper) growing areas of Andhra Pradesh

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Abstract
Blackgram (*Vigna mungo* (L) Hepper) is an important pulse crop grown in during *rabi* season in various agro-climatic zones of Andhra Pradesh, India. Survey conducted during 2018-19 in major blackgram grown areas indicated that of all the lepidopteran caterpillars attacking the crop *Maruca vitrata* (Geyer) causes maximum economic loss. This insect pest appeared from flowering stage to pod maturing stage on blackgram. Incidence of *M. vitrata* varied from 24.85 to 58.79 per cent during *rabi* 2018-19. Majority of the farmers preferred PU-31, TBG-104, LBG-752 and TAU-1 varieties of blackgram for cultivation. The farmers relied on chlorpyrifos, dichlorvos, thiodicarb, spinosad and chlorantraniliprole insecticides for managing *M. vitrata*. Two larval parasitoids *Therophilus marucae, Bassus relativus* and one egg-larval parasitoid *Phanerotoma philippinensis* were observed affecting the egg-larval stages of *M. vitrata* at the time of peak incidence of *M. vitrata* during survey.

Keywords: Spotted pod borer (*Maruca vitrata), Blackgram (Vigna mungo), Therophilus javanus, Bassus relativus, Phanerotoma hendecasisella*

Introduction
In India, blackgram is mainly grown in Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal, Punjab, Haryana, Tamil Nadu and Karnataka states with an area of about 4.29 million hectares, with total production of 1.90 million tonnes and with an average productivity of 485-500 kg ha^{-1} [9]. Andhra Pradesh ranks first in productivity followed by Orissa. The crop is grown in Andhra Pradesh an area of 3.15 lakh ha with a total production of 2.98 lakh tonnes and productivity of 946 Kg ha^{-1} [9]. In Andhra Pradesh, the maximum area under these crops during *rabi* is in coastal region with Guntur district ranking first in production in Andhra Pradesh [1]. Blackgram is affected by important insect pest such as spotted pod borer, *M. vitrata*. *M. vitrata* attacks crops right from the pre flowering to pod maturing stage causing considerable yield loss. Giraddi *et al.* [5] reported that *M. vitrata* causes 100 per cent yield loss in urd bean. The larvae of *M. vitrata* feeds on flowers, buds, and pods by webbing with leaves [7]. This webbing behavior protects the larvae from both biotic and abiotic conditions and makes it difficult to manage the insect by synthetic chemicals leading to repeated application of insecticides for management of this pest. A survey was undertaken to find out the pest incidence and what are the insecticides used by the farmers to manage the *M. vitrata* and what are the natural enemies occurred on *M. vitrata* for implement the successful pest management practices.

Materials and Methods
A roving survey was conducted during *rabi* 2018-19 in five major blackgram growing districts of Andhra Pradesh *viz.*, Prakasam, Nellore, Chittoor, Guntur and Kurnool.

Selection of villages
Based on data obtained from Department of Agriculture, five major blackgram growing districts were selected. In each district two mandals were selected and from each mandal two villages were selected.

Collection of data

From each village, five farmers were selected and from each farmer's field, five one metre Square areas were selected and used for recording observations. Along with incidence of *M. vitrata*, information regarding the names of the varieties of the blackgram grown by farmers' insect pests observed during different growth stages of the crop and insecticides used for the managing various insect pests were also collected. The per cent infestation of *M. vitrata* was calculated by formula

$$\text{Per cent infested plants} = \frac{\text{Number of plants infested per metre square}}{\text{Total number of plants per metre square}} \times 100$$

Data was also recorded on natural Enemies *viz.*, parasitoids, predators from the surveyed plots. Frequency of natural enemies' incidence calculated by using below formula
= Total number of farmers' fields observed - number of fields without incidence of natural enemies

Results and Discussion

In Prakasam district, roving survey was conducted in Samanthapudi and Pulipadu Thanda villages of Darsi mandal and Ghanivaripalem and Idupuvaripalem villages of Chirala mandal during 03-03-2019 and 04-03-2019. During the survey, blackgram crop in the sampling fields was at different growth stages *viz.*, vegetative, flowering and pod formation and pod maturity. The crop was infested with insect pests such as *M. vitrata*, *Spodoptera litura* (Fabricius), *Thrips tabaci* Lindeman, *Bemisia tabaci* (Gennadius) and *Aphis craccivora* Koch prevailed during various growth stages of the crop (Table 1). Among all these insect pests, the incidence of *M. vitrata* was observed to be high at flowering to pod development stage of the crop. The per cent incidence of *M. vitrata* ranged from 24.85 to 31.52 in Samanthapudi and Pulipadu Thanda villages of Darsi mandal respectively (Table 2).

Table 1: Insect pests observed at various growth stages of blackgram during *rabi* 2018-19

District	Mandal	Village	Date of survey	Stage of the crop	Pests observed					Crops in the surroundings
					aphids	thrips	white fly	*S. litura*	*M. vitrata*	
Chittoor	Tirupati Rural	C. Gollapalli	15-12-2018	Flowering	p	p	-	-	p	Groundnut, Greengram
		Pudipatla	15-12-2018	Flowering and Pod formation	p	-	p	p	p	Groundnut, greengram
	Chandragiri	Chandragiri	15-12-2018	Flowering	-	p	-	p	p	Chillies, Bajra
		Kottala	15-12-2018	Vegetative	-	-	-	p	-	Tomato
Nellore	Podalakuru	Marripalle	04-12-2018	Flowering	p	-	-	p	p	Greengram, Jowar
		Gopasamudhram	04-12-2018	Flowering	-	p	-	-	p	Greengram, Bajra
	Kovuru	Inamadugu	05-12-2018	Flowering	p	p	-	p	p	Greengram, Paddy
		Leguntapadu	05-12-2018	Vegetative	-	p	-	-	-	Paddy
Kurnool	Rudhravaram	Kotakonda	30-11-2018	Flowering	p	p	-	p	p	Greengram, Paddy
		Rudhravaram	30-11-2018	Vegetative	p	-	-	-	-	Paddy, Jowar
	Mahanandi	Mahanandi	29-11-2018	Pod formation	-	p	-	-	p	Jowar, Greengram
		Gajulapalli	29-11-2018	Flowering	p	p	-	-	p	Paddy, Banana
Prakasham	Darsi	Samanthapudi	03-03-2019	Vegetative	p	-	-	p	-	Greengram, Redgram
		Pulipadu Thanda	03-03-2019	Pod formation	p	-	p	p	p	Redgram, Jowar
	Chirala	Ghanivaripalem	04-03-2019	Pod formation	-	p	-	-	p	Greengram
		Idupuvaripalem	04-03-2019	Flowering	-	p	-	p	p	Greengram, Redgram
Guntur	Vatticherukuru	Chamallamudi	02-03-2019	Flowering and Pod formation	-	p	-	p	p	Marigold, Tomato
		Katrapadu	02-03-2019	Flowering	-	p	-	p	p	Greengram, Paddy
	Bapatla	Appikatla	01-03-2019	Pod formation	p	-	-	-	p	Groundnut, Chillies
		Jillellamudi	01-03-2019	vegetative	p	p	-	-	-	Greengram, Paddy

Table 2: Incidence of *M. vitrata* during *rabi* 2018-2019

District	Mandal	Village	Date of survey	Per cent incidence of *M. Vitrata* (Mean± S.D)
Prakashan	Darsi	Samanthapudi	03-03-2019	24.85 ± 2.27
		Pulipadu Thanda	03-03-2019	31.52 ± 3.09
	Chirala	Ghanivaripalem	04-03-2019	25.45 ± 3.09
		Idupuvaripalem	04-03-2019	29.70 ± 3.53
Nellore	Podalakuru	Marripalle	04-12-2018	33.94 ± 2.27
		Gopasamudhram	04-12-2018	35.76 ± 3.53
	Kovuru	Inamadugu	05-12-2018	30.30 ± 2.71
		Leguntapadu	05-12-2018	34.55 ± 3.09
Chittoor	Tirupati Rural	C. Gollapalli	15-12-2018	39.39 ± 1.92
		Pudipatla	15-12-2018	43.64 ± 3.09
	Chandragiri	Chandragiri	16-12-2018	33.33 ± 4.29
		Kottala	16-12-2018	38.79 ± 4.02
Guntur	Vatticherukuru	Chamallamudi	02-03-2019	50.91 ± 2.27
		Katrapadu	02-03-2019	49.70 ± 3.09
	Bapatla	Appikatla	01-03-2019	41.21 ± 5.62
		Jillellamudi	01-03-2019	47.27 ± 3.09
Kurnool	Rudhravaram	Kotakonda	30-11-2018	58.79 ± 3.09
		Rudhravaram	30-11-2018	57.58 ± 4.29
	Mahanandi	Mahanandi	29-11-2018	58.79 ± 4.92
		Gajulapalli	29-11-2018	55.15 ± 3.53

Fig 1: *Therophilus javanus* (*Baeognatha javana*) (Bhat and Gupta, 1977)

Fig 2: *Phanerotoma hendecasisella Cameron*

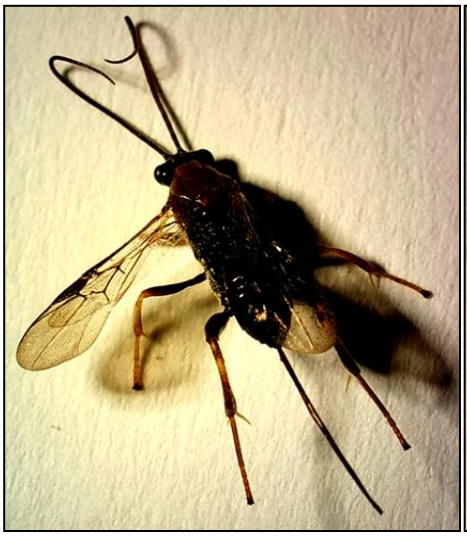

Fig 3: *Bassus relativus* (Bhat and Gupta)

In Nellore district, roving survey was conducted in Marripalle and Gopasamudhram villages of Podalakuru mandal and Inamadugu and Leguntapadu villages of Kovuru mandal during 04-12-2018 and 05-12-2018. During the survey, blackgram crop in the sampling fields was at different growth stages *viz.*, vegetative, flowering and pod formation and pod maturity. The crop was infested with insect pests such as *M. vitrata*, *S. litura*, thrips and aphids (Table 1). Among all these insect pests, the incidence of *M. vitrata* was observed to be high at flowering to pod development stage of the crop. The per cent incidence of *M. vitrata* ranged from 30.30 to 35.76 in Inamadugu village of Kovuru mandal and Gopasamudhram village of Podalakuru mandal respectively (Table 2).

In Chittoor district, roving survey was conducted in C. Gollapalli and Pudipatla villages of Tirupati rural mandal and Chandragiri and Kottala villages of Chandragiri mandal during 15-12-2018 and 16-12-2018. During the survey, blackgram crop in the sampling fields was at different growth stages *viz.*, vegetative, flowering and pod formation and pod maturity. The crop was infested with insect pests such as *M. vitrata*, *S. litura*, thrips, white fly and aphids (Table 1). Among all these insect pests, the incidence of *M. vitrata* was observed to be high at flowering to pod development stage of the crop. The per cent incidence of *M. vitrata* ranged from 33.33 to 43.64 in Chandragiri village of Chandragiri mandal and Perur village of Pudipatla mandal respectively (Table 2).

In Guntur district roving survey was conducted in Chamallamudi and Katrapadu villages of Vatticherukuru mandal and Appikatla and Jillellamudi villages of Bapatla mandal during 02-03-2019 and 01-03-2019. During the survey, blackgram crop in the sampling fields was at different growth stages *viz.*, vegetative, flowering, pod formation and pod maturity. The crop was infested with insect pests such as *M. vitrata*, *S. litura*, thrips and (Table 1). Among all these insect pests, the incidence of *M. vitrata* was observed to be high at flowering to pod development stage of the crop. The per cent incidence of *M. vitrata* ranged from 41.21 to 50.91 in Appikatla village of Bapatla mandal and Chamallamudi village of Vatticherukuru mandal respectively (Table 2).

In Kurnool district roving survey was conducted in Kotakonda and Rudhravaram villages of Rudhravaram mandal and Mahanandi and Gajulapalli villages of Mahanandi mandal during 30-11-2018 and 29-11-2018. During the survey, blackgram crop in the sampling fields was at different

growth stages *viz.*, vegetative, flowering and pod formation. The crop was infested with insect pests such as *M. vitrata*, *S. litura*, thrips and aphids (Table 1). Among all these insect pests, the incidence of *M. vitrata* was observed to be high at flowering to pod development stage of the crop. The per cent incidence of *M. vitrata* ranged from 55.15 to 58.79 per cent in Rudhravaram village of Rudhravaram mandal and Kotakonda village of Rudhravaram mandal, Mahanandi village of Mahanandi Mandal respectively (Table 2).

The per cent damage by *M. vitrata* in the surveyed plots in different villages were in the range of 24.85 to 58.79 per cent during *rabi* 2018-19. Per cent incidence of *M. vitrata* during survey was confirmed with results of Reddy *et al.*, (2018) who reported that per cent infestation of spotted pod borer in Kadapa district was 41.99 ± 6.84 per cent followed by Nellore 39.77 ± 5.97 per cent and Chittoor 38.50 ± 5.54 during *rabi* 2018-19.

The present survey has revealed that, majority of the farmers in all five districts preferred chlorpyrifos (50%), dichlorvos (43%), thiodicarb (40%), spinosad (36%) and chlorantraniliprole (31%) and other insecticides (22%) for management of *M. vitrata* (Table 3). Present survey results were supported by Reddy and Hari Prasad [6], who reported that majority of the farmers preferred chlorpyriphos (51.9%) insecticide followed by the DDVP (8.9%) and thiodicarb (4.4%) to control the spotted pod borer *M. vitrata*.

During a survey undertaken farmers in Prakasam district cultivated TBG-104, PU-31 and LBG -752 varieties were by 35, 40 and 25 per cent respectively. In Nellore district TBG-104, PU-31 and PBG- 1 varieties were cultivated by 45, 35 and 20 per cent respectively. In Chittoor district TBG-104, PU-31 and LBG -752 varieties were cultivated by 50, 40 and 10 per cent respectively. In Guntur district TBG-104, PU-31 and LBG -752 varieties were cultivated by 45, 45 and 10 per cent respectively. In Kurnool district TBG-104, PU-31 and TAU -1 varieties were cultivated by 40, 55 and 5 per cent respectively (Table 4). Most of the observed varieties were supplied by the SAUs and Dept. of Agriculture. Present results were supported by Reddy and Hari Prasad [6] who reported that five genotypes of blackgram were majorly cultivated in the Southern zone of Andhra Pradesh *viz.*, LBG-752, LBG-648, PU-31, LBG-123 and LBG-792. Out of these, LBG- 752 (62.2%) variety occupied the majority of the blackgram growing area followed by LBG- 123 (17.8%), LBG-792 (14.1%), PU-31 (4.4%) and LBG-648 (1.5%).

The highest per cent incidence of natural enemies observed in farmer's field were braconids *viz.*, *Therophilus javanus* (55%), *Phanerotoma hendecasisella* (42%) Ichneumon *wasp Bassus relativus* (47%) and Syrphids (30%) and coccinellids (35%) (Table 5). The Present results were supported by Arodokoun *et al.* [2] who reported that a braconid parasitoid, *Phanerotoma leucobasis*, could inflict about 30 per cent parasitism of *M. vitrata* in Benin, West Africa and Srinivasan *et al.* [8] reported that *Therophilus marucae* (Braconidae: Hymenoptera) besides *T. javanus* emerged as a major parasitoid in a survey during May – June 2011 in Southern Taiwan. *T. marucae* a larval parasitoid and in the present survey it was observed that the field parasitism rate was up to 38 per cent. Borah and Dutta [3] and Borah and Sharma [4] observed different hymenopteran parasitoids and species of predators on *Maruca vitrata* in blackgram and greengram fields of various parts of the Central Brahmaputra Valley Zone of Assam, India.

Table 3: Insecticide usage for managing the *M. vitrata* during *rabi* 2018-2019

S. No.	Insecticide	Total no. of farmers sampled	Per cent Usage
1.	Chlorpyrifos 20% EC	100	50
2.	Dichlorvos 76% EC	100	43
3.	Thiodicarb 75% WP	100	40
4.	Spinosad 45% SC	100	36
5.	Chlorantraniliprole 18.5% SC	100	31
6.	Others	100	22

Table 4: Blackgram varieties grown by farmers during *rabi* 2018-19

S. No.	District	Variety	No. of farmers	*rabi* 2018-2019	
				No. of farmers	% of variety grown
1.	Prakasam	TBG-104	20	7	35
		PU-31		8	40
		LBG-752		5	25
2.	Nellore	TBG-104	20	9	45
		PU-31		7	35
		PBG- 1		4	20
3.	Chittoor	TBG-104	20	10	50
		PU-31		8	40
		LBG-752		2	10
4.	Guntur	TBG-104	20	9	45
		PU-31		9	45
		LBG-752		2	10
5.	Kurnool	TBG-104	20	8	40
		PU-31		11	55
		TAU-1		1	5

Table 5: Incidence of natural enemies in farmer's blackgram fields during *rabi* 2018-19

S. No.	Natural enemies	*Rabi* 2018-19 (n=100)	
		Frequency	Percentage
1.	*Therophilus javaus* (Braconidae)	55	55
2.	*Phanerotoma hendecasisella* (Braconidae)	42	42
3.	*Bassus relativus* (Ichneumonidae)	47	47
4.	Syrphids	30	30
5.	Coccinellids	35	35

Summary and Conclusions

The incidence of *M. vitrata* varied from 24.85 to 58.79 per cent during *Rabi* 2018-19. Majority of the farmers preferred PU-31, TBG-104, LBG-752 and TAU-1 varieties of blackgram for cultivation. Farmers preferred chlorpyrifos, dichlorvos, thiodicarb, spinosad and chlorantraniliprole insecticides for managing the *M. vitrata*. *Therophilus marucae*, *Bassus relativus* larval parasitoids and *Phanerotoma philippinensis* egg-larval parasitoid of *M. vitrata* also observed during survey.

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