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Estimation of pre-harvest avoidable yield loss estimation in groundnut crop due to *Maruca vitrata* (Gayer)

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Abstract
Maruca vitrata (Gayer) damage potential and economic injury levels on groundnut were worked out at MARS University of Agricultural Sciences, Dharwad during *kharif* 2016-17, through artificial release of larvae to individually potted groundnut plants. The methods of artificial infestation of larval population were followed to study the extent of loss caused due to different level of maruca larvae. The treatments include 0, 1, 3, 5, 7, 9 and 11 larvae per groundnut plant and the each treatment was replicated thrice. The loss caused was compared with yield obtained in groundnut plant without larval release. The yield loss in plants released with one larvae was low and where as it was maximum in plants received 11 larvae. There existed a positive relation with *M. vitrata* larval population and yield loss. The highest yield reduction was recorded in treatment plants with 11 larvae per plant (2.55 g/plant) and which was statistically different from the remaining six treatments. Yield loss in groundnut crop at different larval density of *M. vitrata* indicated that when their population exceeds 2.0 larvae per plant causes economic yield loss and estimated economic injury level (EIL) was 2.5 larvae per plant.

Keywords: Groundnut, *Maruca vitrata*, economic injury level (EIL), infestation

Introduction
Groundnut or peanut (*Arachis hypogaea* L.) the 'King' of oilseeds, is an annual legume grown primarily for high quality edible oil. It is one of the most important food and edible oilseed crop of the world. It is a leguminous crop which ranks 6th among the oilseed crops and 13th among the food crops of the world,covering an area of 24.48 million ha with a total production of 42.74 million tonnes (Indiastat, 2014) [1]. Groundnut crop is attacked by more than 90 species of pests and mites (Kenchaiah and Porte, 1989) [2]. Among them *Aproaerema modicella* Deventer, *Amasacta albistriga* Walker, *Spodoptera litura* Fabricus, *Aphis craccivora* Koch, *Frankliniella schultzeri* Trybom, *Thrips palmi* Karny and *Scirtothrips dorsalis* Hood are considered as destructive pests on this crop.
Maruca vitrata (Gayer) has become a serious pest on number of pulses, mainly in tropics and subtropical regions of the world. The pest is reported to feed on 39 host plants including wild hosts and a serious pest of cowpea, pigeon pea, black gram, greengram, beans and soybean in Asia and Africa. This pest can cause damage to the extent of 25 to 40 percent and 9 to 84 percent, respectively in major pulse crops like cowpea and pigeon pea(Ganapathy, 2010) [3]. The pest has been extending its host range and also becoming serious on already reported hosts like groundnut year after year, since 2011 at Dharwad (Anon., 2015) [4]. In case of groundnut, the young larvae initially feed on the young foliage and later third instar larvae either bore into the terminal shoot resulting in stem tunneling or web the leaves and feed on the webbed leaves. The larvae pupates either in webbed leaves or in stem tunnels as the case may be. An average of 1.20 maruca larvae per plant caused 10% damage to the fruiting bodies and the extant of pod damage varied from 25 to 40% in redgram (Patel and Singh, 1977) [5]. The pod damage and yield loss were respectively 54.4 and 20% in cowpea (Ohno and Alam, 1989) [6]. However the pest population has been increasing year after year on groundnut and may information including yield loss are lacking and needs to be enumerated. With this in background, a studywas conducted to derive the scientific information about this notorious pest, the *M. vitrata*on groundnut.

Materials and methods

The study was conducted at Main Agricultural Research Station (MARS), Dharwad, by raising the groundnut plants of variety JL-24 individually in pot of size 10" diameter and 15" height. The methods of artificial infestation of larval population were followed to study the extent of loss caused by the *Maruca vitrata* (Gayer). The treatment details were presented in Table 1 and each treatment was replicated thrice. Completely Randomized Design (CRD) principle was followed and groundnut plants were covered with nylon mesh cages of 0.7 × 0.5 × 0.5 m size before flowering to avoid natural infestation. The bottom edges of the meshs were inserted into the soil in all sides to check the escape or entry of larvae. These nylon mesh cages were erected on bamboo sticks fixed on pot. The artificial release of second instar larvae was carried out when the plants were 45 days old. The observations were recorded onpercent foliage damage, pod yield and haulm yield per plant. The following formulas used to calculate the economic injury level of the pest on groundnut:

$$EIL = \frac{\text{Gain threshold (GT)}}{\text{Regression co-efficient (b)}}$$

$$GT = \frac{\text{Cost of plant protection (Rupees/ha)}}{\text{Market price (Rupees/q)}}$$

$$b = \frac{\Sigma xy - \frac{\Sigma x \Sigma y}{N}}{\Sigma x2 - \frac{(\Sigma x)2}{N}}$$

Table 1: Treatment details of yield loss estimation

Tr. No.	Treatments
1	0 larva per plant (control)
2	1 larvae per plant
3	3 larvae per plant
4	5 larvae per plant
5	7 larvae per plant
6	9 larvae per plant
7	11 larvae per plant

Results and Discussion

Highest pod yield of 19.12 g per plant was recorded in control treatment (*Maruca vitrata* (Gayer)larvae were not released) and was at par with the yield obtained in the treatment plants receiving 1 larva per plant (18.92 g/plant) and differed significantly with other treatments. The pod yield recorded in plants receiving 3 larvae per plant was 18.47 g/plant and which was at par with the treatment receiving 5 larvae per plant (18.14 g/plant). The treatment with 9 larvae per plant recorded pod and haulm yield of 17.38 and 12.00 g/plant, respectively. The lowest pod and haulm yield were recorded in plants receiving 11 larvae (16.57 g/plant & 10.5g/plant, respectively), and was statistically differed with rest of the treatments. The highest yield reduction was recorded in treatment plants with 11 larvae per plant (2.55 g/plant)and which was statistically different from the remaining treatments. The treatment plants with 7 (1.21 g/plant) and 5 larvae per plant (0.98 g/plant) were also differed significantly with rest of the treatments. The lowest pod reduction of 0.20g/plant was observed in the treatment plants with a single larva per plant and was followed by treatment with 3 larvae (0.65 g/plant) per plant. These two treatments were at par with each other and together differed significantly with all the other treatments (Table 2).

Maximum haulm yield of 18 g was recorded in the control and differed statistically with other treatments. The plants, which received 1 larva (16.15 g/ plant) and 3 larvae (15.33 g/plant) per plant were *at par* with each other and differed significantly with the remaining treatments. The treatment plants which received 5 larvae per plant recorded 13.25 g/ plant. The treatment with 7 (12.66 g/plant) and 9 (12 g/plant) larvae per plant were *atpar*with each other and recorded lower haulm yield. The treatment plants receiving 11 larvae per plant recorded lowest haulm yield (10.50 g/plant) among the treatments. Highest reduction of haulm yield was recorded in the treatment receiving 11 larvae per plant and was significantly different from all the other treatments in the trial (7.50 g/plant). The lowest haulm reduction was recorded in treatment with 1 larva per plant (1.85 g/plant), which was followed by the treatment with 3 larvae per plant (2.67 g). Highest percent haulm yield loss was recorded in treatment with 11 larvae per plant (41.66%), which was followed by 9 larvae (33.33%), 7 larvae per plant (29.66%) and 5 larvae per plant (26.38%) (Table2).

Table 2: Yield loss and percent damage at different graded level of *Maruca vitrata* (Gayer) larval infestation in groundnut crop

Number Larvae / plant	Pod yield (g)	Reduction in pod yield (g)	Reduction in pod yield (%)	Haulm yield (g)	Reduction in haulm yield (g)	Reduction in haulm yield (%)	Leaf damage (%)
1	18.92	0.20	1.05	16.15	1.85	10.27	5.22
3	18.47	0.65	3.40	15.33	2.67	14.83	13.12
5	18.14	0.98	5.13	13.25	4.75	26.38	26.09
7	17.91	1.21	6.33	12.66	5.34	29.66	33.97
9	17.38	1.74	9.10	12.00	6.00	33.33	43.08
11	16.57	2.55	13.34	10.50	7.50	41.66	52.31
Control	19.12	-	-	18.00	-	-	-
S. Em. ±	0.15	0.01	0.08	0.08	0.09	1.22	0.02
C.D. @ 5%	0.46	0.02	0.24	0.24	0.28	3.61	0.06

The lowest haulm yield loss was recorded in treatment with 1 larva per plant (10.27%) and was followed by treatment with 3 larvae per pant (14.83%). The percent foliage damage at different larval level of *Maruca vitrata* (Gayer) infestation has shown significant differences among the treatments. The highest percent foliage damage in the decreasing order *viz.* 11 larvae per plant (52.31%), 9 larvae per plant (43.08%), 7 larvae per plant (33.97%), 5 larvae per plant (26.09%), 3 larvae (13.12%), 1 larvae per plant (5.22%). The foliage damage was nil in the control treatment which was absolutely free from the pest (Table 2).Hence, it is clear that as the population on the host plant increases, there will be more foliage damage leading to lower yield. Similarly increase in the number of *Maruca vitrata* (Gayer) can cause reduction in

the pod and haulm yield of groundnut (Fig. 1). Further, foliage damage and *M. vitrata* population have got positive relation. The untreated check (completely free from larval infestation) recorded maximum pod and haulm yield over other treatments in the absence any damage by spotted pod borer. The higher number of 15 larvae per plant recorded highest of 13.28 percent pod loss and 55.55 percent of haulm loss over unreleased check. Further, the same treatment recorded the maximum percentage foliage damage (71.17) over other treatments.

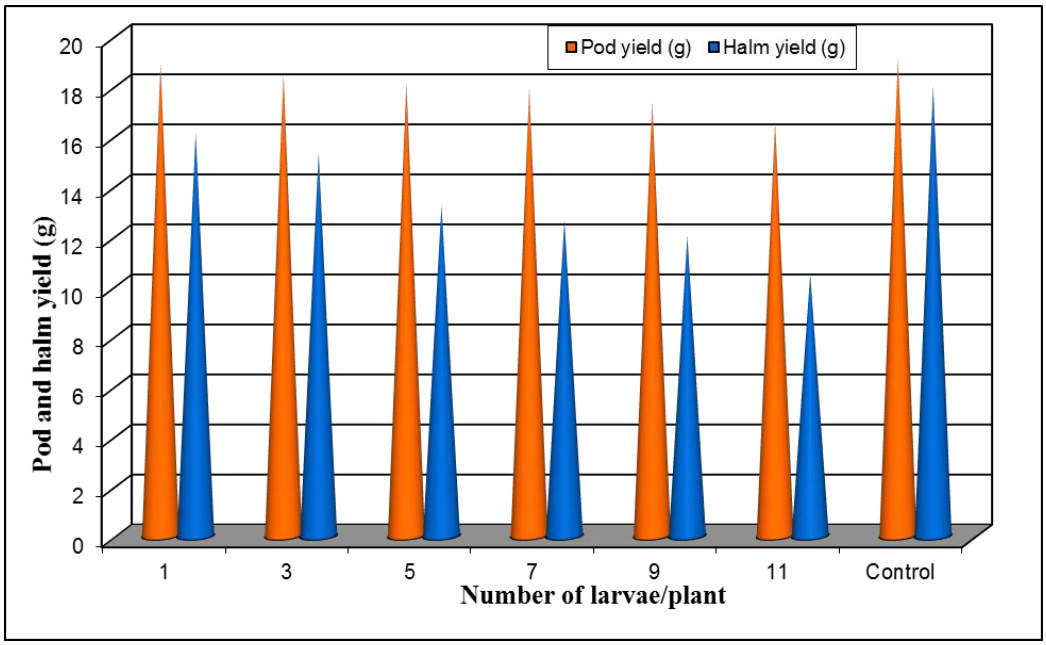

Fig 1: Pod yield and haulm yield as influenced by graded levels of *Maruca vitrata* (Gayer) infestation

Published information on yield loss and percent damage at different spotted pod borer population level in groundnut is not available. However Patel and Singh (1977) [5] recorded 10% damage to the fruiting bodies and the pod damage varied from 25 to 40% by an average of 1.2 larvae per plant. Patnaik *et al*. (1986) [7] reported that 8.2 to 15.9% pod damage, resulting in 3.7 to 8.9% loss in grain yield in Orissa. Similarly in Nigeria, loss in cowpea grain yield has been estimated to be 72% in 1985 and 48% in 1986, and the economic threshold is nearly 40% larval infestation in flowers (Ogunwolu, 1990) [8]. The reported variation in yield loss might be due to change in the crop environment and variation in the maruca population and may also be due to species difference as the present study was conducted with well covered potted plants.

Data obtained from the yield loss estimation experiment was used for the estimation of economic injury level. The calculated regression co-efficient was 0.22. Minimum of one spray of emamectin benzoate was required to keep the crop free from the pest and its application cost was worked out to be Rs. 1,940 ha^{-1} (cost of insecticide + labour charge). Cost of insecticide was Rs. 1,040/- for one spray and labour charge was Rs. 300/- per head. The total labour required for spraying one ha area and the labour cost for the same was 3 and Rs. 900/-, respectively. Considering the market price of the groundnut pod as Rs. 3,500 /q and calculated gainthreshold (GT) was 0.55. Therefore as per the formulae economic injury level of *Maruca vitrata* (Gayer) for groundnut was 2.50 larvae per plant (Table 3). However, reported mean EIL and ETL values of *M. vitrata*were respectively, 1.08 and 0.81 larvae per m row of green gram (Zahid *et al.,* 2008) [9] at Burirhat, Rangapur, Bangladesh, might be mainly due to change in the nature of damage, where the pest feeds directly on pods and seeds, however, in case of groundnut it feeds on foliage and amount of foliage damage intern influence the pod yield.

Table 3: Estimation of economic injury level for *Maruca vitrata* (Gayer) on groundnut crop

Sl. No.	Number of larvae/ plant (x)	Pod yield/ plant (g)	Reduction in yield (g) (y)	xy	x^2
1	1	18.92	0.20	0.20	1
2	3	18.47	0.65	1.95	9
3	5	18.14	0.98	4.90	25
4	7	17.91	1.21	8.47	49
5	9	17.38	1.74	15.60	81
6	11	16.57	2.55	28.05	121
7	Control	19.12			
Total	64		7.33	59.17	826

$$\text{Gain threshold (GT)} = \frac{1940}{3500} = 0.55$$

$$b = 0.22$$

$$\text{EIL} = \frac{GT}{b} = \frac{0.55}{0.22} = 2.50 \text{ larvae/plant}$$

Conclusion

Higher population of *Maruca vitrata* (Gayer) can cause reduction in the pod and haulm yield of groundnut. Further, foliage damage have got positive relation with *M. vitrata* (Gayer) population. Yield loss in groundnut crop at different larval density of *Maruca vitrata* (Gayer) indicated that when

their population exceeds 2.0 larvae per plant causes economic yield loss and estimated economic injury level was 2.5 larvae per plant.

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