Incidence, bionomics and management of spotted pod borer \textit{(Maruca vitrata (Geyer))} in major pulse crops in India-A review

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ABSTRACT

Spotted pod borer is one of the major biotic constraint for pulses production which can cause damage to the economic plant parts such as flower buds, flowers and pods. The larvae feeds on 39 host species of legume crops. The seasonal incidence of spotted pod borer differed from crop to crop and season to season. However, the peak incidence of larvae was observed at flowering and pod development stage in different pulse crops. Female moths lays flat scaly eggs on floral buds, flowers, leaves, leaf axils, terminal shoots and tender pods. Larvae are translucent with dark brown spots on each segment and larval period lasted from 11 to 21 days and the duration of total life cycle varied from 27 to 36 days on different hosts. The efficacy of chemical insecticides belonging to different groups against spotted pod borer was well established on different pulse crops. Neem products such as neem seed kernel extract (NSKE) or neem oil and biocides like \textit{Bacillus thuringiensis} (Bt) showed different levels of efficacy on different crops.

Key words: Pulses, Spotted pod borer.

India is a major pulse growing country in the world, sharing 35-36 per cent area and 27- 28 per cent production of pulse crops. It is producing 12-14 million tones of pulses from 22-24 million ha of land. The commonly grown major pulse crops in India are pigeonpea, mungbean, urdbean, chickpea, horsegram, cowpea and some of the minor pulse crops are drybean, mothbean, lathyrus, lentil and peas. Pulses are rich sources of protein to vegetarians with an inherent capacity to fix large amounts of atmospheric nitrogen in symbiotic association with Rhizobium and thus enriches the soil. Cultivation of pulses in India takes place under diverse agro ecological nitches such as \textit{kharif}/\textit{rabi}, rainfed/ irrigated, mixed/ monocrop, low /high input conditions, traditional/ progressive farming etc., posing a highly variable spectrum of pest problems. The insect pest spectra that infest these pulse crops include more than 40 species on blackgram or greengram, beans and soybean in India. In the absence of host plants during the off-season, it survives on alternate host plants like wild leguminous shrubs and trees and also on weed hosts. The most frequent host plants are \textit{Cajanus cajan}, \textit{Vigna unguiculata}, \textit{Phaseolus lunatus}, and \textit{Pueraria phaseoloids}. Growth indices for larvae are 4.14 on pigeonpea, 4.63 on cowpea, and 5.17 on hyacinth bean (Ramasubramanian and Sundara Babu, 1988; Ramasubramanian and Sundara Babu, 1989). The larva feed on 39 host species, the majority of which belong to leguminaceae (Atachi and Djihou, 1994) and has been reported to occur throughout India in all the legume growing states as summarized below (Table 1).

Seasonal incidence: Seasonal incidence of spotted pod borer varied depending upon the crop and season at different locations. The peak activity of \textit{M. testulalis} has been observed during the month of July, August and October (Lalasangi, 1988). Two population peaks has been observed in moth catches from light traps at ICRISAT, Hyderabad i.e first peak during September and second peak in early November to mid December, while it is between mid September to mid October at Hisar (Srivastava \textit{et al}., 1992). The incidence has been observed between mid October to end of November with the peak at the end of November at
TABLE 1: Distribution of spotted pod borer in India

<table>
<thead>
<tr>
<th>State</th>
<th>Major host</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karnataka</td>
<td>Pulses</td>
<td>Krishnamurthy (1936)</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>Pigeonpea</td>
<td>Patel and Singh (1977)</td>
</tr>
<tr>
<td>Bihar</td>
<td>Legumes</td>
<td>Saxena (1978)</td>
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<tr>
<td>Madhya Pradesh</td>
<td>Legumes</td>
<td>Saxena (1978)</td>
</tr>
<tr>
<td>Delhi</td>
<td>Legumes</td>
<td>Saxena (1978)</td>
</tr>
<tr>
<td>Tamil Nadu</td>
<td>Grain legumes</td>
<td>Sundara Babu and Rajasekaran (1984)</td>
</tr>
<tr>
<td>Gujarat</td>
<td>Greengram</td>
<td>Venkaria and Vyas (1985)</td>
</tr>
<tr>
<td>Andhra Pradesh</td>
<td>Pigeonpea</td>
<td>Rao et al. (1986)</td>
</tr>
<tr>
<td>Orissa</td>
<td>Pigeonpea</td>
<td>Prasad et al. (1989 a, b)</td>
</tr>
<tr>
<td>Haryana</td>
<td>Pigeonpea</td>
<td>Srivastava et al. (1992)</td>
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Dhoni, Bihar (Akhauri et al., 1994), from early September with the peak during mid October at Pant Nagar (Bajpai et al., 1995) in pigeonpea. It is from second fortnight of September to first fortnight of February with peak incidence from second fortnight of November to December first fortnight in field bean at Karnataka (Thejaswi et al., 2008).

While, Gopali et al. (2008) reported that the incidence is bimodal where early infestation starts from September reaching its first peak during middle October and second peak during December in pigeonpea at Karnataka. The peak larval activity coincides with peak flowering stage in blackgram (Shivaraju et al., 2008), Chittibabu et al. (2009), Sonune et al. (2010). Umbarkar et al. (2010) reported that the population of Maruca pod borer started appearing from 5th week after sowing and peak pest density is observed during 7th week after sowing in greengram at Junagadh.

**Influence of weather parameters:** High humidity and low temperatures during the months of November and December are highly favorable for the pest build up (Sharma, 1998). Relative humidity and rain fall had positive correlation while temperatures had negative influence on pest incidence (Ganapathy, 1996). High temperatures, high relative humidity and rainfall favours the population build up which leads to severe infestation in cowpea and pigeon pea (Reddy et al., 2001; Sahoo and Behera, 2001; Akhilesh and Paras, 2005).

The larval population showed significant negative correlation with minimum temperature (Thejaswi et al., 2008; Shivaraju et al., 2008; Chittibabu et al., 2009; Umberkar et al., 2010; Sonune et al., 2010), significant positive correlation with rainfall (Gopali et al., 2008) and morning relative humidity (Chittibabu et al., 2009) in blackgram.

**Damage Potential:** The losses in yield caused by the spotted pod borer are 35 to 40 per cent in Madhya Pradesh as reported by Bindra, (1968). The larvae can cause 10 per cent damage to flowers and 25 to 40 per cent damage to pods in pigeon pea (Patel and Singh, 1976). Singh and Allen (1980) recorded 20 to 60 per cent yield loss in cowpea. Vishakantiaah and Jagadeesh Babu (1980) reported that the infestation levels varied from 9 to 84 per cent in pigeon pea at Bangalore. While, Lalasangi (1988) noticed 37.08 per cent yield loss in cowpea. Ganapathy (1996) estimated the flower damage ranging from 9.4 to 12.7 % in different pigeon pea cultivars at Tamil Nadu, India. Late sowing and dry spell leads to an outbreak of spotted pod borer which resulted in almost 100 % loss of pigeonpea flower buds and pods in Karnataka (Giraddi et al., 2000). The yield losses caused by *M. vitrata* have been estimated to be around 30 million dollars annually in India (Saxena et al., 2002).

**Nature of damage:** Adults prefer to lay eggs on flower buds, flowers, terminal shoots and tender pods (Taylor, 1963). After hatching, the young larvae (1st, 2nd and 3rd instars) especially injure the terminal shoots and the flower buds whereas the older larvae (4th and 5th larval instars) particularly damage the open flowers and the pods. The larvae feed from inside a webbed mass of leaves, flowers, flower buds and pods. This concealed feeding habit protects the larvae from natural enemies and insecticides. Older larvae are highly mobile, feeding continuously on flowers and newly formed pods and causing severe damage throughout the reproductive cycle of the crop (Singh and Jackai, 1988). Normally, larvae feed on anthers, filaments, styles, stigma and ovaries of flowers and larvae move from one flower to another, and each may consume 4-6 flowers before completion of larval development. Third to fifth instar larvae are capable of boring into the pods and occasionally into peduncle and stems (Taylor, 1967). Later on, Jackai (1981) reported that the infestation starts from 21 days after planting in terminal shoots of cowpea and then spreading to reproductive parts and the peak intensity was observed in flowers followed by flower buds, terminal shoots and pods. In general, the incidence is higher on flowers (52.3%) than on pods (37.8%) and leaves (9.9%) Karel (1985). The young larvae nibble into the stems of blackgram from leaf-axils of branches causing wilting (Goud and Vastrad, 1992). In pigeonpea, the larvae damaged the leaves by rolling, webbing and continued feeding inside the rolled leaves. At flowering and pod formation stages, larvae fed on buds, flowers and pods by webbing them. Third instar larvae prefer pods compared to flowers and leaves while, first instar larvae prefer flowers over pods and leaves (Sharma, 1998). Though, the female moths lays eggs throughout the crop growing season, damage occurs mainly during flowering and podding stages, since young larvae feed mainly on flowers, whereas mature larvae attack fruits and pods in beans (Rekha and Mallapur, 2007).

**Economic injury levels:** In pulses, reports on EIL or ETL of Maruca pod borer are very limited from India as well as from other countries. A threshold of 40 % larval infestation in flowers was established (Ogunwolu, 1990) in cowpea. Ganapathy (1996) enumerated that an EIL of 3.0 larvae per plant and a combined threshold of two pairs each of *M. testulalis* and *Exelastis atomosa* per plant at 50 % flowering stage when both occurred together on pigeon pea.
The EIL and ETL for spotted pod borer are 1.08 and 0.81 larvae per one meter row, respectively in mungbean at Bangladesh (Zahid et al., 2008).

**Biology:** In India, the detailed biology of spotted pod borer was studied on pigeonpea by Vishakantaiah and Jagadeesh Babu (1980) and Lalasangi (1988). Where as, Ramasubramanian and Sundarababu (1988) studied its comparative biology on pigeon pea, lablab and cowpea.

**Egg:** Eggs are flat, slightly elongate, pale yellowish, translucent with faint reticulate sculpturing on thin and delicate chorion (Vishakantaiah and Jagadeesh Babu, 1980). Eggs are glued to the under surface of leaves, terminal shoots and flower buds (Goud and Vastrad, 1992). The freshly laid eggs are milky white in colour, dorsoventrally flattened and oval in outline (Naveen et al., 2009).

Number of eggs laid by a female moth and incubation period varies on different hosts. Taylor (1967) recorded a maximum of 140 eggs on cowpea, while Vishakantaiah and Jagadeesh Babu (1980) observed 5 to 15 egg masses that hatched in 3.3 days on redgram. Later, Lalasangi (1988) recorded as high as 338 eggs per female on pigeonpea flower buds. Where as, Ramasubramanian and Sundarababu (1989) recorded an average of 35.3 eggs by a female moth that hatched in about 2.9 days. Arulmozhi (1990) recorded 176 eggs on cowpea, 93 eggs on soybean flour diet and 91 eggs on cowpea flour diet with the incubation period ranging from 3.3 to 3.7 days. The fecundity is around 126/female with an incubation period of 2.54 ± 0.04 days on cowpea at Karnataka (Naveen et al., 2009).

**Larva:** Mature larvae are 17-20 mm long and larval body is translucent with a pair of dark brown spots on each segment and the intensity of spotting varied with host and sometimes the larvae found even without spots and larval stage consisted of five instars. The head capsule is light to dark brown, and the prothoracic plate is dark brown and divided dorsally. The spots become indistinct before pupation. The larvae are active in evenings and fed on the plant throughout night and are photo-negative (Singh and Taylor, 1978). The larval period is about 12.7 days (Vishakantaiah and Jagadeesh Babu, 1980) and 16.4 days (Jackai and Singh, 1983) on pigeonpea. The larval period is very less (7.3 days) on cowpea, while it is very long (21 days) on sunhemp (Jackai and Singh, 1983). The total larval period is around 10 days in Southern India on cowpea (Ramadas, 1983). But, according to Ramasubramanian and Sundarababu (1988), the larval period is 13.9 days on cowpea, 13.3 days on pigeonpea and 12.9 days on hyacinth bean. The larval period is shorter on cowpea (11.1 days) when compared to cowpea flour diet (16.5 days) and soybean flour diet (14.4 days) (Arulmozhi, 1990). The larval period is 15.4 days in greengram and 16.5 days in blackgram (Ganapathy, 1996). The total larval period ranging from 8 to 11 days on cowpea which is indicating that the cow pea is the most favourable host for spotted pod borer when compared to all the other host plants (Ganapathy, 1996; Naveen et al., 2009).

**Pupa:** The pre-pupal period lasts for two days during which larva ceases feeding completely. The spotting on skin also disappeared and the larvae constructed a gauze-like cocoon on dry leaves, flowers and debris (Vishakantaiah and Jagadeesh Babu, 1980; Ramasubramanian and Sundarababu, 1988). Pupae formed at the time of prepupal stage were green which soon were sclerotized and became brown. Moths emerged in about 6 to 9 days (Singh and Taylor, 1978; Jackai and Singh, 1983). The pupae were obtect, brown in colour which was protected with a gauze-like, matty cocoon. Each pupa measured 12.5 mm in length and 3.0 mm in width. Pupal period lasted for eight to ten days on pigeonpea (Vishakantaiah and Jagadeesh Babu, 1980), 11.6 days on sunhemp, 11.1 days on pigeonpea and 5.6 days on cowpea (Jackai and Singh, 1983). According to Ramasubramanian and Sundarababu (1988), pupal period was minimum (6.4 days) in pigeonpea followed by cowpea (6.9 days) and lablab (7.5 days). Arulmozhi (1990) recorded the maximum pupal weight (55.7 mg) coupled with less pupal period (5.9 days) on cowpea flower buds, while it was prolonged when reared on artificial diet i.e. 6.4 days in soybean flour diet and 7.1 days in cowpea flour diet. Recently, Naveen et al. (2009) reported that pre-pupal and pupal periods were 2.10 ± 0.50 and 8.00 ± 0.85 days, respectively and the total developmental period was 22.36 ± 1.45 days on cowpea.

**Adult:** Moths were medium-sized, with fuscous brown forewings bearing a lunulate black-edged white spot in the end of the cell. A black-edged, semi hyaline band beyond the cell from below the costa was conspicuous. Hind wings were semi-hyaline white, with a basal fuscous area and a spot at the upper angle of the cell. A marginal fulvous brown fuscous band from costa to vein 1c with an inner irregular edge was very distinct. Both sexes were morphologically similar (Hampson, 1976). Average life-span of sexes varied on different hosts. Ramasubramanian and Sundarababu (1988) observed the adult longevity varied from 8.6 to 5.9 days in cowpea, 8.5 to 6.1 days on pigeonpea and 10.0 to 6.1 days on lab-lab. On soybean flour diet, the female and male moths lived for 8.3 days and 5.8 days respectively while on cowpea flour diet, the periods varied from 9.0 to 6.1 days in both sexes. Moreover, adult emergence was 96.4 per cent when reared on cowpea flower buds (Arulmozhi, 1990). According to Naveen et al. (2009), the longevity of female and male moths were 10.82 ± 2.45 and 12.41 ± 2.87 days, respectively on cowpea.

**Life cycle:** In pigeonpea, life-cycle lasts for 27 days (Vishakantaiah and Jagadeesh Babu, 1980) and the period of mean life-cycle was 30.2 days for males and 32.6 days for females (Ramasubramanian and Sundarababu, 1988). The duration of total life cycle varied from 31 to 36 days on cowpea (Naveen et al., 2009).
Management

Use of botanicals: Neem seed powder and neem kernel extract were effective against legume pod borer but neem seed kernel extract (NSKE) was less effective than fenvalerate and monocrotophos (Singh et al., 1985). Similarly, Bhat et al. (1988) reported that neem seed extract was the next best treatment to monocrotophos against the pod borers on cowpea. Ramasubramanian and Babu (1991) recorded significant reduction in flower damage due to spotted pod borer in lablab with foliar application of neem seed kernel extract. The effectiveness of NSKE and neem oil against the pod borers on pigeonpea was well documented by Shambulingappa (1994) and Wanjari (1994). Later, Durairaj (1999) also reported that neem seed kernel extract at 5% was effective against lepidopteran borers in pigeonpea. Ganapathy (1996) found that neem seed kernel extract 5% and neem oil 3% recorded low larval numbers (1.0 and 1.3/plant), less flower damage (7.7 and 10.4%), webbings (1.6 and 1.5/plant) and pod damage (6.6 and 7.8%). Similar results were obtained by Akhauri and Yadav (2002) and Prajapati et al. (2003) who used neem seed extract, neem oil, neem cake and black pepper and garlic bulb extract with varied doses against the M. vitrata attacking cowpea and pigeonpea. Mohapatra and Srivastava (2002) also observed a significant reduction in larvae of M. vitrata on pigeonpea when NSKE was sprayed at 5% concentration. Gupta and Pathak (2009) reported that neem oil 1% and Neem oil (in cow urine) 3% + dimethoate 0.03% were found better when compared to individual insecticides in reducing the pod borer damage in blackgram at Madhya Pradesh. Singh et al. (2009) reported the better efficacy of neem oil 0.2% when compared to malathion against pod borer in greengram at Rajasthan. The efficacy of NSKE (5%) + DDVP at 0.5 ml/liter of water was reported by Gopali et al. (2010) in pigeonpea at Karnataka. Conversely, Srinivasan and Sridhar (2008) reported that neem oil 3.0% and NSKE 5.0% were inferior to the conventional insecticides such as endosulfan 0.07% and dichlorvos 0.08% in reducing the larval population in pigeonpea at Tamilnadu. Similarly, Mallikarjuna et al. (2009) also noticed that the indigenous materials such as NSKE 5%, garlic extract 1%, chilli garlic extract 0.5% and panchagavya 3% were less effective against pod borers when compared to newer insecticide molecules such as emamectin benzoate, indoxacarbazep and flubendiamide in dolichas bean at Bangalore.

Biopesticides: The studies on the use of biopesticides against Maruca were limited from India. Manjula and Padmavathamma (1996) recorded the higher efficacy of Bt @ 1 x 10^-3 ml/l and monocrotophos @ 0.025% against maruca on pigeonpea. Durairaj (1999) reported that two strains of Bt (B.t k-l and B.t k-11), NPV and combination of endosulfan and NPV were highly effective in reducing the pod borer damage in pigeonpea. Mohapatra and Srivastava (2002) reported that B.t (Biobit) @ 1000 g a.i./ha was effective in controlling maruca pod borer in pigeonpea. Chandrayudu et al. (2008) recorded the efficacy of commercial formulation of Bt @ 0.0025% in suppression of pod damage due to spotted pod borer in cowpea. Sunitha et al. (2008) reported that Bt @ 6.7 x 10^-3 and M. anisopliae @ 1 x 10^7 were moderately effective against M. vitrata in pigeonpea at Hyderabad. Sreekanth and MahaLakshmi (2012) reported that the per cent inflorescence damage due to legume pod borer was lowest in spinosad 45% SC @ 73 g a.i./ha treated plots (4.74%), followed by Bacillus thuringiensis-1 @ 1.5 kg/ha (10.52%) and Beauveria bassiana SC formulation @ 300 mg/Lt (14.15%) with 80.9, 57.6 and 42.9 per cent reduction over control respectively as against control (24.79%) in pigeonpea.

Chemical insecticides: Several reports were available on insecticidal management of spotted pod borer in different crops at different locations. Samolo and Patnaik (1986) found that monocrotophos and endosulfan at 0.5 kg a.i. ha-1 were most effective in checking the pod borers on pigeonpea. Lal and Yadava (1988) reported that two sprays of dimethoate 0.05 per cent and monocrotophos 0.05 per cent were effective. According to Rahman and Rahman (1988), four sprays of cypermethrin 0.008 per cent (1st at flower initiation, 2nd at 50 per cent flowering, 3rd at 100 per cent flowering and the 4th at 100 per cent pod set) were effective against Maruca with the highest benefit cost ratio of 6.23 in pigeonpea. The efficacy of triazophos, endosulfan, and monocrotophos (Sundara Babu and Rajasekaran, 1984), cypermethrin, deltamethrin, fenvalerate and endosulfan (three sprays) (Sontakke and Mishra, 1991) was reported earlier against pod borers in pigeonpea. Lakshmi et al. (2002) reported that two sprays of chlorpyriphos @ 0.05% at ten days interval was effective in reducing the larval population (48.86%) of M. vitrata on blackgram. Chandrayudu et al. (2006) reported that pod damage by spotted pod borer in cowpea was significantly less in chlorpyriphos + DDVP treatment @ 2.5 + 1 ml/l. While, Malathi (2007) reported that chlorpyriphos 20 EC @ 2.5 ml/l at 50% flowering stage, recorded maximum reduction in M. vitrata (67.98%) on pigeonpea. Patil and Jamadagni (2006) reported that novaluron 10 E.C @ 1.0 ml/lt and alphamethrin 10 E.C @ 1.0 ml/lt significantly reduced the pod borer damage in blackgram. Rao et al., (2007) reported that the newer insecticides such as spinosad 45 EC @ 0.4 ml/l and indoxacarbazep 14.5 EC @ 0.4 ml/l recorded the lowest pod damage by spotted pod borer in pigeon pea. Sunitha et al. (2008) reported that indoxacarbazep 14.5 SC and spinosad 48 SC were highly effective against the third instar larvae of M. vitrata with 80% and 50% mortality respectively in pigeonpea. Sandhya Rani and Eswari (2008) reported that lambda cyhalothrin in combination with dichlorvos was found highly effective with lowest pod damage (4.97%) followed by novaluron and spinosad in greengram at Andhra Pradesh. Singh et al. (2008) reported the higher efficacy of...
E2Y45 20% SC at 30 and 40 g a.i./ha. and spinosad 45% SC at 73 g a.i./ha against pod borers in pigeonpea. Mallikarjuna et al. (2009) recorded the highest larval reduction of pod borers with flubendimide 480SC and thiacloprid 48SC followed by emamectin benzoate 55G and indoxacarb 14.5SC in dolichos bean. Ashok Kumar and Shivaraaju (2009) reported that Thiodicarb 75 WP @ 562.5g a.i./ha and flubendimide 480 SC @ 48g a.i./ha were highly effective followed by Indoxacarb 14.5 SC @ 75g a.i./ha in controlling the pod borers in blackgram. Gopali et al. (2010) reported that Profenophos 50 EC @ 2.0 ml/lit in combination with DDVP @ 0.5 ml/lit was found effective in reducing pod damage (6.23%) by M. vitrata with higher grain yield (10.20 q/ha) and highest cost benefit ratio (1:5.30) in pigeonpea. MahaLakshmi et al. (2012) reported that flubendimide @ 0.2 ml/lit, thiodicarb @ 1.5 g/l and emamectin benzoate @ 0.4 g/l were effective against pod borer in blackgram. Coragen 20 % SC at 20 g a.i./ha can be used against legume pod borer as an alternative for conventional insecticides (MahaLakshmi et al., 2013).

Spray schedules: Bhalani and Parsana (1987) recommended sequential spraying of endosulfan 0.07 per cent at pod initiation stage followed by monocrotophos 0.04 per cent at 50 per cent pod set in pigeonpea. While, Singh and Srivastava (1989) suggested that the spray schedule of either with three sprays of monocrotophos 0.04 per cent or two sprays of endosulfan 0.07 per cent was appropriate in pigeonpea. Rahman, (1991) recommended that cypermethrin or dimethoate at flowering stage or when egg numbers reached two per meter row and it should be repeated at 10-15 days interval in pigeonpea. Ganapathy and Durairaj (1994) suggested sequential spraying of either monocrotophos (0.04%) - fenvalerate (0.02%) - dimethoate (0.03%) or monocrotophos (0.04%)-Cypermethrin (0.025%)-dimethoate (0.03%) starting from 50 per cent flowering time to pigeonpea. Kataria et al. (1994) also advocated that a sequential spray of dimethoate (0.03%) – fenvalerate (0.02%) and monocrotophos (0.04%) was very effective. Patnaik and Mishra (1994) recommended the sequential spraying of endosulfan (0.07%) - endosulfan (0.07%) – monocrotophos (0.04%) at 15 days interval starting from 50 per cent flowering stage in pigeonpea. Malathi (2007) noticed that spraying of profenofos 50 EC (1.0 ml/litre) at bud initiation stage and thiodicarb 75 WP (1.0 g/litre) at pod formation stage was most effective against spotted podborer in pigeonpea.

CONCLUSIONS

The studies on the bionomics, seasonal incidence and ETL’s of M. vitrata were mostly conducted on cowpea and to some extent on pigeonpea and similar studies has to be conducted on other major pulses such as mungbean and urdbean. Information on population dynamics and ETL’s or EIL’s was still needs to be generated on different pulse crops. Several natural enemies have been reported from other countries, but the information regarding the incidence of natural enemies from India was very much scanty which need to be studied intensively. Several studies were conducted on evaluation of chemical insecticides but literature pertaining to use of biopesticides was very limited from India. Usefulness and effectiveness of biopesticides, use of pheromones and adoptability of some cultural practices such as intercropping, border crop and trap crops may be investigated for integrated management of spotted pod borer.

REFERENCES


