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Adoption and Assessment of Integrated Strategies for Managing Major Insect Pests in *Kharif* Green gram [*Vigna radiata* (L.) Wilczek]

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Abstract

For assessing the integrated strategies towards managing insect pest of green gram the concerned experiment was executed for consecutive three years using two treatments, *viz*., IPM nodule and Farmer's practice. In case of IPM module management tactics included seed treatment with fungicide (Tebuconazole 50% + Trifloxystrobin 25%) and insecticide like thiamethoxam, seed dressing with rhizobium, installation of yellow sticky traps, pheromone traps, growing border crops, applying neem based insecticides and need based application of chlorantraniliprole. In case of Farmer's practice only two round spray of chlorpyriphos + cypermethrin were given. In all the years aphid and spotted pod borer population were significantly less compared to the farmer's practice (mean aphid population of 2.53 per 10 cm apical twig in IPM plots against 29.37 in Farmer's practice while pod borer population of 0.77 larva plant^{-1} in IPM and 4.8 in Farmer's practice). Natural enemy population was considerably higher in IPM module (5.23 plant^{-1}) compared to the farmer's practice (1.36 plant^{-1}). Higher incremental benefit cost ratio was also obtained from IPM modules.

Keywords: Economic return, Green gram, Insect pests, IPM, Natural enemies, Seed yield

Introduction

Green gram, scientifically known as *Vigna radiata* (L.) Wilczek, also known as moong or mungbean, is believed to originate in Central Asia, more specifically in India. Following chickpeas, greengram or mungbean is recognized as a staple in the diets of economically disadvantaged individuals, due to its protein content, playing a significant role in fulfilling the substantial requirements of protein (Shafique *et al.*, 2009). In India, the crop ranks as third most important pulse crop, cultivated across approximately 16% of the total pulse-growing areas in the country. The nutritional content of green gram is characterized by its elevated and quickly digestible protein content, constituting roughly 27.94% vegetable protein (Sharanagat *et al.*, 2019). On a dry weight basis, it contains 62-65% carbohydrates, 4.5-5.5% ash, 1.0% oil and 3.5-4.5% fiber. Furthermore, it serves as a valuable source of minerals potassium (1246 mg), including, iron (6.74 mg), phosphorus (367 mg), magnesium (189 mg) and calcium (132 mg). Green gram also provides essential vitamins such as ascorbic acid (4.8 mg), niacin (2.251 mg), pantothenic acid (1.910 mg), thiamine (0.621 mg), riboflavin (0.233 mg) and vitamin A (Kumar and Pandey, 2020). Fully ripe moong seeds or flour are incorporated into a diverse array of preparations or dishes, including snacks, bread, soups, noodles, porridge and even ice-cream. Meanwhile, split seeds (dahl) are mainly consumed by the individuals in Asian countries. Green gram seeds can be sprouted and consumed either cooked or raw as a vegetable. They are inaccurately referred to as 'germes de soja' in French and in English, they are known as 'bean sprouts.' In South India, sprouted whole moong is utilized in curry or as a savory dish, while in North India; it is predominantly used as dahl. In Orissa, Andhra Pradesh, Tamil Nadu and Karnataka it is only known relay crop for rice fallow system during the winter season. In West Bengal, Jharkhand, Uttar Pradesh,

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Bihar, Haryana, Punjab and Rajasthan, the crop serves as a catch crop exclusively in spring or summer months. Additionally it is also cultivated during the *kharif* season in West Bengal. Green gram cultivation in India spanned across 4.5 mha, yielding a total of 2.5 million ton seeds, resulting in 548 kg ha^{-1} grain productivity. This crop contributes 10% share to the overall pulse seed production. Government of India's 3rd advance estimates showed that, the production of mungbean seed for the 2020-21 period is reported to be 2.64 million tonnes (Anonymous, 2021). In addition to abiotic factors, a variety of biotic menacing factors hinder the pulses from achieving its highest yield potential. Greengram is susceptible to infestations by several insect pests and disease causing organisms, as noted by Lal in 1985. A compilation of 198 insect species from 8 orders and 7 mites of the class Arachnida have been documented, encompassing 48 families. In India 111 species of insect fauna and mites have been identified in India, with 60 of them identified as key insect pests affecting green gram and black gram, as reported by Chhabra and Kooner in 1985. Specifically, Lal (1985) reported 18 insect pest species infesting green gram. Among the observed insecs, five pest insects, *viz*., *Spodoptera litura* Fab, *Aphis craccivora* Koch, *Empoasca kerri* Pruthi, *Spilarctia obliqua* Walk., *Madurasia Obscurella* Jac. and *Euchrysops cnejus* Fab. have been identified as important pests affecting black gram, according to Kumar *et al*. in 1998. According to former report, 30% reduction in green gram yield is caused by insect pests (Soundararajan and Chitra, 2011). Indiscriminate use of insecticides invites the chances of several ill effects like resistance generation in pest body, pest resurgence, secondary pest outbreak and environmental contamination. Therefore, a variety of control strategies, including physical, cultural, biological and chemical pest control methods, are combined in the IPM (Integrated Pest Management) strategy (Kennedy and Sutton, 2000), to maintain dynamic and sustainable crop ecosystem. IPM strategies not only diminish environmental hazards but also lower the expenses associated with crop protection, while simultaneously enhancing additional yield. Consequently, this study was conducted to highlight the advantages of implementing IPM strategies in *kharif* mungbean cultivation compared to the pest management practices typically employed by farmers.

Materials and Methods

The concerned experimental study was carried out in the field of District Seed Farm owned by BCKV located at A-B Block, Kalyani, Nadia, West Bengal (22°87′ N latitude and 88°20′ E longitude) in the *kharif* period of three consecutive years, *viz*., 2020, 2021 and 2022. Two mungbean varieties were selected for the concerned experiment: one was IPM 2-3 chosen for growing in the plots intended for adoption of integrated pest management (IPM) module and another one was Samrat grown in the plots intended for adoption of normal farmer's practice. Recommended and optimum agronomic practices regarding seed rate (25 kg ha^{-1}), spacing (30 cm × 10 cm), fertilizer application (20:40:20 for $N:P_2O_5:K$) and weeding were maintained throughout the period of experiment. For adoption of the IPM module some practices were followed. Before sowing the seeds were treated with a pre-mixture fungicide containing Tebuconazole 50% + Trifloxystrobin 25% WG @ 1.5 ml kg^{-1} of seeds to safeguard the crop from soil-borne fungal pathogens during the early establishment of the crop. The seeds were also treated with thiamethoxam 35 FS @ 5 g kg^{-1} of seeds to protect the crop from the sucking pests during the vegetative stage for a certain period of time. Rhizobium inoculation was also done for better establishment of the crop. In the borders of the plot maize crop was grown as a barrier cop to prevent the entry of whiteflies in mungbean crop. During the early crop flourishing 25 days after sowing yellow sticky traps were employed @ 50 traps ha^{-1} to monitor the sucking pests like whitefly, aphid and jassid. Population of gram pod borer was also monitored by installing pheromone traps @ 10 traps ha^{-1}. When the presence of whitefly and other sucking pests were noted on the sticky traps then the crop was sprayed with Azadirachtin at 30 days after sowing. It was also recommended to apply need based application of the insecticides Diafenthiuron 50 WP @ 312.5 g active ingredient ha^{-1} or 100 g Pyriproxyfen 10 EC active ingredient ha^{-1} for sucking insect pests in the places where they are major problem. In our experiment we didn't apply the aforementioned insecticide as the sucking pest did not appear with huge population or they were suppressed by the seed treatment and spraying of neem based insecticide. For managing the pod borer complex comprising of *Helicoverpa armigera* and *Maruca vitrata*, need based spraying of insecticide, *viz*., Chlorantarniliprole 18.5 SC @ 20 g active ingredient ha^{-1} was done to combat the pod borers. In case of farmer's practice the crop was sprayed with a pre-mixture insecticide containing Chlorpyriphos + Cypermethrin @ 1.5 ml L^{-1} of water. The spray was given 4 times at 10 days interval commencing from 30 days after planting. After treating the crop population data of key pests were noted. The population of aphid was computed by counting total number of aphids from 10 cm apical twigs from randomly selected 10 sample plants and mean population data was computed. Larval population of *Maruca vitrata* was also recorded by counting total number of larva from floral web $plant^{-1}$ and mean population was also carried out. Population of natural enemies including coccinellid beetles and spiders was also recorded both from IPM plots and non-IPM plots. Yield of the seeds was recorded from both the plots of IPM and Farmer's practice. Afterwards, cost benefit ratio was calculated for all the treatments based on the current price of green gram seeds in market.

Results and Discussion

Effect of IPM and Farmer's Practice on Pest and Natural Enemy Population

The results prove the superiority of IPM module for managing the insect pests over the farmer's practice in all the three years. From table 1, it is observed that mean population of aphid recorded in the IPM plot were 5.4, 1.4 and 0.8 aphid per 10 cm apical twig in the year of 2020, 2021 and 2022, respectively. Whereas, non-IPM plots recorded the huge aphid population in all the three years and the highest aphid population was observed during 2020 compared to the next two seasons. Similarly high spotted pod borer population of 6.6 larva plant^{-1} was recorded in the year of 2020 in farmer's practice plot. Lowest pod borer population (0.2 larvae plant^{-1}) was recorded in the year of 2021 from IPM plot. Overall mean pest population data suggests that in both the year aphid population was significantly less (2.53 aphid per 10 cm apical twig) in IPM plots compared to the treatments having farmer's practice where heavy aphid population (29.37 aphid per 10 cm apical twig) was recorded. Similarly in overall mean of the three years suggested that pod borer population was significantly less (0.77 larvae plant^{-1}) in IPM plots compared to the non-IPM plots (4.8 larvae plant^{-1}). Population of coccinellid beetles and spiders were significantly increased in IPM adopted fields compared to the farmer's practice because more insecticidal application reduced the natural enemy population in farmer's practice plot (Table 1; Figure 1-3).

Table 1: Population of major pest and natural enemies in IPM plot and Farmer's practice plot

Treatment	Mean aphid population (10 cm apical twig^{-1})				Spotted pod borer population (plant^{-1})				Natural enemy population including spiders and coccinelled beetles (plant^{-1})			
	2020	2021	2022	Mean	2020	2021	2022	Mean	2020	2021	2022	Mean
IPM module	5.4	1.4	0.8	2.53	1.5	0.2	0.6	0.77	6.7	4.8	4.2	5.23
Farmer's practice	55.7	22.8	9.6	29.37	6.6	3.2	4.6	4.8	2.1	1.2	0.8	1.36

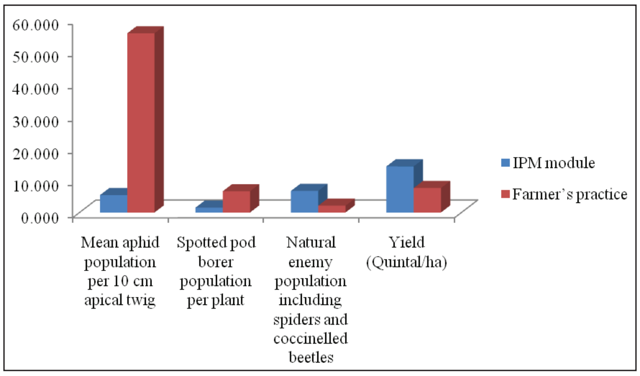

Figure 1: Mean pest and natural enemy population along with seed yield in different treatments during *kharif* 2020

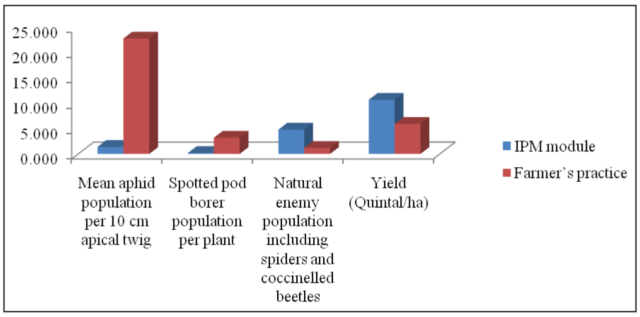

Figure 2: Mean pest and natural enemy population along with seed yield in different treatments during *kharif* 2021

Comparative Study of Module Based Strategy and Farmer's Practices in terms of Seed Yield and Economic Outcomes

Experimental results exhibit that IPM module was superior in terms of both suppression of pest population as well as yield increment. During the *kharif* 2020, the grain yield of mung bean was 1433.33 kg ha^{-1} while from farmer's practice 761.11 kg ha^{-1} seed yield was obtained (Table 2). A record yield increment of 672.22 kg ha^{-1} was observed in the year of 2020. The ultimate return came from green gram seeds selling was, Rs. 79,233.00. In case of farmer's practice the assumed gross monetary return was less (Rs. 41,861.00). A fixed cost of approximate Rs. 12,400.00 was considered

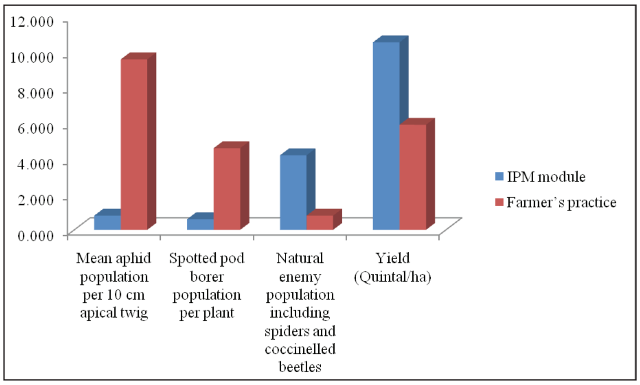

Figure 3: Mean pest and natural enemy population along with seed yield in different treatments during kharif 2022

for both the experimental treatment and that money was spent for buying seeds, fertilizers, herbicides, irrigation cost, labor charges for sowing, fertilizer application, weeding, intercultural operations, *etc*. The net return gained from the IPM module was Rs. 57,878.00 with an incremental benefit cost ratio of 3.71:1, while in farmer's practice the net return as well as benefit cost ratio (B:C ratio) was Rs. 23,257.00 and 2.25:1, respectively, which was significantly less than the IPM module (Table 2; Figure 1-3). In case of *kharif* 2021, the green gram grain yield reached 1,007 kg ha^{1} with the implementation of IPM module, whereas traditional farmer's practices yielded 593 kg ha^{-1} of seeds. This resulted in a remarkable yield increment of 414 kg ha^{-1}. The anticipated gross return from selling green gram seeds amounted to Rs. 55,865.00. In contrast, the farmer's practices expected gross returns of Rs. 32,615.00. The net return from the IPM module was Rs. 34,510.00, with an impressive incremental benefit-cost ratio of 2.61:1. In contrast, the net return and benefit-cost ratio from farmer's practices were Rs. 14,011.00 and 1.75:1, respectively, which were significantly lower compared to the IPM module (Table 2). The same pattern of results was also observed in the third year of the experiment during the *kharif* season of 2022. With the adoption of integrated module, mungbean seed yield reached 1,056 kg

Table 2: Economic comparison between IPM module and Farmer's practice during the experimental years

Treatment	*Kharif*, 2020					*Kharif*, 2021				
	Grain Yield (kg ha^{-1})	Yield increase (kg ha^{-1})	Gross Return (Rs.)	Net Return (Rs.)	Benefit cost ratio	Grain Yield (kg ha^{-1})	Yield increase (kg ha^{-1})	Gross Return (Rs.)	Net Return (Rs.)	Benefit cost ratio
IPM Module	1433.33	672.22	79,233	57,878	3.71:1	1007.0	414.0	55,865	34,510	2.61:1
Farmer's practice	761.11	-	41,861	23,257	2.25:1	593.0	-	32,615	14,011	1.75:1

Table 2: Continue...

Treatment	*Kharif*, 2022				
	Grain Yield (kg ha^{-1})	Yield increase (kg ha^{-1})	Gross Return (Rs.)	Net Return (Rs.)	Benefit cost ratio
IPM Module	1056.0	464.0	58,600	37,245	2.74:1
Farmer's practice	592.0	-	32,560	13,956	1.75:1

[Considered cost: Fixed cost for raising the crop in both the modules = Rs. 12,400.00 ha^{-1}; Tebuconazole 50% + Trifloxystrobin 25WG = Rs. 360.00 per 50 g; Thiamethoxam 35 FS = Rs. 600.00 kg^{-1}; Rhizobium = Rs. 60.00 kg^{-1}; Maize seed = Rs. 600.00 kg^{-1}; Yellow sticky trap = Rs. 8.00 $piece^{-1}$; Pheromone trap = Rs. 60.00 $piece^{-1}$; Azadirachtin 10000 ppm = Rs. 2,380.00 $litre^{-1}$; Chlorantraniliprole 18.5 SC = Rs. 160.00 per 10 ml; Chlorpyriphos + Cypermethrin = Rs. 1,100.00 $litre^{-1}$; Pesticide application cost = Rs. 363.00 $labour^{-1}$; Green gram selling price = Rs. 55.00 kg^{-1}; Maize seed selling price = Rs. 40.00 kg^{-1}]

ha^{-1}, while traditional farmer practices yielded 592 kg ha^{-1} of seeds. This led to a substantial increase in yield by 464 kg ha^{-1}. The expected gross income from selling green gram seeds was Rs. 58,600.00. Conversely, the farmer's practices anticipated gross returns of Rs. 32,560.00. The net return from the IPM module amounted to Rs. 37,245.00, with a notable incremental benefit-cost ratio of 2.74:1. On the other hand, the net return and benefit-cost ratio from farmer's practices were Rs. 13,956.00 and 1.75:1, respectively (Table 2). Results from the three year round experiment prove that IPM module is superior over the common farmer's practices as the adoption of the IPM module not only reduced the pest population but also conserved the natural enemies in the crop environment and they gradually increased their number and employed themselves in controlling the insect pests naturally particularly the aphids. Increasing natural enemy population suggested that a sustainable and ecologically sound crop ecosystem was maintained in the IPM module which in contrast reduced the requirements of chemical pesticide application. Whereas in case of farmer's practice natural enemy population reduced gradually (Table 1) due to heavy pressure of chemical insecticide which is not desirable for sustainable crop production. Besides this, IPM module yielded significantly higher monetary return compared to the farmer's practice.

The findings of this experiment are in accordance with the outcomes of Malik *et al*. (2021) and Banerjee and Ray (2022) who reported the excellence of IPM module compared with Farmer's practice earlier. Findings of the present experiment have very close association with the findings of Gajendran *et al.* (2006) who demonstrated a neem based pesticide (NSKE %) significantly reduces the population of pod borer and pod bug when integrated in the IPM module. They also noted significantly higher benefit cost ratio from IPM module adopted for pest management in green gram compared to farmer's practice. Similar findings were also obtained by Singh and Singh (2015), Kapoor and Shankar (2021), and Kavitha and Vijayaraghavan (2022). Our findings are again partially in line with the discoveries of Patil *et al.* (2015) who obtained more seed yield from IPM module after treating the seed with Rhizobium as obtained in the present experiment. Installation of yellow sticky trap in IPM module is a successful monitoring tool for whitefly and other sucking pests (Lu *et al.*, 2012; Maurya and Tiwari, 2018), which partially supports the present outcomes. Results of our study are partially accordance with the results of Sharma *et al.* (2011) who found that thiamethoxam 70 WS 0.2% is an effective seed treatment chemical for lowering the pest incidence in green gram grown under IPM system. Similar findings were also obtained by Sujatha and Bharpoda (2016) who reported the efficacy of thiamethoxam 25 WG (0.01%) in managing the sucking pests as evidenced in this study. Results of Malik *et al*. (2021) are closely associated with the present outcomes as they reported higher efficacy of biorational insecticide Chlorantarniliprole in managing spotted pod borer infesting green gram from IPM module compared to the farmer's practice where it was not used.

Conclusion

From the three years of experiment it can be concluded that integration of several control tactics for pest management in green gram is not only economically beneficial compared to sole use of chemical insecticides but also beneficial for crop environment where pest and defender coexist in a harmonic way and pesticidal hazards remain far away from the environment. In this way sustainability may be maintained and biodiversity may remain restored.

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References

Anonymous, 2021. Greengram Outlook Report. January to May 2021. Agricultural Market Intelligence Centre, ANGRAU, Lam. Available at: https://angrau.ac.in/downloads/AMIC/GREENGRAM%20OUTLOOK%20REPORT%20-January%20to%20May%202021.pdf. Accessed on: September 22, 2022.

Banerjee, A., Ray, S., 2022. Efficacy of module based integrated approach to combat major insect pests infesting summer green gram. *Journal of Crop and Weed* 18(3), 112-119. DOI: https://doi.org/10.22271/09746315.2022.v18.i3.1624.

Chhabra, K.S., Kooner, B.S., 1985. Problem of flower shedding caused by thrips, *Megalurothrips distalis* (Karny) on summer mungbean, *Vigna radiata* (L.) Wilczek and its control. *International Journal of Pest Management* 31(3), 186-188. DOI: https://doi.org/10.1080/09670878509370978.

Gajendran, G., Chandrasekaran, M., Jebaraj, S., 2006. Evaluation of integrated pest management module against major pests of blackgram in rainfed ecosystem. *Legume Research* 29(1), 53-56.

Kapoor, B., Shankar, U., 2021. IPM modules for pod borer complex on black gram. *Indian Journal of Entomology* 83(2), 242-245. DOI: https://doi.org/10.5958/0974-8172.2021.00060.2.

Kavitha, Z., Vijayaraghavan, C., 2022. Evaluation of botanical soaps for the management of pigeonpea insect pests. *Research Biotica* 4(3), 139-145. DOI: https://doi.org/10.54083/ResBio/4.3.2022/139-145.

Kennedy, G.G., Sutton, T.B., 2000. Emerging technologies for integrated pest management: Concepts, research and implementation. APS Press - The American Phytopathological Society St. Paul, Minnesota. p. 526.

Kumar, A., Sinha, A.K., Yazdani, S.S., Singh, R., Kumar, A., Singh, R., 1998. Incidence of insect pests in urdbean [*Vigna mungo* (Linn.) (Hepper)]. *Shashpa* 5(1), 113-114.

Kumar, S., Pandey, G., 2020. Biofortification of pulses and legumes to enhance nutrition. *Heliyon* 6(3), 1-6. DOI: https://doi.org/10.1016/j.heliyon.2020.e03682.

Lal, S.S., 1985. A review of insect pests of mungbean and their control in India. *Tropical pest Management* 31(2), 105-114. DOI: https://doi.org/10.1080/09670878509370960.

Lu, Y., Bei, Y., Zahang, J., 2012. Are yellow sticky traps an effective method for control of sweet potato whitefly, *Bemisia tabaci*, in the greenhouse or field? *Journal of Insect Science* 12(1), 113. DOI: https://doi.org/10.1673/031.012.11301.

Malik, S., Banerjee, A., Samanta, A., 2021. Evaluation of IPM module against major insect pests of green gram, *Vigna radiata* (L.) Wilczek in lower Gangetic plains of West Bengal. *Environment Conservation Journal* 22(3), 111-115. DOI: https://doi.org/10.36953/ECJ.2021.22313.

Maurya, R.P., Tiwari, S., 2018. Evaluation of various management modules against insect pest complex of black gram and green gram. *Journal of Hill Agriculture* 9(2), 183-188.

Patil, L.M., Modi, D.J., Vasava, H.M., Gomkale, S.R., 2015. Evaluation of front line demonstration programme on green gram variety Meha (IPM-99-125) in Bharuch district of Gujarat. *IOSR Journal of Agriculture and Veterinary Science* 8(9), 01-03.

Shafique, M., Nadeem, S., Hamed, M., Atta, B.M., Shah, T.M., 2009. Performance of some advance desi chickpea genotypes against pod borer, *Helicoverpa armigera* (Hubner) resistance. *Pakistan Journal of Zoology* 41(4), 277-280.

Sharanagat, V.S., Kumar, P., Patro, S., Ghule, P.D., Naryal, S., Meena, S., Singh, L., Kumar, Y., Gundev, P., Nagar, M., Bhadra, R., Mani, S., Nema, P.K., 2019. Influence of germination on physicochemical, thermo-pasting, and antioxidant properties of moong grain (*Vigna radiata*). *Journal of Food Processing and Preservation* 43(5), e13922. DOI: https://doi.org/10.1111/jfpp.13922.

Sharma, O.P., Bambawale, O.M., Gopali, J.B., Bhagat, S., Yelshetty, S., Singh, S.K., Anand, R., Singh, O.P., 2011. Field Guide Mungbean and Urdbean. National Centre for Integrated Pest Management, New Delhi. pp. 12-13.

Singh, P.S., Singh, S.K., 2015. Comparative evaluation of IPM module and farmer's practices in Mungbean, *Vigna Radiata* (L.) Wilczek against major insect pests. *International Journal of Agriculture, Environment and Biotechnology* 8(1), 215-218. DOI: https://doi.org/10.5958/2230-732X.2015.00027.3.

Soundararajan, R.P., Chitra, N., 2011. Effect of bio inoculants on sucking pests and pod borer complex in urdbean. *Journal of Biopesticides* 4(1), 7-11.

Sujatha, B., Bharpoda, T.M., 2016. Evaluation of insecticides against sucking pests in green gram grown during summer. *Trends in Biosciences* 9(13), 745-753.