Influence of plant density of marigold on larval population of gram pod borer H. armigera in chickpea (Cicer arietinum L.)

RS Wasu, VR Tathode and DY Girhepunje

DOI: https://doi.org/10.22271/chemistry.2020.v8.i6v.10977

Abstract
A field experiment on Influence of plant density of marigold on larval population of H. armigera in chickpea (Cicer arietinum L.) was conducted at Entomology Research Farm, PGI, MPKV, Rahuri during Rabi 2019-20 to evaluate the different planting combination of chickpea (Digvijay) with marigold in a Randomized block design (RBD) with 4 replication. All treatment combination record lowest larval population and pod damage as compare to sole chickpea crop. The lowest larval population was observed in T1: Chickpea +Marigold 3 (6:2) i.e. 2.06 larvae per meter row length. In Trap cropping with marigold maximum yield (22.54 q/ha) of chickpea was obtained from Chickpea + Marigold, 6:2 ratio. The average pod damage recorded ranged between 11.18 to 17.03%.

Keywords: Chickpea, H. armigera, sole chickpea crop, trap cropping, marigold

Introduction
Pulses are the important group which occupies a unique position among the food crops in the world of agriculture by virtue of their high protein content. Gram (Cicer arietinum Linnaeus) commonly called as ‘Chickpea’ or ‘Bengal gram’ is the most important pulse crop of India grown in Rabi season. It is a self-pollinated crop and belongs to the sub family Papilionaceae of the family Leguminaceae (Bentham and Hooker, 1975) with its probable origin in South West Asia i.e.in countries like Afghanistan and Persia. Pulses beside rich source of proteins, also enriched the soil by symbiotic nitrogen fixation. Due to their protein richness, pulses are the integral part of daily diet of the Indian people. In nutritional point of view, chickpea seeds contain protein (17.7%), lysine (0.49%) and methionine (0.11%) (Katiyar, 1982). In addition to this, it also carries 56.6% carbohydrates, ash, calcium, phosphorus, iron and vitamin B in considerable amount (Thakur, 1980) [13].

India is the largest producer of chickpea (Cicer arietinum) with 67 per cent of the global production and occupies nearly 31 percent of area in the country contributing over 37 per cent to the national pulse production (Reena et al., 2009) [10]. In 2017-18, chickpea was cultivated in about 106 lakh ha area in India. The country harvested a record production of > 111 lakh ton at the ever highest productivity level of 1056 kg/ha. As usual, Madhya Pradesh has contributed a significant 34% of the total gram area and 41% of total gram production in the country, thereby ranking first both in area and production. Maharashtra (18%) and Rajasthan (13%) were the next in terms of area. (Anonymous, 2018) [1]. Chickpea crop suffers a lot due to the attack of number of insect-pests. Among these Gram pod borer, Helicoverpa armigera (Hubner) (Lepidoptera: Noctuidae) is the most important pest of chick pea. Helicoverpa armigera (Hubner) causes up to 75 percent reduction in yield (Begum et al., 1992) [2]. On average about 30 to 40% pods are found to be damaged by the pod borer resulting in the yield loss of 400 kg/ha (Rahman, 1990) [9]. It is a polyphagous insect also known as American bollworm has become a pest of national importance in India, causing economic losses to several crops like chickpea, pigeon pea, cotton, tomatoes etc. (Sachan 1994) [11].

The most commonly method for the control of this pest is to have a film of a persistent effective insecticide over the foliage. The indiscriminate use of insecticide has eroded sustainability and resulted in build up of pesticide residues, resistance to pesticides, resurgence, secondary outbreak of this pest and is becoming great problem for entomologists.
(Fitt, 1989; Mehrotra, 1991) [5]. So the use of insecticides for the control of this pest is highly criticized for various reasons and therefore switching from insecticides to trap cropping. Trap crop provides protection by preventing the pest from reaching the main crop and the pests are diverted away from the main crop or concentrated in certain pockets of the field where they are easily arrested or controlled. Trap crops have an important attribute that it is distinctly more attractive to the pest than the main crop and have additional function for natural enemies (Pats et al., 1997) [8]. Therefore, The main emphasize of the study is use of marigold as a trap crop against chickpea borer on gram was evaluated in different cropping combinations.

Materials and method

The field experiment on “Influence of plant density of marigold on oviposition/larval population of H. armigera.” was conducted at Entomology Research Farm, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri during Rabi 2019-20 to evaluate the different planting combination of chickpea (Digvijay) with marigold in a Randomized block design (RBD) with 4 replication. Thirty days old seedling were transplanted at the time of sowing of chickpea in the field. For chickpea was sown at a spacing of 30 cm x 10 cm. Crop was raised according to all agronomic package of practices under irrigated condition except the plant protection measures. Data on number of eggs and larvae were recorded from each plot on number basis by examining the pods for pest and will continuing till then availability. Pod borer infestation per plant was recorded at weekly intervals from the randomly tagged 5 plants per meter row length in plot starting from flowering to pod maturity from all replications. All the pods were counted from each plot and examined. The data on damaged (bored), healthy and total pods was recorded from each plot on number basis by examining the pods for H. armigera infestation. The percent pod damage was calculated using the following formula:

\[
\text{Percentage Pod damage} = \frac{\text{Damaged pod}}{\text{Total pod}} \times 100
\]

Table 1: Treatment Details

| Tr. No. | Treatments                      |
|--------|--------------------------------|
| T1     | Chickpea + Marigold 4 (4:2)    |
| T2     | Chickpea + Marigold 3 (6:2)    |
| T3     | Chickpea + Marigold 2 (10:2)   |
| T4     | Chickpea + Marigold at border  |
| T5     | Chickpea sole crop             |

Result and discussion

Influence of plant density of marigold on H. armigera larval population

The effect of plant density of marigold on the incidence of H. armigera in various weeks were recorded. The different Chickpea + Marigold planting ratios were Chickpea + Marigold 4 (4:2), Chickpea + Marigold 3 (6:2), Chickpea + Marigold 2 (10:2) and Chickpea + Marigold at border. Significant effect was found on the H. armigera larval population at the various days after sowing. The effect of plant density of marigold on the incidence of H. armigera (Hub.) in chickpea at the various day after sowing is presented in Table 2.

35 Days after sowing (DAS)

The minimum population of H. armigera (1.77 larvae/mrl) was found in the treatment T1 (Chickpea + Marigold, 10:2 ratio). The treatments T2 (Chickpea + Marigold, 6:2 ratio, 1.91 larvae/mrl), T3 (Chickpea + Marigold, 4:2 ratio, 2.45 larvae/mrl) and T4 (Marigold at border, 2.61 larvae/mrl) were next better treatments which were at par with each other. The highest larval population (3.26 larvae/mrl) was found in the treatment T5 (Sole Chickpea crop).

42 DAS

The minimum population of H. armigera (2.06 larvae/mrl) was recorded in the treatment T2 (Chickpea + Marigold, 6:2 ratio), followed by the treatments T3 (Chickpea + Marigold, 10:2 ratio, 2.26 larvae/mrl) and T4 (Marigold at border, 2.58 larvae/mrl) which were at par with each other. The maximum larval population (4.03 larvae/mrl) was observed in treatment T5 (Sole Chickpea crop).

49 DAS

The minimum larval population of H. armigera (2.11 larvae/mrl) was recorded in the treatment T2 (Chickpea + Marigold, 6:2 ratio) followed by the treatments T3 (Chickpea + Marigold, 10:2 ratio, 2.38 larvae/mrl) and T4 (Marigold at border, 2.36 larvae/mrl) which were at par with each other. The maximum population was found (4.20 larvae/mrl) in the treatment T5 (Sole Chickpea crop).

56 DAS

The minimum population of H. armigera (2.22 larvae/mrl) was recorded in the treatment T2 (Chickpea + Marigold, 6:2 ratio) followed by the treatment T3 (Chickpea + Marigold, 10:2 ratio, 2.50 larvae/mrl) and T4 (Marigold at border, 2.61 larvae/mrl). The next better treatment was T5 (Marigold at border, 4.15 larvae/mrl). The maximum population (5.52 larvae/mrl) was found in the treatment T5 (Sole Chickpea crop).

63 DAS

The minimum pest population (2.46 larvae/mrl) was recorded in treatment T2 (Chickpea + Marigold, 6:2 ratio), followed by the treatments T3 (Chickpea + Marigold, 10:2 ratio, 2.70 larvae/mrl) and T4 (Chickpea + Marigold, 4:2 ratio, 4.13 larvae/mrl) respectively. The maximum larval population (5.73 larvae/mrl) was found in the treatment T5 (Sole chickpea crop).

70 DAS

It was observed that the population decreased from the previous weeks. The maximum population of H. armigera 5.42 larvae/mrl was found in treatment T5 (Sole Chickpea crop) and minimum population (2.28 larvae/mrl) was found in the treatment T2 (Chickpea + Marigold, 10:2 ratio).

77 DAS

The pest population was minimum (2.00 larvae/mrl) in the treatment T2 (Chickpea + Marigold, 6:2 ratio) followed by the treatment T3 (Chickpea + Marigold, 10:2 ratio, 2.23 larvae/mrl). The maximum larval population (4.86 larvae/mrl) was observed in the treatment T3 (Sole chickpea crop).

84 DAS

The minimum pest population (1.84 larvae/mrl) was found in treatment T2 (Chickpea + Marigold, 6:2 ratio) followed by the treatment T3 (Chickpea + Marigold, 10:2 ratio, 2.06 larvae/mrl).
larvae/mrl). The maximum pest population (4.64 larvae/mrl) was found in the treatment T3 (Sole chickpea crop).

91 DAS
The pest population was minimum in (1.64 larvae/mrl) in T2 (Chickpea + Marigold, 6:2 ratio) followed by the treatment T1 (Chickpea + Marigold, 7:2 ratio, 1.86 larvae/mrl). The maximum population of *H. armigera* (4.41 larvae/mrl) was found in the treatment T5 (Sole Chickpea crop).

The trap crop (Marigold) grown with chickpea had significant effect on the larval population of *H. armigera* as presented in Table 2. The statistical analysis of the data revealed that the overall mean minimum population of *H. armigera* (2.06 larvae/mrl) was observed in the treatment T2 (Chickpea + Marigold, 6:2 ratio), followed by T3 (Chickpea + Marigold, 10:2 ratio, 2.26 larvae/mrl) which were at par with each other. The treatments T1 (Chickpea + Marigold, 4:2 ratio, 3.60 larvae/mrl) and T4 (Marigold at border, 3.61 larvae/mrl) were also at par with each other. The maximum larval population (4.67 larvae/mrl) was observed in T1 (Sole Chickpea crop).

In the present investigation the minimum population of *H. armigera* (2.72 larvae/mrl) was observed in the treatment T2 (Chickpea + Marigold, 6:2 ratio). The maximum population (4.67 larvae/mrl) was observed in T3 (sole chickpea crop) at different observation. Sandhu and Arora (2014) conducted dual choice test to study the ovipositional and larval preference of *H. armigera* on the test plants of marigold and coriander while the tomato plants acted as control. The maximum number of eggs were laid on the two varieties of marigold plants (83.6, 80.8) which were significantly higher than the number of eggs laid on coriander plants (67.6, 60.0) and less in tomato plants (25.6, 21.6). The order of preference for oviposition by females of *H. armigera* was: marigold > coriander > tomato which support our findings.

### Table 2: Effect of Trap Crop (Marigold) on the larval population of *H. armigera* Hub. In chickpea.

| Treatment Chickpea + Marigold | Number of Larvae/Meter row length (Days after sowing) | 35 | 42 | 49 | 56 | 63 | 70 | 77 | 84 | 91 | Mean |
|------------------------------|------------------------------------------------------|----|----|----|----|----|----|----|----|----|------|
| T1 Chickpea + Marigold 4(4:2)| 2.45 (1.86)                                          | 3.40 (2.10) | 3.59 (2.14) | 4.34 (2.31) | 4.13 (2.26) | 3.85 (2.23) | 3.56 (2.14) | 3.57 (2.14) | 3.53 (2.14) | 3.60 (2.15) |
| T2 Chickpea + Marigold 3 (6:2)| 1.91 (1.71)                                          | 2.06 (1.75) | 2.11 (1.76) | 2.22 (1.79) | 2.46 (1.86) | 2.28 (1.81) | 2.00 (1.73) | 1.84 (1.69) | 1.64 (1.63) | 1.95 (1.75) |
| T3 Chickpea + Marigold 2(10:2)| 1.77 (1.66)                                          | 2.26 (1.81) | 2.38 (1.84) | 2.50 (1.87) | 2.70 (1.92) | 2.58 (1.89) | 2.23 (1.80) | 2.06 (1.75) | 1.86 (1.69) | 2.26 (1.80) |
| T4 Marigold at border         | 2.61 (1.90)                                          | 2.58 (1.89) | 3.26 (2.06) | 4.15 (2.27) | 4.75 (2.40) | 4.30 (2.30) | 3.79 (2.19) | 3.56 (2.14) | 3.47 (2.11) | 3.61 (2.15) |
| T5 Sole Chickpea Crop         | 3.26 (2.06)                                          | 4.03 (2.24) | 4.20 (2.28) | 5.52 (2.55) | 5.73 (2.59) | 5.42 (2.53) | 4.86 (2.42) | 4.64 (2.37) | 4.41 (2.33) | 4.67 (2.38) |
| Skim +                       | 0.08 (0.09)                                          | 0.09 (0.12) | 0.12 (0.14) | 0.14 (0.10) | 0.10 (0.04) | 0.13 (0.04) | 0.13 (0.04) | 0.13 (0.04) | 0.13 (0.04) | 0.13 (0.04) |
| C.D. at 5%                    | 0.26 (0.28)                                          | 0.26 (0.36) | 0.36 (0.42) | 0.42 (0.31) | 0.31 (0.31) | 0.39 (0.31) | 0.39 (0.31) | 0.39 (0.31) | 0.39 (0.31) | 0.39 (0.31) |

Parenthesis transformed values based on $\sqrt{x + 1}$

### Effect on pod damage and grain yield

Trap cropping of marigold with chickpea crop also affect the larval population of *H. armigera* which affect the pod damage and yield. The effect of plant density of marigold on the per cent pod damage and the grain yield of chickpea under various treatments is presented in Table 3. Significant effect was found in different treatments.

The minimum pod damage (11.18%) was observed in the treatment T2 (Chickpea + Marigold, 6:2 ratio) with 22.54 q/ha chickpea yield. The treatment T1 (Chickpea + Marigold, 10:2 ratio) and treatment T4 (Marigold at border) were next better treatment with 11.35% and 11.84% pod damage and 22.12 q/ha and 19.85 q/ha chickpea yield respectively, which were at par with each other. In treatment T1 (Chickpea + Marigold, 4:2) there was 13.70% pod damage and 18.79 q/ha chickpea yield. The maximum pod damage (17.03%) was observed in the sole chickpea crop giving 16.85 q/ha yield.

In the present investigation, the minimum pod damage (11.18%) was observed in the treatment T2 (Chickpea + Marigold, 6:2 ratio) with 22.54 q/ha chickpea yield whereas the maximum pod damage (17.03%) was observed in the sole chickpea crop giving 16.85 q/ha yield.

Jakhar and Suman (2015) reported that, among six modules tested against *H. armigera* on tomato IPM-IV module (growing of african marigold after every 8 rows of tomato as well as on the periphery of the plot and two spray of *HaNPV* @ 350 LE/ha on appearance of first instar larvae followed by spray of Decidan 32.8% EC @ 15ml/10 litre) was found highly effective and economical for management of tomato fruit borer, *H. armigera* and it exhibited least tomato fruit borer damage (3.44%) and maximum tomato yield (257.25q/ha) which supported our results. Chhangani et al., (2018) revealed that, the marketable yield of gram among different farms caped treatment ranged from 1.26 to 1.89 kg/plot. The maximum marketable yield of 1.89 kg/plot was recorded in gram bordered with marigold with bio pesticide application. The highest cost benefit ratio of 1:1.92, was recorded for gram bordered with marigold with biopesticide treatment; while, lowest cost benefit ratio of 1:1.33 was recorded for gram without farms caped treatment, which coincide with our results.

### Table 3: Damaged pods (%) by *H. armigera* and grain yield (q/ha) in chickpea.

| Treatment Chickpea+Marigold | Pod damage (%) | Grain yield (q/ha) |
|-----------------------------|----------------|-------------------|
| T1 Chickpea+Marigold 4(4:2)| 13.70 (21.72)  | 18.79             |
| T2 Chickpea+Marigold 3 (6:2)| 11.18 (19.53)  | 22.54             |
| T3 Chickpea+Marigold 2(10:2)| 11.35 (19.69)  | 21.12             |
| T4 Marigold at border        | 11.84 (20.13)  | 19.85             |
| T5 Sole chickpea             | 17.03 (24.37)  | 16.85             |
| SEM ±                        | 0.51           | 0.25              |
| C.D. at 5%                   | 1.56           | 1.61              |

~ 1525 ~
Fig 1: Damaged pods (%) by H. armigera and grain yield (q/ha) of chickpea in trap cropping of Marigold.

Conclusion
In Trap cropping with marigold lowest larval population (2.06 larvae per meter row length), lowest pod damage (11.18%) and maximum yield (22.54 q/ha) of chickpea was obtained from Chickpea + Marigold, 6:2 ratio. The average pod damage recorded ranged between 11.18 to 17.03%.

References
1. Anonymous. Annual Report on Pulse production. Ministry of Agriculture & Farmer Welfare, Department of Agriculture Cooperation & Farmers Welfare, Government of India, 2018, 26-30.
2. Begum N, Hussain M, Chowdhury SI. Effect of sowing date and plant Density of pod borer incidence and grain yield of chickpea in Bangladesh Int. Chickpea Newslet.
3. Bentham Hooker. Taxonomic system for seed plants, Genera plantarum; ad exemplaria imprimis in herbarii kewensibus servata definita in three volumes between 1862 and 1883, 1970.
4. Chhangani G, Tali MK, Singh B. Management of gram pod borer Helicoverpa armigera (Hubner) by bio-pesticides in farm scaping system. Journal of Entomology and Zoology Studies 2018;6(4):1052-1054.
5. Fitt GP. The ecology of Heliothis species in relation relation to agro-ecosystem. Annual Rev. Entomol 1989;34:17-52.
6. Jakhar Suman BL. Evaluation of different modules for the management of tomato fruit borer, Helicoverpa armigera pest of tomato. Journal of Applied and Natural Science 2015;7(1):155-158.
7. Katiyar RP. Accelerating pulse production in Himachal hills. Seeds and Farms 1982;8:37-42.
8. Pats P, Ekbom B, Shovgard M. Influence of intercropping on abundance, distribution and parasitism of chilo spp. (Lepidoptera: Pyralidae) Bull Entomol. Res 1997;87:507-513.
9. Rahman MM. Infestation and yield loss in chickpea due to pod borer in Bangladesh. Bangladesh Journal Agriculture Research 1990;15(2):16-23.
10. Reena Singh SK, Sinha BK, Janwal BS. Management of gram pod borer, Helicoverpa armigera (Hubner) by intercropping and monitoring through pheromone traps in chickpea. Karnataka J Agric Sci 2010;22(3):524-526.
11. Sachan JN, Katti G. Integrated Pest Management. Proceeding of International Symposium on Pulses Research, April 2-6, IARI New Delhi, India, 1994, 23-30.
12. Sandhu SS, Arora R. Evaluation of oviposition efficiency on trap crops of marigold and coriander for management of tomato fruit borer, Helicoverpa armigera (Hubner) (Noctuidae: Lepidoptera) on potted plants. Agricultural Research Communication Centre. Indian J Agric. Res 2014;48(5):367-372.
13. Thakur. Scientific crop production. Metropoloton Book Co. Pvt. Ltd. 1 Netagi Subhash Marg, New Delhi 1980;10:289-293.