



INFLUENCE OF FARMSCAPING ON THE OCCURRENCE OF DOMINANT NATURAL ENEMIES OF INSECT PESTS OF COWPEA

B. M. MEENA,* ASHOK KUMAR, H. R. MEENA and R. SWAMINATHAN

Department of Entomology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur-313001, Rajasthan, INDIA

* Corresponding author E-mail: meena.kabir8@gmail.com

ABSTRACT

An experiment on “Influence of farmscaping on the diversity of major insect pests of cowpea [*Vigna unguiculata* (L.) Walp.] and the associated natural enemies” was carried out at the instructional farm, Rajasthan College of Agriculture, MPUAT, Udaipur, during the *kharif* seasons of 2012 and 2013. Under both unprotected and protected conditions in *kharif* 2012 and 2013, the Relative Plant Effect values were maximum for coccinellids in cowpea + niger farmscape treatment; whereas, the Relative Plant Effect (RPE) values were maximum for syrphid fly, wasps, spiders and carabids in cowpea + marigold farmscape treatment.

Key words: Farmscaping, cowpea, marigold, niger, natural enemies

INTRODUCTION

Cowpea, *Vigna unguiculata* (Linnaeus) Walpers, is one of the important pulse crops, also known as black eyed bean or Southern pea in English, while *chola* or *choli*, *chavli*, *lobia* in various vernacular languages in India. Insect pests happen to be key biotic limiting factors in cowpea productivity. The major insect pests reported on cowpea at different growth stages include cowpea aphid (*Aphis craccivora* Koch), foliage beetles (*Ootheca* sp, *Medythia* spp), the flower bud thrips (*Megalurothrips sjostedti* Trybom) the legume pod borer (*Maruca vitrata* Fabricius) and the sucking bug complex, of which *Clavigralla* spp, *Anoplocnemis* spp, *Riptortus* spp, *Mirperus* spp, *Nezara viridula* Fab and *Aspavia armigera* Linnaeus are important and prevalent; without their control, reasonable grain yield cannot be obtained (Jackai and Daoust, 1986; Suh *et al.*, 1986). Farmscaping is the holistic approach to pest control on farms that focus on increasing biodiversity in order to maintain healthy populations of beneficial insects, birds and other wildlife as part of an ecological pest management program (Sreedhar, 2012). Ideal farmscape plantings provide food and shelter for beneficial organisms, suppress weeds, and grow in close proximity to the cash crop without competing for light, water and nutrients. Farmscaping reduce the need of pesticides, lowering the cost and risks associated with indiscriminate application of pesticides. With these facts in view, the present study on influence of farmscaping on the occurrence of

dominant natural enemies of insect pests of cowpea was carried out.

MATERIALS AND METHODS

The experiment was conducted at the Instructional Farm of Rajasthan College of Agriculture, Udaipur. The trial was laid out in uniformly sized plots measuring 5m x 3m (15 sq. m) in Randomized Block Design containing six treatments [Cowpea Sole, Cowpea + Niger (2 :1), Cowpea + Marigold (2:1), Cowpea + Maize (No border 2:1), Cowpea + Maize + Marigold Border (2:1) and Cowpea + Maize + Niger Border (2:1)] with four replications of each; thus in all, there were 24 plots. The row to row distance and plant to plant spacing for cowpea were 30 cm and 10 cm, respectively. Sowing of the recommended varieties of cowpea (RC-19) and niger (RCR 317) were done in the second week of July, 2012-13 and 2013-14 as sole crop and farmscaping crop combination. The seeds of early flowering marigold variety Pusa Narangi were sown in well prepared raised nursery beds. The usual floriculture operations were followed while raising the seedlings. The nursery was raised in the last week of June; mature seedlings of marigold were transplanted in between two rows of cowpea at a distance of 30 cm. The experiments were conducted in two sets, one comprising treatment with plant oils against insect pests, termed protected condition (*A. indica* and *P. pinnata* (3.0 %) and the other without the use of any bio-pesticide, termed natural condition. The associated natural enemies like syrphid flies,

coccinellids, wasps, spiders, mantids, predatory bugs and predatory crickets were recorded by the visual count technique from the same 10 plants per replication randomly tagged, during early hours of the day. For the estimation of population of soil dwelling predators, especially carabids, pitfall traps were laid out in each replication and at least 3 traps were randomly placed in each plot of 15 sq.m. Suitable method was used to analyze the Relative Plant Effect (RPE) index of dominant natural enemies of insect pests as described by Markham and Chanway (1996).

RESULTS AND DISCUSSION

(A) Influence of farmscaping on dominant natural enemies on untreated cowpea under different farmscape treatments:

The Relative Plant Effect (RPE) Index worked out to analyze the effect of farmscaping on the occurrence of dominant natural enemies of insect pests under different farmscape treatments resulted in negative values due to enhanced natural enemy population in farmscaped cowpea than sole cowpea. During *khariif* 2012, the results indicate that under untreated conditions the RPE value for coccinellids was higher (-0.62) in cowpea + niger farmscape treatment and the population of coccinellids was 2.65 times more than that in sole cowpea; whereas, the RPE values for syrphid fly, wasps, spiders and carabids were higher in cowpea + marigold farmscape treatment, being -0.60, -0.59, -0.92 and -0.67 respectively; thereby, the respective population of syrphid fly, wasps, spiders and carabids were 2.50, 2.45, 12.57 and 3.01 times more than that in the sole crop of cowpea (Table 1). Similarly, during the crop season *khariif* 2013 under untreated conditions the RPE values for coccinellids was maximum (-0.39) in cowpea + niger farmscape treatment and the population of coccinellids was 1.64 times more than that in sole cowpea, while the respective RPE values for syrphid fly, wasps, spiders and carabids were maximum -0.49, -0.57, -0.96 and -0.75 in cowpea + marigold farmscape treatment and the population of syrphid fly, wasps, spiders and carabids were 1.97, 2.34, 24.24 and 4.03 times more under cowpea + marigold farmscape treatment than sole crop of cowpea (Table 1).

(B) Influence of farmscaping on dominant natural enemies on treated cowpea under different farmscape treatments:

During *khariif* 2012 under treated conditions, the RPE value for coccinellids was higher (-0.59) in cowpea + niger farmscape treatment and the population of coccinellids was 2.46 times more than that in sole cowpea; whereas, the RPE values for syrphid fly, wasps, spiders and carabids were higher in cowpea + marigold

farmscape treatment, being -0.58, -0.60, -0.94 and -0.65, respectively; thereby, the respective population of syrphid fly, wasps, spiders and carabids were 2.35, 2.52, 17.00 and 2.89 times more than that in the sole crop of cowpea (Table 2). Likewise, during the crop season *khariif* 2013 under treated conditions, the RPE value for coccinellids was maximum (-0.39) in cowpea + niger farmscape treatment and the population of coccinellids was 1.63 times more than that in sole cowpea, while the respective RPE values for syrphid fly, wasps, spiders and carabids were higher -0.51, -0.57, -0.96 and -0.69 in cowpea + marigold farmscape treatment and the population of syrphid fly, wasps, spiders and carabids were 2.06, 2.30, 24.03 and 3.17 times more under cowpea + marigold farmscape treatment than sole crop of cowpea (Table 2).

Earlier, a number of workers have reported that enhanced plant diversity and intercropping of flowering plants within the main crop increased the abundance of natural enemies. Distinctly more aphidophagous syrphids were observed in the weed strips than in the adjacent fields. The weed strips contained a high density of flowering plants and, therefore, proved to be very attractive feeding places for all syrphids (Frank, 1999). Predator/prey population balances are influenced by the *timing* of availability of nectar, pollen and alternate prey/hosts for the beneficial arthropods; therefore, efforts must be made to have year-round beneficial organism habitat and food sources. The beneficial habitat season may be extended by adding plants that bloom sequentially throughout the growing season or the whole year (Dufour, 2000). Lower pest pressure on cowpea crop, higher abundance of predators and higher cowpea yields were observed to be associated with cowpea/greengram cropping systems; therefore, cowpea/greengram should be promoted among other biological control conservation strategies, aiming at enhancing natural enemies in cowpea systems, through habitat manipulation (Munyulia *et al.*, 2006). The abundance of predators (Coccinellidae, Staphylinidae, Syrphidae, Anthocoridae, Mantidae, Dermaptera, ground beetles, predatory mites, lygaeid bugs, dragonflies and spiders) were considerably affected by insecticides and the cropping system. Higher numbers of arthropod pests were observed in onion plants 30 m from the marigold strip, while higher numbers of predators and parasitoids were found at 5 m distance. Species richness and Shannon's diversity index were higher at 5 m from marigold; therefore, marigold rows next to onion fields resulted in higher number of entomophagous species, potentially enhancing the natural control of onion pests. Marigold strips may be an alternative to crop sprays for organic control of onion pests (Silveira, 2009). The presence of predatory and parasitic insects and spiders that migrate into the crop from field margins reduce pest populations (Labanowska-Bury *et al.*, 2009).

Table 1. Effect of farmscaping on the occurrence of natural enemies under different farmscape treatments during *kharif*, 2012

Treatments	Relative Plant Effect (RPE) Indices <i>vis-à-vis</i> Sole Cowpea [$X_a - X_p \div X_a$ or X_p , whichever is larger]									
	Un-treated					Treated				
	Coccinellids	Syrphid fly	Wasps	Spiders	Carabids	Coccinellids	Syrphid fly	Wasps	Spiders	Carabids
FS -1	-0.62 (2.65)	-0.40 (1.67)	-0.47 (1.87)	-0.89 (9.43)	-0.51 (2.05)	-0.59 (2.46)	-0.36 (1.57)	-0.47 (1.90)	-0.92 (12.35)	-0.54 (2.19)
FS -2	-0.37 (1.57)	-0.22 (1.28)	-0.32 (1.46)	-0.81 (5.28)	-0.26 (1.34)	-0.33 (1.50)	-0.15 (1.17)	-0.27 (1.36)	-0.85 (6.55)	-0.24 (1.31)
FS -3	-0.55 (2.21)	-0.60 (2.50)	-0.59 (2.45)	-0.92 (12.57)	-0.67 (3.01)	-0.52 (2.10)	-0.58 (2.35)	-0.60 (2.52)	-0.94 (17.00)	-0.65 (2.89)
FS -4	-0.49 (1.96)	-0.52 (2.07)	-0.52 (2.08)	-0.91 (10.75)	-0.58 (2.40)	-0.46 (1.84)	-0.50 (2.00)	-0.55 (2.22)	-0.93 (14.35)	-0.60 (2.48)
FS -5	-0.58 (2.40)	-0.32 (1.46)	-0.39 (1.63)	-0.88 (8.17)	-0.39 (1.64)	-0.56 (2.25)	-0.28 (1.40)	-0.40 (1.65)	-0.91 (10.07)	-0.44 (1.78)

Legend: FS-1= Cowpea + Niger; FS-2= Cowpea + Maize; FS-3= Cowpea + Marigold; FS-4= Cowpea + Maize + Bordered with Marigold; FS-5= Cowpea + Maize + Bordered with Niger; Negative values were obtained due to enhanced natural enemies population in farmscaped cowpea than sole cowpea; Figures in parentheses indicate the number of times increased natural enemy population in farmscaping treatments over sole cowpea

Table 2. Effect of farmscaping on the occurrence of natural enemies under different farmscape treatments during *khariif*, 2013

Treatments	Relative Plant Effect (RPE) Indices <i>vis-à-vis</i> Sole Cowpea [$X_a - X_p \div X_a$ or X_p , whichever is larger]									
	Un-treated					Treated				
	Coccinellids	Syrphid fly	Wasps	Spiders	Carabids	Coccinellids	Syrphid fly	Wasps	Spiders	Carabids
FS -1	-0.39 (1.64)	-0.37 (1.58)	-0.34 (1.52)	-0.94 (18.12)	-0.59 (2.42)	-0.39 (1.63)	-0.37 (1.57)	-0.40 (1.68)	-0.94 (17.93)	-0.53 (2.12)
FS -2	-0.13 (1.14)	-0.13 (1.14)	-0.29 (1.40)	-0.93 (14.84)	-0.37 (1.59)	-0.11 (1.12)	-0.18 (1.21)	-0.29 (1.40)	-0.93 (14.60)	-0.21 (1.26)
FS -3	-0.30 (1.43)	-0.49 (1.97)	-0.57 (2.34)	-0.96 (24.24)	-0.75 (4.03)	-0.29 (1.40)	-0.51 (2.06)	-0.57 (2.30)	-0.96 (24.03)	-0.69 (3.17)
FS -4	-0.22 (1.28)	-0.43 (1.76)	-0.49 (1.96)	-0.95 (21.15)	-0.70 (3.31)	-0.21 (1.27)	-0.44 (1.78)	-0.50 (2.00)	-0.95 (21.00)	-0.61 (2.56)
FS -5	-0.34 (1.50)	-0.24 (1.32)	-0.37 (1.58)	-0.93 (15.15)	-0.50 (2.00)	-0.33 (1.50)	-0.30 (1.42)	-0.36 (1.56)	-0.94 (15.87)	-0.15 (1.17)

Legend: FS-1= Cowpea + Niger; FS-2= Cowpea + Maize; FS-3= Cowpea + Marigold; FS-4= Cowpea + Maize + Bordered with Marigold; FS-5= Cowpea + Maize + Bordered with Niger; Negative values were obtained due to enhanced natural enemies population in farmscaped cowpea than sole cowpea; Figures in parentheses indicate the number of times increased natural enemy population in farmscaping treatments over sole cowpea

ACKNOWLEDGEMENT

The authors are grateful to the Dean, RCA and Head, Department of Entomology, RCA, Udaipur for providing necessary facilities and also to UGC (University Grant Commission, New Delhi) for the award of National fellowship for higher education to the senior author.

REFERENCES

- Dufour, R. 2000. Farmscaping to enhance biological control. ATTRA, Fayetteville, AK Online: <http://www.attra.nrcat.org/attra-pub/PDF/farmscaping.pdf>.
- Frank, T. 1999. Density of adult hoverflies (Dipt., Syrphidae) in sown weed strips and adjacent fields. *Journal of Applied Entomology*, **123**: 351-355.
- Jackai, L.E.N. and Daoust, R.A. 1986. Insect pests of cowpeas. *Annual Review of Entomology*, **31**: 95-119.
- Labanowska-Bury, D., Dabrowski, Z.T., Eyre, M.D., Leifert, C. and White, R. 2009. The importance of field surrounding flora in protection of vegetable crops against pests. *Progress in Plant Protection*, **49**: 1066-1073.
- Markham, J. H. and Chanway, C. P. 1996. Measuring plant neighbouring effects. *Functional Ecology*, **10**: 548-549.
- Munyulia, M.B.T., Lutherb, G.C. and Kyamanywa, S. 2006. Effects of cowpea cropping systems and insecticides on arthropod predators in Uganda and Democratic Republic of the Congo. Department of Crop Science, Faculty of Agriculture, Makerere University, Kampala, Uganda.
- Silveira, L.C.P., Berti Filho, E, Pierre, L.S.R., Peres, F.S.C. and Louzada, J.N.C. 2009. Marigold (*Tagetes erecta* L.) as an attractive crop to natural enemies in onion fields. *Scientia Agricola*, **66**: 780-787.
- Sreedhar, U. 2012. Farmscaping and bio-rational pest management. Paper presented at national seminar on “Emerging Pest Problems and Their Bio-rational Management”, 2-3rd march, Udaipur, Rajasthan, 7-13 pp.
- Suh, J.B., Jackai, L.E.N. and Hammond, W.N.O. 1986. Observations on pod sucking bug populations on cowpea at Mokwa, Nigeria. *Tropical Grain Legume Bulletin*, **33**: 17-19.

Received: 10.12.2016

Accepted: 28.04.2017