

ABSTRACT

The current study aimed to document the diversity and population ecology of major insect pests and their natural predators in maize crops of Lahore Division, Punjab, Pakistan, focusing on district Kasur and Lahore during 2018 and 2019 agricultural season. Arthropods were sampled bi-weekly from March to July using various methods including sweep nets, pitfall traps, visual counting, handpicking, the wet fingering method, aspirators, and beat sheet. Diversity of insect pest was computed using the Shannon-Weiner and Simpson indices, while species richness was assessed through Menhinick and Margalef indices. A total of 97,671 insects representing 49 species, 45 genera, 27 families and 6 orders were recorded. Family Noctuidae was dominated over the other pest families with a 49.17% share among all pest families. *Spodoptera frugiperda* (J.E. Smith, 1797) of the family Noctuidae was the dominant species with a 18.51% share of the total pests catch. The average estimated species richness for both districts was about 96%. The highest densities of pest were recorded in April and lowest in July. The population densities of maize thrips, spotted stem borer and maize earworm showed negative correlation with temperature, humidity and rainfall, while fall armyworm showed positive correlation with these meteorological parameters. To record the diversity and population dynamics of natural predators in maize crops, sampling was conducted weekly from March to July in both 2018 and 2019. Sampling was performed on fortnightly basis using pitfall traps, sweep nets, beat sheets, visual counting, aspirators and handpicking. The natural predators were categorized into spiders and non-spider groups. Spiders (Arachnida: Araneae) were found as major predator of maize insect pests. Across both districts, a total of 12894 spiders representing 45 different species, 27 genera and 13 families were recorded. Family Aranidae and Lycosidae collectively contributed 53.38% of the total spider catch. *Neoscona theisi* (Walckenaer, 1841) of the family Araneidae was recorded to be the most dominant species at all sites that constituted 11.61% of the total spider collection. Among the non-spider natural predators, coccinellids were reported as the second most abundant predators constituting 10,637 individuals. The sub-family Coccinellinae (Latreille, 1807) was found most abundant, representing 94.72% of the total

catch. *Coccinella septempunctata* (Linnaeus, 1758) was recorded as the most abundant species contributing 21.09% share of coccinellidae. Among the other non-spider natural predators, 10217 individuals belonging to 19 species and 15 families were recorded. Family Syrphidae (29.96%) was found the most abundant family of minor natural predators, followed by the family Chrysopidae (26.20%). *Episyrphus viridaureus* (Wiedemann, 1824) and *Chrysoperla carnea* (Stephens, 1836) were found most dominant species making 56.16% of the total collection of the minor natural predators fauna. The estimated species richness of the minor natural predators was 97%. The population of the natural predators fluctuated over time with highest density in the mid of April and lowest in June during both cropping seasons. Non-significant association was found between temperature, rainfall humidity and active density of the syrphid flies and green lacewing populations. The rich fauna of natural predators in maize fields suggests they could be efficient biological control agents. However, this goal can only be achieved if we eradicate all such practices in maize agroecosystems that are harmful to natural predators. The impact of crop phenology and surrounding field crops on pests and their natural predators was also recorded. For sampling and surveys, visual counting and sweep netting was found most efficient. Fall armyworm was the most dominant pests found on all stages of maize crop, followed by spotted stem borer and maize earworms and thrips. Spiders, coccinellids, syrphid flies, and green lacewing were the main natural predators and found during the whole cropping seasons; however, their densities varied with crop phenology. Spider, coccinellids, and syrphid flies populations were high both at vegetative and reproductive stages, while green lacewing was found only during early vegetative stages of maize crops. Surrounding habitats showed varied impact on population densities of pest and natural predators. Overall, the densities of the pests were found above the economic threshold level. The population of the, fall armyworm, stem borer and maize earworm was affected by the field boundaries, the impact was statistically non-significant ($P < 0.05$). A similar trend was noted for the population of the spiders, coccinellids, syrphid flies and green lacewing. The pests including fall armyworm *Spodoptera frugiperda* (J.E. Smith, 1797) and stem borer *Chilo partellus* (Swinhoe) are major threatening pests to maize crops. New chemistry insecticides have been tried to control their damage in the fields. Formulations with good control on these pests while sparing bio-controlling agents are

always needed for better crop yield. Harmful impacts of selected insecticides were also evaluated against natural predators like spiders and coccinellids and green lacewings. Five commercially available insecticides namely Hombre® (Imidacloprid + Tebuconazole), Sega® (Emamectin Benzoate + Lufenuron), Fipronil® (Fipronil), Carbofuran® (Carbofuran), and Coragen® (Chlorantraniliprole) were evaluated in the present study with an aim to short list best available insecticide against targeting pest i.e., fall armyworm. The selected insecticides targeted fall armyworm in following trends i.e. Coragen® > Carbofuran® > Sega® > Fipronil® > Hombre®. The minimum population reduction was recorded by the Fipronil® on 2-DAT. The harmful impact of the selected insecticides on natural predators such as spiders, coccinellids, and syrphid flies and green lacewing were also evaluated. Spiders were affected by the selected pesticides in the following order: Coragen® > Carbofuran® > Sega® > Fipronil® > Hombre®. On the whole, Coragen® is recommended for the better control of fall armyworm in the maize crops.