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continued on the back inside cover

Cover: Digital illustration of *Impatiens chamchumroonii* in Krita by Dupati Poojitha.



## Comparing three sampling techniques for surveying and monitoring arthropods in Moroccan agroecosystems

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**Abstract:** Insect monitoring is a key component of sustainable and productive crop management. Among the various methods used to observe insect communities, pitfall trapping, visual searching, and sweep-net sampling of vegetation are the most widely applied. Selecting an appropriate sampling method is essential to obtain a comprehensive and accurate representation of species diversity. However, there is a notable lack of quantitative studies comparing the relative effectiveness of these techniques across different insect taxa in Morocco. In this study, the efficiency of three sampling strategies—pitfall trapping, mowing (sweep sampling of herbaceous plants), and visual searching—was evaluated to assess arthropod abundance and diversity in agroecosystems of northwestern Morocco. Between spring and summer 2020, a total of 69 species belonging to seven orders and 27 families were recorded. Pitfall traps and visual searching proved most effective for capturing ground beetles, whereas mowing herbaceous vegetation was particularly effective for collecting flying insects. These results highlight the importance of carefully selecting sampling techniques to ensure accurate estimates of arthropod diversity and abundance. Combining multiple methods provides a more comprehensive overview of arthropod communities in any ecosystem, including agroecosystems.

**Keywords:** Arthropod abundance, arthropod diversity, ground beetles, flying insects, insect sampling, Morocco, mowing vegetation, pitfall traps, sight hunting, sustainable crop management.

### ملخص

تعد مراقبة الحشرات عنصراً أساسياً في إدارة المحاصيل المستدامة والمنتجة. ومن بين الطرق المختلفة المستخدمة لمراقبة مجتمعات الحشرات، فإن أكثرها استخداماً هي مصائد الحفر، والبحث الجصري، والصيد باستخدام الشبكة. ويعد اختيار طريقة مناسبة لجمع العينات أمراً ضرورياً للحصول على صورة شاملة ودقيقة لتنوع الأصناف. غير أن هناك فجوة ملحوظة في الدراسات الكمية التي تقيس الفعالية النسبية لهذه التقنيات عبر مختلف أصناف الحشرات في المغرب. في هذه الدراسة، تم مقارنة كفاءة ثلاث طرق للصيد (مصائد الحفر، والبحث الجصري، والصيد باستخدام الشبكة)، لتقييم وفرة وتنوع المفصليات في النظم الزراعية في شمال غرب المغرب. خلال الفترة الممتدة بين ربيع وصيف عام 2020، تم تسجيل ما مجموعه 69 نوعاً تنتمي إلى سبع فئات و27 عائلة. أثبتت مصائد الحفر والبحث الجصري أنها الأكثر فعالية في اصطياد الخنافس الأرضية، في حين كان الصيد باستخدام الشبكة فعالاً بشكل خاص في جمع الحشرات الطائرة. تسلط هذه النتائج الضوء على أهمية اختيار تقنيات أخذ العينات بعناية لضمان تقديرات دقيقة لتنوع ووفرة المفصليات. يوفر الجمع بين طرق متعددة نظرة عامة أكثر شمولاً على مجتمعات المفصليات في أي نظام بيئي، بما في ذلك النظم البيئية الزراعية.

### الكلمات المفتاحية

وفرة المفصليات، تنوع المفصليات، خنافس الأرض، الحشرات الطائرة، جمع الحشرات، المغرب، الصيد باستخدام الشبكة، مصائد الحفر، الصيد الجصري، الإدارة المستدامة للمحاصيل.

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**Author details:** HANA EL HACHE, PhD, from Ibn Tofail University in Morocco, is a specialist in animal ecology, entomology, systematics, and faunistics. Her work focuses on understanding spatial and seasonal patterns of arthropod communities and assessing the influence of human activities on their distribution. She has played a pivotal role in creating a comprehensive checklist of terrestrial arthropods in agroecosystems of northwest Morocco, providing a valuable resource for biodiversity research and conservation.

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## INTRODUCTION

Over the past few decades, the importance of biodiversity in agroecosystems has been increasingly recognized, largely due to the ecosystem services it provides, including nutrient cycling, biotic regulation, pest control, and pollination (Gardarin et al. 2018; Galloway et al. 2021). Beneficial arthropods, such as crop pollinators and natural enemies of arthropod pests and weeds, play a central role in sustaining the ecological and economic productivity of these systems (Carvalho et al. 2010; Galloway et al. 2021). These services are a direct result of biological processes within the ecosystem, highlighting the intrinsic link between biodiversity and ecosystem functionality (Taraborelli et al. 2022). However, land use practices, particularly intensive agricultural management, pose significant risks to arthropod diversity and abundance (El Harche et al. 2023). Declines in insect populations, especially pollinators and their associated plant species, provide strong indirect evidence of these impacts (Biesmeijer et al. 2006).

Given the high rates of species loss caused by human activities (Dirzo et al. 2014), obtaining reliable estimates of species richness and abundance is critical for both biodiversity monitoring and conservation efforts. Standardized sampling methods are essential to minimize biases and ensure that assessments accurately reflect the composition of arthropod communities. While numerous insect sampling techniques exist, most are designed to target specific taxa or respond to particular stimuli, which limits their ability to capture the full diversity present in a habitat (Russo et al. 2011). This limitation is especially pronounced in highly diverse groups such as Coleoptera, where relying on a single method can provide an incomplete or misleading picture of the community (García-López et al. 2011).

To address this, entomologists frequently combine multiple sampling methods in species inventory and monitoring studies to improve the representativeness of collected data (Quinto et al. 2013). Using complementary techniques increases the likelihood of detecting both common and rare species and allows for a more accurate estimation of community abundance. The careful selection and combination of methods are therefore critical to avoid biased or insufficient assessments, which can arise from limited sampling effort or methodological constraints (Vasconcelos et al. 2014). By employing integrated sampling strategies, researchers can obtain comprehensive data on species richness and relative abundance, providing a stronger foundation for

ecological studies and conservation initiatives.

In this study, we aimed to evaluate the relative effectiveness of three distinct sampling methods for capturing insect assemblages in agricultural landscapes: (1) pitfall traps, (2) visual searching, and (3) mowing vegetation combined with sweep-netting. Specifically, we addressed three research questions: (1) Which of the three methods collects the highest number of species and individual insects? (2) Does species composition vary between methods? and (3) Are particular species more effectively captured by specific techniques? To answer these questions, we conducted a comprehensive, side-by-side comparison of the three methods, both individually and in combination, to identify the most effective approach for inventorying insect communities in agroecosystems

## MATERIAL AND METHODS

### Study area

The study took place in three localities in the Sidi Kacem zone, situated in northwestern Morocco at 34.217 °N & 5.700 °W. This zone is characterized by a semi-arid climate. In autumn, it can go down to 6°C, and during summer over 40°C.

Station 1 has a crop of *Vicia faba* L. (Fabaceae), commonly called beans, with a geographical location of 34.210 °N & 5.709 °W, on silty clay soil. Station 2, located at 34.245 °N & 5.704 °W, is a field of *Triticum aestivum* L. (Poaceae) commonly called soft wheat; it shares the same soil type as Station 1, silty clay. Station 3; 34.255 °N & 5.734 °W, comprises an alfalfa field with *Medicago sativa* L. (Fabaceae) and wasteland mainly covered by *Dittrichia viscosa* L. (Asteraceae) with a sandy clay loam.

### Arthropod sampling

Insect sampling was conducted from spring to summer of 2020, employing three distinct techniques: pitfall, mowing, and sight hunting. Data was recorded twice a month, from March to September 2020. All insects were transferred into clean glass bottles or vials with alcohol (70–80 %) for further processing like pinning, drying, labelling, and identification in the laboratory.

### Pitfall trap

Pitfall traps are a very effective and widely used method that is accepted for sampling epigeal arthropods, including beetles, spiders, and ants. Normally, the traps are placed on the ground to collect insects that live in

terrestrial environments. When an insect approaches the edge of the trap, theoretically, it becomes destabilized and then falls into the receptacle. Following the inspection of the container, captured insects are either collected or counted before the trap is reset. Pitfall traps are in wide use and represent a relatively inexpensive method for estimating populations of insects. Interestingly, a number of recent reviews have discussed the methods involved in pitfall trapping (Skvarla et al. 2014; Hohbein & Conway 2018). It is also not unusual for pitfall traps to inadvertently capture aerial insects. This statement is especially true for traps without a roof and painted in white or yellow colours (Buchholz & Hannig 2013). For the present study, we built pitfall traps using 1 L clear plastic containers, 10 cm in diameter and 17 cm in height, by placing them into the substrate so that their edges are level with the surrounding terrain. Plastic plates attached to rods were placed at the entrances to prevent the entry of rainwater and foreign materials. The soil around the entrance was then compressed to reduce any obstruction that may occur to smaller

arthropod species. The specimens collected were stored in glass containers with 70% alcohol, where they were kept until they were processed in the laboratory.

### Sight hunting

Involved in looking for all the wildlife that was observable by the eyes, wherever it is likely to be located. This includes the ground surface, under rocks, the interior of rotting wood, vegetation, and the surface of tree trunks. When possible, efforts should be made to collect at least 20 to 25 specimens.

### Mowing vegetation

Mowing vegetation by a sweep-netting is a commonly used method of sampling arthropods on vegetation. This method can collect a variety of arthropods, including lepidopterans as well as hemipterans, beetles, and dipterans. Sweep-netting has important advantages, including low equipment cost and the potential for a high yield of specimens per unit effort. A focused sweep was conducted utilizing an entomological net.

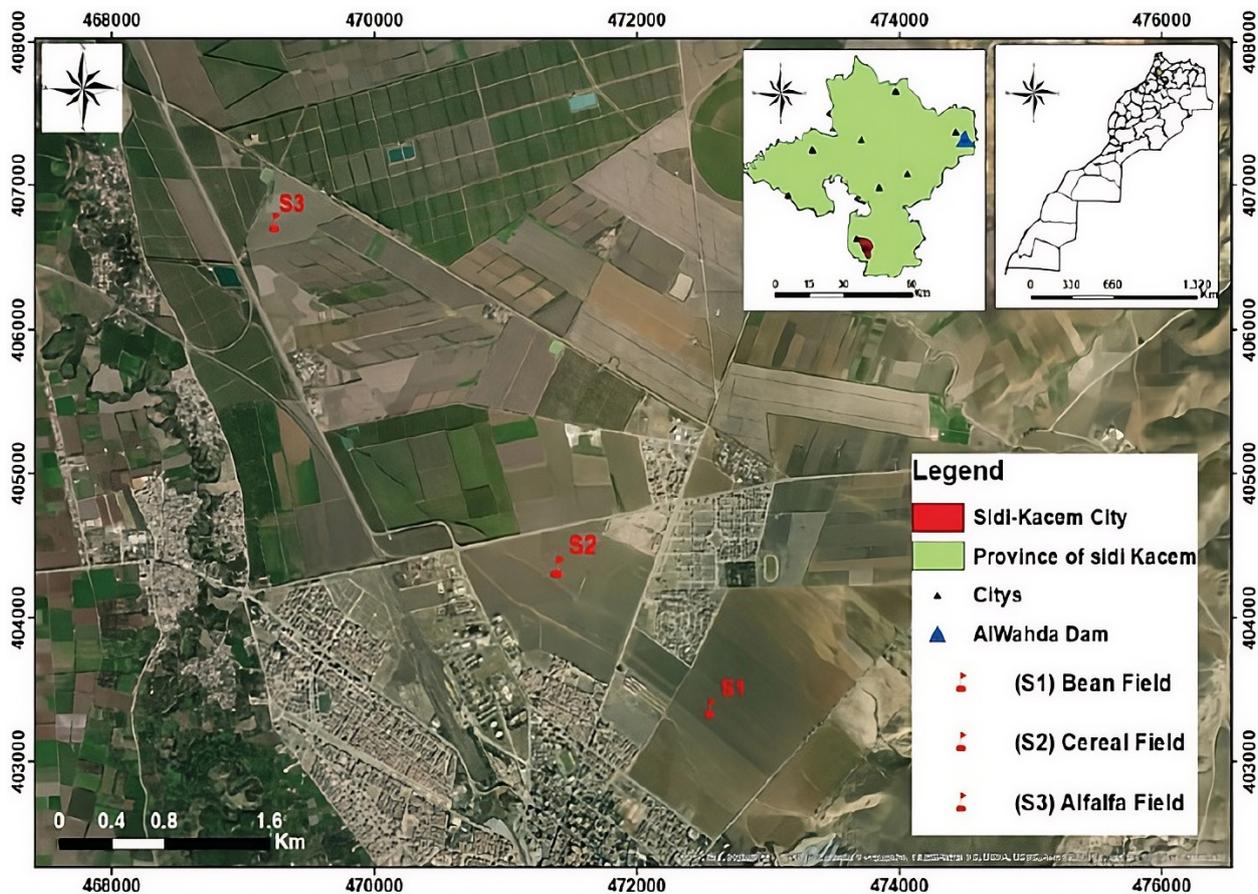


Image 1. Geographic and sampling location of the study area in Sidi Kacem, northwestern Morocco.

We employed a targeted netting strategy combined with timed observations, employing an active search and net approach. This involved walking randomly across the site while carefully observing the fields. Any captured insects were subsequently transferred to vials containing 70% alcohol for later identification.

#### Data analysis

To exploit the data obtained, various ecological indices and statistical analyses were performed. Some of the analyses include the ecological composition indices (species richness), as well as the ecological structure indices (Shannon and equitability indices). The data were analyzed using Microsoft Excel Worksheet (version 16.0 for Windows) and presented as frequency and percentage for comparison between the different stations and trapping methods.

## RESULTS

#### Invertebrate abundance and composition at the three study stations

The results of this study revealed that a total of 735 insects representing 27 families and 69 species were collected (Table 1). Among the sampled habitats, the cereal field exhibited the highest species richness with 55 species, followed by the bean field with 31 species and the alfalfa field with 28 species. Overall, the recorded species belonged to seven insect orders: Hemiptera, Coleoptera, Orthoptera, Lepidoptera, Odonata, Hymenoptera, and Diptera. Coleoptera was the most species-rich order, accounting for 42 species, followed by Hemiptera (7 species), Diptera (6 species), Lepidoptera & Hymenoptera (4 species each), and Orthoptera & Odonata (3 species each), as shown in Table 1. In terms of abundance, Coleoptera also dominated across all three sampling stations with 582 individuals, followed by Hymenoptera (68 individuals) and Hemiptera (31 individuals). The least abundant orders were Diptera, Lepidoptera, Odonata, and Orthoptera, represented by 20, 16, 11, and seven individuals, respectively. These results highlight the marked dominance of Coleoptera both in species richness and individual abundance, while the low representation of other orders underscores the distinct structure and distribution of insect communities within agroecosystems.

#### Comparison and description of the efficacy of sampling methods.

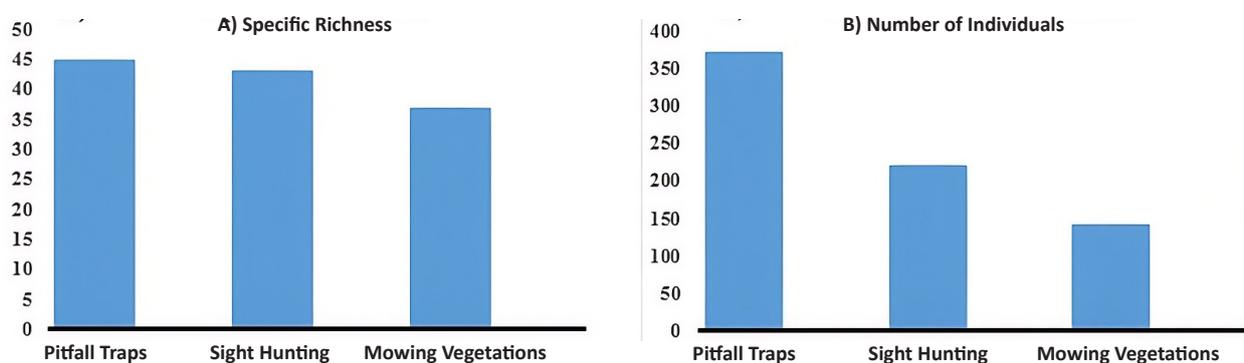
The distribution of individuals captured by the three sampling methods is presented in Table 2. Statistically significant differences were observed in both species richness and abundance among the sampling techniques, indicating variation in their capture efficiency. Pitfall trapping recorded the highest species richness with 45 species and accounted for 36% of the total individuals collected. Sight hunting yielded a comparable level of efficiency, capturing 43 species and representing 34% of the total individuals, differing only slightly from pitfall trapping in terms of species richness. In contrast, sweep netting conducted during vegetation mowing was less effective, recording 37 species and 30% of the individuals (Table 2; Figure 1). These results demonstrate that both pitfall trapping and sight hunting are highly effective sampling methods, whereas sweep netting captures a relatively

At the order level, sampling efficiency varied markedly among methods. Coleoptera dominated pitfall trap captures, reflecting the prevalence of ground-active taxa with surface-oriented movement. In contrast, sight hunting and vegetation mowing were most effective for volant orders such as Hymenoptera, Lepidoptera, Diptera, and Odonata, which are more abundant in vegetation and aerial strata. Hemiptera and Orthoptera displayed intermediate patterns, being captured by all methods but more frequently during sight hunting and mowing, consistent with their mixed mobility and plant associations (Table 2).

At the family level, clear differences in capture efficiency were observed among pitfall traps, sight hunting, and vegetation mowing. Pitfall traps excelled in sampling ground-dwelling Coleoptera, particularly Carabidae and Silphidae, which had the highest abundances (138 & 135 individuals, respectively) and species richness. This method also uniquely captured Staphylinidae, Lygaeidae, and Oedemeridae, yielding the highest overall abundance (372 individuals) and species richness (45 species). Sight hunting was similarly efficient for visually conspicuous and mobile taxa, including Coccinellidae, Reduviidae, and several Diptera and Lepidoptera families, resulting in high species richness (43 species) and substantial abundance (221 individuals). Sweep netting during vegetation mowing was more effective for plant-associated and flying insects, such as Apidae, Vespidae, Pieridae, and Libellulidae, but recorded the lowest overall abundance (142 individuals) and species richness (37 species) (Table 2).

**Table 1. The numbers of species and individuals captured at the three study stations.**

	Beans field		Cereal field		Alfalfa field		Total	
	# ind.	# sp.	# ind.	# sp.	# ind.	# sp.	# ind.	# sp.
Coleoptera	180	22	297	37	105	12	582	42
Hemiptera	6	2	10	5	15	2	31	7
Orthoptera	3	2	2	2	2	2	7	3
Lepidoptera	1	1	4	2	11	2	16	4
Hymenoptera	10	3	25	4	33	4	68	4
Odonata	1	1	5	3	5	2	11	3
Diptera	0	0	2	2	18	4	20	6
Total	201	31	345	55	189	28	735	69

**Figure 1. Species richness (A) & (B) number of individuals of insects collected by different types of traps at three study sites.**

### Seasonal distribution

Overall, the abundance of arthropods was observed to be higher during the spring season compared to the summer season, as depicted in Figure 2. It was found that pitfall traps were more effective than other traps in both seasons, exhibiting the highest Shannon-Weiner's diversity index (3.81 for spring and 3.49 for summer captures). Conversely, mowing vegetation resulted in the lowest values of the diversity index (2.18 for spring and 2.09 for summer), as shown in Table 3.

In terms of evenness index, pitfall traps had the highest values (0.98 for the spring season), followed by sight hunting (0.79 for the spring season) and mowing vegetation (0.70 for the summer season). Overall, mowing had the least diversity index values in both seasons (Table 3).

The relative abundances of the main insect groups varied according to both sampling method and season (spring and summer). Overall, Carabidae emerged as the dominant taxon across all sampling techniques, reflecting their high activity levels and broad ecological distribution within the studied habitats.

The sight hunting method primarily captured

actively moving and visually detectable insects. Carabidae showed the highest abundances, particularly during spring, while Tenebrionidae and Silphidae were represented at intermediate levels. Other taxa, including Apidae, Vespidae, Libellulidae, and Lepidoptera, occurred at relatively low abundances, suggesting limited detectability using this method. In summer, a general decline in abundance was observed, although Carabidae remained dominant (Figure 2).

Pitfall traps proved to be the most effective method for sampling ground-dwelling insects. During spring, Carabidae and Silphidae exhibited particularly high abundances, followed by Tenebrionidae. In contrast, Scarabaeidae, Oedemeridae, and Lygaeidae were captured in low numbers. Although overall abundances decreased in summer, Silphidae remained highly represented, indicating sustained activity during this season.

The vegetation mowing method highlighted insect groups associated with the herbaceous layer. Carabidae continued to dominate in both seasons; however, this method revealed a higher representation of secondary taxa. In spring, several groups occurred at

**Table 2. The numbers of species and individuals captured by different types of traps.**

			Pitfall traps	Sight hunting	Mowing vegetations
Coleoptera	Carabidae	No. of individuals	138	68	32
		Species richness	23	11	10
	Tenebrionidae	No. of individuals	60	34	15
		Species richness	3	3	2
	Scarabaeidae	No. of individuals	12	8	0
		Species richness	3	2	0
	Coccinellidae	No. of individuals	4	9	6
		Species richness	2	2	2
	Staphylinidae	No. of individuals	2	0	0
		Species richness	2	0	0
	Cantharidae	No. of individuals	3	5	7
		Species richness	1	2	2
	Chrysomelidae	No. of individuals	0	4	1
		Species richness	0	1	1
	Silphidae	No. of individuals	135	19	13
		Species richness	5	4	2
Oedemeridae	No. of individuals	3	7	4	
	Species richness	1	1	1	
Hemiptera	Reduviidae	No. of individuals	3	10	2
		Species richness	1	2	1
	Pentatomidae	No. of individuals	0	2	0
		Species richness	0	1	0
	Cercopidae	No. of individuals	0	3	0
		Species richness	0	1	0
	Scutelleridae	No. of individuals	0	2	0
		Species richness	0	1	0
	Alydidae	No. of individuals	0	1	1
		Species richness	0	1	1
Lygaeidae	No. of individuals	5	3	0	
	Species richness	1	1	0	
Orthoptera	Acrididae	No. of individuals	2	4	1
		Species richness	1	3	2
Lepidoptera	Pieridae	No. of individuals	0	4	7
		Species richness	0	2	2
	Nymphalidae	No. of individuals	0	3	1
		Species richness	0	1	1
Hymenoptera	Apidae	No. of individuals	0	8	21
		Species richness	0	2	2
	Vespidae	No. of individuals	0	3	10
		Species richness	0	1	1
	Andrenidae	No. of individuals	4	6	7
		Species richness	1	1	1
Odonata	Libellulidae	No. of individuals	0	5	8
		Species richness	0	2	3
Diptera	Muscidae	No. of individuals	1	4	0
		Species richness	1	1	0
	Stratiomyinae	No. of individuals	0	3	4
		Species richness	0	1	2
	Tabanidae	No. of individuals	0	2	0
		Species richness	0	1	0
	Syrphidae	No. of individuals	0	3	2
		Species richness	0	1	1
	Asilidae	No. of individuals	0	1	0
		Species richness	0	1	0
7	27	No. of individuals	372	221	142
		Species richness	45	43	37

low abundances, including Apidae, Libellulidae, and Lepidoptera. In summer, a marked increase in Apidae was observed, reflecting enhanced activity of pollinators (Figure 2). The exclusive occurrence of Coccinellidae in summer may be related to increased prey availability and seasonal changes in vegetation structure. From a seasonal perspective, spring was characterized by higher overall abundances, likely due to favourable climatic conditions and increased biological activity. Conversely, summer showed a general decline in insect abundance, accompanied by shifts in community composition.

## DISCUSSION

Several studies have been conducted to compare the efficiency of different methods used to assess arthropods (Sabu et al. 2011; Corti et al. 2013; Zaller et al. 2015; Sial et al. 2022). To the best of existing knowledge, the current study stands out as one of the first to compare the effectiveness of pitfall traps, sight hunting, and mowing vegetation in agroecosystems. This study aimed to provide a detailed evaluation of different sampling methods. By conducting this research, the study seeks to shed light on the effectiveness and practicality of employing these methods collectively. The utilization of pitfall traps, sight hunting, and mowing vegetation offers a unique opportunity to comprehensively evaluate arthropod populations. The findings will not only enhance the scientific community's understanding of these assessment techniques and explore the synergistic effects of combining these methods but also pave the way for their wider adoption in ecological studies.

The primary objective was to evaluate the efficacy of pitfall traps, sight hunting, and mowing vegetation in assessing insect diversity across three designated study sites. To ensure comprehensive analysis, the number of insects captured by each sampling method were examined from spring to summer. Throughout the course of the experiment, all sampling traps exhibited remarkable variations in insect populations. When comparing the different sampling methods, differences were found in the number and diversity of the recorded taxa among the tested sampling methods. It became evident that pitfall trapping yielded the highest number of species and individuals, capturing a total of 45 species and accounting for 36% of the overall insect population. These results underscore the reliability of pitfall traps for assessing insect diversity, as their ability to capture a broad range of species and individuals demonstrates their effectiveness in representing the insect communities

within the study sites. Bouget et al. (2020) similarly reported that pitfall traps are highly specific and efficient for sampling invertebrate assemblages that move across the soil surface, effectively capturing carabids as well as numerous flying insects that land on the ground or are displaced by wind. Sight hunting also proved highly effective, accounting for 43 species and 34% of the individuals collected, and together with pitfall trapping, it has been recognized as a particularly useful method for sampling coleopterans. Both techniques are not only efficient but also easy to implement and cost-effective. The utility of these methods is further supported by previous studies, including Pizzolotto et al. (2018) and Ganaoui et al. (2019), which successfully applied similar approaches to sample arthropod communities in various habitats.

In terms of capturing flying insects, mowing herbaceous vegetation proved particularly effective. This method efficiently sampled insects that feed on plants, prey on plant-feeding insects, or utilize foliage and flowers, including Hymenoptera and some Lepidoptera. In this study, mowing traps captured the largest number of Apidae (21 individuals) and also effectively sampled Vespidae (10 individuals), highlighting its suitability for foliage-associated and flying taxa. Coleoptera and Hymenoptera were among the most accessible groups to sample due to their high taxonomic richness, as observed in other studies (Forbes et al. 2018; von Hoermann et al. 2018). The abundance of these taxa is likely influenced by favourable environmental conditions such as temperature, humidity, and availability of food sources (El Harche et al. 2023; Morshed et al. 2023). Pitfall traps, in contrast, were particularly efficient at capturing ground-dwelling insects, including Carabidae (138 individuals), Silphidae (135 individuals), and Tenebrionidae (60 individuals), reflecting their design to ensnare species active on the soil surface. Sight hunting offered a versatile approach, allowing for the collection of both ground-dwelling and flying insects, with a total of 43 species and 221 individuals recorded across taxa. By actively observing insect behaviour and movement, this method successfully captured a wide range of species, complementing the results obtained from pitfall traps and mowing. Together, these three methods provide a comprehensive representation of insect communities within the studied agroecosystems.

Seasonal variation played a significant role in structuring insect assemblages, with higher abundances generally recorded in spring. This pattern is likely linked to favourable climatic conditions, increased soil moisture, and enhanced resource availability during early crop

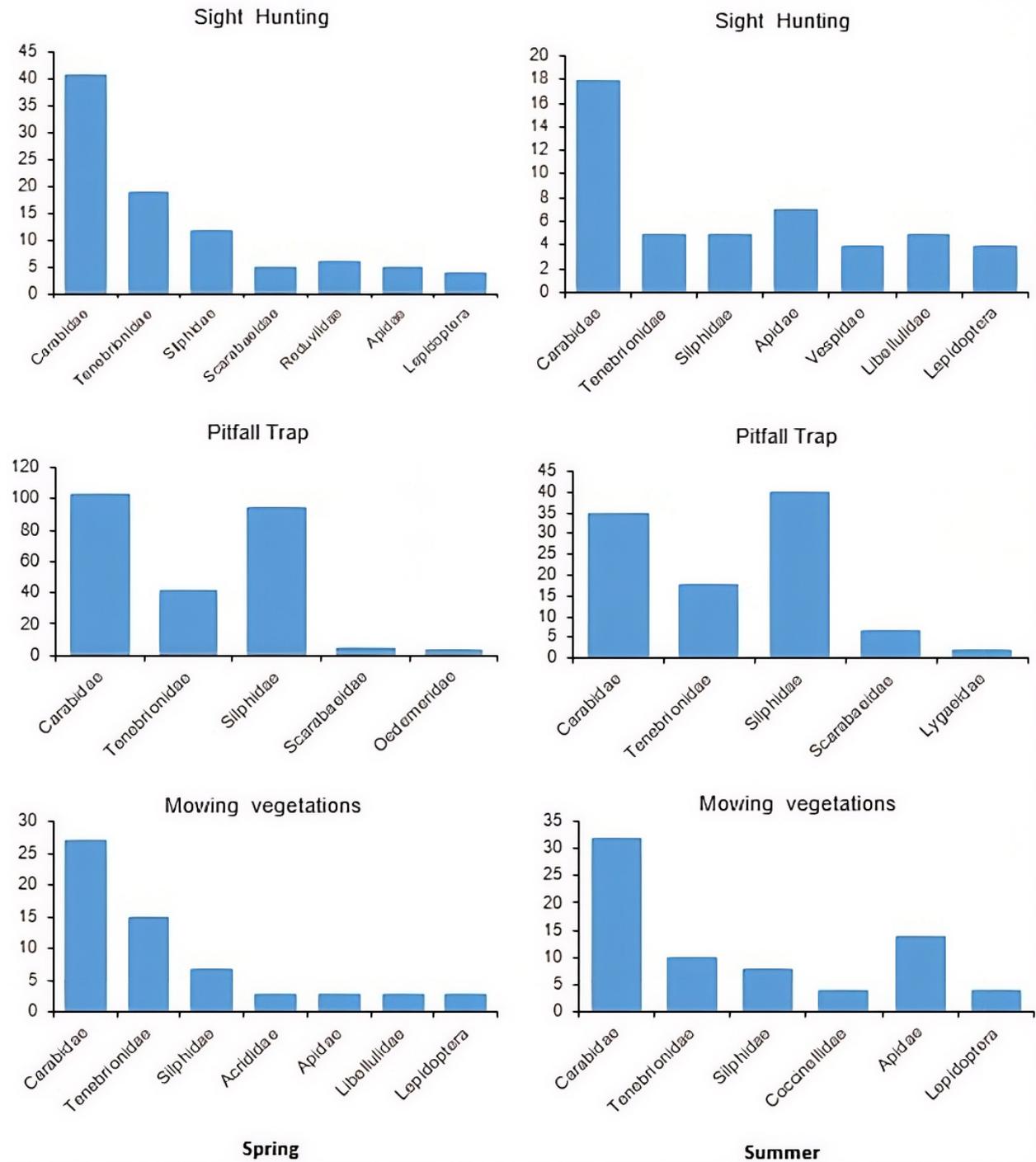


Figure 2. The taxonomic composition of the most dominant family captured during the spring and summer seasons using three different types of collection traps.

development stages (Colinet et al. 2015; Haavik & Stephen 2023). In contrast, the observed decline in abundance during summer may reflect the combined effects of thermal stress, reduced vegetation cover, and increased agricultural disturbance, including irrigation, mechanical operations, and agrochemical applications

(El Harche et al. 2022, 2023). Similar seasonal declines in insect abundance have been reported in Mediterranean and semi-arid agroecosystems, where summer conditions impose strong physiological and ecological constraints on arthropod communities (Coscarón et al. 2009; Robinson et al. 2018; El Abdouni et al. 2022; Zhao

**Table 3. Diversity indices of different arthropod orders captured by different types of traps.**

Trap type	Spring			Summer		
	Pitfall traps	Sight hunting	Mowing vegetations	Pitfall traps	Sight hunting	Mowing vegetations
Shannon Index	3.81	3.68	2.18	3.49	3.36	2.09
Evenness Index	0.98	0.79	0.58	0.87	0.74	0.70

et al. 2022; El Harche et al. 2023).

The effectiveness of pitfall traps in capturing large numbers of Carabidae and Silphidae emphasizes the importance of soil surface conditions in agroecosystems. Ground-dwelling insects are particularly sensitive to soil compaction, tillage frequency, and residue management, all of which directly affect their mobility, shelter availability, and prey access. Recent evidence suggests that intensive soil management simplifies carabid community composition and reduces functional diversity, potentially impairing ecosystem services such as biological control (Makwela et al. 2025). The persistence of Silphidae during summer may indicate tolerance to disturbance and an ability to exploit ephemeral organic resources commonly associated with agricultural activities and livestock presence.

In contrast, vegetation mowing revealed taxa associated with the herbaceous layer, particularly pollinators such as Apidae, whose abundance increased markedly during summer. This seasonal increase likely corresponds to flowering phenology and the availability of floral resources within or near cultivated fields. Recent studies stress that pollinator communities in agroecosystems are highly dependent on landscape heterogeneity, field margins, and the presence of semi-natural habitats (Potts et al. 2010; El Abdouni et al. 2022). Agricultural intensification, characterized by monocultures and the removal of non-crop vegetation, has been shown to reduce pollinator diversity and abundance by limiting nesting sites and floral continuity (Sentil et al. 2024).

Anthropogenic pressures, particularly the use of agrochemicals, represent a major driver of insect community alteration in agricultural landscapes. Recent comparative studies have demonstrated significantly lower pollinator abundance and species richness in agrochemical-contaminated habitats compared to protected or low-input systems, highlighting both direct toxic effects and indirect impacts via habitat degradation (Sentil et al. 2024; El Harche 2023). These findings are consistent with the reduced representation of sensitive taxa observed in the present study, suggesting that chemical inputs may selectively favour disturbance-

tolerant species while excluding more specialized or vulnerable groups.

The exclusive occurrence of Coccinellidae during summer further illustrates the influence of anthropogenic factors on trophic interactions. Lady beetles are closely associated with aphid populations, which often increase in fertilized crops during warmer periods. Their seasonal presence likely reflects prey availability rather than habitat preference, supporting the notion that agricultural inputs indirectly shape predator dynamics through bottom-up effects (Landis et al. 2000).

The different traps used to assess insect diversity, while varying in efficiency, are not only cost-effective but also simple to construct and deploy, allowing their use across a variety of locations. This is particularly advantageous in agricultural areas, where sampling can be challenging and where farmers may be reluctant to allow complex equipment, such as malaise traps or light traps, that could damage crops. The materials and methods selected in our study provide a practical solution that benefits both researchers and farmers, enabling representative sampling of insect diversity without disturbing the fields. The observed variation in abundances among taxa across different collection methods underscores the importance of combining multiple techniques to obtain a more accurate representation of arthropod communities in agroecosystems. Furthermore, the choice of sampling method should be tailored to the specific taxonomic group under investigation.

No single sampling method is sufficient to capture the full diversity of arthropod communities, as efficiency varies according to the ecology, mobility, and microhabitat of each taxon. Flying insects, such as Lepidoptera, Diptera, Hymenoptera, and Odonata, are most effectively sampled through active methods like visual searching and sweep netting, while ground-dwelling taxa, including Carabidae and Tenebrionidae, are best collected with pitfall (Barber) traps. Vegetation-associated and less mobile groups, such as Hemiptera, Orthoptera, and some Coleoptera, are efficiently captured by sweep netting. These findings emphasize the importance of a taxon-oriented, multi-method



sampling approach to obtain comprehensive arthropod inventories and reduce methodological bias in agroecosystem studies.

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