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# First report of capturing efficacy of baited traps against oriental hornet Vespa orientalis L. (Hymenoptera: Vespidae) and off-target honeybees at Apis mellifera apiaries

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# First report of capturing efficacy of baited traps against oriental hornet *Vespa orientalis* L. (Hymenoptera: Vespidae) and off-target honeybees at *Apis mellifera* apiaries

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**Short title:** Bait traps to control hornet wasps in apiary

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**Abstract**

**Background** The Oriental hornet, *Vespa orientalis* L. (Hymenoptera: Vespidae), is an important invasive pest that attacks the honeybee *Apis mellifera* L. (Hymenoptera: Apidae) colonies, particularly foraging and returning workers, thereby disrupting normal foraging activity, weakening colony defenses, reducing colony strength, and under severe infestation, causing complete colony collapse and substantial economic losses to beekeepers. Therefore, the development of effective, economical, and environment friendly management strategies are essential for reducing *V. orientalis* pressure in apiaries. The present study compared four bait formulations for their effectiveness in attracting and trapping Oriental hornets.

**Methods** Three apiaries with 15 *A. mellifera* colonies each were the site used in the study from October 2023 to August 2025. Four bait treatments, honey + sugar (T1), sugar (T2), poultry meat (T3), and sugar + water + vinegar (T4) were evaluated by installing in three replications near honeybee colonies during autumn 2023 to summer 2025. Approximately 20 g of bait was placed in 500 mL plastic jars fitted inside wooden boxes and suspended approximately 1.5 m above ground. Traps were exposed for 72 h and replaced twice weekly, while captured hornets and honey bees were identified, and counted.

**Results** Honey + sugar bait consistently demonstrated the highest trapping efficiency for wasps, with few numbers of honeybees across seasons. The honey + sugar bait generally outperformed poultry meat, sugar, and sugar + water + vinegar baits.

**Discussion** The findings demonstrate that honey + sugar bait is a highly effective attractant for *V. orientalis* and can be incorporated into integrated hornet management programs in honeybee apiaries. Early deployment of baited traps, preferably from spring when hornet populations begin increasing, may facilitate the removal of queens or foundresses and reduce subsequent population

46 buildup, thereby minimizing predation pressure on *A. mellifera* colonies and supporting
47 sustainable beekeeping.

48 **Keywords**: Beekeeping, bee enemy, colony losses, hornet wasp, bait, honeybee.

## Background

European or Western honeybee, *Apis mellifera* L. (Hymenoptera: Apidae), plays a crucial role in maintaining ecosystem health and supporting agricultural productivity worldwide (Papa et al., 2022). *A. mellifera* is the most prevalent pollinator in the world contributing significantly to the yield of approximately 76% of global crops, thus making it vital for global food security mainly due to its long history of domestication and human-mediated dispersal across all continents except Antarctica (Hung et al., 2018; Stanley et al., 2020). Indeed, the economic valuation of pollination services and honey production provided by managed honey bees ranges from US$ 182–577 billion annually, highlighting their profound impact on agricultural economies (Marcelino et al., 2022). Furthermore, their polylectic foraging behavior enables them to contribute to biodiversity maintenance by facilitating the reproduction of numerous plant species that would otherwise be unable to reproduce (Burette, 2015).

Hornet wasps (Hymenoptera: Apidae), particularly invasive species like the Oriental hornet *Vespa orientalis* L, *Vespa basalis* Smith, tropical hornet *Vespa tropica* (L.)., Asian hornet *Vespa velutina* Lepeletier, and European wasp *Vespula germanica* (Fabricius) pose a significant threat to European honeybee apiaries through direct predation and induced stress (Abou-Shaara & Al-Khalaf, 2022; Réquier et al., 2019). Hornets attack foraging workers and guard bees at hive entrances in apiaries often leading to rapid colony collapse under sustained predatory pressure (Matheson et al., 1989; Buteler et al. 2021).

Beyond direct predation, hornets may be vectors for viral pathogens, thereby further compromising honeybee health. Specifically, studies have demonstrated that viruses such as Deformed Wing Virus and Israeli Acute Paralysis Virus, prevalent in honeybee populations, can be transmitted to hornets and even replicate within hornet tissues (Mehmood et al., 2023). The

presence of these shared pathogens within hornet populations highlights a previously unexplored indirect impact on local host-parasite dynamics, potentially exacerbating disease transmission within apiaries (Gabín-García et al., 2021). Furthermore, hornets plunder hives of honey, pollen, and larvae, which ultimately weakens colonies and leaves them susceptible to starvation and pathogens (Power et al., 2023). These multifactorial impacts, ranging from direct mortality and disease transmission to resource depletion and foraging disruption, collectively contribute to considerable overwintering hive losses and can compel beekeepers to cease operations (Arca et al., 2015; Howse et al., 2025).

The escalating threat of invasive hornet species, particularly within apiaries, and their economic and ecological damage necessitate the development and evaluation of effective pest management strategies to mitigate hornet predation and ensure the sustainability of *A. mellifera* apiaries (Bista et al., 2020; Lamas et al., 2024; Réquier et al., 2019). Among these, baited traps are frequently employed due to their perceived simplicity and cost-effectiveness (Lim et al., 2019), yet their efficacy and selectivity in controlling hornet populations while minimizing impact on non-target species, including beneficial insects, remain a subject matter of investigation (Rojas-Nossa et al., 2018).

Moreover, while some beekeepers resort to physical screens or manual hornet eradication, these methods are often unsustainable and can impede bee foraging or lead to substantial economic losses (Rosario et al., 2025). Therefore, a comprehensive understanding of diverse type of baited trap performance, is critical for developing environmentally benign and economically viable control measures.

This study aims to compare the efficacy and relative performance of diverse baited traps for capturing *V. orientalis* within honeybee apiary, thereby informing the development of more

sustainable pest management protocols. Therefore, a comprehensive understanding of diverse type of baited trap performance, is critical for developing environment friendly and economically viable control measures.

## Materials and Methods

### Sample collection

Three apiaries with 15 *A. mellifera* colonies each were setup at the research farm area of Beekeeping & Hill Fruit Pests Research Station (33.65°N, 73.07°E), Rawalpindi, Punjab, Pakistan upon different natural bee flora from October 2023 (autumn) to August 2025 (summer). Four types of baited traps [T1: honey+sugar (1:1); T2: sugar; T3: poultry meat; T4: sugar+water+vinegar (1:1:0.25)] were installed in three replications near hived *A. mellifera* colonies in Oct-Nov (2023 & 2024) and April-Sep (2024 & 2025). Small plastic jars (500 mL volume) provided with bait were hung vertically at 1.5 m height from ground surface upside down fitted in wooden box having trap hole size 2.54 cm at the side wall for the entry of insects to be trapped (Figure 1). In each replication, 20 g of bait was used and the baited traps were installed during mid-day hours in the apiary, remained for 72 hours and then replaced (2 trapping samplings per week). At the end of each trapping period, the caught insects were collected, identified and counted.

### Statistics

Data were analyzed using descriptive statistics, including means, standard deviations, and medians. Normality was assessed using the Shapiro–Wilk test, and homogeneity of variances was evaluated using Levene's test. Because the data did not consistently meet the assumptions of normality, differences in the number of wasps captured among trap types (T1, T2, T3, and T4) were assessed using the nonparametric Friedman test for related samples. When significant differences were detected, pairwise comparisons were performed using the Wilcoxon signed-rank

test, with p-values adjusted using the Holm correction for multiple comparisons. The comparison of numbers of wasps and bees captured were performed separately for each trap type (T1–T4), considering the pooled dataset and each season independently. Because wasp and bee captures were recorded for corresponding sampling units, paired comparisons were performed. Data normality was assessed using the Shapiro–Wilk test, and the Wilcoxon signed-rank test was used for pairwise comparisons when the normality assumption was not met. The tests were two-tailed, and p-values were adjusted using the Holm correction to account for multiple comparisons. Statistical significance was set at $p < 0.05$ using R software (R Core Team 2020).

**Results**

Data of *V. orientalis* and *A. mellifera* captured in four different bait treatments were evaluated from autumn 2023 to summer 2025. In general, the number of wasps captured was higher than those of honey bees.

In spring, the number of wasps captured differed significantly among trap types (Friedman's test: $\chi^2 = 35.36$, df = 3, $p < 0.001$, Figure 2A). Traps T1 and T3 captured similar amounts of *V. orientalis* ($W = 32.5$; $p = 0.16$) both higher than traps T2 and T4 that were similar ($W = 53.0$ $p > 0.46$ Figure 2A; Supplementary Table S1).

In summer, the number of *V. orientalis* captured differed among trap types (Friedman's test: $\chi^2 = 60.16$, df = 3, $p < 0.001$, Figure 2B) with T1 presenting greater number of wasps than T2 ($W = 0.0$, $p < 0.0001$), T3 ($W = 8.5$, $p < 0.0001$), and T4 ($W = 0.0$, $p < 0.0001$), whereas T3 captured significantly more wasps than T2 ($W = 1.5$, $p < 0.001$) and T4 ($W = 2.0$, $p < 0.001$) with similar number of wasps captured ($W = 114.0$, $p = 0.684$, Figure 2B, Supplementary Table S2).

During the autumn, the number of wasps captured were similar among the traps ($p > 0.05$, Figure 2C, Supplementary Table S3).

The population dynamics recorded across all four sampling windows showed low hornet abundance in early spring, a steep rise through June, peak activity in mid-July, and a pronounced decline through August into September (Figure 4).

The number of honey bees that are not the target of the traps were also evaluated. The number of bees captured during the spring was low without difference among the traps ($p \geq 0.067$, Figure 3A, Supplementary Table S4). On the other hand, the number of bees captured differed significantly among the four trap types during summer (Friedman test: $\chi^2 = 26.57$, df = 3, $p < 0.001$), with trap T4 showing the highest mean capture, whereas T3 had the lowest ($p < 0.05$, Figure 3B, Supplementary Table S5).

The number of bees captured differed significantly among the four trap types during autumn (Friedman test: $\chi^2 = 15.75$, df = 3, $p = 0.0013$). T1, T2, and T3 showed high number of bees captured, which were similar ($p > 0.05$), whereas T3 had the lowest number of bees ($p = 0.046$. Figure 3C, Supplementary Table S6).

The comparison between the number of wasps and bees captured for the different traps reveals that traps T1 and T3 captured greater numbers of *V. orientalis* than *A. mellifera* ($p < 0.001$), whereas traps T2 and T4 captured similar number of wasps and bees ($p > 0.05$; Table 1).

Seasonal analyses revealed differences between wasp and bee captures in traps T1 and T3 during spring and summer, with wasps being captured in greater numbers (Tables 2, 3). In autumn, a significant difference was detected only in trap T3, which also captured more wasps than bees (Table 4). No significant differences in the number of *V. orientalis* and *A. mellifera* were observed in trap T2 and T4 during any season.

**Discussion**

The present investigation, conducted across three consecutive trapping windows spanning nearly two years (October 2023 to August 2025), provides consistent evidence that bait composition exerts a decisive influence on the capturing efficiency of the hornet *V. orientalis* in honeybee apiaries under the agro-climatic conditions of Rawalpindi, Punjab, Pakistan. The honey + sugar bait (T1) outperformed the sugar (T2), poultry meat (T3), and sugar + water + vinegar (T4) formulations in almost every sampling event, excepting in the autumn, in which the number of hornet wasps remained lower. All traps tested, also showed the capture of very low number of honeybees in comparison with *V. orientalis.* These findings corroborate earlier reports that carbohydrate-rich attractants are highly effective for trapping hornet wasps of the genus *Vespa* (Lioy et al., 2020; Rojas-Nossa et al., 2018), and extending this observation, for the first time under Pakistani apiary conditions, to *V. orientalis*.

The superior performance of T1 may reasonably be attributed to the dual sugar matrix of honey and sucrose, which releases a complex blend of volatile esters, aldehydes and organic acids that mimic the odor profile of ripening fruit, nectar and honeydew naturally exploited by foraging *V. orientalis* workers (Abou-Shaara & Al-Khalaf, 2022). Adult hornets rely almost exclusively on carbohydrates obtained from nectar, honeydew and plundered honey stores to meet their own energetic requirements, whereas protein, chiefly in the form of live prey or scavenged animal tissue, is foraged predominantly to provision developing larvae within the nest (Rosario et al., 2025). This trophic division of foraging effort offers a plausible explanation for the intermittent parity observed between T1 and the poultry meat bait (T3) on several periods that coincides with the colony growth phase when brood-provisioning demand, and hence protein-directed foraging. Conversely, during the autumn sampling, when colonies had largely transitioned away from brood rearing toward reproductive production, the relative attractiveness of the protein bait declined

sharply relative to T1, reinforcing a seasonally driven, physiologically grounded shift in dietary preference rather than a fixed, unconditional hierarchy of bait efficacy.

The comparatively poor and inconsistent performance of the sugar + water + vinegar bait (T4) merits particular comment, since fermentation-derived volatiles such as acetic acid and ethanol have been reported elsewhere to enhance attractiveness of related *Vespa* spp. (Lim et al., 2019). It is likely that the diluted 1:1:0.25 formulation used here, combined with rapid evaporation of volatile fermentation products under the relatively warm and dry conditions of Rawalpindi during the 72-hour exposure interval, reduced both the sugar concentration available as a phagostimulant and the persistence of attractant volatiles, thereby diminishing overall trap efficiency relative to the more stable and energy-dense honey + sugar bait. This finding agrees with Mata et al. (2024) that trap performance for hornets is highly sensitive to bait formulation, exposure duration, and prevailing climatic conditions, underscoring that attractant recipes optimized for one geographic or climatic context cannot be assumed to transfer directly to another without local calibration.

The population dynamics recorded revealed low hornet abundance in early spring, a steep rise through June, peak activity in mid-July, and a decline through August into September. This pattern is consistent with the known annual colony cycle of *Vespa* spp., in which overwintered, mated foundress queens initiate solitary nests in spring, colonies expand exponentially through the production of successive worker cohorts during summer, and colonies senesce with the production of reproductives and eventual queen and male dispersal in autumn (Bista et al., 2020; Buteler et al., 2021).

Our findings carry direct relevance for apiary protection, given that *V. orientalis* predation compromises honeybee colonies not only through direct mortality of foragers and guard bees but

also through chronic stress, disruption of foraging activity, and resource plunder (Matheson et al., 1989; Réquier et al., 2019; Power et al., 2023), and through its documented capacity to acquire and potentially transmit honeybee viruses (Mehmood et al., 2023; Gabín-García et al., 2021). Because a single foundress queen is responsible for initiating an entire colony each spring, targeted removal during the low-density establishment phase, before exponential worker production begins, represents a disproportionately efficient intervention point relative to attempting mass trapping once colonies have already reached peak worker strength in spring/summer. This observation aligns with the broader literature on hornet eradication strategies, which identifies mistimed intervention as a principal cause of control failure (Howse et al., 2025).

From a practical standpoint, the honey + sugar bait capturing many wasps and few honeybees offers beekeepers a low-cost, readily available, and operationally simple attractant that can be deployed using inexpensive plastic jars and wooden housings without recourse to broad-spectrum insecticides, which risk harming honeybees and other beneficial insects (Rojas-Nossa et al., 2018). Given the smallholder structure of much of world's beekeeping sector, this cost-effectiveness and ease of preparation are important determinants of adoption, and support the integration of baited trapping into locally appropriate, environmentally benign hornet management.

## Conclusion

This multi-seasonal evaluation demonstrates that the honey + sugar bait (1:1) consistently proved to be the most effective attractant for capturing *V. orientalis* in *A. mellifera* apiaries. The results provide actionable insights for beekeepers and pest management professionals to protect apiaries against *V. orientalis* predation. Poultry meat bait approached the performance of the honey + sugar bait specifically during the summer brood-rearing period, reflecting the shifting nutritional

232 priorities of hornet colonies across the annual cycle. It is suggested that traps should be deployed
233 as early spring when mean captures are low. Catching "foundress" queens during this
234 establishment phase can prevent the exponential growth seen in summer.

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238 **Author Contributions**

239 **AB**: Conceptualization, Visualization, Methodology, Data collection, Data analysis, Writing -
240 original draft. **MBSA**: Data collection, Data analysis, Writing - original draft, review & editing.
241 **MR**: Conceptualization, Resources, Supervision, Validation. **AA**: Writing - original draft. **JES**:
242 Data analysis, Writing – Review & editing. **MUQ**: Writing – original draft

243 **Data availability**

244 All relevant experimental data are included in the manuscript.

245 **Declarations**

246 **Ethics approval:** Not applicable.

247 **Concern for publication:** All authors read and approved the final manuscript.

248 **Conflict of interest:** The authors declare that they have no known competing financial interests
249 or personal relationships that could have appeared to influence the work reported in this paper.

250 **References**

251 Abou-Shaara, H.F. & Al-Khalaf, A.A. (2022). Using maximum entropy algorithm to analyze
252 current and future distribution of the Asian hornet, *Vespa velutina*, in Europe and North Africa
253 under climate change conditions. *Journal of Entomological Research Society*, *24*, 7-21.

Arca, M., Mougel, F., Guillemaud, T., Dupas, S., Rome, Q., Perrard, A., Muller, F., Fossoud, A., Capdevielle-Dulac, C., Torres-Leguizamon, M. & Chen, X.X. (2015). Reconstructing the invasion and the demographic history of the yellow-legged hornet, *Vespa velutina*, in Europe. *Biological Invasions, 17*, 2357-2371.

Bista, S., Thapa, R.B., KC, G.B., Pradhan, S.B., Ghimire, Y.N. & Aryal, S. (2020). Incidence and predation rate of hornet (Vespa spp.) on European honeybee (*Apis mellifera* L.) apiary at mid-hill areas of Lalitpur district, Nepal. *Journal of Agriculture Natural Research, 3*, 117-132.

Burette, C. (2015). Cryoconservation des embryons de l'abeille domestique, *Apis mellifera* (Doctoral dissertation, Université de Versailles Saint-Quentin; Institut de recherche sur la biologie de l'insecte; IRBI).

Buteler, M., Yossen, M.B., Alma, A.M. & Lozada, M. (2021). Interaction between *Vespula germanica* and *Apis mellifera* in Patagonia Argentina apiaries: M. Buteler et al. *Apidologie*, *52*, 848-859.

Gabín-García, L.B., Bartolomé, C., Guerra-Tort, C., Rojas-Nossa, S.V., Llovo, J. & Maside, X. (2021). Identification of pathogens in the invasive hornet *Vespa velutina* and in native Hymenoptera (Apidae, Vespidae) from SW-Europe. *Scientific Reports*, *11*, 11233.

Howse, M.W.F., Reason, A., Haywood, J. & Lester, P.J. (2025). Improving wasp control by identifying likely causes of eradication failure. *Journal of Pest Science*, *98*, 213-227.

Hung, K.L.J., Kingston, J.M., Albrecht, M., Holway, D.A. & Kohn, J.R., (2018). The worldwide importance of honey bees as pollinators in natural habitats. *Proceedings of Royal Society B*, *285*, 1870.

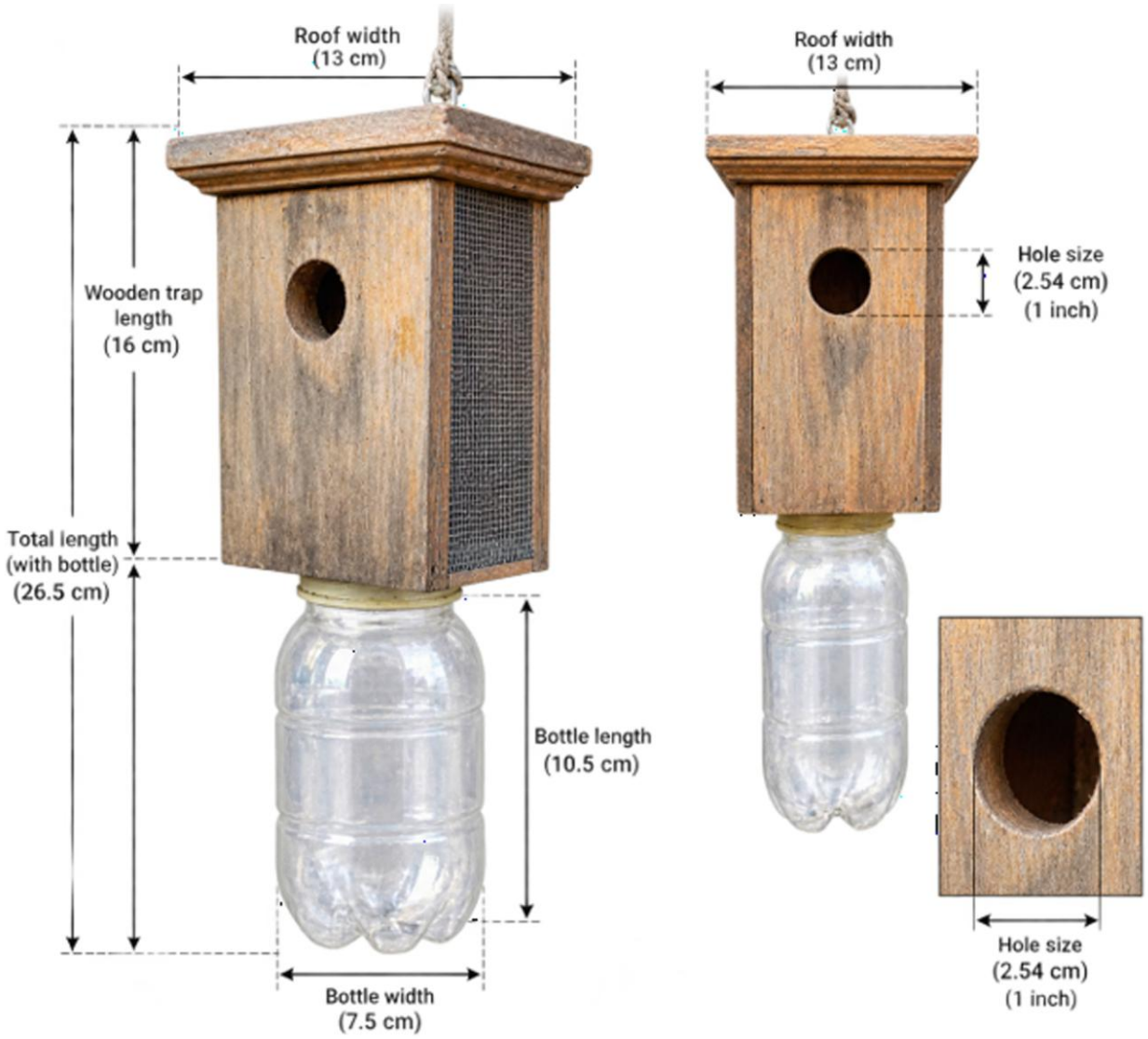
Lamas, Z.S., Chen, Y. & Evans, J.D. (2024). Case report: emerging losses of managed honey bee colonies. *Biology*, *13*, 117.

277 Lim, D.J., Lee, J.E., Lee, J.S., Kim, I. & Kim, I.S. (2019). Attraction of the Invasive Hornet, *Vespa*
278 *velutina nigrithorax*, by using Bacillus sp. BV-1 Cultures. *Korean Journal of Environment*
279 *and Agriculture*, *38*, 104-109.
280 Lioy, S., Laurino, D., Capello, M., Romano, A., Manino, A. & Porporato, M. (2020). Effectiveness
281 and selectiveness of traps and baits for catching the invasive hornet *Vespa velutina*. *Insects*,
282 *11*, 706.
283 Marcelino, J., Braese, C., Christmon, K., Evans, J.D., Gilligan, T., Giray, T., Nearman, A., Niño,
284 E.L., Rose, R., Sheppard, W.S. & vanEngelsdorp, D. (2022). The movement of western honey
285 bees (*Apis mellifera* L.) among US States and territories: History, benefits, risks, and
286 mitigation strategies. *Frontiers in Ecology and Evolution*, *10*, 850600.
287 Mata, F., Alonso, J.M. & Cano-Díaz, C. (2024). Evaluation of Asian hornet (*Vespa velutina*)
288 Trappability in alto-Minho, Portugal: commercial vs. artisanal equipment, human factors,
289 geography, climatology, and vegetation. *Applied Science*, *14*, 7571.
290 Matheson, A., Clapperton, K., Moller, H. & Alspach, P. (1989). The impact of wasps on New
291 Zealand beekeeping - the 1986/ 1987 wasp's survey. New Zealand Beekeeper No. 203: 28-31
292 (Apic. Abst. 1286/90).
293 Mehmood, S., Palmer-Young, E. & Huang, W.F. (2023). The threat of honey bee RNA viruses to
294 yellow-legged hornets: Insights from cross-species transmission events. *Journal of*
295 *Invertebrate Pathology*, *201*, 108005.
296 Papa, G., Maier, R., Durazzo, A., Lucarini, M., Karabagias, I.K., Plutino, M., Bianchetto, E.,
297 Aromolo, R., Pignatti, G., Ambrogio, A. & Pellecchia, M. (2022). The honey bee *Apis*
298 *mellifera*: An insect at the interface between human and ecosystem health. *Biology*, *11*: 233.

299 Power, K., Martano, M., Ragusa, E., Altamura, G. & Maiolino, P. (2023). Detection of honey bee
300 viruses in larvae of *Vespa orientalis*. *Frontiers in Cell Infection Microbiology*, *13*, 1207319.
301 R Core Team (2020) R: a language and environment for statistical computing. R Foundation for
302 Statistical Computing, Vienna, Austria. https:// www.R- proje ct. org/. Accessed 10 September
303 2026
304 Réquier, F., Rome, Q., Chiron, G., Decante, D., Marion, S., Menard, M., Muller, F., Villemant, C.
305 & Henry, M. (2019). Predation of the invasive Asian hornet affects foraging activity and
306 survival probability of honey bees in Western Europe. *Journal of Pest Science*, *92*, 567-578.
307 Rojas-Nossa, S.V., Novoa, N., Serrano, A. & Calviño-Cancela, M. (2018). Performance of baited
308 traps used as control tools for the invasive hornet *Vespa velutina* and their impact on non-
309 target insects. *Apidologie*, *49*, 872-885.
310 Rosario, C.A., Otis, G.W., Miller, R.H., Groover-Landis, A.A., Stanley, E.S. & Mattila, H.R.
311 (2025). Predatory behavior, nesting habits, and impacts on honey bees (*Apis mellifera*) of an
312 invasive hornet (Vespa tropica) on the island of Guam. *Plos One*, *20*, e0332986.
313 Stanley, D.A., Msweli, S.M. & Johnson, S.D. (2020). Native honeybees as flower visitors and
314 pollinators in wild plant communities in a biodiversity hotspot. *Ecosphere*, *11*, e02957.
315

316 **Figure legends**

317 Figure 1. Trap design and dimensions used to capture the hornet wasp *Vespa orientalis*.



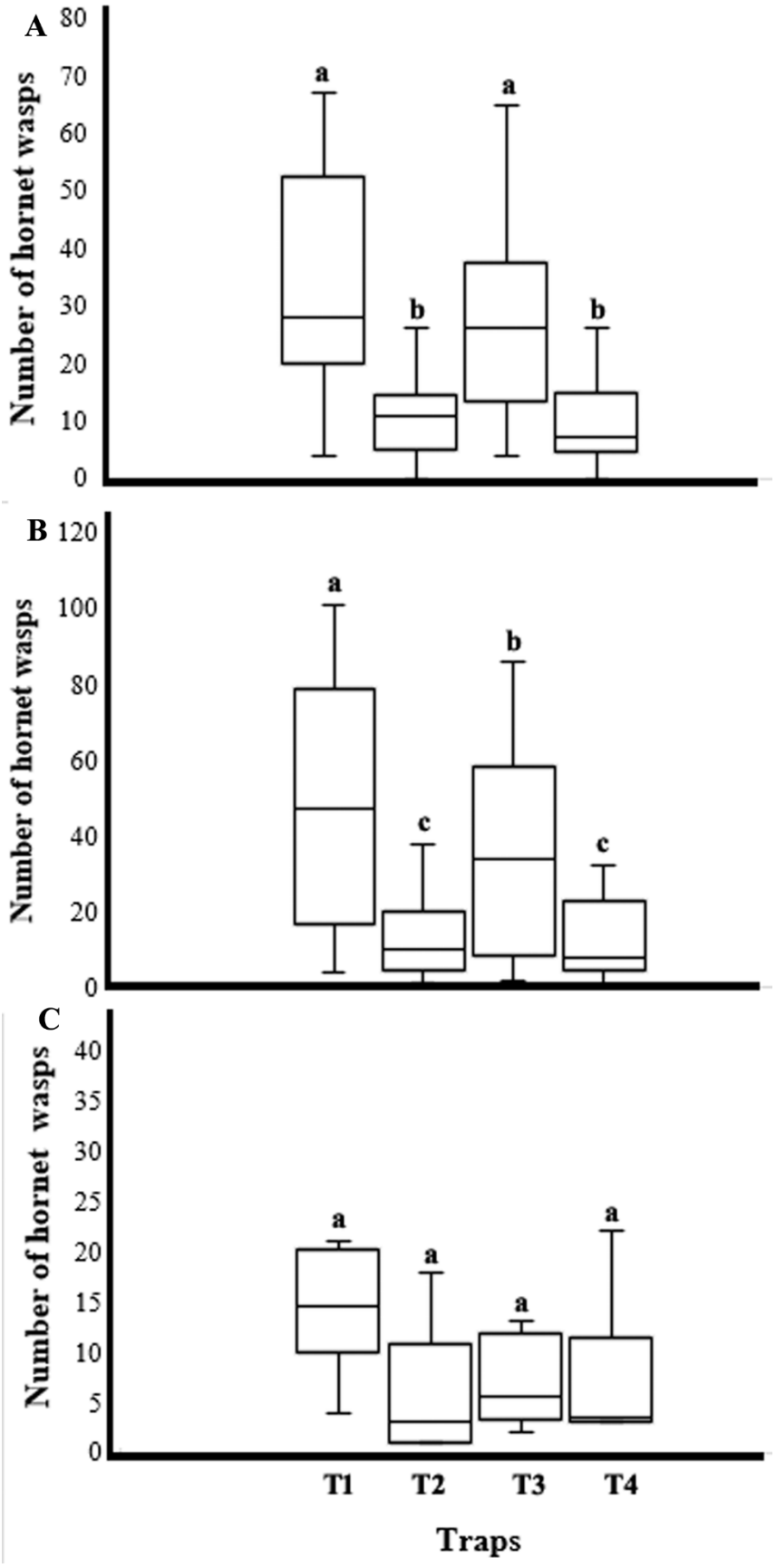

318

319 Figure 2. Number of hornet wasp *Vespa orientalis* captured in different traps (T1, T2, T3, and T4)

320 during seasons 2023-2025. **A)** Spring. **B)** Summer. **C)** Autumn. T1 (honey + sugar), T2 (sugar),

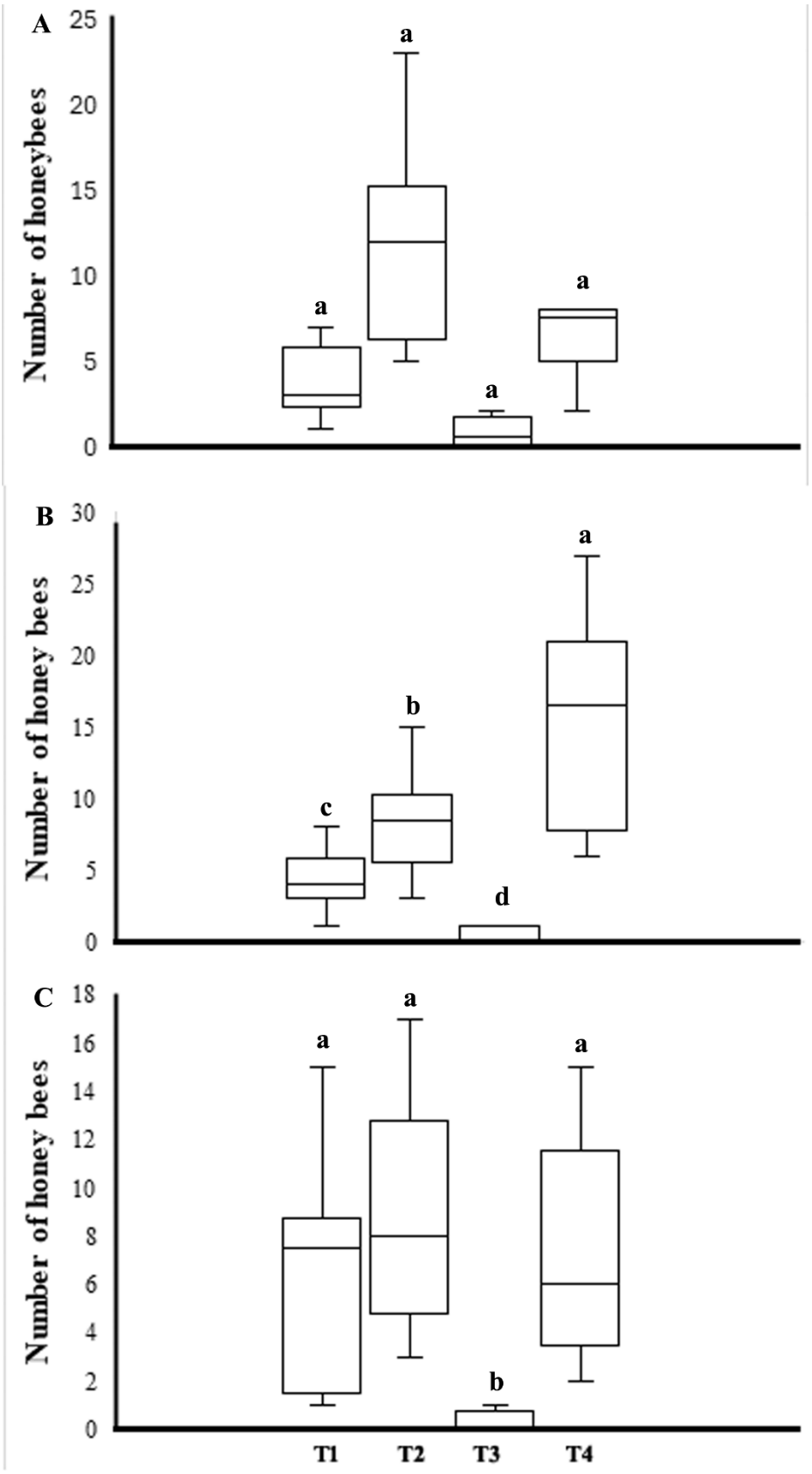
321 T3 (poultry meat), T4 (sugar + water + vinegar). Different letters indicate difference among traps

322 by Wilcoxon signed-rank test at 5% of significance level.


A
Number of hornet wasps
80
70
60
50
40
30
20
10
0
a
b
a
b
B
Number of hornet wasps
120
100
80
60
40
20
0
a
c
b
c
C
Number of hornet wasps
40
35
30
25
20
15
10
5
0
a
a
a
a
T1
T2
T3
T4
Traps

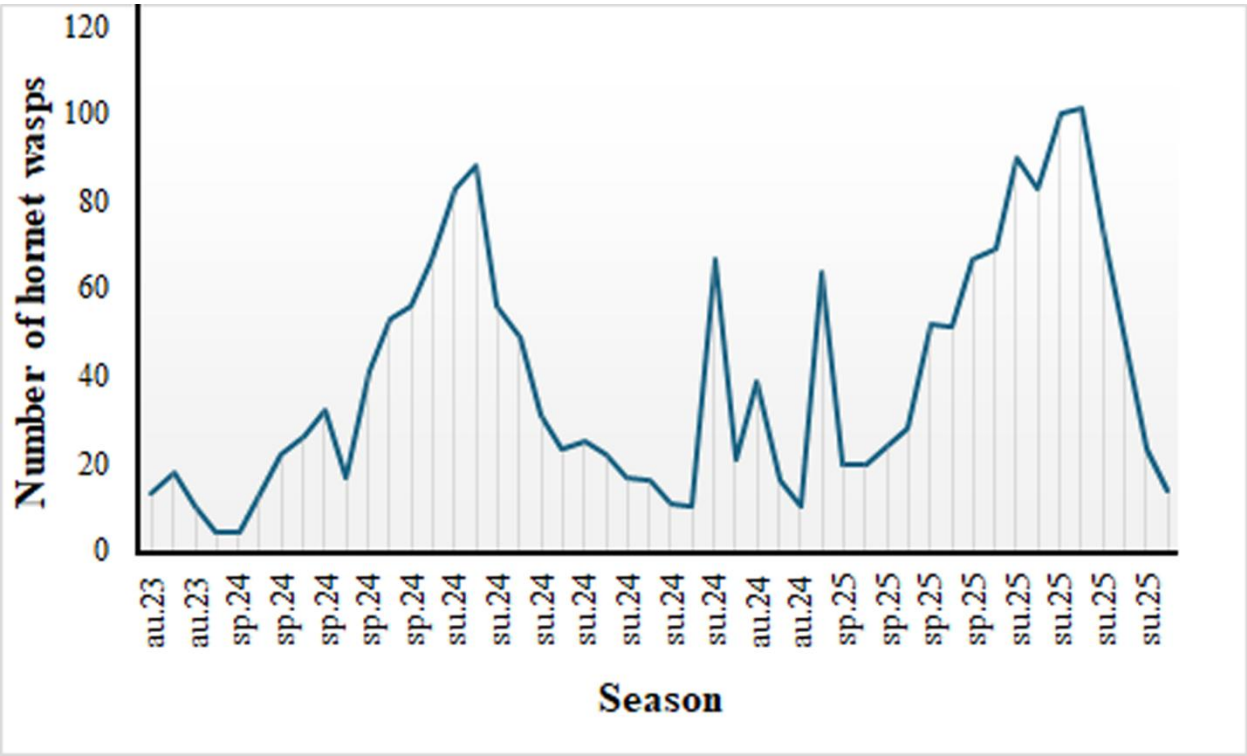
323

Figure 3. Number honey bee *Apis mellifera* captured in different traps (T1, T2, T3, and T4) during seasons 2023-2025. **A)** Spring. **B)** Summer. **C)** Autumn. T1 (honey + sugar), T2 (sugar), T3 (poultry meat), T4 (sugar + water + vinegar). Different letters indicate difference among traps by Wilcoxon signed-rank test at 5% of significance level.


A
Number of honeybees
25
20
15
10
5
0
a
a
a
a
B
Number of honey bees
30
25
20
15
10
5
0
a
b
c
d
C
Number of honey bees
18
16
14
12
10
8
6
4
2
0
a
a
a
b
T1
T2
T3
T4
Traps

328

Figure 4. Number of hornet wasp *Vespa orientalis* weekly captured during seasons 2023-2025. au.23 – autumn 2023, sp.24 – spring 2024, su.24 – summer 2024, au.24 – autumn 2024, sp.25 – spring 2025, su.25 – summer 2025.



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