Hexapoda (*Insecta indica*)
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# Pilot study of fall armyworm pheromone blend ratio response variation in field traps in two locations of Asia-Africa region

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**ABSTRACT**: The Fall Army Worm (FAW) presents an ideal model of intra-species specialisation among two alternative crop habitats as maize strain versus rice strain. Its recent invasion from Mexico via Africa into Asia and Pacific regions is reckoned as globally significant in terms of food production and sustainability of smallholder farming across the tropics.Since the two strains within FAW have also shown distinctness in the ratio of their pheromone blends, there is need to identify locally responsive blend ratios for different locations/regions in order to effectively detect/monitor their local populations in target countries which they have invaded.In this paper we illustrate the approach and initial lessons learnt in evolving such methodology as locally available kit for use by local practitioners. This research note is simply intended to share this vision and stimulate further collaboration so to build a self-supporting R&D network for sharing information leading to future model of kit-based detection of locally responsive blend ratios.

**Key words**: Fall army worm, pheromone trap, blend ratio, testing kit, R&D network

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## Introduction

Insect behaviour is under control of various chemical mediators, most of which fall into one of these groups: pheromones, allomones, kairomones, synomones and apneumones ((Nordlund, 1979). Insect sex pheromones are volatile chemicals that are secreted by one sex, mostly females, to attract other sex of the same insect species for mating (Carde *et al.,* 1975). Presently the global use of synthetic mimics of insect pheromones is of commercial significance and most successfully exploited pheromones are among the order Lepidoptera (moths and butterflies). Pheromone based traps are used extensively in detection and monitoring of invasive pest insect, besides local management of the pests by mass trapping, mating disruption, attract-and-kill, and push-pull are some of the pest control strategies that utilize the sex pheromone mimics of the target insect pests.

The sex pheromone of moth pests is known to be mostly a blend of two or more constituent molecules which are aldehydes and alcohols. Unebehend*et.al* (2014) have concluded that rice strain and maize strain of FAW-*Spodoptera frugiperda* both showed rather geographic than strain-specific differences in their response to pheromone lures (of alternative blend ratios), and that regional sexual communication differences might cause geographic differentiation between populations.

## Materials & Methods

The relative attractancy of the three pheromone components-Z-9-tetradecenyl acetate (Z-9-14Ac), Z-11-hexadecenyl acetate (Z-11-16Ac) and Z-7-dodecenyl acetate (Z-7-12Ac), in respective ratios as listed below were compared.

T1. 87.0:12.5:0.5
T2. 85.0:13.0:2.0
T3. 90.0:8.0:1.5
T4. 90.0:8.0:2.0
T5. 88.0:8.0:4.0
T6. 100.0:0.0:0.0

The pure blends were availed through R&D collaboration arrangement with Ms.Albero Biotech, Bangalore, India. They were individually impregnated in rubber septa @3mg loading using micropipette. The septa wrapped in aluminium foil were sent to the collaborating scientists in the two locations from Sun Agro Biotech Research Centre, Chennai, India, by air courier. The first location of field study was in Burkino Faso which had four replications. The second location was in Karnataka state in India (with single replication).In each location, a field of about one hectare maize crop was selected. The alternative blend lure treatments were kept in standard funnel traps. Ineach replicate the treatments were randomly placed at inter distance of 10 meters. The moth catches were recorded weekly, for 7 weeks in India and six weeks in Burkino Faso.

## Results

**In Burkino Faso:** The overall mean moth catches per trap were low in the six week study with 0.51.6 among the treatments. It was found that overall two blend ratios (T1and T2) were distinctly more

attractive, catching more than double the numbers than the least attractive treatment (T6). (Fig1).

The week-wise means of moth catches confirmed that T1 and T2 were consistently superior to T6, with more moth catches in at least 3 weeks (Fig.2).

**In India-Karnataka:**

The seven week study showed that overall T2 and T4 were superior catching about 50% more moths than T1, besides the superior ratios catching 2-3 times more moths than T3, T5 and T6 . (Fig3).

These preliminary results have shown that the superior blend ratios for male moth catches were similar for one blend ratio (T2) but differed for the next superior blend ratio(T1 versus T$) among the two locations. Evidently the differential pattern in blend ratio responses between the two locations has indicated the scope for geographically distinct populations can differ in relative blend ratio responses.

**Fig:1. Fall Armyworm moth catches among six pheromone blend ratios in Burkino Faso**

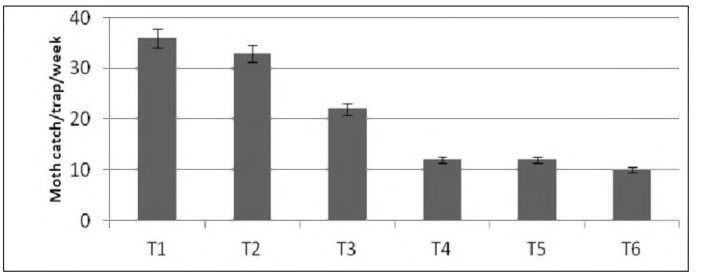



**Fig:2. Weekly pattern of Fall Armyworm moth catch in three treatments**

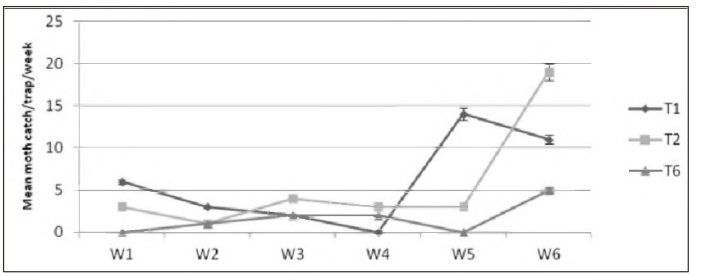
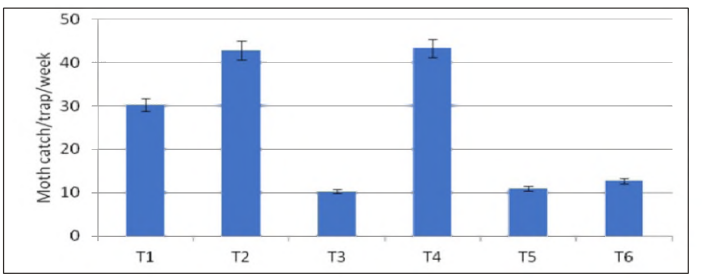



**Fig:3. Fall Armyworm moth catches among six pheromone blend ratios in India**




## Discussion

The present pilot study results have not only shown that the two geographical populations of FAW-*Spodoptera frugiperda* males tended to show contrasting response patterns among the six blend ratios tested. This is in line with such scope for optimization of pheromone blend ratios and components for different geographical populations of FAW as pointed out by Andrade *et.al* (2000),illustrating the local strategy needs for the Caribbean region .This is also in conformity with the findings of Unebehend *et.al* (2014) who had concluded that showed rather geographic than strain-specific differences in their response to pheromone lures( of alternative blend ratios), and concluded that regional sexual communication differences might cause geographic differentiation between populations.

Our present results are in support of the geographical variation in response to commercial lures for

FAW as reported also by Cruz-Esteban *et.al.*(2018)who found that binary combination of Z7-12Ac with Z9-14Ac significantly increased attraction and was at least 10 times more attractive to *S. frugiperda* in Costa Rica than North American or English lures. They also found that addition of Z11-16Ac to binary combinations of Z9-14Ac and Z7-12Ac marginally increased capture rates, while the optimized lure contained Z7-12Ac that is a component not previously reported in *S. frugiperda* from the Caribbean region.

Our findings are linked also the findings of Bhanu *et al.*, (2020) who have shown the same approach as relevant to identifying the most reliable blend ratio for local trapping of FAW in India. Our results are also comparable to the outcome of the most recent studies in Japan (Wakamura*et.al.*2021) using gas chromatography/mass spectrometry analyses of hexane extracts of abdominal glands of one hundred Okinawan females which revealed six candidate compounds for sex pheromone, (*Z*)-9-tetradecenyl acetate (Z9-14:Ac, ca. 6 ng/female), (*Z*)-11-hexadecenyl acetate, (*Z*)-11-tetradecenyl acetate, (*Z*)-7-dodecenyl acetate (Z7-12:Ac), (*E*)-9-dodecenyl acetate, and (*Z*)-9-tetradecen-1-ol at the ratio of 100:10:1.3:0.90:0.13:1.8, respectively, while only small numbers of males were captured with the original blend of these compounds, in the local Japanese location of Okinawa, compared to much more males being attracted to a 100:3 blend of Z9-14:Ac and Z7-12:Ac that had been suggested by others to be the most effective blend in a distant Florida population. Their study demonstrated similar scope to identify the most powerful as well as convenient local sex pheromone formulation to monitor *S. frugiperda* populations locally(a 100:1 blend of Z9-14:Ac and Z7-12:Ac),compared to the six blend composition found in local female glands.

In conclusion our present pilot studies lend support to the concept of evolving a kit-system for local blend ratio selection so to identify the locally most powerful as well as convenient sex pheromone formulation , not only Fall Army Worm but applicable to most other Lepidoptera with two or more pheromone constituents in their blend.

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## References

Andrade, R., Rodriguez, C., Oehlschlager, AC. 2000. Optimization of a pheromone lure for *Spodoptera frugiperda* (Smith) in Central America. *J. Brazilian Chem. Socie.* 11: 609613.

Bhanu, K.R.M., Mamatha, B. and Vinutha, B.M. 2020.Response of fall armyworm, *Spodoptera frugiperda* (J. E. Smith) to different pheromone blends under Indian environmental conditions. *Pest Management in Horticultural Ecosystems.* 61(1):55-62.

Carde, R.T., Baker, T. & Roelofs, W. L., 1975. Behavioural role of individual components of a multichemical attractant system in the Oriental fruit moth. *Nature*, 253: 348-339.

Cruz-Esteban, S., Rojas, J.C., Sánchez-Guillén, D. *et al.,* 2018.Geographic variation in pheromone component ratio and antennal responses, but not in attraction, to sex pheromones among fall armyworm

populations infesting corn in Mexico. *J. Pest. Sci.* 91, 973983 (2018). https://doi.org/10.1007/s10340-018-0967-z

Nordlund, D. A., 1979 - Classification of semio-chemicals as related to plant protection. Abstracts IX *Proc. International Congress of Plant Protection* (Washington, D. C., August 5-11), 355.

Unbehend, M., Hanniger, S., Vasquez, GM., Juarez, ML., Reisig, D., McNeil, JN., Meagher, RL., Jenkins, DA., Heckel, DG. & Groot, AT. 2014. Geographic variation in sexual attraction of *Spodoptera frugiperda* corn- and rice-strain males to pheromone lures. *PLoS ONE* 9(2): e89255. doi:10.1371/journal.pone.0089255.

Wakamura, S., Arakaki, N. & Yoshimatsu, Si.2021. Sex pheromone of the fall armyworm *Spodoptera frugiperda* (Lepidoptera: Noctuidae) of a "Far East" population from Okinawa, Japan. *Appl. Entomol. Zool.* 56, 1925 (2021). https://doi.org/10.1007/s13355-020-00703-9.