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Assessment of different methods of natural enemy collection in three different locations of Vijayapur district of Karnataka

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Abstract
We undertook comparative analysis of natural enemies in grape ecosystem in Vijayapur District of Karnataka during *rabi* season of 2016-17(October-April). Studies included three locations namely Vijayapur (Study area-1), Aliyabad (Study area-2) and Tikota (Study area-3) where in common agronomic practices were maintained but different plant protection measures for major insect pests. Natural enemies were collected through different methods *Viz.*, Herbivore induced plant volatile (HIPV), Yellow sticky trap (YST) and Sweep net (SN). A total of 1312.90 natural enemies were recorded from HIPV followed by a Yellow sticky trap (1078.38) and sweep net (674.44). The abundance was highest in HIPV (43.00 %) followed by a yellow sticky trap (35.00 %) and lowest in sweep net (22.00 %). HIPV method of collection was found significantly superior and on par with yellow sticky trap method in the collection of natural enemies belonging to families Coccinellidae, Syrphidae, Ichneumonidae, Pentatomidae and Miridae, Chrysopidae and Hemerobidae.

Keywords: assessment, grape, natural enemies, HIPV, YST, SN

1. Introduction
Grape (*Vitis vinifera* L.) is one of the most important fruit crop. Balikai and Kotikal (2003) recorded as many as 26 pests infesting grapevines in Northern Karnataka [3]. Mani *et al.* (2014) reported that overall 653 pests are known to damage the crop in different grape growing regions of the world. In India 100 pests are known to damage the crop in which 15-20 are very important [9].

The management of insect pests can be done through using chemical insecticides. But the adverse effects of insecticides have made the scientists to search for alternatives such alternative is Biological control which involves predators, pathogens and parasitoids.

Thus Conservation Biological Control (CBC) is a strategy that enhances guilds or communities of both specialist and generalist natural enemies is now viewed as a pest management strategy, very likely to improve crop protection. Another factor that has encouraged and enhanced the use of CBC in many crop systems is the availability and use of pesticides that are narrow-spectrum and safe to many beneficial insects and mites (James *et al*., 2004) [7].

Herbivore-induced plant volatiles (HIPVs) play an important role in plant defense by either attracting the natural enemies of the herbivores or by acting as feeding and/or oviposition deterrent. Yellow sticky traps are an important part of an Integrated Pest Management (IPM). Sweep netting sampling methods commonly used in agricultural arthropod surveys. No work is reported on the utilization of HIPVs in grape. Understanding how HIPVs influence natural enemies at larger spatial scales is crucial for our understanding of tritrophic interactions and sustainable pest management in agriculture. Hence, it is necessary to know about natural enemies conservation through different collection methods.

2. Materials and Methods
This study was carried out in the grape orchards of Vijayapur District of Karnataka state situated in Northern dry zone (Zone-3) between1602, latitude and 760 42, longitude with an altitude of 593.8 meters above the mean sea level. The total geographical area of the zone is 47.84 lakh ha out of which 36.63 lakh ha area is under cultivation. The most important characteristic feature of this zone is the lowest rain fall (Avg. 602mm) occurring in about 30-

30-35 rainy days. Both black and red soils are predominant in this zone with varying depths to large extent.

The natural enemies were collected by the following different methods to know the present status of natural complex on major pests of grapes during *rabi* season of 2016-17(October-April) on grape. Three fields were taken for experimentation (Vijayapur, Tikota and Aliyabad). Agronomic practices were common in these the fields as per the package of practices, but plant protection measures differed between the locations w.r.t doses of pesticides and also number of applications and timing of application.

In the present study, collection methods *Viz.*, Herbivore induced plant volatile, yellow sticky trapping and net sweeping were adopted to collect the natural enemies at regular weekly interval between October –April (2016-17).

2.1 Herbivore Induced Plant Volatile

The selected vine yards were divided in to five blocks of an area of 0.25 acre per each block with one hundred and fifty vines. An isolation distance of 50 m was maintained between each block. HIPV (Herbivore induced plant volatile) Methyl salicylate 99-100% (Lobal chemie) was delivered through saturated cotton wicks @ 4 wicks/block which was placed in small perforated plastic container. Four yellow sticky traps (YST) were maintained in each block of an area of 0.25 acre to trap the natural enemies adjacent to Herbivore induced plant volatile dispenser. Observations on natural enemies were made weekly interval and yellow sticky traps were replaced once in a week. HIPV was changed at 15 days interval during the entire study period (October –April 2016-17).

2.2 Yellow sticky trap

The traps used in the study were constructed from yellow sticky card uniformly coated with a thin layer of an adhesive compound mixture of synthetic hydro carbon polymers on both side. Observations on natural enemies was made weekly interval and yellow sticky traps were replaced once in a week. Four traps were used for each block of an area of 0.25 acre. Totally five blocks were used for the study. An isolation distance of 50m was maintained between each block. The collections were made between October- April 2016-17.

2.3 Net sweeping

Five orchards of 0.25 acre were selected for the study. Collections were made from triangular net, by sweeping minimum 15 times at each spot; sweeping was done on diagonal basis at regular interval. The sweep net designed and described by Noyes (1982) was used for collection.

The handle (aluminium) was about 1.0 m long with triangular head. The net bag made up of strong and durable white terylene with a very fine mesh that retain even the minute predators and parasitoid inside the net but allowing easy passage of air was used. After each sweep the insects were transferred into polythene bag and brought to lab and cotton dipped in the chloroform was put into the predators and parasitoids collected polythene bags for 10-15 minutes. The predators and parasitoids were stored and separated by using an aspirator and stored using suitable storage methods.

2.4 Preservation of natural enemies

Two categories of permanent preservations *viz.*, liquid preservation and dry preservation as described by Noyes (1982) were followed [11].

2.5 Statistical analysis

The field data averaged into respective parameter requisites was subjected to suitable transformation. After proper analysis, data was accommodated in the tables as per the need of the objectives for interpretation of results. Computer software excel was used for analysis. Paired t- test has been done for comparison of three different methods of collection (Herbivore induced plant volatile, yellow sticky trap and sweep net). Relative abundance of collected natural enemies is also for all study areas individually across all three study areas and collection methods.

3. Results and Discussion

3.1 Comparison of different methods of collection of natural enemies from grape ecosystem.

The total of 69.15, 136.25 and 274.85 coccinellids were collected in Vijayapur (Study area -1), Aliyabad (Study area -2) and Tikota (study area -3) respectively through herbivore induced plant volatiles. Similarly total of 50.80, 119.40, 235.80 were collected through yellow sticky trap and a total of 32.60, 91.20, 113.60 coccinellids were collected through sweep net.

The total of 45. 45, 54.90 and 67.20 syrphids were collected in Vijayapur (Study area -1), Aliyabad (Study area -2) and Tikota (study area -3) respectively through herbivore induced plant volatiles. Similarly total of 35.20, 42.20, 54.40 were collected through yellow sticky trap and a total of 14.00, 20.00 and 38.80 syrphids were collected through sweep net.

The total of 26.80, 56.35 and 67.00 ichneumonids were collected in Vijayapur (Study area -1), Aliyabad (Study area -2) and Tikota (study area -3) respectively through herbivore induced plant volatiles. Similarly total of 20.20, 45.50, 55.80 were collected through yellow sticky trap and a total of 8.80, 26.80, 43.20 were collected through sweep net.

The total of 56.30, 88.80 and 102.00 penatomid and mirid bugs were collected in Vijayapur (Study area -1), Aliyabad (Study area -2) and Tikota (study area -3) respectively through herbivore induced plant volatiles. Similarly total of 44.00, 69.80, 88.80 were collected through yellow sticky trap and a total of 15.60, 48.60, 66.00 were collected through sweep net.

The total of 66.95, 93.95 and 106.95 chrysopids and hemirobids were collected in Vijayapur (Study area -1), Aliyabad (Study area -2) and Tikota (study area -3) respectively through herbivore induced plant volatiles. Similarly total of 50.08, 81.00 and 85.20 were collected through yellow sticky trap and a total of 27.40, 60.60 and 67.20 were collected through sweep net.

The t-test was done to compare the collection methods and the results indicated that there was significant difference in trap collections between HIPV and SN with t value of 3.95, YST and SN with t value of 2. 24 and there was a non significant difference between HIPV and YST with t value of 1.76 from Vijayapur. Similarly in Aliyabad with t value of 3.59, 2.29 and 1.18 and in Tikota with t value of 6.21, 6.14 and 1.27 w. r. t Coleoptera, similar trend also observed in Diptera with t value of 6.22, 4.43 and 1.80 from Vijayapur and in Aliyabad with t value of 6.30, 4.20 and 2.00 and Tikota with t value of 4.20, 2.40 and 1.70 and similar results also in Hymenoptera with t value of 4.40 and 2.76 and 1.29 from Vijayapur and in Aliyabad with t value of 5.75, 3.74 and 2.01and Tikota with t value of 4.06, 2.07 and 1.79 and similar trend also w.r.t Hemiptera with t value of 7.13 and 4.91 and 1.82 from Vijayapur and in Aliyabad with t value of 4.40, 2.46 and 1.93

and in Tikota with t value of 3.35, 2.21 and 1.14 and in Neuroptera with t value of 5.85, 3.27 and there was a non significant difference between HIPV and YST with t value of 2.04 from Vijayapur. Similarly in Aliyabad with t value of 3.64, 2.14 and 1.34 and in Tikota significance differences between HIPV and SN with t value of 3.65and non significant difference between YST and SN, HIPV and YST1.49 and 1.90. (Table1).

3.2 Comparison of different methods of collection of families of natural enemies combined across all three locations

The total of 1312.90, 1078.38 and 674.44 natural enemies belonging to five orders and seven families were collected from three methods *Viz.*, Herbivore induced plant volatile, yellow sticky trap and sweep net respectively.

The t-test was done to compare the three methods collection for each family across three study areas and results indicated that there was a significant difference between collection methods with t value 2.44 for HIPV/YST, t value of 2.30 for YST/SN and t value of 2.36 for HIPV/SN This shows that herbivore induced plant volatile is superior over the yellow sticky trap and sweep net and yellow sticky trap is superior over sweep net method of collection.

3.3 Relative abundance of natural enemies combined across three locations

Totally 3055.34 natural enemies were collected across the three locations by all the three collection methods, out of which a total of 1312.90 natural enemies were recorded from HIPV followed by a Yellow sticky trap (1078.38) and sweep net (674.44). The abundance was highest in HIPV (43.00 %) followed by a yellow sticky trap (35.00 %) and lowest in sweep net (22.00 %) (Table 2).

Most biological control agents, including predators, parasitoids and spiders, at work in the agricultural and urban environments are naturally occurring ones, which provide excellent regulation of many pests with little or no assistance from humans. The existence of naturally occurring biological control agents is one reason that many plant-feeding insects do not ordinarily become economic pests. The importance of such agents often becomes quite apparent when pesticides applied to control one pest cause an outbreak of other pests because of the chemical destruction of important natural enemies. There is great potential for increasing the benefits derived from naturally occurring biological controls, through the elimination or reduction in the use of pesticides toxic to natural enemies (Wakeil *et al.*, 2013) [14].

Herbivore induced plant volatile method of collection was found significantly superior and on par with yellow sticky trap method in the collection of natural enemies belonging to families Coccinellidae, Syrphidae, Ichneumonidae, Pentatomidae and Miridae, Chrysopidae and Hemerobidae at study area-1, 2 and 3 respectively.

Totally 1312.90, 1078.38, 674.44 natural enemies belonging to five orders and seven families were collected across all the three study areas through HIPV, YST and SN respectively.

Herbivore-induced plant volatiles (HIPVs) constitute important cues for parasitoids and predators to find prey or hosts. This may be one of the reasons for the superiority of Herbivore induced plant volatile Methyl Salicylate over the other two methods of collection of natural enemies and present findings are supported by the below presented reports.

James *et al.* (2004) studied synthetic herbivore-induced plant volatiles (HIPV) as a cultural tool to enhance conservation biological control of insects and summarized a number of natural enemy species in the families, Chrysopidae, Hemerobiidae, Anthocoridae, Geocoridae, Miridae, Coccinellidae, Syrphidae, Braconidae, Empididae and Mymaridae which are attracted to sticky traps baited with aqueous methyl salicylate (MeSA), hexenyl acetate, farnesene or octyl aldehyde [7].

Herbivore-induced plant volatiles (HIPVs) constitute important cues for parasitoids and predators to find prey or hosts. Undamaged plants emit relatively low levels of volatiles. Upon herbivory, plants emit an induced blend of volatiles of different chemical classes produced through a variety of biosynthetic pathways. This blend is used by predators and parasitoids as a reliable and well-detectable cue to find herbivore-infested plants (Hare, 2011) [6].

The perception of herbivore induced plant volatile Methyl Salicylate is resulted in the collection of a more number of natural enemies compared to the other two methods of collection (Kessler and Heil, 2011) [8].

The present study is in corroboration with the results of Gadino *et al.* (2012) who reported that syrphidae and coccinellidae family natural enemies attracted to Methyl salicylate, an herbivore-induced plant volatile and also reported that when comparisons made between herbivore-induced plant volatile and yellow sticky cards, herbivore-induced plant volatile showed highest attraction [4].

Yavanna *et al*. (2017) opined that parasitoids and predators may be able to derive important information from HIPVs within this volatile mosaic, but they may be limited in their ability to detect HIPVs at larger spatial scales due to the chemical breakdown of chemical constituents, and mixing of odours from different sources. Furthermore, they may be limited in their ability to initiate directed movement towards these potential sources of hosts/prey, for example if wind speed exceeds the speed of movement [15].

Yellow sticky traps are an important part of an Integrated Pest Management (IPM) program. They are a useful tool to alert about the presence of certain insect pests and also about the presence of natural enemies. By using sticky cards, one can keep track of insect population trends, and make more informed and timely pest management decisions. They help in visual monitoring of both insect pests and natural enemies.

In the present study yellow sticky trap method of collection is found be next best method for natural enemy collection after HIPV. The present findings are also supported by the reports of Griffin (2000) [5], Similar results are also showed by Stephens and Losey (2004), who conclude that number of Coleopteran coccinellids were reported more in yellow sticky trap as compared to sweep net and visual sampling methods [12]. Andrew (2010) who reported that coccinellids were attracted towards yellow sticky card [1].

Angela *et al*. (2012) reported that yellow sticky traps were used to monitor key predator groups including Anthocoridae, Araneae, Coccinellidae and Syrphidae [2].

The current investigation results are similar to the findings of Syobodova *et al*. (2015) who reported that natural enemies like Syrphids, *Chrysoperla carnea* (Chrysopidae) and *Micromus variegatus* (Hemerobiidae) and Lady beetles (Coccinellidae) were collected with the use of yellow sticky traps [13].

Superiority of yellow sticky traps in attracting the natural enemies is attributed to the habitat and host detection orientation movements using visual cues like colours. This is

supported by reports of Michely *et al*., 2012 who reported that orientation using visual cues, principally colours, for habitat or host detection has been reported for several parasitoid families, such as Aphelinidae, Aphidiidae, Braconidae, Cynipidae, Encyrtidae, Ichneumonidae, and Pteromalidae [10].

Table 1: Comparison of different methods of collection of natural enemies* from grape ecosystem

Study area	Order	Natural enemies collected from three different methods					
		Total				t- value	
		HIPV	YST	SN	HIPV/YST	HIPV/SN	YST/SN
Vijayapur	Coleoptera	69.15	50.80	32.60	1.76	3.95	2.24
Aliyabad		136.25	119.40	91.20	1.18	3.59	2.29
Tikota		274.85	235.80	113.60	1.27	6.21	6.14
Vijayapur	Diptera	45.45	35.20	14.00	1.80	6.22	4.43
Aliyabad		54.90	42.40	20.00	2.00	6.30	4.20
Tikota		67.20	54.40	38.80	1.70	4.20	2.40
Vijayapur	Hymenoptera	26.80	20.20	8.80	1.29	4.40	2.76
Aliyabad		56.35	45.50	26.80	2.01	5.75	3.74
Tikota		67.00	55.80	43.20	1.79	4.06	2.07
Vijayapur	Hemiptera	56.30	44.00	15.60	1.82	7.13	4.91
Aliyabad		88.80	69.80	48.60	1.93	4.40	2.46
Tikota		102.00	88.80	66.00	1.14	3.35	2.21
Vijayapur	Neuroptera	66.95	50.08	27.40	2.04	5.85	3.27
Aliyabad Tikota		93.95	81.00	60.60	1.34	3.64	2.14

Table 2: Comparision of different methods of collection of families of natural enemies combined across all three locations and Relative abundance

Families	HIPV	YST	SN	Total
Coccinellidae	480.25	406	237.4	1123.65
Syrphidae	167.55	132	72.84	372.39
Ichneumonidae	150.15	121	78.8	349.95
Pentatomidae and Miridae	247.10	202	130.2	579.30
Chrysopidae and Hemerobidae	267.85	216	155.2	630.05
Total	1312.90 (43 %)	1078.38 (35 %)	674.44 (22%)	3055.34
Different methods	t- test	t-value	S/NS	
	HIPV/YST	2.44	S	
	YST/SN	2.30	S	
	HIPV/SN	2.36	S	

Figure in Parenthesis indicates relative abundance of natural enemies

4. Conclusion

Among the three methods of collection HIPV was found to be significantly superior over yellow sticky trap and sweep net method. Sweep net collection was found to be significantly inferior in collection of natural enemies of grapes in three study areas. Relative abundance of natural enemies across three locations for each method of collections also showed variation.

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6. References

1. Andrew MS. The Feasibility of using *Psyllobora vigintimaculata* (Coleoptera: Coccinellidae), a Mycophagous Ladybird Beetle, for Management of Powdery Mildew Fungi (Erysiphales). Ph. D thesis., Univ. of California. 2010, 130-200.
2. Angela N, Gadino S, Vaughn M, Walton V, Lee JC. Evaluation of methyl salicylate lures on populations of *Typhlodromus pyri*. Biological Control. 2012; 63:48-55.
3. Balikai RA, Kotikal YK. Pest status of grapevine in northern Karnataka. Agricultural Science Digest. 2003; 23(4):276-27.
4. Gadino A, Walton V, Jana CL. Evaluation of methyl salicylate lures on populations of *Typhlodromus pyri* (Acari: Phytoseiidae) and other natural enemies in western Oregon vineyards. Biological Control. 2012; 63:48-55.
5. Griffin. Ovipositional behavior of the 12-spotted lady beetle, *Coleomegilla maculata*: choices among plant species and potential factors influencing those choices. *Master's Thesis*, Uni. of Kentucky, 2000, 279.
6. Hare JD. Ecological role of volatiles produced by plants in response to damage by herbivorous insects. Annual Review of Entomology. 2011; 56:161-180.
7. James DG, Sandra CC, Grasswitz T, Victor R. Using synthetic herbivore-induced plant volatiles to enhance conservation biological control: field experiments in hops and grapes. Paper presented In: Second International Symposium on Biological Control of Arthropod. 2004; 193-293.
8. Kessler A, Heil K. Evolutionary ecology of plant defences: The multiple faces of indirect defences and their agents of natural selection. Functional Ecology. 2011; 25:348-357.
9. Mani M, Shivaraju C, Srinivasa RM. Pests of grapevine. A worldwide list. 2014; 20(2):170-216.
10. Michely F, Santos de AL, Maria CB. Influence of visual cues on host searching and learning behaviour of the egg parasitoids, *Telenomus podisi* and *Trissolcus*. Entomologia Experimentalis et Applicata. 2012; 2(4):222-225.
11. Noyes JS. Collecting and preserving chalcid wasps (Hymenoptera: Chalcidoidea). Journal of Natural History. 1982; 16:315-334.
12. Stephens EJ, Losey JE. Comparison of sticky cards, visual and sweep sampling of coccinellid populations in Alfalfa. Environmental Entomology. 2004; 33(3):535-539.
13. Syobodova Z, Oxans SH, William DH, Hussein MH, Sehnal S. Risk assessment of genetically engineered maize resistant to *Diabrotica spp*: Influence on above-ground arthropods in the Czech. Republic Plos One.

2015; 7:17-20.
14. Wakeil N, Gaafar N, Ahmed S, Volkmar. Side effects of insecticides on natural enemies and possibility of their integration in plant protection strategies. Chemical Ecology. 2013, 953-978.
15. Yavanna A, Felix JJ, Bianchi A, Werf W, Poelman EH, Dicke M. Herbivore-induced plant volatiles and tritrophic interactions across spatial scales. New Phytologist. 2017; 8:111-144.