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农业创新论坛

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Abstract The purpose of this study was to determine the effect of a 12-week, low-intensity, supervised walking program on the physical and psychological health of sedentary, middle-aged women. The study was a randomized, controlled trial. The subjects were 40 sedentary, middle-aged women who were randomly assigned to either a supervised walking program or a control group. The walking program consisted of 12 weeks of walking, 3 times per week, for 30 minutes per session. The control group consisted of 20 women who did not participate in the walking program. The subjects were assessed at baseline and at 12 weeks. The walking program had a significant positive effect on the physical and psychological health of the subjects. The walking program significantly improved the subjects' physical health, as measured by the 6-minute walk test, the 10-minute step test, and the 12-minute step test. The walking program also significantly improved the subjects' psychological health, as measured by the Beck Depression Inventory, the State-Trait Anxiety Inventory, and the Zung Depression Index. The walking program had no significant effect on the subjects' weight, body mass index, or blood pressure. The walking program had a significant positive effect on the subjects' quality of life, as measured by the SF-36. The walking program had a significant positive effect on the subjects' self-esteem, as measured by the Rosenberg Self-Esteem Scale. The walking program had a significant positive effect on the subjects' self-efficacy, as measured by the General Self-Efficacy Scale. The walking program had a significant positive effect on the subjects' self-motivation, as measured by the Self-Motivation Scale. The walking program had a significant positive effect on the subjects' self-regulation, as measured by the Self-Regulation Scale. The walking program had a significant positive effect on the subjects' self-control, as measured by the Self-Control Scale. The walking program had a significant positive effect on the subjects' self-discipline, as measured by the Self-Discipline Scale. The walking program had a significant positive effect on the subjects' self-assertiveness, as measured by the Self-Assertiveness Scale. The walking program had a significant positive effect on the subjects' self-confidence, as measured by the Self-Confidence Scale. The walking program had a significant positive effect on the subjects' self-respect, as measured by the Self-Respect Scale. The walking program had a significant positive effect on the subjects' self-worth, as measured by the Self-Worth Scale. The walking program had a significant positive effect on the subjects' self-esteem, as measured by the Self-Esteem Scale. The walking program had a significant positive effect on the subjects' self-efficacy, as measured by the Self-Efficacy Scale. The walking program had a significant positive effect on the subjects' self-motivation, as measured by the Self-Motivation Scale. The walking program had a significant positive effect on the subjects' self-regulation, as measured by the Self-Regulation Scale. The walking program had a significant positive effect on the subjects' self-control, as measured by the Self-Control Scale. The walking program had a significant positive effect on the subjects' self-discipline, as measured by the Self-Discipline Scale. The walking program had a significant positive effect on the subjects' self-assertiveness, as measured by the Self-Assertiveness Scale. The walking program had a significant positive effect on the subjects' self-confidence, as measured by the Self-Confidence Scale. The walking program had a significant positive effect on the subjects' self-respect, as measured by the Self-Respect Scale. The walking program had a significant positive effect on the subjects' self-worth, as measured by the Self-Worth Scale.

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1. 凡在本行开立存款账户的客户，均可向本行申请开立定期存款账户。

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绿盲蝽越冬卵在葡萄园中的空间分布型和抽样技术研究

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摘 要:分别采用频数比较法、6种聚集度指数、Taylor幂法则和Iwao回归方程分析了酿酒葡萄园中绿盲蝽(*Apolygus lucorum*)越冬卵的空间分布型,并对绿盲蝽越冬卵聚集的原因及理论抽样数进行了分析和计算。结果表明:绿盲蝽越冬卵在酿酒葡萄园区的空间分布格局为聚集分布,且越冬卵密度越高,分布越聚集。利用Iwao回归方程和Taylor幂法则检验,可以看出绿盲蝽越冬卵分布的基本成分是个个体群,个体之间相互吸引,并且聚集度与种群密度有较大的关系。聚集均数(λ)与平均密度($\bar{x}$)线性回归方程为 $\lambda = 0.931x + 0.1841$ ($r = 0.9405$)。绿盲蝽越冬卵在不同密度下,聚集均数 λ 均小于2,表明酿酒葡萄园中绿盲蝽越冬卵的种群聚集主要是由环境作用引起。结合田间调查,聚集分布的原因可能受葡萄园生长期、葡萄冬芽鳞片疏密、种群密度等环境因素影响。利用绿盲蝽越冬卵空间分布型参数建立Iwao理论抽样数模型,可以确定不同虫口密度下绿盲蝽越冬卵的理论抽样数,为今后准确预测绿盲蝽越冬卵在葡萄园内的密度提供了理论依据。研究结果不仅丰富了绿盲蝽越冬卵在酿酒葡萄园上的空间分布格局和抽样技术相关内容,也为早春酿酒葡萄园中绿盲蝽的预测预报及防治策略的制定提供重要依据。

关键词:绿盲蝽;越冬卵;酿酒葡萄;空间分布型;抽样技术

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Spatial Distribution and Sampling Technique of the Overwintering Eggs of *Apolygus lucorum* in the Vineyard

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Abstract: This paper used the frequency distributions, six aggregation indexes, Taylor power rule and Iwao's regression equation to analyze the spatial distribution pattern of the overwintering eggs of *Apolygus lucorum* in the vineyard. In addition, the aggregation reason of the overwintering eggs of *Apolygus lucorum* was analyzed and the theoretical sampling number was calculated. The results showed that the spatial distribution pattern of the overwintering eggs of *Apolygus lucorum* in the vineyard was aggregation distribution, and the higher the density of overwintering eggs, the more aggregation the distribution. Using the Iwao regression equation and Taylor power rule tests, it could be found that the basic component of the distribution of *Apolygus lucorum* overwintering eggs was the individual group, which attracted each others, and its aggregation degree had a great relationship with the mean density. The linear regression equation of mean aggregation number (λ) and average density ($\bar{x}$) was $\lambda = 0.931x + 0.1841$ ($r = 0.9405$). Under different densities, the mean aggregation number (λ) was less than 2, which indicated that the mean aggregation of

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the overwintering eggs of *Apolygus lucorum* was mainly caused by the effect of environment. Combined with the field investigation, the environmental factors such as the growth of grapevines, the density of winter buds scales, and the worm density may be the reasons for the aggregation and distribution of the overwintering eggs of *Apolygus lucorum*. The two theoretical sampling number model was established by using the spatial distribution parameters of the overwintering eggs of *Apolygus lucorum*, which could determine the theoretical sampling number of the overwintering eggs of *Apolygus lucorum* under different worm density, and provided a theoretical basis for the accurate prediction of the density of the overwintering eggs of *Apolygus lucorum* in the vineyard in the future. The results not only enriched the spatial distribution pattern and sampling technology of the overwintering eggs of *Apolygus lucorum* on wine grape, but also provided a reference for the prediction and control of *Apolygus lucorum* in early spring wine vineyard.

Key words: *Apolygus lucorum*; overwintering eggs; wine grape; spatial distribution patterns; sampling techniques

绿盲蝽(*Apolygus lucorum*)属半翅目盲蝽科,是葡萄的主要虫害之一,为害时间早且长,并且在葡萄整个生育期都很活跃,严重影响葡萄的生长发育,给果农带来重大的经济损失^[1]。葡萄生长点被刺吸后会很快干枯,导致葡萄枝条停止生长;葡萄嫩叶受害后,叶面上会有许多刺吸点,随着叶片的不断生长,形成不规则、皱缩的孔洞,影响葡萄植株的长势;葡萄花蕾和果粒受害后不仅会影响葡萄品质,也会使葡萄的产量降低^[2]。近几年,随着葡萄种植面积不断扩大,绿盲蝽在葡萄种植上的影响也愈加严重,并有逐渐加重的趋势^[3],因此要加强绿盲蝽在葡萄种植上的防控,不仅仅是防控绿盲蝽成虫,对绿盲蝽越冬卵、若虫和蛹也要进行了解,针对绿盲蝽各个虫期制定相对应的防控措施,以提供最适宜且绿色的管理方案。

不同生物个体所需的空间大小和性质都有一定差异,这些个体在空间的布局称为种群空间分布格局。昆虫种群的空间分布结构是种群基本特征之一,是在确定是否需要采取防治措施以及决定何时防治时必需具备的知识。通过种群空间分布结构可以确定某一昆虫的抽样方法,掌握不同时期的虫口密度、危害程度等,从而对害虫进行更精确的预测预报及防控^[4]。

目前,绿盲蝽在枣树^[5]、茶^[6]、棉花^[7]等作物上的种群空间分布型已有研究,但在葡萄上的种群空间分布型鲜有报道。因此,本文对绿盲蝽越冬卵在酿酒葡萄园中的空间分布型及抽样技术进行了研究,确定绿盲蝽越冬卵的空间分布格局和不同越冬卵密度下葡萄园中各芽的最佳抽样数,旨在为今后葡萄园中绿盲蝽的绿色防控和抽样调查提供参考依据。

1 材料与方法

1.1 试验地概况

试验调查地位于河北省秦皇岛市昌黎县城北的华夏葡萄种植基地,样地面积约1 hm²。本地属季风区,年均气温11℃;降水较多,年均降水量628.33 mm;无霜期长,平均约186 d。酿酒葡萄品种为赤霞珠(*Cabernet sauvignon*)。

1.2 调查方法

于2019年10月15日采用平行线取样法进行田间取样,对华夏葡萄种植基地种植的酿酒葡萄进行调查并记录数据。在酿酒葡萄园内随机选取1个行区,共取10个行区,每行区随机选取100个萌芽,对所选取的萌芽进行调查并详细记载每个芽上绿盲蝽越冬卵的数量。

1.3 分布型测定

1.3.1 频数比较法 利用频数比较法判断绿盲蝽越冬卵在葡萄园中的空间分布型。将算出的理论频数值与调查分析得出的实际频数值进行卡方(χ^2)检验,确定绿盲蝽越冬卵在葡萄园中的空间分布型^[8-9]。 χ^2 检验时要注意, N 要是够大,理论频数不可以小于5,可将小于5的各项理论频数合并,合并后的理论频数要大于5。

$$\textcircled{1} \text{ 检验公式为 } \chi^2 = \sum \frac{(f - f_0)^2}{f_0}$$

式中, f 为实际频数, f_0 为理论频数。

②泊松分布(Poisson distribution):该分布一般用来描述某一个种群呈随机分布。该分布的理论公式如下,

$$P_k = \frac{e^{-m} m^k}{k!} \quad (k \geq 0)$$

$$P_0 = e^{-m} \quad (k=0)$$

式中, P_k 表示概率, m 为总平均数, $e=2.718$ 。

r 为各抽样单位内绿盲蝽越冬卵数($r=0,1,2,3,\dots$)。

③奈曼分布(Neyman):这种分布呈核心分布,种群个体形成很多大小核心,核心之间的关系是随机的,其公式如下。

$$P_r = \{m_1, m_2, e^{-m_2}/r\} \sum_{j=0}^{r-1} m_1^j p_{r-j-1}/j! \quad r>0$$

$$P_0 = e^{-m_1(1+m_2)} \quad r=0$$

式中, $m_1 = m^2/(S^2 - m)$, $m_2 = S^2/m - 1$, S^2 为方差, $r=0,1,2,\dots$, $j=0,1,2,\dots,r-1$

④负二项分布:该分布和奈曼分布同样为聚集分布,其中负二项分布的特点主要是种群个体之间不会形成核心,其理论公式^[16]如下。

$$P_r = \{k+r-1\}! Q^{k-r} p^r / [k! (k-1)!] \quad r>0$$

$$P_0 = Q^k \quad r=0$$

式中, $p = S^2/m - 1$, $k = m/p$, $Q = p + 1 = S^2/m$, S^2 为方差, $r=0,1,2,3,\dots$ 。

1.3.2 聚集度指标法 选用6种聚集度指标对绿盲蝽越冬卵的空间分布型进行测定^[16-18],各聚集指标见表1。

表1 聚集度指标

Table 1 Aggregation index

指标 Index	空间分布型 Spatial distribution pattern		
	均匀 Uniform	随机 Random	聚集 Aggregated
块状性指标 χ^2/λ	$\chi^2/\lambda < 1$	$\chi^2/\lambda \approx 1$	$\chi^2/\lambda > 1$
丛生指数 I	$I < 0$	$I \approx 0$	$I > 0$
平均拥挤度 L	$L_0/\lambda < 1$	$L_0/\lambda \approx 1$	$L_0/\lambda > 1$
聚集度指标 C_s	$C_s < 0$	$C_s \approx 0$	$C_s > 0$
扩散系数 C	$C < 1$	$C \approx 1$	$C > 1$
负二项分布指标 K	$K < 0$	$K \approx -\infty$	$K > 0$

1.3.3 回归分析法 ①Taylor 幂法则回归模型^[17-18]: $\log S^2 = \log a + b \log x$ 。

式中, S^2 为方差; a 为各行区越冬卵的平均数量; b 为多样统计因素; b 是当平均密度增加时, 方差的增长率。

② χ^2/λ 回归模型^[17-18]: $\chi^2 = \alpha + \beta x$ 。

式中, α 是 χ^2 轴上的截距, β 是回归斜率。

1.4 聚集原因

利用种群聚集均值(λ)来分析范围内绿盲蝽越冬卵的聚集原因。聚集均值计算公式^[19-20]如下。

$$\lambda = x + r/2k$$

当 $\lambda < 1$ 时, 聚集是由环境条件引起的; 当 $\lambda \geq 1$ 时, 聚集原因是由环境条件和昆虫本身聚集习性共同作用或其中一个因素引起。

1.5 理论抽样数

根据 Taylor 幂法则来确定理论抽样数 N , 计算公式^[17-18]如下。

$$N = r^2/D^2 \times \left(\frac{1}{b} + 1 \right) + b - 1$$

式中, r 为一定置信度下的 t 分布值($r=1$), D

为允许误差, α, β 为引入的参数。

1.6 数据处理

采用 DPS 7.05 和 Excel 2010 软件进行数据分析。

2 结果与分析

2.1 绿盲蝽越冬卵频次比较结果

绿盲蝽越冬卵各分布生理论频次的检验结果见表2。由表2可以看出, 聚集分布卡方检验值均小于1, 即聚集分布的实际频次和理论频次检验结果差异不显著。因此, 范围内绿盲蝽越冬卵的分布属于核心聚集分布, 种群个体形成很多大小核心。

2.2 聚集度指标测定与分析结果

本研究采取了6种聚集度指标来测定绿盲蝽越冬卵的空间分布型, 结果见表3。由表3可以看出, 10个行区的平均拥挤度 $L > 0$, 丛生指数 $I > 0$, 块状性指标 $\chi^2/\lambda > 1$, 聚集度指标 $C_s > 0$, 扩散系数 $C > 1$, 负二项分布指标 $K > 0$ 。从以上6种聚集度指标可以看出, 10个

表2 绿盲蝥越冬卵各分布型理论频次的 χ^2 检验Table 2 χ^2 test of distribution patterns theoretical frequency for *Apolytus lacunum* overwintering eggs

样方卵数 Quadrat egg number	实际频数 Actual frequency	理论频数 Theoretical frequency			卡方值 Chi square value		
		泊松 Poisson	奈曼 Neyman	负二项 Negative binomial	泊松 Poisson	奈曼 Neyman	负二项 Negative binomial
0	812	630.00	819.00	776.00	52.58	0.06	1.67
1	58	291.06	51.33	119.59	186.62	0.87	31.72
2	58	67.23	52.88	49.06	1.27	0.60	1.63
3	31	11.71	37.39	24.32	31.81	1.09	1.84
4	27		20.90	13.09		1.28	14.77
5	9		10.19	7.38		0.14	0.35
6	2		8.50	10.55		4.79	6.93
7	0						
8	0						
9	0						
10	3						
Σ	1 000	1 000	1 000	1 000	372.27	9.22	58.91
自由度 Degree of freedom					$n-2=2$	$n-3=4$	$n-3=4$
概率 Probability					$P<0.01$	$P>0.05$	$P<0.01$
适合程度 Appropriateness					不适合 Inappropriate	适合 Appropriate	不适合 Inappropriate

表3 绿盲蝥越冬卵的聚集度指数

Table 3 Aggregation index of *Apolytus lacunum* overwintering eggs

行名 Row area	a	a^2	a^3	F	a^2/F	C_1	C	F_0/a	K	λ
1	0.68	1.5	2.04	1.16	2.31	1.51	2.16	1.61	0.76	0.26
2	0.87	1.68	1.71	0.93	2.07	1.07	1.93	1.55	0.94	0.64
3	0.73	1.25	1.45	0.72	1.98	1.98	1.72	1.57	0.92	0.61
4	0.52	1.12	1.68	1.16	3.23	3.23	2.16	2.03	0.45	0.15
5	0.34	0.96	2.15	1.81	6.33	3.33	2.81	2.90	0.19	0.07
6	0.19	0.71	2.91	2.72	15.30	14.30	3.72	4.85	0.07	0.01
7	0.47	1.06	1.96	1.53	4.65	3.65	2.53	3.44	0.21	0.11
8	0.32	0.76	1.71	1.39	5.33	4.33	2.39	2.81	0.25	0.09
9	0.16	0.47	2.07	1.91	12.93	11.93	2.91	5.13	0.08	0.01
10	0.19	0.6	2.54	2.15	12.40	11.40	3.15	4.60	0.10	0.01

行区的绿盲蝥越冬卵的空间分布型均为聚集分布。

2.3 图形分析结果

由回归方程结果(表4)可以看出, $\alpha = 2.38720 > 0$, $\beta = 1.8188 > 1$, 结合 Jones 提出的 χ^2/F 模型, $\alpha > 0$ 说明绿盲蝥越冬卵个体间相互吸引且分布的基本成分是个体的, $\beta > 1$ 说明种群呈聚集

分布; $\log \alpha = 0.26093 > 0$, $\log \beta = 1.07405 > 1$, 结合 Taylor 的经验公式, $\log \alpha > 0$, $\log \beta > 1$ 表明绿盲蝥越冬卵在假若定面积园区中为聚集分布, 并且聚集度与其种群密度有关, 密度越高, 分布越聚集。

2.4 聚集原因分析

图1显示, 对聚集均值(λ)与平均密度($\bar{x}$)进

等多个环境因素影响。

本研究基本明确了绿盲蝽越冬卵在华夏葡萄园中的分布规律,通过研究其空间格局,进一步了解了葡萄园中绿盲蝽越冬卵的种群特征、种内和种间关系以及种群与环境关系;并通过最适抽样公式的计算,为今后准确预测绿盲蝽越冬卵在葡萄园内的密度提供了理论依据。在制定合适的葡萄冬芽抽样方案的同时,可降低人力物力,方便田间调查。本研究结果为预测早春酿酒葡萄园中的绿盲蝽是否需防治、制定适当的调查方法以及采取合适的防治措施等提供了一定的依据,对提高葡萄园中葡萄的产量和品质具有重要的意义。

参考文献

- [1] 傅宇池,王琦,刘金山.绿盲蝽在葡萄上的发生规律及防治对策[J].果农之友,2014(10):25-26.
- [2] 李林恩,门兴元,叶保华,等.果树盲蝽的发生与防治技术[J].应用昆虫学报,2012,49(3):793-801.
- [3] LI L N, MEN X Y, YE B H, et al. Occurrence and management of fruit aridid [J]. Chin. J. Appl. Entomol., 2012, 49(3): 793-801.
- [4] 高运超,张敬珍,何建伟,等.绿盲蝽在葡萄上的发生规律及防治技术[J].河北农业科技,2013(6):38.
- [5] 张秀梅,刘小京,陈国江.绿盲蝽越冬卵在枣树上的空间分布型研究[J].应用昆虫学报,2006(3):127-129.
- [6] ZHANG X M, LIU X J, YANG Z J. Studies on the spatial distribution pattern of *Lygus lucorum* Meyer-Eu's over winter eggs in zaozhu trees [J]. Chin. J. Econ-Agric., 2006(3): 127-129.
- [7] 李琪,王德鑫,罗元海.黄板对茶园宋代绿盲蝽种群动态及空间分布型的影响[J].茶叶,2013,39(3):134-136.
- [8] 高, WANG M X, SHAO Y H. Influence of yellow sticky trap on green plant bug population dynamics and spatial distribution [J]. J. Tea, 2013, 39(3): 134-136.
- [9] 郑亚杰,陆震群,吴孔祥.棉田绿盲蝽的空间分布型及其抽样模型[J].应用昆虫学报,2012,49(3):605-609.
- [10] JIAO Z B, LI Y H, HUO K M. Spatial distribution of *Spodoptera litura* in cotton fields [J]. Chin. J. Appl. Entomol., 2011, 48(3): 605-609.
- [11] 张宇霖.昆虫生态及预测预报[M].第3版.北京:中国农业出版社,1995.
- [12] 杜远明,陈斯立,罗静华,等.三洲梨期次比较试验项目以及葡萄盲蝽幼虫空间分布格局[J].昆虫学报,2011,54(6): 960-966.
- [13] GUO Q, CHEN S L, LIU Q H, et al. A study on the spatial distribution pattern of *Epiphyas abnormis* (Lepidoptera: Hepialidae) larvae for counter-comparison frequency method [J]. Asia Entomol. Sci., 2011, 26(3): 560-565.
- [14] 刘凯翔,曹敏,白云为,等.山地苹果园苹果实蝇空间分布及抽样技术[J].南京林业大学学报(自然科学版),2019,43(3): 23-27.
- [15] LIU K X, CAO X, JU Y W, et al. Spatial distribution pattern and sampling technique of *Sphenodoptera sternalis* on *Carya ilicifolia* [J]. J. Nanjing Forestry Univ. (Nat. Sci.), 2019, 43(3): 23-27.
- [16] 胡美华,于磊磊,葛秋峰,宋玉安.二点委夜蛾种群空间分布型及抽样技术研究[J].中国植保导刊,2012,32(11): 39-42.
- [17] 杨秀好.棉蚜虫生态学特性的研究[D].北京:北京林业大学,博士学位论文,2013.
- [18] YANG X H. Studies on the bio-ecological characteristics of *Eucalliptus signifer* Walker (Lepidoptera: Hepialidae) [D]. Beijing: Beijing Forestry University, Doctor Dissertation, 2013.
- [19] 丁育群.昆虫生态学[M].北京:科学出版社,1994.
- [20] 李召波,夏涛,王应清,等.晚木蠹蛾幼虫的空间分布型及抽样技术研究[J].云南农业大学学报(自然科学),2019,34(4): 597-602.
- [21] LI Z B, XIA T, WANG Y Q, et al. Research on the spatial distribution pattern and sampling technique of *Neodactylus* *Walk* larvae [J]. J. Yunnan Agric. Univ. (Nat. Sci.), 2019, 34(4): 597-602.
- [22] 牛康杰,王娟,严善春,等.两种刺蛾幼虫空间分布型及抽样技术[J].东北林业大学学报,2019,47(7): 103-107.
- [23] NIU B J, WANG Q, YAN S C, et al. Spatial distribution pattern and sampling technique for two species of *Dactyloctenium* larvae [J]. J. Northeast Forestry Univ., 2019, 47(7): 103-107.
- [24] 熊志平,郑超,李亚强,等.透翅蛾幼虫在松林害虫上的空间分布型及抽样技术[J].江苏农业科学,2016,44(9): 152-154.
- [25] 王勇,王小强,张德强,等.凉山会田葡萄园 MSD 蝽种或田间分布型及抽样技术研究[J].植物保护,2018, 44(2): 129-133.
- [26] WANG Y, WANG X Q, PU D Q, et al. Spatial distribution pattern and *Neodactylus* *Walk* MSD adults in tobacco fields in Luoshuihan and sequential sampling technique [J]. Plant Prot., 2018, 44(2): 129-133.
- [27] 刘凯翔,傅春玲,李和,等.棉飞虱成虫在棉花害虫上的空间分布型及抽样技术[J].应用昆虫学报,2019,56(3): 588-594.
- [28] YAN X F, PU T X, LI G, et al. Spatial distribution of *Scaphium* *scaphium* adults and sampling technique for this species in the regular growing region of *quercus* *Shanxi* [J]. Chin. J. Appl. Entomol., 2019, 56(3): 588-594.
- [29] 曹武雄,田明亮,董通,等.凉山会田葡萄园和油橄榄的空间分布型及抽样技术[J].应用昆虫学报,2018,45(3): 588-590.
- [30] LI W F, LAN M X, XIA T, et al. Spatial distribution pattern and sampling technique for larvae and adults of *Phaenocarpa* *scaphium* [J]. J. Southern Agric., 2018, 49(5): 694-698.
- [31] 杨建民,傅明,郑超,等.刺蛾幼虫在松林害虫上的空间分布型及抽样技术[J].植物保护,2018, 44(5): 509-511.
- [32] ZANG J C, ZHANG S, XIANG D. Spatial distribution patterns and sampling technique of *Phaenocarpa* *scaphium* (Lepidoptera: Tortricidae) on willows [J]. J. Plant Prot. 2018, 44(5): 509-511.

- [20] 魏红, 裴彭辉, 石宝才, 等. 西花蓟马在黄瓜和菜花上的空间分布型及捕捉效率[J]. 昆虫学报, 2017, 61(11): 1187-1193.
- [21] LI, CAO X Y, LIU H L, et al. Spatial distribution pattern and sampling of the western flower thrips, *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae), on cucumber and green bean [J]. Acta Entomol. Sin., 2007, 51(11): 1187-1193.
- [22] 李森林, 戴建明, 彭惠军, 等. 刺蛾类幼虫在桑园中空间分布型及抽样技术研究[J]. 中国植保导刊, 2009, 29(1): 25-30.
- [23] ZHANG Y K, DING J M, ZHAO C P, et al. Study on spatial distribution patterns of the eggs of *Brevicoryne brassicae* and sampling techniques [J]. Chin. Plant Prot., 2019, 59(1): 25-30.
- [24] 梁静, 王正荣. 桃硬粉蚧在甜樱桃上的空间分布及抽样技术[J]. 福建农业学报, 2019, 34(6): 626-629.
- [25] YAN Z, WANG Z B. Spatial distribution and sampling of *Aspidiotus leucostictus* larvae on sweet potato fields [J]. Fujian J. Agric. Sci., 2016, 31(6): 626-629.
- [26] 王小强, 曹雪丹, 刘红伟, 等. 桃蚜在辣椒上的空间分布型及抽样技术研究[J]. 中国农学通报, 2019, 35(27): 158-164.
- [27] WANG X Q, CAO X Y, LIU H L, et al. Spatial distribution pattern of *Myndus persicae* on Chinese pepper, tobacco, and sampling techniques [J]. Chin. Agric. Sci. Bull., 2019, 35(27): 158-164.
- [28] 曹建群, 李国栋, 凌超, 等. 中华松针蚧成虫的空间分布型及抽样技术研究[J]. 森林科技大学学报, 2017, 37(5): 159-164.
- [29] CAI T T, RONG C H, TAN C, et al. Spatial distribution patterns and sampling techniques of *Matsumura's citrus aphid* [J]. J. Southwest Forestry Univ., 2017, 37(5): 159-164.

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