中国热带作物学会  
团体标准

《热带果蔬中农药残留快速筛查 液相色谱-串联质谱法》

（征求意见稿）

编

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《热带果蔬中农药残留快速筛查 液相色谱-串联质谱法》起草组

2025年08月

一、工作简况

**（一）任务来源**

蔬菜水果是广大人民群众的日常生活中的重要一部分，其质量安全关乎着人民的饮食安全和幸福指数。海南省作为热带农业大省，种植品种丰富，产量高，其热带水果、冬季瓜菜等特色产品更是输送至全国市场。然而，海南高温高湿的气候虽利于农作物生长，却也为病虫害滋生创造了温床。为保证蔬果产量与品相，农药、化肥等农业投入品的使用难以避免。近年来，海南蔬菜水果的质量安全问题时有发生，引发社会广泛关注。以豇豆为例，作为海南冬季瓜菜的主要品类，因蓟马、斑潜蝇等病虫害防治难度大，部分种植户过度依赖农药，导致多批次豇豆被检出噻虫胺、灭蝇胺等农药残留超标；荔枝生长受蒂蛀虫、炭疽病威胁，2024-2025年多家水果店销售的荔枝存在氯氟氰菊酯、吡唑醚菌酯等农药残留不合规现象；芒果主产区三亚、东方等地，也出现过百菌清、多菌灵等杀菌剂残留超标的问题，保鲜环节违规使用抑霉唑等保鲜剂，更增添了安全隐患。这些问题不仅威胁消费者健康，还影响海南农产品声誉与出口贸易。

因此，制定一套科学、精准的蔬菜水果定量检测方法标准刻不容缓。目前，我国虽已建立较为完善的农产品质量安全检测标准体系，但海南以生产热带特色果蔬为主，特殊的地域环境与种植条件，使得现有标准难以完全适配。例如，热带果蔬品种特殊、病虫害种类不同，农药使用情况也有差异，亟需根据海南自身特点进行调整，制定符合地方特色的检测方法，确保检测科学、准确、可靠，为全国蔬菜水果质量安全监管提供更有力的技术支持。

针对蔬菜水果的农药残留检测中要求缩短检测周期和提高结果准确度等需求，研发了一套简单、快捷的样品提取方法，将传统方法的前处理步骤从原来的十几步减少到四步，再置于液相色谱-串联质谱仪测定，可以用于果蔬中农药残留检测的快速精准定量分析，大大缩短检测时间，提高试验效率和试验结果的准确性。

此方法的开发，可以解决检测机构人员不足和技术较薄弱的问题，使检测人员快速掌握检测相关技术，从而开展相应的检测工作，提高检测效率和准确性，降低检测成本和时间成本，为海南省出入岛蔬菜水果提供便捷、高效的检测服务。通过该标准的实施和推广应用，将有助于加强农产品质量安全监管力度，有效遏制质量安全问题的发生，促进农业可持续发展和社会和谐稳定，并提升海南省蔬菜水果的市场竞争力和附加值，促进农业增效和农民增收。

中国热带农业科学院分析测试中心和中国热带作物学会作为本标准的制定主体，负责统筹协调标准的计划下达工作。拟于2025年正式启动该标准的制定工作，以迅速响应市场需求。计划编号暂定为T/CSTC 00XX-2025。与现行农产品检测标准相比，本标准更聚焦于海南热带果蔬的特性，优化了检测流程与技术应用，能更精准地应对当地复杂的果蔬农药残留检测场景，对提升海南乃至全国热带果蔬质量安全检测水平具有重要推动作用。

**（二）起草单位**

本标准《热带果蔬中农药残留快速筛查 液相色谱-串联质谱法》由中国热带农业科学院分析测试中心、海南省现代农业检验检测预警防控中心、三亚市现代农业检验检测预警防控中心负责起草，并且成立了标准编制组，进行了人员分工（见表1）。

表1 《热带果蔬中农药残留快速筛查 液相色谱-串联质谱法》起草组分工

|  |  |  |
| --- | --- | --- |
| 姓名 | 单位 | 分工 |
| 张振山 | 中国热带农业科学院分析测试中心 | 项目负责人 |
| 黎舒怀 | 中国热带农业科学院分析测试中心 | 方案设计 |
| 刘春华 | 中国热带农业科学院分析测试中心 | 文献调研，实验数据整理 |
| 吴学进 | 中国热带农业科学院分析测试中心 | 实验方法开发与优化 |
| 龚敏 | 海南省现代农业检验检测预警防控中心 | 文献调研与资料收集 |
| 何婷 | 三亚市现代农业检验检测预警防控中心 | 文献调研与资料收集 |
| 李春丽 | 中国热带农业科学院分析测试中心 | 实验方法开发与优化 |
| 李萍萍 | 中国热带农业科学院分析测试中心 | 实验样品前处理工作 |
| 吴南村 | 中国热带农业科学院分析测试中心 | 实验方法开发与优化 |
| 黄燕霞 | 中国热带农业科学院分析测试中心 | 仪器分析与数据处理 |
| 钟丽琪 | 中国热带农业科学院分析测试中心 | 仪器分析与数据处理 |
| 尹桂豪 | 中国热带农业科学院分析测试中心 | 实验数据整理 |
| 蒙雪茹 | 海南省现代农业检验检测预警防控中心 | 方法验证 |
| 邢孔攀 | 三亚市现代农业检验检测预警防控中心 | 方法验证 |
| 李晓慧 | 海南省现代农业检验检测预警防控中心 | 方法验证 |
| 黎小菊 | 三亚市现代农业检验检测预警防控中心 | 方法验证 |

**（三）主要工作过程**

1. **起草阶段**

组织项目启动会，明确项目目标与分工，为后续工作开展做好部署。张振山、刘春华负责文献调研与资料收集，通过图书馆、专业数据库，系统查阅国内外相关检测标准、研究论文及行业报告，梳理整合形成参考资料，为项目提供理论支持。张振山牵头进行技术方案设计，组织起草组成员召开研讨会，结合海南热带果蔬种植特点，以及液相色谱—串联质谱技术的检测特性，对样品前处理方法、检测参数等内容进行研究讨论，确定检测方法框架。尹桂豪、吴学进等成员主要负责与外部机构沟通协调工作。李春丽、李萍萍等成员依据方案开展实验，以海南常见的豇豆、芒果、荔枝为样本，优化样品提取环节的试剂配比、提取时间和温度等参数。吴南村、吴学进、黄燕霞同步调试维护液相色谱—联质谱仪等仪器设备，保障实验顺利进行。蒙雪茹、邢孔攀、李晓慧、黎小菊负责方法验证工作。基于实验数据和研讨结果，张振山、钟丽琪负责撰写标准文本初稿，对检测方法原理、操作步骤、结果计算等内容进行严谨编写，完成初步的标准草案，为后续标准制定工作奠定基础。

二、标准编制原则和确定标准主要内容的依据

**（一）编制原则**

本标准编写以提高测试方法的选择性、精密度、检测限、准确度、便捷度和分析效率为总原则，充分吸纳科学技术的先进成果与实践经验。在标准的制定过程中严格遵循国家相关方针、政策、法规和规章开展工作。标准的编写规则及表述严格依照多项国家标准执行：以GB/T 1.1-2020《标准化工作导则 第1部分：标准化文件的结构和起草规则》规范整体架构；遵循GB/T 5009.1-2003《食品卫生检验方法理化部分总则》确定检验总体要求；依据GB/T 20001.4-2015《标准编写规则 第4部分：化学分析方法》撰写化学分析内容；参照GB/T 6379.1-2004（等同采用ISO 5725-1：1994）《测量方法与结果的准确度（正确度与精密度）第1部分：总则与定义》、GB/T 6379.2-2004（等同采用ISO 5725-2：1994）《测量方法与结果的准确度（正确度与精密度）第2部分：确定标准测量方法重复性与再现性的基本方法》保障测量结果的准确性和精密度；按照GB/T 8855-2008（等同采用ISO 874:1980）《新鲜水果和蔬菜的取样方法》规范样品采集流程。

在标准制定全程，力求实现技术内容叙述精准无误，文字表达简洁明了、通俗易懂，标准体系架构严谨科学，内容编排与层次划分逻辑清晰、符合规范。

**（二）主要内容以及确定依据**

逐章逐节阐明标准主要内容中的术语、技术指标、参数、公式、性能要求、试验方法、检验规则等提出和确定的依据，即标准中相关技术内容（技术指标）的来源。不要写成任务来源部分的内容。

**1.通用**​

**1.1热带果蔬范围的确定**

本标准将芒果、荔枝、香蕉、菠萝、豇豆、辣椒、丝瓜、苦瓜等纳入适用范围，源于这些作物在海南热带农业中的核心地位与检测实践的适配性。从产业基础来看，这些果蔬是海南的标志性农作物，种植规模稳定且分布广泛：芒果种植面积超140万亩，荔枝约35万亩，豇豆、辣椒等作为冬季瓜菜主力，在全省多个市县形成连片种植基地，不仅是当地农民增收的主要来源，更是保障全国市场供应的重要品类，尤其在冬季北方果蔬供应中占据关键份额。​

同时，长期检测工作积累的经验让这些作物成为标准适用的优选。中国热带农业科学院分析测试中心等机构多年来持续聚焦这类果蔬，仅2023-2024年就完成5000多批次检测任务，对其独特基质特性（如芒果表皮的蜡质层、豇豆的粗纤维结构）和常见农药残留（如克百威、毒死蜱等）的检测形成了成熟方案。在实验优化阶段，团队以芒果、豇豆为代表性样本，针对性调整了前处理试剂配比和LC-MS/MS检测参数，验证了方法对这类作物的精准适配性，能够高效应对检测需求。​

**1.2监测农药种类确定**

本标准选取克百威、阿维菌素、乙酰甲胺磷等100种农药作为监测对象（表3），核心原因在于这些是海南热带果蔬种植中常用或检测风险较高的品种，同时也是监管部门的重点监测对象。从实际应用来看，灭蝇胺、啶虫脒等在豇豆种植中常用于防治蓟马等害虫，多菌灵、吡虫啉等则广泛用于芒果、荔枝的病害防控，使用频率较高。过往监测数据显示，这些农药在热带果蔬中出现残留超标的情况相对突出，如豇豆中的灭蝇胺残留、芒果中的吡虫啉残留等，均是质量安全监管的重点风险点。此外，农业农村部“月月抽”、省级例行监测等任务中，这些农药也常年被列为必检项目，各级检测机构在长期实践中积累了丰富的检测经验，能够精准完成其在不同果蔬基质中的定性与定量分析，确保监测结果的准确性和实用性。

**1.3规范性引用文件**

GB 2763《食品安全国家标准 食品中农药最大残留限量》规定了食品中多种农药的最大残留限量指标，涵盖了各类食品，包括热带水果、蔬菜等，明确了不同农药在不同食品中的残留上限值。本标准在进行农药残留定量检测结果判定时，需依据该标准中对应热带果蔬及农药的最大残留限量条款，以确定检测样品是否符合食品安全要求。

GB/T 6682《分析实验室用水规格和试验方法》规定了分析实验室用水的级别、技术要求、试验方法和检验规则等内容，明确了不同级别实验用水的纯度指标，如pH值范围、电导率、可氧化物质、吸光度等。在热带果蔬农药残留检测实验中，所有涉及的实验用水均需符合本标准中规定的相应级别用水要求，以确保实验结果的准确性和可靠性。

GB/T 8855《新鲜水果和蔬菜的取样方法》规定了新鲜水果和蔬菜在不同情况下的取样原则、取样工具、取样方法、样品数量及样品处理等内容。本标准在进行热带果蔬样品采集时，引用了该标准中关于取样程序和样品量确定的具体条款，以保证所取样品具有代表性，能够真实反映被检测批次果蔬的质量状况。

**1.4试样的制备**

样品取样部位按照GB 2763的规定执行。对于个体较小的样品，去掉皮、核、壳等不可食部分，取出可食部分，全部处理，如荔枝、山竹、圣女果；对于个体较大的基本均匀样品，可在对称轴或对称面上分割或切成小块后再处理，如芒果、木瓜、番石榴；对于细长、扁平或组分含量在各部分有差异的样品，可在不同部位切取小片或截成小段后处理，如豇豆；取后的样品将其切碎，充分混匀，用四分法取样或直接放入组织捣碎机中捣碎成匀浆，放入聚乙烯瓶中。试样应放在清洁、结实的容器或包装袋内，可用聚乙烯瓶或袋。试样应在规定的保质期内进行分析，必要时采用冷冻储存。试样应有清晰牢固的标识标记，防止造成标记的遗失和混乱。

**1.5 前处理方法依据**

称取5 g试样置于提取管中，加入5 mL乙腈进行提取，该比例在保证对目标农药提取效率的前提下，能有效减少乙腈用量，减少后续净化材料的用量，降低仪器检测时的基质干扰。

海南热带果蔬如芒果含较多蜡质、豇豆纤维丰富，提取管中加入2 g萃取剂，可通过吸附基质中的水分与部分极性杂质，促进克百威、毒死蜱等目标农药化合物从复杂果蔬基质向乙腈相转移，实现固液快速分离，获取含待测农药化合物的上清液。

标准用到的挤压式一步固相萃取柱，装填了多种吸附材料，上清液经挤压式一步固相萃取柱净化，可高效吸附提取液中的脂溶性杂质（如芒果中的油脂）、色素（如豇豆、辣椒中的色素）及部分大分子物质，避免这些成分进入仪器后污染系统或干扰检测信号，确保净化后的样品溶液能满足液相色谱-重四极杆质谱联用仪对样品纯净度的要求。

**1.6 液相方法依据**

本标准采用液相色谱-三重四极杆质谱联用仪进行仪器分析，依据其在农药残留检测领域的技术优势，液相色谱部分可通过梯度洗脱（见表2）实现对100种目标农药（涵盖杀虫剂、杀菌剂等）的高效分离，本标准选择0.005mol/L乙酸铵水-甲醇作为流动相，流动相及流速见表2。

表2 流动相及其梯度条件（*VA*+*VB*）

|  |  |  |
| --- | --- | --- |
| 时间min | 流动相*V*A  （含0.005mol/L乙酸铵水） | 流动相*V*B  （甲醇） |
| 0.00 | 90.0 | 10.0 |
| 1.00 | 90.0 | 10.0 |
| 2.00 | 30.0 | 70.0 |
| 4.00 | 30.0 | 70.0 |
| 5.00 | 5.00 | 95.0 |
| 8.00 | 5.00 | 95.0 |
| 9.00 | 90.0 | 10.0 |
| 10.0 | 90.0 | 10.0 |

**1.7 质谱方法依据**

通过多反应监测模式（MRM）对每种农药的特征离子对进行特异性检测，根据每种农药化合物的一级谱图选取响应值高、特征性强的离子作为母离子，然后采用产物离子扫描模式，将各农药化合物的母离子打碎以获得二次碎裂产生的子离子。通过优化碰撞能量对母离子进行碰撞解离，选择丰度值大、特征性强、灵敏度高的2对离子作为子离子，选定2组选定的母离子对和子离子对在MRM模式下进行检测，有效消除基质干扰，满足热带果蔬中多种农药残留同时检测的需求。

仪器型号：Triple Quad 4500液相色谱三重四极杆串联质谱仪（美国SCIEX公司）。色谱柱:ACQUITY\_UPLCTM BEH C18 1.7 um 2.1\*50mm Column；柱温:35℃；进样量:5uL；毛细管电压:5500v；离子源温度:550℃；雾化气压力:344.7kPa；去溶剂气压力:413.7kPa；气帘气压力:172.4kPa；碰撞气压力:55.2kPa；MRM 监测离子及质谱参数见表3。

表3 100种农药监测离子对、碰撞气能量、去簇电压和保留时间

| 序号 | 农药中文名 | 农药英文名 | 电离方式 | 保留时间（min） | 锥孔  电压（V） | 定量离子 | 碰撞能量（V） | 定性离子 | 碰撞能量（V） |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 3-羟基克百威 | 3-hydroxy carbofuran | ESI+ | 5.21 | 60 | 238.1-181.1 | 16 | 238.1-163.2 | 18 |
| 2 | 阿维菌素 | abamectin | ESI+ | 8.21 | 100 | 895.5-751.6 | 63 | 895.5-449.3 | 64 |
| 3 | 乙酰甲胺磷 | acephate | ESI+ | 4.13 | 44 | 184-143 | 12 | 184-125 | 25 |
| 4 | 啶虫脒 | acetamiprid | ESI+ | 5.22 | 64 | 223-126 | 26 | 223-99.1 | 50 |
| 5 | 涕灭威 | aldicarb | ESI+ | 6.34 | 70 | 213-89.1 | 20 | 213-116 | 16 |
| 6 | 涕灭威砜 | aldicarb sulfone | ESI+ | 4.50 | 58 | 223.1-86 | 20 | 223.1-148.1 | 11 |
| 7 | 涕灭威亚砜 | aldicarb sulfoxide | ESI+ | 4.36 | 48 | 207.1-132 | 10 | 207.1-89.1 | 19 |
| 8 | 莠灭净 | ametryn | ESI+ | 7.96 | 80 | 228-96.1 | 35 | 228-158.1 | 31 |
| 9 | 嘧菌酯 | azoxystrobin | ESI+ | 7.86 | 60 | 404.1-372.1 | 22 | 404.1-344 | 35 |
| 10 | 啶酰菌胺 | boscalid | ESI+ | 7.99 | 100 | 343-307 | 28 | 343-140 | 27 |
| 11 | 噻嗪酮 | buprofezin | ESI+ | 8.60 | 100 | 306.2-116.2 | 21 | 306.2-106.1 | 35 |
| 12 | 甲萘威 | carbaryl | ESI+ | 7.47 | 56 | 202-145.1 | 15 | 202-127.1 | 40 |
| 13 | 多菌灵 | carbendazim | ESI+ | 5.07 | 101 | 192-160.1 | 25 | 192-132.1 | 44 |
| 14 | 克百威 | carbofuran | ESI+ | 7.22 | 70 | 222.1-165.2 | 16 | 222.1-123 | 28 |
| 15 | 丁硫克百威 | carbosulfan | ESI+ | 8.49 | 61 | 381.1-159.9 | 21 | 381.1-118.1 | 29 |
| 16 | 氯虫苯甲酰胺 | chlorantraniliprole | ESI+ | 7.81 | 80 | 484-452.9 | 30 | 484-285.9 | 19 |
| 17 | 灭幼脲 | chlorbenzuron | ESI+ | 8.27 | 66 | 309-156 | 21 | 309-139 | 40 |
| 18 | 杀虫脒 | chlordimeform | ESI+ | 4.86 | 39 | 197.2-117.1 | 39 | 197.2-125.1 | 45 |
| 19 | 虫螨腈 | chlorfenapyr | ESI- | 8.43 | -102 | 348.8-80.8 | -72 | 348.8-131 | -55 |
| 20 | 氟啶脲 | chlorfluazuron | ESI+ | 8.80 | 95 | 540-383 | 31 | 540-158.1 | 24 |
| 21 | 毒死蜱 | chlorpyrifos | ESI+ | 8.77 | 41 | 350-198 | 25 | 350-96.9 | 41 |
| 22 | 噻虫胺 | clothianidin | ESI+ | 5.05 | 51 | 250-169.1 | 17 | 250-132 | 21 |
| 23 | 蝇毒磷 | coumaphos | ESI+ | 8.28 | 105 | 363-227.1 | 35 | 363-307 | 24 |
| 24 | 灭蝇胺 | cyromazine | ESI+ | 3.76 | 61 | 167.2-85 | 24 | 167.2-125.1 | 25 |
| 25 | 内吸磷 | demeton | ESI+ | 5.98 | 48 | 259-89 | 22 | 259-61 | 45 |
| 26 | 二嗪磷 | diazinon | ESI+ | 8.34 | 56 | 305.1-169.2 | 27 | 305.1-153 | 27 |
| 27 | 敌敌畏 | dichlorvos | ESI+ | 7.18 | 45 | 221-109 | 25 | 221-127.1 | 24 |
| 28 | 苯醚甲环唑 | difenoconazole | ESI+ | 8.39 | 120 | 406.1-251 | 37 | 406.1-337.1 | 23 |
| 29 | 除虫脲 | diflubenzuron | ESI+ | 8.22 | 68 | 310.9-158.2 | 24 | 310.9-141.1 | 49 |
| 30 | 乐果 | dimethoate | ESI+ | 5.36 | 24 | 230-125 | 22 | 230-199 | 10 |
| 31 | 烯酰吗啉 | dimethomorph | ESI+ | 8.00 | 130 | 388-301 | 31 | 388-165.1 | 41 |
| 32 | 甲氨基阿维菌素苯甲酸盐 | emamectin benzoate | ESI+ | 8.24 | 134 | 886.6-158.2 | 40 | 886.6-302.1 | 41 |
| 33 | 灭线磷 | ethoprophos | ESI+ | 8.20 | 67 | 243-97 | 43 | 243-131 | 26 |
| 34 | 醚菊酯 | etofenprox | ESI+ | 8.71 | 41 | 394.1-107.1 | 53 | 394.1-177.2 | 19 |
| 35 | 氯苯嘧啶醇 | fenarimol | ESI+ | 8.16 | 43 | 331-268.1 | 30 | 331-259.1 | 31 |
| 36 | 腈苯唑 | fenbuconazole | ESI+ | 8.17 | 95 | 337.1-124.9 | 42 | 337.1-70 | 43 |
| 37 | 杀螟硫磷 | fenitrothion | ESI+ | 7.62 | 30 | 278-125 | 25 | 278-246 | 21 |
| 38 | 倍硫磷 | fenthion | ESI+ | 8.31 | 30 | 279-247 | 18 | 279-169 | 16 |
| 39 | 倍硫磷砜 | fenthion sulfone | ESI+ | 7.43 | 32 | 311-125 | 22 | 311-109 | 28 |
| 40 | 倍硫磷亚砜 | fenthion sulfoxide | ESI+ | 7.27 | 32 | 295-280 | 18 | 295-109 | 32 |
| 41 | 氟虫腈 | fipronil | ESI- | 8.15 | -66 | 434.8-329.8 | -21 | 434.8-249.9 | -36 |
| 42 | 氟甲腈 | fipronil desulfinyl | ESI- | 8.10 | -75 | 387-351 | -19 | 387-281.9 | -46 |
| 43 | 氟虫腈硫醚 | fipronil sulfide | ESI- | 8.17 | -78 | 418.8-382.9 | -21 | 418.8-261.8 | -39 |
| 44 | 氟虫腈砜 | fipronil sulfone | ESI- | 8.20 | -88 | 450.9-414.9 | -23 | 450.9-281.9 | -39 |
| 45 | 氯吡脲 | forchlorfenuron | ESI+ | 7.79 | 80 | 248.1-129 | 25 | 248.1-155 | 25 |
| 46 | 赤霉酸 | gibberellic acid | ESI+ | 5.08 | -45 | 345.1-239.2 | -21 | 345.1-143.2 | -34 |
| 47 | 噻螨酮 | hexythiazox | ESI+ | 8.75 | 76 | 353-228 | 21 | 353-168 | 33 |
| 48 | 抑霉唑 | imazalil | ESI+ | 7.66 | 61 | 297.1-159.2 | 35 | 297.1-255 | 25 |
| 49 | 吡虫啉 | imidacloprid | ESI+ | 4.98 | 58 | 256.1-209.1 | 24 | 256.1-175.1 | 27 |
| 50 | 茚虫威 | indoxacarb | ESI+ | 8.31 | 96 | 528-203 | 51 | 528-56 | 55 |
| 51 | 异菌脲 | iprodione | ESI+ | 8.20 | 30 | 330-245 | 20 | 330-288 | 18 |
| 52 | 氯唑磷 | isazofos | ESI+ | 8.12 | 70 | 316-164 | 23 | 316-122 | 35 |
| 53 | 水胺硫磷 | isocarbophos | ESI+ | 7.75 | 100 | 231-121 | 26 | 231-109 | 38 |
| 54 | 甲基异柳磷 | isofenphos-methyl | ESI+ | 8.24 | 20 | 332-121 | 43 | 332-231 | 19 |
| 55 | 异丙威 | isoprocarb | ESI+ | 7.73 | 57 | 194-95 | 19 | 194-137 | 12 |
| 56 | 醚菌酯 | kresoxim-methyl | ESI+ | 8.26 | 60 | 314.1-267 | 15 | 314.1-222 | 20 |
| 57 | 马拉硫磷 | malathion | ESI+ | 7.54 | 46 | 331-99.1 | 31 | 331-127.1 | 17 |
| 58 | 甲霜灵 | metalaxyl | ESI+ | 7.75 | 57 | 280.2-220.2 | 18 | 280.2-192.3 | 23 |
| 59 | 甲胺磷 | methamidophos | ESI+ | 3.08 | 50 | 142-94 | 20 | 142-125 | 18 |
| 60 | 灭多威 | methomyl | ESI+ | 4.65 | 36 | 163-88 | 13 | 163-106 | 13 |
| 61 | 速灭磷 | mevinphos | ESI+ | 5.70 | 55 | 225-127 | 21 | 225-193 | 9 |
| 62 | 久效磷 | monocrotophos | ESI+ | 4.75 | 60 | 224.1-98 | 17 | 224.1-127 | 21 |
| 63 | 腈菌唑 | myclobutanil | ESI+ | 8.07 | 80 | 289-70 | 35 | 289-125 | 46 |
| 64 | 氧乐果 | omethoate | ESI+ | 4.29 | 45 | 214-125 | 30 | 214-183 | 15 |
| 65 | 多效唑 | paclobutrazol | ESI+ | 8.05 | 100 | 294.1-70.1 | 45 | 294.1-125 | 45 |
| 66 | 对硫磷 | parathion | ESI+ | 8.24 | 73 | 292-236 | 20 | 292-264 | 15 |
| 67 | 二甲戊灵 | pendimethalin | ESI+ | 7.75 | 45 | 282.1-212 | 15 | 282.1-194 | 25 |
| 68 | 甲拌磷 | phorate | ESI+ | 5.20 | 51 | 261.1-75.2 | 21 | 261.1-47 | 53 |
| 69 | 甲拌磷砜 | phorate sulfone | ESI+ | 7.67 | 65 | 293-96.9 | 50 | 293-114.7 | 35 |
| 70 | 甲拌磷亚砜 | phorate sulfoxide | ESI+ | 7.61 | 25 | 277-199 | 13 | 277-153 | 19 |
| 71 | 伏杀硫磷 | phosalone | ESI+ | 8.35 | 65 | 368-182 | 20 | 368-111 | 51 |
| 72 | 硫环磷 | phosfolan | ESI+ | 5.98 | 40 | 256.1-140 | 30 | 256.1-228 | 18 |
| 73 | 亚胺硫磷 | phosmet | ESI+ | 7.88 | 51 | 318-160 | 19 | 318-133 | 49 |
| 74 | 辛硫磷 | phoxim | ESI+ | 8.31 | 56 | 299-77.1 | 49 | 299-129.2 | 19 |
| 75 | 抗蚜威 | pirimicarb | ESI+ | 7.43 | 76 | 239.2-182 | 21 | 239.2-72 | 36 |
| 76 | 咪鲜胺 | prochloraz | ESI+ | 8.37 | 41 | 376.2-308 | 17 | 376.2-266 | 22 |
| 77 | 丙溴磷 | profenofos | ESI+ | 8.56 | 80 | 373-302.9 | 25 | 373-345.2 | 18 |
| 78 | 霜霉威 | propamocarb | ESI+ | 4.38 | 51 | 189.1-102.1 | 25 | 189.1-144.1 | 19 |
| 79 | 丙环唑 | propiconazole | ESI+ | 8.33 | 70 | 342.1-159 | 43 | 342.1-69.1 | 43 |
| 80 | 吡唑醚菌酯 | pyraclostrobin | ESI+ | 8.31 | 28 | 388.2-194.1 | 16 | 388.2-163.1 | 30 |
| 81 | 哒螨灵 | pyridaben | ESI+ | 9.22 | 46 | 365-147 | 31 | 365-309 | 19 |
| 82 | 嘧霉胺 | pyrimethanil | ESI+ | 8.05 | 100 | 200.1-107.1 | 33 | 200.1-82 | 33 |
| 83 | 乙基多杀菌素J | spinetoram J | ESI+ | 8.17 | 40 | 748.5-142.1 | 37 | 748.5-203.1 | 42 |
| 84 | 乙基多杀菌素L | spinetoram L | ESI+ | 8.25 | 80 | 760.4-142 | 35 | 760.4-98 | 100 |
| 85 | 多杀霉素A | spinosyn A | ESI+ | 8.10 | 110 | 732.4-142 | 35 | 732.4-98.1 | 95 |
| 86 | 多杀霉素D | spinosyn D | ESI+ | 8.18 | 110 | 746.4-142 | 34 | 746.4-98.1 | 101 |
| 87 | 螺螨酯 | spirodiclofen | ESI+ | 8.93 | 40 | 411.3-313.2 | 25 | 411.3-213.1 | 35 |
| 88 | 戊唑醇 | tebuconazole | ESI+ | 8.32 | 95 | 308-70 | 49 | 308-125 | 47 |
| 89 | 虫酰肼 | tebufenozide | ESI+ | 8.21 | 61 | 353.3-133.1 | 23 | 353.2-297.1 | 15 |
| 90 | 特丁硫磷 | terbufos | ESI+ | 8.66 | 45 | 289.1-103.1 | 14 | 289.1-187 | 19 |
| 91 | 特丁硫磷砜 | terbufos sulfone | ESI+ | 7.91 | 68 | 321.1-171.1 | 17 | 321.1-143.1 | 28 |
| 92 | 特丁硫磷亚砜 | terbufos sulfoxide | ESI+ | 7.91 | 90 | 305-187.1 | 15 | 305-97 | 59 |
| 93 | 噻虫嗪 | thiamethoxam | ESI+ | 4.73 | 53 | 292.1-211 | 17 | 292.1-181 | 30 |
| 94 | 噻苯隆 | thidiazuron | ESI+ | 7.25 | 30 | 221-102 | 22 | 221-128 | 22 |
| 95 | 甲基硫菌灵 | thiophanate-methyl | ESI+ | 7.00 | 60 | 343-151 | 26 | 343-311 | 15 |
| 96 | 唑虫酰胺 | tolfenpyrad | ESI+ | 8.58 | 40 | 384.1-197.1 | 35 | 384.1-171 | 33 |
| 97 | 三唑酮 | triadimefon | ESI+ | 8.09 | 70 | 294-197 | 21 | 294-225 | 17 |
| 98 | 三唑磷 | triazophos | ESI+ | 8.10 | 85 | 314-162.1 | 28 | 314-119.1 | 49 |
| 99 | 敌百虫 | trichlorfon | ESI+ | 5.40 | 45 | 256.9-109 | 25 | 256.9-127.1 | 24 |
| 100 | 肟菌酯 | trifloxystrobin | ESI+ | 8.36 | 40 | 409.1-186 | 23 | 409.1-145 | 63 |

**1.8 关键技术参数的确定依据**

定量限（0.01mg/kg），以信噪比（S/N）=10为通用定量限判定依据。以芒果、豇豆作为代表性热带果蔬，开展加标回收实验，添加克百威、毒死蜱等不同浓度梯度农药标准品，按本标准检测流程分析。结果显示，在该检测方法下，0.01mg/kg浓度水平的农药残留能稳定、准确地定量，其回收率在70%-120%之间，相对标准偏差（RSD）小于15%，满足检测方法对准确性与精密度要求，可精准检测实际热带果蔬中低浓度农药残留。因此，标准中也以0.005 mg/L、0.01 mg/L、0.02 mg/L、0.05 mg/L、0.08 mg/L、0.10 mg/L和0.20 mg/L为浓度，配制基质标准溶液，供液相色谱-质谱联用仪测定，绘制校正曲线，外标法定量。

**1.9 公式确定依据**

试样中农药残留量计算公式

该公式基于物质的量守恒原理，结合液相色谱-质谱联用检测中峰面积与浓度的线性关系推导得出。其中，*ρ*为基质标准工作溶液中被测物质量浓度，*A*为试样溶液中被测物色谱峰面积，*As*为基质标准工作溶液中被测物色谱峰面积，*V*为提取液体积，*m*为试样质量。通过该公式能准确计算出热带果蔬试样中农药残留量，与国际、国内相关农药残留检测标准中的计算方法一致，保证了结果计算的科学性与规范性。

三、主要试验或验证的分析、综述报告，技术经济论证，预期的经济效果

**（一）主要试验或验证的分析、综述报告**

1.试验或验证的分析报告：

**1.1监测农药的质谱参数和色谱质谱图**

采集浓度为0.1mg/L的100种农药混合标准溶液，按照表2流动相及其梯度条件和表3的MRM监测离子及质谱参数，进液相色谱-串联质谱仪分析。图1为克百威等100种农药的标准溶液的总离子流色谱图(TIC，10min)，图2为100种农药的定量定性离子谱图。

结果表明，各待测农药的仪器响应佳，峰形对称尖锐，保留时间稳定，分离情况良好，无明显相互干扰现象。这意味着该套质谱参数和色谱条件能高效区分100种农药，为后续实际样品中农药残留的精准定性和定量奠定了坚实基础，应用效果显著，能满足热带果蔬中多种农药残留同时检测的需求。



图1. 克百威等100种农药的标准溶液的总离子流色谱图(TIC，10min)

图1为0.1 mg/L的克百威等100种农药的标准溶液的总离子流色谱图(TIC，10min) ，图2为100种农药的定量定性离子谱图。

|  |  |  |  |
| --- | --- | --- | --- |
| $[ANALYTE GRAPH]$  1. 3-羟基克百威  3-hydroxy carbofuran | $[ANALYTE GRAPH]$  2. 阿维菌素  abamectin | $[ANALYTE GRAPH]$  3. 乙酰甲胺磷  acephate | $[ANALYTE GRAPH]$  4. 啶虫脒  acetamiprid |
| $[ANALYTE GRAPH]$  5. 涕灭威  aldicarb | $[ANALYTE GRAPH]$  6. 涕灭威砜  ldicarb sulfone | $[ANALYTE GRAPH]$  7. 涕灭威亚砜  aldicarb sulfoxide | $[ANALYTE GRAPH]$  8. 莠灭净  ametryn |
| $[ANALYTE GRAPH]$  9. 嘧菌酯  azoxystrobin | $[ANALYTE GRAPH]$  10. 啶酰菌胺  boscalid | $[ANALYTE GRAPH]$  11. 噻嗪酮  buprofezin | $[ANALYTE GRAPH]$  12. 甲萘威  carbaryl |
| $[ANALYTE GRAPH]$  13. 多菌灵  carbendazim | $[ANALYTE GRAPH]$  14. 克百威  carbofuran | $[ANALYTE GRAPH]$  15. 丁硫克百威  carbosulfan | $[ANALYTE GRAPH]$  16. 氯虫苯甲酰胺  chlorantraniliprole |
| $[ANALYTE GRAPH]$  17. 灭幼脲  chlorbenzuron | $[ANALYTE GRAPH]$  18. 杀虫脒  chlordimeform | $[ANALYTE GRAPH]$  19. 虫螨腈  chlorfenapyr | $[ANALYTE GRAPH]$  20. 氟啶脲  chlorfluazuron |
| $[ANALYTE GRAPH]$  21. 毒死蜱  chlorpyrifos | $[ANALYTE GRAPH]$  22. 噻虫胺  clothianidin | $[ANALYTE GRAPH]$  23. 蝇毒磷  coumaphos | $[ANALYTE GRAPH]$  24. 灭蝇胺  cyromazine |
| $[ANALYTE GRAPH]$  25. 内吸磷  demeton | $[ANALYTE GRAPH]$  26. 二嗪磷  diazinon | $[ANALYTE GRAPH]$  27. 敌敌畏  dichlorvos | $[ANALYTE GRAPH]$  28. 苯醚甲环唑  difenoconazole |
| $[ANALYTE GRAPH]$  29. 除虫脲  diflubenzuron | $[ANALYTE GRAPH]$  30. 乐果  dimethoate | $[ANALYTE GRAPH]$  31. 烯酰吗啉  dimethomorph | $[ANALYTE GRAPH]$  32. 甲氨基阿维菌素苯甲酸盐  emamectin benzoate |
| $[ANALYTE GRAPH]$  33. 灭线磷  ethoprophos | $[ANALYTE GRAPH]$  34. 醚菊酯  etofenprox | $[ANALYTE GRAPH]$  35. 氯苯嘧啶醇  fenarimol | $[ANALYTE GRAPH]$  36. 腈苯唑  fenbuconazole |
| $[ANALYTE GRAPH]$  37. 杀螟硫磷  fenitrothion | $[ANALYTE GRAPH]$  38. 倍硫磷  fenthion | $[ANALYTE GRAPH]$  39. 倍硫磷砜  fenthion sulfone | $[ANALYTE GRAPH]$  40. 倍硫磷亚砜  fenthion sulfoxide |
| $[ANALYTE GRAPH]$  41. 氟虫腈  fipronil | $[ANALYTE GRAPH]$  42. 氟甲腈  fipronil desulfinyl | $[ANALYTE GRAPH]$  43. 氟虫腈硫醚  fipronil sulfide | $[ANALYTE GRAPH]$  44. 氟虫腈砜  fipronil sulfone |
| $[ANALYTE GRAPH]$  45. 氯吡脲  forchlorfenuron | $[ANALYTE GRAPH]$  46. 赤霉酸  gibberellic acid | $[ANALYTE GRAPH]$  47. 噻螨酮  hexythiazox | $[ANALYTE GRAPH]$  48. 抑霉唑  imazalil |
| $[ANALYTE GRAPH]$  49. 吡虫啉  imidacloprid | $[ANALYTE GRAPH]$  50. 茚虫威  indoxacarb | $[ANALYTE GRAPH]$  51. 异菌脲  iprodione | $[ANALYTE GRAPH]$  52. 氯唑磷  isazofos |
| $[ANALYTE GRAPH]$  53. 水胺硫磷  isocarbophos | $[ANALYTE GRAPH]$  54. 甲基异柳磷  isofenphos-methyl | $[ANALYTE GRAPH]$  55. 异丙威  isoprocarb | $[ANALYTE GRAPH]$  56. 醚菌酯  kresoxim-methyl |
| $[ANALYTE GRAPH]$  57. 马拉硫磷  malathion | $[ANALYTE GRAPH]$  58. 甲霜灵  metalaxyl | $[ANALYTE GRAPH]$  59. 甲胺磷  methamidophos | $[ANALYTE GRAPH]$  60. 灭多威  methomyl |
| $[ANALYTE GRAPH]$  61. 速灭磷  mevinphos | $[ANALYTE GRAPH]$  62. 久效磷  monocrotophos | $[ANALYTE GRAPH]$  63. 腈菌唑  myclobutanil | $[ANALYTE GRAPH]$  64. 氧乐果  omethoate |
| $[ANALYTE GRAPH]$  65. 多效唑  paclobutrazol | $[ANALYTE GRAPH]$  66. 对硫磷  parathion | $[ANALYTE GRAPH]$  67. 二甲戊灵  pendimethalin | $[ANALYTE GRAPH]$  68. 甲拌磷  phorate |
| $[ANALYTE GRAPH]$  69. 甲拌磷砜  phorate sulfone | $[ANALYTE GRAPH]$  70. 甲拌磷亚砜  phorate sulfoxide | $[ANALYTE GRAPH]$  71. 伏杀硫磷  phosalone | $[ANALYTE GRAPH]$  72. 硫环磷  phosfolan |
| $[ANALYTE GRAPH]$  73. 亚胺硫磷  phosmet | $[ANALYTE GRAPH]$  74. 辛硫磷  phoxim | $[ANALYTE GRAPH]$  75. 抗蚜威  pirimicarb | $[ANALYTE GRAPH]$  76. 咪鲜胺  prochloraz |
| $[ANALYTE GRAPH]$  77. 丙溴磷  profenofos | $[ANALYTE GRAPH]$  78. 霜霉威  propamocarb | $[ANALYTE GRAPH]$  79. 丙环唑  propiconazole | $[ANALYTE GRAPH]$  80. 吡唑醚菌酯  pyraclostrobin |
| $[ANALYTE GRAPH]$  81. 哒螨灵  pyridaben | $[ANALYTE GRAPH]$  82. 嘧霉胺  pyrimethanil | $[ANALYTE GRAPH]$  83. 乙基多杀菌素J  spinetoram J | $[ANALYTE GRAPH]$  84. 乙基多杀菌素L  spinetoram L |
| $[ANALYTE GRAPH]$  85. 多杀霉素A  spinosyn A | $[ANALYTE GRAPH]$  86. 多杀霉素D  spinosyn D | $[ANALYTE GRAPH]$  87. 螺螨酯  spirodiclofen | $[ANALYTE GRAPH]$  88. 戊唑醇  tebuconazole |
| $[ANALYTE GRAPH]$  89.虫酰肼  tebufenozide | $[ANALYTE GRAPH]$  90. 特丁硫磷  terbufos | $[ANALYTE GRAPH]$  91. 特丁硫磷砜  terbufos sulfone | $[ANALYTE GRAPH]$  92. 特丁硫磷亚砜  terbufos sulfoxide |
| $[ANALYTE GRAPH]$  93. 噻虫嗪  thiamethoxam | $[ANALYTE GRAPH]$  94. 噻苯隆  thidiazuron | $[ANALYTE GRAPH]$  95. 甲基硫菌灵  thiophanate-methyl | $[ANALYTE GRAPH]$  96. 唑虫酰胺  tolfenpyrad |
| $[ANALYTE GRAPH]$  97. 三唑酮  triadimefon | $[ANALYTE GRAPH]$  98. 三唑磷  triazophos | $[ANALYTE GRAPH]$  99. 敌百虫  trichlorfon | $[ANALYTE GRAPH]$  100. 肟菌酯  trifloxystrobin |

图2 克百威等100种农药及其代谢物多反应监测（MRM）色谱图

**1.2基质效应**

为观察基质效应对热带果蔬中农药测定的影响，实验采用空白基质溶液与乙腈作为溶剂，分别将标准溶液稀释至0.005 mg/L、0.01 mg/L、0.02 mg/L、0.05 mg/L、0.08 mg/L、0.10 mg/L和0.20 mg/L一系列相同浓度。通过计算基质标准曲线与溶剂标准曲线的斜率比值来评价基质效应（ME），ME＜0表示存在基质抑制效应，ME＞0则为基质增强效应。

1

kmatrix为基质匹配标准曲线的斜率，ksolvent为溶剂标准曲线的斜率。克百威等100种农药的LC-MS/MS基质效应分析结果见表4。数据显示，大部分农药受基质影响呈现抑制效应，其中克百威、吡虫啉等78种农药表现为基质抑制，且29种农药抑制效应较强（ME＜-20%）；而苯醚甲环唑、水胺硫磷和乙基多杀菌素等22种农药则呈现基质增强效应。

鉴于上述基质效应的存在，为有效校正其对检测结果的干扰，提高定量分析的准确度与可靠性，本研究采用基质匹配外标校准曲线对农药残留进行定量，以确保检测数据能够真实反映热带果蔬中农药的实际残留水平。

表4 克百威等100种农药的LC-MS基质效应

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 农药 | 基质效应ME(%) | 农药 | 基质效应ME(%) | 农药 | 基质效应ME(%) |
| 3-羟基克百威 | -55.7 | 氯苯嘧啶醇 | -5.5 | 甲拌磷砜 | -0.1 |
| 阿维菌素 | -46.1 | 腈苯唑 | 2.1 | 甲拌磷亚砜 | -33.5 |
| 乙酰甲胺磷 | -4.3 | 杀螟硫磷 | -6.7 | 伏杀硫磷 | 8.4 |
| 啶虫脒 | -48.1 | 倍硫磷 | -8.4 | 硫环磷 | -15.8 |
| 涕灭威 | -70.1 | 倍硫磷砜 | -15 | 亚胺硫磷 | -15 |
| 涕灭威砜 | 1.4 | 倍硫磷亚砜 | -26.1 | 辛硫磷 | -23 |
| 涕灭威亚砜 | 0.1 | 氟虫腈 | -29.8 | 抗蚜威 | -3.8 |
| 莠灭净 | -10.2 | 氟甲腈 | -30.5 | 咪鲜胺 | -34.4 |
| 嘧菌酯 | -0.5 | 氟虫腈硫醚 | -11.9 | 丙溴磷 | -4.3 |
| 啶酰菌胺 | -9.8 | 氟虫腈砜 | -27 | 霜霉威 | -8.5 |
| 噻嗪酮 | -1.1 | 氯吡脲 | -26.3 | 丙环唑 | 1.7 |
| 甲萘威 | -76.1 | 赤霉酸 | -3.8 | 吡唑醚菌酯 | 1.9 |
| 多菌灵 | -5.4 | 噻螨酮 | -3.6 | 哒螨灵 | -63.2 |
| 克百威 | -80 | 抑霉唑 | 0.7 | 嘧霉胺 | -7.9 |
| 丁硫克百威 | -15.3 | 吡虫啉 | -45.4 | 乙基多杀菌素J | 15.1 |
| 氯虫苯甲酰胺 | -6.3 | 茚虫威 | -2.7 | 乙基多杀菌素L | 23.9 |
| 灭幼脲 | -36.7 | 异菌脲 | -6.8 | 多杀霉素A | 1.1 |
| 杀虫脒 | 7.4 | 氯唑磷 | -7.2 | 多杀霉素D | 0.4 |
| 虫螨腈 | -15.2 | 水胺硫磷 | 15.6 | 螺螨酯 | -6.6 |
| 氟啶脲 | -63.9 | 甲基异柳磷 | 23.8 | 戊唑醇 | -3.7 |
| 毒死蜱 | -67.4 | 异丙威 | -4.7 | 虫酰肼 | -22.5 |
| 噻虫胺 | -89.5 | 醚菌酯 | -15.2 | 特丁硫磷 | -13.6 |
| 蝇毒磷 | -1.8 | 马拉硫磷 | -7.0 | 特丁硫磷砜 | -22.1 |
| 灭蝇胺 | -10.2 | 甲霜灵 | -9.3 | 特丁硫磷亚砜 | -10.3 |
| 内吸磷 | -12.5 | 甲胺磷 | -3.9 | 噻虫嗪 | -62.4 |
| 二嗪磷 | -2.5 | 灭多威 | -14.7 | 噻苯隆 | -6.6 |
| 敌敌畏 | -2.7 | 速灭磷 | -5.5 | 甲基硫菌灵 | -15.1 |
| 苯醚甲环唑 | 41.9 | 久效磷 | -9.9 | 唑虫酰胺 | 0.8 |
| 除虫脲 | 3.9 | 腈菌唑 | 0.6 | 三唑酮 | -5.1 |
| 乐果 | -39 | 氧乐果 | -28.7 | 三唑磷 | -12.9 |
| 烯酰吗啉 | -14.3 | 多效唑 | 5.8 | 敌百虫 | 0.9 |
| 甲氨基阿维菌素苯甲酸盐 | -41 | 对硫磷 | -2.9 | 肟菌酯 | 2.1 |
| 灭线磷 | 1.1 | 二甲戊灵 | -42.6 |  |  |
| 醚菊酯 | -52.9 | 甲拌磷 | -22 |  |  |

**1.3色谱柱的选择**

在多组分分析方法建立过程中，由于需兼顾极性差异较大的各类化合物，选择适配的色谱柱至关重要。为此，本研究考察了8种色谱柱对60组农药的分离效果，具体包括：①Waters Acquity BEH C18柱（100mm×2.1mm,1.7μm）②Thermo Hypersil Gold C18柱（100mm×2.1mm,1.9μm）③Agilent ZORBAX EclipsePlus C18柱（100mm×2.1mm,1.8μm）④Shim-pack XR-ODS柱（2.0mm×100mm，2.2μm）⑤COSMOCORE C18柱（2.1mm×100mm，2.6μm）⑥ Waters Acquity BEH C18柱（50mm×2.1mm,1.7μm）⑦Waters Acquity BEH HLIC柱（50mm×2.1mm,1.7μm）⑧Agilent ZORBAX EclipsePlus C18柱（50mm×2.1mm,1.8μm）对100组农药的分离效果。

以甲维盐（甲氨基阿维菌素苯甲酸盐）、哒螨灵、甲拌磷和辛硫磷4个农药为代表进行分析，结果如图3所示。其中，亲水相互作用（Hilic）色谱柱（即⑦Waters Acquity BEH HLIC 柱）虽能分离极性至高极性化合物，但由于本标准监测的农药极性范围较宽，且包含大量非极性化合物，该色谱柱对非极性化合物的保留作用较差，导致峰形宽、响应低，部分化合物甚至无保留，难以满足大部分农药的测定需求。​

对比其他7种C18色谱柱，方案①的Waters Acquity BEH C18柱（100mm×2.1mm,1.7μm）在分离效果上表现更优，对100组农药中的绝大多数化合物均能实现良好保留，峰形对称尖锐，分离度高，能有效区分不同农药组分。综合考虑，后续试验选用该色谱柱作为分离柱，以确保多组分农药检测的准确性和可靠性。

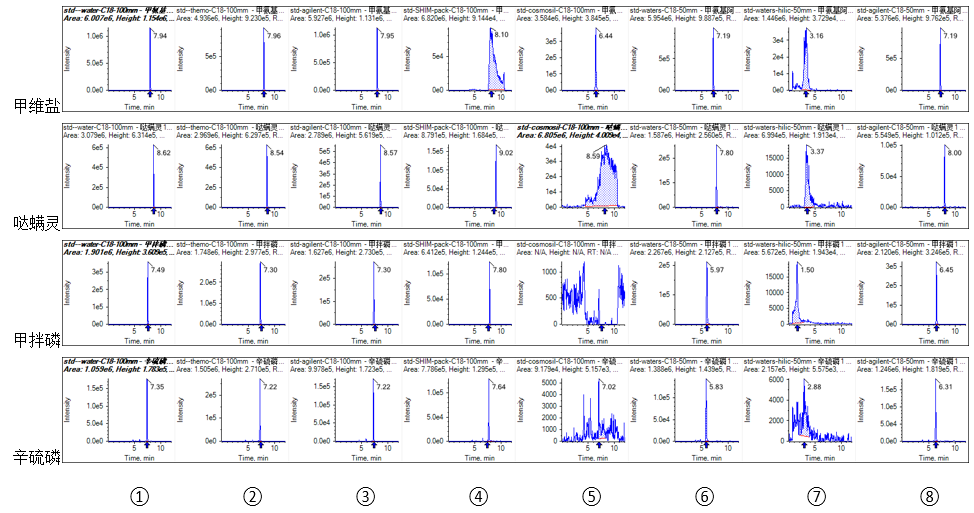


图3 不同的色谱柱下多菌灵等农药的峰形比较

**1.4流动相的选择**

为确定适配的流动相，实验以0.1μg/mL的克百威等100种农药混合标准溶液为对象，考察了4种流动相体系的分离效果，分别为①乙腈-水、②甲醇-水、③乙腈-水（含0.005mol/L乙酸铵）、④甲醇-水（含0.005mol/L乙酸铵），并以峰面积比值和保留时间作为评判依据（峰面积比值小于100%表明前者响应较后者低，比值大于100%则表明前者响应较后者高），具体结果见表5。

由表5数据可知，在流动相选择中，甲醇体系与乙腈体系相比表现出明显优势。以甲醇为有机相的流动相（②和④）对大部分化合物的响应更高，峰面积整体更大，这有助于提升检测灵敏度，尤其对低浓度农药残留的定量分析更为有利。同时，采用甲醇作为流动相时，待测农药的出峰时间稍晚，这种保留行为延长了待测物在色谱柱上的分离时间，有利于待测农药与基质中极性杂质成分的分离，也能促进不同待测农药之间的相互分离，减少峰重叠现象，提高了复杂体系中农药定性和定量的准确性。此外，在流动相中加入0.005 mol/L乙酸铵后，能有效提高目标农药的离子化效率，改善峰形对称性，减少峰拖尾或分裂现象，进一步提升检测的稳定性和准确性。

综合来看，含0.005 mol/L乙酸铵的甲醇-水体系在响应值、分离效果及峰形优化上的综合表现更适配本标准中100种农药的检测需求，为后续检测工作提供了更可靠的条件。

表5 不同的流动相下克百威等农药的峰面积比值和保留时间比较

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 名称 | 峰面积比值%  ③/④ | 保留时间/min  ③ ④ | | 峰面积比值% ①/② | 保留时间/min  ① ② | | 名称 | 峰面积比值%  ③/④ | 保留时间/min  ③ ④ | | 峰面积比值% ①/② | 保留时间/min  ① ② | |
| 3-羟基克百威 | 96.0 | 3.7 | 5.2 | 106.4 | 3.6 | 5.2 | 异菌脲 | 18.2 | 8.0 | 8.2 | 53.2 | 8.0 | 8.2 |
| 阿维菌素 | 70.2 | 8.1 | 8.2 | 20.6 | 8.1 | 8.2 | 氯唑磷 | 55.4 | 8.0 | 8.1 | 44.1 | 8.0 | 8.1 |
| 乙酰甲胺磷 | 54.2 | 3.4 | 4.1 | 61.5 | 3.4 | 4.1 | 水胺硫磷 | 54.1 | 7.4 | 7.8 | 30.7 | 7.4 | 7.8 |
| 啶虫脒 | 91.8 | 4.8 | 5.2 | 52.4 | 4.8 | 5.2 | 甲基异柳磷 | 47.3 | 7.9 | 8.2 | 54.0 | 7.8 | 8.2 |
| 涕灭威 | 25.5 | 5.4 | 6.3 | 2.7 | 5.4 | 6.3 | 异丙威 | 114.1 | 7.5 | 7.7 | 112.1 | 7.5 | 7.7 |
| 涕灭威砜 | 98.3 | 3.2 | 4.5 | 90.8 | 3.2 | 4.5 | 醚菌酯 | 72.2 | 8.1 | 8.3 | 53.8 | 8.1 | 8.3 |
| 涕灭威亚砜 | 65.7 | 3.1 | 4.4 | 61.5 | 3.4 | 4.4 | 马拉硫磷 | 103.7 | 7.2 | 7.5 | 90.9 | 7.2 | 7.6 |
| 莠灭净 | 67.9 | 7.5 | 8.0 | 92.3 | 7.5 | 8.0 | 甲霜灵 | 97.8 | 7.3 | 7.8 | 119.3 | 7.3 | 7.8 |
| 嘧菌酯 | 77.8 | 6.8 | 7.9 | 78.8 | 6.7 | 7.9 | 甲胺磷 | 77.8 | 2.5 | 3.1 | 62.8 | 2.5 | 3.1 |
| 啶酰菌胺 | 44.3 | 7.0 | 8.0 | 76.3 | 7.0 | 8.0 | 灭多威 | 98.6 | 4.4 | 4.7 | 36.9 | 4.5 | 4.7 |
| 噻嗪酮 | 64.1 | 8.0 | 8.6 | 74.5 | 8.0 | 8.6 | 速灭磷 | 94.8 | 5.5 | 5.7 | 38.5 | 5.5 | 5.7 |
| 甲萘威 | 68.4 | 7.2 | 7.5 | 105.0 | 7.6 | 7.5 | 久效磷 | 108.0 | 4.6 | 4.8 | 55.7 | 4.6 | 4.8 |
| 多菌灵 | 54.7 | 4.1 | 5.1 | 47.7 | 4.3 | 5.1 | 腈菌唑 | 113.0 | 8.0 | 8.1 | 84.1 | 8.0 | 8.1 |
| 克百威 | 25.8 | 6.3 | 7.2 | 24.9 | 6.2 | 7.2 | 氧乐果 | 70.9 | 4.2 | 4.3 | 59.7 | 4.2 | 4.3 |
| 丁硫克百威 | 91.4 | 7.9 | 8.5 | 57.7 | 7.9 | 8.5 | 多效唑 | 41.7 | 7.7 | 8.1 | 53.7 | 7.6 | 8.1 |
| 氯虫苯甲酰胺 | 46.1 | 7.6 | 7.8 | 76.8 | 7.5 | 7.8 | 对硫磷 | 51.5 | 8.0 | 8.2 | 67.0 | 8.0 | 8.2 |
| 灭幼脲 | 8.1 | 7.9 | 8.3 | 12.5 | 7.9 | 8.3 | 二甲戊灵 | 29.3 | 7.5 | 7.8 | 108.2 | 7.5 | 7.8 |
| 杀虫脒 | 218.7 | 3.6 | 4.9 | 77.8 | 3.3 | 4.9 | 甲拌磷 | 21.8 | 5.0 | 5.2 | 60.1 | 5.0 | 5.2 |
| 虫螨腈 | 41.0 | 8.0 | 8.4 | 86.1 | 8.0 | 8.4 | 甲拌磷砜 | 12.1 | 7.5 | 7.7 | 44.2 | 7.5 | 7.7 |
| 氟啶脲 | 2.8 | 7.7 | 8.8 | 8.2 | 7.6 | 8.8 | 甲拌磷亚砜 | 61.7 | 7.4 | 7.6 | 23.4 | 7.4 | 7.6 |
| 毒死蜱 | 51.5 | 7.7 | 8.8 | 187.4 | 7.6 | 8.8 | 伏杀硫磷 | 8.9 | 8.0 | 8.4 | 5.0 | 8.0 | 8.4 |
| 噻虫胺 | 26.6 | 3.7 | 5.1 | 47.2 | 3.6 | 5.0 | 硫环磷 | 36.1 | 5.8 | 6.0 | 102.4 | 5.8 | 6.0 |
| 蝇毒磷 | 109.6 | 7.8 | 8.3 | 107.6 | 7.8 | 8.3 | 亚胺硫磷 | 8.1 | 7.7 | 7.9 | 10.8 | 7.7 | 7.9 |
| 灭蝇胺 | 59.4 | 2.9 | 3.8 | 61.0 | 2.9 | 3.8 | 辛硫磷 | 6.2 | 8.3 | 8.3 | 9.1 | 8.3 | 8.3 |
| 内吸磷 | 103.7 | 5.2 | 6.0 | 68.0 | 5.2 | 6.0 | 抗蚜威 | 36.7 | 7.1 | 7.4 | 100.3 | 7.1 | 7.4 |
| 二嗪磷 | 89.3 | 7.9 | 8.3 | 105.0 | 7.9 | 8.3 | 咪鲜胺 | 31.9 | 8.2 | 8.4 | 51.0 | 8.2 | 8.4 |
| 敌敌畏 | 93.0 | 6.8 | 7.2 | 104.7 | 6.8 | 7.2 | 丙溴磷 | 17.8 | 8.2 | 8.6 | 14.9 | 8.2 | 8.6 |
| 苯醚甲环唑 | 57.8 | 7.9 | 8.4 | 64.6 | 7.9 | 8.4 | 霜霉威 | 79.1 | 4.2 | 4.4 | 70.0 | 4.2 | 4.4 |
| 除虫脲 | 5.2 | 5.1 | 8.2 | 8.1 | 5.0 | 8.2 | 丙环唑 | 96.7 | 8.2 | 8.3 | 85.8 | 8.2 | 8.3 |
| 乐果 | 81.9 | 3.8 | 5.4 | 74.7 | 3.7 | 5.4 | 吡唑醚菌酯 | 91.1 | 8.0 | 8.3 | 76.1 | 8.0 | 8.3 |
| 烯酰吗啉 | 37.8 | 4.7 | 8.0 | 57.5 | 4.5 | 8.0 | 哒螨灵 | 22.7 | 8.1 | 9.2 | 65.1 | 8.1 | 9.2 |
| 甲氨基阿维菌素苯甲酸盐 | 73.0 | 5.8 | 8.2 | 59.4 | 4.3 | 8.2 | 嘧霉胺 | 98.1 | 7.6 | 8.1 | 80.1 | 7.7 | 8.1 |
| 灭线磷 | 62.9 | 7.7 | 8.2 | 116.8 | 7.6 | 8.2 | 乙基多杀菌素J | 39.9 | 7.9 | 8.2 | 34.5 | 7.9 | 8.2 |
| 醚菊酯 | 20.0 | 8.6 | 8.7 | 5.3 | 8.6 | 8.7 | 乙基多杀菌素L | 58.6 | 8.2 | 8.3 | 46.7 | 8.2 | 8.3 |
| 氯苯嘧啶醇 | 61.6 | 7.8 | 8.2 | 110.6 | 7.8 | 8.2 | 多杀霉素A | 69.3 | 8.0 | 8.1 | 72.2 | 8.0 | 8.1 |
| 腈苯唑 | 57.5 | 8.1 | 8.2 | 69.4 | 8.1 | 8.2 | 多杀霉素D | 55.0 | 8.1 | 8.2 | 51.3 | 8.1 | 8.2 |
| 杀螟硫磷 | 70.1 | 6.7 | 7.6 | 24.3 | 6.6 | 7.6 | 螺螨酯 | 86.2 | 8.5 | 8.9 | 84.9 | 8.6 | 8.9 |
| 倍硫磷 | 9.6 | 7.9 | 8.3 | 8.3 | 7.9 | 8.3 | 戊唑醇 | 44.7 | 8.1 | 8.3 | 114.6 | 8.1 | 8.3 |
| 倍硫磷砜 | 3.3 | 7.0 | 7.4 | 8.9 | 7.0 | 7.4 | 虫酰肼 | 84.8 | 8.0 | 8.2 | 223.6 | 8.0 | 8.2 |
| 倍硫磷亚砜 | 57.0 | 7.2 | 7.3 | 79.2 | 7.1 | 7.3 | 特丁硫磷 | 74.8 | 7.9 | 8.7 | 70.0 | 7.9 | 8.7 |
| 氟虫腈 | 48.8 | 8.0 | 8.2 | 78.0 | 8.0 | 8.2 | 特丁硫磷砜 | 83.3 | 7.7 | 7.9 | 116.0 | 7.7 | 7.9 |
| 氟甲腈 | 148.3 | 7.8 | 8.1 | 123.2 | 7.8 | 8.1 | 特丁硫磷亚砜 | 59.6 | 7.5 | 7.9 | 101.2 | 7.5 | 7.9 |
| 氟虫腈硫醚 | 89.8 | 7.8 | 8.2 | 75.4 | 7.8 | 8.2 | 噻虫嗪 | 128.6 | 4.6 | 4.7 | 86.3 | 4.6 | 4.8 |
| 氟虫腈砜 | 74.0 | 8.0 | 8.2 | 84.1 | 8.1 | 8.2 | 噻苯隆 | 33.8 | 7.3 | 7.3 | 91.4 | 7.3 | 7.3 |
| 氯吡脲 | 64.1 | 7.3 | 7.8 | 50.8 | 7.2 | 7.8 | 甲基硫菌灵 | 116.9 | 6.9 | 7.0 | 118.2 | 6.9 | 7.0 |
| 赤霉酸 | 103.0 | 4.9 | 5.1 | 48.8 | 4.9 | 5.1 | 唑虫酰胺 | 34.3 | 8.2 | 8.6 | 70.1 | 8.3 | 8.6 |
| 噻螨酮 | 69.8 | 8.5 | 8.8 | 35.4 | 8.5 | 8.8 | 三唑酮 | 38.3 | 7.9 | 8.1 | 113.4 | 7.9 | 8.1 |
| 抑霉唑 | 112.5 | 7.3 | 7.7 | 74.5 | 7.3 | 7.7 | 三唑磷 | 88.5 | 7.8 | 8.1 | 68.6 | 7.8 | 8.1 |
| 吡虫啉 | 76.9 | 4.5 | 5.0 | 81.9 | 4.5 | 5.0 | 敌百虫 | 59.3 | 5.1 | 5.4 | 88.4 | 5.2 | 5.4 |
| 茚虫威 | 36.7 | 8.2 | 8.3 | 36.6 | 8.2 | 8.3 | 肟菌酯 | 115.8 | 8.1 | 8.4 | 64.7 | 8.1 | 8.4 |

**1.5样品前处理与仪器方法**

称取5 g试样（精确至0.01 g）于提取管中，加入5 mL乙腈，剧烈震荡2 min后4000 r/min离心5 min，吸取1 mL上清液于挤压式一步固相萃取柱中，以每秒1滴的流速缓慢过滤于进样瓶中，用于测定。

仪器型号：Triple Quad 4500液相色谱三重四极杆串联质谱仪（美国SCIEX公司）。色谱柱:ACQUITY\_UPLCTM BEH C18 1.7 um 2.1\*50mm Column；柱温:35℃；进样量:5uL；毛细管电压:5500v；离子源温度:550℃；雾化气压力:344.7kPa；去溶剂气压力:413.7kPa；气帘气压力:172.4kPa；碰撞气压力:55.2kPa；选择0.005mol/L乙酸铵水-甲醇作为流动相，流动相及流速见表7。共监测农药100个，MRM监测离子及质谱参数见表3。

**1.6线性范围的考察**

用豇豆和芒果基质溶液（经检测不含待测农药）配制浓度分别为0.005 mg/L、0.010 mg/L、0.020 mg/L、0.050 mg/L、0.080 mg/L、0.10 mg/L和0.20 mg/L的标准工作溶液。以浓度为横坐标，峰面积为纵坐标，绘制标准曲线。结果表明，标准曲线在0.005 mg/L、0.010 mg/L、0.020 mg/L、0.050 mg/L、0.080 mg/L和0.10 mg/L的浓度范围内线性关系良好，相关系数r均≥0.99。

**1.7检测限、定量限**

取芒果空白样品，加入标准溶液进行样品添加实验，经前处理试验并上机，以3倍信噪比（S/N）计算各农药的检测限，10倍信噪比为定量限，各农药的方法检出限在0.040 μg/kg~3.10 μg/kg之间，定量限在0.13 μg/kg~10.3 μg/kg之间。为配合实际样品和定量准确，添加各浓度到0.010 mg/kg进行试验，回收率均符合要求。因此，通过实际添加回收试验最终确定定量限为0.010 mg/kg。

**1.8加样回收率实验**

如表6-表11，为全面验证检测方法在实际样品基质中的准确性与可靠性，本试验严格遵循农药残留检测的质量控制要求，选取0.01mg/kg、0.02mg/kg和0.1mg/kg三个梯度浓度作为加样回收试验的添加水平。这三个浓度的设置既涵盖了低剂量残留检测的灵敏度需求，又覆盖了日常检测中常见的污染水平范围，能够充分反映方法在不同残留量下的回收性能。

试验选取芒果和豇豆两种典型样品基质进行加样实验。操作过程中，精确移取对应浓度的农药标准溶液，分别加入到经确认无目标农药残留的芒果样品和豇豆样品中，充分混匀后静置30分钟，确保标准溶液与样品基质完全融合。随后按照既定的前处理方法对加样后的样品进行处理，处理完成后进行上机分析。为保证试验结果的重复性与稳定性，每个添加水平均设置7次平行测定。

试验结果显示，在芒果样品的加样回收试验中，各目标农药残留的检测回收率呈现良好的稳定性，回收率范围为74.1%～113.8%；在豇豆样品中，各农药残留的检测回收率范围为73.9%～113.5%。同时，两个样品基质中所有平行测定的相对标准偏差（RSD）范围均控制在0～10%以内。

根据GB/T27404-2008《实验室质量控制规范食品理化检测》中的明确要求，农药残留检测的回收率通常应控制在70%～120%之间，相对标准偏差不得超过15%。本试验中芒果和豇豆样品的加样回收结果均完全符合上述标准要求，表明该检测方法在两种样品基质中具有良好的准确性、精密度和适用性，能够满足农药残留日常检测的质量控制需求。

表6 浓度水平0.01 mg/kg添加结果（芒果）

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 序号 | 名称 | 1# | 2# | 3# | 4# | 5# | 6# | 7# | 平均值 | 回收率% | 相对标准偏差% |
| mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | 克百威 | 0.0103 | 0.0103 | 0.0102 | 0.0102 | 0.0101 | 0.0108 | 0.0101 | 0.0103 | 103 | 2.5 |
| 2 | 3-羟基克百威 | 0.0101 | 0.0102 | 0.0103 | 0.0104 | 0.0105 | 0.0108 | 0.0106 | 0.0104 | 104 | 2.2 |
| 3 | 吡虫啉 | 0.0092 | 0.0097 | 0.0100 | 0.0099 | 0.0091 | 0.0099 | 0.0096 | 0.0096 | 96.3 | 3.6 |
| 4 | 吡唑醚菌酯 | 0.0115 | 0.0115 | 0.0115 | 0.0109 | 0.0110 | 0.0108 | 0.0109 | 0.0112 | 112 | 2.7 |
| 5 | 啶虫脒 | 0.0103 | 0.0106 | 0.0101 | 0.0101 | 0.0106 | 0.0110 | 0.0109 | 0.0105 | 105 | 3.4 |
| 6 | 多菌灵 | 0.0115 | 0.0112 | 0.0112 | 0.0110 | 0.0107 | 0.0105 | 0.0117 | 0.0111 | 111 | 3.7 |
| 7 | 多效唑 | 0.0087 | 0.0094 | 0.0088 | 0.0089 | 0.0086 | 0.0093 | 0.0090 | 0.0089 | 89.5 | 3.4 |
| 8 | 甲氨基阿维菌素苯甲酸盐 | 0.0079 | 0.0080 | 0.0080 | 0.0087 | 0.0077 | 0.0087 | 0.0079 | 0.0081 | 81.1 | 5.2 |
| 9 | 灭蝇胺 | 0.0075 | 0.0076 | 0.0071 | 0.0072 | 0.0081 | 0.0080 | 0.0078 | 0.0076 | 75.9 | 5.2 |
| 10 | 嘧菌酯 | 0.0117 | 0.0110 | 0.0106 | 0.0112 | 0.0107 | 0.0115 | 0.0116 | 0.0112 | 112 | 4.1 |
| 11 | 嘧霉胺 | 0.0110 | 0.0116 | 0.0106 | 0.0107 | 0.0109 | 0.0112 | 0.0108 | 0.0110 | 110 | 3.2 |
| 12 | 噻虫嗪 | 0.0106 | 0.0100 | 0.0101 | 0.0106 | 0.0106 | 0.0110 | 0.0101 | 0.0104 | 104 | 3.3 |
| 13 | 霜霉威 | 0.0080 | 0.0075 | 0.0071 | 0.0073 | 0.0076 | 0.0073 | 0.0073 | 0.0075 | 74.5 | 3.7 |
| 14 | 烯酰吗啉 | 0.0101 | 0.0101 | 0.0102 | 0.0105 | 0.0107 | 0.0105 | 0.0102 | 0.0103 | 103 | 2.1 |
| 15 | 毒死蜱 | 0.0081 | 0.0076 | 0.0074 | 0.0070 | 0.0074 | 0.0082 | 0.0074 | 0.0076 | 75.8 | 5.5 |
| 16 | 甲胺磷 | 0.0072 | 0.0077 | 0.0082 | 0.0071 | 0.0081 | 0.0072 | 0.0082 | 0.0077 | 76.5 | 6.3 |
| 17 | 乙酰甲胺磷 | 0.0080 | 0.0073 | 0.0080 | 0.0080 | 0.0083 | 0.0075 | 0.0074 | 0.0078 | 77.8 | 4.9 |
| 18 | 氧乐果 | 0.0076 | 0.0073 | 0.0078 | 0.0074 | 0.0073 | 0.0075 | 0.0071 | 0.0074 | 74.1 | 2.9 |
| 19 | 苯醚甲环唑 | 0.0107 | 0.0111 | 0.0109 | 0.0106 | 0.0116 | 0.0111 | 0.0113 | 0.0110 | 110 | 2.9 |
| 20 | 哒螨灵 | 0.0095 | 0.0086 | 0.0087 | 0.0085 | 0.0088 | 0.0088 | 0.0094 | 0.0089 | 88.9 | 4.3 |
| 21 | 三唑磷 | 0.0095 | 0.0092 | 0.0091 | 0.0101 | 0.0103 | 0.0099 | 0.0096 | 0.0097 | 96.7 | 4.7 |
| 22 | 辛硫磷 | 0.0092 | 0.0087 | 0.0095 | 0.0091 | 0.0089 | 0.0094 | 0.0089 | 0.0091 | 91.0 | 3.1 |
| 23 | 阿维菌素 | 0.0086 | 0.0084 | 0.0080 | 0.0077 | 0.0085 | 0.0083 | 0.0084 | 0.0083 | 82.8 | 3.8 |
| 24 | 亚胺硫磷 | 0.0083 | 0.0078 | 0.0087 | 0.0077 | 0.0076 | 0.0083 | 0.0076 | 0.0080 | 79.9 | 5.3 |
| 25 | 伏杀硫磷 | 0.0099 | 0.0100 | 0.0095 | 0.0098 | 0.0103 | 0.0089 | 0.0093 | 0.0097 | 96.6 | 4.9 |
| 26 | 乐果 | 0.0070 | 0.0081 | 0.0071 | 0.0073 | 0.0079 | 0.0076 | 0.0078 | 0.0076 | 75.5 | 5.5 |
| 27 | 倍硫磷 | 0.0083 | 0.0084 | 0.0075 | 0.0076 | 0.0076 | 0.0076 | 0.0085 | 0.0079 | 79.2 | 5.6 |
| 28 | 杀虫脒 | 0.0081 | 0.0077 | 0.0077 | 0.0087 | 0.0080 | 0.0080 | 0.0078 | 0.0080 | 80.2 | 4.4 |
| 29 | 涕灭威 | 0.0080 | 0.0081 | 0.0081 | 0.0081 | 0.0076 | 0.0075 | 0.0084 | 0.0080 | 79.8 | 3.9 |
| 30 | 涕灭威砜 | 0.0085 | 0.0093 | 0.0087 | 0.0091 | 0.0086 | 0.0085 | 0.0088 | 0.0088 | 87.8 | 3.5 |
| 31 | 涕灭威亚砜 | 0.0096 | 0.0091 | 0.0096 | 0.0088 | 0.0102 | 0.0103 | 0.0094 | 0.0096 | 95.5 | 5.6 |
| 32 | 倍硫磷砜 | 0.0104 | 0.0104 | 0.0107 | 0.0107 | 0.0102 | 0.0100 | 0.0100 | 0.0103 | 103 | 2.8 |
| 33 | 倍硫磷亚砜 | 0.0090 | 0.0093 | 0.0092 | 0.0090 | 0.0100 | 0.0094 | 0.0093 | 0.0093 | 93.1 | 3.5 |
| 34 | 杀螟硫磷 | 0.0082 | 0.0086 | 0.0087 | 0.0086 | 0.0079 | 0.0075 | 0.0077 | 0.0082 | 81.8 | 5.8 |
| 35 | 虫酰肼 | 0.0092 | 0.0090 | 0.0098 | 0.0098 | 0.0100 | 0.0101 | 0.0100 | 0.0097 | 97.0 | 4.3 |
| 36 | 除虫脲 | 0.0080 | 0.0075 | 0.0087 | 0.0087 | 0.0077 | 0.0078 | 0.0081 | 0.0081 | 80.7 | 5.8 |
| 37 | 二甲戊灵 | 0.0107 | 0.0101 | 0.0103 | 0.0103 | 0.0107 | 0.0108 | 0.0109 | 0.0105 | 105 | 2.8 |
| 38 | 氟啶脲 | 0.0100 | 0.0100 | 0.0105 | 0.0102 | 0.0105 | 0.0100 | 0.0106 | 0.0103 | 103 | 2.5 |
| 39 | 甲萘威 | 0.0094 | 0.0090 | 0.0103 | 0.0101 | 0.0092 | 0.0095 | 0.0100 | 0.0096 | 96.5 | 5.0 |
| 40 | 甲霜灵 | 0.0114 | 0.0113 | 0.0115 | 0.0110 | 0.0113 | 0.0111 | 0.0116 | 0.0113 | 113 | 2.0 |
| 41 | 氯吡脲 | 0.0094 | 0.0091 | 0.0089 | 0.0100 | 0.0100 | 0.0098 | 0.0092 | 0.0095 | 94.8 | 4.8 |
| 42 | 氯虫苯甲酰胺 | 0.0103 | 0.0102 | 0.0100 | 0.0103 | 0.0100 | 0.0101 | 0.0095 | 0.0100 | 100 | 2.7 |
| 43 | 灭幼脲 | 0.0100 | 0.0097 | 0.0101 | 0.0097 | 0.0091 | 0.0102 | 0.0100 | 0.0098 | 98.4 | 3.7 |
| 44 | 醚菊酯 | 0.0094 | 0.0098 | 0.0097 | 0.0098 | 0.0097 | 0.0098 | 0.0101 | 0.0097 | 97.5 | 2.2 |
| 45 | 异菌脲 | 0.0070 | 0.0076 | 0.0082 | 0.0074 | 0.0077 | 0.0083 | 0.0070 | 0.0076 | 75.9 | 6.5 |
| 46 | 丙溴磷 | 0.0102 | 0.0097 | 0.0094 | 0.0088 | 0.0100 | 0.0096 | 0.0089 | 0.0095 | 95.0 | 5.7 |
| 47 | 甲基异柳磷 | 0.0080 | 0.0086 | 0.0083 | 0.0087 | 0.0084 | 0.0082 | 0.0082 | 0.0083 | 83.5 | 3.0 |
| 48 | 水胺硫磷 | 0.0084 | 0.0078 | 0.0080 | 0.0081 | 0.0086 | 0.0080 | 0.0088 | 0.0082 | 82.3 | 4.5 |
| 49 | 乙基多杀菌素J | 0.0101 | 0.0101 | 0.0104 | 0.0100 | 0.0108 | 0.0104 | 0.0103 | 0.0103 | 103 | 2.7 |
| 50 | 乙基多杀菌素L | 0.0103 | 0.0109 | 0.0107 | 0.0103 | 0.0101 | 0.0108 | 0.0107 | 0.0105 | 105 | 3.0 |
| 51 | 噻虫胺 | 0.0113 | 0.0113 | 0.0116 | 0.0111 | 0.0110 | 0.0116 | 0.0114 | 0.0113 | 113 | 1.9 |
| 52 | 敌敌畏 | 0.0086 | 0.0087 | 0.0093 | 0.0087 | 0.0089 | 0.0086 | 0.0086 | 0.0088 | 87.6 | 3.0 |
| 53 | 咪鲜胺 | 0.0112 | 0.0110 | 0.0112 | 0.0107 | 0.0110 | 0.0110 | 0.0105 | 0.0109 | 109 | 2.3 |
| 54 | 甲拌磷 | 0.0078 | 0.0085 | 0.0075 | 0.0079 | 0.0082 | 0.0085 | 0.0084 | 0.0081 | 81.3 | 4.9 |
| 55 | 甲拌磷砜 | 0.0086 | 0.0085 | 0.0086 | 0.0076 | 0.0079 | 0.0078 | 0.0084 | 0.0082 | 82.0 | 5.1 |
| 56 | 甲拌磷亚砜 | 0.0083 | 0.0085 | 0.0079 | 0.0081 | 0.0083 | 0.0082 | 0.0075 | 0.0081 | 81.0 | 3.8 |
| 57 | 灭多威 | 0.0095 | 0.0089 | 0.0096 | 0.0103 | 0.0095 | 0.0103 | 0.0093 | 0.0096 | 96.3 | 5.2 |
| 58 | 抗蚜威 | 0.0090 | 0.0101 | 0.0100 | 0.0089 | 0.0096 | 0.0093 | 0.0101 | 0.0096 | 95.5 | 5.4 |
| 59 | 氟虫腈 | 0.0091 | 0.0097 | 0.0099 | 0.0091 | 0.0093 | 0.0097 | 0.0095 | 0.0095 | 94.5 | 3.4 |
| 60 | 氟虫腈砜 | 0.0103 | 0.0093 | 0.0100 | 0.0099 | 0.0098 | 0.0094 | 0.0093 | 0.0097 | 97.1 | 4.0 |
| 61 | 氟虫腈硫醚 | 0.0093 | 0.0096 | 0.0096 | 0.0096 | 0.0100 | 0.0096 | 0.0101 | 0.0097 | 96.9 | 2.9 |
| 62 | 氟甲腈 | 0.0102 | 0.0103 | 0.0101 | 0.0102 | 0.0102 | 0.0105 | 0.0103 | 0.0103 | 103 | 1.2 |
| 63 | 虫螨腈 | 0.0087 | 0.0082 | 0.0077 | 0.0083 | 0.0077 | 0.0080 | 0.0078 | 0.0081 | 80.6 | 4.7 |
| 64 | 赤霉酸 | 0.0103 | 0.0096 | 0.0092 | 0.0089 | 0.0090 | 0.0102 | 0.0090 | 0.0094 | 94.5 | 6.2 |
| 65 | 戊唑醇 | 0.0098 | 0.0101 | 0.0088 | 0.0097 | 0.0098 | 0.0091 | 0.0091 | 0.0095 | 94.8 | 5.1 |
| 66 | 内吸磷 | 0.0088 | 0.0080 | 0.0084 | 0.0080 | 0.0077 | 0.0082 | 0.0088 | 0.0083 | 82.5 | 5.0 |
| 67 | 氯唑磷 | 0.0087 | 0.0085 | 0.0087 | 0.0075 | 0.0086 | 0.0085 | 0.0077 | 0.0083 | 83.1 | 6.0 |
| 68 | 马拉硫磷 | 0.0083 | 0.0085 | 0.0080 | 0.0076 | 0.0080 | 0.0087 | 0.0080 | 0.0082 | 81.5 | 4.7 |
| 69 | 螺螨酯 | 0.0086 | 0.0095 | 0.0094 | 0.0091 | 0.0089 | 0.0090 | 0.0087 | 0.0090 | 90.3 | 3.4 |
| 70 | 噻螨酮 | 0.0093 | 0.0094 | 0.0102 | 0.0099 | 0.0093 | 0.0090 | 0.0100 | 0.0096 | 95.9 | 4.6 |
| 71 | 抑霉唑 | 0.0097 | 0.0091 | 0.0089 | 0.0094 | 0.0098 | 0.0092 | 0.0091 | 0.0093 | 93.1 | 3.6 |
| 72 | 噻嗪酮 | 0.0093 | 0.0098 | 0.0095 | 0.0098 | 0.0094 | 0.0094 | 0.0098 | 0.0096 | 95.6 | 2.6 |
| 73 | 丁硫克百威 | 0.0075 | 0.0081 | 0.0079 | 0.0080 | 0.0074 | 0.0078 | 0.0083 | 0.0079 | 78.5 | 4.1 |
| 74 | 二嗪磷 | 0.0087 | 0.0085 | 0.0077 | 0.0088 | 0.0079 | 0.0080 | 0.0083 | 0.0083 | 82.7 | 4.7 |
| 75 | 速灭磷 | 0.0086 | 0.0078 | 0.0078 | 0.0083 | 0.0082 | 0.0086 | 0.0077 | 0.0081 | 81.4 | 4.8 |
| 76 | 啶酰菌胺 | 0.0091 | 0.0097 | 0.0100 | 0.0096 | 0.0100 | 0.0102 | 0.0099 | 0.0098 | 98.0 | 3.7 |
| 77 | 腈苯唑 | 0.0089 | 0.0102 | 0.0096 | 0.0093 | 0.0092 | 0.0101 | 0.0101 | 0.0096 | 96.2 | 5.3 |
| 78 | 醚菌酯 | 0.0114 | 0.0116 | 0.0114 | 0.0111 | 0.0111 | 0.0113 | 0.0109 | 0.0113 | 113 | 2.2 |
| 79 | 三唑酮 | 0.0106 | 0.0115 | 0.0107 | 0.0109 | 0.0108 | 0.0109 | 0.0117 | 0.0110 | 110 | 3.6 |
| 80 | 硫环磷 | 0.0077 | 0.0080 | 0.0077 | 0.0079 | 0.0084 | 0.0083 | 0.0081 | 0.0080 | 80.3 | 3.3 |
| 81 | 噻苯隆 | 0.0094 | 0.0091 | 0.0096 | 0.0092 | 0.0096 | 0.0093 | 0.0096 | 0.0094 | 94.0 | 2.1 |
| 82 | 灭线磷 | 0.0081 | 0.0085 | 0.0086 | 0.0080 | 0.0086 | 0.0076 | 0.0081 | 0.0082 | 81.9 | 4.3 |
| 83 | 丙环唑 | 0.0103 | 0.0104 | 0.0101 | 0.0106 | 0.0104 | 0.0100 | 0.0104 | 0.0103 | 103.2 | 2.1 |
| 84 | 敌百虫 | 0.0104 | 0.0108 | 0.0108 | 0.0110 | 0.0110 | 0.0105 | 0.0105 | 0.0107 | 106.9 | 2.2 |
| 85 | 多杀霉素A | 0.0093 | 0.0091 | 0.0094 | 0.0090 | 0.0096 | 0.0094 | 0.0091 | 0.0093 | 92.6 | 2.2 |
| 86 | 多杀霉素D | 0.0091 | 0.0095 | 0.0097 | 0.0101 | 0.0096 | 0.0101 | 0.0100 | 0.0097 | 97.4 | 3.9 |
| 87 | 特丁硫磷 | 0.0087 | 0.0083 | 0.0080 | 0.0083 | 0.0082 | 0.0078 | 0.0079 | 0.0082 | 81.6 | 3.6 |
| 88 | 特丁硫磷砜 | 0.0085 | 0.0087 | 0.0084 | 0.0078 | 0.0077 | 0.0088 | 0.0088 | 0.0084 | 83.8 | 5.4 |
| 89 | 特丁硫磷亚砜 | 0.0078 | 0.0084 | 0.0080 | 0.0084 | 0.0080 | 0.0076 | 0.0078 | 0.0080 | 80.0 | 4.1 |
| 90 | 异丙威 | 0.0090 | 0.0091 | 0.0085 | 0.0088 | 0.0092 | 0.0091 | 0.0094 | 0.0090 | 90.2 | 3.2 |
| 91 | 久效磷 | 0.0083 | 0.0076 | 0.0077 | 0.0076 | 0.0077 | 0.0078 | 0.0077 | 0.0078 | 77.5 | 3.5 |
| 92 | 茚虫威 | 0.0092 | 0.0090 | 0.0102 | 0.0096 | 0.0099 | 0.0096 | 0.0091 | 0.0095 | 95.3 | 4.7 |
| 93 | 唑虫酰胺 | 0.0094 | 0.0100 | 0.0096 | 0.0095 | 0.0102 | 0.0090 | 0.0095 | 0.0096 | 95.9 | 4.3 |
| 94 | 对硫磷 | 0.0081 | 0.0083 | 0.0086 | 0.0086 | 0.0081 | 0.0080 | 0.0078 | 0.0082 | 82.0 | 4.0 |
| 95 | 氯苯嘧啶醇 | 0.0088 | 0.0094 | 0.0103 | 0.0098 | 0.0094 | 0.0093 | 0.0094 | 0.0095 | 94.9 | 4.8 |
| 96 | 莠灭净 | 0.0107 | 0.0104 | 0.0101 | 0.0104 | 0.0102 | 0.0109 | 0.0100 | 0.0104 | 104 | 3.1 |
| 97 | 蝇毒磷 | 0.0079 | 0.0084 | 0.0081 | 0.0077 | 0.0087 | 0.0088 | 0.0084 | 0.0083 | 82.9 | 5.0 |
| 98 | 甲基硫菌灵 | 0.0109 | 0.0106 | 0.0117 | 0.0112 | 0.0110 | 0.0107 | 0.0106 | 0.0110 | 110 | 3.7 |
| 99 | 肟菌酯 | 0.0107 | 0.0111 | 0.0116 | 0.0111 | 0.0107 | 0.0116 | 0.0114 | 0.0112 | 112 | 3.6 |
| 100 | 腈菌唑 | 0.0101 | 0.0098 | 0.0093 | 0.0088 | 0.0095 | 0.0096 | 0.0095 | 0.0095 | 95.2 | 4.2 |

表7 浓度水平0.02 mg/kg添加结果（芒果）

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 序号 | 名称 | 1# | 2# | 3# | 4# | 5# | 6# | 7# | 平均值 | 回收率% | 相对标准偏差% |
| mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | 克百威 | 0.0203 | 0.0192 | 0.0186 | 0.0184 | 0.0178 | 0.0189 | 0.0185 | 0.0188 | 94.1 | 4.1 |
| 2 | 3-羟基克百威 | 0.0182 | 0.0195 | 0.0193 | 0.0177 | 0.0181 | 0.0191 | 0.0200 | 0.0188 | 94.2 | 4.5 |
| 3 | 吡虫啉 | 0.0209 | 0.0201 | 0.0204 | 0.0216 | 0.0209 | 0.0204 | 0.0204 | 0.0207 | 103 | 2.5 |
| 4 | 吡唑醚菌酯 | 0.0215 | 0.0232 | 0.0228 | 0.0225 | 0.0210 | 0.0215 | 0.0228 | 0.0222 | 111 | 3.7 |
| 5 | 啶虫脒 | 0.0211 | 0.0200 | 0.0224 | 0.0220 | 0.0218 | 0.0220 | 0.0224 | 0.0217 | 108 | 3.9 |
| 6 | 多菌灵 | 0.0227 | 0.0213 | 0.0214 | 0.0212 | 0.0234 | 0.0222 | 0.0210 | 0.0219 | 109 | 4.1 |
| 7 | 多效唑 | 0.0183 | 0.0173 | 0.0173 | 0.0189 | 0.0188 | 0.0189 | 0.0173 | 0.0181 | 90.6 | 4.3 |
| 8 | 甲氨基阿维菌素苯甲酸盐 | 0.0167 | 0.0158 | 0.0157 | 0.0165 | 0.0172 | 0.0169 | 0.0176 | 0.0166 | 83.0 | 4.2 |
| 9 | 灭蝇胺 | 0.0150 | 0.0148 | 0.0148 | 0.0157 | 0.0148 | 0.0142 | 0.0165 | 0.0151 | 75.6 | 5.0 |
| 10 | 嘧菌酯 | 0.0217 | 0.0211 | 0.0227 | 0.0217 | 0.0230 | 0.0233 | 0.0210 | 0.0221 | 110 | 4.1 |
| 11 | 嘧霉胺 | 0.0223 | 0.0230 | 0.0217 | 0.0224 | 0.0226 | 0.0226 | 0.0230 | 0.0225 | 113 | 2.0 |
| 12 | 噻虫嗪 | 0.0212 | 0.0205 | 0.0207 | 0.0208 | 0.0209 | 0.0211 | 0.0220 | 0.0210 | 105 | 2.4 |
| 13 | 霜霉威 | 0.0161 | 0.0164 | 0.0143 | 0.0164 | 0.0143 | 0.0162 | 0.0157 | 0.0156 | 78.1 | 6.1 |
| 14 | 烯酰吗啉 | 0.0212 | 0.0223 | 0.0211 | 0.0223 | 0.0204 | 0.0204 | 0.0207 | 0.0212 | 106 | 3.9 |
| 15 | 毒死蜱 | 0.0160 | 0.0163 | 0.0162 | 0.0141 | 0.0144 | 0.0149 | 0.0157 | 0.0154 | 76.9 | 5.9 |
| 16 | 甲胺磷 | 0.0158 | 0.0164 | 0.0147 | 0.0150 | 0.0158 | 0.0162 | 0.0156 | 0.0156 | 78.2 | 3.9 |
| 17 | 乙酰甲胺磷 | 0.0153 | 0.0164 | 0.0158 | 0.0161 | 0.0157 | 0.0153 | 0.0155 | 0.0157 | 78.6 | 2.7 |
| 18 | 氧乐果 | 0.0164 | 0.0154 | 0.0140 | 0.0166 | 0.0148 | 0.0154 | 0.0154 | 0.0154 | 77.1 | 5.7 |
| 19 | 苯醚甲环唑 | 0.0213 | 0.0232 | 0.0219 | 0.0230 | 0.0230 | 0.0227 | 0.0210 | 0.0223 | 111 | 4.0 |
| 20 | 哒螨灵 | 0.0189 | 0.0204 | 0.0188 | 0.0188 | 0.0185 | 0.0183 | 0.0198 | 0.0191 | 95.3 | 4.0 |
| 21 | 三唑磷 | 0.0213 | 0.0207 | 0.0205 | 0.0208 | 0.0209 | 0.0213 | 0.0202 | 0.0208 | 104 | 1.9 |
| 22 | 辛硫磷 | 0.0185 | 0.0181 | 0.0173 | 0.0173 | 0.0185 | 0.0181 | 0.0189 | 0.0181 | 90.4 | 3.4 |
| 23 | 阿维菌素 | 0.0157 | 0.0155 | 0.0165 | 0.0160 | 0.0162 | 0.0166 | 0.0166 | 0.0162 | 80.8 | 2.8 |
| 24 | 亚胺硫磷 | 0.0153 | 0.0159 | 0.0167 | 0.0157 | 0.0174 | 0.0173 | 0.0173 | 0.0165 | 82.5 | 5.3 |
| 25 | 伏杀硫磷 | 0.0187 | 0.0181 | 0.0186 | 0.0183 | 0.0192 | 0.0188 | 0.0186 | 0.0186 | 93.1 | 2.0 |
| 26 | 乐果 | 0.0152 | 0.0166 | 0.0158 | 0.0142 | 0.0148 | 0.0157 | 0.0157 | 0.0154 | 77.2 | 5.0 |
| 27 | 倍硫磷 | 0.0158 | 0.0168 | 0.0174 | 0.0155 | 0.0170 | 0.0168 | 0.0165 | 0.0166 | 82.8 | 4.2 |
| 28 | 杀虫脒 | 0.0158 | 0.0158 | 0.0163 | 0.0159 | 0.0152 | 0.0163 | 0.0168 | 0.0160 | 80.1 | 3.2 |
| 29 | 涕灭威 | 0.0164 | 0.0171 | 0.0171 | 0.0166 | 0.0164 | 0.0152 | 0.0175 | 0.0166 | 83.1 | 4.5 |
| 30 | 涕灭威砜 | 0.0180 | 0.0203 | 0.0197 | 0.0185 | 0.0204 | 0.0196 | 0.0184 | 0.0193 | 96.4 | 5.0 |
| 31 | 涕灭威亚砜 | 0.0208 | 0.0207 | 0.0216 | 0.0211 | 0.0214 | 0.0206 | 0.0213 | 0.0211 | 105 | 1.8 |
| 32 | 倍硫磷砜 | 0.0173 | 0.0172 | 0.0187 | 0.0175 | 0.0181 | 0.0179 | 0.0181 | 0.0178 | 89.1 | 3.0 |
| 33 | 倍硫磷亚砜 | 0.0182 | 0.0182 | 0.0177 | 0.0196 | 0.0195 | 0.0200 | 0.0177 | 0.0187 | 93.5 | 5.3 |
| 34 | 杀螟硫磷 | 0.0163 | 0.0157 | 0.0159 | 0.0162 | 0.0171 | 0.0161 | 0.0160 | 0.0162 | 81.0 | 2.8 |
| 35 | 虫酰肼 | 0.0191 | 0.0183 | 0.0184 | 0.0193 | 0.0185 | 0.0190 | 0.0201 | 0.0189 | 94.7 | 3.4 |
| 36 | 除虫脲 | 0.0158 | 0.0159 | 0.0167 | 0.0167 | 0.0154 | 0.0165 | 0.0156 | 0.0161 | 80.5 | 3.4 |
| 37 | 二甲戊灵 | 0.0212 | 0.0222 | 0.0206 | 0.0208 | 0.0202 | 0.0200 | 0.0216 | 0.0209 | 105 | 3.8 |
| 38 | 氟啶脲 | 0.0179 | 0.0203 | 0.0206 | 0.0191 | 0.0188 | 0.0195 | 0.0191 | 0.0193 | 96.6 | 4.7 |
| 39 | 甲萘威 | 0.0170 | 0.0178 | 0.0175 | 0.0178 | 0.0177 | 0.0173 | 0.0185 | 0.0177 | 88.3 | 2.7 |
| 40 | 甲霜灵 | 0.0228 | 0.0222 | 0.0227 | 0.0234 | 0.0229 | 0.0231 | 0.0221 | 0.0228 | 114 | 2.0 |
| 41 | 氯吡脲 | 0.0202 | 0.0212 | 0.0206 | 0.0218 | 0.0218 | 0.0213 | 0.0210 | 0.0211 | 106 | 2.8 |
| 42 | 氯虫苯甲酰胺 | 0.0181 | 0.0186 | 0.0181 | 0.0204 | 0.0204 | 0.0185 | 0.0204 | 0.0192 | 96.0 | 5.9 |
| 43 | 灭幼脲 | 0.0205 | 0.0198 | 0.0179 | 0.0201 | 0.0190 | 0.0193 | 0.0188 | 0.0193 | 96.6 | 4.5 |
| 44 | 醚菊酯 | 0.0195 | 0.0190 | 0.0192 | 0.0205 | 0.0177 | 0.0193 | 0.0198 | 0.0193 | 96.4 | 4.5 |
| 45 | 异菌脲 | 0.0163 | 0.0153 | 0.0159 | 0.0156 | 0.0144 | 0.0158 | 0.0142 | 0.0154 | 76.9 | 5.2 |
| 46 | 丙溴磷 | 0.0178 | 0.0182 | 0.0179 | 0.0186 | 0.0182 | 0.0179 | 0.0188 | 0.0182 | 91.0 | 2.1 |
| 47 | 甲基异柳磷 | 0.0153 | 0.0158 | 0.0159 | 0.0163 | 0.0166 | 0.0159 | 0.0172 | 0.0162 | 80.8 | 3.8 |
| 48 | 水胺硫磷 | 0.0170 | 0.0150 | 0.0151 | 0.0171 | 0.0171 | 0.0160 | 0.0155 | 0.0161 | 80.6 | 5.9 |
| 49 | 乙基多杀菌素J | 0.0206 | 0.0201 | 0.0211 | 0.0217 | 0.0214 | 0.0207 | 0.0202 | 0.0208 | 104 | 2.8 |
| 50 | 乙基多杀菌素L | 0.0214 | 0.0208 | 0.0203 | 0.0216 | 0.0209 | 0.0207 | 0.0213 | 0.0210 | 105 | 2.2 |
| 51 | 噻虫胺 | 0.0226 | 0.0234 | 0.0225 | 0.0225 | 0.0211 | 0.0211 | 0.0214 | 0.0221 | 110 | 3.9 |
| 52 | 敌敌畏 | 0.0192 | 0.0182 | 0.0180 | 0.0177 | 0.0204 | 0.0195 | 0.0193 | 0.0189 | 94.5 | 5.1 |
| 53 | 咪鲜胺 | 0.0206 | 0.0217 | 0.0211 | 0.0216 | 0.0219 | 0.0206 | 0.0212 | 0.0213 | 106 | 2.4 |
| 54 | 甲拌磷 | 0.0167 | 0.0152 | 0.0170 | 0.0163 | 0.0155 | 0.0169 | 0.0173 | 0.0164 | 82.1 | 5.0 |
| 55 | 甲拌磷砜 | 0.0158 | 0.0170 | 0.0159 | 0.0164 | 0.0176 | 0.0176 | 0.0169 | 0.0167 | 83.7 | 4.4 |
| 56 | 甲拌磷亚砜 | 0.0150 | 0.0165 | 0.0174 | 0.0152 | 0.0160 | 0.0174 | 0.0152 | 0.0161 | 80.5 | 6.3 |
| 57 | 灭多威 | 0.0195 | 0.0203 | 0.0185 | 0.0203 | 0.0177 | 0.0182 | 0.0203 | 0.0192 | 96.2 | 5.8 |
| 58 | 抗蚜威 | 0.0199 | 0.0198 | 0.0176 | 0.0197 | 0.0190 | 0.0198 | 0.0195 | 0.0193 | 96.7 | 4.1 |
| 59 | 氟虫腈 | 0.0203 | 0.0188 | 0.0184 | 0.0199 | 0.0195 | 0.0188 | 0.0204 | 0.0195 | 97.4 | 4.1 |
| 60 | 氟虫腈砜 | 0.0206 | 0.0202 | 0.0217 | 0.0209 | 0.0210 | 0.0202 | 0.0215 | 0.0209 | 104 | 2.7 |
| 61 | 氟虫腈硫醚 | 0.0190 | 0.0188 | 0.0205 | 0.0177 | 0.0187 | 0.0185 | 0.0188 | 0.0189 | 94.3 | 4.4 |
| 62 | 氟甲腈 | 0.0185 | 0.0174 | 0.0179 | 0.0179 | 0.0187 | 0.0172 | 0.0178 | 0.0179 | 89.5 | 3.1 |
| 63 | 虫螨腈 | 0.0150 | 0.0171 | 0.0168 | 0.0166 | 0.0173 | 0.0152 | 0.0158 | 0.0163 | 81.3 | 5.6 |
| 64 | 赤霉酸 | 0.0207 | 0.0203 | 0.0204 | 0.0207 | 0.0202 | 0.0218 | 0.0206 | 0.0207 | 103 | 2.6 |
| 65 | 戊唑醇 | 0.0186 | 0.0202 | 0.0205 | 0.0187 | 0.0189 | 0.0205 | 0.0190 | 0.0195 | 97.4 | 4.4 |
| 66 | 内吸磷 | 0.0169 | 0.0167 | 0.0158 | 0.0173 | 0.0165 | 0.0160 | 0.0160 | 0.0164 | 82.2 | 3.3 |
| 67 | 氯唑磷 | 0.0151 | 0.0168 | 0.0175 | 0.0158 | 0.0156 | 0.0164 | 0.0158 | 0.0162 | 80.8 | 5.0 |
| 68 | 马拉硫磷 | 0.0163 | 0.0174 | 0.0159 | 0.0174 | 0.0153 | 0.0168 | 0.0174 | 0.0166 | 83.2 | 5.1 |
| 69 | 螺螨酯 | 0.0200 | 0.0199 | 0.0191 | 0.0188 | 0.0185 | 0.0179 | 0.0201 | 0.0192 | 96.0 | 4.5 |
| 70 | 噻螨酮 | 0.0191 | 0.0194 | 0.0180 | 0.0200 | 0.0194 | 0.0202 | 0.0200 | 0.0194 | 97.2 | 3.9 |
| 71 | 抑霉唑 | 0.0186 | 0.0196 | 0.0199 | 0.0177 | 0.0198 | 0.0198 | 0.0185 | 0.0191 | 95.7 | 4.5 |
| 72 | 噻嗪酮 | 0.0203 | 0.0179 | 0.0198 | 0.0190 | 0.0203 | 0.0192 | 0.0186 | 0.0193 | 96.5 | 4.7 |
| 73 | 丁硫克百威 | 0.0149 | 0.0150 | 0.0157 | 0.0154 | 0.0160 | 0.0150 | 0.0165 | 0.0155 | 77.5 | 4.0 |
| 74 | 二嗪磷 | 0.0175 | 0.0154 | 0.0150 | 0.0153 | 0.0175 | 0.0174 | 0.0170 | 0.0164 | 82.2 | 6.9 |
| 75 | 速灭磷 | 0.0165 | 0.0153 | 0.0151 | 0.0159 | 0.0153 | 0.0168 | 0.0176 | 0.0161 | 80.4 | 5.7 |
| 76 | 啶酰菌胺 | 0.0183 | 0.0178 | 0.0184 | 0.0191 | 0.0196 | 0.0190 | 0.0193 | 0.0188 | 93.9 | 3.4 |
| 77 | 腈苯唑 | 0.0190 | 0.0182 | 0.0196 | 0.0192 | 0.0200 | 0.0185 | 0.0180 | 0.0189 | 94.7 | 3.8 |
| 78 | 醚菌酯 | 0.0219 | 0.0232 | 0.0217 | 0.0216 | 0.0213 | 0.0212 | 0.0233 | 0.0220 | 110 | 4.0 |
| 79 | 三唑酮 | 0.0232 | 0.0222 | 0.0214 | 0.0233 | 0.0223 | 0.0222 | 0.0227 | 0.0225 | 112 | 3.0 |
| 80 | 硫环磷 | 0.0162 | 0.0173 | 0.0156 | 0.0150 | 0.0170 | 0.0175 | 0.0165 | 0.0164 | 82.2 | 5.6 |
| 81 | 噻苯隆 | 0.0189 | 0.0197 | 0.0182 | 0.0198 | 0.0198 | 0.0199 | 0.0187 | 0.0193 | 96.3 | 3.5 |
| 82 | 灭线磷 | 0.0152 | 0.0154 | 0.0155 | 0.0164 | 0.0167 | 0.0152 | 0.0173 | 0.0160 | 79.8 | 5.2 |
| 83 | 丙环唑 | 0.0172 | 0.0181 | 0.0186 | 0.0186 | 0.0170 | 0.0183 | 0.0172 | 0.0179 | 89.4 | 4.0 |
| 84 | 敌百虫 | 0.0217 | 0.0223 | 0.0208 | 0.0211 | 0.0224 | 0.0218 | 0.0213 | 0.0216 | 108 | 2.8 |
| 85 | 多杀霉素A | 0.0209 | 0.0211 | 0.0214 | 0.0209 | 0.0210 | 0.0211 | 0.0216 | 0.0212 | 106 | 1.2 |
| 86 | 多杀霉素D | 0.0213 | 0.0216 | 0.0204 | 0.0217 | 0.0215 | 0.0208 | 0.0218 | 0.0213 | 106 | 2.4 |
| 87 | 特丁硫磷 | 0.0154 | 0.0170 | 0.0152 | 0.0170 | 0.0154 | 0.0157 | 0.0167 | 0.0161 | 80.3 | 5.1 |
| 88 | 特丁硫磷砜 | 0.0162 | 0.0162 | 0.0157 | 0.0174 | 0.0156 | 0.0150 | 0.0173 | 0.0162 | 80.9 | 5.4 |
| 89 | 特丁硫磷亚砜 | 0.0167 | 0.0166 | 0.0168 | 0.0160 | 0.0173 | 0.0150 | 0.0169 | 0.0165 | 82.4 | 4.5 |
| 90 | 异丙威 | 0.0178 | 0.0202 | 0.0201 | 0.0199 | 0.0185 | 0.0187 | 0.0201 | 0.0193 | 96.6 | 5.0 |
| 91 | 久效磷 | 0.0169 | 0.0164 | 0.0160 | 0.0159 | 0.0168 | 0.0151 | 0.0166 | 0.0162 | 81.1 | 3.9 |
| 92 | 茚虫威 | 0.0192 | 0.0176 | 0.0187 | 0.0196 | 0.0190 | 0.0176 | 0.0199 | 0.0188 | 94.0 | 4.8 |
| 93 | 唑虫酰胺 | 0.0204 | 0.0195 | 0.0197 | 0.0182 | 0.0195 | 0.0180 | 0.0200 | 0.0193 | 96.6 | 4.6 |
| 94 | 对硫磷 | 0.0160 | 0.0175 | 0.0152 | 0.0165 | 0.0157 | 0.0158 | 0.0161 | 0.0161 | 80.5 | 4.6 |
| 95 | 氯苯嘧啶醇 | 0.0178 | 0.0200 | 0.0190 | 0.0180 | 0.0205 | 0.0195 | 0.0178 | 0.0189 | 94.7 | 5.7 |
| 96 | 莠灭净 | 0.0183 | 0.0177 | 0.0180 | 0.0199 | 0.0202 | 0.0197 | 0.0204 | 0.0192 | 95.8 | 5.9 |
| 97 | 蝇毒磷 | 0.0164 | 0.0152 | 0.0156 | 0.0156 | 0.0162 | 0.0172 | 0.0153 | 0.0159 | 79.7 | 4.6 |
| 98 | 甲基硫菌灵 | 0.0234 | 0.0212 | 0.0231 | 0.0218 | 0.0222 | 0.0219 | 0.0215 | 0.0221 | 111 | 3.7 |
| 99 | 肟菌酯 | 0.0222 | 0.0229 | 0.0219 | 0.0212 | 0.0222 | 0.0213 | 0.0214 | 0.0219 | 109 | 2.9 |
| 100 | 腈菌唑 | 0.0180 | 0.0190 | 0.0188 | 0.0178 | 0.0182 | 0.0178 | 0.0173 | 0.0181 | 90.6 | 3.2 |

表8 浓度水平0.10 mg/kg添加结果（芒果）

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 序号 | 名称 | 1# | 2# | 3# | 4# | 5# | 6# | 7# | 平均值 | 回收率% | 相对标准偏差% |
| mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | 克百威 | 0.094 | 0.091 | 0.090 | 0.094 | 0.093 | 0.095 | 0.087 | 0.092 | 91.9 | 3.1 |
| 2 | 3-羟基克百威 | 0.093 | 0.091 | 0.086 | 0.086 | 0.088 | 0.090 | 0.085 | 0.088 | 88.5 | 3.3 |
| 3 | 吡虫啉 | 0.102 | 0.109 | 0.105 | 0.104 | 0.109 | 0.101 | 0.108 | 0.105 | 105 | 3.1 |
| 4 | 吡唑醚菌酯 | 0.106 | 0.109 | 0.108 | 0.110 | 0.107 | 0.109 | 0.108 | 0.108 | 108 | 1.3 |
| 5 | 啶虫脒 | 0.102 | 0.101 | 0.108 | 0.106 | 0.102 | 0.101 | 0.105 | 0.104 | 104 | 2.8 |
| 6 | 多菌灵 | 0.105 | 0.107 | 0.106 | 0.108 | 0.109 | 0.109 | 0.107 | 0.107 | 107 | 1.4 |
| 7 | 多效唑 | 0.093 | 0.092 | 0.098 | 0.102 | 0.103 | 0.099 | 0.092 | 0.097 | 96.9 | 5.0 |
| 8 | 甲氨基阿维菌素苯甲酸盐 | 0.089 | 0.091 | 0.086 | 0.088 | 0.086 | 0.088 | 0.089 | 0.088 | 88.0 | 1.9 |
| 9 | 灭蝇胺 | 0.085 | 0.081 | 0.081 | 0.080 | 0.082 | 0.083 | 0.087 | 0.083 | 82.9 | 2.9 |
| 10 | 嘧菌酯 | 0.106 | 0.106 | 0.106 | 0.106 | 0.109 | 0.110 | 0.108 | 0.107 | 107 | 1.6 |
| 11 | 嘧霉胺 | 0.105 | 0.109 | 0.108 | 0.109 | 0.109 | 0.106 | 0.110 | 0.108 | 108 | 1.6 |
| 12 | 噻虫嗪 | 0.107 | 0.109 | 0.103 | 0.105 | 0.106 | 0.107 | 0.107 | 0.107 | 107 | 1.8 |
| 13 | 霜霉威 | 0.087 | 0.085 | 0.088 | 0.082 | 0.087 | 0.086 | 0.087 | 0.086 | 85.9 | 2.3 |
| 14 | 烯酰吗啉 | 0.105 | 0.108 | 0.101 | 0.103 | 0.107 | 0.106 | 0.109 | 0.105 | 105 | 2.7 |
| 15 | 毒死蜱 | 0.086 | 0.085 | 0.083 | 0.088 | 0.081 | 0.081 | 0.081 | 0.084 | 83.6 | 3.4 |
| 16 | 甲胺磷 | 0.087 | 0.081 | 0.081 | 0.086 | 0.082 | 0.080 | 0.087 | 0.083 | 83.4 | 3.7 |
| 17 | 乙酰甲胺磷 | 0.081 | 0.083 | 0.085 | 0.082 | 0.084 | 0.084 | 0.082 | 0.083 | 82.9 | 1.7 |
| 18 | 氧乐果 | 0.087 | 0.082 | 0.083 | 0.083 | 0.082 | 0.083 | 0.082 | 0.083 | 83.2 | 2.3 |
| 19 | 苯醚甲环唑 | 0.105 | 0.109 | 0.109 | 0.106 | 0.108 | 0.108 | 0.109 | 0.108 | 108 | 1.6 |
| 20 | 哒螨灵 | 0.100 | 0.102 | 0.108 | 0.101 | 0.105 | 0.106 | 0.109 | 0.104 | 104 | 3.4 |
| 21 | 三唑磷 | 0.102 | 0.102 | 0.094 | 0.090 | 0.099 | 0.090 | 0.099 | 0.097 | 96.6 | 5.6 |
| 22 | 辛硫磷 | 0.086 | 0.092 | 0.091 | 0.090 | 0.090 | 0.085 | 0.089 | 0.089 | 89.0 | 2.9 |
| 23 | 阿维菌素 | 0.086 | 0.085 | 0.085 | 0.088 | 0.088 | 0.088 | 0.091 | 0.087 | 87.1 | 2.4 |
| 24 | 亚胺硫磷 | 0.085 | 0.088 | 0.087 | 0.084 | 0.088 | 0.085 | 0.086 | 0.086 | 86.1 | 1.5 |
| 25 | 伏杀硫磷 | 0.098 | 0.090 | 0.094 | 0.100 | 0.093 | 0.089 | 0.100 | 0.095 | 94.7 | 4.6 |
| 26 | 乐果 | 0.086 | 0.088 | 0.082 | 0.081 | 0.087 | 0.081 | 0.086 | 0.084 | 84.4 | 3.4 |
| 27 | 倍硫磷 | 0.086 | 0.091 | 0.087 | 0.087 | 0.086 | 0.087 | 0.088 | 0.087 | 87.2 | 1.9 |
| 28 | 杀虫脒 | 0.087 | 0.087 | 0.085 | 0.091 | 0.087 | 0.084 | 0.088 | 0.087 | 87.0 | 2.4 |
| 29 | 涕灭威 | 0.087 | 0.089 | 0.090 | 0.086 | 0.089 | 0.087 | 0.089 | 0.088 | 88.1 | 1.8 |
| 30 | 涕灭威砜 | 0.087 | 0.086 | 0.090 | 0.086 | 0.094 | 0.094 | 0.095 | 0.090 | 90.4 | 4.5 |
| 31 | 涕灭威亚砜 | 0.102 | 0.105 | 0.108 | 0.106 | 0.101 | 0.107 | 0.107 | 0.105 | 105 | 2.5 |
| 32 | 倍硫磷砜 | 0.096 | 0.096 | 0.095 | 0.089 | 0.099 | 0.095 | 0.094 | 0.095 | 95.0 | 3.2 |
| 33 | 倍硫磷亚砜 | 0.093 | 0.102 | 0.100 | 0.091 | 0.088 | 0.100 | 0.088 | 0.095 | 94.7 | 6.4 |
| 34 | 杀螟硫磷 | 0.088 | 0.090 | 0.091 | 0.090 | 0.089 | 0.086 | 0.086 | 0.089 | 88.6 | 2.1 |
| 35 | 虫酰肼 | 0.092 | 0.095 | 0.085 | 0.090 | 0.092 | 0.086 | 0.086 | 0.089 | 89.3 | 4.2 |
| 36 | 除虫脲 | 0.089 | 0.085 | 0.090 | 0.091 | 0.088 | 0.090 | 0.091 | 0.089 | 89.0 | 2.1 |
| 37 | 二甲戊灵 | 0.108 | 0.110 | 0.100 | 0.101 | 0.109 | 0.103 | 0.105 | 0.105 | 105 | 3.9 |
| 38 | 氟啶脲 | 0.103 | 0.104 | 0.108 | 0.105 | 0.104 | 0.105 | 0.108 | 0.105 | 105 | 1.9 |
| 39 | 甲萘威 | 0.102 | 0.103 | 0.089 | 0.093 | 0.096 | 0.101 | 0.096 | 0.097 | 97.1 | 5.1 |
| 40 | 甲霜灵 | 0.109 | 0.108 | 0.105 | 0.109 | 0.106 | 0.105 | 0.109 | 0.107 | 107 | 1.8 |
| 41 | 氯吡脲 | 0.096 | 0.096 | 0.091 | 0.097 | 0.098 | 0.088 | 0.091 | 0.094 | 93.8 | 3.8 |
| 42 | 氯虫苯甲酰胺 | 0.089 | 0.087 | 0.092 | 0.087 | 0.092 | 0.094 | 0.092 | 0.090 | 90.5 | 3.2 |
| 43 | 灭幼脲 | 0.099 | 0.100 | 0.089 | 0.099 | 0.098 | 0.089 | 0.094 | 0.095 | 95.2 | 5.2 |
| 44 | 醚菊酯 | 0.093 | 0.093 | 0.097 | 0.095 | 0.090 | 0.096 | 0.090 | 0.093 | 93.4 | 2.9 |
| 45 | 异菌脲 | 0.083 | 0.085 | 0.083 | 0.081 | 0.084 | 0.083 | 0.087 | 0.084 | 83.7 | 2.2 |
| 46 | 丙溴磷 | 0.099 | 0.101 | 0.098 | 0.091 | 0.103 | 0.101 | 0.092 | 0.098 | 97.7 | 4.8 |
| 47 | 甲基异柳磷 | 0.090 | 0.086 | 0.088 | 0.088 | 0.091 | 0.089 | 0.087 | 0.088 | 88.3 | 1.8 |
| 48 | 水胺硫磷 | 0.090 | 0.086 | 0.090 | 0.089 | 0.085 | 0.088 | 0.084 | 0.087 | 87.4 | 3.0 |
| 49 | 乙基多杀菌素J | 0.090 | 0.091 | 0.090 | 0.087 | 0.093 | 0.091 | 0.087 | 0.090 | 89.7 | 2.5 |
| 50 | 乙基多杀菌素L | 0.101 | 0.106 | 0.103 | 0.103 | 0.102 | 0.109 | 0.101 | 0.104 | 104 | 2.6 |
| 51 | 噻虫胺 | 0.108 | 0.106 | 0.107 | 0.109 | 0.109 | 0.110 | 0.107 | 0.108 | 108 | 1.3 |
| 52 | 敌敌畏 | 0.102 | 0.107 | 0.101 | 0.109 | 0.104 | 0.107 | 0.101 | 0.104 | 104 | 3.1 |
| 53 | 咪鲜胺 | 0.100 | 0.107 | 0.101 | 0.107 | 0.110 | 0.109 | 0.108 | 0.106 | 106 | 3.5 |
| 54 | 甲拌磷 | 0.090 | 0.086 | 0.085 | 0.084 | 0.089 | 0.088 | 0.090 | 0.087 | 87.3 | 2.7 |
| 55 | 甲拌磷砜 | 0.088 | 0.089 | 0.089 | 0.090 | 0.090 | 0.089 | 0.089 | 0.089 | 89.1 | 0.8 |
| 56 | 甲拌磷亚砜 | 0.088 | 0.090 | 0.086 | 0.084 | 0.091 | 0.090 | 0.085 | 0.088 | 87.7 | 3.0 |
| 57 | 灭多威 | 0.090 | 0.096 | 0.092 | 0.097 | 0.091 | 0.094 | 0.093 | 0.093 | 93.3 | 2.9 |
| 58 | 抗蚜威 | 0.093 | 0.097 | 0.100 | 0.095 | 0.095 | 0.098 | 0.090 | 0.095 | 95.4 | 3.4 |
| 59 | 氟虫腈 | 0.093 | 0.090 | 0.089 | 0.089 | 0.088 | 0.087 | 0.087 | 0.089 | 88.9 | 2.4 |
| 60 | 氟虫腈砜 | 0.086 | 0.093 | 0.090 | 0.085 | 0.093 | 0.085 | 0.088 | 0.089 | 88.6 | 3.9 |
| 61 | 氟虫腈硫醚 | 0.092 | 0.096 | 0.093 | 0.097 | 0.100 | 0.093 | 0.100 | 0.096 | 95.9 | 3.4 |
| 62 | 氟甲腈 | 0.101 | 0.092 | 0.091 | 0.102 | 0.093 | 0.101 | 0.101 | 0.097 | 97.2 | 5.0 |
| 63 | 虫螨腈 | 0.085 | 0.085 | 0.090 | 0.086 | 0.088 | 0.087 | 0.089 | 0.087 | 87.1 | 2.2 |
| 64 | 赤霉酸 | 0.094 | 0.103 | 0.102 | 0.101 | 0.099 | 0.103 | 0.099 | 0.100 | 99.9 | 3.2 |
| 65 | 戊唑醇 | 0.104 | 0.105 | 0.103 | 0.106 | 0.105 | 0.102 | 0.104 | 0.104 | 104 | 1.2 |
| 66 | 内吸磷 | 0.088 | 0.090 | 0.090 | 0.088 | 0.089 | 0.089 | 0.086 | 0.089 | 88.6 | 1.9 |
| 67 | 氯唑磷 | 0.086 | 0.087 | 0.085 | 0.087 | 0.089 | 0.089 | 0.086 | 0.087 | 87.1 | 1.8 |
| 68 | 马拉硫磷 | 0.087 | 0.088 | 0.089 | 0.087 | 0.089 | 0.090 | 0.086 | 0.088 | 88.0 | 1.6 |
| 69 | 螺螨酯 | 0.102 | 0.092 | 0.100 | 0.100 | 0.094 | 0.100 | 0.097 | 0.098 | 97.8 | 3.7 |
| 70 | 噻螨酮 | 0.088 | 0.089 | 0.096 | 0.101 | 0.093 | 0.088 | 0.092 | 0.092 | 92.5 | 5.3 |
| 71 | 抑霉唑 | 0.094 | 0.092 | 0.102 | 0.092 | 0.102 | 0.094 | 0.090 | 0.095 | 95.2 | 5.2 |
| 72 | 噻嗪酮 | 0.094 | 0.095 | 0.102 | 0.094 | 0.095 | 0.100 | 0.098 | 0.097 | 96.8 | 3.4 |
| 73 | 丁硫克百威 | 0.086 | 0.082 | 0.081 | 0.087 | 0.081 | 0.083 | 0.086 | 0.084 | 83.6 | 3.4 |
| 74 | 二嗪磷 | 0.090 | 0.090 | 0.089 | 0.085 | 0.090 | 0.087 | 0.089 | 0.089 | 88.5 | 2.3 |
| 75 | 速灭磷 | 0.089 | 0.084 | 0.089 | 0.089 | 0.085 | 0.091 | 0.088 | 0.088 | 87.9 | 2.8 |
| 76 | 啶酰菌胺 | 0.098 | 0.090 | 0.099 | 0.100 | 0.090 | 0.102 | 0.091 | 0.096 | 95.7 | 5.6 |
| 77 | 腈苯唑 | 0.099 | 0.098 | 0.100 | 0.099 | 0.097 | 0.093 | 0.093 | 0.097 | 97.0 | 2.9 |
| 78 | 醚菌酯 | 0.109 | 0.109 | 0.106 | 0.105 | 0.110 | 0.106 | 0.105 | 0.107 | 107 | 1.8 |
| 79 | 三唑酮 | 0.107 | 0.109 | 0.109 | 0.108 | 0.107 | 0.107 | 0.105 | 0.107 | 107 | 1.3 |
| 80 | 硫环磷 | 0.084 | 0.089 | 0.090 | 0.084 | 0.088 | 0.090 | 0.085 | 0.087 | 87.1 | 3.2 |
| 81 | 噻苯隆 | 0.103 | 0.095 | 0.091 | 0.093 | 0.095 | 0.091 | 0.089 | 0.094 | 93.7 | 5.0 |
| 82 | 灭线磷 | 0.085 | 0.085 | 0.089 | 0.086 | 0.086 | 0.088 | 0.088 | 0.087 | 86.8 | 1.9 |
| 83 | 丙环唑 | 0.089 | 0.089 | 0.089 | 0.089 | 0.087 | 0.086 | 0.091 | 0.089 | 88.7 | 1.8 |
| 84 | 敌百虫 | 0.100 | 0.108 | 0.102 | 0.108 | 0.101 | 0.101 | 0.109 | 0.104 | 104 | 3.8 |
| 85 | 多杀霉素A | 0.089 | 0.090 | 0.089 | 0.088 | 0.092 | 0.099 | 0.101 | 0.093 | 92.7 | 5.6 |
| 86 | 多杀霉素D | 0.103 | 0.105 | 0.104 | 0.108 | 0.107 | 0.105 | 0.104 | 0.105 | 105 | 1.7 |
| 87 | 特丁硫磷 | 0.084 | 0.087 | 0.091 | 0.085 | 0.085 | 0.086 | 0.087 | 0.086 | 86.4 | 2.7 |
| 88 | 特丁硫磷砜 | 0.086 | 0.090 | 0.090 | 0.089 | 0.086 | 0.086 | 0.085 | 0.087 | 87.3 | 2.4 |
| 89 | 特丁硫磷亚砜 | 0.090 | 0.086 | 0.087 | 0.090 | 0.088 | 0.085 | 0.086 | 0.087 | 87.3 | 2.3 |
| 90 | 异丙威 | 0.095 | 0.101 | 0.096 | 0.088 | 0.094 | 0.092 | 0.098 | 0.095 | 94.8 | 4.2 |
| 91 | 久效磷 | 0.088 | 0.087 | 0.088 | 0.085 | 0.085 | 0.085 | 0.086 | 0.086 | 86.1 | 1.6 |
| 92 | 茚虫威 | 0.096 | 0.098 | 0.095 | 0.091 | 0.098 | 0.097 | 0.098 | 0.096 | 96.2 | 2.6 |
| 93 | 唑虫酰胺 | 0.100 | 0.096 | 0.102 | 0.098 | 0.089 | 0.094 | 0.093 | 0.096 | 95.9 | 4.5 |
| 94 | 对硫磷 | 0.086 | 0.090 | 0.089 | 0.089 | 0.089 | 0.088 | 0.088 | 0.088 | 88.3 | 1.6 |
| 95 | 氯苯嘧啶醇 | 0.102 | 0.100 | 0.096 | 0.089 | 0.100 | 0.102 | 0.095 | 0.098 | 97.5 | 4.9 |
| 96 | 莠灭净 | 0.100 | 0.104 | 0.104 | 0.107 | 0.108 | 0.108 | 0.109 | 0.106 | 106 | 3.0 |
| 97 | 蝇毒磷 | 0.090 | 0.087 | 0.089 | 0.086 | 0.086 | 0.087 | 0.090 | 0.088 | 87.7 | 2.0 |
| 98 | 甲基硫菌灵 | 0.110 | 0.107 | 0.105 | 0.106 | 0.109 | 0.108 | 0.108 | 0.108 | 108 | 1.4 |
| 99 | 肟菌酯 | 0.106 | 0.109 | 0.107 | 0.106 | 0.108 | 0.107 | 0.106 | 0.107 | 107 | 1.2 |
| 100 | 腈菌唑 | 0.107 | 0.105 | 0.101 | 0.108 | 0.103 | 0.103 | 0.103 | 0.104 | 104 | 2.5 |

表9 浓度水平0.01 mg/kg添加结果（豇豆）

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 序号 | 名称 | 1# | 2# | 3# | 4# | 5# | 6# | 7# | 平均值 | 回收率% | 相对标准偏差% |
| mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | 克百威 | 0.0105 | 0.0103 | 0.0106 | 0.0102 | 0.0106 | 0.0109 | 0.0100 | 0.0105 | 105 | 2.8 |
| 2 | 3-羟基克百威 | 0.0109 | 0.0109 | 0.0105 | 0.0103 | 0.0107 | 0.0106 | 0.0102 | 0.0106 | 106 | 2.5 |
| 3 | 吡虫啉 | 0.0102 | 0.0093 | 0.0094 | 0.0097 | 0.0097 | 0.0094 | 0.0089 | 0.0095 | 95.1 | 4.4 |
| 4 | 吡唑醚菌酯 | 0.0117 | 0.0110 | 0.0108 | 0.0106 | 0.0105 | 0.0111 | 0.0110 | 0.0110 | 110 | 3.4 |
| 5 | 啶虫脒 | 0.0108 | 0.0108 | 0.0104 | 0.0100 | 0.0103 | 0.0107 | 0.0107 | 0.0105 | 105 | 2.9 |
| 6 | 多菌灵 | 0.0106 | 0.0114 | 0.0110 | 0.0106 | 0.0116 | 0.0114 | 0.0113 | 0.0111 | 111 | 3.5 |
| 7 | 多效唑 | 0.0091 | 0.0098 | 0.0099 | 0.0093 | 0.0095 | 0.0088 | 0.0093 | 0.0094 | 94.0 | 4.1 |
| 8 | 甲氨基阿维菌素苯甲酸盐 | 0.0082 | 0.0081 | 0.0079 | 0.0078 | 0.0075 | 0.0078 | 0.0081 | 0.0079 | 79.2 | 2.9 |
| 9 | 灭蝇胺 | 0.0077 | 0.0072 | 0.0078 | 0.0082 | 0.0077 | 0.0072 | 0.0078 | 0.0076 | 76.4 | 4.7 |
| 10 | 嘧菌酯 | 0.0111 | 0.0115 | 0.0111 | 0.0108 | 0.0115 | 0.0106 | 0.0110 | 0.0111 | 111 | 3.0 |
| 11 | 嘧霉胺 | 0.0111 | 0.0106 | 0.0109 | 0.0111 | 0.0108 | 0.0117 | 0.0110 | 0.0110 | 110 | 3.2 |
| 12 | 噻虫嗪 | 0.0106 | 0.0103 | 0.0109 | 0.0102 | 0.0110 | 0.0110 | 0.0107 | 0.0107 | 107 | 3.0 |
| 13 | 霜霉威 | 0.0074 | 0.0072 | 0.0081 | 0.0073 | 0.0071 | 0.0071 | 0.0078 | 0.0074 | 74.1 | 4.9 |
| 14 | 烯酰吗啉 | 0.0103 | 0.0105 | 0.0105 | 0.0101 | 0.0110 | 0.0101 | 0.0101 | 0.0104 | 104 | 3.2 |
| 15 | 毒死蜱 | 0.0080 | 0.0073 | 0.0077 | 0.0076 | 0.0082 | 0.0074 | 0.0073 | 0.0076 | 76.4 | 4.8 |
| 16 | 甲胺磷 | 0.0071 | 0.0079 | 0.0072 | 0.0076 | 0.0080 | 0.0081 | 0.0073 | 0.0076 | 76.0 | 5.3 |
| 17 | 乙酰甲胺磷 | 0.0083 | 0.0073 | 0.0076 | 0.0072 | 0.0081 | 0.0082 | 0.0073 | 0.0077 | 76.8 | 6.3 |
| 18 | 氧乐果 | 0.0077 | 0.0082 | 0.0081 | 0.0080 | 0.0075 | 0.0080 | 0.0081 | 0.0079 | 79.2 | 3.1 |
| 19 | 苯醚甲环唑 | 0.0117 | 0.0117 | 0.0113 | 0.0112 | 0.0112 | 0.0106 | 0.0116 | 0.0113 | 113 | 3.4 |
| 20 | 哒螨灵 | 0.0091 | 0.0097 | 0.0092 | 0.0089 | 0.0093 | 0.0095 | 0.0092 | 0.0093 | 92.6 | 2.8 |
| 21 | 三唑磷 | 0.0090 | 0.0090 | 0.0102 | 0.0095 | 0.0098 | 0.0099 | 0.0101 | 0.0096 | 96.2 | 4.9 |
| 22 | 辛硫磷 | 0.0102 | 0.0096 | 0.0096 | 0.0098 | 0.0092 | 0.0091 | 0.0097 | 0.0096 | 95.9 | 3.8 |
| 23 | 阿维菌素 | 0.0086 | 0.0085 | 0.0076 | 0.0088 | 0.0080 | 0.0077 | 0.0085 | 0.0082 | 82.2 | 5.7 |
| 24 | 亚胺硫磷 | 0.0075 | 0.0084 | 0.0086 | 0.0086 | 0.0078 | 0.0085 | 0.0082 | 0.0082 | 82.4 | 5.2 |
| 25 | 伏杀硫磷 | 0.0103 | 0.0095 | 0.0093 | 0.0097 | 0.0095 | 0.0098 | 0.0093 | 0.0096 | 96.1 | 3.6 |
| 26 | 乐果 | 0.0076 | 0.0077 | 0.0070 | 0.0082 | 0.0070 | 0.0074 | 0.0079 | 0.0076 | 75.6 | 5.7 |
| 27 | 倍硫磷 | 0.0076 | 0.0084 | 0.0083 | 0.0077 | 0.0087 | 0.0075 | 0.0084 | 0.0081 | 81.0 | 5.8 |
| 28 | 杀虫脒 | 0.0076 | 0.0083 | 0.0084 | 0.0078 | 0.0083 | 0.0086 | 0.0082 | 0.0082 | 81.7 | 4.6 |
| 29 | 涕灭威 | 0.0083 | 0.0076 | 0.0076 | 0.0079 | 0.0086 | 0.0078 | 0.0081 | 0.0080 | 80.0 | 4.7 |
| 30 | 涕灭威砜 | 0.0108 | 0.0104 | 0.0105 | 0.0107 | 0.0105 | 0.0107 | 0.0108 | 0.0106 | 106 | 1.5 |
| 31 | 涕灭威亚砜 | 0.0108 | 0.0103 | 0.0108 | 0.0108 | 0.0102 | 0.0100 | 0.0100 | 0.0104 | 104 | 3.6 |
| 32 | 倍硫磷砜 | 0.0090 | 0.0088 | 0.0090 | 0.0091 | 0.0091 | 0.0093 | 0.0090 | 0.0090 | 90.4 | 1.6 |
| 33 | 倍硫磷亚砜 | 0.0098 | 0.0092 | 0.0090 | 0.0101 | 0.0101 | 0.0103 | 0.0099 | 0.0098 | 97.6 | 5.1 |
| 34 | 杀螟硫磷 | 0.0085 | 0.0087 | 0.0081 | 0.0080 | 0.0077 | 0.0078 | 0.0077 | 0.0081 | 80.7 | 4.6 |
| 35 | 虫酰肼 | 0.0105 | 0.0100 | 0.0108 | 0.0105 | 0.0102 | 0.0102 | 0.0101 | 0.0103 | 103 | 2.7 |
| 36 | 除虫脲 | 0.0088 | 0.0087 | 0.0076 | 0.0076 | 0.0078 | 0.0086 | 0.0075 | 0.0081 | 80.8 | 7.3 |
| 37 | 二甲戊灵 | 0.0105 | 0.0108 | 0.0110 | 0.0104 | 0.0104 | 0.0100 | 0.0111 | 0.0106 | 106 | 3.6 |
| 38 | 氟啶脲 | 0.0096 | 0.0090 | 0.0101 | 0.0096 | 0.0091 | 0.0099 | 0.0097 | 0.0096 | 95.8 | 4.1 |
| 39 | 甲萘威 | 0.0090 | 0.0091 | 0.0087 | 0.0095 | 0.0094 | 0.0086 | 0.0093 | 0.0091 | 90.7 | 3.6 |
| 40 | 甲霜灵 | 0.0117 | 0.0115 | 0.0115 | 0.0110 | 0.0105 | 0.0108 | 0.0106 | 0.0111 | 111 | 4.3 |
| 41 | 氯吡脲 | 0.0101 | 0.0091 | 0.0101 | 0.0092 | 0.0100 | 0.0095 | 0.0103 | 0.0098 | 97.6 | 4.7 |
| 42 | 氯虫苯甲酰胺 | 0.0101 | 0.0092 | 0.0097 | 0.0099 | 0.0102 | 0.0099 | 0.0094 | 0.0098 | 97.6 | 3.7 |
| 43 | 灭幼脲 | 0.0090 | 0.0097 | 0.0091 | 0.0100 | 0.0100 | 0.0096 | 0.0094 | 0.0096 | 95.5 | 4.0 |
| 44 | 醚菊酯 | 0.0091 | 0.0094 | 0.0090 | 0.0090 | 0.0095 | 0.0087 | 0.0088 | 0.0091 | 90.8 | 3.3 |
| 45 | 异菌脲 | 0.0079 | 0.0076 | 0.0080 | 0.0079 | 0.0077 | 0.0071 | 0.0077 | 0.0077 | 77.0 | 3.6 |
| 46 | 丙溴磷 | 0.0106 | 0.0100 | 0.0101 | 0.0103 | 0.0105 | 0.0108 | 0.0102 | 0.0104 | 104 | 2.8 |
| 47 | 甲基异柳磷 | 0.0082 | 0.0082 | 0.0082 | 0.0077 | 0.0087 | 0.0088 | 0.0079 | 0.0082 | 82.3 | 4.9 |
| 48 | 水胺硫磷 | 0.0086 | 0.0085 | 0.0081 | 0.0083 | 0.0077 | 0.0080 | 0.0086 | 0.0082 | 82.4 | 3.9 |
| 49 | 乙基多杀菌素J | 0.0109 | 0.0103 | 0.0106 | 0.0104 | 0.0103 | 0.0106 | 0.0109 | 0.0106 | 106 | 2.3 |
| 50 | 乙基多杀菌素L | 0.0105 | 0.0104 | 0.0101 | 0.0105 | 0.0107 | 0.0107 | 0.0108 | 0.0105 | 105 | 2.3 |
| 51 | 噻虫胺 | 0.0107 | 0.0110 | 0.0112 | 0.0117 | 0.0113 | 0.0111 | 0.0115 | 0.0112 | 112 | 2.8 |
| 52 | 敌敌畏 | 0.0097 | 0.0090 | 0.0089 | 0.0091 | 0.0088 | 0.0094 | 0.0098 | 0.0092 | 92.4 | 4.3 |
| 53 | 咪鲜胺 | 0.0109 | 0.0103 | 0.0107 | 0.0102 | 0.0108 | 0.0104 | 0.0102 | 0.0105 | 105 | 2.8 |
| 54 | 甲拌磷 | 0.0077 | 0.0085 | 0.0081 | 0.0077 | 0.0088 | 0.0085 | 0.0087 | 0.0083 | 82.9 | 5.5 |
| 55 | 甲拌磷砜 | 0.0077 | 0.0086 | 0.0082 | 0.0079 | 0.0075 | 0.0078 | 0.0080 | 0.0080 | 79.6 | 4.3 |
| 56 | 甲拌磷亚砜 | 0.0083 | 0.0085 | 0.0085 | 0.0076 | 0.0081 | 0.0085 | 0.0079 | 0.0082 | 81.9 | 4.1 |
| 57 | 灭多威 | 0.0089 | 0.0096 | 0.0091 | 0.0088 | 0.0098 | 0.0089 | 0.0095 | 0.0092 | 92.5 | 4.3 |
| 58 | 抗蚜威 | 0.0102 | 0.0103 | 0.0092 | 0.0096 | 0.0099 | 0.0101 | 0.0101 | 0.0099 | 99.1 | 3.9 |
| 59 | 氟虫腈 | 0.0095 | 0.0103 | 0.0099 | 0.0093 | 0.0088 | 0.0089 | 0.0103 | 0.0095 | 95.4 | 6.5 |
| 60 | 氟虫腈砜 | 0.0102 | 0.0102 | 0.0102 | 0.0105 | 0.0101 | 0.0106 | 0.0101 | 0.0103 | 103 | 2.1 |
| 61 | 氟虫腈硫醚 | 0.0092 | 0.0086 | 0.0094 | 0.0092 | 0.0086 | 0.0087 | 0.0092 | 0.0090 | 89.9 | 3.8 |
| 62 | 氟甲腈 | 0.0103 | 0.0101 | 0.0102 | 0.0104 | 0.0105 | 0.0106 | 0.0103 | 0.0103 | 103 | 1.7 |
| 63 | 虫螨腈 | 0.0085 | 0.0081 | 0.0080 | 0.0081 | 0.0083 | 0.0079 | 0.0080 | 0.0081 | 81.2 | 2.5 |
| 64 | 赤霉酸 | 0.0093 | 0.0094 | 0.0088 | 0.0093 | 0.0088 | 0.0095 | 0.0090 | 0.0091 | 91.5 | 2.9 |
| 65 | 戊唑醇 | 0.0092 | 0.0086 | 0.0090 | 0.0091 | 0.0085 | 0.0090 | 0.0094 | 0.0090 | 89.5 | 3.5 |
| 66 | 内吸磷 | 0.0082 | 0.0078 | 0.0076 | 0.0080 | 0.0079 | 0.0076 | 0.0082 | 0.0079 | 78.9 | 3.4 |
| 67 | 氯唑磷 | 0.0077 | 0.0080 | 0.0088 | 0.0087 | 0.0084 | 0.0079 | 0.0086 | 0.0083 | 83.0 | 5.1 |
| 68 | 马拉硫磷 | 0.0078 | 0.0086 | 0.0075 | 0.0078 | 0.0086 | 0.0087 | 0.0086 | 0.0082 | 82.3 | 6.0 |
| 69 | 螺螨酯 | 0.0100 | 0.0100 | 0.0100 | 0.0101 | 0.0092 | 0.0091 | 0.0089 | 0.0096 | 96.0 | 5.5 |
| 70 | 噻螨酮 | 0.0094 | 0.0093 | 0.0089 | 0.0095 | 0.0093 | 0.0092 | 0.0095 | 0.0093 | 92.7 | 2.2 |
| 71 | 抑霉唑 | 0.0086 | 0.0094 | 0.0087 | 0.0093 | 0.0092 | 0.0093 | 0.0093 | 0.0091 | 91.0 | 3.8 |
| 72 | 噻嗪酮 | 0.0101 | 0.0098 | 0.0095 | 0.0093 | 0.0088 | 0.0099 | 0.0092 | 0.0095 | 95.2 | 4.7 |
| 73 | 丁硫克百威 | 0.0082 | 0.0074 | 0.0071 | 0.0077 | 0.0074 | 0.0070 | 0.0072 | 0.0074 | 74.2 | 5.4 |
| 74 | 二嗪磷 | 0.0080 | 0.0077 | 0.0075 | 0.0083 | 0.0085 | 0.0076 | 0.0080 | 0.0079 | 79.4 | 4.5 |
| 75 | 速灭磷 | 0.0082 | 0.0082 | 0.0082 | 0.0086 | 0.0085 | 0.0079 | 0.0076 | 0.0082 | 81.8 | 4.0 |
| 76 | 啶酰菌胺 | 0.0091 | 0.0086 | 0.0093 | 0.0094 | 0.0095 | 0.0088 | 0.0088 | 0.0091 | 90.8 | 3.7 |
| 77 | 腈苯唑 | 0.0100 | 0.0105 | 0.0104 | 0.0106 | 0.0101 | 0.0104 | 0.0106 | 0.0104 | 104 | 2.3 |
| 78 | 醚菌酯 | 0.0106 | 0.0106 | 0.0109 | 0.0111 | 0.0106 | 0.0109 | 0.0112 | 0.0108 | 108 | 2.2 |
| 79 | 三唑酮 | 0.0115 | 0.0112 | 0.0112 | 0.0108 | 0.0117 | 0.0116 | 0.0115 | 0.0114 | 114 | 2.8 |
| 80 | 硫环磷 | 0.0083 | 0.0084 | 0.0086 | 0.0086 | 0.0084 | 0.0079 | 0.0085 | 0.0084 | 83.8 | 3.1 |
| 81 | 噻苯隆 | 0.0090 | 0.0087 | 0.0089 | 0.0095 | 0.0086 | 0.0089 | 0.0089 | 0.0089 | 89.3 | 3.2 |
| 82 | 灭线磷 | 0.0084 | 0.0087 | 0.0079 | 0.0084 | 0.0077 | 0.0077 | 0.0080 | 0.0081 | 81.1 | 4.6 |
| 83 | 丙环唑 | 0.0102 | 0.0094 | 0.0095 | 0.0102 | 0.0099 | 0.0094 | 0.0094 | 0.0097 | 97.1 | 3.8 |
| 84 | 敌百虫 | 0.0101 | 0.0109 | 0.0109 | 0.0111 | 0.0110 | 0.0105 | 0.0111 | 0.0108 | 108 | 3.5 |
| 85 | 多杀霉素A | 0.0103 | 0.0109 | 0.0102 | 0.0104 | 0.0109 | 0.0102 | 0.0104 | 0.0105 | 105 | 2.8 |
| 86 | 多杀霉素D | 0.0108 | 0.0101 | 0.0103 | 0.0101 | 0.0102 | 0.0106 | 0.0101 | 0.0103 | 103 | 2.6 |
| 87 | 特丁硫磷 | 0.0086 | 0.0085 | 0.0084 | 0.0080 | 0.0075 | 0.0077 | 0.0081 | 0.0081 | 81.4 | 5.1 |
| 88 | 特丁硫磷砜 | 0.0078 | 0.0082 | 0.0075 | 0.0086 | 0.0080 | 0.0077 | 0.0086 | 0.0081 | 80.7 | 5.0 |
| 89 | 特丁硫磷亚砜 | 0.0075 | 0.0080 | 0.0082 | 0.0083 | 0.0083 | 0.0077 | 0.0079 | 0.0080 | 79.8 | 3.8 |
| 90 | 异丙威 | 0.0092 | 0.0089 | 0.0095 | 0.0096 | 0.0099 | 0.0092 | 0.0092 | 0.0094 | 93.6 | 3.4 |
| 91 | 久效磷 | 0.0082 | 0.0076 | 0.0076 | 0.0083 | 0.0083 | 0.0076 | 0.0081 | 0.0080 | 79.6 | 4.4 |
| 92 | 茚虫威 | 0.0098 | 0.0094 | 0.0097 | 0.0091 | 0.0092 | 0.0103 | 0.0098 | 0.0096 | 96.1 | 4.2 |
| 93 | 唑虫酰胺 | 0.0092 | 0.0086 | 0.0088 | 0.0093 | 0.0093 | 0.0093 | 0.0089 | 0.0091 | 90.6 | 3.1 |
| 94 | 对硫磷 | 0.0085 | 0.0078 | 0.0081 | 0.0076 | 0.0086 | 0.0083 | 0.0075 | 0.0081 | 80.7 | 5.4 |
| 95 | 氯苯嘧啶醇 | 0.0098 | 0.0101 | 0.0099 | 0.0101 | 0.0098 | 0.0091 | 0.0096 | 0.0098 | 97.8 | 3.7 |
| 96 | 莠灭净 | 0.0093 | 0.0097 | 0.0093 | 0.0095 | 0.0094 | 0.0101 | 0.0102 | 0.0096 | 96.4 | 4.1 |
| 97 | 蝇毒磷 | 0.0076 | 0.0079 | 0.0077 | 0.0085 | 0.0076 | 0.0086 | 0.0082 | 0.0080 | 80.1 | 5.3 |
| 98 | 甲基硫菌灵 | 0.0109 | 0.0115 | 0.0111 | 0.0113 | 0.0112 | 0.0114 | 0.0106 | 0.0111 | 111 | 2.7 |
| 99 | 肟菌酯 | 0.0106 | 0.0111 | 0.0117 | 0.0111 | 0.0115 | 0.0108 | 0.0106 | 0.0111 | 111 | 3.8 |
| 100 | 腈菌唑 | 0.0098 | 0.0098 | 0.0091 | 0.0089 | 0.0094 | 0.0093 | 0.0101 | 0.0095 | 94.7 | 4.4 |

表10 浓度水平0.02 mg/kg添加结果（豇豆）

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 序号 | 名称 | 1# | 2# | 3# | 4# | 5# | 6# | 7# | 平均值 | 回收率% | 相对标准偏差% |
| mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | 克百威 | 0.0188 | 0.0194 | 0.0180 | 0.0182 | 0.0186 | 0.0179 | 0.0203 | 0.0187 | 93.7 | 4.6 |
| 2 | 3-羟基克百威 | 0.0202 | 0.0204 | 0.0196 | 0.0179 | 0.0179 | 0.0187 | 0.0200 | 0.0193 | 96.3 | 5.6 |
| 3 | 吡虫啉 | 0.0190 | 0.0197 | 0.0205 | 0.0181 | 0.0198 | 0.0185 | 0.0186 | 0.0192 | 95.9 | 4.5 |
| 4 | 吡唑醚菌酯 | 0.0220 | 0.0212 | 0.0228 | 0.0230 | 0.0214 | 0.0234 | 0.0219 | 0.0222 | 111 | 3.7 |
| 5 | 啶虫脒 | 0.0211 | 0.0210 | 0.0203 | 0.0200 | 0.0211 | 0.0203 | 0.0223 | 0.0209 | 104 | 3.6 |
| 6 | 多菌灵 | 0.0234 | 0.0231 | 0.0220 | 0.0233 | 0.0222 | 0.0212 | 0.0222 | 0.0225 | 113 | 3.6 |
| 7 | 多效唑 | 0.0202 | 0.0186 | 0.0180 | 0.0193 | 0.0199 | 0.0184 | 0.0180 | 0.0189 | 94.6 | 4.8 |
| 8 | 甲氨基阿维菌素苯甲酸盐 | 0.0163 | 0.0174 | 0.0154 | 0.0175 | 0.0161 | 0.0170 | 0.0168 | 0.0166 | 83.1 | 4.6 |
| 9 | 灭蝇胺 | 0.0153 | 0.0166 | 0.0145 | 0.0156 | 0.0152 | 0.0166 | 0.0163 | 0.0157 | 78.6 | 5.0 |
| 10 | 嘧菌酯 | 0.0218 | 0.0232 | 0.0218 | 0.0231 | 0.0222 | 0.0225 | 0.0225 | 0.0224 | 112 | 2.5 |
| 11 | 嘧霉胺 | 0.0217 | 0.0215 | 0.0215 | 0.0232 | 0.0211 | 0.0234 | 0.0230 | 0.0222 | 111 | 4.3 |
| 12 | 噻虫嗪 | 0.0200 | 0.0220 | 0.0212 | 0.0221 | 0.0222 | 0.0211 | 0.0213 | 0.0214 | 107 | 3.5 |
| 13 | 霜霉威 | 0.0146 | 0.0154 | 0.0161 | 0.0157 | 0.0165 | 0.0143 | 0.0156 | 0.0155 | 77.3 | 5.0 |
| 14 | 烯酰吗啉 | 0.0209 | 0.0221 | 0.0201 | 0.0206 | 0.0212 | 0.0211 | 0.0214 | 0.0211 | 105 | 2.9 |
| 15 | 毒死蜱 | 0.0164 | 0.0146 | 0.0141 | 0.0161 | 0.0153 | 0.0145 | 0.0145 | 0.0151 | 75.4 | 5.9 |
| 16 | 甲胺磷 | 0.0154 | 0.0160 | 0.0151 | 0.0153 | 0.0158 | 0.0164 | 0.0163 | 0.0158 | 78.8 | 3.1 |
| 17 | 乙酰甲胺磷 | 0.0143 | 0.0146 | 0.0157 | 0.0164 | 0.0141 | 0.0156 | 0.0156 | 0.0152 | 75.9 | 5.6 |
| 18 | 氧乐果 | 0.0159 | 0.0152 | 0.0143 | 0.0147 | 0.0157 | 0.0155 | 0.0164 | 0.0154 | 76.9 | 4.6 |
| 19 | 苯醚甲环唑 | 0.0223 | 0.0222 | 0.0211 | 0.0221 | 0.0227 | 0.0225 | 0.0224 | 0.0222 | 111 | 2.3 |
| 20 | 哒螨灵 | 0.0178 | 0.0183 | 0.0197 | 0.0200 | 0.0194 | 0.0183 | 0.0194 | 0.0190 | 94.8 | 4.3 |
| 21 | 三唑磷 | 0.0191 | 0.0205 | 0.0177 | 0.0188 | 0.0203 | 0.0199 | 0.0194 | 0.0194 | 96.9 | 4.9 |
| 22 | 辛硫磷 | 0.0193 | 0.0182 | 0.0184 | 0.0205 | 0.0181 | 0.0200 | 0.0182 | 0.0190 | 94.8 | 5.2 |
| 23 | 阿维菌素 | 0.0171 | 0.0172 | 0.0157 | 0.0155 | 0.0172 | 0.0168 | 0.0169 | 0.0166 | 83.0 | 4.3 |
| 24 | 亚胺硫磷 | 0.0173 | 0.0164 | 0.0170 | 0.0172 | 0.0153 | 0.0154 | 0.0172 | 0.0165 | 82.7 | 5.3 |
| 25 | 伏杀硫磷 | 0.0215 | 0.0211 | 0.0205 | 0.0216 | 0.0212 | 0.0208 | 0.0207 | 0.0210 | 105 | 2.0 |
| 26 | 乐果 | 0.0142 | 0.0148 | 0.0150 | 0.0152 | 0.0148 | 0.0152 | 0.0158 | 0.0150 | 75.0 | 3.2 |
| 27 | 倍硫磷 | 0.0165 | 0.0160 | 0.0176 | 0.0170 | 0.0175 | 0.0159 | 0.0175 | 0.0169 | 84.3 | 4.3 |
| 28 | 杀虫脒 | 0.0175 | 0.0167 | 0.0167 | 0.0166 | 0.0172 | 0.0172 | 0.0150 | 0.0167 | 83.6 | 4.9 |
| 29 | 涕灭威 | 0.0165 | 0.0159 | 0.0176 | 0.0150 | 0.0170 | 0.0161 | 0.0169 | 0.0164 | 82.1 | 5.2 |
| 30 | 涕灭威砜 | 0.0216 | 0.0216 | 0.0211 | 0.0209 | 0.0212 | 0.0208 | 0.0209 | 0.0212 | 106 | 1.5 |
| 31 | 涕灭威亚砜 | 0.0215 | 0.0214 | 0.0201 | 0.0206 | 0.0215 | 0.0202 | 0.0212 | 0.0209 | 105 | 2.9 |
| 32 | 倍硫磷砜 | 0.0210 | 0.0208 | 0.0214 | 0.0209 | 0.0201 | 0.0202 | 0.0205 | 0.0207 | 103 | 2.2 |
| 33 | 倍硫磷亚砜 | 0.0207 | 0.0201 | 0.0213 | 0.0201 | 0.0205 | 0.0213 | 0.0202 | 0.0206 | 103 | 2.7 |
| 34 | 杀螟硫磷 | 0.0176 | 0.0155 | 0.0151 | 0.0154 | 0.0174 | 0.0164 | 0.0156 | 0.0161 | 80.7 | 6.2 |
| 35 | 虫酰肼 | 0.0200 | 0.0179 | 0.0200 | 0.0194 | 0.0184 | 0.0195 | 0.0200 | 0.0193 | 96.6 | 4.5 |
| 36 | 除虫脲 | 0.0165 | 0.0170 | 0.0168 | 0.0172 | 0.0172 | 0.0156 | 0.0151 | 0.0165 | 82.5 | 5.1 |
| 37 | 二甲戊灵 | 0.0211 | 0.0205 | 0.0220 | 0.0212 | 0.0208 | 0.0207 | 0.0205 | 0.0210 | 105 | 2.5 |
| 38 | 氟啶脲 | 0.0183 | 0.0190 | 0.0189 | 0.0184 | 0.0199 | 0.0190 | 0.0178 | 0.0188 | 93.8 | 3.6 |
| 39 | 甲萘威 | 0.0176 | 0.0189 | 0.0190 | 0.0176 | 0.0190 | 0.0174 | 0.0172 | 0.0181 | 90.5 | 4.6 |
| 40 | 甲霜灵 | 0.0225 | 0.0226 | 0.0233 | 0.0222 | 0.0231 | 0.0213 | 0.0226 | 0.0225 | 113 | 2.9 |
| 41 | 氯吡脲 | 0.0199 | 0.0201 | 0.0179 | 0.0203 | 0.0192 | 0.0179 | 0.0180 | 0.0190 | 95.2 | 5.7 |
| 42 | 氯虫苯甲酰胺 | 0.0196 | 0.0203 | 0.0199 | 0.0183 | 0.0176 | 0.0195 | 0.0200 | 0.0193 | 96.6 | 5.2 |
| 43 | 灭幼脲 | 0.0194 | 0.0181 | 0.0186 | 0.0183 | 0.0191 | 0.0185 | 0.0184 | 0.0186 | 93.1 | 2.6 |
| 44 | 醚菊酯 | 0.0214 | 0.0210 | 0.0215 | 0.0217 | 0.0207 | 0.0204 | 0.0204 | 0.0210 | 105 | 2.7 |
| 45 | 异菌脲 | 0.0146 | 0.0149 | 0.0149 | 0.0142 | 0.0149 | 0.0154 | 0.0145 | 0.0148 | 73.9 | 2.6 |
| 46 | 丙溴磷 | 0.0206 | 0.0195 | 0.0194 | 0.0190 | 0.0181 | 0.0205 | 0.0183 | 0.0194 | 96.8 | 5.0 |
| 47 | 甲基异柳磷 | 0.0168 | 0.0155 | 0.0171 | 0.0154 | 0.0150 | 0.0153 | 0.0151 | 0.0157 | 78.7 | 5.4 |
| 48 | 水胺硫磷 | 0.0156 | 0.0176 | 0.0151 | 0.0172 | 0.0153 | 0.0166 | 0.0150 | 0.0161 | 80.3 | 6.5 |
| 49 | 乙基多杀菌素J | 0.0202 | 0.0218 | 0.0205 | 0.0217 | 0.0200 | 0.0204 | 0.0208 | 0.0208 | 104 | 3.4 |
| 50 | 乙基多杀菌素L | 0.0213 | 0.0214 | 0.0201 | 0.0216 | 0.0217 | 0.0218 | 0.0210 | 0.0213 | 106 | 2.7 |
| 51 | 噻虫胺 | 0.0217 | 0.0212 | 0.0210 | 0.0228 | 0.0218 | 0.0211 | 0.0225 | 0.0217 | 109 | 3.2 |
| 52 | 敌敌畏 | 0.0204 | 0.0202 | 0.0209 | 0.0203 | 0.0201 | 0.0217 | 0.0215 | 0.0207 | 104 | 3.1 |
| 53 | 咪鲜胺 | 0.0207 | 0.0212 | 0.0206 | 0.0202 | 0.0223 | 0.0202 | 0.0201 | 0.0208 | 104 | 3.8 |
| 54 | 甲拌磷 | 0.0165 | 0.0154 | 0.0155 | 0.0159 | 0.0158 | 0.0153 | 0.0162 | 0.0158 | 79.0 | 2.8 |
| 55 | 甲拌磷砜 | 0.0159 | 0.0169 | 0.0175 | 0.0172 | 0.0154 | 0.0171 | 0.0165 | 0.0167 | 83.3 | 4.6 |
| 56 | 甲拌磷亚砜 | 0.0153 | 0.0159 | 0.0152 | 0.0172 | 0.0150 | 0.0154 | 0.0157 | 0.0157 | 78.5 | 4.7 |
| 57 | 灭多威 | 0.0199 | 0.0193 | 0.0205 | 0.0196 | 0.0177 | 0.0192 | 0.0203 | 0.0195 | 97.5 | 4.9 |
| 58 | 抗蚜威 | 0.0196 | 0.0181 | 0.0183 | 0.0177 | 0.0189 | 0.0200 | 0.0199 | 0.0189 | 94.6 | 4.8 |
| 59 | 氟虫腈 | 0.0182 | 0.0187 | 0.0194 | 0.0187 | 0.0186 | 0.0193 | 0.0201 | 0.0190 | 95.0 | 3.4 |
| 60 | 氟虫腈砜 | 0.0183 | 0.0191 | 0.0195 | 0.0198 | 0.0203 | 0.0191 | 0.0196 | 0.0194 | 96.9 | 3.2 |
| 61 | 氟虫腈硫醚 | 0.0206 | 0.0205 | 0.0210 | 0.0205 | 0.0214 | 0.0213 | 0.0204 | 0.0208 | 104 | 2.0 |
| 62 | 氟甲腈 | 0.0214 | 0.0211 | 0.0207 | 0.0214 | 0.0216 | 0.0208 | 0.0214 | 0.0212 | 106 | 1.6 |
| 63 | 虫螨腈 | 0.0153 | 0.0151 | 0.0161 | 0.0152 | 0.0156 | 0.0159 | 0.0152 | 0.0155 | 77.6 | 2.6 |
| 64 | 赤霉酸 | 0.0183 | 0.0178 | 0.0183 | 0.0180 | 0.0185 | 0.0191 | 0.0191 | 0.0185 | 92.3 | 2.6 |
| 65 | 戊唑醇 | 0.0173 | 0.0186 | 0.0179 | 0.0187 | 0.0173 | 0.0186 | 0.0189 | 0.0182 | 90.9 | 3.7 |
| 66 | 内吸磷 | 0.0161 | 0.0172 | 0.0159 | 0.0153 | 0.0170 | 0.0174 | 0.0165 | 0.0165 | 82.5 | 4.7 |
| 67 | 氯唑磷 | 0.0161 | 0.0154 | 0.0159 | 0.0154 | 0.0161 | 0.0156 | 0.0172 | 0.0159 | 79.7 | 3.9 |
| 68 | 马拉硫磷 | 0.0160 | 0.0160 | 0.0161 | 0.0157 | 0.0162 | 0.0170 | 0.0152 | 0.0160 | 80.1 | 3.3 |
| 69 | 螺螨酯 | 0.0178 | 0.0182 | 0.0179 | 0.0180 | 0.0179 | 0.0188 | 0.0183 | 0.0181 | 90.7 | 1.9 |
| 70 | 噻螨酮 | 0.0189 | 0.0185 | 0.0175 | 0.0174 | 0.0175 | 0.0190 | 0.0175 | 0.0180 | 90.2 | 3.9 |
| 71 | 抑霉唑 | 0.0186 | 0.0180 | 0.0196 | 0.0195 | 0.0182 | 0.0186 | 0.0192 | 0.0188 | 94.0 | 3.4 |
| 72 | 噻嗪酮 | 0.0215 | 0.0213 | 0.0216 | 0.0200 | 0.0205 | 0.0215 | 0.0212 | 0.0211 | 105 | 2.8 |
| 73 | 丁硫克百威 | 0.0155 | 0.0153 | 0.0155 | 0.0155 | 0.0143 | 0.0140 | 0.0145 | 0.0150 | 74.8 | 4.4 |
| 74 | 二嗪磷 | 0.0153 | 0.0151 | 0.0167 | 0.0174 | 0.0168 | 0.0162 | 0.0167 | 0.0163 | 81.6 | 5.1 |
| 75 | 速灭磷 | 0.0154 | 0.0159 | 0.0168 | 0.0167 | 0.0158 | 0.0169 | 0.0167 | 0.0163 | 81.5 | 3.9 |
| 76 | 啶酰菌胺 | 0.0214 | 0.0205 | 0.0213 | 0.0208 | 0.0207 | 0.0202 | 0.0217 | 0.0209 | 105 | 2.6 |
| 77 | 腈苯唑 | 0.0205 | 0.0176 | 0.0181 | 0.0178 | 0.0199 | 0.0206 | 0.0191 | 0.0191 | 95.4 | 6.7 |
| 78 | 醚菌酯 | 0.0225 | 0.0225 | 0.0213 | 0.0221 | 0.0226 | 0.0230 | 0.0219 | 0.0223 | 111 | 2.5 |
| 79 | 三唑酮 | 0.0223 | 0.0225 | 0.0228 | 0.0219 | 0.0216 | 0.0210 | 0.0233 | 0.0222 | 111 | 3.4 |
| 80 | 硫环磷 | 0.0173 | 0.0173 | 0.0173 | 0.0163 | 0.0163 | 0.0164 | 0.0173 | 0.0169 | 84.5 | 3.0 |
| 81 | 噻苯隆 | 0.0215 | 0.0218 | 0.0204 | 0.0216 | 0.0208 | 0.0213 | 0.0215 | 0.0213 | 106 | 2.4 |
| 82 | 灭线磷 | 0.0169 | 0.0157 | 0.0158 | 0.0161 | 0.0171 | 0.0150 | 0.0152 | 0.0160 | 79.8 | 4.9 |
| 83 | 丙环唑 | 0.0180 | 0.0189 | 0.0182 | 0.0186 | 0.0197 | 0.0193 | 0.0204 | 0.0190 | 95.1 | 4.6 |
| 84 | 敌百虫 | 0.0204 | 0.0222 | 0.0209 | 0.0202 | 0.0212 | 0.0203 | 0.0209 | 0.0209 | 104 | 3.3 |
| 85 | 多杀霉素A | 0.0182 | 0.0186 | 0.0182 | 0.0185 | 0.0175 | 0.0173 | 0.0171 | 0.0179 | 89.6 | 3.4 |
| 86 | 多杀霉素D | 0.0188 | 0.0175 | 0.0177 | 0.0186 | 0.0174 | 0.0185 | 0.0188 | 0.0182 | 90.9 | 3.4 |
| 87 | 特丁硫磷 | 0.0164 | 0.0151 | 0.0173 | 0.0169 | 0.0168 | 0.0175 | 0.0158 | 0.0165 | 82.7 | 5.3 |
| 88 | 特丁硫磷砜 | 0.0174 | 0.0164 | 0.0154 | 0.0171 | 0.0162 | 0.0172 | 0.0171 | 0.0167 | 83.5 | 4.4 |
| 89 | 特丁硫磷亚砜 | 0.0150 | 0.0150 | 0.0156 | 0.0176 | 0.0154 | 0.0160 | 0.0163 | 0.0159 | 79.3 | 5.6 |
| 90 | 异丙威 | 0.0186 | 0.0201 | 0.0195 | 0.0192 | 0.0184 | 0.0203 | 0.0194 | 0.0193 | 96.7 | 3.7 |
| 91 | 久效磷 | 0.0154 | 0.0164 | 0.0169 | 0.0162 | 0.0151 | 0.0176 | 0.0156 | 0.0162 | 80.9 | 5.4 |
| 92 | 茚虫威 | 0.0208 | 0.0213 | 0.0205 | 0.0213 | 0.0205 | 0.0202 | 0.0208 | 0.0208 | 104 | 2.0 |
| 93 | 唑虫酰胺 | 0.0186 | 0.0183 | 0.0190 | 0.0186 | 0.0188 | 0.0177 | 0.0197 | 0.0187 | 93.4 | 3.3 |
| 94 | 对硫磷 | 0.0165 | 0.0161 | 0.0167 | 0.0164 | 0.0153 | 0.0173 | 0.0151 | 0.0162 | 81.0 | 4.8 |
| 95 | 氯苯嘧啶醇 | 0.0189 | 0.0200 | 0.0178 | 0.0184 | 0.0184 | 0.0201 | 0.0199 | 0.0191 | 95.4 | 4.8 |
| 96 | 莠灭净 | 0.0183 | 0.0191 | 0.0206 | 0.0198 | 0.0183 | 0.0183 | 0.0202 | 0.0192 | 96.1 | 5.1 |
| 97 | 蝇毒磷 | 0.0153 | 0.0171 | 0.0175 | 0.0165 | 0.0169 | 0.0174 | 0.0153 | 0.0166 | 82.9 | 5.6 |
| 98 | 甲基硫菌灵 | 0.0217 | 0.0221 | 0.0216 | 0.0223 | 0.0229 | 0.0218 | 0.0217 | 0.0220 | 110 | 2.2 |
| 99 | 肟菌酯 | 0.0228 | 0.0223 | 0.0212 | 0.0225 | 0.0226 | 0.0233 | 0.0231 | 0.0225 | 113 | 3.0 |
| 100 | 腈菌唑 | 0.0181 | 0.0191 | 0.0206 | 0.0193 | 0.0181 | 0.0185 | 0.0199 | 0.0191 | 95.4 | 4.9 |

表11 浓度水平0.10 mg/kg添加结果（豇豆）

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 序号 | 名称 | 1# | 2# | 3# | 4# | 5# | 6# | 7# | 平均值 | 回收率% | 相对标准偏差% |
| mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg |
| 1 | 克百威 | 0.086 | 0.088 | 0.086 | 0.089 | 0.095 | 0.093 | 0.093 | 0.090 | 90.2 | 3.9 |
| 2 | 3-羟基克百威 | 0.107 | 0.103 | 0.106 | 0.101 | 0.102 | 0.109 | 0.108 | 0.105 | 105 | 2.9 |
| 3 | 吡虫啉 | 0.091 | 0.093 | 0.095 | 0.098 | 0.094 | 0.098 | 0.089 | 0.094 | 94.0 | 3.7 |
| 4 | 吡唑醚菌酯 | 0.110 | 0.108 | 0.109 | 0.106 | 0.109 | 0.108 | 0.108 | 0.108 | 108 | 1.0 |
| 5 | 啶虫脒 | 0.106 | 0.101 | 0.101 | 0.100 | 0.110 | 0.100 | 0.106 | 0.103 | 103 | 3.6 |
| 6 | 多菌灵 | 0.105 | 0.106 | 0.106 | 0.109 | 0.108 | 0.109 | 0.105 | 0.107 | 107 | 1.5 |
| 7 | 多效唑 | 0.091 | 0.090 | 0.101 | 0.102 | 0.089 | 0.095 | 0.101 | 0.096 | 95.6 | 5.9 |
| 8 | 甲氨基阿维菌素苯甲酸盐 | 0.089 | 0.085 | 0.085 | 0.089 | 0.084 | 0.090 | 0.086 | 0.087 | 86.8 | 2.7 |
| 9 | 灭蝇胺 | 0.084 | 0.086 | 0.085 | 0.083 | 0.087 | 0.085 | 0.084 | 0.085 | 84.8 | 1.5 |
| 10 | 嘧菌酯 | 0.107 | 0.108 | 0.108 | 0.106 | 0.105 | 0.106 | 0.108 | 0.107 | 107 | 1.1 |
| 11 | 嘧霉胺 | 0.110 | 0.109 | 0.107 | 0.106 | 0.108 | 0.109 | 0.107 | 0.108 | 108 | 1.4 |
| 12 | 噻虫嗪 | 0.108 | 0.101 | 0.100 | 0.110 | 0.104 | 0.103 | 0.101 | 0.104 | 104 | 3.6 |
| 13 | 霜霉威 | 0.085 | 0.083 | 0.086 | 0.088 | 0.081 | 0.084 | 0.087 | 0.085 | 84.8 | 2.8 |
| 14 | 烯酰吗啉 | 0.109 | 0.110 | 0.104 | 0.101 | 0.108 | 0.102 | 0.100 | 0.105 | 105 | 3.9 |
| 15 | 毒死蜱 | 0.080 | 0.084 | 0.082 | 0.084 | 0.081 | 0.086 | 0.085 | 0.083 | 83.1 | 2.7 |
| 16 | 甲胺磷 | 0.086 | 0.086 | 0.087 | 0.081 | 0.087 | 0.086 | 0.088 | 0.086 | 85.8 | 2.4 |
| 17 | 乙酰甲胺磷 | 0.087 | 0.082 | 0.088 | 0.083 | 0.080 | 0.084 | 0.083 | 0.084 | 83.9 | 3.3 |
| 18 | 氧乐果 | 0.082 | 0.087 | 0.088 | 0.085 | 0.081 | 0.085 | 0.087 | 0.085 | 84.8 | 3.4 |
| 19 | 苯醚甲环唑 | 0.107 | 0.108 | 0.108 | 0.110 | 0.110 | 0.108 | 0.109 | 0.108 | 108 | 1.0 |
| 20 | 哒螨灵 | 0.103 | 0.094 | 0.094 | 0.094 | 0.101 | 0.095 | 0.102 | 0.098 | 97.5 | 4.2 |
| 21 | 三唑磷 | 0.094 | 0.090 | 0.093 | 0.096 | 0.096 | 0.103 | 0.091 | 0.095 | 94.6 | 4.4 |
| 22 | 辛硫磷 | 0.107 | 0.102 | 0.107 | 0.108 | 0.104 | 0.101 | 0.102 | 0.104 | 104 | 2.7 |
| 23 | 阿维菌素 | 0.085 | 0.090 | 0.088 | 0.086 | 0.089 | 0.087 | 0.090 | 0.088 | 87.8 | 2.3 |
| 24 | 亚胺硫磷 | 0.089 | 0.087 | 0.087 | 0.089 | 0.087 | 0.091 | 0.090 | 0.089 | 88.6 | 1.9 |
| 25 | 伏杀硫磷 | 0.101 | 0.092 | 0.098 | 0.101 | 0.093 | 0.099 | 0.098 | 0.097 | 97.3 | 3.9 |
| 26 | 乐果 | 0.084 | 0.082 | 0.082 | 0.088 | 0.081 | 0.088 | 0.082 | 0.084 | 83.8 | 3.3 |
| 27 | 倍硫磷 | 0.086 | 0.089 | 0.088 | 0.085 | 0.085 | 0.088 | 0.091 | 0.087 | 87.4 | 2.4 |
| 28 | 杀虫脒 | 0.087 | 0.090 | 0.087 | 0.087 | 0.087 | 0.086 | 0.088 | 0.087 | 87.3 | 1.3 |
| 29 | 涕灭威 | 0.089 | 0.090 | 0.086 | 0.086 | 0.085 | 0.086 | 0.085 | 0.087 | 86.7 | 2.2 |
| 30 | 涕灭威砜 | 0.102 | 0.101 | 0.103 | 0.107 | 0.107 | 0.108 | 0.104 | 0.104 | 104 | 2.4 |
| 31 | 涕灭威亚砜 | 0.092 | 0.086 | 0.091 | 0.086 | 0.087 | 0.087 | 0.086 | 0.088 | 87.9 | 3.0 |
| 32 | 倍硫磷砜 | 0.102 | 0.089 | 0.097 | 0.100 | 0.093 | 0.089 | 0.100 | 0.096 | 95.7 | 5.7 |
| 33 | 倍硫磷亚砜 | 0.098 | 0.094 | 0.094 | 0.100 | 0.093 | 0.099 | 0.095 | 0.096 | 96.1 | 2.9 |
| 34 | 杀螟硫磷 | 0.084 | 0.090 | 0.085 | 0.090 | 0.086 | 0.085 | 0.088 | 0.087 | 86.8 | 2.7 |
| 35 | 虫酰肼 | 0.094 | 0.091 | 0.102 | 0.098 | 0.088 | 0.097 | 0.101 | 0.096 | 95.9 | 5.5 |
| 36 | 除虫脲 | 0.090 | 0.090 | 0.085 | 0.091 | 0.086 | 0.088 | 0.085 | 0.088 | 88.0 | 2.9 |
| 37 | 二甲戊灵 | 0.103 | 0.100 | 0.102 | 0.110 | 0.105 | 0.101 | 0.103 | 0.104 | 104 | 3.0 |
| 38 | 氟啶脲 | 0.108 | 0.104 | 0.105 | 0.103 | 0.105 | 0.109 | 0.102 | 0.105 | 105 | 2.4 |
| 39 | 甲萘威 | 0.093 | 0.089 | 0.102 | 0.100 | 0.089 | 0.094 | 0.099 | 0.095 | 95.2 | 5.8 |
| 40 | 甲霜灵 | 0.108 | 0.107 | 0.109 | 0.107 | 0.107 | 0.110 | 0.108 | 0.108 | 108 | 0.9 |
| 41 | 氯吡脲 | 0.092 | 0.098 | 0.102 | 0.097 | 0.103 | 0.090 | 0.098 | 0.097 | 97.2 | 4.8 |
| 42 | 氯虫苯甲酰胺 | 0.104 | 0.105 | 0.106 | 0.102 | 0.106 | 0.106 | 0.103 | 0.105 | 105 | 1.4 |
| 43 | 灭幼脲 | 0.100 | 0.099 | 0.095 | 0.093 | 0.101 | 0.095 | 0.096 | 0.097 | 97.0 | 3.2 |
| 44 | 醚菊酯 | 0.089 | 0.088 | 0.093 | 0.092 | 0.093 | 0.094 | 0.090 | 0.091 | 91.3 | 2.6 |
| 45 | 异菌脲 | 0.087 | 0.082 | 0.083 | 0.084 | 0.086 | 0.087 | 0.081 | 0.084 | 84.1 | 3.0 |
| 46 | 丙溴磷 | 0.092 | 0.091 | 0.092 | 0.087 | 0.092 | 0.093 | 0.089 | 0.091 | 90.9 | 2.4 |
| 47 | 甲基异柳磷 | 0.087 | 0.089 | 0.084 | 0.089 | 0.084 | 0.088 | 0.088 | 0.087 | 87.0 | 2.4 |
| 48 | 水胺硫磷 | 0.087 | 0.090 | 0.088 | 0.088 | 0.090 | 0.086 | 0.088 | 0.088 | 88.1 | 1.6 |
| 49 | 乙基多杀菌素J | 0.106 | 0.109 | 0.100 | 0.109 | 0.102 | 0.103 | 0.105 | 0.105 | 105 | 3.1 |
| 50 | 乙基多杀菌素L | 0.094 | 0.093 | 0.099 | 0.095 | 0.093 | 0.090 | 0.095 | 0.094 | 94.0 | 3.0 |
| 51 | 噻虫胺 | 0.106 | 0.108 | 0.108 | 0.107 | 0.106 | 0.108 | 0.109 | 0.108 | 108 | 1.1 |
| 52 | 敌敌畏 | 0.089 | 0.102 | 0.100 | 0.097 | 0.098 | 0.096 | 0.098 | 0.097 | 97.3 | 4.1 |
| 53 | 咪鲜胺 | 0.106 | 0.104 | 0.103 | 0.102 | 0.109 | 0.104 | 0.105 | 0.105 | 105 | 2.2 |
| 54 | 甲拌磷 | 0.085 | 0.087 | 0.090 | 0.091 | 0.090 | 0.087 | 0.090 | 0.089 | 88.6 | 2.7 |
| 55 | 甲拌磷砜 | 0.090 | 0.087 | 0.087 | 0.089 | 0.089 | 0.090 | 0.089 | 0.089 | 88.7 | 1.4 |
| 56 | 甲拌磷亚砜 | 0.088 | 0.087 | 0.086 | 0.089 | 0.086 | 0.091 | 0.089 | 0.088 | 87.9 | 2.1 |
| 57 | 灭多威 | 0.102 | 0.096 | 0.094 | 0.099 | 0.103 | 0.092 | 0.094 | 0.097 | 97.0 | 4.5 |
| 58 | 抗蚜威 | 0.095 | 0.097 | 0.098 | 0.091 | 0.097 | 0.102 | 0.093 | 0.096 | 96.1 | 3.6 |
| 59 | 氟虫腈 | 0.096 | 0.092 | 0.098 | 0.092 | 0.095 | 0.091 | 0.090 | 0.093 | 93.3 | 3.2 |
| 60 | 氟虫腈砜 | 0.096 | 0.103 | 0.098 | 0.098 | 0.096 | 0.097 | 0.096 | 0.098 | 97.6 | 2.4 |
| 61 | 氟虫腈硫醚 | 0.101 | 0.097 | 0.089 | 0.095 | 0.102 | 0.101 | 0.098 | 0.098 | 97.6 | 4.6 |
| 62 | 氟甲腈 | 0.106 | 0.103 | 0.107 | 0.101 | 0.100 | 0.107 | 0.108 | 0.105 | 105 | 3.1 |
| 63 | 虫螨腈 | 0.090 | 0.089 | 0.090 | 0.090 | 0.089 | 0.090 | 0.090 | 0.089 | 89.5 | 0.8 |
| 64 | 赤霉酸 | 0.098 | 0.096 | 0.089 | 0.091 | 0.090 | 0.103 | 0.101 | 0.095 | 95.5 | 5.9 |
| 65 | 戊唑醇 | 0.089 | 0.089 | 0.095 | 0.087 | 0.086 | 0.086 | 0.087 | 0.088 | 88.2 | 3.4 |
| 66 | 内吸磷 | 0.089 | 0.090 | 0.087 | 0.088 | 0.088 | 0.091 | 0.088 | 0.089 | 88.6 | 1.5 |
| 67 | 氯唑磷 | 0.090 | 0.090 | 0.089 | 0.087 | 0.084 | 0.090 | 0.088 | 0.088 | 88.3 | 2.5 |
| 68 | 马拉硫磷 | 0.086 | 0.090 | 0.089 | 0.090 | 0.085 | 0.090 | 0.089 | 0.088 | 88.4 | 2.3 |
| 69 | 螺螨酯 | 0.103 | 0.102 | 0.101 | 0.108 | 0.105 | 0.103 | 0.102 | 0.104 | 104 | 2.3 |
| 70 | 噻螨酮 | 0.108 | 0.101 | 0.101 | 0.109 | 0.107 | 0.104 | 0.101 | 0.104 | 104 | 3.5 |
| 71 | 抑霉唑 | 0.093 | 0.095 | 0.092 | 0.086 | 0.090 | 0.092 | 0.089 | 0.091 | 90.9 | 3.2 |
| 72 | 噻嗪酮 | 0.091 | 0.097 | 0.098 | 0.099 | 0.097 | 0.096 | 0.092 | 0.096 | 95.7 | 3.1 |
| 73 | 丁硫克百威 | 0.083 | 0.087 | 0.084 | 0.085 | 0.081 | 0.080 | 0.080 | 0.083 | 82.8 | 3.0 |
| 74 | 二嗪磷 | 0.089 | 0.084 | 0.086 | 0.086 | 0.086 | 0.085 | 0.084 | 0.086 | 85.6 | 2.0 |
| 75 | 速灭磷 | 0.087 | 0.086 | 0.089 | 0.091 | 0.089 | 0.089 | 0.087 | 0.088 | 88.3 | 1.9 |
| 76 | 啶酰菌胺 | 0.088 | 0.099 | 0.095 | 0.096 | 0.097 | 0.093 | 0.091 | 0.094 | 94.3 | 4.0 |
| 77 | 腈苯唑 | 0.096 | 0.088 | 0.097 | 0.097 | 0.090 | 0.089 | 0.092 | 0.093 | 92.8 | 4.2 |
| 78 | 醚菌酯 | 0.105 | 0.106 | 0.109 | 0.110 | 0.110 | 0.109 | 0.107 | 0.108 | 108 | 1.8 |
| 79 | 三唑酮 | 0.109 | 0.110 | 0.106 | 0.105 | 0.105 | 0.106 | 0.105 | 0.107 | 107 | 1.8 |
| 80 | 硫环磷 | 0.085 | 0.087 | 0.088 | 0.089 | 0.086 | 0.090 | 0.090 | 0.088 | 88.0 | 2.1 |
| 81 | 噻苯隆 | 0.100 | 0.101 | 0.099 | 0.090 | 0.095 | 0.090 | 0.095 | 0.096 | 95.6 | 4.8 |
| 82 | 灭线磷 | 0.085 | 0.089 | 0.084 | 0.085 | 0.087 | 0.089 | 0.090 | 0.087 | 86.9 | 2.6 |
| 83 | 丙环唑 | 0.098 | 0.094 | 0.098 | 0.097 | 0.103 | 0.100 | 0.096 | 0.098 | 98.0 | 2.9 |
| 84 | 敌百虫 | 0.107 | 0.106 | 0.109 | 0.102 | 0.102 | 0.110 | 0.110 | 0.106 | 106 | 3.2 |
| 85 | 多杀霉素A | 0.090 | 0.099 | 0.089 | 0.093 | 0.103 | 0.103 | 0.089 | 0.095 | 95.1 | 6.7 |
| 86 | 多杀霉素D | 0.101 | 0.097 | 0.090 | 0.098 | 0.103 | 0.096 | 0.100 | 0.098 | 97.9 | 4.2 |
| 87 | 特丁硫磷 | 0.090 | 0.089 | 0.090 | 0.086 | 0.084 | 0.085 | 0.086 | 0.087 | 87.3 | 2.8 |
| 88 | 特丁硫磷砜 | 0.086 | 0.087 | 0.087 | 0.086 | 0.085 | 0.086 | 0.087 | 0.086 | 86.3 | 1.1 |
| 89 | 特丁硫磷亚砜 | 0.086 | 0.085 | 0.089 | 0.090 | 0.084 | 0.084 | 0.087 | 0.086 | 86.5 | 2.8 |
| 90 | 异丙威 | 0.101 | 0.106 | 0.106 | 0.106 | 0.101 | 0.109 | 0.108 | 0.105 | 105 | 3.0 |
| 91 | 久效磷 | 0.084 | 0.090 | 0.088 | 0.091 | 0.091 | 0.089 | 0.085 | 0.088 | 88.2 | 3.1 |
| 92 | 茚虫威 | 0.096 | 0.089 | 0.091 | 0.091 | 0.095 | 0.097 | 0.097 | 0.094 | 93.7 | 3.5 |
| 93 | 唑虫酰胺 | 0.098 | 0.095 | 0.100 | 0.094 | 0.091 | 0.098 | 0.090 | 0.095 | 95.1 | 4.1 |
| 94 | 对硫磷 | 0.085 | 0.091 | 0.085 | 0.085 | 0.089 | 0.084 | 0.087 | 0.087 | 86.7 | 2.8 |
| 95 | 氯苯嘧啶醇 | 0.097 | 0.092 | 0.091 | 0.102 | 0.100 | 0.097 | 0.102 | 0.097 | 97.0 | 4.5 |
| 96 | 莠灭净 | 0.109 | 0.105 | 0.106 | 0.101 | 0.106 | 0.104 | 0.106 | 0.105 | 105 | 2.2 |
| 97 | 蝇毒磷 | 0.089 | 0.086 | 0.088 | 0.088 | 0.089 | 0.091 | 0.088 | 0.088 | 88.1 | 1.7 |
| 98 | 甲基硫菌灵 | 0.108 | 0.108 | 0.108 | 0.109 | 0.109 | 0.109 | 0.110 | 0.109 | 109 | 0.7 |
| 99 | 肟菌酯 | 0.109 | 0.109 | 0.109 | 0.108 | 0.106 | 0.107 | 0.107 | 0.108 | 108 | 1.2 |
| 100 | 腈菌唑 | 0.102 | 0.101 | 0.108 | 0.109 | 0.102 | 0.105 | 0.108 | 0.105 | 105 | 3.2 |

**1.9样品测定实验**

为系统掌握热带果蔬中农药残留状况，本研究对收集的262批样品开展全面检测。检测样品涵盖芒果、豇豆、荔枝、香蕉、辣椒、菠萝、丝瓜和苦瓜等多种热带常见果蔬，均采用优化后的前处理方法进行样品处理，并通过液相色谱-串联质谱法（LC-MS/MS）对100种目标农药残留量进行精准监测，每份样品均同步进行2次平行测定，检出结果见表12、表13。

**芒果样品：**在检测的53批芒果样品中，共有9批检出农药残留，检出率为16.98%。检出的农药种类达7种，分别为吡虫啉、多菌灵、苯醚甲环唑、嘧菌酯、氯虫苯甲酰胺、吡唑醚菌酯和戊唑醇，均为果蔬种植中常用的杀虫剂和杀菌剂。其中，有1个芒果样品检出吡唑醚菌酯残留量超过GB 2763-2021《食品安全国家标准 食品中农药最大残留限量》中规定的限值，超标率为 1.89%。

**豇豆样品：**50批豇豆样品的农药残留检出情况相对突出，31批样品检出农药残留，检出率高达62.00%。检出农药包括啶虫脒、多菌灵、甲氨基阿维菌素苯甲酸盐、灭蝇胺、嘧霉胺、烯酰吗啉、倍硫磷、氯虫苯甲酰胺、异菌脲等9种，涉及杀虫剂和杀菌剂两大类。值得注意的是，有2个豇豆样品检出倍硫磷残留超标，超标率为4.00%，倍硫磷作为高毒杀虫剂，其超标情况需重点关注。

**荔枝样品：**69批荔枝样品中，31批检出农药残留，检出率为44.93%。检出的农药种类较多，共15种，包括毒死蜱、丙溴磷、异菌脲、啶虫脒、烯酰吗啉、吡唑醚菌酯、嘧菌酯、噻虫胺、噻嗪酮、除虫脲、氯虫苯甲酰胺等，涵盖了杀虫剂、杀菌剂等多种类型。其中，2个荔枝样品检出除虫脲超标，1个荔枝样品检出吡唑醚菌酯超标，总超标率为4.35%。

**香蕉样品：**40批香蕉样品中，25批检出农药残留，检出率为62.50%。检出的9种农药为吡虫啉、啶虫脒、咪鲜胺、吡唑醚菌酯、多菌灵、除虫脲、抑霉唑、甲基硫菌灵和戊唑醇，主要用于香蕉病虫害防治。检测发现有2个香蕉样品的吡虫啉残留量超过标准限值，超标率为5.00%。

**其他果蔬样品：**在20批辣椒样品中，仅有2批检出农药残留，涉及啶虫脒和苯醚甲环唑两种农药，检出率为10.00%，未发现超标样品。而采集的10批菠萝、丝瓜和苦瓜样品中，均未检出上述100种目标农药残留，检测结果全部合格。

试验结果表明，该检测方法具有良好的平行性。对所有样品的2次平行测定结果进行统计分析，其相对标准偏差（RSD）均小于5%，远低于方法学验证中规定的允许偏差范围。这一数据充分证明，该方法在热带果蔬复杂基质中对目标农药残留量的测定具有较高的精密度和准确性，能够满足日常定量分析的严格要求，可为热带果蔬农药残留监管提供可靠的技术支撑。

表12 样品测定结果一（mg/kg）

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 序号 | 样品名称 | 编号 | 毒死蜱 | 丙溴磷 | 异菌脲 | 啶虫脒 | 烯酰吗啉 | 吡唑醚菌酯 | 嘧菌酯 | 噻虫胺 | 噻虫嗪 | 丙环唑 | 苯醚甲环唑 | 噻嗪酮 | 除虫脲 | 氯虫苯甲酰胺 | 戊唑醇 |
| 1 | 芒果 | mg001 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 2 | 芒果 | mg005 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 3 | 芒果 | mg008 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 4 | 芒果 | mg009 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.026 | ND |
| 5 | 芒果 | mg010 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 6 | 芒果 | mg011 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 7 | 芒果 | mg012 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 8 | 芒果 | mg015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 9 | 芒果 | mg016 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.030 |
| 10 | 豇豆 | jd001 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 11 | 豇豆 | jd002 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 12 | 豇豆 | jd003 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 13 | 豇豆 | jd004 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 14 | 豇豆 | jd005 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 15 | 豇豆 | jd006 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 16 | 豇豆 | jd007 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 17 | 豇豆 | jd015 | ND | ND | ND | ND | 0.010 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 18 | 豇豆 | jd016 | ND | ND | 0.014 | ND | 0.070 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 19 | 豇豆 | jd017 | ND | ND | ND | ND | 0.092 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 20 | 豇豆 | jd018 | ND | ND | ND | ND | 0.029 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 21 | 豇豆 | jd019 | ND | ND | 0.012 | ND | 0.047 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 22 | 豇豆 | jd020 | ND | ND | 0.018 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 23 | 豇豆 | jd024 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 24 | 豇豆 | jd025 | ND | ND | ND | ND | 0.026 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 25 | 豇豆 | jd029 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 26 | 豇豆 | jd031 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 27 | 豇豆 | jd032 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 28 | 豇豆 | jd033 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 29 | 豇豆 | jd034 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 30 | 豇豆 | jd035 | ND | ND | ND | ND | 0.022 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 31 | 豇豆 | jd036 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 32 | 豇豆 | jd038 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 33 | 豇豆 | jd040 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 34 | 豇豆 | jd042 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 35 | 豇豆 | jd043 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 36 | 豇豆 | jd045 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 37 | 豇豆 | jd047 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 38 | 豇豆 | jd048 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.010 | ND |
| 39 | 豇豆 | jd049 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 40 | 豇豆 | jd050 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 41 | 荔枝 | lz001 | ND | ND | ND | ND | ND | ND | ND | 0.024 | ND | ND | ND | ND | ND | 0.073 | ND |
| 42 | 荔枝 | lz002 | 0.240 | ND | ND | ND | 0.094 | 0.046 | ND | 0.052 | ND | ND | 0.024 | ND | ND | 0.012 | 0.060 |
| 43 | 荔枝 | lz003 | ND | ND | ND | ND | ND | 0.014 | ND | ND | ND | ND | ND | ND | ND | 0.093 | ND |
| 44 | 荔枝 | lz005 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.190 | ND | ND |
| 45 | 荔枝 | lz006 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 4.290 | ND | ND |
| 46 | 荔枝 | lz007 | ND | ND | 0.011 | ND | ND | 0.031 | ND | ND | ND | ND | 0.018 | ND | 0.020 | 0.049 | ND |
| 47 | 荔枝 | lz008 | ND | ND | 0.014 | ND | ND | 0.041 | ND | ND | ND | ND | 0.027 | ND | ND | 0.120 | ND |
| 48 | 荔枝 | lz012 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.066 | ND | ND |
| 49 | 荔枝 | lz014 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.020 | 0.099 | 0.014 | ND |
| 50 | 荔枝 | lz015 | ND | ND | ND | ND | ND | 0.092 | ND | ND | ND | ND | ND | ND | 0.100 | 0.086 | ND |
| 51 | 荔枝 | lz018 | ND | ND | ND | ND | 0.120 | ND | ND | ND | ND | ND | 0.084 | ND | 0.094 | 0.034 | ND |
| 52 | 荔枝 | lz023 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.050 | ND | ND | ND | ND |
| 53 | 荔枝 | lz024 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.054 | ND | ND | ND | ND |
| 54 | 荔枝 | lz025 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.074 | ND | ND | ND | ND |
| 55 | 荔枝 | lz026 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.088 | ND | ND | ND | ND |
| 56 | 荔枝 | lz027 | ND | ND | ND | 0.022 | ND | 0.026 | ND | ND | ND | ND | ND | 0.019 | ND | ND | 0.022 |
| 57 | 荔枝 | lz028 | ND | ND | ND | ND | ND | 0.016 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 58 | 荔枝 | lz032 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.032 | ND |
| 59 | 荔枝 | lz033 | ND | ND | ND | 0.014 | 0.120 | ND | 0.064 | ND | ND | ND | 0.091 | ND | 0.014 | 0.290 | ND |
| 60 | 荔枝 | lz034 | ND | ND | ND | ND | ND | **0.18\*** | 0.036 | ND | ND | ND | 0.120 | ND | ND | 0.100 | ND |
| 61 | 荔枝 | lz035 | ND | ND | ND | ND | ND | 0.078 | ND | 0.070 | ND | 0.040 | 0.210 | ND | 0.015 | 0.240 | ND |
| 62 | 荔枝 | lz036 | ND | ND | ND | ND | ND | 0.040 | ND | ND | ND | ND | ND | ND | 1.900 | ND | ND |
| 63 | 荔枝 | lz037 | 0.026 | 0.180 | ND | ND | 0.024 | 0.024 | 0.170 | 0.016 | ND | ND | 0.230 | ND | 0.020 | 0.110 | ND |
| 64 | 荔枝 | lz038 | ND | ND | ND | ND | ND | 0.042 | ND | 0.100 | 0.011 | ND | 0.020 | ND | 0.084 | ND | 0.027 |
| 65 | 荔枝 | lz039 | 0.054 | 0.014 | ND | ND | 0.019 | 0.014 | ND | ND | ND | ND | 0.018 | ND | 0.056 | ND | ND |
| 66 | 荔枝 | lz043 | ND | ND | ND | ND | 0.140 | ND | ND | ND | ND | ND | ND | ND | 0.016 | ND | ND |
| 67 | 荔枝 | lz044 | ND | ND | ND | ND | ND | ND | ND | 0.026 | ND | ND | ND | ND | ND | ND | ND |
| 68 | 荔枝 | lz053 | ND | ND | ND | 0.019 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.012 |
| 69 | 荔枝 | lz054 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.013 | ND | ND |
| 70 | 荔枝 | lz058 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.010 | 0.012 | ND |
| 71 | 荔枝 | lz061 | ND | ND | ND | ND | 0.013 | ND | ND | 0.025 | ND | ND | ND | ND | ND | 0.013 | ND |
| 72 | 香蕉 | xj001 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 73 | 香蕉 | xj005 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 74 | 香蕉 | xj006 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 75 | 香蕉 | xj010 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 76 | 香蕉 | xj011 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 77 | 香蕉 | xj012 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 78 | 香蕉 | xj013 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 79 | 香蕉 | xj014 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 80 | 香蕉 | xj015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 81 | 香蕉 | xj016 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 82 | 香蕉 | xj017 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 83 | 香蕉 | xj019 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 84 | 香蕉 | xj020 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 85 | 香蕉 | xj022 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 86 | 香蕉 | xj024 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 87 | 香蕉 | xj025 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.100 |
| 88 | 香蕉 | xj026 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 89 | 香蕉 | xj027 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 90 | 香蕉 | xj030 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 91 | 香蕉 | xj032 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 92 | 香蕉 | xj033 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 93 | 香蕉 | xj035 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 94 | 香蕉 | xj036 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 95 | 香蕉 | xj038 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 96 | 香蕉 | xj040 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 97 | 辣椒15 | lJ015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 98 | 辣椒16 | lJ016 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |

注：\*为参照GB 2763-2021《食品安全国家标准 食品中农药最大残留限量》检出值超标。

表13 样品测定结果二（mg/kg）

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 序号 | 样品名称 | 编号 | 吡虫啉 | 啶虫脒 | 咪鲜胺 | 吡唑醚菌酯 | 多菌灵 | 除虫脲 | 抑霉唑 | 甲基硫菌灵 | 甲氨基阿维菌素苯甲酸盐 | 灭蝇胺 | 嘧霉胺 | 倍硫磷 | 苯醚甲环唑 | 嘧菌酯 |
| 1 | 芒果 | mg001 | 0.020 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.049 |
| 2 | 芒果 | mg005 | ND | ND | ND | 0.016 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 3 | 芒果 | mg008 | ND | ND | ND | ND | 0.016 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 4 | 芒果 | mg009 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 5 | 芒果 | mg010 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.014 | ND |
| 6 | 芒果 | mg011 | 0.016 | ND | ND | 0.010 | ND | ND | ND | ND | ND | ND | ND | ND | 0.059 | ND |
| 7 | 芒果 | mg012 | 0.023 | ND | ND | **0.053\*** | ND | ND | ND | ND | ND | ND | ND | ND | 0.140 | ND |
| 8 | 芒果 | mg015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.010 | ND |
| 9 | 芒果 | mg016 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.032 | ND |
| 10 | 豇豆 | jd001 | ND | ND | ND | ND | 0.099 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 11 | 豇豆 | jd002 | ND | ND | ND | ND | 0.120 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 12 | 豇豆 | jd003 | ND | ND | ND | ND | 0.200 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 13 | 豇豆 | jd004 | ND | ND | ND | ND | 0.170 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 14 | 豇豆 | jd005 | ND | ND | ND | ND | 0.130 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 15 | 豇豆 | jd006 | ND | ND | ND | ND | 0.180 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 16 | 豇豆 | jd007 | ND | ND | ND | ND | 0.280 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 17 | 豇豆 | jd015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 18 | 豇豆 | jd016 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 19 | 豇豆 | jd017 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 20 | 豇豆 | jd018 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 21 | 豇豆 | jd019 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 22 | 豇豆 | jd020 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 23 | 豇豆 | jd024 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | **0.043\*** | ND | ND |
| 24 | 豇豆 | jd025 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 25 | 豇豆 | jd029 | ND | 0.012 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 26 | 豇豆 | jd031 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.035 | ND | ND | ND | ND |
| 27 | 豇豆 | jd032 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.039 | ND | ND | ND | ND |
| 28 | 豇豆 | jd033 | ND | 0.018 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 29 | 豇豆 | jd034 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | **0.044\*** | ND | ND |
| 30 | 豇豆 | jd035 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 31 | 豇豆 | jd036 | ND | ND | ND | ND | ND | ND | ND | ND | 0.010 | 0.060 | ND | ND | ND | ND |
| 32 | 豇豆 | jd038 | ND | ND | ND | ND | ND | ND | ND | ND | 0.008 | 0.048 | ND | ND | ND | ND |
| 33 | 豇豆 | jd040 | ND | ND | ND | ND | ND | ND | ND | ND | 0.007 | ND | ND | ND | ND | ND |
| 34 | 豇豆 | jd042 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.021 | 0.028 | ND | ND | ND |
| 35 | 豇豆 | jd043 | ND | 0.070 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 36 | 豇豆 | jd045 | ND | ND | ND | ND | ND | ND | ND | ND | 0.006 | ND | ND | ND | ND | ND |
| 37 | 豇豆 | jd047 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.020 | 0.022 | ND | ND | ND |
| 38 | 豇豆 | jd048 | ND | 0.044 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 39 | 豇豆 | jd049 | ND | 0.032 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 40 | 豇豆 | jd050 | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.024 | 0.016 | ND | ND | ND |
| 41 | 荔枝 | lz001 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 42 | 荔枝 | lz002 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 43 | 荔枝 | lz003 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 44 | 荔枝 | lz005 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 45 | 荔枝 | lz006 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 46 | 荔枝 | lz007 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 47 | 荔枝 | lz008 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 48 | 荔枝 | lz012 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 49 | 荔枝 | lz014 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 50 | 荔枝 | lz015 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 51 | 荔枝 | lz018 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 52 | 荔枝 | lz023 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 53 | 荔枝 | lz024 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 54 | 荔枝 | lz025 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 55 | 荔枝 | lz026 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 56 | 荔枝 | lz027 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 57 | 荔枝 | lz028 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 58 | 荔枝 | lz032 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 59 | 荔枝 | lz033 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 60 | 荔枝 | lz034 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 61 | 荔枝 | lz035 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 62 | 荔枝 | lz036 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 63 | 荔枝 | lz037 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 64 | 荔枝 | lz038 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 65 | 荔枝 | lz039 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 66 | 荔枝 | lz043 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 67 | 荔枝 | lz044 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 68 | 荔枝 | lz053 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 69 | 荔枝 | lz054 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 70 | 荔枝 | lz058 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 71 | 荔枝 | lz061 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 72 | 香蕉 | xj001 | 0.013 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 73 | 香蕉 | xj005 | 0.048 | ND | ND | 0.034 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 74 | 香蕉 | xj006 | ND | ND | 0.094 | ND | ND | ND | 0.015 | ND | ND | ND | ND | ND | ND | ND |
| 75 | 香蕉 | xj010 | ND | ND | 0.091 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 76 | 香蕉 | xj011 | ND | ND | ND | 0.190 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 77 | 香蕉 | xj012 | 0.020 | ND | ND | 0.023 | 0.089 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 78 | 香蕉 | xj013 | ND | ND | ND | ND | 0.100 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 79 | 香蕉 | xj014 | ND | ND | 0.085 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 80 | 香蕉 | xj015 | ND | ND | 0.120 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 81 | 香蕉 | xj016 | ND | ND | 0.065 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 82 | 香蕉 | xj017 | ND | ND | ND | ND | 0.230 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 83 | 香蕉 | xj019 | ND | ND | 0.066 | 0.019 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 84 | 香蕉 | xj020 | ND | ND | 0.012 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 85 | 香蕉 | xj022 | **0.064\*** | ND | 0.032 | 0.079 | ND | ND | 0.024 | ND | ND | ND | ND | ND | ND | ND |
| 86 | 香蕉 | xj024 | ND | ND | 0.094 | 0.100 | 0.240 | ND | ND | 0.016 | ND | ND | ND | ND | ND | ND |
| 87 | 香蕉 | xj025 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 88 | 香蕉 | xj026 | **0.061\*** | ND | 0.067 | 0.017 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 89 | 香蕉 | xj027 | 0.037 | ND | ND | 0.180 | ND | 0.097 | ND | ND | ND | ND | ND | ND | ND | ND |
| 90 | 香蕉 | xj030 | ND | ND | ND | 0.150 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 91 | 香蕉 | xj032 | ND | ND | 0.077 | ND | ND | ND | 0.021 | ND | ND | ND | ND | ND | ND | ND |
| 92 | 香蕉 | xj033 | ND | ND | 0.100 | 0.012 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 93 | 香蕉 | xj035 | ND | ND | 0.067 | 0.017 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 94 | 香蕉 | xj036 | ND | 0.016 | 0.069 | 0.018 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 95 | 香蕉 | xj038 | ND | ND | 0.083 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 96 | 香蕉 | xj040 | ND | ND | ND | 0.017 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 97 | 辣椒15 | lJ015 | ND | 0.038 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 98 | 辣椒16 | lJ016 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 0.026 | ND |

注：\*为参照GB 2763-2021《食品安全国家标准 食品中农药最大残留限量》检出值超标。

1. **技术经济论证、预期的经济效果**

技术经济论证：本标准采用的液相色谱-串联质谱法，仪器设备虽前期投入较大，但检测效率高，一次进样可同时检测100种农药及其代谢物，相比传统单农药检测方法，大幅减少检测时间与人力成本。在试剂与材料方面，乙腈、甲醇、乙酸铵等均为常见试剂，价格相对稳定且易获取。同时，标准制定过程充分考虑基层检测机构实际操作能力，流程简便，减少因操作复杂导致的实验误差与重复检测成本。​、预期的经济效果：标准实施后，可提高热带果蔬农药残留检测准确性与效率，减少不合格产品流入市场，降低因农药残留超标引发的食品安全事件风险，避免相关经济损失。对于种植户而言，依据标准规范用药，能提升果蔬品质，增强市场竞争力，增加农产品附加值，带来额外经济收益。对于农产品检测机构，检测效率提升可承接更多检测业务，增加营业收入，促进检测行业良性发展。

综合来看，制定一套适合我国热带果蔬特点的农药残留快速筛查标准具有必要性与紧迫性，本标准在充分考虑国内外技术现状与本地实际需求基础上制定，有望填补相关空白，提升我国热带果蔬农药残留检测技术水平。

1. 采用国际标准和国外先进标准的程度

本标准在制定过程中，参考了欧盟EN15662标准对果蔬分类及检测适用性界定，拓宽了适用范围至热带水果蔬菜。在农药残留检测技术方面，借鉴了美国EPA方法中对多农药残留同时检测的部分思路，优化了液相色谱-质谱联用仪的参数设置与检测流程。本标准在农药种类覆盖上达到100种，在定量限方面，多数农药定量限为0.01mg/kg，能更精准检测低浓度农药残留。在检测效率上，一次进样完成多种农药检测，更贴合我国热带果蔬产业实际情况，具有更强的实用性。

1. 与现行的法律法规和强制性国家标准的关系

本标准与现行的《中华人民共和国食品安全法》紧密衔接，旨在保障热带果蔬的质量安全，符合食品安全监管要求。在技术指标上，严格遵循GB2763《食品安全国家标准食品中农药最大残留限量》，检测结果可直接对照该标准判定热带果蔬是否安全。标准的实施将进一步完善我国热带果蔬农药残留检测标准体系，与现有法律法规和强制性标准协同作用，共同守护食品安全。

1. 重大分歧意见的处理经过和依据

无。

1. 标准作为强制性或推荐性标准的建议

建议本标准作为推荐性标准发布。热带果蔬农药残留检测涉及众多检测机构、种植户等主体，推荐性标准可给予各主体一定自主选择空间，便于根据自身实际情况灵活应用。同时，随着我国热带果蔬产业发展与检测技术进步，推荐性标准有利于及时更新完善。且目前已有相关食品安全强制性标准对农药残留限量作出规定，本标准作为推荐性标准，可在检测技术层面为各主体提供科学指导，与强制性标准相互配合，共同保障热带果蔬质量安全。

1. 贯彻标准的要求和措施建议（包括组织实施、技术措施、过渡办法等）

组织实施：由农业农村部门牵头，联合市场监管部门、农产品检测机构等成立标准实施工作小组，负责标准宣传推广、培训指导与监督检查。组织开展针对检测机构、种植户、经销商等相关人员的培训活动，提高其对标准的理解与执行能力。建立标准实施反馈机制，鼓励相关主体反馈标准实施过程中遇到的问题，以便及时调整完善。​、技术措施：依托基层检测机构的液相色谱-串联质谱联用仪等检测设备，对现有设备进行定期维护与升级。加强检测技术人员培训，提高其操作技能与数据分析能力。建立农药残留检测质量控制体系，定期开展实验室间比对与能力验证活动，确保检测结果准确性与可靠性。过渡办法：在标准发布初期，设置6个月的过渡期，协助各方尽快适应新标准。过渡期内，对检测机构进行技术帮扶，协助其优化检测流程以符合标准要求。对于种植户，通过发放宣传手册、举办讲座等方式，帮助其了解标准内容与规范用药知识。

1. 废止现行有关标准的建议

目前我国较少专门针对热带果蔬农药残留快速筛查的液相色谱-串联质谱法标准，故不存在直接替代、废止现行有关标准情况。

1. 其他应予说明的事项

本标准邀请农业农村部农产品及加工品质量安全检验测试中心(杭州)、广东农科监测科技有限公司、绿城农科检测技术有限公司、广东省农业科学院农业质量标准与监测技术研究所、广西热带作物学会及海南威尔检测技术有限公司共6家单位开展验证工作。加样回收试验浓度设置0.01mg/kg、0.02mg/kg和0.1mg/kg，验证单位针对豇豆和芒果基质，在上述三个添加水平下进行回收率实验，结果显示100种农药的平均回收率在70%-120%之间，相对标准偏差（RSD）均小于15%，完全符合农药残留检测领域对回收率和精密度的常规质量控制要求。从实际应用角度看，这一结果表明该方法在热带果蔬复杂基质中对低至0.01mg/kg的微量农药残留仍能实现检测，日常监管中常见的低污染水平及较高残留风险场景下的农药残留也可准确定量，说明方法具有较强的通用性和可操作性，基层检测机构在常规设备条件下即可有效执行，为热带果蔬农药残留检测提供了稳定可靠的技术支撑。