Application and dissemination of pesticide residual analysis system using a commercially available ELISA kit for agricultural production sites*

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The authors are involved in technical support of the introduction of a self-testing system that analyzes pesticide residues using an immunoassay at agricultural production sites. The practicality of the commercially available ELISA kit was high; however, measurement interference was confirmed in some vegetables. Ultra-filtration and dilution have been proposed to avoid measurement interference. In addition, the user’s manual of the ELISA kit has added improvements for production sites. Voluntary inspection of the pesticide residue was evaluated highly by the market, and trust in this production area was gained. © Pesticide Science Society of Japan

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Introduction

From 2001 through 2002, as various news items about pesticide residues were reported, public concern increased rapidly. As consumers sought safe agricultural produce, production sites had to address the issue of how to communicate with consumers about the safety of pesticide residues.

Against this background, the authors engaged in technical support of the introduction of a self-testing system to conduct simple analysis of pesticide residue at production sites. A simple analysis kit was used to perform an immunoassay for agricultural produce (hereinafter referred to as the kit).

1. Concrete Examples and Effects of the Self-testing System

An example from Saitama Prefecture; at JA Fukaya, the “Reassurance of the Safety of Produce” was devised to differentiate the region from other production sites by adopting a pre-shipment test of pesticide residue. At JA Fukaya, known for the production of green onions, it was an urgent necessity to foster a producing district that could resist low-cost imports.

Thus, the prefecture chose a formula to analyze pesticides before shipment and to publish the data analysis by attaching bar codes on tape bundling the produce. By introducing this system, the prices of specially produced green onion and spinach increased approximately 30% more than those grown generally, and agencies also increased, demonstrating the effect of this sales strategy.

Gifu Prefecture drew up a plan for a guided enterprise adopting the self-testing system for the purpose of monitoring and enforcing the appropriate use of pesticides at morning markets and direct sales stores. The first step of the plan was to detect pesticides outside the indication of pesticides in produce sold at direct sales stores. For the thorough identification of pesticides, Gifu Prefecture conducted self-testing at over 200 morning markets and direct sales stores. In a sample group of over 400 vegetables, 3 to 4 pesticides did not exceed standard values. The result was provided as feedback to producers and utilized at study meetings to increase knowledge about the proper use of pesticides. The region subsequently recovered the confidence of consumers in the safety of its produce.

These examples were the first trials in the country of a self-testing system at a production sites without using outside agencies.

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2. Outline of the Kit and Application for Agricultural Produce

Using an immunoassay, specimens are pretreated in a similar manner as in other ordinary instrumental analyses. Samples are homogenized in a mixer, methanol is added, and the mixture is shaken for extraction. The filtrate is diluted for measurement by the kit. As described above, the extraction is simple, with rapid measurement. We expect that this method could be introduced at production sites.

3. How to Avoid Measurement Interference

The practicality of the kit was examined by comparing the measured results of typical agricultural produce between instruments and kits. There were generally high correlations between the two; thus, it was concluded that all of the kits were suitable for residual analysis of many combinations of produce and pesticides.

However, some of the vegetables, including spinach, had recovery rates of additives over 150% in some cases and, in other cases, measurement values fluctuated with variation coefficients exceeding 15%.

Unrefined extract from agricultural produce contains various components that interfere with the measurements described above. The authors concluded based on tests using spinach that a non-water-soluble component was one of the factors that interfered with measurements.

4. Methods to Avoid Measurement Interference

We therefore investigated methods to avoid measurement interference. The simplest and most effective method is dilution; however, the measurement sensitivity was so high in comparison with the standard residue values of agricultural produce that dilution was impossible in several cases.

Purification using mini-columns, and the use of activated charcoal and ultrafiltration were investigated and found to produce satisfactory results; however, because purification using mini-columns requires steps such as the concentration of solvents, the method could not be used at production sites.

The use of activated charcoal is the simplest method, in which activated charcoal is added at the time of extraction; however, the effect varies depending upon the combination of interfering substances and pesticides. Ultra-filtration was performed once after the extract was diluted with water. Measurement interference could be avoided in most cases in which it had been confirmed. The treatment consisted simply of using a centrifuge; thus, the method was thought to be usable at production sites and was added to the manual.

5. Introduction to Production Sites

The user's manual was compiled based on the above findings, and technical guidance was given at training courses and on other occasions. At some production sites, it is difficult to arrange facilities and exclusive testing staff, requiring further detailed technical support and improvement of facilities.

In technical studies, operative errors by testing staff exceeded 15% in some cases. In addition, working hours and duties differed among individuals; therefore, revisions were made for easier-to-use apparatus selection and error-proof operating procedures, such as the use of disposable apparatus to avoid insufficient rinsing, the use of an aspirator in place of problematic rinsing of wells, and a longer reaction time to reduce individual operator errors.

Conclusion

This demonstrates the fruits of efforts as a body by producers, individuals in charge of agricultural extended sections, administration and research. The designers of the system were certainly farsighted to address the problem of pesticide residue as part of the sales strategy to promote production sites and to plan the introduction of the self-testing system quickly. High appreciation of the efforts by the market also greatly encouraged production sites.

At first, testing of pesticide residues was resisted strongly by producers, but now, analysis centers have been established at the JA, demonstrating the popularity of the concept in various locations. The confidence of consumers in production sites because of these efforts is the greatest result. While safety checks, such as pre-shipment tests, have become the norm, consumers seek even cheaper products, and it is becoming difficult to reflect the cost of tests in the price. Although immunoassays may be judged inferior to simultaneous analysis, they are much cheaper than instrumental analysis, and it is thought that there still is room for immunoassays in self-testing.