Uluslararası İleri Doğa Bilimleri ve Mühendislik Araştırmaları Dergisi
Sayı 9, S. 77-85, 1, 2025

Araştırma Makalesi

International Journal of Advanced Natural Sciences and Engineering Researches
Volume 9, pp. 77-85, 1, 2025

Research Article

https://as-proceeding.com/index.php/ijanser
ISSN:2980-0811

Detection of boric acid pesticide residues in agricultural soil using previously prepared SIQDs

Ali S. ALZAIDY [1*] Bassam F. Alfarhani [2]

[1]*Department of chemistry, College of sciences, Univesity of Al-Qadisiyah, Iraq*
[2] *Department of chemistry, College of sciences, Univesity of Al-Qadisiyah, Iraq*

* *corresponding author: sabahalzaidi18@gmail.com*

(Received: 14 January 2025, Accepted: 21 January 2025)

(2nd International Conference on Modern and Advanced Research ICMAR 2025, January 15-16, 2025)

ATIF/REFERENCE: Alzaıdy, A. S. & Alfarhani, B. F. (2025). Detection of boric acid pesticide residues in agricultural soil using previously prepared SIQDs. *International Journal of Advanced Natural Sciences and Engineering Researches*, 9(1), 77-85.

Abstract-Detection of boric acid pesticide residues in agricultural lands treated with the aforementioned pesticide and selectively detecting them using SIQDs prepared and tested in advance. This is done by preparing a certain concentration of the pesticide in an aqueous solution and testing its fluorescence intensity. Then, preparing a certain concentration of the SIQDs solution and testing the fluorescence intensity. It was found that the fluorescence intensity of the SIQDs is very high, reaching 7 times compared to the fluorescence intensity of the pesticide, which is much lower. The pesticide is detected by measuring the fluorescence intensity of the SIQDs after adding it to the pesticide. 2 ml of the SIQDs solution was taken and added to 2 ml of the pesticide, mixed and shaken for 5 minutes, then the fluorescence intensity signal was measured. It was found that the intensity decreased significantly to become close to the intensity of the pesticide alone, indicating the presence of the pesticide, as it works to reduce the signal intensity as a result of the interaction between the surface of the SIQDs and the pesticide used, which causes extinguishing. It has been practically applied in agricultural lands treated with boric acid.

Keyword: Boric Acid, Silica Quantum Dots Siqds, Fertilizers, Fluorescence.

I. INTRODUCTION

Pesticides[1] are chemical substances that prevent or limit the reproduction and spread of living organisms or kill them. They have direct and indirect harms to humans that cannot be limited, as well as their impact on the environment and all forms of life.[2] These harms vary in severity and differ in the time of their appearance among the different living organisms exposed to them.[3][4] , their danger to the environment and health is considered great. There are many harms of pesticides, the most important of which is their effect on human health and their direct or indirect arrival.[5][6] ,They cause great harm when the pesticide reaches directly through the mouth, inhalation, touch, or eyes in places close to the use of the pesticide.[7] It has an indirect effect through water, food and air polluted with pesticide residues. Among the harms of pesticides on water (rivers, wells, seas) are that pesticides reach the water through several means, including spraying harmful insects that live in water with pesticides to combat them[8]. They also reach through the dissolution of remaining pesticides in agricultural soil through irrigation and rainwater. An important factor in the presence of pesticide residues in water is pesticide factories near rivers and valleys[9][10]. Also, the air laden with pesticide spray is considered a source of water pollution. Many pesticides do not dissolve easily in water and remain for a period before dissolving, eliminating many beneficial organisms. They also accumulate in the bodies of river and marine animals and fish([11] ,especially in their fatty substances, and then reach humans through their consumption, causing many health damages[12]. There are many harms of pesticides on soil as, they are considered one of the most dangerous pollutants of soil and the environment, and the repeated use of these pesticides leads to destruction. Its fertility and acute poisoning by pesticides[13] ,and the destruction of all forms of living organisms, and most pesticides are carcinogenic, especially the group of carbs, which turn into compounds (nitrosamines) in the soil, which are absorbed by plants, and when humans or animals feed on those plants, the result is the transfer of the pesticide to them.[14] Methods and methods of integrated control: (agricultural methods, physical methods, use of organic pesticides of natural origin, biological methods, chemical methods, genetic methods) [15].

II. Methodology

2-1. Chemicals

Materials used

Boric acid pesticide, deionized water, white mushroom residues, NPK fertilizer containing nitrogen, phosphate and potassium in equal proportions, as well as boron nano fertilizer and pre-prepared SIQDs Hydrochloric acid.

2-2. Instrumentation

Required instruments

1- Spectrofluorophoto meter
2- Hot- Plate with Magnetic Stirrer
3- Centrifuge
4- Sonication path
5- Electronic balance
6- pH-meter
7- Oven
8- Furnace
9- Shaker

2-3. Excitation and emission spectra

The spectra were obtained using a fluorescence device, where the wavelengths were measured in the range of 220 to 600 nm, where the excitation and emission spectrum of the silica solution and the boric acid solution were calculated by dissolving a certain amount of each of the two compounds separately in deionized water, where the excitation spectrum was determined at the maximum wavelength, all these measurements were made at room temperature.

2-4. How to detect boric acid in aqueous solution

The boric acid insecticide is detected by preparing a standard solution of the pesticide at a concentration of (200) in a volumetric flask. Different concentrations are prepared according to the gradual dilution and the fluorescence intensity is measured for each concentration at a wavelength of (470 nm), where the intensity was recorded at(100 nm). Then a silica solution is prepared at a concentration of (100 ppm) and the fluorescence intensity is measured at the same wavelength and the intensity obtained is recorded, representing 900 nm. Then we take 2 ml of the silica solution at a concentration of (100 ppm) and add it to (2) ml of the pesticide solution prepared at a concentration of (100ppm) and mix the two solutions with a shaking device for 5 minutes, then transfer the solution to a fluorescent cuvette for the purpose of measurement at a wavelength of (470 nm). We notice a difference in the shape of a significant decrease in the intensity of silica fluorescence as a result of the phenomenon of extinction resulting from the interaction between the pesticide and the quantum dots on the silica surface. The intensity is estimated from the shape (1) at (230 nm), which is 4 times less than the intensity of SIQDs without a pesticide.

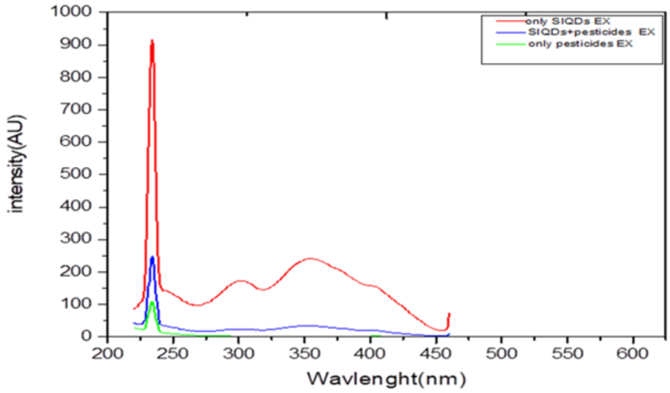


Figure (1) shows the phenomenon of suppression resulting from the presence of the pesticide

We observe a clear decrease in the fluoridation of SIQDs when adding (boric acid) in different concentrations of 20-140ppm of the pesticide, as shown in Figure 8, with (R2) of 0.9945, demonstrating the accurate detection of the concentration of the pesticide. Our results show that previously prepared SIQDs can be a sensitive and selective sensor for the detection of boric acid. Detection limit (LOD) and quantification limit (LOQ) calculated.

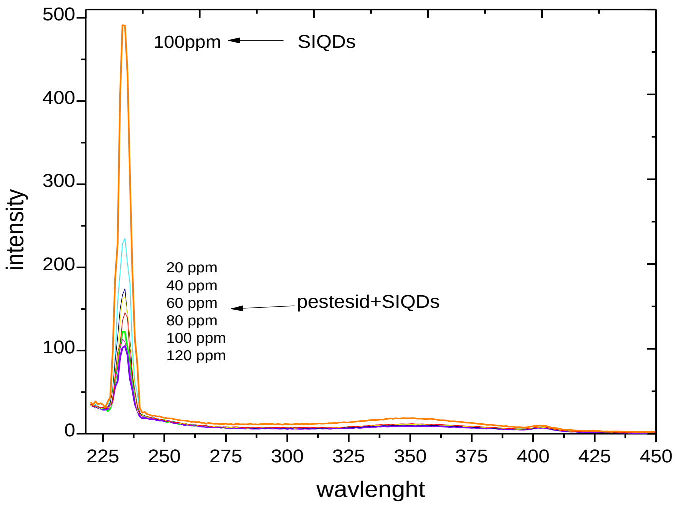


Figure (2) Fluorescence intensity variation of SIQDs with different pesticide concentrations

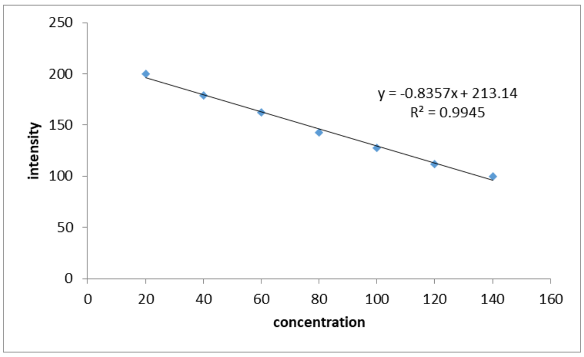
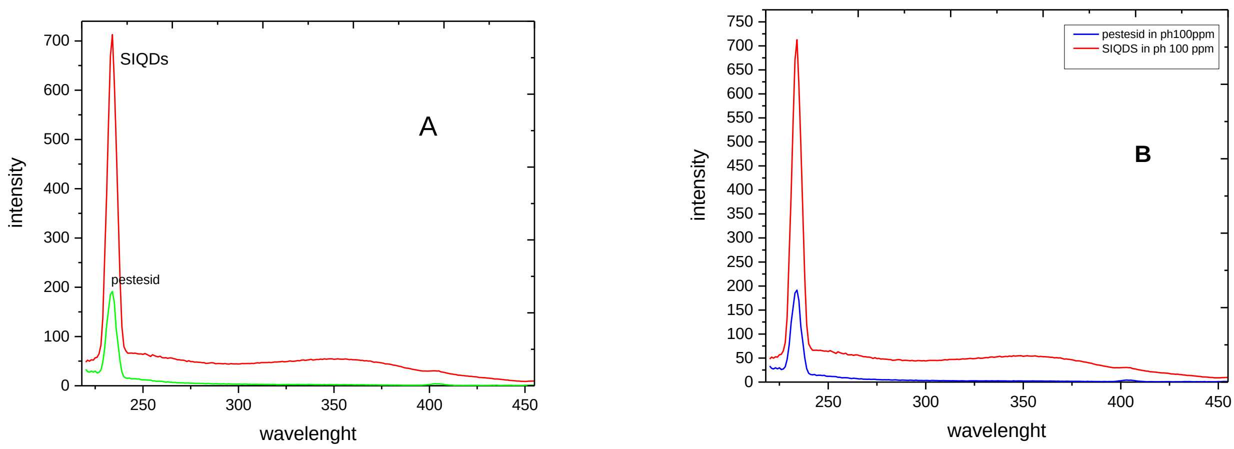


Figure (3) Linear relationship between fluorescence suppression efficiency and pesticide concentrations in the range of 20-160 ppm

The detection limit (LOD) is 0.17 μm and the quantification limit (LOQ) is set as 0.044 μm. The detection limit for the pesticide (boric acid) was lower than the recommended concentration (5.36 μm) by the World Health Organization for drinking water, which shows that SIQDs have a large ability to detect the lowest amount of pesticide used.

3-1. Effect of acidity on detection of residual pesticide in soil

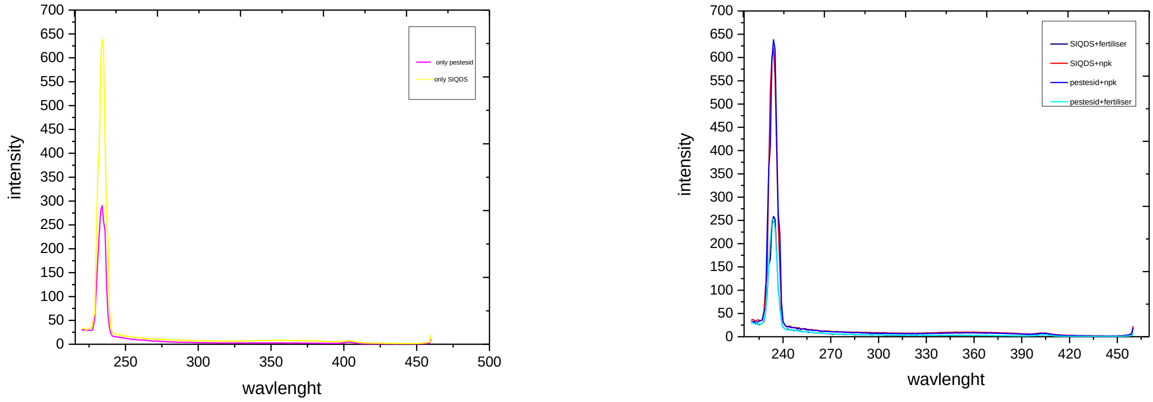
The effect of soil acidity on the pesticide and prepared quantum dots is tested by preparing a volume of (200 ml) of a standard acidic solution with a concentration of(100 ppm), by dissolving hydrochloric acid in non-ionic water, then we take (10 ml)of the solution and put it in a tube and add (0.001) weight of the pesticide to it, then the fluorescence intensity is measured at a specific excitation wavelength of 468 and the intensity is recorded, and in the same way a solution of quantum dots is prepared at the same concentration and the fluorescence intensity is measured, and it was found that the fluorescence intensity of the pesticide and silica in non-ionic water is the same as in the acidic solution, which indicates that acidity does not affect the detection of the pesticide, as shown in Figure (4) A and B



Figure(4) (A) shows the intensity of fluorescence of SIQDs and the pesticide without Hcl (B) shows the intensity of fluorescence of SIQDs and the pesticide with Hcl

3-2Examining the effect of the presence of fertilizers in the soil on the pesticide

A medium similar to the soil treated with the pesticide is prepared by adding materials most of which are found in the soil of agricultural lands. These materials are fertilizers used for the purpose of treating the soil and feeding the plant. NPK fertilizer is used in most agricultural lands for its importance, as well as white mushroom waste. A certain weight of fertilizer is dissolved in deionized water in a 200 ml bottle, then 10 ml of the prepared solution is taken and a weight of the pesticide is dissolved in the same previous way and its fluorescence intensity is measured. Then 10 ml of the solution is taken in a tube and a certain weight of silica is dissolved, then the fluorescence intensity is measured at a specific wavelength. We notice that these fertilizers do not have an effect on silica and the pesticide, which achieves the selectivity of silica in detecting the pesticide, as in Figure (5) A, which shows the fluorescence intensity of SIQDs and the pesticide without fertilizers, and Figure (5) B shows the fluorescence intensity of SIQDs and the pesticide in the presence of NPK fertilizer And white mushroom residues.



Figure(5) A shows the fluorination intensity of SIQDs and pesticide without fertilize Figure(5) B shows the intensity of fluorination of SIQDs and pesticide in the presence of the mentioned fertilizer

3-4. Testing the effect of nano-fertilizers in the soil on the pesticide

When examining the effect of nano-fertilizers (boron, urea) on the intensity of SIQDs and pesticide fluorescence and their effect on detection In the same previous preparation method in the effect of agricultural fertilizer, it was found when measuring the fluorescence of silica and pesticide each separately at a wavelength of (468 nm), no change in the intensity of silica occurred when nano-fertilizers were present, as well as a slight increase in the intensity of the pesticide when measuring as a result of the interference between the pesticide and nano-fertilizer. This can be explained through Figure (6), which shows the intensity of fluorescence of the pesticide and SIQDs before and after the presence of nano-fertilizers.

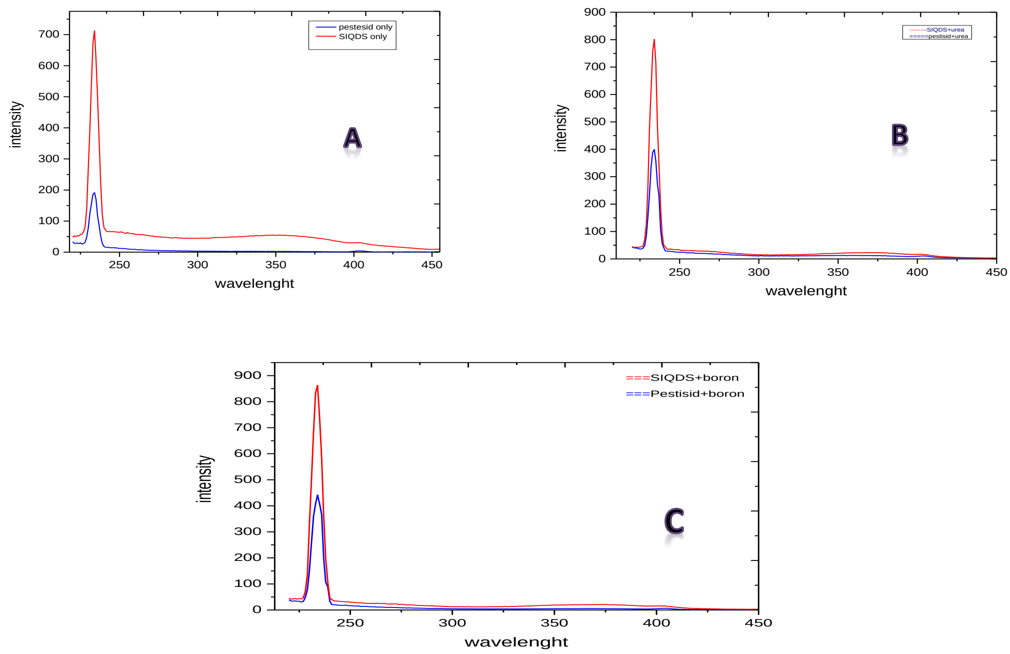


Figure (6), A - which shows the intensity of fluorescence of the pesticide and SIQDs before presence of nano-fertilizers and shows in B,C after presence of nano-fertilizers

3-5. Using different concentrations of nano-fertilizer and choosing the best concentration that achieves the best possible suppression

A zinc fertilizer solution was prepared at different concentrations according to the sequential preparation method from the dilution law, where concentrations (100ppm, 80ppm, 60ppm, 40ppm) were prepared based on the (4-2) method in measuring the intensity of fluorescence and achieving the best suppression in the presence of zinc fertilizer. The best concentration that achieves the best suppression was observed at a concentration of (40ppm) as shown in Figure (7).

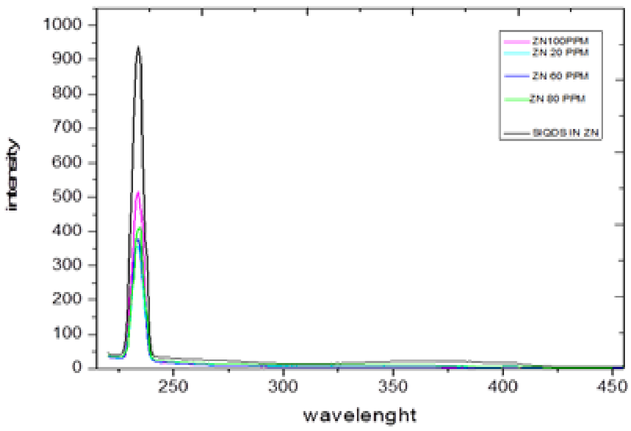


Figure (7) shows the best concentration of fertilizer (40ppm) that achieves the best suppression

3-6. Effect of shaking time on the intensity of suppressi

We notice a difference in the intensity of suppression when shaking the mixture of quantum points with the pesticide, as the intensity of the signal decreases, which indicates that excellent suppression is achieved the longer the shaking time, as it varies from the mixing point without shaking to a time of 6 minutes, which establishes the lowest intensity of the mixture.

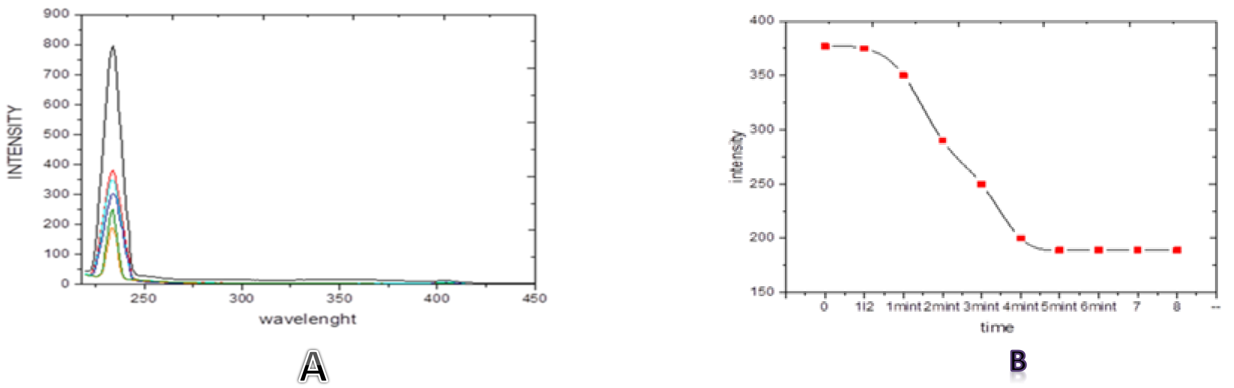


Figure (8) -A shows the difference in intensity with increasing shaking time, Figure (B) shows the best suppression at (6) minutes.

4-1- Detection of the pesticide in the soil

The pesticide is practically detected in agricultural land that has been treated with boric acid pesticide under natural conditions Aquantity of soil was taken from several random locations in the shape of the letter X from five locations and collected together and left to dry, then ground simply, then a sieve is used to get rid of unwanted materials, then weighed and non-ionic water is added to it at a ratio of(3:1) , then mixed for an hour by moving it with a curtain, after which it is filtered, then a volume of (2 ml) is taken from the resulting solution and (2ml)of the prepared silica solution is added to it and the intensity of fluorescence is measured, and it was found that the intensity of fluorescence decreased significantly, which indicates the presence of the pesticide, as it works to reduce the intensity of the signal as a result of the interaction between the SIQDs surface and the pesticide used, extinguishing occurs. As shown in Figure (9) , the phenomenon of suppression resulting from the presence of residual pesticide in the soil is shown.

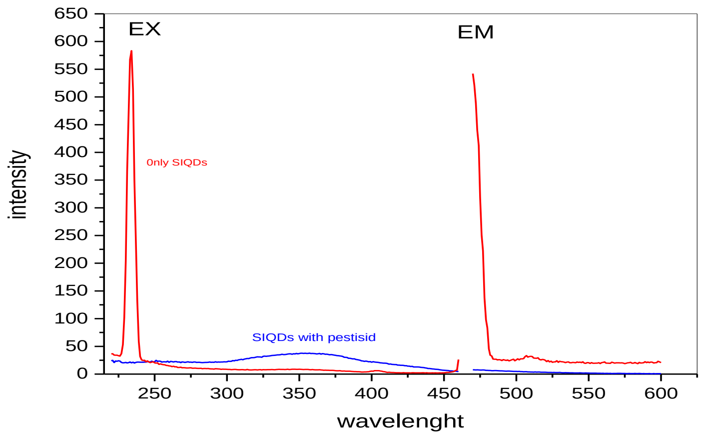


Figure (9) shows the phenomenon of suppression resulting from the presence of residual pesticide in the soil.

III. CONCLUSION

Using SIQDs to detect pesticides in soil treated with boric acid pesticide by measuring the fluorescence intensity of silica in an aqueous solution, then measuring the fluorescence intensity of the pesticide and recording the two readings. We notice that the fluorescence intensity of silica alone is 6 times the fluorescence of the pesticide. Then (2 ml) of pesticide are added to (2ml)of SIQDs, then placed in a fluorescent cuvette and the fluorescence intensity is recorded, where a significant decrease in intensity is observed, indicating the interference between the pesticide and the SIQDs surface. Pesticide detection is applied in agricultural soil after testing the effect of acidity and the presence of NPK fertilizer, white fungus waste, and nano fertilizer such as boron and urea. Then soil treated with boric acid is examined. Aquantity of soil is taken from several random locations in the shape of the letter X from five locations and collected together and left to dry, then ground simply, then a sieve is used to get rid of unwanted materials, then weighed and water is added to it Nonionic in a ratio of (3:1) , then mixed for an hour by stirring it with a straw, then filtered, then take a volume of (2ml) of the resulting solution and add (2ml) of the prepared SIQDs solution to it and measure the intensity of fluorescence, and found a significant decrease in the intensity of fluorescence, which indicates the presence of the pesticide.

REFERENCES

[1] G. Van Maele-Fabry, A.-C. Lantin, P. Hoet, and D. Lison, “Childhood leukaemia and parental occupational exposure to pesticides: a systematic review and meta-analysis,” Cancer Causes Control, vol. 21, pp. 787–809, 2010.

[2] N. Simon-Delso et al., “Pesticides néonicotinoïdes. Tendances, usages et modes d’action des métabolites,” 2014.

[3] T. C. Sparks, “Insecticide mixtures—uses, benefits and considerations,” Pest Manag. Sci., 2024.

[4] Y. Zhang et al., “Physicochemical property guidelines for modern agrochemicals,” Pest Manag. Sci., vol. 74, no. 9, pp. 1979–1991, 2018.

[5] S. Hofstetter, A. Beck, S. Trapp, and A. Buchholz, “How to design for a tailored subcellular distribution of systemic agrochemicals in plant tissues,” J. Agric. Food Chem., vol. 66, no. 33, pp. 8687–8697, 2018.

[6] L. Quiros-Alcala, “Potential health effects of pesticides.,” 2015.

[7] E. P. on P. P. P. and their R. (PPR) et al., “Scientific opinion on pesticides in foods for infants and young children,” EFSA J., vol. 16, no. 6, p. e05286, 2018.

[8] R. C. Gilden, K. Huffling, and B. Sattler, “Pesticides and health risks,” J. Obstet. Gynecol. Neonatal Nurs., vol. 39, no. 1, pp. 103–110, 2010.

[9] C. D. Klaassen and M. O. Amdur, Casarett and Doull’s toxicology: the basic science of poisons, vol. 1236. McGraw-Hill New York, 2013.

[10] D. Lawrence, “Chinese develop taste for organic food: Higher cost no barrier to safer eating,” Bloom. News, Int. Her. Trib. Retrieved, pp. 10–25, 2007.

[11] R. Womble, “National Library of Medicine Web Resources for Student Health Professionals,” Oak Ridge Inst. for Science and Education (ORISE), Oak Ridge, TN (United States), 2010.

[12] N. C. Deziel, M. C. Friesen, J. A. Hoppin, C. J. Hines, K. Thomas, and L. E. B. Freeman, “A review of nonoccupational pathways for pesticide exposure in women living in agricultural areas,” Environ. Health Perspect., vol. 123, no. 6, pp. 515–524, 2015.

[13] K.-Y. Cheng, R. Anthony, U. R. Kortshagen, and R. J. Holmes, "High-efficiency silicon nanocrystal light-emitting devices," Nano Lett., vol. 11, no. 5, pp. 1952–1956, 2011.

[14] L. Nicolle-Mir, "Exposition résidentielle aux pesticides et cancers de l'enfant: nouvelle méta-analyse.," Environnement, Risques & Santé, vol. 15, no. 4, 2016.

[15] S. M. Stavis, J. A. Fagan, M. Stopa, and J. A. Liddle, "Nanoparticle manufacturing–heterogeneity through processes to products," ACS Appl. Nano Mater., vol. 1, no. 9, pp. 4358–4385, 2018.