

# Human Health Significance of Chlorpyrifos Pesticide Residue on Broccoli: Examining Effects of Elevation

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**Abstract**—Broccoli is a vegetable, widely produced in high elevation area of West Java. In its production, farmers use uncontrolled pesticides which are thought to have a large influence on the people who consume them. Allegedly, elevation affects the growth of broccoli and public health. This article reports the significance of the effects of pesticide residues on broccoli plants and their interactions with human health that consume them based on elevation differences. The study was conducted in three locations of broccoli planting with elevations of 600, 1000 and 1500 m above sea level. Sampling of gardens and farmers, insecticides that are not recommended for eradicating pests in broccoli plants namely Abamectin (Agrimec 18 EC, ba 18.4 g), chlorantranilipol (prevathion 50 SC, ba 50 g / L) and provenus (Curachon 500 EC, ba 500 gr / L). sample residue 1 = 2.20 mg / kg (10% greater than the maximum residual limit), sample 2 = 2.47 mg / kg (20% greater than the maximum residual limit), sample 3 = 3.65 mg / kg (82% greater than the Maximum Residue Limit), sample 4 = 3.21 mg / kg (60% greater than the Maximum Residual Limit).

**Keywords:** *broccoli, pesticide residues and health, elevation*

## I. INTRODUCTION

Agricultural commodities have a strategic role in realizing the government to increase foreign exchange earnings. In an era marked by increasingly free trade in commodities between countries in the world including horticultural commodities. Today the demand for domestic and foreign markets for horticultural commodities, especially fruits and vegetables, has increased, so the opportunity to position these commodities is increasingly significant in the Indonesian economy. Demand for tropical horticultural commodities in the international market continues to increase, but exports in Indonesia are still very small or less than 1% of total demand[1].

In general, horticulture farmers, especially vegetables and fruits tend to overuse pesticides to secure their products, although conceptually pesticides are the last alternative in controlling plant pest organisms. According to [2], the factors that cause high pesticide use in developing countries are farmers' reluctance to risk crop failure and incomplete information about the pesticides they obtain.

In the world of agriculture, pesticides are an integral part of agricultural cultivation, all types of plants as part of plant maintenance activities. Insecticidal residues in the

environment are a result of direct use or application. Insecticides are aimed at certain targets such as plants and land but can also be due to insecticides carried away (drift) by the movement of water (rivers, groundwater, sea), and the movement of wind or air. Pesticide residues are also included in the food chain from the lowest trophic level, leading to the highest trophic level.[3]

In horticultural commodities, pesticide residues that are often tracked have a health hazard. For example in the United States, EPA found 14 of 41 pesticides commonly used in the commodity were classified as carcinogens. Pesticide residues are reported to have contaminated 83% of the observed horticultural plants [4]. From the routine DA and USDA monitoring programs, there were 13 types of pesticides which were frequently investigated in fruits and vegetables. For example 60% of spinach samples contained Permethrin residue, 11% in tomato, celery and lettuce samples [5].

In Indonesia, the level of pesticide residues contained in food is quite alarming as well, such as vegetables, carrots, potatoes, mustard greens, shallots, tomatoes and cabbage from various places in vegetable production centers reported to have residues that exceed the maximum limit of 2 ppm. [6].

Our concerns about the impact of pesticide residues and their dangers to human health require that the quality management of horticultural products is not only based on visual appearance but also must be safe for consumers. One form of policy to manage the quality of agricultural products is the regulation of legal food security through the determination of the level or maximum limit of pesticide residues on agricultural products. Residues of a number of chemicals that are left through various cycles, field or indirect, can reach humans, inhaled through breathing, and enter the digestive tract with food and drinking water [7]

From the aspect of quality, food safety and its influence on consumer health are increasingly important as competitiveness, especially for export orientation. In the development of standards carried out by the Codex Alimentaries Commission, quality standards that meet consumer health are the main consideration compared to measures for trade justice [8].

According to [9] after applied pesticides if it can survive in the target field or in the environment in a relatively long period of time it is said to be persistent. Based on persistence, pesticides can be grouped into two groups, namely the

persistent and the less persistent. Very persistent pesticides can leave very long residues and can accumulate in tissues through the food chain for example organochlorines, such as dichloro diphenyl trichloroethane (DDT), cyclodien, hexachlorocyclohexane (HCH) and endrin. Pesticides that are classified as less persistent are effective against various types of target pests but in rapidly degraded soils include organophosphate groups, for example disulfoton, parathion, diazinon, azodrine, 2 gophacide, and others,

Pesticides are one of the sources of pollutants in agriculture. If it is really needed, the application must meet the principles on target, the right dosage, the right way of application, the right time and the right tools need to be applied to minimize environmental damage, especially soil. Based on pest endemic areas, the residual content of pesticides in horticultural plants in West Java is higher than in the central and southern parts. The frequency of application of pesticides in the northern part of West Java is two to three times more than in the central and southern parts [9].

Sampling survey is done by systematic sampling method [10] is a sampling technique that is carried out systematically based on the sequence of members of the population that has been numbered. The aim is to evaluate, understand more deeply, and reveal various problems that occur in pesticide treatment activities in relation to the residual content found in horticultural plants in Indonesia, especially in West Java.

Designing a sampling study based on altitude, is divided into four plots, the first plot is located higher than 1,500 asl, while the second plot is below the first plot with a height of 1 meter, third plot under the second plot with a height of 1 meter from the second plot, while the fourth plot is below after the third plot with a height of 1 meter. Design a sampling study when viewed from the side listed in Figure 2.1.

TABLE 1. RESEARCH ASPECTS WITH INDICATORS, PARAMETER, TYPES AND SOURCES

No	Aspects	Indicator	Parameter	Type
1.	Accumulation of pesticides in plants	Broccoli vegetable	Organophosphate	Kuantitatif
2.	Pesticide residue impacts	Health problems or poisoning	Nausea, vomiting, dizziness, skin itching, respiratory infections, cancer and death	Kuantitatif
3.	Assume health risk intake per day	-	-	Kuantitatif

The steps in data collection are: establishing research boundaries, gathering information through interviews, observations, documents and visual materials, and establishing rules for recording information [12]. The steps for collecting data in this study are as follows: Limitation of research. This research is limited to knowing what obstacles are obstacles to information retrieval in pesticide residue activities in horticultural crops and their impact on horticultural crop farming. To obtain data on this matter, the techniques carried out were conducting structured and semi-structured interviews and literature studies. Interviews, conducted to obtain primary data needed in the study. The

techniques used are structured interviews and semi-structured interviews. Structured interviews were conducted with respondents by distributing questionnaires to respondents who had been chosen by simple random sampling. Whereas semi-structured interviews are collecting data and information by submitting a number of questions verbally and freely and directed using interview guidelines aimed at key information from the local government and the local community, observations were made to collect an overview of the biophysical conditions of the location of the study and validate the information obtained from interviews, as well as to obtain social insights, collection of secondary data (Visual Data Documents),

The method is used for the determination of aldrin pesticide residues, cis and trans isomers, DDT complex, dikofol, dieldrin, endosulfan alpha and beta, endosulfan sulfate, endrin hexachloro hexane, heptachlor, heptachlor epoxid, lindan, mireks, oxycordan, p 'p' - TDE , bromopropylate, chlorotalonyl, dicloflumide, dichloram, mitoxyclor, pentachloroanillin (PCA), pentachlorotioanisol, propachlor, kuintozen, teknazen, vinclozolin in fruits, vegetables and potatoes.

Analysis of the content of active ingredients of pesticides using chemicals such as acetone, florisol, sodium sulfate anhydrous and n-hexane was carried out by the Liquid Gas Chromatography (KGC) method.

The materials used are chopped, Ultra turk (Blender), Rotavapor, chromatograph column 250 mm x 6 mm equipped with telephone faucets and solvent reserves, cotton or glass wool that have been cleaned with a mixture of protoloeum ether and acetone (4: 1, v / v) for 8 hours in sockets, gas chromatographs, which are equipped with electron capture detectors, centrifuges.

II. ANALYSIS METHOD

Calculation of pesticide residue content according to the Testing Guidelines

$$\text{Pesticide residue concentration} = \frac{\text{"Sample Area"} \cdot \text{Standard concentration}}{\text{"Standard Area"} \cdot \text{Bobot sampel}}$$

$$= \frac{1 \cdot 5000 \cdot 3,48}{1 \cdot 1000}$$

Pesticide residue concentration :  
Standard = 19,5  
Standard concentration = 2.3276 ppm

Then after the residue is known, the maximum residual limit standard is adjusted, if the excess, then the pesticide treatment needs to be reviewe

Exposure Analysis

Analysis of exposure according to [13] or exposure assessment, also called contact assessment, aims to identify risk agent exposure pathways so that the amount of intake received by individuals in risky populations can be calculated. the risk agent can be in soil, air, water or food such

as fish, meat, eggs, milk, vegetables and fruits. Data and information needed to calculate intake are all variables in the equation [13]:

$$I = \frac{C \cdot R \cdot tE \cdot fE \cdot Dt}{Wb \cdot t \text{ avg}}$$

Information : I = intake, (mg / kg / day), C = risk agent concentration, ( mg / M3 for air medium, mg / L for drinking water, mg / kg for food or food), R = rate of intake or consumption, (M3 / hour for inhalation, L / day for drinking water, g / day for food), tE = Time of exposure, (hours / day), fE = exposure frequency, (day / year), Dt = duration of exposure, year (real time6 or projection, 30 years for default value residential), Wb = weight, (kg), tavg = average time period (Dt × 365 days / year for non-carcinogenic substances, (70 ears × 365 days / year for carcinogens).

### III. RESEARCH METHODS

Based on the results of pesticide residue analysis using gas chromatography, to achieve the research objectives and based on the framework that has been built in this study, researchers using the survey method approach is quantitative. Sampling survey is done by systematic sampling method [11] is a sampling technique that is systematically based on the sequence of members of the population The purpose is to evaluate, understand more deeply, and uncover various problems that occur in pesticide treatment activities in relation to the residual content found in horticulture plants in Indonesia, especially in Bandung.

### IV. RESULTS AND DISCUSSION

#### A. Types of Pesticide Concentrates in Horticultural Plants

The results obtained in the form of a chromatogram contained in the appendix. From the results of the chromatogram the results are as follows:

TABLE II. CHROMATOGRAM RESULT OS PESTICIDE RESIDUES

Index	Name	Time	Quantity	Height	Area	Area %
1	Klorfiripos	9.37	0.00	642.1	15.9	100.000
2	Klorfiripos	9.32	0.00	732.3	17.9	100.000
3	Klorfiripos	9.37	0.00	1222.1	26.4	100.000
4	Klorfiripos	9.32	0.00	1143.1	23.2	100.000

From the results of calculations with index 1, the results of pesticide residues are 2.20 ppm. This shows that the pesticide residue is 10% higher than the government minimum residual limit of 2.00 ppm.

Similarly, the results of calculations on samples with index 2 obtained pesticide residues of 2.47 ppm. This shows that this sample has 20% higher pesticide residue than the minimum residual limit set by the government of 2.00 ppm.

The results of calculations on samples with index 3 obtained higher pesticide residues of 3.65 ppm. This shows that this sample has 82% higher pesticide residue than the minimum residual limit set by the government of 2.00 ppm.

The results of calculations on samples with index 4 obtained high pesticide residues of 3.21 ppm. This shows that this sample has a pesticide residue that is 60% higher than the residual minimum limit set by the government at 2.00 ppm.

This is due to excessive use of pesticides, not in accordance with applicable regulations. Many farmers assume that using pesticides excessively can accelerate

maximum yields that are free of pests and diseases, besides behind that there are threats to human health, both in terms of farmers who care and consumers. Farmers rarely use protective equipment in the form of masks when spraying on the grounds that they are used to it. Generally farmers use insecticides in the mixing tank until they are used up because they have previously estimated the volume needed for the plant area that they have in one spray. But there are those who throw the rest in the river. After spraying, most farmers clean the spraying equipment in the irrigation canal, in the river and in other parts of the area. This reflects that farmers' understanding of the dangers of insecticides is still limited. The farmers are not aware of the dangers of insecticides because of their incorrect use. There are four types of handling insecticides which are at risk of endangering users, according to [14] : carrying, storing and removing insecticide concentrates (pesticide products that have not been diluted).

#### B. Impact of Pesticides for Communities

TABLE III. QUESTIONNAIRE RESULTS TYPE OF DISRUPTION AND HEALTH IMPACT OF FARMERS

No.	Type of disorder	Impact of Pesticides	Percentage
1.	Nausea	25 orang	25 %
2.	Gag	5 orang	5 %
3.	Dizzy	75 orang	75 %
4.	Itching on the skin	20 orang	20 %
5.	Respiratory tract infections	-	0 %
6.	Cancer	-	0 %
7.	Dead	-	0 %

From the table, we can see the impact of pesticides on farmers. Which causes health problems in the form of nausea, vomiting, dizziness, skin itching. Of the 100 people sampled, most of them 75% experienced health problems in the form of nausea, vomiting, dizziness, itching of the skin and yet no one experienced health problems in the form of respiratory infections, cancer and death. The variability in the percentage of symptoms of health problems in the form of nausea, vomiting, dizziness, skin itching shown in the table is possible because the immune systems of the farmers vary so that the residual pesticide reactions vary.

In addition, secondary pest explosions occur because the development of pests becomes more resistant to insecticides, especially with the emergence of problems of pest resistance, the effectiveness of insecticides decreases, to maintain the killing power of the dose is increased or replaced with other formulations that may be more expensive, thus increasing expenditure for the purchase of pesticides (insecticides) which means a decrease in input efficiency. Economically it will be more burdensome for farmers. This approach causes input to insecticides to be expensive, also for governments that have to spend a lot of foreign exchange to subsidize the purchase of pesticides. Not including the price of the environment and human health of the perpetrators who were negatively affected by pesticides.

The number of people suffering from acute pesticide poisoning is quite a small amount to detect, either in the form of poisoning that requires medical emergency measures or only an allergic reaction that requires immediate action. Several types of diseases that have been studied that can be caused by side effects of the use of pesticide compounds include leukemia, multiple myelomas, lymphomas, soft

tissue sarcomas, prostate cancer, skin cancer, skin cancer, melanoma, brain disease, liver disease, lung cancer, nerve cancer and ovarian neoplasms. Apart from that, several pesticide compounds have been shown to be able to factor carcinogenic agents in both animals and humans. [15]

Symptoms of poisoning in the organophosphate group are: the emergence of movements of certain muscles, blurred vision, watery eyes, foaming mouth, sweating a lot, saliva only comes out, nausea, dizziness, convulsions, vomiting, rapid heartbeat, vomiting, diarrhea, shortness of breath, muscles cannot be moved and eventually faint. [16]

From the results of a simple statistical analysis of 100 farmers, it was found that the average risk intake for farmers was 1.505 gr / day with the highest value of 4,014 gr / day and the lowest risk intake was 423 gr / day. From the results of these calculations, it can be seen that the amount of vegetable and horticulture consumption by farmers as much as 1.505 gr / day contains health risks in the form of accumulating pesticide residues that can be harmful to health. This causes the consumption of vegetables and horticulture to be limited, even though the content of vitamins and minerals in vegetables and horticulture is very necessary for the body's metabolism.

If the assumption is that the average risk to farmers is more than 1,505 gr / day, it will be at risk of being contaminated by toxic substances in the human body. If the toxic substance is collected in the human body until a few years later it will cause cancer which will result in death, but if it is less than 1.505 gr / day, it does not cause significant toxic symptoms. In fact, it turns out that people only consume vegetables ¼ kg and that means it does not cause cancer. Assuming an average risk to farmers of more than 1,505 gr / day or 1.5 kg / day, does not occur in the field.

## V. CONCLUSION

From the results of the study, we can conclude a number of conclusions: based on the results of the analysis of pesticide residues, residual results were obtained: spl 555290713 = 2.20 ppm (10% greater than BMR), spl 556290713 = 2.47 ppm (20% greater than BMR), spl 557290713 = 3.65 ppm (greater 82 % of BMR), spl 558290713 = 3.21 ppm (60% greater than BMR). This shows that the four samples tested contained dangerous residues exceeding the BMR limit (maximum residual limit) of 2 ppm. The results of questionnaires about the impact of pesticides on the health of 100 samples of farmers were obtained, namely: 25% nausea, 5% vomiting, 75% dizziness, skin itching 20%. But no one has health problems in the form of respiratory infections, cancer and death.

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