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# Study on Relationship Between Cucumber Germplasm and Propamocarb Residue Using Subjective Rating Technique

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**Abstract:** Propamocarb (PM) residue in cucumber (*Cucumis sativus* L.) receives little attention. As is well known to all, high PM residue of cucumber could lead to increase in the violation rates of maximum residue limits and ultimately cause harm to human health. Knowledge of PM residue could help cucumber breeders in developing cultivars with low PM residue and improving cucumber quality. In this study, 32 representative cucumber accessions (26 breeding lines and six cultivars) from different regions of China were evaluated for their PM residue in fruit and leaf to provide meaning to the subjective rating, which was highly correlated with PM residual content of fruit ($r$=0.97) and leaf ($r$=0.94). In addition, PM residual content of North China ecotype was the highest and Pickling ecotype was the lowest in fruit and leaf of cucumber. The leaf had significantly higher ($P$<0.01) PM residual content than the fruit, and poor correlation between leaf and fruit was represented. This study verified PM residual relationship between fruit and leaf, and laid the foundation for further identification of germplasm resources and breeding of new varieties for low PM residue of cucumber.

**Key words:** cucumber, ecotype, gas chromatography, germplasm, propamocarb residue

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## Introduction

Cucumber (*Cucumis sativus* L.) is thought to originate from India or China (Harlan, 1975). Statistically, China is the world's largest cucumber producer, with 1.5 million $hm^2$ of harvested area and 25 million metric tons in 2004 (FAO, 2005). Cucumber is one of the most important species that people like eating fresh. However, its growth process is often affected by many diseases and then demands a mass of pesticides. Cucumber is one of the main vegetable varieties with increases in the violation rates of maximum residue limits (MRLs) at present. Pesticide residue has been one of the most important problems in the quality of cucumber fruits (Adachi and Okano, 2006). In recent years, cucumber downy mildew is the important disease in cucumber. Propamocarb (PM) has been a kind of pesticide that mainly controls downy mildew of cucumber in China. Then, the residue of PM in cucumber is a consequent problem. Propamocarb has a human toxicity, with ADI of 0.4 $mg \cdot kg^{-1}$ bw/day and ARfD of 2 $mg \cdot kg^{-1}$ bw set by the Codex Alimentarius.

Gas chromatography (GC) is a major scientific and technological achievement from the 1950s, and has been widely used in the qualitative and quantitative

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analyses of mixtures. The analyses of pesticides are normally carried out by means of GC column in combination with a group-selective or element-selective detector, such as an electron capture or nitrogen phosphorous system (Mondello, 2007). FID detector was used in this study to detect PM residue in fruits and leaves of cucumber, and could meet the requirement of quantitative detection of PM residue. Specific germplasm collections are valuable to plant breeders as a source of new genes or desired traits to improve cultivated crops (Wada and Read., 2011). The study of Sarangthem *et al*. (2013) assessed and prioritized the wild Hedychium resources of Manipur, thus established a desirable potential germplasm for breeding and further biotechnological interventions. Santalla *et al*. (2004) reported the evaluation of runner bean cultivars from Spain for morphological, agronomical and seed quality traits in different environments. They found some valuable germplasms that could be used either in production or breeding, including interspecific hybridization with common bean. In our research, the identification of potential germplasms with low PM residue after PM treatment might be of considerable value in the resistant improvement of cucumber cultivars. To date, no studies had been undertaken to screen the cucumber germplasm resources of low and high PM residue. Therefore, the present study was undertaken to screen the cucumber germplasm resources of low and high PM residue using a subjective rating technique.

In addition, PM residual content between leaves and fruits was compared, and the residual correlation was verified. Ultimately, the accessions with low or high PM residue of cucumber were used in further identification of germplasm resources and breeding of new varieties for improving the cucumber germplasm quality. The objectives of this research were: (i) to identify potential cucumber germplasm with low PM residue after PM treatment and (ii) to verify correlation between fruits and leaves for PM residue in cucumber.

## Materials and Methods

### Plant materials and growing conditions

A total of 32 cucumber accessions from China, which were comprised of North China ecotype (NC), South China ecotype (SC), European greenhouse ecotype (EG) and Pickling ecotype (PE), were used to determine PM residual content in fruits and leaves. These genetic materials were maintained in the germplasm collection at the Cucumber Research Group of Northeast Agricultural University, Harbin, China. The seeds used in the experiment were obtained from plants grown in the same environment in 2010. Seeds of 32 cucumber accessions were sown on 18; March 2011, with the seedlings grown in a mixture of 1 peat: 1 vermiculite (v/v) on the research greenhouse. At the three-leaf stage, seedling plants were transplanted gently into a growth chamber containing the same water and fertility conditions, which grew under controlled environmental conditions. Plants were trained on a trellis of 1.8 m high, and the branches were pruned. Greenhouse temperatures averaged 30℃ (days) and 22℃ (nights).

Experiments were carried out with all the fruits and their corresponding leaves of the mixed sample of each cucumber accession plant, and samples were collected on 55 day after colonization (DAC). At the same time, samples were weighed, immediately frozen in liquid nitrogen, and then were stored at –80℃ until required for determination of PM residue.

### Experimental design

The experiment was conducted in a randomized complete block design and three replications was used, with 1-plant plots. A total of 32 cucumber accessions plants were sprayed by 400 times PM solution, which was higher than the recommended dose (800 times) in order to analyze it better. PM solution was sprayed firstly at 34 DAC (first harvest period), and then sprayed once every 5 days, with 3 times continuously. The root fruits and connected leaves of 32 cucumber