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Commentary Open Access

Limitations of the Pesticide Management Regulation in Korea

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Commentary

Overall amount of the Organization for Economic Co-operation and Development (OECD) pesticide sales were reported as 826,688 tons of active ingredients over the period 2000-2010 [1]. In particular, nearly all EU transition countries such as Estonia, the Czech and Slovak Republics and Hungary, showed a strong growth in pesticide purchases over the 2000s, compared to the 1990s. In terms of average pesticide use per unit arable and permanent crop area, Korea ranked as the second largest user of pesticides (12.5 kg/ha) among OECD countries in 2003 [2]. So, in the aspect of safety and health, pesticide is one of the most important chemicals that should be carefully controlled in Korea. For use of pesticide, the main challenge is to reduce the risks to human health and ecosystems, while increasing the level of crop productivity. Since 1985, the Food and Agriculture Organization of the United Nations (FAO) and World Health Organization (WHO) have published the guidelines regarding pesticide management to provide guidance to governments that seek to review, update or design national pesticide legislation [3]. According to this guideline, almost every country has some type of legislation covering pesticides, but many of existing laws have weaknesses. For example, they may not sufficiently reflect the requirements of international agreements or regional initiatives to harmonize requirements, or they may not be adequately connected to new national legislation on environmental protection, chemicals management, or other relevant areas. In this article, limitations of the current pesticide management regulation to protect the health of users from pesticides were discussed based on the previous pesticide studies in Korea.

From 1957 to 1996, pesticide manufacturers or importers should get permit from the Ministry of Food, Agriculture, Forestry and Fisheries in South Korea. Since 1997, all pesticides manufactured, imported and consumed are supposed to be registered to the authority of the Korea Rural Development Administration (KRDA) by the Pesticide Control Act (PCA) in Korea [4]. In article 23 of PCA, there are two kinds of criteria for safe use of pesticides followed as:

"*Each pest controller or user of pesticides, etc. shall use pesticides, according to the Guidelines for the Safe Use of Pesticides (GSUP), and each manufacturer, importer, dealer or pest controller shall handle pesticides, etc. in accordance with the Standards for Restrictions on the Handling of Pesticides (SRHP).*"

In GSUP, the application time and the maximum allowable frequency of application to the food crops were specified by the registered pesticides. For example, the pesticide containing an active ingredient of Kasugamycin (CAS Number 6980-18-3) can be applied to a white cabbage up to four times before harvesting. This regulation was set on the basis of the pesticide Maximum Residue Limits (MRL) for agricultural commodities. A pesticide MRL called "tolerances" in the United States means the highest level of a pesticide residue that is legally tolerated in or on food or feed when pesticides are applied correctly. Some countries including Korea use the International MRL - Codex Alimentarius to define the residue limits which was established by FAO and WHO in 1963 to develop international food standards, guidelines codes of practices, and recommendation for food safety [5]. For establishing MRL, the cumulative effects of general population from non-occupational exposure to pesticide were considered. Therefore non-edible crops such as flowers were not included in the list of MRL and GSUP. Choi evaluated the exposure level of dichlorovos for farmers to spray with fogger in the green house for chrysanthemum planting [6]. Although this case was the worst scenario monitored in hot summer, the personal exposure level of 142.9 $\mu g/m^3$ exceeded the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV) of dichlorovos, 100 $\mu g/m^3$ [7]. For non-edible crops such as flowers, farmers have a tendency to overuse of insecticides for the merchantability.

The SRHP focused on the hazard communication of pesticide toxicity for manufacturer, importer, dealer and user of pesticide. According to the SRHP, pesticides used in Korea were grouped by four classes of hazard (I; extremely hazardous, II; highly hazardous, III; moderately hazardous, and IV; slightly hazardous) for human and fish toxicity based on acute oral and dermal toxicity to the rat. Employers in chemical manufacturing or importing business should provide the material safety data sheets (MSDS) of the relevant chemical to employees under the Industrial Safety and Health Act. However, pesticides have not been included in the MSDS program as it has been regulated by other registration since 1995. Therefore, there is no regulation of hazard communication considering the potential carcinogenic effects of pesticide used in Korea.

Choi investigated the potential carcinogenic pesticides used in Korea by comparison with the list of Chemicals Evaluated for Carcinogenic Potential (CECP) developed by the Health Effects Division (HED) of the Office of Pesticide Program (OPP) in the US Environmental Protection Agency (EPA) [8]. A total of 1,283 agrochemical items listed on the RHCP in 2009 were entered into the basic database. After excluding items that did not used from 2004 to 2008 by comparison with Agrochemicals Year Book published by Korea Crop Protection Agency in 2009 [9], 987 items were left. For these 987 items, 360 active ingredients with CAS number were finally selected for evaluation of carcinogenicity using the list of CECP established by the HED of the OPP in the US EPA. Among 360 ingredients, 25 ingredients (6.9%) were classified as likely to be carcinogenic (probable) to humans and 52 (14.4%) had suggestive evidence of carcinogenic potential (possible) based on the US EPA classification. In terms of items, 31.1% of 987 items contained one or more of the active ingredients classified as the presumed to have carcinogenic potential for humans or suspected human carcinogens

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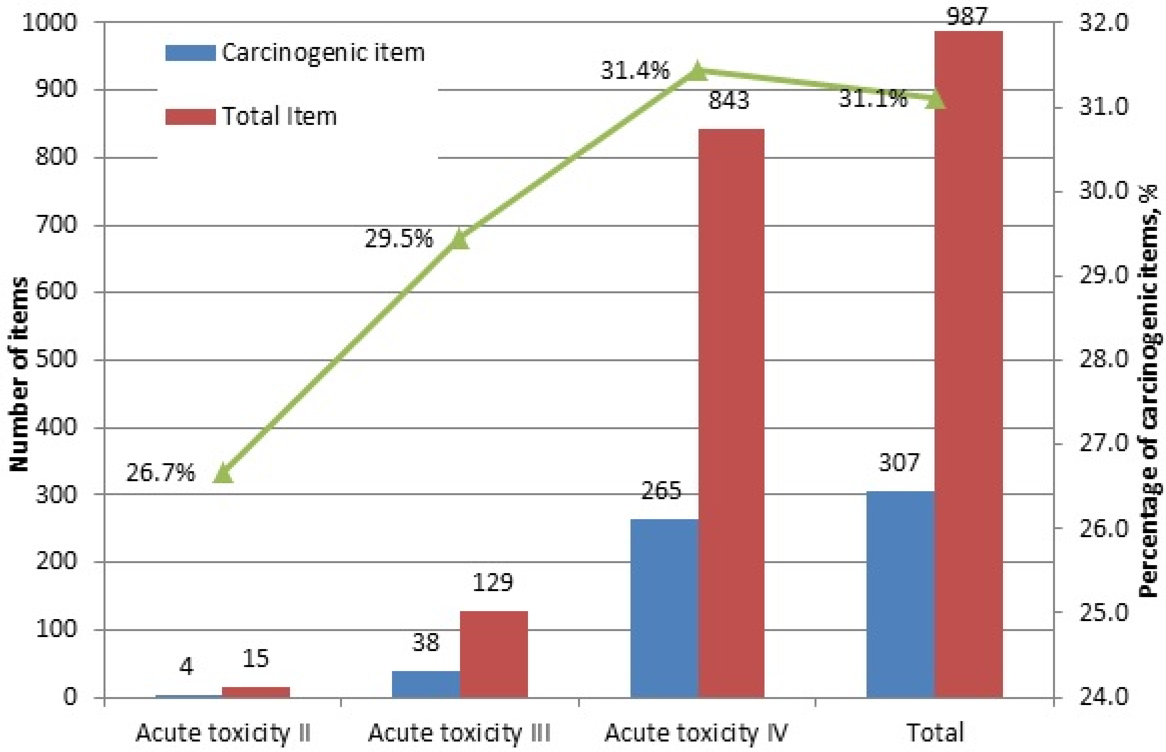
(Figure 1). Figure 1 also showed the results of comparison between acute toxicity and carcinogenicity for pesticide items used in Korea. Interestingly, pesticides with lower acute toxicity were found to have higher carcinogenic potential. Among 843 (IV; slightly hazardous), 129 (III; moderately hazardous) and 15 (II; highly hazardous) items, 31.4%, 29.5% and 26.7% of them showed the potential carcinogenicity, respectively.



	Acute toxicity II	Acute toxicity III	Acute toxicity IV	Total
Carcinogenic item	4	38	265	307
Total Item	15	129	843	987
Carcinogenic item, %	26.7	29.5	31.4	31.1

Figure 1: Comparison of carcinogenic items by acute toxicity.

There have been a lot of studies to evaluate the association between occupational exposure to pesticide and cancer risk. More recent systematic review studies or case-control studies reported positive association between exposure to pesticides and several cancers including prostate cancer [10-12], non-Hodgkin lymphoma (NHL) [13-16], leukemia [13,17], multiple myeloma [13] and lung cancer [18,19]. Alavanja et al. integrated the epidemiological, molecular biology, and toxicological evidence emerging from recent literature assessing the link between specific pesticides and several cancers including prostate cancer, non-Hodgkin lymphoma (NHL), leukemia, multiple myeloma, and breast cancer [20]. They emphasized that, although the review was not exhaustive in its scope or depth, the literature does strongly suggest that the public health problem related to cancer burden among pesticide applicators and others due to pesticide exposure is real.

FAO and WHO recommended that governments must establish and implement policies and programs aimed at risk reduction which should involve the following steps: (1) reducing reliance on chemical pesticides and eliminating overuse; (2) encouraging the use of less hazardous and more selective products; and (3) ensuring proper use [3]. To effectively conduct those three steps, the current GSUP should be amended by considering not only non-occupational exposure but also occupational exposure to pesticide. For SRHP, it is necessary to complement a hazard communication system, which is to provide the information of long-term toxicity such as carcinogenicity, in addition to acute toxicity data on the pesticide.

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