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Pesticide quality prevailed during the last five years in Southern Punjab, Pakistan

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Abstract

The use of good quality pesticides is very crucial in agricultural production as the harms of pesticides to environment, soil, water and non-target species are well known. Use of poor quality pesticides magnifies the issues. Current survey was conducted to check and compared the quality of pesticides available in the market supplied by generic and multinational companies. Data was collected from the Pesticide Quality Control Laboratory Multan. For physical and chemical analysis gas chromatography (GC), high-performance liquid chromatography (HPLC), chemical digestion, Spectrophotometry and titration described by Collaborative International Pesticides Analytical Council. Results confirmed that 96.21% (10353) of total 10766 samples met the quality standards and about 3.77% (411) samples were declared unfit for applications to field crops. As compared to unfit samples of 2015-16, 1.59% increase was observed in the unfit samples of pesticides in 2017-18. Vehari was at the top of the list where an unfit sample was maximum in 2017-18. However, highest number was fit samples were noted in 2017-18 in Layyah. The comparison of branded and generic unfit pesticide samples revealed that branded unfit samples were 6 to 7 times less than generic unfit samples. In conclusion the maintenance of good quality by multinational companies as compared to the generic units in South Punjab.

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Introduction

The use of pesticides to kill insect/pests and weeds is one of the important aspects of agricultural practice in both developed and developing countries. Pesticides belong to the only group of chemicals that are intentionally used with the purpose to control plant and animal pests and to save industrial and agricultural products. Non-selective and extreme use of toxic synthetic pesticides destroyed not only agriculture and environment but have also entered into the food chain thereby affecting all living beings (Sitaramaraju *et al.,* 2014).

Pesticides are very crucial in agricultural production. About one-third of the agricultural production solely dependent on the use of pesticides (Liu *et al.,* 2002). The losses in the production of cereals, fruits and vegetables would reach up to 32, 78 and 54% respectively without the application of pesticides (Cai, 2008). With pesticide application crop losses from pests reduced to 35 to 42%. (Pimentel, 1997; Liu and Liu, 1999). In Pakistan, the use of pesticides varies with crop type, with less usage of herbicides and fungicides. In Pakistan, 60% of pesticides are used mainly for cotton crops and the remaining 40% are used for all other crops (Akhtar *et. al.*, 2018). However, the hazards of pesticide applications to the environment are of grave concerns as well (Pimentel, 2009).

Most of the chemicals used in pesticides are persistent soil contaminants, who adversely affect soil conservation and persists in the soil for decades (Sitaramaraju *et al.,* 2014). Many studies also reported the occurrence of pesticides in the ground and surface water near to agriculture lands across the world (Cerejeira *et al.*, 2003; Konstantinou *et al.*, 2006; Gilliom, 2007; Woudneh *et al.*, 2009; Anasco *et al.*, 2010). According to the World Health Organization, about 220, 000 deaths and 3,000,000 cases of pesticide poisoning are reported each year in developing countries (Lah, 2011). About 2.2 million people, mainly belonging to developing countries are at increased risk of exposure to pesticides (Hicks, 2013).

Pesticides have drastic effects on non-target species and affect plant and animal biodiversity, terrestrial and aquatic ecosystems and food webs and ecosystems (Majewski and Capel, 1995). About 80–90 % of the applied pesticides can volatilize within a few days of application (Majewski and Capel, 1995). It is most common and occurs more frequently take place while using sprayers. The volatilized pesticides evaporate into the air and consequently cause damage to non-target species. For example, the application of herbicides, which volatilise off the treated plants and the vapours are adequate to cause severe harm to other plants (Straathoff, 1986).

The use of low-quality pesticides in developing countries is amplifying the seriousness of the problem. Low quality of pesticides could be owing to many reasons, for example, poor pre-marketing storage conditions, low standard production technology and poor production admixing of products. Insufficient implementation of rules by law enforcing authorities may also open doors for such mal-practices (Akhtar *et al.,* 2018).

According to a report of World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO, 2005) about 30% of pesticides marketing in developing countries amounting to worth US $ 900 million, every year do not fulfil international quality standards. WHO and FAO national quality control laboratories of pesticides also reported low-quality pesticides. To check and verify the quality of pesticides and to overcome the harmful effects of pesticides on the soil, water, environment and non-target species the Government of Pakistan have developed Agricultural Pesticide Ordinance (APO) 1971 and Agricultural Pesticide Rules 1973. Samples of pesticides (insecticides, herbicides, fungicides etc.) registered under APO, 1971 were received from the Govt. nominated pesticide inspectors. The present study was conducted by Pesticide Quality Control Laboratory, Multan to check the registered specifications of these pesticide samples following Standard Test Methods (STM).

Materials and methods

Pesticide samples were collected by Government authorised inspectors from Multan and Dera Ghazi Khan Divisions. Total 10766 pesticides samples were received for quality evaluation from 2013-14 to 2017-18. The samples were stored at ambient temperature and humidity. For physical and chemical analysis gas chromatography (GC), high-performance liquid chromatography (HPLC), chemical digestion, Spectrophotometry and titration described by Collaborative International Pesticides Analytical Council (AOAC, 1990; EPA, 1987; Ashworth *et al*., 1970) were used.

Active ingredient (AI) in the pesticide formulation was calculated as follows:

AI (%) = (wight of standard/weight of sample) × (peak area of sample/peak area of standard) × Purity of standard.

Physical properties like wet sieve test for wettable powders (WP), dry sieve test for dustable powders (DP), granular formulations (GR) and emulsions and oil in water were used for emulsion stability test for emulsifiable concentrates (EC). (Ashworth *et al*., 1970). To ensure that a sufficient amount of active ingredients homogeneously dispersed in emulsion and give a satisfactory and effective mixture during spraying emulsion stability test was performed (Table 1). Pesticide sample fitness on active ingredient content was estimated as per tolerance values and appropriate contents as described by FAO (1999).

Results and discussion

Results revealed that during the 2013-14 96.6% pesticide samples were found fit and 3.34 % samples were declared unfit for crop use. Similarly, in 2014-15 96.02 % samples meet the quality standards and 3.98 % were declared unfit. There is a reduction in the number of pesticide samples received in 2013-14 and 2014-15 compared to 2011-12 from 2174 to 1534 and 1585. The reduction in pesticide usage can be due to the use of integrated pest management (IPM) practices by the farmers for cotton crop (Khan *et al*., 2010) or maybe due to cultivation of *Bacillus thuringiensis* Bt cotton.

Table 1. Emulsion stability limits.

Time after dilution (Hours)	Limits of stability	Value
0	Initial emulsification	Complete
0.5	Cream maximum	2%
2.0	Cream maximum	4%
Free oil	Nil	-
24	Re-emulsification	Nil
24.5	Cream maximum	Nil

The test was carried out in a case when results at 2h were doubtful.

During the year 2016-17 there is a little improvement in the percentage of fit samples and 97.1% pesticide samples were fit and 2.87% were unfit (Table 2). The increased number of fit pesticide samples may be due to improved pesticide quality in Dera Ghazi Khan and Multan Divisions or I can be owing to biasedness of pesticide inspectors.

Table 2. Quality trend (fitness %) of pesticide samples in Southern Punjab over 2013-2018.

Year	Total number of samples	Fit samples	Unfit samples	Fit (%)	Unfit (%)
2013-14	1534	1483	51	96.66	3.34
2014-15	1585	1522	62	96.02	3.98
2015-16	2265	2200	65	97.13	2.87
2016-17	2692	2578	114	95.77	4.23
2017-18	2690	2570	119	95.54	4.46
Total	10766	10353	411	96.21	3.77

The results are not in accordance with the results of Kern and Vaagt (1996) who analysed pesticide samples from 21 developing countries from 1989-1994 and reported that 34% samples could not meet the international quality standards as per limits of FAO. In 2016-17 total 2578 samples were received for quality evaluation and about 95.8% were fit and 4.23% were unfit.

Table 3. South Punjab district wise pesticide samples fitness in (2013-2018).

Name of district	2013-14	2014-15	2015-16	2016-17	2017-18
Khanewal	96.74	95.94	95.89	95.45	96.15
Vehari	95.64	95.26	98.36	97.89	93.99
Multan	98.32	97.89	96.57	94.36	95.77
Muzaffargarh	96.98	94.15	96.62	96.12	95.05
Dera Ghazi Khan	97.42	97.12	96.53	96.12	95.74
Layyah	95.38	96.39	98.18	95.67	96.85
Rajanpur	95.91	95.64	97.98	94.78	95.45
Total	96.62	96.05	97.16	95.77	95.57

During the current facial year, i.e., 2017-18 95.5% pesticide samples were declared fit for applications on crops and 4.46% were declared unfit. Pesticide sample arrival was increased in the last two years and the number of unfit samples was also increased. The greater number of pesticide samples can be due to greater pesticide usage for controlling insect/pests. The increased number of unfit pesticides samples can be due to unbiased sampling of pesticide inspectors or can be due to an increase in number of poor quality of pesticides. The number of fit samples on the basis of pesticide analysis has been shown in Fig. 1.

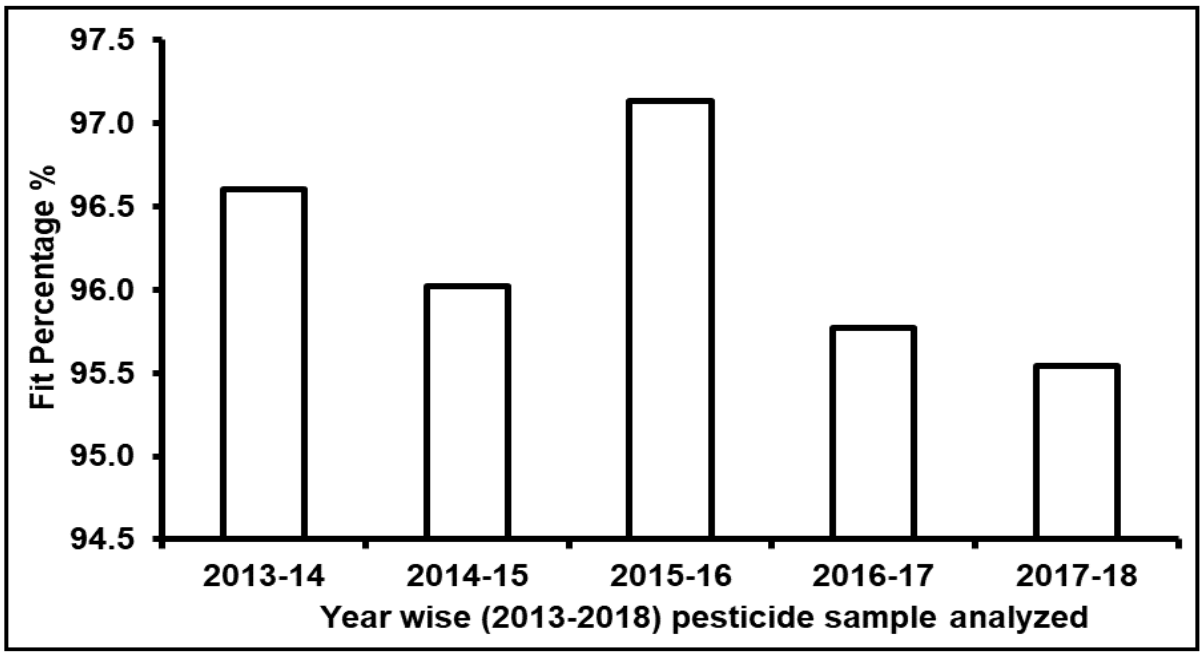

Fig. 1. Quality of pesticide samples analysed in Pesticide Quality Control Laboratory, Multan, Pakistan.

Furthermore, a significant improvement in the quality of pesticide samples was recorded in the samples collected from Multan, Dera Ghazi Khan and Layyah districts (Table 3). However, this improvement is not visible at the farmer level and in the market. A positive and significant improvement can be obtained by unbiased and intelligent representative sampling from the market by pesticide

inspectors through monitoring by Task Force on agriculture and amendment in APO Law, 1971 (DGA, 1997).

Evaluation of branded and generic unfit samples during the years 2013-14 to 2017-18 discloses that the number of branded unfit samples was 6 to 7 times less than generic unfit samples. It shows maintenance of good quality standards of pesticides by the multi-national companies (Fig. 2). However, the generic pesticide import can be done with less prices but at the cost of poor quality. During 1989-1994 pesticide samples from 21 developing countries were analysed for quality evaluation and 34 % were reported to be of low quality as per limits of FAO. (Kern and Vaagt, 1996).

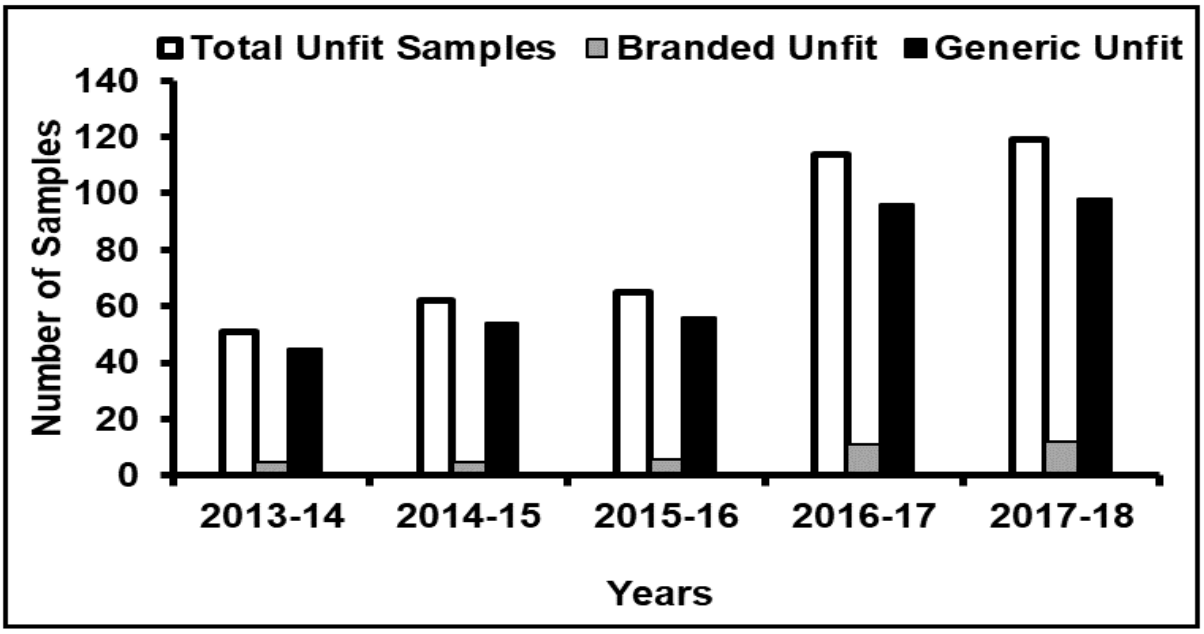

Fig. 2. Comparison of Branded and Generic Unfit Samples analysed in Pesticide Quality Control Laboratory, Multan, Pakistan (2013-2018).

These results are not in accordance with the results of the Pesticide Quality Control Laboratory (PQCL) in Multan (Table 2). These results could be due to biased sampling by the authorized pesticide inspectors or could be owing to the efficient working of the anti-adulteration campaign at divisional level. The need of the hour is to account the pesticide quality status of the country to have a complete and true picture of the pesticide quality control programme at the national level.

Conclusion

Almost 96.16 % of total pesticide samples were found fit for application to the crops. Generic pesticide samples were of poor quality as compared to branded pesticide samples with improved quality. It is recommended that pesticide inspectors should make unbiased and random sampling which would help to reveal the true picture of pesticide quality available in the market. It would also ensure the availability of good quality pesticides to the farmers.

References

Akhtar MN, Rahi AA, Mubeen K, Munir S, Sarwar N, Rafique HM, Akhtar MW. 2018. Impact of pesticide quality control programme in southern Punjab, Pakistan. Biological Sciences-PJSIR **61(1),** 52-55.

Anasco N, Uno S, Koyama J, Matsuoka T, Kuwahara N. 2010. Assessment of pesticide residues in freshwater areas affected by rice paddy effluents in Southern Japan. Environmental Monitoring and Assessment **160(1),** 371-383. http://dx.doi.org/10.1007/s10661-008-0701-z

AOAC. 1990. Official Methods of Analysis: Agricultural Chemicals. Contaminants, Drugs, K. Helrich (ed.),147-231, Association of Official Analytical Chemists, Arlington, Virginia, USA.

Ashworth Rde B, Henriet J, Lovett JF. 1970. CIPAC Handbook. Analysis of Technical and Formulated Pesticides. vol. 1, p. 875-893, Collaborative Inter-national Pesticides Analytical Council Limited. Plant Pathology Laboratory Hatching Green, Harpenden, Hertfordshire, England.

Cai DW. 2008. Understand the role of chemical pesticides and prevent misuses of pesticides. Bulletin of Agricultural Science and Technology **1,** 36-38.

Cerejeira MJ, Viana P, Batista S, Pereira T, Silva E, Valério MJ, Silva A, Ferreira M, Silva-Fernandes AM. 2003. Pesticides in Portuguese surface and ground waters. Water Research **37(5),** 1055-1063.
https://doi.org/10.1016/S0043-1354(01)00462-6

DGA. 1997. Agricultural Pesticides Ordinance 1971(amended up to 1997) and Rules. 1973. Directorate General Agriculture (Ext. and AR), Punjab, Lahore, Pakistan.

EPA. 1987. Manual of Chemical Methods for Pesticides and Devices. 1st edition, (4th update), Environmental Protection Agency, Publication, Association of Official Analytical Chemists, Arlington, VA, USA.

FAO. 1999. Manual on Development and Use of FAO and World Health Organization. Specifications for Plant Protection Products. pp. 17-19, 5th edition, Rome, Italy.

FAO. WHO. 2005. Amount of poor-quality pesticides sold in developing countries alarmingly high (Press release). Rome, Food and Agriculture Organization of the United Nations, and Geneva, World Health Organization. Retrieved October 25, 2016.
http://www.fao.org/WAICENT/OIS/PRESS_NE/PRESSENG/2001/preno105.htm

Gilliom RJ. 2007. Pesticides in U.S. Streams and Groundwater. Environmental Science & Technology **41(10),** 3408-3414.

Hicks B. 2013. Agricultural pesticides and human health. In: National Association of Geoscience, Accessed Jan 13, 2014.

Kern M, Vaagt G. 1996. Pesticide quality in developing countries. Pesticide Service Project, Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) GmbH, P.O. Box 5180, 65726 Eschborn, Germany.Pesticide Outlook Journal **7,** 7-10.

Khan MJ, Zia MS, Qasim M. 2010. Use of pesticides and their role in environmental pollution. World Academy of Science, Engineering and Technology **72,** 122-128.

Konstantinou IK, Hela DG, Albanis TA. 2006. The status of pesticide pollution in surface waters (rivers and lakes) of Greece. Part I. Review on occurrence and levels. Environmental Pollution **141(3),** 555-570.
https://doi.org/10.1016/j.envpol.2005.07.024

Lah K. 2011. Effects of pesticides on human health. In: Toxipedia. Accessed Jan 16.

Liu CJ, Men WJ, Liu YJ. 2002. The pollution of pesticides in soils and its bioremediation. System Sciemces and Comprehensive Studies in Agriculture **18(4),** 295-297.

Liu ZJ, Liu ZB. 1999. The Status of the world agrochemicals. Chemical Technology Market **22(12),** 14-17.

Majewski M, Capel P. 1995. Pesticides in the atmosphere: distribution, trends, and governing factors. Volume one, Pesticides in the Hydrologic

System. Ann Arbor Press Inc: 118.

Pimentel D. 1997. Techniques for Reducing Pesticide Use: Environmental and Economic Benefits. John Wiley and Sons, Chichester, USA.

Pimentel D. 2009. Environmental and economic costs of the application of pesticides primarily in the United States. In: Integrated Pest Management: Innovation-Development Process (Vol. 1) (P Rajinder and A Dhawan eds). Springer, 88-111.

Sitaramaraju S, Prasad NVVSD, Reddy CV, Narayana E. 2014. Impact of pesticides used for crop production on the environment. Journal of Chemical and Pharmaceutical sciences **3,** 75-79.

Straathoff H. 1986. Investigations on the phytotoxic relevance of volatilization of herbicides. Mededelingen **51(2A),** 433–438.

Woudneh MB, Ou Z, Sekela M, Tuominen T, Gledhill M. 2009. Pesticide Multi residues in Waters of the Lower Fraser Valley, British Columbia, Canada. Part I. Surface Water. Journal of Environmental Quality **38(3),** 940-947. https://doi.org/10.2134/jeq2007.052.