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Impact of Pesticide Quality Control Programme in Southern Punjab, Pakistan

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Abstract. This study was taken to evaluate pesticide quality and their impact on crop. Total 14336 number of pesticide samples were received for quality evaluation from 2006 to 2012. The data was analysed statistically at 5% level of significance and treatment means were worked out. The results revealed that out of 14336 analysed samples, 13541 (94.5%) were declared fit for crop use whereas the remaining 795 (5.5%) were found to be unfit. The trend in generic and branded unfit samples between the years 2006 to 2012 revealed that the agencies marketing branded pesticides had better quality than generic ones.

Keywords: Pakistan, pesticides, quality control

Introduction

There are serious ecological and environmental problems with over reliance on pesticides. Persistence of pesticides in the food chain (Carson *et al*., 1962) and the development of resistance in pests towards pesticides (Brown 1971) are the two serious problems encountered. Pesticide usage has become obligatory for crop protection. However, pest suppression with synthetic chemicals is the quickest and most effective method of pest management. Control through pesticides takes least time in situations of massive pest outbreak when compared with biological and cultural control practices.

The pesticide usage differs with crops in Pakistan, with reduced use of fungicides and herbicides. Pesticide is mainly used in Pakistan for cotton crops (60%) and 40% for all other crops. This has increased steadily and substantially over the years in Pakistan (Table 1 and Fig. 1).

Plant Protection Directorate and Pesticide Division was set up for sample testing and understanding research on quality control of pesticides during 1970 at Faisalabad, Pakistan and quality control programme of pesticides was initiated in Punjab, Pakistan. The private sector started this industry by promoting the sale of pesticide during 1980's. Hence, to strengthen the quality control of pesticides two more Pesticide Laboratories were established at Kala Shah Kaku and Multan during 1984-85.

World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO, 2005) reported that in developing countries about 30% marketing of pesticides amounting to worth US $ 900 million per year do not meet international quality standards. Pesticides with low quality have also been reported to WHO and FAO by national quality control laboratories of pesticides. Developed countries have also shown to have low quality pesticides magnifying the seriousness of the issue. Pesticides with low quality could be owing to many reasons like low standard production technology and poor production admixing of products and poor pre marketing store conditions. Inadequate implementation of rules by law enforcing authorities may also open windows for such mal-practices.

In developing countries like Pakistan, the authorized inspectors from Directorate of Pest Warning and Quality Control and Agriculture (extension and adaptive research) Department collect pesticides samples from market. Inspectors have the authority from the Government under APO Law, 1971 to collect the sample on intelligence basis or complaint basis by the farmer

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(DGA, 1997). The collected samples are then sent to Pesticide Quality Control Laboratories for testing. The monitoring programme keeps on assessing the status of sub-standard pesticide samples issued by Pesticide Quality Control laboratory. Afterwards the culprits are dealt as per the law.

Farmers and law enforcing agencies over the past few years, have given serious consideration to this programme. But such information which may provide the guidelines to the stakeholders and general performance or status of pesticide quality control programme over the years is scarce. To address this need data obtained over years has been analysed, presented and discussed here.

Materials and Methods

To check the quality of pesticides in Multan, Dera Ghazi Khan and Bahawalpur Divisions, the Pesticide Quality Control Laboratory (PQCL) Multan, Pakistan was established in 1985. Authorized inspectors collect pesticide samples with different formulations and send to the laboratory. The samples are stored after marking codes. Spectrophotometry, high performance liquid chromatography (HPLC), gas chromatography (GC) and chemical digestion and titration described by Collaborative International Pesticides Analytical Council (AOAC, 1990; EPA, 1987; Ashworth *et al*., 1970) were used for physical and chemical analysis.

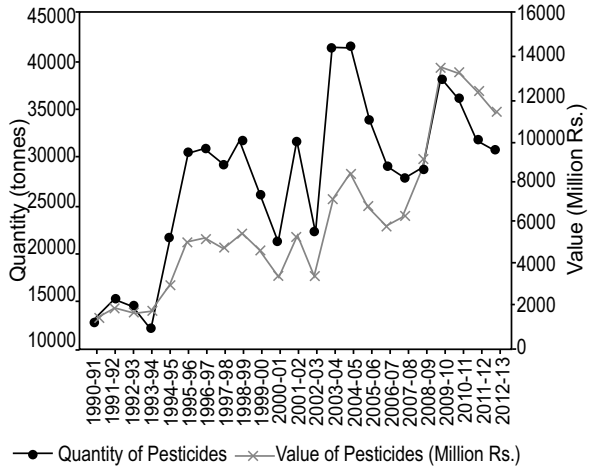

Fig. 1. Import of pesticides (quantity and value) in Pakistan.

Table 1. Crop wise consumption of pesticides over time (million tonnes)

Year	Cotton	Sugarcane	Rice	Maize	Wheat
2006-07	12856	54742	5438	3088	23295
2007-08	11655	63920	5563	3313	21749
2008-09	11819	50045	6952	3593	240333
2009-10	12698	49373	6883	3487	23864
2010-11	11460	55309	4823	3341	24214
2011-12	13595	58038	6160	4271	23517

Active ingredient (a. i.) in the pesticide formulation was calculated as follows:

a. i. (%) = (peak area of sample/peak area of standard) × a.i. content claimed in pesticide formulation

Physical properties like dry sieve test for dustable powders (DP), wet sieve test for wetable powders (WP), granular formulations (GR) and emulsions and oil in water were used for emulsion stability test for emulsifiable concentrates (EC) (Ashworth *et al*., 1970) (Table 2). Emulsion stability test was performed to ensure that a sufficient amount of active ingredients homogeneously dispersed in emulsion to give a satisfactory and effective mixture during spraying.

Pesticide sample fitness on a.i. content was estimated as per tolerance values and appropriate contents as described by FAO (1999). The pesticide inspectors were provided with analytical reports of unfit samples for taking legal action under APO Law, 1971.

The recorded data was analysed statistically by using Fisher's analysis of variance technique and significance of treatment means was compared by least significant difference test at 5% probability level (Steel *et al*., 1997).

Results and Discussion

Standard methods were used to analyse collected pesticide samples by the authorized persons. The samples

Table 2. Emulsion stability limits

Time after dilution	Limits of stability	
0 h (hour)	Initial emulsification	complete
0.5 h	Cream maximum	2%
2.0 h	Cream maximum	4%
	Free oil	nil
24.0 h	Re-emulsification	complete
24.5 h	Cream maximum	nil
Test after 24 h was carried out in case when results at 2 h were in doubt	Free oil	nil

of pesticide received in the PQCL, Multan for analysis improved a lot during 1996-97 to 2004-2005 from 1730 to 3323.

Adoption of integrated pest management (IPM) practices due to Farmer Field Schools reduced number of pesticide samples significantly (Khan *et al*., 2010) and cultivation of *Bacillus thuringiensis* Bt cotton. Furthermore, it resulted in pesticide quality improvement in Dera Ghazi Khan and Multan Division. The number of fit samples on the basis of pesticide analysis has been shown in Fig. 2.

The pesticide import in Pakistan since 1990-1991 to 2012-2013 (Fig. 1) reveals increased import in 2004-2005 by 219% as compared with 1991-92. There is significant reduction in pesticide use afterwards. During each passing year, a reduction in number of unfit samples was recorded i.e. from 247 during 1996-97 to 57 during 2011-12, showing an improvement in quality of pesticide (Fig. 2 and Table 3). However, this improvement is not reflected at farmer level and in the market. A significant and positive change can be achieved by an intelligent market representative sampling by the inspectors through monitoring by Task Force on agriculture and amendment in APO Law, 1971 (DGA, 1997).

Comparison of generic and branded unfit samples during the years 2002-03 to 2012-13 reveals that the number of generic unfit samples was found almost 4 to 5 times more than branded samples. It indicates maintenance of better quality standards of pesticides by the multi-national companies (Fig. 3). Although the pesticide import under generic scheme was with low prices, but at the cost of low quality. Pesticide samples from 21 developing countries were analysed from 1989-1994 where 34% samples were found unfit as per limits of FAO (Kern and Vaagt, 1996).

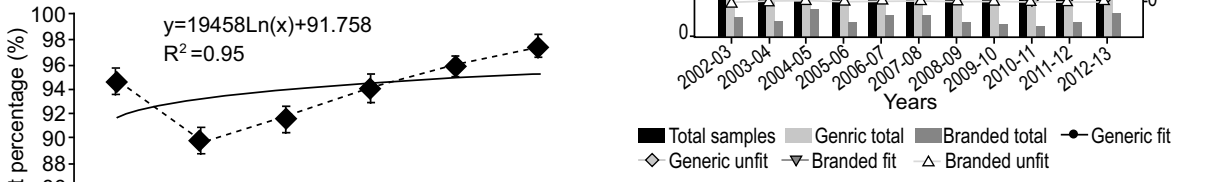

Fig. 2. Quality of pesticide samples analysed in PQCL, Multan, Pakistan.

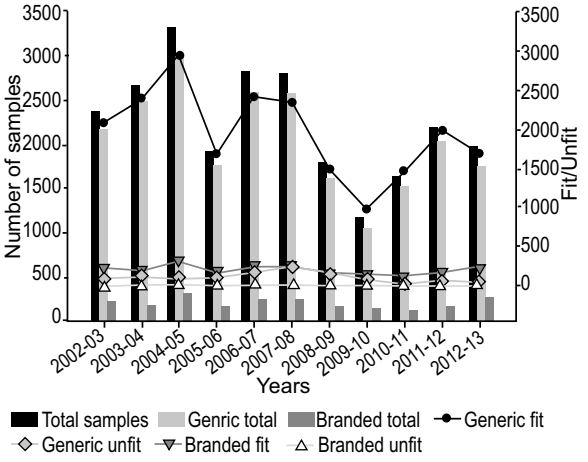

Fig. 3. Trend in generic and branded total, fit and unfit samples (2002-03 to 2012-13).

These results are not in line with those reported by the Pesticide Quality Control Laboratory (PQCL) in Multan (Table 4). It could be owing to biased sampling by the authorized inspectors under the quality control programme.

Table 3. Pesticide samples fitness in southern punjab (2006-07 to 2011-12)

Name of District	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Multan	91.04	85.20	88.00	88.85	94.14	94.76
Khanewal	98.29	89.15	87.00	95.40	97.38	97.54
Vehari	89.56	91.71	94.00	93.39	95.28	98.37
Muzzafar Garh	97.08	90.65	95.00	97.96	97.83	97.00
Dera Ghazi Khan	94.00	95.07	94.00	93.41	96.68	98.11
Layyah	97.66	97.94	94.00	100	97.90	99.16
Rajanpur	96.69	93.01	91.00	96.55	95.36	98.20
Total	94.62	89.92	91.55	94.03	95.83	97.38

Table 4. Quality trend (fitness %) of pesticide samples in Southern Punjab over time (2006-07 to 2011-2012)

Year	Total number of samples analysed	Fit samples	Unfit samples	Fit (%)	Unfit (%)
2006-07	1375	1301	74	94.62	5.38
2007-08	1686	1516	170	89.92	10.08
2008-09	1776	1626	150	91.55	8.45
2009-10	1172	1102	70	94.03	5.97
2010-11	1630	1560	68	95.83	4.17
2011-12	2174	2117	57	97.38	2.62

Furthermore, the results of PQCL have been presented at the division level where anti-adulteration campaign is working effectively. The pesticide quality status of the country needs to be accounted to have a clear picture of the pesticide quality control programme at the national level.

Conclusion

Out of sampled pesticides, 94.5% were found fit for use in field crops on arable lands. Whereas the companies marketing branded chemicals assured improved quality of pesticide than generic chemicals. Furthermore, it is suggested that authorized pesticide inspectors should make intelligent pesticide sampling without merely focusing on completing the assigned target so as to avoid the malpractice in pesticide marketing and to further ensure better quality of pesticides being provided to farmers.

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