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Pesticide Quality Control Program: A case study of Multan

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Abstract

Pesticide use is one of the essential measures of modern agricultural practices in protecting the crops from different pests. This has increased steadily and substantially over the years in Pakistan. Pesticide testing for quality control was started with the establishment of plant protection Directorate at Faisalabad, Punjab during 1970. Agricultural pesticide Ordinance (APO) was promulgated during 1971, for pesticide business regulation and making pesticide registration mandatory. Pesticide Quality Control Laboratory, Multan was established during 1984-85 to make stronger the pesticide quality. APO was made effective through amendments and monitoring by Task Force on Agriculture during 1997. This laboratory has done a laudable job during (2002-2003 to 2012-13). During this period, this laboratory covering the areas of Multan and D.G. Khan divisions received 24617 number of pesticide samples for quality evaluation out of which 23440 (95.2%) for found fit and the remaining 4.8% (1177) were declared unfit for crop use. Viewing the trend in generic and branded unfit samples during the years 2002-2003 to 2012-13 the agencies marketing branded pesticides assured better quality than generic ones. It is recommended that pesticide sampling from the market by the authorized inspectors under quality control program should be done on intelligent basis and not to complete the assigned target in order to curb the pesticide marketing malpractices for improved pesticide supply to farmer and other user.

Key words: Gas chromatography; high performance liquid chromatography; pesticide quality control; pesticide legislation.

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1. Introduction

Use of pesticide has become an indispensable input in agriculture for crop protection. In Pakistan during the last thirty years, pesticide consumption has increased manifold (Jabbar and Mallik, 1994). However, the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) [2005] reported that around 30 percent of pesticides marketed in developing countries with an estimated value of US\$ 900 million annually did not match with internationally accepted standards of quality. High occurrences of substandard pesticides have also been reported to FAO and WHO by national pesticide quality control laboratories of developed countries, emphasizing the significance of the problem.

The possible causes of low-quality pesticides might be due to a range of factors that include poor production technology and quality control, production of counterfeit products, adulteration of products and poor storage prior to marketing. Insufficient enforcement by regulatory authorities as a result of financial, infrastructure and human resource constraints could create an environment that enabled such practices to expand.

During early decades of Pakistan history, the pesticide use began slowly with the realization that agricultural development depends upon the prevention of losses due to pest infestation and

disease epidemics. Federal Department of Plant Protection was established during 1947. During 1952, Agricultural Inquiry Committee was formed which recommended the strengthening of plant protection services. On its recommendation, plant protection work was transferred to Provincial Agriculture Department during 1957. The checking and use of toxic and hazardous materials was streamlined through the administrative order of Pakistan during 1963. Initially the pesticides were supplied to the farmers free of cost up till 1966. Then the private sector came into pesticide business and its distribution was executed by 25% by this sector and 75% through Agriculture Department (Extension wing) up to 1972.

Pesticide quality control program in Punjab was started with the establishment of Plant Protection Directorate at Faisalabad during 1970 and Pesticide Division was set up to undertake sample testing and conducts research on pesticide quality control. Pesticide import, manufacturing, distribution and its use was regulated through Agricultural Pesticide Ordinance (APO) promulgated during 1971 and rules 1973 (Anonymous, 1997). During 1980, 100 percent subsidy was withdrawn and entire responsibility of distribution was shifted to private sector. The private multinational companies aggressively jumped into this business and they promoted the pesticide sale and its use rapidly during eighties. Therefore, the pesticide

quality control was further strengthened with the establishment of two more Pesticide Laboratories at Multan and Kala Shah Kaku during 1984-85; and APO 1971 was made effective through amendments and monitoring by Task Force on Agriculture during 1997.

The pesticide samples are collected from the market by authorized inspectors of Agriculture Department (Extension wing) and Pest Warning and Quality Control Directorate, and supplied to pesticide laboratories for testing under APO, 1971. During the past years, both regulatory agencies and farmers have shown increasing interest in pesticide quality control program. The monitoring program supervised by Task Force on Agriculture continuously assess the level of unfit pesticide samples declared by pesticide laboratory and take legal action against the pesticide marketing defaulters.

2. Methodology

The pesticide control laboratory was established in Multan division in 1985 to monitor the quality control program in three administrative divisions i.e. Multan, Dera Ghazi Khan and Bahawalpur. Since then, this laboratory performed a commendable job and analyzed thousands of pesticide samples in the quality control program. Different pesticide formulation samples are collected by authorized inspectors and received in the laboratory. The samples are coded and stored for physical and chemical analysis. Different analytical techniques such as Spectrophotometry, High Performance Liquid Chromatography (HPLC), Gas chromatography (GC), and Chemical Digestion and Titration described by Collaborative International Pesticides Analytical Council (Ashworth et. al., 1970), Association of Official Analytical Chemists (AOAC, 1990), United States environmental protection Agency manual of chemical methods for pesticide analysis (EPA, 1987). Pesticide formulation samples and analytical standards were prepared at equivalent concentration (0.1%) for dissolving in relevant solvents (acetone, ethyl acetate, chloroform, dichloromethane, methanol etc for GC, 0.05 % for dissolving in water acetonitril, methanol, dioxin, iso-octane, iso-propanol and trimethyl pentane for HPLC, acetone, CS₂ and ethyl acetate for IR) feeding in HPLC, GC and IR/UV spectrophotometers. 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

Different physical properties like dry sieve test for dustable powders (DP) and granular formulations (GR), wet sieve test for wettable powders (WP), and emulsion stability test for emulsifiable concentrates (EC), emulsions and oil in water were performed (Ashworth et al. 1970). Formulation DP was rated fit if material retained on 150 and 74 micron sieve was not more than 0.4 and 12.5% weight/weight (w/w) respectively. Formulation GR was rated fit if the material retained on 1 mm sieve (BS-16 mesh) and passing through 250 micron (BS-60 mesh) was not more than 5.0% w/w. Similarly, formulation WP was rated fit physically if the material retained on 74 micron sieve was not more than 2.0% w/w. 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.

The formulation was (5mL) was diluted at 30 ± 2 °C with 95 mL standard water D (342 mg L⁻¹, pH 6.0-7.0, Ca:Mg = 80:20) and was observed to comply given in the Table 1.

Table1: Stability limits of different parameters at target time intervals.

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
Test after 24 h was carried out in case when results at 2 h were in doubt.	nil Free oil nil

Fitness of pesticide sample on a.i. content was evaluated according to the appropriate contents and tolerance entries described by Food and Agriculture Organization of the United Nation (FAO, 1999) are described.

3. Results and Discussion

Pesticide samples collected from the market and ware houses of the companies by the authorized inspectors were analyzed using different standard methods. The use of pesticide in Pakistan which started in nineteen fifties with the import of 250 metric tons (mt) has increased steadily and substantially over the years in Pakistan (Khan et al., 2010).The data (Fig 1) illustrates the import of pesticides in Pakistan since 1990-1991 to 2012- 2013 that pesticide import increased by 219% in 2004-2005 over 1991-92. But after that, there is decline in the use of pesticide. This decline is due to cultivation of Bt cotton and adoption of integrated pest management (IPM) technology through Farmer Field Schools (Khan et al., 2010).

Table2: Declared contents and their specification.

Declared Content in g kg ⁻¹ or g L ⁻¹ at 20± 2 °C	Tolerance
Up to 25 (2.5)	± 15 % of the declared content for homogeneous formulations (EC, SC, SL etc.), or ± 25 % for heterogeneous formulations (GR, WG, etc
Above 25 up to 100 (2.5-10.0 %)	± 10% of the declared content
Above 100 up to 250 (10.0-25-%)	± 6 % of the declared content
Above 250 up to 500 (25.0-50.0 %)	± 5 % of the declared content
Above 500 (50.0 %)	± 25 g kg ⁻¹ (2.5%)

The number of pesticide samples received in the Pesticide Quality Control Laboratory Multan for analysis increased manifold from 1730 to 3323 during 1996-97 to 2004-2015 (Fig.2). But after that, their number decreased substantially due to reasons mentioned in the above paragraph. . This data indicate the increasing efforts made for pesticide quality improvement in the both divisions (Multan and Dera Ghazi Khan) .The government of the Punjab is trying her best to make quality control more effective with the establishment of Task force on agriculture during 1997. Based upon pesticide analysis, the number of samples declared fit and unfit or shown in (Fig.2) the criteria use for fitness of

pesticide samples was same as described by FAO. However, reduction in unfit samples does not reflect the true picture of improvement in the market and at farmers end, it all depends upon the intelligent based, market representative sampling by the inspectors. This might be due to the reason that APO, 1971 was made more effective through amendments and monitoring by Task Force on agriculture during 1997.

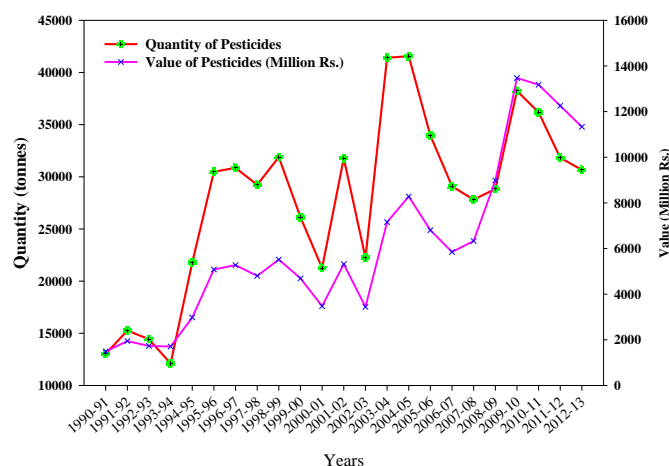


Figure 1. Import of pesticides (quantity and value) in Pakistan

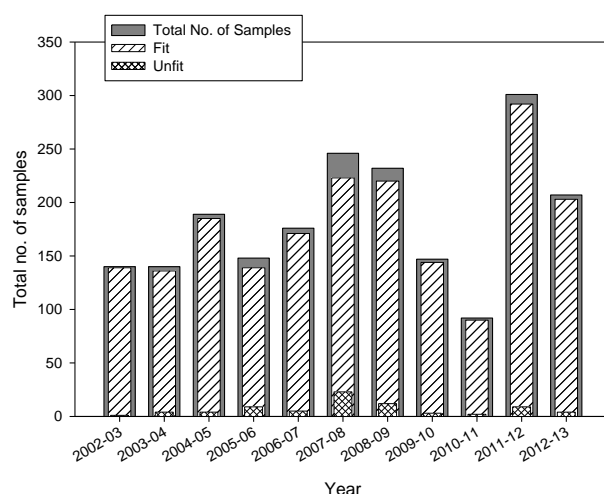


Figure. 2 Tend in total sampling volume and fit and unfit samples since the fiscal year 2002-03 to date.

Seeing the trend in generic and branded unfit samples during the years 2002-03 to 2012-13, the unfit samples under generic were found almost 4 to 5 times more than branded samples including better quality of the pesticides maintained by the multi-national companies (Fig.3). Though it is clear that the import of pesticide under generic scheme reduced its prices, but their quality has become dubious.

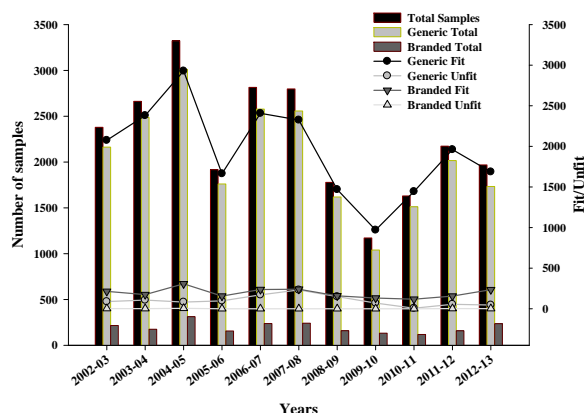


Figure 3. Trend in generic and branded total, fit and unfit samples since the fiscal Year 2002-03 to 2013-14.

A survey regarding the quality of pesticides in developing countries was carried out over a period from 1989 to 1994. Pesticide samples from 21 developing countries were analyzed and 34% of the tested products were found outside FAO permissible limits (Kern and Vaagt. 1996a, Kern and Vaagt. 1996b). There was a difference in between and the results reported by the Pesticide Quality Control Laboratory (PQCL) in Multan. This might be due to biased sampling by the authorized inspectors under the quality control program. Moreover the results reported by the PQCL may be depicting at micro level i.e. at the divisions level where anti-adulteration campaign is effectively working; but the scenario of the pesticide quality of the whole country might be different.

Conclusion

This laboratory has done a laudable job during (2002-2003 to 2012-13). During this period, this laboratory covering the areas of Multan and D.G. Khan Divisions, received 24617 number of pesticide samples for quality evaluation out of which 23440 (95.2%) for found fit and the remaining 4.8% (1177) were declared unfit for crop use. Viewing the trend in generic and branded unfit samples during the years 2002-2003 to 2012-13 the agencies marketing branded pesticides assured better quality than generic ones. It is recommended that pesticide sampling from

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Competing Interests

Authors declare that they have no competing interests and commercial names and details of machines and equipments are for the guidelines only.

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