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OF
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MRP(S)-0455/13-14/KAKA-041/UGC-SWRO dated 08-04-2014

"MONITORING OF PESTICIDE RESIDUES IN FARM VEGETABLES AND ITS IMPACTS ON HEALTH AT BIJAPUR DISTRICT, KARNATAKA"

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S.B.ARTS AND K.C.P. SCIENCE COLLEGE, VIJAYAPUR

SUBMITTED

TO

UNIVERISTY GRANTS COMMISSION

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S.B. ARTS AND K.C.P. SCIENCE COLLEGE,

VIJAYAPUR

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INDEX

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INTRODUCTION

CHAPTER I

INTRODUCTION

ABSTRACT: This project researched stakeholder knowledge about pesticides in Vijayapur district, as well as pesticide use on farms in the region. We documented perceptions of farmers, government officials, and vendors, investigated relevant policies, documented application practices, and applied a method to test for chemicals in market produce. Our findings indicated the presence of pesticides on sampled and vegetables, many of which have been banned in other countries. Moreover, farmers were not always aware of dangers and regulations.

These reports for analysis and action focus on knowledge generation and application as well as on institutions and governance structures concerning the core issues of poverty, food, nutrition, health, transport, environment and resource degradation. This has been possible through joint research efforts, involving institutions of urban governance, integration of organisations of civil society in communication, participation, co-operation and network linking. The deep crisis affecting the farming community in India largely escapes the imagination of the urban population. It might be because food production is almost completely de-linked from food consumption here. Food is seen as a commodity which can be bought over the counter, with quality assured by the tag of the supermarket or a popular brand. The ecological footprint that certain food production systems and supply chains leave is largely ignored or not understood. The distress experienced by food-producing communities is invisible. Consumers also tend to ignore the implications on themselves flowing from lack of food safety. As citizens and as consumers of food, we never relate ourselves to the farming community and always carry a feeling that the technology, policies and regulatory systems related agriculture are the concern of the farmers. This report is the result of a pilot study on 'Pesticides, Residues and Regulation in India'. It is an attempt to break the apathy and ignorance of consumers through the analysis of how pesticides and pesticide residues in food are regulated in India and the potential implications on urban consumers. With a lot of effort from civil society groups and concerned activists, there is now a shift towards production that is not dependent on chemicals. Concern over the health implications of toxic pesticides has also prompted some people to shift towards organically grown foods. On the other hand, governments, agricultural research and extension system and the chemical industry continue to believe in the 'inevitability of pesticides' and continue to talk only about safer pesticides, safe use of pesticides, better regulatory systems etc. The issue of pesticide residues receives some attention only when export consignments from India are rejected or studies on pesticide residues in soft drinks or bottled water are released. The larger issues of food safety for consumers and sustainable resource management for producers are largely ignored. Working backwards, we tried to look at how pesticide residues in food are regulated in India, how pesticides themselves are regulated, recommended, the institutions involved & their functioning etc. The study used both primary and secondary data for its analysis. Our research shows several objectionable gaps and lapses in the regulatory systems, several contradictions even at the conceptual level and gross negligence with regard to assessing and promoting safer and better alternatives. This pilot study is part of the Sustainable Vijayapur 'Megacity Project' (http://www.sustainablehyderabad.in). Support extended by farmers around Hyderabad city and other experts is gratefully acknowledged. Centre for Sustainable Agriculture Pesticides, Residues & Regulation in India 6 1. Introduction Around 203 pesticides have been registered for use in agriculture in India as of December 2006, against various pests and diseases. These pesticides can be broadly classified into Insecticides (used against insect pests), Herbicides (for killing & controlling weeds), Fungicides (against diseases) and others. Another classification is based on the chemical composition – organophosphate compounds, organo-chlorines, synthetic pyrethroids, carbamates, bio-pesticides etc.

Pesticide production and use in the country shows a different pattern from global trends – insecticide use is around 75% in the country, compared to 32% in the world. Herbicide use is only 12% in the country while worldwide, consumption is 47%. Important to note is the fact that weeding is a critical agricultural operation that provides employment to millions of poor agricultural labour, especially women, in the country. Similarly, while carbamate and synthetic pyrethroid compounds are used the most globally [45% together], in India, organophosphates constitute 50% of the consumption. Similarly, bio-pesticides are used only upto 1% amongst all pesticides in India, while worldwide, it is 12%. Another classification of pesticides is as per their acute toxicity, as classified by the World Health Organisation. This classification includes Class Ia – Extremely hazardous, demarcated in red; Class Ib – Highly Hazardous, symbolized by an yellow triangle; Class II – Moderately Hazardous, marked by a blue triangle. Class III is known as “Slightly Hazardous” while the remaining class is supposed to be “Not likely to be

Hazardous". It is to be noted here that two-thirds of the pesticides consumed here fall under WHO Class I and II pesticides. From 1998 to 2005, the decline in Class Ia pesticides has been only 2% - from 11% to 9%. There have been reports of many different problems related to pesticide production and use in the country on the economic, ecological and health fronts. This report will focus particularly on pesticide residues in foods in India. The current study has been taken up by Centre for Sustainable Agriculture, a non-governmental organization based in Hyderabad, Andhra Pradesh. The organization works with farmers across the state to promote ecological, local-resource-based practices in agriculture so that farming becomes viable and sustainable for farmers. Through this, livelihoods of farmers and agricultural workers is sought to be improved. At the same time, the organization also takes up research work so that larger impacts can be made on the farming community through policy influencing and lobbying on relevant issues and to make policies/programmes farmer-friendly and farmercentric. The study has been supported by the Humboldt University's recent efforts at creating a Sustainable Hyderabad

The main objectives of the study were: 1. to compile existing studies on pesticide residues in food and their health implications 2. to map the existing institutions, programs and policies dealing with pesticides, pesticide residues and regulation 3. to investigate the agricultural activity in terms of pesticide consumption on various vegetables at village level in the catchment of a Hyderabad vegetable market This report presents a literature review of other such studies from various parts of the country, a picture of the vegetable cultivation and consumption in and around Hyderabad, an overview of Pesticides, Residues & Regulation in India 7 the regulatory mechanisms in place with relation to pesticide use and the actual implementation of such regulations. Conceptual Framework The debate on pesticide residues in soft drinks and bottled water in India has raised awareness over contamination of our water with toxic pesticide residues. Unfortunately the debate became restricted to the quality standards and norms pertaining to drinking water and foods at the point of consumption. The more fundamental problem of contamination of all natural resources with chemical pesticide residues because of faulty and hazardous agricultural technologies at the farming level is often ignored. Without solving the basic problem, no amount of standard-setting at the consumption level is going to solve the problem, especially in a country like India where enforcement of regulations is notoriously weak or even absent. In this context, Centre for Sustainable Agriculture took up a small study on a pilot basis to understand the pesticide load in vegetable production in those villages which are the catchment areas for the vegetables being sold in Hyderabad markets and the story behind of what is being recommended to farmers and what is being regulated. We felt that with the help of this study it would be possible to create awareness amongst consumers and producers on various issues related to pesticides and residues. Subsequently, we hope to connect the issue with production practices and the need to shift to alternatives like for non-pesticidal management [NPM] in the vegetable production system. Our attempt is also to understand and act on the importance of rural-urban linkages for lasting changes to happen at the farming level, with urban consumers actively supporting this shift by farmers. This in turn will yield beneficial results in many ways to both producers and consumers such as restoration of crop-ecology, profitable economics, improved marketing options for such produce, improvement in health etc. Methodology • Collected and summarized available documentation and studies (published and unpublished) on pesticide residues in vegetables in India in general and Hyderabad in particular from relevant institutions, organizations, and agencies (research, governmental, NGOs etc.). •

A quick survey on the production practices followed by farmers in the catchments of the Mehdipatnam Rythubazar (a big vegetable market in Hyderabad where farmers sell vegetables directly to the consumers) to understand the pesticides used and their status with respect to Agriculture University and Agriculture department recommendations and vis-à-vis Central Insecticide Board and Registration Committee. • Identify and map various institutions, programmes, knowledge resources etc. that affect food quality, especially when it comes to pesticides, to understand shortcomings and ways of improving these. Pesticides, Residues & Regulation in India 8 2. Pesticide Residues in Foods in India Some amounts of pesticides appear as Residues in the crop products that they are used on at the time of harvest and point of consumption. The amount of such residues varies across crops, for different pesticides and locations. Perusal of the residue data on pesticides in samples of fruits, vegetables, cereals, pulses, grains, wheat flour, oils, eggs, meat, fish, poultry, bovine milk, butter and cheese in India indicates their presence in sizable amounts (Bhusan, 2006). Between 1965 and 1998, the contamination of food from pesticides in India has been estimated at only 41% being free from residues, as compared to 63% being free from residues in the European Union in 1996 (Bhushan, 2006). In India, it is also estimated that 20% of the contamination is above Maximum Residue Limits [MRLs] fixed. In EU, this is estimated to be around 1.4% while in the USA, in 1996, it is reported that the contamination above MRLs is around 4.8% only. In the 1980s, the All India Coordinated Research Project on Pesticide Residues [AICRPPR] was set up to monitor pesticide residues all over the country. In 1999, the AICRPPR reported that with all commodities put together, 20% of the food samples tested exceeded the MRLs. Fruits, vegetables and milk are found to be highly contaminated. Monocrotophos, Methyl Parathion and DDVP, all organo phosphorus pesticides, are found to be most prevalent. These are also WHO Class I pesticides. Even in 2001, 61% of the samples tested are found to be contaminated, 11.7% of which were also above MRLs. Recent AIRCRP reports say that contamination has come down quite a lot. The fruit samples are fine now and that around 15% of the milk samples still exceeded MRLs. Hexachlorobenzene (HCB, a fungicide) was identified in water, human milk and human fat samples collected from Faridabad and Delhi (Nair, 1989). DDT and HCH residues were detected in groundnut and sesamum oil samples collected from Tamilnadu (ICMR, 1993). In a multi-centric study to assess the pesticide residues in selected food commodities collected from different states of the country, DDT residues were found in about 82% of the 2205 samples of bovine milk collected from 12 states (ICMR, 1983). About 37% of the samples contained DDT residues above the tolerance limit of 0.05 mg/kg (whole milk basis). The highest level of DDT residues found was 2.2 mg/kg.

The proportion of the samples with residues above the tolerance limit was maximum in Maharastra (74%) followed by Gujarat (70%), Andhra Pradesh (57%), Himachal Pradesh (56%) and Punjab (51%). In the remaining states, this proportion was less than 10%. Data on 186 samples of 20 commercial brands of infants formulae showed the presence of residues of DDT and HCH isomers in about 70 and 94 % of the samples with their maximum level of 4.3 and 5.7 mg/kg (fat basis) respectively. The average total DDT and BHC consumed by an adult were reported to be 19.24 mg/day and 77.15 mg/day respectively (Kashyap, R 1994). Fatty food was the main source of these contaminants. In another study, the average daily intake of HCH and DDT by Indians were reported to be 115 and 48 mg per person respectively which were higher than those observed in most of the developed countries (Kannan, 1992). Pesticides, Residues & Regulation in India 9 Other studies reveal the following: 1. In one study, the tested samples were found 100% contaminated with low but measurable amounts of pesticide residues. Among the four major chemical groups, residue levels of organophosphorous insecticides were highest followed by carbamates, synthetic pyrethroids and organochlorines. About 32% of the samples showed contamination with organophosphorous and carbamate insecticides above their respective MRL values (Kumari Beena et.al 2003). 2. An article from Delhi presents the development of a multiresidue method for the estimation of 30 insecticides, 15 organochlorine insecticides and six organophosphorus insecticides, nine synthetic pyrethriods and two herbicides and their quantification in vegetables. The monitoring study indicates that though all the vegetable samples were contaminated with pesticides, only 31% of the samples contained pesticides above the prescribed tolerance limit (Mukherjee Irani, 2003). 3. Samples of vegetables collected at beginning, middle and end of seasons were analysed for organochlorine levels. Maximum pesticide residues were detected from cabbage (21.24 ppm), cauliflower (1.685) and tomato (17.046) collected at the end of season and okra (17.84 ppm) and potato (20.60) collected at the middle of season. OCP residue levels in majority of samples were above the maximum acceptable daily intake (ADI) prescribed by WHO, 1973 (Neela Bakore, 2002). 4. Twelve most commonly used pesticides were selected to study residual effects on 24 samples of freshly collected vegetables. Most of the samples showed presence of high levels of malathion. DDE, a metabolite of DDT, BHC, dimethoate, endosulfan and ethion were also detected in few samples. Leafy vegetables like spinach, fenugreek, mustard seem to be most affected. Radish also showed high levels of contamination (Sasi K.S and Rashmi Sanghi (2001). 5. Vegetable samples collected at harvest from farmer's fields around Hyderabad and Guntur recorded HCH residues above MRL (0.25 ppm). Residues of DDT and Cypermethrin were found to be below MRL (3.5 & 0.2 ppm respectively) and Mancozeb residues are above MRL (2 ppm) in bittergourd only. Residues of HCH, DDT, aldrin (including dieldrin), endosulfan and methyl parathion in vegetables of Srikakulam were below MRL (Jagadishwar Reddy, 1998). 6. Detectable levels of residues of commonly used pesticides were noticed in tomato (33.3%), brinjal (73.3%), okra (14.3%), cabbage (88.9%) and 100% cauliflower samples. However the levels of concentrated pesticide residues were lower than the MRLs prescribed (Dethe, M. D. et.al 1995). 7. An experiment conducted to estimate the residues of four synthetic pyrethroids and monocrotophos recommended a waiting period of 2 days for deltamethrin, cypermethrin and permethrin as the rate of dissipation was faster and 5 days for fenvalerate and monocrotophos on okra fruits (Hafeez Ahmad and Rizvi S M A, 1993). 8. Wheat flour and eggs contained maximum concentration of OCP residues in a study to estimate various OCPs in different food items collected from 10 localities in Lucknow city. The estimates of dietary intake of total HCH (1.3g) and Lindane (0.2 mg) in the present study is about one and a half times higher than that proposed by ADI and 100 times the values reported from UK and US (Kaphalia B. S, et.al 1985). 9. Out of 400 food stuffs tested 23.7% were positive for pesticide residues. Higher rates were found in animal products (30%), cereals and pulses (26.3%) and vegetables (24%). Out of the Pesticides, Residues & Regulation in India 10 95 samples that tested positive for pesticides, malathion was detected in 44 samples (46.3%); Lindane in 27 samples (28.4%) and DDT in 24 samples (25.3%). Pesticide detection rate for green leafy vegetables during winter months was 53.3% as compared to that of rainy (8.3%) and summer months (23.1%). Corresponding figures for non-leafy vegetables were 30%, 12.5% and 19.5% respectively (Mukherjee D, 1980).

In a response to a starred question (No. 202) in the Indian Parliament on 8/8/2005, the Agriculture Minister revealed the following information: Statement indicating the extent of pesticide residues in various agricultural commodities monitored under All India Network Project on Pesticide Residues: On Vegetables (Cabbage, Cauliflower, Brinjal, Okra, Potato, Beans, Gourds, Tomato, Chilli, Spinach, Carrot, Cucumber, Cowpea Etc.) Year No of Samples analysed Samples above MRL (%) 1999 277 10 (3.6%) 2000 712 81 (11%) 2001 796 93 (11.7%) 2002 592 54 (9%) 2003 666 35 (5.3%) Total 1999-2003 3043 273 (8.97%) On Fruits (Apple, Banana, Mango, Grapes, Oranges, Pomegranate, Guava Etc.) Year No of Samples analysed Samples above MRL (%) 1999 122 8 (6%) 2000 378 8 (6%) 2001 378 0 (0%) 2002 359 3 (0.8%) 2003 317 1 (0.3%) Total 1999-2003 1554 15 (0.97%) In Milk Year No of Samples analysed Samples above MRL (%) 1999 194 116 (60%) 2000 537 94 (17.5%) 2001 468 71 (15%) 2002 No study done 2003 No study done Total 1999-2003 1199 281 (23.4%) These findings are at great variance with the results from other independent studies. During the Joint Parliamentary Committee probing of the pesticide residues study reported by Centre for Science & Environment [CSE, Delhi], the Ministry of Agriculture furnished a note to the Committee on the reasons for agricultural pesticide residues being high in India (especially given the comparatively low [volume] per hectare consumption of pesticides in the country): • Indiscriminate use of chemical pesticides • Non-observance of prescribed waiting periods • Use of sub-standard pesticides • Wrong advice and supply of pesticides to the farmers by pesticide dealers • Continuance of DDT and other uses of pesticides in Public Health Programmes • Effluents from pesticides manufacturing units Pesticides, Residues & Regulation in India 11 • Wrong disposal of left over pesticides and cleaning of plant protection equipments • Pre-marketing pesticides •

Treatment of fruits and vegetables Rejection of Indian export consignments due to presence of chemical residues The presence of residues in agricultural export consignments has often meant rejection of such consignments by the importing countries. Before the advent of the WTO, Indian exporters had to mostly comply with AGMARK specifications. Now, the situation is different. The most popular specifications for spices world over is now as per ASTA cleanliness specifications and also USFDA specifications. The situation gets further complicated since most counties have now set their own specifications. Non-availability of MRLs for recommended pesticides on chilli spice has become a practical problem in promoting chilli exports. The following table shows the alert notices issued by FSAI (Food Safety Authority of Ireland), FSA (Food Standards Agency) of UK, and other organizations on the contamination of Indian foods based on the tests at importing points. Month & Year Importing Country Agricultural Product Reasons January, 2005 UK Chilli powder Sudan Red November, 2004 EU Chilli powder Sudan Red March, 2004 EU Chilli powder Sudan Red January, 2004 EU Chilli powder Sudan Red May, 2003 UK Grapes Methomyl April, 2003 UK Grapes Methomyl, Acephate UK Extra hot chilli peppers Aflatoxins UK 'Dabur' Honey Streptomycin March, 2003 Italy Nutmeg Aflatoxins February, 2003 Italy Chilli powder Aflatoxins Italy Chilli powder Aflatoxins December, 2002 UK Curry powder Salmonella The Netherlands Chilli powder Aflatoxins September, 2002 Italy Herbal products Heavy metals August, 2002 UK Curry powder Ethion Spain 'Cayerre' pepper Aflatoxins March, 2002 UK Coriander Rat droppings Italy Chillies Aflatoxins January, 2002 Greece Crushed chilli & powder Aflatoxins Germany Curry powder Cypermethrin, fenvalerate, phosphamidon November, 2001 Greece Chilli powder and Red chilli Ethion, triazophos, cypermethrin, chlorpyriphos June, 2001 Germany Curry powder Cypermethrin and dicofol May, 2001 UK Grapes Triazophos April, 2001 Germany Curry powder & chilli powder Ethion, cypermethrin July, 2000 Spain Chilli Cypermethrin Source.

The data collected from various Internet resources, and alert sites Pesticides, Residues & Regulation in India 12 It is interesting to know that more than 100 laboratories in the country are engaged in research on pesticide residues under the preview of ICMR, CSIR, ICAR, SAUs and enormous number of independent institutions/ organizations/ laboratories/ industries. The situation with regard to residues persists despite such infrastructure available. Pesticides, Residues & Regulation in India 13 3. Pesticide Regulation in India LEGISLATIONS: In India, the production and use of pesticides are regulated by a few laws which mainly lay down the institutional mechanisms by which such regulation would take place – in addition to procedures for registration, licensing, quality regulation etc., these laws also try to lay down standards in the form of Maximum Residue Limits, Average Daily Intake levels etc.. Through these mechanisms, chemicals are sought to be introduced into farmers' fields and agricultural crop production without jeopardizing the environment or consumer health. These legislations are governed and administered by different ministries – the regulatory regime and its enforcement have several lacunae stemming from such an arrangement. An added dimension is that administration of the legislations includes both state governments and the central government. The Central Insecticides Act 1968 is meant to regulate the import, manufacture, storage, transport, distribution and use of pesticides with a view to prevent risk to human beings, animals and the environment. Through this Act, a Central Insecticides Board has been set up to advise the state and central governments on technical matters and for including insecticides into the Schedule of the Act. This Board, under the Chairmanship of the Director General of Health Services, consists of 29 members. Around 625 pesticides have been included in the Schedule so far. The Board is supposed to specify the classification of insecticides on the basis of their toxicity, their suitability for aerial application, to advise the tolerance limits for insecticide residues, to establish minimum intervals between applications of insecticides, specify the shelf life of various insecticides etc. Then there is a Registration Committee which registers each pesticide in the country after scrutinizing their formulae and claims made by the applicant as regards its efficacy and safety to human beings and animals.

The Registration Committee is also expected to specify the precautions to be taken against poisoning through the use or handling of insecticides. This Registration Committee has five members including the Drug Controller General of India and the Plant Protection Adviser to the Government of India. Around 181 pesticides have been registered by the Committee so far in India. Then, there are other institutions like Central Insecticides Laboratory and Insecticides Inspectors to ensure that the quality of insecticides sold in the market is as per norms. The Central Insecticides Laboratory is also meant to analyse samples of materials for pesticide residues as well as to determine the efficacy and toxicity of insecticides. This laboratory is also responsible for ensuring the conditions of registration. As per this legislation, the central government will register the pesticides whereas the marketing licenses are allowed by state governments. The general enforcement of the legislation is by the state government's agriculture department. Both the Central and State governments have been given the power to prohibit the sale, distribution or use of an insecticide or a particular batch in a specific location for a specific extent and for a specific period by notification in the official gazette [Section 27 of the Insecticides Act, 1968]. Section 26 of the legislation states that the State Government may, by notification in the Official Gazette, require any person or class of persons specified therein to report all occurrences of poisoning (through the use or handling of any insecticide) coming within his or their cognisance to such officer as may be specified in the said notification. Based on such reports, on Pesticides, Residues & Regulation in India 14 grounds of public safety, prohibition of sale of insecticides can be ordered and enforced. The Act also lays down penalties for producing/selling misbranded insecticides or for selling without license or for other contraventions of the Act.

While registration and licensing is done through the above mentioned processes, for banning or prohibiting a pesticide a different mechanism is used in India. Unlike in other countries where registered pesticides automatically come up for periodic reviews for their efficacy and safety (as in the case of some Scandinavian countries) or unlike in countries like Syria where a pesticide is automatically banned in the country if it is prohibited in two other countries, India goes through long processes of review and prohibition, usually through committees set up for the purpose. Expert Committees have been appointed from time to time to review the continued use or otherwise of pesticides which are banned/restricted in other countries. As a result, 27 pesticides and 4 formulations of 3 other pesticides have been banned for use and the use of another 7 pesticides has been restricted. The following expert committees have been set up so far by the Department of Agriculture, GoI: • Committee under the Chairmanship of Dr.S.N. Banerjee in 1984. • Reconstitution of the Committee under the Chairmanship of Dr.S.N. Banerjee in 1989. • Another Committee under the Chairmanship of Director General, ICAR to review DDT and BHC. • Committee constituted under the Chairmanship of Dr. K. V. Raman to review the pesticides during 1995. • Committee constituted under the Chairmanship of Prof. R.B. Singh in the year 1997. As this report is being written, there is another Committee, headed by Dr C D Mayee which is looking at the fate of at least 10 pesticides to begin with and 27 others, on whether they should be continued to be produced and used in India. These are pesticides that have been banned elsewhere in the world. Incidentally, this Committee had been set up in the last quarter of 2005, to review the toxicity, persistence, safety in use and substitutes available for the following pesticides – even after 15 months, there is no decision taken by the Expert Group The production and use of insecticides in India is also governed by the Prevention of Food Adulteration [PFA] Act, 1954, under the Ministry of Health & Family Welfare. This Act and its Rules lay down standards for different food articles as well as provisions for their storage, distribution and sale. The Maximum Residue Limits [MRLs] for different pesticides are regulated through this PFA Act. The Central Committee for Food Standards (CCFS) constituted under Section 3 of the Prevention of Food Adulteration Act, 1954 advises Central/ State Governments on all matters arising out of implementation of the Prevention of Food Adulteration Act, 1954 and the PFA Rules, 1955, including review and formulation of rules, regulations and standards of food articles. The Central Committee for Food Standards (CCFS) has representatives from different Departments in the Central Government, State Governments, trade, industry, technical experts and consumer organizations, besides representatives from the National Institute of Nutrition, Central Food Technology and Research Institute and the Central Food Laboratories. The Central Committee for Food Standards (CCFS) has constituted 9 technical Sub-Committees to assist it.

The "Pesticides Residue Sub-Committee" is one of them and its function is to deal with laying down limits of pesticide residue tolerance in food and also to suggest methods for their detection and estimation. In general, the enforcement of the Act is through the state governments through a system of inspections, sampling and analysis. There are Central Food Laboratories set up under the Act for the purpose of assisting the government in enforcement of the legislation. The Food (Health) Authorities of State/UTs are responsible for implementing the provisions of the Prevention of Food Adulteration Act, 1954 and Rules, 1955. They have been advised from time to time to keep a strict vigil on the level of pesticides/insecticides in food articles, by taking samples of food articles. Data on samples tested and results thereof are required to be sent by the State Governments to the Ministry of Health for purposes of monitoring. Currently, many pesticides have been approved for use in the country for which tolerance levels have not been fixed under the PFA Act. Of the 165 pesticides currently approved for use, tolerance levels have so far been included under Rule 65 of the PFA Rules, for only 71 pesticides. This is less than 50% of the registered pesticides. Those not included under the PFA Act include some pesticides which are termed as "deemed pesticides", which were approved prior to 1971 and for which, therefore, no data is available for undertaking risk assessment from the point of view of food safety and for fixing Maximum Residue Limits. There are also other laws that regulate the manufacture and use of pesticides in the country. The Environment Protection Act, 1986, under the Ministry of Environment & Forests is one other such legislation. Under this Act, several Rules apply to insecticides – like the 'Manufacture, Import and Storage of Hazardous Chemicals Rules' of 1989. This is to mainly avert accidents and manage such disasters, if any. There is also a Public Liability Insurance Act of 1992, again under the Ministry of Environment and Forests, that would apply to pesticides. Other rules under the EPA like the Hazardous Waste (Management & Handling) Rules, 1989, Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981 would be applicable to pesticides, as a Joint Parliamentary Committee's report notes (JPC Report, 2003). The Factories Act of 1948 under the Ministry of Labour will apply to the manufacture of pesticides in the country. The Act consists of 12 Chapters dealing with, among other things, health, safety, special precautions to be taken in the case of hazardous processes, welfare, working hours, employment of women and young persons, leave, penalties, etc. Pesticides, Residues & Regulation in India 16 POLICY Official policy of the Indian government with regard to pest management is that of Integrated Pest Management [IPM]. Right from the time of the Rio Earth conference, India has been highlighting this IPM policy in all its official documents.

The ICAR had also established a National Centre for Integrated Pest Management in 1998 and later shifted it to IARI in 1995. Integrated Pest Management is defined as an eco-friendly approach for pest management encompassing cultural, mechanical, biological methods and need-based use of chemical pesticides with preference to use of biopesticides, biocontrol agents and indigenous innovation potential. What is important to note is that there is much data generated by the agriculture research establishment in India to show that non-chemical IPM practices across crops have yielded better results in terms of pest control and economics for farmers. However, the field level use of pesticides has not changed much. The official establishment usually claims that pesticide consumption in the country has come down because of the promotion and deployment of IPM practices on the ground by the agriculture research and extension departments [as was informed to the JPC in 2003]. However, the actual progress of IPM on the ground has been quite dismal and small. Further, the government often fails to take into account the fact that even if pesticide consumption has decreased in terms of quantities due to a shift to consumption of low-volume, high-concentration, high-value pesticides, the real picture in terms of number of sprays and costs involved is still the same for the farmers. The government reported in the Parliament that since the 8th Plan, the government has established 26 Central IPM centres. Many farmers' field schools have been set up where seasonlong trainings have been undertaken for master trainers. Grant-in-aid is provided to State Governments for establishment of State Biocontrol Laboratories. Twenty-nine such laboratories have been established. Government of India has also prepared IPM packages for fifty one crops with the help of ICAR. The main measures adopted under the IPM programme are supposed to be: • popularizing IPM approach among the farming community • conducting regular pest surveillance and monitoring to assess pest/disease situation • rearing biological control agents for their field use and conservation of naturally occurring bio-agents • promotion of bio-pesticides and neem based pesticides as alternative to chemical pesticides • inclusion of bio-pesticides in the Insecticides Act' Schedule with a view to ensure their quality • to play a catalytic role in spread of innovative IPM skills to extension workers and farmers – HRD in IPM by imparting training to master trainers, extension workers and farmers through Farmers' Field Schools [FFSs] • organisation of FFSs through KVKs, NGOs, SAUs etc. • organization of short duration courses for pesticide dealers, private entrepreneurs, progressive farmers etc. Pesticides, Residues & Regulation in India 17 • release of grants-in-aid to states and NGOs for establishment of bio-control laboratories A total of 9,111 Farmers' Field Schools (FFSs) have been conducted by the Central Integrated Pest Management Centres under the Directorate of Plant Protection, Quarantine & Storage from 1994-95 to 2004-05 wherein 37,281 Agricultural Extension Officers and 2,75,056 farmers have been trained in IPM. Similar trainings have also been provided under various crop production programmes of the Government of India and the State Governments. IPM is sought to be made an inherent component of various schemes viz., Technology Mission on Cotton (TMC), Technology Mission on Oilseeds and Pulses (TMOP), Technology Mission on Integrated Horticultural Development for NE, J & K, Himachal Pradesh, Uttaranchal, Technology Mission on Coconut Development etc. besides the scheme "Strengthening and Modernisation of Pest Management" approach in India being implemented by the Directorate of PPQ&S [Plant Protection, Quarantine & Storage]. In a response to a Parliamentary question, the Ministry of Agriculture expressed that most of the limitations of the IPM programme in India are connected with insufficient production of biopesticides and bio-control agents, the fact that the life span of bio-control agents is limited and so on. INSTITUTIONS & PLAYERS INVOLVED:

In addition to the above laws and the above-described policy of Integrated Pest Management and its implementation, there are other institutions that are involved in the active research, promotion, marketing and use of pesticides in the country, as well as in monitoring pesticide residues. Some of these institutions are listed below: Pesticides Industry in India: In India, the pesticides industry value is estimated to be around 4500 crore rupees. The Indian pesticides industry is the largest in Asia and produces around 90,000 metric tonnes of pesticides annually. The average growth rates of this industry fluctuate between 3% and 15%. The production of pesticides began in the mid-1950s when the first DDT and BHC plants were set up with the help of the World Health Organisation.

Flowing from a conscious and strong boost from the government, the production and consumption of pesticides in agriculture grew quite a lot thanks to the Green Revolution in the country. Most of the pesticides produced in the country are consumed in the domestic market, mainly in agriculture sector – the industry is however seeing a great spurt in exports – both in volume and value – in the recent past. The agricultural sector consumes around 67% of the pesticides produced; within the agricultural sector, two thirds of the consumption is taken up by just a few crops like cotton, paddy, vegetables and fruits. There are around 60 large technical grade manufacturers, including some large multinational companies. The multinational companies include Syngenta, Bayer CropScience, DuPont, Monsanto and DeNocil. Prominent names amongst the Indian players are Rallis (Tata group), United Phosphorus Limited, Searle, Excel Industries, Gharda, Lupin, Aimco Pesticides Ltd, Dhanuka Pesticides, Hindustan Insecticides Limited etc. There are also more than 500 formulators who buy technical grade pesticides from the manufacturers to be processed into formulations. In addition to the technical grade manufacturers and formulators, the marketing of pesticides involves an elaborate distributor and dealer network across the country. Just Bayer [Crop Science and Chemicals], which has a 22% market share in the pesticides market of India operates Pesticides, Residues & Regulation in India 18 through 2500 distributors and 35,000 dealers. Similar is the network used by other large companies operating in India. Export of Indian pesticides has been increasing over the years, while imports have increased at a slower rate too. Amongst the states in India, pesticide consumption varies. Andhra Pradesh is the largest state for pesticides market, followed by Punjab, Maharashtra, Karnataka, Haryana, Gujarat, West Bengal and Tamil Nadu. Pesticides consumption – India – gms/hectare: Country 1999-01 Andhra Pradesh 302 Bihar 82 Gujarat 331

Haryana 827 Karnataka 201 Madhya Pradesh 61 Maharashtra 168 Punjab 889 Tamil Nadu 261 Uttar Pradesh 285 West Bengal 372 Source: FAO stats http://www.fao.org The pesticide consumption varies vastly across different states, depending on several factors, including cropping patterns, irrigation facilities, pest resurgence and resistance situations and so on. Out of the total agrochemical market in India (which varies between 4000 and 4500 crore rupees), approximately 1200 crores worth of pesticides is of counterfeit or spurious chemicals every year, as per industry's own estimates. The industry also admits that in 2000-01, in India, crop loss due to pests were about 60,000 crores of rupees despite plant protection measures! These losses are from 25% of the treated area [FICCI, 2006]. Amongst crops which consume the largest amounts of pesticides, cotton, fruits & vegetables, rice, maize, soybean etc., are to be listed. Highest consumed pesticides in India include Monocrotophos, Endosulfan, Phorate, Chlorpyriphos, Methyl Parathion, Quinalphos, Mancozeb, Paraquat, Butachlor, Isoproturon and Phosphamidon. In volume terms, Organochlorine pesticides constitute 40% of pesticide use, followed by Organophosphates at 30%, Carbamates at 15%, Synthetic Pyrethroids at 10% and others at 5%. In value terms, Organophosphates dominate at 50%, followed by Synthetic Pyrethroids at 19%, followed by Organochlorines at 16%, Carbamates at 4%, Biopesticides at 1% and so on1 .

India is mostly a generic pesticide market (production and use of old molecules which have gone off-patent continues here). Unlike countries like Sweden which have policies related to de-registration of molecules after a particular period, India continues to use pesticides created in the 1950s and 1960s also, which have been subsequently banned in many other countries, including developing countries like Srilanka, Syria, Indonesia, Thailand and some African countries. 1 Production of pesticides in the past few years has been provided in an annexure, as per the PMFAI [Pesticides Manufacturers and Formulators Association of India] Pesticides, Residues & Regulation in India 21 National Agricultural Research System [NARS]: The National Agricultural Research System [NARS] includes the Indian Council of Agricultural Research [which is an autonomous body under the Department of Agricultural Research & Education, under the Ministry of Agriculture, Government of India] and 38 state agricultural universities, 5 deemed-to-be-universities [these are national research institutes in agriculture, dairying, veterinary science, fisheries etc.], 1 Central Agricultural University and 3 Central Universities for the North-Eastern states. The Research set-up of the ICAR includes 47 Central Institutes, 5 National Bureaus, 12 Project Directorates, 31 National Research Centres, and 91

All-India Co-ordinated Research Projects. The ICAR promotes research, education and extension education throughout the NARS by giving financial assistance in different forms. For communication of research findings among farmers, the ICAR maintains a network of Krishi Vigyan Kendras, and Trainers' and Training Centres along with Zonal Co-ordinating Units. Within the ICAR, there is a Crop Science Division, which has a technical section on Plant Protection. Each Section is headed by an Assistant Director General [ADG], assisted by Principal Scientists who constitute middle management. The Plant Protection Section reports to have worked out the etiology, epidemiology and management of major diseases/insect pests and developed location-specific IPM modules for sustainable crop production. The Section also claims that adoption of IPM modules has helped in lowering the quantum of pesticide use. Then there is the Indian Agricultural Research Institute [IARI] in the ICAR. The IARI has a Division of Agricultural Chemicals, set up long ago in 1966. The Division has a mandate to devote exclusive attention to the various aspects of research on pesticides and allied agro-chemicals. The Division generates information on pesticide development, formulation, safety evaluation, biotic and abiotic transformations and so on. The Coordinating cell of the All India Coordinated Research Project (AICRP) on Pesticide Residues, since then re-designated as the All India Network Project on Pesticide Residues [AINPPR], is located in this Division in IARI. This Cell is supposed to serve as a link between the Division and similar other departments in various ICAR institutes and agricultural universities. AICRP on Pesticide Residues or All India Network Project on Pesticide Residues The Ministry of Agriculture through ICAR started an All-India Coordinated Research Project on Pesticide Residues way back in 1984-85.

The aims of the project were to develop protocols for safe use of pesticides by recommending "good agricultural practices" [GAPs] based on "multinational supervised field trials"; to recommend waiting period/pre-harvest interval so that the residues in the food commodities remain well within the prescribed safe limits; and monitoring of pesticide residues in agricultural produce. The data thus generated is to be used for fixing Maximum Residue Limits. In Hyderabad the project is located in Acharya NG Ranga Agriculture University. In 2005, a Central Sector Scheme for Monitoring of Pesticide Residues at the national level has been approved in order to ascertain the prevalence of pesticide residues at farmgate and market yards to enable remedial measures to be undertaken as required. Under this, 21 laboratories under various Ministries/Departments have been provided with equipments to undertake analysis of pesticide residues in vegetables, water, meat & meat products, and marine products. Pesticides, Residues & Regulation in India 22 While this might be so, the Ministry of Agriculture also feels that the inspection of fruits and vegetables for the presence of pesticide residues and other harmful substances falls under the purview of the Ministry of Health & Family Welfare [response by the Minister for Agriculture in the Parliament in December 2006]. As per the directions of the Inter Ministerial Committee constituted to review the use of hazardous chemicals and insecticides, 33 samples of vegetables have been drawn from Agricultural Produce Marketing Committee, Azadpur, Delhi since June, 2006 and tested for residues of organo-chlorine, organo- phosphorus and synthetic pyrethroids pesticides. Residues of chlorpyriphos were detected in two of these samples at the level of 0.18 ppm. 24 of these samples have also been analysed for the presence of heavy metals like lead, cadmium and arsenic. The heavy metals found in the samples of vegetables were below the maximum limit prescribed under the Food Adulteration Rules, 1955. India also has a National Plant Protection Training Institute, which is located in Hyderabad. The Institute has been set up for human resource development in plant protection technology by organizing long and short duration training courses on different aspects of plant protection. The NPPTI organizes post graduate diploma course in Plant Protection of 10 months' duration for in-service personnel of states/Union Territories and unemployed agricultural graduates, in addition to courses in analysis of pesticides formulation and pesticide residues of 3 months' duration each for the benefit of state pesticide testing laboratories, state agricultural universities etc. There are also short duration courses of 1 or 2 weeks for the extension personnel of states that the Institute undertakes. Department of Agriculture in state governments While the CIBRC (Central Insecticides Board and Registration Committee) in the Government of India relies on the NARS and the Ministry of Health & Family Welfare for registering pesticides, fixing MRLs, coming up with Good Agriculture Practices and so on, it is the extension department of each state government that is supposed to promote such GAPs with farmers who are the endusers of these pesticides. They come out with recommended package of practices, based on agriculture scientists' R & D and through Agriculture Officers working along a hierarchy in the department, reach out to farmers with messages related to plant protection. What is interesting to note is that more than the personnel of these extension departments, it is the pesticide industry's retailers who have a more direct access to farmers through their marketing strategies as well as because of constant downsizing of the extension departments over the years. The pesticide manufacturers adopt a variety of strategies to promote their products with farmers – they organize demonstrations in farmers' fields, field days and melas, give freebies and organize contests. They also set targets for distributors and dealers in terms of volume of sales to be accomplished. If such targets are met, there are special incentives like taking the dealers and their families on holiday tours, gifting them with gold jewellery etc. Farmers' economic dependence on pesticide dealers is also one of the reasons why they tend to rely on the advice of dealers and why they adopt recommendations given by the dealers, especially in the absence of consistent extension support from the department of agriculture. Dealers double up as credit suppliers in the absence of proper institutional credit facilities. Pesticides, Residues & Regulation in India 23 Majority of farmers also being illiterate and untrained about chemical pesticide usage, they tend to think that pesticide usage as recommended by the dealers would solve their pest management problems. There is no similarity between farmers' actual usage of pesticides to that recommended at the time of registration or later by agriculture universities and departments. Some concepts for regulating pesticides and their residues for Food Safety Pesticides and their contamination of food products are sought to be regulated through some concepts like Maximum Residue Limits [MRLs], Average Daily Intake [ADIs] and Good Agriculture Practices [GAPs]. Maximum Residue Limit (MRL) is the maximum concentration of a pesticide residue resulting from the use of a pesticide according to Good Agricultural Practice (GAP).

It is the limit that is legally permitted or recognized as acceptable in or on a food, agricultural commodity, or animal food. The concentration is expressed in milligrams of pesticide residue per kilogram of the commodity. Under the PFA Act, MRL or Tolerance Limits (TLs) are fixed considering MRLs recommended by Codex or based on supervised trials conducted in India as well as the dietary habits of our population. Pesticides, being toxic in nature, are supposed to be thoroughly screened for their safety, using different animal models. For this purpose, studies on acute toxicity, chronic toxicity, allergenicity etc., are undertaken. These data are evaluated and the No-Observed-Adverse-Effect Level (NOAEL) is calculated from the chronic toxicity studies. In case of toxic pesticides, acute reference dose is also taken into consideration. This NOAEL and Acute Reference Dose are supposed to be taken as the starting information for prescribing the tolerance limits of pesticides in food commodities. NOAEL is usually referred to in terms of milligrams of that particular pesticide per kilogram of body weight. From this NOAEL, the Acceptable Daily Intake (ADI) is calculated by dividing the figure normally with a safety factor of 100. The figure 100 is taken into consideration as a multiple of 10 (10x10), where the first 10 provides for inter-species variation while the second 10 provides for intra-species variation. Therefore ADI, which is expressed in terms of mg/kg body weight, is an indication of the fact that if a human being consumes that amount of pesticide everyday, throughout his lifetime, it will not cause appreciable health risk on the basis of well known facts at the time of the evaluation of that particular pesticide. MRL is therefore a dynamic concept dependant on extant knowledge and is therefore required to be renewed from time to time. Terminal residues of a particular pesticide on a treated crop are estimated from supervised trials, to assess the maximum residue limit which the pesticide leaves when used as per the Good Agricultural Practice (GAP). Data from nutritional surveys, which reflects details of the regional diet patterns and the quantum of a particular diet taken by human beings, is also needed when estimating the likely daily intake of any given pesticide through food. Thus, the above three parameters i.e. ADI, terminal residues as per Good Agricultural Practice on the crop and the diet pattern of the population are the critical inputs needed to derive the maximum residue limits (MRLs) of pesticides in food commodities. While deriving MRLs, the loss of residues during storage, drying, cooking, washing etc., are also taken into consideration. The main objective of the risk assessment from the point of view of food safety is to ensure that the sum total of pesticide residues in the total diet does not exceed ADI, even after taking into account the possible exposure through other sources. While that is the theory behind fixing these limits, the reality is something else. Pesticides, Residues & Regulation in India 24 SITUATION IN INDIA While the Registration Committee (RC) registers pesticides for their usage, their MRL in food and commodities are prescribed by the Ministry of Health and Family Welfare under PFA (Act), 1954 and rules framed thereunder. What is alarming to note is that in India, MRL as a concept is being wrongly formulated while implementation status is worse.

While pesticides are registered without MRLs being necessarily fixed before or during registration, there are no enforcement mechanisms available to ensure liability for violation of MRLs at least by the organized food industry. During evidence to the Joint Parliamentary Committee formed in 2004, representative of the Ministry of Agriculture and the Director General of Health Services admitted that out of 181 pesticides registered at that time, tolerance limits (MRLs) have been fixed for only 71 pesticides. For another 50 pesticides, such tolerance limits were in the process of finalization. It has been concluded that there are about 27 pesticides registered in the country which do not require fixation of tolerance limits. This means 32 pesticides which are still left for tolerance limits to be fixed – for eight of these, it was decided to follow Codex norms for the time being since data was not available and was being collected. Data for 24 pesticides where are "deemed-to-beregistered" has been submitted. A small example to illustrate the situation with regard to MRLs can be the case of Chilli crop. A list of Pesticides recommended for use as per Insecticide Act, 1968 (as per the information obtained from website of CIBRC 17-01-2007) on Chilli crop is given below. Product Name Carbendazim 50% WP Phorate 10% C.G Endosulfan 4% D.P Quinalphos 25% EC Fenthion 82.5% EC Carbofuran 3% C.G. Dimethoate 30% E.C Endosulfan 35% E.C. Imidacloprid 70% WS Captan 75% WS Fenitrothion 50% E.C. Carbaryl 4% + Lindane 4% GR Fipronil 5% SC Dinocap 48% EC Sulphur 52% flowable However, fixing of MRLs for these pesticides presents another situation. Pesticides for which MRLs are set as per PF Act Carbaryl 5 ppm Dicofol 1 ppm Dimethoate 0.5 ppm Endosulfan 1 ppm Inorganic bromide 400 ppm Pesticides, Residues & Regulation in India 25 Monocrotophos 0.2ppm Mancozeb 1 ppm Quinalphos 0.2 ppm Thiophanate Methyl 0.2 ppm While 15 pesticides have been registered for use on Chilli crop, MRLs have been set for only 8 pesticides under the PFA.

For most pesticides, MRLs are not set, and what is more, many commonly recommended new pesticide molecules are not registered for use on chillies as per Insecticide Act! 'Indiscriminate Use' or 'Indiscriminate Recommendations'? As part of this study, an interesting exercise was taken up, to compare the data between registration recommendation for each pesticide and the recommendations of agriculture departments and finally, the recommendations by the companies manufacturing and selling the pesticides. For example, Acephate is registered for use only on Cotton and Safflower in the country. It is not registered for use on Chillies, Brinjal, Cabbage, Cauliflower, Apple, Castor, Mango, Tomato, Potato, Grapes, Okra, Onion, Mustard, Paddy and many other crops where it is being used extensively now. Further, it is also being recommended by the NARS for use in other crops even without registration! Acephate is being recommended for the control of sap sucking pests in most crops. Further, MRLs have been set only for safflower seed and cotton seed for this pesticide. Other examples of pesticides being recommended by NARS establishment, in violation of registration conditions of the CIB [against the registered status by CIB&RC] are given for two crops below. It is not clear how the

Horticulture department is coming up with its recommendations and the scientificity of the same! It is not only the public sector bodies that are violating the registration rules. The pesticide industry also recommends pesticides that are in violation of the CIB registration norms, as the following table illustrates. Pesticides, Residues & Regulation in India 28 Insecticide Company recommendations* Name/ Technical Name Company name Trade name Crops Insects CIB recommenda tions** Carbendazim 50% W.P. Nagarjuna Agrichem Ltd Zen Rice Sheath Blight Recommended Maize Brown spot Cotton Leaf spot Recommended Ground nut Tikkaleafspot Recommended Peas Powdermildew Recommended Brinjal Leaf spot Recommended fruit rot. Recommended Grapes Tikkaleafspot Tobaco Leaf spot Tikka leafspot Carbendazim 50 % WP BASF india Ltd Bavistin Ground nut Tikka leafspot Recommended Cotton Leaf spot Recommended Rice Sheath Blight Recommended Blast Recommended Apple scab Recommended Wheat Loose Smut Recommended Flag smut Foot rot Grapes Anthracnose Recommended Chillies Damping off Recommended Mango Leaf spot Blight will Powdery mildew Rose Powdery mildew Recommended Tobaco Frog eye spot Anthracnose Carbofuran 3% G Rallis India Ltd Tatafuran Bajra Shootfly Recommended Barley Aphids Recommended Jassids Recommended Cyst Nematode Recommended Maize Stemborers Recommended Shootfly Recommended Thrips Recommended Climbing cutworm Paddy Brown plant Hopper Recommended Gallmidge Recommended Green leaf hopper Recommended Leaf roller/folder Recommended Hispa Recommended White back plant Hopper Stemborers Whort moggot Nematodes Sorgam Shootfly Recommended Stemborers Recommended Cotton grey weevil Flea beefle Wheat Ear cockle Nematodes Recommended Pesticides, Residues & Regulation in India 29 Cereal cyst Nematodes Recommended Cotton Jassids Grey Weevil Stem Weevil Jute Nematodes Recommended Ground nut Pod borer Recommended White grubs Recommended Mustard Mustard leaf hopper or miner Recommended for miner Flea beefle pea Aphid PeaShoot fly Soybean Agromyzid fly White fly Recommended Root knot Nematode Recommended Sugarcane Top borer Recommended Brinjal Root knot Nematode Recommended Reniform Nematodes Recommended Okra Jassids Recommended Chillies Aphids Recommended Thrips Recommended Cabbage Nematodes Recommended Franch bean White grubs Recommended Potato Aphids Recommended Jassids Recommended Tuber Nematodes Tomato Root knot Nematode White fly Recommended Sweetpepper Thrips Apple Woolly,Aphid Recommended Banana Rhizome Weevil Recommended Aphids Recommended Nematodes Recommended

Citrus Nematodes Recommended Leaf roller/folder Mandarrims Soft green scale Recommended Citrus leaf miner Recommended Peach Leaf curl aphid Recommended Tea Cockchafer grubs Tobacco Green peach aphid Root knot Nematode Nematodes Stemborers While the above table illustrates the situation with regard to regulatory violations by companies in the case of only two pesticides (and two companies), an annexure provides more data on this issue. Secondly, the study found that pesticide recommendations do not match with the data produced within the NARS on resistance that had developed in insects for each of those insecticides. It is obvious that insecticide resistance data is not being generated to organically feed into recommendations on use. Farmers in this country have often been blamed for "indiscriminate use" of insecticides [not following the prescribed recommendations] but the data generated by Pesticides, Residues & Regulation in India 30 agriculture scientists on insecticide resistance shows that farmers had good reason for this 'indiscriminate use'. Insecticide resistance to insects As the toxic chemicals are regularly introduced into the crop ecology for the control of pests, there are many means by which an insect/disease causing organisms can develop resistance to the toxins.

As pesticide consumption in India increased from 434 metric tones in 1954 to over 90,000 metric tones till 2001, resistance to pesticides is now known in over 504 insect and mite pests in comparison to only seven insect-pests in 19542 . The same pest occurs in other crops – however, the same pesticides are recommended! Pesticides, Residues & Regulation in India 32 Safety of MRLs An interesting exercise done by Centre for Science and Environment on the non-compatibility between ADI and MRLs in India brings forth the fact that even if MRLs are prescribed are followed in reality, they would be far beyond the ADI levels fixed for each pesticide. Therefore, the question to be asked is "How Safe Are MRLs?". MRLs can be considered safe only if the cumulative daily intake of pesticides remains within the ADI [which is supposed to be worked out based on chronic toxicity]. Such cumulative daily intake depends on the individual [child or adult], the socio-cultural context of dietary intake and on the Theoretical Maximum Daily Intake [TMDI] of pesticides worked out on this basis. CSE did an exercise of calculating the actual TMDI against the ADIs and MRLs of around eight pesticides for the average Indian diet. In the case of Monocrotophos, for example, they first put down the Indian MRL [in mg/kg body weight] for various food commodities like wheat, rice, pulses, vegetables, vegetable oils, milk etc. As per the diets of an average Indian, the total pesticide intake of Monocrotophos for an average adult, for an average Indian diet works out to be 0.1510 mg/day. The prescribed Average Daily Intake of Monocrotophos is 0.0360, based on chronic toxicity potential. Therefore, the total pesticide intake theoretically works out to be 419% more than the ADI. There are other detailed total diet studies which have also reflected similar findings. This raises basic points about the way MRLs are fixed, almost cut away from the ADIs being prescribed through health impact studies. This questions the very validity of considering MRLs as an indication of how safe our food is and the fact that almost all pesticide surveillance rests on such parameters. Pesticides, Residues & Regulation in India 33 4. Vegetable Cultivation around Hyderabad and Consumption in Hyderabad The following is a picture of vegetable cultivation in Andhra Pradesh, as per the Department of Horticulture. From this data, the largest vegetable-cultivating districts in the state are Kurnool, East Godavari, Rangareddy, Chittoor, Guntur, Mahbubnagar and Medak in that order. Cuddapah and Prakasam districts show relatively higher production even with lesser extents under vegetable cultivation as per the department's data. The area of vegetable cultivation hovered around 2.2 lakhs to 2.5 lakh hectares during the past several years, while the production ranged from 27 lakh metric tonnes to 38 lakh metric tonnes.

A compilation of data for some major vegetables [sourced from the Horticulture department's information], from the main districts surrounding Hyderabad [Rangareddy, Medak, Nalgonda and Mahboobnagar], gives the following picture. Pesticides, Residues & Regulation in India 34 Area & Production of vegetables in districts around Hyderabad, From the table above which reflects the trends from previous years, the largest-cultivated vegetables around Hyderabad are Chillis, Tomato, Onion, Bhindi (Okra) and Brinjal in that order. Peri-urban vegetable cultivation is an important agricultural activity for many small and marginal farmers around Hyderabad. Such vegetable cultivation takes place in villages of neighboring districts like Rangareddy, Mahbubnagar, Medak and Nalgonda. Vegetables produced around the city are brought to some major markets on a daily basis from the villages. These include markets like Bowenpalli market, Gaddiannaram market, Gudimalkapur market, Mozamjahi market, Rythu Bazaars etc., which are under the control of the Agriculture Market Committee of Mozamjahi market. The rythu bazaars are supposed to provide space for farmers to market their produce directly to consumers without having to go through middlemen, through transportation arrangements made directly from the villages to the markets. In addition, vegetables like potatoes come from slightly distant production locations including from other states. Consumption data was obtained from one large market to understand the picture of vegetablewise consumption. The following is the information obtained from the Agricultural Market Committee [AMC] at Mozamjahi market in 2004-05 and the last column gives a picture of the average monthly consumption of vegetables from this market in kilograms. Pesticides, Residues & Regulation in India 35 As can be seen from the table below, the average monthly consumption of vegetables from this market ranges from around 1250 Tonnes to 1600. In addition, the following data (2005-06) shows that potatoes, tomatoes, green chillis, carrot and cabbage are some of the most consumed vegetables in the city in that order.: Vegetables arrivals data from Agricultural Marketing Committee, Mozamjahi Market, Hyderabad. Pesticides, Residues & Regulation in India 36 5. Pesticide Use in Vegetable Cultivation around Hyderabad Data on pesticide use in vegetable cultivation was obtained by visiting villages and holding group discussion with vegetable growers in villages Aziznagar, Pedda Mangalaram. The following was the information obtained with regard to the pesticide use at the farm level for some select crops. Many of these pesticides are not recommended and registered with CIB for use against the particular pest in that crop.

Discussion & Recommendations: There are serious unanswered questions related to pesticide registration processes and procedures in the country. To begin with, risk assessment of pesticides is taken up as a routine risk assessment of hazardous chemicals rather than as impact assessment vis-à-vis ecological practices in agriculture for pest management, during the registration process. Further, the food safety assessment of pesticides is de-linked from its registration process – registration happens without ADIs or MRLs being first fixed and without MRL-fixation flowing out of chronic toxicity data. Even in cases where MRLs are fixed, they may not be fixed for all the commodities for which registration has been allowed. The safety assessment from a long term perspective related to health impacts – whether it is related to potential endocrine disruption or teratogenecity or immune system disruption or reproductive health damage and so on. Registration happens based on the developers' data and not independent data generated. At another level, there is an institutional conflict of interest with the Ministry of Agriculture, with a mandate of increasing agricultural production through the use of any technology, expected to regulate pesticides from an environmental and health point of view. The ones who register pesticides have hardly monitored pesticide residues nor is there a system of periodic, automatic review of registered pesticides. It is not clear whether the AICRP on pesticide residues feeds into decision-making related to registration and licensing of pesticides. Further, the system of registering pesticides without MRLs being fixed continues. The current research effort discovered that pesticide residue data is not pro-actively shared with the public nor does it inform regulation related to registration and use. Most surveillance related to pesticide contamination is not shared with the public. In fact, data is presented mostly in forms that make pesticide residues look safe. Official pesticide residue surveillance system's findings do not match with independent studies in the country. There seems to be under-reporting of the level of contamination of Indian products and this is reflected by frequent reports of Indian agricultural export consignments being rejected in other countries due to high levels of residues detected in such consignments. The greater question of whether MRLs fixed are safe or not, from the point of chronic toxicity remains. As CSE's work on MRLs, TMDIs and ADIs has shown, the MRL-fixation itself is questionable in the country in addition to the fact that MRLs are yet to be fixed for many pesticides! Even if MRLs are fixed for all crops for all commodities they are used on and even if such MRLs are followed, there is no guarantee that the cumulative intake of such pesticide residues will be within the Acceptable Daily Intake levels! Further, there is an additional complication allowed through law, in the form of Provisional Registration. Section 9 (3) (b) of the Insecticides Act allows provisional registration of some pesticides without sufficient data generated for assessing safety or efficacy. Pretty often, there are many violations witnessed in the use of such a provisional registration. A popular pesticide like Avaunt (brand name of Indoxacarb) was introduced through such a provisional registration and witnessed aggressive marketing even during that stage. Pesticides, Residues & Regulation in India 39 Research for the current study also revealed that there is gross mismatch between data generated and accepted during registration of pesticides and put out by the CIBRC (which pesticide to be used for what crop, with what GAPs etc.), such data put out by the agriculture/horticulture departments of the state governments and the information put out by the pesticide industry. Needless to say, all of this would not match with the actual use patterns on the ground by farmers, for a variety of reasons. There is also the issue of too many chemicals – that too broad spectrum - being allowed for use for pest control of a specific pest on a specific crop. As CSE has pointed out in its materials, too many chemicals registered means increased costs of regulation and surveillance too. Such costs have to be met out of the tax-payers' money of course. It is not clear how "restricted use" is actually regulated on the ground, after designated a pesticide for ‘restricted use’. Though there are some regulations that the state government brings in for enforcement using its own authority of regulating marketing [like the Andhra Pradesh state government prohibiting marketing of synthetic pyrethroids for use on cotton crop before September each year], enforcement on the ground is weak of such measures too.

RECOMMENDATIONS As the above discussion shows, there are serious shortcomings in the regulatory regime governing pesticide registration and enforcement of such regulation. It becomes increasingly clear that the best regulation to assess and reduce the impact of pesticides has to come at the time of registration itself. Registration processes have to become transparent, broad based and open to public and scientific scrutiny. Such registration has to incorporate safer alternatives into its impact assessment processes. Further, registration should have an in-built mechanism of periodic reviews and should include comparative risk assessment methodologies before introduction of new pesticides. The systems of surveillance related to pesticide residues, resistance buildup in insects etc., have to organically feed into registration decisions. This is the system followed in several countries including some developing countries. Accountability mechanisms on the pesticide industry and the regulators have to be stringent in case of environmental health harms. Standard setting for ADIs and MRLs has to be comprehensive. Better and adequate extension support to farmers is essential for the enforcement of standards. Serious curbing of the aggressive marketing that the pesticides industry engages in, in the pursuit of markets, is a pre-requisite for ensuring safe food for all Indians. There are more pesticides on the market than are needed for the same pest/crop in many cases, often confusing the farmers at the time of purchase. Irrational decisions are actually encouraged through such an environment. It is also clear that the agriculture research establishment is flouting various registration clauses in its violations, almost in competition with the pesticide industry itself. Liability for violations should apply to agriculture universities and other public sector institutions too. Finally, it is also clear that when data is generated for a pesticide, it is generated either for its efficacy or its economics or its safety. Such assessment is not done against established ecological alternatives that farmers are practicing to support the best alternative for farmers in terms of safety, affordability, sustainability and efficacy. Each individual chemical is assessed independently rather than being assessed for its very need to be registered as a pest management option vis-à-vis some ecological alternatives that are available with farmers. The Pesticides, Residues & Regulation in India 40 Non Pesticidal Management [NPM] experience in Andhra Pradesh and its success is enhancing farming livelihoods is appended. This experience on a large scale (of more than two lakh acres of farming being done by women farmers without the use of chemical pesticides) has more than adequately proven that pesticides are not inevitable in our farming. Any fundamental change related to pests, pesticides, pesticide residues and their regulation has to therefore begin by recasting the very pest management paradigm adopted and promoted in this country. Pesticides, Residues & Regulation in India

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CHAPTER II

MATERIAL AND METHODS

Assortment of Samples: The samples were collected from randomly chosen brinjal and tomato plants. After collection of samples, about 1kg sample was separated, sealed in polythene bags and stored at -4^{o}C for residues analysis of carbofuran, acephate, chlorpyriphos, dichlorovos, and imidachloprid. The extraction, clean-up and analytical work was followed by Asi. *et.al[8]*.

HPTLC Residual Analysis method: Brinjal and Tomato samples were extracted by ethyl acetate and analyzed by HPTLC with enzyme inhibition horse blood serum method(acetylcholine esterase enzyme) which was very sensitive for the detection of insecticide residues. The extract was spotted on silica gel plate, which was developed in mobile phase (ethyl acetate) and spot visibility was determined after spraying with acetylcholine esterase enzyme and tris-buffer solution. Rf value and average spot diameter was measured and imidachloprid, carbofuran, acephate, dichlorovos and chlorpyriphos residue concentration in ppm was calculated comparing the standard reagent spot diameter Asi. *et.al*. [8].

Fresh samples of Brinjal and Tomato were collected from various fields in local area of Bijapur. Samples were kept and wrapped in clean paper bag. Small sachet of silica gel helps to keep away it from moisture. A total of three different samples of each vegetable were collected for the analysis.Their detection and quantification by different analytical techniques are the major steps involved in pesticide residue analysis**.**

Reagents and Materials. Water and Acetonitrile were HPLC grade; Analytical grade Dimethyl formamide; anhydrous sodium sulphate were obtained from Fischer-Scientific. Acetic acid and sodium acetate from Merck were used for sample preparation. Analytical grade pesticide standards were obtained from Sigma-Aldrich. Crystalline standards were dissolved in acetonitrile for preparation of stock solution of standards. A standard mix solution was prepared from the individual stock solution to yield 10 mg/ml.

Sample Preparation. The acetate buffered sample preparation method for pesticide was applied to all samples. 50g samples were chopped and crushed in household grinder equipped with stainless steel blades and homogenize with 100 ml acetonitrile. Then 10 g of sodium chloride is added to it. Then, 6 g Na_2SO_4 were added to absorb moisture and shaken well. The extract was centrifuged at 5000 rpm for six minutes. Then ~15ml of the supernatant were filtered through a 0.45 mm PTFE filter. Pesticide was eluted with 20 ml acetonitrile. Sample was concentrated using a rotary evaporator. HPLC Condition Analytical Technologies 3000 series HPLC having UV/visible detector was used for identification and quantification of pesticides. Separation was performed on C18 (4.6ID x 250mm) column. Samples were injected manually through Rhyodyne injector. Detector was connected to the computer for data processing. The working condition of HPLC was binary gradient, mobile phase was acetonitrile: water (70:30), flow rate was 0.8ml/min, injection volume 20 µl, pressure 6-7 MPa and the wavelength of the detector was fixed at 254 nm for the residual analysis of three pesticides endosulfan, Carbendazim &Chloropyrifos. GC Condition Analytical Technologies GC 2012 model having FID detector was used for identification and quantification of pesticides. Separation was performed on Carbowax Packed column (SS 2meters). Samples were injected manually through Rhyodyne injector. Detector was connected to the computer for data processing. Following temperature conditions were maintained: Constant flow rate 1.0 ml/min, injection volume 1.0 µl, injector temperature 100^{o}C, Oven temperature110^{o}C, Detector temperature110^{o}C. Total MS running time 20 min. The individual constituents showed by GC were identified by comparing their MS with standard compounds of NIST library.

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CHAPTER III

ANALYSIS OF PESTICIDE RESIDUES IN VEGETABLES IN VIJAYAPUR, KARNATAKA INDIA

INTRODUCTION

Fruits and vegetables are important components of the human diet since they provide essential nutrients that are required for most of the reactions occurring in the body. Like other crops, fruits and vegetables are attacked by pests and diseases during production and storage leading to damages that reduce the quality and the yield. In order to reduce the loss and maintain the quality of fruits and vegetables harvest, pesticides are used together with other pest management techniques during cropping to destroy pests and prevent diseases. The use of pesticides have increased because they have rapid action, decrease toxins produced by food infecting organisms and are less labour intensive than other pest control methods. However, the use of pesticides during production often leads to the presence of pesticide residues in fruits and vegetables after harvest. The presence of pesticide residues is a concern for consumers because pesticides are known to have potential harmful effects to other non-targeted organisms than pests and diseases. The major concerns are their toxic effects such as interfering with the reproductive systems and fetal development as well as their capacity to cause cancer and asthma.[1] Some of the pesticides are persistent and therefore remain in the body causing long term exposure. The concern has led to governments setting up monitoring systems in order to assess the safety situation and make informed decisions when passing legislation.

Pesticides are used worldwide to protect crops before and after harvest in agriculture, gardening, homes and soil treatment. Variety of pesticides is used in current agricultural practice to manage pests and infections that spoil crops.[2] A wide range of pesticides (13–14%) are used for the production of fruits and vegetables in India due to heavy pest infestation throughout the cropping season of horticultural crops whereas cropped area is only 3%.[3] Pesticides have potentially adverse effects on vegetables, fruits, animal resources and human health.[4] Pesticides are widely used in food production to increase food security despite the fact that they can have negative health effects on consumers.

India is an agrarian country. In the year 2000, the vegetable production in India was 92.8 million tones, grown over an area of 6 million hectares, which is about 3% of the gross cropped area of the country. Potato is the most important vegetable crop in India as it occupies 20% of vegetable area and contributes 27% to the total vegetable production. Nevertheless, vegetable production has been diversifying gradually.[5] In the world, India occupies first position in the production of cauliflower, brinjal and peas, second in onion and third in cabbage.[6] Vegetables form an important component of human diet. They are however, infested by various insect pests like aphids, jasssids, diamond moths, caterpillars, etc. Among the vegetables, brinjal, cauliflower, tomato and okra etc. are some very common vegetables cultivated, throughout the country but all are badly affected by insect-pest and diseases. Brinjal (Solanum melongenaL.) suffers heavily at fruiting stage due to attack of shoot and fruit borers causing 70% damage to the crop and making it totally unfit for human consumption.[7],[8] Cauliflower (Brassica oleracea) also an important vegetable crop with an annual production of 3.39 million tones is heavily attacked by various insects, resulting in severe loss of quality and production.[9] The application of pesticides to agriculture has greatly improved the food production worldwide. India is the second largest producer of vegetables after China, and accounts for 13.4% of world production. Surveys carried out by institutions spread throughout the country indicate that 50-70% of vegetables are contaminated with insecticide residues. India has a wide variety of climate and soils on which a range of vegetable crops can be grown.

Pesticides are widely used to ensure high crop yields. They are used during production and post-harvest treatment of agricultural commodities.[10] However, increased use of chemical pesticides has resulted in contamination of the environment and also caused many associated long term effects on human health.[11] The presence of pesticide residues in food commodities has always been a matter of serious concern. The problem is especially serious when these commodities are consumed.[12] Pesticides have been associated with a wide spectrum of human health hazards, ranging from short-term impacts such as headaches and nausea to chronic impacts like cancer, reproductive harm and endocrine disruption.[13] The heavy use of pesticides may result in environmental problems like disturbance of the natural balance, widespread pest resistance, environmental pollution, hazards to non-target organisms and wildlife, and hazards to humans. Therefore, the objective of present research work was to assess the concentration of such deleterious agrochemicals in vegetables of Vijayapur market and to generate awareness about the lethal effects of these synthetic pesticides on human being.

MATERIALS AND METHODS

Sampling

A total of 25 samples of cauliflower and 25 samples of cabbage were collected from Vijayapur market, when they were ready to sell. After collection, these samples were kept in polythene bags and then transported on ice to the laboratory where they were analyzed immediately or stored at 40C analysis within 24 hours.[14]

Sample preparation and clean up

Samples consisted of 1–2 kg of each vegetable comprising cauliflower and cabbage were collected from Vijayapur market, Karnataka. In the laboratory, samples were packed in plastic bags and kept in refrigerated for analyses. The fresh vegetables samples cut into small pieces and homogenized with a household mill (equipped with stainless steel knives). A 15 g portion of the homogenized sample was weighed into a 50 ml polytetrafluoroethylene (PTFE) tube added 15 ml of acetonitrile containing 1% acetic acid (v/v). Then, 6 g MgSO4 and 2.5 g sodium acetate trihydrate (equivalent to 1.5 g of anhydrous form) were added, and the sample was shaken forcefully for 4 min and kept in ice bath. The samples were then centrifuged at 4000 rpm for 5 min and 6 ml of the supernatant were transferred to a 15 ml PTFE tube to which 900 mg MgSO4 and 300 mg PSA were added. The extract was shaken using a vortex mixer for 20 s and centrifuged at 4000 rpm again for 5 min, approximately 2ml of the supernatant were taken in a vials. This extracts were evaporated to dryness under a stream of nitrogen and reconstituted in n-hexane in auto sampler tube for the GC-MS analysis. Standard preparation For preparation of stock solution, standards were dissolved in ethyl acetate and four levels of intermediate standard solution of each pesticide were prepared maintaining the same matrix concentration for the preparation of calibration curve and stored at -4oC in the dark. Working solutions were prepared daily by appropriate dilution with ethyl acetate. Instrumentation GC–MS analysis was performed with a Varian 3800 gas chromatograph with electronic flow control (EFC) and fitted with a Saturn 2200 ion-trap mass spectrometer (Varian Instruments, Sunnyvale, CA, USA). Samples were injected into a Varian 8200 auto sampler SPI / 1079 split / splitless programmed-temperature injector using a 10µl syringe operated in the large volume injection technique. The glass liner was equipped with a plug of carbofrit (Resteck, Bellefonte, PA, USA). A fused-silica untreated capillary column 30m 0.2mm I.D. from Supelco (Bellefonte, PA, USA) was used as a guard column connected to a Rapid-MS [wall-coated open tubular (WCOT) fused-silica CP-Sil 8 CB low bleed of 10m 30.53 mm I.D., 0.25 mm film thickness] analytical column from Varian Instruments (Sunnyvale, CA, USA) for high speed analysis. The mass spectrometer was operated in electron impact (EI) ionization mode. The computer that controlled the system also held a GC-MS library specially created for the target analytes under our experimental conditions. The mass spectrometer was calibrated weekly with perfluoro-tributylamine. Helium (99.999%) at a flow-rate of 1 ml min- 1 was used as carrier and collision gas.

RESULTS AND DISCUSSION

Pesticides are widely used in agricultural production to prevent or control pests, diseases, weeds, and other plant pathogens in an effort to reduce or eliminate yield losses and maintain high product quality. Cauliflower is widely cultivated in almost all the parts of the world. In India, it is cultivated in about 90 thousand hectares area. There has been a substantial increase in the area of cauliflower (about 20%) during the last two decades. The important cauliflower growing states are Uttar Pradesh, Karnataka, Maharashtra, Bihar, West Bengal, Punjab and Haryana. In the analyzed samples, the detected pesticides comprised of diclorvos, monocrotophos, phorate, parathion, pendamethalin, endosulphan-II, captafol, permethrin and cypermethrin. Current results are in consistent with some earlier reports where reduction (10- 30%) of alphamethrin residues in tomato and brinjal and cauliflower by Gill et al.[15] It has been reported that the farmers repeatedly spray different pesticides on cauliflower crop to protect their crop from various pests without any awareness about their hazardous effect on health. It is also routine practice of farmers to send their produce to market on the next day after the application of spray. These results are further confirmed by Khuhro and Nizamani[16] who reported that farmers frequently sprayed pesticides 2-3 times in a week and it is their common practice to supply the vegetables to the market only a day after spraying with contamination of residues beyond MRLs. Similar findings were reported by Pujeri et al[17, 18] in grapes and pomegranates from our laboratory. Three (12%) out of 25 samples, contained residues of Chlorpyrifos ethyl (MRL value = 0.05, 0.068, 0.093and 0.11mg kg-1)in cauliflower and two (8%) out of 25 samples, contained residues of Confidor (MRL value = 0.046 and 0.079mg kg-1)in cabbage above MRL values.(Table 1). Among the winter vegetables, cabbage Brassica oleracea var. capitata Linn. is a popular and extensively cultivated crop because of its nutritional and economical values. It is grown for its edible enlarged terminal buds, which is a rich source of Ca, P, Na, K, S Vitamin A, Vitamin C and dietary fibre. Frequent detection of all pesticides in the super cabbage samples is worrisome as this may have health implications through synergistic tendencies.[19] The contamination level of pesticide residues could be considered as a possible public health problem. The results also emphasize the need for regular monitoring of a greater number of samples for pesticide residues, especially sample which has to be exported.

CONCLUSIONS

Intensive cultivation technologies produce high infestation of crops by some pests and diseases, trigger off major losses of quality crops and initiate the use of more pesticides. It can be concluded that residues of none of the pesticides exceeded their respective maximum residue limits. It can be concluded that most of the samples of the vegetables having pesticide residue their respective maximum residue limits. Processing (normal and hot water washing) substantially lowers the residues of pesticides in vegetables. The objective of this study was to create awareness among the vegetables consumers who were consuming contaminated vegetables. The present research will not only serve as reference document but also helpful in taking necessary and timely preventive measure to mitigate such problems.

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CHAPTER IV

QUANTITATIVE ANALYSIS OF PESTICIDE RESIDUES IN VEGETABLES

ABSTRACT: Brinjal (Solanum melongena L.) and tomato are cultivated all over India, North-east India is also famous for brinjal cultivation. The Bijapur district of Karnataka is specially known for an indigenous variety of brinjal, Longai Brinjal, local and hybrid variety of Tomato's. The farmers who cultivate brinjal and tomato in this place use a large number of pesticides, herbicides and fungicides for protection of the crop and better yield. In the process they are exposed to a large number of health hazards directly and indirectly. This work aims to study the pesticide residues in brinjal and tomato and to provide appropriate suggestions so that minimum harm is caused to the farmers and maximum yield is obtained.

INTRODUCTION

Pesticides are used worldwide to protect crops before and after harvest in agriculture and gardening. Variety of pesticides are used in current agricultural practice to manage pests and infections that spoil crops [1]. A wide range of pesticides (13–14%) are used for the production of fruits and vegetables in India due to heavy pest infestation throughout the cropping season of horticultural crops whereas cropped area is only 3% [2]. Pesticides have potentially adverse effects on vegetables, fruits, animal resources and human health [3]. Pesticide production and use in the country shows a different pattern from global trends insecticide use is around 75% in the country, compared to 32% in the world. Herbicide use is only 12% in the country while worldwide, consumption is 47%. Important to note is the fact that weeding is a critical agricultural operation that provides employment to millions of poor agricultural labour, especially women, in the country. Similarly, while carbamate and synthetic pyrethroid compounds are used the most globally [45% together], in India, organophosphates constitute 50% of the consumption. Similarly, bio-pesticides are used only up to 1% amongst all pesticides in India, while worldwide, it is 12%.Plant protection products (more commonly known as pesticides) are widely used in agriculture to increase the yield, improve the quality, and extend the storage life of food crops (Fern ndez-Alba and Garc a-Reyes 2008). Pesticide residues are the deposits of pesticide active ingredient, its metabolites or breakdown products present in some component of the environment after its application, spillage or dumping. Residue analysis provides a measure of the nature and level of any chemical contamination within the environment and of its persistence. The pesticides must undergo extensive efficacy, environmental, and toxicological testing to be registered by governments for legal use in specified applications. The applied chemicals or their degradation products may remain as residues in the agricultural products, which becomes a concern for human exposure. Selected sampling programmes can be used to investigate residual levels of pesticide in the environment, their movement and their relative rates of degradation. The maximum residue levels (MRLs) or tolerances in the United States) limit the types and amounts of residues that can be legally present on foods are set by regulatory bodies worldwide. Pesticide residue analysis is tremendously an important process in determining the safety of using certain pesticides. Pesticides polluting the earth and causing problems in human beings and wildlife, the quantity of pesticide being consumed becomes a necessary knowledge. Analytical quality requirements like trueness, precision, sensitivity and selectivity have been met to suit the need for any particular analysis.

According to the latest government report - Monitoring of Pesticide Residues at National Level for the year 2014-15 revealed that out of the 20,618 samples analysed, residues of non-approved pesticides were detected in 12.5 % of the samples. While pesticides residues were detected in 3,857 (18.7%), and 543 samples (2.6%), pesticides residues above MRL (maximum residue limit) as prescribed by FSSAI were detected. No residues were detected in 16,761 samples (81.3%).The samples collected during 2014-15 have been analysed by 25 labs. In lab findings, non-approved pesticides like bifenthrin, acetamiprid, triazofos, metalaxyl, malathion, acetamiprid, carbosulfan, profenofos and hexaconazole, among others, have been detected.

Residues of non-approved pesticides were detected in 1,180 vegetable samples collected from both retail and farm gate markets, 225 fruit samples, 732 spice samples, 30 rice samples and 43 pulses samples, it added.In vegetables, the tests detected the residues of non- approved pesticides such as acephate, bifenthrin, triazofos, acetamiprid, metalaxyl and malathion. In Karnataka, Bangalore centre collected 796 samples; 25.9 % of the samples analyzed contained measurable residues. 2.8 % of all the samples exceeded the MRL. The commonly detected pesticide residues which were found above MRL were chlorpyrifos and ethion. The main pests that attack plants are Brinjal Fruit Borer, Stem borer, Spider Mite, Aphid, Jassid, Whitefly and Roots-cutworm. For the control of these insect pests, the farmers are used different types of insecticides. The farmer community uses the major insecticides such as Acephate,Chlorpyriphos, Dichlorovos, Carbofuran and Imidachloprid. Residues of DDT, DDE, chlorinated hydrocarbons and other pesticides have been found indifferent vegetables included brinjal [4-7].

The present study describe method of extraction, cleanup and determination of a pesticides by using gas chromatography(GC) equipped with mass detector (MS) for the separation, identification and quantification of chlorpyriphos, cypermethrin and monocrotophos on brinjal, tomato, were developed and validated. Finally, the method was applied for the determination of chlorpyriphos, cypermethrin and monocrotophos in the vegetable samples collected from the local market, Bijapur. Therefore, the purpose of this study was to develop an improved analytical method for the determination of the pesticide residues in brinjal and tomato by GC-MS.

MATERIAL AND METHODS

Assortment of Samples: The samples were collected from randomly chosen brinjal and tomato plants. After collection of samples, about 1kg sample was separated, sealed in polythene bags and stored at -4^{o}C for residues analysis of carbofuran, acephate, chlorpyriphos, dichlorovos, and imidachloprid. The extraction, clean-up and analytical work was followed by Asi. *et.al[8]*.

HPTLC Residual Analysis method: Brinjal and Tomato samples were extracted by ethyl acetate and analyzed by HPTLC with enzyme inhibition horse blood serum method(acetylcholine esterase enzyme) which was very sensitive for the detection of insecticide residues. The extract was spotted on silica gel plate, which was developed in mobile phase (ethyl acetate) and spot visibility was determined after spraying with acetylcholine esterase enzyme and tris-buffer solution. Rf value and average spot diameter was measured and imidachloprid, carbofuran, acephate, dichlorovos and chlorpyriphos residue concentration in ppm was calculated comparing the standard reagent spot diameter Asi. *et.al*. [8].

Fresh samples of Brinjal and Tomato were collected from various fields in local area of Bijapur. Samples were kept and wrapped in clean paper bag. Small sachet of silica gel helps to keep away it from moisture. A total of three different samples of each vegetable were collected for the analysis.Their detection and quantification by different analytical techniques are the major steps involved in pesticide residue analysis**.**

Reagents and Materials. Water and Acetonitrile were HPLC grade; Analytical grade Dimethyl formamide; anhydrous sodium sulphate were obtained from Fischer-Scientific. Acetic acid and sodium acetate from Merck were used for sample preparation. Analytical grade pesticide standards were obtained from Sigma-Aldrich. Crystalline standards were dissolved in acetonitrile for preparation of stock solution of standards. A standard mix solution was prepared from the individual stock solution to yield 10 mg/ml.

Sample Preparation. The acetate buffered sample preparation method for pesticide was applied to all samples. 50g samples were chopped and crushed in household grinder equipped with stainless steel blades and homogenize with 100 ml acetonitrile. Then 10 g of sodium chloride is added to it. Then, 6 g Na_2SO_4 were added to absorb moisture and shaken well. The extract was centrifuged at 5000 rpm for six minutes. Then ~15ml of the supernatant were filtered through a 0.45 mm PTFE filter. Pesticide was eluted with 20 ml acetonitrile. Sample was concentrated using a rotary evaporator. HPLC Condition Analytical Technologies 3000 series HPLC having UV/visible detector was used for identification and quantification of pesticides. Separation was performed on C18 (4.6ID x 250mm) column. Samples were injected manually through Rhyodyne injector. Detector was connected to the computer for data processing. The working condition of HPLC was binary gradient, mobile phase was acetonitrile: water (70:30), flow rate was 0.8ml/min, injection volume 20 µl, pressure 6-7 MPa and the wavelength of the detector was fixed at 254 nm for the residual analysis of three pesticides endosulfan, Carbendazim &Chloropyrifos. GC Condition Analytical Technologies GC 2012 model having FID detector was used for identification and quantification of pesticides. Separation was performed on Carbowax Packed column (SS 2meters). Samples were injected manually through Rhyodyne injector. Detector was connected to the computer for data processing. Following temperature conditions were maintained: Constant flow rate 1.0 ml/min, injection volume 1.0 µl, injector temperature 100°C, Oven temperature110°C, Detector temperature110°C. Total MS running time 20 min. The individual constituents showed by GC were identified by comparing their MS with standard compounds of NIST library.

Results and Discussion

Pesticide residues in food pose a significant health effect on human and animals. To provide adequate food for growing population, the usage of pesticide is necessary but dissemination of information regarding food safety, pesticide handling and good agricultural practices (GAP) among farmers is also a dire need. Moreover, good agricultural practices and is the important and effective tools in minimizing pesticide residues in food commodities. Therefore this study will provide adequate information to the farmers for safe harvesting period of the vegetables growing under agroclimatic conditions. On analyzing the data collected from the farmers we know that majority of the farmers are illiterate and a small group are educated/ literate. It has also been found that 99% of the farmers are not at all trained and do not know the proper use of agro-chemicals, they simply use these by learning from their elders, which may not always be correct. Most of the farmers mix two or more pesticides and spray them in the field. This is a very harmful practice both for the farmer and the environment. Generally the farmers do not enter a field for at least three days after spraying insecticides, but during peak harvest period, they harvest brinjals and tomato immediately after spraying (i.e. the next day). It has also been noticed that most of the family members of the farmers suffer from general ill health and chronic diseases. These can be due to the side effects caused by the handling of these harmful chemicals. As majority of the farmers are illiterate and unknowingly use their house for storing the pesticides. Moreover they hardly follow any precautions before and after spraying the chemicals in the field. Pesticides are dangerous for human health if it exceed from the calculated maximum residue limit [9]. Due to spray of pesticides on vegetables, it leaves their residues [10]. The result of the pesticide residue analysis of brinjal samples is represented in table 2. Bai et al [11] determined the concentrations of eight organophosphorous pesticides in 18 of 200 samples. Out Of 12 samples Table. No 1& 2 we have found Carbendazim 0.012, 0.015mg/kg in sample No.5 and sample No11, and Imidacloprid 0.077 and 0.053 mg/kg in the same Brinjal samples. Out 15 tomato samples we found Carbendazim 0.014mg/kg and 0.017mg/kg in sample No.2 and sample No.8 and Indoxacarb 0.015 in smple No.2 and Profenofos 0.022mg/kg and

0.172mg/kg in samples No.2&8 above MRL value. Brazil is still engaged, in some regions, with the problem of non-permitted compound use in tomatoes and the pesticide presence above the MRL[12]. Tomato and cucumber vegetable crops were sprayed at fruit stage with dimethoate or profenofos using a recommended field rate to study the persistence of such insecticide residues at different intervals. Residues on vegetable crops have been subjected to major concern. Various regulatory bodies to ensure safe use of pesticides and to protect consumers from adverse side effects have imposed numerous restrictions. The present work was designed to study the persistence of Carbendazim and profenofos in tomato and brinjal fruits. Emphasis on the safety periods for these insecticides in the tested vegetables was considered.

Table No. 01 Pesticide Residue content in Brinjal in mg/kg

Sr. No.	Name of Pesticide	Limit of Quatification (mg/kg)	Equipment used	Sample .No 5 Residue Content (mg/Kg)	Sample .No 11 Residue Content (mg/Kg)	Sample .No1.2.3.4.6.7.8 9,10,12, Residue Content (mg/Kg)
1	Abamectin	0.01	LCMS/MS	BLQ	BLQ	BLQ
2	Alachlor	0.01	LCMS/MS	BLQ	BLQ	BLQ
3	Acephate	0.01	LCMS/MS	BLQ	BLQ	BLQ
4	Acetamiprid	0.01	LCMS/MS	BLQ	BLQ	BLQ
5	Atrazine	0.01	LCMS/MS	BLQ	BLQ	BLQ
6	Azoxystrobin	0.01	LCMS/MS	BLQ	BLQ	BLQ
7	Benalaxyl	0.01	LCMS/MS	BLQ	BLQ	BLQ
8	Benfuracarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
9	Benomyl	0.01	LCMS/MS	BLQ	BLQ	BLQ
10	Bifenazate	0.01	LCMS/MS	BLQ	BLQ	BLQ
11	Bitertanol	0.01	LCMS/MS	BLQ	BLQ	BLQ
12	Buprofezin	0.01	LCMS/MS	BLQ	BLQ	BLQ
13	Carbaryl	0.01	LCMS/MS	BLQ	BLQ	BLQ
14	Carbosulfon	0.01	LCMS/MS	BLQ	BLQ	BLQ
15	Carbendazim	0.01	LCMS/MS	0.012	0.015	BLQ
16	Carbofuran	0.01	LCMS/MS	BLQ	BLQ	BLQ
17	Carboxin	0.01	LCMS/MS	BLQ	BLQ	BLQ
18	Chlorantraniliprole	0.01	LCMS/MS	BLQ	BLQ	BLQ

19	Chlothianidin	0.01	LCMS/MS	BLQ	BLQ	BLQ
20	Cyazofamid	0.01	LCMS/MS	BLQ	BLQ	BLQ
21	Cymoxanil	0.01	LCMS/MS	BLQ	BLQ	BLQ
22	Diafenthiuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
23	Diazinon	0.01	LCMS/MS	BLQ	BLQ	BLQ
24	Difenocenazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
25	Diflubenzuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
26	Dimethoate	0.01	LCMS/MS	BLQ	BLQ	BLQ
27	Dimethomorph	0.01	LCMS/MS	BLQ	BLQ	BLQ
28	Dinotefuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
29	Dithianon	0.01	LCMS/MS	BLQ	BLQ	BLQ
30	Diuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
31	Dodine	0.01	LCMS/MS	BLQ	BLQ	BLQ
32	Emamectin Benzoate	0.01	LCMS/MS	BLQ	BLQ	BLQ
33	Edifenofos	0.01	LCMS/MS	BLQ	BLQ	BLQ
34	Ethion	0.01	LCMS/MS	BLQ	BLQ	BLQ
35	Famoxadone	0.01	LCMS/MS	BLQ	BLQ	BLQ
36	Fenamidone	0.01	LCMS/MS	BLQ	BLQ	BLQ
37	Fenarimol	0.01	LCMS/MS	BLQ	BLQ	BLQ
38	Fenazaquin	0.01	LCMS/MS	BLQ	BLQ	BLQ
39	Fenthion	0.01	LCMS/MS	BLQ	BLQ	BLQ
40	Fenobucarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
41	Fenpyroximate	0.01	LCMS/MS	BLQ	BLQ	BLQ
42	Flubendiamide	0.01	LCMS/MS	BLQ	BLQ	BLQ
43	Flufenacet	0.01	LCMS/MS	BLQ	BLQ	BLQ
44	Flufenoxuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
45	Flonicamid	0.01	LCMS/MS	BLQ	BLQ	BLQ
46	Flusilazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
47	Hexaconazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
48	Hexythiazox	0.01	LCMS/MS	BLQ	BLQ	BLQ

49	Imidacloprid	0.01	LCMS/MS	0.077	0.053	BLQ
50	Indoxacarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
51	Iprobenphos	0.01	LCMS/MS	BLQ	BLQ	BLQ
52	Isoprothiolane	0.01	LCMS/MS	BLQ	BLQ	BLQ
53	Isoproturon	0.01	LCMS/MS	BLQ	BLQ	BLQ
54	Iprovalicarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
55	Kresoxim Methyl	0.01	LCMS/MS	BLQ	BLQ	BLQ
56	Lufenuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
57	Linuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
58	Malathion	0.01	LCMS/MS	BLQ	BLQ	BLQ
59	Methamidofos	0.01	LCMS/MS	BLQ	BLQ	BLQ
60	Metolachlor	0.01	LCMS/MS	BLQ	BLQ	BLQ
61	Methomyl	0.01	LCMS/MS	BLQ	BLQ	BLQ
62	Monocrotophos	0.01	LCMS/MS	BLQ	BLQ	BLQ
63	Metribuzin	0.01	LCMS/MS	BLQ	BLQ	BLQ
64	Myclobutanil	0.01	LCMS/MS	BLQ	BLQ	BLQ
65	Novaluron	0.01	LCMS/MS	BLQ	BLQ	BLQ
66	Omethoate	0.01	LCMS/MS	BLQ	BLQ	BLQ
67	Oxadiazon	0.01	LCMS/MS	BLQ	BLQ	BLQ
68	Oxycarboxin	0.01	LCMS/MS	BLQ	BLQ	BLQ
69	Paclobutazol	0.01	LCMS/MS	BLQ	BLQ	BLQ
70	Pendimethalin	0.01	LCMS/MS	BLQ	BLQ	BLQ
71	Penconazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
72	Pencycuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
73	Phosphomidon	0.01	LCMS/MS	BLQ	BLQ	BLQ
74	Phosalone	0.01	LCMS/MS	BLQ	BLQ	BLQ
75	Profenofos	0.01	LCMS/MS	BLQ	BLQ	BLQ
76	Propergite	0.01	LCMS/MS	BLQ	BLQ	BLQ
77	Propiconazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
78	Propoxur	0.01	LCMS/MS	BLQ	BLQ	BLQ

79	Quinalphos	0.01	LCMS/MS	BLQ	BLQ	BLQ
80	Simazin	0.01	LCMS/MS	BLQ	BLQ	BLQ
81	Spinosad	0.01	LCMS/MS	BLQ	BLQ	BLQ
82	Spiromesifen	0.01	LCMS/MS	BLQ	BLQ	BLQ
83	Tebuconazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
84	Temephos	0.01	LCMS/MS	BLQ	BLQ	BLQ
85	Tetraconazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
86	Thiacloprid	0.01	LCMS/MS	BLQ	BLQ	BLQ
87	Thiamethoxam	0.01	LCMS/MS	BLQ	BLQ	BLQ
88	Thiophenate Methyl	0.01	LCMS/MS	BLQ	BLQ	BLQ
89	Thiobencarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
90	Thiodicarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
91	Thiometon	0.01	LCMS/MS	BLQ	BLQ	BLQ
92	Thiadimenol	0.01	LCMS/MS	BLQ	BLQ	BLQ
93	Triadimefon	0.01	LCMS/MS	BLQ	BLQ	BLQ
94	Tricyclazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
95	Tridemorph	0.01	LCMS/MS	BLQ	BLQ	BLQ
96	Florchlorfenuron	0.01	LCMS/MS	BLQ	BLQ	BLQ

Table No 2 Pesticide Residue content in Tomato in mg/kg

Sr. No.	Name of Pesticide	Limit of Quatification (mg/kg)	Equipment used	Sample.No.2 Residue Content (mg/Kg)	Sample.No.8 Residue Content (mg/Kg)	Sample.No.1, 3,4,5,6,7,9,10,11,12 Residue Content (mg/Kg)
1	Abamectin	0.01	LCMS/MS	BLQ	BLQ	BLQ
2	Alachlor	0.01	LCMS/MS	BLQ	BLQ	BLQ
3	Acephate	0.01	LCMS/MS	BLQ	BLQ	BLQ
4	Acetamiprid	0.01	LCMS/MS	BLQ	BLQ	BLQ
5	Atrazine	0.01	LCMS/MS	BLQ	BLQ	BLQ
6	Azoxystrobin	0.01	LCMS/MS	BLQ	BLQ	BLQ
7	Benalaxyl	0.01	LCMS/MS	BLQ	BLQ	BLQ
8	Benfuracarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
9	Benomyl	0.01	LCMS/MS	BLQ	BLQ	BLQ
10	Bifenazate	0.01	LCMS/MS	BLQ	BLQ	BLQ
11	Bitertanol	0.01	LCMS/MS	BLQ	BLQ	BLQ
12	Buprofezin	0.01	LCMS/MS	BLQ	BLQ	BLQ
13	Carbaryl	0.01	LCMS/MS	BLQ	BLQ	BLQ
14	Carbosulfon	0.01	LCMS/MS	BLQ	BLQ	BLQ
15	Carbendazim	0.01	LCMS/MS	0.014	0.014	BLQ
16	Carbofuran	0.01	LCMS/MS	BLQ	BLQ	BLQ
17	Carboxin	0.01	LCMS/MS	BLQ	BLQ	BLQ
18	Chlorantraniliprole	0.01	LCMS/MS	BLQ	BLQ	BLQ
19	Chlothianidin	0.01	LCMS/MS	BLQ	BLQ	BLQ
20	Cyazofamid	0.01	LCMS/MS	BLQ	BLQ	BLQ
21	Cymoxanil	0.01	LCMS/MS	BLQ	BLQ	BLQ

22	Diafenthiuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
23	Diazinon	0.01	LCMS/MS	BLQ	BLQ	BLQ
24	Difenocenazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
25	Diflubenzuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
26	Dimethoate	0.01	LCMS/MS	BLQ	BLQ	BLQ
27	Dimethomorph	0.01	LCMS/MS	BLQ	BLQ	BLQ
28	Dinotefuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
29	Dithianon	0.01	LCMS/MS	BLQ	BLQ	BLQ
30	Diuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
31	Dodine	0.01	LCMS/MS	BLQ	BLQ	BLQ
32	Emamectin Benzoate	0.01	LCMS/MS	BLQ	BLQ	BLQ
33	Edifenofos	0.01	LCMS/MS	BLQ	BLQ	BLQ
34	Ethion	0.01	LCMS/MS	BLQ	BLQ	BLQ
35	Famoxadone	0.01	LCMS/MS	BLQ	BLQ	BLQ
36	Fenamidone	0.01	LCMS/MS	BLQ	BLQ	BLQ
37	Fenarimol	0.01	LCMS/MS	BLQ	BLQ	BLQ
38	Fenazaquin	0.01	LCMS/MS	BLQ	BLQ	BLQ
39	Fenthion	0.01	LCMS/MS	BLQ	BLQ	BLQ
40	Fenobucarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
41	Fenpyroximate	0.01	LCMS/MS	BLQ	BLQ	BLQ
42	Flubendiamide	0.01	LCMS/MS	BLQ	BLQ	BLQ
43	Flufenacet	0.01	LCMS/MS	BLQ	BLQ	BLQ
44	Flufenoxuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
45	Flonicamid	0.01	LCMS/MS	BLQ	BLQ	BLQ
46	Flusilazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
47	Hexaconazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
48	Hexythiazox	0.01	LCMS/MS	BLQ	BLQ	BLQ
49	Imidacloprid	0.01	LCMS/MS	BLQ	BLQ	BLQ
50	Indoxacarb	0.01	LCMS/MS	0.015	BLQ	BLQ
51	Iprobenphos	0.01	LCMS/MS	BLQ	BLQ	BLQ

52	Isoprothiolane	0.01	LCMS/MS	BLQ	BLQ	BLQ
53	Isoproturon	0.01	LCMS/MS	BLQ	BLQ	BLQ
54	Iprovalicarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
55	Kresoxim Methyl	0.01	LCMS/MS	BLQ	BLQ	BLQ
56	Lufenuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
57	Linuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
58	Malathion	0.01	LCMS/MS	BLQ	BLQ	BLQ
59	Methamidofos	0.01	LCMS/MS	BLQ	BLQ	BLQ
60	Metolachlor	0.01	LCMS/MS	BLQ	BLQ	BLQ
61	Methomyl	0.01	LCMS/MS	BLQ	BLQ	BLQ
62	Monocrotophos	0.01	LCMS/MS	BLQ	BLQ	BLQ
63	Metribuzin	0.01	LCMS/MS	BLQ	BLQ	BLQ
64	Myclobutanil	0.01	LCMS/MS	BLQ	BLQ	BLQ
65	Novaluron	0.01	LCMS/MS	BLQ	BLQ	BLQ
66	Omethoate	0.01	LCMS/MS	BLQ	BLQ	BLQ
67	Oxadiazon	0.01	LCMS/MS	BLQ	BLQ	BLQ
68	Oxycarboxin	0.01	LCMS/MS	BLQ	BLQ	BLQ
69	Paclobutazol	0.01	LCMS/MS	BLQ	BLQ	BLQ
70	Pendimethalin	0.01	LCMS/MS	BLQ	BLQ	BLQ
71	Penconazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
72	Pencycuron	0.01	LCMS/MS	BLQ	BLQ	BLQ
73	Phosphomidon	0.01	LCMS/MS	BLQ	BLQ	BLQ
74	Phosalone	0.01	LCMS/MS	BLQ	BLQ	BLQ
75	Profenofos	0.01	LCMS/MS	0.022	0.172	BLQ
76	Propergite	0.01	LCMS/MS	BLQ	BLQ	BLQ
77	Propiconazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
78	Propoxur	0.01	LCMS/MS	BLQ	BLQ	BLQ
79	Quinalphos	0.01	LCMS/MS	BLQ	BLQ	BLQ
80	Simazin	0.01	LCMS/MS	BLQ	BLQ	BLQ
81	Spinosad	0.01	LCMS/MS	BLQ	BLQ	BLQ

82	Spiromesifen	0.01	LCMS/MS	BLQ	BLQ	BLQ
83	Tebuconazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
84	Temephos	0.01	LCMS/MS	BLQ	BLQ	BLQ
85	Tetraconazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
86	Thiacloprid	0.01	LCMS/MS	BLQ	BLQ	BLQ
87	Thiamethoxam	0.01	LCMS/MS	BLQ		BLQ
88	Thiophenate Methyl	0.01	LCMS/MS	0.021	0.021	BLQ
89	Thiobencarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
90	Thiodicarb	0.01	LCMS/MS	BLQ	BLQ	BLQ
91	Thiometon	0.01	LCMS/MS	BLQ	BLQ	BLQ
92	Thiadimenol	0.01	LCMS/MS	BLQ	BLQ	BLQ
93	Triadimefon	0.01	LCMS/MS	BLQ	BLQ	BLQ
94	Tricyclazole	0.01	LCMS/MS	BLQ	BLQ	BLQ
95	Tridemorph	0.01	LCMS/MS	BLQ	BLQ	BLQ
96	Florchlorfenuron	0.01	LCMS/MS	BLQ	BLQ	BLQ

Conclusion

It is concluded from this research work that pesticides can be adsorb in pulpy portion of vegetables. But the rate of adsorption is different in different vegetables. Pesticides also leech in vegetables with different rate. If vegetables used after peeling the pesticide residues become in less concentration. Checking for pesticides residues in different vegetable samples should be done after regular intervals. Vegetables like brinjal and tomato are infested with a number of insect pests and if left uncontrolled may cause heavy damage. The study has revealed that chemical control is the principal pest control method followed by the farmers in the study area. Biopesticides and botanical pesticides are applied by a limited number of growers, while application of weedicide has been observed absent. On an average, brinjal crops are each given 10-15 sprayings, and tomato is given 12 applications of pesticides.

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Annexure-I

UNIVERSITY GRANTS COMMISSION

FORMAT FOR SUBMISSION OF PROPOSAL FOR

MINOR RESEARCH PROJECT

PART – A

1. Broad Subject - **Chemistry**

2. Area of Specialization- Environmental chemistry

3. Duration - 08-04-2014 t o 08-12-2015

4. Principal Investigator-

    i. Name: **Dr.U.S.Pujeri**

    ii. Sex: M/F- Male

    iii. Date of Birth: 01/01/1963

    iv. Category: (GEN/SC/ST/OBC) - OBC

    iv. Qualification: M.Sc. Ph.D

    v. Designation: Associate professor

    vi. Address: Office: S.B.Arts and K.C.P.Science College Vijayapur

    Residence: Bhavasar Nagar, Jail Road, Vijayapur- PIN- 586101

    Email/Phone: ulavayya452@gmail.com 9448418452

5. Name of the Institution where the project will be undertaken:

    (a) Department : Chemistry

    (b) College : S.B.Arts & K.C.P.Sc. College Vijayapur

    (c)Affiliating University: Rani Channamma University Belagavi

    (d) Whether the institute is located in rural/backward area: Urban

6. Whether the College is approved under Section 2 (f) and 12 B of the UGC Act? Yes/No - Yes

7. Teaching and Research Experience of Principal Investigator :

    (a) Teaching experience: UG - 30 Years PG - 03 Years

(b) Research experience: 20Yrs.

(c) Publication:

Papers Published : 2-papers

Accepted: N

Communicated: N

Books Published: Accepted : Communicated : (Please enclose the list of papers and books published and/or accepted during last five years) -2 Papers

1. Analysis of Pesticide Residues in Vegetables in Vijayapur, Karnataka, India.
   World Journal of Pharmacy and Pharmaceutical Sciences.
   Volume 4. Issue 07, 2015, ISSN 2278-4357

2. Quantitative Analysis of Pesticide Residue in Vegetables.

   International Journal of Scientific & Engineering Research, Volume 7, Issue 5, May-2016 386 ISSN 2229-5518 IJSER © 2016 http://www.ijser.org

PART – B
Proposed Research Work

8 (i) Project Title- **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka**

(ii) Introduction: This final project report provides a brief project description, a summary of the activities completed, references to deliverables sent during the project timeline and a link to the web site developed as part of the project. Also included are several peer-reviewed scientific papers prepared by researchers associated with the project. These are attached as appendices, which are listed at the end of this report.

(iii) Objectives- The purpose of this research project was to conduct microbial censuses, source identification and develop test procedures for water quality analysis. The goal of this project was to understand pesticide use on small fruit and vegetable farms and determine the knowledge farmers, vendors, consumers, and government officials have about pesticides. We used archival research from government websites to compile state and national policies on pesticide use with regards to farming and food quality in Vijayapur district so that we would know which pesticides are banned, the maximum limits of detection for pesticides when it came time to test produce, and how the government enforces these laws. We also interviewed the Department of Agriculture Officer for Vijayapur District to gain deeper insight on these laws. This semi-standardized interview focused on laws regarding food quality and best and safe practices in farming. We probed to find the current attitude towards public health with regards to food safety and the presence of unwanted chemicals in market produce. This also helped us to determine whether government officials were aware of actual farming practices used in the region.

(iv) Methodology- **Standard Methods (SM) for water and waste water analysis (SMWW-APHA)**

In 1895, members of the American Public Health Association (APHA)recognized the need for Standard Methods in the waste water examination of water. In 1905, the first edition of Standard Methods of Water Analysis was published. The reference book in its 20th edition is, to date, entitled Standard Methods for the examination of water and waste water.

(v) Year-wise Plan of work and targets to be achieved.

9. Financial Assistance required

Item	Estimated Expenditure
i. Books and Journals	10000=00
ii. Equipment, if needed	50000=00
iii. Field Work and Travel	15,000=00

iv. Chemicals and glassware 100,000=00

v. Contingency (including special needs) 15,000=00

vi.Any Other 10000=00

Total: 200000=00

10. Whether the teacher has received support for the research project from the UGC under Major, Minor or from any other agency? If so, please indicate: UGC

i. Name of the agency from which the assistance was approved--UGC

ii. Sanction letter No. and date under which the assistance was approved-

iii. **Amount approved : 200000=00**

Amount Utilized : **208218=00**

iv. Title of the project for which assistance was approved-“ **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka**

v. In case the project was completed, whether the work on the project has been published :

2 papers published

vi. If the candidate was working for the doctoral degree, whether the thesis was submitted and accepted by the University for the award of degree. (A summary of the report/thesis in about 1,000 words may please be attached with the application)**---** **Nil**

vii. If the project has not been completed, please state the reasons

11. (a) Details of the UGC project/scheme completed or ongoing.- **completed**

12. Any other information which the teacher may like to give in support of this Proposal **NIL**

To certify that:

a. The College is approved under Section 2(f) and 12(B) of the UGC Act and is fit to
    a. receive grants from the UGC.
b. General physical facilities, such as furniture/space etc., are available in the

a. Department/College.

c. I shall abide by the rules governing the scheme in case assistance is provided to me from the UGC for the above project.
d. I shall complete the project within the stipulated period. If I fail to do so and if the UGC is not satisfied with the progress of the research project, the Commission may terminate the project immediately and ask for the refund of the entire amount (with interest) released by the UGC.
e. The above research Project is not funded by any other agency.

Signature of Principal Investigator **Principal**

(Seal)

Annexure – II

UNIVERSITY GRANTS COMMISSION
BANGALORE

ACCEPTANCE CERTIFICATE FOR RESEARCH PROJECT

Name: **Dr.U.S.Pujeri**

MRP(S)-0455/13-14/KAKA-041/UGC-SWRO dated 28-03-2014

Title of the Project: “**Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka”.**

1. The research project is not being supported by any other funding agency.
2. The terms and conditions related to the grant are acceptable to the Principal Investigator and University/College/Institution.
3. At present, I have no research project approved by UGC and the accounts for the previous Project, if any have been settled.
4. The College/University is fit to receive financial assistance from UGC and is included in the list of Section 2(f) & 12 (B) prepared by the UGC.
5. The Principal Investigator is a retired teacher and eligible to receive honorarium as he/she is neither getting any honorarium from any agency nor is he/she gainfully employed anywhere.
6. (i) His/her date of birth is: 01/01/1963

   (ii) Age : 54 years
7. The date of implementation of the project is 28/03/2014

Principal Investigator

Principal

College:__________

(Seal)

Date:________

Annexure – III

UNIVERSITY GRANTS COMMISSION

BANGALORE

STATEMENT OF EXPENDITURE IN RESPECT OF MINOR RESEARCH PROJECT

Name of Principal Investigator : **Dr.U.S.Pujeri**

1. Department of Principal Investigator : **CHEMISTRY**

2. Name of College : **S.B.Arts & K.C.P.Science College ,**
Vijayapur (Karnataka)

3 UGC approval Letter No. and Date: MRP(S)-0455/13-14/KAKA-041/UGC-SWRO
dated 08-04-2014

4. Title of the Research Project: **Monitoring of Pesticides in farm vegetables and its Impact on health at Bijapur district, Karnataka.**

5. Effective date of starting the project : 08/04/2014

6 a. Period of Expenditure: From 28/04/2014 to 22/05/2017

b. Details of Expenditure :

S.No.	**Items**	**Amount Approved (Rs.)**	Expenditure Incurred (Rs.)
I.	**Non-Recurring:**		
	i. Books & Journals	10000=00	10189=00
	ii. Equipment	50000=00	52021=00
II.	**Recurring:**		
	i. Contingency	15000=00	15764=00
	ii. Chemicals and glass wares	100000=00	100609=00
	iii. Field Work/Travel (Give details in the Performa)	15000=00	15808=00
	iv. Any other	10000=00	36563=00
	Total	**200000=00**	**230954=00**

7. if as a result of check or audit objection some irregularly is noticed at later date, Action will be taken to refund, adjust or regularize the objected amounts.

8. It is certified that the grant of **Rs. 130000=00 (Rupees One lakh Thirty Thousand only)** received from the University Grants Commission under the scheme of support for Minor Research Project entitled "Title of the Research Project : **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka."** vide UGC letter No. F. MRP(S)-0455/13-14/KAKA-041/UGC-SWRO dated 08-04-2014 has been fully utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid downby the University Grants Commission.

SIGNATURE OF THE PRINCIPAL INVESTIGATOR	PRINCIPAL	STATUTORY AUDITOR
	(Seal)	**(Seal)**

Annexure - IV

UNIVERSITY GRANTS COMMISSION
BANGALORE

STATEMENT OF EXPENDITURE INCURRED ON FIELD WORK

Name of the Principal Investigator: Dr.U.S.Pujeri

S.No	**Name of the Place visited**	**Duration of the Visit**		**Mode of Journey**	**Expenditure Incurred (Rs.)**
1	Basavan Bagewaadi, Muddebihal taluka,	**From** 08-05-2014	**To** 09-05-2014	**By Car(AC)**	3200=00
2	Sindagi taluka,	20-08-2014	21-08-2014	**By Car(AC)**	3400=00
3	Bijapur Taluka	10-12-2014	10-12-2014	**By Car(AC)**	1600=00
4	Indi Taluka	03-05-2015	04-05-2015	**By Car (AC)**	3400=00
5	Bijapur to Pune	20/05/2015	20/05/2015	**By Train**	408=00
6	Pune to Bijapur	20/05/2015	20/05/2015	**By Train**	250=00
7	Bijapur taluka	24/05/2015	24/05/2015	**By Car (AC)**	1750=00
8	Bijapur taluka	08/06/2015	08/06/2015	**By Car (AC)**	1800=00
5				**Total**	**15808 =00**

Certified that the above expenditure is in accordance with the UGC norms for Minor Research Projects.

SIGNATURE OF THE PRINCIPAL INVESTIGATOR | **PRINCIPAL** | **STATUTORY AUDITOR**

(Seal) **(Seal)**

Annexure - V

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

Utilization certificate

Certified that the grant of Rs. 200000=00 (Rupees_One lakh sixty thousand only) received from the University Grants Commission under the scheme of support for Minor Research Project entitled, "Title of the Research Project : **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka."** vide UGC letter No. F. MRP(S)-0455/13-14/KAKA-041/UGC-SWRO dated 04-08-2014 has been fully utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grants Commission.

SIGNATURE OF THE PRINCIPAL INVESTIGATOR **PRINCIPAL** **STATUTORY AUDITOR**

(Seal) **(Seal)**

Abstract

Grant sanctioned	Grant released	Balance to be received from UGC
Rs: 200000=00	**Rs: 130000=00**	**Rs: 70000 =00**

Annexure -VI

UNIVERSITY GRANTS COMMISSION

BAHADUR SHAH ZAFAR MARG

NEW DELHI – 110 002.

Annual/Final Report of the work done on the Minor Research Project.

(Report to be submitted within 6 weeks after completion of each year)

1. Project report No.: **Final**

2. UGC Reference No.F: MRP(S)-0455/13-14/KAKA-041/UGC-SWRO dated 08-04-2014

3. Period of report: from: 08-04-2014to 02/07/2017

4. Title of research project : Title of the Research Project : **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka.**

5. (a) Name of the Principal Investigator **Dr. U.S.Pujeri**

(b) Dept: Chemistry

(c) College where work has progressed: S.B.Arts & K.C.P.Sc. College Vijayapur.

6. Effective date of starting of the project 28-04-2014

7. Grant approved and expenditure incurred during the period of the report:

a. Total amount approved Rs.: 200000=00

b. Total expenditure Rs.208218=00

c. Report of the work done: separate sheet enclosed

i. Brief objective of the project :

1. We traveled to ten farms to learn about pesticide practices on local crops. We asked farmers if they could give us a tour of their farms so that we could gain some insight on the types of crops being grown.

We also conducted unstandardized interviews with farmers to inquire about quality measures on their farms, chronic threats in terms of pests or blights that they face on a regular basis, and how they address these problems. When pesticide use was brought up in the natural flow of the conversation, we were able to ask about the application process and any safety precautions taken before spraying. Unstandardized interviews allowed a more relaxed rapport with the farmers, making it possible for our team to inquire about pesticide use without being forward. Because we learned from the Department of Agriculture that the government and not vendors are responsible for teaching farmers proper application practices, we chose to incorporate further questions about pesticide application into our interview with the Department of Agriculture Officer. This allowed us to gather information on the resources available for farmers in regards to application training.

ii. Work done so far and results achieved and publications, if any, resulting from the work (Give details of the papers and names of the journals in which it has been published or accepted for publication –**Two papers published**

iii. Has the progress been according to original plan of work and towards achieving the objective. if not, state reasons **-Yes**

iv. please enclose a summary of the findings of the study. One bound copy of the final report of work done may also be sent to the concerned Regional Office of the UGC.

v. Any other information-**Nil**

SIGNATURE OF THE
PRINCIPAL INVESTIGATOR **PRINCIPAL**

(Seal)

Annexure – VII

UNIVERSITY GRANTS COMMISSION

BAHADUR SHAH ZAFAR MARG

NEW DELHI – 110 002

PROFORMA FOR SUBMISSION OF INFORMATION AT THE TIME OF SENDING THE FINAL REPORT OF THE WORK DONE ON THE PROJECT

1. Title of the Project: Title of the Research Project : **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka.**

2. NAME AND ADDRESS OF THE PRINCIPAL INVESTIGATOR: **Dr. U.S.Pujeri**

3. NAME AND ADDRESS OF THE INSTITUTION: S.B.Arts & K.C.P.Sc. College
Vijayapur.

4. UGC APPROVAL LETTER NO. AND DATE - MRP(S)-0455/13-14/KAKA-041/UGC-SWRO dated 08-04-2014

5. DATE OF IMPLEMENTATION 28-04-2014
6. TENURE OF THE PROJECT 08-12-2015
7. TOTAL GRANT ALLOCATED Rs 200000=00
8. TOTAL GRANT RECEIVED Rs 130000=00
9. FINAL EXPENDITURE Rs 208218=00
10. TITLE OF THE PROJECT: "Title of the Research Project : **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka"**
11. OBJECTIVES OF THE PROJECT - yes
12. WHETHER OBJECTIVES WERE ACHIEVEDGIVE DETAILS)
13. ACHIEVEMENTS FROM THE PROJECT

- The project shockingly reveals the multiple adverse effects on the health hazards on the consumers.
- While conducting interviews with farmers and pesticide vendors, we asked what different brands of pesticides the interviewees used. We determined the chemical compositions of the pesticides from the labels and compiled them into a list. We checked each chemical's status in India as well as the United States
- Efforts be made to promote and educate the villagers and public .

- The purpose of establishing standards/guidelines should be clearly set out to ensure effective compliance. Similarly, the methods of detection and treatment should be specifically described.
- The regulatory limits should be deduced from scientific data bringing out the relationship between the limit and the toxic elements rather than depending on adhoc decisions.

14. SUMMARY OF THE FINDINGS ;

While conducting interviews with farmers and pesticide vendors, we asked what different brands of pesticides the interviewees used. We determined the chemical compositions of the pesticides from the labels and compiled them into a list. We checked each chemical's status in India as well as the United States. As pesticides become more prevalent in farming practices in Himachal Pradesh, farmers need to develop a deeper understanding of their proper application and effects. Our research, though limited, suggests that stakeholders may not be fully informed about the laws. Moreover, they may not always realize the damage that can be done to health and the environment. It is more likely that laws regarding pesticide regulations will be followed by farmers if they are provided this information on websites, in brochures, and in training workshops that are convenient for them to attend. These changes might help make fruits and vegetables safer and healthier for their own and other communities. The effects of pesticide use are not contained within the boundaries of Himachal Pradesh; drift affects surrounding states as well. When research is done locally, farmers produce vendors, pesticide vendors, consumers, and government officials feel more connected to the issue and become more aware of the impact pesticides they use might have nationally. If pesticide presence and levels are high in the produce of Himachal Pradesh, typically considered an organic farming state, then investigating their use in other states seems equally important. The process we followed is just a possible first step in extending that research.

15. CONTRIBUTION TO THE SOCIETY:

We interviewed ten farmers from the Kullu and Mandi districts, all of whom said they used pesticides. None of the farmers knew which, if any, pesticides were banned. Of these ten farmers, five were asked1 if they take any precautions while spraying. Two indicated they wear gloves and a mask, one said he wears gloves and washes his hands after, one said he takes a bath and washes his clothes after, and one said he has to wear a mask or cover his head else it is harmful. When directly prompted about specific protective measures, however, all five said they cover water supplies, keep animals away, storepesticides separately, and dispose of empty containers; however, they only indicated these measures after they were specifically asked, suggesting they may have been lead by our prompts. Further discussion with all ten farmers revealed that that they buy pesticides when needed instead of in bulk. One of the most important pieces of information that we gathered was that none of the farmers wash their produce before selling it because they say it will degrade the quality; they dowait an average of ten days after spraying before selling. These interviews suggest inconsistencies among farmers concerning the poper approach to safety precautions, a lack of knowledge about banned chemicals, and erroneous assumptions that harmful effects of pesticides can be washed off or can diminish after waiting a period of days. We visted six pesticide vendors in Vijayapur town, but only three were willing to be interviewed. They did allow us to look around their shop and photograph their products. When speaking to the pesticide vendors in Vijayapur town, all three said they depend on manufacturers to provide high quality pesticides. All vendors reported that their customers come to restock once in a quarter and that they sell on average 4-5 kg per month. One of the most important things we learned was that most vendors were also unaware of which pesticides are banned in India, but they assumed the ones provided by manufacturers were legal.

16. WHETHER ANY PH.D. ENROLLED/PRODUCED OUT OF THE PROJECT -NO
17. NO. OF PUBLICATIONS OUT OF THE PROJECT –**Two papers published**

(PRINCIPAL INVESTIGATOR) **(PRINCIPAL)**

(Seal)

Annexure – VIII

UNIVERSITY GRANTS COMMISSION

BAHADUR SHAH ZAFAR MARG

NEW DELHI – 110 002

ASSESSMENT CERTIFICATE

(to be submitted with the proposal)

It is certified that the proposal entitled" Title of the Research Project : **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka"** by Dr./Prof./Mr./Mrs.): **U.S.Pujeri** . Dept. Of Chemistry has been assessed by the Expert committee consisting the following members for submission to the UGC Regional Office for financial support under the scheme of Minor Research Projects:

Details of Expert Committee:

Dr. K. G. Pujari	Principal/Chairman
Dr. S. C. Pattar	Coordinator
Dr. M. S. Yadawe	Member
Dr. S. T. Merwade	Member
Dr. M. B Mulimani	Member
Mr. Rakesh Patil	Administrative Staff Honorary Member
Prof. R.H. Bidari	Coordinator NAAC

The proposal is as per the guidelines.

(PRINCIPAL)

(Seal)

From:

Dr. U.S.Pujeri

Department of Chemistry.

S.B.Arts and K.C.P.Science College,

Vijayapur-586103

Karnataka.

To,

The Deputy Secretary and Regional Head

University Grants Commission,

South West Eastern Regional Office,

P.K.Block,Palace Road,

Gandhi Nagar,

Bangalore-560009.

Ref.NoF.No. MRP(S)-0455/13-14/KAKA-041/UGC-SWRO dated 08-04-2014

Sub: Regarding Submission of Annexure-V of Dr. U.S.Pujeri

Sir/Madam

I am herewith submitting Annexure**-V Minor Research Project Entitled "**Title of the Research Project : **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka".** This is for your information and kind notice.

Thanking You, Principal

Date:23/11/2015

B.L.D.E.ASSOCIATION'S
S. B. ARTS AND K. C. P. SCIENCE COLLEGE
BIJAPUR
RE – ACCREDITED AT THE 'A' LEVEL
Phone: (08352) – 261766, (08352) 262770 Extn. 2223, 2224
Fax: 08352 – 261766 E-mail: bldesbkcp@gmail.com

REF./ : ___________ Date:

From; Dr. **U.S.Pujeri**

Associate Professor in Chemistry
S. B. Arts and K. C. P. Science College, Vijayapur – 586103 Karnataka (India)
M: 9986291865

To : The Account Officer,
South Western Regional Office, University Grants Commission
P. K. Block Palace Road, Gandhinagar, Bangalore – 560009
MRP(S)-0455/13-14/KAKA-041/UGC-SWRO dated 08-04-2014

Sir,

I have already submitted the final report of minor research project Ref. No. 1 entitled Title of the Research Project : **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka.”** for your consideration, Ref. (3) along with documents (1) Two hard bound copies of final report (2) Annexure – III, IV, V, VI, VII (3) Audit report (4) Approval and sanction letters (5) Published paper (Attached to final report) (6) CD of report.

In resposnse to your letter cited above Ref. (2) I would like to clarify the point mentioned in it,

(a) I have already submitted two copies of the final report of the work done as per the guidelines duly signed by Principal and sealed along with Annexure – III, IV, V, VI, VII.
(b) I have already submitted audited utilization certificate as per the guidelines duly sealed and signed by charted accountant and the Principal.
(c) Further I would like to bring to your kind notice that final report of the project is kept in the Chemistry department library and the project summary is uploaded in College Website: http://www.bldeasbkcp.org/

However your kind consideration and quick reference I will submit one more copy of Audited Utilization Certificate, Certificate by Principal stating that the Final Report is kept in department library and summary of project uploaded in College Website. Please release the balancing amount at your earliest.

Thanking you

Bijapur

Your’s faithfully

(U.S.Pujeri)

Submitted through:The Principal S. B. Arts and K. C. P. Science College, Vijayapur

BIJAPUR
RE – ACCREDITED AT THE 'B' LEVEL
Phone: (08352) – 261766, (08352) 262770 Extn. 2223, 2224
Fax: 08352 – 261766 E-mail: bldesbkcp@gmail.com
REF./ PÀæªÀiÁAPÀ : Date:

CERTIFICATE

This is to certify that UGC funded Minor Research Project F. No. MRP(S)-0455/13-14/KAKA-041/UGC-SWRO dated 08-04-2014 entitled "Title of the Research Project : **Monitoring of Pesticides in farm vegetables and its impact on health at Bijapur district, Karnataka"** is completed by Principal Investigator Dr.U.S.Pujeri , associate professor in Chemistry and bound copy of the final report of the project work done is kept in the library of Chemistry department of this college and executive summary of the report has been uploaded in the College Website: http://www.bldeasbkcp.org/

Principal
S. B. Arts and K. C. P. Science College, Vijayapur