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Comparative Use of Chemical and Biological Fertilizers and Pesticides and their Health effects on Farmers in Satara Tahsil, Maharashtra

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Abstract:

The extensive use of chemical fertilizers and pesticides in the agriculture sector poses a serious problem to human health, environment and nation economy. Here, the relationship between the extent of use of chemical fertilizers and pesticides and signs and symptomsof illnesses due to exposure among the farmers from Satara tahsil was assessed. Twenty eight agricultural shops from study areawere surveyed to know the types and quantities of chemical and biological fertilizers and pesticides used up by the farmers.Sixty farmers from study area were interviewed with pretested interview questionnaire to know the signs and symptoms of illnesses related to agrochemical exposure. All interviewed farmers were found to use huge quantities of chemical fertilizers and pesticides than biological fertilizers and pesticides. The signs and symptoms of illness among study population due to chemical fertilizer and pesticide exposure were found to be itching eyes(61%),skin redness(47.6%),dizziness(42.9%),excessive sweating(40.5%),sore throat(26.2%), weakness(16.7%), shortness of breath(7.1%), nausea (4.8%) and stomach pain (4.8%).There is need to create awareness among the farmers to use personal protective measures while handling these chemicals and farmers should be encouraged to turn towards ecofriendly biofertilizers and biopesticides for sustainable agriculture.

Keywords: Chemical fertilizers and pesticides, Human health, Ecofriendly, Biofertilizers, Biopesticides

1.0 Introduction:

India is an agricultural country. Nearly 70% of the population thrives in rural areas, engaged inagriculture making the backbone of our economy.Total land area of our country's surface is 329 million hectare, out of which 145 million hectare is cultivable. Green revolution, no doubt, has been proved as a boon, which helped the rural farmers to attain more agricultural output.To meet the tremendous prenure in food production in the country, chemical fertilizersad pesticides were used to enhance the crop production. However, chemical fertilizers and chemical pesticides changed the agriculture scenario in the world. Pesticides include all classes of chemicals used to kill or repel insects, fungi, vegetation, and rodents (Guidotti et al, Reigert et al, 1999). In India, 90,000 metric ton of technical grade pesticides are used annually to control pests and plant diseases. The pesticides are classified as insecticides, fungicides,weedicides,herbicides, nematodicides and rodenticides. Though there can be benefits using chemical fertilizers and pesticides, inappropriate use cause harm to the environment. The toxic chemicals (arsenic and cadmium) from the chemical fertilizers accumulate in plant products causing health problems in human by biomagnifications (Hansra, 1993). Pesticides have different distribution and persistence patterns in the environment, even if all of them are distributed in some way through air, soil and water. This should be addressed to gain an understanding of how acute and chronic exposure may occur because air, water and soil are the media of exposure. The environmental impact of pesticides is often greater than what is intended by those who use them. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including nontarget species, air, water, bottom sediments, and food (Miller, 2004).

Excessive and inappropriate use of agrochemicals has undeniably resulted in negative and sometimes

irreparable effects on the human health, environment and nation economy. Degraded soils and groundwater pollution caused by chemical leaching have resulted in nutritionally unbalanced and unproductive lands.It is estimated that nearly 10,000 deaths annually to use of chemical pesticide worldwide, with about three-fourths of these occurring in developing countries (Horrigan *et al,* 2002). At present, India is the largest producer of pesticides in Asia and ranks twelfth in the world for the use of pesticides with an annual production of 90,000 tons (The Energy and Resources Institute, India). A vast majority of the population in India (56.7 percent) are engaged in agriculture and are therefore exposed to the pesticides used in agriculture (Gupta, 2004).Pesticides being used in agricultural tracts are released into the environment and come into human contact directly or indirectly. Humans are exposed to pesticides found in environmental media (soil, water, air and food) by different routes of exposure such as inhalation, ingestion and dermal contact. The effects, or symptoms, of pesticide poisoning can be broadly defined as either topical or systemic. Topical effects generally develop at the site of pesticide contact and are a result of either the pesticide's irritant properties or an allergic response by the victim. Dermatitis, or inflammation of the skin, is accepted as the most commonly reported topical effect associated with pesticide exposure (Bruynzeel et al 1993 and Paulsen, 1998). The effects of pesticides on human health are more harmful based on the toxicity of the chemical and the length and magnitude of exposure (Lorenz & Eric, 2009). Children are more susceptible and sensitive to pesticides (Landrigan et al, 1999). Exposure to pesticides results in acute and chronic health problems(Alarcon et al, 2005& Landrigan et al 1999). These range from temporary acute effects like irritation of eyes, excessive salivation to chronic diseases like cancer(Bassil et al,2007), reproductive(Garry et al ,2002 and Loffredo et al 2001),neurological disorders(Savage et al,1988), urogenital anomalies (Garcia-Rodriguez et al, 1996 and Weidner et al,1998)and developmental disorders etc(Y Yassi *et al*,2001).In such situation, use of biological fertilizers and pesticides is of great importance (Davison, 1988). Attempt was made to find out comparative use of chemical and biological fertilizers and pesticides and their health effects on farmers from agriculturally developed villages of Satara tahsil.

2.0 Materials and Methods:

2.1 Study Area:

The Satara district is situated in west part in Maharashtra State.The Satara district is located between 17^0 5' to 18^0 11' north latitudes and 73^0 33' to 74^0 54' east longitudes. It has an average elevation of 742 meters (2434 feet). Satara district has an area of 10,484 km², and a population of 2,796,906 according to 2001 census. This district consists eleven tahsils covering 1739 villages. For the study purpose, Satara city and agriculturally developed nearby villages from Satara tahsil-Saspade, Chikhali, Nagthane, Atit, Pal, Targaon, LimbSatara,Malgaon and Arphal were selected.

2.2 Interview Questionnaire:

The interview questionnaire for agricultural shops include information regarding sale of chemical and biological- fertilizers, weedicides, insecticides and fungicides with their types and amounts sold from shops per week.The interview questionnaire for farmers contained the information about type of crops, fruits and vegetables cultivated in Jun-Oct season,the commonly used chemical fertilizers and pesticides, precautions taken in handling these agrochemicals,signs and symptoms of illnesses related to agrochemical exposure and awareness regarding the use of biofertilizers and biopesticides.

2.3 Data Collection:

Twelve shops from Satara city and 16 shops from agriculturally developed villages(e.g.Saspade, Chikhali, Nagthane, Atit, Pal, Targaon, LimbSatara,Malgaon and Arphal) of Sataratahsil were surveyed inthe month of Oct 2011 and information was collected to know the types and quantities of chemical and biological fertilizers and pesticides used up by the farmers.Sixty farmers from nine villages- Saspade, Chikhali, Nagthane, Atit,Pal,Targaon,LimbSatara,Malgaon and Arphal were interviewed in the month of Sep 2011 and information was collected with the help of questionnaire.

3.0 Results and Discussion:

3.1 *Visit to agricultural shops from Satara city & nearby villages from Satara tahsil:*

Total of 28 agricultural shops were surveyed from Satara city and nearby villages from Satara tahsil. During study, we found huge response from the farmers to chemical fertilizers than biofertilizers. The biofertilizers were sold from only 15 shops.Eight common chemical fertilizers viz. 10:26:26(NPK), Urea ,DAP,12:32:16(NPK),Superphosphate,18:18:10(NPK), 19:19:19(NPK) and 20:20:0(NPK) were sold from market with the quantity ranging from 0.75-6.0 Tonne/week/shop. In contrast, market sale of biofertilizers viz. Vermiwash, Vermicompost, Kalfered, Humistar, Nimbalipend, Multiplex, Bijan and Boomflower was found to be only 0.5-1.25 Tonne/week/shop (Table 1).

Table 1: Comparative market sale of chemical and biological fertilizers

Sr. No	Comparative market sale of chemical and biological fertilizer (Quantity in Tonne/week/shop)			
	Name of chemical fertilizer	Quantity	Name of biological fertilizer	Quantity
1	10:26:26(NPK)	6	Vermiwash	1.25
2	Urea	4	Vermicompost	0.8
3	DAP	2	Kalfered	0.7
4	12:32:16(NPK)	2	Humistar	0.7
5	Superphosphate	1.5	Nimbalipend	0.7
6	18:18:10(NPK)	1	Multiplex	0.6
7	19:19:19(NPK)	1	Bijan	0.5
8	20:20:0(NPK)	0.75	Boomflower	0.5

We found poor response from the farmers to the biopesticides than chemical pesticides (Table 2).The market sale of chemical weedicides was found to be 6.0-9.67 Litres/week/shop from 4 dominating weedicides(viz. Round Up, 2,4-D, Atrazine and Glyphosate) whereas bioweedicides were not available in the market. Five common chemical insecticides(viz.Rogar,Nuwan,Coragen,Chlorpyriphos and Canon) were sold from market with the sale 1.89-4.25 Litres/week/shop whereas only two bioinsecticides(viz. *Metarrhizium spp and Verticillium lecanii*) were sold from market with sale 0.6-0.9 Litres/week/shop.Four common chemical fungicides(Kavach, Biostin, Ridomil and M 45) have a market sale 2.55-5.33 Litres/week/shop whereas market sale of two biofungicides(viz. *Trichoderma viridiae and Beauveria bassiana*) was found to be 0.6-0.9 Litres/week/shop.

Table 2: Comparative market sale of chemical and biological pesticide:

Market sale of chemical and biological insecticides (Quantity in Liters/week/shop)				
Sr. No.	Name of chemical insecticides	Quantity	Name of biological insecticides	Quantity
1	Rogar	4.25	*Metarrhizium spp*	0.9
2	Nuwan	2.92	*Verticillium lecanii*	0.6
3	Coragen	2.8	-	-
4	Chlorpyriphos	2.5	-	-
5	Canon	1.89	-	-
Market sale of chemical and biological fungicides (Quantity in Liters/week/shop)				
Sr.No.	Name of chemical fungicides	Quantity	Name of biological fungicides	Quantity
1	Kavach	5.33	*Trichoderma viridiae*	0.9
2	Biostin	4.0	*Beauveria bassiana*	0.6
3	Ridomil	2.75	-	-
4	M 45	2.55	-	-
Market sale of chemical and biological weedicides (Quantity in Liters/week/shop)				
Sr.No.	Name of chemical insecticides	Quantity	Name of biological insecticides	Quantity
1	Round Up	9.67	-	-
2	2,4-D	6.95	-	-
3	Atrazine	6.11	-	-
4	Glyphosate	6	-	-

3.2 Visit to farmers from agriculturally developed villages of Satara tahsil:

Sixty farmers (48 men and 12 women) were interviewed with the help of questionnaire. The

average age of farmers was 37 years.Soybean, Groundnut, Sugarcane and Rice were the major crops cultivated from the study area during this season. Forty two (70%) farmers (of whom 4 were women) sprayed pesticides by themselves and therefore were directly exposed to pesticides and 90% of them did not use any form of protection, while handling pesticides. The period of exposure ranged from less than a year to 50 years with an average duration of 12 years. A majority of them, 42 (70%), have been spraying pesticides for the past fifteen years.All interviewed farmers were found to use huge quantities of chemical fertilizers and pesticides in their farms. Due to extensive use, crop/vegetable/fruit yield, soil fertility was decreased considerably since last 10 yrs. The signs and symptoms of illness among study population due to chemical fertilizer and pesticide exposure were found to be itching eyes(61%),skin redness(47.6%),dizziness(42.9%),excessive sweating (40.5%),sorethroat(26.2%),weakness(16.7%),shortne ss of breath(7.1%), nausea (4.8%) and stomach pain (4.8%).Higher frequency of these signs and symptoms was noticed among the sprayers than the non-sprayers(Table 3).

Table 3: Signs and symptoms of illness observed among study population (as percentage)

Sr. No.	Signs and symptoms	Sprayers (N=42)	Nonsprayes (N=18)
1.	Itching eyes	61	55.6
2.	Skin redness	47.6	44.4
3.	Dizziness	42.9	33.3
4.	Excessive sweating	40.5	33.3
5.	Sore throat	26.2	22.2
6.	Weakness	16.7	16.7
7.	Shortness of breath	7.1	5.6
8.	Nausea	4.8	-
9.	Stomach pain	4.8	-

We found very poor response from surveyed farmers for the use of biofertilizers and biopesticides. Out of 60 farmers interviewed, only 6(10%) farmers used biopesticides and 24 (40%) farmers used biofertilizers in their farm.

Extensive use of a wide range of chemical fertilizers and pesticides compared to biological fertilizers and pesticides among our study farmers is worrisome.Most farmers in our study were not aware of the health hazards caused by the inappropriate handling of chemical fertilizers and pesticides. Ninety percent of the sprayers did not use any form of protection, while handling these fertilizers and pesticides.Farmers spraying pesticides for more than a decade was 42(70%), which implies that a large number of farmers get exposed to pesticides over long duration. This may cause chronic health impacts to the farmers. Farmers experienced a variety the signs and symptoms related to pesticide. The prevalence of signs and symptoms related to pesticide exposure was higher among the sprayers. Awareness among the farmers needs to be created on use of personal protective measures while handling chemical fertilizers and pesticides. Farmers need to be encouraged to reduce or eliminate the use of these chemicals and to turn towards ecofriendly biofertilizers and biopesticides for sustainable agriculture.

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