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ESTIMATION OF FABRIC BARRIER PROPERTIES TO PESTICIDE RESIDUES

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ABSTRACT

Protective clothing is an important line of defence for workers in hazardous occupations. Even though workers generally recognize the need for protective clothing they often experience problems with the size, design, and function of the clothing as well as experiencing discomfort. Wearing protective clothing and equipment when handling or applying pesticides can reduce the risk of exposure of harmful aspects of pesticide application.

KEYWORDS: Cloth Count, Crease Recovery, Desizing, Pesticide, Protective Clothing, Starch, Yarn Count

INTRODUCTION

Pesticides are substances meant for attracting, seducing, and then destroying, or mitigating any pest.[1, 3] They are a class of biocide. The most common use of pesticides is as plant protection products (also known as crop protection products), which in general protect plants from damaging influences such as weeds, plant diseases or insects. This use of pesticides is so common that the term *pesticide* is often treated as synonymous with *plant protection product*, although it is in fact a broader term, as pesticides are also used for non-agricultural purposes.

In general, Pesticides are the only toxic substances released intentionally into our environment to kill living things. This includes substances that kill weeds (herbicides), insects (insecticides), fungus (fungicides), rodents (rodenticides), and others. Protective clothing is an important line of defence for workers in hazardous occupations especially in farm activities like pesticide application. Keeping this in mind, investigator wanted to find out Estimation of Fabric Barrier Properties to Pesticide Residues.[1, 2]

MATERIALS AND METHODS

Polyester and cotton blends of 60:40 and 100% cotton was selected for the study.

Desizing

The selected fabrics were soaked in 5 g/l soap solution for 24 hours. Soaked samples were squeezed, rinsed thoroughly in cold water and shade dried.

Geometrical Properties

Cloth count (Numerical expression), Mass per unit area (gm), Cloth thickness (mm) Cloth crease recovery (Degree), Yarn Twist (TPI/TPM).

Contamination and Analysis of Test Fabrics

The amount of pesticide penetration through fabrics was measured by quantifying the residues collected on the

filter paper by gas chromatography. The amount of pesticide residue from each sample was calculated from the area of peaks in relation to the standard peak. From the results, fabrics with minimum penetration were selected for the study.

Processing of Test Fabrics

Desizing of fabrics is done to remove any unwanted sizing material, dirt, soil etc. The nature of desizing process usually depends up on the nature of the sizing material, soil, dirt, etc., which are to be removed. The cotton fabric was boiled in a solution containing 2 gm. of sodium carbonate and 1 gm. of sodium hydroxide per 1 litre of water for 45 minutes. During the process the fabric was frequently stirred**.**

Application of Starch

The starch was prepared with 5% commercial starch with boiling method (50 gms / litre) of water.

FINISHING PROCEDURE

- Desized fabrics were dried in direct sunlight for one hour.
- The fabric to be finished was immerse in 5% starch solution liquid and then squeezed out extra starch.
- Dry the fabrics in direct sunlight.

LABORATORY TESTING OF FABRICS

Atmospheric Conditions

For testing of textile materials in the laboratory standard atmosphere has to be maintained. The tested samples were conditioned in an atmosphere with a relative humidity of 65 $\pm$ 2% and a temperature of 27 $\pm$ 2^{o} C prior to testing for 24 hours as per BIS standards.

Preparation of Test Specimens

The test specimens were prepared by cutting the samples as per the templates and procedure lay down by Bureau of Indian Standards 1982. The test specimens were cut from various portions of the fabric both warp way and weft directions, in order to obtain a reliable and complete idea of the properties of the fabric.

Selection of Pesticide

A wide range of pesticide is used to control pests and diseases on crops, majorities are insecticides followed by herbicides (18%) and fungicides (6%). Insecticides are categorized into various groups, among which organophosphates and organ chlorides and synthetic pyrethroids are the major compounds most widely used besides other insecticides. A review of literature pertaining to the pesticide use pattern in tea farmers indicated that the Malathian, a dimethoate insecticide is one of the most commonly used insecticides and so, Malathian was selected for the study.

Pesticide Application

The pesticide spray solution 0.06% (@ 2ml of 30 EC of malathian in one litre of water) was taken in a beaker which is sufficient enough for the samples.

Sprayer was used for spraying. Spray solution was sprayed on the lab test specimens three times uniformly at

three locations within 8 cm diameter.

LABORATORY SPRAY TEST

Spray solution was filled in the sprayer brought to the lab in a bottle for contamination of the test fabrics in the laboratory. Each test fabric measuring 15 cm x 15 cm with 8 cm X 8 cm square marked over each specimen was pinned to Whatman absorbent paper (8 cm X 8 cm marked on it) in such a manner that (8cm x 8cm) square falls over the absorbent paper. Each test specimen was pinned to an aluminum foil. In this manner, twelve test specimens in three sets (with the four test fabrics) were prepared sufficient for three exposures. Spray solution procured from each spray trials was sprayed on the lab test specimens three times uniformly at three locations within 8 cm x 8cm fabric specimens and absorbent paper specimens from one set were transferred into separate glass bottles for residue with hexane. The bottles were capped and shaken gently to ensure the whole pad is wetted with the solvent. All the bottles were carefully labelled, prior to analysis.

GAS CHROMATOGRAPHIC ANALYSIS

Gas chromatography was commonly used for quantitative of pesticide residues.

The total residues calculated from the total areas of standard and samples were expressed as mg/kg in ppm or 1 cm2 in ppm (nano grams per square centimetre of the fabric or 64 cm2 i.e., 8 cm x 8cm).

Residue present in fabric is calculated as

$$\text{Pesticide residue in mg/cm2} = \text{Value} \times \frac{\text{Final vol. of the residue solution (5ml)}}{\text{Weight of the sample}}$$

PESTICIDES COMMONLY USED BY THE FARMERS (ITS CLASSIFICATION)

Table 1

Extremely Hazardous	Highly Hazardous	Moderately Hazardous	Slightly Hazardous	Unlikely to Present Acute Hazard in Normal Use
Phorate Organophosphate	Mono crotophos Organophosphate Profenofos & Cypermethrin Combination pesticide Carbofuran Carbamate	Dimethoate Organophosphate Quinalphos Organophosphate . Endosulphan Organochlorine Carbaryl carbamate Chlorpyrifos Organophosphate Cyhalothrin Pyrethroid Fenthion Organophosphate DDT Organochlorine	Malathion Organophosphate	Carbendazim Carbamate Atrazine Triazine

GEOMETRICAL PROPERTIES OF THE BLENDED FABRICS

Table 2

Type of Fabric		Twist	Yarn Count ('s)	Cloth Count (Threads/Inch)	Cloth Thickness (mm)	Cloth Crease Recovery (Degree)	Cloth Weight (g/sq.mt.)
100% cotton	Warp	S	33	80	0.19	105.8	123
	Weft	Z	35	90		103.2	
Blend 60:40 p/c	Warp	S	47	80	0.15	86	118
	Weft	Z	49	91		82	

RESULTS & DISCUSSIONS: (PESTICIDE RESIDUE RESULTS) 100% COTTON

Table 3

Sl. No	Details of the Samples	Pesticide Residue Present in the Sample	Volume of The Solution	Total Area of the Sample	Residue Present in the Fabric,(mg/Kg)
1	Control	8.07	5 ml	64	0.363
2	Samples washed in 5% Salt water at 120°F	3.40	5 ml	64	0.264
3	Sample washed in 5% salt water at 140°F	3.00	5 ml	64	0.216
4	Sample washed in 2% heavy duty detergent at 120°F	3.89	5 ml	64	0.304
5	Sample washed in 2% heavy duty detergent at 140°F	1.42	5 ml	64	0.110
6	Control (Starch 10%)	9.26	5 ml	64	0.726
7	Sample steeped in 5% Salt water at 120°F	1.45	5 ml	64	0.113
8	Sample steeped in 5% Salt water at 140°F	1.00	5 ml	64	0.067
9	Sample steeped in 2% heavy duty detergent at 120°F	1.00	5 ml	64	0.067
10	Sample steeped in 2% heavy duty detergent at 140°F	1.07	5 ml	64	0.049

RATE OF MALATHIAN ABSORPTION AND RETENTION BY 64 CM^2 TEST FABRICS

Table 3

Fabric Code	Test Fabrics	Mean Residue Absorbed/ Retained for Control Sample (ng/cm^2)	Mean Residue Absorbed/ Retained 5% NaoH at 120 ^{o}F (ng/cm^2)	Mean Residue Absorbed/ Retained 5% NaoH at 140 ^{o}F (ng/cm^2)	Mean residue Absorbed/ Retained 2% Detergent at 120 ^{o}F (ng/cm^2)	Mean residue Absorbed/ Retained 2% Detergent at 140 ^{o}F (ng/cm^2)
100% cotton	UF1	0.362	0.264	0.216	0.304	0.110
	F1	0.723	0.113	0.067	0.067	0.049
Blend 60:40 p/c	UF1	3.39	0.035	0.007	0.004	0.000
	F2	0.351	0.362	0.009	0.008	0.003

UF1 Unfinished 60:40 (Polyester/Cotton) **F1 finished 60:40 (Polyester/Cotton)**

UF2 Unfinished 100% Cotton **F2 finished 100% cotton**

The results presented in Table revealed that among the two fabrics, the rate of percentage Malathian penetrated is the lowest in case of polyester cotton 60:40 fabric, compared to 100% cotton. It may be assumed that these differences could have been due to absorbency of cotton fabric.

RESIDUE PRESENT 100% COTTON (UFI &UF2) RESIDUE PRESENT IN BARRIER FABRIC (P/C BLENDS OF F1&F2)

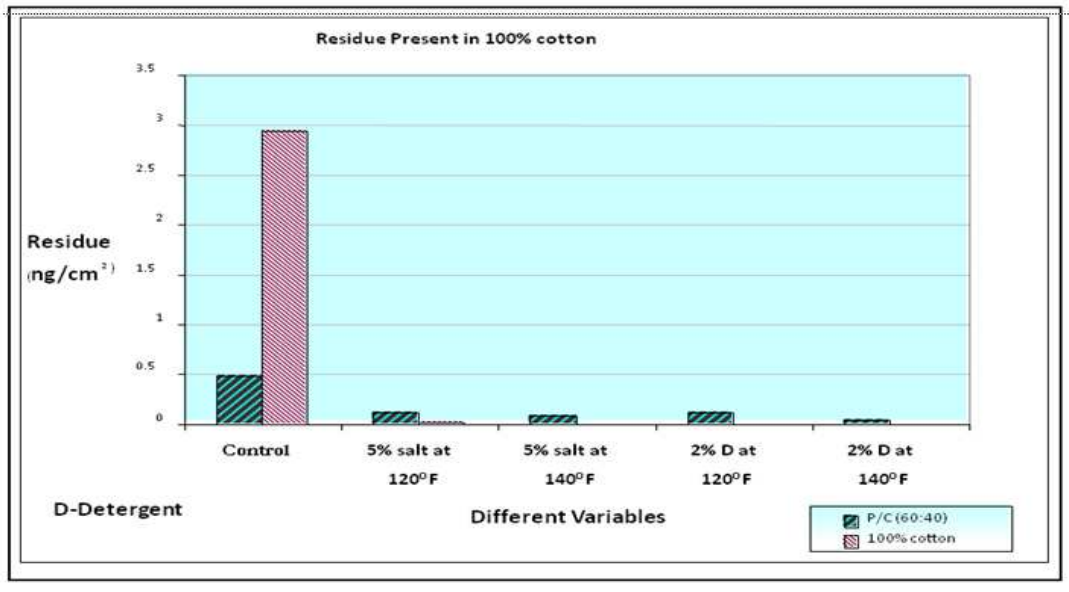

Figure 1: Residue Present 100% Cotton (UFI &UF2)

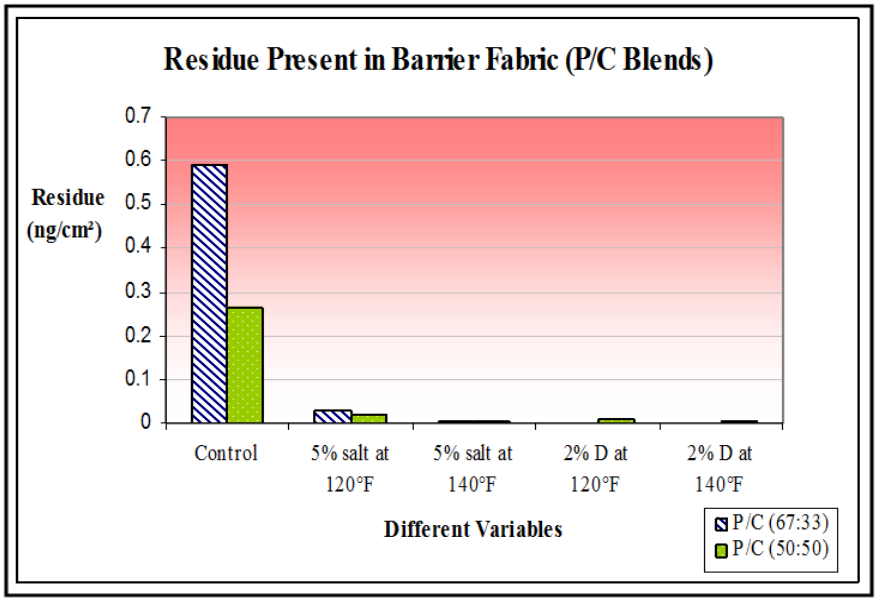

Figure 2: Residue Present in Barrier Fabric (P/C Blends of F1&F2)

CONCLUSIONS

A wide range of pesticide is used to control pests and diseases on crops, majorities are insecticides followed by herbicides and fungicides. Although pesticides have benefits, some also have drawbacks, such as potential toxicity to humans and other species. Study revealed that among the two fabrics, the rate of percentage Malathian penetrated is the lowest in case of polyester cotton blend (60:40) fabric, compared to 100% cotton. It may be assumed that these differences could have been due to absorbency of cotton fabric.

REFERENCES

1. Carolyn Randall (ed.), et al., *National Pesticide Applicator Certification Core Manual* (2013) National Association of State Departments of Agriculture Research Foundation, Washington, DC,
2. Gilden RC, Huffling K, Sattler B (January 2010). "Pesticides and health risks". J Obstet Gynecol Neonatal Nurs **39** (1): 103–110
3. US Environmental (July 24, 2007), what is a pesticide? Epa.gov. Retrieved on September 15, 2007.