Environment & Ecology 29 (1) : 207—210, 2011
 ISSN 0970-0420

Comparative Study of Pesticide Removal from Pesticide Infested Cotton and Cotton / Polyester Blended Fabric

SANDEEP BAINS[1], RAJDEEP KAUR[2] AND PRITPAL SINGH[2]

[1]Department of Clothing & Textiles,[2]Department of Plant Breeding & Genetics, Punjab Agricultural University Ludhiana 141004, India
E-mail : sandeepct@pau.edu

Abstract

The farmers, commercial pesticide applicators and home gardeners who apply common, general-use pestcides to their lawns, flowers and vegetable farms need to protect themselves from ill effects of pesticides on their body. Therefore there is a need to optimize the laundering conditions of the pesticide infested clothing which can be suggested to the pesticide applicators. So a study was conducted in which pesticide infested cotton and cotton / polyester blended fabrics were given different laundering treatments i.e. 5% salt at 50C, 5% salt at 80C, 2% heavy duty detergent at 50C, 2% heavy duty detergent at 80C. The trials were conducted for both unstarched and starched fabric. It was observed that washing cotton fabric with 2% heavy duty detergent solution at 80C was the best condition with both unstarched and starched samples as compared with that of cotton / polyester blended fabric. Further, comparing unstarched and starched samples, it was observed that the starched samples had more per cent transmittance value than the unstarched samples thus reducing penetration of pesticide to some level.

Key words : Cotton, Cotton / polyester, Fenvalerate, Protective Clothing, Transmittance.

Most pesticide accidents happen when users are careless or when they do not know how to handle pesticides safely. The time one spends to learn about the safe use of pesticides is an investment in the health and safety of the person, her/his family, and the others. Pesticides enter the body of the outside workers (spray operators like farmers and area control program workers) and inside workers (pesticide manufacturing unit workers) orally, by inhalation, by respiratory splash and by skin contact. Each of these routes can be avoided by using protective clothing. Protective items worn during the application of pesticides, helps, protect the user and prevent pesticide residues from spreading to areas where people live and work. Fabric selection is another important aspect of protective clothing. Though protective clothing made from cotton or its blends may not provide adequate protection to the skin, when contaminated with a sprayed liquid, so it is essential that the surface of the fabric has been treated in someway to reduce penetration to an acceptable level. Generally, the chemical barrier treatments are given, whose performance is inversely correlated with high air permeability. Clothing with an ideal behavior of high chemical protection and high air permeability for thermal comfort in hot, humid weather by manipulating surface tension of the textiles in response to a chemical challenge is the need of the hour (1). Thus an eco-friendly barrier treatment with starch can act more useful than treating the fabric with chemicals to protect the pesticide applicator from its ill effects. The effectiveness of protective clothing is further affected by the pesticide characteristics and the work habits of the pesticide handlers. Indian farmer is involved in pesticide application with no physical protection. This has led to tremendous health problems. The contaminated work clothing may act as an occlusive dressing facilitating dermal exposure of the pesticide. Thus refurbishment is an essential and critical part of continued safety. Pesticide removal in washing is essential if the garment is to be worm again. Thus, the research was planned to develop protective clothing by using eco-friendly barrier and optimizing the washing conditions for the removal of pesticide from infested cotton and cotton / polyester blended fabric. The Objectives were to optimize the laundering treatments, given to the pesticide infested cotton and cotton/polyester blended fabric, to study the effect of barrier treatment, on absorption of pesticide, to compare the amount of pesticide residue in unstarched and

starched fabric, and to compare the amount of pesticide residue in cotton and cotton / polyester blended fabric.

Methods

Selection of Materials

Pure white cotton and cotton / polyester blended (60 : 40) fabrics with plain weave were procured from local market of Ludhiana. Their physical properties were examined which included, warp : 40 ends/cm, weft : 36 pick/cm, fabric mass : 140 g/m^2, thickness : 0.25mm for cotton fabric and warp : 77 ends/cm, weft : 100 pick/cm, fabric mass : 110 g/m^2, thickness : 0.24 mm for cotton /polyester blended fabric. Fenvalerate 20 EC pesticide was used for the experiment. This pesticide controls sucking insects which infest leaves, fruits, feed and cotton (2).

A barrier treatment was provided to the cotton and cotton/ polyester blended fabric with locally available eco-friendly starch. After spraying the pesticide on unstarched and starched fabric, the pesticide was stripped with the laboratory grade chemicals, acetone and hexane.

Procedure of Work

Ten test fabric samples measuring 15 × 15 cm were cut from each of the scoured cotton and cotton/ polyester blended fabric (3). Only five of the samples from each fabric were given barrier treatment with the application of 10% starch solution and allowed to dry.

Pesticide spray solution was prepared by thoroughly mixing 1ml of fenvalerate 20 EC in one liter of water. Each sample was placed on a tile covered with aluminum foil. An instamatic fixed volume micropipette was used to apply one ml of the prepared solution of pesticide on both unstarched and starched samples. The undisturbed samples were allowed to dry overnight.

Both unstarched and starched samples were laundered as per the following washing conditions:

Control—Unwashed samples, Laundering in 5% salt water at 50C for one hour, Laundering in 5% salt water at 80C for one hour, Laundering in 2% heavy duty heavy duty detergent at 50C for one hour, Laundering in 2% heavy duty heavy duty detergent at 80C for one hour.

Table 1. Comparison of pesticide residue of unstarched and starched cotton and cotton/polyester blended samples. CD_A = 0.175028, CD_B = 0.175028, CD_{AB} = 0.247527. CD—Critical difference, A — Unstarched and Starched samples, B — Laundering treatments, AB—Interaction among both A and B.

With or without barrier treatments	Cotton	Cotton/ Polyester	Mean
Unstarched	45.11	17.24	31.18
Starched	61.08	38.92	50.00
Mean	53.09	28.08	

The unstarched and starched samples of cotton and cotton /polyester blended fabric were separately steeped in salt and heavy duty heavy duty detergent and separately washed at 50 and 80C temperatures. Later, each sample specimen was rined separately in separate beakers to avoid cross contamination and dried in sunlight.

A solution of acetone : hexane i. e. 250 : 250 ml was prepared. Each sample was separately dipped in separate beaker and the solution was allowed to evaporate till only 5 ml of acetone : hexane was left. This 5 ml solution was separately put in conical glass flasks. The experiment was repeated three times for each condition.

The percentage transmittance was observed for all the unstarched and starched samples i.e., their control samples and the samples when washed under different washing conditions using UV/VIS spectrophotometer (UV 3000 +).

Results and Discussion

The effects of different treatments on per cent transmittance of pesticide residue on the unstarched test samples of cotton and cotton/polyester blended fabric were studied. It indicated that there was a change in the per cent transmittance of the residue due to the increase in washing temperature. The difference in per cent transmittance of the residue was also observed when the unstarched samples were treated in salt water or heavy duty heavy duty detergent.

The trasmittance (%) of pesticide residue was compared for starched samples of cotton and cotton/ polyester blended fabric by applying the analysis of

Table 2. Comparison of pesticide residue of unstarched and starched samples with the treatments. CD_A = 0.175028, CD_C = 0.430366, CD_{AC} = 0.608629. CD-Critical difference, A - Unstarched and starched samples, C - Laundering treatments, AC - Interaction among both A and C.

Treatments	Unstarched	Starched	Mean
Control	22.26	31.90	27.08
Salt 5% at 50C	29.83	35.06	32.45
Salt 5% at 80C	32.83	52.43	42.63
Detergent 2% at 50C	34.27	63.83	49.05
Detergent 2% at 80C	36.66	66.76	51.71
Mean	31.17	49.99	

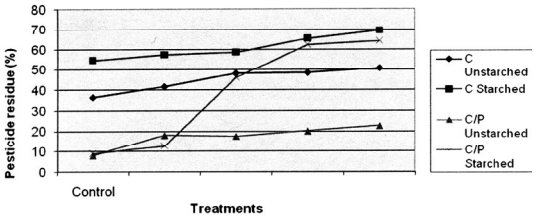

Figure 1. Comparative pesticide residue in cotton and cotton/polyester blended fabric.

variance on the experimental data. The difference among all the values of per cent transmittance of pesticide residue was significant ($P \leq 0.05$).

The interaction among the data for unstarched and starched cotton and cotton/polyester blended samples was observed (Table 1). By comparing cotton and cotton/polyester blended samples it was found that the maximum value of per cent transmittance was in case of cotton samples. As regards the barrier treatment the maximum value of per cent transmittance was found for the samples with barrier treatment i.e. starched samples. Overall, starched cotton has the maximum value of transmittance as compared to the others. By applying analysis of variance on the experimental data it was found that the difference among all the values of per cent transmittance of pesticide residue was significant ($P \leq 0.05$).

After analyzing the data for cotton and cotton/polyester blended samples the interaction was observed in both the cases (Table 2). By comparing unstarched and starched samples it was found that the maximum value of per cent transmittance for three treatments was in starched samples. As regards the five treatments the maximum value of per cent transmittance was found for the samples laundered with 2% heavy duty detergent at 80C. Overall, unstarched sample laundered with 2% detergent at 80C has the maximum value of transmittance as compared to the others. By applying analysis of variance on the experimental data it was found that the difference among all the values of per cent transmittance of pesticide residue was significant ($P \leq 0.05$).

Table 3. Comparison of pesticide residue of cotton and cotton/polyester blended samples with the treatments. CD_B = 0.175028, CD_C = 0.276744, CD_{BC} = 0.391374. CD - Critical difference, B- Cotton and cotton/polyeser blended samples, C- Laundering treatments, BC - Interaction among both B and C.

Treatments	Cotton	Cotton/ Polyester	Mean
Control	42.33	11.03	26.68
Salt 5% at 50C	46.20	15.37	30.78
Salt 5% at 80C	52.93	31.90	42.41
Detergent 2% at 50C	60.03	41.20	50.61
Detergent 2% at 80C	63.97	43.40	53.68
Mean	53.09	28.58	

The interaction among the data for unstarched and starched samples was also observed (Table 3). By comparing unstarched and starched samples it was found that the maximum value of per cent transmittance for all the treatments was in case of cotton samples. As regards the five treatments the maximum value of per cent transmittance was found for the samples laundered with 2% heavy duty detergent at 80C. The trend remained the same for both the fabrics. Overall, cotton sample laundered with 2% detergent at 80C has the maximum value of transmittance as compared to the others. By applying analysis of variance on the experimental data it was found that the difference among all the values of per cent transmittance of pesticide residue was significant ($P \leq 0.05$).

The transmittance (%) of pesticide residue was compared for unstarched and starched cotton and cotton/polyster blended fabric by applying the analysis of variance on the experimental data. By applying analysis of variance on the experimental data it was found that the difference among all the values of per cent transmittance of pesticide residue was significant ($P \leq 0.05$).

A comparison of transmittance (%) of pesticide

residue was done for the cotton and cotton/polyester blended samples. It was found that transmittance (%) value was more in cotton samples rather than that of cotton/polyester blended samples (Fig. 1). Regarding differences in values due to the barrier treatment, transmittance (%) value was more in starched than unstarched samples.

Conclusion

Experimental work was carried out to optimize the laundering conditions of the clothes infested by pesticides. Two types of fabrics (cotton / polyester blend in ratio of 60 : 40 and pure cotton fabric) in plain weave were selected for the experiment. The physical properties of the fabric were studied. Pesticide fenvalerate 20 EC was sprayed on control and samples treated with 10% starch solution. These fabrics were laundered at different laundering conditions. These were dried and pesticide was dissolved in acetone and hexane solution for pesticide residue analysis. It was observed that the least amount of residue was found in the pure cotton starched fabric treated with 2% detergent solution at 80C.

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