IMPROVEMENT OF THERMOPHYSIOLOGICAL STRAIN IN SUBJECTS WEARING PROTECTIVE GARMENTS POR SPRAYING PESTICIDE

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INTRODUCTION

Pesticide is required to keep a steady harvest in modern agriculture. **An** orchardist wears special protective clothing such as pesticide–proof clothing, protective mask, rubber gloves and boots to protect his body from pesticide.But, some workers dislike wearing the usual protective clothing, since it is made of air and water impermeable fabrics, and heat and water dissipation is highly restricted. We studied materials of protective clothes [1)] , gloves [2)] and boots [3)] for pesticide. Furthermore , we studied the effects of cooling the head [4)] and upper torso [5)] by frozen gel strips on the physiological responses in the subjects wearing protective clothing. In our present paper we compared thermoregulatory responses and subjective sensation between usual protective clothes and our newly designed protective clothes.

MATERIALS and METHODS

Six healthy female students served as subjects. They gave written informed consent before the beginning of the experiments. Each subject participated in two sessions: one with usual clothes (**A**) and the other with newly designed clothes (B) having cooling system for the head and chest. Protective clothing **A** was composed of ready nylon clothing, protective mask, polyurethane gloves and rubber boots. In protective clothing **A,** the cooling system was not used. Protective clothing B was composed of cotton pesticide–proof clothes, protective mask, special gloves consisting of two parts: polyurethane around the hand, Goretex (laminated fabric) around the forearm, and special boots consisting of two parts: rubber around foots and ankle and Goretex around the leg. Furthermore, the head and chest were cooled by frozen gel strips fixed in the cap and undershirts. Both clothing was resistant to the peneration of pesticide. Figure 1 shows both clothing ensembles **A** and B. The experiment was carried out in a climatic chamber at 28 ℃ , 60 % RH in summer. Rectal and skin temperatures on the forehead, chest, back, hand, forearm, thigh, leg, and foot were measured using thermistor thermometers. Temperatures and heart rate were recorded every 1 min during the experimental period. Local sweat rates on bilateral forearm areas were recorded continuously. Subjects voted the subjective ratings at the end of each rest and exercise. After T_{re} became a steady state, the subjects were requested to don the protective clothing ensemble. After subjects rested for 15 min in a chair, they repeated three times work/rest schedules of 15 min exercise on a bicycle ergometer (50W) followed by 5 min rest. For head and chest cooling, five frozen gel strips (total 55g) were put on the head and one of an another kind of frozen gel strips (74g) put on the chest just before the first exercise bout. The differences in mean values between A and B were analyzed by Student's paired t–test. A p value less than 0.05 was considered statistically significant.

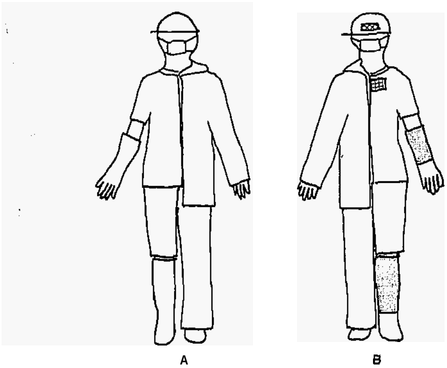

Fig. 1 Two types of protective clothing. Right: newly designed type B. Left: typical type **A.**

RESULTS

Figure 2 shows a typical record of forearm sweat rate in a subject N. F. in both conditions. The sweat rate increased quickly as soon as the subject started to exercise and fell down immediately when she took a rest. Sweat rate increased less in B than in A . Figure 3 shows a typical record of heart rate in a subject N. F. in two conditions. Heart rate fell while resting and rose during exercising in two conditions. Higher increase of heart rate was observed in A during 2nd and 3rd exercise. Figure 4 shows a typical record of T_{re} in a subject N. F. in two conditions. T_{re} continued to rise gradually throughout the experimental period. The increase of T_{re} was inhibited more effectively in B. Figure 5 shows a typical record of comfort sensation in a subject N. F. As seen in the figure, rating seemed to be improved in B.

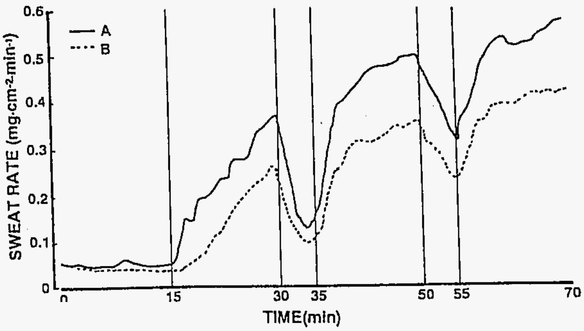

Fig. 2 Sweat rate during rest and exercise under the influence of two types of protective clothing in a subject N. F.

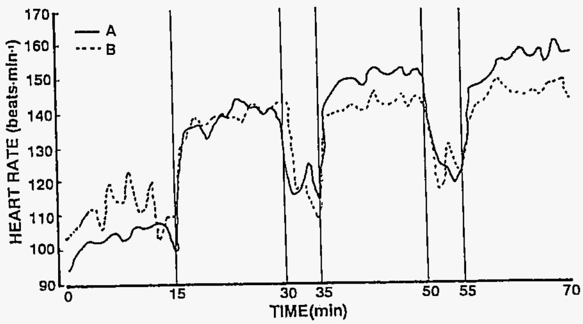

Fig. **3** Heart rate during rest and exercise under the influence of two types **of** protective clothing in a subject N. F.

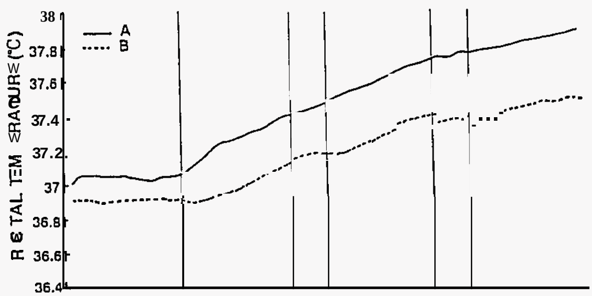

Fig. **4**

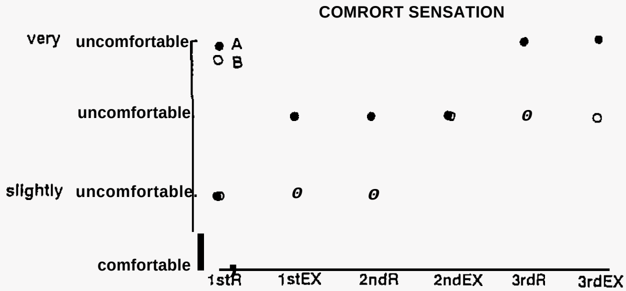

Fig. 5 Comfort sensation during rest and exercise under the influence of two types of protective clothing in a subject N.F.

There were significant differences between **A** and B in rectal temperature, heart rate, local sweat rate, skin temperatures and thermal sansations.

CONCLUSIONS

Protective clothing B reduced thermal strain with improved thermal sensation during exercise and recovery at warm environment.

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