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Studies on larval feeding of some new insect pests on wool-synthetic blend fabrics

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Seven common wool-synthetic blend fabrics containing polyester, terylene, viscose rayon and/or cotton were evaluated for their resistance to the larval feeding of five newly reported wool pests from India. Among the wool pests, the larvae of *Attagenus fasciatus* (Thunberg) fed heavily and caused serious damage to all the blend fabrics. All blend fabrics were found resistant to the larvae of *Attagenus birmanicus* Arrow, *Attagenus indicus* Kalik, *Attagenus lobatus* Rosenhauer and *Anthrenus coloratus* Reitter, except the fabric blended with 50% and 55% viscose rayon which were not resistant to the larvae of *Anthrenus coloratus*. Fabric with 50% viscose rayon was also not resistant to the larvae of *Attagenus birmanicus*. Synthetic fibre pieces were not digested by the larvae of pests as these were passed out unchanged from their digestive tract in excreta.

Keywords: *Anthrenus coloratus*, *Attagenus birmanicus*, *Attagenus fasciatus*, *Attagenus indicus*, *Attagenus lobatus*, Wool pests, Wool-synthetic blend fabrics

Wool and wool-synthetic fabrics/clothing are frequently damaged by insects and are resposible for the heavy losses in stores in India and elsewhere. Over the years, the wool blended synthetic fabrics are preferred in apparels and upholstery items. Preference for these blend fabrics is due to their low cost as compared to that of the pure wool fabrics and superior properties like improved crease resistance and drape. Moreover, these blend fabrics may also give rise to false sense of insectproofness as the synthetic fabrics are resistant to insect attack.

Several workers[1-5] have reported that fabrics containing 30-86% wool with polyester, viscose rayon, orlon, nylon, cordelan, acrylic or cotton are heavily damaged by larvae of beetles species, *Attagenus unicolor* (Barhm), *Anthrenus flavipes* Le Conte and moth species, *Tineola bisselliella* (Hummel). However, the larvae of *Attagenus scalaris* Pic has not been found damaging wool-synthetic fabrics[6]. Vijay Veer *et al.*[7], observed that the larvae of *Attagenus cyphonoides* Reitter were unable to damage fabrics in which wool fibres were mixed with polyester, viscose rayon or terylene fibres while these fabrics were heavily damaged by other two species, *Anthrenus flavipes* Le Conte (the furniture carpet beetle) and *Tinea translucens* Meyrick (the tropical case bearing clothes-moth). The larvae of these species were not able to digest synthetic fibres as these were passed out unchanged from their digestive tract in excreta[7].

In our recent surveys conducted in various wool stores in the country, nine species of beetles have been found damaging woollen textiles and out of these, seven species are new pests of wool[8-9]. These new pests are *Attagenus birmanicus* Arrow, *Attagenus fasciatus* (Thunberg), *Attagenus indicus* Kalik, *Attagenus lobatus* Rosenhauer, *Attagenus augustatus gobicola* Frivaldszky, *Anthrenus oceanicus* Fauvel and *Anthrenus coloratus* Reitter. No data is available on the feeding propensities and damaging potential of the larvae of these newly reported wool pests on wool-synthetic blend fabrics. In this paper, we report the results of exposure of seven types of common wool-synthetic blend fabrics manufactured in India to the larvae of above new pests except *Attagenus augustatus gobicola* and *Anthrenus oceanicus* which are not common in the country.

Feeding tests were carried out with active larvae of *Attagenus fasciatus* (11-12 weeks old), *Attagenus birmanicus* (16-18 weeks old), *Attagenus indicus* (16-18 weeks old), *Attagenus lobatus* (16-18 weeks old) and *Anthrenus coloratus* (16-18 weeks old) taken from standard laboratory cultures maintained at 27±1°C and 50-70% RH. It was observed that the pests larvae were highly voracious eater at the age chosen for the tests.

The test samples of wool-synthetic blend fabrics were of different weight, weave, colour, finish and non-insectproofness and were obtained from four woollen mills. All fabrics were intimately blended as both warp and weft (filling) yarns had the same proportion of blends and were soap scoured before use. A plain weave, undyed, soap scoured, 100% wool fabric weighing 250 g/m^2 was used as control.

The larval voracity tests were carrried out according to the procedure laid down in ISO- 3998 for insectproofness of textiles to the larvae of wool insect pests[10]. Fifteen larvae of test species were released on a fabric disc of 4 cm diam. of known weight placed in a glass petri dish (50mm ×18mm) with perforated aluminium cover and kept for 14 days at 27±1°C and 60±5% RH in a darkened cabinet. Four replicates of each fabric were used. A fabric is considered satisfactorily resistant if all four test specimens have no holes or surface damage (cropping) visible to the unaided eyes and the mean weight loss for test specimens and the weight loss for single specimen are less than 15 mg and 20 mg respectively.

The excreta of the test larvae was fixed on a stub, coated with a thin layer of gold and examined under the Jeol 840 scanning electron microscope.

Damage caused by the larvae of different pests to fabrics under study is shown in Tables 1 and 2. It is observed that among the five wool pests, *Attagenus fasciatus* fed heavily during the test period and caused severe damage to all fabrics except fabric No. 7 which was damaged least and considered as moderately damaged. This fabric contained 60% cotton fibres. Maximum damage was caused by the larvae of *Attagenus fasciatus* to the fabric Nos 4 and 5 having 55% and 50% viscose rayon respectively.

All the blends were found resistant to the larval attack of *Attagenus indicus* and *Attagenus lobatus*. Similarly, all fabrics, except fabric No. 4, were found resistant to larvae of *Attagenus birmanicus*. Fabric Nos 4 and 5 were damaged more by the larvae of these three pests of *Attagenus*. Larvae of *Anthrenus coloratus* also fed more on the fabric Nos 4 and 5; two test specimens of each fabric had minute to large holes though the mean weight loss was less than 15

Table 1—Damage caused by larvae of *Anthrenus coloratus* and *Attagenus birmanicus* on different wool- synthetic blend fabrics

Fabric No.	Wool %	Other fibre %	*Anthrenus coloratus*				*Attagenus birmanicus*			
			Visible damage		Mean wt loss mg	Damage	Visible damage		Mean wt loss mg	Damage
			Cropping[a]	Holes[b]			Cropping[a]	Holes[b]		
1	30	70 polyester	2	A	7.87	Slight	1	A	4.01	Slight
2	40	60 polyester	2	A	10.11	Slight	1	A	5.16	Slight
3	48	52 polyester	2	A	11.17	Slight	1	A	6.00	Slight
4	45	55 viscose rayon	2-3	B-D	13.57	Severe	1	A	8.27	Slight
5	50	50 viscose rayon	3	A-B	14.11	Severe	2-3	B	20.48	Severe
6	90	10 terylene	2	A	13.46	Slight	1	A	5.16	Slight
7	40	60 cotton	1	A	5.05	Slight	1	A	3.89	Slight
8(Control)	100	—	3	D	25.01	Severe	2-3	D	29.95	Severe

[a]Cropping (surface damage): 1—Not detectable; 2—Very slight; 3—Moderate; and 4—Very heavy

[b]Holes: A—Not detectable damage; B—Yarns partially severed; C—Few small holes and d—Several large holes

Table 2—Damage caused by larvae of *Attagenus indicus*, *Attagenus lobatus* and *Attagenus fasciatus* on different wool- synthetic blend fabrics

Fabric No.	Wool %	Other fibre %	*Attagenus indicus*				*Attagenus lobatus*				*Attagenus fasciatus*			
			Visible damage		Mean wt loss mg	Damage	Visible damage		Mean wt loss mg	Damage	Visible damage		Mean wt loss mg	Damage
			Cropping[a]	Holes[b]			Cropping[a]	Holes[b]			Cropping[a]	Holes[b]		
1	30	70 polyester	1	A	4.01	Slight	1	A	0.40	Slight	2	B	15.10	Severe
2	40	60 polyester	1	A	4.68	Slight	1	A	1.54	Slight	2	B	22.10	Severe
3	48	52 polyester	1	A	8.02	Slight	2	A	6.89	Slight	3	B-C	51.99	Severe
4	45	55 viscose rayon	1	A	7.27	Slight	2	A	9.53	Slight	3	B-D	115.84	Severe
5	50	50 viscose rayon	1	A	12.08	Slight	2	A-B	6.61	Slight	3	B-D	79.75	Severe
6	90	10 terylene	1	A	7.05	Slight	1	A	4.30	Slight	3	B	55.92	Severe
7	40	60 cotton	1	A	3.89	Slight	1	A	4.50	Slight	2	B	14.48	Severe
8 (Control)	100	—	2	D	20.80	Severe	2	C	35.95	Severe	4	D	160.68	Severe

[a]Cropping (surface damage): 1— Not detectable; 2—Very slight; 3—Moderate; and 4—Very heavy

[b]Holes: A— Not detectable damage; B—Yarns partially severed; C—Few small holes and D—Several large holes

Fig. 1—Excreta of *Attagenus fasciatus* larvae fed on wool fabric blended with 70% polyester fibres, showing unchanged polyester fibre pieces with mandible marks as indicated with black arrow

mg. It is also observed that fabric No.1 which contained 70% polyester was least damaged by the larvae of all pests. This could be due not only to the fact that it had less amount of wool but also that other factors might contribute, *e.g.* it could have chrome dyed or polyester carrier. The larvae may also find polyester fibres hard to cut as revealed by the scanning electron microscopic observations that several mandible marks were observed on the polyester pieces voided in the excreta (Fig.1). Fabric 7 is most often less damaged than fabric 1.

Larvae of all these five species fed indiscriminately on the test samples and ingested both wool and synthetic/cellulosic fibres as they were perhaps unable to differentiate them. Moreover, they were able to digest only wool fibres as the synthetic/cellulosic fibre pieces were observed in the excreta unchanged as confirmed through scanning electron microscopic studies. Similar observations were made by others[2,3,5-7]. Bry *et al.*[5] observed that larvae of *Attagenus unicolor*, *Anthrenus flavipes* and *Tineola bisselliella* fed selectively on wool and left the synthetic fibres alone when the warp yarns were made of synthetic fibres and weft yarns of wool (non - intimate blend).

The larvae of *Attagenus fasciatus* caused serious damage to most of the wool-synthetic blend fabrics while most of the fabrics were resistant to the larvae of *Anthrenus coloratus*, *Attagenus birmanicus*, *Attagenus indicus* and *Attagenus lobatus*. Thus, the wool-synthethic fabrics and clothing should also be protected in stores in a similar manner as pure wool fabrics against *Attagenus fasciatus* in addition to two other serious wool pests, *Anthrenus flavipes* and *Tinea translucens*.

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