

Protective clothing for male farm workers engaged in wheat threshing

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Received: 27.11.2013; Revised: 14.02.2014; Accepted: 25.02.2014

■ **ABSTRACT** : To mitigate health hazards faced by male farm workers during threshing activity, protective clothing and accessories were designed and their suitability and acceptability were assessed. Designed protective clothing was Apron-1: Apron with polo collar and full sleeves with elasticized cuffs (elastic in one row) along with especially designed cap with pleated mask and beak mask. Apron-1 did not cover face and neck properly; hence, Apron-2 was made with hood. Elasticized cuffs having elastic in one row was causing discomfort; hence elastic was used in two rows. Terry voile fabric used for Apron-1 did not provide proper protection. So as per requirement of the apron, beside terry-voile used for Apron-1, terry-cot (45:55) and poplin were selected for Apron-2. Masks made of voile were assessed during pilot study. Other two fabrics *i.e.* cambric and poplin of different thicknesses were selected for both masks. Coloured/plain glasses, gloves and shoes were procured from the market. Developed dresses and procured accessories were given to 25 males for a period of one month for field trials for assessment of suitability and acceptability. The result highlighted that Apron-2 was assessed to be highly suitable ($\bar{x}_i=2.90$) as compared to Apron-1 ($\bar{x}_i=2.63$) with reference to face and neck coverage, comfortable, elasticized cuffs of sleeves and protection provided by fabric. Both the masks *i.e.* beak ($\bar{x}_i=2.86$) and pleated ($\bar{x}_i=2.80$) made from cambric fabric were found to be highly suitable with regards to ease of wearing and removing, coverage of face, appearance and elastic at sides of mask to keep it in position. Protective glasses provided to workers were found to be highly suitable as these protected their eyes from husk, dust and sunlight. Gloves provided to the male farm workers were found to be highly suitable as these protected hands from itching, irritation and cuts and sores. Protective clothing/accessories were highly acceptable by the male farmers due to ease of wearing/removing, easy to maintain ($\bar{x}_i=1.80$) and did not affect the work efficiency of the wearer ($\bar{x}_i=1.75$).

■ **KEY WORDS**: Health hazards, Protective clothing, Suitability, Acceptability

■ **HOW TO CITE THIS PAPER** : Rani, Punam, Pruthi, Neelam, Singh, Saroj S. Jeet and Makkar, Priya (2014). Protective clothing for male farm workers engaged in wheat threshing. *Asian J. Home Sci.*, 9 (1) : 38-43.

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India has world's largest number of agriculture workers as 58.4 per cent of population is based on agriculture (www.people based on agriculture sector in india.htm). They face many occupational health hazards while performing different farm activities especially at the time of threshing, as it leads to lots of organic dust in the atmosphere causing skin allergies/ailments and respiratory problems. Common health problems encountered during threshing were: dust/husk stick on their body (100%), eye

irritation/itching (83%), headache (75%), skin irritation/itching (70%), breathlessness (68%), sweating (65%), running nose (57%), skin allergy/ailment (47%), sneezing (37%) and bronchitis (7%) (Pruthi, 2008-09). To mitigate the health problems of farm workers, it was felt necessary to design protective clothing/accessories for threshing activity by incorporating requisite functional features and assess their suitability and acceptability. Present paper focuses on protective clothing/accessories for male farm workers.

RESEARCH METHODS

- Protective clothings developed under AICRP for threshing activity were: apron, cap with pleated mask and beak mask. These were tested on 10 farm workers for pilot study.
- Based on observation of the scientists and farm workers, protective clothing required refinement, hence were selected for further research work.
- Accessories procured from the market and tried were: coloured/plain glasses and gloves.

Development of protective clothing and accessories:

Modifications in design:

- Apron-1 and cap did not cover face and neck properly; hence, Apron -2 was made with hood.
- Sleeves with one row of elastic raised and did not provide proper protection to arms, so two rows of elastic were used at cuffs in sleeves of Apron-2.
- Dust accumulation in the pockets made in apron -1, to overcome these problem pockets were made with flap in modified apron.

Modifications in fabric:

- Regarding fabric terry voile used for apron-1 did not provide proper protection, so as per requirement of the apron, four more fabric were procured from the market.
- All the collected samples were tested for various parameters *i.e.* fabric count, fabric weight, fabric thickness and air permeability. The fabric samples were conditioned prior to determination of preliminary data of the fabric.
- Five fabrics tested for aprons for threshing activities were: terry-voile (52: 48), terry-cot (45: 55), terry-cot (55:45), cambric and poplin. Based on the physical properties of fabric beside terry-voile, two more fabrics *i.e.* terry-cot (45:55) and poplin were selected for further research work.

- Masks made of voile were assessed during pilot study. Beside that other four fabrics procured were voile, two types of cambric and poplin with different thickness. Based on physical properties of fabrics, voile, cambric: 1 and poplin: 1 were selected for further research work.
- Protective clothing/ accessories were constructed by incorporating modification using selected fabrics.

Assessment of protective clothing and accessories:

Twenty five farmers were selected from research farm of CCS Haryana Agricultural University, Hisar and nearby villages.

Protective dresses were given to the respondents for a period of one month for assessment of suitability and acceptability.

Suitability of designed garment/accessories were assessed with reference to ease of wearing/removing, protection against husk and comfortability during wear on three point rating scale *i.e.* highly suitable, suitable and somewhat suitable scoring 3, 2 and 1, respectively. To find out the extent of suitability weighted mean score was calculated.

Acceptability of designed garments and accessories was measured with reference to appeal, designing components, work efficiency, maintenance and adoption feasibility and assessed on three point rating scale *i.e.* agree, somewhat agree and disagree scoring 2, 1 and 0, respectively.

Based on physical parameters of the fabric of developed protective clothing/accessories, and assessment of suitability, protective clothing was recommended for farm workers for threshing activity.

RESEARCH FINDINGS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Assessment of fabric properties for protective clothing:

Terry-voile (sample-1) used in apron-1 did not provide

Table 1 : Physical properties of fabrics used for apron

Sr. No.	Fabric used	Fibre content	Weight (g/m ²)	Yarn count	Thickness (mm)	Air permeability (10% level)
1.	Terry voile (Blend)	52 % polyester and 48% cotton	86	77×68	19	133.36
2.	Terry cot	45% polyester and 55% cotton	95	85×72	24	75.01
3.	Terry cot	55% polyester and 45% cotton	82	81×70	25	70.16
4.	Cambric	100% cotton	79	78×69	22	91.68
5.	Poplin	100% cotton	129	84×73	27	58.34

Table 2 : Physical properties of fabrics used for mask

Sr. No.	Fabric used	Fibre content	Weight g/m ²	Yarn count	Thickness (mm)	Air permeability (10% level)
1.	Voile	100% cotton	69	68×65	18	191.70
2.	Cambric:1	100% cotton	79	78×69	23	133.36
3.	Cambric: 2	100% cotton	85	72×61	20	149.21
4.	Poplin :1	100% cotton	129	84×73	27	58.34
5.	Poplin :2	100% cotton	135	85×74	29	45.01

proper protection from organic dust; hence other four thicker fabric samples were collected and tested on various parameters and the data has been presented in Table 1. Two fabrics having lesser air permeability as well as thicker than terry voile were selected for development of apron-2. To make comparison, one blend *i.e.* terry cot (45:55) and poplin were selected for further research work.

Voile used in mask was not very protective against organic dust hence, four more fabric samples collected were tested for their physical properties and data has been presented in Table 2.

Besides voile, two fabrics *i.e.* cambric: 1 and poplin: 1 having moderate air permeability was selected for masks for field trials.

Background profile of farm workers:

Personal profile of farm worker is presented in Table 3 which revealed that maximum number of respondents *i.e.* 72 per cent belonged to the age group of 30 to 50 years, 76 per cent respondents had primary education, more than half of the respondents (56%) were having joint family and rest of the farm workers (44%) were from nuclear families. Majority of the respondents (60%) were landless whereas 24 per cent of respondents had land between 5-10acres. 40 per cent of respondents were doing self cultivation whereas

Table 3 : Background profile of farm workers for threshing period (n=25)				
Sr. No.	Variables	Category	Frequency	Percentage
1.	Age	Below 30years	4	16
		30-50 years	18	72
		Above 50 years	3	12
2.	Education of Respondents	Illiterate	2	8
		Primary	19	76
		Middle	3	12
3.	Family type	Nuclear	11	44
		Joint	14	56
		Matriculate	1	4
4.	Land holding	No land	15	60
		Upto 5 acres	3	12
		5 to 10 acres	6	24
		10 to 15 acres	1	4
5.	Cultivation method	Self-cultivation	10	40.00
		Contract	2	8.00
		Sharing basis	9	36.00
6.	Gross income	Labour	4	16.00
		Below 10,000	6	24.00
		10,000 to 20,000	14	56.00
		20,000 to 30,000	4	16.00
		30,000and above	1	4.00

36 per cent were working on sharing basis. 56 per cent of respondents had monthly income in the range of Rs. 10,000 to 20,000.

Suitability assessment of developed protective clothing/ accessories of farm workers:

Apron:

Data regarding suitability assessment (Table 4) revealed that Apron-2 gave more protection to head and neck ($\bar{x}_w=3.00$) from organic dust to upper body parts of the wearer as compare to Apron 1 ($\bar{x}_w=2.52$) (Fig. 1). Sleeves with elasticized cuffs having elastic in two rows of Apron 2 was assessed to be highly suitable as it gave more protection to arms ($\bar{x}_w=3.00$) as compared sleeves with elasticized cuffs having elastic in one row ($\bar{x}_w=2.80$). Elastic in two rows were found to be comfortable ($\bar{x}_w=2.70$) as compared to elastic in one row ($\bar{x}_w=2.58$). The overall mean score of Apron-2 was found to be higher ($\bar{x}_w=2.90$) as compared to Apron-1 ($\bar{x}_w=2.63$).



Fig. 1: Apron: 1 (Terry vaile) Apron: 2 (Terry cot and poplin)

The data regarding patch pockets with flap indicate that position of pockets, shape and size of pocket was found to be highly appropriate ($\bar{x}_w=2.93$). Flap on the pocket was found to be highly suitable as it prevented accumulation of husk/dust inside the pocket ($\bar{x}_w=2.90$).

Regarding fabric of apron, data revealed that terry cot (45:55) and poplin were assessed to be more protective against organic dust scoring ($\bar{x}_w=2.76$) as compared to terry voile ($\bar{x}_w= 1.48$). Terry cot and poplin were found to be comfortable during wear scoring ($\bar{x}_w= 2.68$) and ($\bar{x}_w=2.60$), respectively. Slight difference was observed between the two fabrics *i.e.* poplin and terry cot might be due to the reason that terry-cot is easy as compared to cotton.

Mask:

Two types of mask were prepared and functional features of both masks were compared (Fig. 2). Both the masks *i.e.* beak and pleated were assessed to be highly

Table 4: Suitability assessment of developed protective clothing/accessories of male farm workers			(n=25)
Functional features of garments	Characteristics of functional features	WMS (\bar{X}_w)	Overall mean score
Apron 1			
Apron with polo collar and cap	Protects head and neck from husk/ dust	2.52***	
Elasticized cuffs(elastic in one row)	Protects arms from husk/ dust	2.80***	2.63***
	Comfortable	2.58***	
Terry voile	Protects from dust	1.48***	1.86**
	Comfortable during wear	2.24***	
Apron 2			
Apron with hood	Protects head and neck from husk/ dust	3.00***	2.90***
Elasticized cuff (elastic in two row)	Protects arms from husk/ dust	3.00***	
	Comfortable	2.70***	
Terry cot	Protects from dust	2.76**	2.72***
	Comfortable during wear	2.68**	
Poplin	Protects from dust	2.76***	2.68***
	Comfortable during wear	2.60***	
Patch pocket with flap	Position of pocket	2.93***	
	Shape and size of pocket	2.93***	2.91***
	Flap prevents accumulation of husk/dust in side pocket	2.90***	
Mask	Easy to put on	2.86***	
Beak mask	Easy to remove	3.00***	
	Coverage of face	2.79***	
	Easy to breathe	2.90***	2.86***
	Shape of mask	2.80***	
	Elastic at sides of mask comfortable during wear	2.83***	
	Easy to wear	2.86***	
Pleated mask	Easy to remove	3.00***	
	Coverage of face	2.86***	
	Easy to breathe	2.76***	2.80***
	Shape of mask	2.83***	
	Elastic at sides of mask comfortable during wear	2.83***	
Fabrics of mask			
Voile	Protects from dust inhalation	2.20**	2.26**
	Comfortable for breathing	2.32**	
Cambric	Protects from dust inhalation	2.80**	2.88***
	Comfortable for breathing	2.96**	
Poplin	Protects from dust inhalation	2.86**	2.12**
	Comfortable for breathing	1.56*	
Goggles/plain glasses	Protects eyes from husk/ dust	3.00***	
Gloves/ Mittens	Prevents irritation and itching on hand	2.80***	2.77***
	Protects hands from cuts and sore	2.75***	

Suitability level: Highly suitable: 2.34-3.00***, Suitable: 1.67-2.33**, Somewhat suitable 1.00-1.66*

suitable with reference to ease of wearing ($\bar{x}_w=2.86$) and ease of removing ($\bar{x}_w=3.00$) and elastic at sides of both masks to keep them in position and comfortable during wear ($\bar{x}_w=2.83$).



There was slightly difference in shape of both masks. Shape of pleated mask was assessed to be highly suitable ($\bar{x}_w=2.83$) and better than beak mask ($\bar{x}_w=2.80$) and it covered face properly ($\bar{x}_w=2.86$) as compared to beak mask ($\bar{x}_w=2.79$). Regarding ease in breathing, beak mask was assessed better ($\bar{x}_w=2.90$) than pleated mask ($\bar{x}_w=2.76$). Overall mean score revealed that both the masks *i.e.* beak and pleated were found to be highly suitable scoring ($\bar{x}_w=2.86$) and ($\bar{x}_w=2.80$), respectively (Table 4). Gandhi *et al.* (2012) have evaluated the efficiency of mask as protective weasure.

The data regarding fabric of masks revealed that poplin and cambric were found to be highly suitable scoring ($\bar{x}_w=2.86$) and ($\bar{x}_w=2.80$) as these protected dust inhalation as compared to voile ($\bar{x}_w=2.20$), whereas cambric was found to be more comfortable for breathing ($\bar{x}_w=2.96$) as compared to poplin ($\bar{x}_w=1.56$) and voile ($\bar{x}_w=.2.32$). The overall mean score of cambric was found to be highest ($\bar{x}_w=2.88$), followed by voile and poplin ($\bar{x}_w=2.26$), ($\bar{x}_w=2.12$), respectively.

Goggles/plain glasses:

Protective glasses provided to workers were found to be highly suitable having weighted mean score ($\bar{x}_w= 3.0$) as these protected their eyes from husk, dust and sunlight.

Gloves/ Mittens:

Protective gloves provided to the male farm workers were found to be highly suitable having ($\bar{x}_w=2.77$) as these protected hands from irritation and itching ($\bar{x}_w=2.80$) and cuts and sores ($\bar{x}_w=2.75$) (Table 4).

Acceptability assessment of developed protective clothing/accessories:

To what extent protective clothing/accessories were accepted by farm workers for threshing activity and the factor which affect their acceptance were also studied (Table 5).

Data presented in Table 5 revealed that protective clothing/accessories were found to be acceptable to maximum number of respondents because of functional features/fasteners used in the garment do not cause pinching’

Table 5 : Acceptability assessment of protective clothing/accessories by farm workers for threshing activity		(n = 25)
Sr. No.	Statements	WMS
1.	Protective clothes and accessories are easy to wear and remove	1.80
2.	Protective clothing does not look awkward	0.80
3.	Functional features/fasteners used in garments do not cause pinching	1.90
4.	Protective clothing do not have adverse effect on the work efficiency	1.75
5.	Protective clothing can be washed & maintained easily	1.80
6.	Design of garment are so simple that person good at stitching can follow the design	1.55
7.	It is worth spending extra money on protective clothing	1.60
8.	One must wear protective clothing /accessories to protect against health problems	1.75
9.	I will suggest other fellows to adopt protective clothing	1.65
10.	The garments are not comfortable due to functional features	0.20
11.	The functional features in protective clothes cause hindrance at work place	0.22
12.	The washing and maintenace of protective clothing is difficult	0.19
13.	It will be difficult to get these stitched due to their complicated design	0.35
14.	The modified garments are protective but no need to adopt these if one is managing with the existing dress	0.65
15.	Protective clothing should not be worn as these might entangled while working	0.20
16.	These garment should not be recommended because they are not useful	0.23

Acceptability Score: High: 1.34 – 2.0, Medium: 0.67 – 1.33, Low: 0 – 0.66

(lowed by 'Protective clothes and accessories are easy to wear and remove' ($\bar{x}_w=1.80$), 'protective clothing can be washed and maintained easily' ($\bar{x}_w=1.80$), 'protective clothing do not have adverse effect on work efficiency' ($\bar{x}_w=1.75$) and 'to prevent health hazards, we should definitely use protective clothing' ($\bar{x}_w=1.75$). Most of the farm workers strongly agreed with the statement that 'I will suggest other fellows to adopt protective clothing' ($\bar{x}_w=1.65$) and 'It is worth spending extra money on protective clothing' ($\bar{x}_w=1.60$). A very few respondents revealed that 'protective clothing/accessories look awkward' ($\bar{x}_w=0.80$).

There were very few respondents who did not like protective clothing/accessories as they were off the view with the statements that "The modified garments are protective but no need to adopt these if one is managing with the existing dress" ($\bar{x}_w=0.65$). Very few of them were also of the view that "Garments are not comfortable due to functional features" ($\bar{x}_w=0.20$), while, 'The functional features in protective clothes caused hindrance at work place' ($\bar{x}_w=0.22$). 'These garment should not be recommended because they are not useful' ($\bar{x}_w=0.23$), 'The washing and maintenance of protective clothing is difficult' ($\bar{x}_w=0.19$). Jyoti (2010) has also generated some information on protective clothing for textile industrial workers.

Conclusion:

Three fabrics tried for aprons for threshing activity *i.e.* terry-voile, terry-cot (45:55) and poplin both terry-cot (45:55) and poplin (100% cotton) were found to be equally suitable and comfortable hence, recommended for apron. Three fabrics used for masks for threshing period were: voile, cambric: 1 and poplin: 1. Voile had highest air permeability and was least protective; cambric had moderate air permeability but was protective as well as comfortable during

breathing whereas poplin was not comfortable hence, cambric fabric was recommended for masks. Apron -2 was assessed to be more suitable than apron I as it was protective as well as comfortable. Both the masks *i.e.* pleated and beak masks were found to be highly suitable and mask made from cambric was more suitable than voile or poplin. Protective glasses were found to be highly suitable as these protected their eyes from husk, dust and sunlight. Protective gloves/mittens prevented irritation and itching on hand and protected hands from cuts and sore. Protective clothing/accessories were found to be highly acceptable to maximum number of respondents as protective clothing do not have adverse effect on work efficiency, functional features/fasteners used in the garments do not cause pinching (Desai, 2006).

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