Effect of mordants on printing with Marigold flowers dye

Radhika Agarwal, Neelam Pruthi* and Saroj Jeet S Singh
Department of Clothing and Textiles
CCS Haryana Agricultural University, Hisar-125 004, Haryana, India
*Correspondent author, E-mail: neelam_pruthi@yahoo.co.in; Address: 165-Sector 15 A, Hisar-125 001
Received 12 June 2006; Accepted 10 January 2007

Abstract
In this study Marigold, Tagetes erecta Linn., petals were used to standardize the printing paste for cotton. Seven mordants used to study their effect on printing with said dye were: aluminium sulphate, copper sulphate, ferrous sulphate, lead acetate, potassium dichromate (chrome), stannous chloride and zinc chloride. Simultaneous mordanting technique was used. The mordants were added on the basis of total printing paste prepared under optimum conditions. Out of seven mordants, two mordants selected on the basis of visual assessment and washing fastness were chrome and copper sulphate. Fast colours were obtained when 3 per cent chrome or 5 per cent copper sulphate was used. The use of mordants produced various colours with marigold flower dye. Beige colour was obtained when dye was used without any mordant whereas it was mustard with chrome and olive green with copper sulphate.

Keywords: Marigold flower, Tagetes erecta, Natural dye, Mordants, Cotton, Chrome, Copper sulphate.

IPC code; Int. cl.*— C09B 61/00, D06P 1/34

Introduction
The art of dyeing and printing has played an important role in adding beauty to the textiles. Dyeing is the art of imparting particular hues and tints to thread, fabric and other materials by employing colouring matters whereas in printing, designs and colours form an artistic expression to embellish the fabric.

The craft of printing occupies a unique place in Indian civilization. It is believed that the process of printing with natural dyes has been in practice since 10th century. India had rich tradition of using natural resources for printing but influx of synthetic dyes in 1856 drove the natural dyes in oblivion. Due to carcinogenic effect of synthetic dyes, the green minded consumers are back to natural dyes as these are non-hazardous, biodegradable and have better compatibility with the environment.

Natural dyes comprise those colorants (dyes and pigment) that are obtained from animal or vegetable matters without chemical processing. Natural dyes with very few exceptions are non-substantive but must be used in conjunction with mordants. A mordant usually a metallic salt, has affinity for both the colouring matter and the fibre, hence by combining with the dye it forms insoluble precipitates on the fabric. The use of mordant also changes the colour of same dye stuff. Thus different colour tones are possible due to mordanting. In present study Marigold, Tagetes erecta Linn., petals were used to standardize the printing paste for cotton. Seven mordants used to study their effect on printing with said dye were: aluminium sulphate, copper sulphate, ferrous sulphate, lead acetate, potassium dichromate (chrome), stannous chloride and zinc chloride.

Materials and Methods
Selection of dye: Marigold petals dried in shade and grounded to powder were used as a dye source in the standardized printing paste.

Selection of fabric: Cotton fabric scoured by standardized method was selected for the printing with marigold flower dye, using standardized printing recipe.

Preparation of printing paste: The optimized printing recipe was used for preparation of printing paste. Optimum variables to prepare printing paste using vegetable dyes were: Dye material concentration-6g/100ml of water; extraction time-45 minutes; extraction pH-7; dye paste -7.5ml; pH of guar paste-6; dye paste and guar paste ratio-1:5; fixer concentration-1.5%.

Abstract
In this study Marigold, Tagetes erecta Linn., petals were used to standardize the printing paste for cotton. Seven mordants used to study their effect on printing with said dye were: aluminium sulphate, copper sulphate, ferrous sulphate, lead acetate, potassium dichromate (chrome), stannous chloride and zinc chloride. Simultaneous mordanting technique was used. The mordants were added on the basis of total printing paste prepared under optimum conditions. Out of seven mordants, two mordants selected on the basis of visual assessment and washing fastness were chrome and copper sulphate. Fast colours were obtained when 3 per cent chrome or 5 per cent copper sulphate was used. The use of mordants produced various colours with marigold flower dye. Beige colour was obtained when dye was used without any mordant whereas it was mustard with chrome and olive green with copper sulphate.

Keywords: Marigold flower, Tagetes erecta, Natural dye, Mordants, Cotton, Chrome, Copper sulphate.

IPC code; Int. cl.*— C09B 61/00, D06P 1/34
Procedure: Six grams of dye powder was boiled in 100 ml of water at 7pH for 45 minutes and the solution was stirred frequently. After removal from water bath solution was strained through nylon cloth. The extracted solution was heated and concentrated to 7.5 ml to make a paste.

The printing paste was prepared by mixing dye paste and guar gum in the ratio of 1:5. It was stirred vigorously to produce a uniform printing paste. Seven mordants identified on the basis of literature used for printing the samples were aluminium sulphate, copper sulphate, ferrous sulphate, lead acetate, potassium dichromate, stannous chloride and zinc chloride. Simultaneous mordanting technique was used and the mordants were added on the basis of weight of printing paste. Printing was done on pre-scoured cotton fabric using screens.

The fabric was then dried and after 24 hours it was steamed at 100°C for 45 minutes in a steaming chamber. The steamed samples were given a cold rinse to remove superficial printing paste. Finally two mordants were selected on the basis of washing fastness and visual assessment of printed samples.

Visual assessment: The printed samples were visually evaluated by five judges having experience of working with natural dyes. For selection of mordants, subjective evaluation was done with reference to colour obtained on three point scale i.e. excellent, good and fair scoring 3, 2 and 1, respectively. Weighted mean score was calculated to draw inferences.

Visual assessment of printed samples

The samples printed with different mordants are shown in Figure 1. The data (Table 1) elucidated that the colour of marigold printed samples mordanted with chrome was assessed the best (3.0) followed by copper sulphate (2.8), zinc chloride (2.6) and ferrous sulphate (2.2). Printing with stannous chloride was least preferred scoring lowest (1.6).

Assessment of fastness to washing

Data regarding washing fastness indicated that the washing fastness of samples printed with marigold dye mordanted with chrome, copper sulphate and zinc chloride was very good as there was negligible change in colour (4/5) and no colour staining (5) was observed. The colour change due to washing of the samples printed with chrome, copper sulphate and zinc chloride were scored as 4/5. However, the samples printed with aluminium sulphate, lead acetate and ferrous sulphate were scored 3/5.

Results and Discussion

Visual assessment of printed samples

The samples printed with different mordants are shown in Figure 1. The data (Table 1) elucidated that the colour of marigold printed samples mordanted with chrome was assessed the best (3.0) followed by copper sulphate (2.8), zinc chloride (2.6) and ferrous sulphate (2.2). Printing with stannous chloride was least preferred scoring lowest (1.6).

Assessment of fastness to washing

Data regarding washing fastness indicated that the washing fastness of samples printed with marigold dye mordanted with chrome, copper sulphate and zinc chloride was very good as there was negligible change in colour (4/5) and no colour staining (5) was observed. The colour change due to washing of the samples printed with chrome, copper sulphate and zinc chloride were scored as 4/5. However, the samples printed with aluminium sulphate, lead acetate and ferrous sulphate were scored 3/5.

Results and Discussion

Visual assessment of printed samples

The samples printed with different mordants are shown in Figure 1. The data (Table 1) elucidated that the colour of marigold printed samples mordanted with chrome was assessed the best (3.0) followed by copper sulphate (2.8), zinc chloride (2.6) and ferrous sulphate (2.2). Printing with stannous chloride was least preferred scoring lowest (1.6).

Assessment of fastness to washing

Data regarding washing fastness indicated that the washing fastness of samples printed with marigold dye mordanted with chrome, copper sulphate and zinc chloride was very good as there was negligible change in colour (4/5) and no colour staining (5) was observed. The colour change due to washing of the samples printed with chrome, copper sulphate and zinc chloride were scored as 4/5. However, the samples printed with aluminium sulphate, lead acetate and ferrous sulphate were scored 3/5.

Results and Discussion

Visual assessment of printed samples

The samples printed with different mordants are shown in Figure 1. The data (Table 1) elucidated that the colour of marigold printed samples mordanted with chrome was assessed the best (3.0) followed by copper sulphate (2.8), zinc chloride (2.6) and ferrous sulphate (2.2). Printing with stannous chloride was least preferred scoring lowest (1.6).

Assessment of fastness to washing

Data regarding washing fastness indicated that the washing fastness of samples printed with marigold dye mordanted with chrome, copper sulphate and zinc chloride was very good as there was negligible change in colour (4/5) and no colour staining (5) was observed. The colour change due to washing of the samples printed with chrome, copper sulphate and zinc chloride were scored as 4/5. However, the samples printed with aluminium sulphate, lead acetate and ferrous sulphate were scored 3/5.

Results and Discussion

Visual assessment of printed samples

The samples printed with different mordants are shown in Figure 1. The data (Table 1) elucidated that the colour of marigold printed samples mordanted with chrome was assessed the best (3.0) followed by copper sulphate (2.8), zinc chloride (2.6) and ferrous sulphate (2.2). Printing with stannous chloride was least preferred scoring lowest (1.6).

Assessment of fastness to washing

Data regarding washing fastness indicated that the washing fastness of samples printed with marigold dye mordanted with chrome, copper sulphate and zinc chloride was very good as there was negligible change in colour (4/5) and no colour staining (5) was observed. The colour change due to washing of the samples printed with chrome, copper sulphate and zinc chloride were scored as 4/5. However, the samples printed with aluminium sulphate, lead acetate and ferrous sulphate were scored 3/5.
samples printed with marigold dye with other mordants ranged from 3/4 to 3 i.e. fairly good to fair 4. Hence, on the basis of visual assessment and washing fastness for marigold dye chrome and copper sulphate mordants were selected for further research work.

Optimization of concentration of mordant

The samples printed with different concentrations of mordants are shown in Figure 2. The washing fastness grades for colour change of marigold (Table 2) when mordanted with 3 and 5 per cent chrome indicated very good results (4/5) followed by 7 per cent chrome (3/4). Mordanting of the same paste with 3 per cent copper sulphate had very good fastness (4/5) followed by 5 and 7 per cent (4). Whereas colour change was more in samples printed without mordant. The data revealed that after washing there was no colour staining (5) of marigold printed samples when mordanted with chrome and copper sulphate at 3 and 5 per cent. The colour staining was also negligible (4/5) in case of samples printed without mordants.

Hence, it has been inferred that optimum concentration of chrome and copper sulphate mordants were 3 and 5%, respectively. Higher concentration of mordant was not selected due to their non-eco-friendly nature, however, further increase in mordant concentration brighten the colour.

Final printing was done with 3% chrome and 5% copper sulphate and the samples were subjected to different colour fastness tests.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Mordants</th>
<th>Visual assessment score</th>
<th>Washing fastness grades</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>WMS</td>
<td>CC</td>
</tr>
<tr>
<td>1.</td>
<td>Aluminium Potassium sulphate (Alum)</td>
<td>2.0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Copper sulphate</td>
<td>2.8</td>
<td>4/5</td>
</tr>
<tr>
<td>3.</td>
<td>Ferrous sulphate</td>
<td>2.2</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Lead acetate</td>
<td>2.4</td>
<td>3/4</td>
</tr>
<tr>
<td>5.</td>
<td>Potassium dichromate (Chrome)</td>
<td>3.0</td>
<td>4/5</td>
</tr>
<tr>
<td>6.</td>
<td>Stannous chloride</td>
<td>1.6</td>
<td>3/4</td>
</tr>
<tr>
<td>7.</td>
<td>Zinc chloride</td>
<td>2.6</td>
<td>4/5</td>
</tr>
</tbody>
</table>

WMS=Weighted Mean Score; CC=Colour change; CS=Colour staining

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Mordant</th>
<th>Per cent mordant</th>
<th>Washing fastness grades</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Conc.</td>
<td>CC</td>
</tr>
<tr>
<td>1.</td>
<td>Without mordant</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Chrome</td>
<td>3</td>
<td>4/5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>4/5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>3/4</td>
</tr>
<tr>
<td>3.</td>
<td>Copper sulphate</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>4/5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

CC=Colour change; CS=Colour staining

Washing fastness grades

The colour fastness grades to washing of cotton printed samples of the marigold dye using different mordants are presented in Table-3.

The result revealed that the washing fastness grades of printed samples for colour staining was 5 with both the mordants (Chrome and copper sulphate). Hence, it is depicted that there was no staining. The grades for colour change ranged from 4-4/5. But after washing the change was towards brighter side; indicating good to very good washing fastness but brighter shades were obtained.

Sunlight fastness

The results highlighted that the light fastness was good to excellent for all the three dyes as their score ranged from 4/5 to 5.
Research Article

Table 3: Colour fastness grade of samples printed using optimum printing paste

<table>
<thead>
<tr>
<th>Dye</th>
<th>Mordant</th>
<th>Per cent mordant Conc.</th>
<th>Colour fastness grades</th>
<th>Colour fastness grades</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wash</td>
<td>Light</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CC</td>
<td>CS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dry</td>
<td>Wet</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CC</td>
<td>CS</td>
</tr>
<tr>
<td>Marigold</td>
<td>Without mordant</td>
<td>-</td>
<td>3</td>
<td>4/5</td>
</tr>
<tr>
<td></td>
<td>Chrome</td>
<td>3</td>
<td>4/5*</td>
<td>5*</td>
</tr>
<tr>
<td></td>
<td>Copper sulphate (5`)</td>
<td>5</td>
<td>4*</td>
<td>5*</td>
</tr>
</tbody>
</table>

*=Brighter than original; CC=Colour change; CS=Colour staining

Dry rubbing fastness
It is evident that the dry rubbing fastness for colour change and colour staining ranged from 4/5 to 5. Hence the result elucidated that fastness to dry rubbing was very good to excellent for marigold.

Wet rubbing fastness
The results of colour fastness of printed samples using selected mordants to wet rubbing revealed that the fastness of marigold dye was good as there was no colour change (4) while good to very good with regard to colour staining (4-4/5).

Range of colours obtained by different mordants
The results of the present study highlighted that there was change in colour of prints with the change of mordants. Printing with marigold flower dye produced silky beige colour. It was mustard with chrome and olive green with copper sulphate. The effect of mordants on colour has also been reported in previous researches\textsuperscript{2-4}.

Conclusion
The suitability of mordants for printing cotton with natural dyes varied from dye to dye. Two mordants selected for marigold were: chrome and copper sulphate and the optimum mordant concentration were 3 and 5 %, respectively. Different mordant produced different colours. Marigold flower dye produced silky beige colour without any mordant.

Mustard colour was produced when chrome was used as a mordant and olive green was obtained on mordanting with copper sulphate.

References