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# A study on the effect of *Telanthera ficoidea* dye on mulberry silk

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■ **ABSTRACT :** It was found that *Telanthera ficoidea* dye can be successfully used on mulberry silk fabric. The colour/shade obtained after the dyeing with mordant alum were cream, mid cream and with tea were dark brown, stone brown, golden brown and copper brown. Dye extracted in acidic medium and using tea as mordant for either pre, simultaneous and post-mordanting showed an increase in count, weight and thickness of mulberry silk fabric. *Telanthera ficoidea* dye offered even penetration to the fabric.

■ **KEY WORDS :** *Telanthera ficoidea*, Dye, Mulberry silk

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Colour is the important art element which transforms the entire fabric of life. The decoraton of textiles may be achieved by adding colour through dyeing and printing. Along with the evolution, the art of dyeing has played an important part in adding beauty to the world.

Dyeing can be done with naturally occurring dyes. The invention of synthetic dyes nearly stopped the use of naturally occurring colouring matters but there is a growing trend all over the world for the natural colourants and in the present context of eco-preservation these have got tremendous commercial potential. There is also a growing awareness of their non-hazardous and non-carcinogenic nature. These factors have brightened the scope of utilization of natural dyes. The use of natural colour is still very limited due to non-availability of dye source, precise and specific ways of application and standard norms. The appropriate technical knowledge of colour extraction, purification and standardization of dyeing techniques is of immense value and requires detailed study. Besides, the focus is now on increasing export of textiles goods, and the use of natural colours for dyeing textile materials which may enhance export prospects as there is a growing interest for naturally dyed products among foreign buyers. So, to explore a new source and develop various shades of colour, *Telanthera ficoidea* was selected. This plant was easily available. It is a semi-erect herb but no reference was found on its use as dye. It can be propagated easily and is generally used for lawn decoration.

In the dyeing of silk fabrics, the most essential requisite is the fastness of the dye as these fabrics are highly expensive. Silk being a protein fibre shows substantivity towards natural dyes. The selection of dyes is therefore very important as dyeing adds value to the fabric and makes it a suitable for various end uses. Hence, the study was proposed with the following objectives :

–To dye silk fabric with the selected dye under varying conditions and to find out the effect of dye and the properties on mulberry silk fabric.

The leaf and stem of *Telanthera ficoidea* plant were used as dyes and these were collected from Assam Agricultural University, Jorhat. The different names of the specimen are given in Table A.

**Table A : Name of the natural dye material (stem and leaf) used for the investigation**

| Sr. No. | Local name | English name | Botanical or scientific name | Family |
|---|---|---|---|---|
| 1. | Bishlayakoroni, Bishohori ,Iron leaf | Purple lady | *Telanthera ficoidea* | Amaranthaceae |

## ■ RESEARCH METHODS

Mulberry silk fabric with plain weave was used for dyeing with *Telanthera ficoidea*. This dye was selected for the investigation, because it showed better shades of colour. It was easily available and also could be propagated easily. So, for the investigation, dried powder of *Telanthera ficoidea* was used for dye and concentration selected after pre-testing was 5 g/100 ml of water.

To remove the natural gum and other impurities present in the fabric, degumming was done with the help of 0.25 g/litre of $Na_2CO_3$, 2% soap/litre by maintaining the liquor ratio 1:40 with the temperature of 60-90°C for 90 minutes. The fabric was then squeezed and rinsed thoroughly under running water and dried in shade.

The nomenculture of the sample was done according to the treatment. The variables for the study were dye extraction method, mordant and mordanting method and fabric sample were dyed under constant conditions of temperature 90°C, time 45 min and M:L::1:40. The O.D. value before and after dyeing were recorded.

**Extraction of dye :**

For the extraction of dye, alkaline and acidic medium were selected and used for dyeing.

**Alkaline method :**

In order to select the amount of alkali of dye extraction, tests were carried out and the concentration selected was 0.5 gm of $Na_2CO_3$ / 100 ml of $H_2O$. The alkalinity of the liquor was maintained at pH 9-10. The concentration selected was based on the optical density value and percent dye absorption.

**Acidic method :**

In order to select the amount of acid for dye extraction, tests were carried out and the concentration selected was 10% of HCl / 100 ml of $H_2O$. The pH of the acidic liquor was maintained at pH 2-3. The concentration selected was based on the optical density value and per cent dye absorption.

**Mordants :**

The mordants selected were alum (metallic mordant) and tea (natural mordant). Tests were carried out to select the concentration of the mordants for dyeing based on the optical density and per cent dye absorption (Table B).

**Table B : Concentration of mordants for dyeing**

| Sr. No. | Name of mordant | Mordant concentration (g/100g of fabric) | Per cent absorption |
|---|---|---|---|
| 1. | Alum | 5 | 48.66 |
| | | 10 | 52.47 |
| | | 15 | 53.69 |
| 2. | Tea | 5 | 51.98 |
| | | 10 | 52.55 |
| | | 15 | 52.55 |

The concentration of alum selected was 15 g per 100 g of fabric and the concentration of tea selected was 10 g per 100 g of fabric.

**Mordanting methods :**

All the three mordanting method *viz.*, pre-mordanting, simultaneous mordanting, post-mordanting were used for the investigation along with dyeing for fixing the colour to the fabric.

**Dyeing method :**

The calculated amount of extracted dye liquor was taken as per the material to liquor ratio. The material to liquor ratio (M : L) was finalized as 1:40 for dyeing. The dyeing time selected was 45 minutes, maintaining the temperature 90°C .The formula which was used to estimate the percentage of dye absorption of fabric sample at a particular wave length (580 nm) :

$$\textbf{Per cent dye absorption} = \frac{\textbf{O.D. before dyeing} - \textbf{O.D. after dyeing}}{\textbf{O.D. before dying}}$$

## ■ RESEARCH FINDINGS AND DISCUSSION

The findings of the study are presented under the following heads.

**Findings of experimental work :**

During the investigation, samples were given different treatments and their effect was recorded. The optical density of the liquor before and after dyeing showed the amount of the dye absorption by the fabric (Table 1).

From Fig. 1, it is evident that all the samples showed good absorbency. The per cent absorption of dye was better when the dye was extracted in acidic medium.

The different shades obtained by mulberry silk fabric samples dyed with *Telanthera ficoidea* with mordant alum and tea were cream, mid cream, dark brown, stone brown, golden brown and copper brown. After dyeing, it was found that mordant alum produced pale shades whereas tea produced a variety of brilliant shades.

**Findings of geometrical properties :**

*Effect of dyeing on count of the fabric (thread/inch)* :

From Table 2 it is evident that all the samples have increased in warp and weft/inch compared with the original (Fig. 2).

*Effect of dyeing on fabric weight (g/m²)* :

From the investigation it was observed that the weight of all dyed samples had increased when compared with the original (Table 3).

The increase in weight may be due to the mordants or due to the absorption of dyes by the fabric. During the

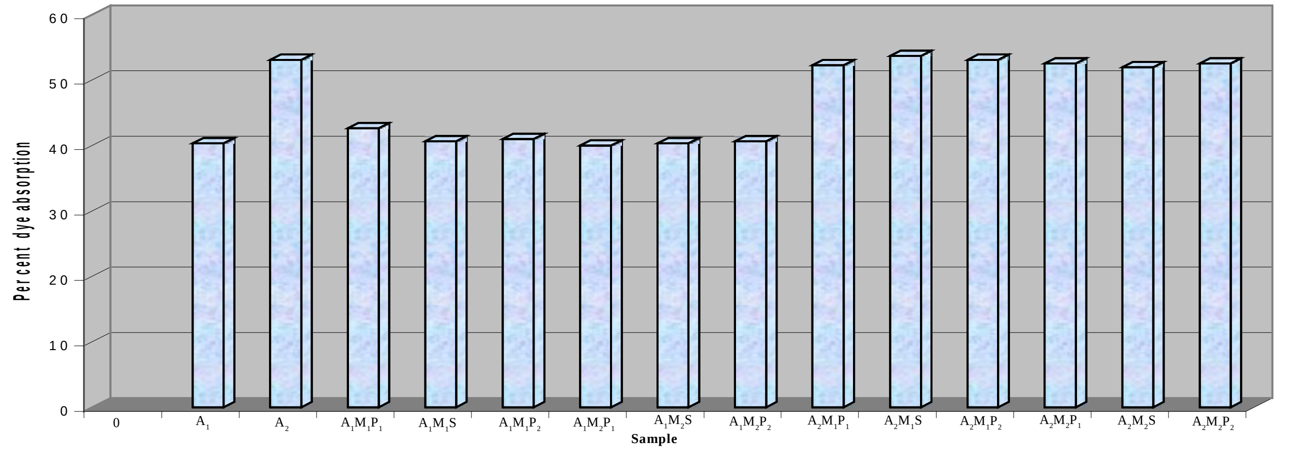


**Fig. 1: Per cent dye absorption during various treatments of dyeing**

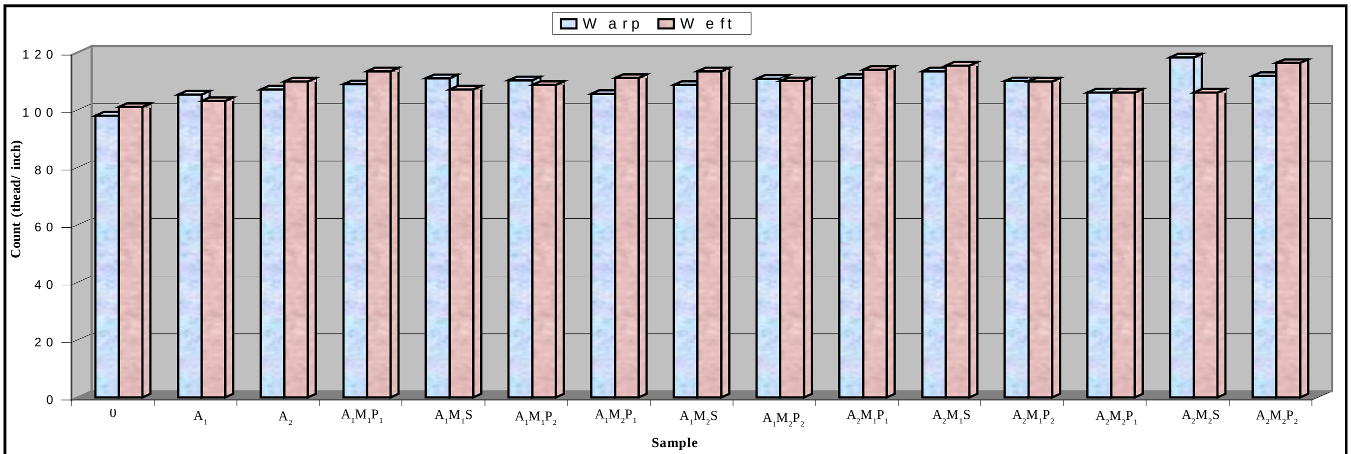


**Fig. 2: Effect of dyeing on count of fabric (thread/inch)**

**Table 1 : Per cent dye absorption during various treatments of dyeing**

| Sr. No. | Sample | Concentration of dye (g/100 ml) | O.D. before dyeing | O.D. after dyeing | Per cent dye absorption |
|---|---|---|---|---|---|
| 1. | O | | | | |
| 2. | $A_1$ | 5 | 3.00 | 1.79 | 40.33 |
| 3. | $A_2$ | 5 | 3.52 | 1.65 | 53.12 |
| 4. | $A_1M_1P_1$ | 5 | 3.00 | 1.72 | 42.66 |
| 5. | $A_1M_1S$ | 5 | 3.00 | 1.78 | 40.66 |
| 6. | $A_1M_1P_2$ | 5 | 3.00 | 1.77 | 41.00 |
| 7. | $A_1M_2P_1$ | 5 | 3.00 | 1.80 | 40.00 |
| 8. | $A_1M_2S$ | 5 | 3.00 | 1.79 | 40.33 |
| 9. | $A_1M_2P_2$ | 5 | 3.00 | 1.78 | 40.66 |
| 10. | $A_2M_1P_1$ | 5 | 3.52 | 1.68 | 52.27 |
| 11. | $A_2M_1S$ | 5 | 3.52 | 1.63 | 53.69 |
| 12. | $A_2M_1P_2$ | 5 | 3.52 | 1.65 | 53.12 |
| 13. | $A_2M_2P_1$ | 5 | 3.52 | 1.67 | 52.55 |
| 14. | $A_2M_2S$ | 5 | 3.52 | 1.69 | 51.98 |
| 15. | $A_2M_2P_2$ | 5 | 3.52 | 1.67 | 52.55 |

**Table 2 : Effect of dyeing on count of fabric (thread/inch)**

| Sr. No. | Sample | Direction | | | |
|---|---|---|---|---|---|
| | | Warp | | Weft | |
| | | Count | Per cent change over control | Count | Per cent change over control |
| 1. | O | 98.0 | | 101.0 | |
| 2. | $A_1$ | 105.3 | (+)7.45 | 103.1 | (+)2.08 |
| 3. | $A_2$ | 107.1 | (+)9.29 | 109.8 | (+) 8.71 |
| 4. | $A_1M_1P_1$ | 108.9 | (+)11.12 | 113.4 | (+) 12.28 |
| 5. | $A_1M_1S$ | 111.0 | (+)13.27 | 107.1 | (+) 6.04 |
| 6. | $A_1M_1P_2$ | 110.3 | (+)12.55 | 108.7 | (+) 7.62 |
| 7. | $A_1M_2P_1$ | 105.6 | (+)7.76 | 111.1 | (+) 10.00 |
| 8. | $A_1M_2S$ | 108.7 | (+)10.92 | 113.4 | (+) 12.28 |
| 9. | $A_1M_2P_2$ | 110.8 | (+)13.06 | 110.0 | (+) 8.91 |
| 10. | $A_2M_1P_1$ | 111.1 | (+)13.37 | 114.0 | (+) 12.87 |
| 11. | $A_2M_1S$ | 113.4 | (+)15.71 | 115.4 | (+) 14.26 |
| 12. | $A_2M_1P_2$ | 110.0 | (+)12.24 | 109.8 | (+) 8.71 |
| 13. | $A_2M_2P_1$ | 106.0 | (+)8.16 | 106.0 | (+) 4.95 |
| 14. | $A_2M_2S$ | 118.2 | (+)20.61 | 106.0 | (+) 4.95 |
| 15. | $A_2M_2P_2$ | 111.8 | (+)14.08 | 116.3 | (+) 15.15 |
| | S.E.± | 3.08 | | 0.76 | |
| | $C.D._{0.05}$ | 6.10 | | 1.50 | |

'+' indicates increase

**Table 3 : Effect of dyeing on fabric weight (g/m²)**

| Sr. No. | Sample | Fabric weight | Per cent change over control |
|---|---|---|---|
| 1. | O | 14.28 | |
| 2. | $A_1$ | 16.78 | (+) 17.51 |
| 3. | $A_2$ | 16.86 | (+) 18.07 |
| 4. | $A_1M_1P_1$ | 17.58 | (+) 23.11 |
| 5. | $A_1M_1S$ | 17.66 | (+) 23.67 |
| 6. | $A_1M_1P_2$ | 17.66 | (+) 23.67 |
| 7. | $A_1M_2P_1$ | 17.86 | (+) 25.07 |
| 8. | $A_1M_2S$ | 17.50 | (+) 22.55 |
| 9. | $A_1M_2P_2$ | 17.36 | (+) 21.57 |
| 10. | $A_2M_1P_1$ | 17.66 | (+) 23.67 |
| 11. | $A_2M_1S$ | 17.20 | (+) 20.45 |
| 12. | $A_2M_1P_2$ | 17.60 | (+) 23.25 |
| 13. | $A_2M_2P_1$ | 18.28 | (+) 28.01 |
| 14. | $A_2M_2S$ | 17.90 | (+) 25.35 |
| 15. | $A_2M_2P_2$ | 17.88 | (+) 25.21 |
| | S.Ed.± | 0.29 | |
| | $CD_{0.05}$ | 0.57 | |

'+' indicates increase

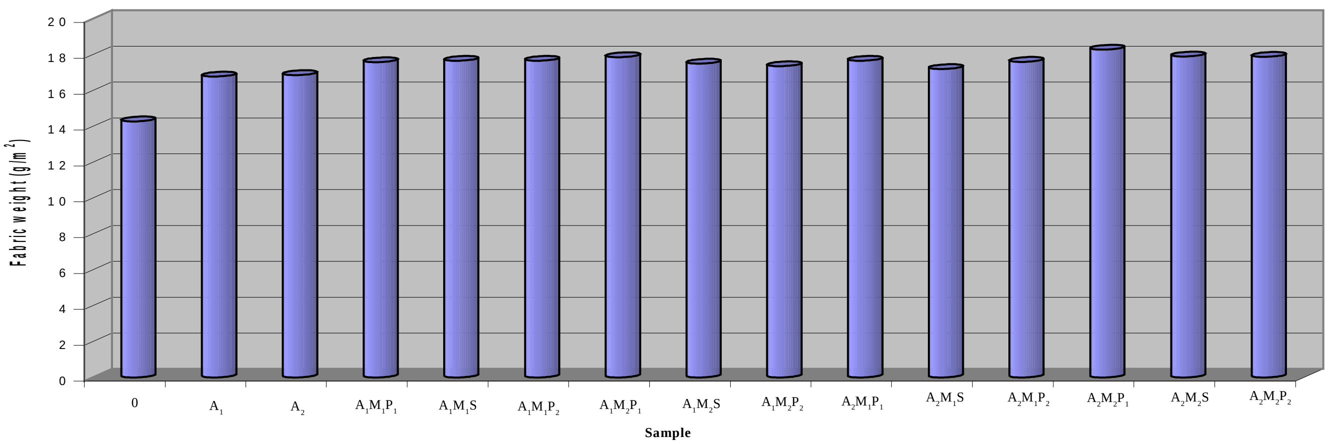


**Fig. 3: Effect of dyeing on fabric weight (g/m²)**

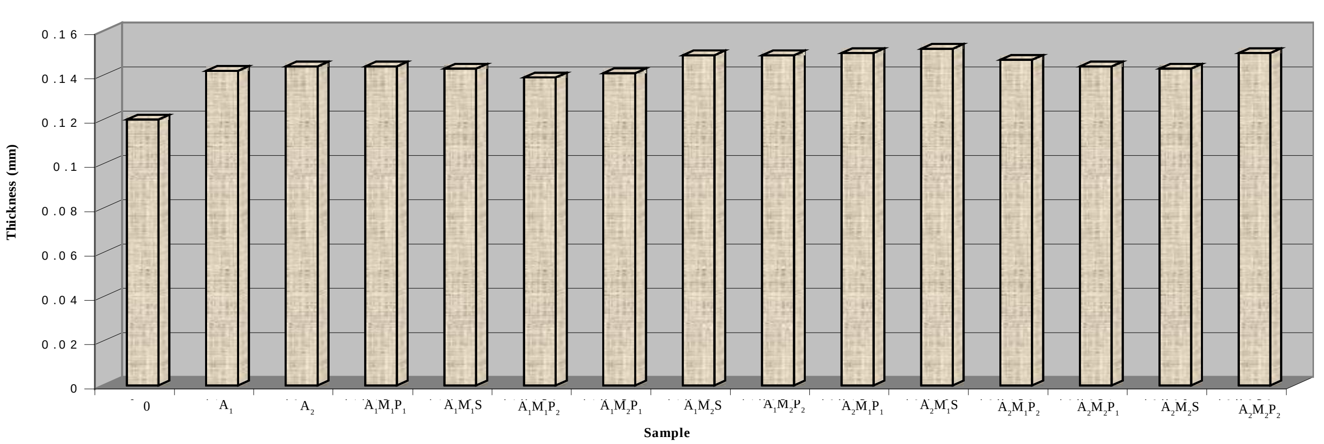


**Fig. 4: Effect of dyeing on the thickness (mm)**

**Table 4 : Effect of dyeing on thickness (mm)**

| Sr. No. | Sample | Thickness (mm) | Per cent change over control |
|---|---|---|---|
| 1. | O | 0.120 | |
| 2. | $A_1$ | 0.142 | (+)18.42 |
| 3. | $A_2$ | 0.144 | (+)19.92 |
| 4. | $A_1M_1P_1$ | 0.144 | (+)20.17 |
| 5. | $A_1M_1S$ | 0.143 | (+)19.08 |
| 6. | $A_1M_1P_2$ | 0.139 | (+)15.75 |
| 7. | $A_1M_2P_1$ | 0.141 | (+)17.58 |
| 8. | $A_1M_2S$ | 0.149 | (+)23.83 |
| 9. | $A_1M_2P_2$ | 0.149 | (+)24.17 |
| 10. | $A_2M_1P_1$ | 0.150 | (+)25.17 |
| 11. | $A_2M_1S$ | 0.152 | (+)26.75 |
| 12. | $A_2M_1P_2$ | 0.147 | (+)22.33 |
| 13. | $A_2M_2P_1$ | 0.144 | (+)20.08 |
| 14. | $A_2M_2S$ | 0.143 | (+)18.83 |
| 15. | $A_2M_2P_2$ | 0.150 | (+)25.17 |
| | S.Ed.± | 0.0005 | |
| | $CD_{0.05}$ | 0.001 | |

'+' indicates increase

investigation, it was found that per cent absorption was higher in case of acidic medium which may result in an increase in the weight of dyed fabric (Fig. 3).

*Effect of dyeing on thickness of fabric* :

From Table 4, it was clear that all the samples had increased in thickness after dyeing and the sample dyed with dye extracted in acidic medium showed higher per cent change in thickness over the control/original sample than the sample dyed with dye extracted in alkaline medium (Fig. 4).

The increase in thickness may be due to the consolidation taking place during dyeing which increases the count and also due to higher absorption of dye.

**Finding of physical properties :**

*Effect of dyeing on breaking strength of the fabric (Newton):*

From the Fig. 5, it was noticed that all the samples showed either increase or decrease value in breaking strength. Dye extracted in acidic medium without mordant showed an increase in breaking strength. However, the use of alum as mordant proved to be better as far as breaking strength is concerned. Greater loss in breaking strength was seen in the

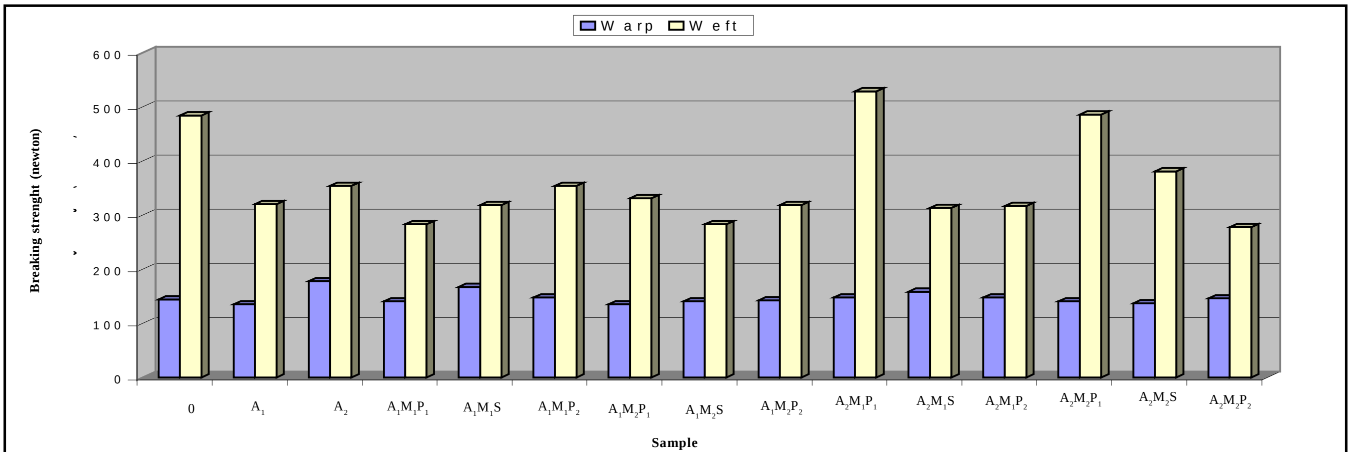


**Fig. 5: Effect of dyeing on breaking strength of fabric (Newton)**

**Table 5 : Effect of dyeing on breaking strength of fabric (Newton)**

| Sr. No. | Sample | Direction: Warp — Breaking load (kg) | Warp — Breaking strength (Newton) | Warp — Per cent change over control | Weft — Breaking load (kg) | Weft — Breaking strength (Newton) | Weft — Per cent change over control |
|---|---|---|---|---|---|---|---|
| 1. | O | 14.70 | 144.13 | | 49.35 | 483.99 | |
| 2. | $A_1$ | 13.79 | 135.23 | (-)6.19 | 32.66 | 320.29 | (-)33.82 |
| 3. | $A_2$ | 18.14 | 177.94 | (+)23.43 | 36.11 | 354.10 | (-)26.84 |
| 4. | $A_1M_1P_1$ | 14.33 | 140.57 | (-)2.49 | 28.85 | 282.92 | (-)41.54 |
| 5. | $A_1M_1S$ | 17.06 | 167.26 | (+)16.02 | 32.48 | 318.51 | (-)34.19 |
| 6. | $A_1M_1P_2$ | 15.06 | 147.69 | (+)2.45 | 36.11 | 354.10 | (-)26.84 |
| 7. | $A_1M_2P_1$ | 13.79 | 135.23 | (-)6.19 | 33.75 | 330.97 | (-)31.62 |
| 8. | $A_1M_2S$ | 14.33 | 140.57 | (-)2.49 | 28.85 | 282.92 | (-)41.54 |
| 9. | $A_1M_2P_2$ | 14.52 | 142.35 | (-)1.26 | 32.48 | 318.51 | (-)34.19 |
| 10. | $A_2M_1P_1$ | 15.06 | 147.69 | (+)2.45 | 53.89 | 528.48 | (+)9.19 |
| 11. | $A_2M_1S$ | 16.15 | 158.37 | (+)9.85 | 31.93 | 313.17 | (-)35.29 |
| 12. | $A_2M_1P_2$ | 15.06 | 147.69 | (+)2.45 | 32.30 | 316.73 | (-)34.56 |
| 13. | $A_2M_2P_1$ | 14.33 | 140.57 | (-)2.49 | 49.53 | 485.77 | (+)0.37 |
| 14. | $A_2M_2S$ | 13.97 | 137.01 | (-)4.96 | 38.83 | 380.79 | (-)21.32 |
| 15. | $A_2M_2P_2$ | 14.88 | 145.91 | (+)1.21 | 28.30 | 277.58 | (-)42.65 |
| | S.E.± | 0.52 | 5.10 | | 0.520 | 5.10 | |
| | $C.D._{0.05}$ | 1.03 | 10.10 | | 1.03 | 10.10 | |

'+' indicates increase, '-' indicates decrease weft direction. Sample (10) $A_2M_1P_1$ showed an increase in breaking strength in both warp and weft direction (Table 5).

*Effect of dyeing on elongation of the fabric (%)* :

The elongation is the difference between the length of a stretched yarn at breaking load and its initial length usually expressed in percentage. From Table 6 it was noticed that sample (4) $A_2M_1P_1$ which was dyed with dye extracted in acidic medium and pre mordanted with alum showed highest elongation in both warp and weft direction. The increase in elongation may be due to an increase in the crimp because of dyeing (Table 6 and Fig. 6). Sengupta (2001). Bhuyan *et al*. (2002), Gulrajani and Maulik (2002) and Agarwal and Gupta (2005) have also made valuable contributions on related aspects of the present investigation.

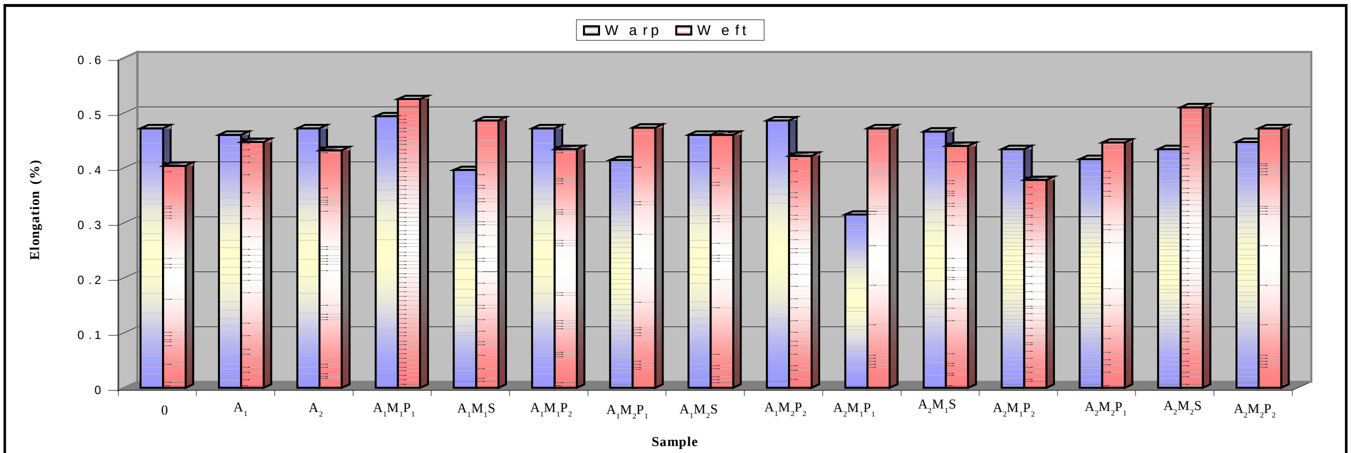


**Fig. 6: Effect of dyeing on elongation of fabric (percentage)**

**Table 6 : Effect of dyeing on elongation of fabric (percentage)**

| Sr. No. | Sample | Direction | | | |
|---|---|---|---|---|---|
| | | Warp | | Weft | |
| | | Elongation | Per cent change over control | Elongation | Per cent change over control |
| 1. | O | 0.472 | | 0.404 | |
| 2. | $A_1$ | 0.460 | (-)2.54 | 0.447 | (+)10.64 |
| 3. | $A_2$ | 0.472 | 0.00 | 0.432 | (+)6.93 |
| 4. | $A_1M_1P_1$ | 0.494 | (+)4.66 | 0.525 | (+)29.95 |
| 5. | $A_1M_1S$ | 0.396 | (-)16.10 | 0.486 | (+)20.30 |
| 6. | $A_1M_1P_2$ | 0.472 | 0.00 | 0.434 | (+)7.43 |
| 7. | $A_1M_2P_1$ | 0.414 | (-)12.29 | 0.473 | (+)17.18 |
| 8. | $A_1M_2S$ | 0.460 | (-)2.54 | 0.460 | (+)13.86 |
| 9. | $A_1M_2P_2$ | 0.486 | (+)2.97 | 0.422 | (+)4.55 |
| 10. | $A_2M_1P_1$ | 0.315 | (-)33.26 | 0.472 | (+)16.83 |
| 11. | $A_2M_1S$ | 0.466 | (-)1.27 | 0.440 | (+)8.91 |
| 12. | $A_2M_1P_2$ | 0.434 | (-)7.97 | 0.378 | (-)6.44 |
| 13. | $A_2M_2P_1$ | 0.416 | (-)11.86 | 0.446 | (+)10.40 |
| 14. | $A_2M_2S$ | 0.434 | (-)8.05 | 0.510 | (+)26.24 |
| 15. | $A_2M_2P_2$ | 0.447 | (-)5.21 | 0.472 | (+)16.83 |
| | S.E.± | 0.036 | | 0.035 | |
| | $C.D._{0.05}$ | 0.071 | | 0.070 | |

'+' indicates increase, '-' indicates decrease

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