

## *Correlation of Wool Fibers from Different Variants*

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**Abstract.** This article analyzes the correlation between the physical and mechanical properties of Karakul wool fibers obtained from different variants. Based on experimental data, the length, diameter, elasticity, and elongation at break of the fibers were compared. Correlation graphs were used to identify statistical relationships between fiber parameters, and optimal processing conditions were proposed. The results of the study are important for adapting semi-coarse wool to industrial processing and improving technological procedures.

**Keywords:** Karakul wool fiber, variants, correlation, fiber diameter, elasticity, statistical analysis, graph, physical-mechanical properties

Correlation graph of wool fibers of options 1 and 2 sheared in the spring season.

Table 1.1 below shows the results of calculating the correlation coefficient based on the strength of processed wool fibers in option 1 and option 3, sheared in the summer season.

*Table 1.*

The strength of the fiber cut in the spring season according to options 1 and 3

| $X$  | $Y$  | $X - M_x$ | $(X - M_x)^2$ | $Y - M_y$ | $(Y - M_y)^2$ | $(X - M_x) \cdot (Y - M_y)$ |
|------|------|-----------|---------------|-----------|---------------|-----------------------------|
| 3.39 | 3.43 | -0.3      | 0.09          | -0.3      | 0.09          | 0.09                        |
| 3.44 | 3.46 | -0.2      | 0.04          | -0.3      | 0.09          | 0.06                        |
| 4.3  | 4.1  | 0.6       | 0.36          | 0.4       | 0.16          | 0.24                        |
| 3.56 | 3.51 | -0.1      | 0.01          | -0.2      | 0.04          | 0.02                        |
| 3.6  | 3.44 | -0.1      | 0.01          | -0.3      | 0.09          | 0.03                        |
| 3.8  | 3.48 | 0.1       | 0.01          | -0.3      | 0.09          | -0.03                       |
| 3.4  | 3.66 | -0.3      | 0.09          | -0.1      | 0.01          | 0.03                        |
| 4.1  | 4.3  | 0.4       | 0.16          | 0.6       | 0.36          | 0.24                        |

|              |              |                    |              |                    |              |             |
|--------------|--------------|--------------------|--------------|--------------------|--------------|-------------|
| 3.39         | 3.8          | -0.3               | 0.09         | 0.1                | 0.01         | -0.03       |
| 3.8          | 4.3          | 0.1                | 0.01         | 0.6                | 0.36         | 0.06        |
| <b>36.78</b> | <b>37.48</b> | <b>-0.1</b>        | <b>0.87</b>  | <b>0.2</b>         | <b>1.3</b>   | <b>0.71</b> |
| $\Sigma X$   | $\Sigma Y$   | $\Sigma (X - M_x)$ | $\Sigma X^2$ | $\Sigma (Y - M_y)$ | $\Sigma Y^2$ | $\Sigma XY$ |
| $\Sigma X$   | $\Sigma Y$   | $\Sigma (X - M_x)$ | $\Sigma X^2$ | $\Sigma (Y - M_y)$ | $\Sigma Y^2$ | $\Sigma XY$ |

The average value of the strength of wool fiber processed in the 1st option, sheared in the spring season, is calculated as follows.

$$M_x = \frac{\Sigma X}{n} = 3,7$$

The average value of the strength of wool fiber processed in the 3rd option , cut in the spring season, is calculated as follows.

$$M_y = \frac{\Sigma Y}{n} = 3,7$$

Correlation coefficient as follows is determined .

$$r = \frac{\Sigma XY}{\sqrt{\Sigma X^2 \Sigma Y^2}} = 0,67$$

the correlation coefficient error as follows is determined .

$$m_r = \pm \frac{1 - r^2}{\sqrt{n}} = 0,18$$

the correlation coefficient reliability as follows is determined .

$$\frac{r}{m_r} = 3,81$$

Ours in our example is equal to, which means  $r = -0,75$  that the correlative link between the investigated results  $r < 0,5$  is less strong vice versa in contact that , and accounts correct that it is done  $\frac{r}{m_r} \leq 3$  according to the criterion, it can be confirmed that it is within the limits of experimental reliability.

Figure 1. shows the correlation graph of wool fibers of options 1 and 3 sheared in the spring season.

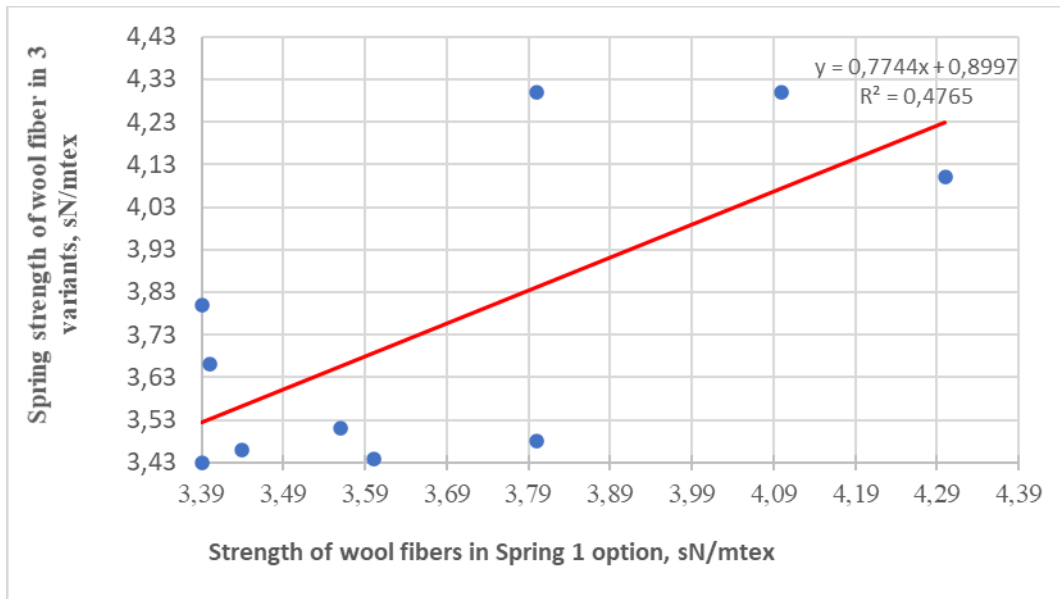


Table 9 shows the results of calculating the correlation coefficient based on the strength of processed wool fibers in option 1 and option 2, sheared in the autumn season.

Table 1.1

The strength of the fiber cut in the autumn season according to options 1 and 2

| $X$         | $Y$         | $X - M_x$          | $(X - M_x)^2$ | $Y - M_y$          | $(Y - M_y)^2$ | $(X - M_x) \cdot (Y - M_y)$ |
|-------------|-------------|--------------------|---------------|--------------------|---------------|-----------------------------|
| 3.6         | 4.6         | -0.6               | 0.36          | 0.5                | 0.25          | -0.3                        |
| 3.5         | 4.2         | -0.7               | 0.49          | 0.1                | 0.01          | -0.07                       |
| 4.2         | 4.3         | 0                  | 0             | 0.2                | 0.04          | 0                           |
| 4.5         | 3.6         | 0.3                | 0.09          | -0.5               | 0.25          | -0.15                       |
| 4.7         | 3.8         | 0.5                | 0.25          | -0.3               | 0.09          | -0.15                       |
| 4           | 4.3         | -0.2               | 0.04          | 0.2                | 0.04          | -0.04                       |
| 4.1         | 3.9         | -0.1               | 0.01          | -0.2               | 0.04          | 0.02                        |
| 4.4         | 3.7         | 0.2                | 0.04          | -0.4               | 0.16          | -0.08                       |
| 4.2         | 4.3         | 0                  | 0             | 0.2                | 0.04          | 0                           |
| 4.5         | 4.2         | 0.3                | 0.09          | 0.1                | 0.01          | 0.03                        |
| <b>41.7</b> | <b>40.9</b> | <b>-0.3</b>        | <b>1.37</b>   | <b>-0.1</b>        | <b>0.93</b>   | <b>-0.74</b>                |
| $\Sigma X$  | $\Sigma Y$  | $\Sigma (X - M_x)$ | $\Sigma X^2$  | $\Sigma (Y - M_y)$ | $\Sigma Y^2$  | $\Sigma XY$                 |

The average value of the strength of wool fiber processed in the 1st option, sheared in the autumn season, is calculated as follows.

$$M_x = \frac{\Sigma X}{n} = 4,2$$

The average value of the strength of wool fiber processed in the 2nd option, sheared in the autumn season, is calculated as follows.

$$M_y = \frac{\sum Y}{n} = 4,1$$

Correlation coefficient as follows is determined .

$$r = \frac{\sum XY}{\sqrt{\sum X^2 \sum Y^2}} = -0,166$$

the correlation coefficient error as follows is determined .

$$m_r = \pm \frac{1 - r^2}{\sqrt{n}} = 0,18$$

the correlation coefficient reliability as follows is determined .

$$\frac{r}{m_r} = -3,64$$

Ours in our example is equal to, which means  $r = -0,166$  that the correlative link between the investigated results  $r < 0,5$  is less strong vice versa in contact that , and

accounts correct that it is done  $\frac{r}{m_r} \leq 3$  to the yardstick according to experimental

reliability on the border that it is confirmation possible .

Figure 1.1 shows the correlation graph of wool fibers of options 1 and 2 sheared in the autumn season.

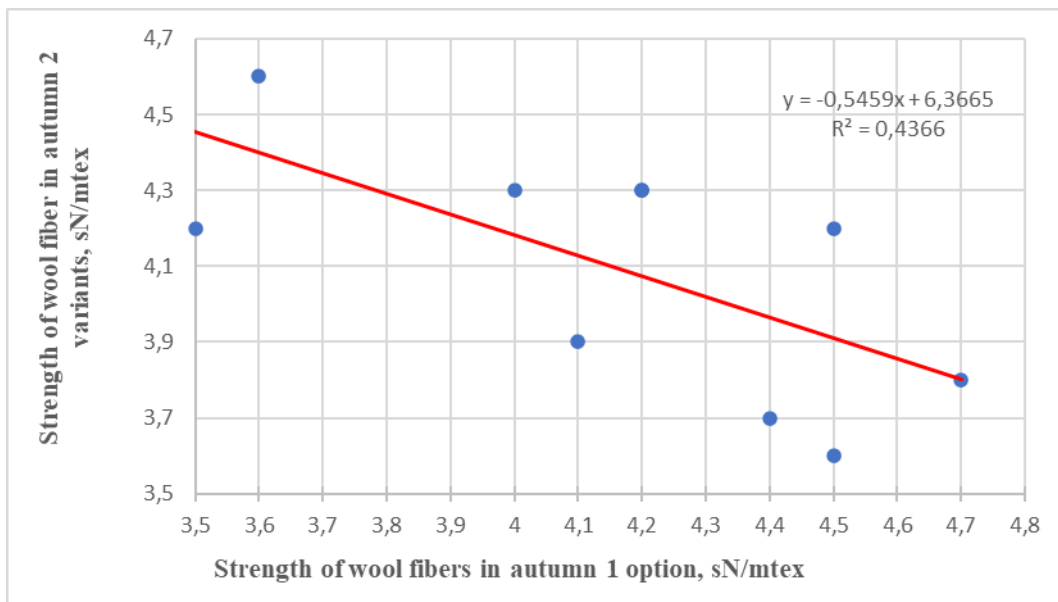


Figure 1.1 Correlation graph of wool fibers of options 1 and 2 sheared in the autumn season.

The graph shows the relationship between the strengths of autumn wool fibers. The blue points in the graph are values of the strength of wool fibers, the red line is the trend (regression) line.

Table 3.10 shows the results of calculating the correlation coefficient based on the strength of processed wool fibers in option 1 and option 2, sheared in the autumn season

*Table 1.2*

The strength of the fiber cut in the autumn season according to options 1 and 3

| $X$         | $Y$          | $X - M_x$        | $(X - M_x)^2$ | $Y - M_y$        | $(Y - M_y)^2$ | $(X - M_x) \cdot (Y - M_y)$ |
|-------------|--------------|------------------|---------------|------------------|---------------|-----------------------------|
| 3.6         | 4.4          | -0.6             | 0.36          | 0.1              | 0.01          | -0.06                       |
| 3.5         | 3.8          | -0.7             | 0.49          | -0.5             | 0.25          | 0.35                        |
| 4.2         | 4.1          | 0                | 0             | -0.2             | 0.04          | 0                           |
| 4.5         | 4.55         | 0.3              | 0.09          | 0.3              | 0.09          | 0.09                        |
| 4.7         | 4.6          | 0.5              | 0.25          | 0.3              | 0.09          | 0.15                        |
| 4           | 4.1          | -0.2             | 0.04          | -0.2             | 0.04          | 0.04                        |
| 4.1         | 4.3          | -0.1             | 0.01          | 0                | 0             | 0                           |
| 4.4         | 4.3          | 0.2              | 0.04          | 0                | 0             | 0                           |
| 4.2         | 4.1          | 0                | 0             | -0.2             | 0.04          | 0                           |
| 4.5         | 4.6          | 0.3              | 0.09          | 0.3              | 0.09          | 0.09                        |
| <b>41.7</b> | <b>42.85</b> | <b>-0.3</b>      | <b>1.37</b>   | <b>-0.1</b>      | <b>0.65</b>   | <b>0.66</b>                 |
| $\sum X$    | $\sum Y$     | $\sum (X - M_x)$ | $\sum X^2$    | $\sum (Y - M_y)$ | $\sum Y^2$    | $\sum XY$                   |

The average value of the strength of wool fiber processed in the 1st option, sheared in the autumn season, is calculated as follows.

$$M_x = \frac{\sum X}{n} = 4,2$$

The average value of the strength of wool fiber processed in the 3rd option, cut in the autumn season, is calculated as follows.

$$M_y = \frac{\sum Y}{n} = 4,3$$

Correlation coefficient as follows is determined .

$$r = \frac{\sum XY}{\sqrt{\sum X^2 \sum Y^2}} = 0,070$$

the correlation coefficient error as follows is determined .

$$m_r = \pm \frac{1 - r^2}{\sqrt{n}} = 0,16$$

the correlation coefficient reliability as follows is determined .

$$\frac{r}{m_r} = 4,33$$

Ours in our example is equal to, which means  $r = 0,070$  that the correlative link between the investigated results  $r < 0,5$  is less strong vice versa in contact that , and accounts correct that it is done  $\frac{r}{m_r} \leq 3$  according to the criterion, it can be confirmed that it is within the limits of experimental reliability. Figure 3.14 shows the correlation graph of wool fibers of options 1 and 3 sheared in the autumn season.

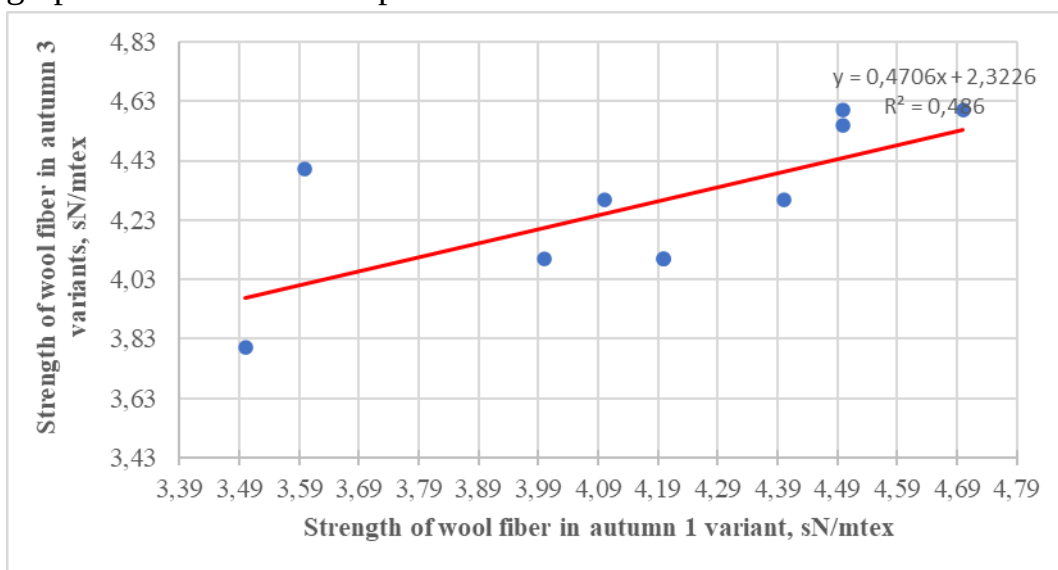


Figure 1.2 Correlation graph of wool fibers of options 1 and 3 sheared in the autumn season.

The graph shows the relationship between the strengths of autumn wool fibers. The blue points in the graph are values of the strength of wool fibers, the red line is the trend (regression) line.

According to the results of determining the correlation coefficients, error and significance of the strength of fibers cut in the spring and autumn seasons, it was found that there is a strong inverse relationship  $\frac{r}{m_r} \leq 3$  between the investigated results , and  $r < 0,5$  it is within the limits of experimental reliability according to the criterion that the calculations are performed correctly.

According to the results of the evaluation of the physico-mechanical properties of softened wool fibers based on the technology developed above, the higher physico-mechanical parameters of the fibers shorn in the autumn season compared to the wool fibers shorn in the autumn season necessitated the determination of the factors affecting

the quality indicators of the wool fibers in the autumn season and conducting a full factorial experiment.

#### Summary for Chapter 3:

1. The technology for processing local sheep wool fibers was implemented in two stages. In the first stage, the wool fibers were pretreated with a solution of water and urea, then dried. In the second stage, the fibers were softened using a solution prepared based on Ciba Sapamine OC and Triamon, which was then spun in a newly developed device.
2. Compared to spring wool, the initial diameter of autumn fiber is 20% less in all options, and the final diameter after fiber processing is 20.12% less in option 1, 20.4% in option 2, and 21% less in option 3.
3. After the initial treatment, the elasticity of autumn fiber is 7%, 8%, 9% more in option 1, 8%, 9% more in option 2, moisture absorption (hydration) of the fiber is 3% more in option 1, 2.5%, 3% more in option 2, the final mass of 100 kg of fiber replacement is 10.2% in option 1, 2 it was observed that it increased by 10.33% and 10.5% in the variant.
4. In the main stage of wool fiber processing, the diameter of wool fibers cut in the spring season decreased by 20.7% in the 1st option, 20.4% in the 2nd option, and 20.2% in the 3rd option. that the elongation at break increased by 0.7% in option 1, by 0.8% in option 2, by 1.1% in option 3, the uniformity ratio increased by 5.75% in option 1, by 6.45% in option 2, by 6.56% in option 3, the average fiber length It was shown that it increased by 2.6% in option 1, by 5.0% in option 2, and by 4.8% in option 3.
5. The process of softening wool fiber is a complex process that involves significant changes not only to its external appearance, but also to its internal structure. As a result of softening, every structure from the dimer to the cuticle changes, making the fiber soft, supple, pliable, and suitable for textile processing.
6. According to the results of determining the correlation coefficients, error and significance of the strength of fibers cut in the spring and autumn seasons, it was found that there is a strong inverse relationship  $\frac{r}{m_r} \leq 3$  between the investigated results, and  $r < 0,5$  it is within the limits of experimental reliability according to the criterion that the calculations are performed correctly.

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