

# Effects of Different Light Quality on Anatomical Structure, Carboxylase Activity of Rubisco and Expression of *rbc* and *rca* Genes in Tobacco Leaves

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## ABSTRACT

By covering tobacco plants with white, red, yellow, blue and purple films to obtain different light quality, the effects of light quality on anatomical structure, carboxylase activity of ribulose 1,5-biphosphate carboxylase oxygenase (Rubisco), and expression of *rbc* and *rca* genes were investigated in tobacco leaves aged from 7 to 70 days.

Compared to the leaves grown under yellow film, red, blue and purple film treatments increased the leaf thickness, palisade and spongy parenchyma thickness, and density of palisade cells, but lowered the tissue interspace in the tobacco leaves. In addition, the leaves with red, blue and purple film treatments showed higher carboxylase activity of Rubisco and net photosynthetic rate and stronger expression of *rbc* and *rca* genes than those with yellow film treatment.

These results indicated that, different light quality obviously influenced the anatomical structure, carboxylase activity of Rubisco and further photosynthesis efficiency of tobacco leaves, and there was a possible relationship among light quality, anatomical structure and photosynthesis efficiency of tobacco leaves to some extent.

## METHODS

### TREATMENTS:

- Covering the tobacco plant with different color plastic film to obtain different light quality.
- Using a white insect-proof net to adjust the light intensity to the same level among five light quality treatments.
- Treatments begin from 30 d after transplant.

### PLANT SAMPLES:

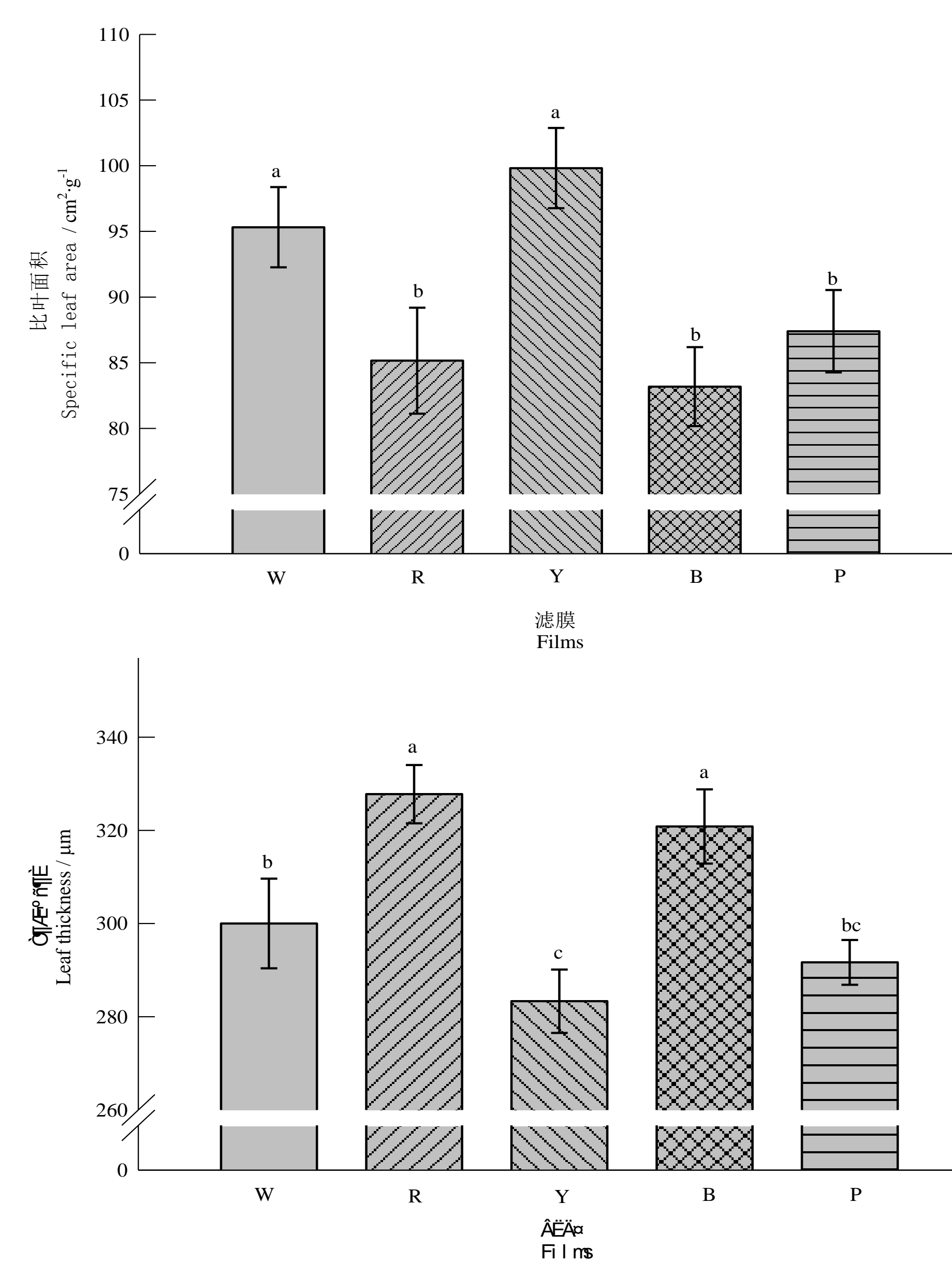
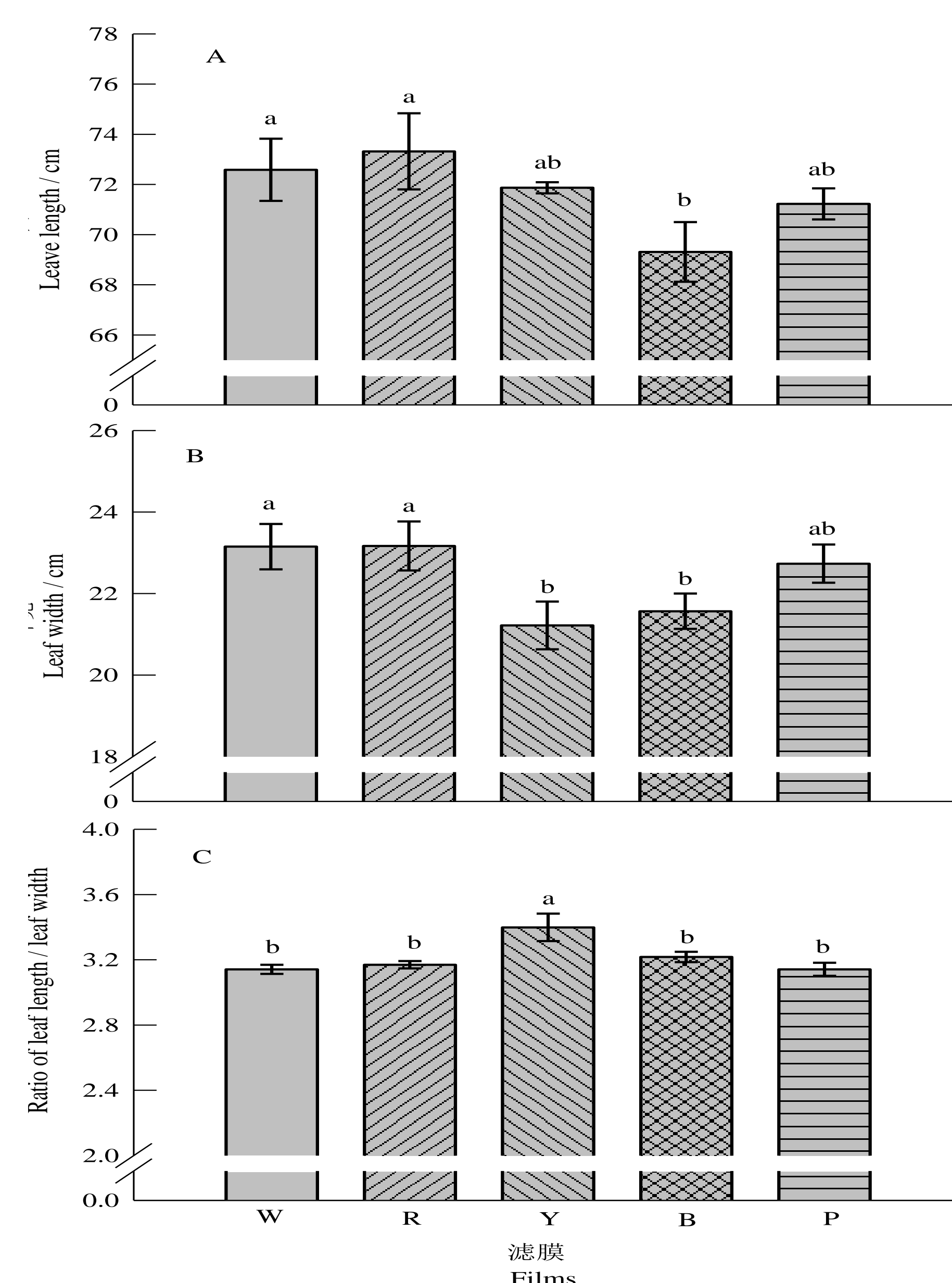
- Select the 11th leaf as experimental material.
- Leaf Samples were collected for the first time when the leaves grew to 0.5 cm long, and then the following samples were collected every two weeks later.

### PHYSIOLOGICAL INDEXES MEASUREMENT

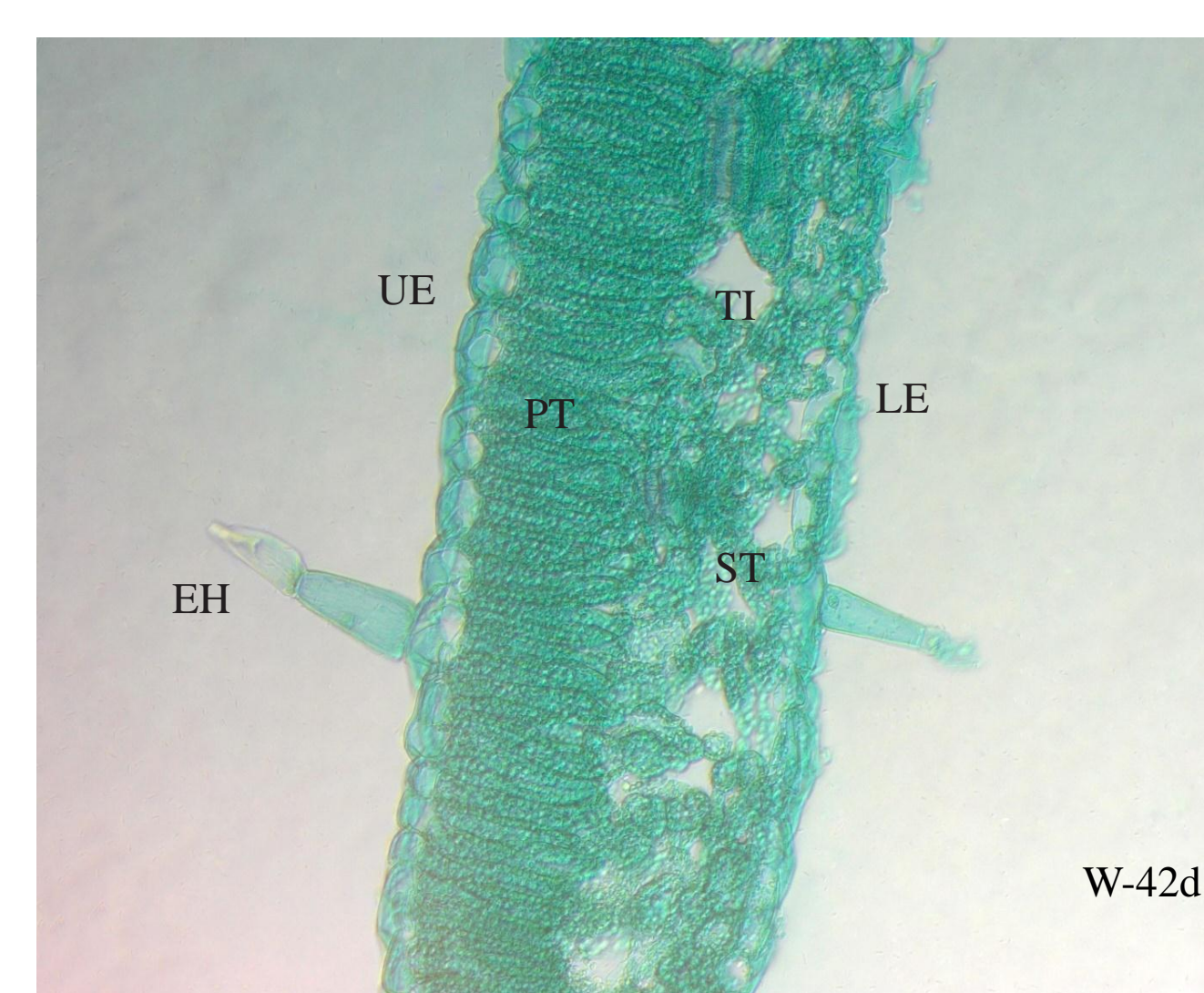
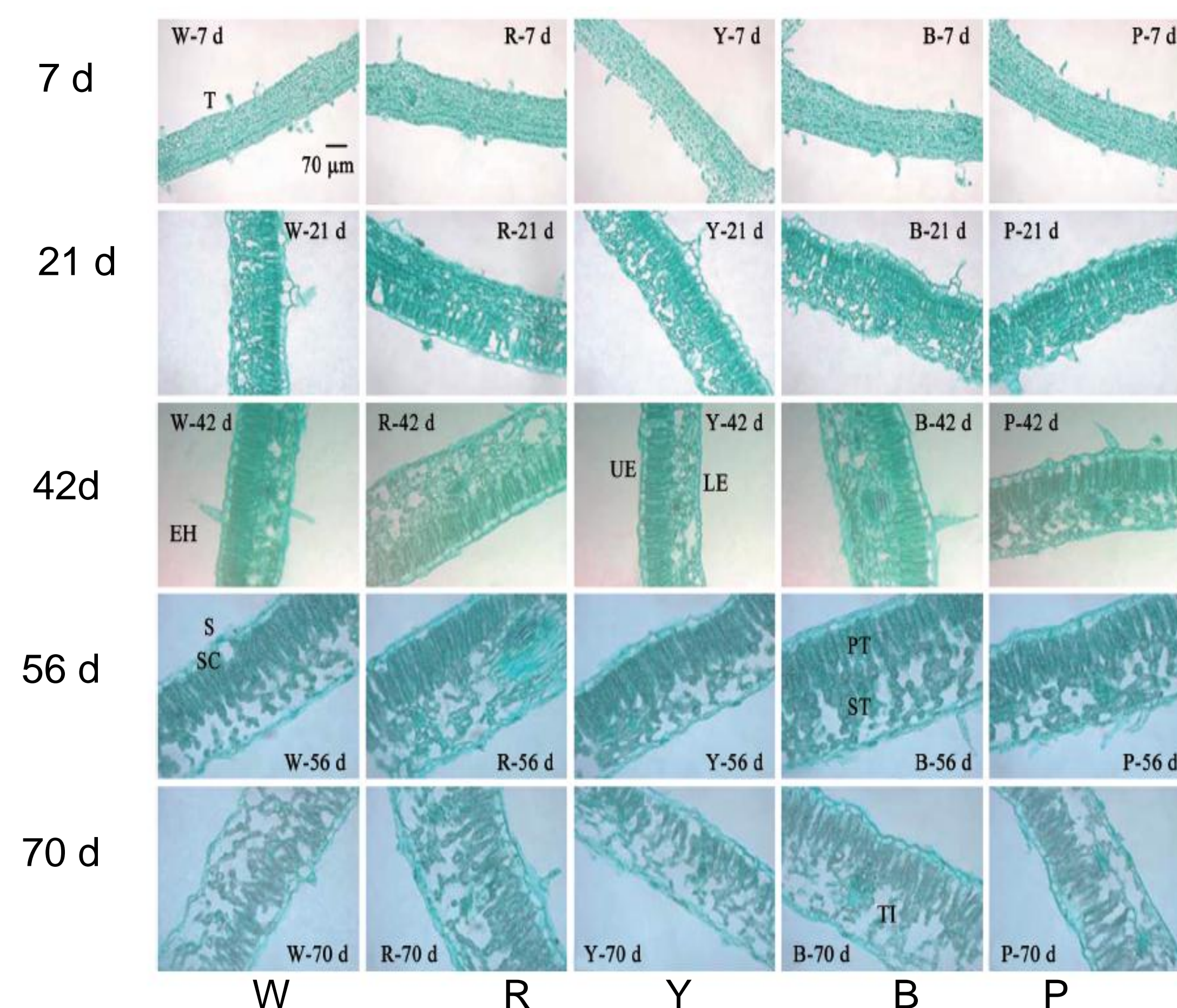
- anatomical structure: make paraffin sections, observe with digital microscope.
- photosynthesis measurement: using Li-6400 RXT at field under artificial light conditions.
- activity of rubisco: calculated according to the absorbance reduction of NADP<sup>+</sup>
- gene expression of *rbc* and *rca*: obtain gene sequence from GenBank, design the primer to do RT-PCR



## RESULTS



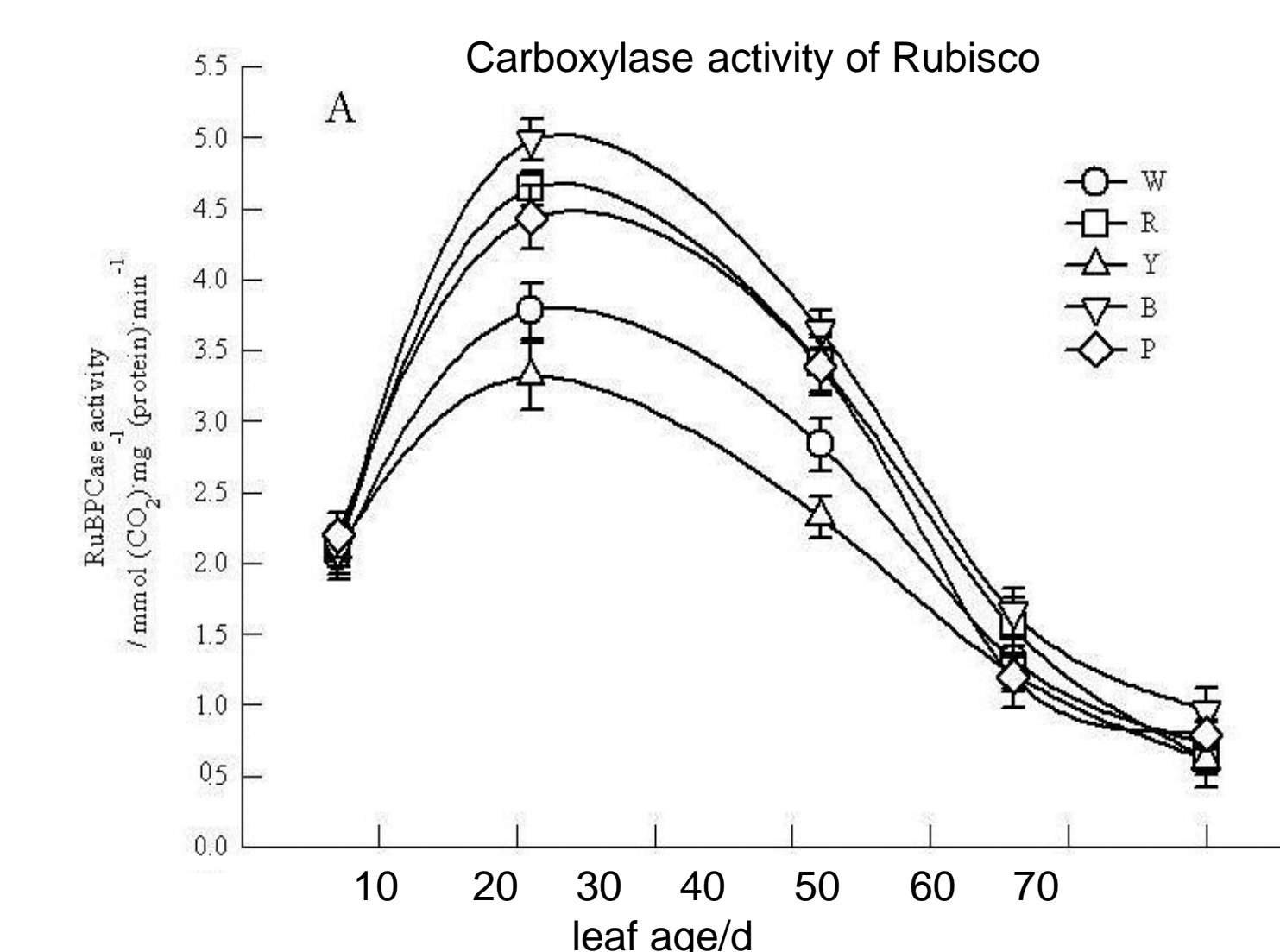
In comparison to white film treatment, blue film treatment reduce the blade length and width, the ratio of blade length to width of yellow treatment was highest among the five treatments. Red and blue film treatment thickened the blade, the SLA was lower under their treatments. Yellow film treatment has reverse effects.



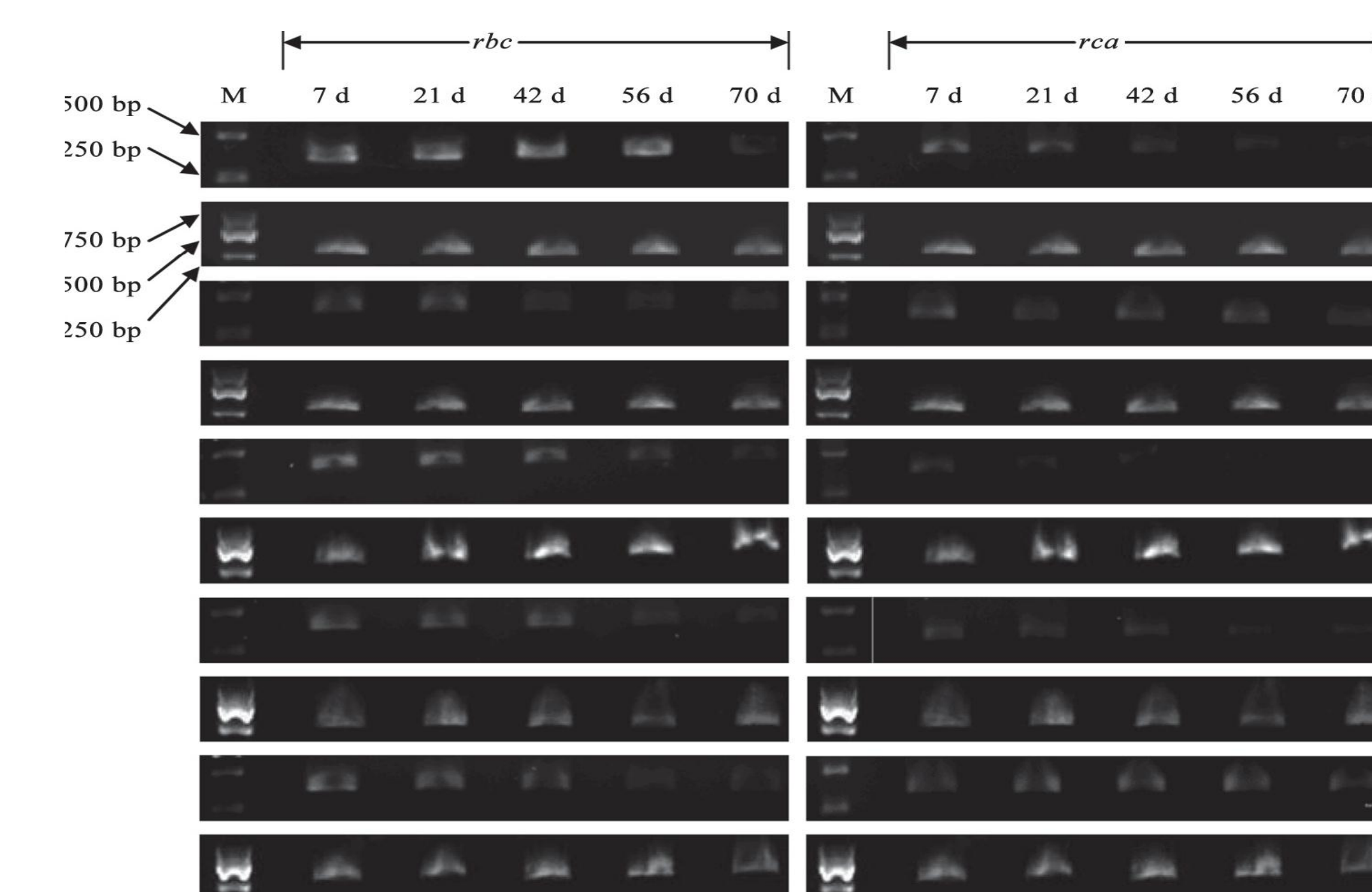
T: trichome; EH: epidermic hair; UE: upper epidermis; LE: lower epidermis; S: stoma; SC: stoma cavity; PT: palisade tissue; ST: spongy tissue; TI: tissue interspace.

Compared to white, red film treating leaf has higher blade palisade tissue thickness; Yellow film treating leaf has lower spongy tissue thickness; Blue film treating leaf has higher palisade tissue thickness and lower thickness of upper epidermis; Purple treatment has no significant effects on these anatomical indexes.

## RESULTS



Rubisco was the key enzyme for the leaf photosynthesis, has both carboxylase activity and oxygenase activity. The carboxylase activity of Rubisco of leaf growing under red, blue and purple film was higher, while that of leaf growing under yellow film was lower.



*Ntrbc* was a nuclear gene coding the small subunit of Rubisco protein. *Ntrac* was also a nuclear gene coding the carboxylase of Rubisco. Both *Ntrbc* and *Ntrac* showed strong expression in leaf grown under red, blue and purple film. White and yellow film treatment inhibited the *Ntrac* gene expression, although the *Ntrbc* gene was slightly affected.

## CONCLUSION

- Red and blue film could improve the tobacco leaf quality, mainly result from fine leaf anatomical structure.
- Red and blue light quality had positive effect to increase the photosynthesis of tobacco leaves and can promote the development of tobacco leaves. Meanwhile, yellow light had a negative effect.
- Expression level of *rbc* and *rca* genes were obviously different under different light quality, and under yellow film treatment the expression of *rca* was especially weak, that might be the cause for lower net photosynthetic rate.
- There was a closely relationship between light quality, anatomical structure and photosynthesis of tobacco leaves to some extent.