



evropský
sociální
fond v ČR



EVROPSKÁ UNIE



MINISTERSTVO ŠKOLSTVÍ,
MLÁDEŽE A TĚLOVÝCHOVY



OP Vzdělávání
pro konkurenceschopnost

INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Effect of nitrogen nutrition on flavonoid accumulation under different UV and PAR regimes

Karel Klem et al.

Tato akce se koná v rámci projektu:

Vybudování vědeckého týmu environmentální metabolomiky a ekofyziologie a jeho zapojení do mezinárodních sítí (ENVIMET; r.č. **CZ.1.07/2.3.00/20.0246**) realizovaného v rámci Operačního programu Vzdělávání pro konkurenceschopnost.



Hypotheses

- Flavonoid biosynthesis is primarily induced by UV radiation (UV-B)
- However, their biosynthesis is strongly related to carbon and nitrogen metabolism (C:N ratio) and therefore the accumulation is modulated by intensity of PAR and nitrogen status

Materials and methods

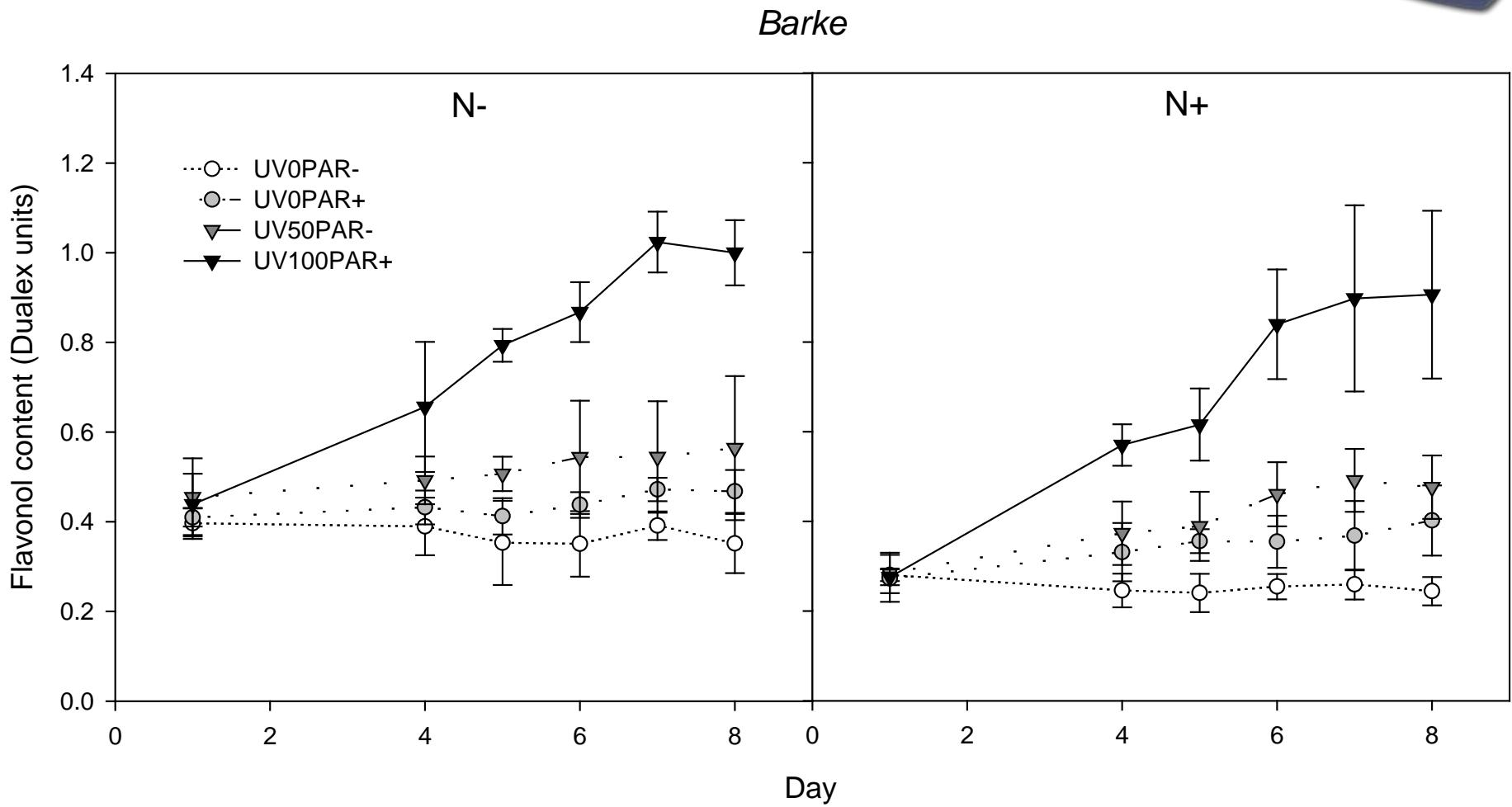
- Four spring barley varieties – Barke, Bonus, Prestige, Sebastian
- Pots filled with mixture of siliceous sand (0 -2 mm) and a light peat substrate with pH 5,5 – 6,5 (1:2)
- fertilization with nitrogen [$\text{Ca}(\text{NO}_3)_2$] to achieve final doses 0 and 10 g N m⁻²
- Using plastic UV filter (Lee Filters) excluding both UV-A and UV-B and shading net reducing both UV and PAR by approx. 50% - four treatments were applied for 8 days UVOPAR-, UVOPAR+, UV50PAR-, UV100PAR+



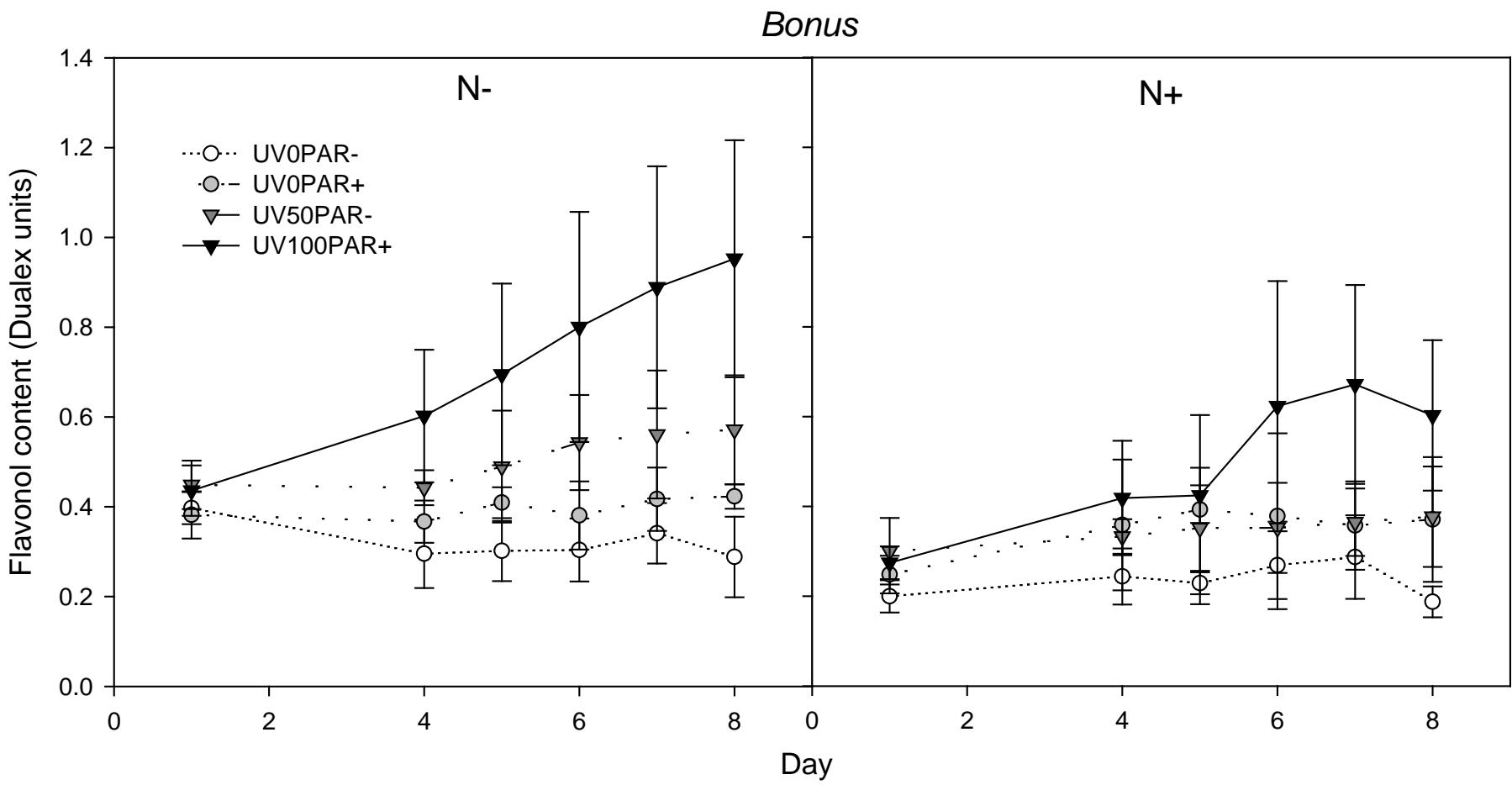
Spring barley
(*Hordeum vulgare*)
covered by UV filter
and shading net
around
BBCH 12 before
fertilization



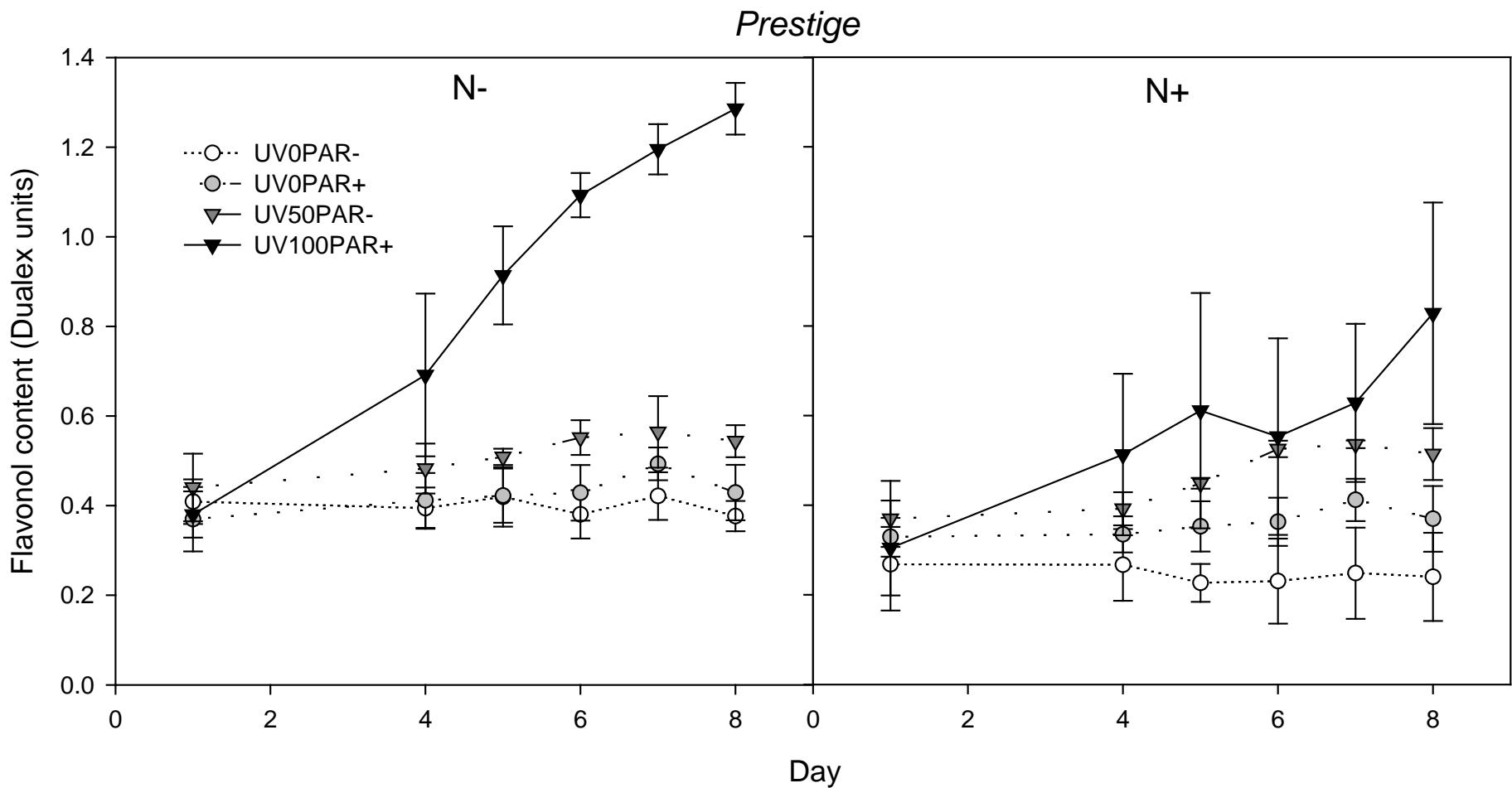
- In variety Barke the effect of N nutrition on accumulation of epidermal flavonoids was only small and affected particularly the constitutive accumulation



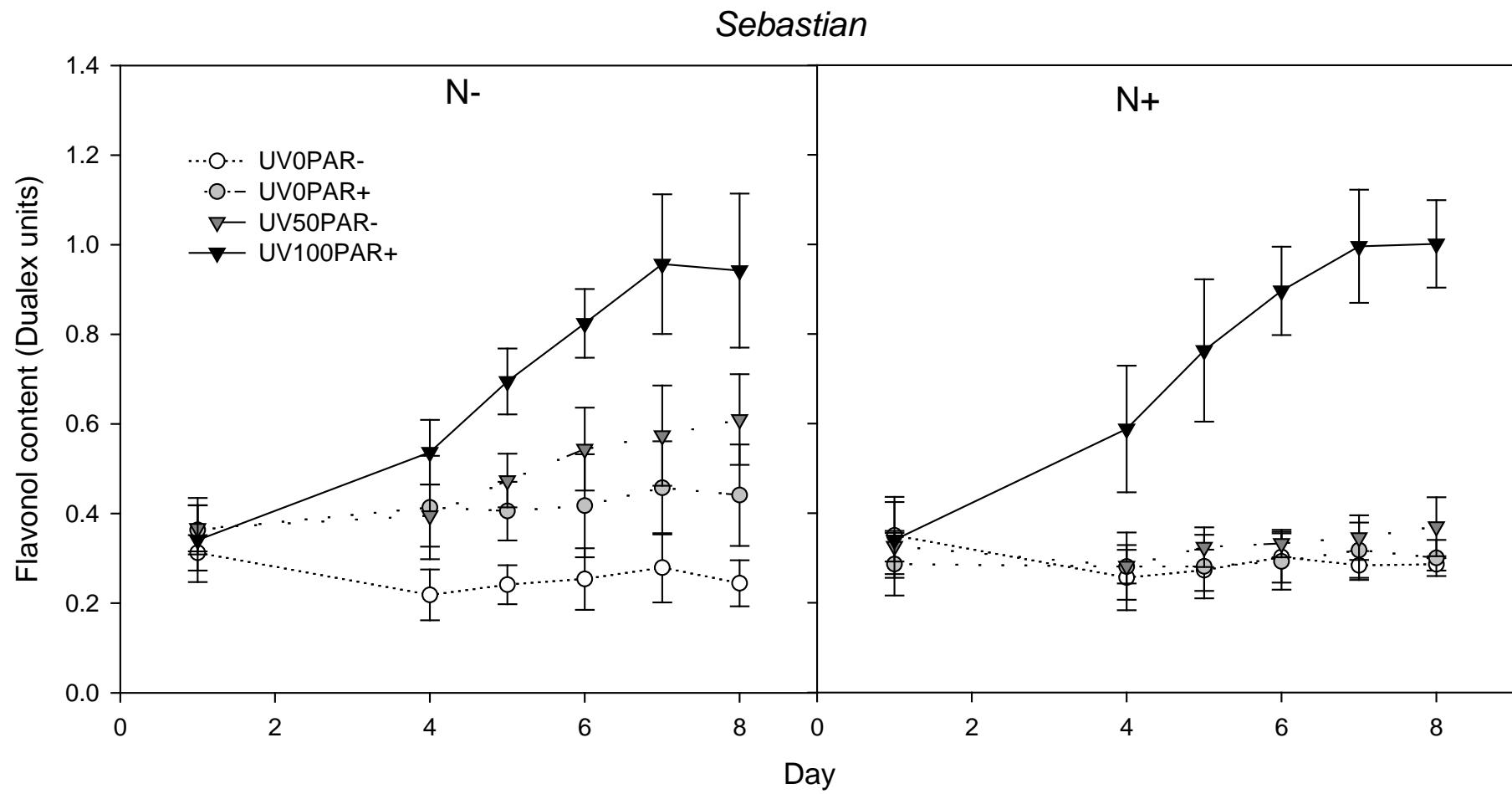
- In variety Bonus the N nutrition strongly reduced the UV induced accumulation of epidermal flavonoids



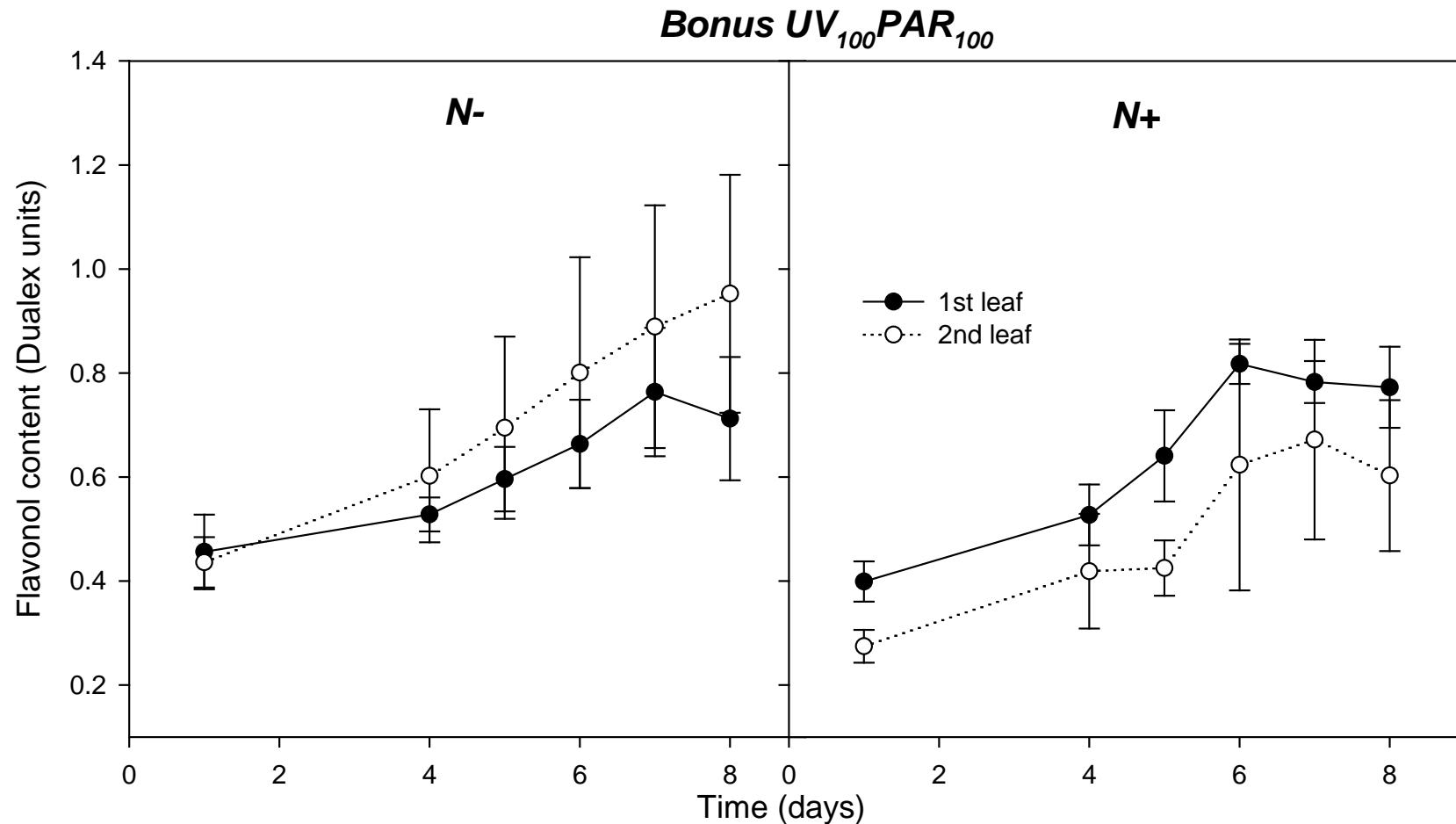
- Similarly in variety Prestige, higher N dose reduced the UV induced accumulation of flavonoids



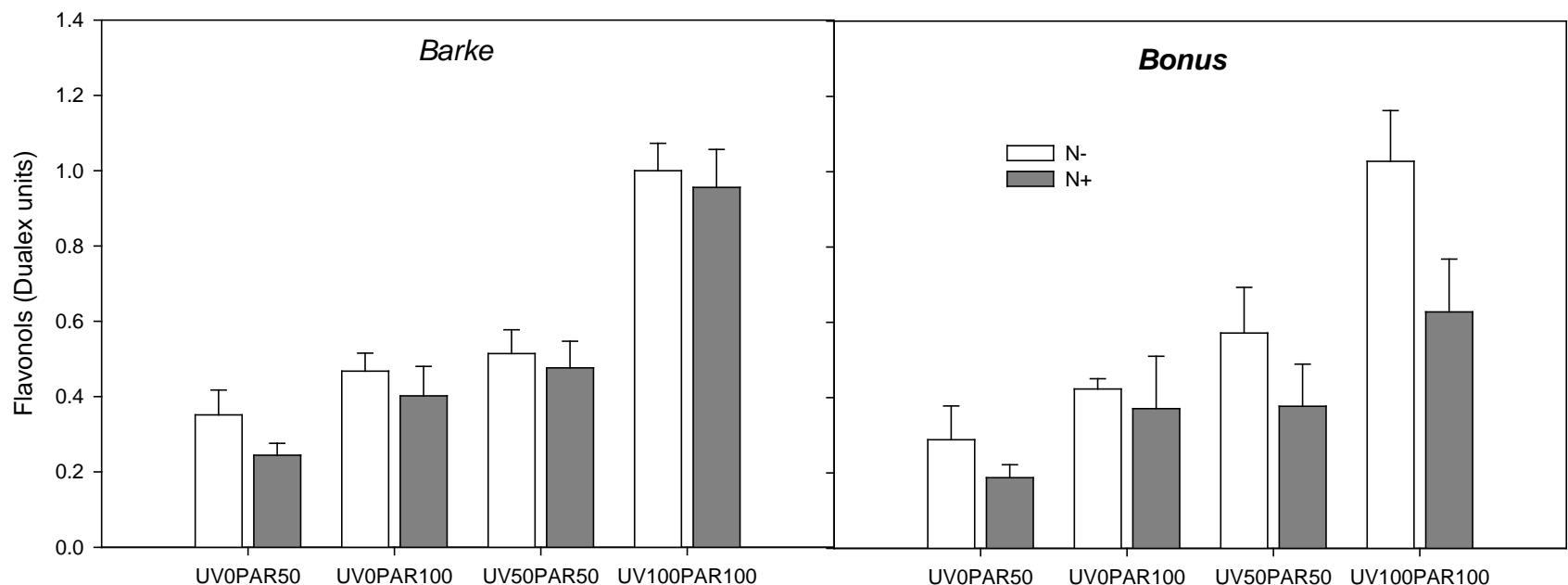
- In variety Sebastian the effect of N nutrition on flavonoid accumulation was more pronounced under lower UV dose (50%) or PAR induced accumulation



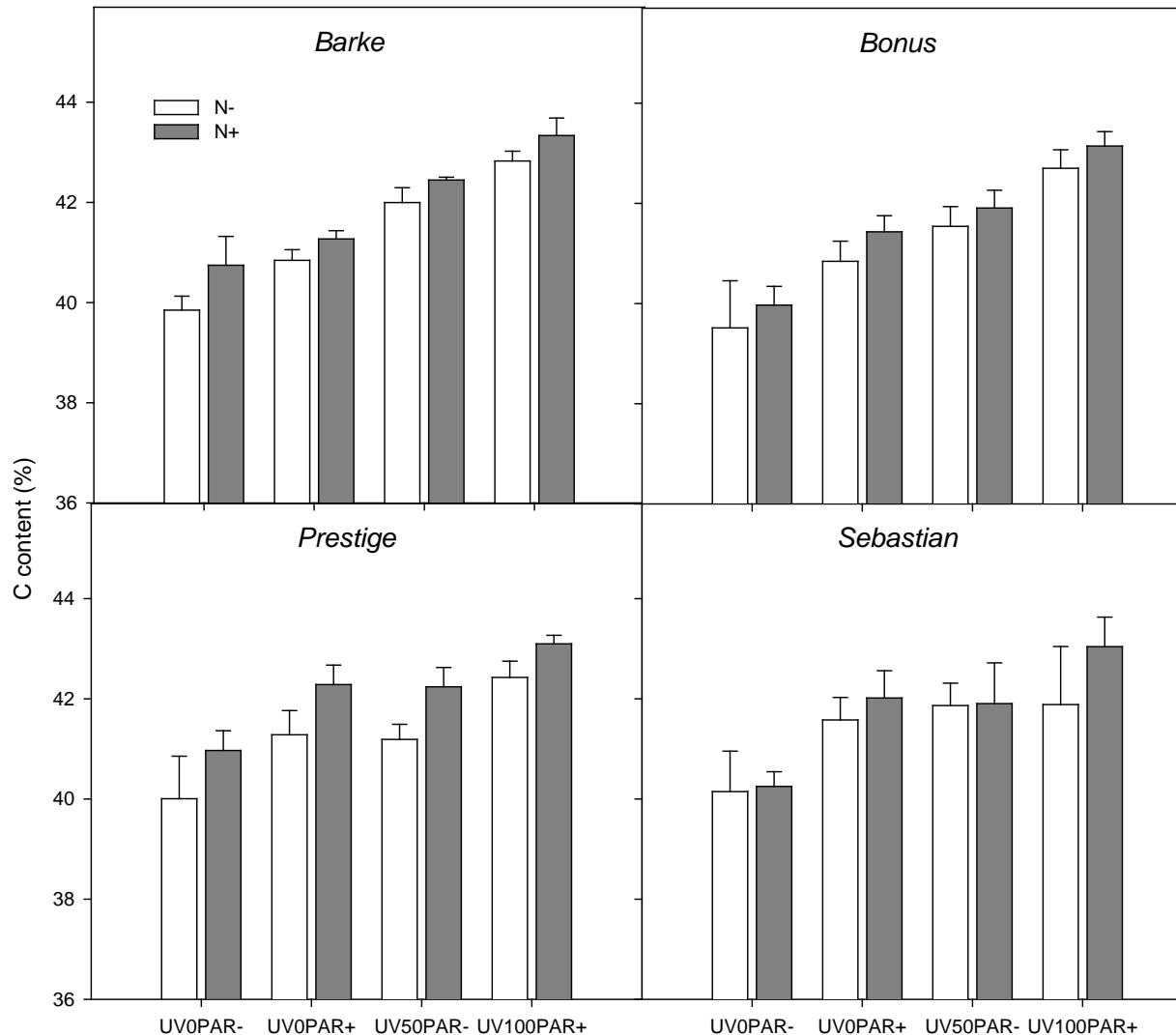
- The data about epidermal flavonoid accumulation were collected also for 1st (older) leaf, which is showing lower effect of N status and also lower effect of UV /PAR on flavonoid accumulation



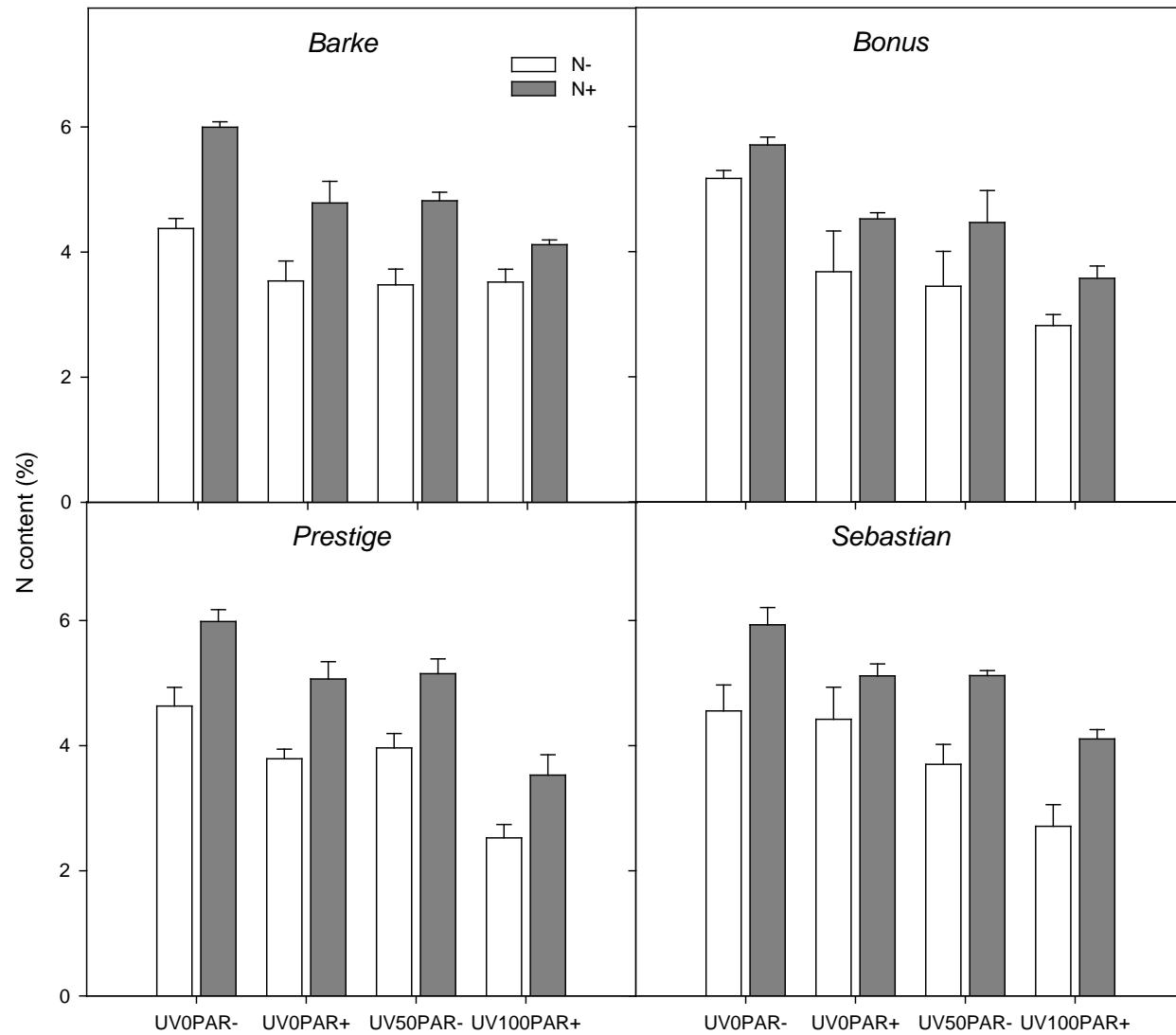
- Differences in epidermal flavonoids 8th day of UV/PAR treatment



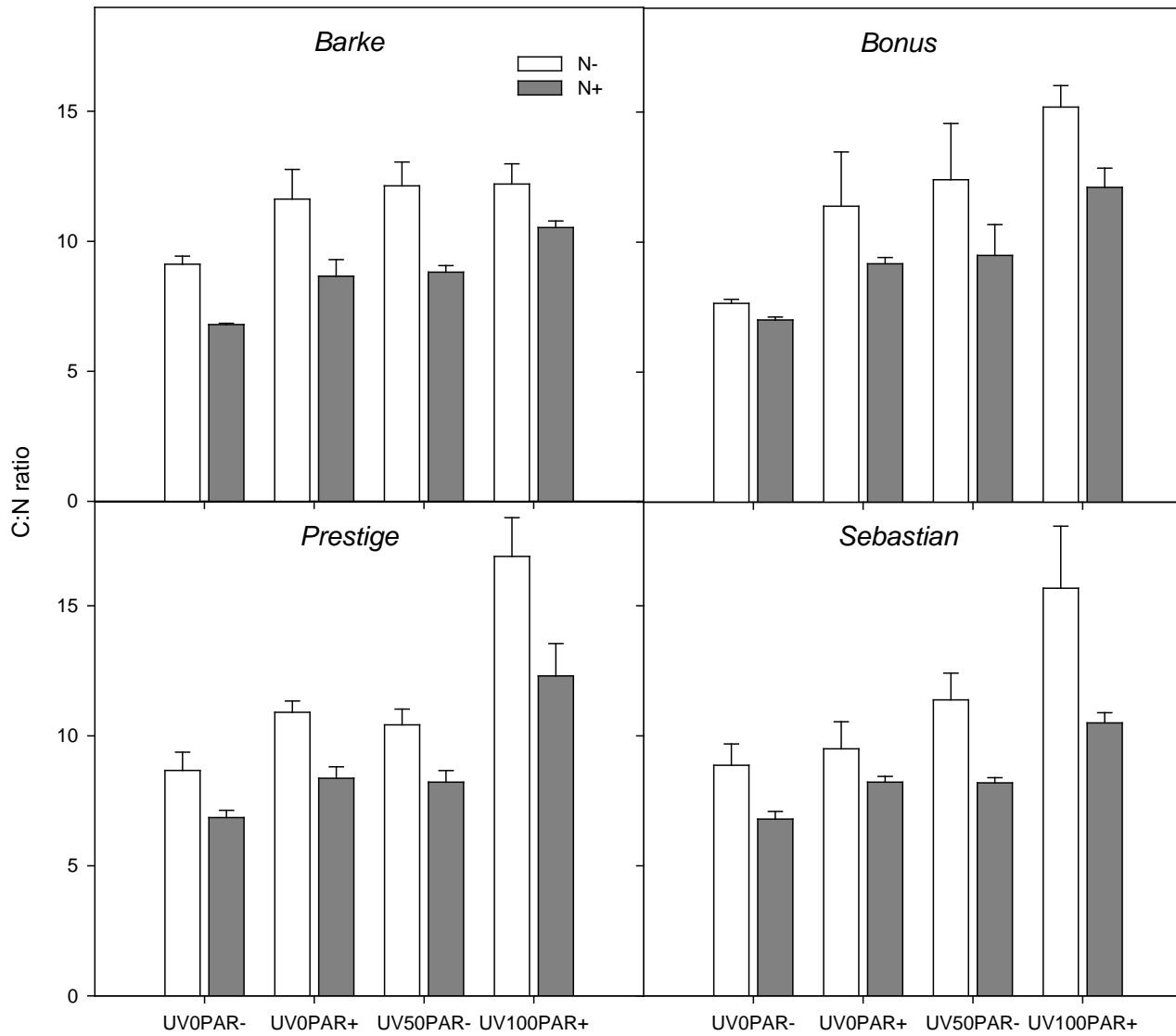
- Carbon content is increasing with higher UV/PAR intensity, but only little affected by N status (slight increase with higher N dose)



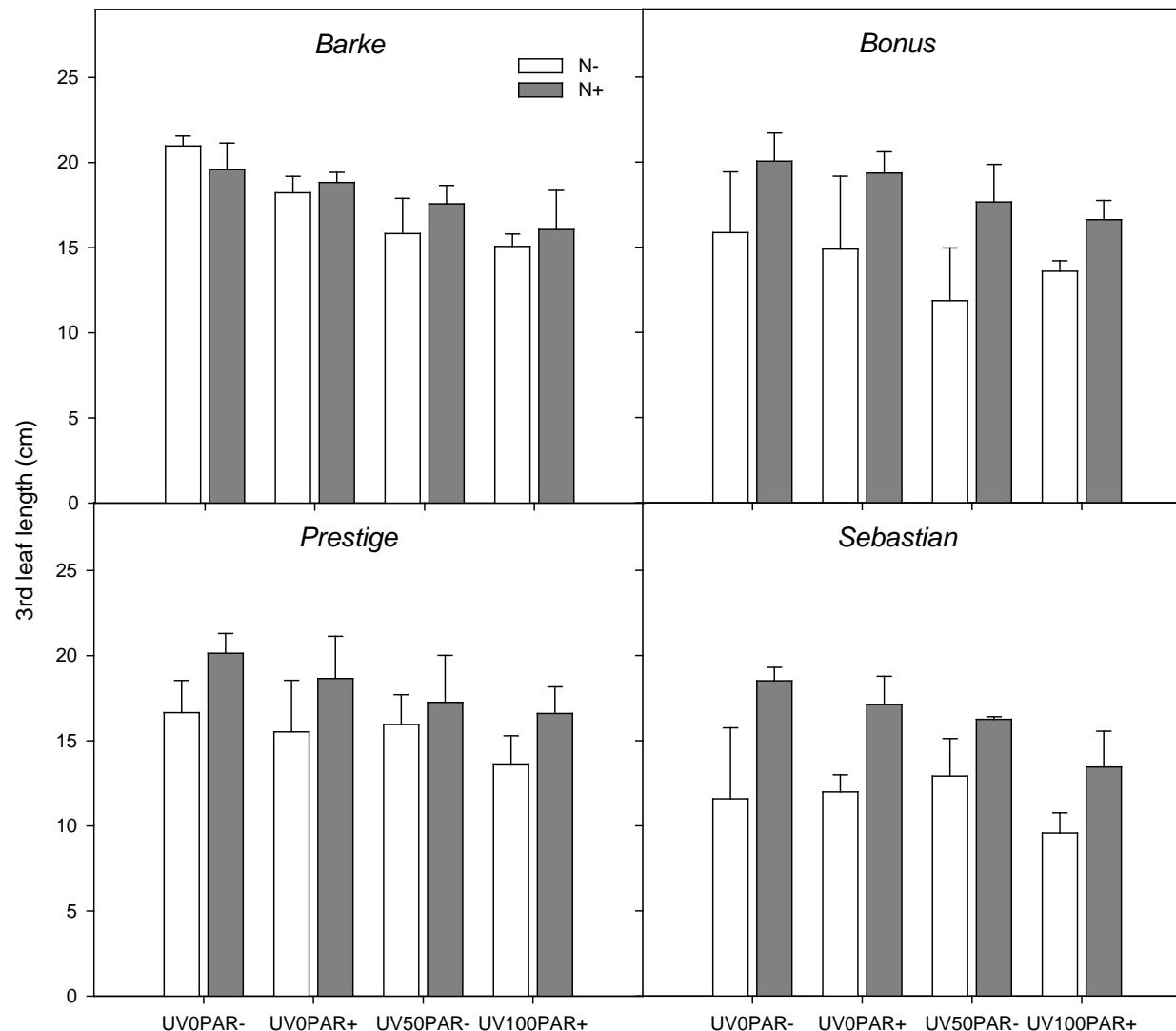
- Nitrogen content was reduced by increasing UV/PAR intensity and increased by higher N dose



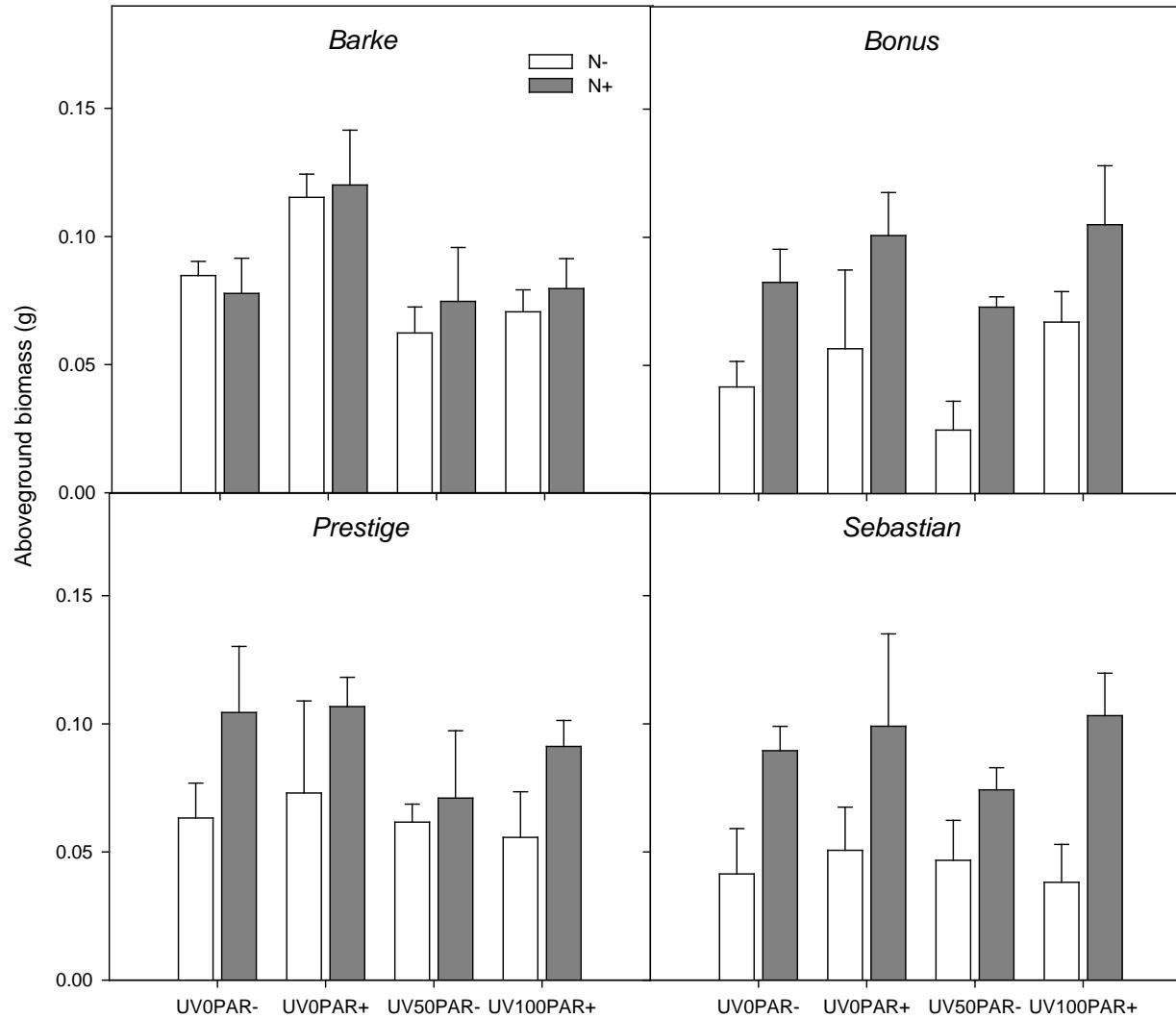
- Higher C:N ratio seems to be preception for higher flavonoid accumulation



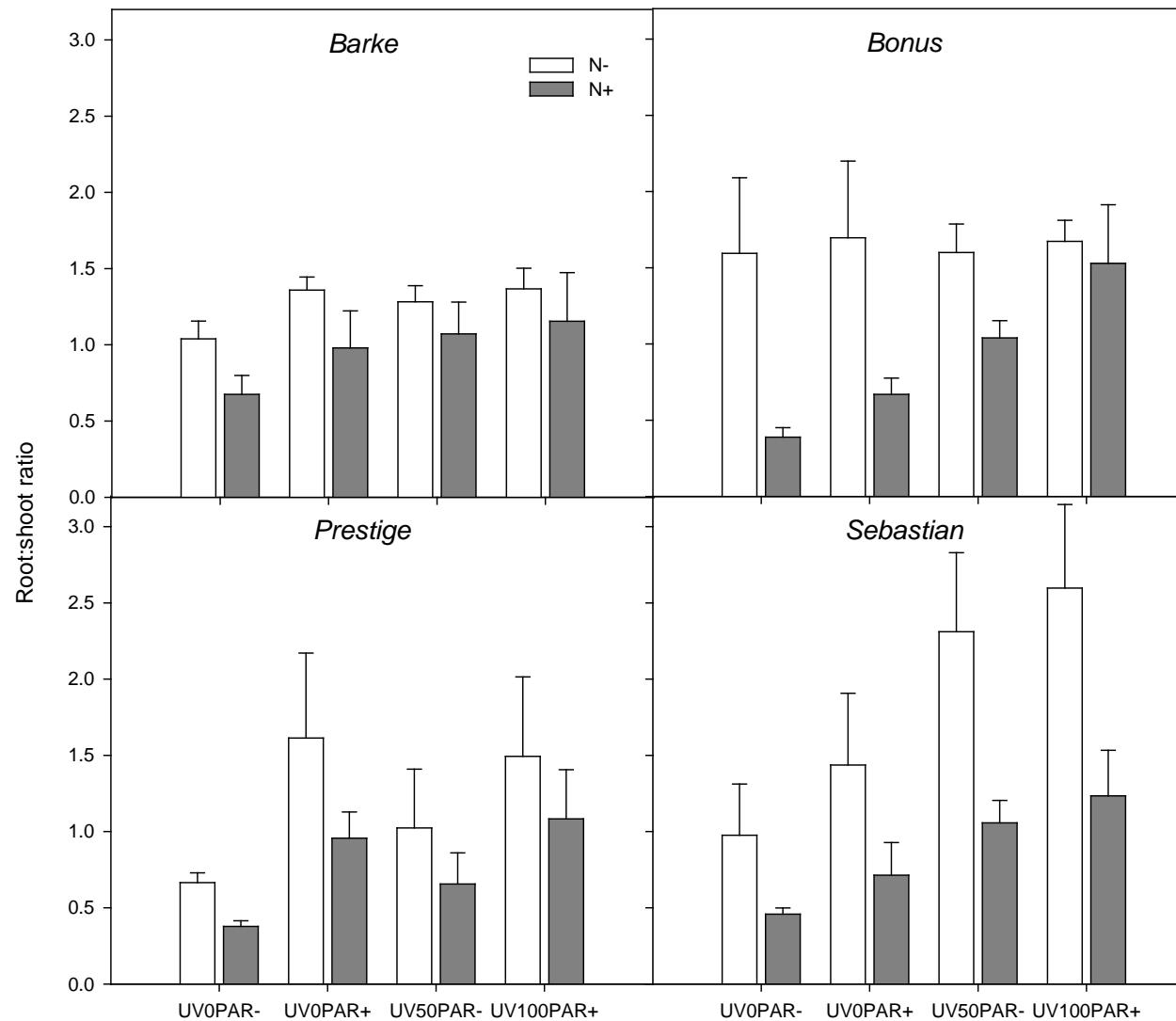
- UV/PAR treatments reduced length of newly developed leaf (3rd leaf). Conversely nitrogen increased leaf length – the effect of N is genotype specific (lower effect in Barke)



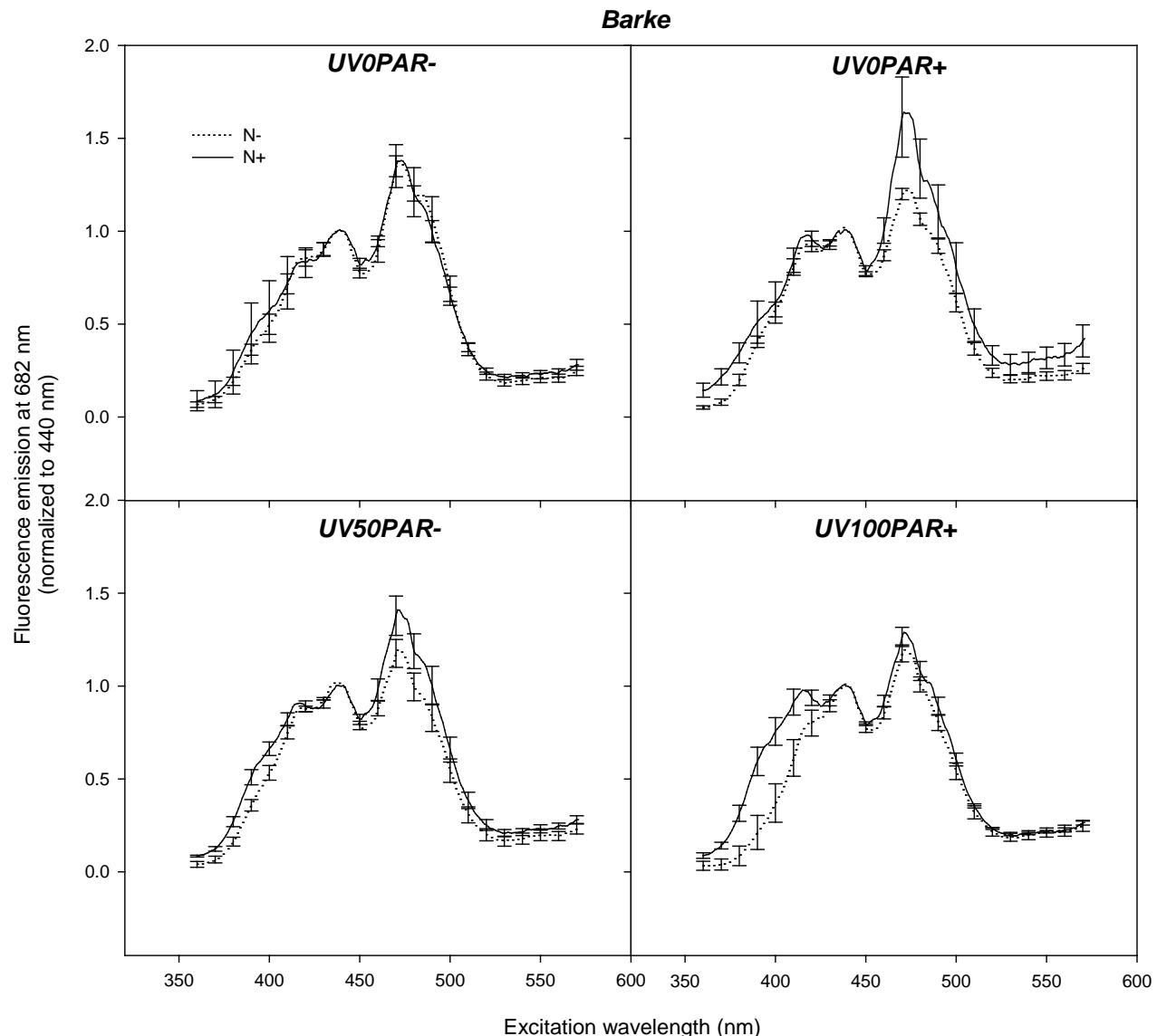
- Total aboveground biomass is highest in higher PAR intensity but reduced under higher UV. The response to both higher UV and higher PAR depends on variety.



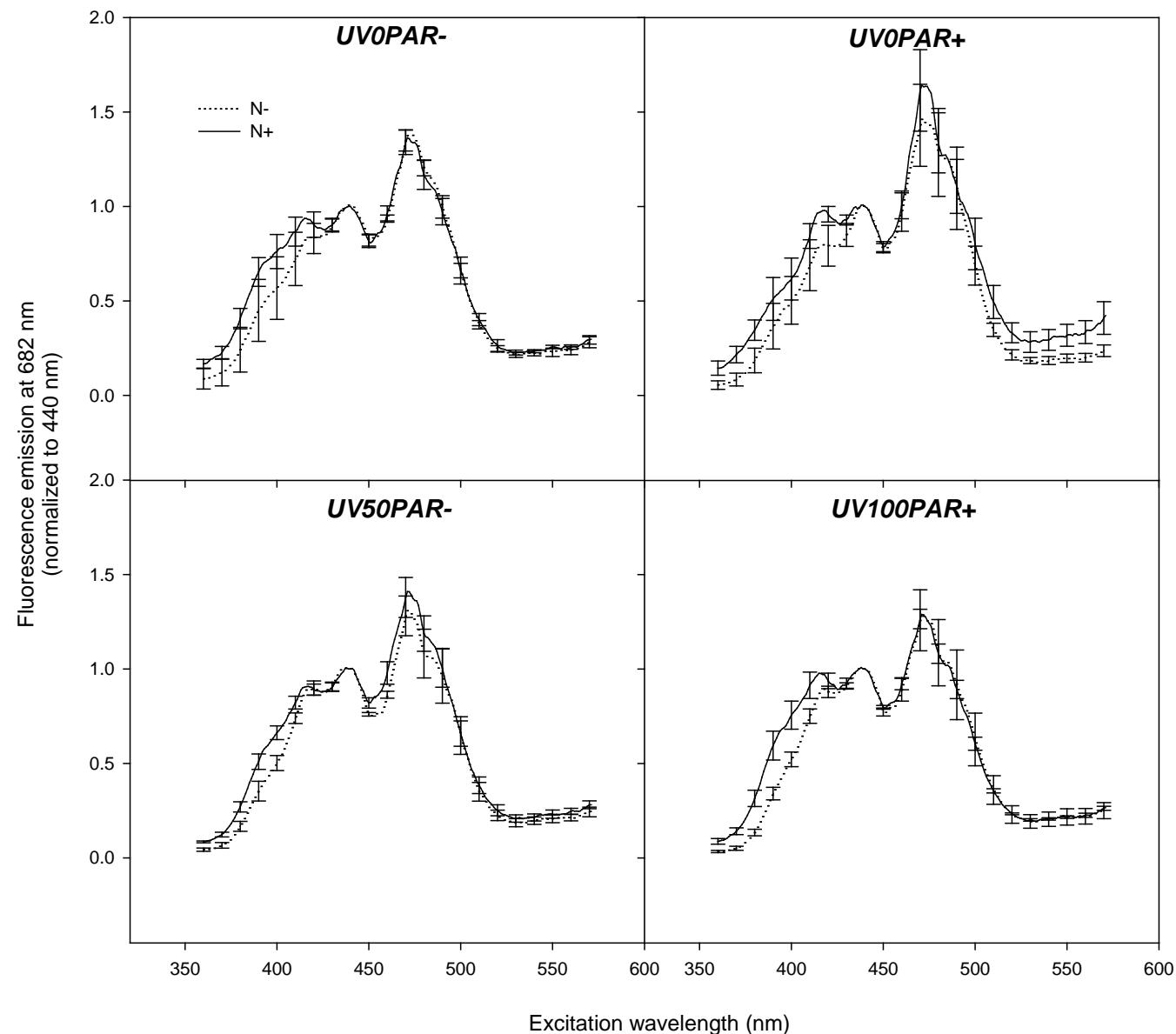
- Root:shoot ratio is reduced by higher N dose, particularly under low UV/PAR. Genotype specific response. In Sebastian higher effect of UV/PAR and increasing nitrogen effect in higher UV/PAR intensities. In variety Bonus higher N effect in lower UV/PAR intensities

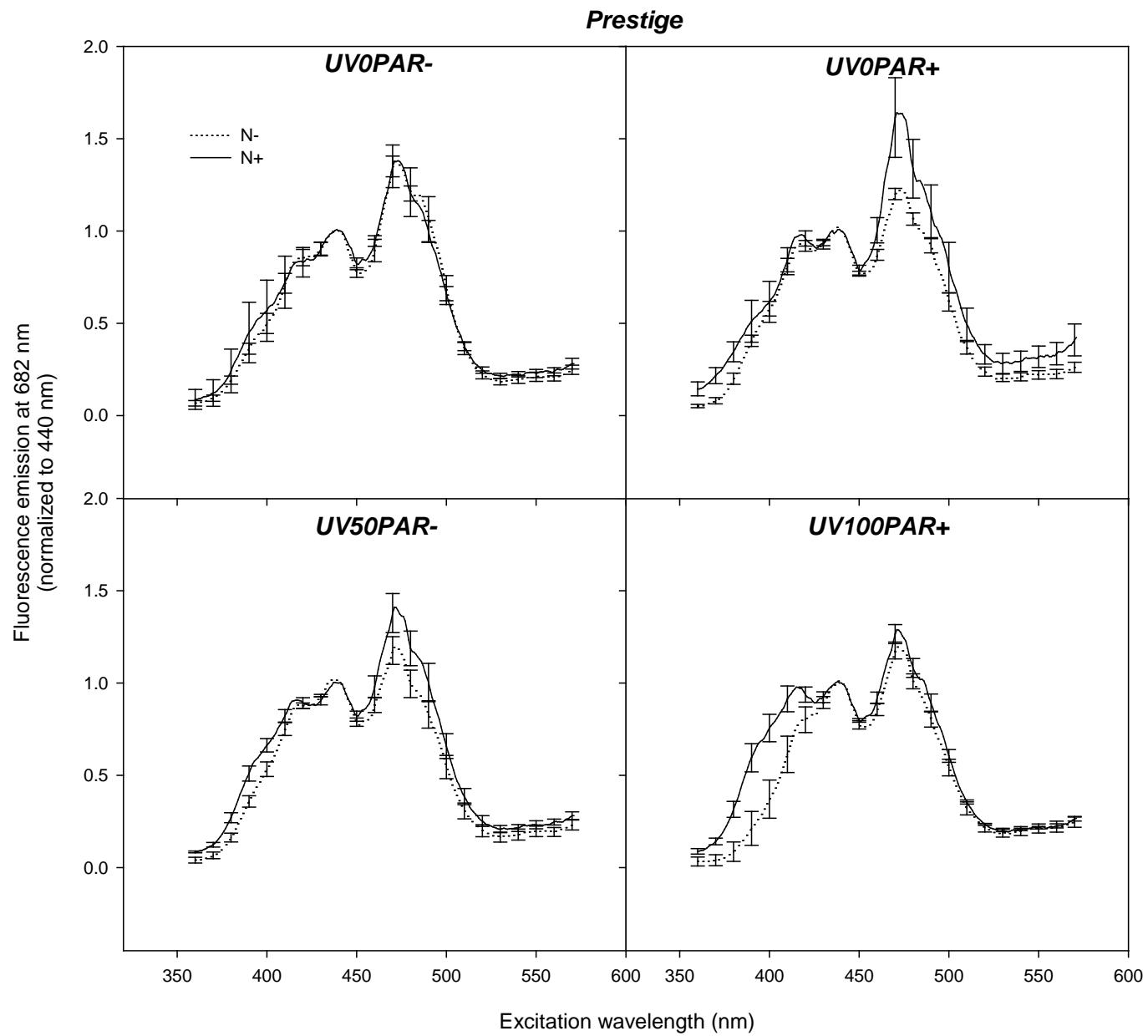


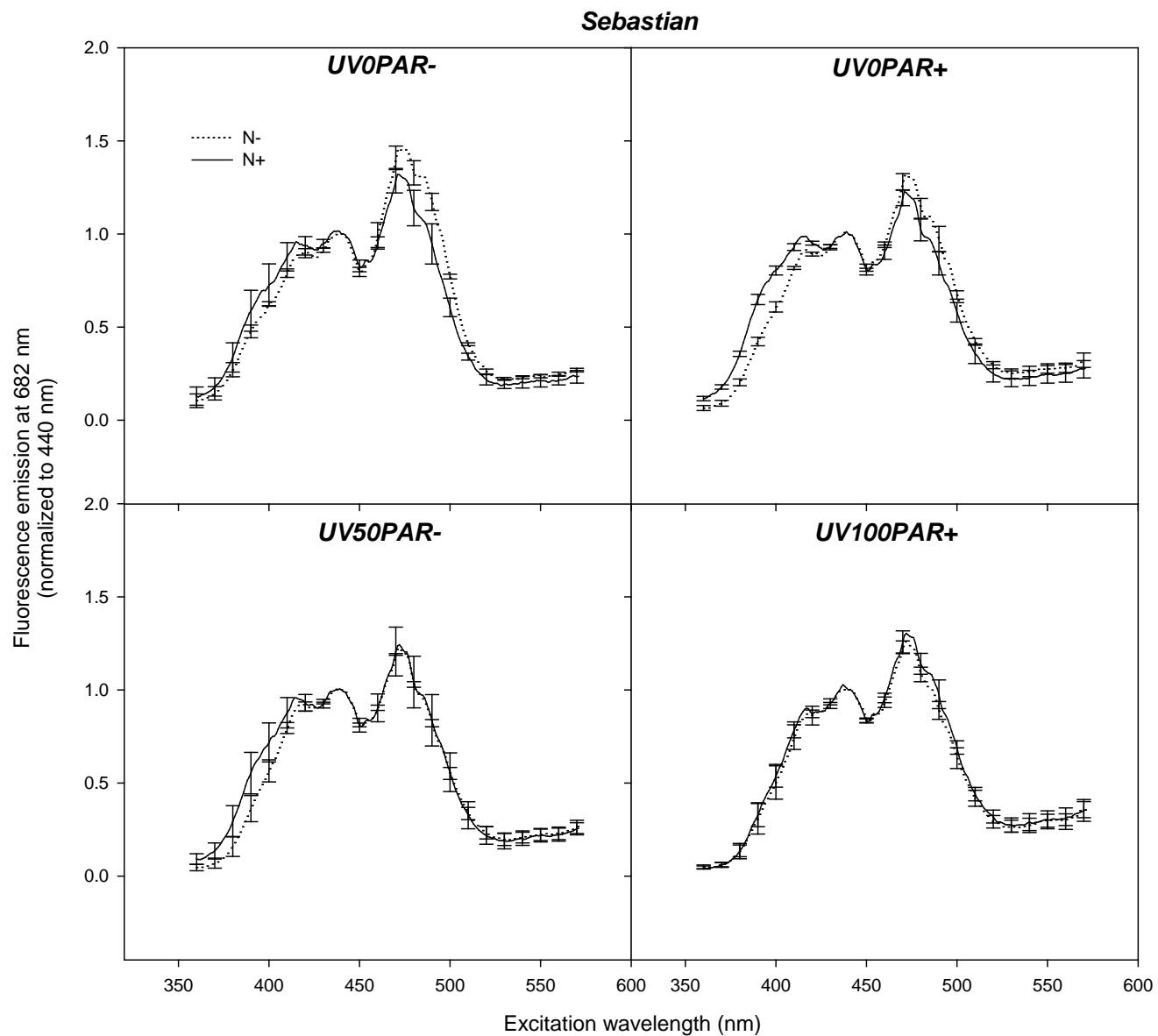
- Significant effect of N in range 360-420nm (flavonoids) and 460- 530 nm (anthocyanins, carotenoids). Flavonoids are more influenced under higher UV intensity, anthocyanins and carotenoids under higher PAR intensity



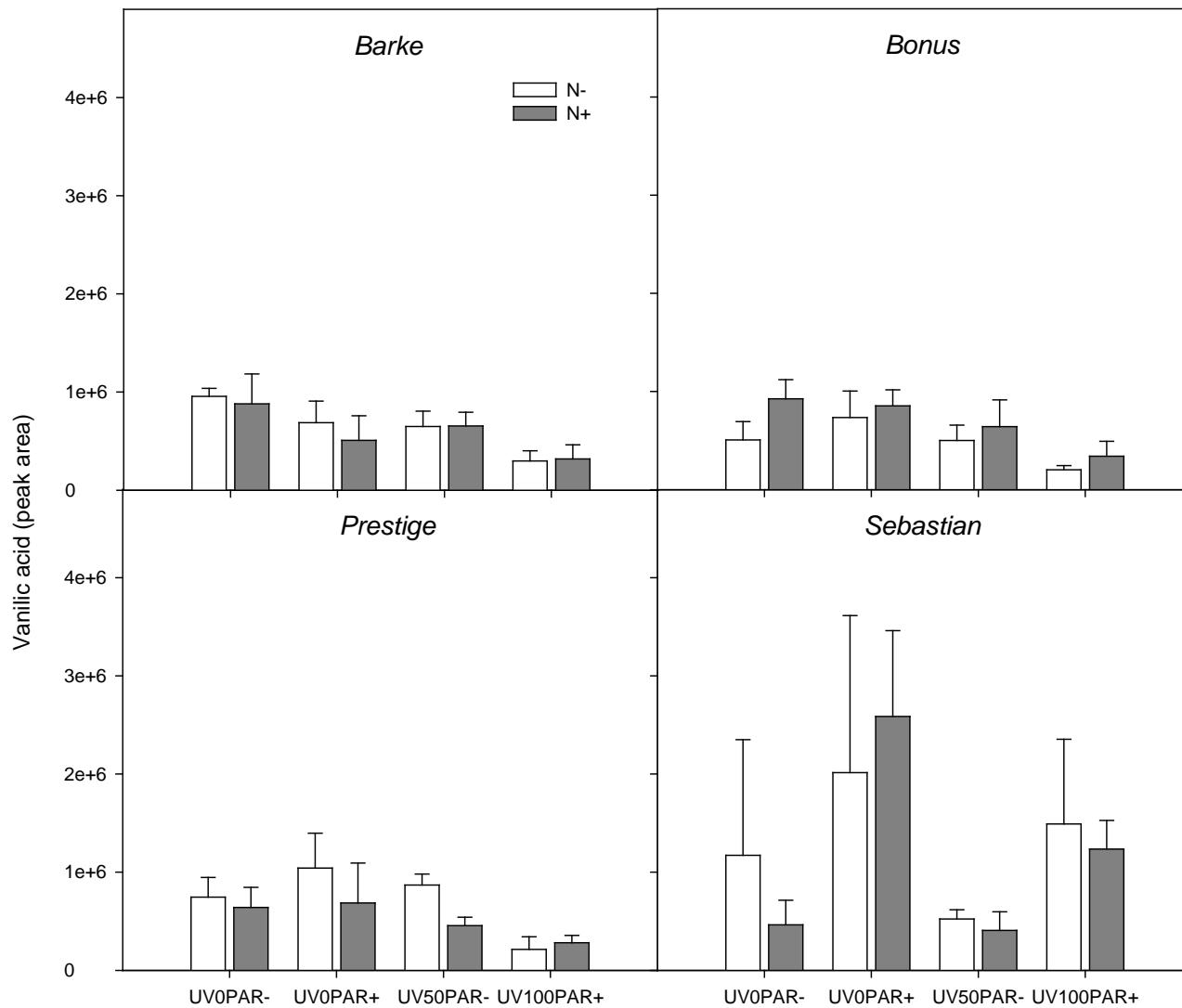
Bonus



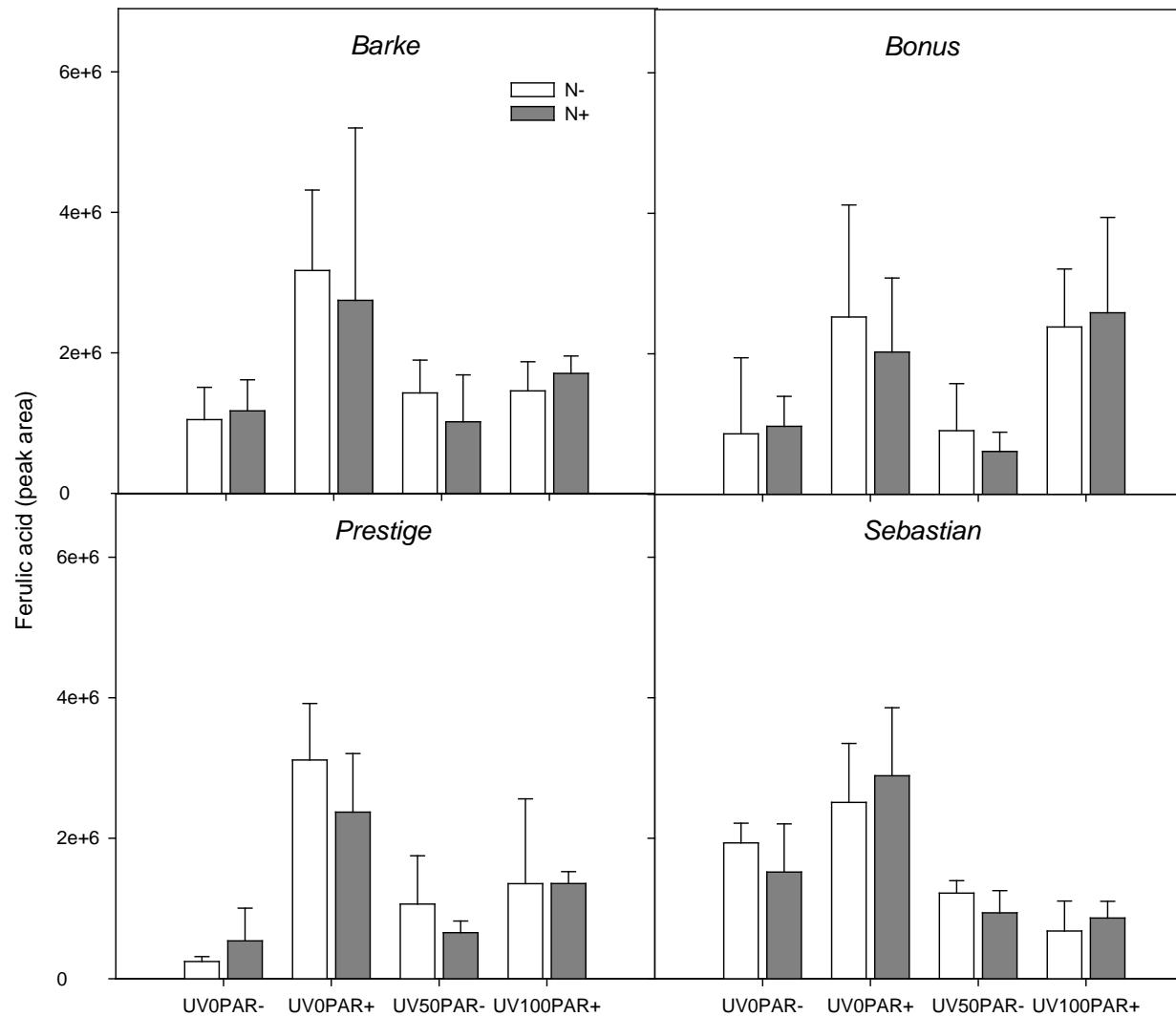




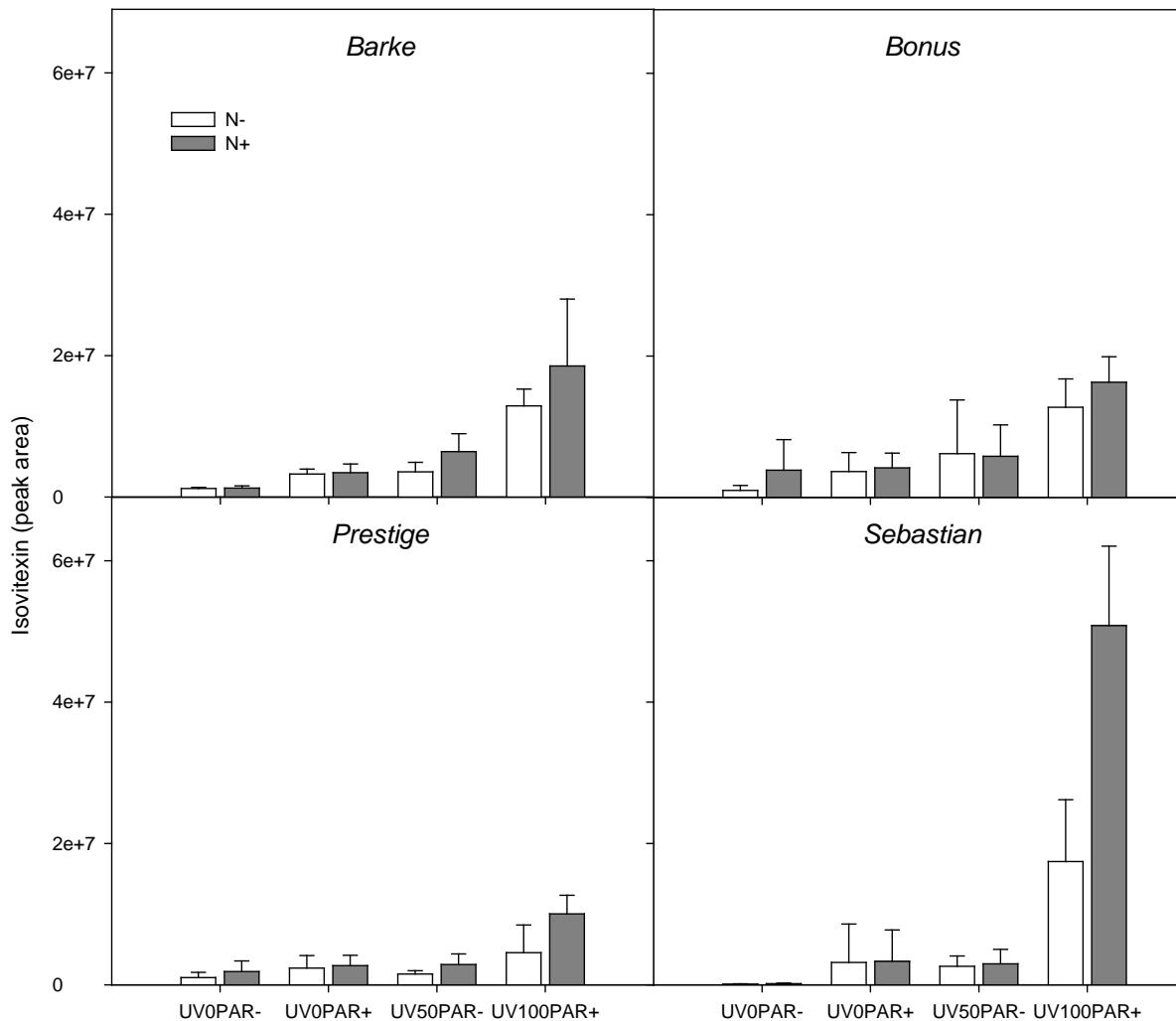
- Some compounds show decrease with elevated UV (PAR) radiation (e.g. Vanillic acid)



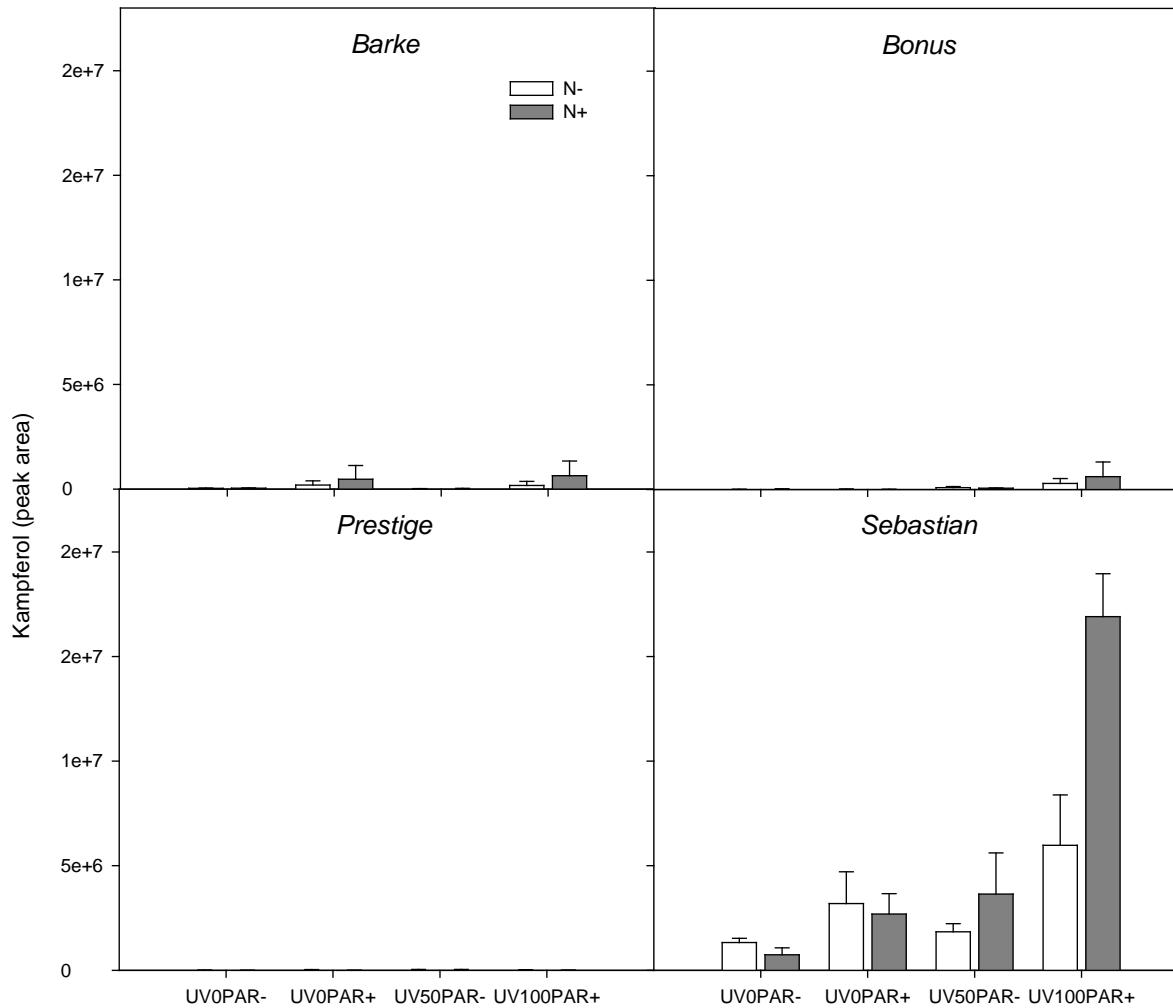
- Accumulation of some compounds is stimulated mainly by PAR but not by UV radiation (e.g. Ferulic acid)



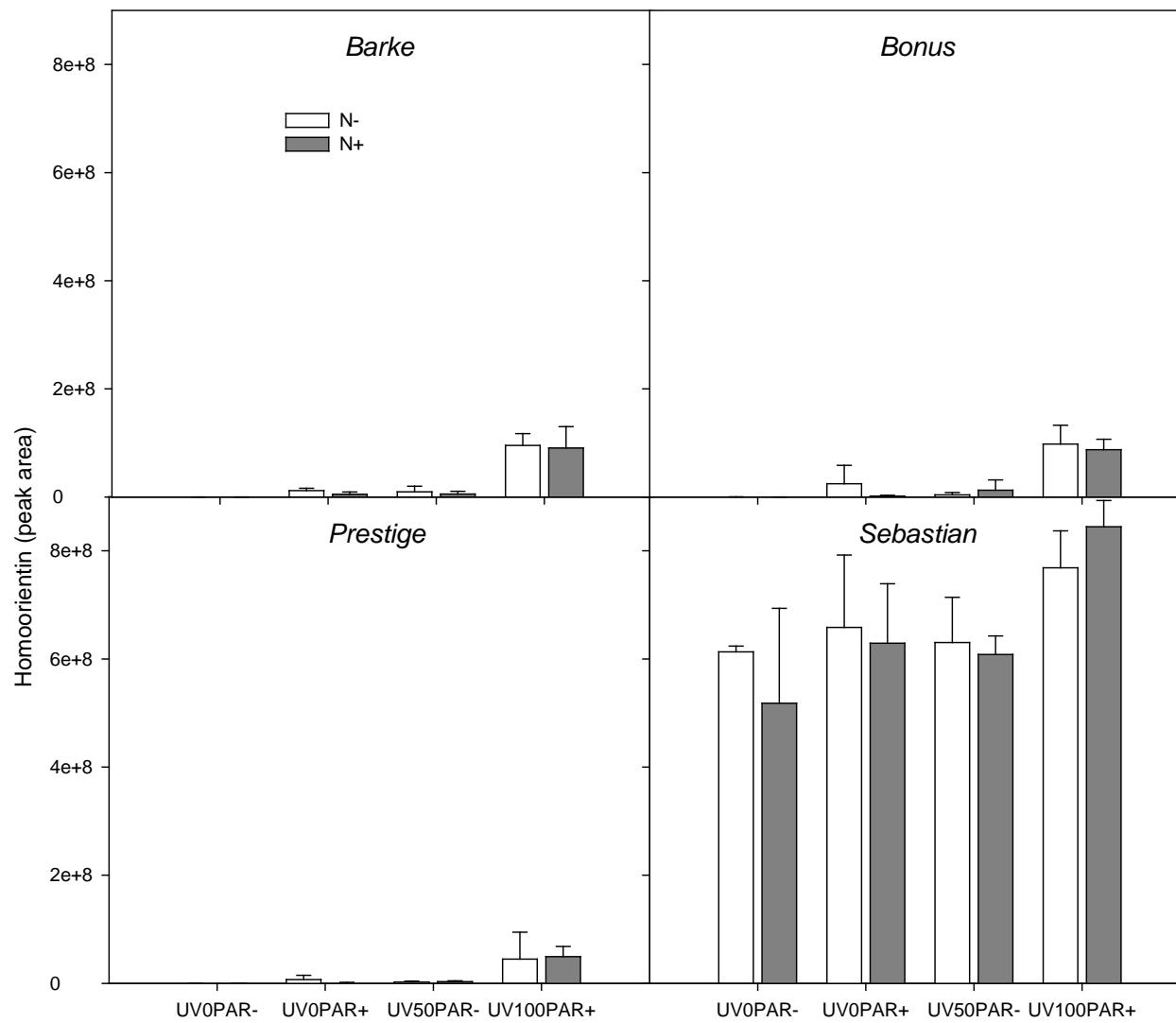
- Accumulation of main flavonoids is induced particularly by UV radiation (e.g. Isovitexin). In most cases the content is positively influenced by N fertilization or no effect observed



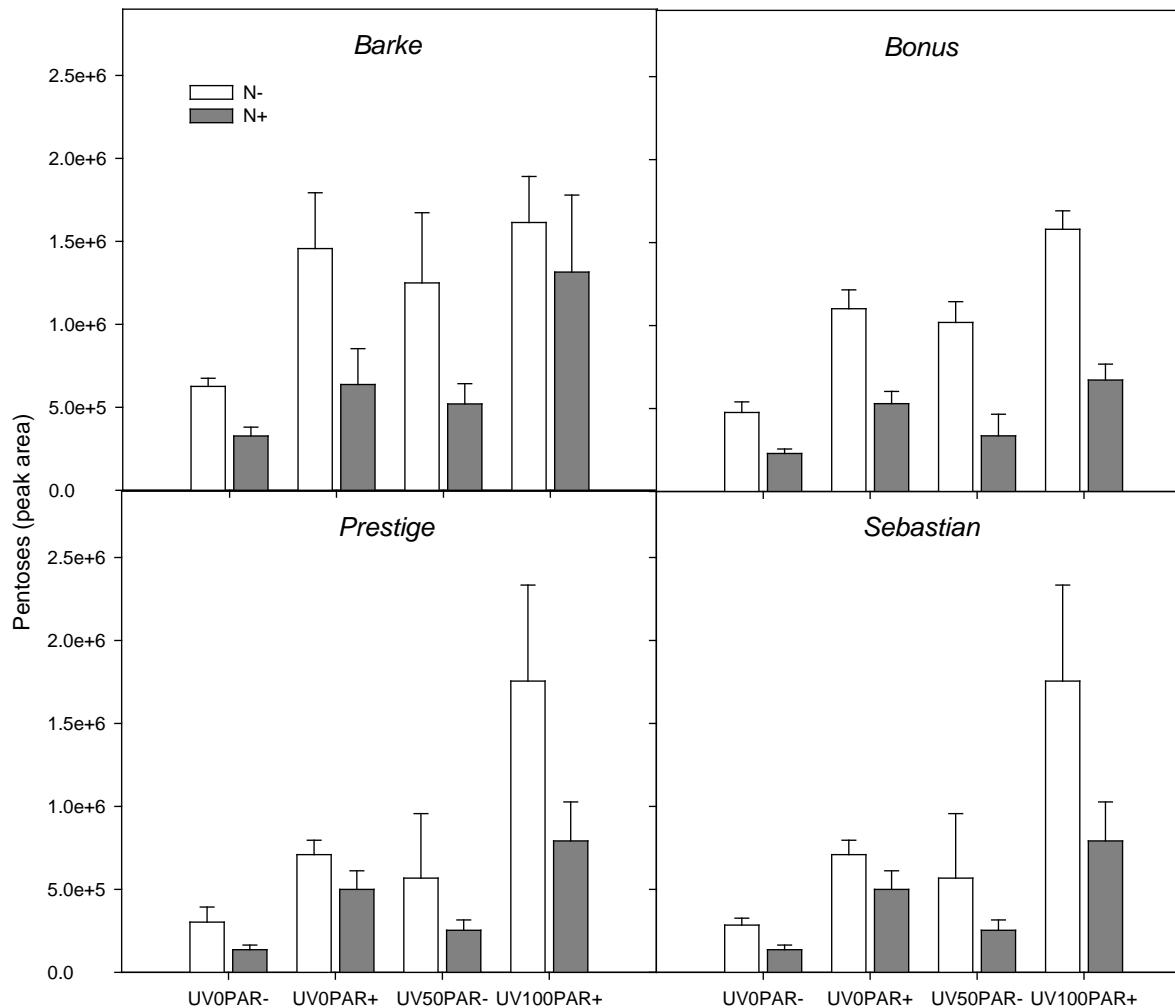
- The total amount of some flavonoids is strongly genotype-related, however the trends in the effect of UV/PAR and N are similar

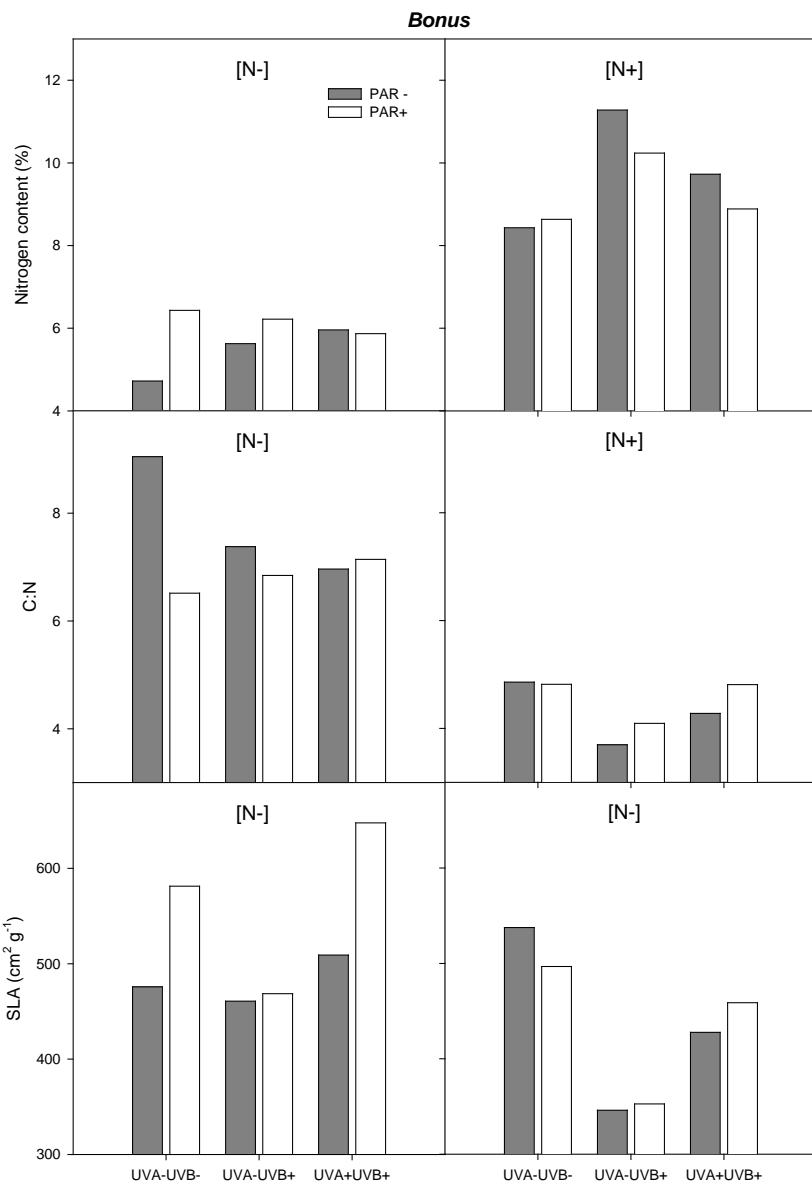
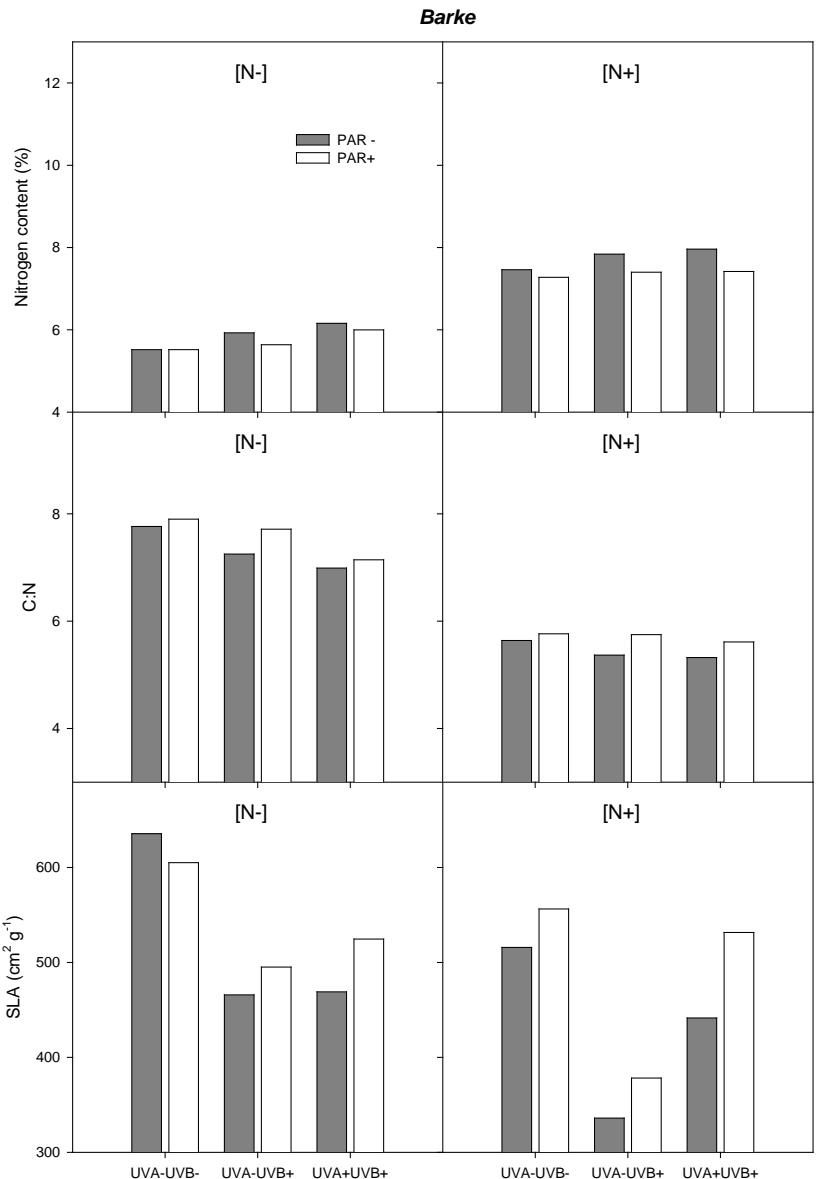


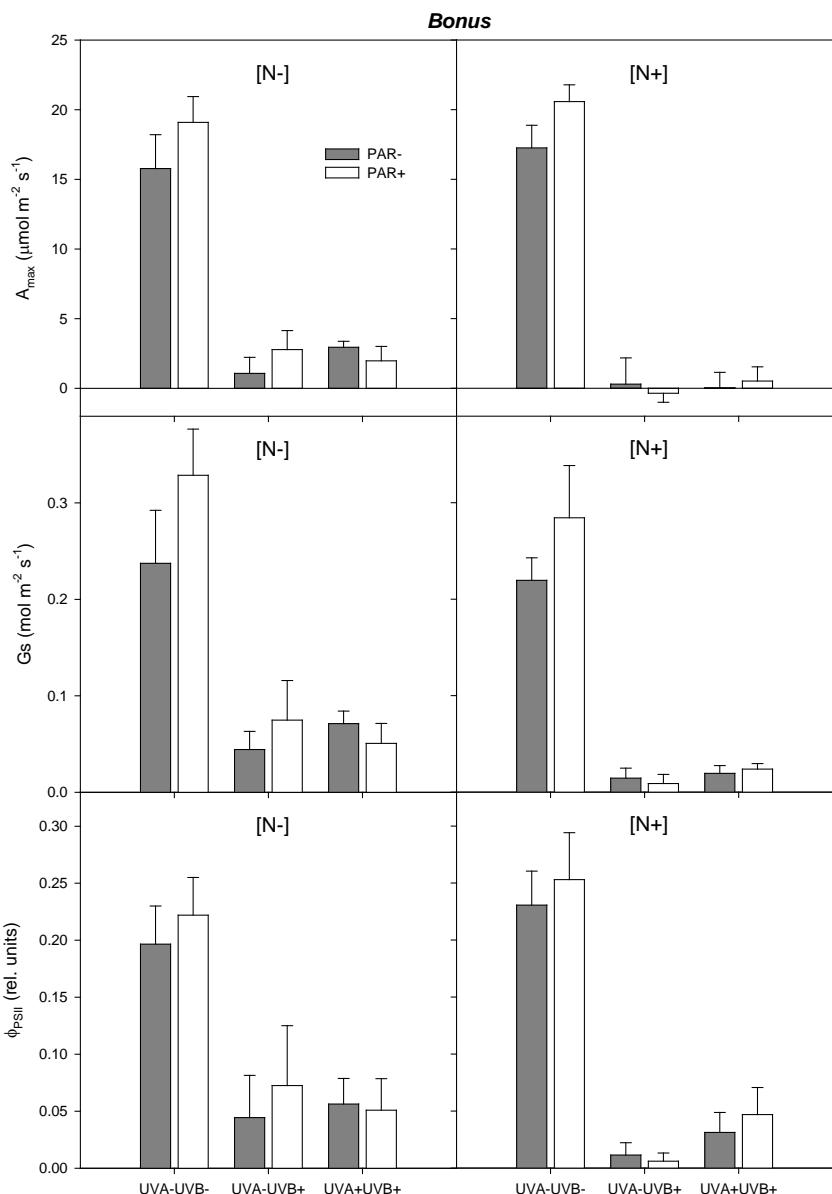
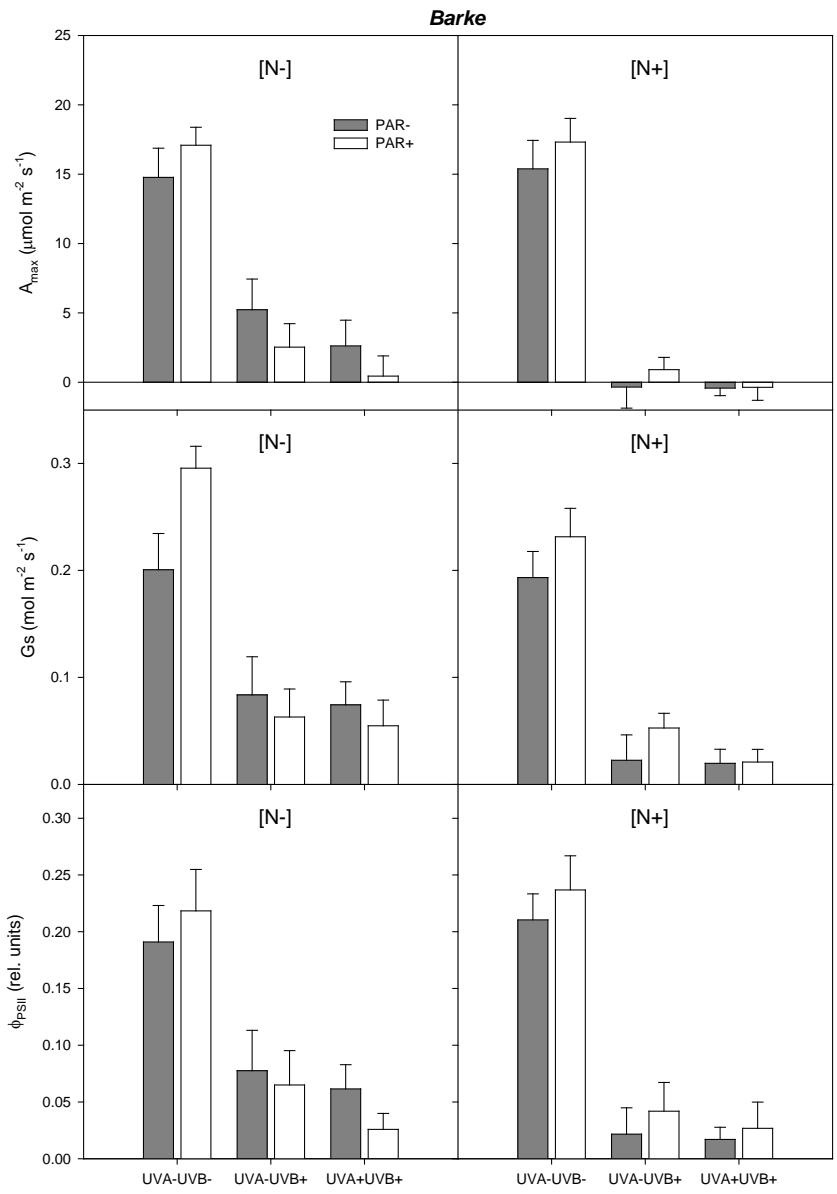
- Similarly for Homoorientin the accumulation of flavonoids is much higher in variety Sebastian



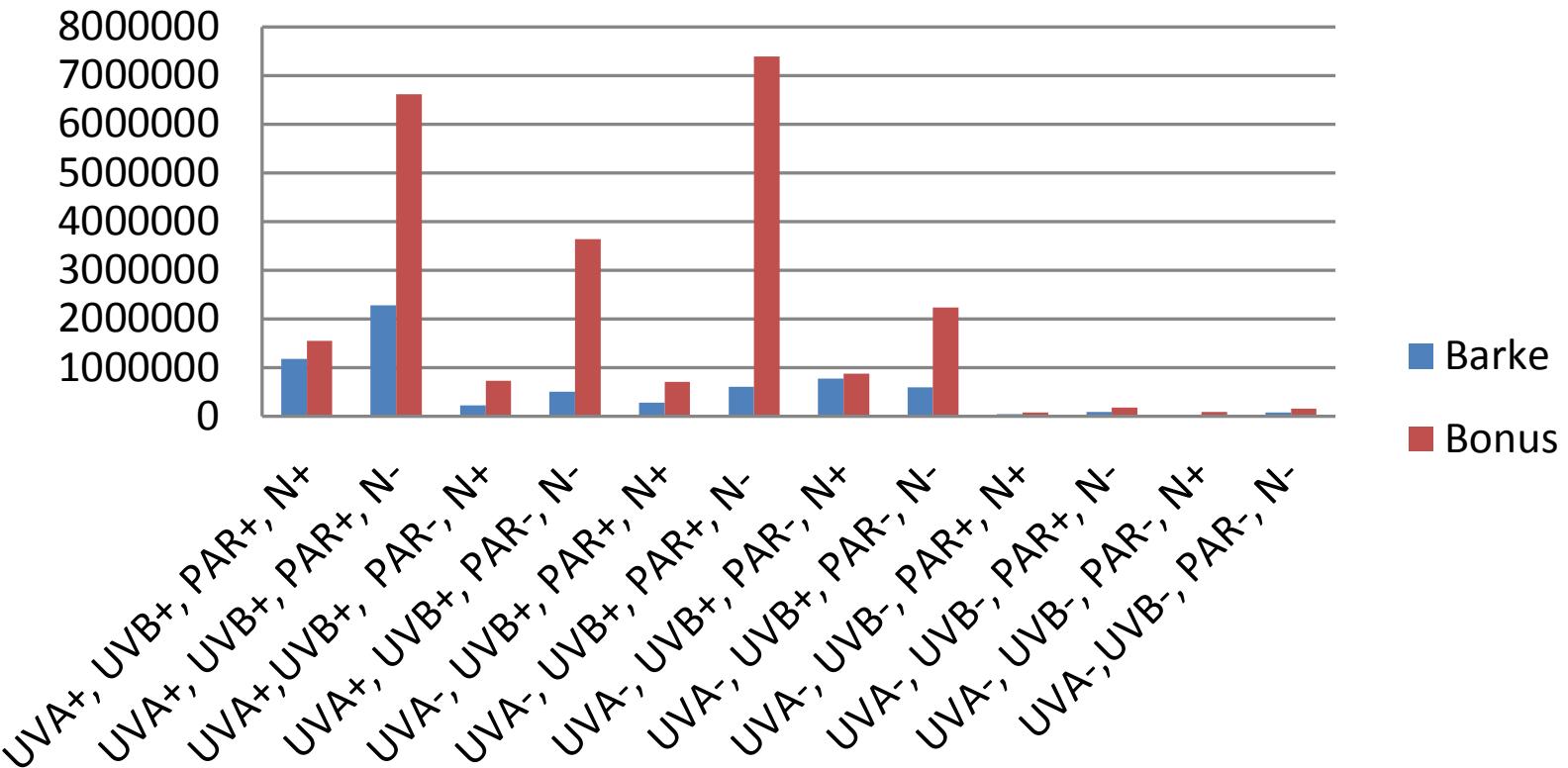
- Is carbohydrate metabolism the main driver of flavonoid biosynthesis? Increasing accumulation of pentoses with higher intensity of PAR and UV and decreasing accumulation with higher N dose



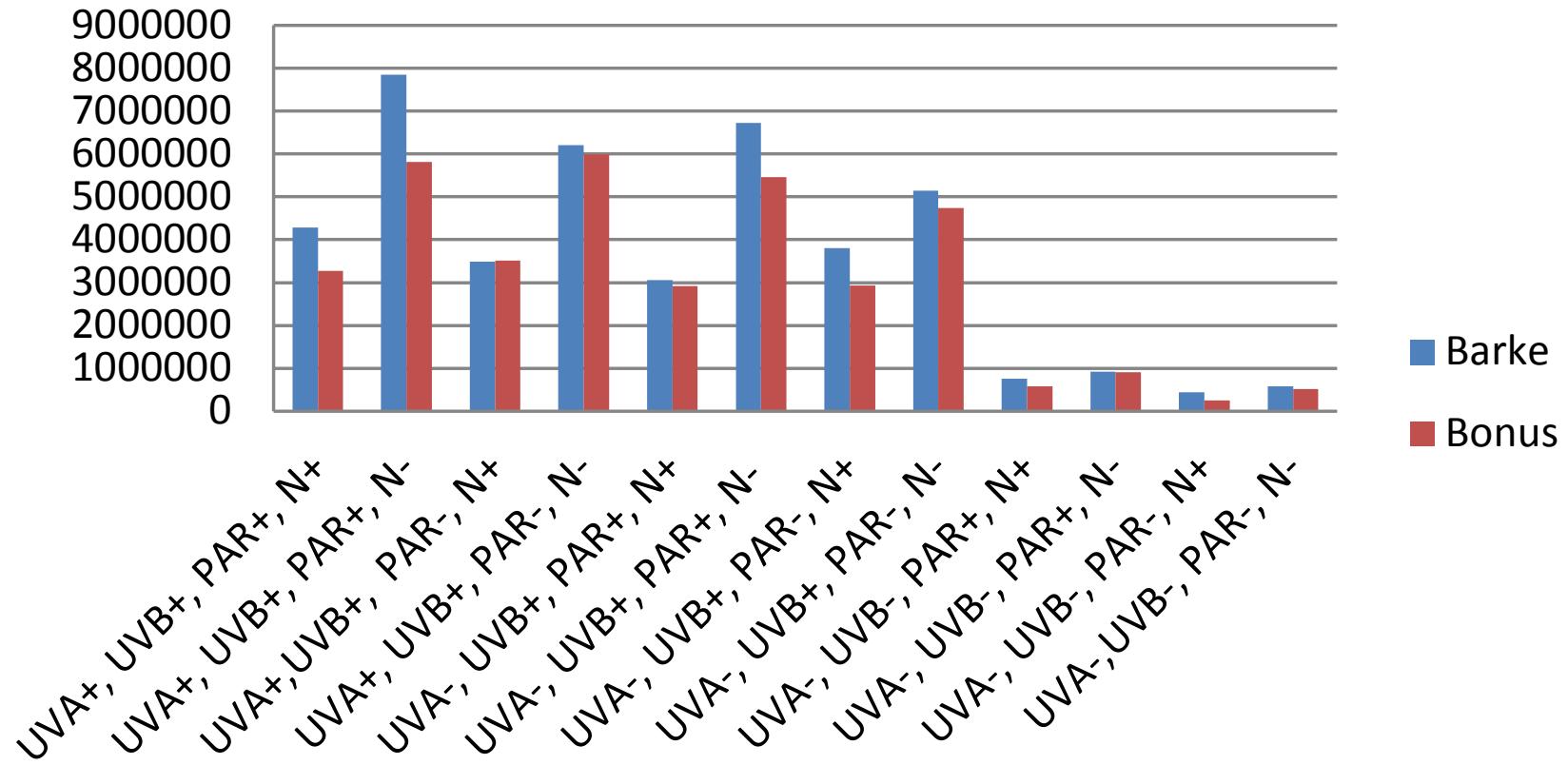




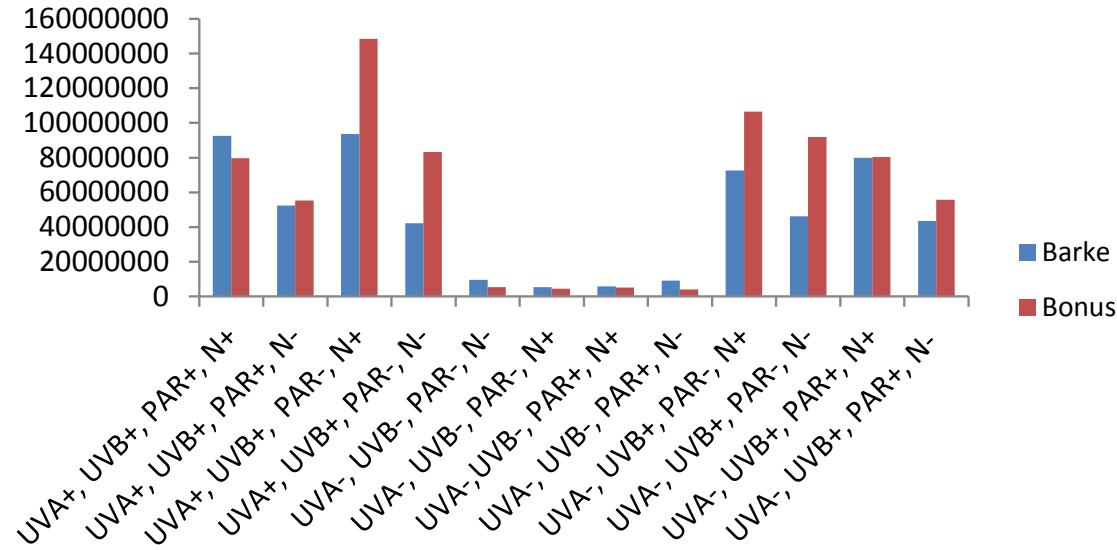
Homoorientin



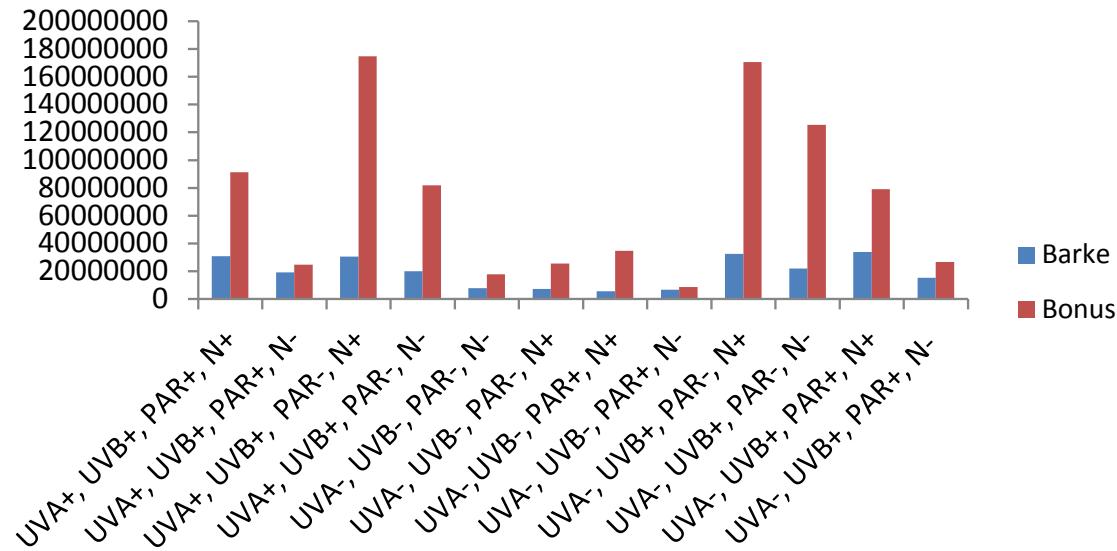
Ferulic acid



Tryptofan



Asparagin



Prolin

