Fig. 1. Two twigs sprouted after morphactin has been sprayed; note the curve below the tip.

Fig. 2. Some anomale leaves and bending of the main shoot in a morphactin-treated seedling.

These facts point to the possible synergic action of GA$_3$ with morphactin on the shooting of dormant lateral buds subsequent to apical dominance break. However, it should be noted that the morphactin plus GA$_3$ treatments seem to be interacting positively; their effect is therefore more than additive, in contrast with what was reported by Mann et al.[1].

The growth depression and morphactin branching properties may suggest some new practical applications of IT 3456 in the field of fruit trees cultivation, as proposed by Mann et al. and Crabbe[1,3].

Riassunto. Il trattamento di giovani piantine di ciliegio dolce con la morfattina IT 3456 provoca l'interruzione della dominanza apicale e, quindi, la emissione di germogli laterali. Un successivo trattamento con gibberellina amplifica il fenomeno, ma conduce alla morte dell'apice del germoglio principale.

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Phytochrome Involvement in the Control of Leaf Shape of *Taraxacum officinale* L.*

During the early stages of its development, *Taraxacum officinale* L. displays a wide range of leaf shapes, from a smooth rounded to a deeply incised runcinate form. There are also changes in the length/breadth ratio (L/B), which decreases as the leaf number increases. As in other cases[1-3], light has a remarkable effect upon the heteroblastic development, influencing both the L/B ratio and the depht of the incisions in the runcinate shape[4,5].

In a previous work it was shown that far red light (FR) can strongly delay the change to the runcinate shape and also increase the L/b ratio[5]. This activity of FR suggested that phytochrome system could be involved in the process.

To test this possibility 3 groups of plants were submitted to the following daily programms: 1. 10 h of white fluorescent light at an intensity of ca. 4500 μw cm^{-2}

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[1] A. Allsop, *Encyclopedia of Plant Physiology* (Ed. W. Ruhland; Springer Verlag, Berlin, Göttingen, Heidelberg 1965), vol. 15–1, p. 1172.

[2] E. Njoku, New Phytol. *55*, 91 (1959).

[3] J. Bensink, Meded. Landbouwhogeschool Wag. *60*, 1 (1960).

[4] E. C. Wassink, Meded. Landbouwhogeschool Wag. *65*, 1 (1965).

[5] R. A. Sánchez, Meded. Landbouwhogeschool Wag. *67*, 1 (1967).

(10 W); 2. 10 W followed by 30 min of 900 μ W cm^{-2} of far red light (10 W + 30 min FR); 3. 10 W + 30 min FR + 20 min of 200 μw cm^{-2} of red light (10 W + 30 min FR + 20 min R). The R and FR sources and filters are the same as those described in[6]. The plants were grown at 20 ± 0.2 °C and 90% RH. The experiment was repeated 3 times and the results shown are averages of the pooled observations. The treatment started when the plants had 2 leaves completely expanded, and until that moment they were grown at the same T °C and RH and receiving 12 h per day of white fluorescent light at the intensity indicated above.

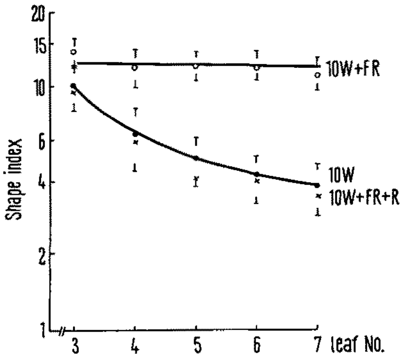

Fig. 1. Effect of far red, or far red followed by red, at the end of each daily white light period on the leaf shape at successive leaf numbers. The 3 groups of plants received each day: 10 h of fluorescent light: 10 W (■); 10 W followed by 30 min of FR: 10 W + FR (○) or 10 W + FR followed by 20 min of R: 10 W + FR + R (*). The figures are the average of 3 experiments and the signs indicate the limits of confidence of the mean ($p \leq 0.05$).

The changes in shape were compared on a leaf number basis, assigning number 1 to the first leaf of less than 20 mm at the beginning of the treatments. The depth of the leaf incisions was quantified by a shape index (SI) calculated as described in an earlier paper[5]; the values of this index decreases as depht of leaf incisions increases.

As can be seen in Figure 1, a progressive decrease in the SI from leaf number 3 onwards is observed in those plants receiving only 10 W, that is, every leaf has deeper incisions than the preceeding one. This trend is not observed when the plants received 30 min of FR at the end of the 10 W period, in this case the SI remained high, up to leaf No. 7, thus the FR irradiation prevented the formation of runcinate leaves so that only rounded or slightly incized leaves are observed (see also Figures 2 and 3). The SI in the plants receiving 10 W + 30 min FR + 20 min R are similar to those of plants receiving only 10 W; the red light irradiation fully reversed the FR effect.

Figure 4 shows the length/breadth (L/B) ratio of leaf No. 2 in every treatment. The regression lines were

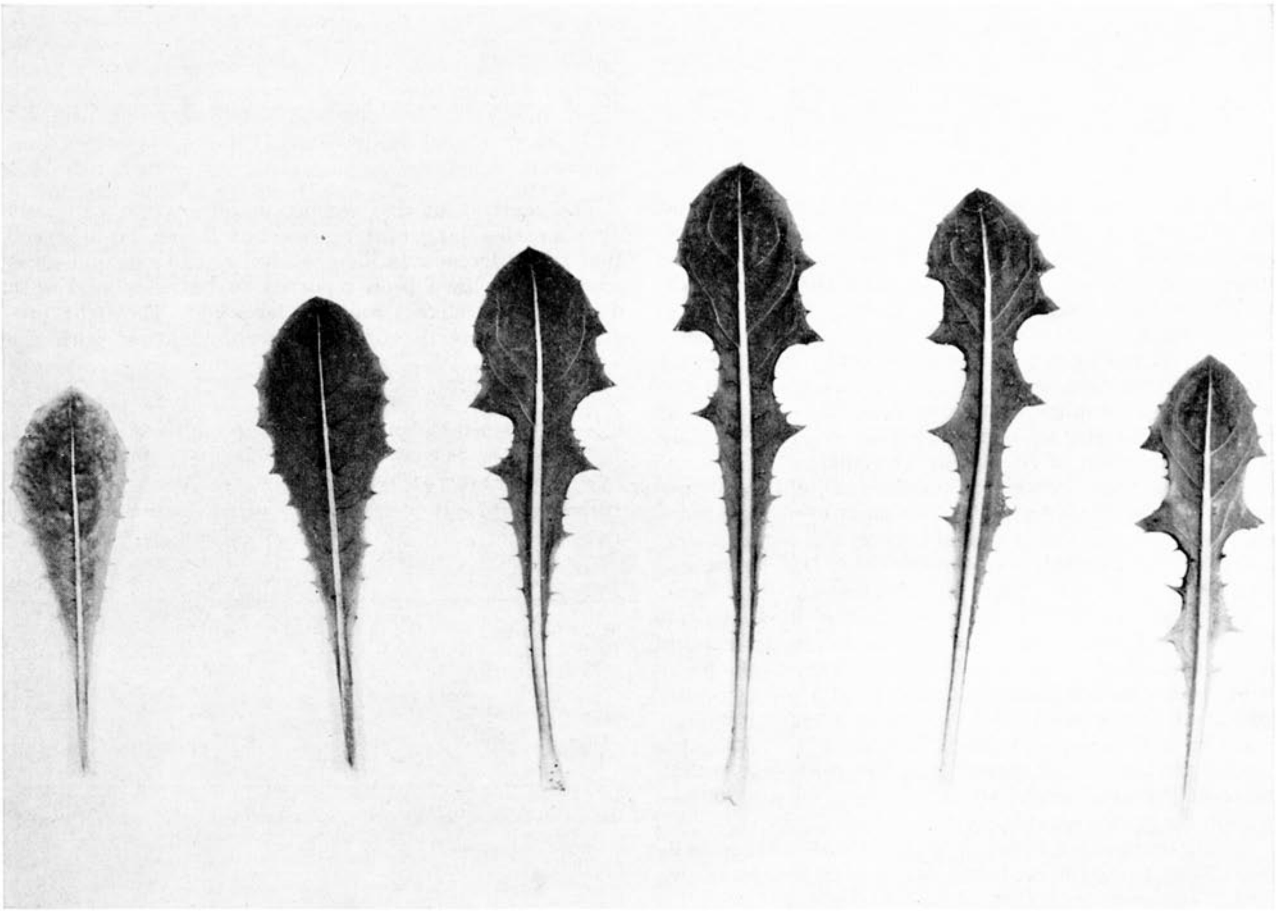

Fig. 2. Shape of leaves of a plant of *Taraxacum officinale* L. grown under 10 h white fluorescent light; ca. 450 μw cm^{-2}. The sequence is indicated by the leaf number.

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[6] S. Burkart and R. A. Sánchez, Bot. Gaz *130*, 42 (1969).

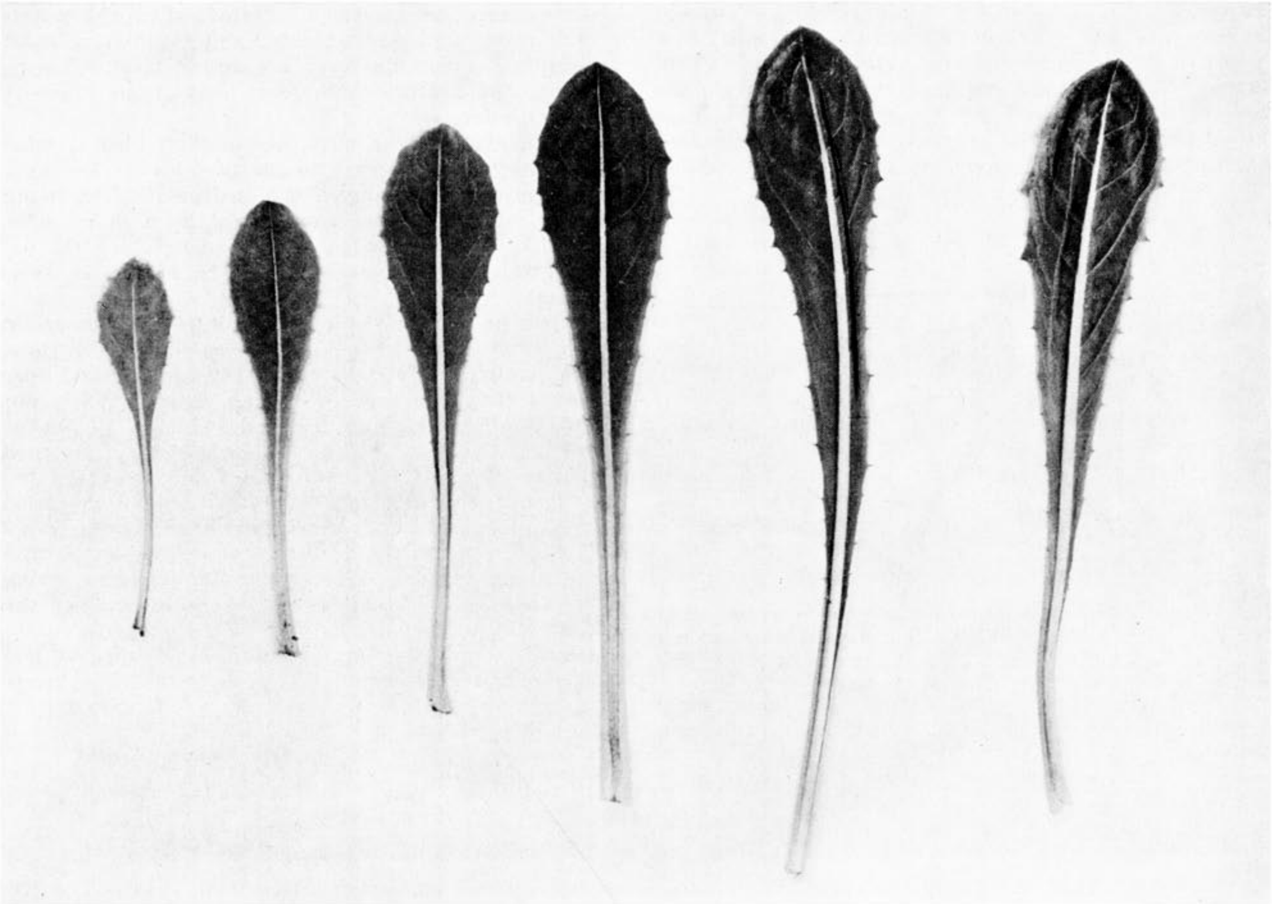

Fig. 3. Shape of leaves of a plant of *Taraxacum officinale* L. grown under 10 h white fluorescent light; ca. 4500 μw cm^{-2} plus 30 min FR before the beginning of each daily dark period.

calculated from daily measurements of length (L) and breadth (B) during the exponential phase of leaf growth; therefore the equations hold only for that period. The slopes corresponding to the 3 groups are: 10 W: $b = 2.53$; 10 W + 30 min FR: $b = 3.30$; 10 W + 30 min FR + 20 min R: $b = 2.35$. The LSD (p 0.01) is 0.56, therefore the far red light given at the end of a 10 W period causes a significant increase in b. The expansion of the leaf in length is more stimulated than the expansion in width. Also in the L/B ratio 20 min of red light fully reversed the effect of 30 min far red light.

Since the usual criteria of photoreversibility and low energy requirements for the involvement of phytochrome are met, and the Pfr is thought to be the active form, it can be said that low levels of Pfr delay the determination of the runcinate shape and increase the L/B ratio.

The nutritional status, and more specifically the carbohydrate level, has been postulated as the decisive factor in the control of leaf shape by light[1]. The involvement of phytochrome suggests the existence of a more specific regulatory factor in addition to or rather than the nutritional level. However, since the Pfr level can also influence dry matter production rate[7,8], the possibility exists that different Pfr levels might affect leaf shape by a modification of the carbohydrate level.

As a first approach to this question, the relative growth rate (R) and the unit leaf rate (E) were measured in the period between the start of the experiment and the beginning of the expansion of leaf No. 5. R and E were calculated according to Watson[9].

The method of dry weight determination can only detect rather large differences, but it can be observed that the differences in light intensity or in external sugar supply that have been reported to be associated with differences in shapes are also large[1,3,5]. The light programs and growth conditions were identical with the

Effect of terminal 30 min FR or 30 min FR followed by 20 min R irradiations on the relative growth rate and the unit leaf rate of *Taraxacum officinale* plants.

Treatment	E (mg cm^{-2} day^{-1})	R (mg mg^{-1} day^{-1})	Total dry weight (mg pl^{-1})
10 W	0.650	0.256	113.2
10 W + 30 min FR	0.578	0.237	88.4
10 W + 30 min FR + 20 min R	0.652	0.253	96.7
LSD ($p \leq 0.05$) = 26.1 mg			

Main light period: 10 h of white fluorescent light of ca. 4500 μ w cm^{-2}.

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[7] R. L. Satter and D. F. Wetherell, Plant Physiol. *43*, 953 (1968).

[8] R. A. Sánchez, in preparation.

[9] D. J. Watson, Adv. Agron. *4*, 101 (1952).

previous experiments. This experiment was also repeated 3 times. The results are shown in the Table I and indicate that the Pfr levels which induced different shapes did not change significantly (at the p 0.05 level) the assimilation in the period between the start of the experiment and the appearance of the first runcinate leaf. The Pfr level influences both R and E but after longer experimental periods than that necessary for the formation of the first runcinate leaf[8].

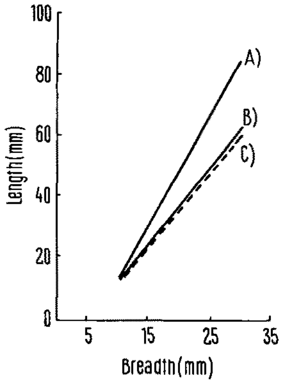

Fig. 4. Effect of terminal far red, or far red followed by red irradiations, on the L/B ratio. A) 10 h of white fluorescent light plus 30 min FR; B) 10 h of white fluorescent light; C) 10 W + 30 min FR + 20 min R. The slopes b of the 3 straight lines are: A) $b = 3.30$; B) $b = 2.53$; C) $b = 2.35$. The LSD ($p \leq 0.05$) = 0.56.

The fact that a light treatment, which does not induce significant changes in photosyntates amount, drastically influences the leaf shape, does not eliminate the possibility that the Pfr effect could in some way be connected with the sugars supply. Two of the possible ways are: 1. modifying the translocation pattern so that different amounts of photosyntates would reach the young expanding leaves; 2. affecting the composition of the carbohydrate pool, since not all the sugars have the same effect on leaf shape[1], changes in the level of the more active could be important.

Resumen. Sobre la base del efecto de irradiaciones de baja energía con luz rojo lejana, y la reversión del mismo por la luz roja, se postula la participación del fitocromo en el control de la forma de la hoja de *Taraxacum officinale*.

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Ein spezieller Rhabdomerentyp im Fliegenauge

Im Fliegen-Komplexauge wurden Rhabdomere gefunden, die einen für Insekten bisher unbekannten Bautyp besitzen. Am Augenrand, besonders entlang der an Frons und Vertex liegenden Leiste, wurden bei 20 Arten aus 7 Familien (Tabanidae, Rhagionidae, Syrphidae, Scatophagidae, Muscidae, Calliphoridae und Sarcophagidae) eine bis wenige Reihen von Ommatidien mit einem mächtig entwickelten zentralen Rhabdomer beobachtet (Fig. 1). Dieses entspricht dem Rhabdomer 7 (R7) bzw. R8 (Numerierung nach Dietrich[1]). Die Flächengrösse im Querschnitt des distalen Teils ist z. B. bei *Calliphora erythrocephala* für die speziellen randzonalen Rhabdomere (ihr Komplex wird als spRZR abgekürzt), R7, durchschnittlich $2,7\ \mu m^2$ ($n = 8$, $s_{\bar{x}} = \pm\ 0,1\ \mu m^2$), für die «normalen» R7

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[1] W. Dietrich, Z. wiss. Zool. *92*, 465 (1909).

[2] E. Eguchi, J. Cell. comp. Physiol. *66*, 411 (1965).

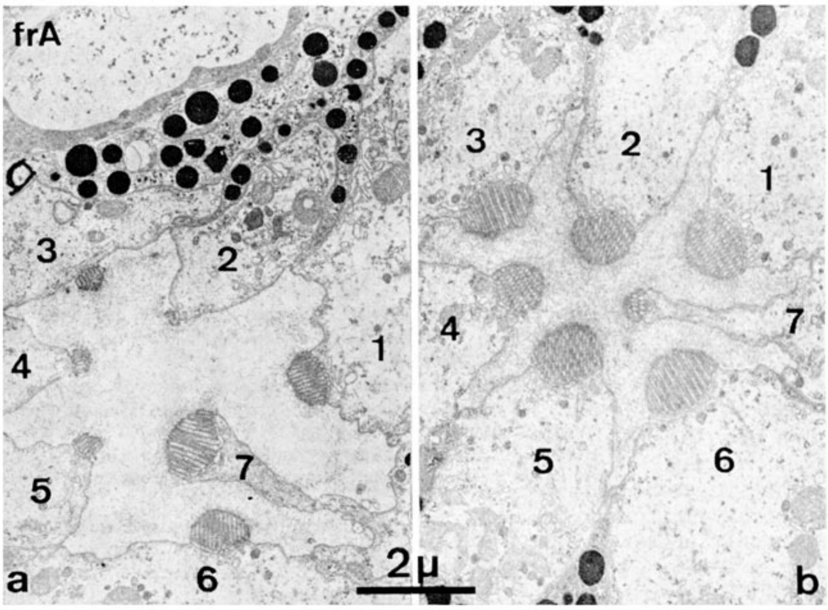

Fig. 1. Querschnitt durch ein randzonales Ommatidium mit grossem R7 (a) und ein ihm benachbartes nicht-randzonales Ommatidium (b) auf gleicher Schnittebene. *Calliphora erythrocephala* ♂. 1–7, Sehzellen; frA, frontaler Augenrand. Diamantmesserschnitt[13].