HOS 4341
HOS 6932

Reproductive Growth
Factors implicated in Flowering

Factors implicated in Flowering

- Hormones
- Sucrose signaling
- Carbohydrate supply

Hormones

- **A. Auxins - exogenous application promotes FBI in mango, pineapple and other bromeliads**

TABLE 1. *Promotion of flowering in cocklebur by low auxin concentrations (1 mg./l. of NAA) applied at various times*

Treatment[a]	Average number of flower primordia per plant		
	All nodes	Lower 10 nodes	Upper 6 nodes
Control	35.4	11.0	24.4
Auxin before induction	56.9	24.0	32.9
Auxin during induction	39.1	13.5	25.6
Auxin after induction	49.3	23.2	26.1

[a] LSD at 1 per cent level, 4.6 flower primordia per plant.

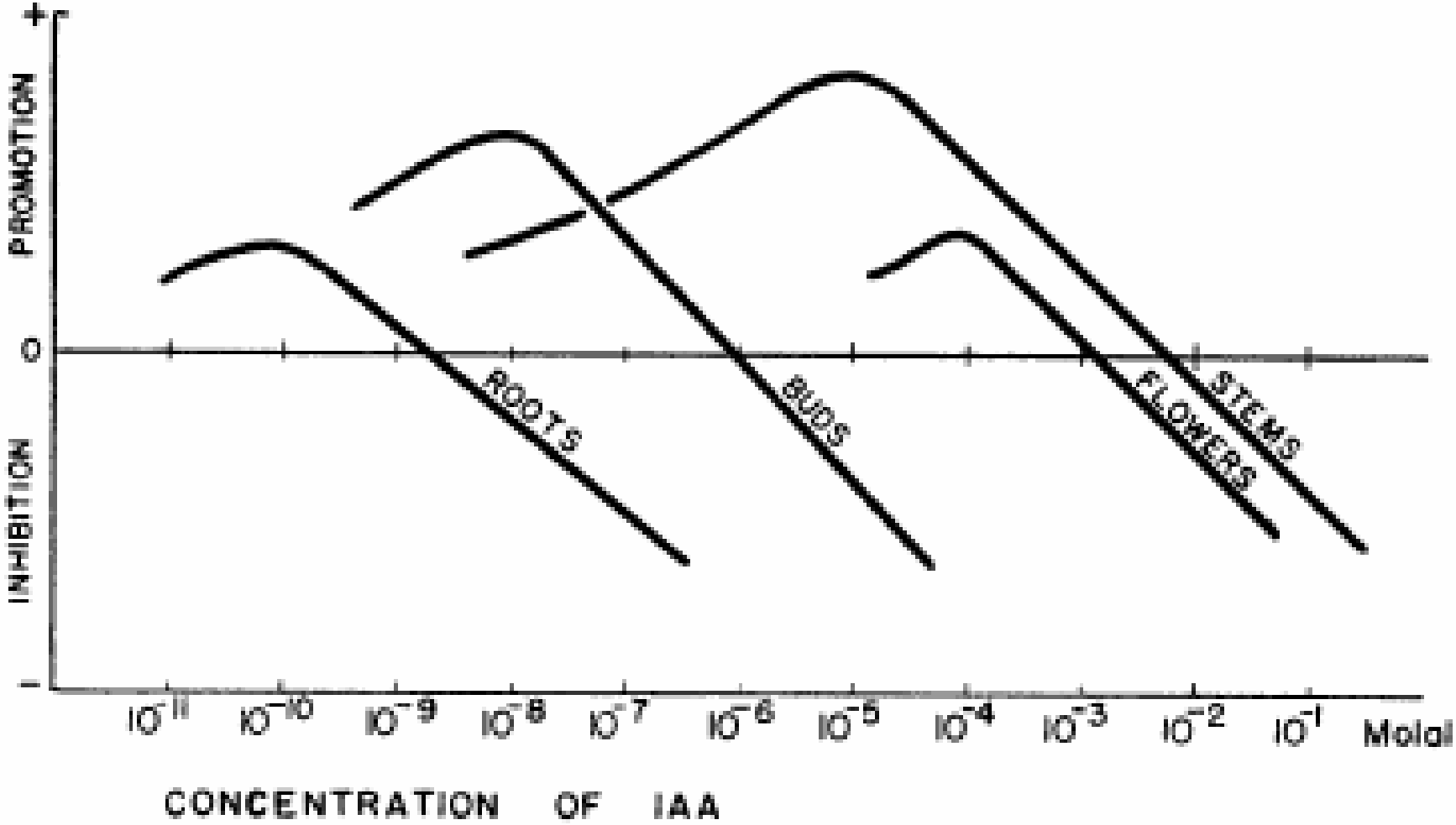
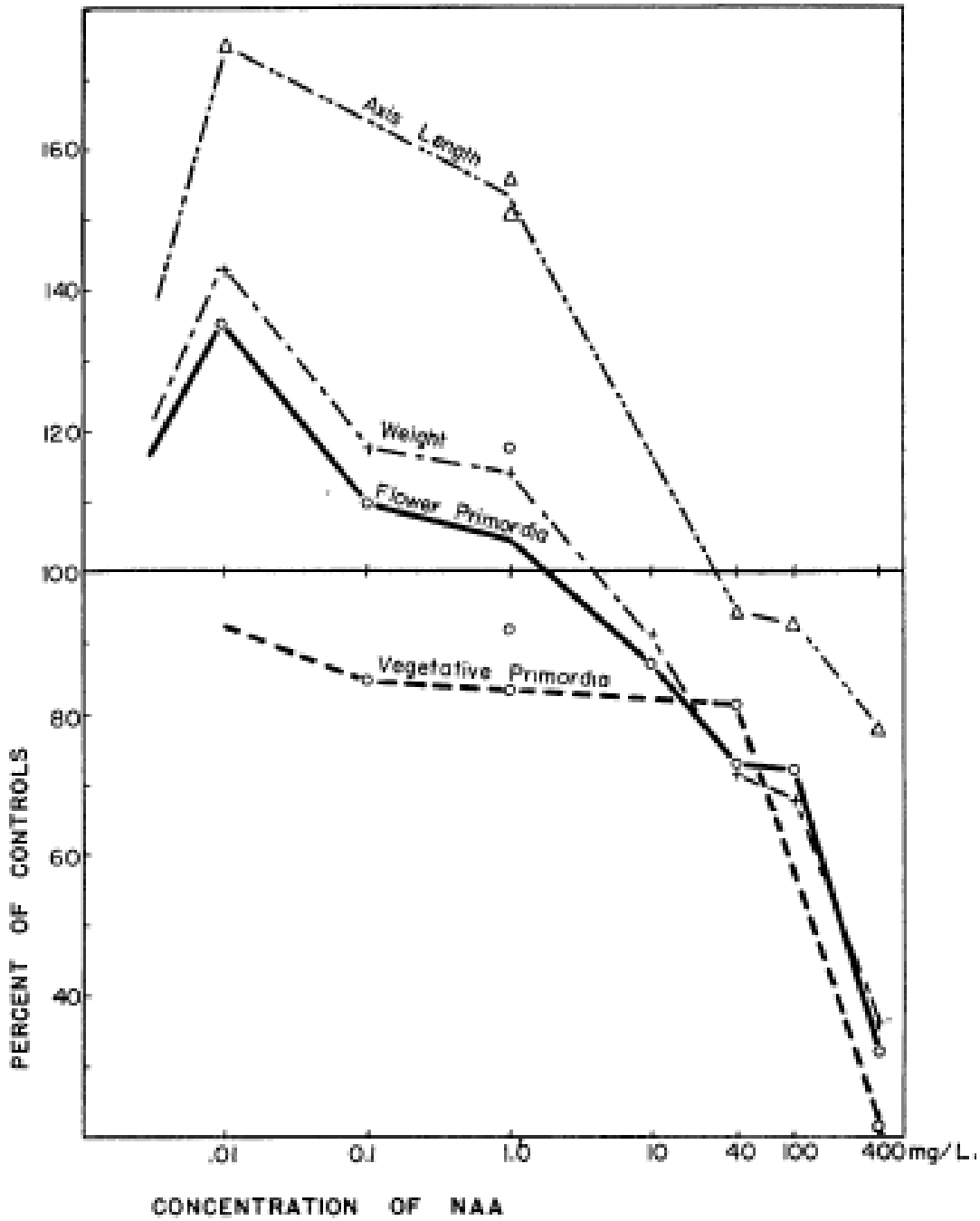


Fig. 3. Scheme for approximate auxin ranges (indoleacetic acid) for promotion and inhibition of different plant organs. Modified from Thimann (1938) with additions.



Effect of exogenous auxin on barley

Gibberellic acid

- **B. Gibberellic acid – Most studied hormone with respect to FBI**
- **In general GA inhibits FBI in SD or DN plants by promoting vegetative growth**
- **In LD plants, GA promotes FBI**

Fig. 4. Precocious vegetative shoot development of indeterminate inflorescences on 'Hass' avocado summer shoots sprayed with GA_3 in December 1993. From left to right, 0, 50, 100, and 1000 mg-L^{-1} GA_3. Picture taken on 5 Mar. 1994. Bar = 30 mm.

Table 1 - Effect of GA_3 applied in November 1993 on the growth of apical buds of summer and fall vegetative flush shoots of the 'Hass' avocado. Observations were made on 3/26/94.

Shoot type	GA_3 applied (mg/liter)	Type of growth (% of total number of buds)		
		Inflorescences	Vegetative shoots	Resting buds
Summer shoots:	0	100.0 a	0.0 c	0.0 a
	50	90.8 ab	9.2 c	0.0 a
	100	54.2 bc	33.3 b	12.5 a
	1000	34.2 c	63.3 a	2.5 a
Fall shoots:	0	92.9 a	5.7 a	1.4 a
	50	96.3 a	3.7 a	0.0 a
	100	71.4 ab	14.3 a	14.3 a
	1000	47.5 b	50.0 a	2.5 a

GA

- **1. Alternate bearing crops - e.g. olive, apple. If the seeds are destroyed in young, developing fruitlets, will get FBI that year**

  Developing seeds contain some inhibitors to FBI. GA? levels high in seed

- **2. Can inhibit GA biosynthesis in SD plants grown under non inductive LD conditions and get FBI**

- **3. Exogenous GA inhibits FBI in strawberry (SD), or DN plants like apple, peach, almond, citrus**

GA

- Prior to actual FBI, one can predict which buds will be floral and which ones vegetative based on shoot type they're borne on

- Population of buds destined to be flowers were identified and GA3 applied to these buds at various times prior to, during and after FBI

	FBI			
	Early Oct	Mid- Dec	Early Jan	Late Jan
•Cont	6	6	6	6
•GA3	2	1	5	6

- GA caused inhibition of FBI

GA

- **In LD plant, Australian drumstick flower (*Craspedia globossa*). GA application promotes flowering under SD conditions**

- **Plants were grown under SD (11 hr) or LD (15 hr) for 10 weeks ± GA at weekly intervals**

No. wks GA applied (500 mg/L)	FB/plant	
	SD	LD
0	2.2	12.9
5	4.5	11.7

GA

- **Some LD grasses (e.g. *Lolium temulentum*) require 1 LD cycle to FBI. GA5 and GA6 act as florigenic substances. If applied to leaf of plants under noninductive SD, will get FBI**

- **Also, after 1 LD, rapid increase in GA5 and GA6 levels is observed in the apex compared with SD maintained plants**

Shoot apex GA (ng/g DW)

	One LD	SD
GA5	131	71
GA6	120	47

Sucrose signaling

- Bernier model of flowering: Under conditions that cue FBI (e.g. PP, temp), there are rapid, transient increases in sucrose translocation from leaves to shoot apices
- This precedes any activation of apical meristem (i.e. increased cell division) that occurs as first steps in transition
- Thus, this is not a source-sink effect, but rather sucrose appears to be acting as a signal
- It is known that sucrose is involved in regulating gene expression e.g. sucrose synthase, Nitrate Reductase, phytochrome
- Insufficient evidence so far to conclude sucrose (or GAs) are floral signals indeed

Sucrose

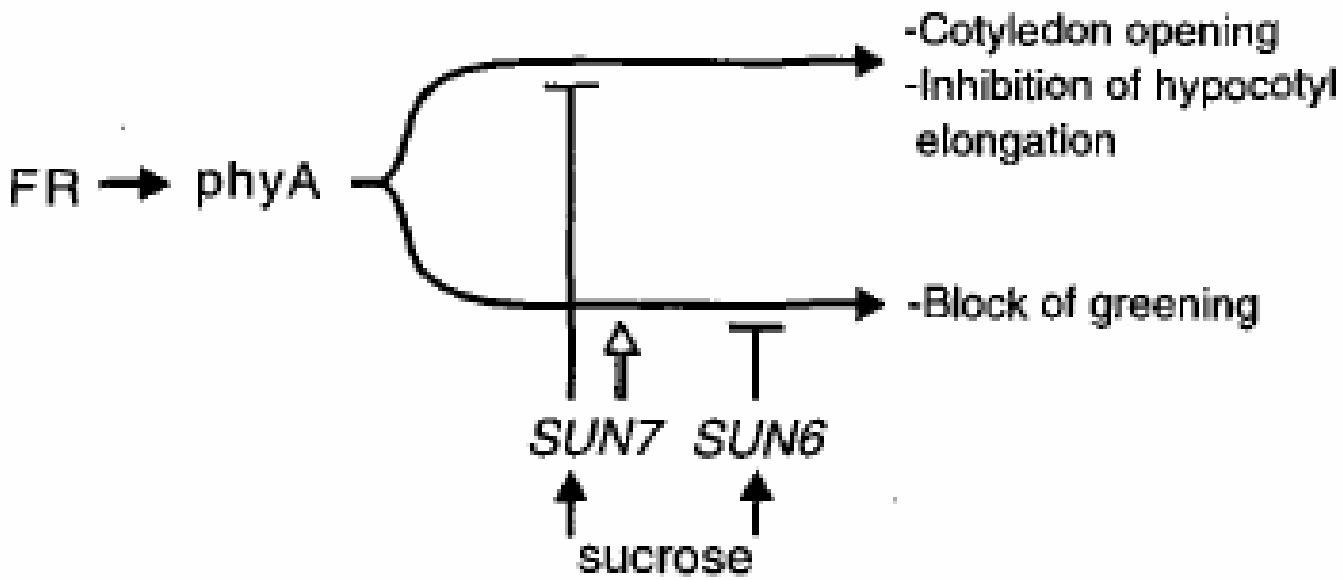


Figure 6. A Model Explaining the Genetic Interactions between *SUN* Genes and phyA Signal Transduction Pathways.

CHO supply

- **Indirect evidence suggests that limitations in CHO supply may decrease FBI**
- **Vegetative/Reproductive processes compete for available CHO**
- **This theory is based on cultural manipulations and observations of correlations between CHO and flowering response**

Cultural manipulations that increase FBI

- - Girdling, ringing - causes CHO accumulation and results in greater flowering response in many plants. e.g. apple, peach. Similar to CHO and juvenility

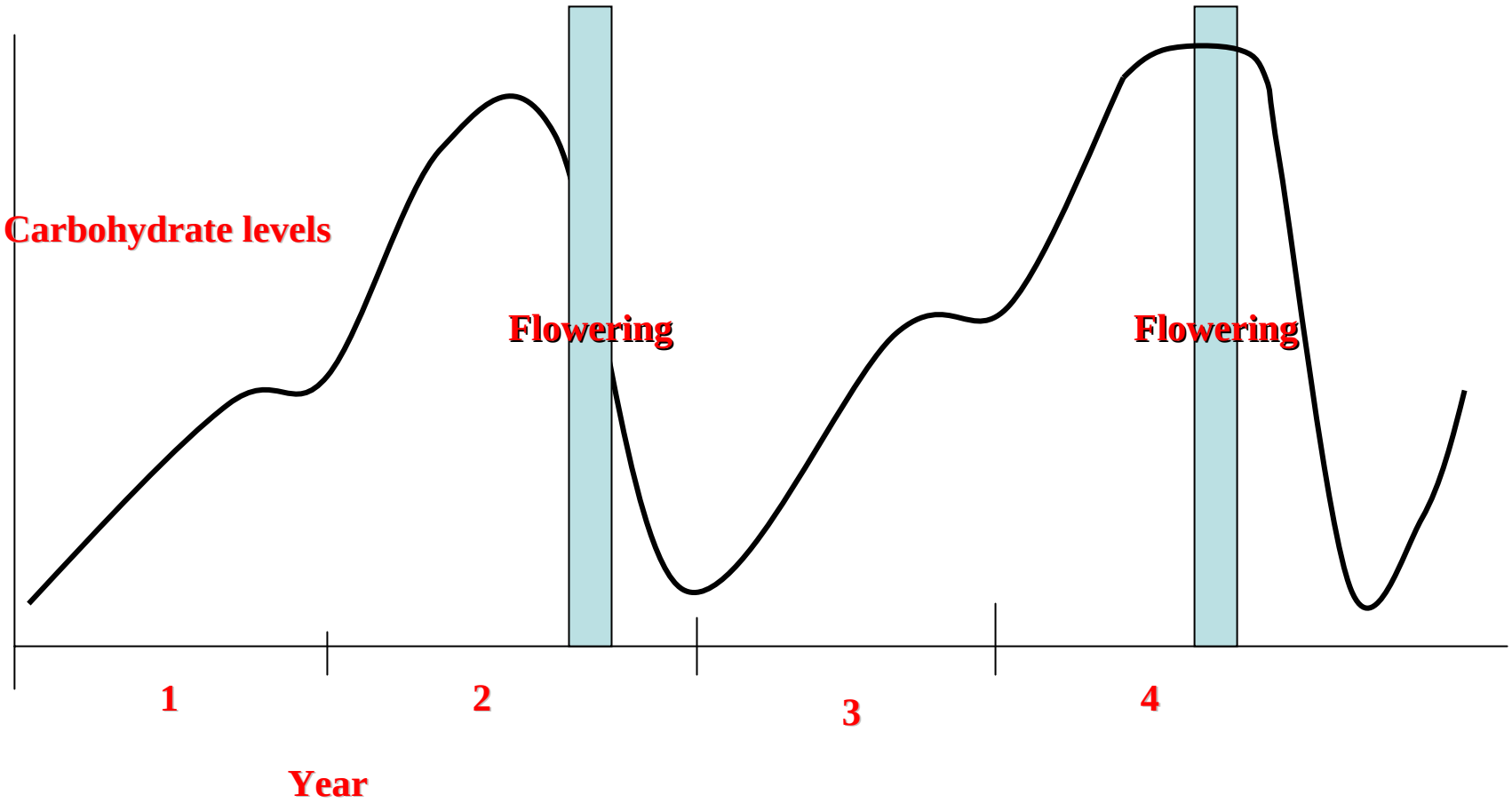
- - Anything that decreases vegetative growth - decreases alternate sinks for CHO, decrease vegetative/reproductive competition, allowing more CHO to be allocated to reproductive process

- e.g. mild water stress - decreases shoot growth, so now CHO produced by existing vegetation can go to reproductive structures

Correlations between endogenous CHO and flowering response

- - Alternate bearing - Woody plants, fruit development of this years crop and FBI for next years crop occur simultaneously. e.g. apple, pecan, olive
- - Attributed to lack of sufficient CHO to mature present crop and have enough left over for FBI
- Evidence for this is correlative in apple
- But, olive - correlation not good.

CHO levels – alternate bearing



Main points

- Auxins promote FBI in general
- Promoting action of auxin is concentration dependent
- This concentration will be different for different plants
- GA inhibit FBI in SD and DN plants and promote in LD plants
- Sucrose acts as a signal during FBI
- Sucrose modulates phytochrome signaling thus affecting FBI
- Based on cultural practices, it is believed that carbohydrate supply determines FBI