CORRELATIVE INHIBITION BY FRUITS OF VEGETATIVE DEVELOPMENT IN INDETERMINATE SOYBEANS[1] /

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Resumen

Se estudió la influencia de las flores y de los frutos en distintos estadios de desarrollo sobre el crecimiento vegetativo en un cultivar de soja de hábito de crecimiento indeterminado.

Plantas noduladas del cv. Williams se cultivaron en macetas con tierra bajo un fotoperíodo de 9 horas. Los tratamientos consistieron en la eliminación cada 3-4 días de: a) pimpollos y flores; b) frutos pequeños; c) frutos casi completamente alargados y d) frutos con semillas en desarrollo.

El crecimiento del ápice caulinar y de las yemas laterales fue estimulado por la escisión de flores y frutos pequeños, mientras que la remoción de frutos casi totalmente alargados produjo una menor promoción del crecimiento vegetativo. La eliminación de frutos con semillas en desarrollo no tuvo influencia.

A pesar de la remoción continua de flores y frutos, el crecimiento vegetativo se prolongó sólo dos semanas y aparecieron sólo 4-5 nudos más en el tallo principal respecto del control. Sobre la base de estos resultados, se infiere que los frutos reprimen el crecimiento de nudos previamente diferenciados en el ápice caulinar y yemas laterales.

Introduction

In monocarpic species vegetative growth ceases during the reproductive phase of the life cycle, a phenomenom that appears related to the development of reproductive structures. Indeed, removal of flowers or fruits may prolong vegetative growth in species such as beans (7), soybeans (3) and peas (4, 5). A causal link between the arrest of vegetative growth and pod development in soybeans seems supported by the fact that fruit removal slightly enhances main stem growth (3) and that delay of fruit development under post-flowering long days results in more prolonged apical growth in Williams soybeans (1). The main object of this work was to determine the stages at which reproductive structures exert their likely inhibitory influence.

Materials and methods

Rhizobium inoculated soybean plants cv. Williams (indeterminate growth habit, Maturity Group III) were grown in pots containing park soil adequately fertilized and permanently kept near field capacity. Plants were raised under a 9-h daily exposure to sunshine (9-h photoperiod) and mean day/night temperature: 24± 4/ 24± 3°C.

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The different surgical treatments involved removal every 3-4 days of: a) flower buds and flowers; b) fruits of average 5-8 mm long, 3.2 mg dry weight; c) fruits of av. 35 mm long, 83.3 mg d. wt., with seed bulges not yet developed; d) fruits of av. 42 mm long, 135.0 mg d. wt., with seed bulges filled by developing seeds. Nodes were considered as developed when the stipules of the accompanying leaf were visible with the aid of a lens, whether the leaf was present or not. Six to eight replicates per treatment were included. The experiment was repeated twice but, since the results of both were essentially identical, only one of such experiments is reported here.

Results and discussion

Apical growth ceased when the first pods entered rapid seed filling, just after reaching full length, which is in agreement with previous observations on the same variety (1). Plants completely depodded by continuously removing young pods (B) showed enhanced and more prolonged apical growth, final main stem node number thus being ca. 44% higher than in intact fruited plants (Figure 1). A lesser enhancement of apical growth was found when young pods remained on the plant (C) while the presence both of young and enlarging pods before seed filling (D) inhibited apex growth to the same extent as in intact fruited plants. On the other hand, it is noteworthy that apical growth was the same were flower buds and flowers removed (A) or allowed to develop into pods (B), hence suggesting that growth arrest is triggered after ovule fertilization. Inhibition of apical growth by fruits before the beginning of seed filling is consistent with our finding that exposure to long days before this stage prolongs apical growth, probably by delaying fruit development, but that long days are later ineffective (1). The effect of flower or fruit removal on branch development showed a similar pattern of responses (Table 1). Again, the presence of flower buds and flowers seemed not inhibitory, but fruit-induced inhibition was found stronger the older the fruits remaining on the plant. It is remarkable that bud sprouting was much more stimulated than further growth of newly formed branches, as implied from the small differences in number of nodes per branch.

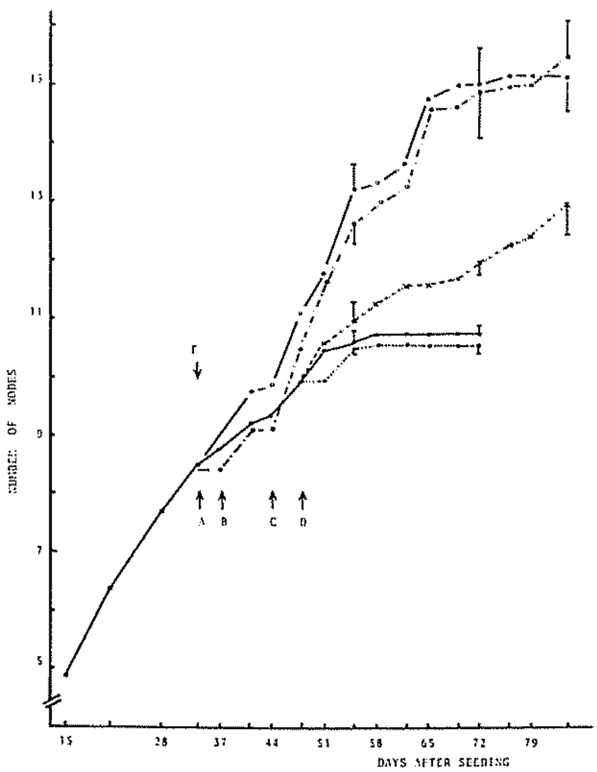

Fig. 1. Evolution of main stem node number in soybean plants subjected to different flower or fruit removal treatments.

•———• intact fruited plants (control); • ——— • —— • deflowered; o ——— · ——— · ——— o pods removed when 5-8 mm long; × – – – – × pods removed when 35 mm long; o ······ o pods removed when 42 mm long. Vertical bars represent mean error. The arrows indicate the date of flowering (F) and the dates when the treatments (A, B, C, D) were initiated.

Even though flower buds and flowers were continuously removed, only 4.5 more nodes appeared in deflowered plants. Lockhart and Gottschall (4), also found that arrest of apex development, though

Table 1. **Branch development in soybean plants as affected by deflowering or defruiting treatments.**

Treatments	Number of	
	Branches	Nodes/branch
Control	1.0 a	2.0 ab
Deflowered	8.3 b	2.5 cd
Defruited:		
pods 5-8 mm, 3.2 mg d. wt.	7.5 b	2.9 d
pods 35 mm, 83.3 mg d. wt.	4.6 c	2.1 bc
pods 42 mm, 135.0 mg d. wt.	0.9 a	1.6 a

Mean values followed by the same letter do not differ significantly at 5% level of probability according to Duncan's test.

greatly delayed, eventually occurred in continuously deflowered pea plants Moreover, although released from competition for available assimilates, nodes newly developed in deflowered and defruited plants were extremely short and stunted, a phenomenom already seen in G2 peas (6) Thus, like in peas (4), other factors besides fruit-induced inhibition would contribute to the arrest of vegetative development Particularly, the action of growing fruits seem to involve mainly an inhibition of internode elongation rather than any influence upon node differentiation by the apical meristem The fact that there are about 20 nodes differentiated along the main stem by the time the 5th trifoliolate leaf has expanded (2) strongly suggests that new nodes enlarged after flower or fruit removal were already differentiated within the apex before the start of the treatments. Therefore, fruit-induced inhibition of vegetative growth would be mainly due to repression of internode enlargement

On the other hand, differentiation of new nodes in apical meristems would probably cease under the influence of other factors, probably linked to photoperiod or photoperiodic induction of flowering

Summary

The study examined the influence of flowers and fruits at different stages of development, on the vegetative growth of a soybean cultivar of indeterminate growth habits

Noded soybean plants cv Williams were grown in pots with a 9 hour daily photoperiod. Treatment involved removal every 3-4 days of: a) flower buds and flowers; b) small fruits; c) almost fully developed fruits and d) fully developed fruits with seed bulges filled with developing seeds

Growth of the apex and of lateral branches was stimulated by the removal of flowers and small fruits while the removal of almost fully developed fruits promoted less vegetative growth. The removal of fruits with developing seeds did not produce a noticeable difference

In spite of repeated removal of flowers and fruits, vegetative growth was prolonged for only two weeks; only 4-5 more nodes appeared on the main stem, when compared with the control plant. The results of this experiment indicate that fruits inhibit the growth of nodes previously differentiated on the apical meristem and lateral branches.

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Reseña de libros

FORSYTH, A y MIYATA K Tropical nature Charles Scribner's Sons, New York 1984. 284 p

En los últimos años han proliferado los libros populares o científicos, o más frecuentemente, una combinación de ambos, sobre la vida animal y vegetal de los bosques tropicales húmedos Las razones eran por demás evidentes: el conocimiento cada vez mejor de la gran diversidad de la naturaleza tropical, no sólo las descripciones de miles de plantas y animales sino también, y sobre todo, las múltiples y a veces complicadas o específicas interacciones que se verifican A esto debe agregarse un perfeccionamiento de la fotografía, con mejor calidad, en el difícil ambiente de bosque Asimismo, resulta cada vez más evidente que el mercado para cierto "turismo científico" en los trópicos aumenta por parte de amantes de la naturaleza, quienes en vez de sólo seguir los relatos por la televisión o por medio de publicaciones, desean familiarizarse personalmente con este ambiente a fin de observar, descubrir y sentir la aventura –por ciento nada peligrosa– de la selva tropical

El libro de Forsyth y Miyata, ambos jóvenes biólogos con PhD de la Universidad de Harvard y con amplia experiencia personal en las selvas de Costa Rica y Ecuador, tiene esta facultad de interesar y maravillar al lector y, lo que es sin duda aún más meritorio, de provocar el deseo de querer experimentar en carne propia la fascinación de observar los trópicos No tiene fotografías, más si dibujos admirables de Sarah Laudry sobre la vida en los bosques

Los diferentes capítulos están escritos en estilo ameno, fácil de seguir, y enfocan la vida y costumbres de ciertos animales y sus completas relaciones con otros animales o plantas Incluyen descripciones y experiencias vividas como las andanzas de las hormigas arrieras o guerreras y quiénes las acompañan para aprovecharse de la huida de los animales espantados; las ranas y su vida nocturna; los insectos atraídos por ciertas orquídeas a las que polinizan; los organismos que parasitan insectos y aves; las aves migratorias; la vida sobre un matapalo (*Ficus*); la lucha en el ambiente de los epífitas, e instructivas especulaciones sobre la razón de la enorme diversidad de especies Hay, asimismo, un capítulo que relata las sensaciones de caminar, observar y sentir de noche en un bosque tropical cuando, en comparación con el día, las manifestaciones de diversas formas de vida son muy diferentes pero no menos interesantes

En un admirable apéndice, los autores incluyen 14 páginas con consejos prácticos para quienes se inician en la observación de la naturaleza tropical, algo que sin duda será de gran interés para quienes organizan o participan en "tours" o deciden, por cuenta propia, apreciar en la forma más cómoda posible las complejidades del mundo tropical Completan el libro un excelente índice de materias y una introducción del Dr Tomas Lovejoy, del Fondo Mundial para la Naturaleza (WWF) y buen conocedor de la selva amazónica

No dudamos que este libro cumplirá admirablemente la meritoria labor de interesar a miles de admiradores actuales y potenciales de los bosques tropicales húmedos, especialmente los jóvenes Estos bosques están siendo destruidos a pasos agigantados Pero, como lo demuestran Forsyth y Miyata, para quienes están armados de algunos conocimientos mínimos este ambiente puede producir las mismas intensas y gratas emociones que las llanuras herbáceas de los parques nacionales del Este Africano con su abundante y espectacular fauna Cuanto mejor se conoce y se aprecia el bosque tropical, mayores serán las posibilidades de preservar muestras representativas para generaciones futuras Los autores merecen el agradecimiento del mundo científico por promover esta causa

El libro está dedicado a la memoria de Ken Miyata, uno de los autores, quien falleció trágicamente en un accidente de navegación cuando ya se estaba revisando las pruebas de galera El mensaje, contagioso de entusiasmo hacia los trópicos de Ken, no será en vano

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