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POD DEVELOPMENT TREND IN *PHASEOLUS VULGARIS* L.

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RINGKASAN

Kacang buncis, varieti Processor, telah ditanam di dalam rumah kaca dan di ladang. Ukuran dan bilangan lenggai ditentukan untuk mengetahui kadar tumbesaran, bilangan dan peratus keguguran lenggai. Keputusan menunjukkan kadar tumbesaran lenggai awal mempunyai kesan terhadap lenggai-lenggai yang keluar kemudian. Pemungutan awal lenggai untuk dijadikan sayur didapati menambah jumlah pengeluaran lenggai dan melambatkan kematian pokok.

INTRODUCTION

Pod development in most leguminous crops follows a general trend : increases to a peak and later decreases due to pod abortion, probably as a result of competition for assimilates. The start of flower or pod abortion signals the onset of dual demand upon each nutritional unit for mineral nutrients and organic metabolites for seed formation and continued pod development (ADAMS, 1967). Under field condition, pod retention of *Phaseolus vulgaris* has been quoted at 32.5% in Cascade variety and 62% in Processor variety (OLUFAJO, 1980).

In this study, trend of pod development, particularly the number, length, rate of growth and percentage of abortion, was monitored. Effects of inoculation and fertilizer application on pod production were also noted.

The effect of pod removal on subsequent pod and seed yield was also studied. Regular picking as practised by our Malaysian farmers reduces the reproductive load of each plant at a particular time and this may mean an increase in pod production. It is therefore, valuable to determine the extent to which dwarf French bean plants can compensate for pod removal and also the possibility of dual use of this crop. It was demonstrated by OLUFAJO (1980) that plants compensated for pod removal by retaining younger pods. BINNIE and CLIFFORD (1981) showed that flower removal in French bean was compensated by pods set from flowers which opened later. Similarly, removal of 50% of the pods at the end of flowering in soybean reduced yield by only 9%–10%, because of compensatory increase in the number of pods set at the non-depodded nodes (HAM, LAWN and BRUN, 1976).

MATERIALS AND METHODS

Phaseolus vulgaris L., Processor variety, was grown both under glasshouse (two seasons) and field conditions in 1980 and 1981 in Kent, England.

In the glasshouse (Experiments I and II) seeds were planted in 23 cm diameter pots filled with sand (sterilised in Experiment II) and placed on plastic trays to minimize loss of nutrients. Each pot eventually contained one treatment plant. Randomized complete block design was used with treatments replicated five times. Watering was done daily with weekly applications of nutrient solutions.

Treatments applied in the glasshouse experiments are given in *Table 1*. The three nutrient solutions used were based on Long Ashton's recommendations (HEWITT, 1952). Rhizobium strain (R3644) from Rothamsted, England was used for inoculation.

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Table 1. Experimental treatments for Experiments I and II in the glasshouse

Treatment	Inoculation		Nutrient solution
Experiment I			
T1	Plain seed		Complete nutrient.
T2	Seed in peat inoculum	)	Given 5 weeks of
T3	Seed in fluid gel inoculum	)	complete nutrient followed
		)	by N−free solution later.
T4	Seed in peat inoculum	)	Maintained on N−free
T5	Seed in fluid gel inoculum	)	solution throughout.
Experiment II			
T1	Plain seed		Complete nutrient.
T2	Plain seed	)	Maintained on low
T3	Surface-sterilized seed	)	N level (28 ppm)
T4	Seed in peat inoculum	)	
T5	Seed in peat inoculum		Maintained on N−free solution.

Pod count, beginning from the appearance of the first pod, was done for all plants in the glasshouse experiments. Recording of the length of the first formed pod was done daily.

In the field experiment (Experiment III), seeds were drilled with a 'stanhay' precision drill at 36 seeds per square metre. Plot size was 2.3 m x 15 m, made up of five drill rows 46 cm apart. Randomized complete block design was used with four replications, and each block was made up of six treatment plots, a factorial combination of inoculation (I0 – non-inoculated and I1 – rhizobium inoculated) and three N levels (0, 75 and 150 kg/ha).

Five plants in each plot were randomly labelled for pod development studies. All counts were done in the field using the same plants to minimize error. At each recording, total number of pods per plant, number of aborted pods and length of the first formed pod were recorded. Daily recordings were taken, beginning when the first pod had been formed (57 days after sowing), up to maturity. The first formed pod was labelled to differentiate it from the remaining pods.

Picking treatments were mainly allocated to an 8 m length of the central three rows of each plot. Each 8 m length was marked using plastic markers, and the following three picking treatments were randomly applied:

P0 – No picking (control),

P1 – Removal by hand of immature edible pods[+] at 16 days after the appearance of the first pod (73 days after sowing), and

P2 – Removal by hand of immature edible pods at 22 days after the appearance of the first pod (79 days after sowing).

Records were kept of the number, fresh weight and oven-dried weight of the pods picked.

All statistical analyses were done using the GENSTAT computer program.

RESULTS AND DISCUSSION

In spite of using the same variety in all the experiments, the time to first podding varied between years and experimental conditions *(Figures 1–3)*. Podding generally set in earlier under glasshouse condition and slightly later under field condition. This was probably due to the colder summer of 1980 which also resulted in lower maximum pod number although this number was achieved at about the same time.

[+]Pods judged suitable for home freezing, canning or for immediate cooking.

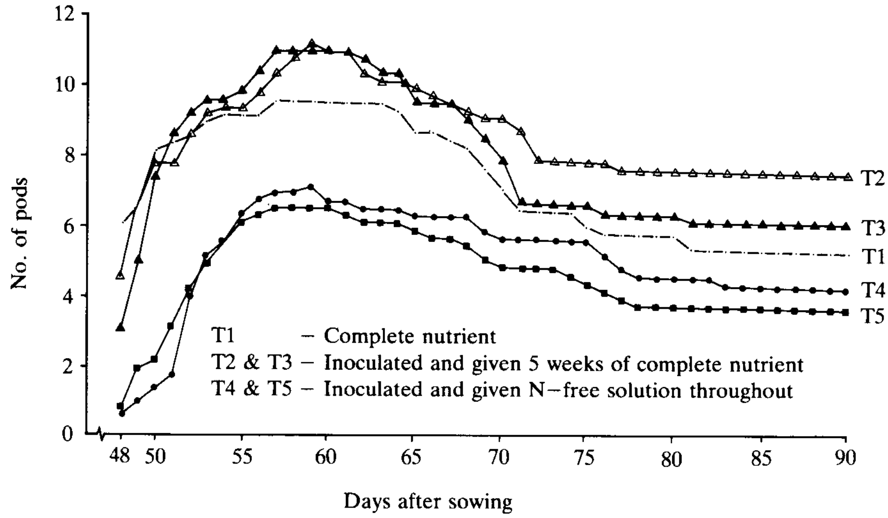

Figure 1. Effect of inoculation treatments on pod production trend (Experiment I).

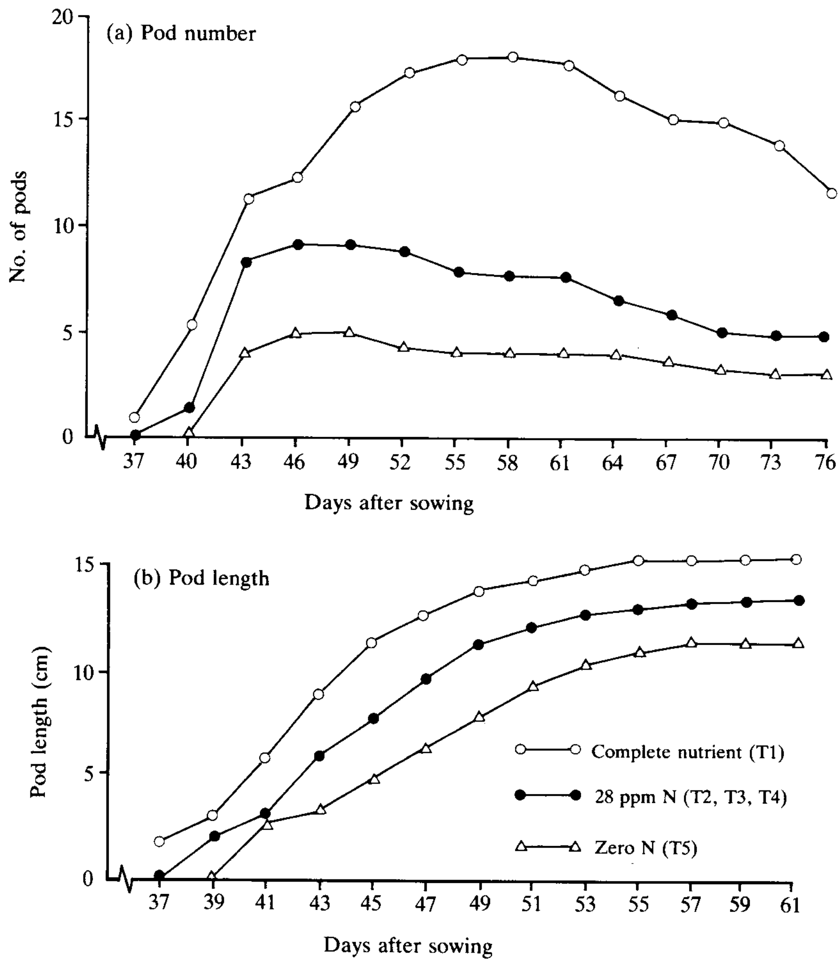

Figure 2. Effect of N levels on pod production trend (Experiment II).

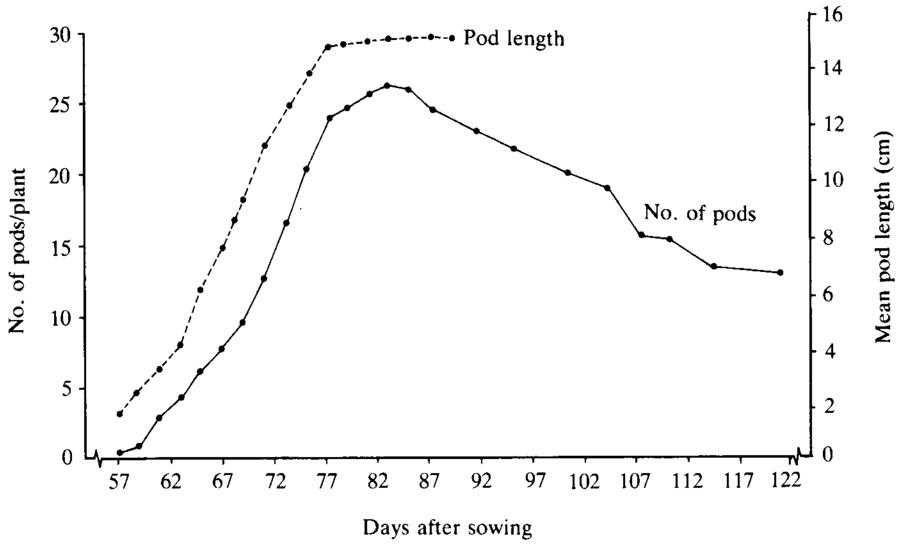

Figure 3. Pod development trend in ***Phaseolus vulgaris.***

There was no treatment effect on the onset of podding *(Figures 1* and *2)* and pods from similarly treated plants set on almost the same day under glasshouse condition. Under field condition, however, first pod appearance varied by seven days among the 60 plants sampled. Visual observation showed that the variation in time of pod set in the field was mainly because of erratic plant emergence which resulted in variable plant development.

The pattern of pod growth was similar in all experiments. Pod number increased to a maximum and decreased later because of pod abortion *(Figures 1–3)* as a result of the diversion of photosynthates to the developing seeds (ADAMS, 1967). The later formed pods tended to give way to seed development. Observations indicated that the majority of pods aborted after the peak pod number had been reached; only a few aborted earlier than this. The earlier pods to abort were the youngest, followed by older pods which failed to develop seeds. This is in agreement with the findings of ADAMS (1967). In adjusting to the limited supplies of available nutrient-metabolite reserves for each nutritional unit, youngest pods drop off first, and if the stress continues, are followed by the abortion of fertilized ovules in the next older pods. In all the three experiments, the later formed pods were observed to be shorter and had fewer developed seeds.

There was variation in the total number of pods initiated per plant between experiments *(Table 2)* and treatments. As the same variety was used in all the experiments, the effect must have been due to the environment. Observations indicated a relationship between the number of pods initiated and the days taken to reach maximum pod number; higher pod number was normally associated with more days to maximum pod number.

There was also an environmental effect on pod retention. The higher the number of pods initiated, the higher was the number aborted. The effect of environment on pod retention was also observed by GOMEZ–BARONA (1977) who found significant differences between years and experimental sites. An experiment by OLUFAJO (1980) also demonstrated differences in pod retention because of N treatments.

The first pod in all treatments was measured to quantify pod development.

Table 2. Pod production and retention under different experimental conditions

Parameter	Experiment I	Experiment II	Experiment III
Av. no. of pods initiated/plant	10.5	19.7	28.0
Av. no. of pods aborted/plant	3.9	6.0	14.0
% abortion	37.1	30.5	50.0

Growth rate increased sharply until a certain stage and slowed down later, probably because of competition for photosynthates as more pods developed *(Figure 3)*.

Table 3 gives the number of pods removed and the total fresh pod yield per square metre for the two pickings. Final number of pods at maturity were given in *Table 4*. The reduction in fruit set due to picking was insignificant. Average number of pods removed at the second picking (P2) was 5.0 per plant, but final number of pods was only reduced by one when compared to the control (P0) *(Tables 3* and *4)*.

Table 3. Fresh pod yield parameters obtained from each picking treatment

Parameter	P1	P2
No. of pods picked/plant	1.5	5.0
Pod fresh wt. (g/plant)	8.6	29.7
Pod dry wt. (g/plant)	0.74	2.79
Fresh pod yield (g/m^2)	309	1 069

P1 = Picked at 73 days after sowing.
P2 = Picked at 79 days after sowing.

Table 4. Effect of picking treatments on yield parameters

Parameter	P0	P1	P2	Level of significance
No. of pods/ plant	12.5	11.9	11.5	N.S.
Seed wt. (g/plant)	362	300	236	**
Individual seed wt. (g)	0.297	0.277	0.237	*
Seed no./pod	4.3	4.4	4.1	N.S.
% moisture in seeds	58.7	59.3	62.8	N.S.

P0 = No picking.
P1 = Picked at 73 days after sowing.
P2 = Picked at 79 days after sowing.
*Significant at $P<0.05$
**Significant at $P<0.01$

Final seed yield was significantly reduced with an increase in picking intensity *(Table 4)*. The reduction in seed yield was mainly because of lower individual seed weight and slightly lower seed number in P2 *(Table 4)*. It was therefore expected that seed yield of the depodded plants (P1 and P2) would increase further if harvesting was delayed. Delayed maturation of plants in the depodded plots was in fact observed in the field where the depodded plants still remained green even when the plants in the control plots had senesced. This was again confirmed by the higher percentage of seed moisture in the picking treatments *(Table 4)*. The delayed senescence of plants in the depodded plots might also mean a longer productive period.

CONCLUSION

The experiments indicated that development of earlier pods affected that of the later ones. Also removing the earlier pods as vegetable increased the total number of developed pods and delayed crop senescence. This suggests that if the pods are continuously picked as vegetable the plants can remain productive for a longer period of time and thus would give a maximum yield. Although this continuous picking system is commonly practised in Malaysia, it is very laborious and impractical under large-scale production. As such it would be useful to resort to the dual use of the crop, where the earlier pods are picked as vegetable (once or twice) while the later ones are left to mature and harvested as grain.

ABSTRACT

French bean, Processor variety, was planted under glasshouse and field conditions. Measurement of pod development and pod count were done to determine the rate of pod growth, total number of pods initiated and percentage aborted. Results indicated that development of earlier pods affected that of the later ones. Removal of earlier pods as vegetable increased total number of developed pods and delayed crop senescence.

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