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The development of the husk tomato plant (*Physalis ixocarpa* Brot.). II. Reproductive parts

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Abstract

The development of the reproductive parts of husk tomato plants cv. 'Rendidora' was investigated and is presented in the form of curves based on regression equations or on the average data. The number of flower buds and flowers existing on a plant was highest at the 9th week after emergence (AE) and showed a second, lower pick toward the end of the experiment. These last flower buds and flowers did not have the opportunity to produce fruits of commercial size. The number of fruits reached its maximum at the 11th week AE but a great proportion of fruits smaller than 2 cm were shed. The plants with the prostrated type of growth showed the maximum yield earlier and tended to produce a larger yield than the erect ones.

Key words: fitted curves, abscission, yield of husk tomato

Resumen

El desarrollo de diferentes partes reproductivas del tomate de cáscara fue investigado y se presenta en forma de curvas. Estas curvas estuvieron basadas sobre datos reales o sobre datos obtenidos de ecuaciones de regresión. El número de botones florales y de flores que se encontraron en la planta alcanzaron su máximo 9 semanas después de la emergencia (DE) y un máximo secundario hacia el fin del experimento. Los botones florales y las flores producidas hacia el final del experimento ya no tuvieron oportunidad de formar frutos de tamaño comercial. El número de frutos alcanzó el máximo valor 11 semanas DE pero una gran proporción de ellos se cayeron antes de llegar a 2 cm diámetro. Las plantas de tipo rastrero produjeron su cosecha máxima más temprano que las plantas erectas.

INTRODUCTION

This paper is the continuation of an earlier one (Cartujano et al. 1985) in which the vegetative growth of the same plants was described.

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Some other results from the same experiment concerning the stem branching habit and its relation to fructification, were published earlier (Mulato et al. 1985). In the present paper the development of the reproductive parts is presented.

The characteristic feature of the husk tomato plant is that it forms only 3-5 internodes in the main axis (juvenile stage of development). The last of them terminates with a node which forms a flower bud, a leaf and 2 laterals. Each of these laterals produces only one internode with a node bearing the same set of appendages: one flower bud, one leaf and 2 laterals. This "module" repeats constantly up to the end of the life of the plant (dichasium type of ramification) (Mulato et al. 1985). Due to this type of development the number of nodes which appear increases gradually, and since each node bears a flower bud, the number of reproductive parts increases as the plant grows. The only modification which sometimes occurs in this scheme is that a node bears one flower bud, one lateral, and 2 leaves, which diminishes the number of ramifications formed (Mulato et al. 1985).

MATERIAL AND METHODS

As mentioned in the earlier paper (Cartujano et al. 1985), the experiment was done in the Agricultural Experiment Station in Zacatepec, in central Mexico, during the dry period of the year (Oct. 31-Feb. 13). The cultivar 'Rendidora' was used (Saray 1982). The plants of this cultivar show two types of growth: prostrated and erect (see Mulato et al. 1985). Due to this, the results are presented separately for each of the types, with the exception of the period up to the 5th week after emergence (AE) when they were indiscernible from each other.

Samples of the plants were taken weekly up to the 7th week AE and thereafter each 2nd week with the exception of the last two samples collected with one week interval (13th and 14th week AE). The plants were cut, divided into parts, dried and weighed. For some other details of the methods see Cartujano et al. (1985). The reproductive parts of the plant were assigned, into one of 4 classes according to their size or stage of development:

Flower buds: a) less than 2 mm in diameter, b) 2-4 mm, c) 4-6 mm and d) more than 5-6 mm in diameter and with yellow petals and/or pistil emerging.

Flowers: a) open flower with erect petals, b) inclined petals, c) corolla already closed after probable pollination, d) corolla partly wilted with brown coloration.

Fruits: a) less than 2 cm in diameter, b) 2-3 cm, c) 3-4 cm, d) more than 4 cm in diameter.

The statistical work-up of the results was the same as in the earlier paper (Cartujano et al. 1985).

RESULTS

The development of reproductive parts. Flower buds started to appear during the 3rd week AE, but were registered in the form of a curve from the 5th week AE (Fig. 1). In the prostrated plants, the number of flower buds of class "a" showed 2 maxima: the first — 7 weeks AE,

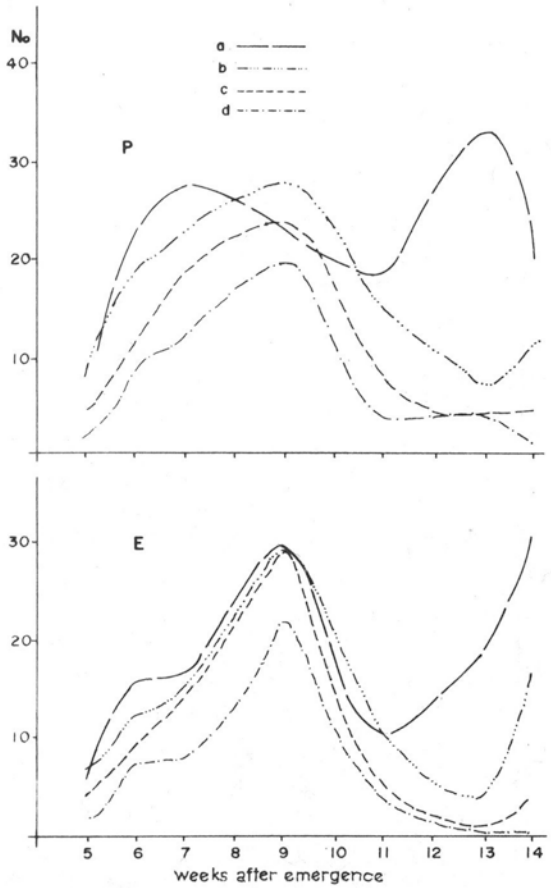

Fig. 1. Number of flower buds in postrated (P) and erect (E) plants of the husk tomato. a-d — four classes according to the size of the buds (see Material and Methods). The curves are based on the real data

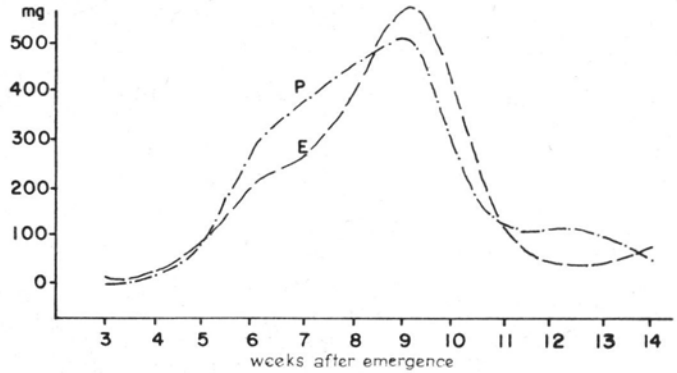

Fig. 2. Dry mass of the flower buds in prostrated (P) and erect (E) plants. Curves based on real data

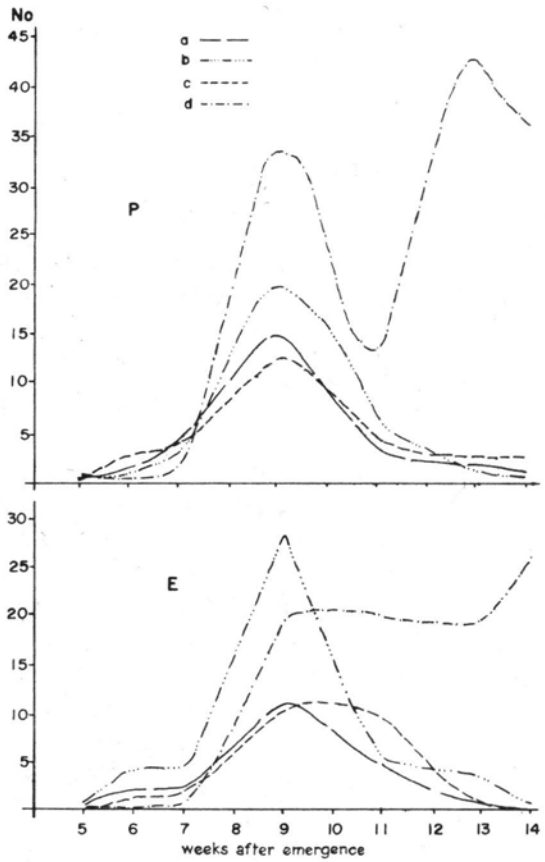

Fig. 3. Number of flowers in prostrated (P) and erect (E) plants. a-d – different stages of flower development (see Material and Methods). Curves based on real data

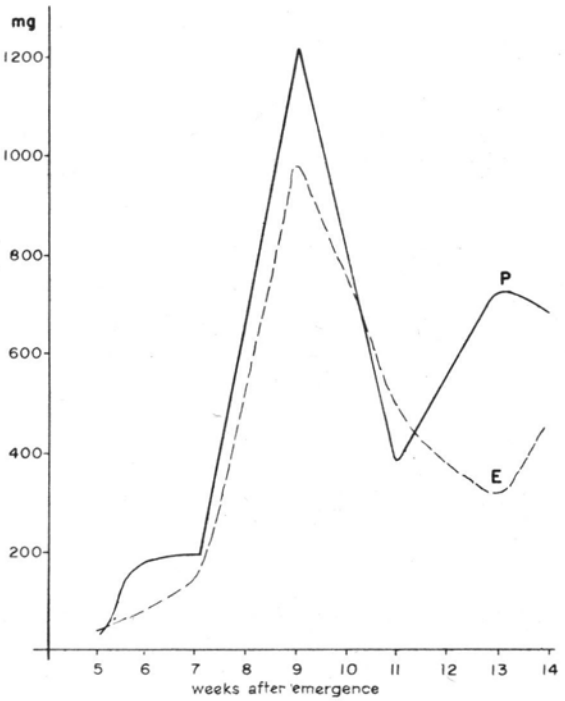

Fig. 4. Total dry mass of flowers in prostrated (P) and erect (E) plants. Curves based on real data

and the other — 13 weeks AE. Flower buds of all other classes showed a maximum at the 9th week AE. In the erect plants the number of flower buds of all classes reached a maximum 9 weeks AE and the buds of class *a* and *b* an additional peak at the end of the experiment (14th week AE). It is obvious that the buds present in the plant during this last period of its life had no opportunity to form a fruit or, sometimes, even a flower due to a moderate rate of development of reproductive parts. The total dry mass of flower buds (Fig. 2) showed a maximum at the 9th week AE for both types of plants, and an additional small peak occurred in the erect plants at the 14th week AE.

The number of flowers of all categories (Fig. 3) showed a miximum 9 weeks AE for both types of plants and the flowers of the largest class presented an additional maximum toward the end of the experiment. This behaviour is also reflected by the total dry mass of flowers (Fig. 4).

The characteristic trait of the variable "number of fruits" (Fig. 5A and B) is that fruits of class *a* are much more numerous than all others (compare also Mulato et al. 1985). This may reflect the phenomenon that the fruit needs more time to reach the diameter of 2 cm than to pass from 2 cm

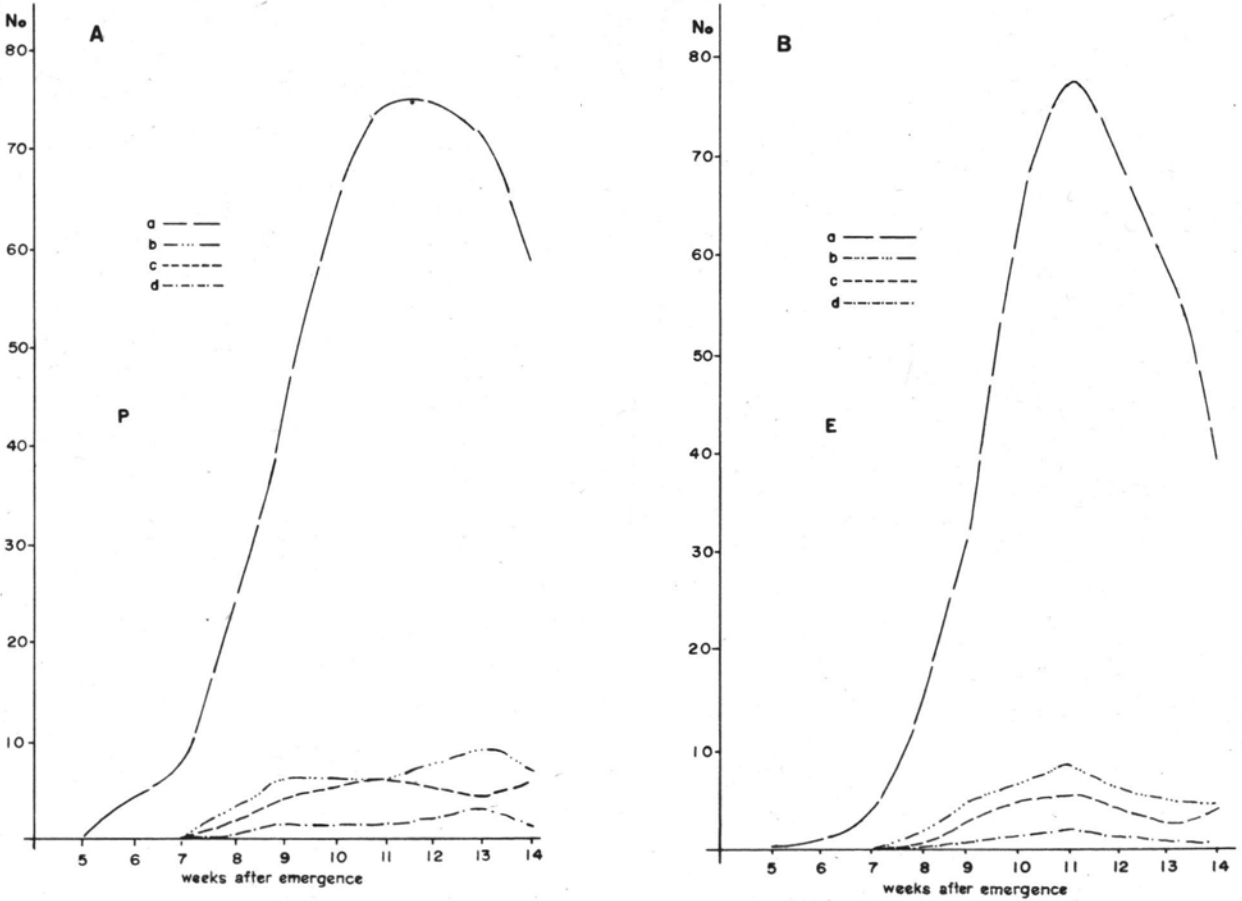

Fig. 5A and 5B. Number of fruits in prostrated (P) and erect (E) plants. Curves based on real data; a-d — see Material and Methods

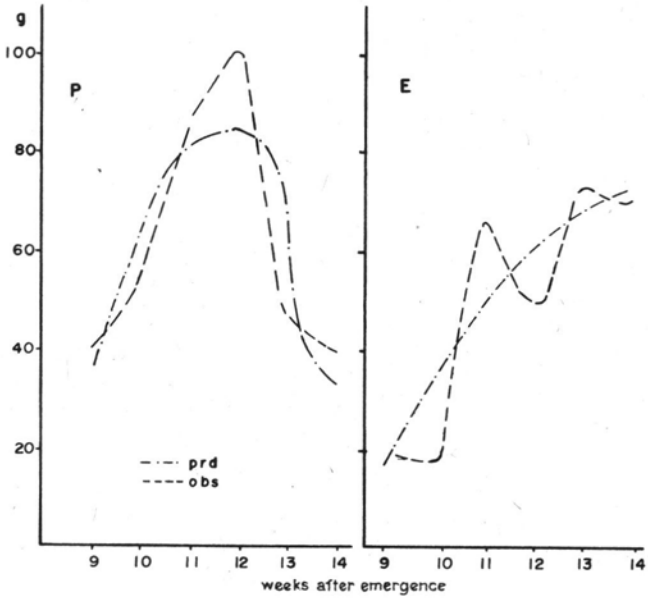

Fig. 6. Fresh mass of the harvested fruits in the prostrated (P) and erect (E) plants. Prd — fitted curves based on regression equations, obs — curves based on the real observed data

to 3 cm or from 3 cm to 4 cm in diameter. However, this may also mean that the fruits of class *a* abscise readily and many of them never reach size of 2 cm. The results of Mulato et al. (1985) show indeed that shedding of fruits of class *a* occurs in the husk tomato on a large scale. In both types of plants, the number of fruits of size *a* reached its maximum 11 weeks AE. The fruits of other size classes, in prostrated plants, occured in rather similar number throughout the experiment with a low maximum for class *c* at the 11th week AE and for class *b* and *d* at the 13th week AE. In the erect plants, the number of fruits of all classes reached its maximum at the 11th week AE and those of class *c* an additional peak at the 14th week AE.

The first fruits were harvested 5 weeks AE, but the commercial harvests began at the 9th week AE (Fig. 6). The maximal weekly harvest was observed in prostrated plants at the 11th week AE and in erect plants at the 13th and 14th week AE. This supports the observation expressed in our earlier paper (Cartujano et al. 1985) that the life cycle of prostrated plants is shorter.

The general opinion among the growers is that prostrated plants are more productive. Our results partly support this view. During the 6th and 7th week AE the prostrated plants produced more flower buds,

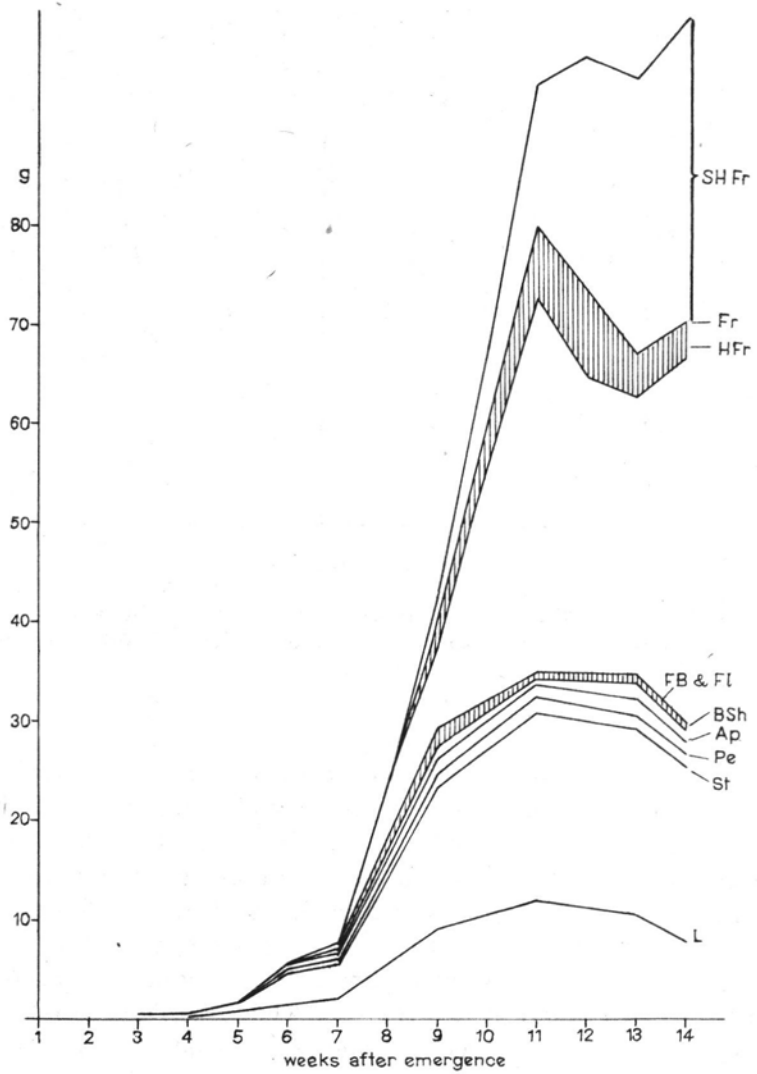

Fig. 7. Participation of particular parts in a dry mass of a plant. L — leaves, St — stems, Pe — petioles, Ap — apices (apical parts which have internodes less than 1 cm), BSh — basal shoots growing on the primary axis, FB and Fl — flower buds and flowers, Fr — fruits in general, HFr — harvested fruits, SHFr — the sum of harvested fruits

flowers and fruits (Table 1), and later on, during the 9th and 10th week AE produced a larger early harvest (Table 2). During the following weeks (11th-14th) the fresh and dry mass of harvested fruits did not differ significantly in plants of both types. The total yield of prostrated plants tended to be higher (Table 2). These results show that the prostrated plants of the 'Rendidora' are earlier bearers and tend to produce more.

Table 1

Comparison of the number and mass of the reproductive parts in prostrated (P) and erect (E) plants. The statistical method of paired plots was used

The variable (dry mass in mg, total number in pieces)	6th week AE			7th week AE		
	P	E	Signi-ficance at 0.05	P	E	Signi-ficance at 0.05
Flower buds (dry mass)	318.3	204.7	+	371.2	241.9	+
Flower buds (total No.)	63.9	45.2	n.s.	80.6	51.5	+
Flowers (dry mass)	174.5	88.4	+	188.5	130.9	n.s.
Flowers (total No.)	10.6	5.6	+	12.8	8.6	+
Fruits (total No.)	3.8	1.8	+	7.5	3.3	+

Table 2

Comparison of the number and fresh and dry mass of fruits of prostrated (P) and erect (E) plants during the first commercial harvests at the 9th and 10th week after emergence (AE) (for other details see Table 1)

The variable	9th week AE				10th week AE				Total yield	
	P	E	significance at		P	E	significance at		P	E
			0.05	0.1			0.05	0.1		
Number of fruits	1.7	0.9	+	+	2.4	1.0	–	+	17.8	14.9
Fresh mass, g	39.1	18.9	+	+	54.9	18.2	–	+	365.7	289.3
Dry mass, g	2.7	1.4	+	+	4.2	1.6	+	+	29.9	25.1

The graph presenting the participation of vegetative and generative parts in the total dry mass of a prostrated plant (Fig. 7) demonstrates that it produces a substantial dry mass of fruits, of which, however, only a small part could be harvested. All other fruits are shed or are destroyed by insects and diseases. This graph shows the best where the efforts of the breader should be directed. The graph for the erect plants is in its general aspect the same, so it may be omitted.

DISCUSSION

Saray (1977) writes that the life cycle of 'Rendidora' plants in Zacatepec, Morelos, i.e. in the same place where this experiment was done, lasts 11-12 weeks. Instead, we have found 14 weeks. Saray also found that the appearance of the first flower buds flowers and fruits was at the 13th, 23rd and 35th day AE, respectively. In our experiment the analogical

dates were: 21st, 28th and 35th day AE. This difference could be caused by the variation in the climatic contitions in particular years. The important factor is that the life cycle of husk tomato is very short. Due to this, in the USSR this plant was succesfully cultivated even in the Leningrad, and Vladivostok regions (Medvedev 1985). The total number of harvested fruits was somewhat higher in our experiment than in experiments of Saray (1982) and Cárdenas (1981).

As it was mentioned, the husk tomato plant produces an increasing number of flower buds as it gets more and more ramified. However, the total dry mass of all buds (Fig. 2) reaches its maximum at the 9th week AE and then decreases. This decrease does not mean that flower buds are not produced in increasing numbers, however, they get smaller and probably are shed in an increasing proportion (observations not quantified, see also Mulato et al. 1985). Many of them which are formed toward the end of the plant life have no chance to produce a fruit or even a flower. From the economic point of view, formation of flower buds during the last period of plant life means only a waste of plant energy.

The peak of flower formation occurs also during the 9th week AE (Fig. 4). The other maximum occurs at the end of plant life. A method should be found to avoid this late blooming which only exhausts the plant.

The maximum of fruit production comes at the 11th week AE, i.e. 2 weeks after the maximum number of flower buds and flowers occurs. Probably, due to the great number of fruits present at the same time on the plant, they compete strongly with each other for the limited supply of nutrients and in consequence, a great proportion of them are shed not reaching commercial size. This also causes great wasting of the chemical energy of a plant — a problem which should be improved by breeders. As shown by Mulato et al. (1985) abscission of small fruits mainly occurs from the apparent lateral and sublateral branches and much less from the apparent main branches.

Our results show that the prostrated plants are early bearers in comparision with the erect ones. From the economic point of view early bearing is an adventage because the plant may avoid the attacks of insects and diseases which are usually intensified towards the end of plant life.

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Rozwój miechunki skórzastej (Physalis ixocarpa Brot.). II. Części generatywne

Streszczenie

Opisano rozwój części generatywnych miechunki skórzastej uprawianej na nawadnianym polu, w warunkach pory suchej w środkowym Meksyku. Wyniki przedstawiono w postaci wykresów z danych rzeczywistych lub skorygowanych przy użyciu analizy regresji. Liczba pąków kwiatowych i kwiatów istniejących na roślinie była największa 9 tygodni po wzejściu i miała dodatkowy szczyt pod koniec doświadczenia. Te późno wytworzone pąki kwiatowe i powstałe z nich kwiaty i owoce nie miały już szans na wytworzenie owoców handlowej wielkości. Liczba owoców znajdujących się na roślinie była największa w 11 tygodniu po wschodach, jednak duża część tych owoców opadła nie dorósłszy do średnicy 2 cm. Rośliny płożące się owocowały wcześniej niż rośliny typu wyniosłego i miały tendencję do lepszego owocowania.