

Figure 1. Evolution de l'activité RuBP carboxylase en fonction de l'étage foliaire.

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EFFECTS OF DEFOLIATION DURING SEED FILLING OF SUNFLOWER.

F. CARDINALI, V.R. PEREYRA, C. FARIZO and G.A. ORIOLI

EERA Balcarce, INTA and Fac. Ciencias Agrarias, U.N.M.P., 7620, Balcarce, Argentina.

ABSTRACT

The effects of total defoliation of sunflower at different times during the seed filling phase were studied under field conditions at the EERA-INTA, Balcarce, Argentina, during the 1980 — 81 season. Plants were defoliated 7, 14, 21, 28 and 40 days after flowering (anthesis), and the dry matter of plant components was determined both at the time of defoliation and at physiological maturity.

The results indicate that defoliation early after flowering caused a marked decrease in harvest index, biological yield

and economic yield, and its components seed number and 1000 seed weight. The effects of defoliation became less severe as plants approached physiological maturity. On the basis of these, and other, results a model of the effect of defoliation at different growth stages is proposed.

INTRODUCTION

The variation in the economic and biological yield of crops is explained by physiological and morphological characteristics and their interaction with the environment, e.g. foliar area, its duration and photosynthetic efficiency.

Even though the leaves are the principal photosynthetic organs that supply the carbohydrate required for the development of the crop, they are not the only plant parts responsible for the process (Rawson *et al.*). Every green part has a photosynthetic capacity and, therefore, can contribute to crop yield. Damage to leaves caused by insects, diseases and non-biological factors such as wind and hail can severely affect the timing and magnitude of the defoliation in field conditions.

There are numerous investigations reported in the literature that attempt to evaluate the effect of defoliation on the economic yield of the crop, including data on the importance of the different leaves or, in other cases, the canopy strata on grain filling (Beltrano *et al.*, 1977; Kasaryan *et al.*, 1977; McWilliam *et al.*, 1974; Patil *et al.*, 1979; Peheira *et al.*, Pereira, 1974; Potdar *et al.*, 1977; Sackston, 1959; Saumell, 1974 and Singh *et al.*, 1977). The effect of the loss of foliar area on the root growth and its absorption capacity is mentioned also (Curtis *et al.*, 1950; Frossard, 1976; Kasaryan *et al.*, 1977; McWilliam *et al.*, 1974).

In other cases, the decisive importance of stem, sheath and inflorescence in the event of loss of most or all leaf photosynthetic surface, particularly in the last period of development of some plants, is apparent (Evans *et al.*, 1976; Rawson *et al.*, 1980).

The present work was conducted to determine the importance of the stem and head as reserve and photosynthetic organs in circumstances of severe losses of foliar area.

MATERIALS AND METHODS

The trial was conducted in the experimental field of the EERA-INTA, Balcarce, Argentina (lat. S 37°45'; long. W 58°18'; altitude 130 m) during the 1980/81 season. The cultivar used was Dekalb G-98, a short cycle commercial hybrid, at a density of 28,600 plants per hectare. Sowing, germination, flowering, physiological maturity and harvest times were: 6/11/80, 16/11/80, 28/1/81, 8/3/81 and 5/4/81, respectively.

The design was a randomized complete block with 5 replications. The treatments were total defoliation (removal of all the laminae) carried out at five times: 7, 14, 21, 28 and 40 days after flowering.

At each defoliation time 10 plants were selected, of which 5 were defoliated as indicated previously, and 5 were used to determine the dry weight of each organ; this indicated the plant conditions at the times the treatment was applied.

RESULTS AND DISCUSSION

Total dry weight and its components as an average of the 5 replications can be seen in Table 1. Each observation date coincides with each defoliation time. Total dry weight and its components at harvest time, for each treatment and control, are shown in Table 2.

Table 1. Dry weight of plant components of sunflower at the time defoliation treatments were imposed.

Treatment (Days after flowering)	Receptacle g plant ⁻¹	Seed g plant ⁻¹	Stem g plant ⁻¹	Leaf g plant ⁻¹	Total g plant ⁻¹	Total-Leaf g plant ⁻¹
7	68.6	18.2	90.6	85.5	262.9	177.4
14	110.4	30.5	109.0	95.8	345.7	249.9
21	90.5	74.3	130.2	82.7	377.7	295.0
28	95.6	103.6	108.4	75.8	383.4	307.6
40	67.4	139.3	117.8	65.2	389.7	324.5
Control	86.4	115.1	131.2	44.2	376.9	334.7

Early defoliation severely affected total dry weight and its components (Table 2), principally head dry weight, but the severity of the effect decreased at more advanced stages of the cycle, and there was no effect when defoliation coincided with physiological maturity (40 days after defoliation).

Table 2. The effect of total defoliation at different times during seed filling on final dry weight of plant components, and yield of sunflower.

Treatment (Days after flowering)	Receptacle	Seed	Stem	Petiole	Total
7	55.2	25.9	87.0	8.3	176.4
14	59.7	33.9	88.9	7.8	190.3
21	69.9	96.4	100.8	7.4	274.5
28	80.5	112.8	115.9	9.8	319.0
40	105.2	131.4	151.6	8.7	396.9
Control	86.4	115.1	131.2	44.2*	376.9

The economic yield was negatively affected, principally by the earliest treatments, due to a decrease in both seed number and weight (Table 3), but with a more marked negative effect in number than in weight.

Table 3.

Treatment (Days after flowering)	No Seeds/Receptacle	Weight of 1000 Dry Seeds	Economic Yield	Harvest Index (%)
7	620 a	42.2 a	740.2 a	14.7
14	669 a	48.6 a	963.8 a	17.8
21	1,345 a	72.0 b	2,751.3 b	35.1
28	1,537 b	74.3 b	3,227.2 b	35.4
40	1,539 b	85.9 b	3,695.1 b	33.1
Control	1,609 b	72.4 b	3,290.7 b	33.8

Harvest index (Table 3) was severely reduced by defoliation 7 and 14 days after flowering. In normal conditions, virtually all of the assimilates produced during this growth stage are used in fruit growth. However, defoliation and the associated loss of photosynthetic activity caused abortion of many of the fruits in the centre of the head and/or loss of fruit weight. Due to the total loss of foliar area, the plant must use reserve substances previously accumulated principally in the head and stem for fruit formation. Some photosynthesis may also take place in the remaining green surfaces.

The receptacle, by having a green surface and a terminal

position, intercepts a high level of radiation and, due to the closeness of the seed, can be a very important source of carbohydrates for grain filling (Rawson and Constable, 1980).

A summary of the information from the current study, and of the data compiled from other sources, on the effects of defoliation is shown in Figure 1. This indicates that the period between the emergence of the floral bud and the end of flowering is the most sensitive to the loss of the leaves. A total defoliation in that period produces the total loss of economic yield. Earlier or later defoliations, or less intense defoliations, produce smaller losses.

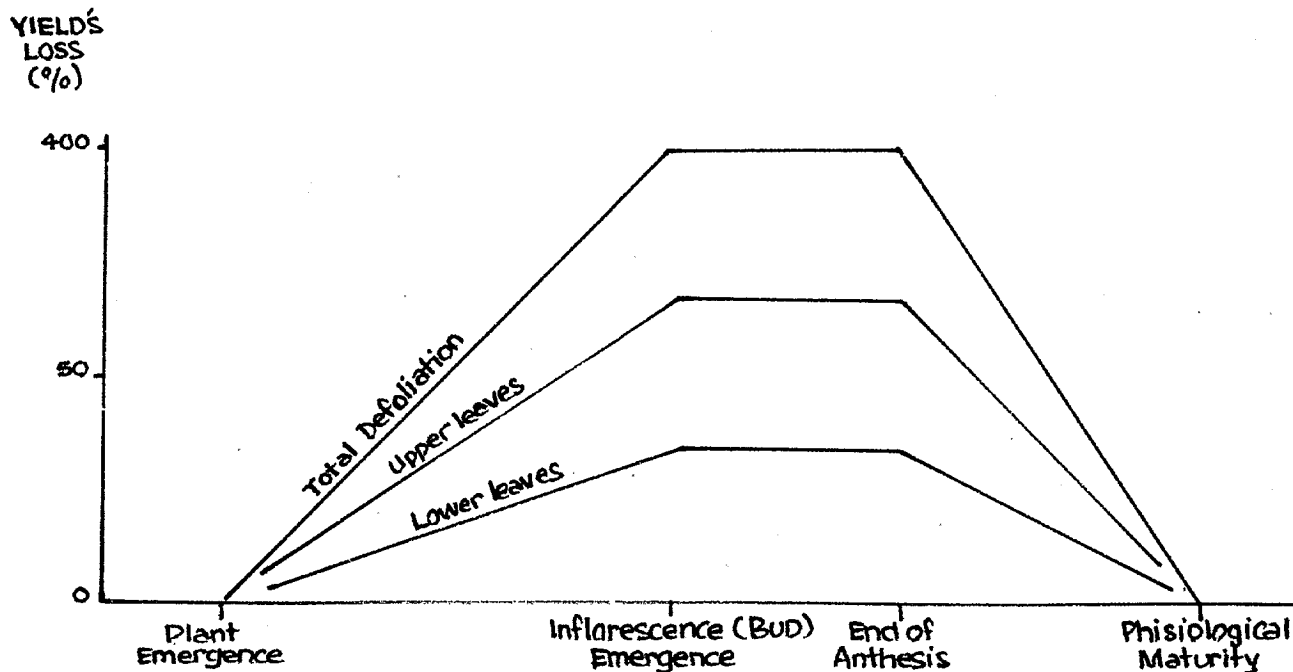


Figure No. 1. Estimation of yield loss with total, 50% (upper leaves) or 50% (lower leaves) defoliations.

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