# SUNFLOWER PLANT CHARACTERISTICS ASSOCIATED WITH PHYSIOLOGICAL MATURITY

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## SUMMARY

At the University of Rio Grande do Sul several plant characteristics associated with physiological maturity were determined during three years on several sunflower genotypes. As reference, physiological maturity was considered when achenes dry weight achieved 95% of its maximum. At this stage, bracts and back of the head coloration ranged from yellow to yellow-brown. The color was not the same for all genotypes but, within each of them was similar across years. The negative aspect of this indicator is that the color remains about the same for a week, thus affecting the accuracy of the reading.

Achenes moisture content varied from 30 to 45% at maturity. It was not constant among years for every genotype.

Receptacle moisture was determined for two years. Water content was constant from flowering up to physiological maturity but water loss started at the onset of maturity. This occured for all genotypes fn both years. Another characteristic was floret abscission. For some cultivars abscission just began at maturity while for others up to 50% had already occurred.

## SUMARIO

En la Universidad de Rio Grande do Sul fueron determinadas, durante 3 años, algunas características de la planta associadas a la madurez fisiológica en varios genotipos de girasol. Como referencia, fue considerada la madurez fisiológica cuando el peso seco de los aquenios alcanzó 95% de su máximo. En ese punto, el color de las brácteas y de la face dorsal del capítulo varió de amarillo a amarillo-marron. El color no fue el mismo para todos los genotipos pero, para cada genotipo, fue el mismo en todos los años. El aspecto negativo de este indicador es que el color permanece aproximadamente igual durante una semana, afectando asi la precisión de la lectura.

La humedad de los aquenios varió de 30 a 45% en el momento de la madurez, y no se mostró constante entre años para cada genotipo.

La humedad de los capítulos fue observada durante 2 años. El contenido de agua permaneció constante desde el florecimiento hasta la madurez fisiológica y la pérdida de agua empezó al principio de la madurez. Esto fue observado para todos los genotipos en ambos años. Otra característica observada fue la caída de las flores. Para algunos cultivares, la caída de las flores apenas empezó con la madurez, mientras que, para otros, ya habia ocurrido hasta 50%.

## INTRODUCTION

Characterizing physiological maturity is important, from the point of view of crop production, to define management decision such as irrigation and harvest procedures. Achene dry weight is maximum at maturity following then moisture loss depending on temperature, radiation, and wind conditions.

Physiological maturity has been associated with several morphological characteristics. Schneiter and Miller (1981) described this stage of

development when the bracts become yellow and brown and the back of the head begins to turn brown. Physiological maturity is also identified by floret abscission. On a plant basis, Browne (1978) showed good agreement between the date of maximum achene dry weight and the middate between the first and the last floret abscission. On a crop basis, Browne (1978) considered maturity as the date when 70% of the crop had floret abscission complete.

Achene moisture at physiological maturity varies between 32 and 45% according to several authors (Anderson, 1975; Robertson et al., 1978; Goyne et al., 1979), being this an approximate measure only, since it is affected by environmental conditions. Capitulum moisture was recorded by Anderson (1975) to be about 70% at maximum achene dry weight.

## MATERIAL AND METHODS

This work was done for three years (1984, 1985, and 1986) at the Agronomy Farm of the Univ. Rio Grande do Sul, Brazil (30°S). Seven sunflower cultivars were used: Issanka, Conti-112, Conti-233, Conti-422, Conti-711, Contisol, and DK-180. All are hybrids except for the first one. Every year the soil was adequately fertilized (NPK) and 60-80 kg/ha N were side-dressed at 30 days after emergence. Plant density was 50,000 plants/ha, with 0.7 m between rows. Seeding was always done at mid-August. Whenever necessary, supplemental irrigation was used. A randomized block design was used with four replications.

Time recordings for achene dry weight, achene moisture, and capitulum receptacle moisture were taken, starting when plants had 50% of the disk flowers in anthesis. For each plot, all plants at the same stage of development were tagged and used in subsequent sampling. At weekly intervals, the average area of the capitulum on which floret abscission had occurred was determined for the plot tagged plants. Also, the color of the bracts and back of the receptacle were recorded. At the same date, during the morning, five plants/plot were sampled. Capitula were hand threshed and moisture of both achenes and receptacles was measured on a dry weight basis.

## RESULTS

Physiological maturity was determined when 95% of the maximum achene dry weight was achieved. The number of days from anthesis (50% of the disk flowers in this stage) to maturity was variable between cultivars and years (Table 1). Early cultivars (Issanka and Conti-112) had the same cycle up to flowering but variable achene filling period. Medium cultivars (DK-180, Conti-711, and Conti-422) showed approximatelly the same filling period, few days shorter than late cultivars (Contisol and Conti-233). The 1985 growing season was severely dry and hot and, despite irrigation, the filling period was shorter (4 to 7 days) than other years (Table 1). Conti-233 shortened the period to 24 days in 1986 due to severe lodging at anthesis (Table 1).

Bracts and back of the head coloration (Table 2) varied from yellow to yellow-brown. On four cultivars (one early and three medium) the yellow color occurred at maturity at all years. For one early and both late cultivars the bracts were yellow-brown and the back of the head yellow to yellow-brown.

Floret abscission, as determined by the average capitulum area where it occured, showed large variation between cultivars (Table 2). For some of them, like DK-180, abscission occurred at the onset of maturity; most of others (especially Conti-233) started well before. For all cultivars, abscission was less in the dry year (1985).

Achene moisture content (Table 1) varied from 30 to 45%. There was a considerable variation among years and cultivars. Receptacle moisture was followed during two years (1985 and 1986) and it remained constant (88-90%) between flowering and physiological maturity. When the later stage occurred, there was a decrease in 1-2% (Table 1) and then the receptacle started to dry rapidly. This phenomenon occurred for all cultivars and years even when the plants lodged at anthesis, as was the case with Conti-233, which reduced the filling period to only 24 days (Table 1).

## DISCUSSION

Achene filling period was relativelly short (30 to 35 days in most cases) and varied according to cultivars and environmental conditions. Some of the plant characteristics associated with physiological maturity were affected by these factors.

The back of the head and bracts color, as indicated by Schneiter and Miller (1981), was constant across years for the same cultivar. Nonetheless, it did not appear as a precise indicator because the color remained the same for several days and varied between cultivars (Table 2), being also affected by conditions such as lodging (which occurred with cv. Conti-233 in 1986) or the incidence of capitulum diseases. Floret abscission can be a convenient criterium provided local (environmental) and genotype influences are considered. Brown (1978) questioned if this criterium could be extended to all environments.

Achene dry weight was utilized as reference for physiological maturity. Its use requires sampling over a long period of time (to get at least part of the curve) and samples have to be large due to variations in achene weight between capitula and within the same capitulum.

The data shown for achene moisture (Table 1) are coincident with those in the literature (Anderson, 1975; Goyne et al. , 1979; Robertson et al., 1978), also proving a poor indicator. At physiological maturity, water content diminishes at a high daily rate, and the occurrence of rains and even daily oscilation in air moisture can induce large variations. Besides, the moisture data may have been affected by the method of estimation. The method used was based on curves for weight and moisture content drawn from weekly samples. The 95% dry weight point was taken just before the weight curve turns horizontal, but errors of 1 to 2 days might be occurring and the date of maturity lies in an interval. Moisture, estimated on the moisture curve for the date of maturity previously obtained, should also be estimated within an interval in a period of sharp moisture decline.

Receptacle moisture was one of the best indicators due to the constancy of the moisture content between flowering and maturity. In all cases the onset of maturity coincides with the beginning of water loss (Table 1).

## CONCLUSIONS

The conclusions from this study were taken considering the cultivars tested and the growing conditions.

No plant characteristic visually determined was precise and easily associated with physiological maturity. The bracts and back of the head coloration was the most easily identified. Nevertheless, since the color remained constant for several days and may be affected by the environment, it was not an exact indicator. Floret abscission was not constant between years and cultivars.

Maturity was also determined from dry weight and moisture content curves. Achene dry weight requires sampling over a long time and a large sample size. Achene moisture could be related to physiological maturity only over a broad range of values. Receptacle moisture always started to decline at physiological maturity.

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TABLE 1. Achenes filling period (days), and achenes and receptacle moisture (%) at physiological maturity in seven sunflower cultivars during three years

| Cultivars | Achenes filling period (days) | | | Achenes moisture (%) | | | Receptacle moisture (%) | |
|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1986 | 1984 | 1985 | 1986 | 1985 | 1986 |
| Issanka[1/] | 32 | 27 | 31 | 44 | 49 | 45 | 88 | 89 |
| Conti-112[1/] | 29 | 21 | 28 | 45 | 43 | 43 | 86 | 86 |
| Conti-422[2/] | 33 | 28 | 33 | 36 | 42 | 32 | 87 | 88 |
| Conti-711[2/] | 33 | 29 | 33 | 47 | 44 | 40 | 89 | 89 |
| DK-180[2/] | 32 | 31 | 34 | 34 | 39 | 35 | 86 | 88 |
| Conti-233[3/] | 37 | 32 | 24* | 30 | 35 | 48* | 86 | 89 |
| Contisol[3/] | 36 | 30 | 42 | 30 | 36 | 36 | 85 | 88 |

[1/] Early cultivar [2/] Medium cultivar [3/] Late cultivar

* Severe lodging at anthesis

TABLE 2. Bracts and back of capitulum coloration and floret abscission at physiological maturity in seven sunflower cultivars and three years

| Years | Plant parts \ Cultivars | Issanka | Conti-112 | Conti-422 | Conti-711 | DK-180 | Conti-233 | Contisol |
|---|---|---|---|---|---|---|---|---|
| | | Bracts and back of capitulum coloration | | | | | | |
| 1984 | Cap. | Y* | Y | Y | Y | Y | YB | YB |
| | Bracts | YB** | Y | Y | Y | Y | B | YB |
| 1985 | Cap. | Y | Y | Y | Y | Y | YB | YB |
| | Bracts | YB | Y | Y | Y | Y | YB | YB |
| 1986 | Cap. | YB | Y | Y | Y | Y | B*** | YB |
| | Bracts | YB | Y | Y | Y | Y | Y | YB |

| Years \ Cultivars | Issanka | Conti-112 | Conti-422 | Conti-711 | DK-180 | Conti-233 | Contisol |
|---|---|---|---|---|---|---|---|
| | Floret abscission (% of the disk area) | | | | | | |
| 1984 | 20 | 5 | 20 | 26 | Zero | 90 | 40 |
| 1985 | 5 | 14 | 12 | 15 | 6 | 38 | 19 |
| 1986 | 30 | 33 | 19 | 48 | 10 | 35**** | 24 |

* = yellow ** = yellow brown *** = brown **** = severe lodging at anthesis