# ANTHESIS IN SUNFLOWER (Helianthus annuus L.)

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## SUMMARY

Anthesis in sunflower is a very important and beautiful moment. We hightlight its variations of duration and their consequences on the production.
The nitrogen, the interactions nitrogen density and nitrogen irrigation are studied for their impact on the anthesis duration. Moreover we present a new description of the anthesis stages.

## INTRODUCTION

Anthesis is a very important moment in the cause of two flowers types opens out. Because the differences of maturity of every florets anthesis have a various flowering duration. This duration is subject to a treble action : the floret number of capitulum, the duration of the fecund cycle to every floret and the climatical conditions. The two first factors are very tied to productive capabilities of the plant, and so the cultural conditions. We study the variations influences of three components on the anthesis duration, density, nitrogen and irrigation.

We present a classification of new anthesis stages all which show dynamic of anthesis.

## MATERIALS AND METHODS

Three experimental plans (in total randomization) are used and analysed by the variance analyse method and the test of homogenous groups to Newman and Keuls.
- Nitrogen influence : experimental plan with one factor (two nitrogen levels). Thirty plants of the cultivar "Pharaon" by plots.
- Nitrogen and density influence : experimental plan with two factors (two nitrogen and three density levels) and two blocks. Ten plants of the cultivar "Pharaon" by plots.
- Nitrogen and irrigation influence : experimental plan with two factors (two nitrogen and two irrigation levels) and two blocks. Ten plants of the cultivar "Mirasol" by plots.

## RESULTS

### 1) Influence to the nitrogen factor

We measure the stem diameter on collar at the floral initiation to show vigour in the course of youthful stages. The differences between the two groups are significant at the level $\alpha = 1\ \%$ for the two first variables. We see that anthesis duration is sensible to the nitrogen factor just as the vigour of the little plant (Cadeac,1988). We suggest a linear model which allow to compute the anthesis duration in function of the stem diameter measured at a youthful stage. We give the following equation :

Anthesis duration = 10,28 + (5,056 * Stem diameter at collar).

The peripheric achenes number is sensible to the nitrogen improvement. The connection between vigour of the little plant and anthesis duration be expressed through the floret number. When this number is growing he seems natural to verify a prolongation of anthesis duration. Moreover we know (Merrien et al., 1983) that the relation between yield and achenes number is tallest.

Picture 1 Nitrogen influence

| | Anthesis duration (days) | Stem diameter at collar (cm) | Capitulum diameter (cm) | Peripheric achenes number |
|---|---|---|---|---|
| 1 nitrogen level 0 u / ha | 13,68 | 0,715 | 20,98 | 1555 |
| 2 nitrogen level 120 u / ha | 16,21 | 1,135 | 20,43 | 1627 |

When the youthful stages are favoured, the number of initiate floret is important, the anthesis duration is long and the yield is better.

2) Influence to the arrangement of nitrogen and density factors

Picture 2 Variance analysis to the anthesis duration

| | S.C.E. | D.D.L. | F Test | Probability |
|---|---|---|---|---|
| Total Variance | 32,07 | 11 | | |
| Density Variance | 22,55 | 2 | 9,19 | 0,0222 |
| Nitrogen Variance | 0,01 | 1 | 0,01 | 0,9388 |
| Inter Density Nitrogen Variance | 3,00 | 2 | 1,22 | 0,3703 |
| Blocks Variance | 0,37 | 1 | 0,30 | 0,6109 |
| Residual Variance | 6,14 | 5 | | |

The effect of the density factor is significant to the level α = 5 %. It is, in this experimentation, the only significant factor. The density factor is accountable to a significant variation of anthesis duration.

To specify this statement we show the variation of duration imputable to evry density level through the following test.

Picture 3 Test of Newman and Keuls for the density factor

| Density factor | Means | Homogenous groups |
|---|---|---|
| 25.000 pl/ha | 14,18 | A |
| 100.000 pl/ha | 11,40 | B |
| 75.000 pl/ha | 11,15 | B |

This test show that only the small level of density is capable of variations to anthesis duration. The sunflowers cultivated in the small level of density are the first to begin anthesis (more than the half of them are flowering three days before the other one).

There is a great difference of floret number by plant between the high and low density level. The end of anthesis arrive at the same period for the twelve plots. Density is a very important source of variations, anthesis is particulary sensible because the exceptional vigour give to the little plants by the low competition level in the low density plots. The yield is significatively less in that plots because the increase of the floret number is not suffisant to make up for the important difference of density.

3) Influence to the arrangement of nitrogen and irrigation

The effect of irrigation factor is significant at the level α = 1 %. The mean duration of anthesis is incremented of a day under the influence of the irrigation factor. We think that an augmentation of the free water during anthesis prolong the setting up period of the floral elements.

This phenomenon retard the individual fade and prolong the anthesis duration.

The nitrogen factor is, in this experimentation, accountable of a significant difference of anthesis duration at the level α = 5 %. It increase the anthesis duration from one half day.

Picture 4 Test of Newman and Keuls for the nitrogen factor

| Nitrogen factor | Means | Homogenous groups |
|---|---|---|
| 80 + 80 u of N | 13,92 | A |
| 80 u of N | 13,52 | B |

Picture 5 Variance analysis to the anthesis duration

| | S.C.E. | D.D.L. | F Test | Probability |
|---|---|---|---|---|
| Total Variance | 2,25 | 7 | | |
| Irrigation Variance | 1,44 | 1 | 48,16 | 0,0049 |
| Nitrogen Variance | 0,32 | 1 | 10,67 | 0,0455 |
| Inter nitrogen irrigation variance | 0,08 | 1 | 2,67 | 0,2006 |
| Blocks Variance | 0,32 | 1 | 10,67 | 0,0455 |
| Residual Variance | 0,09 | 3 | | |

The time of the nitrogen improvement is a discrimination source in the yield. The second improvement at floral initiation favour the opens out longevity of every florets.

4) Anthesis stages

Anthesis in sunflower is a very dynamical phase. He is possible to describe this phase as the consequence of the passing of a centripetal wave. This wave affect the floret buds (F.B.) and start the flowering, caracterized by the stamens apparition (F.E.), then stigmata show off (F.S.) and finish by fade florets (F.F.).

Presence and position of the differents florets types allow to describe the succesive anthesis stages.

If the differents anthesis stages are caracterized by florets, phases of the begining and the end of anthesis are described by the peripheric flowers comportement.

Begining of anthesis is pronounced by the peripheric flowers turning yellow. The ones rise progressively from the capitulum, showing floret buds. Seven stages follow this begening, they authorize the description of this dynamical period.

Stage 1 : the central part is hold by florets F.B., the peripherical part is marked by F.E. florets. This stage ends when peripheric flowers are completely show off.

Stage 2 : Two zones are present on capitulum, they are hold by F.B. and F.E. florets, but they are greatest because the progression of the centripetal wave. The peripheric flowers are showed off during all this stage.
Stage 3 : three zones are now present, the first one in the center of the capitulum with F.B. florets, the second with F.E. florets and the peripherical one with F.S. florets.
Stage 4 : four zones are present in this stage, they are from center to periphery caracterized by the four florets types. Zone with F.B. florets, then F.E. florets, F.S. florets and now apparition of F.F. florets. This stage is the only one wich is absent in the little capitulum.
Stage 5 : Three zones caracterize the capitulum. It is the preceding central zone wich disappear because the centripetal wave is arrived in the center of the capitulum. Later on anthesis progress by the disappearance of stage 4 zones.
Stage 6 : the disappearing of F.E. florets leave two capitular zones. During this stage F.S. florets are out of pollen.
Stage 7 : F.S. florets are going out, capitulum is completely hold by F.F. florets.

Anthesis is finished, peripheric flowers fade and fall rapidely. These peripheric flowers are flowering during all the anthesis stages.

## CONCLUSION

The floret number present on the capitulum is responsible of the anthesis duration. It is possible to develop this floret quantity by modifications of the agronomical conditions during the youthful stages.

Nitrogen improvement at seedling increase the capabilities of numerous floret initiation. It is possible to augment the floret quantity by good nitrogen improvement during youthful stages. The direct consequence is an increase of anthesis duration, if this nitrogen improvement is suffisant it augment the number of full achenes and the oil percentage in seeds (Steer et al., 1983).

Moreover the later nitrogen improvement can't increase clearly anthesis duration and floret number, all the same they have consequences on the filling in level of achenes and the percentage of proteins in seeds (Steer et al., 1984 a et b).

The flowering duration of every floret increase the anthesis duration. Two factors are particulary capable to make longer the flowering, irrigation and certain nitrogen improvement. Irrigation instigate this extension, because it increase anthesis duration without augment significatively the number of florets. The sensibility of anthesis to an hydric adduction is clearly weak, but by prolonging the flowering duration of every floret it increase the fecundation probability of these ones.
The nitrogen improvement, at floral initiation, are them too responsible in a weak measure of the flowering duration increase for every floret. We have see that prolonging anthesis is responsible of a greatest precocity which increase the duration of the filling in phase.

The decrease of density is responsible of variations to anthesis duration. It is possible to increase precocity of anthesis by a decrease of density. The decrease of density increase productivity by plant and by surface unity if the density is not too less.

Finally the study of the duration of different anthesis stages allow to understand the causes of unfecundation of some florets. If anthesis stages (as stage 6) are too rapid an irrigation during anthesis can increase these stages and decrease clearly the number of unfeconded florets in the central zone.

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