

THE EFFECTS OF SOLAR RADIATION ON PLANT GROWTH

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ABSTRACT

Phase 1

Groups 1, 2, and 3

This phase of this continuing project was completed in April, 1994, using Dahlgren #855 hybrid sunflower seeds as **CONTROL** seeds. Data was recorded in a Data Log, and the results are included in this report.

Phase 2

(a) Groups 1a, 2a, and 3a

Three groups (1a, 2a, 3a) of plants will be grown using Dahlgren #855 hybrid sunflower seeds as **TEST** seeds, which were exposed to solar radiation aboard Space Shuttle Discovery on Flight STS-60 in February, 1994. Data will be taken and recorded in a Data Log, and compared directly to data taken and recorded in Phase 1, and compared to the other data recorded in this experiment.

(b) Groups 4, 5, and 6

Three groups (4, 5, 6) of plants will be grown using Park Seed #0950 non-hybrid sunflower seeds as **CONTROL** seeds. Data will be taken and recorded in a Data Log, and compared directly to data taken and recorded in Phase 2 (c), and compared to the other data recorded in this experiment.

(c) Groups 4a, 5a, and 6a

Three groups (4a, 5a, 6a) of plants will be grown using Park Seed #0950 non-hybrid sunflower seeds as **TEST** seeds, which were exposed to solar radiation aboard Space Shuttle Discovery on Flight STS-64 in September, 1994. Data will be taken and recorded in a Data Log, and compared directly to data taken and recorded in Phase 2 (b), and compared to the other data recorded in this experiment.

Phase 3

Groups 7a, 8a, and 9a

This phase will be undertaken, beginning in February 1996, to determine

the effects of solar radiation on second generation plant growth. Several radiated Park Seed #0950 seeds will be planted in the family garden this summer, and the seeds from producing plants will be used to make the determination, using the data recorded in this phase compared to the data recorded in the other phases of this experiment.

INTRODUCTION

Phase 1

Phase 1 of this project was completed in April, 1994, using Dahlgren #855 hybrid sunflower seeds as control seeds, Groups 1, 2, and 3. The Data Log and Written Report for Phase 1 are included as part of the current display.

Phase 2

One-half of a one pound lot of Dahlgren #855 hybrid sunflower seeds were exposed to solar radiation aboard the Space Shuttle Discovery Flight STS-60 during the month of February, 1994.

One-half of a one pound lot of Park Seed #0950 non-hybrid sunflower seeds were exposed to solar radiation aboard the Space Shuttle Discovery Flight STS-64 during the month of September, 1994.

This phase of the project is performed using Dahlgren #855 hybrid sunflower seeds as test seeds, from the one-half lot which was exposed to solar radiation; Park Seed #0950 non-hybrid sunflower seeds as control seeds, from the one-half lot not exposed to solar radiation; and Park Seed #0950 non-hybrid sunflower seeds as test seeds, from the one-half lot which was exposed to solar radiation.

Dahlgren #855 was developed for rapid germination and growth, and high yield and oil content.

Park Seed #0950 sunflower seeds are Helianthus of the Large Flowered Giganteus genus.

The total time required for development of a sunflower plant and the time between the various stages of development depends on the genetic background of the plant and the growing environment.

Shortly after germination the plants enter the vegetative emergence stage, which is described as the stage after the seedlings have emerged and the first leaves are less than 4 cm long.

The various vegetative stages, or V(numbers), are determined by counting the number of true leaves, those leaves at least 4 cm in length, beginning with V1, V2, V3, V4, etc. Should the lower leaves wither and fall, the leaf scars are counted to determine the proper stage.

There are nine stages to the reproductive cycle beginning with R1, where the terminal bud forms a miniature floral head rather than a cluster of leaves. When viewed from directly above, the immature bracts form a

many-pointed star-like appearance. R2 is reached when the immature bud elongates 0.5 to 2.0 cm above the nearest leaf attached to the stem. Leaves that are attached directly to the back of the bud are to be disregarded. R3 is reached when the immature bud elongates more than 2.0 cm above the nearest bud. R4 is reached when the inflorescence begins to open, and ray flowers are visible. R5 is the beginning of flowering. The stage can be divided into substages dependent upon the percent of the head area that has completed or is in flowering. Example - R5.1 = (10%), R5.8 = (80%). R6 is reached when flowering is complete and the ray flowers are wilting. R7 is reached when the back of the head has started to turn a pale yellow color. R8 is reached when the back of the head is yellow but the bracts remain green. R9 is reached when the bracts become yellow and brown. this stage is regarded as physiological maturity.

Hypothesis:

Through this experiment I expect to prove that there will be some significant adverse effects of solar radiation on seed germination, plant growth, or uniformity, or any combination of these.

THE EXPERIMENT

Phase 1

The procedures used in Phase 1 of this project are included in the Written Report for Groups 1, 2, and 3, which is a part of the current display.

Phase 2

Groups 1a, 2a, and 3a: Dahlgren #855 hybrid sunflower seeds, as test seeds, with two seeds planted in a six inch planting pot for each group, with each group having a different soil type. Groups and plants will be identified as marked on their respective planting pots.

Groups 4, 5, and 6: Park Seed #0950 non-hybrid sunflower seeds as control seeds, with two seeds planted in a six inch planting pot for each group, with each group having a different soil type. Groups and plants will be identified as marked on their respective planting pots.

Groups 4a, 5a, and 6a: Park Seed #0950 non-hybrid sunflower seeds as test seeds, with two seeds planted in a six inch planting pot for each group, with each group having a different soil type. Groups and plants will be identified as marked on their respective planting pots.

Two seeds from each one-half lot will be placed in tissue and water to determine the germination time.

Tap water will be measured and added as needed.

Germination, vegetative stages, reproductive stages, and uniformity will be observed and recorded.

Measurements of height of each plant will be taken and recorded.

All data collected during this experiment will be compared.

Results and conclusions will be recorded.

All data collected and observations made will be kept in a Data Log, one for each group, according to the following schedule: Daily for the first twenty days; every second day beginning the twenty second day; every fourth day beginning the forty second day, until this phase of the experiment is completed.

DISCUSSION

This portion of this report will be divided into two sections. The first section will discuss the results of the experiment, through the twenty sixth day. The second portion will discuss the conclusions based upon the results.

Dahlgren #855 -- Germination

Group	Lot	Soil Type	Germination Time	** % Seeds	% Plants
1	Control	Potting	27 hours	100%	100%
2		Sandy			100%
3		Potting/Sandy			100%
1a	Test	Potting	68 hours	100%	100%
2a		Sandy			50%
3a		Potting/Sandy			100%

** This column refers to the 2 seeds placed in tissue and water to determine germination time.

Rate

1. Control = 100%

2. Test = 87.5%

a. Seeds = 100%

b. Plants = 83.3% **

** Group 2a - Plant #2; seed did not germinate.

Time

Test seeds took 2.5 times longer to germinate than Control seeds.

Park Seed #0950 -- Germination

Group	Lot	Soil Type	Germination Time	** % Seeds	% Plants
4	Control	Potting	45 hours	100%	100%
5		Sandy			50%
6		Potting/Sandy			100%
4a	Test	Potting	45 hours	100%	100%
5a		Sandy			100%
6a		Potting/Sandy			100%

** This column refers to the 2 seeds placed in tissue and water to determine germination time.

Rate

Control = 87.5%

- a. Seeds = 100%
- b. Plants = 83.3% **

Test = 100%

** Group 5 - Plant #2; seed did not germinate.

Time

Germination time was consistent between Control seeds and Test seeds.

Dahlgren #855 -- Growth

Group	Lot	Soil Type	Average Group Height	Vegetative Stage
1	Control	Potting	27.75 cm	V6
2		Sandy	24.50 cm	V3
3		Potting/Sandy	28.00 cm	V4
1a	Test	Potting	34.25 cm	V4 - V5
2a		Sandy	** 14.00 cm	V4
3a		Potting/Sandy	34.50 cm	V4

** Group 2a - Plant #2; seed did not germinate.
 Group 2a - Plant #1; growth rate very slow.

Average lot height

Control = 26.9 cm

Test = 27.6 cm

Vegetative stages

Fairly consistent between Control and Test plants with the exception of Group 2a - Plant #1 which did not reach true V1, V2 because the leaves for these two stages were thin and withered and never reached the required length of 4 cm.

Park Seed #0950 -- Growth

Group	Lot	Soil Type	Average Group Height	Vegetative Stage
4	Control	Potting	34.25 cm	V4 - V6
5		Sandy	** 34.00 cm	V4
6		Potting/Sandy	28.25 cm	V4
4a	Test	Potting	39.00 cm	V4 - V6
5a		Sandy	33.50 cm	V4
6a		Potting/Sandy	26.25 cm	V4

** Group 5 - Plant #2; seed did not germinate.

Average plant height

Control = 32.2 cm

Test = 32.3 cm

Vegetative stages

Very consistent between Control plants and Test plants.

Dahlgren #855 -- Uniformity

Group	Lot	Soil Type	Uniformity	
			Stems	Leaves
1	Control	Potting	Normal	* Abnormal
2		Sandy	Normal	* Abnormal
3		Potting/Sandy	Normal	* Abnormal
1a	Test	Potting	Normal	** Abnormal
2a		Sandy	Normal	*** Abnormal
3a		Potting/Sandy	Normal	**** Abnormal

* The leaves on both plants in each group appeared to be abnormal at V1 and V2.

** The leaves of this group appeared to be abnormal at V1 and V2.

*** The leaves on plant #1 appeared to be abnormal at V1 and V2.

**** The leaves in this group appeared to be abnormal at V1, V2, and V3.

Abnormal in appearance meaning that the leaves are very wide and have rounded and disfigured outer tips.

Park Seed #0950 -- Uniformity

Group	Lot	Soil Type	Uniformity	
			Stems	Leaves
4	Control	Potting	* Abnormal	Normal
5		Sandy	Normal	Normal
6		Potting/Sandy	Normal	Normal
4a	Test	Potting	** Abnormal	Normal
5a		Sandy	Normal	Normal
6a		Potting/Sandy	Normal	Normal

* Group 4 - Plant #1; stem is split from the soil level to the cotyledons.

** Group 4a - Plant #1 and Plant #2; stems are split from the soil level to the cotyledons.

Conclusions:

Dahlgren #855

Germination rate -- Group 2a - Plant #2 not germinating could have been caused by the type of soil, or it could have been caused by solar radiation, or it could have been a natural germination failure.

Based upon the information and data available, I conclude that solar radiation did not cause this failure.

Germination time -- The difference in germination time between the Control seeds and Test seeds could be because the Test seeds were tested for germination a full year after the Control seeds were tested, or it could have been caused by solar radiation.

Based upon the information and data available, I conclude that solar radiation did not cause the longer germination time of the Test seeds.

Growth -- The slow rate of growth of Group 2a - Plant #2 could have been caused by the type of soil, or it could have been caused by solar radiation, or it could be a defect as a result of the hybrid cross.

The failure of Group 2a - Plant #1 to reach true V1, V2 could have been caused by the type of soil, or it could have been caused by solar radiation, or it could have been caused by a defect as a result of the hybrid cross.

Based upon the information and data available, I conclude that solar radiation has no significant adverse effects on plant growth.

Uniformity -- Since the leaves on the Control plants as well as the Test plants appeared to have abnormal leaf configuration, and the fact that this condition did not go beyond V3, it does not seem likely that this condition is significant.

Based upon the information and data available, I conclude that solar radiation has no significant effects on the uniformity of these plants.

Park Seed #0950

Germination rate -- Group 5 - Plant #2 not germinating most likely was a natural germination failure.

Germination time -- Germination times were consistent.

Based upon the information and data available, I conclude that solar radiation had no significant adverse effects on the germination rate or germination time of these plants.

Growth -- The average growth rate and the vegetative stages reached were very consistent.

Based upon the information and data available, I conclude that solar radiation has no significant effect on the growth of these plants.

Uniformity -- The fact that stems of a Control plant as well as that of a Test plant were split would indicate that it may be a common occurrence with this type of plant.

Based upon the information and data available, I conclude that solar radiation has no significant effects on the uniformity of these plants.

CONCLUSION

Based upon the results obtained through this experiment, and the conclusions reached based upon that data and other information available, I conclude that solar radiation has no significant adverse effects on seed germination, plant growth, or plant uniformity of either Dahlgren #855 hybrid sunflower seeds and plants or Park Seed #0950 non-hybrid sunflower seeds and plants, when the seeds used to determine germination time and grow Test plants are exposed to solar radiation.

REFERENCES

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NOTE: Information was also obtained from Sioux County Extension Service, and Cenex/Land O'Lakes, Minot, ND.