

WILD SUNFLOWER SPECIES GERMINATION

Gerald J. Seiler

USDA-ARS, Northern Crop Science Laboratory, Fargo, ND 58105, USA

SUMMARY

The age of achenes at harvest of *Helianthus annuus* and *H. petiolaris* had a significant influence on germination. A majority of germination took place by 21 days. Achene dormancy does not appear to be overcome by using a combination of storage temperatures or times. *Helianthus argophyllus* had the highest overall germination of 84%, followed by *H. debilis* ssp. *silvestris* with 76%, *H. petiolaris* with 51%, and *H. annuus* with 44%. Despite the large differences in germination percentage, the coefficient of velocity was similar for all species.

Key words: Sunflower, wild species, achene age, germination storage temperature

INTRODUCTION

Wild annual sunflower species are a source of genes for improving the cultivated sunflower, but efforts to utilize some of the species has been hampered by strong achene dormancy (Chandler and Jan, 1985). It is not known whether this dormancy can be overcome by varying storage times or temperatures. It is also not known what effect the maturity (age) of the achenes at harvest has on future potential germination. Methods to overcome the dormancy in several of the wild annual species would facilitate their use in sunflower breeding programs. The objective of this study was to evaluate the influence of storage temperatures, times, and achene age at harvest on germination of four wild annual sunflower species.

MATERIALS AND METHODS

Four wild annual species used in this study were: *Helianthus annuus* L., *H. argophyllus* T. & G., *H. petiolaris* Nutt. ssp. *petiolaris*, and *H. debilis* T. & G. ssp. *silvestris* Heiser. Twenty-five achenes of each species were germinated in 9-cm diameter petri dishes between two pieces of filter paper saturated with 15 ml of distilled water at pH 7. There were six replications per species/treatment and the experiment was repeated once. Petri dishes were placed in a germinator with temperatures of 10°C for 12 hours (dark) and 20°C for 12 hours (light). Germination counts were made at 21 and 42 days after planting (DAP). An achene was considered germinated when the radicle reached a length of 5 mm. Achene storage temperatures were 20, 5, and -20°C for 0, 120, and 360 days. Achenes were harvested at two physiological ages. The first was 10 days after petal drop (DAF) and 30 DAF.

A coefficient of velocity of germination (C.V.) was calculated as follows:

$$C.V. = 100 (A_i + A_j + \dots A_x) / A_i T_i + A_j T_j + \dots A_x T_x$$
 where A_i = is the number of achenes germinated on day i and T_i is the number of days from planting (Scott et al., 1984). The

C.V. measures the rate of germination and emphasizes the contribution of the earlier germinating achenes.

Germination percentages were arcsin transformed before statistical analysis. The statistical design was a randomized complete block design with six replicates.

RESULTS AND DISCUSSION

The analysis of variance indicated that there was a significant difference due to storage time, species, and achene age, but not storage temperature. The age of achenes at harvest had a significant effect on germination, depending on the species. Achenes of *H. annuus* harvested 10 DAF had about three times as high of germination as those harvested 30 DAF after 21 days in the germinator (Figure 1). This was true no matter how long the achenes were stored (Figure 2). It appears that *H. annuus* develops dormancy as the achenes mature, and this dormancy is not overcome by storing the achenes for short periods of time (1 year or less). The other annual species evaluated generally had similar germination for 10 DAF and 30 DAF achenes, except for *H. petiolaris* ssp. *petiolaris*, which followed the pattern of *H. annuus*. *Helianthus argophyllus* was the only species where 30 DAF achenes had a higher germination than 10 DAF achenes at all storage times (Figure 2).

A slight decline in germination was observed with increased storage time (averaged across achene age) compared to fresh achenes (Figure 2). Significant declines were observed in *H. argophyllus* and *H. annuus* germination after 360 days of storage. *Helianthus petiolaris* ssp. *petiolaris* and *H. annuus* achenes harvested 30 DAF had lower germination than those harvested 10 DAF after 120 and 360 days of storage (Figure 2). The opposite was observed in *H. argophyllus*. Storage time did not appear to influence germination of *H. debilis* ssp. *silvestris* achenes.

Storage temperature did not influence the dormancy of the achenes of *H. annuus*. Achenes which were harvested 10 DAF still had higher germination than 30 DAF achenes (Figure 3). The highest germination for *H. annuus* was for 10 DAF achenes stored at room temperature. Storage at colder temperatures decreased the germination by 22% in *H. annuus*. A rapid decrease in germination was not observed in the other three species.

When averaged over all treatments, *H. argophyllus* had the highest germination (84%). *Helianthus debilis* ssp. *silvestris* had the second highest, averaging 76%, while *H. petiolaris* averaged 51% and *H. annuus* averaged 44% (Figure 1).

The coefficient of velocity (C.V.) is proportional to the rate of germination and emphasizes the contribution of earlier germinating seeds. The C.V. generally increases as more seeds germinate within shorter periods of time. The C.V. was higher for 10 DAF achenes than 30 DAF for *H. annuus* and *H. petiolaris* ssp. *petiolaris* achenes stored 360 days (Figure 4). The opposite was true for the other two species. A similar pattern was observed for achenes stored at different temperatures (Figure 5). Averaged over all treatments, the four species had similar C.V.'s with *H. argophyllus* having slightly higher C.V.'s (Figure 6). This would indicate that even though the four species differ considerably in their germination percentages, those seed that germinate will do so at a similar rate, regardless of the species involved.

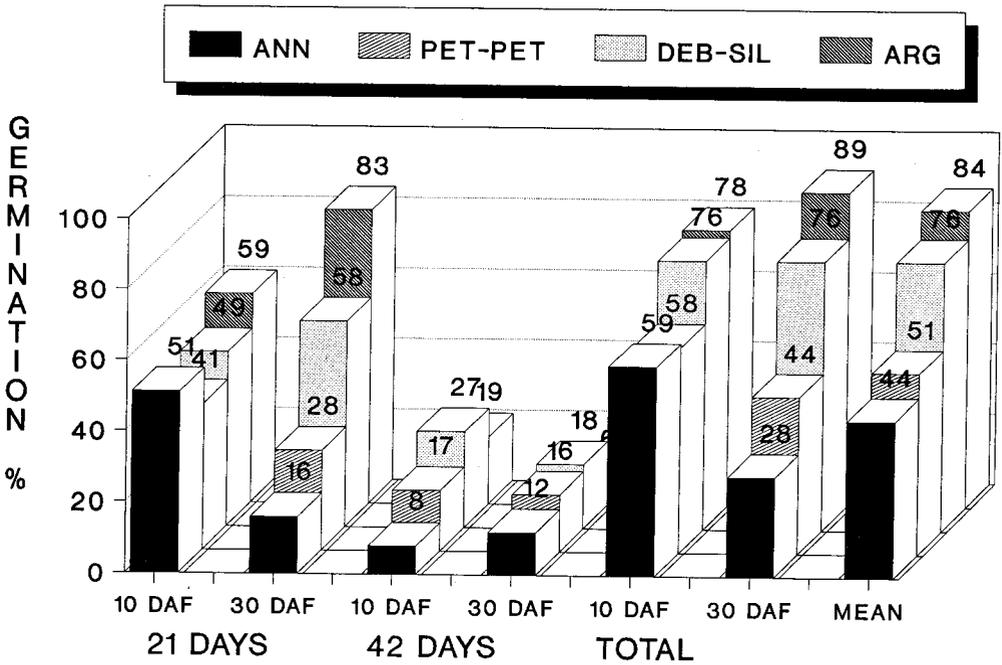


Figure 1. Wild species germination of different age achenes, 21 and 42 days after planting.

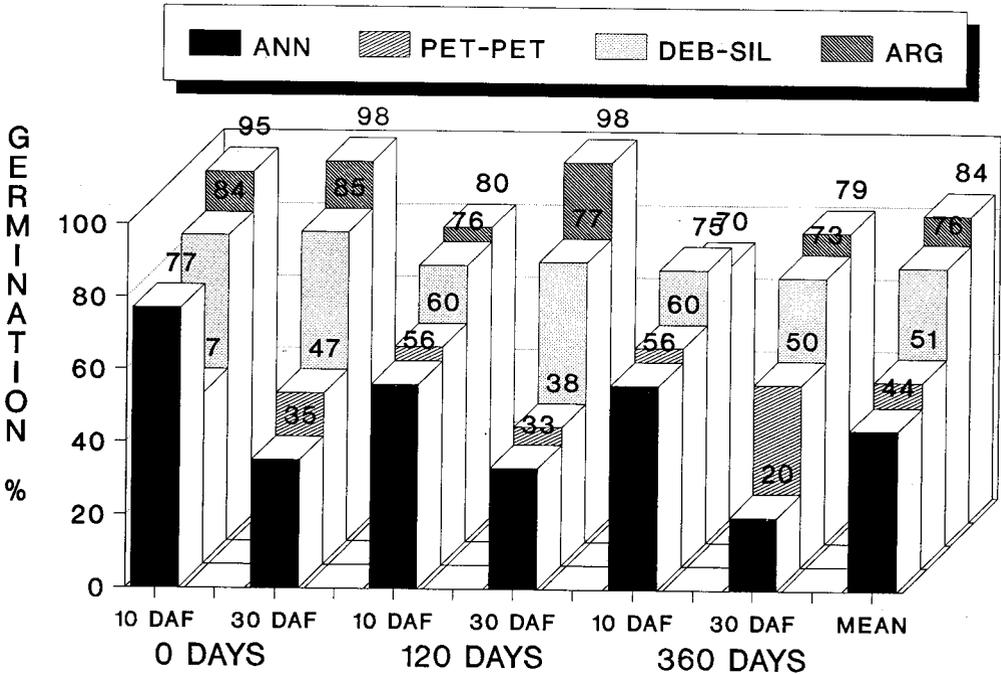


Figure 2. Effect of species, achene age, and storage time on germination.

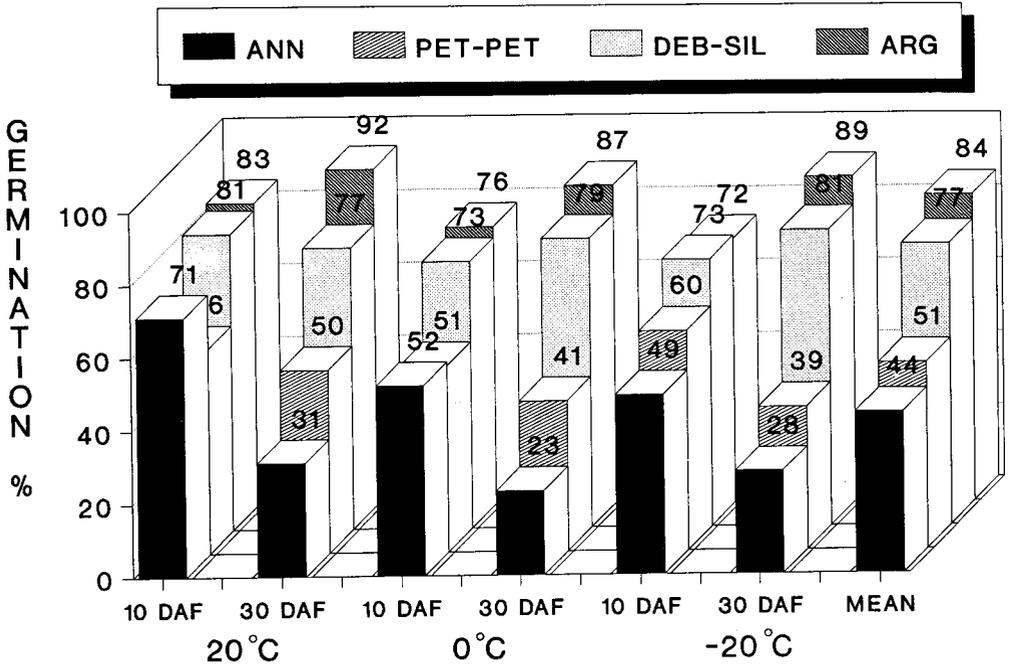


Figure 3. Effect of species, achene age, and storage temperature on germination.

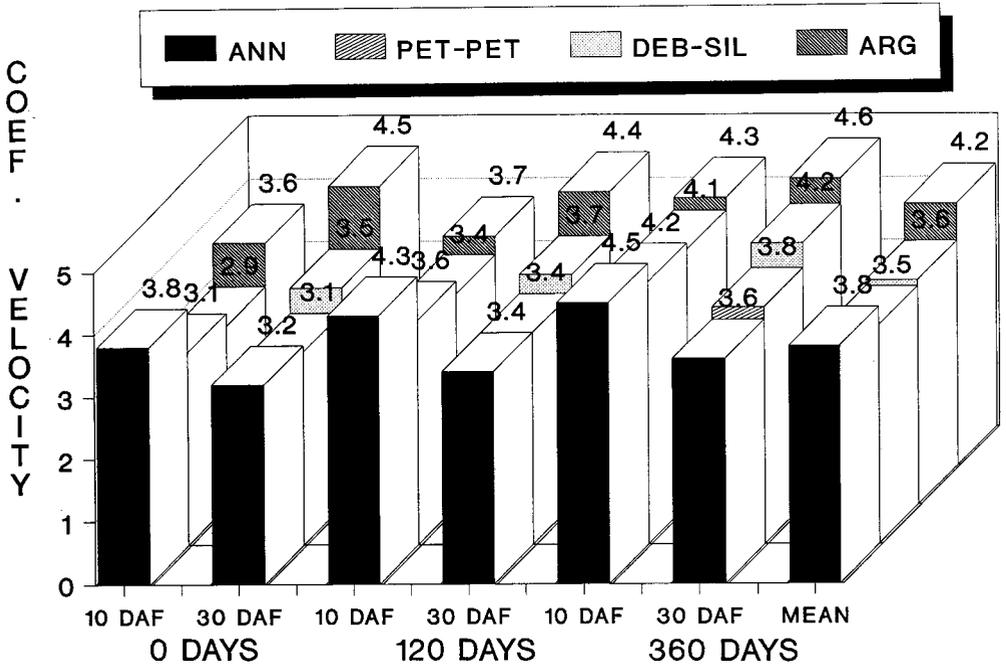


Figure 4. Effect of species, achene age, and storage temperature on the germination coefficient of velocity

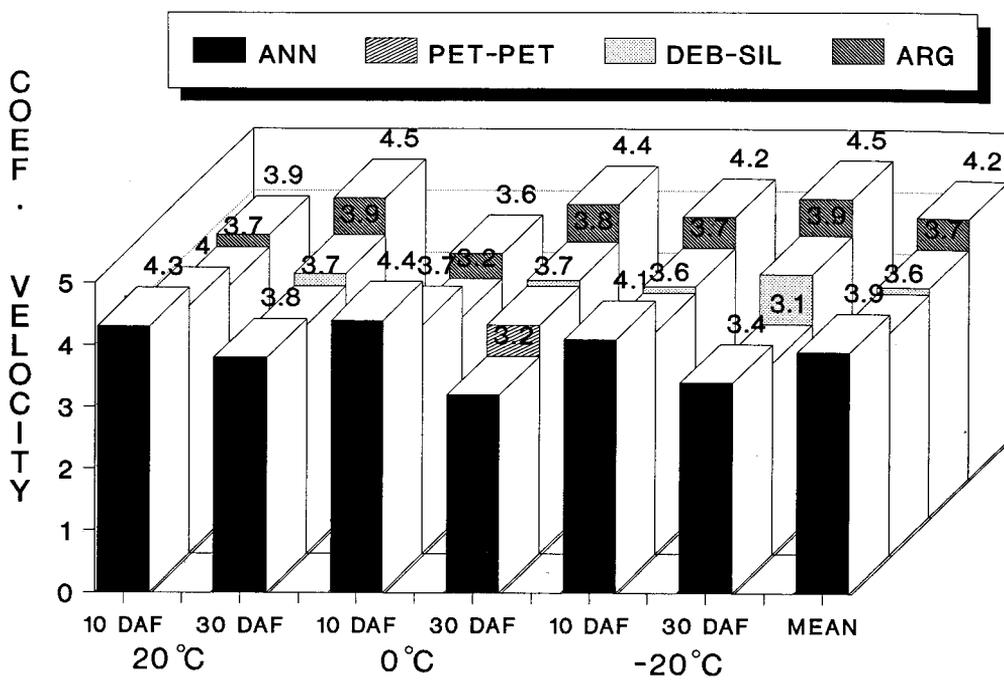


Figure 5. Effect of species, achene age, and storage time on the germination coefficient of velocity

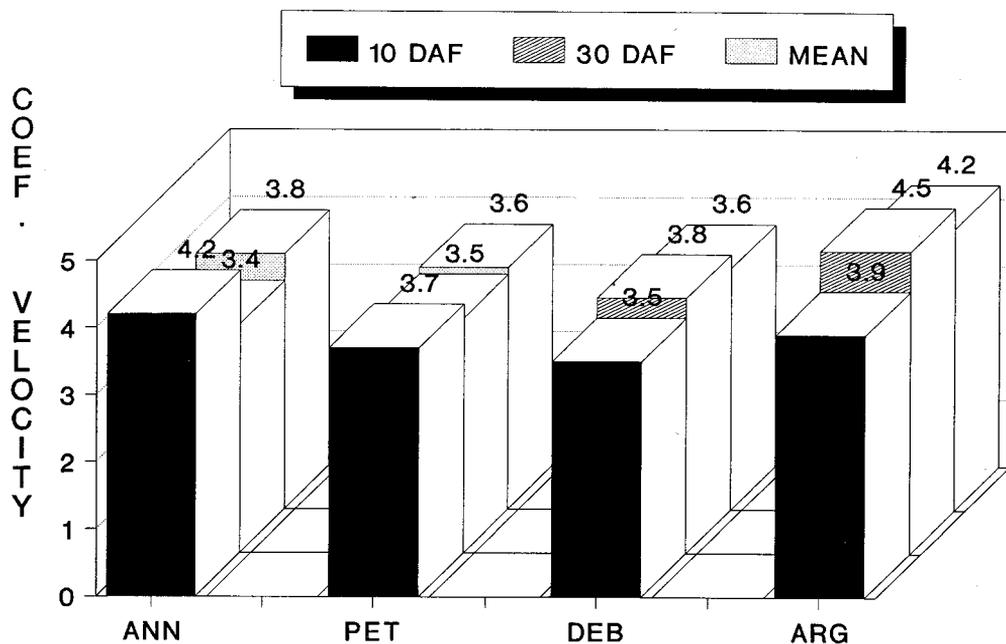


Figure 6. Species germination coefficient of velocity averaged over all treatments

CONCLUSION

A majority of germination in the wild species evaluated took place by 21 DAP, with only a small percentage after that. The age of the seed at harvest is important in *H. annuus* and *H. petiolaris* ssp. *petiolaris*, with younger seed having a higher germination. It was the opposite for the other two species, *H. debilis* ssp. *silvestris* and *H. argophyllus*. Dormancy due to achene age could not be overcome by a combination of achene storage temperature or time. The C.V.'s were generally similar for all species even though they had very different germination rates. The similar C.V. indicates that the achenes of these species germinate at the same rate regardless of the germination percentage.

REFERENCES

- Chandler, J.M. and Jan, C.C. 1985. Comparison of germination techniques for wild *Helianthus* seeds. *Crop Sci.* 25: 356-358.
 Scott, S.J., Jones, R.A., and Williams, W.A. 1984. Review of data analysis methods for seed germination. *Crop Sci.* 24: 1192-1199.

GERMINACION DE ESPECIES SILVESTRES DE GIRASOL

RESUMEN

La edad de los aquenios en la recolección de *Helianthus annuus* y *H. petiolaris* tuvo una influencia significativa en la germinación. Una mayoría de la germinación tuvo lugar a los 21 días. La dormancia de los aquenios no parece ser rota utilizando una combinación de temperaturas o tiempo de almacenaje. *Helianthus argophyllus* tuvo el porcentaje global de germinación más alto de 84% seguido por *H. debilis* spp. silvestres con 76%. *H. petiolaris* con 51% y *H. annuus*, 44%. A germinación, el coeficiente de velocidad fue similar para todas las especies.

GERMINISATION D'ESPÈCES SAUVAGES DE TOURNESOL

RÉSUMÉ

Chez *Helianthus annuus* et *H. petiolaris*, l'âge des akènes à la récolte a une influence significative sur la germination. Dans la majorité des cas, la germination s'est effectuée à 21 jours. La dormance de l'akène ne peut être levée par une combinaison de température de stockage. *Helianthus argophyllus* a montré la germination la plus forte (84%), suivi par *H. debilis* ssp. *silvestris* (76%), *H. petiolaris* (51%) et *H. annuus* (44%). Bien qu'il y ait de grandes différences de pourcentage de germination, la vitesse de germination a été similaire pour toutes les espèces.