POLLEN FLOW IN *HELIANTHUS ANNUUS* VAR. *MACROCARPUS* CKLL. AND *H. ANNUUS* LINN.

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ABSTRACT

Pollen flow in two taxa of *Helianthus annuus* var. *macrocarpus* Ckll. with large capitula and *H. annuus* Linn. with small capitula, was determined. Each of the floral characters studied shows significant difference ; the pollen grains of the two varieties are similar in ornamentation but vary in size. Plants with large capitulum, show more robust vegetative as well as floral characters campared to the other taxa. Both the varieties bear three types of stigmatic papillae which occupy well defined regions on the stigma. The 't' test carried out to measure the pollen loads under different conditions also show significant differences among the two varieties.

INTRODUCTION

Helianthus annuus, the variety with giant capitulum, is an economically important oil-seed crop, while the variety with small capitulum is an ornamental. The capitula comprise both ray florets and disc florets. The ray florets bear only gynoecium and occupy peripheral position in the capitulum, while the disc florets occupy the remaining portion of the capitulum and are arranged in ± circular rows. The florets open in acropetal succession, the youngest occupying the centre.

As regards the morphological nature of the calyx, RENDLE (1937) states "the calyx is represented by a rudimentary structure or becomes fully developed only in the fruit and functions as an organ for aiding dispersal (i. e. pappus) or the pappus takes the form of scales or bristles corresponding in number and position to sepals, as in *Helianthus* where the two sepals are antero-posterior and scaly and are inserted at the base of the corolla tube"

OLESEN (1979) studied the pollen flow in the family Boraginaceae. ORNDUFF (1970) observed this aspect in *Jepsonica parryi* and in 1975 in *Hypericum aegypticum* (Guttiferae). So far, the study of pollen flow has been confined to heterostylous species. MULCAHY AND CAPORELLO (1970) carried out this study in tristylous species of *Lythrum salicaria*. So far, pollen flow studies have not been carried out in the family *Asteraceae* (Compositae). However, considerable work has been done on the taxonomy and morphology of *Helianthus* (HORNER, 1977; VITHANAGE & KNOX, 1977), yet the statistical approach on morphology has not received much attention; therefore, this aspect has been taken up in the present study.

MATERIAL AND METHODS

Potted plants in full bloom (3 days from the opening of the capitulum) of *H. annuus*, giant variety and small variety, were selected. For the study of pollen load, florets were designated on the basis of their position in the inflorescence. The rows of florets, nearly 2-3 whorls situated towards the periphery, consist of overmature florets (O. F.); next 2-3 whorls comprise mature florets (M. F.) while 2-3 whorls next to

mature florets towards the centre consist of immature florets (I. F.). In the text these abbreviations have been used.

The florets of the two varieties in the above mentioned three stages, i. e. O. F., M. F., I. F., were plucked in the morning, afternoon and evening over a period of one month, from 24-7-81 to 24-8-81. While collecting, variability of weather was also taken into account, whether it was sunny, or cloudy with heavy or light rainfall. In order to observe the adherence of pollen to the stigmatic surface some florets were placed directly on a slide while others were kept in water and then mounted on a slide. This was done so as to observe the adherence of pollen grains on the stigma. Both the types of florets were then placed on a slide having a drop of glycerine and cotton blue. The amount of pollen present on the stigma (Pollen load) was measured at a distance of 5 μm from the stigma tip, under the microscope and was calculated using the formula 't'$= \frac{\bar{X}}{\text{S. E. of } \bar{X}}$ where 't' is known as student' 't' and is used to determine, whether the difference in the pollen flow of the two varieties of *Helianthus* is significant or not, $\bar{X}$ is the mean of the observed value and S. E. of $\bar{X}$ is the standard error of the mean.

OBSERVATION AND DISCUSSION

Ray florets occurring peripherally are bracteate, sessile, unisexual (pistillate) and sterile. Gynoecium is bicarpellary with underdeveloped style and stigma. Disc florets occur towards the centre of the inflorescence; they are bracteate, sessile, hermaphrodite and fertile, the style is long and passes through the anther column; its apex bifurcates and ends into a pair of strongly hairy glandular, papillate stigmas which curve at maturity; two epigynous nectories are present. Calyx, corolla and anthers of the taxa show significant differences in all observed floral characters as shown in table 1.

Table 1—Quantitative characters of *H. annuus* (Giant variety) and *H. annuus* (Small variety) disc florets

Sl. no.	Characters	*H. annuus* (Giant var.)		*H. annus* (Small var.)	
		$\bar{X}\pm$S.E.		$\bar{X}\pm$S.E.	
1.	Length of corolla* *in cm.*	0.6	$\pm$0.025	0.4	$\pm$0.0057
2.	Circumference of corolla+	1.23	$\pm$0.33	0.4	$\pm$0.0158
3.	Length of calyx +	0.33	$\pm$0.11	0.22	$\pm$0.0203
4.	Circumference of calyx+	1.05	$\pm$0.057	0.72	$\pm$0.0829
5.	Length of stigma*	0.55	$\pm$0.025	0.25	$\pm$0.0241
6.	Length of style*	0.69	$\pm$0.049	0.41	$\pm$0.135
7.	Length of anthers*	0.59	$\pm$0.0374	0.26	$\pm$0.032
8.	Diameter of apex of paipllae *in* μm	9.74	$\pm$0.844	5.49	$\pm$0.0682
9.	Diameter of base of papillae ,,	10.687	$\pm$1.36	7.5	$\pm$0.731
10.	Diameter of pollen grains ,,	36.1	$\pm$1.91	26.5	$\pm$1.913

$\bar{X}$ =actual mean
S.E. =standard error
n =number of observations, i.e. 15
* =measured from the base of the pistil
\+ =measured from the base of lobes or teeth.

Stigmatic pollen load—In *H. annuus* (giant var.) in the morning the pollen load on the stigma (i. e. number of pollen grains present) was 43; in the afternoon it was 55 and in the evening it was 59. In small variety of *H. annuus* the pollen load on stigma was 139 in the morning, 115 in the afternoon and 113 in the evening. In small variety the immature florets had 133 and the overmature florets had 56 pollen grains on their stigmas. In giant variety the immature florets had 42 pollen grain, the mature ones had 40 while the overmature ones had 60 pollen grains on their stigmas.

When the weather was sunny, the pollen load in giant variety was 61, while it was 27 during cloudy weather. During slight rainfall the pollen load was 44 and after heavy rainfall it was 37. In small variety the pollen load on comparative stages of flower

Table 2. *Students' 't' test*—Showing significant differences in the pollen load of stigma in giant variety (*H. annuus* var. *macrocarpus* Ckll.) and small variety (*H. annuus* Linn.) disc florets under variable conditions.

Sl. no.	Parameters	Degree of freedom	't' values	Inferences
I	*Type of Flower*			
1.	I.F.	14	3.291**	Significant
2.	M.F.	14	5.702**	Significant
3.	O.F.	14	2.780*	Significant
II	*Different Time Interval*			
1.	Morning	14	4.735*	Significant
2.	Afternoon	14	4.802**	Significant
3.	Evening	14	2.469*	Significant
III	*Weather*			
1.	Heavy rainfall	14	1.975†	Insignificant
2.	Scanty rainfall	14	4.785**	Significant
3.	Cloudy	14	11.78*	Significant
4.	Sunny	14	3.805**	Significant
IV	*Florets collected in Water or without Water*			
1.	In water	14	4.769**	Significant
2.	Without water	14	5.471**	Significant

**Significant at .05 and .01 probability level.
*Significant at .05 probability level.
†Insignificant at either of the two probability levels, i.e. at .05 and .01
Degree of freedom=Number of observations—.1. which is 15-1=14.

in sunny weather was 145, during cloudy weather it was 96, after scanty rainfall the pollen load was 125 and after heavy rainfall the pollen load was 135.

In giant variety the florets were placed directly on the slide and the pollen load observed was 57 while the pollen load for those florets first collected in water and then placed on the slide was 42. (This was done to observe whether water causes loosening of attachment of pollen on the stigma causing decrease of the pollen load). For small variety the pollen load for those florets which were first placed in water and then mounted on the slides was 102.

Table 2 shows that considerable differences exists in the pollen loads between giant variety and small variety of *H. annuus* when the following parameters are considered.

(i) Type of florets
(ii) Time interval
(iii) Weather conditions

The giant and small varieties of *H. annuus* are different in the floral characters and pollen load, as is obvious from tables 1 and 2. Giant variety has more robust floral structures as compared to small variety, i. e. the size of calyx, corolla, stigma and stigmatic papillae which are larger in the former compared to the latter.

The pollen loads of giant variety and small variety show significant differences except after heavy rainfall, when the difference between the two was insignificant. This may be because when the rainfall is heavy the pollen in both the taxa gets washed away.

Variations between the pollen loads of these two varieties when subjected to changing conditions follow more or less the same pattern. A significant finding which is somewhat incongrous that has emerged from this study is that when the weather is cloudy or when there is scanty rainfall, the pollen load is less as compared to days when there is heavy rainfall. No satisfactory explanation for this phenomenon is available at present. This study has also revealed that significant differences exsists between giant and small varieties with regards to pollen flow, and it was also observed that the differences between the two varieties are significant under various conditions except after heavy rainfall.

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