

POLLEN PRODUCTION IN WEEDS ASSOCIATED WITH SOME RICE CULTIVARS IN BURDWAN DISTRICT, WEST BENGAL, INDIA

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ABSTRACT

The paper evaluates the production of pollen grains per anther/per flower in 73 species of weeds of rice fields in the district which are referable to Gramineae (22 species), Cyperaceae (11 species), Compositae (9 species), Pontederiaceae, Commelinaceae, Acanthaceae, Scrophulariaceae (3 species each), Nymphaeaceae, Onagraceae, Leguminosae, Rubiaceae, Amaranthaceae, Polygonaceae (2 species each) and one species each of Alismaceae, Campanulaceae, Convolvulaceae, Hydrophyllaceae, Lentibulariaceae, Lythraceae and Euphorbiaceae.

Among these *Nymphaea stellata* Willd. produces the highest number of pollen (15,484) per anther. The production of pollen grain per flower in *N. stellata* and *N. lotus* Linn. is more than one hundred thousand. These are followed by *Aeschynomene indica* Linn. (56,640), *Eichhornia crassipes* Solms. (37,320), *Monochoria hastata* Presl. (28,920), *Oryza coarctata* Roxb. (28,296) and *Hydrolea zeylanica* Vahl. (22,240) in production of pollen grains per flower. On the other hand *Cyperus iria* Linn. produces only 64 pollen grains on an average per flower.

INTRODUCTION

The study of pollen production by a flower or a cone or an inflorescence has hitherto been done mainly on the cultivated plants or on the forest trees by AGNIHOTRI AND SINGH (1975), BERI AND ANAND (1971), BRAMLETT (1973), FIRBAS AND SAGROMSKY (1947), HYDE (1951), KUGLER (1970), NAIR AND RASTOGI (1963), NAIR AND SHARMA (1970), NAIR AND KAPOOR (1974), NAIR AND CHATURVEDI (1975), OBERLE AND GOERTZEN (1952), POHL (1937), SNYDER AND CLAUSON (1973), SREERANGASWAMY AND RAMAN (1974), TRIVEDI AND VERMA (1975), and VAISH (1973). SNYDER AND CLAUSON (*l. c.*) measured the quantity of pollen produced in terms of cubic centimeters (cc) for 100 strobili in gymnospermous plants and 100 inflorescences or flower in angiosperms. NAIR AND RASTOGI (1963) studied the pollen production per flower/anther by liquid dispersion method.

MATERIAL AND METHOD

In the present investigation the authors collected unopened mature buds from which 10 anthers were dissected out at random from 10 different flowers. These were measured and then crushed individually on different slides each with a drop of 50% glycerine+water solution. The pollen grains in each slide under cover slip was counted and thus the average value of pollen production per anther was calculated. The values thus arrived at were multiplied with the number of anthers present in each taxon in a flower which gives the values of pollen produced by a flower.

The pollen production in 73 species of weeds associated with rice cultivars were studied. These are referable to Gramineae (*Andropogon annulatus*; *Chrysopogon aciculatus*; *Cynodon dactylon*; *Digitaria sanguinalis*; *Echinochloa colona*; *E. frumentacea*;

Eragrostis amabilis; *Eriochloa procera*; *Hymenachne pseudointerrupta*; *Imperata arundinacea*; *Leersia hexandra*; *Leptochloa chinensis*; *Oryza coarctata*; *Paspalum distichum*; *Paspalum scrobiculatum*; *Panicum distachyum*; *Paspaledium flavidum*; *P. isachnae*; *P. portiferum*; *P. repens*; *Rottboellia compressa*; *Setaria glauca*); **Cyperaceae** (*Cyperus iria*; *C. difformis*; *C. pilosus*; *Fimbristylis diphylla*; *F. miliacea*; *F. monostachya*; *F. dichotoma*; *Kyllinga microcephalus*; *Mariscus microcephalus*; *Scirpus articulatus*; *S. supinus*); **Pontederiaceae** (*Eichhornia crassipes*; *Monochoria vaginalis*; *M. hastaeifolia*); **Nymphaeaceae** (*Nymphaea lotus*; *N. stellata*); **Commelinaceae** (*Aneilema nudiflorum*; *Commelina nudiflora*; *Cyanotis axillaris*); **Onagraceae** (*Jussiaea repens*; *Ludwigia parviflora*); **Compositae** (*Blumea lacera*; *Centipeda orbicularis*; *Eclipta alba*; *Galinsoga parviflora*; *Gnaphalium indicum*; *Grangea maderaspatana*; *Sphaeranthus indicus*; *Tridax procumbens*; *Vernonia cinerea*); **Leguminosae** (*Aeschynomene indica*; *Phaseolus trilobus*); **Convolvulaceae** (*Ipomoea aquatica*); **Acanthaceae** (*Cardanthera triflora*; *Hemigraphis hirta*; *Hygrophila spinosa*); **Rubiaceae** (*Dentella repens*; *Oldenlandia corymbosa*); **Alismaceae** (*Sagittaria guayanensis*); **Amaranthaceae** (*Alternanthera phitoneroideis*; *Alternanthera sessilis*); **Scrophulariaceae** (*Bonaya brachiata*; *Dopatrium junceum*; *Ilysanthes parviflora*); **Polygonaceae** (*Polygonum flaccidum*; *P. plebijum*); **Hydrophyllaceae** (*Hydrolea zeylanica*); **Lythraceae** (*Ammannia peploides*); **Campanulaceae** (*Sphenoclea zeylanica*); **Lentibulariaceae** (*Utricularia stellaris*); **Euphorbiaceae** (*Phyllanthus niruri*).

DISCUSSION

AGNIHOTRI AND SINGH (1975) studied pollen production in 10 species of Indian grasses. According to these authors the size of the pollen grains and the length of the pollen grains and the length of the anther can be correlated with the pollen production in a taxon. It means that if the size of the pollen grain and the length of the anther is smallest then the number of pollen production by that particular taxon is lowest. The present investigation however do not support this conclusion fully. Table-1 shows that in *Eriochloa procera* Retz. and *Panicum repens* Linn. the length of anther is 1 mm while the size of pollen grain is smaller in the latter species than the former. The production is also less in the latter.

However, a critical analysis of 73 species shown in table-1 do not always show correlation. It has also been observed in floating hydrophytes, example *Nymphaea stellata*, *N. lotus*, *Eichhornia crassipes*, *Monochoria vaginalis* and *M. hastaeifolia*, produce highest number of pollen grains per flower among the species investigated.

Cyanotis axillaris, *Commelina nudiflora* and *Sagittaria guayanensis* which grow both in muddy soil and also in submerged condition of the soil produce on an average over 1500 pollen grains per flower.

Those species like *Cyperus iria* and *C. difformis* which occur in the rice field almost round the year, the production of pollen grains per flower is the least e. g. 64 and 28 respectively, *Paspalum distichum* being the exception.

Similarly those grasses and sedges which flower heavily for a period of 2 to 3 months such as *Leptochloa chinensis*, *Scirpus supinus*, *S. articulatus*, *Cyperus pilosus*, *Fimbristylis monostachya*, *Centipeda orbicularis*, *Grangea maderaspatana*, *Hemigraphis hirta*, *Oldenlandia corymbosa* produce less than 1500 pollen grains per flower. Thus it is evident that pollen production per flower in a taxon is not only dependent on the size of anther or the size of the pollen grains but it is controlled by many other factors, such as periodicity, response to light, nutrient availability, etc.

Table 1—Showing the length of anther, pollen dimension and pollen production/
anther/flower

Botanical name	Anther length in mm	Pollen pr./ anther	Pollen pr./ flower	Diameter length × breadth/P/E		
				Pollen Average in (μ)	Size Range in (μ)	Dominant Size in (μ)
Family—Gramineae						
<i>Andropogon annulatus</i> Forsk.	2.1	1716	5148	33	30-38	32
<i>Chrysopogon aciculatus</i> Trin.	2.2	1340	4020	30	27-32	30
<i>Cynodon dactylon</i> Pers.	1.4	608	1824	26	24-27	27
<i>Digitaria sanguinalis</i> Scop.	1.1	220	660	34	29-38	32
<i>Echinochloa colona</i> Link.	0.89	404	1212	32	29-35	32
<i>Echinochloa frumentacea</i> Link.	0.7	380	2280	30	30-32	30
<i>Eragrostis amabilis</i> Wight & Ann.	0.25	84	168	22	16-22	22
<i>Eriochloa procera</i> Retz.	1.0	608	1824	35	29-37	35
<i>Hymenachne pseudointerrupta</i> C. Muell.	1.7	1028	3084	28	27-30	30
<i>Imperata arundinacea</i> Cyrill.	2.2	2208	4416	28	24-30	27
<i>Leersia hexandra</i> Sw.	2.4	1616	9676	24	22-27	24
<i>Leptochloa chinensis</i> Nees.	0.25	52	156	20	19-27	19
<i>Oryza coarctata</i> Roxb.	5.0	4716	28296	40	38-43	41
<i>Paspalum distichum</i> Linn.	1.2	912	2736	35	27-38	35
<i>Paspalum scrobiculatum</i> Linn.	0.51	212	636	32	29-32	32
<i>Panicum distachyum</i> Linn.	0.9	720	2160	31	29-32	32
<i>Paspaledium flavidum</i> Retz.	1.01	732	2196	35	29-35	32
<i>Panicum isachnae</i> Roth.	1.0	600	1800	24	20-22	22
<i>Panicum proliferum</i> Lamk.	1.6	780	2340	19	19-22	22
<i>Panicum repens</i> Linn.	1.0	108	324	32	30-32	32
<i>Rottboellia compressa</i> Linn.	1.7	2716	8148	22	22	22
<i>Setaria glauca</i> Beauv.	0.9	540	1620	28	24-29	29
Family—Cyperaceae						
<i>Cyperus iria</i> Linn.	0.19	32	64	28	27-29	27
<i>Cyperus difformis</i> Linn.	0.12	28	28	18	14-22	19
<i>Cyperus pilosus</i> Vahl.	1.6	1824	5472	28 × 24	27 × 22-30 × 22	27 × 24
<i>Fimbristylis diphylla</i> Vahl.	0.5	344	344	26	24-27	27
<i>Fimbristylis miliacea</i> Vahl.	0.39	248	248	21	19-22	22

Table 1—(Contd.)

Botanical name	Anther length in mm	Pollen pr./ anther	Pollen pr./ flower	Diameter length × breadth/P/E		
				Pollen Average in (μ)	Size Range in (μ)	Dominant Size in (μ)
<i>Fimbristylis monostachya</i> Hassk.	0.74	396	792	27	24-27	27
<i>Fimbristylis dichotoma</i> Vahl.	0.49	276	552	26	24-27	27
<i>Kyllinga microcephalus</i> Liebm.	0.5	300	900	19 × 18	16 × 17-22 × 19	19 × 22
<i>Mariscus microcephalus</i> Presl.	0.7	312	936	22 × 22	19 × 22-24 × 22	22
<i>Scirpus supinus</i> Linn.	0.43	196	588	26 × 25	19 × 24-27 × 30	27 × 24
<i>Scirpus articulatus</i> Linn.	0.84	420	1260	41 × 38	35 × 32-49 × 46	41 × 38
Family—Pontederiaceae						
<i>Eichhornia crassipes</i> Solms.	3.75	6220	37320	51 × 39	49 × 38-56 × 41	51 × 41
<i>Monochoria vaginalis</i> Presl.	1.8	2412	14472	35 × 28	32 × 27-35 × 29	35 × 27
<i>Monochoria hastaeifolia</i> Presl.	3.6	4812	28920	40 × 27	35 × 32-43 × 29	38 × 30
Family—Nymphaeaceae						
<i>Nymphaea lotus</i> Linn.	1.2	6104	numerous	29 × 23	27 × 22-29 × 24	29 × 21
<i>Nymphaea stellata</i> Willd.	1.0	15484	numerous	25 × 23	27	24 × 22
Family—Commelinaceae						
<i>Aneilema nudiflorum</i> R. Br.	0.82	2628	5256	36 × 23	32 × 24-38 × 22	35 × 22
<i>Commelina nudiflora</i> Linn.	1.51	2116	6348	39 × 26	29 × 21-41 × 27	35 × 29
<i>Cyanotis axillaris</i> D. Don	1.12	1912	11472	36 × 23	32 × 24-38 × 22	35 × 22
Family—Onagraceae						
<i>Jussiaea repens</i> Linn.	2.4	496	4960	71 (Triporate) 92 (Polyporate)	65-92	71
<i>Ludwigia parviflora</i> Roxb.	0.81	600	2400	46	40-49	49
Family—Compositae						
<i>Blumea lacera</i> DC.	1.6	276	1380	28	27-28	27
<i>Centipeda orbicularis</i> Lour.	0.18	96	384	16	16	16
<i>Eclipta alba</i> Hassk.	0.69	228	892	24	22-24	24
<i>Galinsoga parviflora</i> Cav.	0.31	52	208	18	16-19	19
<i>Gnaphalium indicum</i> Linn.	0.56	216	1080	15	14-16	16
<i>Grangea maderaspatana</i> Poir	0.25	56	280	19	16-22	19
<i>Sphaeranthus indicus</i> Linn.	0.86	816	4080	19	16-22	19
<i>Tridax procumbens</i> Linn.	1.64	532	2660	26	22-27	27
<i>Vernonia cinerea</i> Less.	0.73	76	380	26	24-27	27
Family—Leguminosae						
<i>Aeschynomene indica</i> Linn.	0.96	5664	5640	16	13-18	18

Table 1—(Contd.)

Botanical name	Anther length in mm	Pollen pr./ anther	Pollen pr./ flower	Diameter length × breadth P/E		
				Pollen Average in (μ)	Size Range in (μ)	Dominant Size in (μ)
<i>Phaseolus trilobus</i> Ait.	0.67	436	4360	31	24-35	32
Family—Convolvulaceae						
<i>Ipomoea aquatica</i> Forsk.	3.5	876	4380	78	68-83	81
Family—Acanthaceae						
(Measurement=P/E)						
<i>Cardanthera triflora</i> Ham.	2.6	3856	15424	28/34	27/29-30/35	29/35
<i>Hemigraphis hirta</i> T.	1.8	1284	5136	35/27	32/27-38/27	35/27
<i>Hygrophila spinosa</i> T. and F.	2.2	2200	8800	51/63	49/62-56/62	51/62
Family—Rubiaceae						
<i>Dentella repens</i> Frost . .	0.93	1208	6040	18	16-19	19
<i>Oldenlandia corymbosa</i> Linn.	0.6	252	908	28	27-29	27
Family—Alismaceae						
<i>Sagittaria guayanensis</i> H. B. & K. Nov	1.3	3348	33480	29	27-30	30
Family—Amaranthaceae						
<i>Alternanthera philoxeroides</i> Griseb	1.78	2744	13720	19	19	19
<i>Alternanthera sessilis</i> R. Br.	0.2	164	492	14	14	14
Family—Scrophulariaceae						
<i>Bonnya brachiata</i> Link & Otto.	1.1	2496	4992	19	19-22	19
<i>Dopatrium junceum</i> Ham.	0.63	652	1304	23	19-27	22
<i>Ilysanthes parviflora</i> Benth.	0.346	2004	8016	14	14	14
Family—Polygonaceae						
<i>Polygonum flaccidum</i> Meisn.	0.35	36	180	41	29-46	43
<i>Polygonum plebijum</i> R. Br.	0.173	72	360	20/14	19/14-22/16	22/14
Family—Hydrophyllaceae						
<i>Hydrolea zeylanica</i> Vahl.	1.8	4448	22240	19	16-22	19
Family—Lythraceae						
<i>Ammannia peploides</i> Spreng.	0.26	320	1280	14	14	14
Family—Campanulaceae						
<i>Sphenoclea zeylanica</i> Gaertn.	0.67	2888	14440	14	14	14
Family—Lentibulariaceae						
<i>Utricularia stellaris</i> Linn.	1.0	1184	2368	37	32-40	40
Family—Euphorbiaceae						
(Measurement=P/E)						
<i>Phyllanthus niruri</i> Linn.	0.086	164	492	20/22	19/14-26/18	20/14

Table 2—Showing the duration of occurrence of weeds and their flowering time.

Botanical name	Duration of occurrence	Peak flowering time
<i>Andropogon annulatus</i>	Throughout the year	April-May
<i>Chrysopogon aciculatus</i>	May to November	July-Early August
<i>Cynodon dactylon</i>	Throughout the year	May-June
<i>Digitaria sanguinalis</i>	July to November	September
<i>Echinochloa colona</i>	March to October	May
<i>Echinochloa frumentacea</i>	April to July	Late April-May
<i>Eragrostis amabilis</i>	August to December	September-October
<i>Eriochloa procera</i>	April to October	May-June
<i>Hymenachna pseudointerrupta</i>	September to December	October
<i>Imperata arundinacea</i>	April to December	July-August
<i>Leersia hexandra</i>	Throughout the year	October-November
<i>Leptochloa chinensis</i>	March to September	April-May
<i>Oryza coarctata</i>	October to January	November
<i>Paspalum distichum</i>	March to November	May-June, August-September
<i>Paspalum scrobiculatum</i>	May to November	August
<i>Panicum distachyum</i>	September to January	October-November
<i>Paspaleidum flavidum</i>	March to October	August-September
<i>Panicum isachnae</i>	July to October	August-September
<i>Panicum proliferum</i>	August to December	September-October
<i>Panicum repens</i>	May to October	May-June
<i>Rottboellia compressa</i>	August to December	October-November
<i>Setaria glauca</i>	June to November	September-October
<i>Cyperus iria</i>	March to September	April-May, August-September
<i>Cyperus difformis</i>	March to October	April-May, September
<i>Cyperus pilosus</i>	October to January	October-November
<i>Fimbristylis diphylla</i>	March to October	May-June
<i>Fimbristylis miliacea</i>	April to January	May-June
<i>Fimbristylis monostachya</i>	June to October	Late July-September
<i>Fimbristylis dichotoma</i>	July to October	Late July-September
<i>Kyllinga microcephalus</i>	April to October	July-September
<i>Mariscus microcephalus</i>	September to December	October
<i>Scirpus supinus</i>	September to January	October-November
<i>Scirpus articulatus</i>	September to January	October November
<i>Eichhornia crassipes</i>	March to October	April, August

Table 2—(Contd.)

Botanical name	Duration of occurrence	Peak flowering time
<i>Monochoria vaginalis</i>	March to September	June-July
<i>Monochoria hastoefolia</i>	April to November	July-August
<i>Nymphaea lotus</i>	June to September	August-September
<i>Nymphaea stellata</i>	June to October	August-September
<i>Aneilema nudiflorum</i>	July to October	August-September
<i>Commelina nudiflora</i>	September to January	October-November
<i>Cyanotis axillaris</i>	August to January	September-October
<i>Jussiaea repens</i>	March to October	August-September
<i>Ludwigia parviflora</i>	April to January	August-September
<i>Blumea lacera</i>	January to March	February-March
<i>Cenptipeda orbicularis</i>	December to April	January-February
<i>Eclipta alba</i>	Throughout the year	Throughout the year
<i>Galinsoga parviflora</i>	November to February	January-February
<i>Gnaphalium indicum</i>	November to March	December-January
<i>Grangea maderaspatana</i>	March to June	March-April
<i>Sphaeranthus indicus</i>	October to April	December—Mid. February
<i>Tridax procumbens</i>	Throughout the year	August-September
<i>Vernonia cinerea</i>	September to February	October-November
<i>Aeschynomene indica</i>	July to December	August-September
<i>Phaseolus trilobus</i>	April to September	May-June
<i>Ipomoea aquatica</i>	May to February	October-November
<i>Cardanthera triflora</i>	March to June	April-May
<i>Hemigraphis hirta</i>	February to June	March-April
<i>Hygrophila spinosa</i>	September to March	November-December
<i>Dentella repens</i>	Late March to June	May
<i>Oldenlandia corymbosa</i>	Throughout the year	May
<i>Sagittaria guayanensis</i>	August to October	Late August-Mid. September
<i>Alternanthera philoxeroides</i>	March to October	March-April
<i>Alternanthera sessilis</i>	Throughout the year	Throughout the year
<i>Bonnya brachiata</i>	March to October	May-June
<i>Dopatrium junceum</i>	March to June	May-June
<i>Ilysanthes parviflora</i>	January to July	March-April
<i>Polygonum flaccidum</i>	March to December	May-June
<i>Polygonum plebijum</i>	December to May	February-March

Table 2—(Contd.)

Botanical name	Duration of occurrence	Peak flowering time
<i>Hydrolea zeylanica</i>	September to January	November-December
<i>Ammannia peploides</i>	October to February	November-December
<i>Sphenoclea zeylanica</i>	March to January	May, October-November
<i>Utricularia stellaris</i>	August to December	September-Early October
<i>Phyllanthus niruri</i>	July to October	August-September

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