effects due to vicinal position of the H-bonding groups are demonstrated by Roberts *et al.*[27]. Since the groups in the gallic acid are strongly internally H-bonded, so free reorientation appears inadequate.

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FLORAL BIOLOGY AND STIGMA-POLLEN MATURATION SCHEDULE IN ISABGUL *PLANTAGO OVATA* F.

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ABSTRACT

Stigma-pollen maturation schedule and their interrelationship in diploid and tetraploid isabgul (*Plantago ovata* F.) revealed that anthesis in maximum number of florets occurred during early morning hours and stigma maturity was distributed to both morning and evening hours. Effective artificial crossing can be achieved by pollinating the matured stigmata daily till anthesis in the lowest floret of that spike takes place when the immature florets are clipped off. Protogyny was confirmed In diploid and tetraploid, 14 and 5 florets, respectively, had matured stigmata before anthesis started in the spike. Minimum time-gap between stigma receptivity and anthesis was 14 hours. Stigma receptivity and hair development on the stigma and the style were simultaneous.

PROTOGYNY prevails in almost all the species of Plantaginaceae[1]. In *Plantago ovata* protogyny can be confirmed by the protruding stigmata, through the tip of the buds. The detailed morphology of spike and floret has been studied by Osol *et al.*[2]. The results of an experiment conducted to study stigma-pollen maturation schedule, in diploid and tetraploid isabgul, are presented here.

Time of anthesis and stigma receptivity were studied using ten spikes from ten plants each of diploid variety Gujarat Isabgul-1 and tetraploid strain FC-411181-37. Every floret with receptive stigma (*i.e.*, when style

elongated and stigma and part of the style became visible outside the floret) and mature anthers (*i.e.*, when filament elongated, anthers protruded and anthesis occurred) was marked at different timings (Table I).

TABLE I

Per cent stigmata and pollen maturity at various timings

Timings	In 2*n* florets		In 4*n* florets	
	Stigma	Pollen	Stigma	Pollen
7·30 to 8·30	38·35	84·61	59·59	92·42
9·30 to 10·30	11·14	13·70	5·52	6·00
11·30 to 12·30	2·90	1·69	5·12	1·28
17·00 to 17·30	47·53	0·00	29·77	0·30

To avoid confusion in counting, as soon as it was noticed that the stigma of a floret had become receptive, the bract of the floret, which protected the young unopened floret, was marked with a dot of black colour. Later on, when anthesis occurred in the same floret, it was again marked with a second dot, using red colour. The commercially available black and red fabric paints of 'Camel' brand were used for marking the floret. The data (time and date of marking) were collected from the day the stigma of the first floret (the lowest) became receptive till anthesis was over in the topmost floret of the spike. Data were collected for every floret of ten spikes of diploid and ten spikes of tetraploid for (1) time and date of stigma receptivity and (2) time and date of anthesis. Total number of florets studied were 501 and 424 for diploid and tetraploid, respectively.

Correlation study on hair development on the style and stigma, and pollen presence was done on gynoecia of florets collected from different positions in the inflorescence. Gynoecia were carefully dissected out from the florets without damaging the anthers. By this procedure gynoecia at various stages of maturity were obtained. These were stained with 2% aceto-carmine and examined under the microscope.

In both diploid and tetraploid, anthesis was mainly confined to early morning hours and stigma receptivity was restricted to morning as well as evening hours with the lowest frequency at noon (Table I).

In a spike, on an average, 14 lower florets in diploid and 5 lower florets in tetraploid had receptive stigma prior to initiation of anthesis in that spike (Table II). Moreover, no incompatibility system has been reported in this plant[3]. Therefore, it was concluded that in

TABLE II

Number of florets in which stigma became receptive prior to anthesis in the lowest floret of the same spike

Spike No.	Diploid	Tetraploid
1	18	5
2	16	4
3	18	5
4	2	1
5	8	2
6	17	3
7	15	11
8	6	7
9	16	12
10	23	4
Average	14	5

these lower 14 florets in diploid and 5 florets in tetraploid, cross pollination, either xenogamous or geitonogamous type, had occurred. Therefore, in isabgul, which is small statured (about 40 cm) and in which numerous but very small florets are crowded on a spike, following sequential steps are suggested for artificial crossing: (1) Cover the spike with tissue paper bag before stigma of the basal floret becomes receptive. Pollen should be collected in the morning at 7·00 a.m. or soon after dew had evaporated, in butter paper bag. (2) As soon as stigma of the floret becomes receptive, dust pollen from the male parent on all the receptive stigmata. Continue this operation everyday. (3) The day anthesis is observed in the basal floret, which is the first floret to have anthesis in the spike, stop pollination and clip off florets in which stigmata have become receptive on this particular day as well as older florets, if any of them has receptive stigma. Also clip off other younger florets in which stigmata have not yet become receptive. This way it will be possible to artificially pollinate about 14 florets per spike, which, if pollination will be successful, will produce 28 seeds. (4) It is essential to cover the spike with tissue paper bag till step (3) is completed. However, by following this procedure, on an average only 5 florets per spike can be utilized for artificial pollination in tetraploid.

Average number of florets in a diploid spike at Anand (50·1) and at Delhi (55·6) were almost the same. However, anthesis in a spike was over in 7·3 days at Anand while it took nearly double this time (13·4 days) at Delhi. This difference might be due to higher temperature (21·9° C) at Anand and lower (15·8° C) at Delhi during the flowering period.

The range in time gap between stigma receptivity and anthesis, in a single floret varied from 14 to 120 hrs

(Table III). However, for most of the florets, it was between 24 and 62 hours and in none, out of the 925 florets studied, stigma receptivity and anthesis coincided (Table III). Further, when fully developed, all the florets had stigma of about the same length, and, no distinct difference in style length was observed.

TABLE III

Time gap between stigma receptivity and anthesis in diploid and tetraploid

Time gap (in hrs.)		Per cent floret	
		Diploid	Tetraploid
24		13·21	22·64
38		13·60	27·10
46		2·4	5·66
48		17·2	29·72
62		19·2	7·31
	Sub-Total	65·6	87·03
0–4		0·00	0·00
14–24		11·48	2·13
24–62 (Excluding the duration mentioned above)		12·46	7·58
62–86		9·66	3·30
120		0·5	..
	Total	34·10	13·01

These findings did not tally with those of Mital and Bhagat[4] who studied 10 florets and concluded that a floret had either long or short style and in a short styled floret, stigma maturation and anthesis coincided. In none of the 925 florets observed, stigma remained inside the bud till anthesis had taken place. In all the cases, stigmata protruded out, through the tip of the bud, hours before anthesis. Microscopic studies revealed that only such stigmata had hair with pollen sticking to them. The concealed stigmata neither had hair nor pollen, indicating thereby that they were not receptive. These results were considered as the evidence for protogyny in *P. ovata*. These observations were inconsistent with those reported by Mital and Bhagat[1], who concluded: "The stigma in *P. ovata* appears to be signle in bud-stage having pointed apex covered with hairs. But next day when flower opens, it splits into two."

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A STUDY ON THE NEUROMUSCULAR JUNCTIONS OF HUMAN VASTUS LATERALIS BASED ON THEIR ACETYLCHOLINESTERASE ACTIVITY

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ABSTRACT

The neuromuscular junctions on human vastus lateralis were found to show a difference in their staining intensities when stained for acetylcholinesterase (Ache) and the mean diameter of the paler junctions was found to be significantly greater than that of the compact, strongly stained junctions.

THE neuromuscular junctions were considered to show changes in their morphology during certain experimental[1,2] and pathological[3] conditions. However later reports[4,6] indicate the presence of different types of neuromuscular junctions in the normal muscle fibres of rats. But reports about the neuromuscular junctions in the normal human limb muscle showing such differences in their Ache activity are lacking. As this knowledge will help in the proper understanding of the human neuromuscular apparatus in health and