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## Indicative parameters of *Plantago major* L. in anthropogenic ecotopes

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Fig. 1

**Introduction.** *Plantago major* L. is a commonly known medical plant. Infusion of leaves of plantain enhances the secretion of bronchial glands, has a mucolytic, anti-inflammatory effect, stimulates the secretion of gastric juice, increases its acidity. Plantain leaves are part of the Pectorales Species №2, as well as they are used to obtain the total preparation Plantagluclide containing a mixture of polysaccharides. Juice obtained from fresh leaves has a wound-healing, antispasmodic and hemostatic effect. Due to the variety of application options, it is essential to control the purity of raw materials. This can be done by using fluctuating asymmetry method (FA), which measures minor non-directional deviations from strict bilateral symmetry.

**The goal** of the work is to study the indicative parameters of *Plantago major* L. in Izmailovsky Boulevard and identify the index of its FA.

### Research methods

To calculate the FA index, we made a number measurements from 110 leaves (Fig. 2, Table 1). Then, we calculated the relative difference for each character per leaf (Left-Right / Left+Right) and the average relative difference for the whole leaf.

By using the Sturges's rule, we determined the optimal number of groups in which to divide the sample:

$$n=1+3,322*\lg N=1+3,322*\lg 110=7.7815$$

≈8 groups,

Next, we calculated the value of the equal interval and divided leaves into 8 groups (Table 2):

$$i=\frac{X_{max}-X_{min}}{n}=\frac{0.15-0.0105}{8}=0.0174$$

Then, based on the existing classification, the data was regrouped into three categories. The uniform distribution of units within each category was taken into account (Table 3).

Another one regrouping was conducted to account for individual variability within an specimen. Therefore, if FA indexes of leaves from one specimen were close, they fell into the same group (Table 4)

The instability of *Plantago major* L. development in the ecotope is influenced by a variety of abiotic factors, as well as by anthropogenic ones. In this study, we focused on the impact of vehicle emissions on plantain growth. We measured the number of vehicles that stopped at a traffic light for one cycle and those that were moving for 20 minutes. We also took into account the types of vehicles (cars, vans, buses and trucks), and calculated the total amount of pollutants emitted.

For moving vehicles (Table 5):

$$TEM = \sum_{i-n} EM = \sum_{i-n} \left( \frac{L}{1200} * SME * Vd * r \right)$$

At the traffic light (Table 6):

$$TEC = \sum_{i-n} EC = \sum_{i-n} \left( \frac{P}{60*60} * SEC * Vs \right)$$

Table 1

№ of fraction	AW		LL	LS	LW		LW/LL		MV		VD	
	Left	Right			Left	Right	Left	Right	Left	Right	Left	Right
1	5	5	70	86	25	24	0.36	0.34	11	12	9	9
1	13	12	76	120	22	22	0.2895	0.2895	10	9	8	8
2	10	10	66	100	25	21	0.3788	0.3182	9	11	7	8
2	11	13	89	128	27	26	0.3913	0.3768	12	14	7	8
3	16	12	92	140	35	39	0.3804	0.424	11	16	11	14
3	15	11	72	117	23	18	0.3194	0.25	9	5	8	7

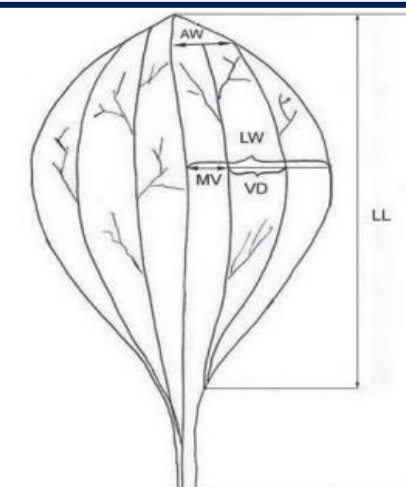


Fig. 2. Diagram of a *Plantago major* L. (*ssp. major*) leaf showing leaf width (LW), vein distances within a leaf (VD), the distance from the midrib to the neighboring vein in the left and in the right side of a leaf, measured at a leaf's widest point (MV), leaf-blade apical width (AW), leaf-blade length (LL). These leaf characters are bilaterally symmetrical and only measurements of the right sides of these characters are shown in the diagram. Leaf size (LS) and width to leaf-blade length ratio (LW/LL) are also used leaf characters for numerical analysis.

Table 2

№ of group	FA index	№ of leaves
1	< 0.0279	10
2	0.0279 – 0.0453	34
3	0.0453 – 0.0627	28
4	0.0627 – 0.0801	25
5	0.0801 – 0.0975	4
6	0.0975 – 0.1149	7
7	0.1149-0.1323	1
8	> 0.1323	1

Table 3

№ of group	FA index	№ of leaves
1	0.0131 - 0.0445	38
2	0.0445 - 0.0727	42
3	0.0727 - 1.5	27

Table 4

№ of group	FA index	№ of leaves
1	< 0.0366	24
2	0.0366 – 0.0704	58
3	> 0.0704	28

Table 5

Moving vehicles	passenger cars	vans and mini-buses <3.5 t	trucks < 12 t	trucks > 12 t	buses > 3.5 t	average flow rate, km/h	r	the length of the road section (L), km
the number of vehicles driven in 20 min (in both directions) (Vd)	161	10	15	0	7	40	0,75	0,33
specific mileage emission (SME)	0,005	0,034	0,38	0,45	0,28			
emission (EM), g	0,000166031	7,013E-05	0,00117563	0	0,0004043			
total emission (TEM), g	0,001816031							

Table 6

At the traffic light	passenger cars	vans and mini-buses <3.5 t	trucks < 12 t	trucks > 12 t	buses > 3.5 t	the time of the working traffic light in seconds (red and yellow lights) (P)	number of cycles per 20 min
the number of cars at the traffic light per cycle (on both sides of the crossroad) (Vs)	16.08	0.913	0.75	0	0.333332	106	12
specific emission at the crossroad (SEC)	0.01	0.03	0.22	0.45	0.2		
emission per cycle (EC), g	0.004734667	0.0008065	0.00485833	0	0.001963		
total emission per cycle (TEC), g	0.012362438						
total emission per 20 min, g	0.148349261						

**Conclusion.** At the point of the study, the vehicle emission is average, the total FA index is 0.0469, which corresponds to a high level of pollution. The sample was divided into 3 fractions (with minor, high and very high level of pollution) using the method of mathematical grouping for subsequent chemical analysis.