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RESEARCH REGARDING THE POTENTIAL OF BIOMETRIC FEATURES OF PLANTS IN THE AUTOMATIC DISCRIMINATION OF WEED BIOLOGICAL GROUPS

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The implementation of a precision agricultural system aims to reduce unevenness in a lot, so that, in the same soil and climate conditions, the plants can benefit from the same growth and development conditions and the individual (plant) production output is similar (almost zero differences), close to the potential production level. The research aimed to assess the possibilities to discriminate and automatically classify weeds according to the biometric features of leaves. 22 weed species were assessed, out of which 18 were dicotyledonous and 4 monocotyledonous. The findings of the research were that, upon analysis of the three main features, namely length, width and the ratio length/width and shape, an appropriate classification can be obtained for the biological group (monocotyledonous/dicotyledonous) based on just the length/width ratio. Thus, for the analysed dicotyledonous species the length/width ratio is under 5 and for the analysed monocotyledonous species the respective ratio is over 7.

Key words: weed, weedclassification, biometrical determination.

INTRODUCTION

Agriculture faces more and more pressure due to the increased prices of the main synthesis inputs, which consume a lot of energy and the volatility of selling prices.

The Precision Agricultural System (PAS) consists of managing various inputs according to the local land needs, which requires accurate knowledge of the characteristics of each parameter influenced by an application so as to reduce unevenneess, use inputs efficiently and increase revenues. SAP implementation requires the use of the identification and quantification of the size of a specific parameter in the field, with a greater degree of automation[1,18].

If weed control works in SAP, managing herbicide is differentiated by weed biological group (monocot or dicot), and in order to implement this system, you need a system for automatic discrimination of weeds by properties anatomomorfologice of weeds and crop plants[15,17].

The present research was carried out so as to generate a weed discrimination and classification algorithm, which can automatically map weed groups (monocotyledonous and dicotyledonous) once implemented in an automatic system of discrimination, classification and differentiated application of herbicides and connected to a GIS system.

Research objective was to develop an algorithm for the discrimination and classification of weeds on properties an atomomorfologice that implemented in an automatic classification discrimination and all ow the classification of biologic al weed in two groups: monocots and dicots. The automatic classification of weed scan beused with precision equipment herbicide forweed control groups differently, orcoupledwith a GPS receiver for mapping groups and groups of weed distribution map in GIS development[11,19].

The research aimed at identifying the potential to be used in developing an algorithm for discrimination and classification of weeds. To determine the potential for discrimination of weed softer the shape of leaves were studied three distinguishing criterialeaflength, width, length/ width.

METHODOLOGY

In order to determine the differentiation potention of the proposed criteria, the following were examined 8 annual dicotyledonous weed species: *Amaranthus retroflexus, Xanthium strumarium, Solanum nigrum, Chenopodium album, Galinsoga parviflora, Portulaca oleracea, Poligonum convolvulus, Datura stramoniu,*

3 perennial dicotyledonous species*: Convolvulus arvense, Cirsium arvense, Sonchus arvensis,;*

3 annual monocotyledonous species*: Setaria sp., Echinochloa cruss galli,*

1 perennial monocotyledonous species *Sorgum halepense*

For each of the 18 weed species, (occuring in the Experimental Field of the Agrotechnics Department in Moara Domneasca) their biometric characteristics were analysed so as to assess the discrimination potential of the main biometric elements.

These analyses were performed 10 to 12 days after corn and sunflower emergence, which is the best time to apply postemergent weed control treatments.

For each of the 18 weed species 100 analyses were performed and the following parameters were determined:

Length, width and length/width ratio

For each of these indicators, the minimum, maximum, average and relative concentration were determined.

The length L was determined by measuring the length of the leaf limb;

The width l was determined by measuring the width of the leaf limb;

The ratio r was calculating by dividing the length by the width for each analysed leaf;

min represents the minimum value on the interval;

MAX represents the maxium value on the interval;

The interval between the min and max value was divided in 10 segments and the relative concentration was calculated on each segment:

$Cr_x = nx/N$

where N is the total number of determinations, and nx is the number of values belonging to the x interval

The number of determinations N for each of the indicators measured in the field and for each of the 18 weed species was 100.

In fact the distribution intervals were calculated as follows:

I = MAX-min

where MAX is the minimum value of the indicator analysed in the N determinations

min is the minimum value of the indicator analysed in the N determinations

$$I_j = \min + \frac{I}{10} \times j$$

where I/10 is the tenth part of the variation interval of each indicator belonging to the interval

and j is the analysed interval.

The mean $m = \frac{\sum_1^{10} L}{N}$ the median $md = \frac{\sum_1^{10} L}{N+1}$

Because, when N=100, it can be approximated that N+1 is almost equal to N, and the mean is equal to the median.

RESULTS

For Amaranthus retroflexus we added the table with the determinations for each indicatoram and for other studied species we insered only the graphics.

Table 1

Amaranthus retroflexus, biometrical data

Length													
	min	1	2	3	4	5	6	7	8	9	10	max	m
intervale	13	13	17.3	21.6	25.9	30.2	34.5	38.8	43.1	47.4	51.7	56	24,2
		17.3	21.6	25.9	30.2	34.5	38.8	43.1	47.4	51.7	56		
number		46	8	10	9	6	8	5	3	3	2		
concentration		46 %	8 %	10 %	9 %	6 %	8 %	5 %	3 %	3 %	2 %	100 %	
Width													
	min	1	2	3	4	5	6	7	8	9	10	max	
intervale	7	7	10.3	13.6	16.9	20.2	23.5	26.8	30.1	33.4	36.7	40	16,39
		10.3	13.6	16.9	20.2	23.5	26.8	30.1	33.4	36.7	40		
nr		27	20	13	14	6	7	8	1	2	2		
concentration		27 %	20 %	13 %	14 %	6 %	7 %	8 %	1 %	2 %	2 %	100 %	
Report length / width													
	min	1	2	3	4	5	6	7	8	9	10	max	
intervale	1.06	1.06	1.17	1.28	1.39	1.49	1.60	1.71	1.82	1.93	2.03	2.14	1,51
		1.17	1.28	1.39	1.49	1.60	1.71	1.82	1.93	2.03	2.14		
nr		4	10	21	14	18	12	7	9	4	1		
concentration		4 %	10 %	21 %	14 %	18 %	12 %	7 %	9 %	4 %	1 %	100 %	

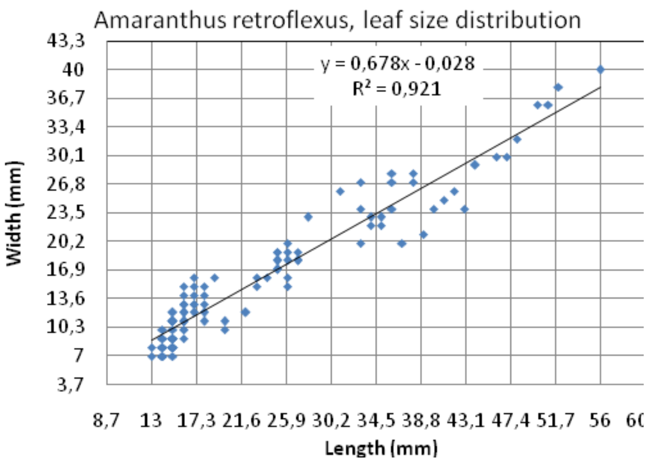

Fig. 1. For amaranthus retroflexus the length of leaf is from 8.7 to 60,3 mm, and width is from 3,7 to 43,3 mm.

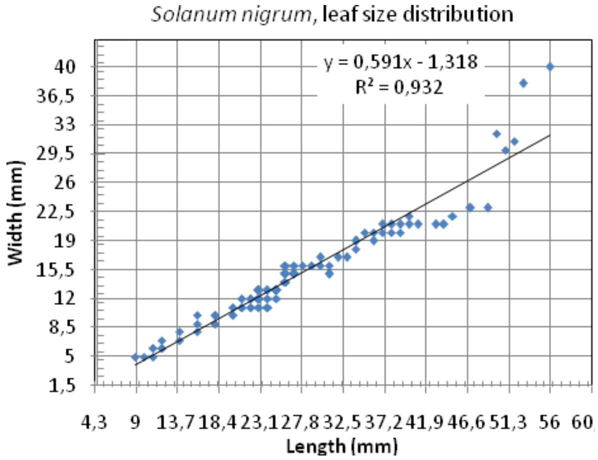

Fig. 2. For *Solanum nigrum*the length of leaf is from 4,3 to 60,7 mm, and width is from 1,5 to 40 mm.

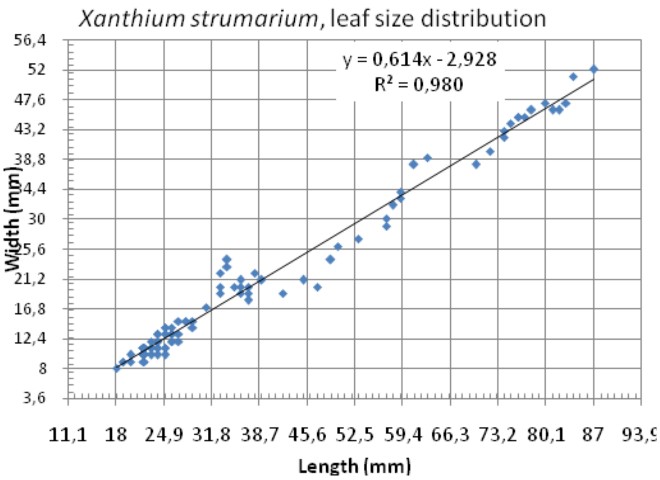

Fig. 3. For *Xanthium strumarium*the length of leaf is from 11.1 to 93 mm, and width is from 3,6 to 56.4 mm.

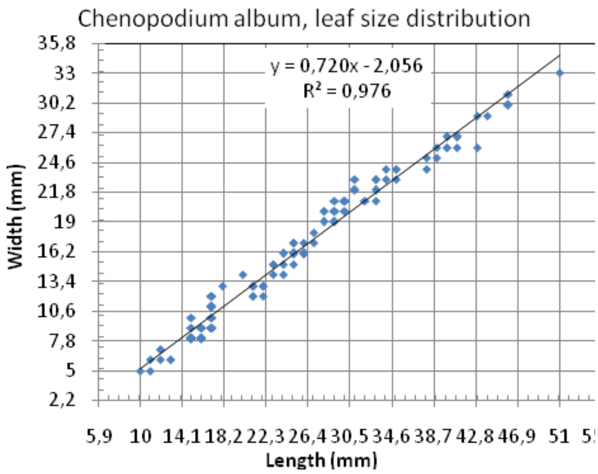

Fig. 4. For *Chenopodium album*the length of leaf is from 5,9 to 55,1 mm, and width is from 2,2 to 35,8 mm.

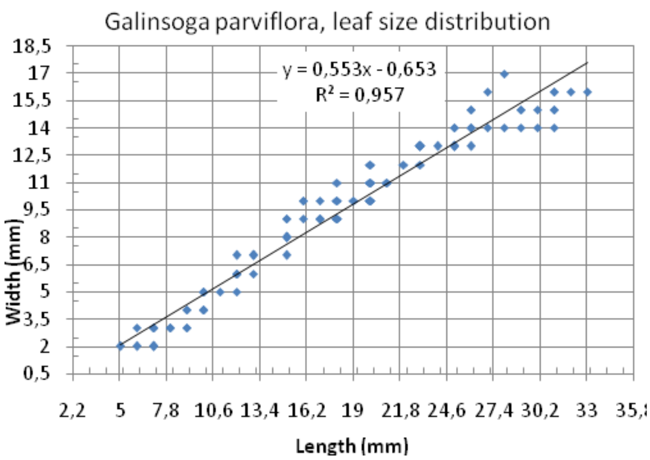

Fig. 5. For Galinsoga parviflorathe length of leaf is from 2,2 to 35,8 mm, and width is from 0,5 to 18,5 mm.

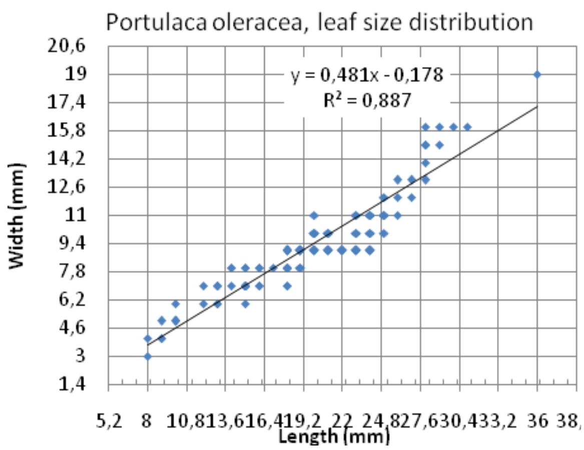

Fig. 6. For *Portulaca oleracea*the length of leaf is from 5,2 to 38,8 mm, and width is from 1,4 to 20,6 mm.

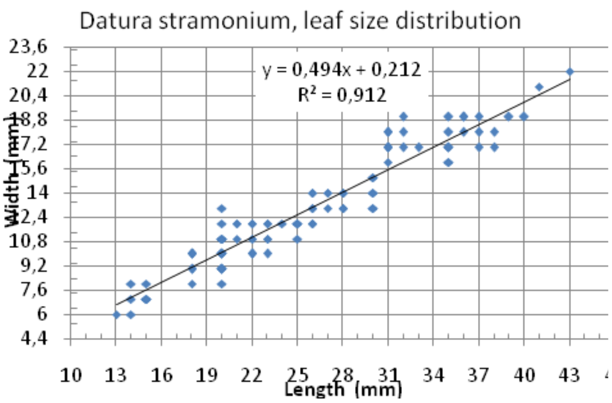

Fig. 7. For Datura stramoniumthe length of leaf is from 10 to 46 mm, and width is from 4.4 to 23,6 mm.

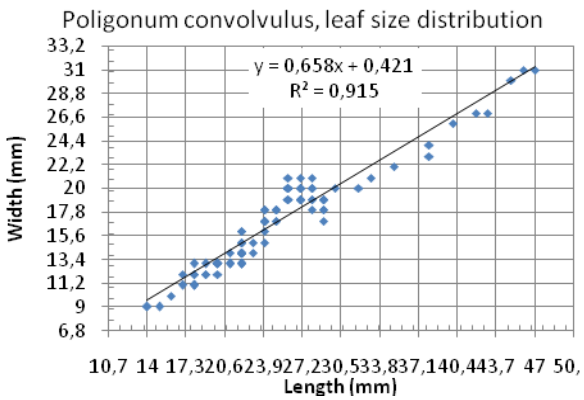

Fig. 8. For *Poligonum convolvulus*the length of leaf is from 10,7 to 50,3 mm, and width is from 6,8 to 33,2 mm.

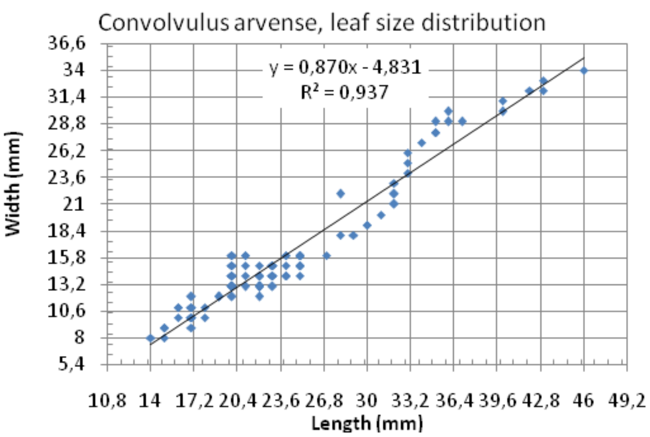

Fig. 9. For Convolvulus arvensethe length of leaf is from 10,8 to 49,2 mm, and width is from 5,4 to 36 mm.

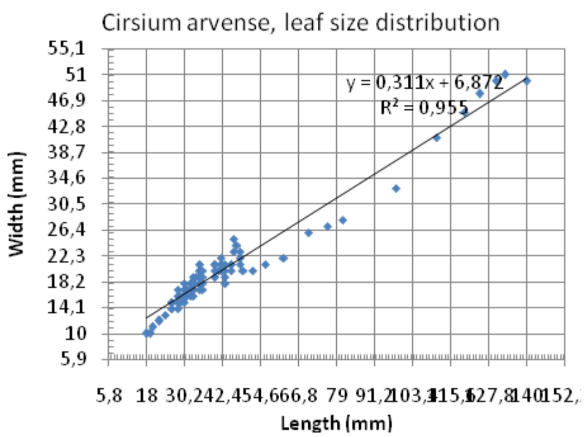

Fig. 10. For *Cirsium arvense*the length of leaf is from 5,8 to 52,28 mm, and width is from 5,9 to 51 mm.

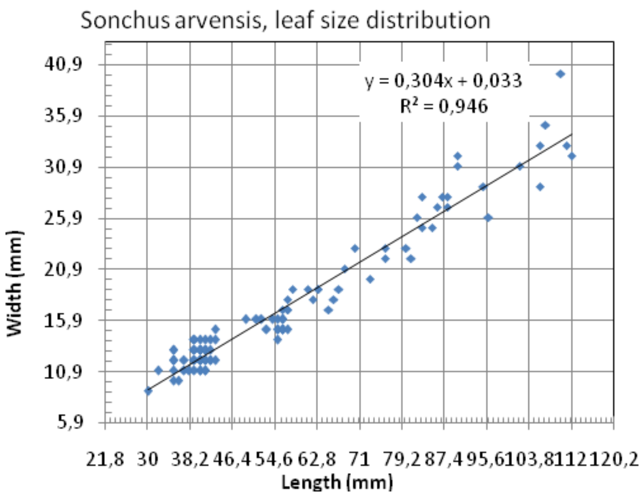

Fig. 11. For Sonchus arvensis the length of leaf is from 21,8 to 112 mm, and width is from 0,5 to 40 mm.

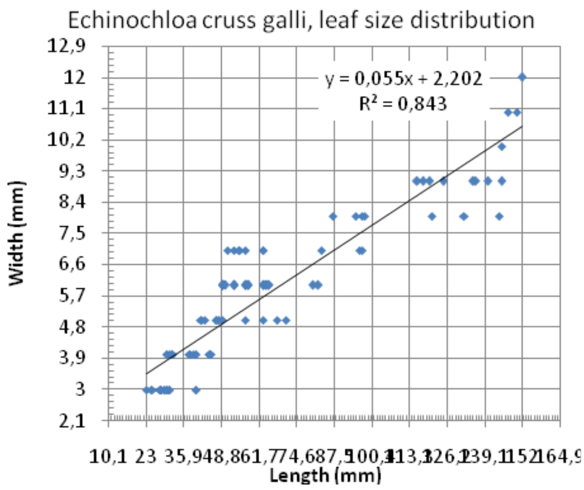

Fig. 12. For *Portulaca oleracea*the length of leaf is from
10,1
to 64,9 mm, and width is from 2,1 to 12,9 mm.

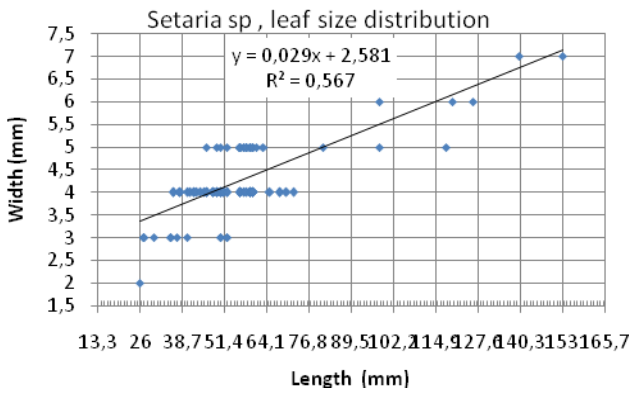

Fig. 13. For Setaria sp the length of leaf is from 13,3 to 65,8 mm, and width is from 1,5 to 7,5 mm.

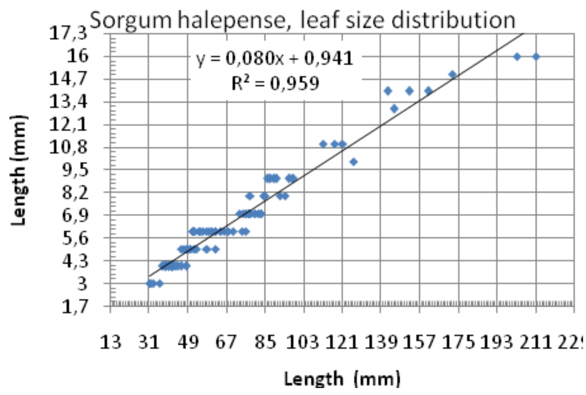

Fig. 14. For *Sorgum halepense*the length of leaf is from 13 to 38,8 mm, and width is from 1,7 to 17 mm.

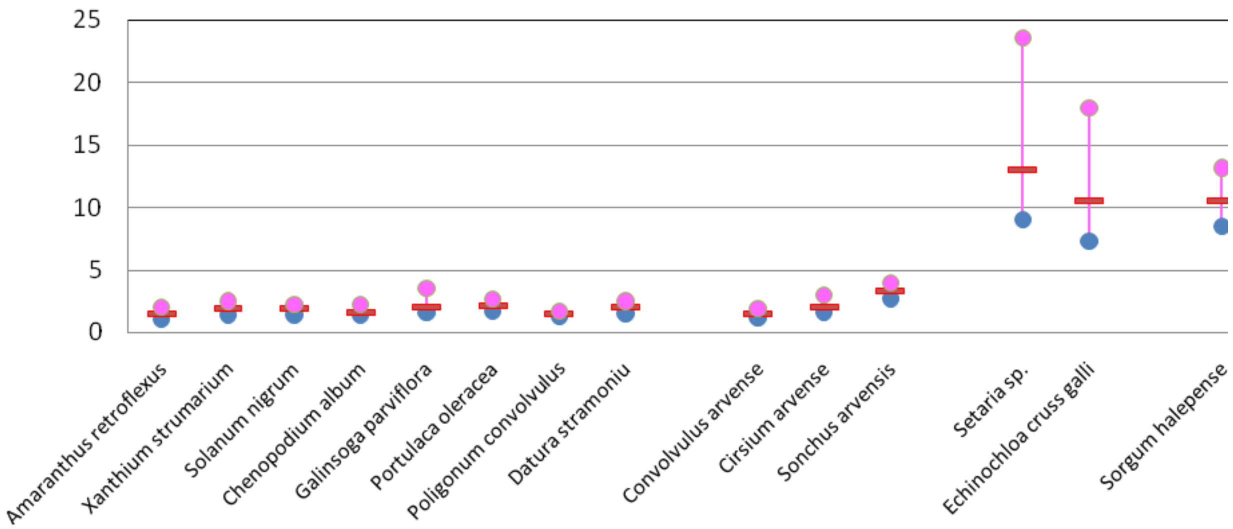

Fig. 15. Report length/width (minimum, medium, maximum) for all species.

By analysing the data gathered in fig 15 we could notice that, in dicotyledonous weed species the length of the leaf limb, measured starting from the insertion point of the leafstalk on the limb to the tip of the limb, varied from 5 to 140 mm, the limb width was between 2 and 52 mm and the ratio between the limb length and width was between 1.06 and 4.5.

In monocotyledonous weed species the limb length was between 23 and 211 mm, the width between 2 and 13.19 mm and the length/width ratio varied between 7.3 and 23.6.

By comparing the three analysed indicators for the two weed groups, it can be seen that there are differences among these three indicators, which can be used in discriminating among the two groups of monocotyledonous and dicotyledonous weeds.

The information presented in table 3 prove that the analysis of biometric data can be used in discriminating the two weed groups: monocotyledonous and dicotyledonoous.

The results represented the basis of the multifactorial classification system of weed species according to biometric data.

Out of the three analysed indicators the length/width ratio is the essential criterion used in the classification because it can divide weed species in the two monocotyledonous and dicotyledonous classes.

CONCLUSIONS

The limb length in the analysed weed species was between 5 and 211 mm, and the limb width was between 2 and 52 mm. The length/width ratio was between 1.06 and 23.6.

In dicotyledonous species the length/width ratio was below 4.5 and in monocotyledonous species this ratio was above 7.3.

By using the three analysed indicators weed species can be discriminated.

Out of these indicators the highest specificity is manifested by the length/width ratio.

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