

STUDY ON VARIABILITY OF *CICHORIUM INTYBUS* L. FLOWERS AND FRUITS

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Abstract

Variability studies of weeds in agricultural fields are useful in promoting integrated management measures. It was found that a higher variability of any species can be controlled more easily by various methods. And if *C.intybus* species was a significant spread in agricultural fields, while variability information they are fewer. Weed, being adapted white luvisoil the south of the country has shown that inflorescence have diameters between 3 and 5 cm, with a ligulae flower number between 13 and 25 pieces. Their modal values were 3.8-4.0 cm in diameter and 15-16 ligulae flowers number in head (capitula). Fruit s (achene) were formed in a number between 1 and 15 in the head, with a length between 1.5 and 2.6 mm, and the width between 0.7 and 1.1 mm. Modal values of these dimensions of fruits were 7-9 pieces/ head, with 1.9-2.0 length and 0.9 mm width. Correlations between the various characters showed positive results, and that means the plant have a good adaptation to the various vegetation conditions.

Keywords: *Cichorium intybus*, head, ligulae flowers, fruits.

1. INTRODUCTION

One of weeds spread into farmland imports is the common chicory, *Cichorium intybus* L. (pro syn *C.divaricatum* Schur.) (CICIN in Bayer code). The name derives from the Greek words *kio-* plant to go, and *chorion-* field, that occurs everywhere in the fields. Species belonging subfam. *Liguliflorae* and contains *laticiferae* vessels in young organs (Nyárady, 1965). *C.intybus* is known since Roman times, both as an herb and edible plants as well as food (Aliotta, 1987). In herbal medicine (Bremness, 1988; Chirilă, 1987) recommended use young leaves in an amount of 15 to 30 mg.day⁻¹, regular salad (Chirilă, 2001). *Foliosum* variety grown in different regions of Europe, considered a food rich in nutrients (Bianco, 2001). Chemical analyzes of this variety blooming plants showed significant content items (table 1).

Another variety, *sativum*, is characterized by persistent thickened root (Radu et Andronescu, 1984). This root contains a variety of principles (Nyárády, 1965), required in proper food (table 2). Therefore variety is grown in different farms as a crop with known technology (Bîlteanu, 1993).

Table 1. Nutrient values of *C.intybus* plants, var. *foliosum* (Bianco, 2001)

Minerals	Concentrations	Vitamins	Concentrations
Phosphorus, P	34- 35 mg.100 g ^{-1*}	B ₁ - tiamine	0.06 mg.100 g ⁻¹
Potassium, K	280- 450 mg.100 g ⁻¹	B ₂ - riboflavine	0.08 mg.100 g ⁻¹
Calcium, Ca	80- 110 mg.100 g ⁻¹	B ₃ - niacine	0.41 mg.100 g ⁻¹
Magnezium, Mg	17- 25 mg.100 g ⁻¹	C	29-50 mg.100 g ⁻¹
Sodium, Na	45- 94 mg.100 g ⁻¹	A	4000 U.I.

*fresh material

Table 2. Active ingredients from *C.intybus* root, var. *sativum* (Nyárády, 1965)

Active ingredients from roots	
Main	Secondary
Inuline, 15 %	Tanante materials, pectines, rezines, volatile oils, rubber, lactucine, cicorine, carbon hydrates

Roasted root yield is for surrogate coffee, Arabic coffee substitute (Bown, 1995). At the same time represents a forage plant, been one of the valuable components of the hay needed to feed. In terms of agricultural plant for the roots can grow as biennial plant. The improvement has been achieved with some variety in the root and hypocotyl the package may reach 300 to 500 g per plant (Bîlteanu, 1988).

At the same time the plant known and spread „savage” evident in pastures, meadows, as ruderal species all over us (Prodan et Buia, 1958). Also on white luvisols from South, plant have spread widely, and to know some of the elements of variability on plant expresses a point, was made to experiment. A new theory, the current environment protection, showed that a weed to control and contain the spread of new variability elements are required. Thus, the weed variability exhibit greater morphological characteristics, methods can be applied to control easier. From what is known so far, floral and fruit elements are described less: inflorescence 3-4 cm in diameter, with *ligulae* blue flower, and fruits 2-3 mm long, with specific short papus (Anghel et al, 1975). Generally head of *C.intybus* contains only *ligulae* flowers, with blue- azure color. *Ligulae* flowers presents striations and specific teeth peak. The flowering period occurs during July and lasts until the coming cold. In the present study we analyzed the size and number of corolla *ligulae* flowers at flowering in July. Fruits analyzes were done to their early maturity in August.

2. MATERIALS AND METHODS

Measurements were conducted in the summer of 2014. *C.intybus* plants have been analyzed in cultivated and uncultivated land, located on the high terrace of Argeş river, south of the town of Piteşti. The analyzed head are in full bloom in July and fruits formed before release. The flowering heads were measured like diameter and length of corolla *ligulae* flowers. Fruits were measured like number by head, the length (height) and width of the central portion. Plants were chosen by covering the surfaces in zig-zag. Thus analyzed and measured a total of 200 flower heads that bloom and mature by 200 heads.

Morphological characters measured were then analyzed by drawing polygons frequency (%), or histograms. For example, if the diameter of the inflorescence, the number of flowers, the number of

head achenes and of the fruit length were used every class intervals, in the width of the fruits of the absolute values were used. With this statistical method we find the followings:

- modal values, the highest frequencies,
- limits the variability of ranged characters studied,
- specific character of each plant ecotype of the review.

Among the characters examined some correlations were established, with which they could observe any trends in the ecotype characters studied. Values are presented as the average of all measurements, and the statistical calculations were made by using variance analysis (the rows of variation) and Excel program. Statistical parameters were calculated using the formulas:

- $\bar{a} = \frac{\sum x}{n}$, \bar{a} = media, and x = values,
- S^2 (variance) = $\frac{1}{n-1} \left[\sum x^2 - \frac{(\sum x)^2}{n} \right]$,
- S (standard error) = $\sqrt{S^2}$,
- $S\%$ (variation coefficient) = $\frac{S}{\bar{a}} \cdot 100$.

3. RESULTS AND DISCUSSIONS

Variability of *C.intybus* flowering heads. The first character was analyzed surrendered diameter flourished. The absolute values varied between the inflorescence diameter ranged between 3.1 and 5.2 cm (figure 1).

Inflorescence diameter modal value was between 3.8 and 4.0 cm (30 % frequency). Very close to it was the frequency of 28 % for diameters between 3.5 and 3.7 cm. Limits the size of the heads *C.intybus* diameters were between 3.1 and 5.2 cm. In general, the inflorescence diameters between 3.1 and 4.4 cm were 93 % of all plants analyzed. Instead, larger diameters between 4.5 and 5.2 cm were rare and the plant may be news luvicsoil area of southern.

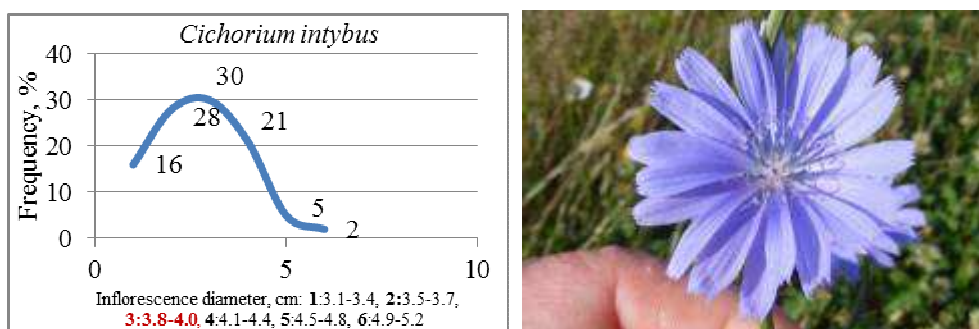


Figure 1. The frequency of inflorescence diameter, *C. intybus* weed

The second character examined was the number of *ligulae* flower of flower head. The flowers that were the *C.intybus* included between 13 and 25pieces (figure 2). Modal value highlighted flower petals 15-16 of head. The flower *ligulae* flowers 15-20 were 90 % of the total. Exceptions were heads with 13-14 flowers as minimum limit and the maximum 21 to 25 flowers, whose rates were 7 % and 3 % of the total. Inflorescences with a large number of flowers, 24 and 25 pieces of flower head was only one each of the total analyzed. From this point of view *C.intybus* may be an exception for plants grown sporadically in these environmental conditions.

Between inflorescence diameter and number of flowers in head has established a positive correlation (figure 3). This means that the flowers of larger diameter, there is a relative greater number of *ligulae* flowers.

Fruits size variability. The surrender of *C.intybus* were the burrs formed with dimensions: length and width of the portion of average fruit. Modal value of the number of fruit of head was 48 % belonging to the limit of 7-9 pieces. Limits of total number of fruits in head was between 1 and 15 pieces. 4 to 12 fruits were 91 % of the total. Heads with 1-3 fruits were at a rate of 4 %, while those with 13-15 achenes, 5 % of the total (figure 4).

C.intybus fruits have been described (2-5 sections) edges, and 2-3 mm in length (Nyárády, 1965). From measurements (under the microscope) was found that the modal value of character was between 1.9 and 2.2 mm, with frequencies of 35 to 36 %. 1.7-1.8 mm lengths were 17 % of the total and 6 % were achenes of 1.5-1.6 cm and 2.3-2.4 mm.

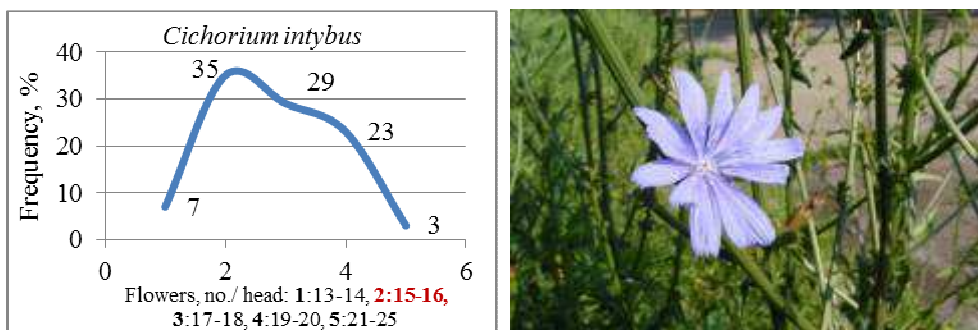


Figure 2. The frequency of head flowers number, *C. intybus* weed

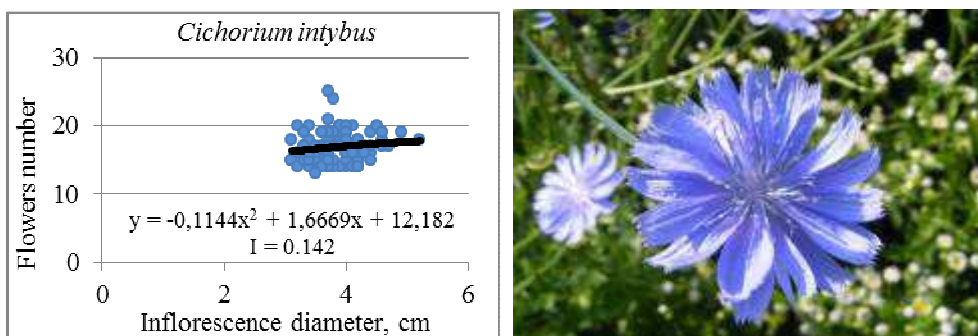


Figure 3. Correlation between inflorescence diameter and flowers number of *C.intybus* weed

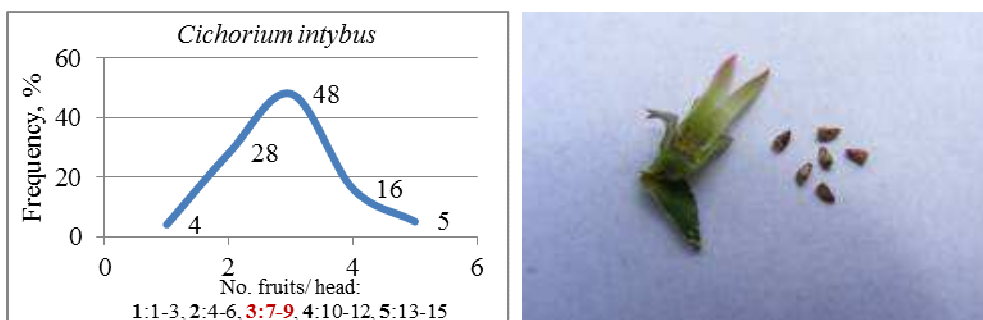


Figure 4 The frequency of fruit number per head, *C.intybus* weed

That lengths 2.5-2.6 mm constituted only 1 % of the total (figure 5). Width fruits have had 0.9 modal value (44 %). The limits of variation of the character was in range 0.7 and 1.1 mm. 0.8-1.0 fruits widths were 92 % of the total, while the 0.7 mm wide fruits were 6 % and 1.1 mm only 2 %. Between the number of fruits and dimensions were established positive correlations (figure 6). Between the number of fruits and their length has a correlation coefficient significantly distinct. The correlation between the number of fruits in a head and their width, correlation coefficient is statistically very well secured. These two connections demonstrate that the heads with more achenes, their dimensions are quite large.

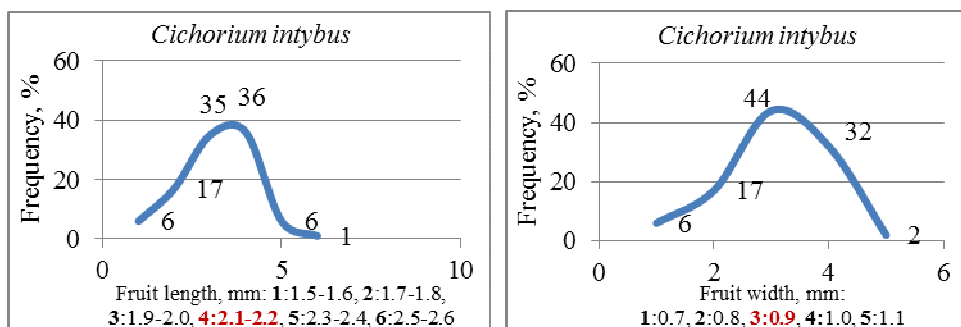


Figure 5. The frequency of length and width of *C.intybus* fruits

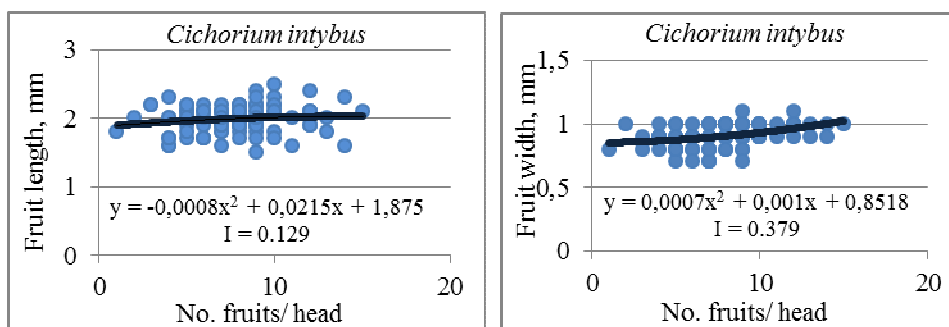


Figure 6. Correlations between fruit number and its length and fruit number and its width

Between the two dimensions of fruits of *C.intybus* established a highly sensitive correlation (figure 7). This shows that the burrs can be longer and a width slightly larger as more advanced fruit, likely due to more favorable growing conditions.

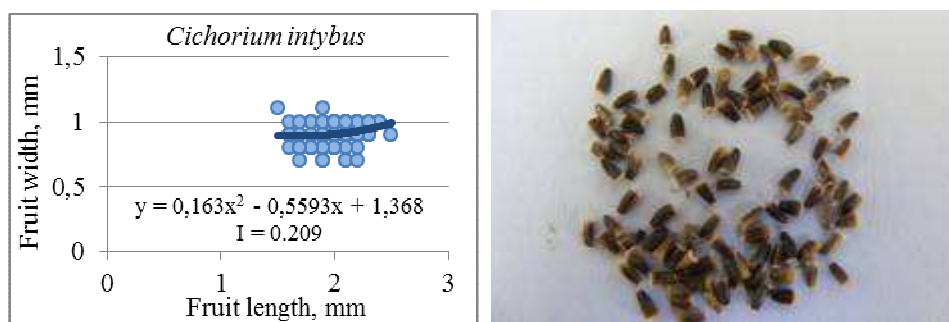


Figure 7. Correlation between fruit length and fruit width, *C.intybus* weed

Other aspects of variability C.intybus flowers and fruits. For a better characterization were calculated a series of other statistical indicators variability. The data refer to the average (\bar{a}), the variance (s^2), standard deviation (error, s) and variation coefficient ($s\%$) (table 3). Values were with sensitive oscillations.

Regarding the average of, it is found that corolla diameter was 3.9 cm, number of petals around 17, number of fruits in head approx.. 8, fruits length of 2 mm, and fruits width 0.9 mm. Variability expressed as coefficient of variation shows low values, except the number of fruits in the head, with a limit considered high: 35 %.

4. CONCLUSIONS

A common species, which has seen a growing spread, is cicoria commune (ital.)- *C.intybus*. Its characters, especially the reproductive morphology are less known. Although savage form (as a weed) can select and promote forms of culture, varieties even, because of the qualities demonstrate in time.

In terms of its control to stop penetration and reduce infestation of agricultural land can promote variability studies. Between finding variability and degree of weed control were found positive correlations.

Table 3. Statistic indices of *Cichorium intybus* flowers and fruits variability

Indices	Inflorescence		Fruits		
	Diameter, cm	Flowers number	No/ capitula	Lenght, mm	Width, mm
Media, \bar{a}	3.8574	16.8911	7.7624	1.9901	0.9069
Variance, s^2	0.0431	4.7180	7.4530	0.0005	0.0081
Standard deviation, s	0.2076	2.1721	2.7300	0.0224	0.0897
Coef. of variation, $s\%$	5.38	12.86	35.17	1.13	9.87

Variability studies focused *C.intybus* inflorescence and fruits. The way character was established variability investigated, revealed ecotype characteristic values existing in the white luvicsoil (table 4).

Variability data obtained are considered to be important for the expression of weed ecotype. They express both an evolution and a completed data drawn from the literature.

Table 4. The structure and distribution of analysis values from *C.intybus* inflorescence and fruits

Inflorescence		Fruits		
Diameter cm, %	No. of flowers, %	No./ head, %	Length, mm, %	Width, mm, %
3.1-3.4 16%	13-14 7%	1-3 4%	1.5-1.6 6%	0.7 6%
3.5-3.7 28%	15-16 35%	4-6 28%	1.7-1.8 17%	0.8 17%
3.8-4.0 30%	17-18 29%	7-9 48%	1.9-2.0 35%	0.9 44%
4.1-4.4 21%	19-20 23%	10-12 16%	2.1-2.2 36%	1.0 32%
4.5-4.8 5%	21-25 3%	13-15 5%	2.3-2.4 6%	1.1 2%
4.9-5.2 2%			2.5-2.6 1%	

5. ACKNOWLEDGEMENTS

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