

VARIABILITY OF *VICIA CRACCA* L. WEED FRUIT CHARACTERS

Nicolaie Ionescu ^{1,*}, Florian Trașcă ¹, Gina Mincă ¹, Maria Voica ¹,
Iulia Ciodaru ¹, George Alexandru Lazăr ¹

¹Agricultural Research and Development Station Pitești, Șos. Pitești-Slatina, km. 5,
117030, Pitești, România

Abstract

The species has been an increasing trend in winter wheat crop. Cause is still better adaptability to existing conditions. Variability studies may bring some new information on how this adaptation took place. Racemes fruit had lengths between 6 and 15 cm, with a higher frequency 9-10 cm. Number of pods in raceme was between 1 and 10, mainly through 3-4 pods. The length of the beans was between 20 and 35 mm, with a higher percentage of between 26 and 28 cm. Width pods ranged between 5 and 10 mm, to 6 mm higher frequency. The number of beans in a pod ranged between 1.1 and 7.0, with greater frequency at 4.1-5.0. Grain diameter was between 2.0 and 3.1 mm with a frequency oscillating. The thousand kernels mass (TKM) was between 5.0-23.0 g, with the dominant 8.1-11.0 g. The correlations between different variables were positives. Foremost so long racemes with number of the pods/ raceme ($r = 0.315^{***}$), then the length of the pods with the number of grains/ pod ($r = 0.251^{**}$), and MTK with grain diameter ($r = 0.710^{***}$). The study showed high adaptability of weeds in winter wheat crop.

Keywords: grains, pods, racemes, variability, *Vicia cracca*.

1. INTRODUCTION

Weed control has entered in a new stage (Arthokin, 2004). The herbicides is restricted to protect the environment and existing weed species have evolved (Jackson et Sparrow, 2007; Seefeldt et al., 2007). Adapting to new conditions can be demonstrated by observing the trends of variability (USDA, ARS, 2004; Eliášova et al., 2014) as many characters, including morphology. It was found that a weed variability characters (including reproductive) as high, was able to adapt much better to the conditions of a crop (Preston et al., 2002). The current trend requires accepted control measures that should be accepted and even complex diversified. A weed known in winter wheat fields is vicia - *Vicia cracca* L. [pro syn *Ervum cracca* (L.) Trautv., *Vicia hiteropus* Freyn., *V. lilacina* Ledeb., *V. macrophylla* (Maxim) B. Fedtsch., tufted vetch, blue vetch, VICCR in Bayer code]. The plant grows quickly and produces between 10 and 40 flowers in an raceme (Aarsen et al., 1986). Flowers have colors from blue to purple and violet, and open between May to July. The corolla is typical of the *Fabaceae* family (zygomorphic), 8-12 mm long. The flower has a single carpel and 10 stamens. Once fertilization occurs pods of 1.5-2.0 cm long and 0.6-1.0 cm wide. Inside formed 3-8 grains. The grains become mature in July-September period, have 2-3 mm in diameter and weight of 12 to 25 mg. Their surface is smooth and black to dark brown, with small spots. Grain hilum is characteristic. The 1000 grain weight is about 10 g. Tufted vetch is a perennial and toxic plant in varying degrees, especially the grains (Klebesadel, 1980; Bergeron and Jodoin, 1987). With the

birthplace Europe and Asia (USDA, ARS, 2004), the species prefers autumn cereals, although increases on the edge of fields and as fallow lands (Preston et al., 2002). With its tendrils weed climbing and flowering on the wheat strains, being visible. By performing measurements in different conditions of vegetation, it might bring some new elements in the description of this weed species prevalent in Agriculture. In the winter wheat crop the pods and beans maturation in late June and early July period. In the present study we analyzed in the final stage: the length of the racemes, the number of pods from a inflorescence, weight of the raceme pods, pod length and width, the number of grains from raceme and grains weight/raceme. For grains were determined: diameter, the number from a pod, and its absolute weight.

2. MATERIALS AND METHODS

Measurements were performed at the beginning of July the last three years (2014-2016) on *V. cracca* mature plants. The specific actions made were:

1. Choose of the samples:

i) were elected areas under winter wheat crop well infested with the weed, ii) were harvested 100 mature fruits/racemes, one by one every ten steps going diagonal zigzag, like in the weed mapping system and were placed in bags, iii) they were brought into the laboratory and were kept for a period of maturation (two weeks), iv) after that were determined: the raceme length (in the place of attachment to the top), the number and weight of pods formed/fruit. The length, width, number of grains in a raceme and its total weight. Grains formed were determined number from a pod (the pod from middle fruit), grain diameter and thousand grains weight (TGW).

2. Histograms make: for express the variability, some determinations have settled by class intervals, the other values were used as such. Excel was used. Study has highlighted several aspects like modal values (highest frequencies), variability within ranges of characters studied, and expression of the plant ecotype.

3. Studied correlations between all characters: was used Excel, were obtained correlation coefficients (r). The significance of these coefficients obtained was compared with Erna Weber r_{\max} values for 5%, 1% and 0.1% transgression probability levels.

4. Statistical analysis: was done on the strings of variation (by 100 values), analysis of variance was used-Anova test, formulas used were: $\bar{a} = \frac{\sum x}{n}$, where \bar{a} = media of determinations, and x = the values, S^2 (variance) = $\frac{1}{n-1} \left[\sum x^2 - \frac{(\sum x)^2}{n} \right]$, S (standard error) = $\sqrt{S^2}$, and S % (variation coefficient) = $\frac{S}{\bar{a}} \cdot 100$.

Finally it was developed a summary of the data on the study of variability characters for fruits and beans of *V. cracca*, established by determinations.

3. RESULTS OBTAINED

Variability of *V. cracca* fruits. The plant forms raceme filled with flowers visible in the field of winter wheat. After flowering pods are formed and define the specificity of fruit/raceme. By measuring the length of raceme at clamping to the top they were found some aspects (figure 1). The racemes in full bloom are specific (figure 2). The modal value ranged from a maximum length of 9.1-10 cm (25%). The limits of variation of this character were between 6.1 and 15 cm. Shorter raceme of 6.1-7 cm were 3% frequency, while the longest between 13.1-15 were a total of 9%.

Pods number from a raceme was between 1 and 10. The modal value shows that the highest frequency had 3-4 pods (58%), followed by the 1-2 pods (20%), and then with 5-6 pods (19%).

Raceme with 7-10 pods were only 3% of total (figure 3). After counting, the pods from each raceme were weighted. The limits within which their weight fluctuated was 0.10 g and 0.70 g (figure 4). Modal value was 0.21-0.30 g. The lightest pods of 0.10 g were under 3%, and the heaviest of 0.70 g, were only 4%.

Pods dimensions refer to the length and width that they had. Pods form is spear almost flattened, brown, sometimes black dot. The sizes may be between 20 to 30 mm long and 5-6 mm wide. From determinations the pods had 20-35 mm length and 5-10 mm width. The modal value of the length of the pods was 26-28 mm (39%) (figure 5).

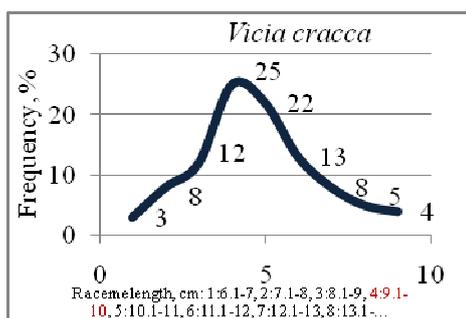


Figure 1. Frequency of raceme length



Figure 2. Picture of V. cracca weed flowers

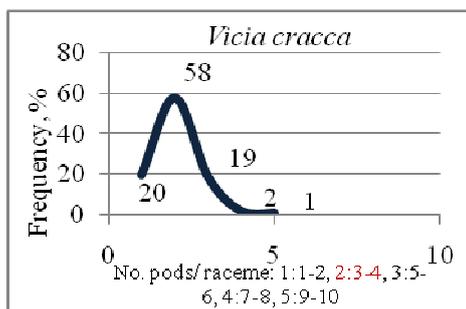


Figure 3. Frequency of pods number/raceme

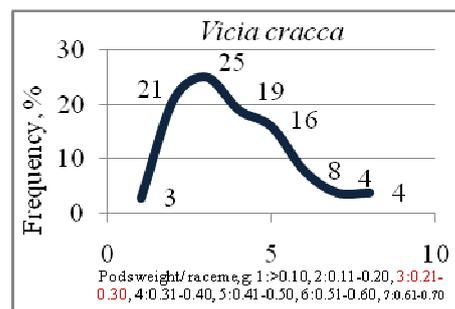


Figure 4. Frequency of pods weight/raceme

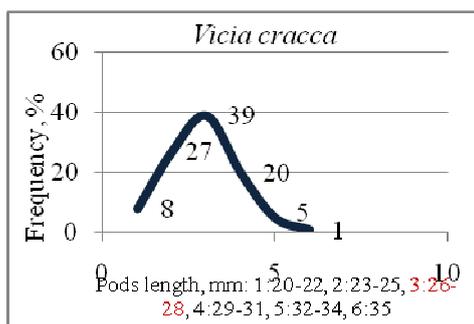


Figure 5. Frequency of pods length

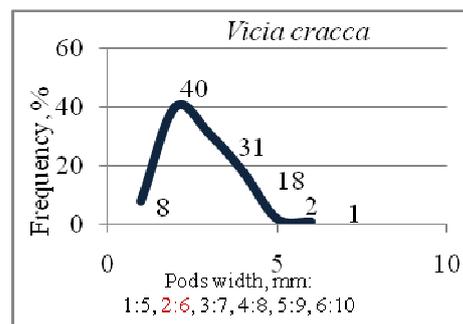


Figure 6. Frequency of pod width

The lengths of 23-25 mm were cluster of frequency 27%. Pods with 20-22 m long were 8%, and 35 mm only 1%. The width of the pods was variable, commonly up to 10 mm. From tests carried out it has been found that the modal value was 6 mm (40%) (figure 6). The limits of variation of the pods width were between 5 and 10 mm. Pods of 7 mm and 8 mm had frequency of 31% and 18% respectively. The pods with 9 mm in width represented only 2%.

Variability of *V. cracca* beans. The number of grains which was formed on a raceme to be quite variable. Modal value ranged from 11 to 15 grains/raceme. The limits of the number of grains/raceme were between 5 and 40. 6-25 grains were represented 85%, that with 5 grains 4%, and 31-40 grains were 11% (figure 7). Weight of beans from a raceme was between 0.01 and 0.50 g. Higher frequency had grains of 0.11-0.20 g/raceme (34%). It was approached beans with 0.01-0.10 g (27%) and 0.21-0.30 g (28%) (figure 8).

V. cracca beans have globular shape, with a diameter between 2.5 and 3.4 mm. Their color can be black, mottled, or greyish-green-brown. Determinations of grains had a diameter between 2.0 and 3.1 mm (figure 9). The variability of this trait was special in that the values were distributed almost equally inconstant between categories (figure 10).

The number of beans in a pod may be between 4 and 8. Ecotype had reviewed 1.1-7.0 grains/pod. Greater frequency was at 4.1-5.0 (40%) (figure 11). 19% had the grains between 3.1-4.0 and 5.1-6.0/pods. Fewer and larger grains accounted for 4% of the total. The absolute weight (TMW) of the grains was between 5 and 23 g. The distribution shows a maximum value at 8.1-11.0 g (33%), followed by category 11.1-14.0 g (26%) and that of 14.1-17.0 g (22%). Grains with thousand mass weight (TMW) below 5 g was 3%, and 20.1-30.0 g, only 1% (figure 12).

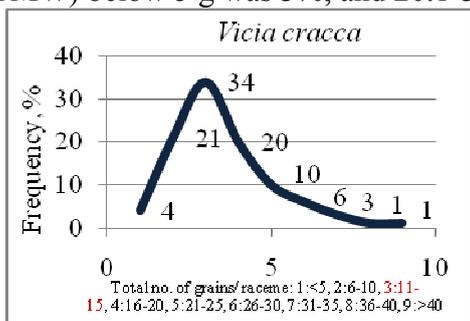


Figure 7. Frequency of grains number/raceme

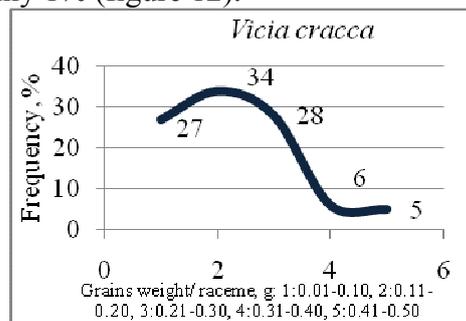


Figure 8. Frequency of grains weight/raceme

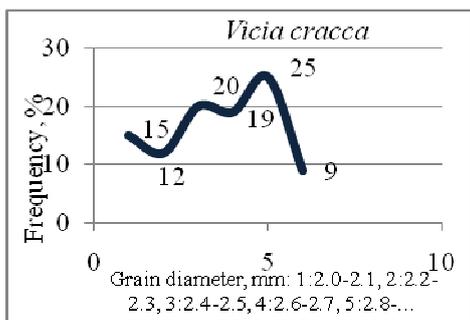


Figure 9. Frequency of grains diameter

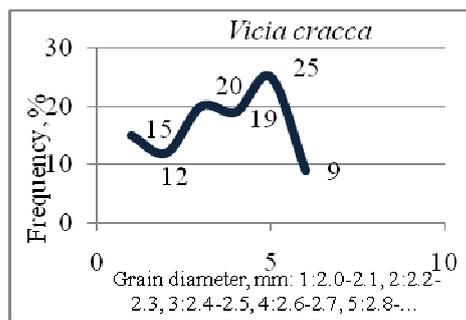


Figure 10. Pods and grains of *V. cracca* weed

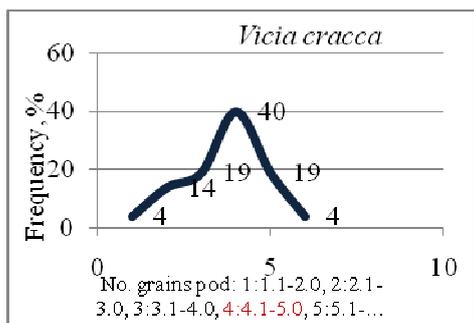


Figure 11. Frequency of grains number/pod

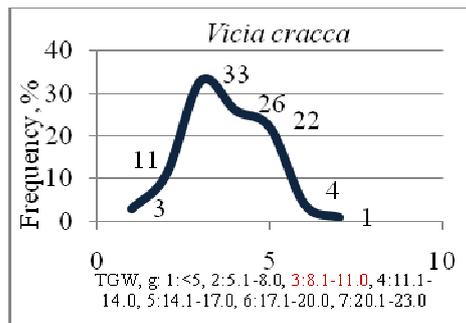


Figure 12. Frequency of thousand grains weight, TGW

Correlations between the main characters. The correlation coefficients were tested by Erna Weber transgression probability for 5%, 1% and 0.1% levels. Correlations between all characters examined revealed some negative aspects. Thus, between the width of the pod with the pod number of grains ($r = -0.040$) and with thousand grains weight, TGW ($r = -0.017$). These situations indicate that the average number of grains formed in the absolute weight of the pods and their pods were formed thinner due to appearance to the cylindrical thereof. But in most correlations were obtained situations very favorable (table 1). Of them, the correlation between the raceme length and total number of pods/raceme, was very positive ($r = 0.315^{***}$). This racemic fruit as are longer, the more pods can form. The relationship may be the expression of existing conditions in winter wheat grown here (figure 13). Between pods length and number of grains formed was obtained a distinct positive correlation (figure 14). The correlation coefficient is $r = 0.251^{**}$ and demonstrates that not all bean pods longer forme more grains. The cause may be in the structure and number of pods formed on a raceme. The raceme has more pods, even longer, the number of beans in a pod proved that varies. In another correlation between absolute weight of the grain and diameter, the result was very positive, with a very high value of the correlation coefficient ($r = 0.710^{***}$) (figure 15). This shows that when the beans were heavier, the diameter was larger. Feature is important because different conditions favor germination of grains (figure 16).

Table 1. Correlations between different characteristics of *V. cracca* weed fruits

| Characters | Raceme length | Total no. of pods | Pod weight | Pod length | Pod width | Total no. of seeds | Seeds weight | Seed diameter | No. seeds/pod | TGW |
|--------------------|---------------|-------------------|------------|------------|-----------|--------------------|--------------|---------------|---------------|----------|
| Raceme length | 1 | 0.315*** | 0.319** | 0.039 | 0.022 | 0.326*** | 0.316** | 0.079 | 0.058 | 0.133 |
| Total no. of pods | | 1 | 0.858*** | 0.309** | 0.093 | 0.865*** | 0.777*** | 0.039 | 0.007 | 0.114 |
| Pod weight | | | 1 | 0.482*** | 0.136 | 0.911*** | 0.956*** | 0.290** | 0.327*** | 0.395*** |
| Pod length | | | | 1 | 0.376*** | 0.396*** | 0.397*** | 0.251** | 0.251** | 0.149 |
| Pod width | | | | | 1 | 0.069 | 0.058 | 0.101 | -0.040 | -0.017 |
| Total no. of seeds | | | | | | 1 | 0.874*** | 0.024 | 0.481*** | 0.122* |
| Seeds weight | | | | | | | 1 | 0.347*** | 0.399*** | 0.530*** |
| Seeds diameter | | | | | | | | 1 | -0.007 | 0.710*** |
| No. seeds/pod | | | | | | | | | 1 | 0.069 |
| TGW | | | | | | | | | | 1 |

LSD 5 % = 0.19 LSD 1 % = 0.25 LSD 0.1 % = 0.32

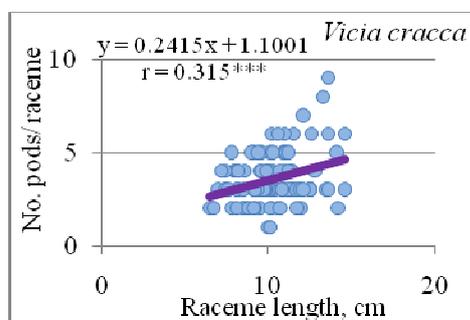


Figure 13. Correlation between raceme length with pods number/raceme

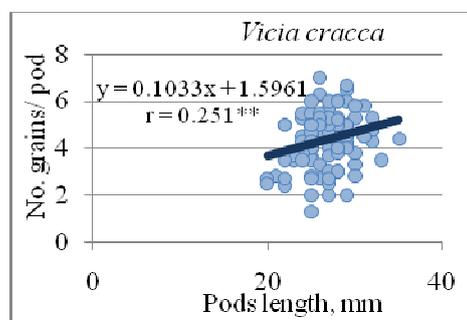


Figure 14. Correlation between pods length with grains number/pod

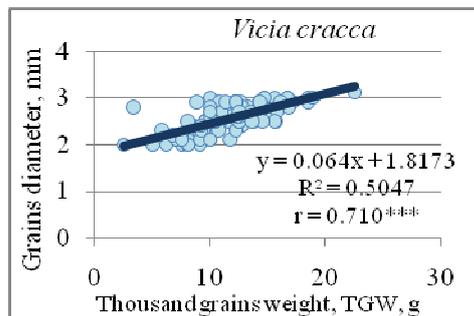


Figure 15. Correlation between TGW and grains diameter

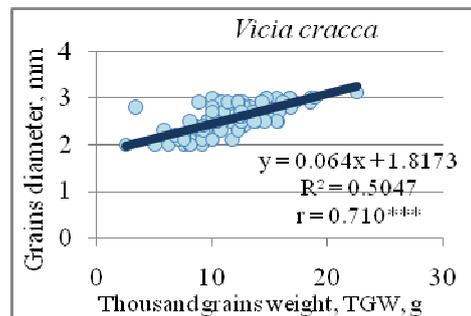


Figure 16. V. cracca grains

Statistical analysis of *V. cracca* fruit variability. Were calculated for each character analyzed: the average (\bar{a}), the variance (s^2), the standard error (s) and the coefficient of variation (CV,%). Statistical estimates made have highlighted the characteristic values of *Vicia cracca* ecotype of wheat crop. The values obtained were characteristic. Such raceme fruit measured 10.27 cm in length, formed 3.58 pods, and weighted 0.342 g. The pods have 26.57mm of lengths and 6.69 mm in width (table 2). Raceme produced an average of 15.6 grains, and weighing 0.185 g. The number of grains from a pod was 4.363, the grain diameter was 2.565 mm, and the absolute weight of the grains (as TGW) was 10.56 g (table 3).

Table 2. Statistical indices of *Vicia cracca* L. fruits

| Indices | Racemes | | | | |
|-----------------------|--------------|--------------|----------------|-----------------|----------------|
| | Length, cm | No. of pods | Pods weight, g | Pods length, mm | Pods width, mm |
| Average, \bar{a} | 10.27 | 3.58 | 0.342 | 26.57 | 6.69 |
| Variance, s^2 | 3.451 | 2.024 | 0.0295 | 18.460 | 0.9837 |
| Standard error, s | 1.8576 | 1.4226 | 0.1718 | 4.2965 | 0.9918 |
| Coef. de variation, % | 18.09 | 39.74 | 50.23 | 16.17 | 14.83 |

Table 3. Statistical indices of *Vicia cracca* L. grains

| Indices | Grains | | | | |
|-----------------------|--------------|------------------|----------------|--------------------|--------------|
| | Total number | Grains weight, g | No. grains/pod | Grain diameter, mm | TGW, g |
| Average, \bar{a} | 15.60 | 0.185 | 4.363 | 2.565 | 10.56 |
| Variance, s^2 | 57.3636 | 0.0119 | 1.312 | 0.0974 | 37.212 |
| Standard error, s | 7.5739 | 0.1092 | 1.1454 | 0.3122 | 6.1002 |
| Coef. de variation, % | 48.55 | 59.03 | 26.25 | 12.17 | 57.77 |

4. CONCLUSIONS

A common species that cause significant damage is *Vicia cracca* L. The weed is widespread in southern territory, because the existing cross-ecotype is very well adapted to the specific biology of the winter wheat crop. To a control through its management it is good to know as many of morphological characters. It was found that a species that express variability broadest possible help in finding the most suitable method of control. Morphological variability, especially reproductive, being less known, may express cross-type existing in these conditions (table 4).

Table 4. Media values of morphological characters of *Vicia cracca* L.

| No. | Characters | Literature | Our new research |
|-----|---------------------------------|------------|------------------|
| 1. | Raceme length, cm | 8 - 12 | 6.1 – 14.6 |
| 2. | No. pods/ raceme | 3 - 6 | 1 - 9 |
| 3. | Pods weight/ raceme | - | 0.08 – 0.79 |
| 4. | Pod length, mm | 16 - 30 | 20 - 35 |
| 5. | Pod width, mm | 4.3 – 10.0 | 5.0 – 10.0 |
| 6. | No. total of grains/ raceme | - | 4 - 41 |
| 7. | Grains weight/ raceme, g | - | 0.04 – 0.50 |
| 8. | No. grains/ pod | 4 - 8 | 1.3 – 6.5 |
| 9. | Grain diameter, mm | 2.0 – 3.4 | 2.0 – 3.1 |
| 10. | Mass of thousand grains, MTG, g | 12 - 25 | 3.3 – 22.5 |

Thus the racemes had wider lengths, formed several pods with longer lengths and widths usual. The number of grains of a pod was small, with a diameter smaller and absolute weight reduced.

5. ACKNOWLEDGEMENTS

The authors thanks to professors, researchers and farmers for necessity of promoting the weed ecology into the new integrated weed management (IWM) system.

6. REFERENCES

- Aarsen, L.W., Hall, I.V., Jensen, K.I.N. (1986). The biology of Canadian Weeds. 76. *Vicia angustifolia* L., *V. cracca* L., *V. tetrasperma* (L) Schreb., and *V. villosa* Roth. *Canadian Journal of Plant Science*, 66, 711-737.
- Artokhin, K.S.(2004). Atlas of weed plants.Rostov-na-Donu. In: G.I. Bazdyrev, L.I. Zotov, V.D. Polin.*Weed plants and their control in modern agriculture* (pp.1-144). MSKHA, Moscow.
- Bergeron J.M., Jodoin L. (1987). Defining “High Quality” Food Resources of Herbivores: The Case for Meadow Voles. *Oecologia*, 71(4): 510- 517.
- Eliášová, A., Trávníček, P., Mandák, B. and Münzbergová, Z. (2014). Autotetraploids of *Viciacracca* show a higher allelic richness in natural populations and a higher seed set after artificial selfing than diploids.*Annals of Botany*, 113(1), 159-170.
- Jackson, B.E., Sparrow, S.D. (2007). Response of Seedling Bird Vetch (*Vicia cracca*) to Six Herbicides.*Weed Technology*, 21, 692-694.
- Klebesadel, L.J. (1980). Birdvetch: Forage Crop, Ground Cover, Ornamental or Weed?*Agroborealis*, 12(1), 46-49.
- Preston, C.D., Pearman, D.A. and Dines, T.D. (2002). New Atlas of the British and Irish Flora.*Oxford University Press*, Oxford, UK.
- Seefeldt, S.S., Conn, J.S., Jackson, B.E., Sparrow S.D. (2007). Response of seedling bird Vetch (*Viciacracca*) to six herbicides. *Weed Technology*, 21, 692–694.
- USDA, Natural Resource Conservation Service (2008).*The PLANTS Database*. National Plant Data Center, Baton Rouge, LA, USA, from: <http://plants.usda.gov>
- USDA, ARS, National Genetic Resources Program(2004). *Germplasm Resources Information Network*. From: <http://www.ars-grin.gov/cgi-in/npgs/html/taxon.pl?418855>