

## In Which Family Shall We Put The Genus *Veronica* L.?

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**The Scrophulariaceae family has been updated in recent years. It has been discussed in papers and other publications if the family can maintain its classical taxonomic position any more. In connection with this subject, this article tries to explain and to prove that the Veronicaceae family must be established and especially that *Veronica* L. has to be included as a monotypic genus in this family, presenting scientific data and morphological evidence. Some other similar, close and different views on this subject are described and discussed, too. In addition, our brief view and interpretation about the classification and diagnosis of plants at the molecular level is discussed with respect to its necessity, advantages and disadvantages.**

**Key words:** Antirrhinaceae, Plantaginaceae, Scrophulariaceae, Veronicaceae

### INTRODUCTION

*Veronica* L., is a large genus in terms of taxon number, is mostly found in north and south hemisphere and approximately has more than 300 taxons (Albach and Chase, 2001). Taxa belonging to *Veronica* type have lots of polymorphic structures and have lots of problems taxonomically (Öztürk, 1982). 86 species of *Veronica* and more than 107 taxa can be found in Turkey (Öztürk, 2001; Fischer, 1978; Davis et al., 1988; Ekim, 2000). In Turkey's Flora *Veronica* type taxa are generally annual or perennial; leaves are facing one another; divided or undivided; flowers are in racemose or spica state; corolla is round, slightly zygomorphic, bluish, purple, reddish and in oviform; fruits are bilocular, locular or in septicidal capsule form; seed are in high and low numbers and in puffed or variolitic form (Davis, 1978). Morphologic and cytological studies related to *Veronica* and DNA sequence analyses can be found in literature (Fischer, 1967, 1972, 1975, 1978; Martinez-Ortega and Rico, 2001; Wagstaff and Garnock-Jones, 1998; Albach et al., 2004, 2005). In recent years, nomenclature reorganization of angiosperm and vascular plant families has been on the front burner and within this framework Scrophulariaceae family has been under dispute. In this context, there have been disagreements on taxonomical nomenclature reorganization on *Veronica* genus.

There have been questions like if *Veronica* genus should be in Veronicaceae family or Antirrhinaceae family or

Plantaginaceae family. In this study, it is claimed that *Veronica* should be in a different monotypic family by the name Veronicaceae with some morphological evidence. Prof. Dr. Avni Öztürk, who has been researching and publishing about *Veronica* taxa since 1974 as an expert, has stated that *Veronica* should be evaluated differently from Scrophulariaceae and should be in a different family by the name Veronicaceae since 1974. Indeed, in the coming years when James Reveal made a publication about Veronicaceae family, Öztürk did regret he had not published his ideas and data on this subject and in 2003 he presented his congratulations to James Reveal and asked him to send his publication about the subject (Reveal, 1997, 2008). However Reveal replied as following: "Dear Prof. Dr. Öztürk, Scrophulariaceae family, about which was published by R.G. Olmsted and recognized, could not maintain its known position so far, this situation cannot go on like that, new families should be claimed and in related article, an extensive bibliographic literature is presented. Veronicaceae was first claimed by the French botanist Durande in 1782 and was mentioned in a small book that can hardly be found; it had stayed unknown until this suprageneric name was mentioned by A. Öztürk. Nowadays, plant family characteristics have been used according to International Code of Nomenclature since 1763; Durande (1782) in his handwritten book and Cassel (1817) in his book used the name Veronicaceae family; however, like Öztürk, since they could not publish their works the name remained incomplete.

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*Veronica* has high number of taxa diversity in taxon levels and has more than 240 species in the world's flora, 86 species in Turkey's flora, 4 sections, lots of subspecies, varieties and forms; and has more than 400 taxa around the world (Öztürk, 2001; Öztürk, 1977, 1982). The number of taxons in *Veronica* is higher than many other families' taxon numbers and its genus is equal to big families; it is quite normal and logical that a genus having a high number of taxons is known by its name and classified as a single-genus, monotypic family. Hence, in 1782 Durande adopted such view and used the name Veronicaceae in his small book that can hardly be found, this supported our aim in the study. It is an interesting and original approach that Öztürk had this view since 1982 without being aware of Durande's book; it is clear that Öztürk had this view naturally and scientifically as a *Veronica* expert and a botanist academician by making a high number of field surveys and literature research on *Veronica* taxa, personally collecting and drying thousands of *Veronica* population species in field, morphologically examining and identifying thousands of *Veronica* species in herbarium, by having seen the all *Veronica* species in Vienna University Botanical Institution and Vienna Nature History Museum Herbariums, also by examining *Veronica* species in Turkey's herbariums and examining hundreds of literatures in different languages with texts and description writings, monographs, keys, photographs and shapes for 42 years, making many original research and publications with partly karyosystematic studies, preparing and presenting scientific congress assertions, discovering new *Veronica* taxa and making publication about them (Öztürk and Fischer, 1982, 1989, 1992; Öztürk and Öztürk, 2000a,b,c; Öztürk, 2008, 1978a, 1978b, 1981, 1982, 1983, 1986, 1989, 2000, 2001, 2005, 2004a,b; 2006).

In this study, it is claimed that *Veronica* type cannot be included in Plantaginaceae and Scrophulariaceae families with lots of scientific reasons, morphological evidence and literature; and with these data forming Veronicaceae family and explaining and proving that *Veronica* should be included in this family as a monotypic type and as a result naming the family aimed publishing as Veronicaceae (Durande, 1782; Cassel, 1817) ex A. Öztürk.

## MATERIAL AND METHODS

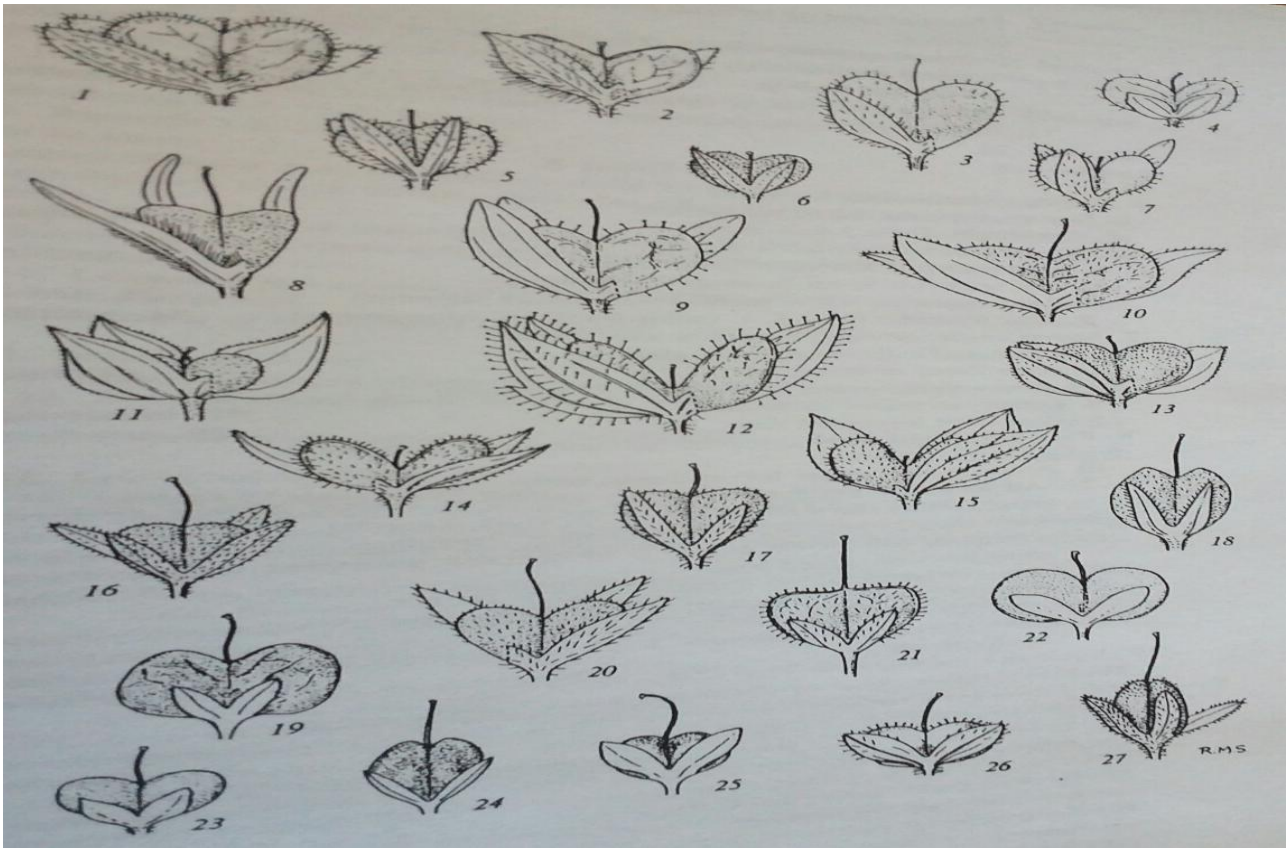
To use some morphological figures, results and literature sources about Plantaginaceae and Scrophulariaceae families, *Plantago* and *Veronica* genus, it has tried to reach the target in this article (Komarov, 1955; Fischer, 1978; Davis, 1978; Watson and Dalwitz, 1992; Tutel, 2005). Plant materials are deposited herbarium of Van Yüzüncü Yıl University (VANF). All cited author names

are verified and compared with each other by Brummit and Powell's (1992) 'Authors of Plant Names' book.

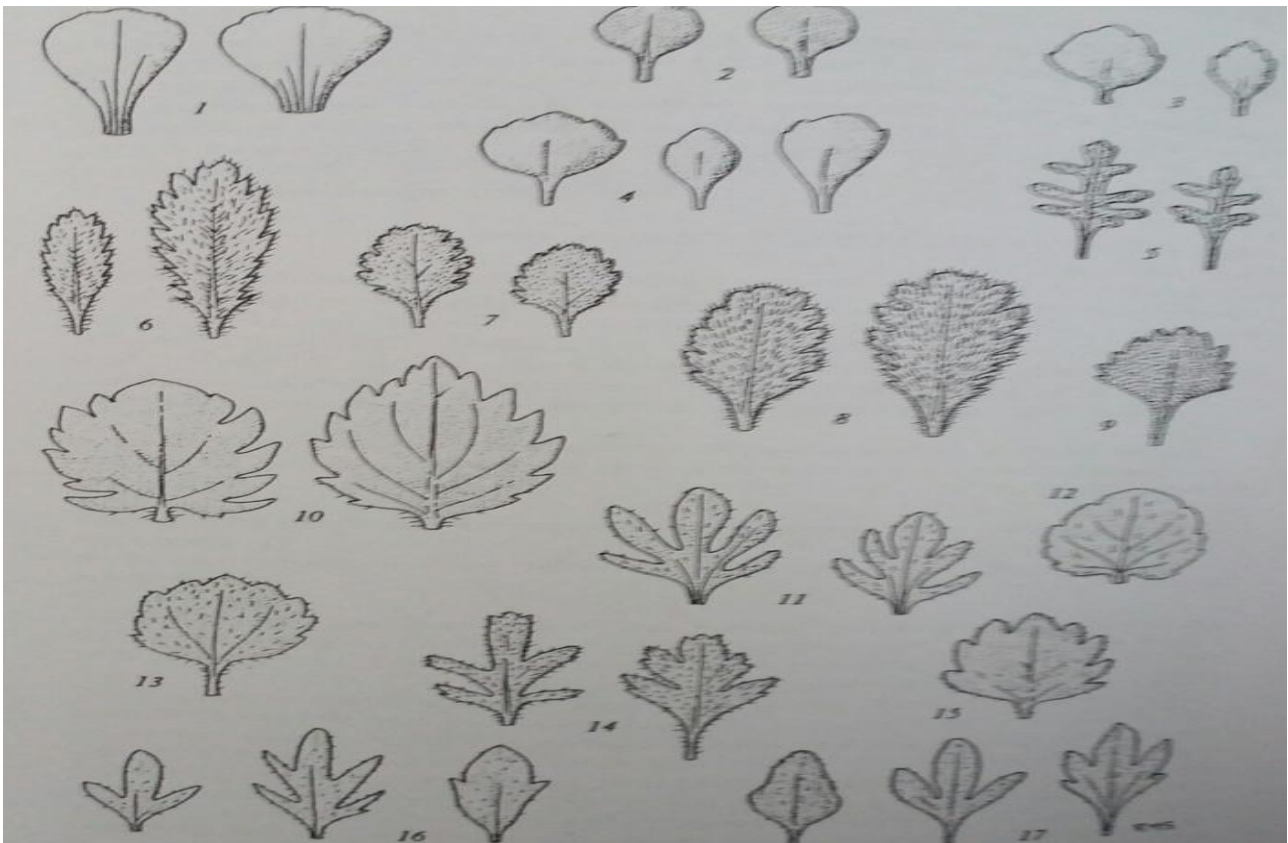
## RESULTS AND DISCUSSION

In APG (The Angiosperm Phylogeny Group) II (Chase ve ark., 2003) *Veronica* genus is included in Plantaginaceae. Olmsted (2001) and Reeves (1998) and in this study this issue does not accept; in this study this situation is trying to prove with morphologic datas and literature sources. According to APG II list of families in Lamiales as follows: Lamiales Bromhead (1838): Acanthaceae Juss. (1789), nom. cons.; Bignoniaceae Juss. (1789), nom. cons.; Byblidaceae (Engl. & Gilg) Domin (1922), nom. cons.; Calceolariaceae (D. Don) Olmstead (2001); Carlemanniaceae Airy Shaw (1964); Gesneriaceae Rich. & Juss. ex DC. (1816), nom. cons.; Lamiaceae Martynov (1820), nom. cons.; Lentibulariaceae Rich. (1808), nom. cons.; Martyniaceae Horan. (1847), nom. cons.; Oleaceae Hoffmanns. & Link (1809), nom. cons.; See Orobanchaceae Vent. (1799), nom. cons.; Paulowniaceae Nakai (1949); Pedaliaceae R.Br. (1810), nom. cons.; Phrymaceae Schauer (1847), nom. cons. Plantaginaceae Juss. (1789), nom. cons.; Plocospermataceae Hutch. (1973); Schlegeliaceae (A.H. Gentry) Reveal (1996); Scrophulariaceae Juss. (1789), nom. Cons.; Stilbaceae Kunth (1831), nom. cons.; Tetrachondraceae Wettst. (1924); Verbenaceae J.St.-Hil. (1805), nom. cons. (Chase et al., 2003).

Olmsted (2001) and Reeves (1998) are accepting includes the *Veronica* in Antirrhinaceae; in this study it is trying to prove that *Veronica* genus should take place in a separate family as Veronicaceae. In this reseach, Plantaginaceae and *Veronica* taxa have not morphological similarities and some morphological and literature souches presented to supporting this claim. Namely in *Veronica* species have simple hair types, very short rotate elegant corolla structure, 2 epipetali stamens, generally as the gutless capsula fruit structure, corolla with 4 petal, pleurobotric and akrobotric inflorescence, raceme inflorescences have show often spicate, physiognomic and other morphologic differences showed that (Figure 1), *Veronica* not to be included in Plantaginaceae family; for these *Veronica* will require the separation and should be included as a separate family Veronicaceae (Fischer, 1978; Öztürk, 1977, 1978, 1982; Öztürk and Fischer 1982; Öztürk, 1983; Öztürk, 1986; Kampny and Dengler, 1997; Öztürk and Öztürk, 2000; Martinez, 2000; Tutel et al., 2005; Çiftçi, 2012). This opinion is also supported by Albach and Chase, that according to results which obtained his molecular study *Veronica* genus classified in the Veroniaceae family (Albach and Chase, 2001).



**Figure 1. Capsul and calyx of *Veronica* species:** 1. *V. triphyllos*, 2. *V. viscosa*, 3. *V. pontica*, 4. *V. bozakmanii*, 5. *V. dillenii*, 6. *V. verna*, 7. *V. arvensis*, 8. *V. grisebachii*, 9. *V. filiformis*, 10. *V. persica*, 11. *V. intercedens*, 12. *V. bornmuelleri*, 13. *V. polita*, 14. *V. campylopoda*, 15. *V. biloba*, 16. *V. cuneifolia*, 17. *V. dichrus*, 18. *V. pectinata*, 19. *V. scutellata*, 20. *V. chamaedrys*, 21. *V. officinalis*, 22. *V. montbretii*, 23. *V. liwanensis*, 24. *V. turrilliana*, 25. *V. telephifolia*, 26. *V. serpyllifolia*, 27. *V. monticola* (Fischer, 1978)



**Figure 2. Leaf structure of some *Veronica* species:** 1. *V. davisii*, 2. *V. telephiifolia*, 3. *V. liwanensis*, 4. *V. montbretii*, 5. *V. oltensis*, 6. *V. pectinata*, 7. *V. cuneifolia*, 8. *V. dichrus*, 9. *V. microcarpa*, 10. *V. peduncularis*, 11. *V. triphyllus*, 12. *V. filiformis*, 13. *V. trichadena*, 14. *V. pontica*, 15. *V. polita*, 16. *V. verna*, 17. *V. grisebachii* (Fischer, 1978)

Some *Veronica* species have long and dense raceme inflorescence (*V. dahurica*, *V. lutea*, *V. linariifolia*, *V. lanata*, *V. spuria*, *V. laeta*, *V. septentrionalis*) showed similarities some *Plantago* species except roughly dense spica raceme, there is also no significant morphological similarity (Figure 3-5). Thus, with such frequent and long-racem terminal flower of *Veronica* species: *V. longifolia* and *V. orchidea* were transferred *Pseudolysimachion* genus in Flora of Turkey and named as *P. longifolium* (L.) Opiz and *P. orchideum* (Crantz) T. Wraber (Fischer, 1978). In Flora of Armenia (Fischer,

1987; Gabrielyan, 1962); *V. spicata* took place as *P. spicatum*; In Flora of Italy *V. barrelieri* took place as *P. barrelieri* (Fischer, 1982) (Figure 4). Besides *Veronica* corolla has 4 petals (Figure 7), *Plantago* corolla has 5 petals (Figure 3), so there is no structure similarities. Although some *Veronica* species are showed very few similar physiognomy with Plantaginaceae; even so Plantaginaceae taxa were separated form *Veronica* genus (Figure 3-6; Misra, 1964; Rezk, 1980,1987; Munuz-Centeno et al., 2006, Fischer, 1982).



**Figure 3. Morphologic and physiognomic structure of *Plantago media* L. (Tutel, 1993).**



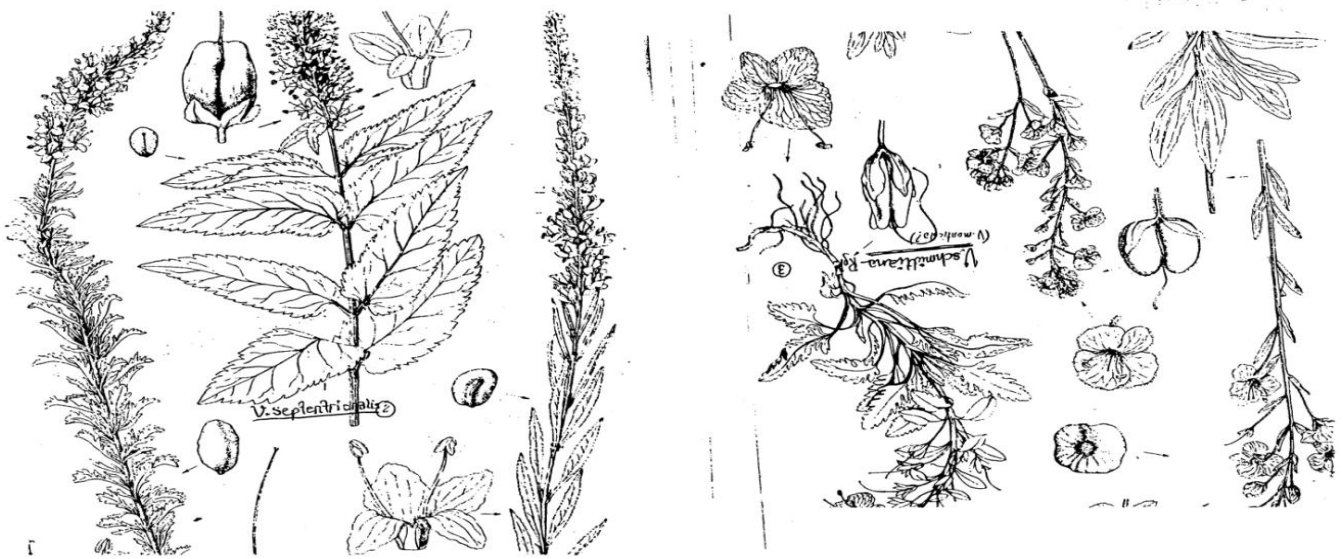
**Figure 4. General images of some *Pseudolysimachion* species: (Fischer, 1982).**



*Plantago* sp.: 1 fruits plant;  
2 inflorescence;  
3 flower;  
4 fruit; 5 seed (Anonymous 1)

*Veronica* sp.: 1 flowering plant;  
2 capsula and calyx;  
3 corolla (Anonymous 2)

**Figure 5. General view of some *Plantago* and *Veronica* species (physiognomic-morphologic).**



**Figure 6. Physiognomic and morphologic structure of some *Veronica* species (Komarov, 1955)**

There are many differences, besides have similar long rotate (short ring) structure base of crown between *Verbascum* (Scrophulariaceae) and *Veronica*; *Verbascum* taxa have few similarities with regard to crown morphology with *Veronica*. *Veronica* corolla color is mostly blue and not seen any yellow (Figure 7); in *Verbascum* yellow crown color is very common (Figure 7). Although *Veronica* has simple indumentum, commonly *Verbascum* has compound indumentum hair types; the structure of *Verbascum* is rough and the structure of *Veronica* taxa are thick texture (Figure 7; Yamazaki, 1957). Seed morphologies of *Veronica* genus and other Scrophulariaceae and Plantaginaceae genuses are also markedly different from each other (Figure 8,9).



*Verbascum* sp. (Anonymous 3)



*Veronica* sp. (Anonymous 4)

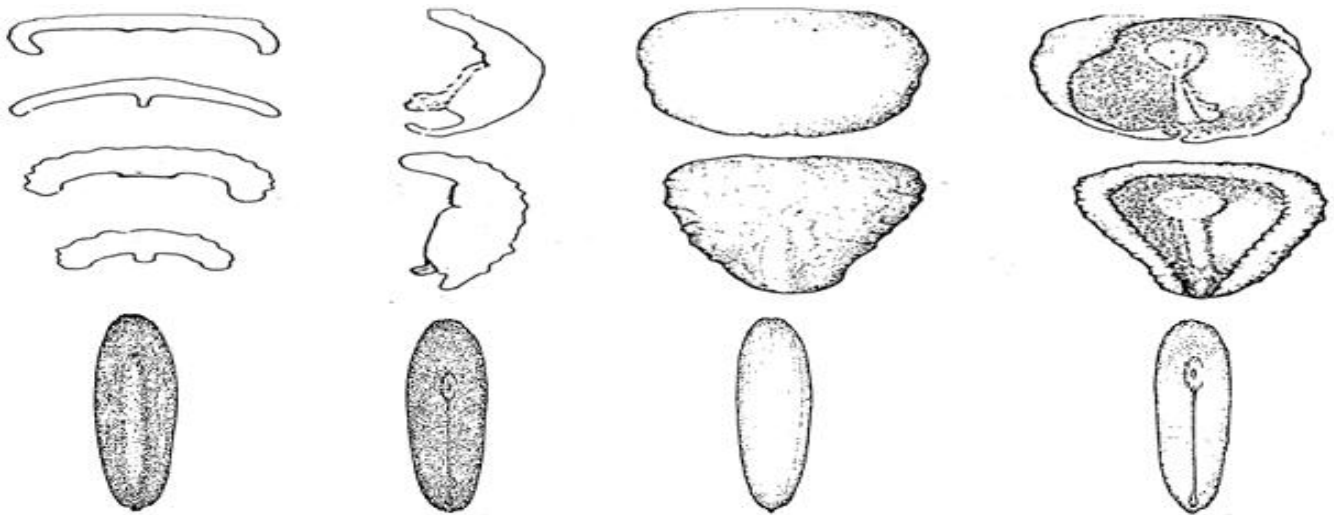
**Figure 7. Morphologic structure of some *Verbascum* and *Veronica* species.**



**Figure 8. Seed structure of some *Scrophulariaceae* taxa:**

1. *Scrophularia criptophila*, 2. *Verbascum stenocarpum*, 3. *Anarrhinum orientale*, 4. *A. majus* subsp. *majus*, 5. *Misopates orontium*, 6. *Chaenorhinum minus* subsp. *minus*, 7. *C. minus* subs. *anatolicus*, 8. *C. litorale*, 9. *C. rubrifolium*, 10. *C. calycinum*, 11. *Linaria genistifolia* subsp. *confertifolia*, 12. *L. pelisseriana*, 13. *L. kurdica*, 14. *Cymbalaria microcalyx* subsp. *dodekanesi*, 15. *Kickxia commutata* subsp. *graeca*, 16. *K. elatine* subsp. *crinata*, 17. *Odontites aucheri*, 18. *Parentucellia latifolia* var. *latifolia*, 19. *P. viscosa*, 20. *Bellardia trixago*, 21. *Rhinanthus angustifolius* subsp. *grandiflorus*, 22. *Lesquereuxia syriaca*, 23. *Pedicularis condensata*, 24. *P. cadmea* (Davis, 1978)

Seed morphology of *Veronica* taxa are also markedly different from Scrophulariaceae taxa (Figure 8-9; Munos-Centeno et al., 2006; Martinez-Ortega and Rico, 2001; Aseyeva, 2002; Juan and Fernandez, 1994). In *Veronica* and *Verbascum* stamen and staminods are also different from each other (Kulppa, 1968; Fischer, 1978; Davis, 1978; Karavelioğulları and Aytaç 2008; Öztürk 1977,1981). Although Antirrhineae tribus have long zygomorphic petals and the base of petals don't show a significant short rotate structure; in *Veronica* taxa petals are short and petal crown is very short ring or circle shaped (Öztürk 1977; Reeves, 1998).



**Figure 9. Seed structure of some *Veronica* taxa**

Similar to this study, in their article titled 'Disintegration of the Scrophulariaceae' Olmsted and *et al.*, (2001) indicate that Veronicaceae involves Antirrhineae tribes and partly or completely involves Plantaginaceae family; however, in our study we state that Veronicaceae does not involve these and should be a family that is particular to *Veronica* genus. Olmsted *et al.*, (2001) only object to Veronicaceae's involvement in Plantaginaceae and support similar results that are mentioned in our study. However, in this study Plantaginaceae's involvement in Veronicaceae is viewed inconvenient and it is objected. Our study related to Veronicaceae matches up with the studies of Durande (1782) and Cassel (1817). Moreover Cassel used the name Veronicaceae Cassel in 1817; but, since Plantaginaceae Juss. family was published as a family that was involving Veronicaceae in 1789 it became the maintained name and in 1817 since Veronicaceae was published later by Cassel this name was regarded as a synonym. Plantaginaceae Juss. was published by Jussieu beforehand as the maintained name and was used compulsorily. Even though some chemical and karyological evidences was found between Plantaginaceae and Veronicaceae and it is claimed that there is phylogenic relationship after making an evaluation only in this regard, this should be supported by morphological characteristics.

Classification in molecular levels is a difficult thing and its practicality should be considered. If this situation is not considered, how and to what extent could we examine and identify plant samples in herbariums. In this case, will herbariums fall into discredit? Or after that will identifications take place in both laboratories and herbariums? Those who thought *Veronica* should be included in Plantaginaceae might take some molecular similarities into consideration. Yet, in that case isn't it necessary to have molecular systematics of all types, families and even other taxa? At that case plant identifications could be necessary to be made with molecular examinations and this is quite hard and tricky. Morphological characteristics should be important in identification while molecular level characteristics should not. Collected plant samples are fundamentally

morphological, partly anatomical, somewhat karyological and cytological in terms of characteristics that can be seen and measured by naked eye or microscope. Given the primary characteristics playing a role in identification and classification are and will be morphological and anatomical ones, how real the validity of molecular classification in practice could be? All these are worth thinking and discussing. Classification, morphological-anatomical characteristics, that are essential and valid in identification, and karyological and cytological data that are partly helpful are all realistic and valid. Moreover, since genetic characteristics related to morphological ones are reflected on plant's external structure they have been used for centuries. Therefore, we benefit from morphology that is always valid in practice in identification of plants. However, to what extent could we benefit from molecular identification in practice! Are we supposed to examine plant samples' DNA in herbariums? We know that genetic characteristics are already reflected on morphology and with phenotype it constitutes idiosyncrasy. Due to these reasons how reliable and useful accepting *Veronica* genus should be in Plantaginaceae family could be? How useful some chemical characteristics that cannot be seen by eye or microscope or DNA base sequences could be in identification of plants and practice? How could molecular similarities and relationships in herbariums be identified and used? It is said that some plant families and other taxa can have relationships in terms of some similarities and chemical structures and can be regarded as auxiliary elements in classification. Will giving priority to some molecular similarities by excluding morphological characteristics and placing *Veronica* genus in Plantaginaceae that has no morphological similarities be luxurious or fantasy?

Consequently, this study is in favour of molecular, karyosystematic, chemosystematic studies; besides, these kinds of studies should be helpful to morphological classification, not preclude it. Also *Veronica* genus should be placed in another family as Veronicaceae and should be named Veronicaceae (Durande, 1782; Cassel, 1817) ex A.Öztürk. In fact, Öztürk presented a scientific paper suggesting *Veronica* should be regarded as a monotypic type by the name Veronicaceae in 2004 (Öztürk, 2004) and this was tried to be proved with evidences. Furthermore, we naturally and logically think that our

study collected data that will support and light the ways of other studies that was made and will be made; in addition, making comments about the subject and discussing about

the practicality, benefits and harms of the classifications that are out of morphological data is necessary for humanity and science.

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