UDK 632.51
Review paper – Pregledni rad

Datum prijema: 24.05.2024.
Datum odobrenja: 06.06.2024.
Doi broj: 10.5937/33ah-51194

Stellaria media (L.) Vill. (common chickweed) – a strong or weak competitor in the autumn and early-spring sown crops?

Zvonko Pacanoski
Faculty of Agricultural Sciences and Food, Ss. Cyril and Methodius University, Skopje, N. Macedonia
e-mail: zvonkop@fznh.ukim.edu.mk

SUMMARY

Due to its capability to produce considerable amounts of seeds in temperate climate conditions, *Stellaria media* (L.) Vill. colonizes easily any cold and humid environment prior before the fall-spring seeded crops can become competitive. Usually, it is a weed occurring in many crops in temperate and boreal climates, where it is often among the earliest spring appearing weeds. *S. media* is considerably one of the most common weeds in winter and spring cereal stands, a highly competitive weed in peas and winter oilseed rape, one of the prevailing weed species in seedling lucerne, a serious weed in citrus, one of the most frequent weeds in strawberry, and one of the most common weeds present in conventional sugar beet. *S. media* is a principal weed problem in vegetable cultivation and in turf and gardens in almost all countries in the temperate part of the planet.

On the other hand, in comparative trials of weed competitiveness and yield suppression in many crops, *S. media* had a smaller competitive capacity than *Raphanus raphanistrum, Chenopodium album*, *Galium aparine, Polygonum persicaria*, *Alopecurus myosuroides, Avena fatua,* and numerous others weeds. In field experiments conducted in fall-spring seeded crop plants, as well as established crops, like established lucerne, *S. media* was recognized as a weak competitor, except in cases at higher densities. The real competitiveness related to the reduction of crop yield generated by *S. media* relies on many circumstances, including the emergence time of the crop. *S. media* manifests a strong initial growth and usually generates substantial reduction in yield when it emerges before or simultaneously with the crop plants. It is a greatly adaptable

species as well, which implies that its vigorous development and resource capturing will lead to a large number of individuals with a highly competitive capacity.
Keywords: *Stellaria media*, crops, weeds, competitor.

BIOLOGICAL AND ECOLOGICAL CHARACTERISTICS OF *S. MEDIA*

Stellaria media (common chickweed) in the pink family (*Caryophyllaceae*) (Matuszkiewicz, 2006) is a native, prostrate or erect, somewhat succulent winter annual species classified as "ephemeral" (Janjić and Kojić, 2000; Grădilă, 2017), common in winter-cereal crops (Meiss et al., 2010; Bónis et al., 2010), winter oilseed rape (Lutman et al., 2000), seedling (Pacanoski, 2011) and established alfalfa (Pacanoski et al., 2017), grown mainly in temperate and semi-arid areas (Holland et al., 2008; Saska et al., 2008). However, *S. media* is capable to emerge and grow in winter and early spring period at quite cool environmental conditions (Khamare et al., 2019), increasing its competitive capacity above other plants (Holm et al., 1991b; Storkey and Cussans, 2000). Its optimal growth and development is in humid areas, with the inflorescence surviving during the winter in cold, moist environments when temperatures do not descend below 2°C (Turkington et al., 1980). In some circumstances it can blossom and inseminate even under deep snow (10-20 cm) (Sobey, 1981). However, it is sensitive to drought, and throughout torrid and arid summer months it dies out (Roberts and Dawkins, 1967; Sobey, 1981). *S. media* is a sciophilous weed and therefore well adapted to flourish in the shade of a canopy of crops (King, 1966; Fogelfors, 1977).

S. media is mainly best suited to commonly disturbed agroecosystems through its capability to emerge during the year in temperate environments, usually in autumn and spring (ADAS, 1977; Roberts and Feast, 1970), briefly after seed maturation (Hunková et al., 2011), and a brief germination-flowering cycle and seed development (Holm et al., 1991b; Miura and Kusanagi, 2001). The seeds of *S. media* have a low temperature for germination (2-7°C) (King, 1966; Vrbničanin and Božić, 2021; Pacanoski, 2023). This ability provides seeds to be prepared for autumn germination (Miura and Kusanagi, 2001). Germinated autumn plants set seeds in the spring, and these seeds germinate immediately and create a next generation during the same vegetation season (Hanf, 1970). In fact, it has two principal germination flushes, in the late autumn and early spring (Roberts and Dawkins, 1967). In temperate climate, majority of its seeds germinate in the autumn, over-wintering in the vegetative stage, while it flowers and sets seed early in the spring and then dies out during the dry, hot summer months (Kostov, 2006). The average life cycle is 5-7 weeks, and the biggest part of this time (4-5 weeks) is needed for the flowering stage (Sinha and Whitehead, 1965). Usually, *S. media* produces one or two generations per year, but in some circumstances even three (Kojić and Janjić, 1996). Based on modeling its emergence and weather data patterns, temperature is the crucial factor which determines emergence occurrence (Grundy et al., 1999). The second one is moisture of the soil which is only essential if the temperature demand is fulfilled. Nevertheless, if the soil is very moist, seeds can sprout at much higher temperatures. However, temperatures above 30°C fully inhibit weed seed germination (Roberts and Lockett, 1975; Turkington et al., 1980).

The seeds of *S. media* typically germinate at or very close to the surface of the soil. The optimal depth for emergence is 1.0 cm and the maximum 4.0 cm (King, 1966). According to Chancellor (1964) nearly all seedlings (98-100%) emerged from the soil depth of 3 cm in the field condition, except for the odd seedlings which emerged from 4 cm deep. Generally, the seeds germinating percentage decreases with soil depth increasing, implying some light requirements are needed (Grundy and Mead, 2000; Benvenuti et al., 2001; Milberg et al., 2001; Grundy et al., 2003). In that context, according to Andersson et al. (1997), in the full light conditions germination of the seeds was 80-95%, seed germination in the dark-short light conditions 94-99% and with only 30-35% seed germination in full darkness.

A single *S. media* plant was recorded to form about 80 flowers if grown together with wheat crop and more than 3,200 flowers if grown solitary. One seed pod might contain up to 20 seeds, but usually between 6 and 10 (Turkington et al., 1980; Grime et al., 1988). According to Salisbury (1961) the average seed quantity per single plant is between 2,200-2,700 seeds. As reported by Guyot et al. (1962) and Pacanoski (2023) the seed production per plant ranges from 15,000 to 25,000. In another study, the seed number per pod was between 3 and 15, with a mean of 9.4 seeds per capsule, which means 750 to 30,400 produced seeds per single plant (Salisbury, 1964). In competitive relation with wheat, one plant of *S. media* produces about 800 seeds (Lutman et al., 2000; Lutman, 2002; Mertens and Jansen, 2002). In similar conditions, the average number of seeds per single plant ranges between 298 and 600 in winter cereals, from 151 to 193 in spring cereals and from 863 to 1,004 in winter oilseed rape and root crops, respectively (Pawlowski, 1966). In their investigations, Lutman (2002) and Hill et al. (2014) found that *S. media* produced 30,000 to 120,000 seeds m^{-2}.

Based on seed characters, *S. media* seeds should persist 2-4 years according to Líška et al. (1995) or for longer than 5 years in soil, according to Deyl and Ušák (1964) and Thompson et al. (1993). It is well-known that seeds which are buried keep their viability no less than 25 and, in many cases, more than 40 years (Salisbury, 1962). *S. media* has an average rate of annual decline of seed viability of 35% and an expected duration of 95% decline for a period of 7-8 years (Lutman et al., 2002). Decline of *S. media* seedbank growing in crop rotation with autumn-seeded crops in a period of 3-4 years with the prevention of seed soil back demonstrated a 99% decline for a period of 11.1 years with an average annual decline of 30% (Lawson et al., 1993). According to Popay et al. (1994), the annual percent of seeds decline in agricultural land was 41%.

S. media grows on a wide range of soils (Salisbury, 1974), but thrives best on humid, clay (King, 1966), around neutral pH (Khamare et al., 2019) soils. It does not grow good on acidic soils (van Delden et al., 2002). On these soils the reduction of its growth is obvious, often because of Al toxicity below pH 5.0 (Buchanan et al., 1975; Turkington et al., 1980). High K soil levels positively influence *S. media* field distribution (Andreasen et al., 1991). It is a typical nitrophilous weed, effectively using high quantities of N (Mahn, 1988). The massive abundance of its population suggests an overabundance of N, but deficiency of Ca and P in the soil (Cavan et al., 2000). *S. media* grows in soils with similar characteristics together with *Matricaria matricarioides, Polygonum lapathifolium, Senecio vulgaris, Amaranthus retroflexus, Chenopodium album, Capsella bursa-pastoris, Agropyron repens* and *Poa annua* (Turkington et al., 1980).

EXAMPLES OF *S. MEDIA* AS A STRONG COMPETITOR

Due to its capability to produce considerable amounts of seeds in conditions of temperate climate, *S. media* colonizes easily any cold and humid environment before the fall-spring seeded crops can become competitive. According to Holm et al. (1991b), *S. media* was considered one of the 12 strongest colonizer plants amongst uncultivated vegetations, and the 72nd worst weed worldwide, as it is considered a troublesome weed in over 20 crops in more than 50 states in the world (Coleman et al., 2021). Usually, it is a common weed in many annual and perennial crops in temperate and boreal climates, where it is often among the earliest spring appearing weeds (Whitehead and Wright, 1989; Frick and Thomas, 1992; Storkey and Cussans, 2000). European weed scientists ranked *S. media* as the most problematic weed in all agricultural plants, particularly fruits and vegetables (Schroeder et al., 1993; Coleman et al., 2021). *S. media* is considered as one of the most prevalent weeds in winter and spring cereal crops cultivated in northern parts of Europe (Holm, 1997). Klostermyer (1989) and Kust (1989) had begun to identify the competitive abilities of some broadleaf weeds in autumn-seeded crops in Germany, ranking species based on their competitiveness. They concluded that *S. media* was the weed with the highest competitive capacity among all studied broadleaf weeds. In Sweden, in spring cereals and peas, together with *Chenopodium album*, *Galeopsis* spp., *Matricaria inodora* and *Myosotis arvensis*, *S. media* was one of the most dominant weeds (Wilson et al., 1993; Lundkvist, 2009). In Slovakia, the most frequent weed in winter wheat and winter oilseed is *S. media* (Hunková et al., 2011). Regardless of the tillage system, plough or ploughless tillage, *S. media* was one of the predominant weeds in spring wheat and bean in Poland (Woźniak, 2011; Mazur, 2019). In central Alberta, Harker (2001) recorded that *S. media* is the second most abundant weed in barley, canola and peas with a mean density of 417, 141 and 237 plants m^{-2}, respectively. *S. media* is among three most noxious weeds in small-grain crops in England and Alaska, and considered to be the most troublesome weed in wheat in Pakistan (Muntaha et al., 2018) and Bangladesh (Hossain et al., 2009). It is a highly competitive weed in seedling alfalfa in many countries (Childs, 1992; Meiss et al., 2010; Yazdani et al., 2012), a serious weed in citrus in Spain (Verd'u and Mas, 2007), among the predominant weed species in Lithuanian strawberry (Šniauka and Pocius, 2008), and some of the most frequent present weeds in conventional sugar beet crops in UK (Lainsbury et al., 1999) and Germany (Defelice, 2004). In Denmark, *S. media* is one of the most widespread weeds in spring-seeded crop plants (Jensen, 1991; Bitarafan and Andreasen, 2020). It is viewed as a problematic weed in Japan, Ireland, and Finland, as well (Holm et al., 1991b). *S. media* coupled with *Poa annua* is on of the two most dominant weeds in Danish cultivated fields (Andreasen et al., 1996). It is a main or prevalent weed in small-grain, fodder, vegetable and fruit production and in gardens in the vast majority of countries worldwide (Holm et al., 1991a,b; Guerra et al., 2020). It is also a problematic weed in turf due to its low growing pattern as well as accelerated growth rate which enables it to persist despite repeated mowing (Uva et al., 1997). *S. media* appears in corn and wheat crops in northern and central parts of Italy even in conditions of a broad spectrum of rotational cropping systems and different levels of inputs (Zanin et al., 1992; Barberi et al., 1997). As we mentioned previously, this weed is dominant in cultivated fields in Denmark, which implies its high incidence in the seedbank in the soil (Streibig, 1988). Similarly, *S. media* seed was found in 44% of seedbank in cultivated soils in Scotland (Warwick, 1984). In seedbank investigations in cropland in France too, prevalence of *S. media* seeds was high in the seedbank, as well as in the emerged population (Barralis and Chadoeuf, 1987). Furthermore, seeds of *S. media* are the contaminating fraction in seeds of cereals, sugar beets, fodder beets, oilseed rape and many other crops (Fryer and Makepeace, 1977).

In field experiments in Germany, a single plant of *S. media* m^{-2} caused yield reductions of 0.03, 0.07 and 0.09% respectively in spring barley, winter wheat, and winter barley (Röder et al., 1989 cit. by Anonymous, 2014). Taking into consideration mentioned findings, the economic thresholds for *S. media* control in spring barley, winter wheat, and winter barley were 55-65, 20-25 and 15-20 plants m^{-2}, respectively. In trials in Netherlands, Kropff et al. (1987) recorded those 11 plants m^{-2} resulted in yield losses of 21% in sugar beet crop. In Belgium, in varied weed floristic compound, *S. media* plants provided the highest impact on barley crop yield reduction, especially when it appeared in early crop growth stages (van Himme et al., 1983), because *S. media* roots grow more rapidly than barley's, which resulted in superior N absorption (Mannand and Barnes, 1950) and out-competing for environmental facilities, causing quantitative and qualitative yield reductions (Lutman et al., 2000). *S. media* reduced grain yields of barley by about 80% in greenhouse studies in England. Similar, heavy field infestations of this weed in barley in Michigan caused a yield reduction between 66 and 80% (Anonymous, 2021). In the UK, in the trials conducted by Lutman et al. (2000), the yield of oilseed rape was decreased by 5% with an average *S. media* weediness of 37 plants m^{-2}, despite the fact that significant extent for this data between the trials was noted (1.4 - 328 plants m^{-2}). In the UK, Carver et al. (1997) established that the economic threshold for S. *media* control in linseed crops is 40 plants m^{-2}. In the field trials conducted from 1979 to 1988 in wheat in eastern Scotland, with a common weed floristic compound in which dominated *S. medi*a, losses were calculated at 3.5% on the basis of a yield level of 8.28 t ha^{-1} (Davies, 1988). Finally, de la Fuente et al. (1999) revealed that *S. media* is one of the indicator weed species for low soil degradation and higher potential soybean yield reduction in soybean–wheat rotation fields in Argentina.

EXAMPLES OF *S. MEDIA* AS A WEAK COMPETITOR

In comparable field experiments in which weed competiveness and yield reduction in sugar beet (Farahbakhsh and Murphy, 1986) and wheat (Farahbakhsh et al., 1987) were estimated, *S. media* had a smaller competitive capacity than the broadleaf *Raphanus raphanistrum* and *Chenopodium album* as well as the grasses *Alopecurus myosuroides* and *Avena fatua,* respectively (Wright et al., 2012). Although *S. media* plants have a far greater leaf area index, *C. album* has higher competitive superiority over sugarbeet due to considerably higher growth of *C. album* plants, which allows them to outgrow the sugar beets (Kropff et al., 1987). This effect illustrates the importance of the plant height factor in crop weed competition. In a similar study in the same crop, *C. album* was weed with the fastest growth, compared to *Polygonum persicaria* and *S. media*. *C. album* (120-150 cm) and *P. persicaria* plants (80-100 cm) overgrow sugar beet crop unlike *S. media* (50-60 cm), which did not outgrow the sugar beets. In fact, *S. media* decreased the sugar beet yield inconsiderably, with a relative damage coefficient below 1, which means a smaller competitive capacity than the crop (Kropff et al., 1995). Many studies have been carried out to establish the competitive potential of various weeds in winter wheat crops. According to Marshall et al. (2003), *S. media* is moderately competitive with a relative competitive index (RCI) of 0.2. Similarly, the RCI for *S. media* in winter oilseed rape in Germany was 0.12 (Munzel et al., 1992). The results of Smatana and Macák (2014) show that *S. media* was among 10 of the most predominant weed plants in winter wheat fields in South-western Slovakia, but weeds with high RCI (bigger than 1) among them were: *Tripleurospermum perforatum*, *Agropyrum repens, Polygonum convolvulus, Cirsium arvense* and *Galium aparine*. According to the degree of aggressiveness, the scale for the weed competitiveness in barley, wheat, oilseed rape and bean was the following: *Galium aparine* > *Avena fatua* > *Veronica persica* > *Stellaria media* > *Matricaria recutita* (Rezaul-Karim, 2002). *M. recutita* was the weed with the smallest competitive ability, despite the fact that it did not portray significant differences with *S. media*. Similar competitive abilities were recorded in kale: the most competitive was *Sinapis arvensis*, followed by *Polygonum convolvulus*, *Alopecurus myosuroides*, *Chenopodium album, Polygonum aviculure* and *Polygonum persicaria*, then *Matricaria maritima* ssp. *inodora*, and in the end *Stellaria media, Capsella bursa-pastoris, Veronica persica* and *Anagallis arvensis.* A related order of weed aggressiveness was obtained in wheat (Welbank, 1963). In winter wheat field trials, low growing weed species, including *S. media* had inconsiderably competitive abilities, regardless of their presence at high densities. The oilseed field trials carried-out in the UK showed that weed densities below 250 plants m^{-2} generated a yield reduction lower than 5% (Anonymous, 2014).

The real competitive influence and related reduction of crop yield due to *S. media* will rely on several factors, including the emergence time of the crop. It shows aggressive initial growth and generates a substantial reduction in yield when it emerges before or simultaneously with the crop plants. Because of its highly expressed plasticity (van Acker et al., 1997), early development and resource use will cause individuals with a greater competitive capacity. In the study of Lutman et al. (1995), 10-20 *S. media* plants m^{-2} in autumn reduced oil seed rape yield by 5% or more. In other study (Aberdeen, 1992), the oil seed rape was particularly vigorous and the *S. media* was much less competitive (5% yield loss from 348 plants m^{-2}). Thus, it appears that there may be a general relationship between oil seed rape crop vigor and yield loss by *S. media*. In a similar study, *S. media* reduced oil seed rape yield by only 1.9%

which was lower than predicted, even though it was more vigorous than the other two species (*Viola arvensis* and *Veronica hederifolia*) during the spring and early summer (Anonymous, 2001). *S. media* is capable of reducing oilseed rape yields, only when the crop is grown in unfavorable conditions (Lutman and Dixon, 1990). Further, *S. media* is not a significant risk in winter white lupins, probably because the crop accepts elementary (no mineral) nitrogen in the process of symbiotic nitrogen fixation (Anonymous, 2001), and *S. media* is a typical nitrogen- demanding weed (NAS, 1968).

S. media is a weak competitor in established crop plants, such as established alfalfa (Pacanoski et al., 2017). Evidence for other studies also suggest that established alfalfa has a deeper rooting system, compared with the shallow rooting *S. media*, and may therefore be better able to exploit deeper sources of water. *S. media* can be a very vigorous plant and its prostrate growth habit can produce extensive ground cover from relatively few plants. The ability to cover the ground with few plants means that at higher population densities the weed itself may suffer. It has been noted in several trials affected by drought (Carver et al., 1997), where *S. media* seemed to be competing with itself for water more so than with the crop and suffered more as a result. Also, whereas *S. media* has a prostrate growth habit, the crop has an erect habitat and competition for light would therefore not be significant. From these observations, it would appear that although *S. media* can be very impressive in its rate of ground cover, its ability to compete with, and reduce the yield of established alfalfa does not correlate with this owing to differences in growth habit between the crop and weed, tendency of the weed to compete with itself more than the crop, and greater susceptibility of the weed to drought.

CONCLUSION

Although the native range of *S. media* is Europe, it has been distributed by human activities worldwide, and is now among the most ubiquitous weeds across the globe (in over 50 countries worldwide) (Holm et al., 1997). It occurs as a weed of many annual (small-grain, pulse, oilseed, sugar beet and vegetable) and perennial (fodder, fruit, grapevine) crops. The real competitive capacity associated with yield losses provided by *S. media* are a result of many factors, including its emergence time regarding the crop. The greater weed occurrence which causes the large yield reductions is also very important. Generally, *S. media* manifests a strong initial growth and usually generates a substantial reduction in yield when it emerges before or simultaneously with the crop plants. Because of its highly expressed plasticity, early development and resource capturing will lead to a large number of individuals with a high competitive capacity. On the other hand, *S. media* is a weak competitor in established crop plants. Despite the fact that *S. media* can be very effective in its capability of soil cover, its capacity to compete with, and decrease the established crop yields does not relate with differences in weed prostrate and crop erect growth habitats. Predisposition of the weed to compete with itself more than with the crop, and its greater susceptibility to drought, makes *S. media* less competitive in these crops.

LITERATURE

***ADAS*:** Common Chickweed, MAFF Advisory Leaflet No. 528, HMSO, Edinburgh, UK. 1977.

***Andersson, L., Milberg, P., Noronha, A.*:** Germination response of weed seeds to light of short duration and darkness after stratification in soil. Swedish Journal of Agricultural Research, 27, 113-120, 1997.

***Andreasen, C, Jensen, J. E., Streiberg, J. C.*:** Soil properties and plant nutrients affecting the occurrence of *Poa annua, Stellaria media* and *Viola arvensis* on arable land. Proceedings of the Brighton Crop Protection Conference- Weeds, Brighton, UK, 395-402, 1991.

***Andreasen, C., Stryhn, H., Streibig, J. C.*:** Decline of the flora in Danish arable fields. Journal of Applied Ecology, 33, 619-626, 1996.

***Anonymous*:** Biology and control of weeds and volunteer rape in broad-leaved crops. AR0210, 2001. sciencesearch.defra.gov.uk

***Anonymous*:** Common chickweed (*Stellaria media*). Plantwise Knowledge Bank, 2014. https://www.plantwise.org/KnowledgeBank

***Anonymous*:** Common chickweed. Michigan State University [MSU] - Extension publication, 2021. https://www.canr.msu.edu/weeds

***Barberi, P., Silvestri, N., Bonari, E.*:** Weed communities of winter wheat as influenced by input level and rotation. Weed Research, 37, 301-313, 1997.

***Barralis, G., Chadoeuf, R.*:** Weed seed banks of arable fields. Weed Research, 27, 417-424, 1987

***Benvenuti, S., Macchia, M., Miele, S.*:** Quantitative analysis of emergence of seedlings from buried weed seeds with increasing soil depth. Weed Science, 49, 528-535, 2001.

***Bitarafan, Z., Andreasen, C.*:** Retention of *Fallopia convolvulus, Sinapis arvensis, Spergula arvensis* and *Stellaria media* at Spring Oat Maturity. Agronomy, 10 (1), 46, 2020.

***Bónis, P., Balázs, F., Balázs, J., Kismányoky, T.*:** Effect of sowing date on the weed infestation of winter wheat a in long-term experiment Acta Agronomica Hungarica, 58 (Suppl.), 69-74, 2010.

***Buchanan, G. A., Hoveland, C. S., Harris, M. C.*:** Response of weeds to soil pH. Weed Science, 23, 473-447, 1975.

***Carver, M. F. F., Overthrow, R. B., Lutman, P. J. W., Andrews, F.*:** Weed control in spring linseed: Effects on knotgrass, chickweed, fat hen and oats on yield. Project report No. OS19, HGCA, 1997.

***Cavan, G., Potier, V., Moss, S. R.*:** Genetic diversity of weeds growing in continuous wheat. Weed Research, 40, 301-310, 2000.

***Chancellor, R. J.*:** The depth of weed seed germination in the field. In the Proceedings of the 7th British Weed Control Conference, Brighton, UK, 607-613, 1964.

***Chancellor, R. J.*:** Decline of arable weed seeds during 20 years in soil under grass and the periodicity of seedling emergence after cultivation. Journal of Applied Ecology, 23, 631-637, 1986.

***Childs, D.*:** Common chickweed control in alfalfa WS-18, Purdue University, 1992. https://www.agry.purdue.edu

***Chiriță, N., Henegar, R.*:** Results on the chemical control of weeds in winter wheat in the Roman area. Cercetări Agronomice în Moldova, 18, (2), 37-41, 1985.

***Coleman, M., Kristiansen, P., Sindel, B., Fyfe, C.*:** Chickweed (*Stellaria media*): Weed management guide for Australian vegetable production. School of Environmental and Rural Science, University of New England, Armidale, 2021.

***Davies, D. H. K.*:** Yield responses to the use of herbicides in cereal crops; East of Scotland trials 1979-88. Aspects of Applied Biology, 18, 47-56, 1988.

***de la Fuente, E. B., Suarez, S. A., Ghersa, C. M., Leon, R. J. C.*:** Soybean weed communities: relationships with cultural history and crop yield. Agronomy Journal, 91, 234-241, 1999.

***Defelice, M. S.*:** Common chickweed, *Stellaria media* (L.) Vill.- ‘Mere Chicken Feed?”, Weed Technology, 18 (1), 193–200, 2004.

***Deyl, M., Ušák, O.*:** Plevele polí a zahrad. Praha: ČSAV, 389s, 1964.

***Dorado, J., Sousa, E., Calha, I. M., Gonzalez-Andujar, J. I., Fernandez-Quintanilla, C.*:** Predicting weed emergence in maize crops under two contrasting climatic conditions. Weed Research, 49, 251-260, 2009.

***Farahbakhsh, A., Murphy, K. J.*:** Comparative studies of weed competition in sugar beet. Aspects of Applied Biology, 13, 11-16, 1986.

***Farahbakhsh, A., Murphy, K. J., Madden, A. D.*:** The effect of weed interference on the growth and yield of wheat. In the Proceedings of the 1987 British Crop Protection Conference, Weeds, 3, 955-961, 1987.

***Fogelfors, H.*:** The competition between barley and five weed species as influenced by MCPA treatment, Swedish Journal of Agricultural Research, 7 (3), 147-151, 1977.

***Frick, B., Thomas, A. G.*:** Weed surveys in different tillage systems in southwestern Ontario field crops. Canadian Journal of Plant Science, 72, 1337-1347, 1992.

***Fryer, J. D., Makepeace, R. J.*:** Weed control handbook, vol. I - Principles. 7th ed. Blackwell, Oxford, Gr. Br. 510 pp, 1977.

***Grădilă, M.*:** Management of some noxious dicotyledonous weeds in rape crops in Southern Romania. Acta Zoologica Bulgaric, Suppl., 9, 219-223, 2017.

***Grime, J. P., Hodgson, J. G., Hunt, R.*:** Comparative plant ecology, Unwin Hyman Ltd, London, UK, 1988. http://www.gardenorganic.org.uk

***Grundy, A. C., Peters, N. C. B., Rasmussen, I. A., Hartmann, K. M., Sattin, M., Andersson, L., Mead, A., Murdoch, A. J. Forcella, F.*:** Emergence of *Chenopodium album* and *Stellaria media* of different origins under different climatic conditions. Weed Research, 43, 163-176, 2003.

***Grundy, A. C., Mead, A.*:** Modeling weed emergence as a function of meteorological records. Weed Science, 48, 594-603, 2000.

***Grundy, A. C., Mead, A., Bond, W.*:** Linking meteorological events to weed emergence in the field. In the Proceedings of the 11th EWRS Symposium, Basel, 1999.

***Guerra, N., Haramoto, R., Schmitt, J., Costa, G. D., Schiessel, J. J., Oliveira Neto, A. M.*:** Weed control and selectivity herbicides pre emerging in garlic cultivars. Planta Daninha.38: e020228966, 2020.

***Guyot, L., Guillemat, J., Becker, Y., Barralis, G., Demozay, D., le Nail, Fr.*:** Semences et plantules des principales des mauvaises herbes. Association de Coordination Technique Agricole, Paris, 1962.

***Hanf, M.*:** Weeds and their seedlings. BASF UK Ltd, 1970.

***Harker, K. N.*:** Survey of yield losses due to weeds in central Alberta. Canadian Journal of Plant Science, 81, 339-342, 2001.

***Hill, E. C., Renner, K. A., Sprague, C. L.*:** Henbit (*Lamium amplexicaule*), common Chickweed (*Stellaria media*), shepherd's-purse (*Capsella bursa-pastoris*), and field pennycress (*Thlaspi arvense*): Fecundity, seed dispersal, dormancy, and emergence. Weed Science, 62 (1), 97-106, 2014.

***Holland, J. M., Smith, B. M., Southway, S. E., Birkett, T. C., Aebischer, N. J.*:** The effect of crop, cultivation and seed addition for birds on surface weed seed densities in arable crops during winter. Weed Research, 48, 503-511, 2008.

***Holm, L., Doll, J., Holm, E., Panchho, J., Herberger, J.*:** World weeds. Natural histories and distribution. New York: J. Wiley. 1129 p., 1997.

***Holm, L. G., Pancho, J. V., Herberger, J. P., Plucknett, D. L.*:** A Geographical atlas of world weeds. Malabar, FL: Krieger. 391 p., 1991a.

***Holm, L. G., Plucknett, D. L., Pancho, J. V., Herberger, J. P.*:** The world's worst weeds: Distribution and Biology. Malabar, FL: Krieger. 609 p., 1991b.

***Hossain, A., Sarker, M. A. Z., Mowlick, S., Kabir, M. R., Bazzaz, M. M.*:** Effect of herbicides on weed control in wheat. International Journal of Biological Research, 6 (1), 1-6, 2009.

***Hunková, E., Winkler, J., Demjanová, E.*:** The weed seed bank assessment in two soil depths under various mineral fertilising. Acta Univ. Agric. et Silvic. Mendel. Brun., LIX, 5, 105-112, 2011.

***Janjić, V., Kojić, M.*:** Weed's atlas (Atlas korova), Agricultural Research Institute, Serbia, 2000. [in Serbian]

***Jensen, P. K.*:** Weed size hierarchies in Denmark. Weed Research, 31, 1-7, 1991.

***Khamare, Y., Marble, C., Boyd, N., Steed, S*.:** Biology and management of common chickweed (*Stellaria media*) in ornamental crop production. ENH1313, Environmental Horticulture Department, UF/IFAS Extension, 2019. https://edis.ifas.ufl.ed

***King, L. J*.:** Weeds of the world; biology and control. Plant Science, Monogr. Intersci. Publ. Inc., New York, N.Y. 526 pp, 1966.

***Klostermyer, J*.:** Competition by *Stellaria media* (L.) Vill. and *Matricaria inodora* L. in oilseed winter rape (*Brassica napus* L. var. *napus*) an development of an empirical decision model for post-emergence weed control. PhD Thesis, Georg August Universitat (Gotttingen) pp. 85, 1989.

***Kojić, M., Janjić, V*.:** The fundamentals of weed science (Osnovi herbologije), Agricultural Research Institute, Serbia, 1996. [in Serbian]

***Kostov, T*.:** Herbology, Scientific book, Skopje, 2006.

***Kropff, M. J., Lotz, L. A. P., Weaver, S. E., Bos, H. J., Wallinga, J., Mig, T*.:** A two parameter model for prediction of crop loss by weed competition from early observations of relative leaf area of the weeds. Annals of Applied Biology, 126, 329-346, 1995.

***Kropff, M. J., Joenje, W., Bastiaans, L. Habekotte, B. van Oene H., Werner, R*.:** Competition between a sugar beet crop and populations of *Chenopodium album* L. and *Stellaria media* L. Netherlands Journal of Agricultural Science, 35, 525-528, 1987.

***Kust, G*.:** Erarbientung vorlaufiger schadenschwallen und eines entscheidungmodells zur unkrautbekampfung in winterraps (*Brassica napus* L. var. *napus*) unter berucksichtigung der artpezifischen konkurrenz von unkrautern und ausfallgerste. PhD Thesis, Georg August Universitat (Gotttingen), pp. 82, 1989.

***Lainsbury, M. A., Hilton, J. G., Burn, A*.:** The incidence of weeds in UK sugar beet crops during autumn 1998. In the Proceedings of the Brighton Crop Protection Conference - Weeds, Brighton, UK, 817-820, 1999. http://www.gardenorganic.org.uk

***Lawson, H. M., Wright, G., McN., Wilson, B. J., Wright, K. J*.:** Seedbank persistence of five arable weed species in autumn-sown crops. In the Proceedings of the Brighton Crop Protection Conference- Weeds, 305-310, 1993.

***Líška, E., Černuško, K., Cigľar, J., Borecký, V*.:** Atlas burín. Nitra: VŠP v Nitre, 276 s. ISBN 80-7137-193-9, 1995.

***Lundkvist, A*.:** Effects of pre- and post-emergence weed harrowing on annual weeds in peas and spring cereals. Weed Research, 49, 409-416, 2009.

***Lutman, P., Bowerman, J. W., Palmer, P. G. M., Whytock, G. P*.:** Prediction of competition between oilseed rape and *Stellaria media*. Weed Research, 40, (3), 255-269, 2000.

***Lutman, P. J. W*.:** Estimation of seed production by *Stellaria media, Sinapis arvensis* and *Tripleurospermum inodorum* in arable crops. Weed Research, 42, 359-369, 2002.

***Lutman, P. J. W., Dixon, F. L*.:** The competitive effects of volunteer barley (*Hordeum vulgare*) on the growth of oilseed rape (*Brassica napus).* Annals of Applied Biology, 117, 633-644, 1990.

***Lutman, P. J. W., Bowerman, P., Palmer, G. M., Andrews, F*.:** Cost-effective weed control in winter oilseed rape, Project Report No. OS15, 1995. https://cereals.ahdb.org.uk

***Mahn, E-G*.:** Changes in the structure of weed communities affected by agrochemicals – what role does nitrogen play? Ecological Bulletins, 39, 71-73, 1988.

***Mannand, H. H., Barnes, T. W*.:** The competition between barley and certain weeds under controlled conditions IV. Competition with *Stellaria media*, Annals of Applied Biology, 37, 139-148, 1950.

***Marshall, E. J. P., Brown, V. K., Boatman, N. D., Lutman, P. J. W., Squire, G. R., Ward, L. K*.:** The role of weeds in supporting biological diversity within crop fields. Weed Research, 43, 77-89, 2003.

***Matuszkiewicz, W*.:** Przewodnik do oznaczania zbiorowisk roślinnych Polski. Warszawa: Wydawnictwo PWN, 2006. [In Polish]

***Mazur, A*.:** The role of seed coat in the germination and early stages of growth of bean (*Phaseolus vulgaris* L.) in the presence of chickweed (*Stellaria media* (L.) Vill.). Annales Universitatis Paedagogicae Cracoviensis Studia Naturae, 4, 103-118, 2019.

***Meiss, H., Mediene, S., Waldhardt, R., Caneill, J., Munier-Jolai, N.*:** Contrasting weed species composition in perennial alfalfas and six annual crops: implications for integrated weed management. Agronomy for Sustainable Development, 30 (3), 657-666, 2010.

***Mertens, S. K., Jansen, J. H.*:** Weed seed production, crop planting pattern, and mechanical weeding in wheat. Weed Science, 50, 748-756, 2002.

***Milberg, P., Hallgren, E. Palmer, M. W.*:** Timing of disturbance and vegetation development: how sowing data affect the weed flora in springsown crops. Journal of Vegetation Science, 12, 93-98, 2001.

***Miura, R., Kusanagi, T.*:** Variation in factors determining flowering time in the *Stellaria media* complex. Weed Research, 41, 69-81, 2001.

***Muntaha, S., Iqbal, L., Shamia, M., Alamzeb, M., Iqbal, A., Parmar, B., Mehreen R., Bilal A.*:** Identification of most important weed species in wheat crop under high altitude in northern Pakistan. Journal of Pharmacognosy and Phytochemistry; SP1: 913-917, 2018.

***Munzel, L.*:** Uberprufung und weiterentwicklung eines schadenschwallen-modells zur gezielten unkrautbekampfung in winterraps (*Brassica napus* L. var. *napus*). PhD Thesis, Georg August Universitat (Gotttingen) pp. 124, 1992.

***NAS (National Academy of Science)*:** Brush and weed control on ranges and pastures, pp.267-294 in Principals of plant and animal pest control, vol. 2, Weed control, National Academy of Sciences, Washington, DC, 1968.

***Pacanoski, Z.*:** Weed control in newly seeded alfalfa (*Medicago sativa* L.) with postemergence herbicides. Herbologia, 12 (3), 55-65, 2011.

***Pacanoski, Z., Týr, Š., Vereš, T.*:** Weed control in dormant alfalfa (*Medicago sativa* L.) with active ingredients' metribuzin, imazetapyr and pronamide. Journal of Central European Agriculture, 18 (1), 42-54, 2017.

***Pacanoski, Z.*:** Biology, Ecology and Control of Weeds. Scientific book.COBISS MK-ID 60577541, Student Service, Skopje, pp. 835. 2023. [in Macedonian]

***Pawlowski, F.*:** Prolificacy, height and ability of producing shoots on some weed species growing among crop plants. Annales Universitatis Mariae Curie-Sklodowska Lublin-Polonia, 21 (9), 175-189, 1966.

***Popay, A. I., Cox, T. I., Ingle, A., Kerr, R.*:** Effects of soil disturbance on weed seedling emergence and its long-term decline. Weed Research, 34, 403-412, 1994.

***Rezaul-Karim, S. M.*:** Competitive ability of different weed species. Journal of Agronomy, 1, 116-118, 2002.

***Roberts, H. A., Dawkins, P. A.*:** Effect of cultivation on the numbers of viable weed seeds in soil. Weed Research, 7, 290-301, 1967.

***Roberts, H. A., Feast, P. M.*:** Seasonal distribution of emergence in some annual weeds. Experimental Horticulture, 21, 36-41, 1970.

***Roberts, H. A., Lockett, P. M.*:** Germination of buried and dry-stored seeds of *Stelleria media*. Weed Research, 15, 199-204, 1975.

***Salisbury, E. J.*:** Weeds and aliens. New Naturalist Series, Collins, London, 1961.

***Salisbury, E. J.*:** The biology of garden weeds. Part I. Journal of the Royal Horticultural Society, 87, 338-350 & 390-404, 1962.

***Salisbury, E. J.*:** Weeds and aliens. Collins, London, Gr. Br. 38a pp., 1964.

***Salisbury, E. J.*:** The variation in the reproductive organs of *Stellaria media* (sensu stricto) and allied species with special regard to their relative frequency and prevalent modes of pollination. In the Proceedings of the Royal Society, Ser. B. 185, 331-342, 1974.

***Saska, P., van der Werf, W., de Vries, E., Westerman, P. R.*:** Spatial and temporal patterns of carabid activitydensity in cereals do not explain levels of predation on weed seeds. Bulletin of Entomological Research, 98, 169-181, 2008.

***Schroeder, D., Mueller-Schaerer, H., Stinson, C. A. S.*:** A European weed survey in 10 major crop systems to identify targets for biological control. Weed Research, 33 (6), 449-458, 1993.

***Sinha, R. P., Whitehead, F. H.*:** Meiotic studies of British populations of *Stellaria media* (L.) Vill., *S. neglecta* Weihe and *S. pallida* (Dumort.) Pir. New Phytologist, 64, 343-345, 1965.

***Smatana, F. J., Macák M*.:** Weed infestation dynamics of winter wheat fields in southwestern Slovakia. Research Journal of Agricultural Science, 46 (2), 338-344, 2014.
***Sobeydg, D. G*.:** Biological flora of the British Isles, 150. *Stellaria media* (L.) Vill. Journal of Ecology, 69, 311-335, 1981.
***Storkey, J., Cussans, J. W*.:** Relationship between temperature and the early growth of Triticum aestivum and three weed species. Weed Science, 48, 467-473, 2000.
***Streibig, J. C*.:** Weeds – the pioneer flora of arable land. Ecological Bulletins 39, 59-62, 1988.
***Šniauka, P., Pocius, A*.:** Thermal weed control in strawberry, Agronomy Research, 6 (Special issue), 359-366, 2008.
***Thompson, K., Band, S. R., Hodgson, J. G*.:** Seed size and shape predict persistence in soil. Functional Ecology, 7, 236-241, 1993.
***Turkington, R., Kenkel, N. C. Franko, G. D*.:** The biology of Canadian weeds. 42. *Stellaria media* (L.) Vill. Canadian Journal of Plant Science, 60, 981-992, 1980.
***Uva, R. H., Neal, J. C., diTomaso, J. M*.:** Weeds of the Northeast. Ithaca, NY: Cornell University Press. 397 p. 1997.
***van Acker, R. C., Lutman, P. J. W., Froud-Williams, R. J*.:** The influence of interspecific interference on the seed production of *Stellaria media* and *Hordeum vulgare* (volunteer barley). Weed Research, 37, 277-286, 1997.
***van Delden, A., Lotz, L. A. P., Bastiaans, L., Franke, A. C., Smid, H. G., Groeneveld, R. M. W., Kropff, M. J*.:** The influence of nitrogen supply on the ability of wheat and potato to suppress *Stellaria media* growth and reproduction. Weed Research, 42 (6), 429-445, 2002.
***van Himme, M., Stryckers, S. J., Bulcke, R*.:** Onderzoek naar de toelaatbare (on) kruidbezetting in wintergerst. Mededelingen van het Centrum van Onkruidonderzoek, 38, 21-23, 1983.
***Verd́ u, A. M., Mas, M. T*.:** Mulching as an alternative technique for weed managementin mandarin orchard tree rows. Agronomy for Sustainable Development, 27, 367-375, 2007.
***Vrbničanin, S., Božić, D*.:** Korovi. Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd, 2021. [in Serbian]
***Warwick, M. A*.:** Buried seeds in arable soils in Scotland. Weed Research, 24, 261-268, 1984.
***Welbank, P. J*.:** A comparison of competitive effects of some common weed species. Annals of Applied Biology, 51 (1), 107-125, 1963.
***Whitehead, F. H., Sinha, R. P*.:** Taxonomy and taximetrics of *Stellaria media* (L.) Vill., *S. neglecta* Weihe and *S. pallida* (Dumort.) Pire. New Phytologist, 66, 769-784, 1967.
***Whitehead, R., Wright, H. C*.:** The incidence of weeds in winter oilseed rape in Great Britain. Aspects of Applied Biology, 23, 211-218, 1989.
***Wilson, B. J., Wright, K. J., Butler, R. C*.:** The effect of different frequencies of harrowing in the autumn of spring on winter wheat and on the control of *Stellaria media* (L.) Vill., *Galium aparine* L. and *Brassica napus* L. Weed Research, 33, 501-606, 1993.
***Woźniak, A*.:** Weed infestation of a spring wheat (*Triticum aestivum* L.) crop under the conditions of plough and ploughless tillage. Acta Agrobotanica, 64 (3), 133–140, 2011.
***Wright, S., Orloff, S., Banuelos, G., Rios, S., Hutmacher, K*.:** Weed management in wheat 2012. https://alfalfa.ucdavis.edu
***Yazdani, A. A. Abravan P., Fazeli A. A*.:** Effects of alfalfa sowing rate and planting methods on weeds population dynamic in establishment year. International Research Journal of Applied and Basic Sciences, 3 (5), 1045-1051, 2012.
***Zanin, G., Mosca, G., Catizone, P*.:** A profile of the potential flora in maize fields of the Po valley. Weed Research, 32, 407-418, 1992.

Stellaria media (L.) Vill. (mišjakinja obična) – jak ili slab kompetitor u ozimim i ranoprolećnim usevima?

REZIME

Zbog sposobnosti da produkuje značajne količine semena u umerenoj klima zoni, *Stellaria media* (L.) Vill. je odličan kompetitior na hladnijim i vlažnijim staništa na kojima se gaje ozimi i ranoprolećni usevi. Mišjakinja kao korov se obično javlja u različitim usevima u umerenom i borelnoj klima zoni, gde klija i niče ranije od većine drugih korova. *S. media* je jedan od najčešćih korova u ozimim i jarim strnim žitima, zatim veoma je konkurentna u usevu graška i uljane repice, zatim vrlo čest korov u lucerištima, zasadima citrusa, jedna od najčešćih korova u zasadu jagoda, i jedan od najčešćih korovskih vrsta u konvencionalnoj proizvodnji šećerne repe. *S. media* takođe pravi ozbiljne problem u povrtarskoj proizvodnji, kao i na travnjacima i baštama u svim zemljama umerenog klimata na planeti zemlji.

S druge strane, *S. media* kao slab kompetitor značajno manje utiče na pad prinosa pojedinih useva u poređenju sa drugim korovskim vrstama kao što su: *Raphanus raphanistrum, Chenopodium album*, *Galium aparine, Polygonum persicaria*, *Alopecurus myosuroides, Avena fatua* itd. Na osnovu poljskih eksperimenata, u ozimim i prolećnim ratarskim usevima, kao i etablirnim lucerištima *S. media* se pokazala kao slab kompetitor, osim ukoliko se ne javi u velikoj brojnosti. Stoga, prava konkurentska sposobnost vrste *S. media* i efekat na smanjenje prinos useva zavisi od mnogo faktora, uključujući i vreme nicanja useva. *S. media* se karakteriše snažnim početnim rastom što se značajno reflektuje na pad prinosa useva kada mišjakinja nikne ranije ili istovremeno kada i usevi. Takođe, to je veoma prilagodljiva vrsta, a kao rezultat toga njeno brzo nicanje, snažan razvoj i efikasno iskorišćavanje prirodnih resursa rezultira velikom brojnošću jedinki po jedinici površine, odnosno velikom konkurentskom sposobnošću mišjakinje.

Ključne reči: *Stellaria media,* usevi, korovi, kompeticija.