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Original article

# *Eragrostis Pilosa (L) P. Beauv.* a New Invasive and Economically Important Weed in Rice Fields in the Kocani Region

Gordana Glatkova [a, *], Halil Sürek [a], Dobre Andov [a],
Danica Andreevska [a] & Zvonko Pacanoski [a]

[a] Institute of Agriculture Skopje, University Ss. Cyril and Methodius, Skopje, North Macedonia
[a] Trakya Agricultural Research Institute, Edirne, Turkey
[a] Faculty for Agricultural science and food, University Ss. Cyril and Methodius, Skopje, North Macedonia

**Abstract**

Investigations were carried out in rice fields in the Kocani region. The aim for this investigations was to determine the weed species which has never been registered in Kocani rice fields before. Also, to examine in which localities it appears, the reasons for its occurrence in the rice fields and the impact of this weed on rice yield. After determining it was discovered that the examined weed is *Eragrostis pilosa (L) P. Beauv* (indian love grass). This is a non-typical weed for rice fields in Kocani region. *Eragrostis pilosa* in the rice fields in Kocani region for the first time was noticed in 2010 in vicinity of the village Mojance. In 2012 it also appears in the rice fields in vicinity of villages Kucicino, Ciflik, Burilcevo and Dolni Podlog. In 2013 it spreads in the rice fields in vicinity of villages Cesinovo and Grdovce and in the majority of the rice fields around the city of Kocani. Water deficiency in the rice fields is the reason for *Eragrostis pilosa* occurrence. Depending on the weed intensity the rice yield was reduced from ca. 25 to 55%. Its spreading will be a serious economically problem in the rice production in the Kocani region.

**Keywords:** *Eragrostis Pilosa*, Rice, Yield, Water Deficiency, Weed.

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* **Corresponding author:**

Glatkova Gordana is a associate professor in the Department of Plant Protection at the Institute of Agriculture in Skopje, University Ss. Cyril and Methodius, Skopje, North Macedonia. Her research interests includes weed management, weed biology and ecology, herbicides.
Email: gordana_glatkova@yahoo.com

## INTRODUCTION

Rice (*Oryza sativa L.*) in the Republic of Macedonia are currently grown on about 4500 ha with average yield of 5992 kg/ ha (Ministry for Agriculture, Forestry and Water Utilization, 2012). Almost 90% of total rice crop is produced in the Kocani region. Rice production depends on many abiotic and biotic factors. Weeds are the most serious biotic factors that affected rice yield and quality (Subhas and Jitendra, 2001; Mandal et al., 2002). About 40% of world rice production and 55-60% of rice production in Europe decreases due to weeds competition (Oerke et al., 1994a; 2004b). In the Republic of Macedonia rice yield loss due to uncontrolled weeds ranged from 40-60% (Pacanoski and Glatkova, 2009). Yield decreasing depends on the weeds density as well as the weeds species composition. According to Kostov (2006) worldwide in the rice fields, about 100 weeds species appears, of which about 30 are typical for rice fields. In Macedonian rice fields weed flora is represented by about 20 common weed species. This weeds are typical for the rice fields and belonging to grasses, broadleaf weeds and sedges.

Under certain conditions, in the rice field untypical weed flora may occur. Such are the weeds of the genus *Eragrostis* Wolf (Poaceae). During 1980-83 and 1984-90 in Punjab the surveys revealed 56 weed species in transplanted rice including *Eragrostis diarrhea* (Sandhu & Singh, 1993). *Eragrostis tenella* and *Eragrostis unioloides* are noticed in paddy fields, paddy levee and paddy adjacent in Wayanad District in Western Ghats, India (Prajeesh et al., 2014). According to Chandrasena (1987) in rice fields in Shri Lanka *Eragrostis gangetica, Eragrostis tenella* and *Eragrostis uniolides* there has been occurrence frequent, occasional and widespread, respectively. Marita et al. (1999) reported that *Eragrostis tenella* is common in upland rice in India, Indonesia, Philippines, Thailand, and Vietnam and present in Bangladesh, Lao PDR, and Myanmar.

The genus *Eragrostis* Wolf (Poaceae) has about 40 species in the tropics and subtropics of the world, and 10 species in Europe (Clayton et al., 2006). Because of this the identification of the species is quite difficult. Bittencourt et al. (2016) emphases that *Eragrostis pilosa* morphology resembles that of *Eragrostis plana, Eragrostis tenuifolia, Eragrostis curvula* and *Eragrostis pilosiuscula*. How difficult it is to distinguish the some species is the fact that almost all specimens collected in the territory of Poland until 2005 and previously identified as *Eragrostis pilosa*, it proved that belonged to *Eragrostis albensis.* (Nobis and Nobis, 2009).

In Macedonian weed flora 3 species (*Eragrostis pilosa (L) P.B., Eragrostis megastachya (Koel) Lk and Eragrostis minor Host.)* have been recorded (Lozanovski, 1994). This weeds usually appear in vegetable and leguminous crops fields, vineyards and orchards.

Until 2010 in the rice fields in the Kocani region no weed species belonging to genus *Eragrostis* were noticed. A mass spread of weed species belonging to this genus has been recorded since 2010 to 2014.

The objective of this survey was to determine the new weed species in rice fields in the Kocani region, to determine in which localities it appeared, the reasons for its mass spread and its impact on the rice yield.

**Materials and Methods**

The data on *Eragrostis pilosa* occurrence and distribution within the rice field in the Kocani region were collected from field observation which has been conducted between 2010 and 2014 in diferent villages in the Kocani region.

The weed is determined in the Institute of Biology-Faculty of Natural Sciences and Mathematics – Skopje by the following keys: Hayek, A., 1925. *Eragrosis* Host in Prodromus Florae peninsulae Balcanicae, 1: 246. Verlag des Repertoriums, Dahlem bei Berlin. (Hayek, 1932: 246) and Tutin, T.G., 1980. *Eragrosis* Host in Tutin, T.G. et al. (eds.). Flora Europaea, 5: 257. Cambridge University Press. London.

Preliminary measurements were made of the depth of water, *Eragrostis pilosa* density and its impact on rice yield. The correlation between them was examined. Measures were taken in several plots in each village where *Eragrostis pilosa* has been occurred and the average values were presented.

**Results and Discussion**

Determination indicates that the observed weed is *Eragrostis pilosa* which belongs to fam. Poaceae. Common name is Indian love grass, hairy love grass. Synonyms are *Eragrostis multicaulis Steud; Eragrostis perplexa L. H. Harvey; Eragrostis pilosa (L.) P. Beauv. var.perplexa (L. H. Harvey) S. D. Koch; Poa pilosa L*. *Eragrostis* is derived from the name of the Greek god of love, *Eros*, and *agrostis*, meaning grass.

***General description***

This weed is annual. Tufted. Culms are erect, or geniculately ascending; 8–70 cm long. Ligule is a fringe of hairs. Leaf-blades 2–20 cm long; 1–4 mm wide. Inflorescence is a panicle. Panicle is open; elliptic, or ovate; 4–25 cm long. Primary panicle branches whorled at lower nodes. Panicle branches are eglandular and bearded in axils. Spikelets are solitary. Fertile spikelets are pedicelled. Pedicels are eglandular.Spikelets comprising 4–14 fertile florets; with diminished florets at the apex. Spikelets are linear; laterally compressed; 3–7 mm long; 0.7–1.2 mm wide; breaking up at maturity; rhachilla persistent; shedding paleas, or retaining paleas (in temperate regions). Glumes are deciduous; dissimilar; shorter than spikelet. Lower glume is ovate; 0.5–0.7 mm long; 0.5–0.7 length of upper glume; hyaline;

without keels; 0 -veined. Lower glume lateral veins absent. Lower glume apex acute. Upper glume is ovate; 1 mm long; 0.6–1 length of adjacent fertile lemma; hyaline; 1-keeled; 1 -veined. Upper glume lateral veins absent. Upper glume apex acute. Fertile florets appressed to rhachilla. Fertile lemma ovate; 1–1.6 mm long; membranous; keeled; 3 -veined. Lemma apex obtuse, or acute. Palea keels scaberulous. Apical sterile florets resembling fertile though underdeveloped. Anthers 3; 0.2–0.3 mm long. Caryopsis with adherent pericarp; ellipsoid; laterally compressed; plano-convex; 0.6–1 mm long. (Clayton et al., 2006).

***Distribution of Eragrostis pilosa (L) P. Beauv***

*Eragrostis pilosa* is native to Euroasia and Africa. Worldwide it is widespread in Europe: central, southwestern, southeastern, and eastern. Africa: north, west tropical, west-central tropical, northeast tropical, east tropical, southern tropical, south, and western Indian ocean. Asia-temperate: Siberia, Soviet far east, Soviet Middle Asia, Caucasus, western Asia, Arabia, China, Mongolia, and eastern Asia. Asia-tropical: India, Indo-China, Malesia, and Papuasia. Australasia: Australia. Pacific: southwestern, south-central, northwestern, and north-central. North America: eastern Canada, northwest USA, north-central USA, northeast USA, southwest USA, south-central USA, southeast USA, and Mexico. South America: Mesoamericana, Caribbean, northern South America, western South America, Brazil, and southern South America.

As a weed in Europe *Eragrostis pilosa* has been reported in Albania, Austria, Bulgaria, Czechoslovakia, France, Germany, Greece, Hungary, Italy, Portugal, Romania, Russian Federation (European), Spain, Switzerland, Ukraine, Serbia, Croatia, Bosnia and Hercegovina and Macedonia. Eragrostis pilosa prefers moist pastures and open, disturbed ground from 500 to 3200 m (Holm et al., 1997). According to Zeid et al. (2011) Eragrostis spp. are deemed invasive and noxious as they have found their way into other regions that were not designated for hosting them.

***Distribution of Eragrostis pilosa (L) P. Beauv in rice fields in the Republic of Macedonia***

*Ergrostis pilosa* in most rice production countries is a non-typical weed for rice fields. Holm et al. (1997), emphases that this weed is found in more than 30 crops in over 50 countries. According to the same authors it is most important in Brazil (cotton), Indonesia (rice), Korea (barley and wheat), Dominican Republic (rice), Taiwan (sugarcane), India (dry land crops) and the Ukraine (vineyards).

*Eragrostis pilosa* in the rice fields in the Kocani region for the first time we have noticed in 2010 in vicinity of the village Mojance (41° 52' 27" N and 22° 22' 54" E). In 2012 it also appears in the rice fields in vicinity of villages Kucicino (41° 50' 42" N and 22° 19' 4" E), Ciflik (41° 52' 8" N and 22° 19' 4" E), Burilcevo (41° 50' 32" N and 22° 17' 5" E) and Dolni Podlog (41° 53' 10" N and 22° 22' 01" E). In 2013 it spreads in the rice fields in vicinity of villages Cesinovo (41° 52' 18" N and 22° 17' 24" E)

and Grdovce (41° 52' 54" N and 22° 25' 5" E) and in the majority of the rice fields around the city of Kocani (41° 55' N and 22° 25' E). (Figure 1 and Figure 2)

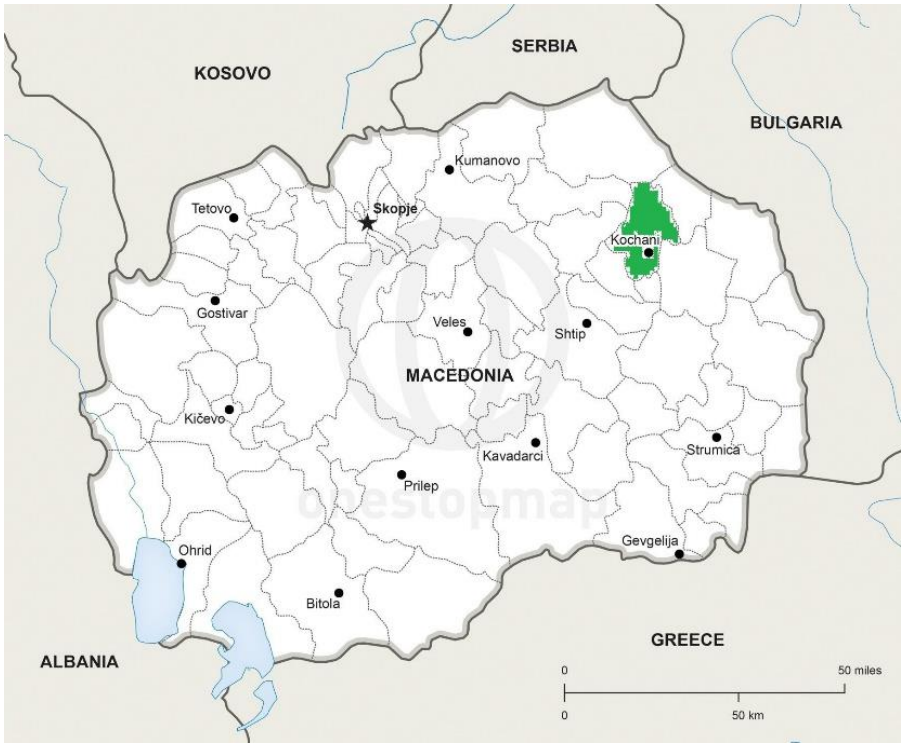


**Figure 1.** Map of the Republic of Macedonia showing Kocani region

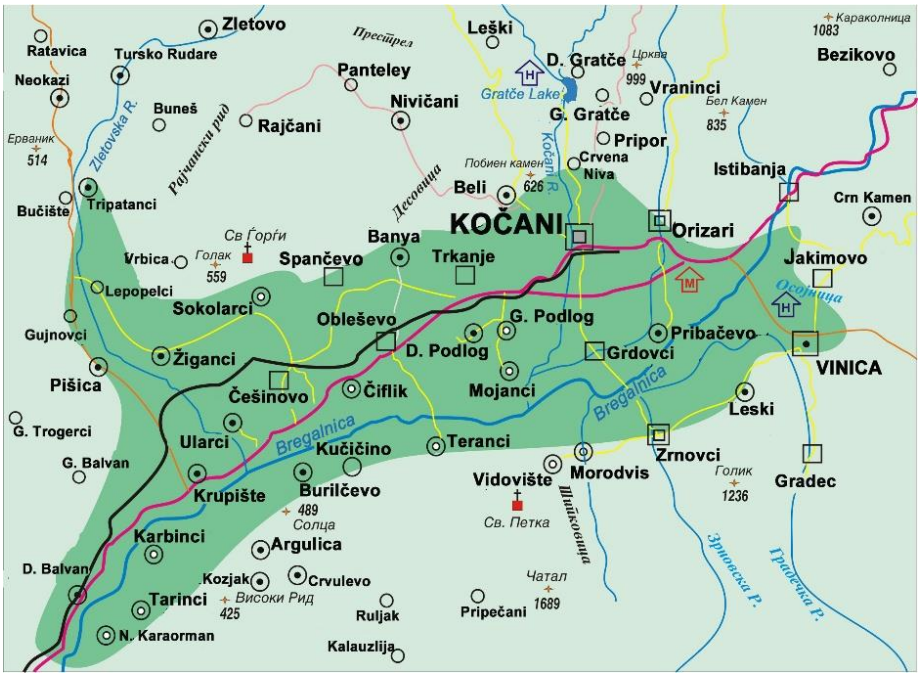


**Figure 2.** Map of villages in Kocani region

In Nithya and Ramamoorthy, (2015) studies in five different villages in and around Vanur taluk (India) Eragrostis pilosa was found in two of them. According to Özaslan (2015) *Eragrostis colina* is

determinate in rice field in five provinces in Anatolia region in Turkey. Moody (1989) reported that *Eragrostis pilosa* was found in some rice fields in India, Indonesia and Burma. *Eragrostis pilosa* and *Eragrostis plana* has been found in lowland environment Itaqui/ Rio Grande do Sul in Brazil promoting interference by competing with the rice. (Wolffenbüttel, 2016)

In our survey we found that *Eragrostist pilosa* in rice fields in the Kocani region mostly occur in plots that are not regularly supplied with water. It also appears on surfaces with water supply, but where the soil is very permeable (sandy loam and alluvium). As much as the water is swollen the occurrence of *Eragrostis pilosa* was more invasive (Table. 1).

**Table 1**. Average water depth, weed densities and grain yield in rice fields in Kocani region

| **Water depth (cm)** | ***Eragrostis pilosa* densities (no $m^{-2}$)** | **Grain Yield (kg $ha^{-1}$)** |
|---|---|---|
| 8-15 | 2-3 | 5250 |
| 2-4 | 20-40 | 4040 |
| Without water (wet surface) | 70-100 | 3310 |
| Without water (dry surface) | 140-190 | 2150 |

In Wolffenbüttel (2016) experiment where *Eragrostis pilosa* and *Eragrostis plana* were grown to three soil moisture conditions (50% and 100% of the soil water retention capacity and flooding), simulating different water condition in the rice paddy (low floodplain land and soil with 10 cm water depth) was observed that the flooding most negatively influenced the dry mass of shoots and roots, reducing the number of tillers and panicle per plant.

In some rice fields in the Kocani region where a part of the plot was well-watered, there was no presence of *Eragrostis pilosa*. In the same plots a part that was slightly exalted and water deficit was present this weed has been predominant (Figure 3.). This means water deficiency in rice fields in Kocani region is key predictor for *Eragrostis pilosa* occurrence.

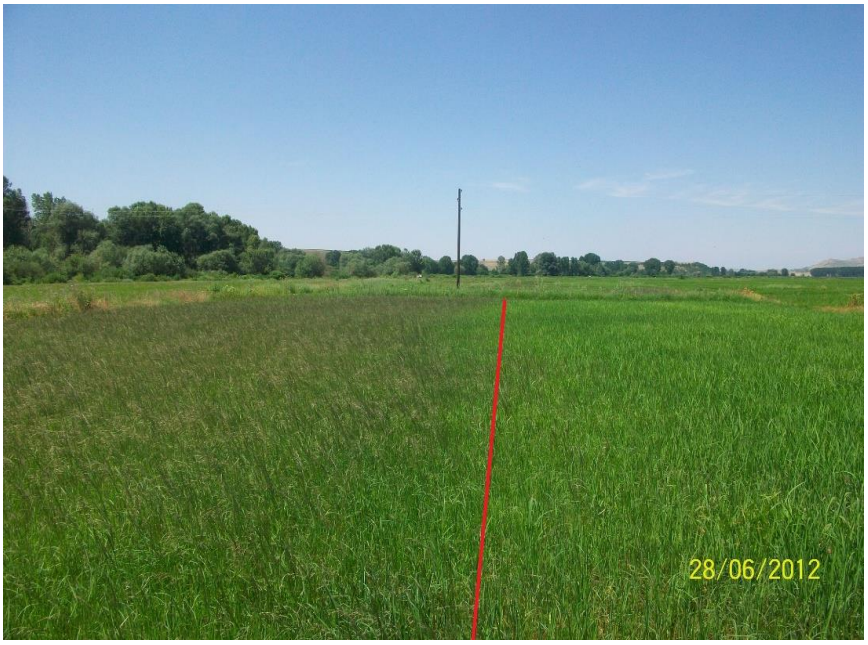


**Figure 3.** Different density of *Eragrostis pilosa* in same plot depending on water

In (Figure 4.) we can notice the 100% Eragrostis pilosa density in the rice field with water deficiency during the all growing season.


**Figure 4.** Rice field with almost 100% *Eragrostis pilosa* density

Proper water management (depth 8 -15cm) during all rice growing season it's one of the most valuable methods for weed suppressing in rice production in Macedonia. Some authors (Andov and Andreevska, 2010, Ilieva, 2015) have noted that. Pinke et al. (2014) results support that occurrence of *Echinocloa crus-galli* is associated with lower water depth. In Caton et al. (1999) experiment water depth significantly affects weed species composition and densities. Bhagat et al. (1996) emphases that

surface ponding of water in rice reduces weed emergence and growth with variable degrees of success depending upon water depth, nature of weed species and time of ponding. The water management supply and the water level in rice production during the rice vegetation has an important role to the control of invasive plants (Wolffenbüttel, 2016).

Weed competition caused large reductions in rice yield. Depending on the water depth and *Eragrostis pilosa* densities the rice yield in Kocani region was reduced from 25 to 60% (Table 1.) The spreading of *Eragrostis pilosa* will be a serious economically problem in the rice production in the Kocani region. Because of that proper water management depth (8 -15cm) must be priority for rice production in this region.

**Conclusion**

*Eragrostis pilosa* is the weed that we have determined in the rice fields in the Kocani region. Its occurrence is invasive in the rice fields with deficit of water during the rice growing season. Decreasing of rice yield due to *Eragrostis pilosa* densities has been estimate at 25-55%. Proper water management during all growing season is a priority measure for suppressing *Eragrostis pilosa* occurrence.

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