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STUDY OF THE WEEDING IN COMMON BEAN (*PHASEOLUS VULGARIS* L.) IN BULGARIA

Ivaylo Dinkov*, Mariyan Yanev

Agricultural University - Plovdiv, Bulgaria
E-mail: iivanov_d@au-plovdiv.bg

Abstract

Weeding is one of the factors that leads to a significant reduction in the yield of beans (*Phaseolus vulgaris* L.) in field production, as well as contamination of the harvested produce with the above-ground mass of weed plants. Weed control is an annual challenge, since it is not always possible to completely destroy them. The reasons for this are the great species diversity of weeds, their high biological and ecological plasticity, as well as their different sensitivity to herbicides and other control methods. In addition, under the influence of the applied agricultural techniques, crop rotations, agroclimatic conditions and other factors, weed associations change dynamically. This requires systematic examination and recording of weeding. In this regard, in 2024 and 2025, weeding was monitored in areas with common beans grown in several regions of Bulgaria. 26 types of weeds and self-seeding of rapeseed and millet were identified from the 18 farms surveyed. The group with the most representatives is the group of late-spring weeds, of which the most common are *Chenopodium album* L., *Setaria viridis* L., *Amaranthus* spp., *Xanthium strumarium* L., etc. It was found that in the surveyed areas the early spring and winter-spring weeds have limited species diversity and low density. Of the perennial weeds, the most widespread is *Convolvulus arvensis* L. During the mapping, the presence of the stem parasite *Cuscuta campestris* Yunker in the lands of the villages of Tsarev Brod and Vrachantsi and the semi-parasitic weed *Rhinanthus major* L. in the lands of the village of Tsarev Brod was also found.

Keywords: common bean, weeds, distribution

INTRODUCTION

Common bean (*Phaseolus vulgaris* L.) is among the most important legumes grown worldwide, of key importance for food security, sustainable agriculture and soil fertility. The crop is distinguished by its high content of plant proteins, fiber, vitamins and minerals, as well as its unique ability to fix atmospheric nitrogen through symbiosis with rhizobium bacteria (Karavidas et al., 2022). In Europe,

beans are traditionally grown in countries such as Bulgaria, Greece, Italy, and Spain. In the USA, it is an important crop for both fresh consumption and processing (Pavlovic et al., 2024).

The impact of weeds on yield has been the subject of numerous studies. Soltani et al. (2018), in a study by the Weed Science Society of America, estimated that if no weed control methods were applied, dry bean yield losses due to weed competition were 71.4%.

Karavidas et al. (2022) noted that in the absence of weed control, yields can drop by over 40%, especially in intensive farming systems. To achieve high yields, weed control is important, as competition between beans and weeds can lead to production losses ranging from 12 to 80% (Srivastava et al., 2013; da Costa et al., 2013; Esmaeilzadeh and Aminpanah, 2015; Mekonnen, 2020). Not all weeds are equally harmful to yield, however, broadleaf weed species such as *Amaranthus retroflexus* L., *Chenopodium album* L., *Portulaca oleracea* L., *Datura stramonium* L., *Convolvulus arvensis* L., the reed weed species *Cyperus esculentus* L., *Cyperus rotundus* L. and the monocotyledon species *Cynodon dactylon* L., *Sorghum halepense* L., *Echinochloa crus-galli* L., *Eleusine indica* L., *Setaria viridis* L., *Digitaria sanguinalis* L. are frequently found in areas where common beans are grown (Sadeghi and Sasanfar, 2013; da Costa et al., 2013; Esmaeilzadeh et al., 2015; Feizollah and Aminpanah, 2016; Ngadze et al., 2018; Singh et al., 2018).

Aguyoh and Masiunas (2003b) noted that *Amaranthus retroflexus* L. is becoming increasingly common in snap bean production in the Midwestern United States and can cause over 50% yield loss when crop and weed emergence coincide. *Chenopodium album* L. has been identified as a problem weed in snap bean production in New York (Van Wychen, 2022) and Oregon (Peachey, 2019). It has been the subject of research in this culture since the mid-1980s (Vencill et al., 1990; Wilson and Hines, 1987). In the early 2000s, *Digitaria sanguinalis* L. was observed as a weed in snap bean production in the Midwest region of the USA and could cause yield losses of over 50% at densities of only 2 plants per square meter (Aguyoh and Masiunas, 2003a). In a study conducted in East Africa, Byiringiro et al. (2017) reported that early sowing resulted in increased seed yield of common bean and reduced weed density compared to late sowing.

Weed species observed in legume trials over the past twenty years are: *Amaranthus spp*. L., *Ambrosia artemisiifolia* L., *Chenopodium album* L., *Cyperus spp*. L., *Digitaria sanguinalis* L., *Ipomoea spp*. L., *Portulaca oleracea* L., *Raphanus raphanistrum* L., and *Solanum physalifolium* Rusby (Aguyoh et al., 2003a, 2003b; Bailey et al., 2003; Boyhan et al., 2013; Bradley et al., 2007; Peachey, 2019; Peachey et al., 2004; Van Wychen, 2022).

Some weeds cause indirect damage through their seeds and other residues entering the crop (Tonev et al., 2019). For example, fruits of *Solanum spp*. L. can result in the rejection of the entire batch by processors (Peachey, 2019). In a large-scale study of 358 snap bean fields in the USA, Pavlovic et al., (2024), identified 109 species from 31 plant families as secondary weeds. The most common are *Amaranthus hybridus* L., *Amaranthus palmeri* L., *Amaranthus retroflexus* L., *Chenopodium album* L., *Digitaria sanguinalis* L. and *Ipomoea hederacea* L.. The above-mentioned weeds were found in 95% of the surveyed fields, with in some

cases the density exceeding 10 plants per square meter, and the weed cover reaching over 5% of the area. The presence of weed cover during bean harvest not only reduces yield, but also creates a risk of contamination of the produce with plant residues, which leads to a decrease in market value (Pavlovic et al., 2024).
The aim of this study is to study the weeding in common bean (*Phaseolus vulgaris* L.) in three districts of Bulgaria.

MATERIAL AND METHODS

In 2024 and 2025, a one-time mapping of weed infestation in production areas with common beans in the Southeastern, Northeastern and North-Central regions of Bulgaria, grown under different agro-ecological conditions, different agricultural techniques and after different predecessors, was carried out.

In 2024, a total of 10 farms were surveyed, located in 10 areas, in 10 municipalities, in 6 districts and three regions of Bulgaria. In the first year of the study, 58.9 ha of field beans were mapped out of a total of 97.8 ha, which represents 60.2% of the areas where the crop was grown in the respective lands (Table 1). In 2025, 8 farms were surveyed, in 8 areas of 8 municipalities, in 6 districts and three regions of our country. 36.3 ha out of a total of 52 ha were mapped, which represents 69.8% of the bean areas (Table 2).

In 2024, the fallow system was mainly practiced in bean cultivation, with the exception of one farmer who applied conservation agriculture - in the land of the village of Indzhe Voyvoda, Kikinovo area. Beans were mainly sown after wheat, with the exception of two farmers who planted them after watermelons and fallow land. These farmers used herbicides with the exception of the experimental station Institute of Agriculture and Seed Science “Obraztsov Chiflik” – Rousse. To control weeds, three of the farmers used soil herbicides: Stomp Aqua - village of Indzhe Voyvoda; Bismark KS - Sarafovo district and Dual Gold 960 EC - village of Telerig. During the growing season, the herbicide Korum was applied in the Sarafovo district, the village of Senokos and the village of Vladimirovtsi. Bean treatments with Bazagran 480 SL were applied in three locations – the village of Dragantsi, the village of Tsarev Brod and the village of Vrachantsi. In the village of Tulovo, the beans were treated with Maza 4 SL. Select Super 120 EC was used to control monocotyledonous weeds in the village of Indzhe Voyvoda. Herbicides for the control of monocotyledonous weeds were also applied in the village of Telerig - Fuzilad Forte 150 EC and the village of Vrachantsi - Tornado 5 EC.

In 2025, the predecessors of the investigated beans are wheat, barley and triticale. For weed control only in the village of Tsarev Brod, the soil herbicide Stomp Aqua was used. During the growing season in Vladimirovtsi, Telerig and Vrachantsi, the vegetation herbicide Bazagran 480 SL was applied. The vegetation herbicide Korum was used in the village of Senokos and the village of Dragichevo. Mixed weeding in the village of Tulovo was controlled with Maza 4 SL. Select Super 120 EC was applied only in the village of Vrachantsi. Weed control at the Institute of Agriculture and Seed Science “Obraztsov Chiflik” – Rousse is carried out by hoeing.

The bean sowing scheme is diverse - from wide row spacing combined with mechanized hoeing to narrow-row sowing without hoeing.

Table 1. Surveyed areas with common beans in 2024.

Settlement	**Area**	**Prede-cessor**	**Surveyed area, hectares**	**Total area, hectares**
Southeast Bulgaria				
1. Tulovo village, Maglizh municipality, Stara Zagora region	Pishmana	Wheat	3.5	3.5
2. Dragantsi village, Karnobat municipality, Burgas region	Papazlaka	Fallow	9.0	9.0
3. Indzhe Voyvoda village, Sozopol municipality, Burgas region	Kikinovo	Wheat	5.0	5.0
4. Sarafovo district, Burgas city, Burgas municipality, Burgas region	Agala	Wheat	10.0	10.0
Northeastern Bulgaria				
1. Tsarev Brod village, Shumen municipality, Shumen region	Pounardzhika	Water-melons	2.2	2.2
2. Telerig village, Krushari municipality, Dobrich region	Yuzhen kanton	Wheat	9.5	9.5
3. Vrachantsi village, Dobrich municipality, Dobrich region	Paskalev blok	Wheat	3.7	4.4
4. Senokos village, Balchik municipality, Dobrich region	At koru	Wheat	8.4	21.7
North Central Bulgaria				
1. Vladimirovtsi village, Samuil municipality, Razgrad region	Kodzha yug	Wheat	7.5	7.5
2. Institute of Agriculture and Seed Science “Obraztsov Chiflik” – Rousse, Ruse city, Ruse municipality, Ruse region	Experimental field of Institu-te of Agricultu-re and Seed Science “Ob-raztsov Chiflik” – Rousse	Wheat	0.1	25.0
Total – 10	**10**		**58.9 ha 60.2%**	**97.8 ha 100%**

The measurement route method was used to record weeding, according to the Methodology for Recording and Filing Weeding in Major Field Crops (Dimitrova et al., 2004).

For each surveyed field, 10 reporting points were determined, evenly distributed across the entire area. The density of individual weeds and total weeding was assessed on a 4-point scale as follows: score 0 – free of weeds, score 1 – light weeding (1-5%), score 2 – medium weeding (5-25%), score 3 –

heavy weeding (25-50%) and score 4 – very heavy weeding (over 50%). Weed species that are very rare and occur in single specimens are marked with a + sign. Based on the results obtained from the surveyed points, the average density in points is calculated. When considering weeding, the phase of development of the weeds, their habit, as well as the so-called correction coefficient, have an influence. A summarized assessment of the existing weeding is illustrated by the so-called corrected score, including the average weeding score and the correction coefficient.

Table 2. Surveyed areas with common beans in 2025.

Settlement	**Area**	**Prede-cessor**	**Surveyed area, hectares**	**Total area, hectares**
Southeast Bulgaria				
1. Tulovo village, Maglizh municipality, Stara Zagora region	Krushaka	Barley	1.5	2.4
2. Dragantsi village, Karnobat municipality, Burgas region	Mogilata	Wheat	8.5	8.5
Northeastern Bulgaria				
1. Tsarev Brod village, Shumen municipality, Shumen region	Eskibalak	Triticale	1.5	2.4
2. Telerig village, Krushari municipality, Dobrich region	Angelov blok	Wheat	7.5	7.5
3. Senokos village, Balchik municipality, Dobrich region	Karaklaka	Wheat	7.2	10.5
4. Vrachantsi village, Dobrich municipality, Dobrich region	Trite mogili	Wheat	4.0	7.2
North Central Bulgaria				
1. Institute of Agriculture and Seed Science “Obraztsov Chiflik” – Rousse, Ruse city, Ruse municipality, Ruse region	Experimental field of Institute of Agriculture and Seed Science “Obraztsov Chiflik” – Rousse	Wheat	0.1	6.0
2. Vladimirovtsi village, Samuil municipality, Razgrad region	Enigyol	Wheat	6.0	7.5
Total – 8			**36.3 69.8%**	**52.0 100%**

RESULTS AND DISCUSSIONS

Nineteen weed species and *Brassica napus* L. volunter have been recorded in Southeastern Bulgaria, with *Chenopodium album* L., *Setaria viridis* L. and *Convolvulus arvensis* L. being widespread. With the highest density corrected score of 3.60 and 4.00, although only in one settlement, *Xanthium strumarium* L. occurs. *Amaranthus retroflexus* L. was recorded only in the land of the village of Tulovo, and *Solanum nigrum* L. only in the Sarafovo district. *Poligonum aviculare* L. with a corrected score of 0.70 was registered in the villages of Tulovo and Indzhe Voyvoda. *Echinochloa srus-galli* L., *Persicaria lapathifolia* L. and *Rumex crispus* L. are also poorly distributed and occur in one of the settlements (Table 3). *Raphanus raphanistrum* L., *Myagrum perfoliatum* L. and *Sorghum halepense* L. were found in insignificant density in Southeastern Bulgaria.

From the collected data, it is striking that in the village of Indzhe Voyvoda, mainly perennial weeds are found - *Rumex crispus* L., *Mentha arvensis* L. and *Rubus caesius* L.. Their presence is most likely due to the abandonment of plowing with turning the soil layer, which cuts down perennial weeds to a depth.

It is also worth noting the development of another weed atypical for beans, *Equisetum arvense* L., which is very often an indicator of soil acidification. It was reported only in 2024 in the village of Tulovo with a 0.35 corrected score (Table 3).

Table 3. Species composition and corrected weeding score in the Southeastern region of Bulgaria in 2024 and 2025.

Weeds	***Settlements***					
	Tulovo		**Dragantsi**		**Indzhe voyvoda**	**Sarafovo**
	2024	**2025**	**2024**	**2025**	**2024**	**2024**
Anthemis arvensis L.	1.00	0	1.00	0	0	1.00
Polygonum convolvulus L.	0	0	1.00	+	0	0.81
Raphanus raphanistrum L.	0	+	0	0	0	0
Myagrum perfoliatum L.	0	+	0	0	0	0
Chenopodium album L.	0.42	1.50	0.42	0.80	0	0.98
Setaria viridis L.	0.49	0	0.80	0.60	1.12	0.70
Amaranthus retroflexus L.	0.56	1.50	0	0	0	0
Xanthium strumarium L.	4.00	3.60	0	0	0	0
Solanum nigrum L.	0	0	0	0	0	0.70
Poligonum aviculare L.	0.70	0	0	0	0.70	0
Echinochloa srus-galli L.	0	0	0	0	0.96	0
Persicaria lapathifolia L.	0	0	0.63	0	0	0
Rumex crispus L.	0	0	0	0	0.60	0
Sorghum halepense L.	0	+	0	0	0	0
Mentha arvensis L.	0	0	0	0	0.40	0
Equisetum arvense L.	0.35	0	0	0	0	0
Convolvulus arvensis L.	0.35	1.00	0.42	0.70	0.28	+
Cirsium arvense Scop.	0	1.00	0	0	0.35	0
Rubus caesius L.	0	0	0	0	0.70	0
Brassica napus L. volunteer	0	0	0.91	0	0	1.40

In Northeastern Bulgaria, *Convolvulus arvensis* L. and *Cannabis ruderalis* Janisch are found everywhere, followed by *Solanum nigrum* L. and *Sorghum halepense* L.. It is noteworthy that despite the large distribution area, the density of these weeds is low. In Northeastern Bulgaria, *Datura stramonium* L. and *Panicum miliaceum* L. volunteer occur in insignificant density. In 2024, the root semi-parasitic weed *Rhinanthus major* L. with a corrected score of 0.60, as well as the stem parasite *Cuscuta campestris* Yunker with a corrected score of 0.50, was discovered in the Tsarev Brod region (Table 4.).

Self-seeding of *Brassica napus* L. in Dragantsi and Sarafovo (Southeastern Bulgaria) and of *Panicum miliaceum* L. in Vrachantsi (Northeastern Bulgaria) is of no economic importance for the normal growth and development of beans. They are the result of shortcomings in the quality of the predecessor's collection.

Table: 4. Species composition and adjusted weeding score in the Northeastern region of Bulgaria in 2024 and 2025.

Weeds	***Settlements***							
	Tsarev brod		**Telerig**		**Vrachantsi**		**Senokos**	
	2024	**2025**	**2024**	**2025**	**2024**	**2025**	**2024**	**2025**
Chenopodium album L.	0.70	0	0.80	0	0	0.60	+	0.60
Setaria viridis L.	0	0	0	1.05	0	0.60	0	0
Amaranthus retroflexus L.	0.50	0	0	0	0.15	0.50	+	0
Amaranthus blitoides S.Wats.	0	0	0.60	+	0.20	+	+	+
Xanthium strumarium L.	0	0.30	0.50	0.10	0	0	+	0.50
Cannabis ruderalis Janisch	0.60	0.60	0.50	0.50	0	0.60	+	0.50
Solanum nigrum L.	0.50	0.40	0.45	0.55	0.35	0	0	0
Portulaca oleracea L.	0	0	0	0.45	0	0	0	0
Datura Stramonium L.	0	0	0.50	0	0	+	+	0
Echinochloa srus-galli L.	0	0	0	0	0.20	0	+	0
Sorghum halepense L.	0.36	0.42	0.20	0.20	0.20	0	0	0
Convolvulus arvensis L.	0.50	0.50	0.15	0.45	0.25	+	+	0.50
Cirsium arvense Scop.	0	+	0	0	0	0	0	0
Cuscuta campestris Yunker	0.50	0	0	0	0.10	0	0	0
Rhinanthus major L.	0.60	0	0	0	0	0	0	0
Panicum miliaceum L. volunteer	0	0	0	0	0.50	0	0	0

In North Central Bulgaria, *Chenopodium album* L. and *Convolvulus arvensis* L. were identified during the two years of the survey. In the same fields, with the exception of the village of Vladimirovtsi, in 2024 *Setaria viridis* L. was recorded, and in 2025 *Cirsium arvense* Scop. at the Institute of Agriculture and Seed Science “Obraztsov Chiflik” – Rousse. The development of *Avena fatua* L. again in “Obraztsov Chiflik” – Rousse in 2025 alone is also impressive. The appearance of early spring weeds is most likely due to gaps in soil cultivation. Another weed reported once in North Central Bulgaria is *Rubus caesius* L. – in 2024 in the village of Vladimirovtsi with a corrected score of 0.60. It is important to note that some

time ago there was a development of forest vegetation on this field, which determined the appearance of *R. caesius* L. (Table 5).

Table 5. Species composition and adjusted weeding score in the North Central Region of Bulgaria in 2024 and 2025.

Weeds	***Settlements***			
	Vladimirovtsi		**Institute of Agriculture and Seed Science "Obraztsov Chiflik" – Rousse**	
	2024	**2025**	**2024**	**2025**
Avena fatua L.	0	0	0	0.50
Polygonum convolvulus L.	0	0	0.50	0
Chenopodium album L.	0.25	0.35	0.15	0.60
Setaria viridis L.	0	0.98	0.50	0.56
Amaranthus retroflexus L.	0	0	+	0.60
Amaranthus blitoides S.Wats.	0	0.42	0	+
Xanthium strumarium L.	0	0	0	+
Poligonum aviculare L.	0	0.30	0.30	0.63
Portulaca oleracea L.	0	0.35	+	0.90
Persicaria lapathifolia L.	0	0	0.60	0
Tribulus terrestris L.	0	0	+	0.45
Sorghum halepense L.	0.60	0	0	+
Convolvulus arvensis L.	0.50	0.50	0.20	0.85
Cirsium arvense Scop.	0.50	0.50	0.60	0
Rubus caesius L.	0.60	0	0	0

CONCLUSIONS

The current study on weed infestation of common beans in Bulgaria shows the presence of 26 weed species and self-seeding of rapeseed and millet.

The large distribution area of *Convolvulus arvensis* L. and *Chenopodium album* L., despite the low density, shows high adaptability and resistance to applied agricultural practices.

The high density of weeds such as *Xanthium strumarium* L. and *Amaranthus retroflexus* L. in certain areas, as well as the occurrence of *Equisetum arvense* L. on acidic soils, indicate the need for targeted control measures tailored to the ecological characteristics of the area.

The spread of perennial weeds *Rumex crispus* L., *Mentha arvensis* L. and *Rubus caesius* L. in the village of Indzhe Voyvoda as a result of the abandonment of plowing with inversion of the soil layer requires differentiated soil cultivation.

In Northeastern Bulgaria, widespread distribution of weeds atypical for beans such as *Cannabis ruderalis* Janisch, *Cuscuta campestris* Yunker and *Rhinanthus major* L. is observed.

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