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Assessment of the Efficiency of Combined Seeding Rates of Common Vetch and Ryegrass for Controlling Weed Development in Organic Forage Cultivation Systems

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Abstract: Weed suppression is a crucial factor in sustainable agriculture, and optimizing plant mixtures can enhance weed control efficiency. This study evaluates the effects of different mixture ratios of common vetch (*Vicia sativa* L.) and annual ryegrass (*Lolium multiflorum* L.) on forage yield, biomass production dry matter production, and weed suppression in organic forage cropping systems. Field experiments were conducted during the 2021-2022 growing season at two locations in Turkey: Ankara/Yenikent and Manisa/Beydere, using 11 mixture ratios ranging from 100% vetch to 100% ryegrass. Results showed that ryegrass-dominant mixtures, particularly 10% vetch / 90% ryegrass and 30% vetch / 70% ryegrass, achieved the highest forage and dry matter yields while maintaining effective weed suppression. Pure ryegrass systems (100% ryegrass) exhibited the highest overall productivity, whereas pure vetch (100% vetch) treatments were less effective in weed control and biomass production. Environmental differences between locations significantly influenced the performance of mixtures, with Manisa/Beydere yielding higher overall results. This study highlights the potential of optimizing vetch-ryegrass mixtures to balance forage yield, weed suppression, and adaptability in organic cropping systems, offering practical insights for sustainable forage production.

Keywords: common vetch; ryegrass; mixture; dry matter; suppressing weed

1. Introduction

Organic farming aims to enhance environmental sustainability by minimizing the use of chemical fertilizers and pesticides. In this context, organic forage production plays a significant role in achieving economic and environmental goals in livestock farming. However, one of the main challenges in organic farming is weed management. Weeds can negatively impact crop yield and quality, especially in organic systems where the use of chemical herbicides is prohibited. Overcoming this challenge requires providing adequate ground cover and utilizing indigenous plant species.

Several studies have shown that mixtures of legumes (especially vetch species) and grasses (such as ryegrass) can improve soil health and enhance weed suppression (Kirchhof *et al.*, 2017; Vyn *et al.*, 2018). Vetch, by increasing soil nitrogen content, can provide a competitive advantage for other plants, while ryegrass, with its rapid growth and ground-covering ability, can inhibit weed

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development (Akinsanmi *et al.,* 2020). However, the effectiveness of these mixtures can be further optimized by using the correct proportions.

One of the significant challenges in animal husbandry in Turkey is the availability of quality forage products. The scarcity of high-quality roughage can be addressed in two main ways. First, by preserving naturally occurring pastures and preventing their destruction through appropriate grazing techniques. Second, by improving the quality of animal rations through the cultivation of forage plants in field agriculture (Kuşvuran *et al.,* 2014). The decline in natural pastures has increased the need for efficient and high-quality forage production from field agriculture (Geren *et al.,* 2003). Therefore, it is essential to determine the appropriate ratios of legumes and cereals that contain the necessary protein, carbohydrates, and micronutrients for animals (Gonzalez-Andujar and Fernandez-Quintanilla, 2004).

By determining the optimal planting time and appropriate mixture ratios, the most suitable feed mixture in terms of yield and quality can be identified. For instance, cultivating mixtures of cereals and legumes before summer main crops in irrigated areas and alternating them with winter crops in arid regions can provide a sustainable solution to the hay deficit (Asci *et al.*, 2015).

Common vetch (*Vicia sativa*) and ryegrass (*Lolium multiflorum*) are two legumes and grasses, respectively, that have gained attention for their potential in integrated weed management. Common vetch is known for its ability to fix atmospheric nitrogen, thereby improving soil fertility, and providing a competitive edge against weeds (Giller, 2001). Ryegrass, on the other hand, is recognized for its rapid growth and dense canopy, which can effectively shade out weeds and reduce their establishment (Liebman and Davis, 2015; Arlauskienė *et al.,* 2021).

The combination of these two species may offer synergistic benefits, enhancing the overall efficacy of weed suppression in organic systems.

The assessment of combined seeding rates of common vetch and ryegrass is crucial for optimizing their competitive interactions and maximizing their weed-suppressive potential. Research indicates that the interaction between different plant species andtheir respective seeding rates can significantly influence weed dynamics (Bàrberi, 2002). Bystrategically varying these eding rates of common vetch and ryegrass, it may be possible to achieve an ideal balance that promotes healthy crop growth whiles imultaneously minimizing weed pressure.

Furthermore, understanding the ecological interactions between the sespecies can lead to improved management practices that align with organic farming principles. The integration of diverse plant species not only contributes to weed control but also enhances biodiversity, improves soil structure, and promotes resilience against environmental stresses (Altieri, 1999). This study aims to evaluate the efficiency of combined seeding rates of common vetch and ryegrass in controlling weed development within organic forage cultivation systems, providing insights that could inform organic farmers and agronomists seeking to enhance their weed management strategies.

The aim of this study is to determine the most suitable mixture ratios of vetch and ryegrass for organic forage production and to investigate how these mixtures influence weed suppression. While several studies have explored the potential of such mixtures, determining the effects of different ratios will provide more concrete results, especially in terms of local environmental conditions and agricultural practices. Additionally, understanding how these mixtures can enhance the efficiency and sustainability of organic production systems is of great importance. This study aims to deepen our understanding of the role of indigenous plant species in organic farming and contribute to the development of effective weed management strategies through the identification of optimal mixture ratios.

2. Materials and Methods

This study was conducted during the 2021-2022 vegetation period at two locations: Manisa/Beydere and Ankara/Yenikent. Two distinct plant materials were used: **Aneto common vetch (*Vicia sativa* L.)** and **Trinova annual ryegrass (*Lolium multiflorum* L.)**.

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Aneto is a variety developed through the selection breeding method. It has an average plant height of 48.3 cm and a 1,000-seed weight of 55.9 g. **Trinova**, on the other hand, is a tetraploid variety bred through hybridization and selection, with an average plant height of 96.7 cm.

2.1. Climatic Data

Climatic data for the research area were obtained from the General Directorate of Meteorology and are presented in Figures 1 and 2. Analysis of the data reveals that the long-term average temperature was 7.8°C in Ankara and 12.3°C in Manisa, while the average precipitation was 39.0 mm in Ankara and 86.1 mm in Manisa.

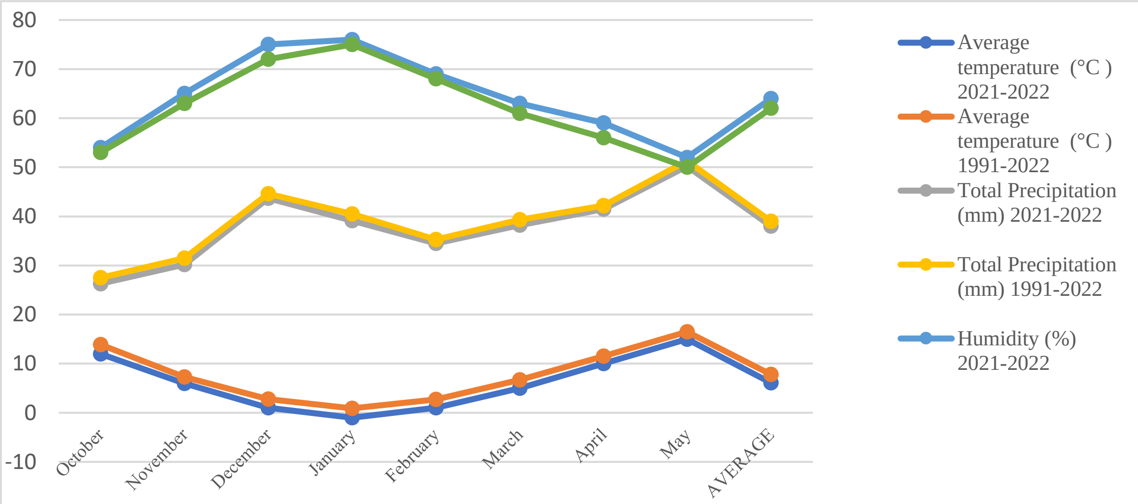

Figure 1. The following data pertains to the climate of the research area for the 2021-22 and long-term periods (Ankara/Yenikent).

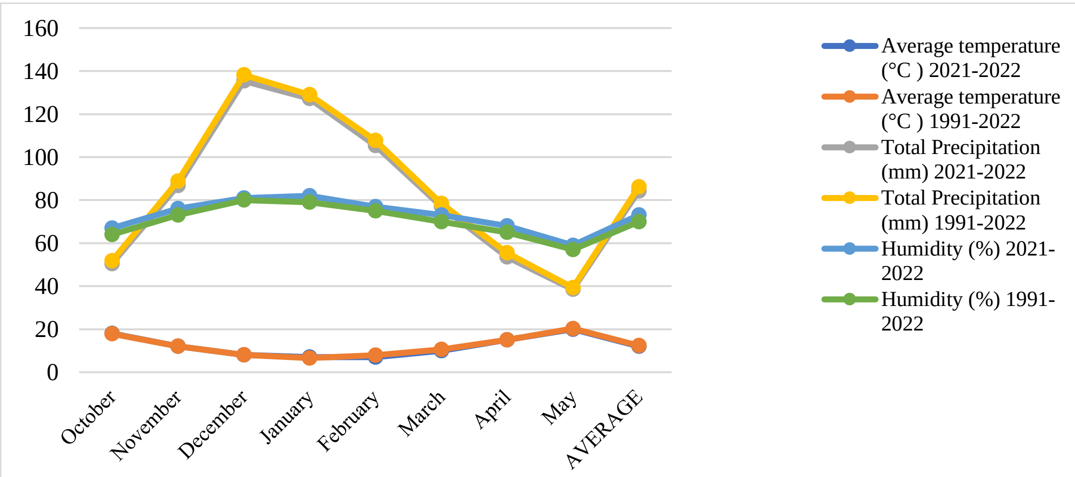

Figure 2. The following data pertains to the climate of the research area for the 2021-22 and long-term periods (Manisa/Beydere).

2.2. Experimental Design and Sowing Procedure

The research was conducted using a randomized block design with three replications at both locations. The study included 11 different mixture ratios: 100% RG (Trinova), 100% V (Aneto), 10% V / 90% RG, 20% V / 80% RG, 30% V / 70% RG, 40% V / 60% RG, 50% V / 50% RG, 60% V / 40% RG, 70% V / 30% RG, 80% V / 20% RG, and 90% V / 10% RG.

Sowing was carried out on October 21, 2021, using a six-row trial seeder with a row spacing of 25 cm. In line with the technical guidelines provided by TTSM (Turkey Seed Certification and Testing

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Directorate), 30-40 kg ha^{-1} of nitrogen (N) and 80-100 kg ha^{-1} of phosphorus (P_2O_5) fertilizers were applied during sowing. The experimental plot size was 5 m × 1.5 m, equating to a total area of 7.5 m^{-2} per plot. Each treatment was replicated three times, resulting in a total of 33 plots. Weed control was performed manually and using a hoe in the spring.

2.3. Measurements and Harvesting

Plant height was measured as the distance from the soil surface to the plant tip. Measurements were conducted on 10 randomly selected plants for each pure stand and on 10 plants per species for mixtures within each plot. Measurements were taken using a millimeter-graded ruler, and average values were calculated (TTSM Technical Instructions, 2022).

Harvest timing was determined based on the growth stage of common vetch, specifically when the lower pods were fully formed, and seeds had reached maturity. To minimize edge effects, the two outermost rows of each six-row plot and the first 50 cm from the plot's edge were excluded from data collection. The remaining 4 m^2 area was harvested using a mower, and the green forage yield was weighed. The recorded values were then converted to yield per hectare following TTSM guidelines.

From the green forage obtained in each plot, a 500-gram sample was randomly selected and dried in a drying oven at 70°C for 48 hours until a constant weight was achieved. Afterward, the sample was left for 24 hours to stabilize and then reweighed to determine the dry forage weight. The hay yield per hectare was calculated by multiplying the dry matter ratio by the green forage yield (TTSM Technical Instructions, 2022).

Two 1-square-meter frames were randomly placed within each plot. After manually collecting the weeds within the frames, the fresh weight of the green biomass was measured. The collected weed samples were then dried in a drying cabinet at 70°C for 48 hours until a constant weight was achieved. Subsequently, the samples were equilibrated for 24 hours and weighed again to determine the dry biomass weight. The ratio of dry biomass to fresh biomass was calculated and used to estimate the hay yield per hectare.

Figure 1. Field area.

2.4. Statistical Analysis

The data obtained from the study were analyzed for variance using the randomized block design within the MSTAT-C package. The Duncan multiple range test was applied to identify statistically significant differences among the means.

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3. Results

3.1. Plant Height (cm)

The plant height of common vetch was significantly influenced by the planting systems in both locations and the general average (Table 1). The highest plant height was observed under the 100% V planting system across all conditions, with the values being 55.3 cm in Ankara/Yenikent, 75.0 cm in Manisa/Beydere, and 65.2 cm as the general average.

Planting systems with higher proportions of ryegrass (RG) tended to reduce the plant height slightly, with the lowest value recorded at 10% V 90% RG (63.2 cm for the general average). Significant differences were noted among treatments, with lower LSD values indicating reliable distinctions in plant height between groups.

The low coefficient of variation (CV%) across locations and the general average suggests high consistency and reliability in the data. Overall, the results indicate that higher vetch proportions in the mixture support greater plant height, likely due to reduced competition from ryegrass.

The plant height of ryegrass was also significantly influenced by the planting system (Table 2). The pure ryegrass system (100% RG) resulted in the highest general average height (75.6 cm), followed by the 10% V 90% RG system (74.8 cm). As the proportion of vetch increased, the height of ryegrass tended to decrease, with the lowest value (70.3 cm) observed in the 90% V 10% RG system.

The differences in plant height across treatments were statistically significant, with low CV% values indicating consistent results. This suggests that ryegrass performs optimally in pure stands or when present in high proportions in mixed systems. These findings are crucial for understanding the interactions between ryegrass and vetch in mixed cropping systems. The results can guide the determination of optimal mixture ratios for achieving both high-quality forage production and biodiversity in pastures.

Table 1. Plant height of common vetch (*Vicia sativa*) grown under different proportions of pure and mixed planting systems (cm).

PlantingSystems	Ankara/ Yenikent	Manisa/ Beydere	General Average
%100 V	55.3 a	75.0 a	65.2 a
%90 V/ %10 RG	54.3 abc	74.7 ab	64.5 ab
%80 V/ %20 RG	55.0 a	73.7 bcd	64.3 ab
%70 V /%30 RG	52.7 c	74.7 ab	63.7 bcd
%60 V /%40 RG	53.7 abc	73.7 bcd	63.7 bcd
%50 V/ %50 RG	54.7 ab	73.7 bcd	64.2 bc
%40 V/ %60 RG	53.0 bc	73.7 bcd	63.3 cd
%30 V/ %70 RG	53.0 bc	74.3 abc	63.7 bcd
%20 V/ %80 RG	54.0 abc	73.3 cd	63.7 bcd
%10 V /%90 RG	53.7 abc	72.7 d	63.2 d
F	*	**	**
CV (%)	**1.8**	**0.9**	**1.3**
LSD	**1.69**	**1.1**	**1.0**

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Table 2. Plant height of ryegrass (*Lolium multiflorum*) under different proportions of pure and mixed planting systems (cm).

PlantingSystems	Ankara/ Yenikent	Manisa/ Beydere	General Average
%100 RG	58.9 a	92.3 a	75.6 a
%90 V/ %10 RG	51.9 e	88.7 b	70.3 e
%80 V / %20 RG	54.0 d	88.5 bc	71.3 cde
%70 V /%30 RG	54.8 d	86.2 d	70.5 de
%60 V /%40 RG	55.2 d	87.6 bcd	71.4 bcd
%50 V / %50 RG	55.8 bc	87.1 cd	71.5 bcd
%40 V/ %60 RG	54.9 cd	88.2 bc	71.6 bc
%30 V/ %70 RG	55.4 bcd	88.9 b	72.2 bc
%20 V/ %80 RG	56.5 b	88.2 bc	72.4 b
%10 V /%90 RG	58.3 a	91.2 a	74.8 a
F	**	**	**
CV (%)	**1.5**	**1.0**	**1.2**
LSD	**1.45**	**1.59**	**1.01**

3.2. Green Forage Yield (kg ha^{-1})

The table presents the average green forage yield values (kg ha^{-1}) for common vetch and annual grass mixtures in the 2021-2022 growing season under different planting systems. The yields are analyzed based on various mixture ratios and locations (Ankara/Yenikent and Manisa/Beydere). Additionally, the general average yield and success ranking for each planting system are provided. **100% RG** provides the highest yield in both locations. The average yield in Ankara/Yenikent is 24933 kg ha^{-1}, and in Manisa/Beydere it is 29200 kg ha^{-1}, resulting in an overall average of 27067 kg ha^{-1}. This system ranks first in the success order. **40% V 60% RG** mixture results in the lowest yield, with 13767 kg ha^{-1} in Ankara/Yenikent and 17911 kg ha^{-1} in Manisa/Beydere, giving an overall yield of 15839 kg ha^{-1}. This system ranks 11th. The **90% V 10% RG** mixture (12900 kg ha^{-1} and 33244 kg ha^{-1}, respectively) ranks second, with a particularly high yield in Manisa/Beydere. Other mixtures, particularly those with 50% and 60% RG, also show good performance. For example, the **60% V 40% RG** and **50% V 50% RG** mixtures resulted in average yields of 21417 kg ha^{-1} and 19717 kg ha^{-1}, respectively. The F and CV (coefficient of variation) values are important for understanding the variability and reliability of the data. Especially at extreme mixture ratios like 100% RG and 100% V, there are significant differences in yields. This indicates that different mixture ratios have an impact on yield, and the data is relatively reliable. The data reveals the impact of different mixture ratios of vetch and grass on green forage yield. Based on the results, the **100% RG** mixture provided the highest yield, while the **40% V 60% RG** mixture gave the lowest yield. However, the yields of different mixtures vary depending on the planting region and climatic conditions. In general, mixtures with a higher proportion of (100% RG) tend to result in higher yields.

These findings can be useful for developing agricultural strategies to select more efficient and environmentally adaptable plant mixtures.

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Table 3. Average Green Forage Yield Values (kg ha^{-1}) of Common Vetch and Rye Grass Mixtures for the 2021-2022 Growing Season.

PlantingSystems	Ankara/ Yenikent	Manisa/ Beydere	General Average	OrderSuccess
%100 RG	24933 a	29200 b	27067 a	1
%100 V	14400 ef	23200 cd	18800 d	7
%90 V/ %10 RG	12900 f	33244 a	23072 b	2
%80 V/ %20 RG	14333 ef	22355 d	18344 d	9
%70 V /%30 RG	17267 cd	20844 de	19056 d	6
%60 V /%40 RG	16433 de	26400 bc	21417 bc	4
%50 V/ %50 RG	15300 def	24133 cd	19717 cd	5
%40 V/ %60 RG	13767 ef	17911 e	15839 e	11
%30 V/ %70 RG	21200 b	23466 cd	22333 b	3
%20 V/ %80 RG	17433 cd	18667 e	18050 de	10
%10 V /%90 RG	19333 bc	17867 e	18600 d	8
F	**	**	**	
CV (%)	**96.3**	**92.2**	**94.4**	
LSD	**2774.1**	**364.6.5**	**2220.1**	

3.3. Dry Matter Yield (kg ha^{-1})

Observations on the dry hay yield of common vetch and rye grass were conducted separately for the Ankara and Manisa locations. The results of the dry matter yield values obtained are presented in Table 4. In addition, when the average dry matter yield values obtained from common vetch and Ryegrass plants are examined. The highest dry matter yield in Ankara/Yenikent was observed in the **10% V 90% RG** mixture (4512 kg ha^{-1}), whereas in Manisa/Beydere, the **90% V 10% RG** mixture yielded the highest (6505 kg ha^{-1}). The general average indicates the **100% RG** system as the most successful in overall dry matter yield (4780 kg ha^{-1}), followed by the **90% V 10% RG** mixture (4673 kg ha^{-1}). Systems with a higher percentage of **Ryegrass (RG)** generally performed better in both locations, suggesting its strong contribution to biomass production. However, high variability (as reflected by high CV%) implies that yield stability across regions may vary depending on environmental factors. Significant differences among the treatments (indicated by F values) confirm that planting mixtures influence dry matter yield. The LSD values highlight the minimum difference needed to declare significant differences between the means. Mixtures with higher proportions of **RG** (e.g., 100% RG, 90% V 10% RG, and 30% V 70% RG) rank highest in terms of average yield. Farmers aiming for high dry matter yields might prioritize mixtures with a dominant proportion of ryegrass, especially in environments similar to the study regions.

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Table 4. Average Dry Matter Yield Values (kg ha^{-1}) of Common Vetch and Annual Ryegrass Mixtures for 2021-2022 Growing Season.

PlantingSystems	Ankara/ Yenikent	Manisa/ Beydere	General Average	OrderSuccess
%100 RG	4059 ab	5501 b	4780 a	1
%100 V	2748 fe	4421 cde	3584 fg	9
%90 V/ %10 RG	2840 def	6505 a	4673 ab	2
%80 V/ %20 RG	2659 f	3679 e	3169 g	11
%70 V /%30 RG	3282 dc	3849 e	3566 fg	10
%60 V /%40 RG	3206 cde	5161 bc	4183 cd	5
%50 V/ %50 RG	3252 cd	4880 bcd	4066 de	7
%40 V/ %60 RG	3660 bc	3832 e	3747 ef	8
%30 V/ %70 RG	3920 b	5274 b	4597 abc	3
%20 V/ %80 RG	3902 b	4246 de	4074 de	6
%10 V /%90 RG	4512 a	4142 de	4327 bcd	4
F	**	**	**	
CV (%)	**82.3**	**95.0**	**91.0**	
LSD	**485.1**	**754.2**	**444.1**	

3.4. The Effects of Treatments in the Experiment on Weeds and Weed Measurement Evaluations (gm^{-2}).

The **100% vetch (V)** treatment resulted in the highest weed fresh (107.0 g m^{-2}) and dry weight (29.8 g m^{-2}), indicating poor weed suppression. In contrast, mixtures with higher proportions of **Ryegrass (RG),** particularly **70% V 30% RG** and **60% V 40% RG**, demonstrated significantly better weed suppression, with fresh weights of 13.7 g m^{-2} and 26.0 g m^{-2}, respectively, and dry weights below 10 g m^{-2}. Mixtures containing a greater proportion of ryegrass effectively suppressed weeds due to its dense canopy and rapid growth characteristics (Table 5).

The **70% V 30% RG** treatment exhibited the best weed suppression, suggesting this mixture is ideal for minimizing weed biomass.

The significant **F** values and low LSD values confirm that the differences in weed suppression among treatments are statistically valid and not due to random variation. Incorporating Ryegrass into vetch-dominated mixtures can effectively reduce weed biomass.

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Table 5. Weed Suppression Results (Fresh and Dry Weight) of Common Vetch and Annual Ryegrass Mixtures for 2021-2022 (g m^{-2}) (Manisa/Beydere).

Planting Systems	Fresh Weight (g m^{-2})	Dry Weight (g m^{-2})
%100 RG	39.7 e	14.7 de
%100 V	107.0a	29.8 a
%90 V/ %10 RG	42.8 e	13.0 e
%80 V/ %20 RG	24.0 f	10.7 f
%70 V /%30 RG	13.7 g	9.0 f
%60 V /%40 RG	26.0 f	9.8 f
%50 V/ %50 RG	38.0 e	13.3 de
%40 V/ %60 RG	53.0 d	15.2 d
%30 V/ %70 RG	71.0 c	19.5 c
%20 V/ %80 RG	96.7 b	27.0 b
%10 YF /%90 RG	55.5 g	20.8 c
F	**	**
CV (%)	**9.4**	**6.8**
LSD	**8.3**	**1.9**

In the experiment conducted in Ankara, the 90% V/10% RG treatment resulted in the highest weed weights, with fresh weights at 71.3 g m² and dry weights at 40.5 g m², but it was the least effective at suppressing weeds. Conversely, the 60% V/40% RG application achieved the best weed suppression, resulting in the lowest wet and dry weed weights. Ryegrass (RG) mixtures, particularly those with 20%, 30%, 40%, 50%, and 60% RG, demonstrated weed suppression rates of 32.7%, 35.2%, 61.7%, 42.6%, and 36.3%, respectively (Table 6).

Mixtures with higher ryegrass content effectively suppressed weeds, thanks to their dense canopy and rapid growth. However, weed suppression did not improve in sowing systems with more than 60% ryegrass.

The significant F values and low LSD values indicate that the differences in weed suppression between treatments are statistically significant and not due to random variation. Incorporating ryegrass into vetch-dominated mixtures can effectively lower weed biomass.

The results from the Ankara/Yenikent experiment were consistent with those from Manisa/Beydere. Analyzing the data in terms of feed values and nutritional quality suggests that ryegrass-containing mixtures should be integrated into planting systems based on the local climate and growing conditions.

Table 6. Weed Suppression Results (Fresh and Dry Weight) of Common Vetch and Annual Ryegrass Mixtures for 2021-2022 (g m^{-2}) (Ankara/Yenikent).

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Planting Systems	Fresh Weight (g m^{-2})	Dry Weight (g m^{-2})
%100 RG	49,7 bc	22,2 bcd
%100 V	67,7 a	29,3 ab
%90 V/ %10 RG	71,3 a	40,5 a
%80 V/ %20 RG	48,0 bc	19,2 de
%70 V /%30 RG	46,2 bc	20,3 cde
%60 V /%40 RG	27,3 c	11,7 e
%50 V/ %50 RG	40,9 c	25,4 bcd
%40 V/ %60 RG	45,4 bc	22,8 bcd
%30 V/ %70 RG	52,4 b	25,7 bcd
%20 V/ %80 RG	55,1 b	30,0 b
%10 YF /%90 RG	48,4 bc	20,2 cde
F	**	**
CV (%)	**11.3**	**23,34**
LSD	**9.6**	**6.4**

Table 7. Comparison of Weed Coverage Areas (%) in Application Plots of Common Vetch and Ryegrass Mixtures for 2021-2022 (Manisa/Beydere).

Planting Systems	Fresh Weight Coverage (%)	Dry Weight Coverage (%)
%100 RG	1.4 c	2.7 de
%100 V	4.6 a	6.8 a
%90 V/ %10 RG	1.3 c	2.0 f
%80 V/ %20 RG	1.1 cd	2.9 d
%70 V /%30 RG	0.7 d	2.3 ef
%60 V /%40 RG	1.0 d	2.0 f
%50 V/ %50 RG	1.6 c	2.7 de
%40 V/ %60 RG	3.0 b	4.0 c
%30 V/ %70 RG	3.0 b	3.7 c
%20 V/ %80 RG	5.2 a	6.3 a
%10 V /%90 RG	2.9 b	5.1 b

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F	**	**
CV (%)	**15.9**	**8.7**
LSD	**0.6**	**0.5**

The **100% vetch (V)** and **20% V 80% RG** treatments exhibited the highest weed coverage percentages for both fresh (4.6% and 5.2%) and dry weight (6.8% and 6.3%), indicating poor weed suppression in these systems (Table 6). Mixtures with higher proportions of **ryegrass (RG),** particularly **70% V 30% RG** and **60% V 40% RG,** demonstrated the lowest weed coverage percentages, with fresh weight coverage at 0.7% and 1.0%, respectively, and dry weight coverage below 2.3%. The best-performing system in terms of reducing weed coverage was **70% V 30% RG**, achieving the lowest fresh and dry weight weed coverage percentages.

Mixtures with **≥50% RG** consistently reduced weed coverage, highlighting the suppressive ability of ryegrass due to its competitive growth and ground coverage. The significant **F** values and low LSD values indicate reliable differences among treatments, validating the effectiveness of certain mixtures in minimizing weed coverage.

Farmers aiming to suppress weed coverage should focus on mixtures with at least **30%-50% Ryegrass** content. These combinations are effective in reducing weed growth while maintaining forage productivity.

4. Discussion

In this study, the effects of different vetch and ryegrass ratios on the potential of suppressing weeds in organic forage crop production were investigated. The results indicate that mixture ratios significantly affect weed suppression capacity. Similarly, the literature reports that legume-grass mixtures suppress weeds through synergistic interactions (Liebman & Davis, 2000; Frankow-Lindberg *et al.*, 2009).

Our study found that mixtures with a high proportion of ryegrass were more effective in weed suppression. This can be attributed to the rapid initial growth and dense root system of ryegrass (Hauggaard-Nielsen *et al.*, 2001). Notably, mixtures containing 75% ryegrass exhibited lower weed biomass compared to pure vetch. Similarly, a study by Dhima *et al.* (2007) reported that mixtures with a high proportion of ryegrass were more successful in weed suppression.

However, as the proportion of vetch increased, soil nitrogen content also rose. This finding is consistent with the ability of legumes to fix atmospheric nitrogen (Carlsson & Huss-Danell, 2003). Nevertheless, the reduced weed suppression efficiency in mixtures with high vetch proportions can be explained by the slower development of vetch and its delayed ground coverage (Blackshaw *et al.*, 2005).

Additionally, increasing plant diversity is known to contribute positively to ecosystem services (Tilman *et al.*, 2001). Mixed cropping systems have been reported to provide more stable production and improve soil health compared to monocultures (Lithourgidis *et al.*, 2011). In this context, the vetch-ryegrass mixtures used in our study demonstrate potential both for weed suppression and for enhancing soil fertility.

In conclusion, while ryegrass has a high weed suppression capacity, an optimal balance should be achieved considering the nitrogen-enhancing effect of vetch. Future studies should explore how this balance can be optimized through different sowing times and management strategies.

The results of this study align with the literature findings on the effects of vetch and ryegrass ratios on weed suppression capacity. Mixtures with a high proportion of ryegrass were observed to be more successful in weed suppression, which can be attributed to the rapid growth ability and dense root system of ryegrass (Hauggaard-Nielsen *et al.*, 2001). Similarly, Dhima *et al.* (2007) reported that high ryegrass content mixtures were more effective in suppressing weeds.

On the other hand, an increase in the proportion of vetch provides an advantage for long-term productivity by increasing soil nitrogen content. It is well known that legumes enhance soil nutrient

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value by fixing atmospheric nitrogen (Carlsson & Huss-Danell, 2003). However, the slow growth of vetch and its delayed ground coverage can be limiting factors for weed control (Blackshaw *et al.*, 2005).

Furthermore, increasing plant diversity positively contributes to ecosystem services and supports sustainable agriculture (Tilman *et al.*, 2001). Mixed cropping systems offer more stable production and soil health advantages compared to monocultures (Lithourgidis *et al.*, 2011). In this context, vetch-ryegrass mixtures appear to have significant potential for both weed suppression and soil fertility enhancement.

5. Conclusion

The findings highlight the importance of optimizing vetch and ryegrass mixture ratios for organic forage production. Pure ryegrass systems (100% RG) were the most productive in terms of forage and dry matter yields but offered less diversity in nutrient composition. The variations detected between two diverse geographical territories are presumed to result from climatic and geographical discrepancies.

Key conclusions from this study include:

- **Yield Performance:** Pure ryegrass (100% RG) achieved the highest forage and dry matter yields but lacked nutritional diversity.
- **Balanced Approach:** Ryegrass-dominant mixtures (e.g., 30% V 70% RG, % 60 V %40 RG) provided high yields, effective weed suppression, and improved nutritional benefits from vetch.
- **Weed Control:** In regions with high weed pressure, ryegrass-dominant mixtures are recommended due to their superior weed suppression.
- **Sustainability & Efficiency:** Incorporating legumes and grasses in appropriate proportions enhances the sustainability and efficiency of organic forage cropping systems.
- **Practical Recommendations:** Farmers should tailor mixture ratios based on regional and climatic conditions and specific production goals to optimize both yield and weed management.

These findings provide practical guidance for selecting optimal forage mixtures in organic cropping systems.

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References

1. **Acar, Z., Aşçı Önal, Ö., Ayan, İ., Mut, H. & Başaran, U.** (2006) Mixed cropping systems in forage crops. Ondokuz Mayıs University Faculty of Agriculture Journal, 21 (3), 379-386.
2. **Altieri, M. A.** (1999). *The ecological role of biodiversity in agroeco systems*. Agriculture, Ecosystems & Environment, 74(1), 19-31.
3. **Altın, M., Gökkuş, A., Koç, A.** (2005) Pasture and Meadow Improvement. Ministry of Agriculture and Rural Affairs, General Directorate of Agricultural Production and Development, Ankara.
4. **Altınok, S. & Hakyemez, B.H.** (2002) The effects of different mixture ratios on forage yield in mixtures of hairy vetch (*Vicia villosa* L.) and Narbon vetch (*Vicia narbonensis* L.) with barley (*Hordeum vulgare* L.) under Ankara conditions. Journal of Agricultural Sciences, 8 (1), 45-50.
   Anlarsal, A.E. &Yağbasanlar, T. (1996) The effect of different mixture ratios of vetch and some cereal species on forage production under dry conditions in the Çukurova region. Turkish Journal of Agriculture and Forestry, 20, 157-163.
5. **Akinsanmi, O. A., Olanrewaju, O. S., & Adeyemi, A. A.** (2020). "Effect of Legume-Grass Mixtures on Weed Control and Forage Yield in Organic Farming Systems." *Field Crops Research*, 259, 107-114.

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6. **Arslan, A. & Gülcan, H.** (1996) A study on the effect of annual ryegrass sowing time on forage yield and some agricultural traits in different vetch and barley mixtures grown as winter catch crops in the Southeastern Anatolia Region. Turkey 3rd Pasture, Rangeland, and Forage Crops Congress, June 17-19, 1996, Erzurum.
7. **Asci, O.O., Acar, Z. &Arıcı., Y.K.** (2015) Hay yield, quality traits and interspecies competition of forage pea-triticale mixtures harvested at different stages. Turkish Journal of Field Crops, 20 (2),166-173.
8. **Arlauskienė, A., Jablonskytė-Raščė, D., Šarūnaitė, L., Toleikienė, M., Masilionytė, L., Gecaitė, V., Kadžiulienė, Ž.** (2021).Perennialforagelegumecultivationandtheirabove-groundmassmanagementmethodsforweedsuppression in arable organic cropping systems. *Chemical and Biological Technologies in Agriculture*. 8, 34.
9. **Avcıoğlu, R, W. O. Boberfeld, H. Soya, H. Geren & E. Beckmann.** (2003) Investigations on some yield and quality characteristics of second crops of *Vicia sativa* and *Trifolium resupinatum* and their mixtures with *Lolium multiflorum*, Verband Deutsch-Türkischer Agrar-und Naturwissenschaftler Türkische Sektion und Deutsche Sektion, 7. Symposium ErgebnisseDeutsch Türkischer Agrarforschung, 24-30.03.2003, Ankara s: 109-112.
10. **Avcıoğlu, R. & Soya, H.** (1977) Common Vetch. Ege University Faculty of Agriculture, Animal Science Association Publications, No:5, İzmir.
11. **Bakoğlu, A., & Memiş, A.** (2002) Determination of Seed Yield and Some Characteristics in Different Ratios of Common Vetch (*Vicia sativa* L.) and Barley (*Hordeum vulgare* L.) Mixtures. Fırat University Journal of Science and Engineering, 14 (1): 29-35.
12. **Bàrberi, P.** (2002). *Weed management in organic farming: a review*. European Journal of Agronomy, 16(3), 229-240.
13. **Bayram, G.** (1998) Research on the Effects of Mixture Ratios and Nitrogen Fertilization on Forage Yield and Forage Quality in Oat (Avena sativa L.) and Common Vetch (*Vicia sativa* L.) Intercropping. Master's Thesis, Uludağ University.
14. **Blackshaw, R. E., Anderson, R. L., Lemerle, D., & Powles, S. B.** (2005). Cultural weed management. *In: Inderjit (Ed.), Weed Biology and Management*. Springer.
15. **Büyükburç, U & Karadağ, Y.** (1999) A study on the yield and adaptation of winter vetch varieties (*Vicia pannocina* Crantz and *Vicia villosa* Roth.) grown under the ecological conditions of Tokat-Kazova and Yozgat-Sarıkaya. Turkey 3rd Field Crops Congress, November 15-18, Adana, Volume 3, pp. 207-211.
16. **Carlsson, G., & Huss-Danell, K.** (2003) Nitrogen fixation in perennial forage legumes in the field. *Plant and Soil, 253*(2), 353-372.
17. **Dhima, K. V., Lithourgidis, A. S., Vasilakoglou, I. B., &Dordas, C. A.** (2007) Competition indices of common vetch and cereal intercrops in two seeding ratio. *Field Crops Research, 100* (2-3), 249-256.
18. **Elçi, Ş.** (1976) The General Principles of Forage Crops and Pasture-Meadow Cultivation. Roto, Ankara.
19. **Frankow-Lindberg, B. E., Brophy, C., Collins, R. P., & Connolly, J.** (2009) Biodiversity effects on yield and unsown species invasion in a temperate forage system. *Annals of Botany, 103*(6), 913-921.
20. **Foley, J.f., Mcılwee, A., Lawler, I., Aragones, L., Woolnough, A.P., Berdıng, N.** (1998) Ecological Implications of Near-Infrared Reflectance Spectroscopy: A Tool for Rapid, Cost-Effective Prediction of the Composition of Plant and Animal Tissues and Aspects of Animal Performance. Oecologia 116: 293-305.
21. **Gallandt, E. R.** (2006) How can we target the weed seedbank. Weed Science, 54(3), 588–596.
22. **Geren, H., Soya, H., Avcıoğlu, R.** (2003) The Effect of Different Harvest Times on Some Quality Characteristics in Annual Ryegrass and Hairy Vetch Mixtures. Ege University Faculty of Agriculture Journal, 40 (2): 17-24.
23. **Giller, K.E.** (2001)Nitrogen Fixation in Tropical Cropping Systems. CAB Publishing, Wallingford, UK.
24. **Gonzalez-Andujar, J. L. & Fernandez-Quintanilla, C.** (2004) Modelling the population dynamics of annual ryegrass (Lolium rigidum) under various weed management systems. Crop Protection, 23(8), 723–729.
25. **Hauggaard-Nielsen, H., Ambus, P., & Jensen, E. S.** (2001). Interspecific competition, N use and interference with weeds in pea–barley intercropping. *Field Crops Research, 70* (2), 101-109.
26. **İptaş, S., Büyükburç, U. & Yılmaz, M.** (1994) Research on the winter adaptation of annual legume forage crops in Tokat and its surroundings. Field Crops Congress, April 25-29, pp. 17-21, Bornova-İzmir.

27. **İptaş, S., Yılmaz, M.** (1996) A study on the effects of annual ryegrass sowing times on yield and quality in vetch-cereal mixtures under Tokat ecological conditions. Gaziosmanpaşa University Faculty of Agriculture Journal, 13(1): 383-395.
28. **Jabran, K.** (2017) Manipulation of Allelopathic Crops for Weed Control. Springer International Publishing AG, Switzerland.
29. **Kirchhof, G., Möller, K., & Lindner, J.** (2017).The Role of Legume-Grass Mixtures in Weed Suppression and Forage Production. *Agronomy Journal*, 109(6), 2182-2192.
30. **Kusvuran, A., Kaplan, M., Nazlı, I., R.** (2014) Effects of Mixture Ratio and Row Spacing in Hungarıan Vetch (*Vicia pannonica* Crantz.) and Annual Ryegrass (*Lolium multiflorum* L.) Intercropping System on Yield and Quality Under Semi Arid Climate Conditions. Turkish Journal of Field Crops,19(1): 118-128.
31. **Liebman, M., & Davis, A. S.** (2000). Integration of soil, crop and weed management in low-external-input farming systems. *Weed Research*, *40*(1), 27-47.
32. **Liebman, M., Davis, A. S.** (2015). *Managing Weeds in Organic Farming Systems: An Ecological Approach.*
33. **Lithourgidis, A. S., Dordas, C. A., Damalas, C. A., & Vlachostergios, D. N.** (2011). Annual intercrops: an alternative pathway for sustainable agriculture. *Australian Journal of Crop Science*, *5*(4), 396-410.
34. **Munzur, M**. (1982) Determination of Suitable Cereal+Vetch Mixtures and Research on Their Grazing Suitability and Forage Yields Under Ankara Conditions. Ph.D. Thesis, Ankara University, Institute of Science, Ankara.
35. **Öztürk, A., Bulut, S., Yıldız, N., Karaoğlu, M.M.** (2012) Effects of organic manures and non-chemical weed control on wheat: I-Plant growth and grain yield. *TarımBilimleriDergisi*, 18(1): 9-20
36. **Pannwitt, H., Westerman, P. R., Mol, F., Selig, C. &Gerowitt, B.** (2017) Biological control of weed patches by seed predators; responses to seed density and exposure time. Biological Control, 108, 1-8.
37. **Serin, Y., Tan, M.** (2008a) Establishment of Forage Crop Facilities. (Ed: Y. Serin), Forage Crops and Pasture-Based Livestock Training, Erciyes University Publication No: 160, Kayseri, pp. 26-50.
38. **Tilman, D., Cassman, K. G., Matson, P. A., Naylor, R., & Polasky, S.** (2001). Agricultural sustainability and intensive production practices. *Nature*, *418*(6898), 671-677.
39. **Tükel, T. & Yılmaz, E.** (1987) A study on determining the optimal mixture ratio in vetch (*Vicia sativa* L.) + barley (*Hordeum vulgare* L.) mixtures grown under dry conditions in Çukurova. Doğa Journal of Agriculture and Forestry, 115 (1), 171-178.
40. **Yolcu, H., Polat, M., Aksakal, V.** (2009) Morphologic, Yield and Quality Parameters of Some Annual Forages As Sole Crops and Intercropping Mixtures in Dry Conditions For Livestock. *Journal of Food, Agriculture & Environment*,7 (3- 4): 594-599. 2009.
41. **Yolcu, H., Tan, M.** (2008) Organic Forage Crop Cultivation. *Atatürk University Faculty of Agriculture Journal*, 39(1): 145-150.
42. **Vyn, T. J., Dinnes, D. L., & Lynch, J. P.** (2018). "Effectiveness of Legume-Grass Mixtures in Weed Suppression in Organic Forage Systems." *Agricultural Systems*, 165, 19-28.