Study of the competitiveness of two wheat varieties under the influence of several plant densities of wild mustard and their effect on yield and its components

Bilal I. Mohammed 1 and Zian H. Ahmed 2
bilal.muhammed@epu.edu.iq zhyan.ahmad@epu.edu.iq
*Corresponding email: bilal.muhammed@epu.edu.iq
-1,2Department of food security and quality control, Khabat Technical Institute, Erbil Polytechnic University, Erbil, Kurdistan region, Iraq

Abstract:

During the winter seasons of 2022-2023 and 2023-2024, research was conducted on the Khabat Technical Institute/Erbil Polytechnic University field. To study the evaluation of the competition of two wheat varieties with different densities of wild mustard (Sinapis arvensis) on growth parameters and yield. In a random complete block design (RBCD) with three replications, a factorial experimental design was used; the first factor represents two varieties of wheat (Adana and Smeto), and the second factor represents five densities of wild mustard (0, 5, 10, 15, and 20 plants/m²). That highest plant height (cm) was obtained from the Smeto variety with a density of wild mustard (20) in the field of wheat per m², while the highest leaf area (cm²) and leaf area index were obtained from the Adana variety with a density of wild mustard. The maximum rate of dry matter (g m²), crop growth rate (g plant^{-1} day^{-1}), and relative growth rate (g g day^{-1}) were obtained from the cultivation of the Smeto variety without a density of wild mustard from the season of 2023-2024. However, the maximum number of tillers plant^{-1} and the number of spikes plant^{-1} were recorded from the interaction between the Adana variety without densities of wild mustard from the season of 2022-2023, and the number of grain spikes, the weight of 1000 grains (g), the grain yield (kg ha^{-1}), and the biological yield (kg ha^{-1}) were recorded from the interaction between the Adana variety without densities of wild mustard from the season of 2023-2024, while the height value was recorded from the cultivation of the Smeto variety with a density (20) of wild mustard in the field of wheat per m² from the season of 2023-2024.

Key words: Wheat, varieties, wild mustard, growth, Yield.

Introduction

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The genus Triticum, which contains common bread wheat (Triticum aestivum L.), durum wheat (Triticum durum L.), and other annual winter crops, is where wheat evolved from wild grasses, as well as a wheat a winter crop that ranks first among field crops because to its strategic importance in national politics and economies, since it provides the primary source of food for more than one-third of the world's population [2]. Wheat grains are employed in the whole bread business, as well as pasta, cookies, and a variety of confectionery, due to their high carbohydrate and protein content crop waste, such as straw and hay, is also utilized for dry animal feed [11]. Wheat adapts to a wide range of environmental conditions, and the differences

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in the performance and productivity of varieties are due to genetic and environmental factors. These differences may be reflected in the vegetative characteristics of wheat plants [17]. The selection of varieties suitable for a specific environment is one of the most important strategies to achieve the best productivity per unit area. The use of improved varieties in terms of production mechanisms contributed to growth characteristics and yield, but it was done under specific levels of chemical fertilization [8.[

The yield of wheat seeds decreased as the density of wild mustard increased. The decline in spike and seed numbers per area unit were the causes of the decrease in seed yield at high weed densities. [18]. This weed reproduces by seeds and is one of the most common weed species in tropical and semi-tropical climates across the world.

Wild mustard's unrestricted growth pattern, increased height, LAI, and DMA make it easier to collect growth-related resources, making it a highly competitive crop compared to wheat [14]. Often found in wheat fields, wild mustard species can result in significant crop losses if left uncontrolled [13]. Hence, Effective weed management reduces crop loss from weed presence and weed competition [10.[

Evaluations of wild mustard competition in winter cereals have shown yield reductions of 26 in wheat yields. [14] indicated that the number of tillers and wheat crop output decreased as the density increased from 4 to 16 plants per m². The foundation of successful weed management strategies is competition for finite resources like light, water, and nutrients. [15] showed that when using different densities of wild mustard in wheat field, the maximum yield reduction at high densities of wild mustard was 32 plants. Several wheat varieties were also used and among the varieties, the maximum and minimum yield reduction were in "Arta" and "Morvarid" varieties, respectively. The calculated competition indices indicated that "Morvarid" variety in competition with wild mustard had a high ability to prevent yield loss (high tolerance). [4] Data showed that wheat grain production was significantly reduced by interspecific competition between wild mustard and wheat, with grain yield loss reaching 40.2% at 15 wild mustard plants/m2. When wild mustard initially emerges in the field, preventative measures can be taken because of its high germination potential in the early years. Effective herbicide or tillage control of wild mustard before wheat sowing is one preventive strategy that enables the use of herbicides during the growing season to manage weeds [19]. Additionally, metsulfuron, triasulfuron, propoxycarbazone, or pyroxsulam are excellent ALS-inhibiting active components for controlling wild mustard in wheat production, according to [12.[

The objective of this study is to evaluate the competition of two wheat varieties with different densities of wild mustard (Sinapis arvensis) on growth parameters and yield.

Materials and methods:

This study was conducted at the Khabat Technical Institute-Erbil Polytechnic University for two winter seasons, 2022-2023 and 2023-2024. The factorial experiment was done using a randomized complete block design, with three replications. The first factor represents two varieties of wheat (Smeto and Adana) that were growing, and five densities of wild mustard (0, 5, 10, 15, and 20 plant m²). These varieties were obtained commercially and researched at the Erbil Research Station Centre.

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The experiment unit was carried out in the field; planting was done manually in November at a depth of 3 cm. Additionally, 100 kg ha^{-1} of diammonium phosphate $(NH_4)_2 HPO_4$ (18% N 46% P_2O_5) fertilizer was applied upon planting. Also, 80 kg ha^{-1} of urea fertilizer (46% N) was administered to the plant throughout vegetative development for both years. Before planting, soil samples were collected from different parts of the field at 0 to 30 cm depth. The samples were then dried by air, sieved using a 2 mm sieve, and packaged for examination (Table 1). At the flowering stage, five plants were randomly selected from each experimental unit to evaluate growth metrics such as plant height (cm), leaf area (cm^2), and leaf area index (LAI) using the Viticanopy computer application [6], and Dry matter (g m^2) refers to the dry mass of the plant after 48 hours of drying at 80°C. The weight was then converted to (g m^2). CGR (g m^2 day^{-1}) is determined by dividing dry matter yield (g m^2) at the flowering stage by the number of days from sowing to the flowering stage, Net Assimilation Rate (NAR) (g cm^2 day^{-1}), and Relative Growth Rate (RGR) (g g day^{-1}) [9]. From all plants in plots, to study yield and yield components: number of tillers, number of spike $plant^{-1}$, number of grain $spike^{-1}$, weight of 1000 grains (g), grain yield (kg ha^{-1}), biological yield (kg ha^{-1}), and harvest index.%

According to variance analyses performed with the Statistical Analysis System [16], each measured attribute had its data statistically analyzed [7], to compare the means, we utilized Duncan's multiple range test (DMRT) at a significance level of 5% [3.[

Table (1): Some physical and chemical parameters of the soil at the depth of (0 - 30 cm).

Depth cm	PSD %			Soil Texture	pH	Ec ds/m	O.M %	(N) %	Available (P)	K^+	Ca^{+2}	Mg^{+2}
	Sand	Silt	Clay									
	g/kg soil					dS/m	%		$mg.g^{-1}$	Mmolic.L^{-1}		
0-30	8	59	43	Silty clay	7.3	1.2	1.1	0.28	3.77	0.24	6.61	3.87

Results and Discussion:

-1 Effect of two wheat varieties and densities of wild mustard on growth parameters:

The effect of wheat varieties and densities of wild mustard is shown in table (2), the highest plant height (115.80 cm), dry matter (1265.33 g m2), and crop growth rate (7.12 g plant-1 day-1) recorded in Smeto variety from season 2023-2024, whereas the highest leaf area (243.13 cm2) and leaf area index (7.29) was recorded from Adana variety in similar season.

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The results obtained were consistent with the findings of [1]. showed wheat varieties had a significant effect on tiller number and stem elongation. However, the various densities of wild mustard showed substantial differences among all the studied growth parameters, the highest plant height (116.30 cm) was recorded from the density (20) of wild mustard from season 2023-2024 and net assimilation rate (1.146 g cm2 day-1) was recorded from season 2022-2023 in the density (20) of wild mustard in the field of wheat per m2. While the highest leaf area (275.20 cm2), leaf area index (8.25), dry matter (1287.33 g m2), crop growth rate (7.35 g plant-1 day-1) and relative growth rate (0.041 g g day-1), were obtained from the least density of wild mustard (0 control) from season 2023-2024.

Table (3) displayed a wide variation between treatments from the interaction between variety and weed density on growth parameters of plant; the highest plant height (118.33 cm) obtained from Smeto variety with density of wild mustard (20) in the field of wheat per m2 from season 2023-2024, while the lowest plant height (101.00 cm) from Adana variety with the seme density at season 2022-2023 and the highest leaf area (280.33 cm2) and leaf area index (8.41) obtained from Adana variety with never density of wild mustard from season 2023-2024, whereas the lowest leaf area (184.667 cm2) and leaf area index (5.54) was recorded from interaction between Smeto variety with density of wild mustard (20) in the season 2022-2023. The maximum rate of dry matter (1297.66 g m2), crop growth rate (7.41 g plant-1 day-1) and relative growth rate (0.0393 g g day-1) were obtained from cultivation Smeto variety without density of wild mustard, but the minimum rate of dry matter (1053.33 g m2), crop growth rate (5.99 g plant-1 day-1) and relative growth rate (0.0333 g g day-1) were obtained from cultivation Adana variety with density of wild mustard (20) in the season 2022-2023. The highest net assemulation rate (1.24 g cm2 day-1) was recorded from interaction Smeto variety with density (20) of wild mustard in the field of wheat per m2 in the season 2023-2024, and the lowest net assemulation rate (0. 893g cm2 day-1) was obtained from Adana variety without density of wild mustard in the season 2022-2023. Also [15], stated increase density from 4-16 plant m2, caused to decrease of some growth parameters as leaf area, dry matter, crop growth rate and relative growth rate of wheat crop.

Table (2): Effect of variety and weed density on growth parameters of plant.

Varieties	Plant height cm	Leaf area cm^{-2}	LAI	Dry matter $g\ m^2$	C G R $g\ m^2\ day^{-1}$	N A R ($g\ cm^2\ day^{-1}$)	R G R ($g\ g\ day^{-1}$)
			2022-2023				
Adana	**103.13 b**	**230.33 a**	**6.91 a**	**1185.40 b**	**6.97 b**	**1.018 a**	**0.03 a**
Smeto	**113.80 a**	**221.26 b**	**6.63 a**	**1247.53 a**	**7.10 a**	**1.081 a**	**0.03 a**
Weed density							

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Control	**106.00 c**	**269.00 a**	**8.07 a**	**1272.83 a**	**7.25 a**	**0.913 b**	**0.039 a**
5	**107.33 bc**	**246.00 b**	**7.38 ab**	**1256.83 ab**	**7.28 a**	**0.982 b**	**0.038 b**
10	**108.00 b**	**222.66 c**	**6.68 bc**	**1239.83 b**	**7.18 ab**	**1.075 ab**	**0.038 b**
15	**109.50 ab**	**201.00 d**	**6.03 c**	**1189.33 c**	**6.89 b**	**1.144 a**	**0.036 c**
20	**111.50 a**	**190.33 e**	**5.71**	**1123.50 d**	**6.51 c**	**1.146 a**	**0.034 d**
			2023-2024				
Adana	**106.13 b**	**243.13 a**	**7.29 a**	**1233.50 b**	**6.85 b**	**1.011 a**	**0.028 a**
Smeto	**115.80 a**	**232.33 b**	**6.97 b**	**1265.33 a**	**7.12 a**	**1.053 a**	**0.029 a**
Weed density							
Control	**102.30 d**	**275.20 a**	**8.25 a**	**1287.33 a**	**7.35 a**	**0.895 e**	**0.041 a**
5	**104.43 c**	**232.50 b**	**6.97 b**	**1234.66 ab**	**6.86 ab**	**0.954 d**	**0.036 b**
10	**109.00 bc**	**212.33 c**	**6.37 bc**	**1212.44 b**	**6.74 ab**	**1.023 c**	**0.035 b**
15	**112.20 b**	**205.66 d**	**6.17 c**	**1196.66 c**	**6.65 b**	**1.095 b**	**0.034 b**
20	**116.30 a**	**194.43 e**	**5.83 d**	**1153.30 d**	**6.41 c**	**1.114 a**	**0.032 c**

Table (3): Effect of interaction between variety and weed density on growth parameters of plant t.

Varieties x *Weed density*	**Plant height cm**	**Leaf area cm^{-2}**	**LAI**	**Dry matter g $plant^{-1}$**	**C G R g $plant^{-1}$ day^{-1}**	**N A R (g cm^2 day^{-1})**	**R G R (g g day^{-1})**
				2022-2023			
Adana control	**101.00 d**	**274.000 a**	**8.22 a**	**1248.00 ab**	**7.34 ab**	**0.893 f**	**0.0393 a**
Adana 5	**102.66 d**	**249.667 b**	**7.49 b**	**1235.00 b**	**7.26 b**	**0.970 e**	**0.0390 b**
Adana 10	**103.00 cd**	**227.000 c**	**6.81 cd**	**1230.66 b**	**7.24 b**	**1.06 c**	**0.038 c**
Adana 15	**104.00 c**	**205.000 d**	**6.15 d**	**1160.00 e**	**6.82 c**	**1.10 b**	**0.036 d**
Adana 20	**105.00 b**	**196.000**	**5.88 e**	**1053.33 f**	**5.99 d**	**1.05 c**	**0.033 e**

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Smeto control	**111.00 ab**	**264.000 ab**	**7.92 a**	**1297.66 a**	**7.41 a**	**0.936 e**	**0.039 b**
Smeto 5	**112.00 ab**	**242.333 b**	**7.27 b**	**1278.66 a**	**7.30 ab**	**1.00 d**	**0.039 b**
Smeto 10	**113.00 ab**	**218.333 cd**	**6.55 cd**	**1249.00 ab**	**7.13 b**	**1.08 c**	**0.038 c**
Smeto 15	**115.00 ab**	**197.000 e**	**5.91 d**	**1218.66 c**	**6.96 c**	**1.17 b**	**0.037 cd**
Smeto 20	**118.00 a**	**184.667 f**	**5.54 f**	**1193.66 d**	**6.82 c**	**1.23 a**	**0.036 d**
			2023-2024				
Adana control	**105.40 g**	**280.33 a**	**8.41 a**	**1265.33 ab**	**7.03 ab**	**0.93 g**	**0.0391 a**
Adana 5	**106.46 ef**	**254.66 b**	**7.64 ab**	**1245.66 b**	**6.92 b**	**0.95 fg**	**0.039 a**
Adana 10	**107.30 f**	**236.50 bc**	**7.10 b**	**1237.66 b**	**6.88 cd**	**1.10 d**	**0.038 b**
Adana 15	**106.60 ef**	**212.43 c**	**6.37 c**	**1176.33 d**	**6.54 d**	**1.13 cd**	**0.037 c**
Adana 20	**109.55 d**	**206.66 d**	**6.20 cd**	**1078.88 e**	**6.20 e**	**1.08**	**0.034**
Smeto control	**113.20 c**	**274.33 ab**	**8.23 a**	**1293.33 a**	**7.19 a**	**0.96 fg**	**0.039 a**
Smeto 5	**114.30 bc**	**253.33 b**	**7.60 ab**	**1288.67 a**	**7.16 a**	**1.06 e**	**0.038 b**
Smeto 10	**115.60 bc**	**225.66 bc**	**6.77 cd**	**1262.33 ab**	**7.01 ab**	**1.12 cd**	**0.036 d**
Smeto 15	**117.20 b**	**204.12 d**	**6.12 d**	**12243.66 b**	**6.80 cd**	**1.22 b**	**0.037 c**
Smeto 20	**118.33 a**	**195.74 e**	**5.87 e**	**1202.33 c**	**6.68 d**	**1.24 a**	**0.035 e**

-2 Effect of two wheat varieties and densities of wild mustard on yield component:

From (Table, 4) showed highly significant differences between heat varieties and densities of wild mustard on yield component and their interactions. It was found that the greatest number of tillers (9.93) plant-1, number of spike plant-1 (9.46) were recorded from Adana variety from the season 2022-2023, but the number of grain spike-1(45.66), weight of 1000 grain (41.87 g), grain yield (735.66 kg ha-1) and biological yield (1788.66 kg ha-1) were recorded from Adana variety from the season 2023-2024, while the lowest number of tillers (7.33) plant-1 number of spike (7.11) plant-1 were recorded from Smeto variety from the season 2023-2024, and number of grain (33.66) spike-1, weight of 1000 grain (35.13 g), grain yield (653.66 kg ha-1) and biological yield (1550.66 kg ha-1) were recorded from Smeto variety from the season 2022-2023 .

However, the different densities of wild mustard showed significant differences among

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all the studied on yield component, the maximum number of tillers (11.50) plant-1, number of spike plant-1 (11.33), number of grain spike-1 (44.06), weight of 1000 grain (40.66 g), grain yield (886.33 kg ha-1) and biological yield (1866.63 kg ha-1) were obtained from the least density of wild mustard (0) from the season 2023-2024, while the lowest number of tillers (6.66) plant-1 number of spike (6.23) plant-1 were recorded from the density (20) of wild mustard in the field of wheat per m2 from the season 2023-2024, but number of grain (33.00) spike-1, weight of 1000 grain (34.50 g), grain yield (535.00 kg ha-1) and biological yield (1177.00 kg ha-1) were recorded from the density (20) of wild mustard in the field of wheat per m2, however the heights harvest index (48.05)% was obtained from this density from the season 2022-2023. These variations brought about by competition for finite resources like light, water, and nutrients serve as the foundation for creating weed management strategies [14 [

From interaction between varieties with densities of wild mustard on yield component table (5), it was found that the maximum number of tillers (12.33) plant-1, number of spike plant-1 (11.66), number of grain spike-1 (47.33), weight of 1000 grain (45.06 g), grain yield (956.03 kg ha-1) and biological yield (1915.66 kg ha-1) were recorded from interaction between Adana variety without densities of wild mustard from the season 2023-2024, while the lowest number of tillers (6.00) plant-1 number of spike (6.00) plant-1 and number of grain (31.00) spike-1 were recorded from interaction Smeto variety with density (20) of wild mustard in the field of wheat per m2 from the season 2022-2023, while the lowest weight of 1000 grain (30.66 g), grain yield (510.00 kg ha-1), biological yield (1213.33 kg ha-1), were obtained from interaction Adana variety with density (20) of wild mustard in the field of wheat per m2 from the season 2022-2023.

However, the different varieties with densities of wild mustard had significant differences on harvest index%, the heights value (49.91%), was recorded from cultivation Adana variety with density (0) of wild mustard in the field of wheat per m2 from the season 2023-2024, but the lowest value (41.79%), was recorded from cultivation Adana variety with density (20) of wild mustard from the season 2022-2023. The results obtained correspond with [4], observation that increasing wild mustard from plant m2 caused a decrease in yield component traits of the wheat crop.

Table (4): Effect of variety and weed density on yield component of plant.

Varieties	No. of tillers plant^{-1}	No. of spikes plant^{-1}	No. kernels spike^{-1}	Weight of 1000 kernel (g)	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest Index %
			2022-2023				
Adana	**9.93 a**	**9.46 a**	**44.46 a**	**40.06 a**	**733.33 a**	**1720.66 a**	**42.62 a**
Smeto	**7.93 b**	**7.66 b**	**33.66 b**	**35.13 b**	**653.66 b**	**1550.66 b**	**42.15 a**
Weed density							
Control	**11.00 a**	**10.33 a**	**41.00 a**	**40.16 a**	**882.50 a**	**1861.83 a**	**48.05 a**

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5	**10.00 ab**	**9.66 b**	**38.33 b**	**39.50 b**	**785.83 b**	**1635.16 b**	**47.39 b**
10	**8.83 b**	**8.33 c**	**36.50 bc**	**37.83 cd**	**674.16 c**	**1407.50 c**	**47.89 b**
15	**8.00 b**	**7.83 d**	**34.50 c**	**36.00 d**	**590.00 d**	**1248.33 d**	**47.26 b**
20	**6.83 c**	**6.66 e**	**33.00 c**	**34.50 e**	**535.00 e**	**1177.00 e**	**45.45 c**
			2023-2024				
Adana	**9.11 a**	**8.86 a**	**45.66 a**	**41.87 a**	**735.66 a**	**1788.66 a**	**41.13 a**
Smeto	**7.33 b**	**7.11 b**	**35.33 b**	**36.33 b**	**658.56 b**	**1577.66 b**	**41.74 a**
Weed density							
Control	**11.50 a**	**11.33 a**	**44.06 a**	**40.66 a**	**886.33 a**	**1866.63 a**	**47.48 a**
5	**10.33 ab**	**10.00 ab**	**38.33 b**	**39.88 ab**	**788.63 b**	**1656.66 b**	**47.60 ab**
10	**7.88 b**	**7.66 b**	**36.66 bc**	**38.33 ab**	**675.66 c**	**1472.56 c**	**45.88 c**
15	**7.93 b**	**7.33 b**	**34.76 bc**	**36.96 b**	**594.05 d**	**1288.68 d**	**46.10 b**
20	**6.66 c**	**6.23 c**	**33.33 c**	**35.07 c**	**537.66 e**	**1178.33 e**	**45.63 c**

Table (5): Effect of Interaction between variety and weed density on yield component of plant.

Varieties x *Weed density*	**No. of tillers plant^{-1}**	**No. of spikes plant^{-1}**	**No. kernels spike^{-1}**	**Weight of 1000 kernel (g)**	**Grain yield (kg ha^{-1})**	**Biological yield (kg ha^{-1})**	**Harvest Index %**
			2022-2023				
Adana control	**12.00 a**	**11.33 a**	**45.00 a**	**43.00 a**	**933.33 a**	**1912.66 a**	**48.79 a**
Adana 5	**11.00 ab**	**10.66 b**	**42.66 b**	**37.33 cd**	**736.66 c**	**1611.66 c**	**45.70 cd**
Adana 10	**10.00 b**	**9.33 cd**	**40.00 c**	**35.00 d**	**625 de**	**1431.66 de**	**43.65 e**
Adana 15	**9.000 c**	**8.66 d**	**37.00 d**	**32.66 e**	**565 e**	**1315 e**	**42.96 ef**
Adana 20	**7.66 de**	**7.33 e**	**35.00 e**	**30.66 f**	**510 f**	**1213.33 f**	**41.79 f**
Smeto control	**10.00 b**	**9.33 cd**	**37.00 d**	**39.00 bc**	**831.66 b**	**1711.66 b**	**48.58 a**
Smeto 5	**9.00 c**	**8.66 d**	**34.00 e**	**40.00 b**	**835 b**	**1721.66 b**	**48.49 a**
Smeto 10	**7.66 de**	**7.33 e**	**33.00 fg**	**40.66 b**	**723.33 c**	**1513.33 c**	**47.79 b**
Smeto 15	**7.00 e**	**7.00 f**	**32.00 fg**	**39.33 bc**	**615 de**	**1381.66 de**	**44.51 d**
Smeto 20	**6.00 f**	**6.00 g**	**31.00 g**	**38.33 c**	**560 e**	**1316.66 e**	**42.53 ef**

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			2023-2024				
Adana control	**12.33 a**	**11.66 a**	**47.33 a**	**45.06 a**	**956.03 a**	**1915.66 a**	**49.91 a**
Adana 5	**11.66 ab**	**11.33 ab**	**44.36 ab**	**38.66 d**	**745.36 b**	**1621.33 c**	**45.97 b**
Adana 10	**10.50 b**	**9.66 cd**	**41.05 b**	**36.05 f**	**628.66 c**	**1435.66 d**	**43.79 d**
Adana 15	**9.66 cd**	**8.93 ef**	**38.30 cd**	**33.68 g**	**576.30 d**	**1326.34 e**	**43.45 d**
Adana 20	**6.95 e**	**6.53**	**34.33 f**	**31.33 h**	**515.50 f**	**1233.66 g**	**42.03 e**
Smeto control	**10.23 b**	**10.23 b**	**38.50 cd**	**40.05 b**	**838.06 ab**	**1725.36 b**	**48.57 ab**
Smeto 5	**9.66 cd**	**9.66 cd**	**35.06 e**	**39.66 cd**	**836.30 ab**	**1720.46 b**	**48.61 ab**
Smeto 10	**7.95 d**	**7.23 f**	**33.66 g**	**39.00 cd**	**722.66 b**	**1467.33 d**	**49.25 ab**
Smeto 15	**7.32 d**	**7.06 f**	**31.45 h**	**38.13 d**	**617.50 c**	**1366.09 e**	**45.20 b**
Smeto 20	**6.66 f**	**6.66 g**	**31.05 i**	**37.86 ef**	**556.66 e**	**1246.66 f**	**44.65 c**

Conclusions:

It is concluded that the highest plant height (cm), dry matter (g m^2), crop growth rate (g $plant^{-1}$ day^{-1}), and net assimilation rate (g cm^2 day^{-1}) were recorded in the Smeto variety from the season 2023-2024, whereas the highest leaf area (cm^2) and leaf area index from growth parameters and also the greatest number of tillers $plant^{-1}$, number of spike $plant^{-1}$, number of grain $spike^{-1}$, weight of 1000 grain (g), grain yield (kg ha^{-1}), biological yield (kg ha^{-1}), and harvest index were recorded from the Adana variety from the season 2023-2024. The increased density of wild mustard results in the lowest of all growth parameters and yield components compared to the decreased density from both seasons.

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