Bionatura
Latin American Journal of Biotechnology and Life Sciences

Article

Effect of mixing ratios and spraying with microelements on the growth and yield of forage for a mixture of oats and clover

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Available from. http://dx.doi.org/10.21931/RB/2023.08.04.67

ABSTRACT

A field experiment was carried out in the fields of the Agricultural Research Station-College of Agriculture, University of Basra, during the winter season of 2021-2022. To study the effect of seeding rates of both oats and Egyptian clover with mixing percentages of 100% oats, 75% oats + 25% clover, 50% oats + 50% clover, 75% clover + 25% oats, 100% clover as the first factor and microelements at a concentration of 1500, 3000 and 4500 ppm as a second factor. The time for spraying with micro-elements was in the branching stage, 7-10 days after the first spray and 7-10 days after the second spray. The experiment was carried out in a factorial experiment with three replications, according to a randomized complete block design, RCBD. Three cuttings were taken during the crop's growth period. The height of the oats and clover plants, the number of oat tillers, the number of clover branches, the weight ratio of leaves to tillers and stems, and the amount of green and dry forage were measured. The results of the study showed that the different ratios of mixing oats and clover crops contributed to the production of the studied traits; 50% of oats + 50% of clover in the second cutting recorded the highest yield of green fodder (66.84 tons ha^{-1}) and dry fodder yield (22.37 tons ha^{-1}). As for the effect of concentrations of microelements, the level of 4500 ppm achieved superiority in all growth characteristics of all cutting, and the highest yield was recorded in green fodder (65.57 tons ha^{-1}) and dry forage (22.44 tons ha^{-1}) at the second cutting. 50% oats + 50% clover at the level of 4500 ppm gave the highest yield for green fodder (69.66 tons ha^{-1}) and dry (24.81 tons ha^{-1}).

Keywords: Mixture; Spraying; micro-nutrients; green fodder; *Avena sativa*; Clover.

INTRODUCTION

Managing forage field crops, including forage mixtures and mixture ratios of cereal crops and forage legumes, is essential in producing abundant forage yields, especially in cropping systems with limited external inputs. This can be attributed to some potential benefits of mixture farming systems, such as higher productivity. Improved livestock feed quality through the complementary effects of two or more crops grown at the same time on the same land area [1], Improving soil fertility by adding nitrogen by fixing this element by legumes in addition to reducing the damage caused by pests of various kinds [2] and giving better resistance to sloughing,

in addition to the fact that the cereals protect legumes from frost. The mixture has a different growth period, which leads to the provision of green fodder for a relatively more extended period [3].

Determining the optimal mixing ratios will reduce the degree of competition and give a clear indication of the amount of response and mutual benefit between the plant species that make up the forage mixture during the different stages of growth, which is reflected in the production of abundant and more fodder. A balance in its nutritional value due to its high protein content and low fibre content, Increasing the yield per unit area of forage and the elements it contains comes through multiple means, including breeding, improvement and genetic programs and the development of agricultural technologies such as the use of different seeding rates and their application to forage mixtures, and since the forage mixture consists of plants belonging to two different families in growth, namely the grassy family (oats), and the legume family (Clover), each of the plant density of these two components is important in providing nutritionally balanced fodder from feed mixtures, the primary motive for cultivating fodder mixtures [4] and other matters that may affect the performance of the forage mixture are the nutrients of different types, which effect on the activity of plants and increase their effectiveness, and therefore all of these factors may affect the quantity and quality of yield due to their impact on many of the biological processes that take place inside the plant and thus increase the biomass of the plant [5].

The interest in plant nutrition and the search for new sources of nutrition in the addition of micro-nutrients to the plant is one of the necessary elements for plant growth that the plant needs in small quantities compared to what it needs from N, P and K such as zinc, iron, copper, manganese and molybdenum, which significantly affect the vital and physiological processes, as they are essential for its growth and development. It increases its resistance to diseases and enters into the composition of enzymes or forms auxiliary factors, and its availability has a positive impact on improving plant growth and increasing its productivity in quantity and quality [6].

Accordingly, the use of different proportions of the feed mixture for each oat and clover with different concentrations of microelements (iron, copper, zinc, manganese, molybdenum) in this experiment was to choose the most appropriate composition of the feed mixture and to know the extent of the effect of microelements on growth and yield characteristics, as well as on the interaction between the forage mixture and the elements and its effect on the yield.

MATERIALS AND METHODS

A field experiment was carried out to study the effect of mixing seed ratios of different forage mixtures of oats (Shifa) variety with Egyptian clover (Mosqawi) as the first factor (100% oats, 75% oats + 25% clover, 50% clover + 50% oats, 75% clover +25%. Oats and 100% clover) and spraying with micro-elements (1500, 3000 and 4500 ppm) as a second factor on the growth and yield of green forage. I performed a factorial experiment. A randomized complete block design with three replications was used. The experiment soil was analyzed to determine its chemical and physical properties, estimated according to [7 and 8] (Table 1).

Adjective	PH	Soil	water	OM	N	P	K	clay	silt	sand
Unit		E. C. (dc/m)	E. C. (dc/m)	g kg^{-1}	Available (mg/kg)			gm Kg^{-1}		
Value	7.37	8.62	3.20	1.95	32.00	2.89	0.51	360	510	130

Table 1. The physical and chemical properties of the experimental soil and irrigation water.

The land designated for agriculture was prepared by plowing it with two orthogonal plows at a depth of 30 cm, and the soil was smoothed using disc harrows. The planting date was 1/11/2021. Phosphate fertilizer was added all at once when planting with an amount of (100 kg P^{-1}) in superphosphate (21% P) [9] .Nitrogen fertilizer was added with an amount of (120 kg N ha^{-1}) in the form of urea fertilizer (46%N) in two equal doses, the first after seedling emergence (30 after sowing) and the second in the elongation stage [10]. The irrigation process was carried out according to the plant's needs at one weekly irrigation. The hoeing and weeding operations were carried out manually whenever the need arose.

The spray solution was prepared by dissolving the required weight of the fertilizer, and the concentrations used were 1500, 3000, and 4500 parts per million. The elements were sprayed in three stages, which are in the branching stage (45 days after planting), after the first cutting (7-10 days) and after the second cutting (7-10 days)—spraying nutrients based on the specified concentrations of them. The plants were 60 days after planting (the first cutting), 45 days from the first cutting (the second cutting) and 40 days from the second cutting (The third cut). The following characteristics were studied: plant height, the number of tillers and branches, the weight of leaves, and the weight of tillers or stems green and dry forage. GenStat Program was used for statistical analyses ($p>0.05$).

RESULTS

Effect of Seeding Rates

The results shown in Table No. 2 indicate the significant effect of the different mixing ratios on the height of oats and clover plants, as the mixing ratio of 100% for oats was given the highest height oats plants (67.49 and 70.80 cm) for the first and second cuttings respectively, while in the third cutting the mixing percentage was recorded as 50% Oats + 50% clover had the highest height of oats plants (66.69 cm), without a significant difference from 100% oats (65.38 cm). The mixing ratio of 100% of clover showed the highest plant heights of 45.58, 57.69 and 61.25 cm for the three cuts, respectively. The mixing ratio was measured as 100% oats and recorded the most significant number of tillers for three cutes, as it gave 526.6, 574.4 and 560.0 tiller m-2 for the three cutes, respectively. 100% with clover recorded the most significant number of branches, which amounted to 440.41, 460.6 and 476.6 branches m^{-2} for three cutes, respectively. The results of Table 2 indicated that the ratios of 75% oats + 25% clover and 50% oats + 50% clover were superior. The highest percentage of leaf weight/oat tillers weight was recorded in the first and third cuttings, reaching 60.67 and 59.39% for the first cut and 59.05 and 59.90% for the third cut, respectively.

In the second cut, the percentage of mixing 50% oats + 50% clover was superior, and the most significant percentage was 58.94%. The treatment was superior to 50% oats + 50% clover in the first cutting, and the highest percentage of leaves/branches of clover was 61.49%. In the second and third cuttings, the mixing ratio exceeded 25% oats + 75% clover; the highest percentage was 72.14% and 67.02 for the two cuttings followed. The treatment was superior to 50% oats + 50% clover in the yield of green fodder and recorded 59.37- and 66.84-tons ha^{-1} for the first and second cuttings respectively, while in the third cutting, the mixing ratios were 50% oats + 50% clover and 25% oats + 75% clover in the superiority and recorded the highest yield, which amounted to 58.05- and 58.25-tons ha^{-1}, respectively. The mixing ratio also exceeded 50% oats + 50% clover in the first cut and recorded the highest dry forage yield, which amounted to 18.71 tons ha-1. As for the second and third cuttings, the two forgetful of mixing 50% oats + 50% clover and 25% oats + 75% clover and recorded

the most significant dry fodder yield amounting to 22.37- and 22.29-tons ha^{-1} in the second cutting, 22.08- and 21.37-ton ha^{-1} in the third cuts respectively.

Effect of Micronutrient Fertilization

The results in Table 3 indicate no significant effect of the difference in the concentrations of microelements on the height of oats and clover plants in the first cutting. The second and third cuttings exceeded 4500 ppm, and the highest heights of oats were recorded at 71.99 and 66.26 cm for the two plants, respectively. The highest height of clover plants was 56.33 and 58.54 cm for the two cuttings, respectively, without significant difference from the level of 3000 ppm (55.78 cm) in the third cutting. The level exceeded 3000 ppm gi, giving it the most significant number of tillers for oats, which amounted to 487.3 tillers m^{-2} at the first cut. There were no significant differences between the levels 1500 and 4500 in the number of tillers at the exact cutting (466.3 and 466.9 tillers m^{-2}). The levels of micronutrient fertilization did not significantly affect the number of oat tillers in the second cut.

In contrast, in the third cut, the level exceeded 4500 ppm, and the most significant number of tillers was 487.1 tiller m^{-2}, the level exceeded 4500 ppm, and the most significant number of branches of clover plants was 375.88. and 437.0 and 427.2 tiller m^{-2} branches of the three cutting, respectively. The level exceeded 4500 ppm in the ratio of the weight of leaves/oats and scored the highest percentage of 59.70, 53.00 and 60.18% for the three cuttings, respectively.

In comparison, the level of 1500 ppm recorded the lowest percentage of 57.32, 49.92 and 56.42% for the three cutes, respectively. The spray with a concentration of 4500 ppm in the first and second cutes produced the highest percentage of leaf/branch weight of clover plant by giving 58.94 and 64.13% for the two cuttings, respectively. In contrast, in the third cutting, the first level exceeded (1500ppm) and recorded the highest percentage of leaf weight/stem weight, which amounted to 67.19 %. The level exceeded 4500 ppm and recorded the highest green forage yield of 57.31, 65.57- and 56.95 tons ha^{-1} for the three cutes. The level of 1500 ppm recorded the highest dry forage yield of 17.05 tons ha^{-1} in the first cut, while the level exceeded 4500 ppm, recording the highest dry forage yield of 22.44- and 20.44-tons ha-1, respectively, for the second and third cutting.

The Effect of the Interaction Between Seed Rates and Levels of Trace Elements

The results of Table 4 showed that the interaction between the proportions of mixing and fertilization with microelements significantly affected the height of oats and clover plants in the first cut. The mixing ratio exceeded 100% of oats at 3000 ppm; the highest height of oats plants was recorded at 67.84 cm. In the second cut, the mixing ratios were 100% oats, 75% oats + 25% clover, and 50% oats + 50% clover at the level of 4500 ppm of microelements, and they recorded the highest height of oats plants reaching 75.76, 72.28 and 73.77 cm, respectively, without significant difference between them. In the third cutting, the mixing ratios of 100% oats, 50% oats + 50% clover were superior at the level of 4500 ppm, and they recorded the highest height of oats plants, reaching 72.39 and 66.84 cm, respectively, without significant difference between them. In the first cut, the mixing ratio of 100% clover at all levels of microelements (1500, 3000 and 4500 ppm) was significantly superior. The highest height of clover plants was recorded, reaching 45.68, 45.52 and 45.54 cm for the three levels, respectively, while in the second cutting, the mixing percentage was 100%.

Clover at the level of 4500 ppm, and the highest height of the clover plant was 64.54 cm. In the third cutting, the mixing ratio of 100% clover and 50% oats + 50% clover at 4500 ppm, recording the highest height of

clover, 67.13 and 60.71 cm for the two ratios, respectively. 100% oats and the level 4500 ppm recorded the most significant number of oat tillers, 564.4 per m-2, without a significant difference from the same mixing ratio at the level of 3000 ppm (538.30 tillers.m^{-2}) in the first cutting. In contrast, in the second cutting, the mixing ratio exceeded 100 oats at the three levels of concentrations of microelements, recording the most significant number of oat tillers. They were 568.7, 567.9, and 577.50 per m^2 for the three concentrations, respectively, without significant differences.

The mixing ratio was superior to 100 oats at the 3000 and 4500 ppm levels (the third cut), and the most significant number of oats tillers was recorded at 566.00 and 581.00 per m^{-2} for the two levels, respectively, without significant difference between them. The results of Table 4 indicate the superiority of the mixture percentage of 100% clover at the levels 3000 and 4500 ppm in the first cut, recording the most significant number of branches of clover plants, which amounted to 442.16 and 458.62 branches m-2 for the two levels respectively. In contrast, the mixture was unique to 100% clover in the second and third cuttings. The level is 4500 parts per million, and the most significant number of branches was recorded, which amounted to 482.20 and 496.00 branches m-2, respectively. The combination of 50% oats + 50% clover at the level of 4500 ppm in the first cutting recorded a significant superiority, recording the highest percentage of leaf/branch weight of clover. It amounted to 63.99%, while in the second cutting, the percentage was superior to 25% oats + 75% clover at 4500 ppm. It gave 68.45% without significant difference from the mixing ratio of 50% oats + 50% clover at levels 3000 and 4500 ppm (64.57 and 67.33%). Also, in the third cut, the percentage exceeded 25% oats + 75% clover at the level of 4500 ppm, and the highest percentage of leaf weight/clover branch weight was recorded at 74.67%.

The mixing ratio was superior to 75% oats + 25% clover in the first cutes at 3000 and 4500 ppm levels. The most significant percentage of leaf weight/ oats tillers weight was 60.80 and 62.89% for the two levels, respectively, without a significant difference from the mixing ratio of 50% oats + 50% clover at levels 1500 and 4500 ppm, which recorded 59.97 and 62.26% for the two levels respectively, In the second twice cutes, the mixing ratio exceeded 50% oats + 50% clover at the levels 3000 and 4500 ppm, and recorded the most significant percentage of 59.25 and 59.89% for the two levels, respectively, while in the third cutes, the mixing percentages were 50% oats + 50% clover and 25% oats. +75% clover at the level of 4500ppm, recording the highest percentage of leaf weight/tillers weight of 62.10 and 61.04%, respectively.

The results of Table 4 indicated that the mixing ratio of 50% oats + 50% clover was superior at the level of 4500 ppm in the first cutting, recording the highest yield of green fodder that amounted to 62.31 tons ha^{-1}. In comparison, in the second cutting, the same mixing ratio exceeded at the levels of 3000 and 4500 ppm, recorded 67.42- and 69.66-tons ha^{-1} without a significant difference from the mixture of 25% oats + 75% clover at the level of 4500 ppm (667.22 tons ha^{-1}). In contrast, in the third cutting, the mixing ratios exceeded 50% oats + 50% clover and 25 % oats + 75% clover at 4500 ppm. It gave the largest green forage yield, reaching 61.35- and 60.29-tons ha^{-1} for the mixing proportion sequentially. In the first stage, the mixing ratio exceeded 50% oats + 50% clover at levels 1500, 3000 and 4500 ppm, and the largest amount of dry forage yield was recorded.

Amounting to 18.49, 18.93- and 18.70-tons ha^{-1} for the three mixing ratios sequentially and without significant difference between them, while in the second cut, the mixture of 50% oats + 50% clover at the level of 4500 ppm was superior, recording the most significant yield of dry forage. It amounted to 24.81 tons ha^{-1}, while in the third cutting, the percentage exceeded 50% oats + 50% clover at the levels 3000 and 4500 parts. In million, 22.10 and 23.19 tons of ha^{-1} were recorded for the two levels, respectively (Table 4).

Traits	Plant height (Cm)		No. Oats tillers Tiller m-2	No. clover branch Branch m-2	Leaves Wt. / branch Wt. %	Leaves Wt. / tiller Wt. %	green fodder yield ton ha-1	Dry fodder yield ton ha-1
	Oats	Clover						
Seeds rate								
Oats(%100)	67.49	-	526.6	-	-	53.85	53.15	**15.22**
Oats :clover (25:75)	62.34	41.41	439.1	231.08	53.43	60.67	57.09	**16.73**
Oats :clover (50:50)	63.11	41.11	472.6	362.36	61.49	59.39	59.37	**18.71**
Oats :clover (75:25)	61.72	41.03	466.9	403.92	58.21	56.81	57.55	**17.10**
clover (%100)	-	45.58	-	440.41	55.61	-	52.97	**14.45**
L.S.D(0.05)	3.280	1.860	26.96	5.298	0.984	1.689	1.648	**0.954**
Second cutting								
Oats(%100)	70.80	-	574.4	-	-	45.38	62.33	**20.30**
Oats :clover (25:75)	68.62	52.93	509.9	332.7	55.40	54.05	64.31	**20.43**
Oats :clover (50:50)	69.72	52.56	478.3	404.5	64.73	58.94	66.84	**22.37**
Oats :clover (75:25)	64.26	43.10	366.2	450.2	67.02	47.38	64.29	**22.44**
clover (%100)	-	57.69	-	460.6	63.02	-	61.25	**20.99**
L.S.D(0.05)	2.305	2.996	22.07	10.20	0.993	0.823	1.435	**0.922**
Third cutting								
Oats(%100)	65.38	-	560.0	-	-	56.37	52.37	**16.78**
Oats :clover (25:75)	57.74	54.90	509.0	365.1	58.57	59.05	55.87	**18.96**
Oats :clover (50:50)	66.69	56.34	449.0	377.6	68.60	59.90	58.05	**22.08**
Oats :clover (75:25)	59.65	48.14	373.4	423.3	72.14	58.30	58.25	**21.37**
clover (%100)	-	61.25	-	476.6	62.48	-	50.67	**18.97**
L.S.D(0.05)	3.906	5.044	22.65	6.77	1.148	0.886	1.167	**0.650**

Table 2. Effect of seed rates on green and dry forage growth and yield for oats and clover.

Traits	Plant height (Cm)		No. Oats tillers Tiller m-2	No. clover branch Branch m-2	Leaves Wt. / branch Wt. %	Leaves Wt. / tiller Wt. %	green fodder yield ton ha-1	Dry fodder yield ton ha-1
	Oats	Clover						
Micronutrient levels	First Cutting							
1500ppm	64.32	42.34	466.3	340.42	55.42	57.32	54.92	**17.05**
3000ppm	62.82	42.17	487.3	362.02	57.20	56.01	55.85	**16.46**
4500ppm	63.86	42.33	466.9	375.88	58.94	59.70	57.31	**15.82**
L.S.D(0.05)	2.840	NS.	NS.	4.588	0.852	1.463	1.276	**0.739**
Second cutting								
1500ppm	66.04	51.15	485.2	383.7	61.06	49.92	61.94	**20.29**
3000ppm	67.02	55.78	484.4	415.2	62.44	51.40	63.89	**21.09**
4500ppm	71.99	58.54	477.0	437.0	64.13	53.00	65.57	**22.44**
L.S.D(0.05)	1.996	4.368	NS.	17.67	0.860	0.713	1.112	**0.714**
Third cutting								
1500ppm	58.17	51.15	459.6	396.8	67.19	56.42	53.55	**18.76**
3000ppm	62.67	55.78	471.4	408.0	63.54	58.61	54.62	**19.70**
4500ppm	66.26	58.54	487.1	427.2	65.61	60.18	56.95	**20.44**
L.S.D(0.05)	3.383	4.368	19.62	5.86	0.994	0.767	0.904	**0.503**

Table 3. Effect of fertilization with microelements on green and dry fodder growth and yield for a mixture of oats and clover.

Micronutrient Levels	Seeds rate	Plant height (Cm)		No. Oats tillers Tiller m^{-2}	No. clover branch Branch m^{-2}	Leaves Wt./ branch Wt. %	Leaves Wt. / tiller Wt. %	green fodder yield ton ha^{-1}	Dry fodder yield ton ha^{-1}
		Oats	Clover						
First cutting									
1500 Ppm	Oats(%100)	67.42	-	477.2	-	-	54.02	50.40	**16.91**
	Oats : clover (25:75)	65.00	39.67	461.1	211.06	52.23	58.31	57.27	**16.47**
	Oats : clover (50:50)	63.51	41.57	449.3	346.40	58.49	59.97	57.88	**18.49**

	Oats : clover (75:25)	61.36	42.45	477.4	383.76	56.73	57.00	57.62	**17.80**
	clover (%100)	-	45.68	-	420.45	54.24	-	51.41	**15.58**
3000 Ppm	Oats(%100)	67.84	-	538.3	-	-	52.15	54.50	**14.57**
	Oats : clover (25:75)	58.77	42.79	444.4	235.23	53.33	60.80	56.47	**17.28**
	Oats : clover (50:50)	62.71	41.42	476.3	363.94	61.99	55.93	57.93	**18.93**
	Oats : clover (75:25)	61.71	38.96	490.4	406.76	57.44	55.16	56.58	**16.46**
	clover (%100)	-	45.52	-	442.16	56.03	-	53.79	**15.04**
4500 Ppm	Oats(%100)	67.21	-	564.4	-	-	55.39	54.55	**14.19**
	Oats : clover (25:75)	63.25	41.77	411.8	246.95	54.74	62.89	57.52	**16.45**
	Oats : clover (50:50)	62.86	40.35	492.3	376.72	63.99	62.26	62.31	**18.70**
	Oats : clover (75:25)	62.10	41.68	432.9	421.24	60.46	58.28	58.47	**17.03**
	clover (%100)	-	45.54	-	458.62	56.58	-	53.71	**12.75**
	L.S.D(0.05)	5.681	3.238	46.70	9.177	1.704	2.926	2.854	**1.653**
Second cutting									
1500 Ppm	Oats(%100)	68.41	-	568.7	-	-	43.18	59.83	**19.67**
	Oats : clover (25:75)	66.38	45.56	536.5	320.3	55.52	51.35	63.37	**19.32**
	Oats : clover (50:50)	67.58	45.24	480.5	351.5	62.29	57.68	63.44	**20.59**
	Oats : clover (75:25)	62.06	42.45	355.0	428.7	65.61	47.46	62.00	**21.41**

	clover (%100)	-	53.35	-	434.5	60.83	-	61.94	**20.46**
3000 Ppm	Oats(%100)	68.50	-	567.9	-	-	45.38	61.36	**19.89**
	Oats : clover (25:75)	67.20	54.67	525.8	323.4	55.59	54.59	65.70	**20.61**
	Oats : clover (50:50)	68.42	54.76	472.4	414.9	64.56	59.25	67.42	**21.71**
	Oats : clover (75:25)	63.96	42.31	362.4	457.7	67.01	46.38	63.66	**22.33**
	clover (%100)	-	55.18	-	465.0	62.59	-	61.33	**20.93**
4500 Ppm	Oats(%100)	75.76	-	577.5	-	-	47.59	65.79	**21.33**
	Oats : clover (25:75)	72.28	58.57	467.2	354.5	55.08	56.22	63.85	**21.35**
	Oats : clover (50:50)	73.77	57.68	482.0	447.1	67.33	59.89	69.66	**24.81**
	Oats : clover (75:25)	66.77	44.54	381.3	464.3	68.45	48.31	67.22	**23.12**
	clover (%100)	-	64.54	-	482.2	65.65	-	61.36	**21.59**
	L.S.D(0.05)	4.992	5.189	38.22	17.67	1.720	1.426	2.486	**1.597**
Third cutting									
1500 Ppm	Oats(%100)	61.50	-	533.1	-	-	54.75	51.06	**16.13**
	Oats : clover (25:75)	53.25	50.34	508.5	353.6	59.50	57.42	55.17	**17.47**
	Oats : clover (50:50)	65.68	50.58	433.3	370.0	67.55	57.92	55.13	**20.94**
	Oats : clover (75:25)	52.23	45.34	363.5	407.7	69.51	55.60	56.63	**20.84**
	clover (%100)	-	58.35	-	456.1	72.21	-	49.76	**18.40**
3000	Oats(%100)	62.24	-	566.0	-	-	56.74	51.71	**16.42**

Ppm	Oats : clover (25:75)	57.82	56.03	496.6	359.2	56.67	59.76	56.11	**19.40**
	Oats : clover (50:50)	67.56	57.73	460.3	374.2	68.71	59.67	57.66	**22.10**
	Oats : clover (75:25)	63.05	51.10	362.9	420.7	72.23	58.24	57.84	**21.46**
	clover (%100)	-	58.26	-	477.7	56.55	-	49.80	**19.14**
4500	Oats(%100)	72.39	-	581.0	-	-	57.62	54.33	**17.79**
Ppm	Oats : clover (25:75)	62.14	58.35	521.9	382.5	59.55	59.96	56.33	**20.01**
	Oats : clover (50:50)	66.84	60.71	453.5	388.7	69.53	62.10	61.35	**23.19**
	Oats : clover (75:25)	63.69	47.97	393.7	441.6	74.67	61.04	60.29	**21.82**
	clover (%100)	-	67.13	-	496.0	58.68	-	52.44	**19.38**
	L.S.D(0.05)	6.765	8.737	39.23	11.72	1.989	1.534	2.020	**1.125**

Table 4. The effect of the interaction between levels of micronutrient fertilization and seeding rates on the growth of the forage mixture of oats and clover.

DISCUSSION

A field experiment was applied to determine the effect of different mixing ratios of oats and clover crops and different concentrations of a group of microelements on the growth and yield of green and dry forage. The results indicated that both factors had a significant effect in most of the studied traits, as the percentage of single mixing for both crops was superior to (100% oats and 100% clover) and recorded the highest plant height and the most significant number of tillers and branches for both crops with a significant difference from the other mixing ratios, and the reason can be attributed to the reason This leads to an increase in the production of dry matter in the case of monoculture as a result of the lack of competition between plants, and then increasing the ability of the plant to absorb water and nutrients from the soil, which was reflected in an increase in the efficiency of the photosynthesis process and stimulating stem cells to divide and elongate, and the survival of oats and clover plants within the single system It gave it a higher number of strands and branches than it is in the overlapping condition, which allowed it to grow well, which was reflected in an increase in its ability to branch as a result of obtaining its nutritional requirements in the soil better than the treatments that included mixing oats with clover at high seeding rates that led to an increase in competition between plants

and then The lack of their ability to branch, that the increase in the process of branching or tillering the plant with the increase in seeding rates is originally due to the increase in the number of seeds per unit area, which was reflected in Positively on the formation of saplings and their competition with other plants, and this result agreed with [30 11, 5] who indicated the superiority of monoculture in increasing the number of stems of clover at the expense of mixed cultivation with grass crops. In the first cut, the seeding rates with the most significant percentage in favor of oats (75% oats + 25% clover) were superior in the ratio of leaf weight/tillers weight (60.67%) or branches for oats and clover. In the second and third cuttings, the seeding rates with a high percentage of clover were a higher percentage of leaf/stem weight, as the mixing ratio gave 25% oats + 75% clover the highest ratio of leaf weight/branch weight of clover (72.14%) at the third cutting, The reason for the decrease in the ratio of leaves/branches of clover in the first cutting of the mixture mentioned above may be attributed to the small number of branches of clover in the early stages of growth are insufficient to produce a large number of branches, in addition to the cessation of the activity of the basal buds during this stage, and the increase of this characteristic in the later cutes explains the extent to which clover plants benefit from the protection of the accompanying oats in their early stages of growth, which gives a valuable indicator of livelihood for placing the legume and cereal plants in a mixed manner to obtain nutritional value forage. High, and the reason for the increase in the ratio of leaf weight/weight of clover branches in the last mowing can be attributed to the increase in the number of branches (476.6 branches m-2) and thus the increase in the number of leaves and leaf area and thus better plant growth and this result was in agreement with [5, 12].

The equal percentage of seeds for both crops (50% oats + 50% clover) exceeded the green and dry fodder yield, recording the highest weights. The reason for the increase in both green and dry yields can be attributed to the increase in the number of tillers and branches of oats and clover per unit area and the increase in the height of oats plants, which contributed to raising the forage yield to the level of moral superiority of intercropping cultivation over single cultivation at the three cuttings. Besides, the increase in the mixing rates compared to the single rates differed from one mowing to another. The increase in green fodder after the first cut by the effect of the seed mixture can be attributed to the increase in plant density. Planting high seeding rates led to an increase in the number of plants of the forage mixture per unit area, which was positively reflected in the forage yield. This result was in agreement with [13,11, 5, 14].

The obtained results indicate that the high levels of micronutrients concentrations (4500ppm) had a significant role in increasing all the studied growth characteristics, as the 4500ppm level contributed to the increase in the average plant height, number of branches and rims, and the ratio of leaf/stem or tillers weight for both clover crops and oats, The reason for the increase in plant height may be attributed to the increase in the level of fertilization with microelements to the role of iron in increasing the efficiency of the photosynthesis process by increasing the content of chlorophyll in the plant in addition to its role in the formation of many essential compounds in the photosynthesis process such as cytochromes and ferredoxins [15]. This result agrees with [16 17] in the role of iron in increasing the height, in addition to the positive effect of manganese in improving growth characteristics and is a critical element in photosynthesis [6]. This result agrees with [18]. The micro-elements contributed to the increase in the number of branches. The reason may be attributed to the role of micro-elements in increasing photosynthesis and then increasing the vegetative total and stimulating the growth of branches, as well as their role in increasing the readiness and absorption of nutrients and increasing their content in the plant, which leads to an increase in the activity of vital activities and an increase in meristem cell division, which gives a significant and rapid vegetative and root growth with a high efficiency in absorbing nutrients more [19]. Micro-elements also have a role in the formation and division of plant cells. Then, their

elongation and increased cleavage [20,21] are due to the increased branching of plants with an increase in the amount of fertilizer to encourage the growth of roots, which is directly related to the increase in the number of tillers [22, 29]. Increasing the height of oats and clover and the number of tillers and branches when increasing the fertilization with microelements had a positive effect on the ratio of leaves to clover branches through the optimal exploitation of the produced and accumulated materials by directing them to build the most effective plant parts such as leaves instead of using them to increase the weight of the stems at the expense of the weight of the leaves

This resulted in better growth of the leaves. Then an increase in their weight, which was reflected in an increase in their ratio to the vegetative part, As well as the role of the basic micro-elements in physiological processes such as photosynthesis and the formation of amino and nucleic acids and energy compounds in addition to the formation of living organelles such as mitochondria and chloroplasts and encouraging the division, expansion and elongation of cells, which means the formation of good vegetative and root growth that increases vegetative characteristics whose increase leads to an increasing number of leaves and their weight per plant [23] and this agrees with [24], the positive role of fertilization with microelements on growth characteristics, which was reflected in the superiority of growth characteristics and thus led to the superiority of the yield of green and dry forage [25,28].

CONCLUSIONS

We conclude that the cultivation of forage crops in the form of a mixture with equal seeding rates between oats and clover under levels of up to 4500 ppm of micronutrients gives a high forage yield of nutritional and economic value.

Author Contributions: "Conceptualization, ISRAA and LAMIAA; methodology, ISRAA; formal analysis lamia investigation lamina.; resources ISRAA.; data curation, ISRAA.; writing—original draft preparation, lamiaa; writing-review and editing, ISRAA and LAMIAA.; visualization, lamiaa.

Funding: This research is not externally funded.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The study did not report any data.

Acknowledgments: University of Basrah, College of Agriculture, Department of Field Crops

Conflicts of Interest: The author declares no conflict of interest.

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Received: 26 September 2023 / Accepted: 15 April 2023 / Published:15 December 2023

Citation: Mohammed I. S., Al-Freeh L. S. Effect of mixing ratios and spraying with microelements on the growth and yield of forage for a mixture of oats and clover. Revis Bionatura 2023;8 (4) 67. http://dx.doi.org/10.21931/RB/2023.08.04.67