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Effects of different doses of plant mega minerals applied to different forage crops mixtures on dry grass crops and some quality criteria

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Abstract

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This study is in Osmanbey village of Şanlıurfa province for two years during the growing seasons has been carried out. The aim was to determine the effects of different doses of mega minerals or plant activators doses on total dry hay quantity and some quality metrics on different proportions of vetch and triticale mixtures. The trial was established in three replication according to the experimental design of split plots to allocate mixture ratios to the main plots, while different plant mega mineral doses to be allocated to the lower plots. For the trial, 60% Vetch, 40% triticale mixture, 7.2 kg/da Adi vetch + 8 kg/da Tacettinbey triticale, while 45% Vetch + 55% triticale mixture, 6 kg/da Adi vetch + 10 kg/da triticale seed ratios were tested. Treatments applied were 12 kg urea and 6 kg triple superphosphate fertilizer. For the mixtures, 45% vetch + 55% triticale and 60% vetch + 40% triticale, mega mineral plant activators fertilizer doses were determined as 0, 300, 600, 900, 1200 g/da but the plant activators were applied in half doses during to growth stages of wheat, the stem elongation and tillering.

According to the results of the 2 years study, it was found that the plant mineral fertilizer doses applied to a different mixture of forage plants had statistically significant effects on dry hay per decare (da) and the yield was 1166.2 kg/da according to the total average of two years. Based on the highest values, according to the average of two years, were 129.4 cm in triticale plant height, 88.1 cm in vetch plant height, 85.48% in dry hay, and 30.54% in dry hay vetch respectively while the raw protein ratio was 13.45%. As a result, it was concluded that the plant activators minerals application increased yield and yield quality significantly.

Keywords: activator; fertilizer; mixture; triticale; vetch

Introduction

The quality of animal products decreases due to the lack of sufficient quality animal feeding. For example, animals are pastured insufficiently due to a lack of grazing lands in Turkey. For this reason, animal feeding should be done on the basis of obtaining higher performance from our animals. Therefore, they must be fed with balanced nutrition that is high in terms of forage plants. The forage plant has the characteristics of protecting soil and water as well as raising the yields. In arid regions, we can use rainwater to reduce the damage caused by drought. Using rainwater in agricultural production is an economical and useful method (Kuzucu, 2017). Besides, as the feed crops are cheap resources, animals will basically have the necessary nutrients which are rich in minerals and vitamins, and which increase the reproductive power of animals for the microflora of their stomach. According to Serin & Tan (2004), this fact provides high-quality animal nutrition which is important. For this reason, cultivation areas of forage crops grown in our country in agricultural fields are at a rate of

6.3%, whereas in developed countries it is at a rate of 25% and we also should increase our forage crops at least to 25%. Although the GAP region is suitable for the production of fodder crops both in terms of soil structure and climatic conditions, fodder cultivation is very low in the region and even it is lower than other grain and industrial plant areas. In recent years, especially the animal production enterprises established with the support of the state have increased the amount of feed plants deficit and therefore the lack of feed plants in our region has made us feel more in need of them. Cultivation of decoy crops suitable for main and intermediate crop agriculture in the field of agricultural land will be evaluated in an economic way as well as the abundant and high quality feed crops needed by our animals will be obtained (Çalık et al., 2017). Triticale, which has an important place in animal feeding, is a hybrid of wheat and rye. Triticale is grown for hay and seed production.

Climate change and rainfall shortages limit agricultural production. Especially, due to the 2008 and 2010 droughts in the southeastern Anatolia region, agricultural production has been decreased. The average 30-year rainfall in this semi-arid region was 344.1 mm. The lowest rainfall, between 1982 and 2011, was 227.3 mm in 2008 and the highest rainfall was 573.1 mm in 1996 (Kuzucu et al., 2016). In arid and barren areas in our region, where silage corn does not grow, forage crops are a great alternative to silage plants.

Vetch plants, which have a short vegetation period, thus can be used as hay and grain. It can be grown on all types of soil and under climate conditions, and it has a feed value at least as high as alfalfa. In addition to these, when animals eat it as fresh grass they do not bulge, therefore, it does make a good forage crop. If the protein content in vetch grains is 20% or above, it can be broken down and given to animals as a concentrate feed. The straw leftovers from the harvested plants for grain, yield is also a good animal feed (Açıkgöz, 2011). Triticale is rich in carbohydrates and vetch is rich in protein as a result they both constitute a balanced feed for animal nutrition. Forage production can be achieved without loss of crops and quality as the mixtures of legume plants such as vetch and triticale with cereals provide support to legumes which are upright growing plants (Aydın & Tosun, 1991). In their study, the effects of mixture ratio on grass yield and grass quality in vetch and triticale mixture under Diyarbakır conditions, they found that pure plantation yields were lower in terms of hay than mixture plantation (Hatipoğlu et al., 1999).

It is important in agriculture to choose the types and varieties of forage plants with high yield potential to close our forage gap and to apply the methods that would increase yield and yield quality such as mixed cultivation, as well as applying new technologies that increase the forage crop yield. One of the technological developments in agriculture is mega minerals, which are plant activators, i.e. single-grain calcite activated state and fertilizers that strengthen plant resistance (Anonim, 2005). Among the superior qualities of these fertilizers, they increase plant resistance to diseases and accelerate the growth and the vegetation process of the plant. Also, shortening the storage life of crops, reducing the water need of the plant, and increases the amount of photosynthesis. When these plant activators are squeezed into the leaves of the crops, they pass deep into the plant through the stomata of the leaf. Activated calcite, due to its large surface, turns into CaO and CO_2 respectively in the plant. Thus, the plant can reach carbon dioxide and calcium continuously, the amount of water needed would be reduced, and the activity of photosynthesis would be increased. This study was carried out to determine the effects of vetch+triticale plant in different mixture ratios and mineral fertilizers applied at different doses on crop's qualities such as plant height, yield and raw protein ratios in the plant.

Material and Method

Plant material and filed preparation

In this study, triticale (×*Triticosecale Wittm*. ex A.*Camus* cv. Tacettinbey) and vetch (*Vicia* L. cv. Adi) seeds were used were used as plant materials (Figure 1). The selfless vetch cultivar is a cultivar that has been successfully cultivated for the purpose of producing dry hay. The optimal harvest time for the grass is the period when the lower fruits begin to take shape. Tacettinbey triticale varieties are winter, dry and bed resistant; good reaction to fertilizer and threshing ability. Plant activators used were comprised of 50% CaO, 3% wa-

Fig. 1. An overview of the experimental field – triticale (×*Triticosecale Wittm*. ex A.*Camus* cv. Tacettinbey) and vetch (*Vicia* L. cv. Adi) were used as plant materials (Photo A. Çalık)

ter-soluble iron (Fe) and manganese (Mn), 1% MgO, 0.02% Ph and 7-10% water-soluble copper (Cu). Topsoil was mixed with ammonium sulfate containing 21% nitrogen and 42% P_2O_5 as phosphorus fertilizer triple superphosphate.

Treatments and agronomic management

Research mixture ratios were established in three replications according to the experimental pattern of plots divided randomly into blocks so that the main parcel and different plant mega mineral doses would be assigned to the lower parcels (Figure 2). In pure vetch and pure triticale sowing, 12 kg/da and 20 kg/da seed were used respectively. According to the ratio of sowing, 60% Vetch, 40% triticale mixture, 7.2 kg/da Adi vetch + 8 kg/da Tacettinbey triticale, 45% Vetch, 55% triticale mixture, 6 kg/da Adi vetch + 10 kg/da triticale seed were mixed. Plots of 6 m^2 size in the experiment were composed of eight rows each with a length of 3 m. The distance between rows in the plot was taken as 25 cm. In the experiment, 12 kg of 46% urea or 6 kg of Triple superphosphate fertilizer per decare was applied (Aydin & Tosun, 1991). As seed mixtures 55% triticale + 45% vetch and 40% triticale + 60% vetch were applied. Plant activator or Megamineral fertilizer's doses were determined as 0, 300, 600, 900, 1200 g/da, and was applied in half during stem elongation and tillering periods. The harvest in the trial plots was done by hand during the full flowering period of the Vetch plant which was present in the mixture.

Fig. 2. An overview of the experimental field

Statistical analysis

The results were subjected to variance analysis according to randomised block design of split plots. Analysis of variance was performed using JMP 5.0.1 statistical package program (SAS Institute, 2002); the difference between means, LSD (5%) multiple comparison tests were conducted (Steel & Torrie, 1980).

Results and Discussion

Effect of different plant mineral doses (cm) on Triticale plant height

Two-year values of the triticale plant height were given below according to the combined 2 years results (Table 1). The results of a mixture of vetch and triticale varieties that received different doses of mega minerals or plant activators in different proportions are presented in Table 1.

Triticale plant height ranged between 88.4 and 131.5 cm because of mega mineral fertilizer applications. The highest value was obtained from 129.4 cm to 900 g/da mega mineral application and 60% vetch-40% triticale mixture ratios. The lowest value was taken from the control plants with a height of 91.1cm. Our findings on triticale plant height values, (Alp, 2009); 98.12-116.35 cm, (Yanbeyi et al., 2006); 94.7-117.4 cm, (Geren et al., 2012); 87.7-119.2 cm with are in line with (Çalık et al., 2017); the results achieved with 88.13-136.40 cm.

Effect of different plant mineral doses on Vetch plant height, cm

Different proportions of vetch and triticale mixtures treated with different doses of mega-mineral plant nutrient doses were indicated below (Table 2).

Table 1. Average values and groups related to triticale plant height, cm

	Treatments	Mega mineral fertilizer applications, g/da					Average
Study year	% Mixture Ratios	0	300	600	900	1200	
1st Year	45% Vetch-55% Triricale	88.4	110.5	112.8	121.4	114.6	109.5e
	60% Vetch-40% Triricale	91.5	107.2	108.6	127.3	110.8	109.0e
2st Year	45% Vetch-55% Triricale	93.8	115.9	122.7	129.2	120.4	116.4b
	60% Vetch-40% Triricale	102.5	119.3	128.3	131.5	123.2	120.9a
Average of 2 years	45-55% Average	91.1d	113.2c	117.7b	125.3a	117.5b	112.9d
	60-40% Average	97.0d	113.2c	118.4b	129.4a	117.0bc	115.0c

* Column followed by the same letter are not significantly (LSD test; P = 0.05)

Table 2. Average values and groups related to vetch plant height, cm

	Treatments	Mega mineral fertilizer applications, g/da					Average
Study year	% Mixture Ratios	0	300	600	900	1200	
1st Year	45% Vetch-55% Triricale	70.4	75.2	76.8	81.2	76.3	75.9f
	60% Vetch-40% Triricale	71.2	71.5	78.9	84.7	79.2	77.1e
2st Year	45% Vetch-55% Triricale	76.3	81.4	83.2	85.3	82.5	81.7b
	60% Vetch-40% Triricale	77.1	76.5	79.6	91.5	86.2	82.1a
Average of 2 years	45-55% Average	73.3e	78.3d	80.0b	83.2a	79.4c	78.8d
	60-40% Average	74.15d	74.0e	79.2c	88.1a	82.7b	79.6c

*Column followed by the same letter are not significantly (LSD; P = 0.05)

The highest average value of vetch plant height was obtained from 60% vetch-40% triticale mixture (88.1 cm), while the lowest values were obtained from 45% vetch-55% triticale (73.3 cm). Based on the average of 2 years, it is obvious that the highest value is obtained from a mixture of 60% vetch - 40% triticale when mega minerals were applied at a rate of 900 g/da. The lowest value is obtained from the control group of 45-55% triticale mixtures.

In this study, the total vetch plant height values of two years varied from 50.93 cm to 99.45 cm and the highest vetch plant height values result were from plants treated with 3 kg/da nitrogen and 3 kg/da phosphorus fertilizer application (Çalık et al., 2017). Our results were in agreement with previous studies (Cömert, 2004); the value obtained by has been found to support our plant-sized values of mixtures of different proportions and different plant activator doses as 80.20 cm (Eğritaş & Aşçı, 2014).

Effect of different plant mineral doses on total dry hay yield, kg/da

Two-year mean values according to the years of total dry grass yield and related groups measured from parcels with different doses of mega mineral plant activator applied to the mixture of vetch and triticale varieties in different proportions were listed below (Table 3).

Two-year average values and groups are given, we can see the trial years for the total dry grass yield (Table 3). As a result of mega mineral fertilizer applications to the average dry grass yield, it was observed that the values change between 524.8-1172.8 kg/da in two years. According to the two-year average values, the highest values were obtained from the mega mineral application of 1166.2 kg/da and 900 kg/da to the mixtures of 45% vetch-55% triticale mixture rates. The lowest value (734.0 kg/da) was obtained from the control group.

Different rates obtained in this study when the data were examined in Vecth+Triticale mixtures and when different mega mineral doses were applied to the plant; 871.4 kg/da (Eğritaş & Aşçı, 2014); 764.44 kg/da (Ergin, 1995); 753.1 kg/da (Bugdaycigil, 1996) and 761.8 kg/da (Iptaş & Yilmaz, 1996); 846.4 kg/da (Hasar & Tukel, 1994); 1031.8 kg/da (Çil, 2000); dry hay yield in 72,281-1478,8 kg/ha ranged between the highest total dry matter yield, 9 kg/da nitrogen and 6 kg/da of phosphorus fertilization from 1545.3 kg/da obtained (Çalık et al., 2017); 1071.4 kg/da (Iptaş & Yilmaz, 1998) and 491.2-968.4 kg/da (Çil, 1998); were in line with the amount of yield obtained.

Effect of different plant minerals doses on triticale ratio in total dry hay, %

According to the two-year average of the values related to the triticale ratio in the total dry grass, measured from different doses of mega mineral parcels applied to the mixture of vetch and triticale varieties in different proportions were listed in Table 4.

The average highest values of the triticale ratio in total dry grass were taken from mixture ratios of 60% vetch-40%

Table 3. Average values and groups related to total dry grass yield, kg/da

	Treatments	Mega mineral fertilizer applications, g/da					Average
Study year	% Mixture Ratios	0	300	600	900	1200	
1st Year	45% Vetch-55% Triricale	785.6	832.2	916.8	1159.6	1107.4	960.3ab
	60% Vetch-40% Triricale	593.4	689.4	730.3	925.7	986.2	785.0c
2st Year	45% Vetch-55% Triricale	682.4	787.1	1134.2	1172.8	1158.6	987.0a
	60% Vetch-40% Triricale	524.8	635.9	873.9	1041.3	899.5	795.0b
Average of 2 years	45-55% Average	734.0d	809.6c	1025.5b	1166.2a	1133.0ab	973.6a
	60-40% Average	559.1d	662.6c	802.1b	983.5a	942.8ab	790.0bc

* Column followed by the same letter are not significantly (LSD test; P = 0.05)

Table 4. Average values and groups related to triticale ratio in total dry hay yield, %

	Treatments	Mega mineral fertilizer applications, g/da					Average
Study year	% Mixture Ratios	0	300	600	900	1200	
1st Year	45% Vetch-55% Triricale	85.12	85.32	86.70	85.73	84.62	85.49a
	60% Vetch-40% Triricale	84.34	85.97	86.42	87.14	85.31	85.83a
2st Year	45% Vetch-55% Triricale	82.78	83.92	83.96	84.79	84.50	83.99b
	60% Vetch-40% Triricale	82.32	84.35	82.64	83.82	81.87	83.00b
Average of 2 years	45-55% Average	83.95c	84.62ab	85.33a	85.26a	84.56ab	84.74ab
	60-40% Average	83.33b	85.16a	84.53ab	85.48a	83.59b	84.41ab

* Column followed by the same letter are not significantly (LSD test; P = 0.05)

triticale mixture with 85.83%, while the lowest value was 83.00% with 60% vetch-40% triticale respectively. Based on the average of years, the highest value was obtained as 85.48% from 60% vetch-40% triticale mixture with 900 g/da mega mineral application. The lowest value was 83.33% from the control group of 60-40% triticale mixture. The difference between the years probably was due to the different amount of rainfall.

Effect of different plant mineral doses on vetch ratio in total dry hay, %

Two-year mean values for the total dry grass vetch ratio measured from parcels where mega mineral plant activator doses were applied to the mixture of vetch and triticale varieties at different rates and the groups associated with them were given in Table 5.

Average two-year mean values for the Vetch ratio values in the total dry hay and the groups formed are given (Table 5). As a result of mega minerals fertilizer applications to vetch ratio in total dry hay in the average of two years, it is observed that the values changed from 23.93 to 30.54%. According to the two-year average values, the highest value was obtained from mega minerals applications of 30.54% to 900 g/da to mixture ratios of 60% vetch-40% triticale. The lowest value is obtained from 45% vetch-55% triticale mixture.

Our values for the Vetch ratio in total dry grass were in accordance with the results achieved with 14.33% -33.87% (Ergin, 1995). The reasons for the different results in the study were probably due to ecological conditions, different kinds of soil conditions, and mega mineral fertilizer doses applied.

Effect of different plant mineral doses on crude protein ratio, %

Average of the values related to the crude protein ratio, measured from the parcels where different doses of mega mineral fertilizer were applied to the mixture of vetch and

Table 5. Average values and groups related to vetch ratio in total dry grass values, %

	Treatments	Mega mineral fertilizer applications, g/da					Average
Study year	% Mixture Ratios	0	300	600	900	1200	
1st Year	45% Vetch-55% Triricale	20.97	24.59	24.30	25.27	25.31	24.08b
	60% Vetch-40% Triricale	23.56	27.82	28.51	31.21	23.95	27.01ab
2st Year	45% Vetch-55% Triricale	26.90	26.13	26 04	26 06	25.50	26.12ab
	60% Vetch-40% Triricale	25.64	29.72	28.65	29.87	26.92	28.16a
Average of 2 years	45-55% Average	23.93ab	25.36a	25.17a	25.66a	25.40a	25.10b
	60-40% Average	24.60b	28.77ab	28.58ab	30.54a	25.43b	27.58a

* Column followed by the same letter are not significantly (LSD test; P = 0.05)

Table 6. Average values and groups related to crude protein ratio values, %

	Treatments	Mega mineral fertilizer applications, g/da					Average
Study year	% Mixture Ratios	0	300	600	900	1200	
1st Year	45% Vetch-55% Triricale	11.01	11.09	10.04	11.02	10.03	10.63bc
	60% Vetch-40% Triricale	11.04	12.05	13.06	13.08	12.04	12.25ab
2st Year	45% Vetch-55% Triricale	11.04	11 08	12.03	12.08	12.01	11.64b
	60% Vetch-40% Triricale	13.02	12.09	13.08	14.01	12.07	12.85a
Average of 2 years	45-55% Average	11.01b	11.08ab	11.03b	11.55a	11.02b	11.14b
	60-40% Average	12.03b	12.07b	13.07ab	13.45a	12.05b	12.83a

* Column followed by the same letter are not significantly (LSD test; P= 0.05)

triticale varieties in different proportions and according to the groups related to them (Table 6).

The highest crude protein ratio values obtained were taken from mixture ratios of 60% vetch-40% triticale mixture with 14.01%, while the lowest value was from 45% vetch-55% triticale with 10.03% 1200 g mega mineral doses application per year. For the average of 2 years, the highest value was obtained from a mixture of 60% vetch - 40% triticale by application of 900 g/da mega mineral and 13.45%. The lowest value was obtained from the control group of 45-55% triticale mixture. When the results of the research were examined in vetch + triticale mixtures and doses of different plant activator, our values from the total crude protein content were 15.5% with a value of (Budak, 2005); in 4.14-21.20% values (Yousıf, 2016) and 10.63-11.43% (Alp, 2009).

Conclusion

This study was conducted to obtain the highest yield and quality with different doses of plant mega mineral applied to different proportions of mixtures. According to the results, when plant activator doses applied to vetch and triticale mixture at 60% rate, triticale and vetch plant height, total dry grass yield, triticale and vetch ratio in dry grass and crude protein ratio were examined. When 900 g/da application of plant mega mineral applied to the plants, triticale and vetch plant height, dry grass yield, dry grass triticale and ratio, crude protein ratio were seen to increase. It was obtained from plant activator applications per year at a 900 g/da ratio. The highest triticale plant height was obtained from the plant activator applications of 129.4 cm with 60% vetch and 40% triticale mixture with 900 g/da, while the highest value for vetch plant height was obtained from 88.1 cm with 60% vetch and 40% ratio.

The highest dry grass yield was obtained by applying 900 g/da of 45% vetch and 55% triticale mixture with an average of 1166.2 kg/da over two years, while the triticale and vetch ratios in dry hay were obtained by applying 85.48%, 30.54% and 60% vetch + 40% triticale 900 g/da of mixture respectively. It is determined that the crude protein ratio in the total grass was obtained from the application of 60% vetch+40% triticale mixture and the average of two years was 13.45%. The two-year results, according to mega doses of plant minerals vetch triticale mixtures in different proportions and doses of the activators in the application of high yield and quality criteria. When evaluated in 60% vetch + 40% triticale mixtures to be applied to 900 gr/da plant, the highest value was obtained with the application of a mega mineral activator, and the doses tested for this study were determined to be the most appropriate for hay production.

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