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THE ROLE OF INTERCROPPING ON YIELD POTENTIAL OF COMMON VETCH (*Vicia sativa L.*)/OAT (*Avena sativa L.*) CULTIVATED IN PURE STAND AND MIXTURES

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ABSTRACT

The present experiment was conducted under the ecological conditions of Tekirdag, Turkey during 1999-2001. Three levels of different mixtures vetch *(Vicia sativa L.)* and oat (*Avena sativa L.)* (25% vetch + 75% oat, 50% vetch + 50% oat, 75% vetch + 25% oat) and pure common vetch (100% vetch + 0% oat), pure oat (0% vetch + 100% oat) were used as experimental treatments. The objective of this research study was to determine the effects of different mixtures ratio on yield and yield components of common vetch (*Vicia sativa L.)* + oat (*Avena sativa L.*). Seeds were broadcasted at a rate of 180kg ha^{-1} for the grasses and 120kg ha^{-1} for the vetch. Field trials were arranged in a randomised complete block design with three replications. Plant height, number of branch per plant, number of pods per plant, herbage yield and dry matter yield were recorded. The two years' results showed that the highest and dry herbage yields were obtained from 25% vetch *(Vicia sativa L.*) + 75% oat (*Avena sativa L.).* As a result, the best mixture was 25% vetch *(Vicia sativa L.)* + 75% oat *(Avena sativa L.).* By this mixture, 25.3 t/ha herbage yield and 6.5 t/ha dry matter yields were taken.

Keywords: vetch, oat, intercropping, mixture ratio.

INTRODUCTION

Vetch (*Vicia sativa L.*) is a common forage legume in rainfed and semiarid systems of the Mediterranean region. In Mediterranean region, mixtures of certain annual legumes with winter cereals are used extensively for forage production (ANIL, *et al.*, 1998; QAMAR *et al*., 1999 and PAPASTYLIANOU, 2004).

Common vetch (*Vicia sativa L.*) is the most important legume used for fresh and dry fodder production in Turkey. It has an important role in crop rotation before sowing of wheat. Cereals are also important contributors to animal feeding in Turkey, both as grain and forage. Cereals grown in this region are capable of high yields owing to many years of plant breeding and optimization of cultural practices.

The incorporation of legumes in forage mixtures with grasses or cereals is an important and well-established practice in some regions. Furthermore, oat, barley, wheat and triticale are added to provide a climbing frame for the legumes and to increase the bulk of feed produced.

In forage-animal production system, legumes are preferred owing to several advantages over monocultures (HAYNES, 1980). In general, legumes are rich in protein while grasses are rich in carbohydrates. Cereals constitute forages relatively low in protein (ROBINSON, 1969), and animals usually require some form of relatively costly protein concentrate supplementation (ANIL et al., 1998). The production of high-protein and more nutritious hay of mixtures (JUNG *et al.*, 1991; SENGUL, 2002). Furthermore, the beneficial effects of mixtures may vary with sowing methods and mixture combinations (ALTIN and GOKKUS, 1988). Besides, berseem clover intercropped with one cultivar each of oat, barley, or triticale, biomass yields, species composition and forage quality were affected by cereal species (ROSS *et al.*, 2004).

Choice of cereal species affects the performance of intercrops grown for forage (JEDEL and HELM, 1993). The choice of a legume species and compatible plant densities are very important for high forage yields and quality in intercrops with cereals (ALTINOK *et al.*, 1997). Furthermore, several factors can affect growth of the species used in intercropping, including cultivar selection, seeding ratios, and competition between mixture components (CABELLERO *et al.*, 1995; CARR *et al.*; 2004; DROOSHIOTIS, 1989; ROBERTS *et al.*, 1989; PAPASTLIANU, 1990)

ROSS *et al.*, (2004) found that intercropping oat with pulse crops produced **,** greater DM yield than intercropping barley or triticale (*Triticosecale* rimpaui Wittm.) with pulse crops, but intercrops with barley or triticale gave a better combination of quality and protein content than intercrops with oat

Yields are generally higher in the mixtures because of more efficient light utilization (BROUGHAM, 1958), allopathic effects (PUDNAM and DUKE, 1978) and transfer of symbiotically fixed nitrogen grasses (LEDGARD, 1991)

Intercropping with pea increased forage and N yield. These results suggest that forage yield is reduced but quality is enhanced when oat (CARR and *et. al.*, 2004). Grass/legume pastures are for example more productive than pure grass pastures and they can support greater animal performance (NELSON and MOSER, 1994). Other work has suggested that grain cereal-legume intercropping has the potential to provide higher grain yield (HAYMES and LEE, 1994; 1999) and more nutritionally balanced forage (ANIL *et al.*, 1998).

The highest green fodder and dry fodder yield were obtained from 3 vetch + 1 barley, 15 April cutting

date. Botanical composition were not effected by cutting date, but were effected by mixture rates (YILMAZ *et al.*, 1996).

The highest dry matter yield was obtained as 10.46 t/ha from 25% vetch + 75% oat in the first year while dry matter yield was obtained as 9.65 t/ha from pure stands oat in the second year (BAYRAM and CELIK, 1999).

CABBELERO *et al.*, (1995) reported that mixtures of common vetch with oat produced 34% more forage yield than common vetch alone, but 57% less than monoculture oat.

The highest green and dry herbage yields were obtained from pure stands of barley and the mixtures contained the high barley ratio, the lowest green and dry herbage yields were obtained from pure stands of common vetch (ARSLAN and GULCAN, 1996).

In the mixtures, as the percentage of cereal increased, so did green and dry herbage yield and the best mixture was 50% common vetch + 50% barley. By this mixture, 27.75 t/ha^{-1} herbage yield and 7.6 t/ha^{-1} dry matter yields were obtained (BASBAG *et al.*, 1999).

KONAK *et al.*, 1997, reported that, the highest herbage yield was obtained 41.14 t/ha, dry matter yield was obtained 11.18 t/ha from the mixture of vetch + oats. The highest number of branches and number of seed per plant was determined from 75% vetches + 25% barley by (ORAK *et al.*, 1999).

Kokten and Tansi (1999), found that the highest forage and dry matter yield were determined from the 75% oat + 25% chicklink.

In mixtures of common vetch with triticale, forage yield was lower by 18% than that in mixtures of common vetch with oat (LITHOURGIDIS *et al.*, 2006).

Higher land use efficiency per unit land area (HAYMES and LEE, 1999); and the opportunity to continue to use standard agricultural machinery and practices (BULSON *et al.*, 1997). There is also potential for intercropping in organic production systems, as reviewed by THEUNISSEN (1997).

Seeding ratio mixtures indicated a significant advantage from intercropping which was attributed to better economics and land use efficiency than the other mixtures (DHIMA *et al.*, 2006).

The objective of the present research study was to determine the effects of different mixtures ratio on yield and yield components of common vetch (*Vicia sativa L.)* + oat (*Avena sativa L.*)

MATERIALS AND METHODS

Site

The experiments were conducted in the field area of the Agricultural Experimental Station at Tekirdag-a part of Namık Kemal University, located at 41^{o} N, 27.5^{o} E, about 5m altitude above mean sea level during 1999-2001.

Experimental design and plant material

In this study both species were planted as monocrops and mixtures. Three levels of different mixtures vetch *(Vicia sativa L.)* and oat (*Avena sativa L.)* (25% vetch + 75% oat, 50% vetch + 50% oat, 75% vetch + 25% oat) and pure common vetch (100% vetch + 0% oat), pure oat (0% vetch + 100% oat) were used as experimental treatments.

Seed was broadcasted at a rate of 180kg ha^{-1} for the grasses and 120kg ha^{-1} for the vetch. Field trials were arranged in a randomised complete block design with three replications (SOYSAL, 1993).

Total long year rainfall, average temperature and average relative humidity were 536.7mm, 10.9 ^{0}C and 77.2 %, respectively in Tekirdag. The soil was clay, poor in organic matter (94%) and moderate in phosphorus contents (132.6kg ha^{-1}).

Measurements

In this experiment, plant height, number of branch per plant, number of pods per plant, herbage yield and dry matter yield were recorded. Plots were 5m wide and 1.8m long. Forage and dry matter yield was determined by harvesting the whole plot. Plants were harvested by hand. The dry matter yield was calculated after drying a sample of 500g green forage in an oven at 78^{0}C for 48 hours.

The plant height measured by averaging the natural standing height of five plants per plot. Cereal and legume harvested for herbage and dry matter yield at the boot stage and at the beginning of flowering, respectively. The main branch number was an average of primary branches on the stems of five plants.

The results were analysed by using MSTAT statistical computer package program (ANONYMOUS, 1982).

RESULTS AND DISCUSSION

Plant Height

The different mixture on yield and yield components of common vetch + oat is given Table-1. There were no significant differences between the mixture rates, years and their interactions.

The highest plant of vetch height (89.8cm) and (79.4cm) was obtained from mixture 75% vetch + 25% oat while the lowest plant height (64.5cm) and (57.8cm) from pure stands of vetch in the first and second year (Table-1). The mean values for the plant height of vetch were obtained as 79.4cm and 71.9cm in the first and second years, respectively. The plant height was greater in the first year than the second year. TUNA and ORAK (2002), pointed out that plant height of common vetch were obtained 56.54cm and 23.90cm in the first and second year, respectively. BASBAG *et al.*, (1999) found similar results.

Plant height of common vetch decreased with the decreasing its ratio in the mixture. Mixture stands of vetch

were taller than pure stands of vetch due to competition between species.

The highest plant of oat height (128.7cm) and (129cm) was obtained from pure stands of oat while the lowest plant height (118.2cm) and (122.7cm) mixture 25% vetch + 75 % oat in the first and second year, respectively.

The mean values for the plant height of oat were obtained as 122.6cm and 125.6cm in the first and second years, respectively .Plant height of oat was influenced by the mixture ratios. The highest plant heights were obtained from pure stands (TUREMEN *et al.*, 1990).

Herbage and Dry Matter Yield

The different mixture on yield and yield components of common vetch + oat is given in Table-1. Differences between mixture rates were tested by the LSD test. Differences between years, mixture and their interactions were statistically significant. The highest herbage yield (29.0 t/ha) was obtained from mixture 25% vetch + 75% oat while the lowest herbage yield (17.8 t/ha) from pure stands of vetch in the first year. In this study, the highest herbage yield (23.1 t/ha) was found from pure stands of oat while the lowest herbage yield (15.6 t/ha) from mixture 75% vetch + 25% oat, in the second year. The mean values for the herbage yield were obtained as 24.9 t/ha and 20.1 t/ha in the first and second years, respectively. The mixtures were more productive than pure vetch sowing. Dry yields also were taken similar results like herbage yield. In the first year, we found 7.2 t/ha and 5.0 t/ha maximum and minimum dry matter yield from mixture 25% vetch + 75% oat and pure common vetch, respectively. Hence, the highest and the lowest dry matter yields were obtained as 7.0 t/ha and 4.8 t/ha from pure oat and mixture 25% vetch + 75% oat in the second year, respectively. The mean values for the dry matter yield were as 6.4 and 5.6 t/ha in the first and second years. The effect of mixture ratio was found significant on the yield of herbage and dry matter yield for first and second year (Table-1). As the seed rate of vetch in mixture increased, the herbage and dry matter yield decreased.

Table-1. The different mixture on yield and yield components of common vetch + oat.

	Mixture rates	**Plant height** (cm)		**Number of pods**	**Number of branch**	**Herbage yield** t/ha	**Dry matter yield** t/ha
		Vetch	**Oat**	**Vetch**	**Vetch**		
1st Year	Pure vetch	64.5	-	8.2	1.9	17.8ef	5.0de
	25%vetch+75%oat	80.1	118.2	8.0	1.8	29.0a	7.2a
	50%vetch+50%oat	83.4	119.8	8.2	1.9	27.2ab	7.1ab
	75%vetch+25%oat	89.8	124.0	8.6	2.0	25.0bc	6.3bc
	Pure oat	-	128.7	-	-	25.4bc	6.6ab
Mean		**79.4**	**122.6**	**8.2a**	**1.9**	**24.9a**	**6.4a**
2nd Year	Pure vetch	57.8	-	7.2	1.6	21.5d	5.4de
	25%vetch+75%oat	74.1	122.7	6.3	1.5	21.7d	5.7cd
	50%vetch+50%oat	76.5	125.0	6.9	1.7	18.5e	5.1de
	75%vetch+25%oat	79.4	126.0	7.1	1.7	15.6f	4.8e
	Pure oat	-	129.0	-	-	23.1cd	7.0ab
Mean		**71.9**	**125.6**	**6.8b**	**1.6**	**20.1b**	**5.6b**
Mean	Pure vetch	61.1c	-	7.7	1.7	19.6c	5.2d
	25%vetch+75%oat	77.1b	120.4	7.1	1.6	25.3a	6.5ab
	50%vetch+50%oat	79.9ab	122.4	7.5	1.8	22.9b	6.1bc
	75%vetch+25%oat	84.6a	125.0	7.8	1.8	20.3c	5.5cd
	Pure oat	-	128.8			24.2ab	6.8a
LSD		Y:NS M: NS MxY: 6.150		Y:1.021 M:NS MxY:NS		Y:22.5895 M.16.7918 MxY:23.7489	Y:3.3757 M.5.60542 MxY:7.9265

1. Means with the same letter (s) are not significantly different at the same 0.05 significance level, byLSD method.
Y = Year, M = Mixture, MxY = Mixture Year
2. Non-significant parameters are not shown, NS = not significant

The best results in term of herbage and dry yields were taken from mixture 25% vetch + 75% oat being followed by 50% vetch + 50% oat, 75% vetch + 25% oat mixtures (Table-1). It appears from the results that there was progressive and significant ($P<0.05$) increase in herbage and dry matter yield with the increase in oat ratio.

Similar results have been reported by ALTIN and UCAN (1996); BAYRAM and CELIK (1999); ERBAY, (1996), ASLAN and GULCAN (1996); BASBAG *et al.* (1999); TANSI *et al.* (1993) and KOKTEN and TANSI (1999).

The highest green forage (39.65t ha^{-1}) and dry matter yields (10.71t ha^{-1}) were obtained from the mixture

including 25% common vetch and 75% barley (KARADAG and BUYUKBURC, 2003).

Some researchers reported that yields of mixtures of legumes and cereals were intermediate or even lower than yields of monocultures due to competition between species (VANDERMEER, 1990; CABALLERO *et al.*, 1995; ASSEFA and LEDIN, 2001 and VELAZQUEZ-BELTRAN *et al.*, 2002).

Number of pods per plant

Table-1 shows that the number of pods per plant was found to be 8.6 (highest) for 75% vetch + 25% oat mixture and 8.0 (lowest) for 25% vetch + 75% oat mixture in the first year. In the second year, the highest number of pods per plant (7.2) was found from pure vetch while the lowest number pods per plant (6.3) from 25% vetch + 75% oat mixture.

Number of pods per plant (8.2) was higher in the first year than in the second year (6.8). Consequently**,** number of pods per plant was affected by the seed rates in the mixtures. Number of pods per plant decreased with decrease vetch ratio in the mixture due to dominant stands of oat.

TUNA and ORAK (2002) reported that the mean values for the number of pods per plant of common vetch varieties were determined as 8.86 and 6.73 in 1998 and 1999, respectively. ROBINSON (1960) and AKBARI (1967) found similar results for the number of pods per plant.

Number of branch per plant

There were no significant differences between the mixture rate, years and their interactions (Table-1).

The mean values for the number of branch per plant mixture vetch + oat are given in Table-1. The mean value for the number of branch per plant was found 1.9 and 1.6 in the first and second year, respectively. The number of branch per plant of common vetch varied between 1.5 and 2.0. In addition to, the highest and lowest number of branch per plant of common vetch was obtained from mixture 75% vetch + 25% oat and 25% vetch + 75% oat. Similar data was reported by (ORAK *et al.*, 1999).

CONCLUSION

The vetch and oat mixtures were found to be advantageous increasing forage yield.

According to the data obtained from this research work, the best results in terms of herbage and dry yields were taken from mixture 25% vetch + 75% oat being followed by 50% vetch + 50% oat, 75% vetch + 25% oat mixtures. Herbage and dry yield of mixtures increased the proportion of vetch declined. If it is desired to obtain higher herbage and dry matter yield per unit area, then it is suggested that the mixture of 25% vetch + 75% oat or pure oat could be the condition of Tekirdag and similar conditions.

If it is desired to obtain quality hay yield per unit area, then it is suggested that the mixture of 75% vetch + 25% oat could be the condition of Tekirdag and similar conditions.

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