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EFFECTS OF FERTILIZATION ON SEED YIELD AND FORAGE QUALITY OF COMMON VETCH (*Vicia sativa* Roth.)

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Abstract

This research was conducted to determine the effects of five phosphorus rates (0, 30, 60, 90 and 120 kg ha^{-1}) on seed yield and forage quality of common vetch (Vicia sativa Roth.). The crude protein yield, dry matter intake (DMI), digestible dry matter (DDM), seed yield and 1000 seed weight were determined in this research. Phosphorus rates significantly affected all components determined in common vetch. Phosphorus rates increased crude protein yield, dry matter intake (DMI), digestible dry matter (DDM), seed yield and 1000 seed weight of common vetch.

Key words*: Common vetch, crude protein yield, seed yield, 1000 seed weight.*

INTRODUCTION

Common vetch is commonly grown to provide a seed and hay crop in many different farming systems in Turkey (Albayrak et al., 2004). Several researchers found that seed yield varied from 0.45 to 2.76 t ha^{-1} in common vetch grown in the different regions of Turkey (Elçi and Orak, 1991; Açıkgöz et al., 1986; Arslan and Anlarsal, 1996; Gökkuş et al., 1996; Mermer et al., 1996; Anlarsal et al., 1999; Başbağ et al., 2001; Albayrak et al., 2006). Vetches can be used for the grazing of livestock, green manure, forage or silage, or the grain fed to livestock (Caballero, 1993; Chowdhury et al., 2001; Egan and Crouch, 2006). Phosphorus fertilization affects dry matter yield and chemical composition of vetch (Bell et al., 2001; Turk, 2001).

Phosphorus (P) plays a major role in legume crop nutrition. Cell division, root lengthening, seed and fruit development, early ripening and resistance to various stresses (i.e., low temperature, diseases) are closely related to P nutrition. Phosphorus deficiency can cause nitrogen (N) deficient legume plants since it helps out the formation of rhizobia bacteria in their root nodules (Israel, 1987; Sekhon et al., 1986). Turk and Tawaha (2001) concluded that phosphorus application significantly affect the seed yield, number of pods per plant, number of seeds per pod, number of primary branches per plant, 100 seed weight, pod length and seed weight per plant of Vetch. The factors influencing the nutritive value of forage are many and the degree to which they are interrelated may vary considerably from one area to another. These factors may include, alone or in combination, plant type, climate, season, weather, soil type and fertility, soil moisture, leaf to stem ratio, physiological and morphological characteristics and others, and may change depending on whether the plants are annuals perennials, grasses or legumes. Nutrient composition levels are not necessarily the only criterion in evaluating the nutritive value of plants (Stobbs, 1975; Cook and Harris, 1979).

The aim of this research was to determine the effects of P on seed yield and forage quality of common vetch.

MATERIALS AND METHODS

The study was conducted at Usak (38°39′N, 29°39′E, elevation 910 m) located in the Aegean region of Turkey. Total precipitation was 378 mm in 2014 (March–June). The long-term average is 280 mm. Average temperature was 15.1°C in 2014. The long- term average is 14.9°C.

The experiments were established in a randomized complete block design with three replications in March in 2014. Five different phosphorus rates (0, 30, 60, 90 and 120 kg P ha^{-1}) were applied in this study. Seeding rate

was 80 kg ha^{-1}. Individual plot size was 1.8 × 6 m = 10.8 m^2. Phosphorus was broadcast as triple superphosphate (46% P_2O_5) during sowing in March.

The harvest time was based on the 50% flowering stage (May 20) of common vetch for forage quality. All plots were harvested for seed yield on June 14. Crude protein yield, dry matter intake (DMI) and digestible dry matter (DDM) were investigated in samples were taken from quadrats (1 m^2). Samples taken from each plot were dried at room temperature then dried in an oven at 65°C till they reached constant weight. After cooling and weighing, the samples were ground for mineral contents analyses.–Nitrogen content was calculated by Kjeldahl method (Kacar 1972). The ANKOM Fiber Analyzer was used for NDF and ADF analysis. ANKOM F57 filter bags were used for ADF and NDF analysis in this study.

Dry matter intake (DMI) and digestible dry matter (DDM) values were estimated according to the following equations adapted from (Horrocs and Vallentine, 1999):

DMI (% of BW) = 120/ NDF % dry matter basis

DDM (% of DM) = 88.9-(0.779 x ADF % dry matter basis)

The data were analyzed together using the Proc GLM (SAS 1998). Means were separated by LSD at the 5 % level of significance.

RESULTS AND DISCUSSIONS

The results of ANOVA summarized in Table 1. The results of variance analysis showed that crude protein yield, DMI, DDM values, seed yield and 1000 seed weight of common vetch were influenced significantly by phosphorus treatments (Table 1).

Table 1. Results of Analysis of Variance Traits Determined

	df	Crude protein yield	DMI	DDM	1000 seed weight	Seed yield
Block	2	0.96	0.0007	0.027	0.03	0.33
Phosphorus	4	159.96**	0.16**	4.65**	26.21**	292.77**
Error	8	1.43	0.0005	0.015	0.26	2.92

df: degrees of freedom, *P<0.05 and **P<0.01.

Table 2. The CP yield, DMI, DDM, 1000 seed weight and seed yield of common vetch at different phosphorus doses

Phosphorus doses (t ha^{-1})	Crude protein yield (t ha^{-1})	DMI (%)	DDM (%)	1000 seed weight (g)	Seed Yield (t ha^{-1})
0	0.43 d	3.33 d	67.79 c	47.46 d	1.59 d
30	0.46 c	3.58 c	69.27 b	49.80 c	1.67 c
60	0.53 b	3.61 c	69.47 b	51.90 b	1.74 b
90	0.60 a	3.84 b	70.64 a	54.08 a	1.81 a
120	0.58 a	3.90 a	70.92 a	54.45 a	1.83 a
LSD (5%)	0.02	0.04	0.31	0.96	0.03

In present study, increasing P fertilization increased crude protein yield. The highest CP yield was obtained from 90 and 120 kg ha^{-1} P rate (0.60 and 0.58 t ha^{-1}), while the lowest CP yield (0.43 t ha^{-1}) was obtained from control plot (Table 2). Similar result was reported by Balabanlı and Akkeçili (2006).

The highest DDM value was obtained from 90 and 120 kg ha^{-1} P rate, while the lowest DDM value was obtained from control plot (Table 2). The highest DMI value (3.90%) was obtained from 120 kg ha^{-1} P rate, while the lowest DMI value (3.33%) was obtained from control plot. Dry matter intake is estimated from NDF and DDM from acid detergent fiber. Equations have been developed that predict DMI from forage NDF levels and DDM from levels of ADF in the forage (Linn and Martin, 1989). Subsequently, estimated DMI and DDM of the forage are used in an equation to assign a relative feed value (RFV) to the forage, which is used as an estimate of potential energy intake of a forage. In present study, increasing phosphorus treatments resulted in an increase in DDM and DMI values. The NDF is used to predict DMI and is negatively correlated with DMI, which means that when NDF is high the

quality and the DMI are low (Horrocks and Vallentine, 1999).

Phosphorus fertilizer increased 1000 SW of common vetch. The highest 1000 SW were obtained from 90 and 120 kg ha^{-1} P rate (54.45 and 54.08 g), while the lowest DM yield (47.46 g) was obtained from control plot (Table 2). Similar results were reported by Turk and Tawaha (2001), Noulas et al., (2012). Elçi and Orak (1991) reported that 1000 seed weight of common vetch changed between 41.83 and 63.35 g. Arslan and Anlarsal (1996) reported that 1000 seed weight of common vetch changed between 44.1 and 56.94 g. Our results are in agreement with those reported by Elçi and Orak (1991), Arslan and Anlarsal (1996).

The highest seed yield was obtained from 90 and 120 kg ha^{-1} P rate (1.83 and 1.81 t ha^{-1}), while the lowest DM yield (1.59 t ha^{-1}) was obtained from control plot (Table 2). Increase in seed yield due to P application is well documented by many authors (Gurmani et al., 2006; Turk and Tawaha, 2001; Noulas et al., 2012). Several researchers found that seed yield varied from 0.45 to 2.76 t ha^{-1} in common vetch grown in the different regions of Turkey (Elçi and Orak, 1991; Açıkgöz et al., 1986; Arslan and Anlarsal, 1996; Gökkuş et al., 1996; Mermer et al., 1996; Anlarsal et al., 1999; Başbağ et al., 2001; Albayrak et al., 2006).

CONCLUSIONS

Common vetch has adequate mineral content for ruminant animal requirements for production in the Agean conditions of Turkey. Increasing P rates resulted in increased seed yield and forage quality. The highest seed yield and 1000 seed weight were obtained from 90 and 120 kg ha^{-1} P rates. The content of CP increased while increasing P fertilization rates. As P rate increased from 0 to 120 kg ha^{-1}, DMI and DDM values increased. At the end of this research conducted in Agean conditions of Turkey, 90 kg ha^{-1} phosphorous fertilizer is recommended for high seed yield and forage quality in common vetch.

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