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Effects of Different Row Spacing and Seeding Density on Hay and Grain Yields of Hungarian Vetch under Rainfed Conditions of Central Anatolia

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Summary: Cereal-fallow rotation system has long been used in Central Anatolia where precipitation is low and sporadic. Replacement of fallow with Hungarian vetch (*Vicia pannonica* Crantz.) has proved its value to the farmers. However the Hungarian vetch husbandry has not been well understood as a rotation crop. This study was conducted to determine whether seed and hay yield of Hungarian vetch can be improved through manipulating row spacing and seeding rates in a wheat-vetch two-year rotation system. Crop was seeded into 17.5, 35, 52.5 and 70 cm apart rows at 6, 9, 12 and 15 kg/0.1ha seeding rates in October. Treatments were arranged in a split-plot manner design in RCBD where main plots were row spacing. Seed and hay yields were measured and results were analysed by standard variance analyses and by Modified Stability Analysis (MSA). Plots 17.5 cm row-spacing and 12 kg/0.1ha seeding rate produced more seed than other plots when average precipitation during the growing season was less than 300 mm. If in a growing season precipitation exceeds 300 mm, seeding rate should be increased to 15 kg/0.1ha. Higher hay yields were obtained from plot with 52.5 cm row spacing and 12 kg/0.1ha seeding rate in regardless of precipitation. It is concluded that narrow row spacing covers more soil surface in early season that conserves soil moisture which is utilized by plants for enhanced early vegetative growth. Rapid utilization of this soil water from narrow-spaced plots resulted in early flowering and consequently longer generative period contribute to higher seed yield. Wider row-spacing promote vegetative growth by decreasing shading effects of plants. A seeding rate of 12 kg/0.1ha seems appropriate for both high seed and hay yields.

Key-words: Hungarian vetch, Modified Stability Analysis, Seeding rate, Row spacing, Hay and Grain Yield

INTRODUCTION

In Turkey, fallow-cereal two-year rotation system has been practiced traditionally for hundreds of years in the Central Anatolia where precipitation is low and sporadic. The rapidly growing small ruminant population and severe degradation of the rangelands have resulted in feed deficit. Only about 3 % of arable land is devoted to forage crops which can not fulfill this deficit. Hungarian vetch (*Vicia panonica* Crantz.) has been found a promising crop to replace fallow year even in the environments where annual average precipitation is less than 400 mm (Durutan et al, 1988, Kurt et al, 1989). This vetch has several of advantages as a rotation crop because of its high hay quality and yield, winter hardness and adaptability to poor farming conditions. It has none-shattering characteristics that produce more seed than other vetches. Being a legume crop it has ability of increasing the nitrogen in the soil to be utilized by the subsequent crop. Early winter soil coverage also reduces potential water run-off and consequently soil losses due to erosion.

This study was conducted to determine whether grain and hay yield of Hungarian vetch could be improved through manipulating row spacing and seeding rates in wheat-vetch two-year rotation system under rainfed conditions of Central Anatolia.

MATERIALS AND METHODS

The trials were conducted at Haymana ,which has a typical dry continental climate and is located at an altitude of 1055m.. Total precipitation received during growing period (October-June) in 1991, 92 and 93 were 314, 291 and 274 mm, respectively. Soil is poor in organic matter (1-2%) and is high in clay content and $CaCO_3$.

Treatments were arranged in a split-plot design where main plots were row spacing and sub-plots were seeding rates. Row spacing were 17.5, 35, 52.5 and 70 cm, and seeding rates were 6, 9, 12, 15 kg/0.1 ha. Stubble left after wheat harvest was burnt and soil was cultivated with duck-foot cultivator prior to seeding. All treatments were drilled in 2.5m x 15m plots with three replications in October. Diammonium phosphate (18N-46 P%) at 10 kg/0.1ha was applied at seeding.

For harvesting, plots were split in to two parts. Plants in one half were harvested at the full flowering stage (usually mid June) for hay production whereas plants in the other half were harvested at maturity for seed (late July). Samples of hay from each plot were dried at 70 oC for 48 hours for determining hay yields on dry matter basis.

Trial results were evaluated with variance analyses as well as Modified Stability Analysis (MSA). MSA was used to see interaction effects of the two treatments and variation of yields across the trial years. In this method, trial years and replications are considered as a separate environments. Average yields (hay and seed) of all treatment combinations were calculated and used as environmental index for that specific replication and year. The yields of treatment combinations were plotted and regressed against environmental index using a linear regression model.

RESULTS AND DISCUSSION

Average seed and hay yields obtained from three-year trials are shown in Table 1. Yields were analysed for individual years. Also combined analyses were carried out for three years. The last two columns present combined analyses results.

Seed Production

Results indicate that there was no interaction between treatments in any year except in combined analyses of three years. Individual treatments were effective on seed yields. Row spacing were significant in every analysis (1991, 1992 and combined) but not in 1993. Plants that were grown in narrow row-spaced plots produced highest grain yields than the wider row-spaced plots.

Effect of seeding rates was found significant only in the year 1992 and in combined analyses. Higher grain yields were obtained from the plots where 9-12 kg/0.1ha seed rate was used. In combined analyses where interaction between treatments was significant, the highest average seed yield (87 kg/0.1 ha) was obtained from plots that were 17.5 cm row spaced and 12 kg/0.1ha seed rate used. (Table 1)

Since no interaction among treatments was found and it was difficult to see changes across the years, MSA was used to overcome this problem. In Figure 1, where only the best seed yielding treatment combinations are given, effects of treatments vary across environments. In our study, amount of precipitation received during the growing period of Hungarian vetch is one of the factors that determines experimental conditions. In this study, a good environment (which has higher overall treatment averages, higher environmental indices) is represented by the year 1991 and the worst environment by 1993. The highest seed yields were obtained from the plots with 17.5 cm row spacing and 15 kg/0.1ha seed rate in good environment (in the years similar to 1991 precipitation or in the regions which have precipitation regime similar to 1991). However, in the environments (precipitation in the range of years 1992 and

1993), where potential average seed yield is less than about 80 kg/0.1ha, seeding rate should be reduced to 12 kg/0.1ha to obtain maximum seed yields.

Hay production

There was no significant interaction « row spacing x seed rate » in any of the trial years. However, hay production significantly differed in year 1992 for row spacing and for seed rate in all the three years. Plots with 52.5 cm row spacing produced the highest average hay yield (292 kg/0.1ha). Seed rate of 12-15 kg/0.1ha produced higher hay yields than the other seed rates (Table 1). Figure 2 indicates variation of treatment interaction across environments for hay yield. Plants in plots with 52.5 cm row spacing and 12 kg/0.1ha seeding rate always produced higher hay yields than other plots in every environment followed by plots with 17.5 cm row spacing and 12 kg/0.1ha seeding rate.

Observations made at early establishment stage showed that plants in the narrow row-spaced plots covered soil surface earlier than the plants in the wider row spaced plots. These plants in the former plots also flowered earlier compared with the latter. Higher seed yield from narrow-spaced plots may be explained with this early flowering. For both seed and hay yield, 12 kg/0.1ha seeding rate is optimum regardless of row spacing. However, if available soil moisture is high, seeding rate could be increased for higher yields.

We conclude that narrow-row spacing covers more soil surface in early season conserving soil moisture by decreasing proportion of moisture losses from soil. This extra moisture rapidly utilized by plants for early vegetative growth resulting in early flowering and consequently longer generative period and thus higher seed yield. Contrarily on the country, wider-row spacing promote vegetative growth by decreasing shading effects of the plants.

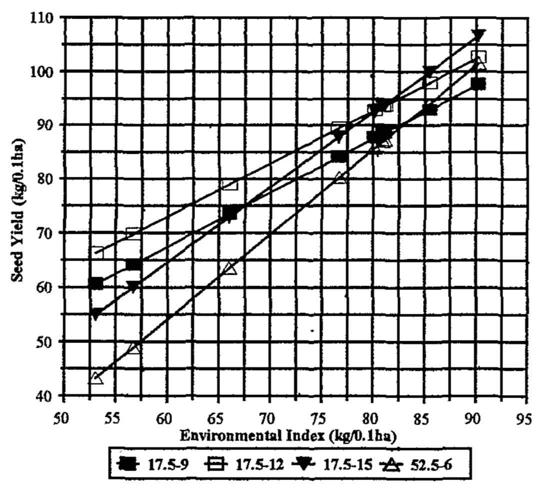

Figure 1. Effects of row space x seeding rates on Hungarian vetch seed yields across environments (1991-1993)

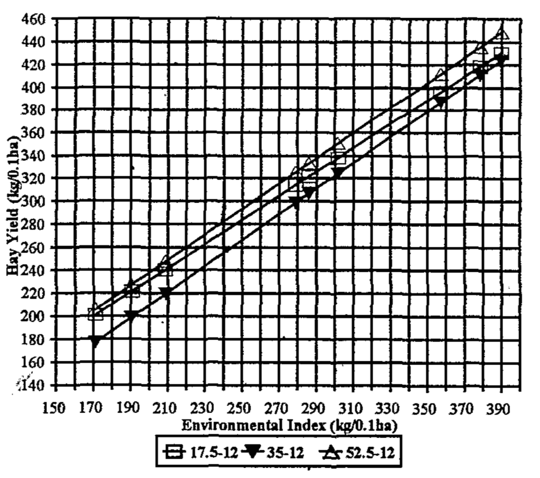

Figure 2. Effects of row space x seeding rates on Hungarian vetch hay yields across environments (1991-1993)

Table 1. Average seed and hay production under different row spacing and seeding rate.

Row Spacing (cm)	Seeding Rate (kg/0.1ha)	Seed and hay yield obtained(kg/0.1ha)							
		1991		1992		1993		Average	
		Seed	Hay	Seed	Hay	Seed	Hay	Seed	Hay
17.5	6	76	318	72	269	38	148	62 h	245
	9	86	381	95	249	66	166	82 abc	265
	12	85	422	102	284	75	185	87 a	297
	15	90	416	102	325	63	224	85 ab	322
	mean	***84 a***	***384***	***93 a***	***282 b***	***61***	***181***	***79 a***	***282***
35.0	6	84	331	89	280	58	160	77 bcde	257
	9	82	380	95	276	61	178	80 abcd	278
	12	83	418	81	290	53	206	73 defg	305
	15	85	386	62	294	62	228	70 efgh	303
	mean	***84 a***	***379***	***82 b***	***285 b***	***59***	***193***	***75 b***	***286***
52.5	6	72	303	108	272	52	163	77 bcde	246
	9	84	353	91	280	58	194	77 bcde	276
	12	70	452	86	319	61	233	72 defg	335
	15	72	383	66	325	50	228	63 h	312
	mean	***74 b***	***373***	***88 ab***	***299 a***	***55***	***205***	***72 b***	***292***
70.0	6	83	310	88	287	66	141	79 abcde	246
	9	79	368	85	259	62	199	75 cdef	275
	12	68	398	70	309	63	183	67 fgh	297
	15	70	384	76	301	48	204	65 gh	296
	mean	***75 b***	***365***	***80 b***	***289 ab***	***60***	***182***	***72 b***	***279***
	F LSD	0.05 6	ns	0.05 9.2	0.05 11.6	ns	ns	0.01 0.05 4† 9.1‡	ns
Means of seeding rates									
	6	79	316 c	89 a	277 bc	54	153 c	74 b	249 c
	9	83	371 b	92 a	266 c	62	184 b	79 a	274b
	12	76	423 a	85 ab	301 ab	63	202 ab	75 ab	309 a
	15	79	392 ab	77 b	311 a	56	221 a	71 b	308 a
	F LSD	ns	0.01 38.0	0.05 8.5	0.05 31.3	ns	0.01 24.0	0.01 4.5	0.01 13.6

† LSD value for row spacing means
‡ LSD value for row spacing x seeding rate interaction
ns none significant
values having the same letter are not significantly different at P = 0,05.

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