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Effect of Different Sulphur Doses on Yield and Yield Components at Field Pea *(Pisum sativum sp. arvense L.)* Genotypes

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Abstract: The present study was conducted to determine the effects of sulphur doses (5 doses), year and genotype factors on plant height, pod number, seed number, seed number per pod, biological yield, seed yield and 1000 seed weight on different field peas in experimental field of Yuzuncu Yil University during 2005-2006 years. For this aim, the data were analyzed using three-way ANOVA design (2 genotypes×2 years×5 sulphur doses×3 replications). The effects of genotype factor on pod number ($p<0.05$), seed yield ($p<0.01$) and biological yield ($p<0.01$) were found to be significant, whereas the influence of year on plant height, pod number, seed number and biological yield were significant ($p<0.01$). It has been suggested in present study that: The effects of genotype by year interaction on seed number and biological yield were significant, the effect of genotype by dose interaction on biological yield was found to be significant, the effects of dose by year interaction on seed number and biological yield were significant and the effects of genotype×year×dose interaction on seed number per pod, seed number and biological yield were found to be significant. As a result, it was concluded that genotype 2 in terms of pod number, seed number and biological yield was found to be more advantageous than genotype 1 as well as the highest seed yield and biological yield were obtained from 4th sulphur dose.

Key words: Sulphur dose, field pea, yield, yield component

INTRODUCTION

Sulphur absence is one of major topics on plants. Sulphur absence in soils are gradually increasing with reduction of sulphur proportion in atmosphere and the descending usage of ammonium sulfate containing sulphur, but the ascending usage of urea from N fertilizers without sulphur. Many investigator's main concern, who has studied on this topic, is to examine the effects of different sulphur forms and doses on yield and quality characteristics of plants.

Gilbert and Shaw (1997) who studied on comparison of elemental sulphur, super-phosphate, seed applications (including gypsum or elemental) covered by different forms under greenhouse and field conditions, reported that 0.1-20 kg ha^{-1} dose application of gypsum and elemental sulphur led to positive responses on *Stylosanthes guianensis* , which is one of range plants under these conditions. Average of 3 year yield in field experiment increased yield as high as 4500 and 12000 kg ha^{-1} . The differences among different sulphur forms didn't find each other.

Joshi *et al.* (1998), who conducted to determine the effect of 60 kg N and S 40 kg S ha^{-1} on *Brassica juncea* plants, reported that, with increasing N amount, oil level decreased, but increased S amount and maximum linoleic and linolenic acids were obtained by using these N and S doses. Patel *et al.* (2004), who conducted to examine the effects of 20-40 kg S ha^{-1} at gypsum form on clover seed after 2 herbage harvests, stated that seed yield, dry matter and crude protein yields provided significantly increases.

Christa *et al.* (2004), inspecting the effect of S applications on yield of sugar beet under pot and field experiments, determined that S level in soil under field condition was sufficient, but the least under pot studies and yield and sucrose contents decreased in S applications. When S content in young leaves was 0.3% or more than 0.3% (N/S ratio was less than 20), sugar beet plants were explained to have sufficient S. Thus, it is given a decision whether plant will need S element, observing young leaves of sugar beet plant in July month.

Losak and Wisniowska-Kielian (2006), who established response of summery garlic to three sulphur

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doses (S_0 = 18.3; S_1 = 40; S_2 = 60 mg S-SO_4 kg^{-1}) under pot condition, reported that increase rate of yield ranged from 9.5-22.7% compared to control group.

Ryant and Hrivna (2004), working on determination of the effects of various sulphur forms and doses on yield and quality of summery wheat, stated that the best response was obtained by application of elementer sulphur to leaves.

The study aimed to determine the effects of sulphur doses (5 doses), year and genotype factors on plant height, pod number, seed number, seed number per pod, biological yield, seed yield and 1000 seed weight on different field peas.

MATERIALS AND METHODS

Plant material: As plant material, two field pea genotypes with 110121 and 110121-1 numbers, which have given positive responses in previous studies, were used in the present study.

Plant growth and treatments: The field experiment was carried out in 3-way ANOVA design (2 genotypes×2 years×5 sulphur doses) with ×3 replications. All combinations of genotypes×years×sulphur doses were assigned randomly to all plots. Each plot set at 5×4 m = 20 m^2. Distances between plots and blocks set as 2 m. Five different S doses used in the present study were 0, 40, 80, 120 and 160 kg ha^{-1}.

Statistical analysis: The aim of the present study was to determine the effects of years, genotype, sulphur application as well as these factor's two and three-way interactions on plant height, pod number, seed number, seed number per pod, biological yield, seed yield, 1000 seed weight of plant. For this aim, the data on elements were analyzed using 3-way ANOVA with 3 replications. Statistical Analyses were performed using GLM (General Linear Model) procedure of SAS package program (SAS, 1998). Duncan's Multiple Range Test was used to determine whether the difference between two means was statistically significant.

RESULTS AND DISCUSSION

ANOVA and Duncan's Multiple Range test results of Plant height, Pod number, Seed number, Seed number per pod, Biological yield, Seed yield and 1000 seed weight are presented in Table 1.

The effect of year factor on plant height in field pea was found to be significant ($p<0.05$), whereas the influences of genotype, S dose, genotype×year interaction, genotype×S dose interaction, year×S dose interaction and genotype×year×S dose interaction on plant height were non-significant. It is clear in Table 1 that plant height in 2005 was found to be higher than that in 2006 and the difference between plant height averages of second and third doses was only found to be significant ($p<0.05$).

Table 1: ANOVA and Duncan's Multiple Range test results of Plant height, Pod number, Seed number, Seed number per pod, Biological yield, Seed yield, 1000 seed weight

	F values						
Variation source	Plant height(cm)	Pod number	Seed number	Seed number per pod	Biological yield (kg ha^{-1})	Seed yield (kg ha^{-1})	1000 seed weight (g)
Genotypes	0.04	5.10*	25.37**	0.01	45.2**	0.75	0.03
Year	50.69**	12.27**	138.04**	0.57	233.91**	32.91**	0.00
Dose	1.84	9.36**	7.3**	2.3	26.36**	20.0**	1.69
Genotype*year	0.08	0.29	13.04**	3.28	13.73**	2.12	2.24
Genotype*dose	0.048	1.02	1.65	2.38	6.27**	1.73	0.78
Year*dose	1.22	1.18	1.45	1.39	20.79**	4.06**	1.03
Year*dose*genotype	0.84	1.14	0.46	4.69**	7.72**	5.31**	0.53
R^2	63.07	63.1	84.6	54.0	93.1	80.01	31.5
Genotype							
1	46.19a	12.16b	36.8b	4.25a	2195.0b	816.0a	133.47a
2	45.94a	14.47a	46.55a	4.24a	2800.0a	851.3a	133.95a
Year							
2005	50.7a	11.52b	30.31b	4.31a	1803.2b	716.2b	133.66a
2006	41.43b	15.11a	53.04a	4.18a	3202.0a	951.1a	133.76a
Dose							
1	46.03ab	9.38d	34.36c	4.55a	1740.40d	621.3d	130.34a
2	48.2a	10.57cd	38.31c	3.88b	2202.40c	703.3cd	136.68a
3	43.37b	12.94bc	40.68bc	4.47ab	2843.6ab	762.7c	138.04a
4	45.02ab	17.49a	48.68a	3.98ab	3028.8a	1126.7a	133.85a
5	47.72ab	16.2ab	46.35ab	4.36ab	2697.6b	954.3b	129.62a

*: $p<0.05$ **: $p<0.01$, a,b :The difference between two means with difference letter in each main factor was at significant at 5 (%) level

As seen from Table 1, the effects of main factors such as genotype ($p<0.05$), year ($p<0.01$) and S dose ($p<0.01$) on pod number in field pea were found to be significant, but the effects of genotype×year interaction, genotype×S dose interaction, year×S dose interaction and genotype×year×S dose interaction on pod number were non-significant. As shown in Table 1, it is obvious that Genotype 2 was found to be higher pod number (more advantageous) than other ($p<0.01$) and pod number in 2005 was found to be lower than that in 2006. The differences between averages of all doses found to be significant ($p<0.05$).

As seen from Table 1, the effects of main factors such as genotype ($p<0.01$), year ($p<0.01$), S dose ($p<0.01$), genotype×year interaction ($p<0.01$) on seed number in field pea were found to be significant, but the effects of other factors were non-significant. It is demonstrated clearly that Genotype 2 was found to be higher seed number (more advantageous) than Genotype 1 ($p<0.01$) and doses with the best response were 4th and 5th S doses.

It is clear in Table 1 that the effect of genotype×year×S dose interaction on Seed number per pod was only found to be significant ($p<0.01$), other factors were non-significant.

The effects of all main factors and interactions on biological yield (kg ha^{-1}) were found to be significant ($p<0.01$).

The effects of year, S dose, year×S dose interaction and genotype×year×S dose interaction on seed yield (kg ha^{-1}) were found to be significant ($p<0.01$), but the effects of other factors were found to be non-significant.

The effects of all main factors and interactions on 1000 seed weight (g) were found to be non-significant (Table 1).

CONCLUSION

It was concluded that expect for 1000 seed weight (g), other yield and yield components were positively affected by ascending S doses. This finding was exactly in agreement with those reported by many authors (Gilbert and Shaw 1997; Joshi *et al*., 1998; Patel *et al*., 2004; Christa *et al*., 2004; Losak and Wisniowska-Kielian, 2006; Ryant and Hrivna, 2004).

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