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Agronomic performance of the selected Turkish grass pea (*Lathyrus sativus* L.) landraces

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Abstract. Eighteen selected Turkish landraces, one registered variety and four ICARDA origin genotypes of grass pea (*Lathyrus sativus* L.) were assessed for seed yield, protein ratio, 1000 seed weight and ODAP content in the Central Anatolian conditions under spring (2015) and autumn (2014) sowing. The effects of the genotype and sowing time were significant on the studied traits. Except protein ratio, investigated traits were higher among genotypes under autumn sowing. Seed yield varied from 101,90 to 187,31 kg/da, with a mean of 149,62 kg/da in spring sowing and was between 129,13 and 310,95 kg/da with a average of 205,85 kg/da in autumn sowing. Mean ODAP content of genotypes was 3.95 and 3.27 mg g^{-1} in autumn and spring sowing respectively. Many of the landraces were superior than registered variety in terms of the all the investigated traits in both sowing time. Especially higher seed yield and low ODAP content in the landraces is promising for developing new cultivars.

Keywords. Grass pea – Landraces – Seed yield – ODAP.

Performances agronomiques de la gesse turque (*Lathyrus sativus *L.) sélectionnée parmi les variétés locales

Résumé. *Dix-huit variétés locales turques sélectionnées, une variété enregistrée et quatre génotypes d'origine ICARDA de gesse (*Lathyrus sativus *L.) ont été évalués pour le rendement grainier, le ratio de protéines, le poids de 1000 graines et la teneur en ODAP pour un semis dans les conditions de l'Anatolie centrale au printemps (2015) et à l'automne (2014). Les effets du génotype et du moment du semis étaient significatifs sur les caractéristiques étudiées. Sauf le ratio de protéines, les caractères étudiés étaient plus élevés chez les génotypes en semis d'automne. Le rendement en graines variait de 101,90 à 187,31 kg/da, avec une moyenne de 149,62 kg/da dans les semis de printemps et était entre 129,13 et 310,95 kg/da avec une moyenne de 205,85 kg/da en semis d'automne. La moyenne de teneur ODAP des génotypes était de 3,95 et 3,27 mg g-1 pour les semis en automne et au printemps respectivement. Beaucoup de variétés locales étaient supérieures aux variétés enregistrées en termes des caractères évalués pour les deux temps de semailles à la fois. En particulier, le haut rendement en graines et la faible teneur en ODAP dans les variétés locales sont prometteurs pour le développement de nouvelles variétés.*

Mots-clés. *Gesse – Variétés locales – Rendement en graines – ODAP.*

I – Introduction

Agricultural point of view, *L. sativus (*grass pea*)* is a most important species of the *Lathyrus* genus in the entire world as food (Jackson and Yunus, 1984) and, lesser as feed and forage. Grass pea is atractive crop with a number of agronomic characters such as drought tolerance; insects and pests resistance; nitrogen fixation; hardy root system; low input requirment, high seed yield and protein content (Campbell, *et al.,* 1994). These features made grass pea an excellent crop in sustainable farming especially in drought-prone and marginal areas. Overconsumption of grass pea more than three months as a staple diet caused motor system disease named lathyrism. The responsible agent for lathyrism is ß-N-oxalyl-L-a,ß-diaminopropionic acid (ODAP). So, reducing the ODAP content is main concern in grass pea breeding (Kumar *et al*., 2011).

Although increasing interest, grass pea has received very little attention in Turkey and, aproximately all the cultivated seeds are landrace types. The new varieties with high yield and

low ODAP content can contribute to increase grass pea cultivation. Thus present stuy aim to investigate seed yield and chemical content (protein, ODAP) of selected gass pea genotypes.

II – Materials and methods

Eighteen landraces, previously selected for seed yield within Turkish landraces, one registered variety and four ICARDA lines of *Lathyrus sativus* (Table 1) were investigated for seed yield, 1000 seed weight (TSW), seed protein ratio and ß-N-oxalyl-L-a,ß-diaminopropionic acid (ODAP) content in the Central Anatolian conditions under autumn and spring sowing. Experiments were established on 9 October 2014 and 24 March 2015 and arranged as randomised block design with three replications. Climatic conditions in growing season were given in Fig. 1. Total nitrogen was determined by the Kjeldahl method and protein ratio was estimated using a conversion factor of 6.25. Quantitative estimation of ODAP was done by the method of Rao (1978) with some modifications. Anova was performed by using SPSS 13.0 package program and Duncan's multiple range test was used to separate the means.

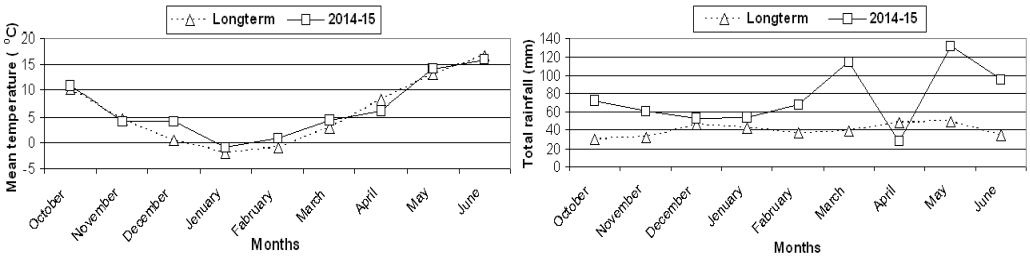

Fig. 1. Climatic condidtions in experimental area during vegetation period.

III – Results and discussion

Seed yield, seed protein ratio, TSW and seed ODAP content of grass pea genotypes under autumn sowing (AS) and spring sowing (SS) were given in Table 1. Over the genotypes, mean seed yield, protein ratio, TSW and ODAP content of grass pea genotypes were different between AS and SS and, except protein content, were higher in AS. In addition, the effect of the genotypes on all the traits was significant ($p<0,05$) in both sowing time. Inter genotype variation (CV%) was also clearly high for all the traits under AS (Table 1). Under AS, mean seed yield of the grass pea genotypes varied from 129.13 kg/da to 310.95 kg/da (average 205. 85 kg/da) an it was higher about 30 percent than SS. High yielding genotypes were landrace 6408 and 5501 in AS while its were landrace 6410, 6402, 2401, 2006 in SS.

Contrary to other traits, protein content was higher in SS and also it was a trait that showed lowest variation among genotypes with 3.00 CV% in AS and 2.43 CV% in SS. Protein content in grass pea seed varied from 24.11% to 27.04% (average 25.67%) in AS and varied from 25.48% to 27.82% (average 26,79%) in SS. The highest protein content was determined in landrace 4401 and 4901 in AS and was determined in landrace 4404, 4403 and 4901 in SS. Average TSW of genotypes was clearly high in AS. It was between 118.93 g and 177.80 g in AS and was between 122.60 g and 148.66 g in SS. Landrace 0201, Sel 564 and Sel 560 had highest TSW. Similarly Sel 560 and 564 had highest TSw under SS.

ODAP content was different between sowing times. It showed high variation among genotypes especially in AS (CV= 31.68%) and was the highest in landrace 4403 (6.15 mg g-1), 4404 (5.85 mg g-1) and 4901(6.41 mg g-1) 5501(5.82 mg g-1). The landrace 4403, 4401 and Sel 566 were highest ODAP content genotypes in SS. ODAP content is highly affected by climatic conditions

and shows high genotype × environment interaction (Girma and Korbu, 2012). It can reach up 16 mg g-1 (Tamburino et al., 2012), 2 mg g-1 is critical value (Abd El-Moneim et al., 2010). In terms of the ODAP content, the best genotype seem to be Sel 565 for AS and landrace 5501 for SS, however, its seed yield not high at the same seasons.

Table 1. Origin of the investigated grass pea genotypes

Genotypes	Genotype origins			
	City	Town	Willage	Rakım (m)
Sel 560	ICARDA			
Sel 564	ICARDA			
Sel 566	ICARDA			
Sel 565	ICARDA			
0201	Adıyaman	Merkez	Dardogan	825
1501	Burdur	Bucak	Kızılkaya	787
1603	Bursa	Harmancık	Demirciler	719
1604	Bursa	Local seed market		
1803	Cankırı	Eldivan	Elmacı	957
2006	Denizli	Cal	Baklancakırlar	886
2401	Elazıg	Merkez	Uzuntarla	995
4301	Kutahya	Domaniç	-	
4401	Malatya	Darende	Yenikoy	1600
4403	Malatya	Darende	Basdirek	1445
4404	Malatya	Local seed market		
4901	Mus	Merkez	-	
5001	Nevsehir	Kozaklı	Kalecik	1120
5006	Nevsehir	Acıgol	Tatlarin	1113
5501	Samsun	Kavak	Degirmenci	600
6402	Usak	Merkez	Kasbelen	960
6408	Usak	Ulubey	Kılsa	800
6410	Usak	Ulubey	Kılsa	800
Gurbuz	Registered variety			

These results show that many of the investigated landraces are superior than registered variety in both sowing time, therefore, can be canditate variety. Especially landrace 6408, 4301 and 1803 are promising for AS while landrace 6410, 6402, 2401, 2006 for SS due to their high seed yield and low or moderate ODAP content.

IV – Conclusions

The differences between sowing time indicate that breeding or selection program of grass pea should be carried out for autumn and spring seasons sperately. In general, autumn sowing produced a high seed yield but also high ODAP content. Today ODAP not seem to be a problem and it can be detoxified with some physical of chemical methods. For these reason, autumn sowing seem to be best way. However, grass pea is a plant having spreading growth habit. Therefore, if grass pea will be seeded in autumn, lodging should be taken into account.

Table 2. Seed yield, potein ratio and ODAP content of grass pea genotypes under autumn and spring sowing

Genotype	Seed yield (kg/da)		Protein ratio (%)		TSW (g)		ODAP (mg g-1)	
	Autumn	Spring	Autumn	Spring	Autumn	Spring	Autumn	Spring
Sel 560	177.86 i	142.69 b-f	24.11 j	25.50 i	168.67 ab	148.66 a	3.76 de	3.35 cde
Sel 564	129.13 n	141.53 c-f	24.69 i	25.48 i	172.33 a	148.03 ab	3.29 d-h	3.38 cde
Sel 566	217.37 f	124.44 fg	25.07 h	26.29 fgh	152.07 cde	143.28 abc	3.34 d-g	3.89 ab
Sel 565	211.29 f	161.30 a-d	24.55 i	25.71 hi	145.87 def	130.12 c-i	2.11 j	2.90 efg
0201	147.99 m	145.52 b-f	26.06 d	26.71 c-f	177.80 a	144.31 abc	3.86 cd	3.15 d-g
1401	178.01 i	152.55 b-f	25.59 g	27.13 a-e	131.93 gh	115.34 ij	2.22 ij	2.97 d-g
1603	210.67 f	155.88 b-e	25.52 g	26.88 b-f	158.80 bc	133.02 b-g	3.57 de	3.03 d-g
1604	170.68 jk	139.68 c-f	26.02 de	25.96 ghi	170.87 a	138.58 a-e	2.86 fgh	3.03 d-g
1803	272.10 c	129.12 ef	25.84 de	27.36 abc	141.27 efg	119.43 g-j	3.18 e-h	3.29 c-f
2006	201.28 g	172.36 ab	26.69 b	26.59 d-g	146.83 def	113.28 j	3.47 def	3.17 d-g
2401	167.53 kl	171.67 ab	25.85 de	27.23 a-d	140.30 fg	126.13 d-j	2.76 ghi	3.51 bcd
4301	298.10 b	164.77 abc	25.79 ef	26.49 efg	138.93 fg	137.98 a-f	3.57 de	2.71 gh
4401	161.79 l	134.26 def	27.04 a	27.11 a-e	147.47 c-f	123.59 e-j	5.02 b	4.03 a
4403	152.88 m	101.90 g	25.84 de	27.81 a	139.57 fg	131.13 c-h	6.15 a	4.1 a
4404	190.47 h	133.98 def	26.42 c	27.82 a	155.30 cd	139.66 a- d	5.85 a	3.82 abc
4901	163.91 kl	154.49 b-e	26.85 ab	27.45 ab	139.03 fg	125.17 d-j	6.41 a	3.79 abc
5001	176.53 ij	159.26 a-d	26.00 de	26.76 b-f	150.03 c-f	122.78 f-j	5.00 b	2.95 efg
5006	265.23 d	149.40 b-f	24.49 i	27.09 b-e	148.50 c-f	121.79 g-j	3.17 e-h	2.99 d-g
5501	304.56 ab	153.52 b-f	25.28 h	26.52 d-g	139.13 fg	122.01 g-j	5.82 a	2.39 h
6402	195.98 gh	172.13 ab	25.25 h	26.97 b-f	127.20 hi	125.41 d-j	3.57 de	3.31 cde
6408	310.95 a	157.50 b-e	25.16 h	26.91 b-f	118.93 i	115.79 hij	2.68 hij	3.50 bcd
6410	239.74 e	187.31 a	26.46 c	27.35 abc	122.73 hi	112.60 j	4.68 b	2.75 fgh
Gurbuz	190.45 h	136.00 c-f	25.88 de	26.94 b-f	120.13 i	114.54 ij	4.40 bc	3.25 d-g
Mean	205.85	149.62	25.67	26.79	145.81	128.38	3.95	3.27
Min	129.13	101.90	24.11	25.48	118.93	112.60	2.11	2.39
Max	310.95	187.31	27.04	27.82	177.80	148.66	6.41	4.10
CV%	25.47	12.56	3.00	2.43	11.21	8.90	31.68	13.45

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