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Phenology and grain yield of some common vetch (*Vicia sativa* L.) accessions in Tunisia

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Abstract. The phenology and agronomic characteristics of seven accessions of common vetch (*Vicia sativa* L.) were assessed over two years and contrasting sites through making the following notations and measurements: flowering and maturing dates, seed and biological yield, pod number per plant, seed number per pod, seed weight, and percent of shattering. Analysis of variance showed a significant effect of the environment (sites, year and site x year interaction) on all the agronomic and phenologic traits except the number of pods/plant. Significant variation was found between accessions for earliness, seed weight and number, and seed yield. All accessions flowered earlier in the sub-humid site while seed yield, seed number and weight were higher in the semi arid site. Positive and significant correlations were found between seed yield and seed number (r=0.47, P<0.04, n=19), flower number and seed weight (r=0.88; P<0.001) and flower number and seed yield (r=0.93; P<0.0001). The highest average seed yield was recorded for INRAT 303, a local variety (1232 kg ha^{-1}), while the lowest value was recorded for accession VS7 from Syria (888 kg ha^{-1}). Based on their earliness and lower shattering rate, accessions VS8 and VS15 originating from Cyprus and Afghanistan respectively, were selected as promising grain yielding lines.

Keywords. *Vicia sativa* L. – Semi arid – Sub humid – Seed yield – Shattering.

Phénologie et rendement en graines de quelques accessions de vesce commune (*Vicia sativa *L.) en Tunisie

Résumé. *La phénologie et les caractéristiques agronomiques de 7 accessions de vesce commune (*Vicia sativa *L.) ont été évaluées sur deux années et deux sites contrastés à travers les notations et les mesures suivantes: date de floraison et de maturité, rendement en graines et rendement total, nombre de gousses/plante, nombre de graines/gousse, poids des graines et pourcentage d'égrainage. L'analyse de variance montre un effet significatif de l'environnement (site x année) sur tous les caractères agronomiques et phénologiques sauf sur le nombre de gousses/plante. Toutes les accessions fleurissent précocement dans le site subhumide alors que le rendement en graines, le nombre et le poids des graines sont plus élevés dans le site semi-aride. Des corrélations significatives ont été trouvées entre le rendement en graines et le nombre de graines/gousse (r=0,47, P<0,04, n=19), entre le nombre de fleurs et le poids des graines (r=0,88; P<0,001) et entre le nombre de fleurs et le rendement en graines (r=0,93; P<0,0001). Le rendement en graines moyen le plus élevé a été enregistré chez la variété locale INRAT 303 (1232 kg ha^{-1}), alors que le plus faible a été observé chez l'accession VS7 en provenance de Syrie (888 kg ha^{-1}). En se basant sur la précocité et le faible taux d'égrainage, les accessions VS8 et VS15 provenant respectivement de Chypre et d'Afghanistan, ont été retenues comme étant des lignées prometteuses à bon rendement en graines.*

Mots-clés. *Vicia sativa* L. *– Semi-aride – Sub-humide – Rendement en graines – Égrainage.*

I – Introduction

In Tunisia, the current situation is marked by an increase in consumption and prices of basic products (cereals for human consumption and concentrates for animals). The use of productive and well adapted forages and cereals varieties in association with appropriate management techniques and practices is likely to reduce production costs and provide economical solutions to farmers. Nowa-

days, several registered varieties of forage legumes (e.g. vetch and pea) and grasses (e.g. oats, barley, tall fescue) selected from local or introduced genetic resources may contribute positively to these requirements. Beside their large adaptation and high nutritional values, these varieties are able to provide a rich and balanced diet for animal husbandry. Among them, vetch grains present high crude protein content (about 30%) and are candidates to potentially replace soybean in the formulation of concentrate for ruminants (Ben Salem, pers. comm.). In previous studies, it has been proven that grazing vetch by dairy sheep resulted in a substantial reduction of soybean meal incorporation level in the daily diet (Atti and Hassen, data not published). In the purpose of searching alternatives to soybean meal, the aim of the present study is to test introduced and local accessions of common vetch for earliness and grain yield potential under Tunisian environments.

II – Materials and methods

1. Trials management

The trials were conducted under rain fed conditions in two contrasting sites (Oued Béja and Oued Mliz) during two cropping years (2009/2010 and 2010/2011). Oued Beja site (OB) has a sub humid Mediterranean climate with 600 mm average annual rainfall, cold winter and hot summer. Oued Mliz site (OM) has a semi arid environment with 460 mm rainfall, cold winter and hot dry summer. The total amount of rainfall recorded in Oued Béja was 362 mm and 498 mm in 2010 and 2011, respectively, and that recorded in Oued Mliz was 498 mm and 593 mm in 2010 and 2011, respectively. The two experiment years were dryer in Oued Béja and wetter in Oued Mliz compared to their corresponding average rainfall.

2. Plant material

In 2010-2011, four accessions originated from different Mediterranean countries were received from ICARDA in the frame of germoplasm exchange and, evaluated in comparison with two local checks (var. Mghila and var. INRAT 303). For each year and site, a complete block design with three replications was used. Each accession was sown in a plot of four rows of 4 m long and 30 cm apart.

3. Measurements

Agronomic traits were determined during the first and the second year in both sites through measuring seed yield, seed yield components such as seed weight and number, pod number and weight, number of flowers per plant, biological yield, percentage of shattering and empty pods. The four latest parameters were evaluated at Oued Béja only during one year and that was made on 20 individual plants randomly taken from each plot. The remaining plants were cut for seed yield. Phenologic traits such as days to flowering and days to maturity were recorded in both sites.

4. Statistics

Analysis of variance was performed on seed yield with year and site as random effects and accession as fixed effect. For the other agronomic traits, ANOVA was performed with the year random effect. Analyses were performed using SAS (SAS Institute, 1998-2000).

III – Results and discussion

There is a significant effect of site, year and site x year interaction on all agronomic and phenologic traits except the number of pods per plant (Table 1). Significant variation was found between accessions for earliness, seed weight and number and seed yield. Pod number and seed weight were two times higher in the semi arid site of Oued Mliz than in the sub humid site of Oued Béja (Table 1).

On average, accessions flowered and matured earlier in Oued Béja than in Oued Mliz (107.5 days *vs* 125.5 days and 145.6 days *vs* 163 days, respectively) (Table 1). The average biological yield ranged from 438 kg ha^{-1} for var. INRAT303 to 2867 kg ha^{-1} for accession VS7. These results are consistent with those obtained by Larbi *et al*. (2010) in North West Syria (3.3 and 2.2 t ha^{-1} in wet and dry environments, respectively). Shattering rate varied between accessions from 20 to 32% in var. Mghila and accession VS11, respectively. INRAT303 was the most shattering variety.

Table 1. Means of all accessions of common vetch (*V. sativa* L.) for phenologic and agronomic traits

Accession name	Days to flowering	Days to pod maturity	Number of flowers†	Biological yield (kg ha^{-1})†	Shattering† (%)	Seed number pod^{-1}	1000 seed weight (g)	Pod number plant^{-1}
VS 15	110.2^{c}	145.7^{c}	29.13^{b}	800^{bc}	28.0^{b}	5.2^{a}	54.8^{bc}	58.3^{a}
VS 8	107.4^{c}	145.4^{c}	38.20^{b}	1620^{bac}	21.9^{b}	5.0^{a}	59.2^{bc}	60.5^{a}
VS 11	110.9^{c}	148.5^{c}	37.67^{b}	1283^{bac}	31.7^{b}	5.1^{a}	59.0^{ba}	52.0^{a}
VS 7	121.7^{a}	162.8^{a}	32.80^{b}	2867^{a}	31.0^{b}	4.7b^{a}	59.4^{ba}	57.5^{a}
INRAT 303	121.7^{a}	162.5^{a}	94.90^{a}	438^{c}	50.0^{a}	3.9^{b}	52.9^{c}	61.7^{a}
Mghila	113.5^{b}	152.1^{b}	17.50^{b}	2575^{ba}	20.0^{b}	4.8^{ba}	63.6^{a}	44.2^{a}
Total mean	*114.5*	*152.3*	*37.8*	*1512*	*27.8*	*4.8*	*58.7*	*54.5*
SE	*2.6*	*2.4*	*26.6*	*954.1*	*7.3*	*0.9*	*4.8*	*18.7*
Mean OB	*107.5*	*145.6*	–	–	–	*3.9^{b}*	*52.2^{b}*	*55.6^{a}*
Mean OM	*125.5*	*163.0*	–	–	–	*6.3^{a}*	*68.9^{a}*	*52.8^{a}*

† Recorded at one site and for one year only (Oued Béja 2010). Numbers with the same letter in a same column are not significantly different at P<0.05 level. OB: Oued Béja site, OM: Oued Mliz site.

Seed yield was two times higher in the semi arid site than in the sub humid one (Table 2). This proves that common vetch is more adapted to dry and cold conditions.

Table 2. Seed yield (kg ha^{-1}) of *Vicia sativa* accessions evaluated in two sites and over two years

	Oued Béja site				Oued Mliz site				
	2010		2011		2010		2011		
Accessions	**Mean**	**Sd**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Accession average**
VS 7	206.8	98.5	–	–	1570.1	138.4	–	–	888.5^{b}
VS 8	308.0	125.8	1218.0	172.8	1754.7	300.8	323.3	134.3	901.0^{b}
VS 11	380.4	171.2	1023.3	538.4	1604.1	309.8	373.3	66.6	845.3^{b}
VS 12	245.5	173.7	–	–	1553.8	285.4	–	–	899.7^{b}
VS 15	154.2	69.7	1328.0	176.5	1860.6	224.9	406.7	32.1	937.4^{b}
INRAT303	342.9	380.4	–	–	2122.6	126.3	–	–	1232.7^{a}
Mghila	708.8	116.9	719.3	267.0	1639.6	493.6	380.0	249.8	861.9^{b}
Year average									
2010	1032.3^{a}								
2011	721.5^{b}								
Site average									
Oued Béja	303.0^{b}								
Oued Mliz	1235.3^{a}								

–: not included in the trial; values with the same letter are not significantly significant at P<0.05. SD: standard deviation.

Compared to other countries, the average total seed yield recorded in our experiments (0.9 t ha-^{1}) is higher than that obtained by Berger *et al.* (2002) in north Syria (0.4 t ha^{-1}) and lower than that obtained by Benyoussef *et al*. (data not published) (1.7 t ha^{-1} for both Mghila and INRAT303 under 356 mm in Tunis), and that of Larbi *et a*l., (2010) in wet conditions of north Syria (1.2 t ha^{-1}). A highest grain yield of 2.2 t ha^{-1} was obtained by Miki *et al.* (2013) in one accession of Serbia. Under more favourable climate in Tunisia (> 600mm rainfall), Hassen and Atti (data not published) obtained a biological seed yield of 3 t ha^{-1} for the variety Mghila grown in a mixture with spring triticale used as tutor.

Significant correlations were found between flower number and seed weight (r=0.88. p<0.0001) and flower number and seed number per pod (r=0.93. P<0.001) which themselves are correlated to seed yield (r=0.54, P<0.02, n=19; r=0.47, P<0.04, n=19).

IV – Conclusion

The evaluation of common vetch under contrasting environments has demonstrated interesting grain yields for the semi arid conditions. High seed weight, low shattering rate and earliness are important criteria for selecting promising lines of common vetch. Based on these criteria, VS8 and VS15 were retained for registration as commercial cultivars for grain purpose.

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