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Analysis of Genetic Parameters for Some Agronomic Traits of Introduced Ethiopian Mustard (*Brassica carinata* A. Brun) Genotypes

Yared Semahegn Belete, Misteru Tesfaye Wolde Yohannes and Tadesse Debele Wami
Holetta Research Center, Ethiopian Institute of Agricultural Research, P.O. Box 2003, Addis Ababa, Ethiopia

Corresponding Author: Yared Semahegn Belete, Holetta Research Center, Ethiopian Institute of Agricultural Research, P.O. Box 2003, Addis Ababa, Ethiopia

ABSTRACT

The present investigation was undertaken to estimate various genetic parameters for some agronomic traits of introduced Ethiopian mustard (*Brassica carinata* A. Brun) genotypes. The experiment was laid out in randomized complete block design with three replications at Holetta Research Center, Ethiopia. Analysis of variance showed significance difference among the genotypes for traits studied except plant height and seed yield. Phenotypic Coefficient of Variation (PCV) and Genotypic Coefficient of Variation (GCV) ranged from 1.2-10.2% and 1.9-6.8%, respectively. The highest heritability values was shown by oil content (99.8%) followed by days to flowering (96.5%) and days to maturity (89.1%). High heritability along with high genetic advance (as percent of mean) was recorded for days to flowering and oil content. Days to flowering, days to maturity and oil content are important traits to be considered for further variety development program.

Key words: Agronomic traits, Ethiopian mustard, erucic acid, genetic parameters, germplasm introduction

INTRODUCTION

Ethiopian Mustard (*Brassica carinata* A. Brun) is one of the oilseed crops grown in Ethiopia. Enhancing cultivation of oilseeds, in general, is valuable in improving the livelihood of the farming community in the country (Wijnands *et al*., 2007). As compared to other vegetable oil, the oil of Ethiopian mustard contains less amount of the fatty acids with 16- and 18-C atoms but comparable with other vegetables oil in other long chain monoenoic fatty acid like erucic acid (Downey, 1990; Becker *et al*., 1999). The presence of high erucic acid content (35-44%; Becker *et al*., 1999) 35-51%; (Alemayehu and Becker, 2001) in the seed oil of the crop is among the most bottlenecks for its production and use as edible vegetable oil. This is because the seed oil is not considered favourably as a constituent of the human diet due to its unpleasant taste as a consequence of its high content of erucic acid (C22:1). Major oilseed processors in Ethiopia blend it with other seed oil like cotton seed (*G. hirsutum* L.) for production of edible oil. Successful breeding programs, however, have decreased the content of erucic acid in the seed oil (De Haro *et al*., 2001). Broadening the genetic base through introduction is among the breeding strategies for improvement of Ethiopian mustard (Alemu and Teklewold, 2011). Evaluation of the introduced material using various genetic parameters, however, is a pre-requisite for improvement as well as enhancement of its production for target purpose. The nature and magnitude of genetic variation have been

determined using various techniques for various crops such as lentil (*Lens esculenta* Moench) (Singh and Singh, 1997), Tomato (*Solanum lycopersicum* L.) (Rehman *et al*., 2000; Hussain *et al*., 2001; Dar and Sharma, 2011), *Rosa damascene* (Alsemaan *et al*., 2011), Coffee (Gichimu and Omondi, 2010), Wheat (Ismail *et al*., 2001), toria (*Brassica campestris* L. var Toria) (Sheikh *et al*., 1999), *Amaranthus* hybrid (Oboh, 2007), *Tribulus terrestris* (Raghu *et al*., 2007), Indian mustard (*Brassica juncea* L.) (Singh and Singh, 1997; Ghosh and Gulati, 2001) and Ethiopian mustard (Belete, 2011; Belete *et al*., 2011). This study was undertaken to estimate various genetic parameters for some agronomic traits of introduced Ethiopian mustard genotypes.

MATERIALS AND METHODS

The experimental material consisted of 5 Ethiopian mustard genotypes including 2 checks (standard variety Holetta-1 and local check). The three Ethiopian mustard genotypes such as 25X-1, N2-7399 and N2-3093 were introduced from Spain. 25X-1 was developed through interspecific crosses of selected lines of Ethiopian mustard, rapeseed (*B. napus* L.) and Indian mustard (*B. juncea* L. Czern). It is characterized by seed oil with no erucic acid (Mean±SD of 0.8±0.2 g kg^{-1}). N2-7393 and N2-3093 were developed from the Ethiopian mustard line C-101 by chemical mutagenesis and are characterized by seed oil with low (Mean±SD of 89±13 g kg^{-1}) and medium (Mean±SD of 182±14 g kg^{-1}) erucic acid genotypes, respectively. The above mentioned three genotypes were developed at the Institute for Sustainable Agriculture (CSIC) in Córdoba, Spain and released in 1998 (De Haro *et al*., 2001). The standard check Holetta-1 is characterized by seed oil with medium erucic acid content. It was developed through interspecific hybridization using Ethiopian mustard line MS-YD and *Brassica juncea* line Zem-1 with seed oil free of erucic acid (Kirk and Oram, 1981) here at Holetta Research Center and released in 2005. These materials were planted at Holetta Research Center in a Randomized Complete Block Design with three replications in 2007/08 cropping season. All the recommended agronomic practices were applied during the entire cropping season. Data were recorded on days to flowering, days to maturity, plant height in cm, seed yield in kg ha^{-1} and oil content in percent of total fat.

Data analysis: Data were subject to analysis of variance using AGROBASE™ software (Agronomix Software Inc., Canada). Phenotypic and genotypic variances of each trait were calculated as outlined by Robinson *et al*. (1951) as follows:

$$\sigma_g^2 = \frac{(MS_g - MS_e)}{r}$$

$$\sigma_p^2 = \frac{MS_g}{r}$$

where, σ^2_g is genotypic variance (GV), σ^2_P is Phenotypic Variance (PV), MS_g is mean square of genotypes (GMS), MS_e is mean square of error (EMS) and r is number of replication.

Phenotypic and genotypic coefficients of variations were estimated as per Burton and de Vane (1953) using the following formulae:

$$\text{Phenotypic coefficient of variation (PCV)} = \frac{\sqrt{\sigma_p^2}}{\bar{X}} \times 100$$

$$\text{Genotypic coefficient of variation (GCV)} = \frac{\sqrt{\sigma_g^2}}{\bar{X}} \times 100$$

where, X is mean of the trait considered.

The broad-sense Heritability (H) of each trait were calculated by dividing genotypic variance to phenotypic variance and multiplied by 100. And, the expected genetic advance under selection assuming selection intensity of 5% (2.063) was calculated for each trait following Johnson *et al.* (1955) using the following formula:

$$GA = k \times \sigma_p \times H$$

where, GA is expected genetic advance under selection, k is selection intensity σ_p is phenotypic standard deviation and H is heritability in the broad sense.

The genetic advance as percent of mean (GAM) of each trait was thus estimated by dividing the expected genetic advance of the trait to the mean of the trait considered and multiplied by 100.

RESULTS AND DISCUSSION

Analysis of variance showed significant variation among the genotypes for the traits measured except plant height and seed yield (Table 1). Days to flowering ranged from 76.00-86 days with a mean value of 80.47 days. According to Table 2, days to maturity ranged from 176 to 184 days with a mean value of 180 days. Plant height ranged from 199.3 to 205.7 cm with a mean value of 202.3 cm. Seed yield ranged from 2009-2548 kg ha^{-1} with a mean value of 2173.5 kg ha^{-1}. Oil content ranged from 40.3-43.9% with a mean value of 41.9%. Phenotypic Coefficient of Variation (PCV) and Genotypic Coefficient of Variation (GCV) ranged from 1.2-10.2 and 1.9-6.8%, respectively. The highest PCV and GCV were recorded for seed yield (10.2 and 6.9%, respectively) followed by days to flowering (5.8 and 5.7%, respectively) and oil content (3.4% for both PCV and GCV). The lowest PCV and GCV were recorded for days to maturity (2.0 and 1.9%, respectively) and plant height (1.2 and 0.7%, respectively) (Table 3). Aytac and Kinaci (2009) and Belete *et al.* (2012) found similar findings for high PCV and GCV value for seed yield in winter rapeseed (*B. napus* L.) and Ethiopian mustard, respectively. The highest heritability values was shown by oil content (99.8%) followed by days to flowering (96.5%) and days to maturity (89.1%). Plant height revealed the lowest heritability value of 36.0% which indicates that there was high environmental influence on the performance of this trait. Ali *et al.* (2003) reported similar findings of heritability values for traits such as days to flowering (66%), days to maturity (90%), Plant height (26%) and seed yield (48%) in winter rapeseed (*Brassica napus* L.). Days to flowering (11.5), Oil content (7.1) and seed yield (9.5), showed high genetic advance as percent of mean. High

Table 1: Mean squares of the five Ethiopian mustard genotypes for the traits studied

				Traits	
Mean squares	DF	DM	PH (cm)	Seed yield (kg ha^{-1})	Oil content (%)
EMS	2.27	4.27	11.20	81953.43	0.01
GMS	65.27**	39.27**	17.50	148850.43	6.22***
RMS	3.27	5.60	46.87	334151.30	0.02**

***Significant at 0.01 and 0.001 levels, respectively, EMS: Error mean squares, GMS: Genotype mean squares, RMS: Replication mean squares, DF: Days to flowering, DM: Days to maturity, PH: Plant height

Table 2: Mean and range values of the five genotypes for various traits studied

	Traits				
Genotypes	DF	DM	PH (cm)	Seed yield (kg $^{-1}$ ha)	Oil content (%)
25X-1	78.00	180.67	199.33	2009.00	41.43
N2-7399	86.00	184.00	203.67	2048.67	41.00
N2-3093	85.00	183.33	201.33	2053.67	43.90
Holetta-1	77.33	176.00	201.67	2208.33	42.80
Local check	76.00	177.00	205.67	2548.00	40.33
Mean	80.47	180.20	202.33	2173.53	41.89
Range	76.00-86.00	176.00-184.00	199.33-205.67	2009.00-2548.00	40.33-43.90
CV (%)	1.87	1.15	1.65	13.17	0.23

CV: Coefficient of variation, DF: Days to flowering, DM: Days to maturity, PH: Plant height

Table 3: Estimates of components of variance, heritability and genetic advance for various traits of the studied Ethiopian mustard genotypes

	Variance		CV				
Traits	GV	PV	GCV	PCV	H (%)	GA	GAM (%)
DF	21.00	21.760	5.69	5.80	96.5	9.29	11.54
DM	11.67	13.090	1.90	2.01	89.1	6.65	3.69
PH (cm)	2.10	5.830	0.72	1.19	36.0	1.79	0.88
Seed yield (kg^{-1} ha)	22299	49616.810	6.87	10.25	44.9	206.33	9.49
Oil content (%)	2.07	2.073	3.43	3.44	99.8	2.96	7.07

CV: Coefficient of variation, GV: Genotypic variance, PV: Phenotypic variance, GCV: Genotypic coefficient of variation, PCV: Phenotypic coefficient of variation, H: The broad sense heritability, GA: Genetic advance, GAM: Genetic advance as percent of mean, DF: Days to flowering, DM: Days to maturity, PH: Plant height

heritability along with high genetic advance was recorded for days to flowering and oil content (Table 3). This result is in agreement with the findings of Belete *et al*. (2012) in Ethiopian mustard.

CONCLUSION

The introduced genotypes have been found helpful for further variety development in our condition. Traits such as days to flowering, days to maturity and oil content should be considered in aforementioned endeavour.

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