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CORRELATION STUDIES FOR SOME AGRONOMIC AND QUALITY TRAITS IN *BRASSICA NAPUS* L.

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ABSTRACT

Genetic variability and trait correlations were investigated in a study conducted at The University of Agriculture, Peshawar during the growing season 2010-11. Data were recorded on days to flower completion, plant height, seed pod^{-1}, 100 seed weight, oil, protein, glucosinolate, linolenic acid and erucic acid content. Highly significant (P≤0.01) variation was observed for all traits except 100 seed weight. Correlations were positive significant for plant height with seed pod^{-1}(0.37), days to flowering completion with linolenic acid (0.47**), 100 seed weight with protein content (0.37*), oil content with erucic acid content (0.85**). Likewise negative significant associations were observed for oil content with protein content (-0.56**), 100 seed weight with linolenic acid (-0.04*).*

Keywords: **Genetic variability, trait correlation, agronomic and quality traits**

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INTRODUCTION

In Pakistan during the year, 2010-11 total cultivated area under rapeseed was 439 thousand acres, producing 157 thousand tons of seed, which yielded 50 thousand tons of oil. While in 2011-12¸the total cultivated area under rapeseed was 575 thousand acres, producing 203 thousand tons of seed, which yielded 61 thousand tons of oil (Anonymous, 2011-2012).

There is a huge production consumption gape which can be reduced by breeding improved cultivars. The local landraces are higher in terms of erucic acid and glucosinolate content though undesirable from edible perspective it has its merits. Different quality characteristics are required for use of seed for non-edible products, such as detergents, lubricants, cosmetics, hydraulic oils or biodiesel (Shahidi, 1990; Kimber and McGregor., 1995). The glucosinolates are nitrogen and sulphur containing natural plant products that have become increasingly important as flavour precursors, cancer prevention agents and crop protectants (Graser *et al*., 2000). Generally, correlation coefficients show relationships among independent characteristics and the degree of linear relation between these characteristics (Korkut *et al.,* 1993). Traits are less likely to be under separate control. Trait association is a key tool in yield improvement by virtue of its component traits having simpler inheritance and high heritability. The current study was therefore aimed at investigating trait associations among selected traits.

MATERIALS AND METHODS

This research was conducted at New Developmental Farm, The University of Agriculture Peshawar during the crop season 2009-10, to study the phenotypic trait correlation in *B. napus*. All the agronomic and cultural practices applied were same. Block to block distance was 1.5 m. Length of the row was 5 m each, with row to row distance of 60 cm. The genotypes evaluated were TUA-242, TUA-2719, TUA-1500, TUA-2716, TUA-2702, TUA-2717, TUA-2704, TUA-2709, TUA-2728 and TUA-2751. Data was recorded on 10 randomly selected plants for morphological traits (days to flowering completion, plant height, seed pod^{-1} and 100 seed weight) and biochemical traits (protein, oil, glucosinolate, oleic acid, linolenic acid and erucic acid content) Biochemical analysis was conducted at Nuclear Institute for Food and Agriculture (NIFA) Peshawar using Near Infra-red Reflectance Spectroscopy System FOSS 6500 equipped with ISI version 1.02a software of Infra Soft International. Data were subjected to analysis of variance following Steel and Torrie (1984). All possible phenotypic correlations were computed using MSTAT C software.

RESULTS AND DISCUSSION

Analysis of variance showed highly significant (P ≤ 0.01) differences among genotypes for the studied traits except 100 seed weight (Table 1). Our results are supported by the findings of Aytac and Kinaci (2009) who reported significant differences for protein content. Abideen *et al.,* (2013) reported highly significant differences for plant height, 1000 seed weight, seed pod^{-1}, oil, protein, glucosinolate, linolenic acid and erucic acid contents which are in conformity with the current study except 1000 seed weight which may be attributed to the genetic background of genotypes evaluated.

Table 1. ***Mean squares for morphological and biochemical Traits in B. napus L..***

Traits	Replication	Genotype	Error	CV %
Days to flower completion	57.60	673.47**	5.156	2.23
Plant height	82.37	3107.57**	601.547	14.79
Seed pod-1	55.30	61.05**	14.485	19.22
100 seed weight	0.00	0.06ns	0.259	15.24
Oil content	0.96	23.27**	0.259	1.10
Protein content	0.58	8.85**	0.727	3.64
Glucosinolate	0.78	2047.05**	2.917	2.31
Oleic acid	0.68	119.21**	0.352	1.18
Linolenic acid	0.26	1.94**	0.298	7.15
Erucic acid	0.00	434.37**	0.144	0.91

** = Highly significant, * = Significant, NS = Non significant, CV = Coefficient of Variation

Days to flower completion ranged 84 to 137 days with genotype TUA-2751 completed flowering earlier than the rest of genotypes. Plant height varied from 81-198 cm and genotype TUA-2702 produced shortest plants. Seed pod^{-1} ranged from 13 to 28 with maximum seeds pod^{-1} set by genotype TUA-1500. The data for 100 seed weight ranged from 0.35 to 0.52 g. Seed weight was highest for genotype TUA-242. The data for oil content varied from 42.1-50.1 % with highest percentage recorded for genotype TUA-2704. Protein content ranged 21.6 to 27.1 % with genotype TUA-242 having highest percentage. Glucosinolate content varied from 41.4 to 124.1 % with genotype TUA-2751 having lowest content. Oleic acid content varied from 43.0 to 61.4 % and maximum percentage was recorded in genotype TUA-1500. Data for linolenic acid ranged from 6.5 to 9.2 with minimum percentage exhibited by genotype TUA-2728. Erucic acid content ranged 23 to 51.8 %. Minimum content was recorded for genotypes TUA-1500 and TUA-2751 (Table 2).

Table 2. ***Range, mean values and best genotype for days to flower completion, plant height, 100 seed weight, seed pod^{-1}, protein content, oil content, erucic acid content, glucosinolate content and linolenic acid content in Brassica napus L.***

Traits	Range	Mean	Best Genotype (s)
Days to flower completion	84-137	110.50	TUA-2751
Plant height (cm)	81-198	139.50	TUA-2702
Seed pod^{-1}	13-28	20.50	TUA-1500
100 seed weight (g)	0.35-0.52	0.43	TUA-242
Oil content (%)	42.1-50.1	46.10	TUA-2704
Protein content (%)	21.6-27.1	24.30	TUA-242
Oleic acid (%)	43.0-61.4	50.31	TUA-1500
Linolenic acid (%)	6.5-9.2	7.80	TUA-2728
Glucosinolate (%)	41.4-124.1	82.70	TUA-2751
Erucic acid (%)	23-51.8	37.40	TUA-1500, TUA-2751

Days to flower completion is negatively correlated with 100 seed weight (-0.06^{ns}), erucic acid (-0.14^{ns}), glucosinolate (-0.36^{ns}), oil (-0.18^{ns}) and protein content (-0.01^{ns}); positive significantly correlated with linolenic acid (0.47**) whereas positive non-significantly associated with plant height (0.32^{ns}) and seed pod^{-1} (0.06^{ns}) (Table 3). Nasim *et al.* (2013) reported negative significant correlation for days to flowering completion with plant height whereas it was negative non-significantly and positive non-significantly correlated with 100 seed weight and seed pod^{-1}, respectively. Phenotypic correlation for plant height was positive with seed pod^{-1} (0.37*), 100-seed weight (0.24^{ns}) protein content (0.07^{ns}), erucic acid (0.15^{ns}), glucosinolate (0.25^{ns}) and oil content (0.18^{ns}). Results are not in conformity with Nasim *et al.*, (2013) who reported plant height to be positive significantly associated with 100 seed weight and negative non-significantly correlated with seed pod^{-1} which may be attributed to the different genotypes evaluated in respective studies. Plant height showed negative correlation with linolenic acid (-0.05^{ns}) (Table 3). Khan *et al.* (2006) observed positive correlation between plant height and protein content which supports our results. Our results are contradictory to the observations of Lionneton *et al*. (2004) who reported that plant height is negatively correlated with 100 seed weight which may be attributed to the different genetic background of the genotypes evaluated. Akber *et al*. (2003) and Ahmadi (2010) reported positive correlation between 100 seed weight and plant height which are in conformity with our results. Marjanovec-Jeromela *et al.* (2008) reported significant positive correlation of plant height with oil percentage and 1000 seed weight. Phenotypic correlation for seed pod^{-1} was negative with protein content (-0.01^{ns}), erucic acid (-0.17^{ns}) and linolenic acid content (-0.18^{ns}) whereas positive with 100-seed weight (0.11^{ns}) and glucosinolate (0.06^{ns}) and oil content (0.15^{ns}) (Table 3). Our results are in conformity with Ahmadi (2010) who observed positive correlation between seed pod^{-1} and oil content. Nasim *et al.* (2013) reported positive significant correlation between 100 seed weight and seep pod^{-1}. Khan *et al.* (2008) reported negative significant association for seed pod^{-1} with linolenic acid content. Data perusal revealed negative correlation for 100 seed weight with linolenic acid (-0.04*) and its positive association with erucic acid (0.22^{ns}), glucosinolate (0.36^{ns}), oil content (0.24^{ns}) and protein (0.37*) (Table 3). Khan *et al.* (2008) reported positive correlation between glucosinolate content and 100 seed weight which supports our results. Marjanovec-Jeromela *et al.* (2008) reported significant positive correlation between 1000 seed weight and oil content. Phenotypic correlation for oil content was negative with protein content (-0.56**), linolenic acid content (-0.12^{ns}); positively correlated with glucosinolate (0.26^{ns}) and erucic acid content (0.85**) (Table 3). The contrasting relationship between oil and protein content was supported by Alemeyehu and Becker (2000), who observed negative correlation. Lionneton *et al*. (2004) reported that glucosinolate is negatively correlated with plant height, 100 seed weight and oil content. Abideen *et al.* (2013) also reported positive significant association between oil and erucic acid content. Protein content was positively associated with erucic acid (0.46**), linolenic acid (0.06^{ns}) and glucosinolate content (0.26^{ns}) (Table 3). Abideen *et al.* (2013) reported positive significant association between protein and linolenic acid content which is in contrast to the current study. Glucosinolate content was positively non-significantly correlated with linolenic (0.01^{ns}) and erucic acid (0.31^{ns}) (Table 3). Abideen *et al.* (2013) also reported positive non-significant association between glucosinolate and erucic acid content. Linolenic acid content was negative non-significantly correlated with erucic acid (-0.01^{ns}). The same association was reported by Abideen *et al.* (2013).

Table 3. ***Phenotypic correlations among studied traits in Brassica napus L.***

Traits	DFC	PH	SPP	HSW	OC	PC	GSL	OA	LA	EA
DFC		0.32^{ns}	0.06^{ns}	-0.06^{ns}	-0.18^{ns}	-0.01^{ns}	-0.36^{ns}	-0.14^{ns}	0.47**	-0.14^{ns}
PH			0.37*	0.24^{ns}	0.18^{ns}	0.07^{ns}	0.25^{ns}	-0.21^{ns}	-0.05^{ns}	0.15^{ns}
SPP				0.11^{ns}	0.15^{ns}	- 0.01^{ns}	0.06^{ns}	0.20^{ns}	-0.18^{ns}	-0.17^{ns}
HSW					0.24^{ns}	0.37*	0.36^{ns}	-0.11^{ns}	-0.04*	0.22^{ns}
OC						-0.56**	0.26^{ns}	-0.75**	-0.12^{ns}	0.85**
PC							0.26^{ns}	0.45**	0.06^{ns}	0.46**
GSL								-0.28^{ns}	0.01^{ns}	0.31^{ns}
OA									-0.20^{ns}	-0.92**
LA										-0.01^{ns}
EA										

** = Highly significant, * = Significant, ns= Non significant, days to flower completion (DFC), plant height (PH), seed pod^{-1} (SP-1), 100 seed weight (HSW), oil content (OC), protein content (PC), glucosinolate content (GSL), oleic acid (OA), linolenic acid (LA) and erucic acid content (EC).

CONCLUSIONS AND RECOMMENDATIONS

Sufficient genetic variability existed for all the traits except 100 seed weight. Oil content was positive and negative significantly correlated with erucic acid and protein percentage, respectively. Plant height and seed pod^{-1} were noted to be positively and significantly correlated with each other. Genotype 1500 exhibited high oleic acid and low erucic acid percentage, both of these characters are of vital importance for breeders. Genotype 242 has high seed weight and high percentage of protein content and both of these traits are desirable from breeding perspective though the inverse relationship between oil and protein demands that one of them has to be compromised. On the other hand genotype 2751 took fewer days to complete flowering and is low in glucosinloate and erucic acid contents. These genotypes can be exploited in future breeding programs.

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