African Journal of Biotechnology Vol. 10(55), pp. 11541-11556, 21 September, 2011
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB11.1642
ISSN 1684–5315 © 2011 Academic Journals

Full Length Research Paper

Genetic diversity through stability analysis for various fatty acids profile in indigenous *Brassica* species

Naushad Ali Turi[1]*, Farhatullah[1] and Malik Ashiq Rabbani[2]

[1]Department of Plant Breeding and Genetics, KPK Agricultural University, Peshawar, Pakistan.
[2]Institute of Agri-Biotechnology and Genetic Resources, NARC, Islamabad, Pakistan.

Accepted 5 August, 2011

A total of 120 locally collected accessions of *Brassica napus, Brassica juncea and Brassica rapa* were evaluated for two years and three different locations of the country to check the level of stability among these accessions for various fatty acids composition. Combined stability analysis of variance for two years and three locations showed significant genetic variation within brassica accessions for all the fatty acids profile. Season x location, genotype x season, genotypes x locations and genotypes x season x locations were highly significant for all the studied parameters, while the values recorded for regression coefficient (b) and deviation from the regression (S^2_d) also showed high amount of variations. From the observed results, some accessions which produce the values near to the stranded values were recommended for further studies in future breeding programmes.

Key words: *Brassica* species, stability, environmental interaction.

INTRODUCTION

Brassica oilseed crops have initially high levels of nutritionally undesired erucic acid (C 22:1) in the oil and glucosinolates in the seed meal after oil extraction. Presence of high concentrations of very long-chain fatty acids, especially erucic acid in the seeds, oil yielding brassica species has been reported to be nutritionally undesirable (Gupta et. al., 2004). Hence, awareness were developed on the establishment of new brassica varieties having low erucic acid (>2%) content. This is not surprising since canola is a gained name recently given to nutritionally superior seed, oil and meal produced by genetically modified rapeseed plants. Oilseed rape (*Brassica napus* L.) and turnip rape (*Brassica campestris* L.) have long been cultivated as oil crops in Asia and northern Europe. The seed harvested from these crops is small, round and black, brown or yellow in color. Upon crushing, the seeds yield 40 to 44% oil and a nutritionally well balanced high protein (36 to 37%) meal.

The seed looks very much like turnip or mustard seed or seed of cabbage and broccoli, to which these crops are closely related (Kramer et al., 1983).

Rapeseed/canola crop is the world's third most important edible oil source with an annual growth rate exceeding that of palm. The main rapeseed-producing regions of the world are China, Canada, Indian subcontinent and Northern Europe, where either the annual or biennial form of these crops is grown depending upon the duration and severity of the winter. In general, the biennial form of rapeseed/canola is considered to be less winter-hardy than winter barley. Throughout most of the Indian subcontinent, a third Brassica oilseed species, *Brassica juncea* (L.) Czern., commonly known as tame mustard, is grown on about 60% of the oilseed Brassica area. Canadian and European nutritionists were interested in rapeseed oil because it differed from other edible vegetable oils in its fatty acid composition. Rapeseed oil contains significant amounts of the monoenoic fatty acids with 20 (eicosenoic) and 22 (erucic) carbon chains as opposed to the common carbon chain lengths of 16 and 18 carbon atoms found in most vegetable oils. Feeding studies with laboratory rats in the late 1940s and early 1950s suggested that these long chain fatty acids may not be the most desirable from a nutritional point of view and studies were undertaken to see if they could be reduced through conventiotional plant breeding. This entirely new edible oil was found to have superior properties as a salad and cooking oil as well as being suitable for

*Corresponding author: E-mail nalipk82@yahoo.com.

Table 1. Different brassica genotypes/accessions evaluated for morpho-physiological and seed traits during 2007 to 2008 and 2008 to 2009.

S/N	Number of accession	Species	Status
1	40	*Bassica napus*	Locally collected accessions
2	40	*Brassica juncea*	Locally collected accessions
4	40	*Brassica rapa*	Locally collected accessions

margarine and shortening blends.

Further modifications in the fatty acid composition of rapeseed oil are being investigated. Researchers are more interested in the development of a *B. napus* variety with a low linolenic content of less than 3%. Such oil has been shown to have superior storing qualities. Similarly, it is possible to raise the level of the polyunsaturated fatty acid linoleic to 30% or more and at the same time reducing the level of linolenic acid. The breeder's dilemma at the moment is that nutritionists are saying that the present composition of the low erucic acid rapeseed oil is almost ideal, with the lowest saturated fatty acid content of any of the vegetable oils coupled with approximately 8 to 10% alpha-linolenic acid (Downey, 1990).

The presence of genotype by environment interaction would be the one that contributed the least to interaction is of major concern to plant breeders, since, large interaction can reduce yield and complicate most stable genotype in the tests. Both genotype and environment plays key role in the phenotype of an organism and these two properties are not always additive which highlight the presence of both genotypes x environment interactions (GEI). The GEI result in unpredictable show off between the genotypes in different environments. Considerable variation in GEI is the output of magnitude of difference among different genotypes, as a result the position of the relative genotypes also changed (Falconer, 1981; Perkins and Jinks, 1968). There are mainly two kinds of GEI and defined these two forms as qualitative (rank changes) and the other is quantitative (absolute differences between genotypes). So, due to GEI it becomes difficult for plant breeder to select any promising and stable genotype in the future breeding programme (Hill, 1998; Yau, 1995). The vast climatic conditions and soil types escalates the problem of GEI even further. In order to surmount this problem, the worldwide tool used by most of the scientists and researcher in the majority of the crops during the selection of genotype, is to yield related experiments on diverse environments and mainy years to check the stability of genotype on different location and its yield related performance. The evaluation of genotype performance in genotype x location x year experiments is habitually difficult because of the presence of location x year interaction (environmental effects) (Lin and Binns, 1988a).

Therefore, the objective of the present study was to investigate the stability of locally collected *Brassica* species under diverse environmental conditions for various fatty acids profile which will be used in the future breeding programmes.

MATERIALS AND METHODS

Experimental material

Plant material consisted of 120 local accessions of *Brassica* species. These were comprised 40 *B. napus*, 40 *B. juncea* and 40 *B. rapa* accessions. These accessions were collected from different locations of Pakistan. Details of these species are presented in Table 1.

The collected 120 indigenous brassica species were evaluated at three different locations for its stability. These locations include Khyber Pakhtunkhwa Agricultural University Peshawar, national agriculture research centre (NARC), Islamabad and summer wheat nursery (SWN) Kaghan during 2007 to 2008 and 2008 to 2009, respectively. The first year's experiments were sown on October 15, 2007 and same set of experiments were planted on October 14, 2008 for 2nd year characterization. While sowing in kaghan for first year were done on 21, May 2007 and same experiment were repeated on 18 May, 2008. Experiment were design with two replications having a row length of 4 m, row to row distance of 30 cm and plant to plant distance of 10 cm. All the cultural practices were applied as recommended.

Bio-chemical analysis of seed sample for various fatty acids compositions

In order to determine the fatty acids compositions of these collected brassica accessions, all seed samples were determined through NIR (Near Infra Red) spectroscopy system FOSS 6500 equipped with ISI version 1.02a software of Infra soft international according to the manufacturer's protocol. During this process, well cleaned dried seed samples of 20 to 25 g will be used. These analyses were carried out at Biochemical Lab, Crop Breeding Section at Nuclear Institute for Food and Agriculture (NIFA), Tarnab, Peshawar:

1. Oil content (%)
2. Protein content (%)
3. Glucosinolates content (μM g^{-1})
4. Erucic acid content (%)

Data analysis

After recording of the data on these fatty acids for two years and three locations, then the combined stability analysis for the recorded date were done by using Finlay and Wilkinson (1963) procedure.

Table 2. Values of selected *Brassica napus* accessions for oil content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Accession number	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
501	42.7	51.9	49.2	47.9	45.4	49.4	48.4	47.7	1.49	2.17
502	42.3	50.2	50	47.5	45	46.5	45.5	45.7	1.29	1.35
504	40.7	46.7	47.2	44.9	43.4	45.8	44.8	44.7	1.45	2.53
505	39.3	46.6	45.1	43.7	42	47	46.0	45	0.52	1.25
506	42.4	50.7	50.3	47.8	45.1	48.4	47.4	47	1.34	2.58
510	44.8	48.5	49.1	47.5	47.5	46.3	46.3	46.7	1.07	1.12
511	40.8	50.8	48.8	46.8	43.5	51.3	53.3	49.4	0.71	1.03
519	48.8	50.4	50.1	49.8	51.5	41.8	43.8	45.7	1.03	0.86
520	37	47.6	46.5	43.7	39.7	47.5	49.5	45.6	0.71	2.22
521	37.6	47.5	45.9	43.7	40.3	43	45.0	42.8	1.00	2.73
522	41.5	50.2	50.0	47.2	44.2	46.2	48.2	46.2	1.01	7.14
523	42.6	49.1	49.4	47	45.3	45	47.0	45.8	1.72	1.47
528	47.2	42.0	43.1	44.1	49.9	42.8	44.8	45.8	1.51	2.23
529	43.4	45.9	45.9	45.1	46.1	47.4	49.4	47.6	1.70	3.60
530	37.5	44.6	44.5	42.2	40.2	45	47.0	44.1	1.03	1.89
531	32.6	46.2	46.7	41.8	35.3	44.5	46.5	42.1	0.25	1.54
532	43.6	47.2	47.1	46	46.3	41.8	43.8	44	1.30	2.11
533	38.3	43.3	44.1	41.9	41	44.1	46.1	43.7	0.75	0.67
534	42.1	40.5	40.1	40.9	44.8	40.6	42.6	42.7	0.87	1.01
535	33.7	41.4	41.2	38.8	36.4	43	45.0	41.5	0.85	1.45
536	44.9	45.8	45.9	45.5	47.6	44	43.0	44.9	1.53	0.70
541	45.4	48.6	49.1	47.7	48.1	51	51.0	50	0.12	3.60
543	38.6	46.6	46.4	43.9	41.3	44.3	46.3	44	1.15	1.31
544	40.3	45.3	45.1	43.6	43	51.4	50.4	48.3	1.44	0.95
545	40.3	37.1	37.6	38.3	43	47.9	47.9	46.3	1.29	1.66
546	41.8	43.9	44.0	43.2	44.5	47.1	46.1	45.9	1.48	1.35
547	38.4	42.3	43.3	41.3	41.1	44.7	46.7	44.2	1.54	1.76
548	40.4	41.3	42.1	41.3	43.1	42.9	44.9	43.6	1.79	1.28
553	44.7	37.0	37.0	39.6	47.4	47.5	49.5	48.1	0.30	3.33
554	43.1	47.1	47.3	45.8	45.8	45.6	47.6	46.3	1.24	2.66
555	43.5	38.6	38.5	40.2	46.2	43.1	45.1	44.8	0.44	2.74
561	41.3	46.6	46.6	44.8	44	40.3	42.3	42.2	1.95	2.08
562	43.2	45.9	45.9	45	45.9	44	46.0	45.3	1.23	1.51
563	43.3	49.5	49.5	47.4	46	45.3	47.3	46.2	1.33	1.57
564	44.8	46.1	46.5	45.8	47.5	45.1	45.1	45.9	0.46	3.41
565	46	49.8	48.6	48.1	48.7	51.2	50.2	50	0.80	2.11
566	42.4	46.0	46.0	44.8	45.1	50.1	49.1	48.1	0.11	2.00
568	43.8	48.5	48.2	46.8	46.5	48.9	47.9	47.8	0.14	2.80
569	40.4	43.5	43.1	42.3	43.1	47	49.0	46.4	1.54	2.02
570	43.8	48.9	49.2	47.3	46.5	42.2	44.2	44.3	1.16	1.99

RESULTS AND DISCUSSION

From the breeder's point of view, location is fixed factor and yield stability over time is the only relevant component of genotypes yield stability (Annicchiarico, 2002).

The appearance of oil yield and all its related components and other fatty acids composition is highly influenced by the intricate genotype x environment interactions (Ana et. al., 2008). Therefore, it is always recommended to test the stability of each genotype in extensive range of environments. Data obtained after those trials will enable a breeders or scientists in the selection of better genotypes in the breeding

progarmmes (Tuck et al., 2006).

Combined stability analysis of variance for two-years and three-locations showed highly significant genetic variation within brassica accessions; in *B. napus,* highly significant differences ($p<0.01$) were observed in genotype x year and genotype x location for oil content and significant for all other traits. In *B. juncea*, highly significant differences were recorded in genotype x year for protein and erucic acid, in genotype x year x location for glucosinolates and erucic acid and significant for the remaining parameters. In *B. rapa,* highly significant differences were observed in genotype x year for oil and protein content, genotype x location for oil, protein and glucosinolates while in genotype x year x location for oil, protein, glucosinolates and erucic acid contents and significant for all other attributes.

In the present study, significant differences for the mean values of the studied traits showed the diverse range of the collected species. As these accessions were collected from different ecological zones of the country, the analysis significant results further strengthen the variability of these accessions by the earlier findings of Yan (2001).

In *B. napus,* data recorded for oil content (%), in 2007 to 2008 were in the range of 38.3 and 49.8%, where the minimum 38.3 were recorded for accession 545 and maximum 49.8% recorded for accession 519. On the hand, the data recorded for oil %, during 2008 to 2009 were in the range of 41.5 to 50%, where the minimum 41.5% were recorded for accession 535 and maximum 50% recorded for accession 541 (Table 2). Protein content (%), in 2007 to 2008 was in the range of 23.5 to 29.4% and in 2008 to 2009; the values were in the range of 21.2 to 28.2%. The minimum value 23.5% during 2007 to 2008 was recorded for accession 506, while the maximum value 29.4% in accessions 531 and 535; while the minimum value 21.2 in 2008 to 2009 were in accession 565 and maximum 28.2% were in accession 521 (Table 3). Glucosinolates content (µM g^{-1}) values during 2007 to 2008 and 2008 to 2009 were in the range of 48.6 to 117 µM g^{-1} and 53.3 and 133 µM g^{-1}, respectively. The minimum value 48.6 µM g^{-1} recorded for accession 531 and maximum value 117 µM g^{-1} in accession 569 and on the other hand, the minimum 53.3 µM g^{-1} in accession 511 and maximum 133 µM g^{-1} in accession 554 (Table 4). The values for erucic acid % during 2007 to 2008 were in the range of 19.1 to 60.4 in which the minimum 19.1% recorded in accession 534 and maximum 60.4% were recorded in accession 564. In 2008 to 2009, the values ranged from 22.2 to 58.5%, where the minimum 22.2% recorded in accession 534 and the maximum 58.5% in accession 555 (Table 5).

In *B. juncea*, data recorded for oil content (%), in 2007 to 2008 were in the range of 39.8 and 49.6%, where the minimum 39.8% were recorded for accession 649 and maximum 49.6% recorded for accession 640. On the hand, the data recorded for oil %, in 2008 to 2009, were in the range of 43.2 to 49.6%, where the minimum 43.2% were recorded for accession 613 and maximum 49.6% recorded for accession 630 (Table 6). Protein content (%), in 2007 to 2008 was in the range of 24.0 to 30.0% and in 2008 to 2009; the values were in the range of 21.4 to 28.6%, respectively. The minimum 24.0% during 2007 to 2008 were recorded for accession 658 while the maximum 30.0% in accession 641, while the minimum 21.4% in 2008 to 2009 were in accession 660 and maximum 28.6% were in accession 640 (Table 7). Glucosinolates content (µM g^{-1}) values during 2007 to 2008 and 2008 to 2009 were in the range of 58.6 to 98.2 and 57.2 to 104.6 µM g^{-1}, respectively. The minimum value 58.6 µM g^{-1} recorded for accession 614 and maximum value 98.2 µM g^{-1} in accession 676 and on the other hand, the minimum 57.2 µM g^{-1} were recorded for accession 641 and maximum 104.6 µM g^{-1} for accession 605 (Table 8). The values for erucic acid % during 2007 to 2008 were in the range of 28.0 to 56.4%, in which the minimum 28.0% recorded in accession 617 and maximum 56.4% in accession 612. In 2008 to 2009, the values ranged from 28.9 to 56.7%, where the minimum 28.9% recorded in accession 617 and the maximum 56.7% in accession 612 (Table 9).

For *B. rapa* data recorded for oil content (%), in 2007 to 2008 were in the range of 40.3 and 49.4%, where the minimum 40.3% were recorded for accession 849 and maximum 49.4% recorded for accession 863. On the hand, the data recorded for oil %, in 2008 to 2009 were in the range of 43.2 to 51.6%, where the minimum 43.2% were recorded for accession 828 and maximum 51.6% recorded for accession 829 (Table 10). Protein content (%), in 2007 to 2008 was in the range of 23.4 to 29.5% and in 2008 to 2009; the values were in the range of 23.1 to 29.3%. The minimum 23.1% during 2007 to 2008 were recorded for accession 864 while the maximum 29.5% in accessions 832 and 850, while the minimum value 23.1% in 2008 to 2009 were in accession 856 and 864 and maximum 29.3% were in accession 870 (Table 11). Glucosinolates content (µM g^{-1}) values during 2007 to 2008 and 2008 to 2009 were in the range of 60.6 to 101.3 and 68.5 to 105.6 µM g^{-1}, respectively. The minimum 60.6 µM g^{-1} recorded for accession 853 and maximum 101.3 µM g^{-1} in accession 867 and on the other hand, during 2008 to 2009, the minimum 68.5 µM g^{-1} were recorded for accession 853 and maximum 105.6 µM g^{-1} for accession 868 (Table 12). The values for erucic acid (%) during 2007 to 2008 were in the range of 34.7 to 57.6% in which the minimum 34.7% were recorded for accession 800 and maximum 57.6% were recorded for accession 863. In 2008 to 2009, the values ranged from 39.4 to 58.5%, where the minimum 39.4% recorded for accession 800 and the maximum 58.5% for accession 819 (Table 13).

Similarly, significant variations were also recorded for locations, years and a three combined interaction for the studied accessions. These variations showed the environmental fluctuations and diverse genetic makeup of

Table 3. Values of selected *Brassica napus* accessions for protein content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Accession number	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
501	27.2	21.8	22.0	23.7	24.5	24.1	25.1	24.6	1.11	1.33
502	26.5	22.4	22.6	23.8	23.8	23.9	24.9	24.2	0.94	1.7
504	27	23.9	24.1	25	24.3	22.6	23.6	23.5	1.02	2.26
505	29.1	27.7	27.9	28.2	26.4	23.9	24.9	25.1	1.05	0.46
506	24.9	22.7	22.9	23.5	22.2	23.3	24.3	23.3	1.29	2.1
510	24	24.2	24.4	24.2	21.3	24.4	25.4	23.7	0.69	0.98
511	28.3	23.0	23.2	24.8	25.6	19.2	19.2	21.3	0.65	0.46
519	22.4	22.0	22.2	22.2	19.7	25.1	25.1	23.3	1.18	1.39
520	29	26.7	26.9	27.5	26.3	27.2	25.2	26.2	0.34	1.56
521	28.4	24.9	25.1	26.1	25.7	30.5	28.5	28.2	1.48	1.98
522	27.6	23.7	23.9	25.1	24.9	26.3	24.3	25.2	1.17	1.82
523	27.7	23.7	23.9	25.1	25	23.6	21.6	23.4	0.89	1.5
528	24.4	25.6	25.8	25.3	21.7	28.2	26.2	25.4	0.62	1.33
529	25.9	26.9	27.1	26.6	23.2	23.5	21.5	22.7	1.05	2.42
530	26.7	25.3	25.5	25.8	24	25.6	23.6	24.4	0.94	1.49
531	33.9	27.1	27.3	29.4	31.2	26.4	24.4	27.3	0.76	1.79
532	22.6	24.5	24.5	23.9	19.9	27.5	25.5	24.3	1.44	1.18
533	29.7	27.4	27.4	28.2	27	26.6	24.6	26.1	1.16	1.3
534	25	26.2	26.2	25.8	22.3	29.9	27.9	26.7	0.69	1.44
535	27.9	30.3	30.1	29.4	25.2	27.8	25.8	26.3	1.15	0.99
536	24.3	25.5	25.3	25	21.6	26	27.0	24.9	0.97	0.73
541	23.8	24.3	24.1	24.1	21.1	20.2	21.2	20.8	0.80	2.31
543	28.2	25.3	25.1	26.2	25.5	29.6	27.6	27.6	0.88	0.92
544	28	26.8	26.6	27.1	25.3	21.9	22.9	23.4	1.16	1.16
545	27.3	30.0	29.8	29	24.6	24.4	25.4	24.8	0.48	1.40
546	27.3	27.0	26.8	27	24.6	23	24.0	23.9	0.88	0.97
547	27.4	27.0	26.8	27.1	24.7	27	25.0	25.6	0.72	0.99
548	26.4	28.7	28.5	27.9	23.7	27.4	25.4	25.5	1.14	1.43
553	25.7	21.2	21.0	22.6	23	24.3	22.3	23.2	0.57	1.48
554	23.2	27.9	27.7	26.3	20.5	27.6	25.6	24.6	0.83	2.49
555	24.5	30.0	29.8	28.1	21.8	27.8	25.8	25.1	1.25	1.34
561	24.9	25.2	25.0	25	22.2	27	25.0	24.7	1.01	1.68
562	24.9	26.9	26.7	26.2	22.2	26.9	24.9	24.7	0.74	1.91
563	25.6	22.1	21.9	23.2	22.9	25.2	25.2	24.4	0.72	2.08
564	23.5	28.0	27.8	26.4	20.8	24.5	25.5	23.6	2.17	2.36
565	24.8	26.5	26.6	26	22.1	20.3	21.3	21.2	1.13	1.33
566	24.2	26.8	26.8	25.9	21.5	22	23.0	22.2	1.42	1.40
568	26.4	22.5	22.1	23.7	23.7	22.3	23.3	23.1	1.37	1.60
569	26.4	27.3	26.9	26.9	23.7	21.9	21.9	22.5	1.72	1.53
570	25.8	23.7	22.8	24.1	23.1	28.2	26.2	25.8	0.42	0.62

the accessions. High amount of variations showed broaden genetic back ground of these accessions. As these accessions were obtained from different location of the country and the variations among these accessions proved the reach genetic background of studied accessions. These results were further strengthen by the earlier findings of Singh and Chaudary (1985b), Koanwar and Talukdar (1986) and Bhatinagar and Tiwari (1989) who also obtained significant differences for genotype x interaction. Similar results were obtained earlier by Majid et al. (2007). The divergence from regression for most of the accessions was highly significant which showed that these accessions were unstable at all the locations. However, since these are local accessions; we can

Table 4. Values of selected *Brassica napus* accessions for glucosinolates content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Accession number	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
501	83.2	102.6	98.1	94.6	80.4	118.5	115.5	105	1.77	13.84
502	81.2	89.9	87.2	86.1	69.5	74.9	71.9	72.1	2.40	9.61
504	73.9	97.0	93.0	88	71.1	87.2	84.2	80.8	0.42	3.37
505	100.4	77.9	80.1	86.1	97.6	71.5	68.5	79.2	1.92	11.38
506	68.5	94.2	94.0	85.6	65.7	102.6	99.6	89.3	0.74	6.82
510	55.1	90.2	90.2	78.5	57.9	100.2	97.2	85.1	4.17	13.43
511	58.8	100.7	98.3	85.9	61.6	49.2	49.2	53.3	1.09	9.75
519	86.1	76.7	80..7	81.4	88.9	94.8	94.8	92.8	1.88	14.65
520	56.6	57.1	67.1	60.3	9.4	115.6	115.6	80.2	0.61	14.06
521	94.3	109.3	109.3	104	97.1	91.5	94.5	94.4	1.00	8.83
522	47.0	50.2	54.9	50.7	49.8	63.4	66.4	59.9	2.24	37.39
523	54.5	71.3	71.3	65.7	57.3	83.5	86.5	75.8	0.23	16.90
528	53.4	59.6	60.1	57.7	56.2	91.5	94.5	80.7	0.11	17.59
529	46.7	53.1	53.1	51	49.5	71.4	73.4	64.8	0.14	17.44
530	97.3	69.1	66.1	77.5	100.1	101.6	103.6	102	2.66	13.98
531	43.3	50.2	52.3	48.6	16.1	90.3	92.3	66.2	0.60	11.12
532	51.4	55.3	56.0	54.2	54.2	68	70.0	64.1	1.55	9.50
533	63.4	70.1	66.3	66.6	66.2	65.7	65.7	65.9	1.17	2.99
534	54.6	60.7	62.1	59.1	57.4	68.4	68.4	64.7	1.59	23.63
535	55.5	50.4	55.5	53.8	18.3	141.5	141.5	100	2.84	10.71
536	99.9	109.3	109.3	106	97.1	89.4	86.4	91	2.16	10.70
541	93.5	91.3	90.3	91.7	90.7	104.1	101.1	98.6	3.31	25.97
543	66.2	85.4	84.4	78.7	148.7	71.5	74.5	98.2	1.02	22.90
544	86.4	104.2	99.8	96.8	142.9	104.4	101.4	116	2.02	23.59
545	89.9	90.5	87.4	89.3	131.8	106.5	103.5	114	1.90	14.23
546	100.0	97.6	97.6	98.4	111.1	92.9	89.9	98	2.91	18.93
547	88.8	89.8	87.7	88.8	137.2	100.2	100.2	113	3.01	12.64
548	89.9	85.3	86.2	87.1	135.2	90.9	93.9	107	1.88	15.86
553	110.2	99.3	95.0	102	113.1	89.6	92.6	98.4	0.43	19.92
554	111.8	110.1	115.7	113	114.6	139.9	144.9	133	0.34	19.68
555	116.4	113.7	113.7	115	119.2	129.4	132.4	127	0.83	17.2
561	118.3	85.3	85.3	96.3	121.1	83.7	85.7	96.8	3.76	7.90
562	106.0	97.3	99.2	101	108.8	99.1	102.1	103.0	2.40	8.90
563	80.1	85.2	85.2	83.5	106.8	87.4	84.4	92.9	3.27	27.47
564	113.7	110.1	111.1	112	110.9	120.2	117.2	116	0.28	21.86
565	105.6	107.2	107.0	107	102.8	94.3	91.3	96.1	2.70	12.14
566	107.2	110.4	110.4	109	104.4	88.8	85.8	93.0	0.69	15.51
568	115.6	110.2	110.2	112	112.8	69.3	66.3	82.8	0.14	11.74
569	116.6	116.8	116.8	117	119.4	71.4	71.4	87.4	2.70	19.85
570	104.4	97.7	97.7	99.9	107.2	133.9	136.9	126.0	2.60	16.04

obtain the best results if we use them in our regular breeding programmes (Arshad et. al., 2003).

Regression coefficient (b) values for oil % were in the range of 0.30 to 1.95%, where the minimum was recorded for accession 553 and the maximum 1.95% for accession 561. While on the other hand, the values for deviation from regression (S^2_d) were in the ranges of 0.67 to 3.41 and the minimum 0.67 recorded for accession 533 and maximum 3.41 for accession 564 (Table 2). The b values recorded for protein % were in the range of 0.42 to 2.17, minimum 0.42 was recorded for accession 570 and maximum 2.17 for accession 564 and on the other hand, S^2_d values were in the range of 0.46 to 2.36, having minimum for accession 505 and maximum for accession

Table 5. Values of selected *Brassica napus* accessions for erucic acid content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Accession number	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
501	56.8	59.8	60.8	59.1	53.4	53.7	56.7	54.6	0.36	9.42
502	55.3	53.5	51.5	53.4	58.4	41.4	44.4	48.1	1.06	1.41
504	56.2	54.0	53.1	54.4	52.8	46.4	49.4	49.5	1.31	1.89
505	47.3	48.5	46.1	47.3	43.9	29.1	32.1	35	1.43	3.62
506	38.6	42.9	44.2	41.9	35.2	52.2	55.2	47.5	1.44	1.63
510	24.6	23.5	23.9	24	21.2	52.9	52.9	42.3	1.04	2.13
511	45.0	45.6	44.0	44.9	41.6	48.8	48.8	46.4	0.93	2.12
519	59.8	54.5	55.1	56.5	56.4	56.1	56.1	56.2	1.03	11.89
520	57.7	57.5	57.1	57.4	58.1	45.0	48.0	50.4	1.36	2.59
521	36.7	39.5	39.4	38.5	33.3	50.0	55.0	46.1	0.92	2.36
522	60.5	56.9	56.4	57.9	57.1	41.7	46.7	48.5	1.88	16.51
523	49.4	54.2	54.2	52.6	52.8	37.8	40.8	43.8	0.51	1.72
528	42.6	50.5	48.2	47.1	46.0	45.7	45.7	45.8	1.56	2.21
529	53.9	41.8	41.5	45.7	57.3	35.6	35.6	42.8	0.88	6.11
530	47.1	53.9	52.9	51.3	50.5	48.4	48.4	49.1	0.29	2.03
531	40.6	42.9	43.0	42.2	44.0	56.5	56.5	52.3	1.28	3.73
532	37.4	36.8	35.8	36.7	40.8	52.0	54.0	48.9	2.92	4.05
533	44.1	47.2	47.1	46.1	47.5	26.3	28.3	34	2.02	1.53
534	16.3	20.4	20.5	19.1	19.7	22.4	24.4	22.2	1.47	4.74
535	45.4	57.1	56.3	52.9	48.8	58.2	60.2	55.7	2.25	2.00
536	59.0	51.6	50.7	53.8	55.6	46.1	49.1	50.3	1.77	5.98
541	51.8	57.1	57.6	55.5	48.4	51.2	51.2	50.3	0.55	12.26
543	48.6	51.9	51.6	50.7	52.0	35.6	37.6	41.7	0.20	1.69
544	51.2	54.5	54.8	53.5	57.9	50.3	53.3	53.8	0.09	7.11
545	58.7	60.6	59.7	59.7	55.3	38.9	38.9	44.4	0.95	3.24
546	51.6	52.6	52.2	52.1	58.2	49.4	52.4	53.3	0.81	3.80
547	57.1	54.9	55.0	55.7	53.7	39.6	44.6	46	1.18	4.44
548	49.6	50.7	50.5	50.3	53.0	42.0	42.0	45.7	0.57	3.62
553	32.9	32.6	32.9	32.8	32.1	28.9	30.9	30.6	1.32	3.00
554	52.7	52.3	51.8	52.3	56.1	57.4	59.4	57.6	0.16	3.59
555	55.2	52.4	52.8	53.5	58.6	57.5	59.5	58.5	0.93	2.71
561	52.4	49.3	49.3	50.3	55.8	52.0	54.0	53.9	1.42	3.82
562	59.5	54.7	54.3	56.2	56.1	55.1	60.1	57.1	1.08	2.59
563	60.5	49.7	49.4	53.2	58.1	45.9	45.9	50.0	0.85	4.95
564	60.8	60.5	60.0	60.4	59.4	45.1	45.1	49.9	1.33	2.38
565	60.3	57.7	56.1	58.0	58.9	56.4	59.4	58.2	2.88	1.49
566	60.7	58.9	58.1	59.2	57.3	53.7	56.7	55.9	2.18	4.72
568	59.8	25.8	25.4	37.0	56.4	60.2	58.2	58.3	0.21	5.06
569	53.1	45.9	45.7	48.2	59.7	48.5	48.5	52.2	1.43	2.66
570	58.0	59.5	59.7	59.1	54.6	49.8	54.8	53.1	1.26	4.64

564 (Table 3). Data recorded for glucosinolates on the basis of b values were in the range of 0.11 to 4.17, where the minimum 0.11 was recorded for accession 528 and the maximum 4.17 recorded for accession 510. The values for S^2_d were in the range of 3.37 to 37.39 having the minimum 3.37 value was recorded for accession 504 and the maximum 37.39 value was in recorded for accession 522 (Table 4). The erucic acid % values for b were in the ranges of 0.20 to 2.92, where the minimum 0.20 was recorded for the accession 543 and the maximum 2.92 value was recorded for accession 532. On the other hand, the values recorded for S^2_d were in the ranges of 1.41 to 16.51, having the minimum 1.41 value was recorded for accession 502 and the maximum 16.51

Table 6. Values of selected *Brassica juncea* accessions for oil content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Accession number	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
600	43.9	45.9	45.3	45.0	46.6	45.4	43.4	45.1	1.19	3.82
601	46.4	44.6	46.8	45.9	49.1	46.2	44.2	46.5	0.46	2.97
602	46.6	43.6	44.2	44.8	49.3	47.8	45.8	47.6	1.55	1.79
603	46.4	44.7	45.2	45.4	49.1	48.6	46.6	48.1	0.63	2.01
604	42.3	48.6	47.9	46.3	45.0	45.3	43.3	44.5	0.85	1.95
605	43.9	44.1	44.3	44.1	46.6	43.4	53.1	47.7	1.22	2.88
606	45.9	44.1	44.0	44.7	48.6	47.7	41.4	45.9	0.40	2.37
607	41.4	40.4	41.2	41.0	44.1	47.2	45.7	45.7	1.09	4.00
608	40.8	42.8	43.7	42.4	43.5	44.9	45.2	44.5	1.20	2.34
609	42.4	48.2	48.9	46.5	45.1	45.8	44.9	45.3	1.61	2.99
610	43.5	42.0	43.3	42.9	46.2	44.4	45.8	45.5	1.62	2.59
611	45.4	39.5	40.2	41.7	48.1	46.6	44.4	46.4	1.16	2.24
612	36.7	45.3	46.2	42.7	39.4	48.2	46.6	44.7	0.46	3.33
613	31.8	46.1	45.8	41.2	34.5	49.8	45.2	43.2	0.97	3.58
614	36.1	43.4	43.5	41.0	38.8	48.0	46.8	44.5	0.93	1.35
615	46.0	44.1	44.7	44.9	44.1	49.7	45.0	46.3	1.05	1.24
616	43.8	43.2	44.2	43.7	41.9	51.6	46.7	46.7	1.01	3.78
617	38.4	49.1	49.0	45.5	36.5	48.6	48.6	44.6	0.78	1.63
618	44.2	46.6	46.3	45.7	42.3	47.4	45.6	45.1	1.10	1.97
619	44.9	42.1	42.6	43.2	43.0	49.1	44.4	45.5	1.59	1.32
625	45.7	43.8	44.2	44.6	43.8	45.9	46.1	45.3	1.45	3.14
626	44.5	48.2	47.8	46.8	42.6	54.4	41.9	46.3	1.38	2.01
630	48.0	45.9	45.4	46.4	46.1	52.2	50.4	49.6	0.57	3.06
638	42.0	49.8	49.4	47.1	40.1	48.3	48.2	45.5	0.60	0.64
639	43.6	45.6	45.4	44.9	41.7	46.7	46.3	44.9	1.59	1.39
640	50.6	49.1	49.0	49.6	34.8	45.4	44.3	41.5	0.30	1.76
641	42.7	51.2	51.2	48.4	48.7	45.1	45.7	46.5	0.67	1.70
642	43.0	43.9	43.6	43.5	40.8	45.6	44.4	43.6	0.86	1.44
643	43.7	46.1	45.8	45.2	41.1	48.0	44.1	44.4	1.08	2.64
644	48.3	46.5	45.6	46.8	41.8	47.2	45.6	44.9	1.06	2.74
649	41.1	38.9	39.4	39.8	46.4	43.7	48.0	46.0	0.45	1.66
657	48.1	43.9	44.6	45.5	41.0	45.9	47.2	44.7	0.98	1.54
658	40.2	43.4	44.2	42.6	39.0	48.3	43.7	43.7	0.13	1.55
659	46.1	46.0	45.9	46.0	39.8	45.9	46.4	44.0	0.75	1.85
660	42.9	44.3	45.4	44.2	46.7	48.1	48.2	47.7	1.64	2.13
672	39.2	43.6	44.3	42.4	38.8	45.3	47.0	43.7	1.55	2.39
673	43.9	42.0	43.2	43.0	44.2	44.0	46.9	45.0	1.13	2.01
674	46.4	49.8	49.0	48.4	41.0	50.1	51.1	47.4	0.67	2.50
675	46.6	47.3	47.2	47.0	41.4	48.5	44.0	44.6	1.60	1.28
676	46.4	46.4	46.6	46.5	42.1	47.7	43.4	44.4	0.98	2.43

value was recorded for accession 522 (Table 5).

Regression coefficient (b) values for oil % were in the range of 0.30 to 1.64, where the minimum 0.30 was recorded for accession 640 and the maximum 1.64 for accession 660. While on the other hand, the values for deviation from regression (S^2_d) were in the ranges of 0.64 to 3.82, among these the minimum 0.64 values were recorded for accession 638 and maximum 3.82 for accession 600 (Table 6). The b values recorded for protein % were in the range of 0.17 to 2.47, minimum 0.17 was recorded for accession 658 and maximum 2.47 for accession 612 and on the other hand, S^2_d values were in the range of 0.55 to 2.95, having minimum for accession 676 and maximum for accession 609 (Table

Table 7. Values of selected *Brassica juncea* accessions for protein content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Accession number	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
600	28.1	23.9	24.4	25.5	25.4	23.3	25.3	24.7	1.43	1.87
601	25.0	23.8	25.2	24.7	22.3	21.8	23.8	22.6	1.66	1.61
602	21.8	28.6	26.2	25.5	19.1	25.4	27.4	24.0	2.00	2.15
603	23.7	27.1	27.1	26.0	21.0	21.4	23.4	21.9	0.06	1.32
604	26.0	25.6	25.0	25.5	23.3	24.6	26.6	24.8	0.34	1.84
605	25.5	26.5	26.2	26.1	22.8	24.1	28.1	25.0	1.86	1.88
606	23.8	26.4	26.4	25.5	21.1	23.0	26.1	23.4	0.31	1.58
607	28.1	29.1	30.0	29.1	25.4	21.5	25.0	24.0	0.66	2.46
608	28.1	27.5	26.5	27.4	25.4	26.6	23.5	25.2	3.30	2.84
609	29.4	23.7	23.5	25.5	26.7	24.0	26.6	25.8	0.45	2.95
610	25.2	28.7	28.1	27.3	22.5	27.5	24.0	24.7	1.45	2.59
611	25.2	29.3	28.7	27.7	22.5	26.0	27.5	25.3	1.55	1.50
612	29.4	26.6	27.3	27.8	26.7	23.5	26.0	25.4	2.47	1.92
613	34.8	26.5	26.6	29.3	32.1	21.9	26.5	26.8	0.36	1.90
614	33.1	27.6	25.4	28.7	30.4	23.0	24.9	26.1	0.43	0.91
615	25.8	27.3	25.7	26.3	27.7	22.6	26.0	25.4	1.11	1.54
616	26.3	27.4	27.0	26.9	28.2	20.7	25.6	24.8	1.01	2.77
617	35.7	24.4	25.4	28.5	37.6	22.5	23.7	27.9	0.45	2.11
618	27.9	24.6	25.6	26.0	29.8	24.2	25.5	26.5	1.35	1.79
619	26.9	28.4	27.6	27.6	28.8	22.9	27.2	26.3	2.16	1.05
625	24.5	24.6	25.4	24.8	26.4	25.7	25.9	26.0	2.90	0.67
626	25.4	30.0	28.7	28.0	27.3	21.5	27.7	25.5	1.96	1.16
630	24.5	25.8	24.7	25.0	26.4	21.4	23.5	23.8	1.45	1.38
638	27.7	24.9	25.5	26.0	29.6	25.5	23.4	26.2	0.43	1.23
639	26.0	28.8	28.4	27.7	27.9	27.2	21.9	25.7	2.09	0.71
640	22.3	30.0	29.7	27.3	31.4	26.9	27.5	28.6	0.18	0.90
641	24.7	33.0	32.3	30.0	24.2	28.2	26.2	26.2	1.53	2.47
642	25.5	23.8	24.1	24.5	26.6	25.2	25.9	25.9	1.33	2.00
643	26.1	25.0	25.2	25.4	27.4	27.2	27.2	27.3	0.80	2.49
644	25.1	27.3	26.8	26.4	28.0	23.8	25.2	25.7	1.45	1.80
649	23.5	24.9	24.2	24.2	27.0	25.2	27.2	26.5	0.40	1.95
657	19.8	26.1	27.2	24.4	23.4	25.2	23.8	24.1	1.53	1.52
658	22.2	24.7	25.0	24.0	24.8	26.0	25.2	25.3	0.17	1.52
659	26.0	26.3	26.0	26.1	22.4	26.5	24.0	24.3	1.99	2.31
660	27.5	25.8	25.2	26.2	22.2	22.0	20.0	21.4	1.26	1.21
672	28.4	26.4	25.9	26.9	24.6	24.9	24.3	24.6	1.76	2.16
673	28.1	27.0	26.6	27.2	27.9	25.0	25.5	26.1	0.92	1.97
674	25.0	24.9	25.1	25.0	29.4	22.9	23.0	25.1	2.14	1.59
675	21.8	31.0	30.5	27.8	26.2	22.5	28.0	25.6	1.99	1.44
676	23.7	25.6	25.0	24.8	25.1	21.4	25.3	23.9	1.41	0.55

7). Data recorded for glucosinolates on the basis of b values were in the range of 0.14 to 2.29, where the minimum 0.14 value was recorded for accession 638 and the maximum 2.29 value for accession 612. The values for S^2_d were in the range of 5.26 to 33.52, where the minimum 5.26 value was recorded for accession 601 and the maximum 33.26 value was recorded for accession 615 (Table 8). The erucic acid % values for b were in the ranges of 0.16 to 9.56, where the minimum 0.16 was recorded for the accession 638 and the maximum 9.56 value was recorded for accession 602. On the other hand, values recorded for S^2_d were in the range of 1.41 to 13.77, having the minimum 1.41 value was recorded for accession 619 and the maximum 13.77 value was

Table 8. Values of selected *Brassica juncea* accessions for glucosinolates content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Acc. No.	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
600	89.3	84.8	85.1	86.4	92.6	99.1	101.1	97.6	2.13	21.74
601	97.1	67.6	66.2	77.0	100.4	97.6	99.6	99.2	1.56	5.26
602	93.3	74.6	75.0	81.0	96.6	99.8	97.8	98.1	1.00	8.52
603	92.3	72.7	73.1	79.4	95.6	96.1	98.1	96.6	1.34	19.73
604	75.4	86.1	84.3	81.9	78.7	78.0	80.0	78.9	1.75	8.59
605	95.3	67.8	66.0	76.4	98.6	109.3	105.9	104.6	2.11	21.58
606	54.9	80.2	79/1	67.6	58.2	63.8	61.3	61.1	1.96	18.68
607	86.1	87.1	88.2	87.1	89.4	95.5	94.8	93.2	0.88	8.28
608	75.6	87.4	86.4	83.1	78.9	78.2	77.5	78.2	0.51	14.07
609	88.3	71.7	72.1	77.4	91.6	102.1	108.2	100.6	0.97	28.91
610	68.7	73.1	72.6	71.5	72.0	81.7	80.1	77.9	2.37	21.14
611	59.6	87.2	86.0	77.6	62.9	66.9	66.7	65.5	0.16	10.53
612	96.7	92.6	90.2	93.2	100	103.7	104.9	102.9	2.29	18.06
613	95.4	82.8	83.2	87.1	98.7	104.5	107.7	103.6	0.40	20.73
614	38.2	69.1	68.5	58.6	41.5	79.6	77.5	66.2	1.77	13.58
615	68.6	64.7	64.0	65.8	71.9	81.5	77.6	77.0	1.52	33.52
616	94.1	81.3	80.6	85.3	97.4	100.9	102.1	100.1	0.66	31.11
617	95.9	89.8	88.7	91.5	99.2	100.1	101.4	100.2	1.18	24.42
618	95.4	76.9	77.1	83.1	98.7	102.9	104.1	101.9	1.00	7.01
619	96.9	95.8	96.0	96.2	100.2	106.0	105.9	104.0	0.37	15.89
625	67.3	69.5	70.1	69.0	70.6	82.0	84.0	78.9	1.83	19.23
626	56.9	88.4	88.0	77.8	53.6	58.3	60.0	57.3	1.73	17.06
630	75.6	80.8	79.2	78.5	72.3	94.3	96.3	87.6	1.71	27.42
638	73.3	81.2	81.2	78.6	70.0	79.3	82.3	77.2	0.14	17.71
639	85.0	84.2	84.5	84.6	81.7	61.5	75.5	72.9	1.92	12.00
640	49.9	86.0	85.3	73.7	51.3	77.5	77.3	68.7	0.31	11.10
641	77.3	91.4	91.1	86.6	53.8	58.2	59.5	57.2	0.59	31.44
642	77.6	88.0	87.4	84.3	81.2	85.0	86.5	84.2	0.24	27.62
643	98.7	87.1	88.2	91.3	81.5	78.1	79.2	79.6	0.71	24.88
644	71.3	92.2	93.2	85.6	82.6	84.8	84.0	83.8	2.22	22.94
649	82.5	57.1	56.0	65.2	75.2	86.6	88.1	83.3	0.40	12.46
657	87.4	92.7	92.0	90.7	90.7	98.8	102.1	97.2	0.94	17.05
658	74.8	80.5	80.2	78.5	96.2	101.3	100.6	99.4	1.16	15.96
659	92.6	74.3	74.3	80.4	66.6	71.8	69.7	69.4	0.45	12.24
660	75.7	73.1	73.0	73.9	51.8	93.2	84.7	76.6	0.39	25.89
672	86.7	88.7	88.4	87.9	79.2	81.1	82.8	81.0	1.68	24.38
673	89.3	87.3	88.3	88.3	96.5	99.6	97.8	98.0	0.89	17.04
674	97.1	98.2	99.1	98.1	79.6	97.8	91.2	89.5	0.45	26.00
675	93.3	90.1	89.3	90.9	90.6	93.3	90.2	91.4	2.04	13.73
676	92.3	103.2	99.0	98.2	87.1	98.0	101.1	95.4	0.19	14.54

recorded for accession 616 (Table 9).

Regression coefficient (b) values for oil % were in the range of 0.38 to 1.39, where the minimum 0.38 was recorded for accession 870 and the maximum 1.39 for accession 831. While on the other hand, the values for deviation from regression (S^2_d) were in the ranges of 0.46 to 8.56 and among these the minimum 0.46 was recorded for accession 866 and maximum 8.56 for accession 856 (Table 10). The b values recorded for protein % were in the range of 0.10 to 1.86, where the minimum 0.10 was recorded for accession 868 and maximum 1.86 for accession 83 and on the other hand, S^2_d values were in the range of 0.78 to 2.73, having minimum for accession 821 and maximum for accession

Table 9. Values of selected *Brassica juncea* accessions for erucic acid content during 2007-08 and 2008-09 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Acc. No.	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
600	35.1	38.6	38.1	37.3	38.5	35.8	33.7	36.0	3.58	4.83
601	25.2	30.1	29.8	28.4	28.6	28.1	30.1	28.9	4.19	6.20
602	54.4	54.5	55.0	54.6	57.8	52.3	54.3	54.8	9.56	4.05
603	31.1	33.1	32.1	32.1	30.2	30.5	29.2	30.0	0.56	4.94
604	29.2	32.2	31.2	30.9	32.6	33	32.1	32.6	1.52	4.49
605	53.2	54.4	54.2	53.9	54.6	55.7	53.2	54.5	1.97	11.76
606	27.2	41.0	41.2	36.5	30.6	31.1	31.7	31.1	0.25	8.39
607	52.8	49.1	49.0	50.3	48.5	49.0	49.1	48.9	5.09	3.66
608	51.2	42.0	44.1	45.8	46.9	46.3	44.6	45.9	0.44	3.24
609	50.4	46.9	45.1	47.5	46.1	48.9	48.3	47.8	2.82	6.39
610	53.1	46.2	47.0	48.8	58.8	58.2	60.9	59.3	0.66	3.53
611	49.7	43.1	44.2	45.7	55.7	56.8	55.7	56.1	0.56	6.72
612	57.2	57.0	55.0	56.4	52.9	58.5	58.8	56.7	5.09	8.70
613	35.3	37.9	38.1	37.1	37.4	39.4	39.5	38.8	0.55	3.57
614	36.4	37.7	36.0	36.7	32.1	33.6	33.0	32.9	1.37	6.00
615	30.9	29.1	27.6	29.2	29.6	30.0	29.5	29.7	1.24	11.25
616	35.2	38.6	37.1	37.0	36.9	39.8	39.0	38.6	4.44	13.77
617	29.6	27.3	27.1	28.0	27.4	29.5	29.8	28.9	0.14	2.35
618	40.4	42.6	42.0	41.7	40.1	42.2	41.5	41.3	0.24	3.03
619	50.8	50.9	50.1	50.6	46.5	48.3	49.2	48.0	1.33	1.41
625	30.3	30.7	28.5	29.8	31.2	33.3	33.0	32.5	2.77	4.55
626	50.2	54.3	49.2	51.2	48.3	47.3	46.9	47.5	2.06	5.84
630	40.5	44.1	44.0	42.9	39.4	41.2	42.0	40.9	1.20	2.15
638	50.9	50.4	51.1	50.8	46.6	53.1	54.4	51.4	0.16	11.5
639	38.2	40.1	42.1	40.1	33.9	35.9	34.2	34.7	1.37	2.64
640	32.0	33.1	33.0	32.7	31.4	33.9	33.1	32.8	3.56	6.16
641	43.5	43.2	42.0	42.9	44.2	43.9	43.6	43.9	5.35	12.56
642	38.0	39.1	39.0	38.7	47.8	49.6	50.0	49.1	1.03	4.64
643	34.4	35.1	34.5	34.7	32.3	34.1	34.4	33.6	1.40	5.79
644	56.4	51.2	50.0	52.5	58.7	53.7	52.6	55.0	3.89	8.16
649	29.2	31.2	30.2	30.2	30.7	32.8	31.1	31.5	2.17	2.31
657	43.0	42.1	41.2	42.1	44.1	44.5	44.7	44.4	1.73	3.66
658	30.5	33.7	33.5	32.6	32.5	33.8	33.2	33.2	0.24	5.69
659	43.3	44.0	43.7	43.7	42.0	42.2	41.4	41.9	4.79	4.01
660	29.8	30.5	31.1	30.5	34.3	37.2	37.0	36.2	3.62	5.77
672	34.4	34.6	33.8	34.3	35.8	34.2	33.8	34.6	2.75	11.03
673	38.1	40.9	41.0	40.0	37.6	41.2	42.2	40.3	2.08	1.42
674	40.2	39.4	39.0	39.5	39.1	41.1	42.2	40.8	1.24	5.14
675	42.4	44.4	45.2	44.0	37.7	40.8	40.0	39.5	0.39	2.63
676	35.1	37.6	39.1	37.3	33.1	33.7	34.8	33.9	2.58	4.36

800 (Table 11). Data recorded for glucosinolates on the basis of b values were in the range of 0.15 to 2.61, where the minimum 0.15 was recorded for accession 829 and the maximum 2.61 was recorded for accession 856. The values for S^2_d were in the range of 3.22 to 42.6, where the minimum 3.22 value was recorded for accession 832 and the maximum 42.6 value was for accession 868 (Table 12). The erucic acid % values for b were in the ranges of 0.19 to 3.33, where the minimum 0.19 was recorded for the accession 861 and the maximum 3.33 was recorded for accession 870. On the other hand, S^2_d values were in the range of 1.03 to 12.68 and the minimum 1.03 value was recorded for accession 829 and the maximum 12.68 value was recorded for accession

Table 10. Values of selected *Brassica rapa* accessions for oil content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Accession number	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
800	32.5	46.0	46.1	41.5	34.7	47.7	51.1	44.5	2.04	6.82
801	40.8	43.3	46.5	43.5	43.0	48.0	48.0	46.3	0.99	2.98
802	42.2	46.3	43.5	44.0	44.4	46.9	47.9	46.4	0.60	2.31
803	41.8	46.5	44.0	44.1	44.0	44.1	45.1	44.4	1.00	2.55
816	39.4	39.5	47.9	42.3	41.6	45.9	46.9	44.8	1.02	2.08
817	39.8	47.0	33.9	40.2	42.0	44.3	45.3	43.9	0.44	1.92
818	40.2	43.5	45.8	43.2	42.4	47.8	48.8	46.3	0.66	2.19
819	39.2	44.0	43.9	42.4	41.4	53.5	52.5	49.1	1.14	2.94
820	39.5	47.9	48.5	45.3	41.7	49.9	48.9	46.8	1.67	2.71
821	41.9	33.9	47.5	41.1	44.1	46.8	45.8	45.6	0.97	1.24
822	39.0	45.8	48.7	44.5	41.2	47.5	48.5	45.7	0.95	0.50
823	38.8	43.9	40.8	41.2	45.0	46.3	47.3	46.2	0.88	2.34
824	37.8	48.5	41.1	42.5	42.8	47.3	48.3	46.1	1.09	2.38
825	42.8	47.5	41.8	44.0	42.5	44.0	45.0	43.8	1.32	1.93
826	40.2	48.7	46.4	45.1	43.9	46.5	47.5	46.0	1.35	1.66
827	42.1	40.8	44.2	42.4	41.3	48.2	49.2	46.2	0.80	2.66
828	40.6	41.1	41.0	40.9	40.9	43.8	44.8	43.2	0.98	3.08
829	40.3	41.8	41.2	41.2	44.9	54.5	55.5	51.6	1.29	2.90
830	41.4	46.4	34.7	40.8	44.2	50.9	51.9	49.0	1.11	3.11
831	41.7	44.2	43.0	43.0	41.4	47.8	48.8	46.0	1.39	1.33
832	39.1	41.0	44.7	41.6	47.1	50.5	51.5	49.7	1.15	2.03
833	38.7	41.4	44.4	41.5	37.0	49.3	51.3	45.9	1.33	2.22
834	42.7	41.7	44.0	42.8	43.5	50.3	48.0	47.3	1.38	2.83
849	42.0	34.7	44.3	40.3	44.5	53.1	50.3	49.3	1.30	1.59
850	39.2	43.0	44.0	42.1	42.6	50.0	50.9	47.8	0.95	1.20
851	37.2	44.7	50.2	44.0	44.7	50.2	48.8	47.9	1.16	2.54
852	38.7	44.4	45.0	42.7	46.8	52.9	47.9	49.2	1.18	1.22
853	44.9	44.0	44.8	44.6	49.5	50.8	48.2	49.5	1.23	3.77
854	34.8	44.3	49.1	42.7	43.2	51.2	43.1	45.8	1.24	1.39
855	41.3	44.0	46.5	43.9	43.7	46.8	49.2	46.6	0.62	2.86
856	42.3	50.2	41.6	44.7	42.1	46.8	44.8	44.6	0.58	8.56
861	40.4	45.0	46.9	44.1	47.1	47.0	47.8	47.3	0.78	3.50
862	47.1	44.8	46.8	46.2	40.1	48.8	50.3	46.4	0.43	1.12
863	49.2	49.1	49.8	49.4	45.0	48.1	47.8	47.0	1.09	4.81
864	51.9	46.5	47.0	48.5	46.1	49.6	48.1	47.9	0.43	1.71
865	45.6	41.6	39.5	42.2	44.0	45.9	47.6	45.8	1.02	2.09
866	46.1	46.9	44.4	45.8	42.4	47.2	41.1	43.6	0.64	0.46
867	43.4	44.0	42.7	43.4	43.5	43.1	41.1	42.6	0.83	3.24
868	45.4	40.3	43.4	43.0	44.3	43.9	49.8	46.0	0.58	3.25
870	47.5	42.7	41.7	44.0	38.5	49.8	48.0	45.4	0.38	1.32

865 (Table 13).

These findings were supported by the earlier findings of Ali et al. (2008) who also obtained same results. Similarly, Rao et al. (2002), Setegn and Habtu (2003), Volker et al. (2004) and Salem (2005) findings also supported our results.

According to this model, a stable genotype should have a high mean yield, b = 1.0 and $S^2_d = 0$. It is however, specifically the deviation from the regression (S^2_d) which is used as a measure of a genotype's stability across environments.

According to Finlay and Wilkinson (1963), the genotypes having regression coefficients (b) value near to 1.0 signify average stability, but that should be allied

Table 11. Values of selected *Brassica rapa* accessions for protein content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Accession number	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
800	30.0	30.6	25.4	28.7	27.8	21.4	23.0	24.1	0.83	2.73
801	31.7	26.5	27.3	28.5	29.5	22.4	24.4	25.4	1.35	2.00
802	30.7	27.1	25.9	27.9	28.5	20.1	23.1	23.9	1.12	2.51
803	30.6	27.3	28.6	28.8	28.4	22.4	25.4	25.4	0.79	1.09
816	30.9	28.9	24.7	28.2	28.7	21.2	22.2	24.0	1.25	1.99
817	30.9	25.8	27.0	27.9	28.7	24.1	25.1	26.0	0.77	0.97
818	30.1	25.9	26.4	27.5	27.9	22.8	23.8	24.8	0.96	0.98
819	28.2	28.6	25.0	27.3	26.0	22.0	23.0	23.7	1.03	1.47
820	29.0	24.7	23.6	25.8	26.8	21.4	22.4	23.5	0.77	1.12
821	30.0	27.0	24.9	27.3	27.8	23.9	24.9	25.5	1.44	0.78
822	31.1	26.4	24.2	27.2	28.9	19.7	22.7	23.8	1.15	1.21
823	31.6	25.0	26.6	27.7	26.9	22.3	25.3	24.8	1.18	1.88
824	29.9	23.6	27.4	27.0	29.8	19.8	22.8	24.1	1.68	1.54
825	29.1	24.9	28.0	27.3	23.4	20.7	23.7	22.6	1.57	1.63
826	30.8	24.2	27.0	27.3	27.5	20.8	23.8	24.0	1.74	1.74
827	30.0	26.6	27.9	28.2	28.6	20.4	23.4	24.1	1.29	2.09
828	32.0	27.4	29.4	29.6	28.3	23.5	26.5	26.1	1.26	0.98
829	25.6	28.0	26.2	26.6	28.1	25.0	26.0	26.4	1.48	0.99
830	29.2	27.0	27.8	28.0	29.5	24.4	25.4	26.4	1.48	1.71
831	29.7	27.9	29.5	29.0	28.5	26.9	27.9	27.8	1.86	1.34
832	30.8	29.4	28.4	29.5	25.4	24.7	25.7	25.3	1.25	1.73
833	30.5	26.2	28.5	28.4	25.7	27.3	25.8	26.3	1.55	2.07
834	30.3	27.7	28.4	28.8	27.8	24.8	26.7	26.4	1.68	2.20
849	31.7	27.8	25.4	28.3	27.9	25.0	23.0	25.3	1.36	2.25
850	30.7	29.5	28.4	29.5	28.3	28.7	20.9	26.0	1.08	1.76
851	31.6	28.4	22.5	27.5	26.7	22.0	22.7	23.8	1.17	1.33
852	31.3	28.5	26.4	28.7	23.7	22.9	24.5	23.7	1.20	1.61
853	27.6	28.4	26.5	27.5	22.2	24.7	24.8	23.9	0.96	2.21
854	27.9	25.4	24.6	26.0	27.0	25.2	27.5	26.6	0.78	2.37
855	30.0	28.4	24.6	27.7	28.1	27.6	23.2	26.3	0.99	1.87
856	30.1	22.5	29.0	27.2	23.4	20.3	25.6	23.1	0.35	2.26
861	30.5	26.4	24.2	27.0	25.0	21.7	26.0	24.2	0.76	2.34
862	24.3	26.5	27.6	26.1	27.0	21.0	28.3	25.4	0.81	2.15
863	21.3	24.6	28.0	24.6	27.0	21.1	23.3	23.8	0.55	2.13
864	19.8	24.6	25.8	23.4	25.0	21.2	23.1	23.1	0.23	2.26
865	24.6	29.0	28.9	27.5	28.7	23.5	23.2	25.1	0.26	1.33
866	25.7	24.2	29.0	26.3	29.0	18.9	24.8	24.2	0.46	0.89
867	27.6	27.0	27.4	27.3	28.6	28.7	26.7	28.0	0.03	1.45
868	25.9	30.8	27.2	28.0	25.4	22.3	24.0	23.9	0.10	2.60
870	25.4	27.4	27.7	26.8	39.6	23.7	24.7	29.3	0.46	1.23

with high value of mean yield establish the stability of that genotype. When the regression coefficients are approximating 1.0 and are linked with high yield mean, genotypes are adapted to all environments. On the other hand, those genotypes which have low mean yields, then genotypes are poorly adapted to all environments. On the other hand, those genotypes which have regression coefficients above 1.0 showed the increased sensitivity of the genotypes to the environmental change, as a result showing below average stability and great specific adaptability to high yielding environments. Regression coefficients decreasing below 1.0 provide a measure of greater resistance to environmental change, having above average stability but showing more specific

Table 12. Values of selected *Brassica rapa* accessions for glucosinolates content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Accession number	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
800	62.3	93.1	97.3	84.2	66.2	98	91.2	85.1	1.81	27.88
801	92.1	88.9	92.2	91.1	96.0	91.3	91.3	92.9	0.90	20.28
802	65.0	90.0	91.7	82.2	61.1	93.9	96.9	84.0	1.74	23.48
803	47.8	92.2	91.1	77.0	43.9	91.4	94.4	76.6	1.15	13.31
816	68.7	106.8	85.3	86.9	64.8	80.6	80.6	75.3	1.06	12.7
817	64.2	107.1	74.5	81.9	60.3	95.2	95.2	83.6	0.84	18.40
818	98.5	91.7	82.8	91.0	94.6	96.7	96.7	96.0	0.70	22.80
819	91.4	91.1	103.3	95.3	87.5	88.8	91.8	89.4	1.71	6.38
820	60.4	85.3	45.7	63.8	56.5	91.6	94.6	80.9	0.91	27.22
821	99.6	74.5	91.5	88.5	95.7	67.2	70.2	77.7	0.58	13.35
822	84.7	82.8	53.8	73.8	80.8	84.9	87.9	84.5	1.25	24.98
823	60.8	103.3	81.2	81.8	66.5	94.1	97.1	85.9	1.40	30.73
824	75.4	65.7	81.5	74.2	92.3	93.9	96.9	94.4	1.31	6.32
825	70.4	91.5	102.6	88.2	99.9	81.2	84.2	88.4	1.11	20.39
826	36.2	53.8	75.2	55.1	74.0	87.1	90.1	83.7	0.21	10.08
827	80.6	81.2	96.5	86.1	99.0	96.2	99.2	98.1	1.15	8.19
828	87.6	81.5	79.6	82.9	81.9	73.8	76.8	77.5	2.00	19.45
829	95.2	102.6	90.6	96.1	71.7	91.8	94.8	86.1	0.15	19.31
830	69.2	75.2	66.2	70.2	64.0	94.6	97.6	85.4	0.99	21.56
831	69.3	96.5	96.0	87.3	77.0	70.2	73.2	73.5	1.16	24.48
832	94.3	79.6	108.7	94.2	59.9	87.9	90.9	79.6	1.29	3.22
833	77.2	90.6	61.1	76.3	55.9	97.1	99.9	84.3	2.42	19.63
834	76.4	105.3	43.9	75.2	44.6	96.9	87.2	76.2	0.27	27.68
849	68.7	66.2	103.9	79.6	66.4	93.2	81.7	80.4	0.25	25.63
850	81.7	96.0	102.9	93.5	81.1	89.2	77.4	82.6	1.39	21.86
851	78.3	108.7	92.9	93.3	53.3	86.7	71.3	70.4	1.20	8.20
852	46.2	61.1	104.9	70.7	79.9	79.4	94.4	84.6	1.03	19.25
853	64.6	43.9	73.4	60.6	46.2	73.3	86.1	68.5	1.32	23.39
854	60.6	103.9	74.8	79.8	94.5	77.5	75.3	82.4	0.23	18.57
855	49.3	102.9	51.1	67.8	73.2	85.5	75.5	78.1	1.59	10.92
856	71.1	92.9	77.0	80.3	87.4	98.8	83.5	89.9	2.61	22.54
861	85.8	104.9	52.6	81.1	95.0	100.4	90.1	95.2	1.09	15.81
862	58.0	73.4	85.5	72.3	51.0	101.7	100.1	84.3	0.39	21.33
863	84.6	74.8	92.1	83.8	65.5	100.6	101.8	89.3	0.49	24.79
864	50.9	51.1	107.1	69.7	50.2	101.7	100.6	84.2	1.60	18.17
865	99.2	77.0	106.8	94.3	102.3	104.2	101.7	102.7	0.86	4.65
866	68.5	52.6	110.3	77.1	101.5	105.3	103.0	103.3	1.70	16.73
867	89.8	103.1	110.9	101.3	105.0	104.9	102.9	104.3	1.14	21.39
868	69.5	114.6	105.2	96.4	103.9	108.1	104.7	105.6	1.39	42.6
870	41.1	110.9	103.3	85.1	101.2	106.6	103.4	103.7	1.13	22.12

adapted to low yielding environments**.** On the basis of overall study of stability, regression coefficient (b) values showed high amount of variations for all the studied parameters. Also, the results obtained for deviation from regression (S^2d) showed a wide range of variations. These findings were strengthened by the earlier findings of Ojo et al. (2002) and Adebisi and Ajala (2007) and Adebisi (2004) also obtained high amount of variation for both regression coefficient and deviations from regression. Similarly, Beaver et al. (1995) and Kakani (1989) also supported our findings. Similarly, the earlier finding of Yan (2001) also obtained high level of variation for oil related parameters in oilseed *B. napus.* Similarly, Sudaric (2006) also obtained similar results.

Table 13. Values of selected *Brassica rapa* accessions for erucic acid content during 2007 to 2008 and 2008 to 2009 along with their mean values, regression coefficient (b) and deviation from regression (S^2_d).

Acc. No.	2007 to 2008				2008 to 2009				b	S^2_d
	Kag	Pesh	Isld	Mean	Kag	Pesh	Isld	Mean		
800	30.1	38.6	35.5	34.7	21.4	53.7	43.2	39.4	0.67	3.31
801	48.6	34.2	51.9	44.9	52.9	58.0	60.0	57.0	1.32	5.41
802	54.2	40.1	41.8	45.4	58.5	54.9	56.9	56.8	0.38	1.66
803	49.4	51.2	56.6	52.4	46.5	48.8	50.8	48.7	2.59	10.08
816	41.2	60.8	58.9	53.6	38.3	45.9	47.9	44.0	0.90	3.27
817	46.5	34.5	44.0	41.7	43.6	42.8	44.8	43.7	1.23	2.99
818	54.1	41.8	50.5	48.8	51.2	58.3	60.3	56.6	2.83	3.23
819	60.7	46.6	55.4	54.2	57.8	57.9	59.9	58.5	1.63	3.21
820	40.0	38.9	47.5	42.1	37.1	49.3	51.3	45.9	2.98	12.14
821	60.3	44.0	41.2	48.5	57.4	38.8	40.8	45.7	1.12	5.12
822	50.7	40.5	36.3	42.5	47.8	50.9	52.9	50.5	0.40	2.47
823	49.2	65.4	47.8	54.1	57.0	58.0	60.0	58.3	1.77	5.57
824	61.3	49.5	52.3	54.4	55.0	55.8	57.8	56.2	1.02	6.08
825	59.9	60.2	58.7	59.6	56.4	53.9	55.9	55.4	3.60	5.55
826	54.7	56.3	60.7	57.2	52.9	53.0	55.0	53.6	0.25	2.36
827	60.9	47.8	57.6	55.4	50.7	57.3	59.3	55.8	1.87	3.69
828	52.1	52.3	54.1	52.8	47.7	53.3	55.3	52.1	2.22	5.00
829	59.4	38.7	58.7	52.3	53.3	50.9	52.9	52.4	0.31	1.03
830	54.7	60.7	21.4	45.6	54.6	52.3	54.3	53.7	1.54	5.06
831	50.0	57.6	52.9	53.5	52.5	41.8	43.8	46.0	3.28	4.82
832	47.8	54.1	50.8	50.9	55.3	53.9	55.9	55.0	0.30	4.81
833	44.8	48.7	58.5	50.7	50.6	51.0	60.8	54.1	0.58	3.12
834	50.4	51.5	46.5	49.5	42.3	58.8	58.9	53.3	1.87	3.62
849	51.7	21.4	60.0	44.4	57.4	45.2	60.6	54.4	0.73	5.21
850	49.6	52.9	37.1	46.5	45.2	60.9	55.1	53.7	0.93	5.48
851	54.2	50.8	54.6	53.2	56.2	49.0	56.8	54.0	1.20	4.31
852	51.9	58.5	37.1	49.2	54.4	57.1	60.5	57.3	0.43	2.70
853	52.4	46.5	46.0	48.3	56.3	58.8	54.4	56.5	2.13	4.25
854	47.7	30.0	59.0	45.6	54.4	54.7	53.1	54.1	1.69	6.64
855	39.4	58.1	52.7	50.1	53.7	47.3	52.7	51.2	0.62	3.89
856	54.5	27.6	53.4	45.2	46.5	51.6	45.3	47.8	0.85	3.65
861	42.3	49.1	40.6	44.0	44.3	58.0	55.1	52.5	0.19	4.38
862	58.3	46.0	47.3	50.5	57	58.8	53.0	56.3	0.76	3.81
863	56.6	59.0	57.1	57.6	33.4	49.3	53.6	45.4	1.33	5.74
864	54.2	37.7	34.5	42.1	41.3	57.1	51.3	49.9	1.74	2.60
865	52.3	53.4	60.8	55.5	50	58.1	59.1	55.7	3.32	12.68
866	60.6	48.6	51.7	53.6	58.5	58.5	38.5	51.8	1.19	3.65
867	60.1	35.5	39.7	45.1	55.6	49.0	47.0	50.5	1.80	3.50
868	36.6	40.4	60.6	45.9	60	52.4	60.8	57.7	1.68	8.65
870	59.0	30.7	57.5	49.1	15.4	58.4	60.0	44.6	3.33	2.39

Other findings are further supported by the earlier findings of Shafi et al. (1992).

Conclusion

Environmental effect as well as GEI had the strongest influence on the fatty acid composition of oilseed brassica species. In the present attempt, some of the locally collected accessions exhibit stability for the fatty acids; therefore, it is recommended that such accessions should be included in the future breeding programmes. So, from the overall stability study of the selected genotypes across different locations the following accessions of

different brassica species were recommended for further study in future breeding programmes. These includes, 803, 807, 811, 812, 822, 825, 829, 830, 831, 832, 833, 838, 840, 846, 847, 850, 851, 853, 855, 859, 860, 862, 864, 866, 505, 500, 503, 514, 515, 523, 530, 534, 539, 541, 545, 549, 553, 604, 610, 615, 621, 628, 635, 640, 645, 646, 650, 655, 656, 657, 658 and 659.

REFERENCES

Ali Y, Atta BM, Akhter J, Monneveux P, Lateef Z (2008). Genetic variability, association and diversity studies in wheat (*Triticum aestivum* L.) germplasm. Pak. J. Bot., 40(5): 2087-2097.

Adebisi MA, Ajala MO (2007). Effect of genotypes and seed production environment on seed quality of sesame (*Sesamum indicum* L). Tanzania J. Agric. Sci. 8(2):87-102.

Adebisi MA (2004). Variation, stability and correlation studies in seed quality and yield components of sesame (*Sesamum indicum* L.). Unpublished PhD Thesis, Univ. Agric. Abeokuta Nigeria. 123pp.

Ana M, Radovan M, Anto M, Mirjana J, Zvonimir Z, Nevena N (2008). Oil yield Stability of winter rapeseed (*Brassica napus* L.) genotypes. Agric. Conspec. Sci. 73 (4).

Annicchiarico P (2002). Genotype x Environment Interactions: Challenges and Opportunities for Plant Breeding and Cultivar Recommendations. FAO Plant Production and Protection Paper No. 174. FAO, Rome.

Arshad M, Bakhsh A, Haqqani AM, Bashir M (2003). Genotype x environmeninteraction for grain yield in chickpea (*Cicer arietinum* L.). Pak. J. Bot., 35(2): 181-186.

Beaver JS, Paniagna CV, Coyne DP, Freytag GF (1995). Yield stability of dry bean genotypes in the Domimcan Republic. Crop Sci. 25:923-926.

Bhatinagar PS, Tiwari SP (1989). Phenotypic stability analysis of yield in soybean. Bio. Vigyanam .15: 90-93.

Finlay KW, Wilkinson GN (1963). The analysis of adaptation in a plant breeding programme. Aust. J. Agri. Res. 14:742-754.

Kakani R (1989). Stability analysis in taramira (*Eruca sativa* Mill.). M.Sc. (Ag). Thesis, RAU, Bikaner.

Koanwar BK, Talukdar P (1986). Stability analysis for yield and its components in soybean. Crop improv. 13: 172-175.

Majid SA, Asghar R, Murtaza G (2007). Yield stability analysis conferring adaptation of wheat to pre- and post-anthesis drought conditions. Pak. J. Bot., 39(5): 1623-1637.

Ojo DK, Adebisi MA, Salau AN (2002). Effect of seed production environments on seed germination, seed yield and yield components in tropical soybean genotypes. Moor J. Agric. Res. 3(1):68-75.

Rao MSS,Mullinix BG, Rangappa M, Cebert E, Bhagsari AS, Sapra VT, Joshi JM, Dadson RB (2002). Genotype x Environment Interactions and Yield Stability of Food-Grade Soybean Genotypes. Agro. J. 94:72-80.

Salem SA (2005). Yield Stability of Some Soybean Genotypes Across Diverse Environments. Pak. J. Bio. Sci. 7(12): 2109-2114.

Singh O, Chaudhry CD (1985 b). Stability analysis for protein and oil content in soybean. J. Oil Seed Res. 2:57- 61.

Setegn G, Habtu A (2003). Genotype x environment interaction and stability analysis of seed yield in navy bean genotypes. Afr. Crop Sci. J. 11(1): 1-7.

Shafi B, Mahler KA, Price WJ, Auld DL (1992) . Genotype x environment interaction effects on winter rapeseed yield and oil content. Crop Sci 32: 922-927.

Sudaric A, Simic D, Vrataric M (2006). Characterization of genotype by environment interactions in soybean breeding progarmmes of southeast Europe. Plan Breeding 125: 191-194

Tuck G,Glendining M, Smith P, House J, Waltenbach M (2006). The potential distribution of Bioenergy crops in Europe under present and future climate. Biomass Bioenergy 30: 183-197.

Volker MS, Antje M, Christian, Heiko BC (2004). Genotype x Environment Interactions and Heritability of Tocopherol Contents in Canola. Crop Sci. 44:728-731.

Yan W (2001). GGE biplot- a windows application for graphical analysis of multienvironment trial data and other types of two-way data. Agro. J. 93: 1111-1118.