RESEARCH PAPER

Some Characters of Different Genotypes of Brassica napus in Erbil City-Kurdistan Region-Iraq

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ABSTRACT:

The study was conducted at GrdaRrasha Research Field / College of Agriculture / University of Salahaddin / Erbil City – Kurdistan Region-Iraq during the winter growing season of (2014-2015), to select a genotype which has adaptation to our region depending on yield and quality in addition to anatomical study of the studied genotypes. For this purpose a field experiment was conducted for comparison among (12) genotypes using randomize complete block design (RCBD) with three replicates under supplemental irrigation condition. The results indicated that Dunckled genotype superior significantly in days from sowing to maturity, number of pods plant^1, Seeds Pod^1, Seed index, Seed yield (Mg ha^-1), biological yield and harvest index with the values of (166.33 days , 248.63, 25.68, 6.10 , 5.20, 16.20 and 0.32 respectively, while the highest values of oil% and oil yield were recorded from Bard-1 genotype. Results also revealed the presence of large variations in numbers of vascular bundles per midricts; stem epidermal layers and thickness of cells; cortex and vascular bundles for different genotypes. The differences were observed in the vascular bundles per midrib of leaf large vascular bundle surrounded by collenchyma, except Bard-1,Rally, Rendy and Rapiferathe midribs composes of three semicircular vascular bundles. and showed variations in stem epidermal layers, were two layers as in Sultan, Bacara, and Rapifera .

KEY WORDS: Brassica, Genotypes, Yield component, Anatomy of rapeseed .

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INTRODUCTION :

Canola regards as the major oilseeds industry crops and supplies over 13.2% of the world’s edible oil, which providing national economic benefits in employment, processing, manufacturing and exports (Robbelen et al, 1989).

The major centers of distribution of the family are in the Irano-Turanian, Mediterranean and Saharo-Sindian regions, Turkey is one of the richest countries in the world (Al-Shehbaz 1984, Warwick et al. 2006 and Kasem et al. 2011). The anatomical characters have been used as evidences in taxonomy for more than one hundred years, since high power microscopes become commonly available (Stace, 1984). Both Metcalfe and Chalk (1950) mentioned description anatomic properties for most di-cotyledons family, and Brassicaceae family. It was donated to the genus Brassica simply. Metcalfe and Chalk (1957) studied the anatomy of the family Brassicaceae and determined the diagnostic anatomical characteristics as epidermal cell type, stoma type and the arrangement of the sclerenchyma cells

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Brassicaceae is one of the largest families of angiosperm comprising 338 genera and 3709 species and distributed throughout the world, mainly in temperate regions of the Northern Hemisphere (Al-Shehbaz 1984, Warwick et al. 2006 and Kasem et al. 2011). The anatomical characters have been used as evidences in taxonomy for more than one hundred years, since high power microscopes become commonly available (Stace, 1984). Both Metcalfe and Chalk (1950) mentioned description anatomic properties for most di-cotyledons family, and Brassicaceae family. It was donated to the genus Brassica simply. Metcalfe and Chalk (1957) studied the anatomy of the family Brassicaceae and determined the diagnostic anatomical characteristics as epidermal cell type, stoma type and the arrangement of the sclerenchyma cells...
around the vascular bundles of the leaves. Challenge for growers and the industry over the next few years will be to continue to improve productivity by adopting best varieties, practice management and being responsive to climate variability to ensure a stable supply of high quality oilseed for domestic and international markets (Don et al., 2009). It has an excellent export potential and it is a labor intensive crop. The major reasons for low yield in our country are lack of use of both high yielding varieties and appropriate technologies yield and its formation process depend on genetic, environmental and agronomic factors as well as the interaction between them .DON et al(2009) mention that average canola yields vary over a range of around (1 t ha⁻¹) in the drier regions but up to (3-4 tha⁻¹) in the more favorable growing areas or on irrigation. Therefore, there is a scope to increase the yield level of mustard by using high yield varieties(HYV) seed and by adopting proper management practices ,the amount of oil may vary between cultivars and, even more so, between environments and seasons for the same cultivar. The aim of this study was to select a genotype which has adaptation to our region, has high yield and good quality.

2. MATERIALS AND METHODS

Part (1)
The field experiment was carried out at the GrdaRasha Research Field / College of Agriculture / University of Salahaddin, Erbil with GPS reading of (Latitude 36°4' N and Longitude 44°2'E) to investigate the effect of 12 Brassica genotypes on growth characters , yield , quality and anatomical characters using randomize complete block design (RCBD) with three replicates. The area of each experimental unit was (1*2)m². The properties of the studied soil were recorded from table(1). On 1st November 2015 the sowing was done manually using a seed rate of 4 kg ha⁻¹ (Hashim ,2016) in 40 cm spaced lines on a well prepared seed bed . Each plots was fertilized with (160) g urea, (64 g)Triple Super Phosphate (TSP) and (48) g K₂SO₄ respectively, they applied during the sowing time except nitrogen fertilizer (urea) divided into two doses, half of urea applied at sowing time, the second part applied at inflorescence initiation stage. The studied genotypes were Rapifera-swedin, Bard-1- Hendi, Dunckled-Hendi, Hybrizock-France, Coscar-Hendi, Pactol -Local, Rendi- swedin, Rally-France, Sultan - Hendi ,Heroz– British - Bonanza-France, Bacara-Hindi). The Intercultural operations and supplemental irrigation were done whenever it is necessary; table (2) shows the amount of rainfall during the field experiment. The studied growth characters were:

- Period from sowing to emergence stage (appearance 50% of cotyledons above soil surface).
- Period from sowing to stem elongation stage.
- Period from sowing to flowering stage (50% of the plants with bloom).
- Period from sowing to physiological maturity stage.

Ten plants were selected randomly from middle rows of each plot to measure:
- Plant height (cm).
- Number of primary branches plant⁻¹.
- Number of secondary branches plant⁻¹.
- No. of silique plant⁻¹.
- No. of seeds silique⁻¹.
- Weight of 1000 seeds (g).

The plants were harvested at different times (from 14/5 to 16/6/2015) depending on genotype maturing, then seed and biological yield were calculated (Mg ha⁻¹).

- Oil percentage was determined using Soxhlet apparatus for oil extraction as mentioned by Association of Official Analytical Chemists A.O.A.C. (1980).

- Oil yield (Mg ha⁻¹): The oil yield was calculated by using the following formula:

\[
\text{Oil yield (Mg ha}^{-1}\text{)} = \text{Oil }\% \times \text{Seed yield (kg ha}^{-1}\text{)}.
\]
Table (1): Some physical and chemical properties of the soil*.

| Soil properties          | 0-30 cm |
|--------------------------|---------|
| PSD (particle size distribution) |         |
| Sand                     | 13      |
| Silt (%)                 | 41.5    |
| Clay                     | 45.5    |
| Textural class           | Silty clay |
| pH                       | 7.73    |
| Ec dS.m⁻¹                | 0.20    |
| O.M %                    | 0.90    |
| Total (N) %              | 0.10    |
| Available (P) µg.g⁻¹     | 4.5     |
| Available (K) µg.g⁻¹     | 180     |

*The soil properties were analyzed at the Directorate of Agriculture Research Center, Erbil.

Part 2:
The samples fixed in FAA solution for 24 hours. The dehydration was in ascending concentration of ethanol alcohol. Clearing by xylene, and infiltration the samples were placed in a mixture solution of absolute alcohol and xylene for 1.5-2 hours, then pure xylene for 2 hours. The samples were placed in the mixture of melted paraffin and xylene 1:1 for 2hrs. Then poured in pure paraffin for overnight in oven at 60-70°C. Embedding process which poured in paraffin wax in prepared metal templates. The samples were sectioned 6-8µm thickness, then stained by safranin and fast green, and mounted by DPX (Dextrin plastisizer xylene) (Saeed, 2003).

Table (2): Metrological data during growing season of (2014-2015).

| Month    | Air temperature (°C) | Months precipitation mm | Relative Humidity% |
|----------|----------------------|-------------------------|--------------------|
|          | Max | Min | Mean |                              |                    |
| October  | 35.3| 10.6| 22.7 | 56.4                          | 45.9               |
| November | 25.5| 4.5 | 14.2 | 77.7                          | 58.8               |
| December | 21.8| 2.5 | 11.4 | 44.4                          | 70.5               |
| January  | 19.3| -0.2| 8.3  | -                             | 67.9               |
| February | 21.5| 0.4 | 10.2 | 35.3                          | 67.5               |
| March    | 25.1| 4.1 | 13.9 | 40.4                          | 58.4               |
| April    | 34.8| 5.3 | 18.8 | 11.9                          | 44.9               |
| May      | 41.0| 14.4| 27.4 | 3.3                           | 24.5               |
3. RESULTS AND DISCUSSION

Table (3) shows significant effect of rapeseed genotypes on the days from sowing to emergence, elongation, flowering and physiological maturity stage, the highest number of days to reach the mentioned stages were (23.67,139.00,154.23 and 197.67) day were recorded from Rapifera genotype respectively while the lowest number (12.00) days to reach emergence stage was obtained from Hybrizock genotype these differences may be due to their genetic variation, these results was conform with the finding of Sarkees et al. (2007).

The number of days to reach elongation flowering and physiological stage were (103.00, 124.67 and 166.33) day were recorded from Bard-I genotype respectively this may be due to genetic variation among the studied genotype and their adaptation to the climatically condition of Erbil governorate, similar results were recorded by Armin and Golparvar (2013) they mentioned that the cultivar had significant effect on stem elongation, while Anwar-shah and Rahman (2009) stated that there was significant differences in physiological maturity among rapeseed genotypes fig (1) and table (3).

Daily oral administration of fluoxetine for one month caused several histological alterations in liver, kidney and cerebrum of rats.

As shown from table (4) the genotypes significantly affected on plant height number of primary and secondary branches. The highest values were (162.17cm, 7.67 and 4.37 branch plant\(^{-1}\)) were recorded from Hybrizock, Rally and Hybrizockgenotypes respectively on the other hand the lowest values of plant height, secondary and primary branches (123.08 cm, 4.10 and 2.13 branch plant\(^{-1}\)) were obtained from Bacara, Rendy and Rendy respectively these results were in agreement with those of Shirani Rad (2012) and Mousavlet al (2011) they explained that number of branches plant\(^{-1}\) varies among genotypes. These differences in various morphological characteristics between Brassica species are due to differences in their genetic map as the environmental conditions were the same for both the species (Iqbalet et al, 2008).

Effect of genotypes on yield components:
The genotypes impacted significantly on yield component and seed yield as explained in table (4), the highest number of silique plant\(^{-1}\) (248.63), seeds silique\(^{-1}\) (25.68), seed index (6.10) seed yield (5.20 Mg ha\(^{-1}\)), Biological yield (16.20 Mg ha\(^{-1}\)) and harvesting index (0.32) were obtained from Dunckled genotype in addition to some other genotype, while the lowest value of silique plant\(^{-1}\) (119.2) from Bonanza, in the same time seeds silique\(^{-1}\), seed index seed yield and Biological yield (16.90, 3.30, 1.60, and 6.10) were obtained from Rapifera genotype respectively. The harvest index was (0.22) obtained from Rendy genotype, these results are agree with Hashim (2016).

Table (4) refers to the role of genotypes in limiting, the highest seed yield value (5.20 Mg ha\(^{-1}\)) ton ha\(^{-1}\) was recorded from Dunckled genotype while the lowest value (1.60 Mg ha\(^{-1}\)) was obtained from Rapifera, this may be due to the role of yield component values, since the highest values of silique plant\(^{-1}\), Seeds silique\(^{-1}\) and seed index were recorded from Dunckled genotype caused obtain the highest seed yield as shown from table (4). It means genotype caused 3.25 times increase in seed yield or the ratio between the highest yield and lowest yield genotype = 3.25, This variation in yield also may be due to genetic variation between them. This may be due to the value of seed yield and biological yield of Dunckled genotype which profited better from environment source and yielded higher HI by transforming more photosynthetic matters to seed. To produce economic yield by generating more green canopy (Naseriet al., 2012). It appears from the above results that the ratio between highest and lowest seed yield which regards as most important aim or goal of farmers was 3.25 or genotypic caused 3.25 times increase in seed yield, these differences contributed to their genetic properties this, was in line with (Abdul Sattaret al., 2013).

At the same time there is significant effect of genotypes on biological yield, the highest and lowest values (16.20 and 6.10) Mg ha\(^{-1}\) were recorded from Dunckled and Rapifera genotype, this high variation between them explain the role of genotype genetic variation adaptation in limiting biological yield. The highest HI value also recorded from Dunckled genotype (0.32) in addition to some other genotypes for...
seed index, while the lowest value (0.26) was obtained from Rapifera genotype.

From the same table (4) it appears that highest oil % and oil yield were recorded from the Bard-1 genotype (40.33% and 201.65 Mg ha⁻¹) while the lowest values were recorded from Coscar and Rapifera respectively, the lowest value of oil yield for Rapifera genotype may be due to the low value of seed yield these results agree with Baghdadi et al. (2012) Hashim (2016). They explained that different cultivars have significant effect on oil yield, this may be due to genetic variation, this results was agreed with Baghdadi et al. (2012) and Bagheri, et al. (2011) they explained that cultivars had significant effect on oil content. There are (6-12) vascular bundles in the leaf cross section, circular-semicircular, surrounded by parenchyma bundle sheath. A single ovate-semicircular, large vascular bundle in the midrib, always surrounded by collenchyma, except Bard-1, Rally, Rendy and Rapifera the midrib is composed of three semicircular vascular bundles. Its length ranged between 180-200µm as a minimum in Coscar and Heroz, and between 380-400µm as a maximum in Rally Table (1), Plates (1-2).

Table (3) Effect of genotypes on growth stages.

| Genotypes | Days from sowing to  |  |  |  |
|---|---|---|---|---|
|  | Emergence | Elongation | Flowering | Physiological maturity |
|  | Stage |
| Rapifera | 23.67a | 139.00a | 154.33a | 197.67a |
| Bard-1 | 16.67bcd | 103.00f | 124.67e | 166.33de |
| Dunkled | 21.67ab | 108.00e | 132.33cd | 166.33de |
| Bacara | 15.00cde | 125.00c | 148.67ab | 189.67b |
| Rally | 15.00cde | 130.33b | 150.67ab | 189.00b |
| Sultan | 20.00 abc | 109.67e | 131.67cd | 171.67cde |
| Heroz | 20.33abc | 116.00d | 138.00c | 174.33cd |
| Bonanza | 14.33de | 119.33d | 147.00b | 189.67b |
| Hybrizock | 12.00e | 126.00c | 153.00ab | 188.67b |
| Coscar | 23.33a | 108.67e | 131.00de | 177.67c |
| Pactol | 14.67bcd | 109.00e | 128.33de | 187.00b |
| Rendy | 15.67cde | 131.00b | 154.33a | 192.33ab |
Table 4 Effect of genotypes on measures at maturity stage, yield and yield components*.

| Genotypes | Plant height (cm) | No. branch | Number of | Seed index | Seed yield (Mg ha⁻¹)* | Biological yield (Mg ha⁻¹)* | HI | Oil |
|-----------|------------------|------------|-----------|-------------|-----------------------|-----------------------------|----|-----|
| Rapifera  | 142.4ab          | 5.53ab     | 2.67b     | 132.33b     | 16.90b                | 3.76b                       | 1.60b | 6.10b | 0.26b | 34.33abc | 54.93d |
| Bard-1    | 146.7ab          | 5.13ab     | 4.33a     | 169.67ab    | 20.15ab               | 4.82ab                      | 5.00b | 15.40b | 0.32b | 40.33a   | 201.65a |
| Dunkled   | 146.13ab         | 4.43ab     | 3.67ab    | 248.63a     | 25.68a                | 6.10a                       | 5.20a | 16.20a | 0.32a | 36.66abc | 190.63a |
| Bacara    | 123.08b          | 4.47ab     | 2.73b     | 132.20b     | 21.29ab               | 4.36ab                      | 2.00b | 7.00b  | 0.29b | 34.66bc  | 69.32d  |
| Rally     | 139.73ab         | 7.67a      | 2.93b     | 135.60b     | 24.87b                | 4.12ab                      | 1.90b | 7.00b  | 0.27b | 34.33abc | 65.23a  |
| Sultan    | 137.97ab         | 4.93ab     | 3.23ab    | 216.57a     | 23.22a                | 4.38ab                      | 3.50a | 10.30a | 0.32a | 38.44abc | 126.85c |
| Heroz     | 132.33b          | 4.37ab     | 3.73ab    | 183.17ab    | 25.51b                | 3.37ab                      | 3.00a | 12.00a | 0.25b | 35.52abc | 106.56c |
| Bonanza   | 147.67ab         | 4.50a      | 2.83b     | 119.20b     | 22.29ab               | 4.25ab                      | 2.85b | 11.22a | 0.25a | 35.26abc | 100.49c |
| Hybrizock | 162.17a          | 5.63ab     | 4.37a     | 163.87ab    | 17.60a                | 4.15ab                      | 3.95b | 12.50bc | 0.32a | 35.33abc | 139.55b |
| Coscar    | 135.67ab         | 5.23ab     | 3.53ab    | 161.33ab    | 23.98a                | 4.80ab                      | 4.45bc | 14.00b | 0.32a | 33.66abc | 149.79b |
| Pactol    | 146.87ab         | 4.70ab     | 3.70ab    | 153.33ab    | 21.57ab               | 4.95ab                      | 4.10bc | 13.00b | 0.32a | 39.33abc | 161.25bc |
| Rendy     | 133.10ab         | 4.10ab     | 2.13b     | 124.00a     | 22.70ab               | 3.89b                       | 2.20b | 9.88a  | 0.22a | 36.66abc | 80.65a  |

Part 2:

1- The leaf

The cross sections of the leaves were taken from the middle cauline leaves. In all genotypes the lamina was differentiated into distinct palisade and spongy layers. The epidermis is simple uniseriate, except at the midrib region, the upper and lower epidermis cells were in two rows in all examined specimens slides. The shapes of epidermal cells were oblong-ovate and sub-spherical, its width ranged between 18-24µm. as a minimum in Sultan and Bacara, and between 30-36µm as a maximum in Herozand Rapiferasurrounded from the outer side by uniform, thin cuticle layer Stomata typically cruciferous, generally occurring on both surfaces (amphistomatic). The mesophyll layers were distinguished into two layers. The palisade tissue consist of 2-3 rows of cells, thickness ranges between 90-192µm. with clearly intercellular spaces between cells, except Rally and Rendy, its
cells are close, intercellular spaces is very small, called compact mesophyll. The palisade region each series has its long axis at right angles to the epidermis, but parallel to the epidermis when in the spongy mesophyll, thickness ranges between 66-180 µm. with irregular shapes. No special contents noted in these cells as shown in table (5).

2- Stem:
The cross sections of the stems taken from the middle of flowering stem, were circular in Bard, Sultan, Coscar, Heroz, Hardi and Rally, semicircular in Pactol, Dunkled, Bonanza, Hybrizock and Rendy, quadrangular in Rapifera. The epidermis consists of a single continuous layer of elongate, semi-circular or circular cells with different sizes. In Sultan, Hardi, and Rapifera consist of two layers. The internal and external walls of epidermal cells are straight or convex, contain tannins (tanniferous, idioblast) the tannin take the shape of the epidermal cells and full most of the cell lumen. Its width ranged between 15-18 µm. as a minimum in Pactol, and between 36-42 µm. as a maximum in Hardi and Rapifera. The cuticle layer is thin. Table (6), Plates (3).

The cortex consists of parenchyma tissue layers, have intercellular spaces and thick wall cells, also contain tannin. Down wards there were few layers of polygonal and circular parenchyma tissue untanniniferous cells surrounded the stele (vascular bundles), except, in Bard, Hardi, Rally and Rapifera. There was continuous lignified sclerenchyma’s forming ring on and under the vascular bundles ring. The vascular tissue was cylindrical, the phloem usually takes a strip oriented outwards the vascular cylinder, consist of sieve tubes and parenchymal cells; the phloem has the form of a continuous ring. The xylem follows the phloem inwardly, arranged as radial rows; it does not form a continuous ring. The pith consist of parenchymal cells usually large in size towards inside, very broad pith regionit length range between 2.80-3.36 mm. as a minimum in Dunkled, and 3.92-4.60 mm, as a maximum in Pactol, it may become hollow at maturity.
### Table (5): Thickness of leaf cross section parts of *Brassicanapus* genotypes in micrometer

| sp. genotype | epidermis* | palisade tissue* | spongy tissue* | midrib vascular bundles*** |
|--------------|------------|------------------|----------------|--------------------------|
| Rapifera     | 30-36      | 90-135           | 66-120         | 260-300                  |
| Bard-1       | 18-27      | 120-135          | 75-90          | 240-320                  |
| Dunkled      | 24-30      | 135-150          | 115-150        | 220-230                  |
| Bacara       | 18-24      | 105-120          | 135-180        | 200-220                  |
| Rally        | 21-30      | 105-150          | 120-150        | 380-400                  |
| Sultan       | 18-24      | 90-96            | 90-150         | 220-240                  |
| Heroz        | 30-36      | 135-150          | 165-180        | 180-200                  |
| Bonanza      | 24-30      | 120-192          | 90-135         | 200-210                  |
| Hybrizock    | 18-30      | 105-120          | 120-135        | 200-220                  |
| Coscar       | 21-27      | 150-165          | 96-165         | 180-200                  |
| Pactol       | 24-30      | 135-180          | 135-150        | 200-220                  |

* width  ** length

### Table (6): Thickness of stem cross section parts of *Brassicanapus* genotypes in micrometer.

| sp. genotype | epidermis | cortex | vascular bundles | pith* |
|--------------|-----------|--------|-----------------|-------|
| Rapifera     | 36-42     | 300-400| 220-400         | 3.08-3.36 |
| Bard-1       | 21-30     | 200-250| 220-300         | 3.92-4.48 |
| Dunkled      | 24-30     | 180-220| 350-400         | 2.80-3.36 |
| Bacara       | 36-42     | 180-220| 320-480         | 3.42-4.20 |
| Rally        | 27-30     | 180-300| 320-400         | 3.36-3.50 |
| Sultan       | 33-45     | 150-200| 280-330         | 3.36-3.64 |
| Heroz        | 24-27     | 220-280| 280-380         | 3.42-3.64 |
| Bonanza      | 18-21     | 200-240| 260-340         | 3.75-3.92 |
| Hybrizock    | 24-27     | 200-260| 320-400         | 3.36-3.64 |
| Coscar       | 21-24     | 180-300| 250-400         | 3.36-3.50 |
| Pactol       | 15-18     | 150-250| 280-420         | 3.92-4.60 |
| Rendy        | 24-27     | 200-220| 280-340         | 3.50-3.64 |

* In millimeters
Plate (1): Cross sections of A. blades (40X) ; B. midribs (100X) of B. napus
Plate (2): Cross sections of A. blades (40X) ; B. midribs (100X) of *B.napus* genotypes.
Plate (3): Cross sections of stems (100X) of *B.napus* genotypes.
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