Variability and characterization of different Jew's mallow Corchorus olitorius. genotypes.

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Dedication

To those who are seeking the truth...

To the revolutionists, honorable and free who are born to pave the way for others, to give Peace, justice and dignity …

To all nobles and liberals those who unseen won't stop to give birth to them …

They are the preachers of the values of justice and honor…

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Abstract

A study of variability and characterization of different Jew's mallow genotypes (Corchorus olitorius), Baladi, Janobi, Egyptian, and Faw were tested on different planting dates, 16th of October 2003, early winter, 24th of January 2004, late winter, 2nd of May 2004, early summer, 3rd of July 2004.late summer, under Shambat conditions.

It was found that the genotypes interacted significantly with environments. Among the planting dates, May 2, showed the highest growth and seed yield. The genotype Faw showed better performance for seed yield and its contributing characters than the other genotypes. There was a high degree of resemblance between the accessions for most early vegetative growth and some of yield components characters.

None of the accessions was found to be homogenous in stem color, leave color and seed color.

Testing over planting dates within season was showed a lot of significant differences.

The interaction between genotypes and seasons was found to be in significant, indicating that the performance of genotypes was consistent over seasons.

ملخص الأطروحة

أجريت هذه التجربة لمقارنة أربعة مصادر وراثية محلية من الملوخية بلدي، جنوبي، مصري وفاو في الحقل التجريبي بكلية الدراسات الزراعية- جامعة السودان للعلوم والتكنولوجيا في أربعة مواقيت مختلفة خلال الموسم 2003 /2004 تمت مقارنة ثلاثة مصادر وراثية من الملوخية في التجربة الأولى وأربعة مصادر وراثية في التجارب الثانية والثالثة والرابعة.

ركزت المقارنة على النمو الخضري والإنتاجية تحت ظروف الصيف و الشتاء. دلت نتائج التجربة على تفوق السلالة فاو على باقي السلالات الأخرى في النمو الخضري الذي تمثل في عدد الأوراق، عدد الفروع، طول النباتات، طول الجذور، قطر القرون، الوزن الرطب للأوراق، الوزن الجاف للأوراق، عدد النباتات في المتر المربع، عدد القرون. والإنتاجية للبذور والأوراق. ولكن الفرق بين السلالات في الإنتاج ومقاييس النمو لم يكن معنويا. على أن الفرق بين موسم الصيف و الشتاء كان معنويا. وقد تعرضت السلالات للإجهاد المائي بسبب تذبذب الري في التجربة الرابعة.

أظهرت السلالات درجة عالية من التشابه في صفات الشكل الخارجي للنباتات ؛ كما أظهرت درجه عالية من عدم التجانس في لون الأوراق؛ الساق والبذور

إختبار السلالات قيد الدراسة تحت تواقيت الزراعة المختلفة داخل الموسم أظهر قدر من الاختلافات، بينما لم يظهر إختبار هذه السلالات عبر المواسم (صيف- شتاء) أي فروقات معنوية.

CHAPTER ONE

INTRODUCTION

Corchorus olitorius (Jew's mallow, Jute , Nalta Jute, Tossa, long – fruited Jute, Bush okra, West Africa Sorrell (Eng), Corette Potagere (Fr), Yute (Sp) Corcoro (Ital), Krin - Krin (W. Afr), Ewedu, oyo. Eyo (Nig) Molukhyia (Arab) is a member of the Tiliaceae (Jute family), is a diploid Chromosome number: 2n = 14 (Tindall 1983).

Probably of south China origin, now found growing wild in parts of tropical Asia (India) tropical Africa, naturalized in many tropical countries.

Jew's mallow is an important green vegetable of the Middle East, Egypt and Sudan as well as parts of tropical Africa. Jute is usually grown for the fibers, but the cultivar grown for vegetable use in short and branched (Yammaguchi 1983).

The crop is grown extensively throughout the Sudan, both under irrigated as a popular vegetable crop, and as a wild plant all over the rainfed areas of the country through the year except for the periods of low temperature in winter. The production in the Sudan is usually consumed locally.

In the Sudan, a number of different local landraces and Egyptian introductions are grown in different parts of the country. The local accessions are known as (Baladi) and each one is named after the area from which it is collected.

These accessions show a lot of variability in many characters, such as yield, plant height and color of stem.

Low yield, limited local use, lack of endurance for long period of storage and low market prices were the most factors that gave the lower priority to the improvement of the crop in agricultural development plans in the Sudan.

We look forwards to have better cultivars than are presently grown, and the local accessions could be improved by adding characters like high yield, earliness, low fiber content, high mucilage, high seed yield, adaptability to low temperature for winter production, resistance to pests like grey blister beetle and resistance to diseases like damping – off disease.

Furthermore, information regarding the effects of the different environmental factors and their interaction with genotype, are not available, very little breeding work on Jew's mallow has been done in the Sudan. As the success of any breeding program depends on the amount and nature of genotypic variability available, and the interrelationships of yield and its components, the present investigation was undertaken to ascertain variability in Jew's mallow, to obtain information on the association between the different yield contributing characters and to use the data, so obtained, to make tentative suggestions for the improvement of this crop with the following objectives:

1- To study the extent of variability.
2- To characterize the genotypes under study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Taxonomy:

Jew's mallow Corchorus olitorius .L. Tiliaceae. Malvals. Dilleniidae. Magnoliopsida (Dicotyledons). Mangonliophyta. Spermatophyta. Tracheobionta. Planate (USDA 2003).

The genus Corchorus has around 50 – 60 species, but over 170 Corchorus names are given in index kewensis (Edmonds 1990).These species are found throughout the tropics and subtropics. The genus is extremely variable and all species are highly fibrous. Commercial jute fiber is obtained from two cultivated species, C.olitorius, and C. capsularis. (International Jute Organization 1985).

2.2 Cytotaxonomic background:

Species of the genus Corchorus is pan tropical in distribution. Most of the few species that have been counted, including the cultivated ones, have 2n =2x = 14. A few tetraploids (2n = 28) are also known. There is no information about cytotaxonomic relationships of the wild species (Singh, 1971).

The two-cultivated ones can be crossed, but only with great difficulty (Bhaduri and Bairagi, 1968). Swaminathan et al. (1961) reported translocation in the hybrid and Datta (1958) detected considerable differences in chromosome morphology between the two species.

Reported from Africa, Hindustani, and China-Japan centers of diversity, tussa jute, or CVS therefore, is reported to tolerate disease, fungi high pH, laterite, limestone, and salt (Duke, 1978).

2.3 Botanical description:

Herbs or shrubs often annuals, growing 2 - 3 m high.

Stem: Upright slender up to 1 – 1.5 m, glabrous, well developed with abundant fibers in the phloem tissue.

Leaves: Alternate, light green, linear, deciduous, blades herbaceous, elliptic – lanceolate, apically acute or acuminate, glabrous, leaves 6 – 10 long, 3.5 – 5 cm broad, laterally dehiscent.

Flowers: Solitary or in cymes, normally opposite to the leaves, up to 1 cm in diameter, sepals free 5, narrow, 3 mm long, oblong- apiculate-lanceolate, mucronate, subcucullate, essentially glabrous, pale to deep yellow. Petals 5, 7-8 mm in length, about as long as sepals, oblong, spathulate, short-clawed, yellow, stamens numerous 10 to many, free, glabrous, the filaments filiform, the anthers dorsfixed , laterally dehiscent, style short with flattened stigma, terete, glabrous, the stigma lobed, microscopically papillose, fimbriate, ovary superior, 5- locular with numerous ovules in each locule, pilose. Inflorescence axillary or leaf opposed, cymose or fasciculate with 1-6 flowers, flowers perfect 4 or 5- merous, bracts lanceolate, peduncle shorter than the petiole, pedicles 1-3, very short.

Fruits: Long, cylindrical, 10 – rigid a beaked capsule, 5 – 10 cm × 5 – 8 mm, loculicidally dehiscent 3 – 6 valved capsule, erect, linear to subglobose, some times with transverse partition between the seeds,180 – 230 seeds per capsule.

Seeds: Pyramidal, smaller than those of C.capsularis 1-2 mm in length, exalate, angular, approximately 500 seeds /g. (Smith, 1981–Tindall, 1983 – Kritikar and Basu 1975).

Pollination: Normally self – pollinated but some cross – pollination does occur, 2 – 5 percent or more in C.olitorius, where flowers are larger, average is 13 percent. For pure seed production some isolation advisable. In India at least 15 m recommended between different varieties. Best grown on weed free or fallow land especially reserved for seed production. In British Guiana grown in mono culture because labor requirements conflict with other crops. In Taiwan grown in rotation with peas and rice (FAO 1961).

2.4 Distribution:

2.4.1 Early history:

Corchorus olitorius has been used (hardly cultivated) as a minor vegetable in Africa and the Middle East for a very long time, hence, no doubt, some of the uncertainty as to where it is truly native. As fibers, both species where certainly domesticated in India in quiet recent times. There is no Sanskrit word for jute and the name (a local Indian one) was first given general currency by the botanist Roxburg, in Calcutta in the late eighteen century (Singh et al 1970). There is much disagreement in the literature as to the natural distribution of the two species. Corchorus olitorius is pan – tropical but may often be escaped rather than wild. Kundu (1951) regarded it as primarily African, capsularis has often been regarded as Chinese but kundu thought the evidence for its being truly native in Indo – Burma was strong.

Rather pan tropical in distribution, perhaps more often a weed than a cultivar. Considered a serious weed in Australia, Egypt, Mozambique, the Philippines, Senegal and Thailand, a principal weed in the Sudan, and a common weed in Afghanistan, India, Kenya, Nepal, Turkey, and Zambia. (Holm et al, 1979). Systemic attempts have been made to grow jute in West Africa, Sudan, Egypt, Turkey, Iran, Thailand, Java, Paraguay, Brazil, Argentina and Mexico (Duke 1983).

2.5 Ecology:

Ranging from warm temperature thorn through tropical desert to wet forest life zones, Jew's mallow is reported to tolerate annual precipitation of 4.0 to 42.9 dm (mean of 15 cases =18),annual temperature of 16.8 to 27.5°c (mean of 15 cases =23.8) and pH of 4.5 to 8.2 (mean of 13 cases = 6.5). (Duke, 1978). Elevations of less than 700 m are normally required for satisfactory growth, yield are likely to diminish above this altitude. Short – day conditions are satisfactory for growth and development, some forms are sensitive to longer days and flowering may be adversely affected (Tindall 1983).

Usually grown during rainy season thriving best with 1,500 mm of rainfall and in moist heat with optimum temperature 24 – 35°c (75° - 95°f). In most Jew's mallow regions maximum temperature does not exceed 35°c, or fall below 15°c. and humidity varies 65 – 95 percent .will not grow in areas with a cold season. C.capsularis a more hardy species growth on both high and low lands. Withstands water logging, often sown earlier, C.oiltorius prefers high lands and cultivation is more limited. Low land areas liable to flooding not suitable for seed production. Tropical areas with late season rains also not suitable, seed pods damaged near harvest time, but in some regions crop can be grown out of season. (FAO, 1961).

2.6 Cultural requirements:

2.6.1 Propagation and planting:

Seeds are sown broadcast on prepared beds, preferably at the beginning or the end of the wet season, and the seedlings thinned to leave plants at a square spacing of 20 – 30 cm × 20 – 30 cm, depending on the vigor of the selection. Alternatively, seeds may be sown in a seedbed and transplanted to rows 45 – 55 cm apart, 35 – 45 cm between plants. Soaking of seeds in warm water before sowing may over come erratic germination due to a dormancy factor. Approximately 5kg/ha of seed is required for a density of 250.000 plants / ha. (Tindall, 1983).

2.6.2 Growth period and harvesting:

Leaves and young shoots 20 – 30 cm, in length may be harvested when fully developed, about 40 – 60 days from sowing or transplanting. The removal of the terminal shoot encourages the development of lateral branches. (Tindall, 1983).

2.7 Yield:

Leaf yield varies from 5 – 8 t / ha per annum (Tindall, 1983).

2.8 Seed production:

A self - pollinated crop with up to 10% of out – breeding. There is some variation between local selections and off – types should be weeded out. The mature plant is threshed to extract the seed but care should be taken to harvest before significant seed loss occurs due to shattering. The average seed yield is 250 kg /ha. (Tindall, 1983).

2.9 Biotic factors (pest and disease):

2.9.1 Pest:

Schmutterer, 1969 classified the pest of C.olitorius into two divisions, the occasional pests and minor pests, the occasional are, Bagrada hilaris, Podagrica puncticollis, Hymenia recurvalis, Taracbe zelleri, and Spodoptera exigua, while the minors are Pectinophora gossypiella, Grammodes geometrica, G.stolida, T.marmoralis, Anomis sabulifera.

(Tindall, 1983, FAO 1974, Thangavel, et al 1974) added another pests, Achaea acerata (sweet potato butterfly), Achaea terpsichore (sweet potato butterfly), Myllocerus spp (weevils), Podagrica uniforma, Podagrica sjostedti (leaf beetle), The semilooper Anomis sabulifera may stunt the growth. The yellow mite Polyphagtarsonemus lauts may also reduce yields.

2.9.2 Disease:

Sclerotium rolfsii causes wilt, Macrophomina phaseoli infested seed by blight. Anthracnose spots caused by Colletotrichum gloeosporioides and C.corchorum may infect 50 - 90% of a Jew's mallow population. Damping – off and wilt caused by Pythium butlerisubrum, P. middletonii sparrow. P. splendens. Cercospora leaf spot caused by Cercospora corchori or Corynespora cassiicola. Die back (Black-band disease) caused by Diplodia corchori syd. Rosellinia root rot caused by Botryobasidium rolfsii and Sclerotium rolfsii, stem rot caused by Macrophomina phaseolina. Bacterial leaf spot caused by Xanthomonas campestris. Bacterial wilt caused by Pseudomonas solanacearum .Stem gall caused by Phycoderma corchori lingappa. Thanatephorus leaf spot caused by Thanatephorus cucumeris. Leaf mosaic (chlorosis) caused by a virus transmitted by grafting but not mechanically, no insect vector has been identified, but evidence of seed transmission of the disease, as well as transmission through pollen from infected plants, has been reported .C . Capsularis is susceptible to infection by leaf mosaic, but C.olitorius is quiet resistant. Mineral deficiency symptoms can be observed, C. capsularis has been reported more susceptible than C.olitorius. (Cook, 1981, Schmutterer 1969, Tindall, 1983, FAO1974, Thangavel, et al 1974).

2.10: Chemistry:

Per 100g, the leaves are reported to contain 43-58 calories, 80.4- 84.1g H_2O, 4.5 - 5.6g protein, 0.3g fat, 7.6-12.4 total carbohydrate, 1.7 - 2.0g fiber, 2.4g ash, 266-366 mg Ca, 97-122 mg P, 7.2-7.7 mg Fe, 12 mg Na, 444mg K, 6.410 - 7.850ug beta-carotene equivalent,0.13-0.15mg thiamine, 0.26-0.53mg riboflavin, 1.1-1.2mg niacin, and 53-80mg ascorbic acid. Leaves contain oxidase and chlorogenic acid. The folic acid content is substantially higher than that of other folacin-rich vegetables, Ca 800 micro grains per 100g (Ca 75% moisture) or Ca 3200 micro grams on a zero moisture basis (Chen and saad, 1981). The seeds contain 11.3-14.8% oil (Watt and Breyer – Brand Wijk, 1962), reportedly estrogenic (Sharaf *et. al*., 1979), which contains 16.9% Palmitic-, 3.7% Stearic-, 1.8% behenic-, 1.1% lignoceiic-, 9.1% oleic-, 62.5% linoleic-, and 0.9% linoleic-acids as well as large portions of B, Mn, Mo, and Zn.

Nakamura *et. al* 1998 reported that three new cardenolide glycosides were isolated from the seeds of Corchorus olitorius Jew's mallow. On the basis of chemical and spectroscopic evidence, their structures were established as cannogenol 3-O-beta-D-glucopyranosyl-(1 right arrow 4) O – beta – D – boivinopyranoside, perilogenin 3 – 0 –beta –D – glucopyranosyl – (1 right arrow 4) - O - beta - D - digitoxopy ranoside and digitoxigenin 3 - O - beta - D - glucopyranosyl – (1 right arrow 6) - O - beta - D - glucopyranosyl – (1 right arrow 4) - O - beta - D - digitoxopyranoside.

Azuma Keiko, et.al 1999 reported that six phenolic antioxidative compounds (5 – caffeoylquinic acid) (chlorogenic acid), 3, 5 – di caffeoylquinic acid, quercetin 3 – galactoside, quercetin 3 – glucoside, quercetin 3 – (6 – malonyl glucoside), and quercentin 3 – (6-malonyl galactoside) (tentative)) were identified from the leaves of Corchorus oiltorius L. by NMR and FAB – MS.

The contents of these phenolic compounds, ascorbic acid, and alpha – toco pherolnol in C.olitorius leaves were determined, and their antioxidative activities were measured using the radical generator – initiated peroxidation of linoleic acid. The results obtained showed that 5 – caffeoylquinic acid was a predominant phenolic anti oxidation in C.olitorius leaves.

2.11 Uses:

2.11.1 Folk medicine:

Reported to be demulcent, deobstruent, diuretic, remedy Lactagogue, Purgative and tonic, Jew's mallow is a folk remedy for aches and pains, dysentery, enteritis, fever, pectoral pains and tumors. Ayurvedics use the leaves for ascites, pain, piles, and tumors. Elsewhere the leaves are used for cystitis, dysuria, fever and gonorrhea. The cold infusion is said to restore the appetite and strength, Duke and Wain, 1981 – List and Horhammer, 1969-1979 both the species C.olitrius ands C.capsularis used as herbal medicine to control or prevent dysentery, worm and constipation ect. Jew's mallow leaves are being used as health – food in Japan. Jew's mallow leaves are rich in vitamins, carotenoids, calcium, potassium and dietary fibers. Jew's mallow leaf contain anti tumor promoters, phytol and Mono galactosyl – diacylglycerol. It may reduce risk of cancer. Japan has been importing dry Jew's mallow leaf from Africa and they are using it as the substitute of coffee and tea. In Europe, Jew's mallow leaves are being used as soup (shamsuzzaman, 2003).

Two anti tumor promoters against tumor promoter – induced Epstein – Barr virus activation were isolated from the leaves of Jute (Corchorus capsularis and C.olitorius). Their active components were identified as phytol (3.7, 11, 15, tetra methyl 1 - 2 – hexadecen – 1 - 01) and monogalactosyl diacylglycerol (1, 2 – di – O – alpha – linolenoyl – 3 – O – beta – D – galactopyranosyl – sn - glycerol) Furumoto, et.al 2002.

2.11.2 Fiber:

As a natural fiber producing crop, jute ranks next to cotton in importance. jute fiber is chiefly used for manufacturing hessian , twine ,rope, sacking, backing for carpeting, jute blended yarn, jute decorative fabrics, making mats, gunny cloth, cordage, hangings, paper, hand – woven goods and webbing for upholstered furniture (International Jute Organization, 1985).

2.11.3 New Ozone (O3) indicator:

Jew's mallow Chorchorus olitorius c.v local, found to be more sensitive as bio indicator plant for ozone (O3), under the Egyptian environment conditions. Madkour, SA and Laurence – JA 2002.

2.12 Nutrient value:

While perhaps better known as a fiber crop, Jew's mallow is also a medicinal vegetable, eaten from Tanganyika to Egypt. Dried leaves are used in soups under the Arabic name "Molukhyia". In India the leaves and tender shoots are eaten. The dried material is there known as "nalita". Injection of olitoriside markedly improve cardiac insufficiencies and have no cumulative attributes, hence, it can serve as a substitute for strophanthin (Duke, 1983). The tender mucilaginous leaves are harvested and used as a cooked vegetable, in a similar manner to spinach greens. Harvested leaves may be dried and stored for significant periods (Tindall, 1983).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Materials:

The present study was carried out at the demonstration farm of the college of agricultural studies, Sudan University of Science and Technology, which is situated at shambat on the eastern bank of the Nile at latitude 15° 40 N and longitude 32° 32°E and 376 meters above the sea level.

Four field experiments were conducted using Jew's mallow during the season 2002/03 and 2003/ 04 Appendix (1) given the climatologically data for the two growing seasons.

3.1.1 Genotypes:

The germplam used considered of local landraces from different parts of the country. (Faw) accession obtained from Agri Business Sudan Company, while (Janobi) accession obtained from Arab seed company, (Egyptian) and (Baladi) accessions obtained from local seed producers.

3.2 Methods:

The layout adapted was randomized complete block design with six replications, was used to accommodate the 24 treatments. In the first planting date, the collections were sown on the 16^{th} of October 2003 (early winter), while in the second planting date it was sown on the 24^{th} of January 2004 (late winter). The third planting date was sown on the second of May 2004 (early summer), while in fourth planting date sowing was on the third of July 2004 (late summer), The first planting date started with the accessions Baladi, Janobi, Egyptian while the next planting dates included them blus Faw accession.

The soil is light clay with pH of 7.7. The area was deeply ploughed and left over about two weeks, and then it was rotated and raked. Apre -watering was given to all the plots to control weeds, then rotated and raked again. The experimental plot measured was 3 × 3 meter. Planting was done manually. The crop was sown broad casting on flats at the rate of 17.1 gm per plot i.e. (8 kg / feddan).The experiment was conducted under irrigation, where water was supplied generally carried out according to plant need at intervals of 7 – 10 days in the winter planting dates and 5 – 7 days in summer planting dates. N fertilizer was supplied in the form of urea (46% N) into one application at rate of 107 gm/plot (50kg/feddan) broadcasted uniformly just prior to the third irrigation. Regular hand weeding was done to eliminate the competition from weeds. No significant damage by pest and disease was observed.

Sampling of growth analysis started after the crop was about 4 weeks old. At harvesting time the portion of the plot to be harvested was measured, excluding plants with in the measured portion of the plot 50 ×50× 50×50cm. (¼ $meter^2$) were pull out of the soil and tied in a bundles. Each plot was harvested separately. The number of plants in the measured area was counted. The bundles were taken to common botany laboratory, samples of ten plants from each collection in each replication were chosen at random and tagged and observations on a number of characters were recorded on them. The mean values of ten plants were utilized for statistical analysis by MSTATC computer program. The growth attributes recorded were:

1- Length of Plants (cm): was measured from the ground level to the tip of the stem.
2- Length of roots (cm).
3- Number of plants per feddan.
4- Weight of fresh plants per feddan (g).
5- Fresh weight of leaves (g): was measured without petioles.
6- Fresh weight of roots (g).
7- Dry weight of leaves (g): dried in an oven at 105°c for 48 hours and then weighed.
8- Dry weight of roots (g): dried in an oven at 105°c for 48 hours and then weighed.

9- Number of leaves per plant.

10- Pigmentation on the stem.

11- Number of branches per plant: was counted at the end of the planting date.

12- Pod yield (g): the weight of all pods per plant.

13- Number of pods per plant: the sum of the number of pods from all picking for a particular plant.

14- Average pod weight (g): obtained by dividing the pod yield per plant by the number of pods of that plant.

15- Pod length (cm): measured from the base of the pod (without including the calyx) to its apex.

16- Pod diameter (cm): measured by a vernier at the base of the fruit.

17- Number of seeds per pod: samples of 10 mature pods were taken from each plot. The pods were longitudinally opened and the number of seeds in each pod was counted.

18- 1000 – Seed weight (g): samples from each plot of 1000 dry ripe seeds from each plot were counted and weighed.

19- Seed yield / unit area (kg / FD).

20- Fresh leaves yield / unit area (kg / FD).

¼ $meter^2$ was left to mature seeds, ten plants were taken at random and a number of characters were recorded.

The fresh weight was recorded. Pods left to sun dry, and the dry weight was recorded.

CHAPTER FOUR

RESULTS

Analysis of variance was computed for the data in each planting date separately and for each two planting dates (summer and winter) combined data. According to the analysis of variance in the two planting dates (summer and winter) usually was homogeneous. Where as mean values were heterogeneous. The L.S.D values were not too large except in the case of number of plants, weight of plants/m^2, yield of dry seeds/ Feddan, and yield of fresh leaves /Feddan.

Furthermore, one of the objectives of this study was to obtain estimates of components of variance under average conditions. Therefore, the data from the four planting dates were combined in all cases. Generally, the results obtained followed a similar trend for the traits studied. There were a few exceptions to the general trend. The results obtained from the four planting dates were in general agreement, but in a few cases, important differences were noted, individually and in the combined data. The phenotypic variability for all characters can be summarized as follows:

4.1 Length of plants (cm):

The individual analysis of variance for plant length Table (1) showed no significant differences between accessions.

The grand means for plant length of the accessions are shown in Table (1). No significant varietals differences in plant length were found at individual planting date. Faw accession showed the highest plant length, followed by Baladi and Egyptian. Janobi showed the lowest plant length. It is also clear from the individual analysis of variance for plant length Table (1) that different Jew's mallow accessions responded differently to the planting dates.

The variation was not that great among the planting dates, however, such differences were clear at the second planting date.

Table (2) illustrates performance analysis, which was carried out for length of plants. The performance analysis of early and late winter season showed that the three accessions differed significantly through planting dates of winter. Whereas there were no significant differences between Baladi and Janobi and there were no significant differences between Janobi and Egyptian. On the other hand, the performance analysis for length of plants for summer planting dates showed no significant differences between accessions Table (3).

4.2 Length of roots (cm):

Comparisons of the means of the accessions are presented in Table (4), shows the difference in the length of roots between the four accessions was non significant, within the planting date. The highest length of roots was obtained with Faw accession for planting date two, followed by Baladi and Egyptian. Janobi showed the lowest root length.

The over all mean of root length for the evaluated accessions was 15.32 cm in the second planting date and 9.19 cm in the first planting date and 8.70 cm in the fourth planting date and 8.47 cm in the third planting date. The performance analysis showed that the four accessions differed none significantly in the character of root length.

Table (1): Mean values for Length of plants (cm).

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	24.98 a	57.99 a	42.83 a	42.88 a	42.17
Janobi	25.94 a	54.07 a	42.99 a	41.69 a	41.17
Egyptian	23.29 a	52.40 a	42.65 a	49.20 a	41.88
Faw	X	56.83 a	47.88 a	42.58 a	49.09
Grand Mean	24.73	55.32	44.08	44.08	
LSD 0.05	4.22	7.68	7.63	10.38	
C.V %	15.19	15.97	16.57	16.20	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

Table (2): performance of early and late winter season on length of (plants, roots, pods) cm, and diameter of pods. (cm)

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

1- Baladi in early winter. 4- Baladi in late winter.

2 – Janobi in early winter.
5- Janobi in late winter.

3- Egyptian in early winter.
6- Egyptian in late winter.

Genotype	Length of plants	Length of roots	Length of pods	Diameter of pods
1	**57.99 a**	**15.35 a**	**4.68 a**	**0.48 a**
2	**54.07 ab**	**15.31 a**	**4.71 a**	**0.50 a**
3	**52.40 b**	**15.21 a**	**4.60 a**	**0.49 a**
4	**24.98 c**	**8.88 b**	**4.72 a**	**0.49 a**
5	**25.94 c**	**9.10 b**	**4.66 a**	**0.47 a**
6	**23.29 c**	**9.57 b**	**4.73 a**	**0.47 a**
Grand Mean	**39.78**	**12.24**	**4.68**	**0.48**
LSD 0.05	**5.32**	**0.85**	**0.19**	**0.53**
C.V %	**19.78**	**19.92**	**7.67**	**3.29**

Table (3): Performance of early and late summer season on length of (plants, roots, pods) cm, and diameter of pods cm.

Genotype	Length of plants	Length of roots	Length of pods	Diameter of pods
1	**42.83 a**	**8.48 ab**	**48.27 a**	**4.95 a**
2	**42.99 a**	**7.75 b**	**48.70 a**	**4.75 abc**
3	**42.65 a**	**7.65 b**	**47.00 a**	**4.80 ab**
4	**47.88 a**	**10.02 a**	**47.45 a**	**4.83 a**

5	**42.88 a**	**8.69 ab**	**49.48 a**	**4.55 bcd**
6	**41.69 a**	**8.82 ab**	**47.30 a**	**4.50 cd**
7	**49.20 a**	**8.71 ab**	**47.52 a**	**4.50 cd**
8	**42.58 a**	**9.25 ab**	**49.93 a**	**4.46 d**
G.mean	**44.08**	**8.67**	**48.20**	**4.66**
LSD 0.05	**9.99**	**1.77**	**5.85**	**0.25**
C.V	**16.76**	**26.26**	**10.35**	**4.67**

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

1- Baladi in early summer. 5- Baladi in late summer.

2 – Janobi in early summer. 6- Janobi in late summer.

3- Egyptian in early summer. 7- Egyptian in late summer.

4- Faw in early summer. 8- Faw in late summer.

The comparisons of means for combination effect on length of roots for winter planting dates Table (2) showed there were no significant differences between the accessions among the first planting date, also there were no significant differences between the accessions during the second planting date whereas, it showed significant differences when combined together.

On the other hand, the performance analysis which was carried out for length of roots for summer planting dates Table (3) showed no

a significant difference between accessions except Faw accession was significantly higher than Janobi and Egyptian respectively.

4.3 Number of plants/ m^2:

It is clear from Table (5) that certain accessions exhibited a limited range of differences. The highest number of plants was obtained with Faw accession in planting date three, followed by Egyptian in planting date four and Janobi in planting date one .Baladi accession showed the lowest number of plants.

The grand mean of the evaluated planting dates was 921.0, and 892.0, and 374.44, and 323.25 respectively.

The comparisons of means for performance effect on number of plants for winter planting dates Table (6) showed no significant differences were observed among the tested genotypes for this character.

On the other hand, the performance analysis for number of plants for summer planting dates Table (7) showed no significant differences between accessions.

4.4 Number of leaves:

Mean values for the number of leaves of the four accessions studied, are given in Table (8). Number of leaves of the accession Faw 16.22 was not significant, but greater than that of all other accessions, followed by Egyptian 14.37, which was also insignificant, but greater than the rest of the accessions, followed by Baladi 11.91. Janobi was the lowest number of leaves.

Analysis of variance showed there were significant differences between planting dates for the character of number of leaves.

The performance analysis for number of leaves for winter planting dates Table (6) showed the differences between the accessions was significant.

On the other hand, comparisons of means for performance on number of leaves for summer planting dates Table (7) showed no significant differences.

4.5 Number of branches:

Mean values for the number of branches is presented in Table (9). No significant differences were observed among the means of tested genotypes for this character. The highest number of branches was given by the Faw accession (7.44) followed by the Janobi (6.58), and Egyptian (6.54). Baladi; showed the lowest number of branches (6.29).

Analysis of variance showed significant main effect between planting dates and accessions for this character. Number of branches was highest in planting date three, followed by planting date four and two, while planting date one was the lowest.

The comparison of means for performance on number of branches for winter planting dates Table (6) showed a lot of differences between genotypes tested; Egyptian was significantly higher than Baladi in the second planting date.

On the other hand, the performance analysis for number of branches for summer planting dates Table (7) showed also many differences between accessions Baladi and Janobi in the first planting date was similar to significant higher than Faw and Janobi in the second planting date.

4.6 Fresh weight of leaves (g):

Table (10) gives the results of four planting dates to study the effect of planting date on fresh weight of leaves. Freshly harvested leaves in planting date one showed the lower weight than the other planting dates and the differences was significant.

The highest fresh weight of leaves was in planting date two (27.08) followed by planting date three (10.06) and four (8.60) respectively.

The highest fresh weight of leaves was obtained with Faw accession followed by Baladi and Egyptian respectively, the lowest

was Janobi. The range in the mean of this character was 17.7, 13.06, and 12.97 respectively.

Table (11) illustrates performance analysis which was carried out for fresh weight of leaves for winter planting dates. It showed in significant differences through the first planting date and through the second planting date, but it was differed significant when combined data.

On the other hand, comparisons of means for performance on fresh weight of leaves for summer planting dates Table (12) showed in significant differences.

4.7 Fresh weight of roots (g):

The performance of the four accessions for the character of fresh weight of roots relative to the planting dates is summarized in Table (13). No significant differences were shown by the accessions.

The mean values of the fresh weight of roots for the evaluated accessions was 5.44 obtained by Egyptian ;in the second planting date 4.95, for Baladi in the third planting date, (4.88) , for Janobi in the four planting date, and 4.38 for Faw accession in the first planting date.

It is also clear that different accessions responded differently to the planting date, Table (11) illustrates performance analysis which was carried out for fresh weight of roots for winter planting dates. It showed no significant differences were observed among the tested genotypes for this character in each planting date separately, but it showed significant differences for the two combined data.

On the other hand, the performance analysis for fresh weight of leaves Table (12) for summer planting dates showed insignificant differences.

Table (4): Mean values for Length of roots/ cm

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	8.88 a	15.35 a	8.48 a	8.69 a	10.35
Janobi	9.12 a	15.31 a	7.75 a	8.82 a	10.25
Egyptian	9.57 a	15.21 a	7.65 a	8.71 a	10.28
Faw	X	15.42 a	10.02 a	9.25 a	11.56
Grand Mean	9.19	15.32	8.47	8.87	
LSD 0.05	1.09	0.25	3.294	0.7831	
C.V %	16.55	17.21	33.00	13.51	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

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Table (5): Mean values for Number of Plants/m^2

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	310.7 a	365.0 a	778.0 a	830.7 a	571.1 a
Janobi	417.3 a	322.7 a	812.5 a	922.0 a	618.6 a
Egyptian	395.3 a	277.3 a	1053.0 a	798.0 a	630.9 a
Faw	X	328.0 a	1042.0 a	1017.0 a	795.6 a
Grand Mean	374.444	323.250	921.458	892.000	
LSD 0.05	177.5	108.3	441.6	297.4	
C.V %	21.94	40.83	38.39	37.89	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

Table (6): performance of early and late winter season on number of (plants, leaves, branch and pods).

Genotype	Number of plants/m^2	Number of leaves	Number of branch	Number of pods
1	365.0 a	19.00 b	5.88 ab	10.67 a
2	322.7 a	19.00 b	5.66 ab	12.00 a
3	277.3 a	20.50 a	6.66 a	9.66 ab
4	310.7 a	7.66 c	2.66 c	5.83 b
5	417.3 a	7.00 c	4.50 abc	9.50ab
6	395.3 a	7.83 c	3.50 bc	9.16 ab
Grand Mean	348.05	13.50	4.80	9.47
LSD 0.05	192.5	1.37	2.37	4.46
C.V %	37.75	36.75	28.13	38.16

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

1- Baladi in early winter. 4- Baladi in late winter.

2 – Janobi in early winter. 5- Janobi in late winter.

3- Egyptian in early winter. 6- Egyptian in late winter.

Table (7): Performance of early and late summer season on number of plants, leaves, branches and pods.

Genotype	Number of plants	Number of leaves	Number of branch	Number of pods
1	778.0 a	10.33 a	10.17 a	10.00 a
2	812.5 a	9.16 a	10.17 a	9.50 a
3	1053.0 a	20.17 a	8.50 ab	7.83 ab
4	1042.0 a	10.00 a	8.83 ab	10.33 a
5	830.7 a	10.67 a	6.50 b	4.16 c
6	922.0 a	9.66 a	6.00 b	3.50 c
7	798.0 a	9.00 a	7.50 ab	2.83 c
8	1017.0 a	8.66 a	6.50 b	4.33 bc
G.mean	906.72	10.95	8.02	6.56
LSD 0.05	325.4	11.29	3.34	3.536
C.V %	36.83	98.40	35.57	45.97

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

1- Baladi in early summer. 5- Baladi in late summer.

2 – Janobi in early summer. 6- Janobi in late summer.

3- Egyptian in early summer. 7- Egyptian in late summer.

4- Faw in early summer. 8- Faw in late summer.

Table (8): Mean values for Number of leaves

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	7.66 a	19.00 a	10.33 a	10.67 a	11.91
Janobi	7.00 a	19.00 a	9.16 a	9.66 a	11.20
Egyptian	7.83 a	20.50 a	20.17 a	9.00 a	14.37
Faw	X	30.00 a	10.00 a	8.66 a	16.22
Grand Mean	7.50	22.12	12.41	9.50	
LSD 0.05	1.39	15.97	15.64	2.65	
C.V %	17.38	37.45	123.40	19.79	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

4.8 Dry weight of leaves (g):

Table (14) show that the differences among the genotypes are not significant for the character of dry leaves weight. On overall basis it is seen that the Faw accession gave the maximum dry weight of leaves (3.03) closely followed by the Baladi (2.51) then Janobi (2.44) and Egyptian (2.26). Further the results revealed that a maximum of dry weight of leaves was obtained in the second planting date followed by the fourth planting date. The comparisons of means for performance on dry weight of leaves for winter planting dates Table (11) showed insignificant differences were observed among the tested genotypes for this character in each planting date separately, but it showed significant differences for the two planting dates combined data. On the other hand, the performance analysis for dry weight of leaves for summer planting dates Table (12) showed many significant differences between genotypes, whereas Baladi in planting date four significantly higher than Egyptian in planting date three.

4.9 Dry weight of roots (g):

Analysis of variance for this character and it is mean comparison is given in Table (15), it reflects that the differences of means among different genotypes were not significant.

Both Janobi and Baladi accession showed the highest dry weight of roots (0.42), followed by Egyptian (0.40), and Faw was the lowest (0.40). The highest dry weight of roots was obtained in planting date four, followed by planting date three and planting date one.

The comparisons of means for performance on dry weight of roots for winter planting dates Table (11) showed insignificant differences were observed among the tested genotypes for this character in each planting date separately, but it showed significant differences for the two planting dates combined data.

On the other hand, the performance analysis for dry weight of roots for summer planting dates Table (12) showed no significant differences between accessions.

4.10 Weight of plants / m^2 (g):

The analysis of variance for weight of plants /m^2 and Duncan's multiple range test Table (16) indicates no significant differences among the genotypes.

Further study of Table (16) shows the superiority of Janobi accession (2199.7) in manifestation of weight of plants /m^2 character when compared with other accessions values, followed by Faw (1830), and Egyptian (1627.5), the lowest was Baladi (1626.5). Further study of Table (16) shows the highest weight of plants /m^2 was obtained in planting date four (2563.95), followed by planting date three (1745.45), and planting date two (1629.52), planting date one was the lowest (1128.54).

The comparisons of means for performance on weight of plants/ m^2 for winter planting dates Table (17) showed no significant differences were observed among the tested genotypes for this character in each planting date separately except Janobi accession was

Table (9): Mean values for Number of branches.

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	2.66 a	5.83 a	10.17 a	6.50 a	6.29
Janobi	4.50 a	5.66 a	10.17 a	6.00 a	6.58

Egyptian	**3.50 a**	**6.66 a**	**8.50 a**	**7.50 a**	**6.54**
Faw	**X**	**7.00 a**	**8.83 a**	**6.50 a**	**7.44**
Grand Mean	**3.55**	**6.29**	**9.41**	**6.62**	
LSD 0.05	**2.89**	**1.94**	**3.25**	**3.64**	
C.V %	**33.93**	**17.55**	**28.05**	**44.71**	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

Table (10): Mean values for Fresh weight of leaves (g).

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	**7.36 a**	**25.60 a**	**10.15 a**	**9.15 a**	**13.06**

Janobi	**8.31 a**	**24.40 a**	**10.35 a**	**7.55 a**	**12.66**
Egyptian	**9.21 a**	**23.83 a**	**8.95 a**	**9.91 a**	**12.97**
Faw	**X**	**34.50 a**	**10.80 a**	**7.80 a**	**17.7**
Grand Mean	**8.30**	**27.08**	**10.06**	**8.60**	
LSD 0.05	**2.91**	**15.07**	**2.38**	**3.37**	
C.V %	**29.61**	**34.50**	**31.40**	**45.59**	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

Genotype	Fresh Wt of leaves	Fresh Wt of roots	Dry Wt of leaves	Dry Wt of roots
1	**25.61 a**	**6.81 a**	**4.95 a**	**0.11 b**
2	**24.40 a**	**6.08 a**	**4.30 a**	**0.13 b**
3	**23.83 a**	**6.78 a**	**4.41 a**	**0.11 b**
4	**7.36 b**	**1.78 b**	**0.81 b**	**0.33 a**

5	**8.31 b**	**1.73 b**	**1.00 b**	**0.46 a**
6	**9.21 b**	**1.75 b**	**1.18 b**	**0.45 a**
Grand Mean	**16.45**	**4.15**	**2.77**	**0.26**
LSD 0.05	**3.75**	**0.81**	**1.03**	**0.14**
C.V %	**35.67**	**49.18**	**57.93**	**75.91**

Table (11): Performance of early and late winter season on fresh weight of leaves and roots and dry weight of leaves and roots (g).

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

1- Baladi in early winter. 4- Baladi in late winter.

2 – Janobi in early winter. 5- Janobi in late winter.

3- Egyptian in early winter. 6- Egyptian in late winter.

Table (12): Performance of early and late summer season on fresh weight of leaves and roots and dry weight of leaves and roots (g).

Genotype	Fresh Wt of leaves	Fresh Wt of roots	Dry Wt of leaves	Dry Wt of roots
1	**10.15 a**	**3.13 a**	**2.01 ab**	**0.65 a**

2	**10.35 a**	**3.03 a**	**2.15 ab**	**0.56 a**
3	**8.95 a**	**2.61 a**	**1.66 b**	**0.51 a**
4	**10.80 a**	**3.30 a**	**2.15 ab**	**0.50 a**
5	**9.15 a**	**2.51 a**	**2.28 a**	**0.60 a**
6	**7.55 a**	**2.11 a**	**2.31 a**	**0.53 a**
7	**9.91 a**	**3.18 a**	**1.78 ab**	**0.55 a**
8	**7.80 a**	**2.53 a**	**1.86ab**	**0.65 a**
G.mean	**9.33**	**2.80**	**2.02**	**0.57**
LSD 0.05	**3.75**	**1.37**	**0.49**	**0.18**
C.V%	**38.51**	**39.54**	**31.90**	**40.93**

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

1- Baladi in early summer. 5- Baladi in late summer.

2 – Janobi in early summer. 6- Janobi in late summer.

3- Egyptian in early summer. 7- Egyptian in late summer.

4- Faw in early summer. 8- Faw in late summer.

Table (13): Mean values for Fresh weight of roots (g).

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	**7.36 a**	**6.81 a**	**3.13 a**	**2.51 a**	**4.95**

Janobi	**8.31 a**	**6.08 a**	**3.03 a**	**2.11 a**	**4.88**
Egyptian	**9.21 a**	**6.78 a**	**2.61 a**	**3.18 a**	**5.44**
Faw	**X**	**7.33 a**	**3.30 a**	**2.53 a**	**4.38**
Grand Mean	**1.75**	**6.75**	**3.02**	**2.58**	
LSD 0.05	**2.91**	**1.54**	**0.87**	**1.33**	
C.V %	**49.52**	**42.46**	**28.75**	**48.45**	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

Table (14): Mean values for Dry weight of leaves (g)

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean

Baladi	**0.81 a**	**4.95 a**	**2.01 a**	**2.28 a**	**2.51**
Janobi	**1.00 a**	**4.30 a**	**2.15 a**	**2.31 a**	**2.44**
Egyptian	**1.18 a**	**4.41 a**	**1.66 a**	**1.78 a**	**2.26**
Faw	**X**	**5.10 a**	**2.15 a**	**1.86 a**	**3.03**
Grand Mean	**1.00**	**4.69**	**1.99**	**2.06**	
LSD 0.05	**0.57**	**1.18**	**0.68**	**0.83**	
C.V %	**42.70**	**48.67**	**30.05**	**36.38**	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

Table (15): Mean values for Dry weight of roots (g).

Genotype	**Planting date (1)**	**Planting date (2)**	**Planting date (3)**	**Planting date (4)**	**Mean**
Baladi	**0.33 a**	**0.11 a**	**0.65 a**	**0.60 a**	**0.42**
Janobi	**046 a**	**0.13 a**	**0.56 a**	**0.53 a**	**0.42**
Egyptian	**0.45 a**	**0.11 a**	**0.51 a**	**0.55 a**	**0.40**

Faw	**X**	**0.15 a**	**0.50 a**	**0.56 a**	**0.40**
Grand Mean	**0.41**	**0.12**	**0.55**	**0.58**	
LSD 0.05	**0.23**	**0.55**	**0.20**	**0.16**	
C.V %	**69.97**	**36.27**	**53.20**	**31.30**	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

significantly higher than Baladi in the second planting date, but it showed significant differences for the two planting dates combined data. On the other hand, the performance analysis for weight of plants/m^2 for summer planting dates Table (18) showed no significant differences between accessions.

4.11 Weight of seeds / 10 pods (g):

The results in Table (19) shows that maximum value for the weight of seeds/10 pods was obtained from Faw accession (76.55) , followed by Janobi (63.51) Baladi (62.67) , Egyptian was the lowest (57.58) .

Weight of seeds /10 pods in planting date four (121.54) showed highest average weight than the rest of planting dates, followed by planting date three (115.87), and the difference was not significant, followed by planting date one (2.30), and the lowest weight was obtained with planting date two (2.04) and the difference was not significant between planting date one and two but the difference was highly significant between summer planting dates and winters.

The comparison of means for performance on weight of seeds / 10 pods for winter planting dates Table (17) showed many differences between accessions. Egyptian was significantly lower than Baladi and Janobi.

On the other hand, the performance analysis for weight of seeds / 10 pods for summer planting dates Table (18) showed also a lot of differences between accessions. Baladi was significantly higher than Egyptian and Faw, whereas both Baladi and Janobi in the fourth

Table (16): Mean values for Weight of plants / m^2 (g).

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	**1335.0 a**	**1604.0 a**	**1692.0 a**	**1875.0 a**	**1626.5**
Janobi	**1181.0 a**	**1597.0 a**	**1503.0 a**	**4518.0 a**	**2199.7**
Egyptian	**1032.0 a**	**1647.0 a**	**1842.0 a**	**1989.0 a**	**1627.5**
Faw	**X**	**1670.0 a**	**1945.0 a**	**1875.0 a**	**1830.0**
Grand Mean	**1182.54**	**1629.52**	**1745.45**	**2563.95**	
LSD 0.05	**478.3**	**104.9**	**578.9**	**3929.0**	

C.V %	16.29	24.44	39.83	135.19

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

Table (17): Performance of early and late winter season on weight of plants/ m^2, 10 pods, seeds/ 10 pods and 1000 seeds (g).

Genotype	Wt. of plants/m^2	Wt.of 10 pods	Wt. of seed/10 pods	Wt. of 1000 seeds
1	1604.0 a	4.06 a	1.98 c	1.85 a
2	1597.0 a	4.03 a	2.06 bc	1.81 a
3	1647.0 a	3.83 a	1.96 c	1.73 a
4	1335.0 ab	3.81 a	2.23 ab	1.31 bc
5	1181.0 b	4.03 a	2.30 a	1.46 b
6	1032.0 b	4.06 a	2.36 a	1.18 c
Grand Mean	1399.2	3.97	2.15	1.56
LSD 0.05	357.9	0.49	0.18	0.22
C.V %	24.55	13.02	13.85	13.86

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

1- Baladi in early winter. 4- Baladi in late winter.

2 – Janobi in early winter. 5- Janobi in late winter.

3- Egyptian in early winter. 6- Egyptian in late winter.

Table (18): Performance of early and late summer season on weight of plants/m^2, 10 pods, seeds / 10 pods, 1000 seeds (g).

Genotype	Wt. of plants/m^2	Wt. of 10 pods	Wt. of seeds/10 pods	Wt. of 1000 seeds
1	1692.0 a	5.01 a	129.7 a	1.46 a
2	1503.0 a	4.85 a	122.2 abc	1.43 a
3	1842.0 a	4.30 a	104.0 c	1.28 a
4	1945.0 a	4.78 a	107.7 bc	1.48 a
5	1875.0 a	4.70 a	116.8 abc	1.38 a
6	4518.0 a	4.73 a	127.5 ab	1.18 a
7	1989.0 a	4.48 a	122.0 abc	1.20 a
8	1875.0 a	4.33 a	119.8 abc	1.30 a
G.mean	2154.70	4.65	118.70	1.34
LSD 0.05	2981	0.77	21.56	2.04
C.V	116.74	14.18	15.50	14.56

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

1- Baladi in early summer. 5- Baladi in late summer.

2 – Janobi in early summer.   6- Janobi in late summer.

3- Egyptian in early summer.   7- Egyptian in late summer.

4- Faw in early summer.   8- Faw in late summer.

planting date markedly higher significantly than Egyptian in the third planting date.

4.12 Weight of 1000 seeds (g):

The individual analysis of variance showed that the differences among the genotypes were not significant. The highest weight of 1000 seeds scored by Baladi accession (1.50), followed by both Janobi and Faw were expressed similar value of weight of 1000 – seeds (1.47), the lowest was produced by Egyptian (1.34) Table (20).

Non-significant variations in 1000 seeds weight were observed among the planting dates. On the other hand, the grand mean for this character was (1.76) in planting date two, followed by (1.41) in planting date three, the lowest (1.32) was given in planting date one.

Table (20) illustrates performance analysis, which was carried out for weight of 1000 seeds. The combined analysis showed that the four accessions differed insignificantly in the character studied. There were significant differences between accessions in planting date four.

The comparisons of means for performance effect on weight of 1000 seeds for winter planting dates Table (17) showed a lot of differences between accessions. Baladi was significantly higher than both Janobi and Egyptian, whereas, Egyptian significantly lower than Janobi.

On the other hand, the performance analysis for weight of 1000 seeds for the summer planting dates Table (18) showed no significant differences between accessions.

Table (19): Mean values for Weight of seeds / 10 pods (g).

Genotype	Planting date(1)	Planting date(2)	Planting date (3)	Planting date (4)	Mean
Baladi	2.23 a	1.98 a	129.7 a	116.8 a	62.67
Janobi	2.30 a	2.06 a	122.2 ab	127.5 a	63.51
Egyptian	2.36 a	1.96 a	104.0 b	122.0 a	57.58
Faw	X	2.16 a	107.7 b	119.8 a	76.55
Grand Mean	2.30	2.04	115.87	121.54	
LSD 0.05	0.21	0.27	21.34	22.64	
C.V %	13.42	17.31	14.97	15.13	

Note: Means with the same letter (s) for the character are not significant at 0.05 level.

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4.13 Weight of 10 pods (g):

Non-significant variations in weight of 10 pods were observed among the different Jew's mallow accessions Table (21). The grand mean for the weight of 10 pods are given in Table (21), the highest weight was produced by Egyptian accession (4.42), followed by Janobi (4.41), followed by Baladi (4.40), the lowest weight of 10 pods was obtained for Faw accession (3.29).

The comparisons of means for performance on weight of 10 pods for winter planting dates Table (17) showed no significant differences were observed among the tested genotypes for this character.

On the other hand, the performance analysis for weight of 10 pods for summer planting dates Table (18) showed also no significant differences between accessions.

4.14 Number of pods:

The analysis of variance showed insignificant difference between accessions. The number of pods for each of the four genotypes is shown in Table (22).

It is clear that different Jew's mallow accessions responded differently to the planting dates. The grand mean in planting date two was the highest (11.79), planting date three ranked second (9.41), followed by planting date one (8.16), the lowest number of pods was in planting date four (3.70).

Comparisons of means for performance on number of pods for winter planting dates Table (6) showed significant differences only between Baladi, however, was similar to Janobi but both was significant higher than Baladi in the second planting date.

On the other hand, the performance analysis for number of pods for summer planting dates Table (7) showed also a lot of differences between accessions Baladi and Janobi in the third planting date was significant higher than Baladi, Janobi, Egyptian, and Faw in the fourth planting date, while Egyptian in the third planting date was significant higher than Baladi, Janobi, and Egyptian in the fourth planting date.

4.15 Length of pods (cm):

The results of Duncan's Multiple Range Test for length of pods of every accession are presented in Table (23).The Janobi accession had a slight length advantage over the other accessions (4.77), followed by Baladi, and Faw, the

Egyptian recorded the lowest value for mean pod length. The analysis of variance indicated no significant differences between the tested genotypes. The length of pods was also variable character and the extent of variability was nearly similar in most of the planting dates. Planting date three and four were superior in the length of pod, followed by planting date one, the lowest was shown by the planting date two.

Comparisons of means for performance on length of pods for winter planting dates Table (2) showed no significant differences was observed among the tested genotypes for that character.

Table (20): Mean values for Weight of 1000 seeds (g).

Genotype	Planting date (1)	Planting date(2)	Planting date (3)	Planting date (4)	Mean
Baladi	1.31 a	1.85 a	1.46 a	1.38 a	1.50
Janobi	1.46 a	1.81 a	1.43 a	1.18 a	1.47
Egyptian	1.18 a	1.73 a	1.28 a	1.20 ab	1.34
Faw	X	1.65 a	1.48 a	1.30 ab	1.47
Grand Mean	1.32	1.76	1.41	1.26	
LSD 0.05	0.44	0.26	0.26	0.19	
C.V %	15.96	14.52	15.36	12.45	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

Table No. (21): Mean values for Weight of 10 pods (g).

Genotype	Planting date(1)	Planting date(2)	Planting date(3)	Planting date (4)	Mean

Baladi	3.81 a	4.06 a	5.01 a	4.70 a	4.40
Janobi	4.03 a	4.03 a	4.85 a	4.73 a	4.41
Egyptian	4.06 a	4.83 a	4.30 a	4.48 a	4.42
Faw	X	4.06 a	4.78 a	4.33 a	3.29
Grand Mean	3.97	4.00	4.73	4.56	
LSD 0.05	0.42	0.3393	0.7715	0.81	
C.V %	12.93	15.49	13.24	14.46	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

Table (22): Mean values for Number of Pods

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	5.83 a	10.67 a	10.00 a	4.16 a	7.66
Janobi	9.50 a	12.00 a	9.50 a	3.50 a	8.62
Egyptian	9.16 a	9.66 a	7.83 a	2.83 a	7.37
Faw	X	14.83 a	10.33 a	4.33 a	9.83
Grand Mean	8.16	11.79	9.41	3.708	
LSD 0.05	6.38	6.75	4.57	2.43	
C.V %	55.49	31.49	39.43	53.39	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

On the other hand, the performance analysis for length of pods for summer planting dates table (3) showed also no significant differences between accessions.

4.16 Diameter of pods (cm):

Table (24) indicates that all accessions exhibited a more or less similar range of the diameter of pod, the minimum number was (2.55) and the maximum was (3.26).

The accession Faw was characterized by the highest diameter of pods, where as the lowest diameter of pods was characteristic of the accession Janobi.

Although there are no clear differences between accessions, it responded differently to the planting dates in diameter of pods, planting date three ranked firstly, followed by planting date four, the lowest was expressed by planting date one. The variation, however, was not that great among the summer planting dates, the mean were (4.83) and (4.50) respectively, Table (24).

Also there were no significant differences among the winter planting dates, the mean were (0.48) and (0.49) respectively. On the other hand, significant difference in diameter of pods was found between summer and winter planting dates Tables (2 - 3).

Comparisons of means for performance on diameter of pods for winter planting dates Table (2) showed no significant differences was observed among the tested genotypes for that character.

On the other hand, the performance analysis for diameter of pods for summer planting dates Table (3), showed a lot of differences between accessions. Baladi was significantly higher than the rest of accessions in the fourth planting date. Faw was significantly lower than both Janobi and Egyptian, which were similar together in the fourth planting date.

4.17 Yield of seeds / Feddan:

Table (25) illustrates mean values for dry seed yields, Faw accession was markedly higher (7352.66) than that of all other accessions, followed by Janobi (5135.5), followed by Baladi (5109.25), while the lowest mean value of this character (4531.25) given by Egyptian accession. No significant varietals differences in dry seed yields were found among the tested material.

Comparisons of means for performance on yield of seeds / Feddan for winter planting dates Table (27) showed a lot of significant differences were observed among the tested genotypes for that character. Baladi was significantly lower than Janobi and Egyptian. Janobi in the fourth planting date significantly higher than Baladi, but lower than Egyptian.

On the other hand, the performance analysis for yield of seeds / Feddan for summer planting dates Table (28) showed a lot of differences between accessions. Baladi and Faw were significantly higher than the rest of the accessions in the fourth planting date.

4.18 Yield of fresh leaves/Feddan:

Mean values for yield of fresh leaves/ Feddan are presented in Table (26). Freshly harvested leaves in planting date three showed highest yield than other planting dates, followed by the second planting date, planting date four ranked third, while the first planting date was the lowest.

The highest yield was obtained with Faw accession (3890.33), followed by Janobi (2702.25) followed by Baladi (2639.79), while Egyptian was the lowest (2561.5).

Comparisons of means for performance on yield of fresh leaves / Feddan for winter planting dates Table (27) showed a lot of differences between accessions. Faw was significantly higher than the rest of accessions. Janobi, however, was similar to Faw but significantly higher than Egyptian and Baladi. Baladi was significantly lower than the rest of accessions.

Genotype	Planting date(1)	Planting date(2)	Planting date(3)	Planting date (4)	Mean

On the other hand, the performance analysis for yield of fresh leaves/Feddan for summer planting dates Table (28) showed in significant differences.

Table (23): Mean values for Length of pods (cm).

Baladi	**4.72 a**	**4.68 a**	**4.82 a**	**4.82 a**	**4.76**
Janobi	**4.66 a**	**4.71 a**	**4.87 a**	**4.87 a**	**4.77**
Egyptian	**4.73 a**	**4.60 a**	**4.70 a**	**4.70 a**	**4.68**
Faw	**X**	**4.59 a**	**4.74 a**	**4.74 a**	**4.69**
Grand Mean	**4.70**	**4.65**	**4.78**	**4.78**	
LSD 0.05	**0.12**	**0.19**	**6.44**	**6.44**	
C.V %	**6.89**	**7.20**	**10.95**	**10.29**	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

Table (24): Mean values for Diameter of pods (cm).

Genotype	**Planting date (1)**	**Planting date (2)**	**Planting date(3)**	**Planting date (4)**	**Mean**
Baladi	**0.49 a**	**0.48 a**	**4.95 a**	**4.55 a**	**2.61**
Janobi	**0.47 a**	**0.50 a**	**4.75 a**	**4.50 a**	**2.55**

Egyptian	**0.47 a**	**0.49 a**	**4.80 a**	**4.50 a**	**2.56**
Faw	**X**	**0.48 a**	**4.83 a**	**4.46 a**	**3.26**
Grand Mean	**0.48**	**0.49**	**4.83**	**4.50**	
LSD 0.05	**0.04**	**0.03**	**0.30**	**0.24**	
C.V %	**3.83**	**2.56**	**5.19**	**4.48**	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

Table (25): Mean values for Yield of seeds /g /FD

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	**1659.0 a**	**3382.0 a**	**11560.0 a**	**3836.0 a**	**5109.25**
Janobi	**3818.0 a**	**3436.0 a**	**9598.0 a**	**3690.0 a**	**5135.5**

Egyptian	3546.0 a	2499.0 a	9491.0 a	2589.0 a	4531.25
Faw	X	4735.0 a	12990.0 a	4333.0 a	7352.66
Grand Mean	3007.42	3513.01	10909.39	3612	
LSD 0.05	2361	2910	9604	2292	
C.V %	61.02	6731	71.54	51.57	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

Table (26): Mean values for Yield of fresh leaves /g / FD

Genotype	Planting date (1)	Planting date (2)	Planting date (3)	Planting date (4)	Mean
Baladi	971.9 b	3547.0 a	2978.0 a	3063.0 a	2639.97
Janobi	1427.0ab	2953.0 a	3520.0 a	2909.0 a	2702.25
Egyptian	1511.0 a	2427.0 a	3247.0 a	3061.0 a	2561.5
Faw	X	3716.0 a	4966.0 a	2989.0 a	3890.33
Grand Mean	1303.42	3160.77	3677.62	3005.35	
LSD 0.05	499.9	1114	2632	1448	
C.V %	29.81	28.65	58.15	39.16	

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

Table (27): Performance of early and late winter season on yield of seeds (g) / FD and yield of fresh leaves (g)/ FD

Genotype	Yield of Seed (g)/FD	Yield of fresh leaves (g)/FD
1	1659.0a	971.9 d
2	3818.0 a	1427.0 cd
3	3546.o a	1511.0 cd
4	3382.0 a	3547.0 a
5	3436.0 a	2953.0 ab
6	2499.0 a	2427.0 bc
Grand Mean	3056.574	2139.632
LSD0.05	690.2	986.4
C.V %	60.05	38.77

Note: Means with the same letter (s) for the character are not significant at 0.05 levels.

1- Baladi in early winter. 4- Baladi in late winter.

2 – Janobi in early winter. 5- Janobi in late winter.

3- Egyptian in early winter. 6- Egyptian in late winter.

Table (28): Performance of early and late summer season on yield of seeds and leaves (g)/ FD

Genotype	Yield of	Yield of fresh

	seeds/FD	leaves/FD
1	11560 a	2978.0 a
2	9598.0 ab	3520 a
3	9491.0 ab	3247.0 a
4	12990 a	4966.0 a
5	3836.0 b	3063.0 a
6	3690 b	2909.0 a
7	2589.0 b	3061.0 a
8	4333.0 b	2989.0 a
G.mean	7260.76	3341.48
LSD 0.05	6462	2059
C.V	75.93	52.75

Note: Means with the same letter (s) for the character are not significant at 0.05 levels

1- Baladi in early summer. 5- Baladi in late summer.

2 – Janobi in early summer. 6- Janobi in late summer.

3- Egyptian in early summer. 7- Egyptian in late summer.

4- Faw in early summer. 8- Faw in late summer.

4.19 Effect of winter and summer seasons on yield and vegetative attributes:

Comparison of means for effect of winter and summer planting dates Tables (29 – 30 -31 – 32 - 33) showed no significant differences was observed among the genotypes for all characters except for the weight of 1000 seeds and fresh weight of roots.

On the other hand the performance of the genotypes for the characters relative to the seasonality, showed that higher mean values were obtained in the summer were length of plants, 43.70, length of pods 4.76, number of plants 825.86, number of branches 7.77, dry weight of roots 0.56, fresh weight of plants /m^2 1750.30, weight of 10 pods 4.68, weight of seeds /10 pods 2.88, yield of seeds /Feddan 6793.38 and yield of fresh leaves /Feddan, while the higher mean values were obtained in the winter were length of roots 12.21, diameter of pods 4.82, number of leaves 13.41, number of pods 9.47, fresh weight of leaves 16.45, fresh weight of roots 4.15, dry weight of leaves 2.77, and weight of 1000 seeds 1.56.

On the average Baladi accession had higher mean number of leaves, fresh weight of leaves, dry weight of leaves, weight of 1000 seeds, length of pods and diameter of pods. Janobi accession had the highest mean dry weight of roots, number of branches, number of pods, weight of 10 pods, weight of seeds /10 pods, yield of seeds/ Feddan and yield of fresh leaves /Feddan.

Egyptian accession had the highest mean length of plants, fresh weight of roots, length of roots, length of plants, fresh weight of roots, fresh weight of plants and number of plants.

The interaction between genotypes and seasons Table (29- 30- 31- 32- 33) showed no significant differences was observed between genotypes within seasons.

Table (29): Mean values of winter and summer planting dates for length of plants, roots, pods/ cm and diameter of pods /cm

Genotype	Length of plants	Length of roots	Length of pods	Diameter of pods
Baladi	39.20 a	10.33 a	4.74 a	4.76 a
Janobi	41.17 a	10.23 a	4.70 a	4.69 a
Egyptian	41.87 a	10.88 a	4.65a	4.70 a
Winter	37.80	12.21	4.64	4.82
Summer	43.70	8.75	4.67	4.61
Grand Mean	40.75	10.48	4.70	4.72
L.S.D 0.05	5.25	1.41	0.25	0.13
C.V %	22.30	23.27	9.48	34.96

Note: Mean with the same letter(s) for the character, are not significantly different at 0.05 level.

Table (30): Mean values of winter and summer planting dates for number of plants/m^2, leaves, branches and pods.

Genotype	Number of plants/ m^2	Number of leaves	Number of branches	Number of pods
Baladi	582.8 a	11.75	6.12 a	7.66 a
Janobi	558.8 a	10.58 a	6.50 a	8.95 a
Egyptian	629.9 a	11.29 a	6.20 a	7.29 a
Winter	355.13	13.41	4.77	9.47
Summer	825.86	9.00	7.77	6.47
Grand Mean	590.50	11.20	6.27	7.97
L.S.D 0.05	144.0	2.267	1.25	1.84
C.V %	42.15	34.96	34.52	40.02

Note: Mean with the same letter(s) for the character, are not significantly different at 0.05 level.

Table (31): Mean values of winter and summer planting dates for Fres wt. of leaves, Fresh wt. of roots, Dry weight of leaves

Genotype	Fres wt. of leaves	Fresh wt. of roots	Dry weight of leaves	Dry weight of roots
Baladi	13.07 a	3.56 a	2.51 a	0.42 a
Janobi	12.65 a	3.42 b	2.44 a	0.48 a
Egyptian	12.98 a	3.58 a	2.26 a	0.43 a
Winter	16.45	4.15	2.77	0.33
Summer	9.34	2.76	2.03	0.56
Grand Mean	12.90	3.46	2.40	0.45
L.S.D 0.05	2.76	0.26	0.69	0.18
C.V %	37.08	46.99	49.92	69.62

and dry weight of rootrs/ g

Note: Mean with the same letter(s) for the character, are not significantly different at 0.05 level.

Table (32): Mean values of winter and summer planting dates for Weight of plants/ m^2,Weight of 10 pods, Weight of seeds/10 pods, Weight of 1000 seeds/g

Note: Mean with the same letter(s) for the character, are not significantly different at 0.05 level.

Table (33): Mean values of winter and summer planting dates for Yield of Seeds /g / FD, Yield of fresh leaves / g / FD

Genotype | Yield of Seeds /g / FD | Yield of fresh leaves / g / FD

Genotype	Weight of plant/ m^2	Weight of 10 pods	Weight of seeds/10 pods	Weight of 1000 seeds
Baladi	1594. a	4.39 a	2.48 a	1.50 a
Janobi	1503. a	4.41 a	2.61 a	1.47 a
Egyptian	1628. a	4.17 a	2.45 a	1.35 b
Winter	1399.37	3.97	2.15	1.56
Summer	1750.30	4.68	2.88	1.32
Grand Mean	1574.83	4.32	2.51	1.44
L.S.D 0.05	212.8	0.35	0.22	0.12
C.V %	23.36	14.37	15.52	14.30

		FD
Baladi	**5108.15 a**	**2640.01**
Janobi	**5135.54 a**	**3827.14**
Egyptian	**4531.22 a**	**2561.60**
Winter	**3056.56**	**2139.62**
Summer	**6793.38**	**8379.54**
Grand Mean	**4924.97**	**3009.58**
L.S.D 0.05	2208	2026
C.V %	**77.51**	**116.39**

Note: Mean with the same letter(s) for the character, are not significantly different at 0.05 level.

CHAPTER FIVE

DISCUSSION

5.1 Variability study:

In the present investigation, the components of variance, the phenotypic, genotypic and environmental values of variance were determined for all characters under study. The combination between all the characters studied, have been computed. A wide range of phenotypic variability was examined in the genotypes studied. It is of interest to partition the observed phenotypic variability into early growth vegetative and yield and its components. Because of the high genotype x planting date interaction, hence an estimate of variance obtained from a particular experiment would be valid only under the conditions of that experiment; further studies on testing procedures over years and perhaps locations are highly recommended.

5.1.1 Phenotypic variability:

There have been relatively few reports of early vegetative growth heterosis in Jew's mallow.

In this study, the significant differences detected among the four evaluated Jew's mallow genotypes, for weight of seeds / 10 pods, weight of 1000 seeds and yield of fresh leaves /Feddan.

The non-significant differences among the genotypes for number of plants, number of leaves, number of branches, number of pods, fresh weight of leaves, fresh weight of roots, dry weight of leaves, dry weight of roots, length of plants, weight of plants, weight of 10 pods and yield of seeds /Feddan, as indicated by individual analysis of variance, could be attributed to low genetic variance involved. This indicates that there is small genetic variation among the germplasm used for these characters. Moreover, the germplasm used in this investigation was collected from local seed producers (uncertified seeds), so small genetic variation may be expected for these characters.

Most of the characters studied gave the same overall mean in the same planting date (winter or summer), where as, the number of plants, number of leaves, number of branches, fresh weight of leaves, and length of plants showed wide differences in the overall means between winter and summer.

The change in overall means of these characters was due to the interaction of accessions with environment. Such interaction was significant for these characters. The characters, which gave constant means over the winter and summer planting dates, were more stable and less sensitive to changes in environment.

The absence of significant genotype X planting date (environments) interactions indicated that the genotypes had responded similar in different environments for these traits.

The genotypes with the best performance at one environment would also be superior at others, that the genotype ranking remained almost constant.

On the other hand, the presence of significant interactions of genotypes with environments (planting dates) for weight of seeds/10 pods, weight of 1000 seeds and yield of fresh leaves/ Feddan indicates that the relative performance of some genotypes was more adapted than other as an average for all planting dates, for these traits. This could be attributed to the differences in the plant material used and the environment. The relative consistency in overall mean for length of pods weight of seeds/ 10 pods, and weight of 1000 seeds at the four planting dates, may indicate that these characters were less sensitive to environmental fluctuations and can be used as varietals index. In contrast, the fluctuations in the overall mean of the rest of the variables might be (to some extent) due to the interaction between the genotypes and environments.

5.2 Yield components:

All yield components, number of pods per plant, number of seeds per pod, weight of seeds per 10 pods, weight of 1000 seeds, number of branches, yield of seeds, and yield of fresh leaves which were selected to account for the variability in yield, had positive genotypic relationship association with seed yield / plant except length of pods, weight of 10 pods, weight of 1000 seeds which had a negative one. The grand means for yield components of the accessions are shown in tables (3, 4, 10, 11, 12, 15, 16, 17, and 18). Faw accession exceeded the mean of other accessions in seed yield.

The primary cause for the superiority of Faw accession over the other was the higher number of pods and weight of seeds per pod produced by Faw accession. The increase in number of branches of the Faw accession was also a factor contributing to their yield advantage.

The Janobi accession averaged higher in number of branches, number of pods, and weight of seeds than the Baladi and Egyptian accession. However, because of their relatively high number of pods/plant and number of branches/plant the Janobi accession had a slight yield advantage over the other accessions. On the all basis, seed yield was accompanied by the highest values for number of branches, number of pods, and weight of seeds. These results are in close agreement with those obtained by Bhattacharjee, et.al 2000 they reported the superiority of seed production and quality might be attributed to increase in seed weight. On the other hand, mean dry seed per plant ranged from (2.47) as the highest dry seed yields per plant obtained for Faw accession, to (1.61) as the lowest yield of dry seed was produced by Baladi accession, Janobi ranked second for dry seed yields per plant (2.13), followed by Egyptian (1.80). Similar results for dry seed yields per plant is in accordance with that of Akoroda and Akintobi 1981 in Jew's mallow, they reported that the dry seed yields per plant in oniyaya cultivar was 2.6 g during the dry season. Yield of dry seeds in summer planting dates showed highest yield than winter planting dates this adopted result is in complete harmony with Ahmed, et. al 1993 work of variety X environment interaction on seed yield and its components in tossa jute tested on six different sowing dates. Faw accession had the highest dry seed yields in the third planting date compared to all other accessions, followed by Janobi accession in the fourth planting date, which was also significant greater than the rest of the accessions, followed by Baladi accession in the second planting date, Egyptian ranked last in the first planting date.

These findings were in agreement with results of Hossain, et.al 2001 in Jew's mallow, they found that sowing in the field in natural condition in the 15^{th} of both February and March (short and long day period respectively) gave high yielding comparing to early sowing. Planting date four was expected to give best results under environmental conditions of Khartoum state, but the reduction in yield and vegetative growth was properly due to water stress which leads to meager results.

Because Jew's mallow is also medicinal vegetable crop, yield of fresh leaves was computed. It can be seen that such observations are in agreement with the results obtained in dry seed yields, the Faw accession showed the highest yield of fresh leaves/ Feddan in the third planting date, followed by Janobi in the second planting date, followed by Baladi in the third planting date, Egyptian was the lowest in the first planting date. The suitability of summer for high leaves yielding has been studied by many workers, Begum; et.al 1991 reported that Jew's mallow grows well during hot summer month in long day.

In the case of ginning out turn the accession Faw appeared to be superior by giving better result for manifestation of heterosis when compared with other accessions values for most characters like number of plants, number of leaves, number of branches, number of pods, fresh weight of leaves, dry weight of leaves, length of plants, length of roots, and diameter of pods, while it ranked last for some characters like fresh weight of roots, dry weight of roots, and weight of 10 pods, but ranked second for characters like weight of plants/ m^2, weight of 1000 seeds, weight of seeds/ 10 pods, and ranked third for length of pods. It can be seen that, Janobi accession averaged slightly higher than the mean of the other accessions in weight of plant/ m^2, length of pods, and dry weight of roots together with Baladi accession, while it ranked second for some characters like number of branches, number of pods, weight of 10 pods, weight of seeds per 10 pods together with Faw accession, while it ranked third in number of plants, fresh weight of roots, and dry weight of leaves, while it ranked last for characters like number of leaves, length of plants, length of roots, fresh weight of leaves, and diameter of pods.

On the average, Baladi accession had higher mean weight of 1000 seeds and dry weight of roots together with Janobi accession, while it ranked second for some characters like length of plants, length of roots, length of pods, fresh weight of leaves, fresh weight of roots, dry weight of leaves, and diameter of pods, and ranked third for number of leaves, number of pods, weight of 10 pods, and while it ranked last for number of plants, number of branches, weight of plants / m^2, and weight of seeds/ 10 pods.

Egyptian accession had the highest mean fresh weight of roots, and weight of 10 pods compared to all other accessions, while it ranked second for the characters like number of plants, number of leaves, and while it ranked third for length of plants, length of roots, number of branches, diameter of pods, weight of plants / m^2, fresh weight of leaves, dry weight of roots, and weight of seeds,/10 pods, while it was expressed the lowest number of pods, length of pods, dry weight of leaves, and weight of 1000 seeds.

Although there are no clear-cut differences between accessions, the performance of the accessions relative to the planting dates showed a lot of variation. In the present investigation higher mean number of leaves, number of pods, fresh weight of leaves, fresh weight of roots, dry weight of leaves, length of plants, length of roots, and weight of 1000 seeds was obtained in the second planting date, while the superiority of the third planting date was detected in characters like number of plants, number of branches, length of pods, diameter of pods, and weight of 10 pods, while the higher mean weight of plants / m^2, dry weight of roots, length of pods, and weight of seeds / 10 pods was expressed in the fourth planting date.

5.3 Interaction between genotypes and seasons:

The comparisons of means for combination effect on yield components for winter planting dates showed no significant differences were observed for the characters weight of 10 pods, length of pods, and diameter of pods. Where as, number of branches, number of pods, weight of seeds /10 pods, and weight of 1000 seeds. Both yield of seeds/ Feddan and yield of fresh leaves/ Feddan expressed significant differences among winter planting dates. On the other hand, comparisons of means for combination effect on yield components for summer planting dates showed no significant differences were observed for the characters weight of 10 pods, weight of 1000 seeds, length of pods, and yield of fresh leaves / Feddan, while number of branches, number of pods, weight of seeds /10 pods, diameter of pods, and yield of seeds / Feddan was significant.

The performance of the accessions relative to the seasonality showed a lot of variation. The results obtained in this investigation indicate that the performance of the genotypes in winter for the characters like length of roots, diameter of pods, number of leaves, number of pods, fresh weight of leaves, fresh weight of roots, dry weight of leaves and weight of 1000 seeds is a fairly good approximation of its average performance in summer, This can be attributed to the effect of water stress on late summer planting date of 2nd July 2004 experiment, that made the data results obtained so meager. This fact indicates that these characters and the differences between accessions are mostly due to environment factors.

On the other hand, the interaction between genotypes and seasons (winter and summer) was found to be in significant, indicating that the performance of genotypes was consistent over seasons. The in significant variation can be attributed also to the effect of water stress on late summer planting date of 2nd July 2004 experiment.

CHAPTER SIX

SUMMARY AND CONCLUSION

A study of variability and characterization of different Jew's mallow genotypes, four accessions of Jew's mallow (Corchorus olitorius), Baladi, Janobi, Egyptian, and Faw were tested on four different planting dates 16^{th} of October 2003, early winter, 24^{th} of January 2004, late winter, 2^{nd} of May 2004, early summer, 3^{rd} of July 2004, late summer, under Shambat conditions. Analysis of variance, mean performance, and combination were studied for eighteen characters.

It was found that the accessions interacted significantly with the environments. Among the planting dates, May 2^{nd} showed the highest growth and seed yield. The highly significant differences among the genotypes were observed on the characters, weight of seeds /10 pods, weight of 1000 seeds and yield of fresh leaves / Feddan.

It is clear that there is a high degree of resemblance between the accessions for most early vegetative growth and some of yield components characters, the consistency for these characters would be attributed in part to non – significant effect of the interaction variance resulting in a relatively constant over all mean, since the different environments had slight effect on the expression of this traits.

There is also a great morphological similarity between the accessions, leaf characteristics, existing of red stapler spots, was shown by all the accessions.

None of the accessions was found to be homogeneous in stem color, leave color, and seed color. The color of the stems was conveniently grouped into three main classes, namely green, light red and brown and there were intermediate shades giving a wider range of color. The color of the leaves was ranked from light green to dark green. The color of the seeds ranked from light green for Baladi accession to dark green for the rest of the accessions.

The insignificant variation can be attributed to the fact that yield in Jew's mallow is a complex character, which is greatly affected by environment that might mask the effect due to genetic factors.

Seeds yield was accompanied by the highest values for number of branches, number of pods, number of seeds per pod, and weight of seeds.

The results obtained in this investigation indicate that the performance of the Faw accession is a fairly good approximation of its average performance in winter, also showed better performances for seed yield and its contributing characters, and was the most prominent in most of the characters studied than the others, followed by Janobi accession.

Lack of uniformity, in the performance of accessions within the planting dates and between planting dates may be an important consideration, especially where complementary factors for growth and yield are present. So the difference of characteristics among the plants can be attributed in part to genetic factors as well as to environments.

Further studies on testing procedures over several years and perhaps locations are highly recommended for reliable evaluation of the material to get scope for improvement in certain traits by selection.

The interaction between genotypes and seasons (winter and summer) was found to be in significant, indicating that the performance of genotypes was constant over seasons.

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Appendix (1)
Station: - Shambat
Period: - From Oct. To Dec .2003

Element	Mean Temperature °C		Relative Humidity (%)	Total Rainfall (Mm)
Month	Max	Min		
October	39.9	23.9	31	3.4
November	36.1	20.3	29	0
December	31.5	15.1	33	0
Total/ annual				3.4

For the period (Jan. To October 2004)

Element	Mean Temperature °C		Relative Humidity (%)	Total Rainfall (Mm)
Month	Max	Min		
January	31.4	14.0	29	TR
February	32.3	15.1	27	0
March	37.2	18.1	23	0
April	40.9	21.0	16	0
May	44.0	23.8	19	0
June	41.3	26.7	28	0.5
July	40.3	26.2	34	5.4
August	38.7	25.7	42	44.0
September	40.0	26.6	37	1.0
October	40.0	26.6	37	1.0
Total	38.0	23.7	36	24.0

Note: - Max = Maximum Min= Minimum

Source: Metrological Authority – administration of data service- Khartoum.