Journal Homepage: -www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
ISSN NO. 2320-5407
Article DOI:10.21474/IJAR01/6858
DOI URL: http://dx.doi.org/10.21474/IJAR01/6858

RESEARCH ARTICLE

MORPHOLOGICAL CHARACTERIZATION AND GENETIC DIVERGENCE IN MYANMAR SESAME (*Sesamum indicum* L.) GERMPLASM.

Myint Aye[1], Tin Tin Khaing[2] and Nang Hseng Hom[3].

1. Assistant Lecturer, Department of Plant Breeding, Physiology and Ecology, Yezin Agricultural University, Yezin, Nay Pyi Taw, Myanmar, Phone- (+959-43034770)
2. Principle and Professor, Magway Campus, Yezin Agricultural University, Myanmar
3. Prorector, Yezin Agricultural University, Yezin, Nay Pyi Taw, Myanmar

……………………………………………………………………………………………………....

Manuscript Info

……………………….

Manuscript History

Received: 05 February 2018
Final Accepted: 07 March 2018
Published: April 2018

Keywords:-
Diversity, genetic advance, germplasm. heretability.

Abstract

………………………………………………………………

Loss of genetic diversity proceeds at a fast rate due to climate change, over-exploitations, replacement of traditional cultivars and agri-modernization in the dry zone. Therefore, it is needed to evaluate the morphology of sesame germplasm from different origins and to identify the genetic diversity of cultivated sesame germplasm collected from different ecological conditions. Forty collected sesame germplasm from diverse ecological conditions are characterized during pre-monsoon season from February to May 2014 at the upland research field of Department of Plant Breeding, Physiology and Ecology, Yezin Agricultural University (YAU), Nay Pyi Taw, Myanmar. The experimental design was Randomized Complete Block Design with two replications. All germplasm showed wide range of variability for stem, leaf and flower traits, and yield and yield component characters. Progeny selection will be effective to improve the number of primary branches per plant, number of capsules per plant and seed yield per plant indicating high heritability with high genetic advance. In correlation analysis, days to first flowering, days to 50% flowering, plant height, number of primary branches per plant, number of secondary branches per plant, number of capsules per plant and capsule length were found to be the main yield contributing traits in sesame production. By cluster analysis, ten clusters may help in germplasm selection as breeding materials for production of climate-friendly cultivars of sesame.

……………………………………………………………………………………………………....

Introduction:-

Oilseed crops play a vital role in Myanmar’s high consumption of cooking oil compared to other neighbouring countries. Sesame, queen of oilseeds, is rich in vitamin 'E' and the antioxidants (sesamin and sesamolin) contains high 50-58% oil with oleic and linoleic fatty acids, 20% protein, calcium, phosphorous, oxalic acid and excellent qualities of seed oil and meal (Rao 2005). Sesame has a large diversity in cultivars and cultural systems around the world as well as in Myanmar. Sesame crop is grown throughout the country and round the year. The total sesame sown area in Myanmar was about 1.6 million hectare in the year 2011-2012 (DAP 2013).

Corresponding Author:- Myint Aye.
Address:- Assistant Lecturer, Department of Plant Breeding, Physiology and Ecology, Yezin Agricultural University, Yezin, Nay Pyi Taw, Myanmar.

A large diverse of sesame germplasm are predominantly grown in Mandalay, Magway and Sagaing Regions that lie in the dry zone of Myanmar. Therefore, it is known as “oil pot” of Myanmar because its weather condition favours drought resistant, edible oil crops. The dry zone is one of the most climate sensitive and natural resource poor regions in Myanmar. Drought and water scarcity are the dominant climate-related hazards in the dry zone of Myanmar.

Myanmar still exhibits a great deal of variation in sesame because heterogeneous landraces are grown in various growing areas for centuries. However, current climate shocks (drought and high temperature) in this region are now threatening agricultural crops including sesame germplasm. Climate shocks reduce the sesame productivity and production stability that already have high levels of food insecurity. In Myanmar, the palm oil is imported every year because of the self-insufficiency of edible oil consumption although sesame oil is very excellent for the health of human. In Myanmar, plan for the increase in sown area and yield per hectare of sesame oilseed crop and plant breeding program is needed to support local sufficiency policy for edible oil. Genetic diversity in crop plants is essential to sustain level of high productivity.

Genetic variation survives for agronomically vital characters in sesame but its production is still very low in Myanmar. Loss of genetic diversity of the germplasm have been proceeding at a fast rate due to climate change, over-exploitations, replacement of traditional cultivars and modernization of agriculture,. The landraces and wild species are an important source of genetic diversity and raw material for breeders and still the backbone of agricultural production (Ali et al. 2009). The local varieties or landraces are a product of natural selection which was cultivated by farmers over long period of time on account of their adaptability and resistance to biotic and abiotic stresses. A number of disasters have occurred as a result of narrow genetic base of plants that possess very little resistance to certain biotic and abiotic stresses.

In Myanmar, due to continuous genetic erosion of landraces and largely unpredictable needs of the future, it needs to collect, multiplicate, evaluate, characterize and conserve a large diverse of sesame germplasm for current and future need for food security, nutrition and environmental protection before they disappear forever. Therefore, to fulfill these requirements, this study was carried out with the following objectives; (1) to evaluate the morphology of sesame varieties from different origins, and (2) to identify the genetic diversity of cultivated sesame germplasm collected from different ecological conditions.

Materials and Methods:-

The experiments were conducted in the upland field of Department of Plant Breeding, Physiology and Ecology, Yezin Agricultural University from February 2014 to May 2014 (pre-monsoon period, irrigated hnan). The size of the experiment is 1555 m^2. The forty sesame germplasm were collected from the different regions of Myanmar from April to May 2013. The forty sesame germplasm, their original sources and remarks were shown in Table 6. The two germplasm were collected from Sagaing Region, twenty seven germplasm from Magway Region, nine germplasm from Mandalay Region, and two germplasm Shan State.

The forty genotypes of sesame were raised in a randomized complete block (RCB) design with two replications. Each plot consisted of a single row, 3.7 m long adopting a spacing of (0.5 m × 0.15 m). Plots were over-planted and thinned at the 21 days old to a final stand of approximately 25 plants in each row. Cultural practices such as hand-weeding, inter-weeding, and fertilizer application for sesame production were conducted as necessary.

The data were collected on five random plants in each of the germplasm for each replication. The twelve morphological characters and twelve yield and yield component characters were recorded by referencing with Descriptors for Sesame (*Sesamum spp.*) (IPGRI 2004). The data were statistically analyzed for simple analysis of variances according to Statistix, version 8.0. Correlation coefficient between yield and yield component characters were evaluated by XLSTAT (2014). Cluster analyses, using Spearman correlation coefficient and unweighted pair group method with arithmetic mean (UPGMA), were performed with the XLSTAT (2014) Statistical Analysis Software.

The phenotypic and genotypic coefficients of variation were computed by the formula suggested by Singh and Chaudhary (1985). Heritability in broad sense (H_{bs}) was computed by the formula suggested by Singh and Chaudhary (1985). The expected genetic advance (GA) with 5% selection intensity was calculated as the formula given by Johnson et al. (1955). The genetic advance as percent of mean (GA %) were computed using formula given by Johnson et al. (1955).

Results and Discussion:-

Morphological characters of forty sesame germplasm:-

All germplasm showed wide range of variability for all the morphological traits studied except plant growth type, stem colour, and shape (**Table 1**).

Analysis of variances for yield and yield components of sesame germplasm:-

The analysis of variance revealed statistically significant differences at 0.1% probability level among the 40 sesame germplasm for yield and yield component characters **(Table 2).** It was indicated that there were much genetic variation among germplasm in all characters. This result agreed with the observation of Saha et al. (2012).

Mean, coefficients of variation, heritability and genetic advance for quantitative traits in sesame germplasm:-

Different parameters such as the mean performance, range, phenotypic variance and genotypic variance, phenotypic coefficients of variation (PCV) and genotypic coefficients of variation (GCV), heritability estimates and predicted genetic advance over mean for all the characters are presented in **Figure 1.** The phenotypic coefficient of variation (PCV) was greater than genotypic coefficient of variation (GCV) for all characters. This indicated that the environment had an important role in the expression of these characters. The traits, number of primary and secondary branches per plant, number of capsules per plant and seed yield per plant showed high PCV and GCV estimates. This value is enough scope for selection based on these characters, and the diverse germplasm can provide materials for a sound breeding program. The high PCV and GCV observed for these traits is in confirmation with earlier report of Sumathi and Muralidharan (2010), Saravanan and Nadarajan (2003) and Solanki and Gupta (2003) and Shadakshari *et.al.* (1995). High coefficient of variation for number of capsules per plant was also reported by Anitha *et al.* (2000). However, low coefficient of variation for number of seeds per capsule was reported by Thangavel *et al.* (2000).

Days to emergence, plant height, capsule width and 1000 seed weight showed moderate PCV and GCV which is in agreement with the observation of Parameshwappa et al. (2009). The remaining traits such as days to first flowering, days to 50% flowering, days to maturity and capsule length recorded low PCV and GCV. Sudhakar et al. (2007) and Shadakshari et al. (1995) reported similar to this results. Low variability for these characters has also been reported by Krishnaiah et.al. (2002). Estimate of PCV and GCV values gives only the extent of variability existing for various traits. Estimates of heritability and genetic advance would give better idea about the possible gains of selection.

The broad sense heritability estimates obtained were high for all the characters studied except number of secondary branches per plant, which recorded very low heritability. Estimates of heritability and genetic advance in combination are more important for selection than heritability alone. High heritability combined with high genetic advance (as per cent of mean) observed for number of primary branches per plant, number of capsules per plant and seed yield per plant. Similar results were reported by Furat and Uzun (2010), Reddy et al. (2001) and Krishnaiah et al. (2002). These characters were controlled by additive gene effects and phenotypic selection for these characters would likely to be effective. Days to first flowering, days to 50% per cent flowering, days to physiological maturity, plant height, capsule length, capsule width and 1000 seed weight showed high heritability with low genetic advance. These characters may be governed by non-additive gene action. These results are similar to the findings of Sudhakar et al. (2007) and Reddy et al. (2001) and Sumathi and Muralidharan (2010).

Correlation coefficient between yield and yield component characters in sesame germplasm:-

Correlation coefficient between yield and yield component characters in sesame germplasm was shown in **Table 3**. Correlation coefficient analysis measures the mutual relationship between various characters and is used to determine the component character on which selection can be done for improvement in yield. Yield is a complex quantitative trait, greatly influenced by environmental fluctuations. Selection based on yield performance alone may give a biased result and leads to ambiguity. A study of nature and degree of association of component characters with yield assumes greater importance for fixing up characters and selection would be more effective.

Seed yield plant^{-1} showed significantly positive correlation with days to first flowering (0.64**), days to 50% flowering (0.48**), plant height (0.66**), number of primary branches plant^{-1} (0.40**), number of secondary branches plant^{-1} (0.40**), number of capsules plant^{-1} (0.81**), capsule length (0.32*). This was indicated that the greater the plant height, number of branches plant^{-1}, number of capsules plant^{-1} and capsule length, the higher the seed yield plant^{-1}. If days to first and 50% flowering were late, number of leaves on plant may be plenty before flowering and then more photosynthesis may take place in these leaves. Therefore, seed yield plant^{-1} may be high due to these traits. Similar results were reported by Sankar and Kumar (2003) and Kumar and Sundararajan (2002).

Cluster analysis based on similarity characters:-

In cluster analysis, the forty sesame germplasm were grouped based on quantitative and qualitative traits as shown in **Figure 2.** There were ten clusters based on similarity of coefficients of forty germplasm. Critical assessment of clusters exposed that clusters were heterogeneous within and between each other based on major character relations. The only one germplasm consisting each of cluster I, VII and X is due to their specific characters. The two germplasm contain in cluster VI, VIII and IX. The three germplasm include in only cluster II. The five germplasm contain in cluster IV and eight germplasm in cluster III. Cluster V, the biggest group among clusters, includes the fifteen germplasm. The forty sesame germplasm were grouped by Pearson method using quantitative and qualitative traits. The only one germplasm, Hnan (Sixty Day), from Pahkokku was grouped in Cluster I. Cluster II comprises three germplasm, Kanshi(three Month), Yoe Sein (AhPhyu) and Ba Pan from Thar Si, Yin Mar Pin and Magway. Cluster III is formed only by the eight accession Kanshi, Sa Mon Net, Gwa Taya, Sin-Yadana 8 (Ah Phyu), Hnan Nyo, Sone Phyu, Phyu Ma, Raj 2 (Ah Phyu) and five of them were collected in Magway, two in Seed Bank, Department of Agricultural Research, Yezin and one in Wan Dwin. Cluster IV showed five germplasm, Boat Thet Yin, Hnan War, Magway Net (4/06), Zoat Kalay Ni and Moe Hnan collected from Magway.

In cluster V, fifteen germplasm were included Magway Ni (2/04), Magway Ni (1/04), Hnan Ni (25/160), Magway Phyu, Sin- Yadana 3, Magway 7/9, Shan Hnan, Shwe Ta Sote (Ah Phyu), Me Thela, TMV (4), Yoe Sein (Ni Nyo), Hnan Phyu, Mying Mu Hnan, Naung Cho Hnan and Zoat Kalay. Two germplasm mainly collected in Naung Cho and Shan state, three in DAR, Yezin and the others in Magway. In cluster VI, two germplasm were found, Chone Kyaw and Ah Ni Myo Chito collected from Magway. Cluster VII composed of one germplasm, Theit Pan Hnan Net from Magway. The two germplasm, Sin-Yadana 4 and Yamato were grouped in cluster VIII from collected from Magway and Japan. In cluster IX, two germplasm, Sin-Yadana 5 and Sin-Yadana 6 (Net) were found in Magway and DAR, Yezin. Cluster X is comprised of one germplasm, Hnan Net from Magway.

Predominance of qualitative traits for different clusters of forty sesame germplasm:-

Predominance of qualitative traits for different clusters of sesame germplasm was shown in **Table 4.** Cluster I was mainly characterized by lanceolate in leaf shape, opposite and basal branching type, early maturity, short stature, high primary, low number of capsules plant^{-1}, long capule length, low 1000 seed weight, low seed yield, predominantly white with pink shadding in flower color. Cluster II comprised accessions with lanceolate in leaf shape, and basal branching type, green with yellow cast in leaf colour, green with purple in petiole colour, one flower per leaf axil, white with pink shadding in flower colour, long capule length, low 1000 seed weight, low yield, to short plant height, low branching habit and early in maturity. Cluster III was primarily characterized by lanceolate in leaf shape, opposite and basal branching pattern, green colour in petiole, one flower per leaf axil, early maturity, short stature, low 1000 seed weight, medium seed yield, medium number of capsules plant-1 and width, flower with white deep purple shading. The five germplasm in cluster IV were characterized by lanceolate in leaf shape, opposite and basal branching, green leaf colour with green petiole, one flower in leaf axil, white colour in flower, medium maturity, medium plant height, more secondary branches, low capules, low capsule width and length,and medium seed yield.

The largest group of germplasm in cluster V were associated with lanceolate in leaf shape, opposite and basal branching, white flower with deep pink shadding, medium in maturity, high plant stature, high primary branches, higher number of capsules, short capsule size and high in yield potential. Cluster VI consisted accessions with lanceolate in leaf shape, mixed and basal branching, green leaf with yellowish cast, one flower in leaf axil, white flower with deep pink shadding, medium maturity, tall plant height, low number of branches plant-1, more capsule length, medium in seed yield.

Cluster VII was mainly characterized by anceolate in leaf shape, opposite and basal branching, green leaf with yellowish cast, one flower in leaf axil, white flower with pink shadding, medium maturity, shortplant stature, low number of primary branches plant-1and more secondary branches, more length and low width in capsule, low in seed yield. Germplasm in cluster VIII were associated with lanceolate in upper leaf shape and ovate in middle, non-branching stem, green leaf with yellow cast, more than flower in leaf axil, white flower with pink shading, late in maturity, high plant stature, low branches, more capsule width, high seed weight and cluster IX was primarily characterized by lanceolate in upper leaf shape and ovate in middle, opposite and basal branching pattern, green leaf colour with purple petiole, one flower per leaf axil, white flower, late in maturity, high plant stature, short capsule width and medium seed yield. Germplasm in cluster X were associated with lanceolate in leaf shape, opposite and basal branching, white flower with deep pink shadding, medium in maturity, medium plant stature, more primary branches, more number of capsules, low seed weight and medium in yield potential.

Means performance of different sesame clusters based on quantitative traits:-

Means performance of different sesame clusters based on quantitative traits was shown in **Table 5**. Cluster I was mainly characterized by early flowering and maturity, short stature, high branching habit, low number of capsules plant^{-1}, medium capsule length, low 1000 seed weight and low seed yield. Cluster II comprised accessions with early flowering and maturity, short plant height, medium branching habit, low number of capsules plant^{-1}, long capsule length, medium 1000 seed weight and low seed yield.

Cluster III was primarily characterized by early flowering and maturity, short plant height, medium branching habit, low number of capsules plant^{-1}, medium capsule length and width, low 1000 seed weight and low seed yield. The five germplasm in cluster IV were characterized by early flowering and maturity, medium plant height, medium primary and high secondary branching habit, low number of capsules plant^{-1}, short capsule width and length, high 1000 seed weight and low seed yield. The largest group of germplasm in cluster V was associated with early flowering, medium maturity, high plant stature, high primary and medium secondary branching habit, high number of capsules plant^{-1}, short capsule length and medium width, medium 1000 seed weight and high in yield potential. Cluster VI comprised accessions with medium flowering and early maturity, tall plant height, medium branching habit, low number of capsules plant^{-1}, high capsule length and medium width, medium 1000 seed weight and medium seed yield. Cluster VII was mainly characterized by early flowering, medium maturity, short plant stature, medium branching habit, low number of capsules plant^{-1}, high length and short width in capsule, medium 1000 seed weight and low seed yield.

Germplasm in cluster VIII were associated with late flowering and maturity, high plant stature, low branching habit, medium number of capsules plant^{-1}, medium length and short width in capsule, high 1000 seed weight and medium seed yield. Cluster IX was primarily characterized by late flowering and maturity, high plant stature, high branching habit, high number of capsules plant^{-1}, medium length and short width in capsule, medium 1000 seed weight and low seed yield. Germplasm in cluster X were associated with late flowering and maturity, medium plant height, high primary and low secondary branching habit, low number of capsules plant^{-1}, medium length and width in capsule, low 1000 seed weight and low seed yield potential.

Clustering of landraces was not associated with the geographical distribution instead accessions were mainly grouped due to their morphological differences. These results were agreed with investigations of Dixit and Swain (2000) and Gupta et al. (2001). This may be the movement of sesame genotypes from one area to another in compilation sites. A few ecological conditions could also direct the gene flow between populations from diverse geographical origins. Although sesame has been described as a self-pollinated plant, recent indication raises the option of natural out-crossing in sesame (Pathirana 1994; Baydar and Gurel 1999).

Conclusion:-

All germplasm showed wide range of variability for morphological and yield and yield components except plant growth type, stem shape and main stem colour. Number of primary branches plant^{-1}, number of capsules plant^{-1} and seed yield plant^{-1} showed high heritability along with high genetic advance. Therefore, progeny selection will be effective to improve these characters. Days to first flowering, days to 50% flowering, days to physiological maturity, plant height, capsule length, capsule width and 1000 seed weight showed high heritability with low genetic advance. These characters can be exploited through heterotic breeding. In correlation analysis, days to first flowering, days to 50% flowering, plant height, number of primary branches per plant, number of secondary branches per plant, number of capsules per plant and capsule length were found to be the main yield contributing traits in sesame production.

According to cluster analysis, ten clusters of germplasm from different regions were closely related and germplasm from the same region had different genetic background. Not only intraregional diversity but also interregional diversity could be a valuable source for sesame improvement. The diverse sesame germplasm could be candidates for potential breeding sources for production of climate-friendly sesame cultivars.

A lack of information about genetic diversity has been a barrier to improve sesame in Myanmar. The results of this study provided a better understanding of sesame populations in different ecological regions. Therefore, the wise use of results obtained in this study would facilitate the improvement of climate-friendly sesame varieties through breeding and the *in situ* and *ex situ* conservation of sesame genetic resources. Molecular markers should be tested to confirm this result.

Acknowledgements:-

This project was supported by funds from Department of Plant Breeding, Physiology and Ecology, Yezin Agricultural University, Myanmar. The author acknowledges Dr. Nang Hseng Hom, Pro-rector (Admin), Dr. Mie Mie Aung, Professor and Head, Dr. Tin Tin Khaing, Professor, Yezin Agricultural University for their valuable advices and supports, and final year students, Htain Linn Aung, Htoo Kyaw Kyaw, Khaing War Win Tint, Khaing War War Soe, and Thet Thet Nyein (Group IV, Plant Breeding Specialization, 2014 batch), for the managements of the experimental field.

Table 1:- Predominance of morphological characters for forty sesame germplasm:-

Character	Percentage of germplasm		
Seedling vigour	30% Low	37% Medium	33% High
Plant growth type	100% Indeterminate		
Stem shape	100% Square		
Stem branching	5% Main	10% Mixed	85% Opposite
Branching pattern	5% Nonbranching	95% Branching	
Main stem color	100% Green		
Leaf color	30% Green	70% Green with yellow cast	
Petiole color	3% Purple	30% Green with purple	67 % Green
Upper leaf shape	3% Linear	97% Lanceolate	
Middle leaf shape	47% Ovate	53% Lanceolate	
No. of flower per leaf axil	5% One	95% More than one	
Exterior corolla colour	18% White	58% White with pink shading	25% White with deep pink shading

Table 2:- Analysis of variance for quantitative characters in sesame:-

Character	Mean square			
	Genotype	Block	Error	CV(%)
Days to emergence	1.06**	0.64^{ns}	0.28	7.56
Days to first flowering	10.08**	0.11^{ns}	0.63	2.36
Days to 50% flowering	11.79**	0.45^{ns}	0.60	2.19
Days to maturity	28.10**	0.61^{ns}	1.56	1.48
Plant height	518.72**	64.51^{ns}	22.70	5.05
Primary branches plant^{-1}	2.80**	0.11^{ns}	0.19	15.54
Secondary branches plant^{-1}	2.76**	0.10^{ns}	0.07	17.43
Capsuleplant^{-1}	610.07**	2.44^{ns}	0.60	1.99
Capsule length	7.78**	0.05^{ns}	0.04	0.66
Capsule width	1.77**	0.01^{ns}	0.01	1.47
1000 seed weight	0.73**	0.01^{ns}	0.01	1.82
Seed yield plant^{-1}	21.33**	0.07^{ns}	0.11	5.61

" ** " Significant at 1% probability level, " ns " Non-significant

Table 3:-Correlation Coefficients between yield and yield component characters in sesame germplasm:-

Cha.	DTFF	DTFPF	DTPM	PH	PB	SB	NCPP	CL	CW	TSW	SYPP
DTE	-0.37*	-0.33*	-0.21	-0.18	-0.44**	-0.03	-0.27	0.17	0.12	0.26	-0.30
DTFF		0.91**	0.47**	0.78**	0.38*	0.20	0.70**	0.14	-0.09	-0.18	0.64**
DTFPF			0.58**	0.76**	0.41**	0.27	0.64**	0.07	-0.23	-0.27	0.48**
DTPM				0.40*	-0.07	-0.01	0.15	-0.04	-0.12	-0.07	0.01
PH					0.30	0.29	0.80**	0.19	-0.01	-0.15	0.66**
PB						0.61**	0.60**	0.13	-0.25	-0.42**	0.40**
SB							0.50**	0.15	-0.17	-0.12	0.40**
NCPP								0.35*	-0.08	-0.22	0.81**
CL									-0.05	-0.46**	0.32*
CW										0.17	0.08
TSW											-0.07

" ** and *" Significant at 1% and 5% probability level respectively

DTE= Days to emergence, DTFF=Days to first flowering, DTFPF=Days to 50% flowering, DTM=Days to maturity, PH=Plant height, PB=Number of primary branches plant^{-1}, SB= Number of secondary branches plant^{-1}, CPP= Number of capsule plant^{-1}, CL=Capsule length, CW=Capsule width, TSW=1000 seed weight, SYPP= Seed yield plant^{-1}

Table 4:-Predominance of qualitative traits for different clusters of sesame germplasm:-

	Cluster									
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**
SV	Medium	High	Medium	High	Medium	Medium	High	High	Low	Low
PGT	Indeter-minate	Indeter-minate	Indeter-minate	Indeter-minate	Indeter-minate	Indeter-minate	Indeter-minate	Indeter-minate	Indeter-minate	Indeter-minate
SS	Square	Square	Square	Square	Square	Square	Square	Square	Square	Square
SB	Opposite	Opposite	Opposite	Opposite	Opposite	Mixed	Opposite	No	Mixed	Opposite
BP	Basal	Basal	Basal	Basal	Basal	Basal	Basal	Non	Basal	Basal
ULS	Lanceolate	Lanceolate	Lanceolate	Lanceolate	Lanceolate	Lanceolae	Lanceolae	Lanceolae	Lanceolae	Lanceolae
MLS	Lanceolate	Lanceolate	Lanceolate	Lanceolate	Lanceolate	Lanceolate	Lanceolae	Ovate	Ovate	Ovate
MSC	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
LC	Green	Green with yellowish cast	Green	Green	Green	Green with yellowish cast	Green with yellowish cast	Green with yellowish cast	Green	Green
PC	Green	Green with purple	Green	Green	Green	Green	Green	Green	Green with purple	purple
FPLA	One	One	One	One	One	One	One	More than one	One	One
ECC	White with pink shadding	White with pink shadding	White with deep pink shadding	white	White with deep pink shadding	White with deep pink shadding	White with pink shadding	White with pink shadding	White with pink shadding	white

SV=Seedling vigour, PGT=Plant growth type, SS=Stem shape in cross section, SB=Stem branching, SB= Branching pattern, ULS=Upper leaf shape, MLS=Middle leaf shape MSC=Main stem colour, LC=Leaf colour, PC=Petiole colour, FPLA=Flower per leaf axil ECC=Exterior corolla colour

Table 5:-Means performance of different sesame clusters based on quantitative traits:-

	Cluster									
Character	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**
Days to emergence	7.0	8.0	6.5	7.5	7.0	7.5	9.0	8.0	6.5	6.5
Days to first flowering	31.5	32.0	31.0	31.0	33.0	34.0	32.5	36.5	36.0	37.0
Days to 50% flowering	35.0	33.0	32.0	32.5	35.5	35.5	36.0	38.0	39.5	38.5
Days to maturity	82.5	80.0	81.0	84.0	84.5	83.5	86.5	89.5	89.0	87.5
Plant height	84.2	86.9	86.9	91.8	103.0	103.5	83.5	106.3	113.3	96.5
Primary branches plant^{-1}	3.3	1.8	2.3	2.5	3.5	1.6	1.6	0.6	3.3	4.0
Secondary branches plant^{-1}	1.5	1.0	0.8	3.2	2.6	0.0	3.5	0.0	1.5	0.0
Capsule plant^{-1}	29.0	28.8	31.6	25.1	50.1	28.0	29.2	40.0	52.8	52.3
Capsule length	30.2	31.2	30.5	27.4	28.7	31.0	31.5	29.5	29.4	29.9
Capsule width	7.9	8.1	8.0	8.5	8.1	8.5	7.0	9.5	6.1	8.2
1000 seed weight,	1.4	2.7	1.4	3.3	2.5	2.4	2.3	3.1	2.0	1.6
Seed yield plant^{-1}	3.0	4.0	4.5	4.5	8.5	5.6	3.2	7.0	5.6	5.9

Table 6:-List of forty sesame germplasm, their original sources and remarks:-

No.	Germplasm	Source	Remark
1	Hnan (Sixty Day)	Pahkokku	LC
2	Kanshi(three Month)	Thasi	LC
3	Kanshi	Wundwin	LC
4	Yoe Sein (AhPhyu)	Yin Mar Pin	LC
5	Boat Thet Yin	Magway	LC
6	Hnan War	Magway	LC
7	Magway Ni (2/04)	Magway	LC
8	Magway Ni (1/04)	Magway	LC
9	Hnan Ni (25/160)	Magway	LC
10	Chone Kyaw	Magway	LC
11	Magway Phyu	Magway	LC
12	Magway Net (4/06)	Magway	LC
13	Ba Pan	Magway	LC
14	Theit Pan Hnan Net	Magway	RC
15	Sa Mon Net	Magway	LC
16	Sin-Yadana 3	Magway	RC
17	Sin-Yadana 4	Magway	RC
18	Sin-Yadana 5	Magway	RC
19	Magway 7/9	Magway	RC
20	Yamato	Seed Bank, DAR	BL
21	Shan Hnan	Shan	LC
22	Shwe Ta Sote (Ah Phyu)	Seed Bank, DAR	LC
23	Me Thela	Magway	LC
24	Gwa Taya	Magway	LC
25	Sin-Yadana 6 (Net)	Seed Bank, DAR	RL
26	TMV (4)	Seed Bank, DAR	BL
27	Sin-Yadana 8 (Ah Phyu)	Seed Bank, DAR	RC
28	Hnan Nyo	Magway	LC
29	Zoat Kalay Ni	Magway	LC
30	Ah Ni Myo Chito	Magway	LC
31	Yoe Sein (Ni Nyo)	Seed Bank, DAR	LC
32	Hnan Phyu	Magway	LC
33	Hnan Net	Magway	LC
34	Sone Phyu	Magway	LC
35	Mying Mu Hnan	Sagaing	LC
36	Phyu Ma	Magway	LC

37	Naung Cho Hnan	Naung Cho	LC
38	Raj 2 (Ah Phyu)	Seed Bank, DAR	BL
39	Moe Hnan	Magway	LC
40	Zoat Kalay	Magway	LC

LC =Local cultivar, BL = Breeding line, RC =Released cultivar,
DAR = Department of Agricultural Research, Myanmar

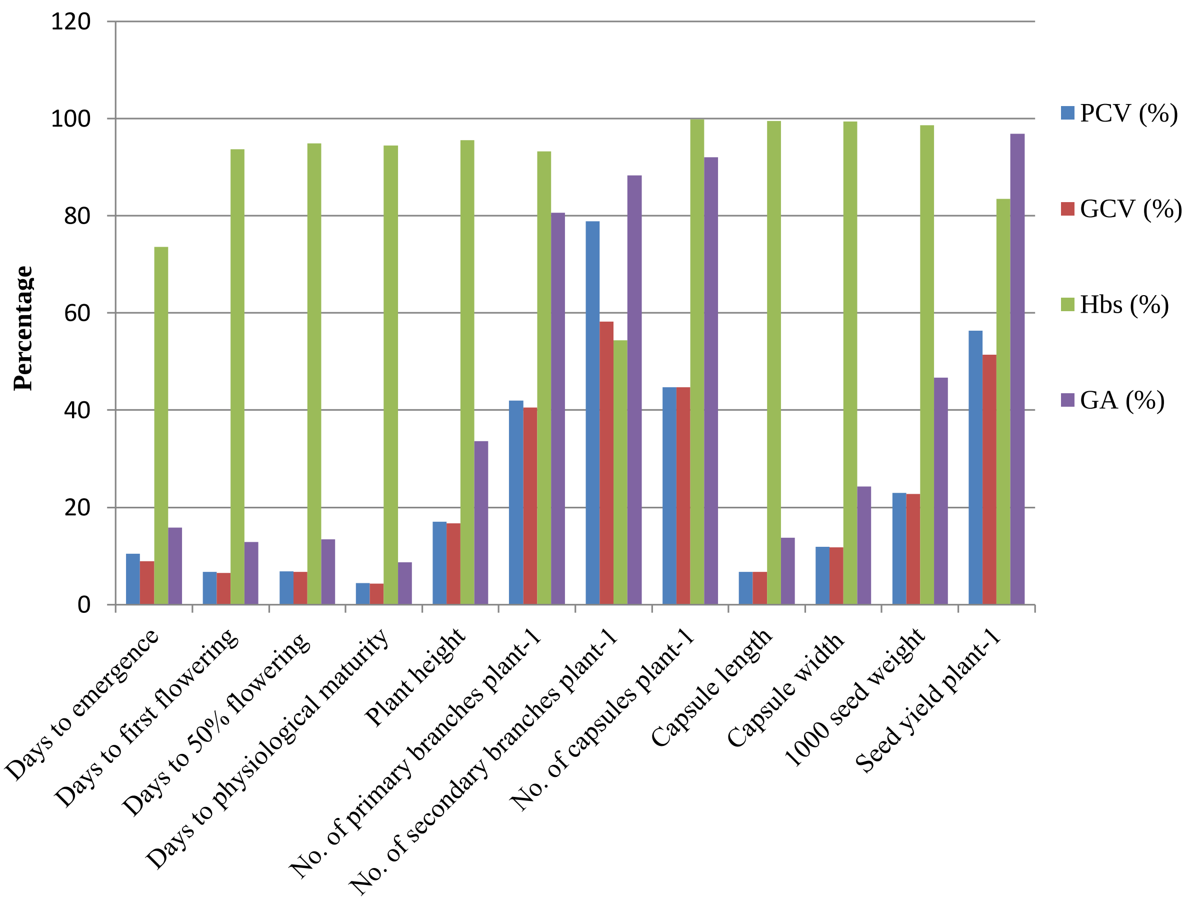

Figure 1:-Parameters estimation of variability for yield and yield components in sesame:-

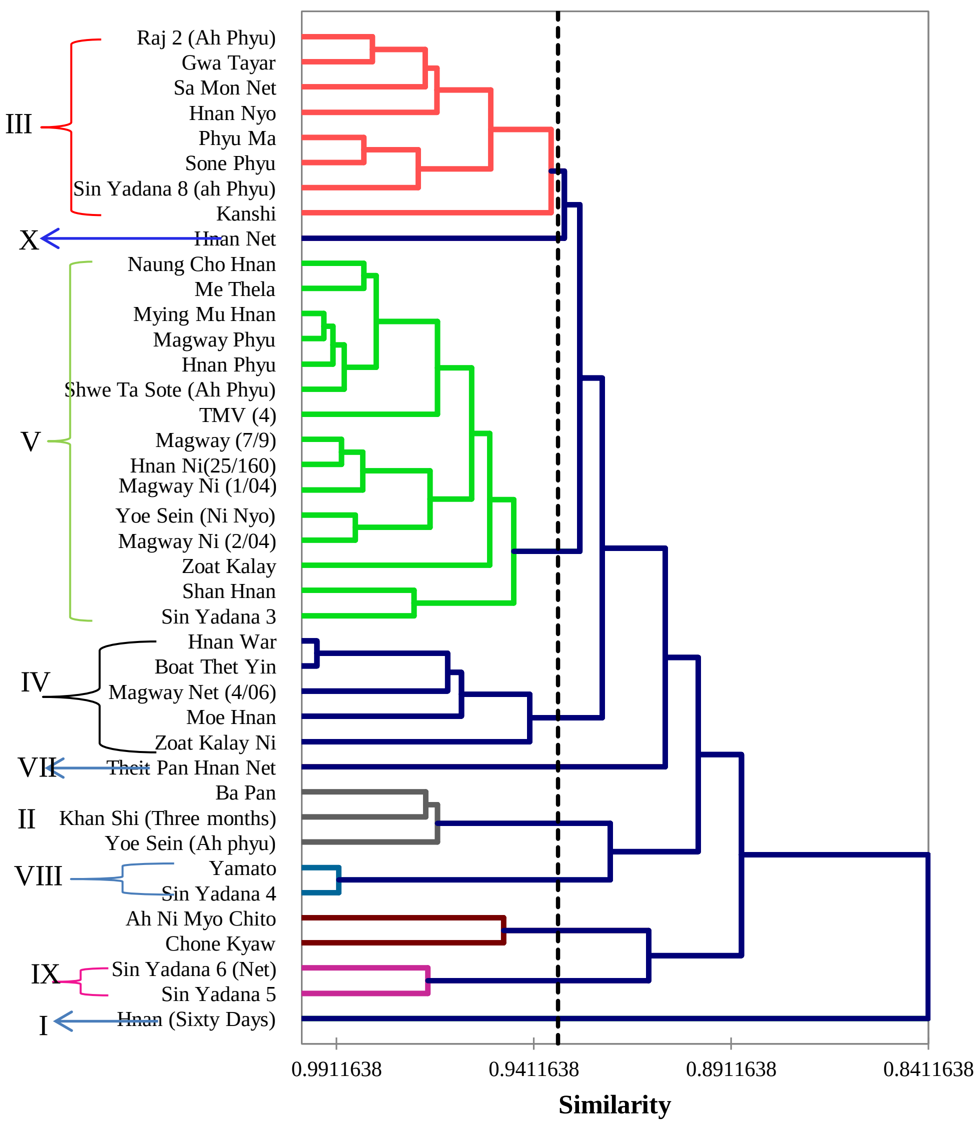

Figure 2:-Dendrogram based on quantative and qualitative characters of forty sesame germplasm:-

References:-

1. **Ali, M. A., S. Niaz, A. Abbas, W. Sabir and K. Jabran. 2009.** Genetic diversity and assessment of drought tolerant sorghum landraces based on morphophysiological traits at different growth stages. 2:214-227.
2. **Anitha, V. Y., K. Saravanan and J. Ganesan. 2000.** Studies on variability and genetic advance for certain characters in mutant populations of sesame (*Sesamum indicum* L.). *Sesame and Safflower Newsetter.* 15:39-43.
3. **Baydar, H. and F. Gurel. 1999.** The effects of honey bees on cross-pollination and hybrid seed production in sesame (*Sesamum indicum* L.). *Turkey Field Crops Journal*. 4:21-24.
4. **DAP (Department of Agricultural Planning). 2007.** Myanma Agriculture in Brief. Ministry of Agriculture and Irrigation, Nay Pyi Taw, Myanmar.
5. **Dixit, U. N. and D. Swain. 2000.** Genetic divergence and heterosis in sesame. *Indian Genetics Journal*. 60:213-219.
6. **Furat, S. and B. Uzun. 2010.** The use of agro-morphological characters for the assessment of genetic diversity in sesame (*Sesamum indicum* L). *Plant Omics. Journal.* 3:85-91.
7. **Gupta, R. R., B. M. S. Parihar and P. K. Gupta. 2001.** Genetic diversity for some metric characters in sesame (*Sesamum indicum* L.). *Crop Research.* 21:350-354.

8. **IPGRI (International Plant Genetic Resources Institute). 2004.** Descriptors for sesame (*Sesamum* spp.). International Plant Genetic Resources Institute, Rome, Italy and National Bureau of Plant Genetic Resources, New Delhi, India.
9. **Johnson, H. W., H. F. Robinson and R. E. Comstock. 1955.** Estimation of genetic and environmental variability in soybean. *Agronomy Journal*.
10. **Krishnaiah G, R. R. Reddy and M. R. Sekar. 2002.** Variability studies in sesame. *Crop Research*. 24: 3, 501-504
11. **Kumar, S. P. and P. Sundararajan. 2002.** Variability studies in the second generation of intervaterial crosses in sesame. *Sesame and Safflower Newsletter*. 17:36-40.
12. **Parameshwappa, K. N., M. B. Chetti and J. Shamrao. 2009.** Association between seed yield and yield attributing characters in sesamum (*Sesamum indicum* L.) *Agricultural Science Digest*. 22:18-20.
13. **Pathirana, R. 1994.** Natural cross-pollination in sesame (*Sesamum indicum* L.). *Plant Breeding Journal*. 12:167-170.
14. **Rao, G. S. V. S. 2005.** Genetic variability in sesame. *Sesame and Safflower Newsletter*. 19:20-24.
15. **Reddy, P. A. V., M. R. Sekar, A. R. G. Ranganatha and A. Dhanraj. 2001**. Genetic variability and herita-bility for seed yield and its components in sesame (*Sesamum indicum* L.). *Oilseeds Research Journal*. 18:173-175.
16. **Sahaa, S., T. Begumb and T. Dasguptaa. 2012.** Analysis of genotypic diversity in sesame based on morphological and agronomic traits. *Czech Genetics and Plant Breeding Journal*. 45:72-78.
17. **Sankar, D. and C. R. A. Kumar. 2003.** Combining ability and heterosis studies for yield and its components in sesame. *Sesame and Safflower Newsletter*. 16:9-12.
18. **Saravana, S. and N. Nadarajan. 2003.** Combining ability studies in sesame. *Sesame and Safflower Newsletter*. 18:1-6.
19. **Shadakshari, Y. G., K. Virupakshappa and G. Shivashankar. 1995.** Genetic variability studies in germplasm collection of sesame (*Sesamum indicum* L.). *Mysore Agricultural Research Journal*. 29:133-137.
20. **Singh, R.K. and V. D. Chaudhry.** 1985. Biometrical Methods in Quantitative Genetic Analysis. Klyani Publishers, New Delhi, India.
21. **Solanki, Z. S. and D. Gupta. 2003.** Inheritance studies for seed yield in sesame. *Sesame and Safflower Newsletter*.18:25-28.
22. **Sudhakar, N, Sridevi O and Salimath 2007.** Variability and character association analysis in sesame, *Sesamum indicum* L. *Oilseeds Research Journal*. 24:56-58.
23. **Sumathi, K. and S. Muralidharan. 2010.** Identifying some pulse cultivars based on key characters alone among popular varieties of Tamil Nadu. *Seed Technology Newsletter*. 32:146-148.
24. **Thangavel, P., K. Saravanan, P. Senthil Kumar, Y. Anbuslvan and J. Ganesan. 2000.** Variability, heritability and genetic advance in sesame (*Sesamum indicum* L). *Sesame and Safflower Newsletter*. 15:19-22.