International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(1): 1912-1915

Received: 14-11-2018
Accepted: 18-12-2018

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Assesment of genetic diversity in collected accession of aloe vera from Chhattisgarh using morphological characters

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Abstract
The present investigation was carried out to study the genetic variability, $h^{2,}$ genetic advance for 8 traits in aloe vera. The experimental materials comprised of 13 genotypes of aloe vera (*Aloe barbadensis*) were evaluated to study the PCV, GCV, GA% and diversity pattern. Wider variability as observed for plant height (cm), leaf length (cm), no. of spines per leaf, no. of leaves per plant, no. of suckers, gel content per leaf(g). The PCV value was slightly higher than the GCV showed the slight influence of environment in the expression of the Accession. High h^2 coupled with high genetic advance was recorded in plant height (cm), leaf length (cm), no. of spines per leaf, no. of suckers, gel content per leaf (g). Hence selection will be effective for these traits. The genotype was studies for the diversity and D^2 statistic was done and the Accessions were grouped into four cluster. The distributing pattern indicates that the maximum numbers of genotypes (5) were into cluster IV Followed by cluster II, cluster I and cluster III. The maximum inter cluster distance was observed in between I and IV (5.350) followed by cluster IV and III (3.569) these suggest that wider diversity among the group and hybridization programme involved parents from these cluster is expected to give higher frequency of better segregator, therefore Accession 1,2,3,12,13 can be used as potential donors for hybridization programme to develop variety with higher yield.

Keywords: aloe vera, accession, diversity, characters and cluster

Introduction
Aloe vera syn *barbadensis* Mill. of the family Liliaceae is a tropical plants easily grown on dry and hot climates (Reynold and Dweck, 1999) [11]. Aloe vera, generally known as "Ghrith Kumari" (in Hindi), has become neutralized almost all part in India (Klein and Penneys, 1988) [8]. *Aloe vera* is originally from Southern Africa and cultivation in elsewhere is the result of introduction (Akinyele and Odeyi, 2007) [1]. In India, it is found in Rajasthan, Andhra Pradesh, Gujarat, Maharashtra, Himachal Pradesh and Tamil Nadu. *Aloe vera* contains 75 potentially active constituents: vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids (Atherton, 1998) [2]. The plant was described to contain a large amount of phenolic compounds (Okamura *et al.*, 1996) [10], some of them were used as cathartic (Ishii *et al.*, 1990) [6]. It has been known and used for centuries due to its health, beauty, medicinal and skin care properties (Liu *et al.*, 2011) [9].

Genetic polymorphism in medicinal plants has been widely studied, which helps in distinguishing plants at inter and/or intraspecific level. It also plays important role in conservation which helps to preserve the genetic variation and evolutionary process in viable populations of ecologically and commercially viable varieties/genotypes in order to prevent potential extinction. Morphological, biochemical and molecular markers have been widely used for genetic diversity studies (Gonclaves *et al.*, 2009) [5].

Traditionally, diversity is estimated by measuring variation in phenotypic or qualitative traits such as growth habit, color of flower etc. Because of several defects there is a reduction in the ability of these morphological markers for the estimation of genetic diversity in plants, of which the main factor is its high dependence on the environment for expression, yet they can provide a base for genetic variation. On the other hand both biochemical and molecular markers avoid many of the environmental affects acting on characters by directly observing variation controlled by gene or by observing the genetic material. Molecular markers can give an effective tool for efficient selection of desired agronomic traits as compared to morphological and biochemical markers because they are based on the plant genotypes and also are independent of environmental variation, developmental stages and plant growth

(Franco *et al.*, 2001) [4]. The present investigation was carried out to know the genetic diversity based on morphological traits.

Materials and Methods

The plant materials for study were collected from different Districts of Chhattisgarh state and studied for genetic diversity by using their morphological traits. There was 13 Accession collected and planted in Herbal garden of IGKV, Raipur.

Table 1: Set-I List of germplasm Accessions collected from different district of C.G.

S. No.	District	Accessions	No. of Accessions
1	Bilaspur	Acc1	110
2	Ambikapur	Acc2	147
3	Raipur	Acc3	97
4	Baikunthpur	Acc4	10
5	Bhilai	Acc5	19
6	Kondagaon	Acc6	13
7	Raigarh	Acc7	5
8	Champa	Acc8	7
9	Dhamtari	Acc9	17
10	Jagdalpur	Acc10	8
11	Jashpur	Acc11	5
12	Raipur	Acc12	105
13	Raipur	Acc13	125

Morphological characters

The plants material for the study was collected from different location of CG. Were selected and investigated for Morphological characters such as plant height, leaf length, leaf width, leaf thickness, (all data were taken in cm) number of spines/plant, number of leaf/plant leaf gel weight (gm), were recorded in all aloe Accessions for comparative studies. The statistical analysis of quantitative data was done using Randomized Block Design (RBD).

Results and Discussion

Mean performance of genotype and analysis of variance:

The Average performances of the 13 aloe barbadensis genotype are shown in the table 1. Analysis of variance was worked out for high gel content and its attributing traits indicated that the mean sum of squares due to genotypes were highly significant for plant height (cm), leaf length (cm), leaf width (cm), Thickness of leaf (cm), no. of spine/plant, no. of leaf/plant, no. of suckers per plant and gel content per leaf (g). Significant mean sum of squares due to gel content (g) per leaf and attributing character revealed that existence of considerable variability in the material studied for the improvement of various traits and better chances of improvement through selection on the basis of their traits.

Table 1: Analysis of variance for different character of aloe vera

S. No.	Sources of Variation	Mean Sum of Squares		
		Replication	Genotype	Error
	Degree of freedom	2	12	24
1.	Plant height (cm)	92.026**	408.966**	25.248
2.	Leaf length (cm)	14.795**	225.979**	23.850
3.	Leaf width (cm)	0.182	2.374	0.421
4.	Thickness of leaf (cm)	0.005	0.055	0.011
5.	No. of spine/plant	26.564**	313.248**	10.453
6.	No. of leaf/plant	3.308	21.299**	3.197
7.	No. of suckers per plant	0.718	143.521**	2.162
8.	Gel content in per leaf(g)	1,474.956**	4,833.364**	408.295

Estimation of genetic variability

Genetic parameters of variation are presented in Table 2 for all the characters. The overall mean and range for gel content and its components revealed that there are suitable genetic variability present for most of the characters among the germplasm Accession under study. Genetic parameters of variation are discussed character wise.

Character mean and range

Plant height (cm)

The plant height (cm) ranged from 20 to 65 cm with an average plant height 46.43 cm. Among all Acc.-12(65cm.) was recorded as maximum and Acc-11(20cm) was recorded as the minimum plant height.

Leaf length (cm)

The leaf length ranged was recorded 16 to 53 cm, with an average Leaf length (cm) 34.48cm. Among all Acc.-12 was recorded longest in leaf length with (53cm.) and Acc-11 was recorded the short leaf length with 16 cm.

Leaf width (cm)

The leaf width ranged was recorded 4.0 to 7.9 cm. with an average Leaf width with 5.82cm. Among all acc.-12 was recorded longest in leaf width with (7.9cm.) and acc-11 was recorded the short leaf length with 4.0 cm.

Thickness of leaf (cm)

The Thickness of leaf (cm) ranged was recorded 0.2 to 0.8 cm, with an average Thickness of leaf (cm) 0.54 cm. Among all acc.-12 was recorded longest in leaf length with (0.8 cm.) and acc-11 was recorded the short leaf length with 0.2 cm.

No. of spine/plant

The No. of spine/plant ranged was recorded 12 to 56. with an average No. of spine/plant29.64. Among all acc.-12 was recorded maximum (56) No. of spine/plant and acc-11 was recorded the minimum with 12 No. of spine/plant.

No. of leaf/plant

The No. of leaf/plant ranged was recorded 6 to 18, with an average No. of leaf/plant 10.76. Among all acc.-13 was recorded maximum in No. of leaf/plant (18) and acc-11 was recorded the minimum No. of leaf/plant with 6.

No. of suckers per plant

The No. of suckers per plant ranged was recorded 02 to 32 with an average No. of suckers per plant 6.32. Among all acc.-12 was recorded maximum in No. of suckers per plant and Acc-11 was recorded the minimum No. of suckers per plant with.

Gel content/leaf (g)

The Gel content (g) ranged was recorded 15.1to 178.4 (g) with an average Gel content (g) 77.17 g. Among all acc.-1 was recorded maximum in gel content/leaf (g). And Acc-11 was recorded the minimum gel content per leaf (g) with 21.8 cm.

Genotypic and phenotypic coefficient of variation

Genotypic and phenotypic coefficient of variation is simple measures of variability these measures are commonly used for the assessment of variability. The related value of this type of coefficient gives an idea of magnitude of variability present in a population. Thus the component of variation such as

Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were computed. Categorized as low (less than 10%), moderate (10-20%) and high (More then 20%) as suggested by Sivasubramanian and Madhavamenon (1973).

In present Investigation the PCV value was slightly higher than GCV which showed that the trait was influenced by the environment. Among the different gel content per plant and its attributing traits, number of suckers per plant had highest magnitude of GCV (106.658) and PCV (109.078) followed by number of spines per plant (GCV 33.894) and (PCV 35.606) followed by plant height (cm) (GCV 24.355) and (PCV 26.651), followed by Leaf length (cm) (GCV 23.80) and (PCV 27.695), followed by Thickness of leaf (cm) (GCV 22.337) and (PCV 29.507) followed by No. of leaf/plant (GCV 22.810) and (PCV 28.212), followed by Gel content in (g) per leaf ((g) (GCV 49.767) and (PCV 56.235). The high moderate GCV and PCV were observed for leaf width (13.842 and 17.766%).

Heritability and Genetic advance as percentage of mean

Heritability estimates provide the information regarding the amount of transmissible genetic variation to total variation and determine genetic improvement and response to selection. Thus, heritability is the heritable portion of the phenotypic variance. It is a good index of the transformation of characters from parent to their off springs. Heritability and genetic advance are important selection parameters. Improvement in the mean genotypic value of selected plants over the parental population is known as genetic advance. It is the measure of genetic gain under selection. The success of genetic advance under selection depends on genetic variability, heritability and selection intensity.

In present investigation high magnitude of heritability was recorded for most of the traits. The highest variability was recorded for the traits *e.g.* plant height(cm) (83.515), leaf length (cm) (73.856),no. of spine/plant (90.615), no. of suckers/plant (95.112) and gel content /plant (g) (78.320). It indicated that these character is least influenced by the environment or therefore selection of such character will be rewarded.

Genetic advance is a measure of genetic gain under selection. The success of genetic advance under selection depends on heritability of the character under consideration. This indicates that though the character is less influenced by environmental effects, the selection for improvement of such trait may not be useful because, heritability is based on total genetic variance which includes fixable (additive) and non fixable (dominance and epistatic) variance. The magnitude of genetic advance as percent of mean was recorded high for all the traits. Only some traits observed moderate genetic advance plant height (21.291%), Leaf length (14.532%), Leaf width (1.295%), Thickness of leaf (0.189%), No. of spine/plant (19.701%). No. of leaf/plant (4.091%), suckers (13.827%), gel content (70.017%).

All the traits possessing high values of genetic advance indicate that the characters are governed by additive genes and selection will be rewarding for improvement of such trait.

High heritability coupled with high genetic advance as percentage of mean was found in the character gel content/plant (78.32 and 70.01). It indicates that heritability is due to additive gene effect or selection of such character may be effective. High heritability coupled with moderate genetic advance as percentage of mean was found in trait plant height (cm) (83.515 and 21.291) leaf length (73.856) and (14.532), No. of spine/plant (90.615) and (19.70), No. of suckers per plant (95.612) and (13.827). It showed that the character is govern by additive genes and selection will be rewarding for improvement of such trait.

This present study also suggests that, there is no relationship between geographical and genetic diversity as genotype chosen from different eco-geographical regions are grouped in different clusters. Cluster IV were the largest which consisted of 5 Accession, followed by cluster II, with 4 Accession followed by cluster I with 3 Accession and cluster III (1 genotype). From the clustering pattern, it was found that the genotype from different region were independent of their genetic region. Hence the genotypes studied are reliable enough for hybridization and selection.

The inter and intra cluster distance among the four cluster are presented in table 4 and fig 1. The maximum inter cluster distance was observed in between I and IV (5.350) followed by cluster IV and III (3.569). This suggested that the hybridization programme involving parents from these cluster is expected to give higher frequency of better segregates or desirable combination for development of useful genetic stocks or varieties. The minimum inter cluster distance was observed in between II and III (2.667) followed by cluster I and II (2.883).

The maximum intra cluster distance was observed in cluster IV (2.183) followed by cluster I (1.298), cluster II (1.5), cluster III (1.03).

Table 2: Estimation of genetic parameter for different trait in aloe vera.

S. No.	Character	Mean	Range		Standard Error	GCV (%)	PCV (%)	Heritability	Genetic Advance
			Min.	Max.					
I	Plant height (cm)	46.43	20	65	4.103	24.355	26.651	83.515	21.291
II	Leaf length(cm)	34.48	16	53	3.988	23.801	27.695	73.856	14.532
III	Leaf width (cm)	5.82	4.00	7.9	0.530	13.842	17.766	60.709	1.295
IV	Thickness of leaf(cm)	0.54	0.2	0.8	0.086	22.337	29.507	57.309	0.189
V	No. of spine/plant	29.64	12	56	2.640	33.894	35.606	90.615	19.701
VI	No. of leaf/plant	10.76	06	18	1.460	22.810	28.212	65.370	4.091
VII	No. of suckers	6.43	02	32	1.201	106.658	109.078	95.612	13.827
VIII	Gel content per plant(g)	77.17	15.1	178.4	16.498	49.767	56.235	78.320	70.017

Table 3: Genotype of aloe vera in different cluster

Cluster	No. of genotypes	Name of genotype
Cluster I	3	Acc 7,Acc10, Acc11
Cluster II	4	Acc 5, Acc 6, Acc8, Acc9
Cluster III	1	Acc 4
Cluster IV	5	Acc 1, Acc2, Acc3, Acc12, Acc 13

Table 4: Average intra –cluster among 4 cluster of aloe vera

Cluster	I	II	III	IV
I	1.298			
II	2.883	1.005		
III	2.940	2.667	1.03	
IV	5.350	2.941	3.567	2.183

Table 5: Mean performance of genotype in individual cluster for different trait.

Cluster	Character								
	Entries	Plant height(cm)	Leaf length(cm)	Leaf width(cm)	Thick of leaf (cm)	No. of spine/plant	No. of leaf/plant	No. of suckers	Gel content in (g) per plant
I	3	32.00	22.89	4.89	0.39	20.00	7.67	3.33	33.18
II	4	47.42	33.25	6.17	0.49	25.50	11.33	4.00	55.67
III	1	34.00	30.00	5.33	0.63	26.00	8.00	5.00	113.77
IV	5	56.80	43.33	6.22	0.66	39.47	12.73	10.53	113.45

Table 6: Desirable genotype based on cluster performance

Characters	Cluster			
	I	II	III	IV
Plant height (cm)	Acc10,	Acc5, Acc8, Acc9	Acc4	Acc1, Acc2
Leaf length(cm)	Acc7, Acc10	Acc5, Acc8, Acc9	Acc4	Acc1, Acc2, Acc3, Acc12, Acc13
Leaf width (cm)	Acc7, Acc10	Acc5, Acc8, Acc9	Acc4,	Acc1, Acc3
Thickness of leaf(cm)	Acc11	Acc5	Acc4	Acc2, Acc13
No. of spine/plant	Acc7	Acc8	Acc4	Acc2, Acc3, Acc12
No. of leaf/plant	Acc7, Acc10	Acc5, Acc8	Acc4	Acc1, Acc3
No. of suckers	-	Acc5	-	Acc12, Acc13
Gel content (g)/per plant	Acc7	Acc6	Acc4,	Acc1, Acc3

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