

Genetic diversity study in ivy gourd [*Coccinia grandis* (L.) Voigt.]

J Saikia*, DB Phookan, P Talukdar** and RN Sharma**

Received: October 2015 / Accepted: April 2016

Abstract

An experiment was conducted to study the genetic diversity in ivy gourd [*Coccinia grandis* (L.) Voigt.] genotypes collected from different parts of Assam and other North Eastern States (Arunachal Pradesh, Tripura and Nagaland) during the summer seasons of 2013 and 2014. Among the 6 clusters the intra-cluster distance varied from 0.00 to 3.48 and maximum inter-cluster distance was observed between cluster IV and cluster V (7.83). Cluster IV showed desirable values for number of primary branches (6.66), peduncle length (2.27 cm), fruit length (7.10 cm), number of fruits per plant (302.83), fruit weight (28.92 g) and yield per plant (7.55 kg). The most important characters contributing towards divergence were fruit weight (37.23% contribution) followed by number of fruits per plant (30.30%). D^2 analysis revealed that the pattern of distribution of genotypes from different locations into different cluster was random.

Keywords: Genetic diversity, cluster analysis, ivy gourd

Introduction

Ivy gourd, (*Coccinia grandis* (L.) Voigt) [Syn. *C. Indica* Wight and Arn., *C. cordifolia* (L.) Cong.] belongs to the family Cucurbitaceae, is an underexploited semi-perennial creeper vegetable. It is indigenous to India and its wild form is also found in many parts of India (Maurya, 2013). It helps to regulate blood sugar levels. Compounds in the plant inhibit the enzyme glucose-6-phosphatase, which is one of the key liver enzymes involved in regulating sugar metabolism (Shihib *et al.*, 1993). Use of Ivy gourd fruits in the treatment of jaundice has been reported (Wasantwisut and Viriyapanich, 2003). Ethanolic extract of fruits and leaves of Ivy gourd revealed the presence of saponins (Gawade and Rao, 2012). Diversity

of genes within species increases its ability to adapt to adverse environmental conditions. Study on genetic diversity helps in protection from duplication of genotypes and can identify diverse parents for hybridization programme. Mahalanobis D^2 statistic is a proven powerful tool in quantifying the degree of divergence between biological populations at the genotypic level and to access relative contribution of different components to the total divergence (Jatasra and Paroda, 1983).

Very little work has been done on the genetic improvement of ivy gourd. Availability of better cultivars can propel ivy gourd evolution from an underutilized species to an important horticultural crop in Indian Agriculture (Nag *et al.*, 2012). The North Eastern Region is considered to be the richest reservoir of genetic variability of large number of horticultural crops including ivy gourd (Yadav *et al.*, 2009).

Materials and Methods

The present experiment was conducted during the summer season of 2013 and 2014 in Randomized Block Design with three replications at the Experimental Farm, Department of Horticulture, AAU, Jorhat Assam. The experimental material comprised of 22 ivy gourd genotypes collected from farmers of different parts of Assam and other North Eastern states (Arunachal Pradesh, Nagaland and Tripura) including a variety from IIVR, Varanasi. Being dioecious in nature, to evaluate these 22 genotypes, a common male parent was also included as an experimental material. Out of total 25 initial collections, 3 genotypes i.e. IG-9, IG-21 and IG-24 were found to be bitter. Therefore, these genotypes were excluded. Stem cuttings (semi-hardwood) of 30 cm length and 1.5-2.0 cm thick were used for planting. The plant population included female and male plants at the ratio of 10:1. Planting was done on 25th February, 2013 at a spacing of 2m x 2m. All the recommended package of practices were followed. Observations were recorded on 5 randomly selected plants for eleven traits

Department of Horticulture, Assam Agricultural University, Jorhat -785013, Assam

* Corresponding authors E- mail : jsbaruah5@gmail.com

**Department of Plant Breeding & Genetics, Assam Agricultural University, Jorhat -785013, Assam

(Node number at which first female flower appeared, days to 50% flowering, days to 1st harvest, number of primary branches per plant, petiole length (cm), peduncle length (cm), fruit length (cm), number of fruits per plant, fruit weight (g), fruit width (cm) and yield per plant (kg)). To determine the genetic diversity, D^2 (Mahalanobis, 1936) statistics was used. The correlated unstandardized mean values for all the genotypes for 11 quantitative characters under consideration were transformed into the uncorrelated standardized value. Based on the correlated squares of generalized distance (D^2 values), the grouping of the genotypes into cluster was done by using Tocher's method (Rao, 1952). With the help of D^2 value between and within clusters, cluster diagram showing the relationship between different populations was drawn.

Results and Discussion

The genetic diversity among 22 genotypes was measured by employing D^2 statistic. Genotypes under study were grouped into 6 (six) different clusters (Table 1). Cluster V comprised the highest number of genotypes (6) followed by cluster I (5) and cluster III and IV (4), respectively. The cluster VI had only one genotype. The dendrogram representing 22 genotypes depicting the spatial position of each cluster in relation to others is presented in Fig.1. The clustering pattern of the genotypes under this study revealed that the genotype collected from the same or nearby location were grouped into different clusters. The result was in accordance with the findings of Ram (2001), Khan (2006) and Kabir *et al.* (2009) in pointed gourd. Genotypes collected from

Table 1. Clustering pattern of 22 genotypes of ivy gourd

Cluster	Number of genotypes	Genotypes and their source
I	5	IG-1 (Jorhat, Assam) IG-2 (Jorhat, Assam) IG-3 (Golaghat, Assam) IG-4 (Golaghat, Assam) IG-7 (Barpeta, Assam)
II	2	IG-5 (Nagaon,) IG-6 (Numaligarh)
III	4	IG-14 (Arunachal Pradesh) IG-15 (Nalbari) IG-20 (Sonitpur) IG-22 (Dhubri)
IV	4	IG-16 (Naojan) IG-17 (West Tripura) IG-18 (Gaurisagar) IG-19 (Tinsukia)
V	6	IG-10 (Kamrup) IG-11 (Biswanath Chariali) IG-12 (Nagaland) IG-13 (Biswanath Chariali) IG-23 (Jorhat) IG-25 (IIVR, Varanasi)
VI	1	IG-8 (Mangaldoi)

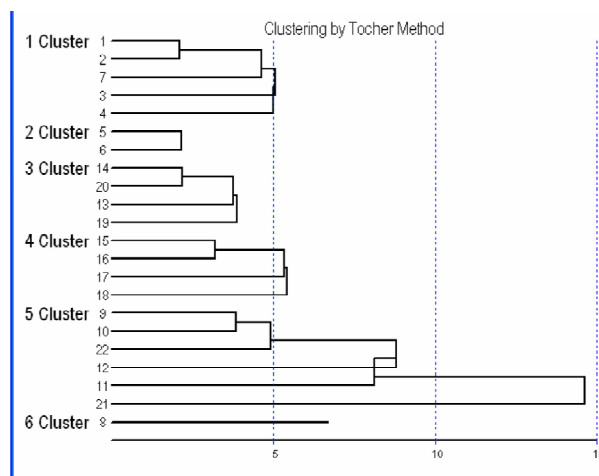


FIG 1. Dendrogram of 22 Genotypes of Ivy Gourd

different states grouped in the same cluster revealed that genotype distribution need not necessarily determine genetic divergence. Similar finding was also reported by Sanwal *et al.* (2008) in chow-chow.

The intra and inter-cluster distance (D^2 values) are presented in Table 2. Among the six clusters, the intra-cluster distance varied from 0.00 to 3.48. As the cluster VI contained only one genotype, the intra cluster distance was found to be 0.00. The maximum inter-cluster distance was observed between cluster IV and cluster V (7.83). The inter cluster proximity was seen to be minimum between cluster I and VI as indicated by lowest inter cluster distance of 3.40. The genotypes belonging to these clusters were relatively closer to each other in comparison to genotypes grouped in other clusters. The inter cluster distances were larger than the intra cluster distances suggesting wider genetic diversity among the genotypes at different groups. Presence of diversity among ivy gourd genotypes of the present study is in accordance with earlier reports of Kabir *et al.* (2009) in pointed gourd and Choudhary *et al.* (2011) in ridge gourd.

The cluster means in respect of 11 characters are presented in Table 3. The maximum number of primary branches was noticed in cluster IV (6.66) while minimum was observed in cluster V (4.91). The

Table 2. Intra (bold face) and inter-cluster distance among clusters in ivy gourd

Cluster	Cluster					
	I	II	III	IV	V	VI
I	2.48	3.71	3.62	4.54	4.93	3.40
II		1.47	4.79	4.18	6.75	4.03
III			2.20	6.27	4.62	5.11
IV				2.61	7.83	5.38
V					3.48	5.69
VI						0.00

Table 3. Cluster means for different economic traits in ivy gourd

Cluster	Cluster means of traits										
	Number of primary branches	Petiole length (cm)	Node number at which 1 st female flower appears	Days to 50% flowering	Days to 1 st fruit harvest	Peduncle length (cm)	Fruit length (cm)	Fruit width (cm)	Number of fruits per plant	Fruit weight (g)	Yield/plant (kg)
I	5.50	3.10	6.00	64.20	71.47	2.06	5.92	2.66	245.73	24.81	5.67
II	5.75	3.51	5.17	63.84	70.67	2.20	6.96	3.03	262.00	27.07	6.53
III	4.53	3.70	6.38	63.92	71.79	2.04	5.99	2.69	208.50	25.19	4.57
IV	6.66	3.19	6.54	65.08	72.58	2.27	7.10	2.71	302.83	28.92	7.55
V	4.91	3.57	6.50	63.89	71.22	1.99	5.09	2.54	225.06	18.76	4.00
VI	5.67	3.23	5.17	61.67	69.33	1.83	5.67	2.60	271.00	24.30	6.01
Overall mean	5.50	3.38	5.98	63.76	71.17	2.06	6.12	2.70	252.52	24.84	5.72

genotypes in cluster II and VI were the earliest as they recorded minimum values for node number at which first female flower appeared and days to 50% flowering. The cluster mean for number of fruits per plant ranged from 208.50 to 302.83, which were attained by group III and IV respectively. Regarding fruit weight, cluster IV had the highest mean value (28.92 g) followed by cluster II (27.07 g). Cluster IV showed desirable values for number of primary branches (6.66), peduncle length (2.27 cm), fruit length (7.10 cm), number of fruits per plant (302.83) and fruit weight (28.92 g). Fruit yield per plant, the most important economic character was also highest in cluster IV (7.55 kg) followed by cluster II (6.53 kg). So, it may be suggested that there is a vast scope to develop new varieties with more yield potential and other attributes of economic importance by using genotypes grouped under cluster IV. In the present study, the genotype namely IG-16, IG-17, IG-18 and IG-19 were grouped in cluster IV. The genotypes of the highly divergent clusters may be utilized in different crossing fashion for effective exploitation of heterosis (Rao *et al.*, 2003).

Contribution of different characters towards divergence is presented in Table 4. Out of 11 quantitative characters fruit weight was the main contributor towards divergence (37.23% contribution). This was followed

Table 4. Contribution of different characters towards divergence

Character	Times Ranked 1 st	Contribution (%)
1. Number of primary branches	1	0.43
2. Petiole length (cm)	11	4.76
3. Node number at which 1 st female flower appears	10	4.33
4. Days to 50% flowering	0	0.00
5. Days to 1 st fruit harvest	21	9.09
6. Peduncle length (cm)	15	6.49
7. Fruit length (cm)	9	3.90
8. Fruit width (cm)	8	3.46
9. Number of fruits per plant	70	30.30
10. Fruit weight (g)	86	37.23

by number of fruits per plant (30.30%), days to 1st fruit harvest (9.09%) and peduncle length (6.49%). Relatively, smaller contribution was made by number of primary branches (0.43%). The characters contributing more to the divergence are given greater emphasis for deciding on the cluster for the purpose of further selection. Similar observation was also reported in pointed gourd (Kabir *et al.*, 2009). Genetic diversity analysis helps to identify the genetically diverse genotypes for their use in breeding programmes. Various methods have been advocated by several workers, to estimate genetic divergence in crop plants (Hussain, 1973). Out of several methods available Mahalanobis's generalized distance estimated by D² statistic (Rao, 1952) is an unique tool for discriminating population considering a set of parameters together rather than inferring from indices based on morphological similarities and polygenic relationship.

In general, it was observed from the D² analysis that the pattern of distribution of genotypes from different locations into different clusters was random. The absence of relationship between genetic diversity and geographical distance indicates that factors other than geographical origin, such as exchange of genetic stocks, genetic drift, spontaneous variation, natural and artificial selection are responsible for genetic diversity.

सारांश

कुन्दरू में अनुवांशिक विविधता को ज्ञात करने के लिये असम तथा पूर्वोत्तर राज्यों (अरुणाचल प्रदेश, त्रिपुरा एवं नागालैण्ड) के विभिन्न क्षेत्रों से एकतित्र जननद्रव्यों का मूल्यांकन वर्ष 2013 एवं 2014 में किया गया। कुल 6 समूहों में इंट्रा-क्लस्टर दूरी 0.00 से 3.48 एवं अधिकतम इन्टर-क्लस्टर दूरी समूह-4 तथा समूह 5 (7.83) पाया गया। समूह-4 में वांछित मूल्य प्राथमिक शाखाओं की संख्या (6.66), डंठल की लम्बाई (2.27 सेन्टी मीटर), फल की लम्बाई (7.10 सेन्टी मीटर), फल/पौध (302.83), फल भार (28.92 ग्राम) तथा उपज प्रति पौध (7.55 किलोग्राम) रहा। सबसे महत्वपूर्ण गुणों के लिये विचलन योगदान फल भार (37.23 प्रतिशत योगदान) के लिए पाया गया, इसके बाद फल/पौध (30.33 प्रतिशत) रहा। डी वर्ग से स्पष्ट हुआ

कि विभिन्न स्थानों से प्राप्त जीनप्ररूपों का वितरण विभिन्न समूह में बेतरतीब रहा।

References

- Choudhary BR, Pandey S, Singh PK, Singh R (2011) Genetic divergence in hermaphrodite ridge gourd (*Luffa acutangula*). Veg. Sci. 38(1): 68-72.
- Gawade SP, Rao MVC (2012) Antitheatotoxic Activities of Ci Compound: b Sitosterol Isolated from fruits and leaves of *Coccinia indica*. Indian J Pharm Edu Res 46(1): 7-11.
- Hussain SH (1973) Multivariate analysis and group distribution in world collection of *Elusine coracana*. Gaertn. NCSI, Publication pp 81.
- Jatasra DS, Paroda RS (1983) Genetic divergence in wheat. Indian J Genet 43: 63-67.
- Kabir MY, Khan ASMMR, Hassain MSC (2009) Genetic divergence in pointed gourd. J Agric Rural Dev 7(1&2): 87-92.
- Khan ASMMR (2006) Study of genetic diversity and production technology of pointed gourd. Ph.D. Thesis, Bangladesh Agricultural Univ., Mymensingh, Bangladesh pp. 77-93.
- Mahalanobis PC (1936) On the generalized distance in statistics. Proc Nat Inst Sci Ind 2: 49-55.
- Maurya KR (2013) Farmer-friendly ivy gourd. Indian Hort 58(5): 14-15.
- Nag H, Singh D, Bahadur V, Collis JP (2012) Evaluation of ivy gourd (*Coccinia cordifolia* L.) genotypes in Allahabad agro-climatic condition. Hort Flora Res Spectrum 1(3): 259-262.
- Ram D (2001) Non-hierarchical Euclidean cluster analysis in pointed gourd. Indian J Hort 58(3): 264-268.
- Rao CR (1952) Advance Statistical Methods in Biometrical Research. John Wiley and Sons, New York, pp. 45-110.
- Rao ES, Verma VK, Munshi AD (2003) Breeding potential of cucumber (*Cucumis sativus* L.) genotypes using D² analysis. Indian J Hort 60(1): 53-58.
- Sanwal SK, Yadav RK, Singh PK, Rai N (2008) Variability and genetic diversity studies in indigenous chow-chow genotypes on North-East India. Indian J Hort 65: 167-170.
- Shibib BA, Khan LA, Rahman R (1993) Hypoglycaemic activity of *Coccinia indica* and *Momordica charantia* in diabetic rats: depression of the hepatic gluconeogenic enzymes glucose-6-phosphates and fructose-1, 6-bisphosphatase and elevation of both liver and red-cell shunt enzyme glucose-6-phosphate dehydrogenase. J Biochem 292: 267-270.
- Wasantwisut E, Viriyapanich T (2003) Ivy gourd in human nutrition and traditional applications, plants in human wealth and nutrition policy. 91: 60-67.
- Yadav RK, Deka BC, Sanwal SK (2009) Genetic resources of vegetable crops of North Eastern Himalayan Region, ENVIS Bulletin: Himalayan Ecology, 17