Variability Studies in some Perilla (*P. frutescens* L. Britton) Accessions of North-east India

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Abstract

Fifty *Perilla frutescens* (L.) Britton accessions, collected from different parts of north-eastern region of India including one exotic collection from Australia were evaluated to assess the genetic variability, heritability and genetic advance for thirteen morphological and yield traits. Significant genetic variation was observed for all the characters. Higher estimates of heritability coupled with high to moderate estimates of genetic advance as percentage of mean were observed for plant heights, number of leaves plant^{-1}, petiole length, number of primary branches plant^{-1}, length of main inflorescence, number of inflorescences plant^{-1} and leaf breadth, seed yield plant^{-1}, 1000-seed weight, showing the possibility of improvement of these traits through selection.

1. Introduction

Perilla frutescens (L.) Britton, a member of family Lamiaceae, is a self pollinated annual, bushy and aromatic herbaceous oilseed crop. According to Godin and Spensley (1971), the crop is a native of India and China. Although, the wild ancestral species of the cultivated Perilla species is unknown. Makino (1961) suggested that the crop probably originated in China because China is the main area of diversity of Perilla (Zeven and de Wet, 1982) and the history of cultivation of this crop is very old in China (Li, 1969). The species is distributed in the humid tropical, sub-temperate and temperate climates of the Himalayan region of India, Nepal, Southeast Asia, China, Korea, Japan and Taiwan within the altitude range of 300m to 3500m. In Korea, Perilla is the third most important oilseed crop in terms of acreage and production (Shin and Kim, 1994). On the other hand, in India, it is cultivated in an unorganised manner to a very limited scale in the north-eastern hill region, Kumaon, Garhwal and Himachal Pradesh. The local hilly people of this region grow Perilla in certain pockets under *jhum* (shifting) cultivation or in kitchen garden to use as condiments. In Nagaland, it is also used for dying cotton and medicinal. Improvement of existing germplasm is necessary under local condition in order to boost the production and productivity of this crop. Success of any breeding programme usually depends upon the quantum of genetic variability present in the breeding materials. Hence, an experiment was conducted to assess the extent of genetic variability, heritability and genetic advance as percentage of mean in fifty Perilla accessions collected from different parts of north-eastern India.

2. Materials and Methods

The materials for the present investigation comprised of fifty Perilla germplasm accessions collected from different parts of north-eastern region of India except one exotic collection from Australia (Table 1). The experiment was conducted during two consecutive years using an Randomised Block Design (RBD) with two replications. Seeds of all the fifty accessions were sown during *kharif* seasons of 2005 and 2006. A plot consisted of four rows of 2m length, spaced 50cm apart. Subsequently, the crop was thinned out to maintain a plant to plant distance of 20-25cm. Well rotten compost or FYM @ 5 MT ha^{-1} was applied one month before final land preparation. Inorganic fertilizers @ 40:40:20 kg ha^{-1} of N: P_2O_5: K_2O was also applied. Five randomly selected plants from each entry in each replication were tagged for recording observations on thirteen morphological and yield traits (Table 2a&b and Table

3a&b). The estimates of genotypic variance (σ_g^2), phenotypic variance (σ_p^2), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense ($h^2_{b.s.}$) and genetic advance (GA) as percentagea of mean were worked out following standard procedure (Singh and Choudhury, 1985).

3. Results and Discussion

Table 1: List of investigated *Perilla* genotypes along with their place of collection

Sl. No.	IC/EC No.	Place of collection	Sl. No.	IC/EC No.	Place of collection
1.	IC-006444	Tuensang, Nagaland	26.	IC-419475	Salumi, Kiphire, Nagaland
2.	IC-006447	Wokha, Nagaland	27.	IC-419701	Kiphire, Kiphire, Nagaland
3.	IC-006441	Khonoma, Kohima, Nagaland	28.	IC-419564	Pungro, Kiphire, Nagaland
4.	IC-003913	Tuikhuralu, Mizoram	29.	IC-419477	Salumi, Kiphire, Nagaland
5.	IC-211608	Tidding, Lohit, Arunachal Pradesh	30.	IC-419706	Chomi, Kiphire, Nagaland
6.	IC-003942	Kawnpui, Mizoram	31.	IC-521289	Wokha, Nagaland
7.	IC-006446	Phek, Nagaland	32.	IC-521290	Balek, Arunachal Pradesh
8.	IC-006440	Kiruphema, Kohima, Nagaland	33.	IC-204210	Lunglei, Mizoram
9.	IC-003865	Khawzawl, Saiha, Mizoram	34.	IC-521291	Tuensang, Nagaland
10.	IC-003908	Seling, Mizoram	35.	IC-521292	Chipiketo, Nagaland
11.	IC-006443	Chizami, Phek, Nagaland	36.	EC-216268	Australia
12.	IC-204185	Bomdila, West Kameng, Arunachal Pradesh	37.	IC-335408	Lawngthlai, Mizoram
13.	IC-006442	Phek, Nagaland	38.	IC-335402	Lunglei, Mizoram
14.	IC-003955	Kolasib, Mizoram	39.	IC-330441	Shanshak, Ukhrul, Manipur
15.	IC-012640	Kohima, Nagaland	40.	IC-330445	Shanshak, Ukhrul, Manipur
16.	IC-521282	Anutangree, Phek, Nagaland	41.	IC-334313	Disi village, West Siang, Arunachal Pradesh
17.	IC-521283	Mizoram	42.	IC-521293	Chipiketo, Nagaland
18.	IC-521284	Lephori, Phek, Nagaland	43.	IC-374609	Chaural, Saiha, Mizoram
19.	IC-521285	Mizoram	44.	IC-374590	Newlaty, Saiha, Mizoram
20.	IC-521286	Akhegowa, Phek, Nagaland	45.	IC-374494	Thlatlang, Saiha, Mizoram
21.	IC-521287	Meghalaya	46.	IC-374593	Newlaty, Saiha, Mizoram
22.	IC-521288	Mokokchung, Nagaland	47.	IC-374543	Zwangling, Chintuipui, Mizoram
23.	IC-416861	Mariyang, Upper Siang, Arunachal Pradesh	48.	IC-374513	Darzo, Lunglei, Mizoram
24.	IC-419606	Pungro, Kiphire, Nagaland	49.	IC-369352	Zote, Champhai, Mizoram
25.	IC-419598	Pungro, Kiphire, Nagaland	50.	IC-369349	Champhai, Mizoram

Table 2a: Mean data on thirteen morphological and yield traits for fifty genotypes of Perilla during 2005

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	IC-006444	148.50	249.33	173.83	11.24	9.35	5.10	19.67	188.17	8.22	198.00	1.44	26.87	421.74
2	IC-006447	156.00	251.00	263.84	12.39	10.77	6.90	21.67	166.49	7.60	202.00	1.45	26.00	369.28
3	IC-006441	161.50	219.17	153.34	11.60	9.24	5.83	16.00	144.85	8.02	201.00	1.65	24.08	425.32
4	IC-003913	160.00	267.17	160.17	12.00	9.39	5.97	20.67	132.15	7.05	203.00	1.42	31.50	496.37
5	IC-211608	148.50	283.33	95.67	11.35	9.07	5.83	21.34	149.35	7.99	196.50	1.77	16.96	372.36
6	IC-003942	157.00	224.67	93.17	12.83	11.05	6.64	15.75	131.69	7.94	202.00	1.45	17.79	264.46
7	IC-006446	167.00	261.00	167.17	12.62	10.38	6.00	19.67	132.32	10.95	207.00	1.68	13.73	218.49
8	IC-006440	162.00	188.17	96.50	11.98	11.12	6.98	14.67	135.32	8.92	202.00	1.46	17.00	223.00
9	IC-003865	153.50	204.34	94.50	11.54	8.20	6.87	17.00	127.69	9.55	198.50	1.49	10.46	133.99

Continue

10	IC-003908	156.00	215.17	108.50	10.62	8.80	5.72	18.83	153.84	8.77	197.50	1.08	15.01	208.96
11	IC-006443	160.00	184.17	91.00	10.09	7.70	4.79	16.83	145.82	8.30	197.50	1.39	20.68	232.46
12	IC-204185	159.50	205.67	103.00	12.03	10.03	5.73	16.17	143.32	7.92	200.50	1.67	26.22	280.92
13	IC-006442	161.00	249.84	89.67	13.95	11.84	7.75	19.17	155.34	8.07	197.50	1.22	16.36	228.15
14	IC-003955	153.50	244.33	84.83	11.69	9.49	6.42	20.92	164.85	8.20	197.00	1.52	16.53	304.20
15	IC-012640	158.50	212.67	162.83	11.45	10.58	6.54	19.83	170.82	7.62	204.00	1.38	14.94	288.86
16	IC-521282	155.00	186.67	91.00	10.45	8.80	5.64	16.92	148.15	8.53	198.00	1.26	16.40	217.44
17	IC-521283	166.50	194.83	100.50	10.58	8.62	4.70	17.17	141.02	7.68	200.50	1.40	26.46	323.99
18	IC-521284	162.50	203.17	90.17	10.55	8.42	5.15	16.17	136.75	7.34	202.50	1.27	18.67	279.98
19	IC-521285	162.50	213.00	123.34	11.65	10.20	6.00	21.84	148.17	9.69	197.50	1.53	23.29	220.96
20	IC-521286	164.00	231.84	73.50	11.57	9.22	5.82	16.50	158.67	8.04	201.50	1.45	22.18	237.47
21	IC-521287	168.00	240.00	120.84	10.83	9.47	5.54	16.84	133.34	9.29	208.50	1.69	19.00	277.65
22	IC-521288	159.50	229.50	101.17	11.27	9.08	5.15	18.00	168.17	8.72	201.00	1.27	19.91	280.06
23	IC-416861	166.00	178.50	167.17	11.99	8.90	4.49	20.33	159.00	7.34	210.50	1.23	20.13	259.58
24	IC-419606	172.50	197.50	129.33	10.80	8.95	6.37	16.50	146.00	7.50	208.50	1.42	18.10	242.43
25	IC-419598	170.00	251.00	125.50	11.40	9.80	5.62	16.75	160.69	9.22	204.50	1.65	21.50	227.33

A=Sl. No.; B=Accession No.; C=Days to 50% flowering; D=Plant height (cm); E=No. of leaves plant^{-1}; F=Leaf length (cm); G=Leaf breadth (cm); H=Petiole length (cm); I=No. of primary branches plant^{-1}; J=No. of inflorescences plant^{-1}; K=Length of main inflorescence (cm); L=Days to maturity; M=1000-seed weight (g); N=Seed yield plant^{-1}(g); O=Seed yield plot^{-1} (g);

Table 2b: Mean data on thirteen morphological and yield traits for fifty genotypes of Perilla during 2005

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
26	IC-419475	175.50	225.34	54.17	13.22	10.67	6.15	17.34	137.00	7.32	213.00	1.67	10.45	124.05
27	IC-419701	160.00	220.50	94.50	11.32	9.27	6.39	15.67	138.67	10.15	198.00	1.38	21.77	257.28
28	IC-419564	158.50	227.00	65.33	11.75	9.77	6.14	17.50	132.50	8.50	200.50	1.10	12.83	194.26
29	IC-419477	166.00	247.33	73.34	13.35	11.27	7.17	18.34	156.32	9.27	212.50	1.68	14.66	152.24
30	IC-419706	169.50	196.67	87.50	13.88	12.22	7.22	21.17	167.00	9.17	220.00	1.58	9.27	143.63
31	IC-521289	162.00	255.84	68.84	13.57	10.38	6.20	16.17	146.15	8.88	203.00	1.62	16.79	151.93
32	IC-521290	164.50	250.34	210.17	11.20	9.37	6.09	21.00	146.79	7.30	203.00	1.47	24.88	235.46
33	IC-204210	159.00	239.17	72.17	12.35	10.12	6.97	16.50	108.67	7.52	205.00	1.41	14.10	204.19
34	IC-521291	160.50	241.34	82.83	12.99	11.35	6.50	18.84	165.67	8.50	198.50	1.31	22.26	273.51
35	IC-521292	157.00	257.34	75.67	12.17	9.59	6.33	16.84	145.83	7.82	204.00	1.41	13.50	148.87
36	EC-216268	164.00	225.83	126.33	13.13	10.85	6.62	17.30	130.65	8.52	205.00	1.45	14.02	161.77
37	IC-335408	165.50	225.17	77.67	11.79	9.57	6.22	22.58	137.00	7.30	202.00	1.18	22.15	209.04
38	IC-335402	159.00	214.33	89.17	12.32	9.83	5.94	18.34	167.00	6.75	207.50	1.36	18.52	171.46
39	IC-330441	163.50	272.50	74.67	13.53	10.84	6.97	14.84	143.85	8.10	205.00	1.30	19.15	199.94
40	IC-330445	161.00	209.17	76.84	12.00	9.87	5.87	19.00	157.50	8.10	206.50	1.44	16.94	191.47
41	IC-334313	163.00	181.83	65.00	11.73	10.07	6.14	16.67	163.84	7.60	203.00	1.01	23.72	202.58
42	IC-521293	170.00	292.00	77.17	12.92	10.07	6.25	14.67	165.83	8.84	211.00	1.43	19.01	204.98
43	IC-374609	166.50	243.50	72.67	12.25	10.23	6.17	22.67	162.35	7.68	211.50	1.14	21.65	202.02
44	IC-374590	161.00	171.83	58.17	10.67	8.70	4.27	16.00	186.84	6.37	199.50	0.67	12.08	166.69
45	IC-374494	156.00	167.00	52.33	12.75	10.19	6.19	17.17	152.00	7.17	201.50	0.89	14.11	123.18
46	IC-374593	159.00	203.33	221.00	10.32	8.05	4.08	14.17	192.00	6.13	198.50	0.76	15.79	178.20

Continue

47	IC-374543	163.00	185.83	74.17	10.77	7.89	4.07	17.17	121.84	6.19	201.50	0.68	12.07	125.05
48	IC-374513	156.50	209.83	56.84	11.92	9.39	5.43	15.67	162.00	7.77	210.00	0.85	12.49	129.44
49	IC-369352	157.00	185.50	122.17	10.02	7.72	4.43	25.00	194.83	7.17	195.50	0.96	20.95	122.48
50	IC-369349	163.00	168.84	71.34	11.60	9.42	5.67	23.59	149.17	7.30	203.50	0.85	9.75	114.13
	Mean	161.39	222.07	105.21	11.84	9.70	5.94	18.19	151.46	8.08	203.12	1.34	18.25	228.46
	CD (p=0.05)	3.87	22.83	32.43	1.15	0.68	0.72	2.16	15.77	0.78	3.13	0.11	31.72	22.43

Table 3a: Mean data on thirteen morphological and yield traits for fifty genotypes of Perilla during 2006.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	IC-006444	152.00	221.34	161.00	11.10	9.23	5.09	23.34	191.67	8.82	192.50	1.35	26.52	411.90
2	IC-006447	158.50	223.67	263.50	11.85	9.74	6.89	21.83	172.67	7.52	198.00	1.35	27.64	394.46
3	IC-006441	159.50	206.50	157.00	11.34	9.67	5.72	17.34	135.00	7.77	200.50	1.66	22.56	420.25
4	IC-003913	159.50	248.50	170.50	11.12	9.15	6.03	23.50	142.17	6.67	201.50	1.38	30.01	482.68
5	IC-211608	148.50	258.34	103.50	11.35	9.28	5.85	22.84	162.50	8.00	194.50	1.64	19.63	347.77
6	IC-003942	159.00	207.17	92.00	10.59	10.52	6.64	18.42	147.84	7.23	200.00	1.45	21.76	285.65
7	IC-006446	168.50	250.00	181.50	13.00	10.37	6.00	22.50	147.34	10.27	205.00	1.64	15.41	233.80
8	IC-006440	162.00	191.00	103.00	11.17	10.92	6.41	19.00	146.84	8.43	200.50	1.47	18.49	239.52
9	IC-003865	157.50	203.17	90.75	11.50	8.33	6.58	20.34	136.17	9.17	197.00	1.71	10.65	144.18
10	IC-003908	159.00	191.83	117.50	10.42	9.07	5.45	20.50	167.17	8.12	196.50	1.09	19.28	230.85
11	IC-006443	160.00	185.50	111.00	9.87	7.95	4.76	18.50	152.17	7.95	195.50	1.41	21.45	251.13
12	IC-204185	161.50	209.50	109.00	11.84	9.90	5.56	19.50	144.67	7.97	199.00	1.67	30.02	276.58
13	IC-006442	161.00	238.84	92.50	13.34	11.58	7.48	21.17	161.34	8.17	194.50	1.19	17.80	253.43
14	IC-003955	155.50	224.84	93.50	10.88	9.43	6.44	22.92	169.34	8.10	196.00	1.51	14.34	274.25
15	IC-012640	156.50	194.84	162.00	10.37	9.99	6.44	22.17	170.00	7.44	202.00	1.41	17.11	294.45
16	IC-521282	153.50	180.00	88.00	10.15	8.82	5.72	19.09	157.34	8.17	196.50	1.28	17.12	212.80
17	IC-521283	164.00	191.17	107.50	10.17	9.17	4.69	19.67	139.34	7.00	201.00	1.40	25.24	302.17
18	IC-521284	160.00	192.83	95.00	10.25	8.72	5.15	17.50	145.00	7.37	198.50	1.26	20.64	284.19
19	IC-521285	158.50	199.00	125.50	11.59	10.48	5.89	23.17	154.50	9.05	195.50	1.54	25.09	214.90
20	IC-521286	160.00	204.50	82.50	10.69	9.03	5.76	18.67	162.00	7.72	199.00	1.44	21.80	237.30
21	IC-521287	166.00	215.34	130.67	10.25	9.09	5.63	20.00	140.00	9.00	206.00	1.73	20.33	280.95
22	IC-521288	157.50	202.67	107.33	11.29	8.95	5.21	21.00	167.84	8.60	197.00	1.13	22.37	269.81
23	IC-416861	166.00	177.67	163.34	11.97	8.82	4.49	21.50	161.67	7.00	208.00	1.17	19.33	260.40
24	IC-419606	168.00	202.17	128.17	10.15	8.55	6.31	19.67	154.34	7.47	206.50	1.43	17.11	243.53
25	IC-419598	167.50	241.50	125.00	11.30	9.70	5.51	17.92	169.00	9.14	204.00	1.63	20.91	228.10

A=Sl. No.; B=Accession No.; C=Days to 50% flowering; D=Plant height (cm); E=No. of leaves plant^{-1}; F=Leaf length (cm); G=Leaf breadth (cm); H=Petiole length (cm); I=No. of primary branches plant^{-1}; J=No. of inflorescences plant^{-1}; K=Length of main inflorescence (cm); L=Days to maturity; M=1000-seed weight (g); N=Seed yield plant^{-1} (g); O=Seed yield plot^{-1} (g);

The mean performance of all the accessions under investigation on thirteen morphological and yield traits are presented in Table 2 and Table 3, respectively for the years 2005 and 2006. Among the fifty accessions tested, IC-009313 recorded the highest seed yield plant^{-1} (30.75g), followed by IC-204185, IC-006447, IC-006444, IC-521283. Similarly, IC-369352 showed highest number of primary branches (26.33) and maximum number of inflorescences (203.00) plant^{-1} with earliest maturity duration, while IC-521287 recorded maximum 1000-seed weight (1.71g). The estimates of genotypic variance (σ_g^2), phenotypic variance (σ_p^2), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability in broad sense ($h^2_{b.s.}$) and genetic advance (GA) as percentage of mean for different characters are presented in Table 4 and

Table 3b: Mean data on thirteen morphological and yield traits for fifty genotypes of Perilla during 2006

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
26	IC-419475	171.50	207.34	60.50	13.50	11.00	6.14	19.84	143.67	7.88	210.00	1.59	11.54	138.89
27	IC-419701	157.50	202.00	101.50	10.92	9.05	6.41	18.34	153.00	9.14	194.50	1.36	24.48	261.03
28	IC-419564	155.50	200.00	71.00	11.27	9.50	6.25	19.84	143.67	8.00	198.50	1.10	12.72	184.91
29	IC-419477	165.00	226.50	80.67	12.97	10.78	7.03	23.00	166.17	8.85	207.50	1.66	15.08	153.08
30	IC-419706	169.00	183.50	98.50	13.67	12.34	6.86	24.00	179.84	8.29	216.50	1.49	12.06	165.25
31	IC-521289	159.00	234.34	77.67	13.57	10.80	5.96	18.50	150.00	8.49	199.00	1.61	20.79	174.96
32	IC-521290	161.50	220.17	205.00	10.79	9.63	6.15	21.00	139.50	7.04	201.50	1.42	21.03	226.37
33	IC-204210	159.00	222.67	77.84	12.02	10.10	6.60	19.33	118.00	7.29	202.50	1.48	16.05	221.30
34	IC-521291	162.00	218.00	83.17	13.07	11.55	6.37	20.50	166.00	8.19	195.00	1.38	18.14	252.64
35	IC-521292	158.00	217.34	80.33	12.20	9.90	6.03	20.00	155.17	8.00	200.50	1.43	14.16	151.09
36	EC-216268	158.00	205.50	131.67	12.67	10.45	6.63	18.70	153.17	8.69	202.00	1.42	15.01	173.45
37	IC-335408	162.00	201.67	78.84	11.32	9.06	6.15	24.25	146.67	7.70	198.00	1.18	21.61	212.32
38	IC-335402	156.50	186.67	103.83	11.00	9.47	5.85	21.00	172.50	6.75	202.00	1.30	22.12	192.84
39	IC-330441	161.50	246.00	80.83	13.17	11.13	6.63	16.84	152.50	7.69	202.50	1.20	21.00	207.69
40	IC-330445	159.00	194.17	87.67	11.83	10.22	5.74	22.00	168.50	7.94	203.00	1.52	20.84	205.50
41	IC-334313	159.00	166.84	69.50	10.17	9.50	6.14	18.67	175.00	7.07	198.50	1.02	25.69	207.90
42	IC-521293	167.50	286.84	85.34	12.82	10.02	6.31	17.34	170.00	9.27	205.00	1.48	20.63	217.07
43	IC-374609	163.00	232.50	75.34	12.67	10.30	6.16	25.17	176.00	8.04	206.00	1.16	25.19	216.18
44	IC-374590	157.50	174.34	64.34	11.33	9.39	4.28	18.00	197.00	6.42	193.50	0.64	13.53	181.72
45	IC-374494	152.50	167.33	55.67	11.09	9.79	6.21	18.67	163.84	7.50	195.00	0.98	15.82	139.50
46	IC-374593	157.00	188.00	233.50	10.42	8.69	4.05	16.17	199.00	6.09	194.00	0.74	18.11	189.65
47	IC-374543	158.50	187.50	86.84	10.74	8.32	4.26	18.00	129.84	6.42	196.00	0.68	13.52	141.23
48	IC-374513	152.00	201.67	65.17	11.08	9.27	5.38	18.17	168.00	7.95	207.00	0.95	13.77	138.05
49	IC-369352	156.50	176.00	120.34	9.17	7.85	4.36	27.67	211.17	6.84	192.00	0.84	24.74	148.06
50	IC-369349	159.00	168.00	87.67	11.19	9.39	5.56	25.09	154.17	6.95	198.50	0.81	11.06	126.88
	Mean	159.94	207.53	110.48	11.44	9.68	5.86	20.44	159.00	7.89	200.07	1.33	19.42	234.05
	CD (p=0.05)	4.58	14.87	18.08	1.02	0.76	0.33	1.96	12.45	0.64	2.82	0.89	4.92	33.40

Table 4: Estimation of variances and other related parameters for different characters during 2005

Characters	σ_g^2	σ_p^2	PCV	GCV	h^2_{bs}	GA as % of mean
Days to 50% flowering	28.28	31.98	3.50	3.30	88.44	6.38
Plant height (cm)	878.08	1007.00	14.29	13.34	87.20	25.67
No. of leaves plant^{-1}	1927.19	2187.33	44.45	41.73	88.11	80.68
Leaf length (cm)	0.83	1.16	9.09	7.70	71.78	13.44
Leaf breadth (cm)	1.02	1.13	10.96	10.39	90.02	20.31
Petiole length (cm)	0.63	0.76	14.67	13.38	83.15	25.13
No. primary branches plant^{-1}	5.83	6.98	14.53	13.28	83.55	25.01
No. of inflorescences plant^{-1}	291.02	352.51	12.40	11.26	82.56	21.08
Length of main inflorescence (cm)	0.88	1.02	12.50	11.59	85.98	22.13
Days to maturity	25.05	27.46	2.58	2.46	91.20	4.85

Continue

1000-seed weight (g)	0.07	0.08	20.78	20.36	96.01	41.11
Seed yield plant^{-1} (g)	23.16	27.59	28.78	26.37	83.94	49.77
Seed yield plot^{-1} (g)	6911.52	7160.25	37.04	36.39	96.52	73.65

Table 5: Estimation of variances and other related parameters for different characters during 2006

Characters	σ_g^2	σ_p^2	PCV	GCV	h^2_{bs}	GA as per cent of mean
Days to 50% flowering	19.77	24.95	3.12	2.78	79.25	5.10
Plant height (cm)	617.53	672.22	12.49	11.97	91.86	23.64
No. of leaves plant^{-1}	1883.40	1964.22	40.12	39.28	95.88	79.24
Leaf length (cm)	1.06	1.32	10.04	9.01	80.48	16.64
Leaf breadth (cm)	0.83	0.97	10.19	9.41	85.36	17.92
Petiole length (cm)	0.58	0.61	13.27	12.97	95.52	26.11
No. primary branches plant^{-1}	5.66	6.61	12.58	11.64	85.63	22.19
No. of inflorescences plant^{-1}	305.30	343.61	11.66	10.99	88.84	21.34
Length of main inflorescence (cm)	0.69	0.79	11.27	10.52	87.14	20.23
Days to maturity	24.22	26.19	2.56	2.46	92.48	4.87
1000-seed weight (g)	0.08	0.08	20.96	20.69	97.44	42.07
Seed yield plant^{-1} (g)	20.68	26.68	26.59	23.41	77.52	42.46
Seed yield plot^{-1} (g)	5801.02	6076.97	33.31	32.54	95.46	65.50

Table 5, respectively for the years 2005 and 2006. The analysis of variance revealed the presence of significant variation in the experimental materials for all the characters under study indicating the scope for exploiting these genotypes for increased yield. Similar results were also obtained by Verma et al. (2008), Sharma and Hore (1994), Minja et al. (2004), Nam et al. (2004), Lee et al. (2002), Pandey and Bhatt (2008).

In order to understand the genotypic variation and genotypic value of the materials under investigation, it is essential to estimate some genetic parameters like genotypic and phenotypic coefficient of variation, heritability and genetic advance. Environment plays an important role in the expression of quantitative characters and for this reason it is of utmost importance to partition the total variance into genotypic (heritable) and environmental (non-heritable) components.

The present study revealed that the contribution of genotypic variance to the total phenotypic variance was far greater in magnitude than that of environmental variance for all the characters. Relatively higher estimates of GCV and PCV were observed for 1000-seed weight, seed yield plant^{-1} and number of leaves plant^{-1} and medium estimates for leaf length, length of main inflorescence, number of inflorescences plant^{-1}, number of primary branches plant^{-1}, plant height and petiole length during both the years of experimentation. The results indicate the presence of substantial genetic variability for these traits and sufficient improvement could be achieved if selection is practiced based on these traits. High coefficient of variations was also obtained by Sharma and Hore (1994) for seed yield plant^{-1}, 500-seed weight and number of leaves plant^{-1} in Perilla.

To determine the relative amount of heritable portion of the total variance, the estimates of heritability in broad sense and genetic advance as percentage of mean were taken into account so that emphasis could be laid on highly heritable characters for further improvement of the population. The present study revealed high heritability coupled with higher estimates of genetic advance as percentage of mean for number of leaves plant^{-1}, 1000-seed weight and seed yield plant^{-1}. Plant height, petiole length, number of primary branches plant^{-1}, length of main inflorescence, number of inflorescences plant^{-1} and leaf breadth also showed high heritability, however, the estimates of genetic advance for these traits were found to be medium in magnitude. High heritability indicates greater correspondence between phenotypic and genotypic values. However, for effective selection, high heritability of a character should be accompanied by high genetic advance (Johnson et al., 1955); because such characters are mostly controlled by additive gene action as reported by Panse (1957). Thus, it could be inferred that simple selection based on phenotypic performance for these traits would be effective. On the other hand, relatively low estimates of heritability and genetic advance were observed for days to 50% flowering, days to maturity and leaf length during both the years of experimentation. These characters would be more sensitive to environmental changes and might be under the influence of complex inheritance. Assessment of these traits

needs well laid out experiments in different locations.

4. Conclusion

Variability analysis revealed highly significant difference among the genotypes for all the characters. The characters like 1000-seed weight, seed yield plant^{-1} and number of leaves plant^{-1} showed relatively higher estimates of GCV and PCV. High estimates of heritability coupled with high to moderate estimates of genetic advance as percentage of means were observed for number of leaves plant^{-1}, 1000-seed weight, yield plant^{-1}, plant height, number of primary branches plant^{-1}, length of main inflorescence and number of inflorescences plant^{-1}, showing possibility for improvement of these traits through selection. Among all the materials under investigation, IC-003913 recorded the highest seed yield plant^{-1} (30.75g), followed by some other accessions *viz.*, IC-204185, IC-006447, IC-006444, IC-521283. Thus, these accessions can be considered as promising ones and further testing in multi-location trials should be carried out for proper evaluation and subsequent release as variety.

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