

Evaluation of *Coleus forskohlii* Accessions for Tuber and Forskolin Yield

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Abstract

A replicated field evaluation trial was conducted involving 13 accessions of *Coleus forskohlii* Briq. (Lamiaceae), a forskolin yielding aromatic herb with fasciculate tuberous roots. Forskolin (diterpenoid) is used for treatment of glaucoma, cardiomyopathy and certain cancers. Significant differences were recorded for all the characters except dry mass of roots. Maximum tuber number per plant (12.0) was in IIHR-59. Accession IIHR-59 also produced highest fresh and dry mass of tubers (870 g and 88.75 g, respectively) per plant. The harvest index was maximum (45.1%) in IIHR-80. The forskolin content was estimated using HPLC and was found to vary from 0.025 per cent (IIHR-1) to 0.798 per cent (IIHR-12). Forskolin yield per plant was highest in IIHR-7 (85.00 mg). The accession IIHR-80 with medium tuber yield and higher forskolin content (0.715%) can be promoted for commercial cultivation as the crop is propagated through vegetative means.

INTRODUCTION

Coleus forskohlii Briq. (Lamiaceae), a tuber bearing, perennial aromatic, Indian herb is an exclusive source of 'forskolin' (labdane diterpene). Forskolin is used in the preparation of drugs against glaucoma, congestive cardiomyopathy and certain cancers (deSouza et al., 1986). Apart from their medicinal uses, the tubers are also used as a condiment and pickled. *C. forskohlii* cultivars grown in India and those collected from wild exhibit a wide diversity in exomorphic and yield characters (Bahl and Tyagi, 1989). The forskolin content in tubers from wild sources is variable and large scale indiscriminate collection of this plant from its natural habitat has contributed to its enlistment as an endangered species (Vishwakarma et al., 1988). Therefore, collection, conservation, and evaluation of available diversity are of utmost important before the valuable genetic diversity is completely lost. In the present study, an evaluation of tuberous collections was undertaken for their tuber and forskolin yielding characters.

MATERIALS AND METHODS

The plant materials for the present study consisted of thirteen accessions originally collected from diverse regions of India. The experiment was laid out in a completely randomised design with three replications. Polybag rooted terminal shoot cuttings were used for planting. A spacing of 1 m x 1 m was adopted to avoid interplant competition. The roots were harvested 150 days after planting. Two randomly selected plants per replication were used for recording observations. Data on yield was recorded and analysed statistically using analysis of variance technique (Table 1).

The forskolin estimation was carried out using HPLC technique as per the procedure described by Inamdar et al. (1984) with little modification.

Chromatographic system: Waters HPLC

Pump: Waters 575, binary gradient operated under isocratic conditions.

Detector: Waters 2487 dual absorbance detector.

Software: Millennium 32 chromatography software.

Chromatographic conditions:

(a) Mobile phase: HPLC acetonitrile grade: Millipore water (50 : 50)

- (b) Flow rate: 1.6 ml/min, 0.8 ml/pump
- (c) Detection wavelength: 220 nm
- (d) column used: FID Symmetry C18 column (4.6 mm x 250 mm)
- (e) Injection volume: 20 μ l

RESULTS AND DISCUSSION

Data recorded on yield and its component characters showed significant differences among accessions. The only the dry mass of roots per plant was the only non-significant result. The number of tubers per plant was significantly superior in accession IIHR-59 (12.0), whereas accession IIHR-75 had lowest number of roots (3.5) per plant. In case of length of tubers, maximum length was recorded in IIHR-80, whereas IIHR-75 had the lowest value. Fresh weight of tubers was significantly superior in IIHR-59 (870.0 g/plant). It produced more number of tubers per plant, which had directly contributed to increase the tuber yield per plant in this accession. Lowest root yield was in accession IIHR-16 (19.5 g). Wide variation in fresh root yield was also recorded by Hegde and Krishnan (1998), Shah and Kalakoti (1996) from their evaluation studies using different genotypes. In dry weight of tubers per plant, higher dry tuber yield was recorded in IIHR-59 and the lowest was in IIHR-59. The accession IIHR-59 yielded higher fresh weight of tubers per plant and higher value for dry tuber yield. Hegde and Krishnan (1998) established significant correlation between fresh and dry weights of roots in *C. forskohlii*. Under wider spacing of 120 x 120 cm, Hegde and Krishnan (1998) observed significantly superior value in accession K for dry tuber yield (114.5 g/plant). No significant yield variation was observed due to variation in spacing (Shah and Kalakoti, 1996). Therefore the variation in tuber yield under the present study is only due to genotypic effect.

The harvest index (HI) also showed significant differences among the accessions. The values ranged from 4.07 (IIHR-1) to 45.11 (IIHR-80) per cent. A high HI in a high dry matter producing genotype is an ideal combination which is rarely achieved. The accession IIHR-80 recorded intermediate yield potential with higher HI (45.11%) and could be an ideal parent for breeding programmes targeted at transferring this character to other genotypes. Nasyrov (1978) indicated that 50 per cent HI is an index of rational partition and utilisation of assimilates. In this respect, IIHR-80 seems to be unique by having nearly a 50 per cent HI value.

Results of forskolin estimation among different accessions revealed that content of forskolin and its yield differed significantly. Maximum value recorded was for IIHR-12 (0.798%). This is the maximum value for any accession reported so far. Vishwakarma et al. (1988) recorded variation in forskolin content of 0.01 to 0.44 per cent from among 38 genotypes studied. Maximum yield of forskolin per plant (mg) was recorded for IIHR-7 (85.00 mg). Although IIHR-12 recorded highest forskolin content (0.798%), because of its poor dry tuber yield, (45.83 g/plant), forskolin yield per plant was low. Accession IIHR-80 with moderate dry root yield and fairly higher forskolin content (0.715%) recorded higher forskolin yield per plant.

The present study has demonstrated the presence of wide variation for tuber and forskolin yielding characters. Accession IIHR-59 was found to be higher tuber yielding type and IIHR-80 demonstrated a higher harvest index. Therefore IIHR-80 holds promise as potential parent in crop improvement programme. Though IIHR-59 recorded higher dry tuber yield per plant, due to its poor forskolin content (0.049%), it cannot be promoted for commercial cultivation for production of raw material to user industries. However, as a compromising formula between two clients, the farmer and industry, accession IIHR-80 may be a strong candidate for commercial cultivation for its moderate tuber yield high forskolin content as well as forskolin yield per plant.

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Tables

Table 1. Yield characters in *Coleus forskohlii* accessions.

Sl. No.	Accession	No. of tubers /plant	Length of tubers /plant (cm)	Fresh wt. of tubers /plant (g)	Dry wt. of tubers /plant (g)	HI (%)	Forskolin	
							Content (%)	Yield (mg/pl.)
1.	IIHR-1	6.00	9.75	211.66	31.66	4.07	0.025	31.67 (2.78)
2.	IIHR-7	8.33	8.86	355.33	85.00	10.66	0.182	85.00 (12.41)
3.	IIHR-12	4.66	12.00	228.33	45.83	15.95	0.798	42.50 (19.05)
4.	IIHR-14	11.83	17.76	436.66	70.00	13.91	0.252	70.00 (13.03)
5.	IIHR-15	8.00	9.86	240.00	67.00	19.97	0.620	67.00 (17.86)
6.	IIHR-16	9.66	11.76	195.00	55.00	14.02	0.729	55.00 (19.25)
7.	IIHR-59	12.00	14.01	870.00	88.75	7.28	0.049	42.60 (6.61)
8.	IIHR-66	4.83	10.20	540.00	71.00	19.47	0.214	71.00 (12.25)
9.	IIHR-68	3.83	11.33	260.00	65.00	10.20	0.044	70.00 (5.87)
10.	IIHR-71	3.50	10.90	540.00	82.50	6.65	0.113	82.50 (9.65)
11.	IIHR-75	5.33	8.79	520.00	83.33	9.52	0.223	83.33 (13.61)
12.	IIHR-80	13.66	16.85	751.66	65.00	45.11	0.715	65.00 (20.86)
13.	IIHR-100	12.33	13.10	353.33	70.00	10.51	0.237	70.00 (12.80)
	Mean	7.99	11.94	366.33	67.70	17.08	-	67.83
	F- test	*	*	*	NS	*	-	*
	CD (5%)	2.37	1.43	58.97	-	9.46	-	6.16

* Significant $p = 0.05$; NS - non-significant
 Figures in parentheses are transformed values.