Research Article

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Evaluation of cowhage (*Mucuna pruriens* L.) genotypes for growth, yield and quality characters in arecanut plantation under hill zone of Karnataka

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Abstract

Cowhage (*Mucuna pruriens* L.) is leguminous medicinal plant grown in the tropics. Eight cowhage genotypes were used to study the performance of their growth, yield and quality characters in arecanut plantation under hill zone of Karnataka. Significant differences were recorded in genotypes with respect growth, yield and quality attributes. The genotype Arka Dhanvantari recorded the maximum vine length (282.03 cm) and number of trifoliate leaves (71.03) at harvest. Maximum number of bunches per plant (6.47), stem girth (0.93 cm), pods per bunch (4.00), number of bunches per plant (4.67) and pod yield per plant (136.38 g) was produced in genotype IIHR Selection-2. Genotype Arka Aswini exhibited maximum pod length (11.02 cm) and pod width (1.89 cm) over other genotypes. Maximum seed yield per plant (96.13 g), per plot (2.88 kg) and per hectare (3384.56 kg) was recorded in the genotype IIHR Selection-2. Genotype Arka Aswini exhibited maximum 100 seed weight (136.23 g). Maximum L-DOPA content (5.17 %) was recorded in genotype Arka Aswini which was followed by IIHR Selection-2 (4.69 %). The genotype IIHR Selection-2 recorded maximum L-DOPA yield (4.52 g plant^{-1}).

Keywords: Cowhage, genotypes, L-DOPA, *Mucuna pruriens,* quality and yield

Introduction

Cowhage (*Mucuna pruriens* L.) is an important annual twining herb climber, popular leguminous crop not only for its medicinal property but also grown as cover crop in tropical and subtropical areas of the world as it helps in nitrogen fixation. It belongs to the family 'Fabaceae', sub family Papilionaceae. It is commonly known as 'velvet bean', 'cowitch' and 'cowhedge' in English. Cowhage is not only cultivated in India but also grown as a commercial cover crop in rubber, arecanut and coconut plantations in Sri Lanka, Bangladesh, South East Asia and Malaysia. There are about 14 species spread over the foot hills of Himalayas, the plains of West Bengal, Madhya Pradesh, Karnataka, Kerala, Andhra Pradesh, Uttar Pradesh, Andaman and Nicobar Islands in India (Farooqi and Sreeramu, 2001).

Mucuna is known for medicinal properties as its all parts contains important active principles (Caius, 1989). The seeds of cowhage have attracted considerable attention since they are the source for the catecholic amino acid 3-(3, 4-dihydroxyphenyl)-L-alanine, also known as L-DOPA (Bell *et al*., 1971; Daxenbichler *et al*., 1972). L-DOPA, a neurotransmitter precursor, is used in the treatment of Parkinson's disease. No systematic information is available regarding the evaluation of available cowhage genotypes and released varieties for commercial cultivation as intercrop in arecanut plantations. Hence, this work was carried out to study the growth, yield and quality of different cowhage genotypes grown as an intercrop in arecanut plantations.

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Table 1. Different genotypes of *Mucuna pruriens* used for the present study

Sl. No.	Genotype	Colour of the seed	Source
1.	Arka Aswini	Black	ICAR-IIHR, Bengaluru
2.	Arka Dhanvantari	Black	ICAR-IIHR, Bengaluru
3.	IIHR Selection -2	White	ICAR-IIHR, Bengaluru
4.	IIHR Selection -3	White	ICAR-IIHR, Bengaluru
5.	IIHR Selection -8	Black with brown patches	ICAR-IIHR, Bengaluru
6.	IIHR Selection -10	White	ICAR-IIHR, Bengaluru
7.	Farmer Selection-1	Black with ash colour patches	Tarikere
8.	Farmer Selection-2	Black with brown blotches	KVK, Davangere

Material and methods

An experiment was designed to know the performance of cowhage (*Mucuna pruriens* L.) genotypes, grown as an intercrop in arecanut plantation under hilly zone of Karnataka State. The experiment was laid out in randomized complete block design (RCBD) with three replication and eight genotypes at College of Horticulture, Mudigere, during the year 2014-2015. Details of the genotypes used are provided in Table 1.

Each genotype was sown and maintained with spacing of 60 cm x 45 cm between row and plant, respectively. Seed sowing was taken up in the month of November 2014 and irrigation schedule and other cultural practices were followed as per the package of practices. Observations were recorded on five randomly tagged plants from each genotypes of each replication avoiding border plants. Observations were recorded and analyzed statistically for various growth and yield parameters such as number of pods bunch^{-1}, number of bunches plant^{-1}, pod length (cm), pod width (cm), pod yield (g plant^{-1}), seed yield (g plant^{-1}), seed yield (kg plot^{-1}), seed yield (kg ha^{-1}) and seed weight (g 100 seeds^{-1}) and quality parameters such as L-DOPA content (%) and L-DOPA yield (g plant^{-1}).

Determination of L-DOPA content in seeds

The harvested seeds of cowhage were used for the determination of L-DOPA content by Ultra High Performance Liquid Chromatography (UHPLC) at ICAR-IIHR, Bengaluru. L-DOPA was extracted with 0.1 M orthophosphoric acid and estimation was done with Ultra-High Performance Liquid Chromatography (UHPLC), using 5 µm Phenomenex C18 column, with sodium dihydrogen orthophosphate as mobile phase at pH 2.8. Retention time of sample was between 3.2-3.3 minutes. The percentage of L-DOPA was calculated by comparing the peak area of sample with peak area of the standard according to the formula given below:

$$\text{L - Dopa(\%)} = \frac{\text{Test area}}{\text{Standard area}} \text{ X } \frac{\text{Standard (L-Dopa) weight}}{\text{standard dilution}} \text{ X } \frac{\text{Test solution}}{\text{Test weight}} \text{ X } \frac{98.5}{100} \text{ X } 100$$

L-DOPA yield plant^{-1} was calculated by taking the L-DOPA content (%) and seed yield plant^{-1} (g).

Result and Discussion

Growth parameters

Significant difference was observed in genotypes with respect to growth parameters. Vine length varied significantly among the genotypes at various stages of crop growth like 40 DAS, flowering and harvest stage (Table 2). Genotype Arka Dhanvantari was found to be vigorous in its growth habit at harvest with respect to vine length (282.03 cm) and it was on par with genotypes IIHR Selection-2 (271.33 cm) and IIHR Selection-10 (264.40 cm), whereas, it was minimum in Farmer Selection-1 (227.67 cm) which was less vigorous in growth. The difference in the vine length was mainly due to duration of the crop and genetic factor of the respective genotype as well as influence of the growing environmental conditions. This result is in close conformity with the Vadivel and Janardhan (2000a) in *Mucuna pruriens* L.,

Table 2. Performance of cowhage (*Mucuna pruriens* L.) genotypes for vegetative parameters

Genotype	Vine length (cm)			Number of trifoliate leaves			Number of branches at flowering	Stem girth at harvest (cm)
	40 DAS	At flowering	At harvest	40 DAS	At flowering	At harvest		
T_1 - Arka Aswini	122.35	189.50	247.10	13.57	49.87	61.17	5.37	0.69
T_2 - Arka Dhanvantari	112.34	226.00	282.03	15.80	59.40	71.03	6.03	0.91
T_3 - IIHR Selection-2	102.24	217.53	271.33	14.53	55.60	68.63	6.47	0.93
T_4 - IIHR Selection-3	106.98	195.13	256.00	13.43	47.50	60.10	5.40	0.73
T_5 - IIHR Selection-8	95.15	194.67	249.13	13.87	48.60	60.70	5.50	0.74
T_6 - IIHR Selection-10	118.64	207.97	264.40	14.40	53.23	63.53	6.07	0.75
T_7 - Farmer Selection-1	85.32	179.87	227.67	12.30	45.73	56.70	4.53	0.61
T_8 - Farmer Selection-2	100.50	195.03	253.00	13.03	47.13	59.90	5.03	0.65
S. Em ±	**7.18**	**6.77**	**8.18**	**0.63**	**1.57**	**2.12**	**0.19**	**0.06**
CD @ 5%	**21.78**	**20.53**	**24.80**	**1.91**	**4.78**	**6.44**	**0.58**	**0.18**

DAS: Days after sowing

Sarada *et al*. (2005) in fenugreek and Das *et al*. (2014) in French bean for variability vine length.

Number of trifoliate leaves plant^{-1} was maximum (71.03) in genotype Arka Dhanvantari (Table 2). The increased number of leaves plant^{-1} recorded in Arka Dhanvantari might be due to increased vine length, number of branches plant^{-1}, number of root nodules plant^{-1} and long duration of the genotype. The minimum (56.70) number of trifoliate leaves plant^{-1} was recorded in Farmer Selection-1. The variation in these parameters are due to decreased vine length, number of branches plant^{-1} and less number of root nodules plant^{-1} resulting in reduced growth and poor leaf production. Similar results have been also reported by Pugalenthi and Vadivel (2007) in *Mucuna pruriens* L. and Mamatha *et al*. (2010) in *Mucuna utilis* L.

Yield parameters

The yield and yield parameters in cowhage genotypes found significant differences (Table 3). Number of pods bunch^{-1} was maximum (4.00) in the genotype IIHR Selection-2 which was on par with genotype IIHR Selection-10 (3.73) and Arka Dhanvantari (3.60), while the minimum (2.20) number of pods bunch^{-1} was recorded in genotype Farmer Selection-1. This difference may be due to the maximum inflorescence length, number of flowers inflorescence^{-1} and also higher assimilatory surface area due to the higher leaf area which in turn altered the canopy structure and might have lead to the stimulation of more number of pods bunch^{-1}. Similar variation for number of pods in different genotypes was reported by Pugalenthi and Vadivel (2007) in *Mucuna pruriens* L. and Singh and Kaur (2007) in fenugreek.

Number of bunches plant^{-1} was maximum (4.67) in the genotype IIHR Selection-2 and was on par with genotypes Arka Dhanvantari (4.33) and IIHR Selection-10 (4.20) followed by IIHR Selection-8 (3.93). This increase in number of bunches plant^{-1} may be attributed to the vigorous growth of plants which accumulate higher photosynthates in the plants. Similar variation for number of bunches plant^{-1} in different genotypes were reported by Mamatha *et al*. (2010) in *Mucuna utilis* L.

The genotype Arka Aswini recorded maximum pod length (11.02 cm) and pod width (1.89 cm). This may be attributed to their genetic makeup and the different agro-ecological regions from which they have been originated. Pandey *et al*. (2011) in French bean, Islam *et al*. (2010) in hyacinth bean and Subramanian *et al*. (2005) in fenugreek observed similar variations in pod length.

The maximum pod yield plant^{-1} (136.38 g) was recorded in the genotype IIHR Selection-2. It is clearly visible that existence of relationship between production of number of pods bunch^{-1} and number of bunches plant^{-1} might have increased the pod yield plant^{-1}. These results are in conformity with the results reported earlier in *Mucuna pruriens* L. (Gurumoorthi *et al*., 2003; Pugalenthi and Vadivel, 2007).

The genotype IIHR Selection-2 (96.13 g) recorded the higher seed yield plant^{-1} and it was on par with genotype IIHR Selection-10 (83.07 g) followed by Arka Dhanvantari (74.73 g). The increased seed yield plant^{-1} may be mainly due to the increased number of pods, pod length, pod width, leaf area plant^{-1} and also may be due to maximum nodulation capacity. The present results are in close conformity with the findings of Mamatha *et al*. (2010) in *Mucuna utilis* L. and Verma and Korla (2003) in fenugreek.

The seed yield plot^{-1} and hectare^{-1} was calculated in which significant difference among the

Table 3. Performance of cowhage (*Mucuna pruriens* L.) genotypes for yield parameters

Genotype	No. of pods bunch^{-1}	No. of bunches plant^{-1}	Pod length (cm)	Pod width (cm)	Pod yield (g plant^{-1})	Seed yield (g plant^{-1})	Seed yield (kg plot^{-1})	Seed yield (kg ha^{-1})	100 seed weight (g)
T_1 - Arka Aswini	2.67	3.67	11.02	1.89	80.13	58.77	1.76	2068.99	136.23
T_2 - Arka Dhanvantari	3.60	4.33	9.37	1.72	104.40	74.73	2.24	2631.13	88.05
T_3 - IIHR Selection-2	4.00	4.67	11.01	1.85	136.38	96.13	2.88	3384.56	101.59
T_4 - IIHR Selection-3	2.80	3.80	9.05	1.69	85.70	60.77	1.82	2139.41	89.14
T_5 - IIHR Selection-8	3.07	3.93	9.74	1.66	94.50	64.50	1.94	2270.85	112.74
T_6 - IIHR Selection-10	3.73	4.20	9.39	1.75	120.20	83.07	2.49	2924.53	117.05
T_7 - Farmer Selection-1	2.20	3.33	10.07	1.72	72.53	51.97	1.56	1829.45	119.85
T_8 - Farmer Selection-2	2.47	3.60	10.10	1.73	82.09	58.63	1.76	2064.30	122.90
S. Em ±	**0.17**	**0.16**	**0.29**	**0.05**	**5.41**	**4.35**	**0.13**	**153.20**	**4.82**
CD @ 5%	**0.51**	**0.47**	**0.88**	**0.14**	**16.41**	**13.20**	**0.40**	**464.70**	**14.61**

genotypes was recorded. Higher seed yield (2.88 kg) plot^{-1} and hectare^{-1} (3384.56 kg) was recorded in the genotype IIHR Selection-2, while minimum seed yield (1.56 kg) plot^{-1} and hectare^{-1} (1829.45 kg) was in the genotype Farmer Selection-1. This increase in the seed yield might be due to the maximum number of pods, number of bunches, pod length, pod width and number of seeds plant^{-1}. These findings are in agreement with the results reported by Das *et al*. (2014) in French bean.

The maximum weight of 100 seeds was recorded in Arka Aswini genotype (136.23 g) and was on par with genotype Farmer Selection-2 (122.90 g) which may be due to large size of the seed and maximum recovery. The minimum weight (88.05 g) of 100-seeds recorded in genotype Arka Dhanvantari could be attributed to the minimum number and weight of seeds. These results corroborate the findings of Gurumoorthi *et al*. (2003) and Mamatha *et al*. (2010) in *Mucuna pruriens* L.

Quality parameters

Significant differences were observed in genotypes with respect to quality parameters (Table 4). L-DOPA content was found to be maximum (5.17 %) in the genotype Arka Aswini followed by genotypes IIHR Selection-2 (4.69 %) and Arka Dhanvantari (4.51 %) while, the genotype Farmer Selection-2 had lowest L-DOPA content (3.68 %). This difference in L-DOPA content could be probably due to the variation in precursor compounds of L-DOPA present in the seeds and genetic factor of the individual genotype and environmental conditions. The similar results were also reported by Vadivel and Janardhan (2000b), Leelambika *et al*. (2010) and Mahesh and Sathyanarayana (2011) in *Mucuna pruriens* L.

The L-DOPA yield plant^{-1} was maximum in genotype IIHR Selection-2 (4.52 g plant^{-1}) followed by genotypes IIHR Selection-10 (3.54 g plant^{-1}) and Arka Dhanvantari (3.36 g plant^{-1}). This may be due to the maximum seed yield plant^{-1} and also L-DOPA (%) had resulted in an increase of L-DOPA yield plant^{-1}. Whereas, the lowest L-DOPA yield plant^{-1} was recorded in the genotype Farmer Selection-1 (1.94 g plant^{-1}). This might be due to the lowest seed yield plant^{-1} and L-DOPA (%). This variation in L-DOPA yield plant^{-1} is due to genotype character and environmental interactions. These findings are in close conformity with the results of Vadivel and Janardhan (2000a) and Archana and Renu (2011).

Table 4. Performance of cowhage (*Mucuna pruriens* L.) genotypes for quality parameters

Genotype	L-DOPA (%)	L-DOPA yield (g plant^{-1})
T_1 - Arka Aswini	5.17	3.03
T_2 - Arka Dhanvantari	4.51	3.36
T_3 - IIHR Selection-2	4.69	4.52
T_4 - IIHR Selection-3	4.23	2.58
T_5 - IIHR Selection-8	4.04	2.60
T_6 - IIHR Selection-10	4.25	3.54
T_7 - Farmer Selection-1	3.75	1.94
T_8 - Farmer Selection-2	3.68	2.15
S.Em ±	0.14	0.24
CD @ 5 %	0.41	0.71

Conclusion

The present research on identification of suitable genotypes of cowhage in arecanut plantation under hill zone of Karnataka revealed that the genotype IIHR Selection-2 performed better in terms of number of bunches plant^{-1}, number of pods bunch^{-1}, pod yield and seed yield attributes followed by genotypes IIHR Selection-10 and Arka Dhanvantari. The L-DOPA content (%) was found maximum in Arka Aswini while, highest L-DOPA yield plant^{-1} was obtained in IIHR Selection-2.

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