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Research Article

NUTRITIVE VALUE OF LEAVES IN DIFFERENT GENOTYPES OF CASTOR (*RICINUS COMMUNIS* L.)

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ABSTRACT
An attempt has been made to find out the nutrient status of castor genotypes raised under rainfed condition for their suitability to feed the eri silkworm to put forth optimum growth and development to realize higher cocoon and egg production. The castor genotypes differed significantly with regard to bio-chemical constituents of leaves. Leaf moisture was more with DCS-85 (71.15%) and less with 48-1 (63.45%), while Chlorophyll 'a', 'b' and total chlorophyll contents were highest in 48-1 (2.965, 1.156 and 4.115 mg/g). On the other hand, crude protein and total carbohydrates were more with Local genotype (34.56 and 53.61%) and less with GCH-4 (13.48 and 32.96%). The major foliar nutrient status of castor genotypes *viz*., nitrogen, phosphorus and potassium were more with Local (5.529, 0.396 and 4.002%), while these were less in GCH-4 (2.156%), DCH-177 (0.125%) and 48-1 (1.946%), respectively. Similarly, secondary nutrients *viz*., calcium and sulphur were higher with Local genotype (6.716 and 0.491%), while magnesium was more with DCH-177 (2.111%). However, GCH-4 recorded lower calcium (3.010%) and magnesium (1.375%), while sulphur was less with DCH-177 (0.109%).
Key words: Castor, *Ricinus communis*, Rainfed, Foliar nutrients, Eri silkworm.

INTRODUCTION
Castor (*Ricinus communis* L.) is one of the ancient oilseed crops of the world. India accounts for nearly 68 per cent of the world castor area and 76 per cent of world castor production and ranks first in both area and production in the world (Anonymous, 2003). Among different host plants, castor is the primary host plant of eri silkworm and castor also plays an important role in oilseed production in the country. The nutritive value / composition of leaves depends on the host plant variety and environmental conditions such as growing season, temperature, duration of sunshine hours and nature and type of soil, manures, fertilizers, soil moisture and method of leaf harvest, etc.

The quality of leaves provided to the worms for feeding has been considered as the prime factor influencing the production of good cocoon crop. It has been observed that growth, development and cocoon yield are influenced by the castor genotype and quality of leaves fed to the worms. Nutritional status of leaves has been considered as a major factor in the survival of non-mulberry silkworms (Pandey, 1995). Better the quality of leaves, greater would be the chances of getting the good cocoon harvest (Ravikumar, 1988). Castor is rich in varietal composition and many local and high yielding varieties / hybrids are widely grown in Assam and other parts of the country. The selection of castor genotypes is an important factor for better growth and development of eri silkworm for higher productivity in terms of cocoon yield. It has also been noticed that the silk ratio varies with the type of host and eri silkworm breed used for rearing (Dookia, 1980). In this back drop, the present study was and the results are reported in this paper.

MATERIALS AND METHODS
The castor varieties viz., 48-1, Kranti and Local – green non-powdery and hybrids viz., DCS-9, DCH-177, GCH-4, DCH-32 and DCS-85 were procured from the Directorate of Oilseeds Research, Rajendranagar, Hyderabad and University of Agricultural Sciences, Krishinagar, Dharwad. The seeds of

eight castor genotypes were sown during last week of June during 2005 and 2006 in the premises of the Department of Sericulture, UAS, GKVK, Bangalore which is located at a latitude of 12°58’ North, longitude of 77°35’ East and altitude of 930 meters above the mean sea level with spacing of 0.9m x 0.45 m with a plot size of 5.0 x 4.0 m and the crop was raised as per recommended package of practices under rainfed condition and the experiment was laid out in a randomized complete block design with three replications (Anonymous, 2000). The leaf samples at three different heights of the plant viz., top, middle and bottom, were collected in paper bags at 90 days after sowing and composite leaf samples were made. Leaves were shade dried for three days and then dried in hot air oven at 70^{o}C until constant weight was obtained. The dried leaf samples were ground into fine powder and preserved in butter paper bags for chemical analysis. Each sample had three replications. The foliar constituent’s viz., moisture and crude protein were estimated following the methods suggested in A.O.A.C. (1970). Chlorophyll ‘a’, ‘b’ and total chlorophyll were estimated as per the method of Hiscox and Israelstam (1979) and were computed using the standard formulae (Arnon, 1949). The total carbohydrate content of the leaf was estimated following the procedure of Dubios *et al*. (1956). Further, nitrogen, phosphorus, potassium, calcium, magnesium and sulphur were analyzed as per the procedure of Jackson (1973). The data showing values in the percentage were subjected to angular transformation (Snedecor and Cochran, 1979). The data was analyzed statistically as outlined by Sundararaj *et al*. (1972) at 5% level of significance.

RESULTS AND DISCUSSION

The data on the bio-chemical (leaf moisture, Chlorophyll, crude protein and total carbohydrates) and macronutrient (nitrogen, phosphorus, potassium, calcium, magnesium and sulphur) status of leaves of eight castor genotypes are provided in Tables 1 and 2 and are discussed in the light of earlier works in the following paragraphs.

Leaf Moisture

Leaf moisture content among the castor genotypes varied significantly with highest content being in DCS-85 (71.15%) along with DCH-32 (68.25%). The genotypes GCH-4 (65.96%), Local (64.96%), Kranti (64.91%), DCS-9 (64.16%) and DCH-177 (63.65%) were found next best with parity among them. However, least leaf moisture content was recorded in 48-1 genotype (63.45%). These results are in conformity with the observations of Kaleemurrhaman and Gowri (1982), Basaiah (1988), Sannappa and Jayaramaiah (2002), Govindan *et al.* (2003a and 2003b) and Chandrappa *et al*. (2005) who observed variations in moisture content of leaves among the castor genotypes. Variation in moisture content among different genotypes could be attributable for their inherent characters. The increase in leaf moisture content may also be due to the enhancement in hydrogen ion concentration of plant sap due to accumulation of chlorides and less moisture loss by evapo-transpiration with the castor genotypes (Eaton, 1942).

Chlorophyll

Marked differences existed among the leaves of castor genotypes in respect of chlorophyll contents *viz*., ‘a’, ‘b’ and total chlorophyll. Significantly higher chlorophyll contents were recorded with 48-1 genotype (2.965, 1.156 and 4.115 mg/g) and the same were less with DCS-9 (2.425, 0.692 and 3.115 mg/g). However, in the remaining genotypes the chlorophyll contents varied from 2.515 to 2.894 mg/g, 0.794 to 0.964 mg/g and 3.337 to 3.758 mg/g, respectively. Chandra *et al.* (2000) observed variation in chlorophyll ‘a’, ‘b’ and chlorophyll a/b ratio in leaves of host plants of eri silkworm. These results are in conformity with the observations of Sannappa and Jayaramaiah (2002) who recorded chlorophyll ‘a’, ‘b’ and total chlorophyll contents to be 1.226, 1.353 and 2.579 mg/g with Local castor genotype. Similarly, Chandrappa *et al*. (2005) recorded higher chlorophyll ‘a’, ‘b’ and total chlorophyll contents in 48-1 genotype (2.948, 1.251 and 4.234 mg/g) and these contents were lower with JI-226. In the presence of light, the silkworm synthesizes the red fluorescent protein from chlorophyll ‘a’ which has anti-viral property, thus reducing the incidence of viral diseases in eri silkworms.

Crude Protein

Crude protein content varied markedly among the leaves of different castor genotypes. Notably higher crude protein content was registered by Local genotype (34.56%) which was significantly superior over rest of the genotypes. The genotypes DCS-85 (28.76%), DCH-32 (27.50%), DCH-177 (24.46%) and Kranti (23.91%) were next in the order with former two and later two genotypes being on par with each other, nevertheless, GCH-4 genotype recorded lower crude protein content of 13.48 per cent. Similarly, Kaleemurrahaman and Gowri (1982), Basaiah (1988), Sannappa and Jayaramaiah (2002), Govindan *et al.* (2003a and 2003b) and Chandrappa *et al.* (2005) also recorded variation in crude protein content among castor genotypes raised under rainfed situation.

Total Carbohydrates

Significant variations were noticed for total carbohydrate content among the leaves of castor genotypes. Local genotype recorded highest carbohydrate content of 53.61 per cent. The genotypes DCS-85 (47.49%) and DCH-32 (45.16%), DCH-177 (44.60%) and Kranti (44.19%) were found next best with no statistical variations among themselves. The genotype GCH-4 recorded lowest carbohydrate content of 32.96 per cent. The present observations are in agreement with the findings of Kaleemurrahaman and Gowri (1982), Basaiah (1988), Sannappa and Jayaramaiah (2002) and Govindan *et al.* (2003a and 2003b) and Chandrappa *et al.* (2005) who too observed variation in the total carbohydrate content among the castor genotypes.

Nitrogen

Marked variations were noticed for nitrogen content among the leaves of different castor genotypes. Local genotype recorded significantly highest nitrogen content of 5.529 per cent. Further, DCS-85 (4.601%) and DCH-32 (4.400%); DCH-177 (3.914%) and Kranti (3.826%) were found next best with negligible variations between them. However, 48-1 recorded the least nitrogen content (2.221%).

Phosphorus

Notable difference existed in foliar phosphorus among the castor genotypes with significantly highest content in Local (0.396%). The genotypes GCH-4 (0.225%), DCS-85 (0.211%), DCH-32 (0.191), DCS-9 (0.144%) and Kranti (0.134%) were next in rank with vivid differences among them. DCH-177 registered the least content of phosphorus (0.125%) and was on par with 48-1 (0.130%).

Potassium

Potassium content varied significantly among leaves of selected castor genotypes with more being in Local genotype (4.002%) followed by GCH-4 (3.400%), DCS-85 (2.715%), DCS-9 (2.560%), DCH-32 (2.265%), DCH-177 (2.170%) and Kranti (2.165%) with the later three genotypes being similar. However, potassium content was less with 48-1 genotype (1.946%).

Further, EL-Shaarawy *et al.* (1975a) recorded higher nitrogen, phosphorus and potassium contents with bloomy red variety of castor than the bloomy green variety confirming that these contents varied with varieties of castor. Similarly, Sannappa and Jayaramaiah (1999), Govindan *et al.* (2002) and Chandrappa *et al*. (2006) also noticed variation in the macro nutrient status of leaves among different castor genotypes and this may be attributable to inherent characters of castor genotypes.

Calcium

Considerable variations were observed in calcium content among the leaves of different castor genotypes. It was highest in Local genotype (6.716%) followed by DCS-85 (6.252%). Kranti (5.785%) and DCH-177 (5.761%); DCS-9 (4.110%), 48-1 (4.100%) and DCH-32 genotypes (3.916%) were found similar. On the other hand, GCH-4 genotype recorded lowest leaf calcium content of 3.010 per cent.

Magnesium

Magnesium content differed significantly among the leaves of selected castor genotypes with highest being in DCH-177 (2.111%) closely followed by Kranti (2.105%), DCH-32 (1.816%), 48-1 (1.726%), DCS-9 (1.560%) and DCS-85 (1.516%). Local genotype recorded lowest magnesium content of 0.826 per cent.

Sulphur

In respect of sulphur content, variation was found among leaves of different castor genotypes. Local genotype registered highest sulphur content of 0.491 per cent. The genotypes DCS-85 (0.166%), DCH-32 (0.160%) and 48-1 (0.145%) were found next best with parity among them. Similarly, GCH-4 (0.129%), DCS-9 (0.117%) and Kranti (0.110%) showed no statistical variation among them with the later being the least in respect of sulphur content. These results are in concurrence with those of Kaleemurrahaman and Gowri (1982), Sannappa and Jayaramaiah (1999) and Govindan *et al.* (2002) who found marked variations in the secondary nutrient status of leaves in different castor genotypes. The analysis of leaves of castor genotypes for nutritive status has revealed considerable variation. The variability in the foliar constituents of castor genotypes observed could also be attributed to the native status and the nutrient management practices adopted during cultivation. Thus the foliar contents of major and secondary nutrients may vary from region to region and also season to season. The variation in nutrients could be one of the attributable reasons for variability in the suitability of castor genotypes as food for eri worms. Hence, these indices may help to decide the selection of quality leaves suitable for different ages of eri silkworms so as to harvest higher cocoon yield and obtain profitable returns by rearers.

Table 1: Bio-chemical constituents of leaves as Influence by selected castor genotypes

Genotypes	Leaf Moisture (%)	Chlorophyll (mg/g)			Crude Protein (%)	Total Carbohydrates (%)
		'a'	'b'	Total		
1. DCS-9	64.16 (53.23)	2.425	0.692	3.115	17.19 (24.49)	38.71 (38.47)
2. 48-1	63.45 (52.81)	2.965	1.156	4.115	13.88 (21.87)	34.63 (36.04)
3. Kranti	64.91 (53.69)	2.515	0.826	3.337	23.91 (29.23)	44.19 (41.66)
4. DCH-177	63.65 (52.93)	2.894	0.867	3.758	24.46 (29.63)	44.60 (41.90)
5. GCH-4	65.96 (54.43)	2.700	0.926	3.624	13.48 (21.53)	32.96 (35.42)
6. DCH-32	68.25 (55.71)	2.846	0.794	3.670	27.50 (31.62)	45.16 (42.22)
7. DCS-85	71.15 (57.52)	2.612	0.964	3.570	28.76 (32.42)	47.49 (43.56)
8. Local	64.96 (53.71)	2.765	0.799	3.548	34.56 (36.00)	53.61 (47.07)
F-test	*	*	*	*	*	*
S. Em ±	0.891	0.112	0.050	0.155	0.795	0.793
C. D. at 5%	2.672	0.336	0.151	0.465	2.385	2.378

Figures in the parentheses are angular transformed values

Table 2: Major and secondary nutrient status of leaves of selected castor genotypes

Genotypes	Major Nutrients			Secondary Nutrients		
	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Calcium (%)	Magnesium (%)	Sulphur (%)
1. DCS-9	2.750 (9.534)	0.144 (2.143)	2.560 (9.198)	4.110 (11.68)	1.560 (7.158)	0.117 (1.929)
2. 48-1	2.221 (8.562)	0.130 (2.039)	1.946 (8.003)	4.100 (11.60)	1.726 (7.524)	0.145 (2.168)
3. Kranti	3.826 (11.27)	0.134 (2.066)	2.165 (8.457)	5.785 (13.47)	2.105 (8.338)	0.110 (1.871)
4.DCH-177	3.914 (11.40)	0.125 (2.012)	2.170 (8.464)	5.761 (13.88)	2.111 (8.352)	0.109 (1.842)
5. GCH-4	2.156 (8.435)	0.225 (2.709)	3.400 (10.62)	3.010 (9.990)	1.375 (6.721)	0.129 (1.984)
6. DCH-32	4.400 (12.10)	0.191 (2.476)	2.265 (8.646)	3.916 (11.40)	1.816 (7.730)	0.160 (2.267)
7. DCS-85	4.601 (12.38)	0.211 (2.627)	2.715 (9.481)	6.252 (14.48)	1.516 (7.059)	0.166 (2.190)
8. Local	5.529 (13.59)	0.396 (3.611)	4.002 (11.52)	6.716 (15.02)	0.826 (4.015)	0.491 (3.999)
F-test	*	*	*	*	*	*
S. Em ±	0.160	0.026	0.118	0.125	0.452	0.059
C. D. at 5%	0.480	0.077	0.353	0.375	1.354	0.176

Figures in the parentheses are angular transformed values

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