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Short Communication

Harvest index and biological yield as selection criteria for mulberry (*Morus* spp.)

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Mulberry (*Morus* spp.) is generally a diploid, belongs to the genus *Morus* of the family Moraceae. It is a fast growing deciduous plant and perennial in nature. It can be grown successfully both under temperate/tropical and irrigated/rain fed conditions. The success of cocoon crop production depends mainly on the utilization of quality leaves in required quantity.

The productivity of a crop is determined by its genetic make up and its response to agricultural inputs beside the environment to which it is growing. Dry matter accumulation in plant depends on the photosynthetic surface and the rate of net assimilation.

In mulberry, where the economic product is leaf, the uptake of nitrogen from soil is high and responses to application of nutrients have been reported. It appears that a number ef physiological and biochemical process of nitrogen metabolism which precede plant maturity may be used as selection criteria for Enhanced N-metabolism [1].

Nitrogen is an essential constituent of amino acids, amides, proteins, nucleic acids, nucleotides and hexo-enzymes which are essential cell constituents. Nitrogen supports vegetative growth particularly the leaf biomass. Nitrogen harvest index appears to be more important in case of mulberry, as the leaf protein is converted to silk protein (sericin and fibroin) through biological process [2]. In the present study, variation in harvest index, biological yield, nitrogen harvest index and other physiological components and their relation with harvest index, nitrogen harvest index and total protein yield have been studied in eleven mulberry genotypes.

Eleven mulberry genotypes developed by different progenitors *viz.*, V-1, C-1730, C-2016, C-2017, RFS-175, Anantha, Thallaghatapura, Vishala, S-1635. S-1 and Local were used for the study. The experiment was carried out in an established plantation of two years old plants with 90 × 90 cm spacing under fully irrigated condition in Randomized Block Design with 3 replications having eighty-four plants per genotype per replication. Fifteen plants in each replication and for each genotype were considered for leaf yield data recording. Farm yard manure was applied at the rate of 20 mt/ha/year and N:P:K at the rate of 336:180:112 kg/ha/yr were applied to the plot in five splits. Micro-nutrient: Morizyme-B, was sprayed @2.5 ml/l (750 litre solution was used for spraying one hectare) twice during one cycle of growth from pruning to leaf harvest comprising of 70 days *i.e.*, on 25th and 32nd day after pruning as a component of the recommended package of practices. The data on leaf yield and biological yield were recorded by harvesting the randomly selected plants on 60th day after pruning. The leaves and stem were dried separately in an oven at 80^{o}C for 48 h to obtain the dry weights which were utilized for calculating harvest index.

The leaf protein was calculated on dry wt. basis using the following formula and expressed in percentage.

$$\text{Protein yield (g/plant)} = \frac{\text{Leaf yield} \times \text{leaf protein}}{100}$$

Harvest index (HI) was obtained by dividing the leaf yield with biological yield.

$$\text{HI} = \frac{\text{Leaf yield}}{\text{Total biological yield (Leaf + Stem)}} \times 100$$

The experiment was conducted for five seasons *i.e.*, spring (February), summer (May), rainy (July), autumn (September) and winter (November) for three years and pooled data were analyzed statistically. The mean values obtained for the various parameters along with CD and CV values are presented in Table 1. Perusal of the data revealed that in general the genotypes differed significantly with respect to all the parameters. Nitrogen harvest index was found maximum in S-1635 (0.89) followed by V-1 (0.88), but no significant difference was found among the genotypes V-1, C-2017, Anantha, RFS-175 and S-1635, which indicates the genotypes are similar in this trait.

The correlation of leaf yield and biological yield and protein yield with its component characters revealed

Table 1. Component characters along with harvest index, nitrogen harvest and protein

Genotype	Leaf yield (g/plant) dry wt.	Stem yield (g/plant) dry wt.	Biologic al yield (g/plant) dry wt.	Harvest index	Leaf nitrogen (%)	Stem nitrogen (%)	Nitrogen Harvest index	Leaf crude protein (%)	Protein yield (g/plant)
V-1	73.84	48.36	122.22	60.42	4.08	0.839	0.8812	25.48	18.82
C-1730	84.66	60.11	144.78	58.48	3.70	0.774	0.8707	23.15	19.60
C-2016	83.52	59.86	143.38	58.25	3.61	0.757	0.8692	22.54	18.83
C-2017	92.58	61.24	153.82	60.19	4.02	0.829	0.8801	25.15	23.27
Anantha	78.41	51.03	129.45	60.58	3.88	0.819	0.8793	24.27	19.03
RFS-175	79.05	52.17	131.22	60.24	3.85	0.796	0.8798	24.04	19.01
TGH	65.72	57.80	123.53	53.21	3.29	0.704	0.8415	20.54	13.50
Vishala	81.52	60.87	142.40	57.25	3.45	0.736	0.8627	21.58	17.60
S-1635	132.53	80.29	212.82	62.27	4.50	0.944	0.8871	28.10	37.26
S-1	74.47	60.74	135.21	55.08	3.32	0.729	0.8480	20.73	15.44
Local	60.87	56.48	117.36	51.87	3.27	0.696	0.8350	20.46	12.45
CD at 5%	2.33	1.30	2.77	0.89	0.08	0.010	0.0100	0.53	0.85
CV%	1.66	1.36	1.15	0.90	1.33	0.76	0.36	1.33	2.56

that biological yield was found to be significantly correlated with leaf yield (0.98**) and protein yield (0.94**) and similar findings were also observed by Jalaja *et al.* [2]. Harvest index and nitrogen harvest index did not show significant correlation with biological yield and with leaf yield the level of correlation was found weak and significant at 1% level. Nitrogen content in leaf was found to be significantly correlated with both leaf yield and protein yield.

Among the genotypes significant variations were revealed for all the parameters studied, indicating that the parameters were genotype specific. Harvest index and nitrogen harvest index (dry wt. basis) were found to be variety specific, indicating that some of the characters can be used for selection of genotypes and these results are in confirmation with Jalaja *et al.* [2]. There is no doubt that higher harvest index represents increased physiological capacity of plant system to mobilize and translocate photosynthetic products to organs of commercial value. Kretesz [3] opined that until the breeders understand the detailed physiological aspects of yield, biological yield in conjunction with harvest index may be used as two simple but valuable criteria for assessment of yield potential of a plant. In the present investigation, leaf yield and biological yield were found to be highly correlated indicating that biological yield may also be considered as one of the predictor for leaf yield.

Heritability estimates (broad sense) for all the biomass component characters indicated that highest heritability was obtained for biological yield (99%) followed by protein yield (98%) and harvest index (93%). High estimates of heritability are expected to result in high genetic advance in harvest index. Bhatt [4] and Rosielle and Frey [5] reported that harvest index is controlled by additive gene action. Results of the present investigation indicate that biological yield and harvest index have predictive value in selecting the genotypes. As high heritability was observed in harvest index, this character can also be used in selection. Nitrogen content and protein yield also showed high heritability as protein yield was directly correlated with harvest index and nitrogen harvest index. Hence, nitrogen harvest index may also be used as a selection criterion.

In mulberry, increasing leaf protein content apart from higher leaf yield is one of the major objectives because the main constituent of silk is protein and the leaf protein is converted to silk through the biological process involving silkworm. The high NHI opens up the possibility to increase the protein content without additional fertilizer application by improving nitrogen partitioning efficiency.

The direct relationship of protein yield with all the component characters including nitrogen harvest index indicates that with increase of NHI, the leaf protein can be improved. Based on the results of the present investigation, use of biological yield and harvest index may be considered as selection criteria in mulberry. Results also revealed the usefulness of considering NHI for screening better genotypes during the selection processes.

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